In-Group Favouritism in Collective Decisions*

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Abstract

This paper presents a model of in-group favouritism in collective decisions. The focus is on the role of the institutional set-up for whether individuals' discriminatory preferences are mitigated or exacerbated. When are collective decisions less biased than individual decisions? Do diverse committees discriminate less than homogeneous ones? The analysis suggests that homogeneous committees can be expected to discriminate more than individual decision makers both under unanimity rule and under majority rule, but the reasons behind this are different under the two rules. Diversity in committees may help mitigate or avoid own group favoritism and can be expected to lead to less discrimination than decisions by homogeneous committees or by an individual decision maker.

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1 Introduction

To discriminate is to treat two individuals with equal productivity characteristics differently because of their group identity. While most economic models of discrimination focus on a situation in which an individual makes decisions, many decisions are taken collectively (examples include examination committees, hiring committees, promotion committees, juries and more). To tackle discrimination it is therefore important to understand more about discrimination in group decisions. In particular, when does the institutional set-up mitigate or exacerbate individuals' discriminatory tendencies? When will a group make less discriminatory decisions than an individual would? Can we expect homogeneous committees to make biased decisions? Can diversity in committees lead to less discrimination and if so why?

In an earlier experimental study I tested some of the above hypotheses in a controlled environment and showed that individuals may behave differently in individual decisions and when they have to coordinate their decision with someone else (Daskalova, 2018). The experiment also found strong effects of co-decision maker identity on whether discrimination arises in a joint project assignment decision. When decision makers had to coordinate their decision with someone from their own group they strongly favored own over other group candidates. In contrast, when having to coordinate with a co-decision maker from the other group, individuals did not discriminate between own and other group candidates.

A number of observational studies on the effect of gender and racial composition in committees show that the answer to the diversity question is generally not so clear-cut (Bagues and Esteve-Volart, 2010; Bagues et al., 2017; Price and Wolfers, 2010; Anwar et al., 2012). In contexts ranging from tenure decisions towards men and women in the Italian academic system to decisions towards men and women about roles in the Spanish judiciary to jury decisions about defendants of different races in the US to decisions of teams of basketball referees in the NBA towards own or other race players, these studies show that sometimes having no members of one's group in the committee may lead to negative discrimination towards that group. In other situations, however, having more people of one's own group in the committee can also lead to worse outcomes for members of that group. These studies illustrate that the decision making set-up, the context, the identities involved, the historical relations between groups, and many other factors can affect whether discrimination arises in a particular situation.

This paper presents a model to study the question of how the decision making set-up affects whether discrimination arises in a collective decision. In doing so I necessarily abstract from a variety of factors present in specific committee decision making situations in order to focus on a few that may be common across many such situations.

In particular I focus on discrimination related to own/other group identity. The model postulates that committee members have group identities (here: Blue or Green). Committee members have to collectively choose among one of two candidates - the Blue or the Green candidate. Both the group identities of the committee members and of the candidates are common knowledge. Each committee member has a type describing their own/other group bias which is drawn from a continuous distribution. This type is private information. The committee members have to independently vote in favor of a Blue or a Green candidate. Their decisions are aggregated though a committee decision making rule. The candidate is chosen if the votes for her reach the threshold required by the decision making rule. The committee members' payoffs depend on their group identity, the group identity of the candidate chosen, as well as on their individual bias. If the required votes are not reached, no one is chosen and the committee members receive a payoff of zero. The analysis examines how the decision making set-up influences whether discrimination arises in equilibrium. A key question is whether the outcomes expected in a homogeneous and in a diverse committee may differ. I consider decision making under unanimity rule and under majority rule.

The main findings under unanimity rule are that when two people of the same group make decisions, discrimination in favor of the own group arises in a unique equilibrium when the importance of candidates' qualifications is less than the upper bound on the bias parameter. When the importance of qualifications is higher than the upper bound on the bias, multiple equilibria may arise, including such where the other group is favored. However, even in cases of multiplicity of equilibria, following either the criterion of Pareto dominance or the criterion of focality would clearly predict an outcome in which discrimination in favor of the own group occurs in a homogeneous committee.

In a diverse committee of two, discrimination never arises in the unique equilibrium when the importance of qualifications is low. When the importance of qualifications is high, the incentives to coordinate on a candidate increase and so multiple equilibria arise here as well. However, in contrast to the homogeneous committee case, here in case of equilibrium multiplicity an equilibrium in which the Blue candidate is chosen with a very high probability always coexists with an equilibrium in which the Green candidate is chosen with the exact same very high probability. When multiple equilibria arise in the heterogeneous committee case, none of the usual equilibrium selection criteria leads to a prediction that a candidate from one group is more likely to be chosen than a candidate from the other. Thus, even when multiple equilibria exist a diverse committee maximizes ex-ante fairness.

The model, however, also shows that there may sometimes be a cost to having a diverse committee in terms of the probability of a candidate being chosen. When the committee decides by unanimity rule and an unique interior equilibrium arises, the probability of choosing a candidate (any one of the two) is lower than if a homogeneous committee makes decisions.

I next analyse the case of decision making under majority rule. I show that under the assumption of pivotality, a committee member's problem reduces to their problem in individual decision making. Having a diverse committee again mitigates discrimination against the minority group relative to the homogeneous committee case. Under majority rule there is no cost when it comes to probability of choosing a candidate as a candidate is always chosen.

Comparing the amount of discrimination in a homogeneous committee with discrimination in individual decisions, the analysis suggests that a committee of individuals who have the same group identity would discriminate more than one individual. This happens both under unanimity rule and under majority rule, but the reason it occurs is different under the two rules. Under unanimity rule individuals take into account what they expect their co-decision makers to do and this leads them to favor the own group in situations in which they would not do so if they were deciding alone. Under majority rule again homogeneous committees discriminate more than individuals and the more committee members there are in a homogeneous committee the more discrimination is expected to arise. However, in contrast to the homogeneous committee case, this is not due to strategic consideration, but to aggregation of the biases of individual committee members.

The main contribution of the paper is to present a first theoretical study of the effect of the collective decision making set-up on whether discrimination arises. In terms of message, it provides a simple but compelling argument for why diverse committees may help mitigate or entirely eliminate discrimination in collective decisions. Even if individual decision makers still act according to their biases, the fact that they are more likely to be biased in different directions and are aware of that may lead to less biased collective decisions.

The structure of the paper is as follows. In Section 2 I discuss some related literature. Section 3 describes the model. Section 4 presents the analysis. Section 5 discusses the findings. Finally, Section 6 concludes.

2 Some Related Literature

This paper belongs to the literature on discrimination and social identity. Economic models of discrimination can be divided roughly into several classes. Preference-based models look at discrimination arising from a distaste of associating with a particular group and show that this distaste may lead an employer to hire individuals from groups that are discriminated against only at lower wages (Becker, 1957). Statistical discrimination models show that discrimination may arise due to incomplete information of an employer about the characteristics of individual applicants she faces together with different prior beliefs about the averages in the groups they belong to (Arrow, 1973; Phelps, 1972; Coate and Loury, 1993). Cognitive models consider discrimination resulting from some form of cognitive limitation such as categorization or implicit bias (Fryer and Jackson, 2008; Bartoš et al., 2016). Several authors consider discrimination persisting as a consequence of a discriminatory social norm in a society, the violation of which would lead to punishment in spite of no actual existence of tastes for discrimination on part of the perpetrator (Akerlof, 1976; Pęski and Szentes, 2013).

A key difference between the model presented here and all of the above is that they consider one person making a decision on the employer side, while I focus on a collective decision. Moreover, the model presented here, abstracts from some channels of discrimination, such as statistical discrimination, social norms, and cognitive discrimination. It assumes that individuals are more likely to favor the own over the other group and looks at the question when the collective institutional set-up will mitigate or exacerbate such individual tendencies.

Recent work by Ramachandran and Rauh (2018) and Basu (2010, 2015) looks at two people coordinating their decisions. A common theme between their models and this model is the idea that beliefs about another decision maker's behavior may play a role in whether discrimination arises in such situations. However, the questions they address in their models and the points they make are very different: their key message is to show that discrimination may persist in an economy even when tastes for discrimination against particular groups (e.g. black people or women) have died out. In contrast to these two theories of why discrimination may persist even without tastes, I focus on the role of the institutional set-up (committee homogeneity or diversity, and different decision making rules) in whether individuals' discriminatory tastes are mitigated or exacerbated by the collective decision making set-up.

Another related line of research is the theoretical literature on social identity. Akerlof and Kranton's work (Akerlof and Kranton, 2000) is based on the idea that people belong to social categories and that these social categories might have different social norms attached to them. Violating such norms creates various identity related externalities. In their theory discrimination may arise to offset a negative externality that an individual causes by violating norms. There is also a literature on homophily, the tendency to associate with people like oneself (Kets and Sandroni, 2019). Bramoullè and Goyal (2016) discuss the origins and consequences of own group favoritism showing that own group favoritism can arise as individuals have an interest to trade favors. Social Identity Theory in social psychology offers a complementary explanation of own group favoritism (Tajfel, 1970, 1982; Tajfel and Turner, 1979). The underlying assumption there is that people categorize themselves and others into groups. As they identify with their own group, they derive positive utility from their own group doing well. Hence they are more likely to give more to or to rate more highly members of their own group.

This paper is also complementary to the experimental literature on social identity and discrimination. Motivated by the conjecture that the decision making set-up may matter for whether individuals treat own and other group candidates differently, in Daskalova (2018) I conducted what I believe to be the first controlled lab experiment on the question whether an individual behaves differently (when it comes to discrimination) when deciding alone versus when deciding with someone else. The findings of the experiment were in line with this conjecture. Furthermore, the experiment showed that the identity of the co-decision maker may play a big role for how an individual behaves: individuals strongly favored the own group when deciding with a co-decision maker of the own group, but discrimination did not arise when the two decision makers had different identities.

There have been numerous other experimental studies on the role of social identities in decision making in other set-ups. There appears to be some heterogeneity in behaviour, but overall it seems that in studies using group identities induced in the lab favoring the own over the other group is prevalent (Charness et al., 2007; Chen and Li, 2009; Chen and Chen, 2011; Currarini and Mengel, 2016; Daskalova et al., 2016a,b; Eckel and Grossman, 2005; Falk and Zehnder, 2013). Experimental studies of discrimination (both lab and field) have often focused on testing for the existence of discrimination or on trying to disentangle what type of discrimination is present in a given context (Banerjee et al., 2009; Bartoš et al., 2016; Belot, 2015; Bertrand and Mullainathan, 2004; Fershtman and Gneezy, 2001; Gneezy et al., 2012; List, 2004).

A very large number of observational studies look at discrimination towards particular groups (e.g. women compared to men or black compared to white people) in contexts ranging from the labor market to credit markets to police searches to sports (Altonji and Blank, 1999; Antonovics and Knight, 2009; Ayres and Siegelman, 1995; Gallo et al., 2012; Knowles et al., 2001). Of particular relevance and motivation for this paper are the observational studies looking at the role of group identities in collective decision making set-ups. Bagues and Esteve-Volart (2010) look at the gender composition of recruiting committees for candidates to the Spanish judiciary. They find that a female candidate is less likely to be hired when the committee is majority female. Bagues et al. (2017) look at applications for tenured positions in Italian academia and find that having a higher share of female evaluators in the committee does not benefit women. Price and Wolfers (2010) look at referee decisions in basketball and find that more fouls are awarded against players are awarded when the refereeing crew is opposite race than when it is of the own race. Anwar et al. (2012) find that a black defendant is more likely to be convicted by an all white jury than by a jury with at least one black member. All of these empirical studies illustrate that the effect of committee homogeneity and diversity is not unambiguous. While the model presented here does not and cannot aim to capture details of the very diverse committee decision making situations possible, the aim is that through abstraction it can capture some factors relevant for whether discrimination arises or not in various collective decision making situations.

The approach of looking at the importance of the institutional set up is related to the political economy literature on differences in individual behavior in individual and collective decisions and on the importance of the decision making rule (Austen-Smith and Banks, 1996; Austen-Smith and Feddersen, 2005, 2006; Feddersen and Pesendorfer, 1998). However, the question addressed here is very different from the questions addressed in that literature. While they study a situation where individuals draw private signals about the true state of the world and the question of interest is the likelihood of information being correctly aggregated in a collective decision, here there is no true state of the world to be discovered. The focus is on how discriminatory biases will be mitigated or exacerbated in different collective decision making set-ups.

There is a literature focusing on the importance of diversity in groups when it comes to the ability to solve complex problems or the ability to coordinate on a common outcome (Hong and Page, 2001; Page, 2008; Kets and Sandroni, 2017). This paper complements that literature by considering the importance of diversity for whether discrimination arises in collective choice rather than its importance for solving a problem or for coordinating.

3 Model

The set-up of the model is the following.

Committee Members

Consider a committee of $N = \{1, 2, ..n\}$ individuals that has to choose one of two candidates as a collective. Each committee member belongs either to the Blue (B) or to the Green (G) group. The group identity of individual committee members $I_i \in \{B, G\}$ is common knowledge. Committee members can differ in how biased they are in favor of (or possibly against) their own group and against (or possibly in favor of) the other group. This bias parameter d_i is their type. Assume that the type of each committee member is independently and uniformly distributed over the $[a, b]$ interval, i.e. $d_i \sim \mathcal{U}[a, b]$ with $a \leq 0$, $b > 0$, and $|a| < |b|$.[1] Let F denote the cumulative distribution function of d_i. Each committee member knows only her own type and this as well as the distribution of types in the population is common knowledge.

Candidates

Committee members have a choice between two candidates $C_i \in \{B, G\}$,

[1]The assumption is motivated by findings of the experimental literature on the effect of social identity in decision making that suggest that there is heterogeneity in the population, but that overall people are more likely to favor the own over the other group.

where B stands for the candidate from the Blue group and G stands for the candidate from the Green group. For simplicity I use the same notation for the group identities of the committee members and candidates. The average productivity of a candidate from the Blue group is denoted by $q(B)$ and the average productivity of a candidate from the Green group by $q(G)$. In order to abstract from differences in productivity and from differences in beliefs about productivity and statistical discrimination, I assume that $q(B) = q(G) = q > 0$. Both the group identities of the candidates and the average productivity in the two groups are common knowledge.

Each committee member chooses between one of two actions: $A_i = \{0, 1\}$, where $a_i = 0$ stands for voting for the Green candidate and $a_i = 1$ stands for voting for the Blue candidate. A strategy for a player (committee member) i is a function $s_i : [a, b] \rightarrow \{0, 1\}$ that identifies a choice of $a_i \in \{0, 1\}$ for every type $d_i \in [a, b]$.

Decision Rule, Outcomes, and Preferences

The voting choices of individual committee members are aggregated through a predefined collective decision making rule that sets the threshold number of votes $\hat{k}$ necessary for choosing a candidate. Under unanimity rule, this threshold $\hat{k} = n$. Under majority rule, $\hat{k} = \frac{(n+1)}{2}$. If no candidate reaches the required threshold, then no candidate is chosen. Hence the set of possible outcomes that can be achieved by the committee are: $O = \left\{\tilde{B}, \tilde{G}, \emptyset\right\}$, where $\tilde{B}$ $(\tilde{G})$ denotes the collective outcomes of choosing the Blue (Green) candidate, respectively and $\emptyset$ the outcome of no candidate chosen. Committee member i's preferences over final outcomes are defined as follows:

$$
\begin{aligned}
U_i^B(\tilde{B}) = U_i^G(\tilde{G}) &= q + d_i \\
U_i^B(\tilde{G}) = U_i^G(\tilde{B}) &= q - d_i \\
U_i^B(\emptyset) = U_i^G(\emptyset) &= 0,
\end{aligned}
$$

where U_i is the utility of committee member i, which depends on their group identity (the superscript), their type d_i, as well as (in brackets) the outcome realized from the set of possible outcomes.

Timing

Group identities are given. Nature chooses the type of each committee member independently by drawing from the predefined distribution. Individuals are informed of their type but not of the others' type(s). Individuals vote simultaneously and independently for a candidate. The outcome is then realized according to the predefined decision rule.

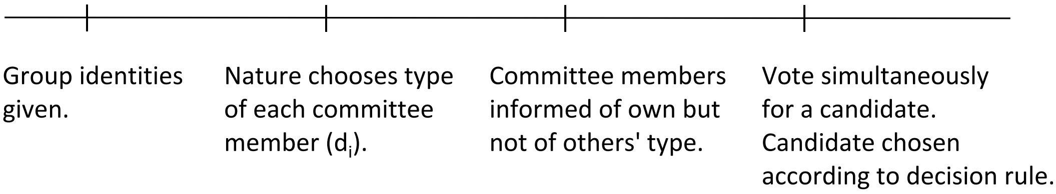

Figure 1: Timeline

Equilibrium

This is a Bayesian game with a continuous type space and a discrete set of actions. The equilibrium concept employed is Bayesian Nash Equilibrium.

4 Analysis of the Model

This section presents the analysis of the model for alternative decision making situations. The main results and intuition are presented in the main text while all proofs are in the Appendix.

4.1 Benchmark Individual Decision Making

Before analyzing the equilibria in the different committee decision making cases it is helpful to establish as a benchmark whether and if so how much discrimination can be expected if it is an individual making a decision rather than a committee. For this purpose and without loss of generality assume that the individual i is a member of the Blue group. They have the choice between the Blue candidate and the Green candidate. The payoff consequences from the Blue or the Green candidate being chosen are the same as in the collective decisions, the only difference is that here the outcome depends on their individual choice only. Consider when the Blue individual's expected utility from hiring a Blue candidate is higher than their expected utility from hiring a Green candidate.

$$
\begin{aligned}
EU_i^B(B) &> EU_i^B(G) \\
q + d_i &> q - d_i \\
d_i &> 0
\end{aligned}
$$

The above inequality shows that a Blue individual will hire a Blue candidate if their bias in favor of the own group is positive. Else they will hire a Green candidate. Recall that the bias of the individual is ex-ante unknown and uniformly distributed in $[a, b]$ with $a \leq 0$, $b > 0$, and $|b| > |a|$. We need to consider the probability that the bias is above the threshold and the probability that the bias is below the threshold. Here these probabilities correspond to the probability of a Blue candidate and of a Green candidate being chosen, respectively.

Lemma 1. *Discrimination in Individual Decisions.*

If a Blue individual makes decisions, $\Pr(\tilde{B}) = 1 - F(0) = \frac{b}{b-a} > \Pr(\tilde{G}) = F(0) = \frac{-a}{b-a}$. *The expected amount of discrimination in favor of the own group candidate is* $\Pr(\tilde{B}) - \Pr(\tilde{G}) = \frac{b+a}{b-a}$.

To sum up, in this set-up if an individual makes decisions, they have a positive probability of choosing a candidate from the own group and a positive probability of choosing a candidate from the other group (provided $a < 0$). The probability of choosing a candidate from the own group is, however, higher with the extent of discrimination depending on the parameters of the distribution of the bias.[2]

4.2 Two committee members, homogeneous committee

Consider next a committee of two, who have to independently vote for one of two candidates, the Blue or the Green candidate. Assume that the committee is homogeneous in the sense that both committee members have the same group identity. For the sake of exposition, I assume throughout this section and in the proofs related to it that both committee members belong to the Blue group, but of course, the case of two Green committee members is analogical.

I first show that the best response of Player i to any strategy of Player j is a threshold rule and derive the equilibria in this set-up characterizing their properties. I then present the implications of the analysis for when discrimination can arise in the homogeneous committee case. Finally, I present some comparative statics.

Assume that player i assigns probability ν_j to player j voting for the Blue candidate and probability $1 - \nu_j$ to player j voting for the Green candidate.

[2]Note that in the special case when $a = 0$, that is when the distribution of bias is such that an individual can only have a positive bias in favor of the own group and a negative bias against the other group, the probability of choosing the own group candidate in individual decisions becomes one.

Voting Blue is a best response for the Blue player i if and only if:

$$EU_i^B(B) > EU_i^B(G)$$
$$\nu_j(q + d_i) > (1 - \nu_j)(q - d_i)$$
$$d_i > q - 2\nu_j q$$

This implies that if Player i expects Player j to vote Blue for sure, i.e. $\nu_j = 1$, Player i will vote Blue for sure if they have a positive bias in favor of the own group and will also vote Blue if they have a negative bias against the own group as long as the importance of qualifications overshadows the bias, i.e. as long as their payoff from an own group candidate being chosen is positive $q + d_i > 0$. On the other hand, if Player i expects Player j to vote Green for sure, i.e. $\nu_j = 0$, Player i will vote Blue as long as they care more about the bias than about the qualifications of the candidate, i.e. as long as their payoff from choosing an other group candidate is negative $q - d_i < 0$, but they will vote Green otherwise. As the game is symmetric, the same holds for the other player.

The next lemma shows that any equilibrium in this game is symmetric, that is in equilibrium the probability of player i voting for the Blue candidate must be the same as the probability of player j voting for the Blue candidate.

Lemma 2. *Symmetric Equilibrium Two Player Homogeneous Committee*

Any equilibrium must be symmetric, i.e. $\nu_i = \nu_j$.

Proposition 1 describes the equilibrium in the two players homogeneous committee case (both Blue). It states that the best response of a Player i to any strategy $s_j(d_j)$ of Player j is a threshold rule: there exists some threshold type $\hat{d}_i$ such that choosing the other group candidate is a best response for types of player i below the threshold type and choosing the own group candidate is a best response for types of player i above the threshold type. The optimal equilibrium strategies are the same for both players.

Proposition 1. *Equilibrium Two Players Homogeneous Committee*

In equilibrium each (Blue) player has a threshold type $\hat{d}_i$ *such that the optimal strategies are:*

$s_i(d_i) = 0$ *(vote Green) if* $d_i \leq \hat{d}_i$

$s_i(d_i) = 1$ *(vote Blue) if* $d_i > \hat{d}_i$.

In equilibrium the thresholds are the same for both players and depend on the importance of the candidates' qualifications "q" relative to the parameters of the bias distribution (”a” and ”b”). The next proposition characterises the properties of the equilibria arising in the homogeneous committee case:

Proposition 2. *Equilibrium Properties Two Players Homogeneous Committee*

The equilibrium is:

(i) When $0 < q < -a$: a unique interior equilibrium such that $a < \hat{d}_i = \hat{d}_j = \frac{-q(b+a)}{b-a-2q} < 0 < \frac{b+a}{2}$.

(ii) When $-a \leq q < b$: a unique corner equilibrium such that $\hat{d}_i = \hat{d}_j = a$.

(iii) When $q = b$: two corner equilibria such that $\hat{d}_i = \hat{d}_j = a$ and $\hat{d}_i = \hat{d}_j = b$.

(iv) When $q > b$: two corner equilibria such that $\hat{d}_i = \hat{d}_j = a$ and $\hat{d}_i = \hat{d}_j = b$ plus an interior equilibrium such that $\frac{b+a}{2} < \hat{d}_i = \hat{d}_j = \frac{-q(b+a)}{b-a-2q} < b$.

The first important equilibrium property to note is that for low values of q, there is a unique equilibrium, whereas for high values of q multiple equilibria arise. The intuition is that the game is similar to a game of strategic complementarities. How strong the complementarity is depends on the value of q. The higher the q, the higher the payoff from coordinating versus not coordinating and hence the greater the incentive to coordinate (keeping one's bias constant). This is what makes possible the existence of the equilibrium such that both hire the other group with probability one in case $q \geq b$.

A second finding is that whenever there the equilibrium is unique, the own group candidate is chosen with higher probability than the other group candidate. For $0 < q < -a$ (case i), the equilibrium is interior, that is the threshold $\hat{d}_i \in (a, b)$. Moreover the threshold is below the mean of the type distribution ($\hat{d}_i < \frac{b+a}{2}$), meaning that there are more types above the threshold than types below the threshold. That is, more types choose the own group candidate than the other group candidate, but there are some types who choose the other group candidate. As q increases up to $-a$, the equilibrium threshold decreases and the corner equilibrium arises where all types choose the own group candidate.

A third finding is that whenever the equilibrium is not unique, that is $q \geq b$, the corner equilibrium such that all types vote for the own group candidate $\hat{d}_i = \hat{d}_j = a$ always exists. The next lemma discusses some equilibrium selection arguments for the case where multiple equilibria exist, i.e. for cases (iii) and (iv) from Proposition 1.

Lemma 3. *Equilibrium Selection Two Players Homogeneous Committee*

Re (iii) when $q = b$: the equilibrium in which $\hat{d}_i = \hat{d}_j = a$ Pareto dominates the equilibrium in which $\hat{d}_i = \hat{d}_j = b$.

Re (iv) when $q > b$: the equilibrium in which $\hat{d}_i = \hat{d}_j = a$ Pareto dominates the equilibrium in which $\hat{d}_i = \hat{d}_j = b$, as well as the interior equilibrium in which $\frac{b+a}{2} < \hat{d}_i = \hat{d}_j < b$. Moreover, the interior equilibrium is not locally stable.

Thus, Lemma 3 indicates that if Pareto dominance is followed as an equilibrium selection criterion, the prediction in cases where multiple equilibria arise is that the equilibrium in which both players vote for the own group candidate with probability one in a homogeneous committee would be chosen. For the case where $q > b$, where also an interior equilibrium exists such that more types hire the other than the own group candidate, this interior equilibrium (besides being Pareto dominated) is also not locally stable. That is, if one player deviated slightly from equilibrium, the best response dynamics would converge to one of the corner solutions.

The concept of focality (Schelling, 1980) may provide a further perspective on equilibrium selection in this setting. When the group identities of both players are the same (e.g. Blue), choosing the Blue over the Green candidate may become focal even without considering its Pareto superiority. This will be the case if players pay attention to the action label "Blue", which is focal as it is the same as the group identities of the committee members. This focality argument disregards the payoff consequences from choosing the Blue or the Green candidate, but in fact both the label focality and the Pareto dominance arguments point to the same equilibrium where both committee members in a homogeneous committee choose the own group candidate.

The key question of interest is whether and when discrimination in favor of the own group would arise in a homogeneous committee. Such discrimination here is defined as a higher probability of the committee choosing the own than the other group candidate.

Corollary 1. *Discrimination Two Players Homogeneous Committee*

i) For $q < b$, discrimination in favor of the own group $P(\tilde{B}) > P(\tilde{G})$ always arises in the unique equilibrium.

ii) For $q \geq b$, multiple equilibria arise. If Pareto dominance is used as a selection criterion, the prediction is discrimination in favor of the own group $P(\tilde{B}) > P(\tilde{G})$.

Corollary 1 summarizes the analysis relating to discrimination. Whenever the importance of candidate qualifications is lower than the bias of the most biased type, the unique equilibrium prediction is discrimination in favor of the own group. Whenever the importance of candidate qualifications is at least as high as the bias of the most biased type, multiple equilibria are possible, including an equilibrium in which the other group candidate is chosen with probability one. Selecting the equilibrium that entails strictly higher payoffs for both players among the alternative equilibria would imply that the own group candidate is chosen with probability one.

Lemma 5 shows that the higher the importance of qualifications in the homogeneous committee case, the higher the lower the threshold of individual players' in the interior equilibrium (outside of a point where it is discontinuous), i.e. the more types vote for the own group candidate.

Lemma 4. *Comparative Statics Two Players Homogeneous Committee*

For $a < \hat{d}_i = \hat{d}_j < b$, the symmetric equilibrium threshold is decreasing in q (for $q \neq \frac{b-a}{2}$).

Finally, before concluding this section, consider briefly a further effect of the assumptions on biases. How does the analysis change if $a = 0$, that is, players can be only positively biased in favor of the own and negatively biased against the other group? In that case, for $q < b$, there is a unique corner equilibrium in which the own group candidate is chosen with probability one. For $q \geq b$, players again have a high incentive to coordinate and as the importance of qualifications is greater than the upper bound on the bias, multiple equilibria arise, some involving a higher probability of choosing the other group candidate. As before, in case of multiple equilibria, the Pareto dominant one is always the one where the own group candidate is chosen with probability one.

4.3 Two committee members, heterogeneous committee

Now consider the case of a heterogeneous committee, where one committee member is Blue and the other Green. For the sake of exposition, I will assume here that player i is Blue and player j is Green.

I first show that the best response of each player to any strategy of the other player is a threshold strategy and derive the equilibria characterizing their properties. I then discuss the implications of the analysis for when discrimination can arise in the heterogeneous committee case. Finally, I present some comparative statics.

Assume as before that player i assigns probability ν_j to player j voting for the Blue candidate and probability $1 - \nu_j$ to player j voting for the Green candidate.

Player j assigns probability ν_i to player i voting for the Blue candidate and probability $1-\nu_i$ to player i voting for the Green candidate. The best response calculation of the Blue Player i is the same as before, i.e. the Blue Player i will choose Blue if $d_i > q - 2\nu_j q$ and will choose Green otherwise. Now consider the Green Player j. Voting Blue is a best response for the Green Player j if and only if:

$$EU_j^G(B) > EU_j^G(G)$$
$$\nu_i(q-d_j) > (1-\nu_i)(q+d_j)$$
$$d_j < 2\nu_i q - q$$

This implies that if the Green Player j expects the Blue Player i to vote Blue for sure, i.e. $\nu_i = 1$, the Green Player j will vote Blue if $d_j < q$, i.e. they will vote Blue as long as they care more about the qualifications of the candidate than about the bias and hence their payoff from choosing an other group candidate $q - d_j > 0$. Else they will vote Green. On the other hand, if the Green Player j expects the Blue Player i to vote Green for sure, i.e. $\nu_i = 0$, Player j will vote Blue only if they are very biased against the own group and the payoff from voting for the own group candidate is negative $q + d_j < 0$. Else they will vote Green. This leads to Proposition 3.

Proposition 3. *Equilibrium Two Players Heterogeneous Committee*

In equilibrium the Blue Player i has a threshold type $\hat{d}_i$ such that such that the optimal strategy is:

$s_i(d_i) = 0$ *(vote Green) if* $d_i \leq \hat{d}_i$

$s_i(d_i) = 1$ *(vote Blue) if* $d_i > \hat{d}_i$.

and the Green Player j has a threshold type $\hat{d}_j$ such that such that the optimal strategy is:

$s_j(d_j) = 0$ *(vote Green) if* $d_j > \hat{d}_j$

$s_j(d_j) = 1$ *(vote Blue) if* $d_j \leq \hat{d}_j$.

The thresholds depend as before on the importance of the qualifications ”q”, as well as the parameters of the distribution of the bias ”b” and ”a”. Note that due to the fact that the two players have different group identities, their optimal strategies (in the sense of the candidate they vote for below/above the threshold) are different. The Blue Player will vote Blue if their type is above the threshold (i.e. if they are more rather than less own group biased) and the Green Player will vote Blue if their type is below the threshold (i.e. if they are less rather than more own group biased). The next proposition describes the properties of the equilibria arising in the two players heterogeneous committee case.

Proposition 4. *Equilibrium Properties Two Players Heterogeneous Committee*

The equilibrium is:

(i) When $0 < q < \frac{b-a}{2}$*: a unique interior equilibrium such that* $a < 0 < \hat{d}_i = \hat{d}_j = \frac{q(b+a)}{b-a+2q} < \frac{b+a}{2}$.

(ii) When $\frac{b-a}{2} < q < b$*: two semi-interior equilibria such that* $\hat{d}_i = a$, $\frac{b+a}{2} < \hat{d}_j < b$ *and* $\frac{b+a}{2} < \hat{d}_i < b$, $\hat{d}_j = a$ *plus an interior equilibrium such that* $a < 0 < \hat{d}_i = \hat{d}_j = \frac{q(b+a)}{b-a+2q} < \frac{b+a}{2}$.

(iii) When $q \geq b$*: two corner equilibria such that* ($\hat{d}_i = a$, $\hat{d}_j = b$) *and* ($\hat{d}_i = b$, $\hat{d}_j = a$) *plus an interior equilibrium such that* $a < 0 < \hat{d}_i = \hat{d}_j = \frac{q(b+a)}{b-a+2q} < \frac{b+a}{2}$.

There are several features of the equilibria worth noting. First, again for low values of q there is a unique interior equilibrium such that each player sets the same threshold and more types vote for the own than for the other group candidate. Second, the threshold above which players vote for the own group candidate in this interior equilibrium is higher than in its counterpart in the homogeneous committee case. This means that although again in this equilibrium more types vote for the own than for the other group candidate, the relative proportion of types voting for the own over the other is lower than in the homogeneous committee case. Third, an interior equilibrium exists under all values of q in the heterogeneous committee case.

Fourth, again whenever the value of q is high, i.e. incentives for agreeing versus not agreeing increase, multiple solutions arise. For intermediate values of q, i.e. $\frac{b-a}{2} < q < b$, additional to the interior equilibrium in which each chooses more own than other group candidates, there are two "semi-interior" equilibria. In one of them the Blue committee member votes for the Blue candidate with probability one and more types of the Green committee member vote for the Blue candidate than for the Green, but still there are some types who vote for the Green. In particular these are the types who have a negative utility from a candidate from the other group being chosen (for whom $q - d_i < 0$), so that even if they believe that the Blue committee member votes for the Blue candidate with probability one, they prefer the option of not coordinating (and getting a payoff of zero) to the option of choosing the Blue candidate. The same holds for the respective counterpart equilibrium in which the Green committee member votes for the Green candidate with probability one and the Blue committee member votes for the Blue candidate with a small positive probability. These two semi-interior equilibria always co-exist.

When q increases further and becomes greater than the upper bound of the taste distribution b, qualifications and the incentive to coordinate matter more than taste ($q - d_i < 0$ can no longer hold) and therefore instead of the two semi-interior equilibria there are two corner solutions, such that both the Blue and the Green committee member vote for the Blue candidate with probability one or such that both the Blue and the Green committee member vote for the Green candidate with probability one.

In contrast to the homogeneous committee case, here there is no possibility to Pareto rank the semi-interior or the corner solutions in the heterogeneous committee case. The intuition is that the two corner equilibria involve one player always voting for the own group candidate and the other player always voting for the other group candidate. Thus, the player who votes for the own group candidate in the equilibrium where this candidate is chosen will achieve a higher payoff than the one who votes for the other group candidate.

What does the above analysis mean for the question whether discrimination arises in a heterogeneous committee? The findings are summarized in Corollary 2. In the interior equilibrium, both when it is unique and when it is not, each committee member has a higher probability of voting for the own than for the other group candidate. The threshold above which each of them votes for the own group candidate is the same and thus the probability that both vote for the Blue is the same as the probability that both vote for the Green, meaning that no discrimination arises in the interior equilibrium. This is in contrast to the homogeneous committee case when discrimination always arises in the interior equilibrium.

Corollary 2. *Discrimination Two Players Heterogeneous Committee*

i) For $q < \frac{b-a}{2}$, discrimination does not arise in the heterogeneous committee case, that is $P(\tilde{B}) = P(\tilde{G})$.

ii) For $q > \frac{b-a}{2}$, multiple equilibria arise in the heterogeneous committee case. In the interior equilibrium, discrimination does not arise, $P(\tilde{B}) = P(\tilde{G})$. In one of the remaining equilibria $P(\tilde{B}) > P(\tilde{G})$ and in the other $P(\tilde{G}) > P(\tilde{B})$, with the differences in probabilities between the two equilibria being exactly the same for a given set of parameter values. Hence no a priori reason to predict discrimination in favor of one group over another.

In each of the two corner solutions where one votes for the own group candidate with probability one and the other for the other group candidate with probability one, one of the two candidates will be chosen with probability one. Hence, within such a corner equilibrium discrimination will arise. In one of them it will be in favor of the Blue candidate and in the other it will be in favor of the Green candidate. However, the usual equilibrium selection criteria do not tell us which of the two equilibria could be selected. Hence, one could argue that a priori there is no reason to expect that discrimination against one group is more likely than discrimination against the other group in this set-up. The argument for the two semi-interior solutions is similar.

Lemma 5 shows that the higher the importance of qualifications in the heterogeneous committee case, the higher the threshold of individual players' in the interior equilibrium, i.e. the fewer types vote for the own group candidate.

Lemma 5. *Comparative Statics Two Players Heterogeneous Committee*
For $a < \hat{d}_i = \hat{d}_j < b$, the interior equilibrium threshold is increasing in q.

In case the distribution of bias is such that committee members can only like the own group and dislike the other (i.e. for $a = 0$), the results are qualitatively similar as in the case when $a < 0$ is possible.

4.4 Homogeneous committee of $n \geq 3$

Consider the case of a committee of $n \geq 3$ (where n is an odd integer) members who decide collectively by majority rule. I first discuss the case of a homogeneous committee, that is all committee members have the same group identity. I illustrate with $n = 3$ and then argue that the case of $n > 3$ is analogical. I use the case where all players are Blue for expositional purposes. Of course, the case when all three are Green is analogical.

Assume that ν_i, ν_j, and ν_k are the common knowledge probabilities that each of the two other players assign to player i, j, k, respectively voting for the Blue player. The rest probabilities $1 - \nu_i$, $1 - \nu_j$, $1 - \nu_k$ they assign to voting for the Green player. I show that the best responses are threshold rules and characterize the interior equilibrium in this set-up. Finally, I discuss implications for discrimination.

Note that under majority rule a player will be pivotal if half of the other players have voted Blue and the other half have voted Green. With three players there are two ways in which this can happen.

From the perspective of player i, it is a best response for i to vote Blue:

$$EU_i^B(B) > EU_i^B(G)$$
$$\nu_j(1-\nu_k)(q+d_i) + (1-\nu_j)\nu_k(q+d_i) > \nu_j(1-\nu_k)(q-d_i) + (1-\nu_j)\nu_k(q-d_i)$$
$$(q+d_i) > (q-d_i)$$
$$d_i > 0$$

The best response of a Blue player i to any strategies $s_j(d_j)$ and $s_k(d_k)$ is a threshold rule: there exists some $\hat{d}_i$ such that i's best response is to choose $a_i = 0$ if $d_i \leq \hat{d}_i$ and to choose $a_i = 1$ if $d_i > \hat{d}_i$. The above expected utility calculation in the case of three Blue players shows that it is a best response for player i to vote Blue if and only if $d_i > 0$. As everything is symmetric, the same holds for player j and for player k. Note that the threshold here does not depend on q, a, b. What is important is that as a player is pivotal only when half of the others have voted Blue and the other half have voted Green, the probabilities on each side of the expected utility calculation from voting Blue versus Green cancel out. Hence the equilibrium threshold in the three player homogeneous committee case under majority rule is the same as in individual decision making. In terms of calculating their expected utility from alternative actions it is as if they are deciding on their own. This is regardless of whether $n = 3$, $n = 5$ or $n =$ any odd integer greater than that.

Proposition 5. *Interior Equilibrium $n \geq 3$ Players Homogeneous Committee*

In equilibrium each (Blue) player has a threshold type $\hat{d}_i = 0$ such that the optimal strategies are:

$s_i(d_i) = 0$ *(vote Green) if* $d_i \leq \hat{d}_i$

$s_i(d_i) = 1$ *(vote Blue) if* $d_i > \hat{d}_i$.

Proposition 5 gives the equilibrium type thresholds in the interior equilibrium in the n player homogeneous committee case.

Corollary 3. *Discrimination n Players Homogeneous Committee*

Discrimination in favor of the own group arises in the interior equilibrium in the n player homogeneous committee case, i.e. $P(\tilde{B}) > P(\tilde{G})$ *(when n Blue players make a decision).*

The magnitude of discrimination is:

$$P(\tilde{B}) - P(\tilde{G}) =$$

$$= \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (\frac{b}{b-a})^{k} (\frac{-a}{b-a})^{n-k} - \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (\frac{-a}{b-a})^{k} (\frac{b}{b-a})^{n-k}$$

4.5 Heterogeneous committee of $n \geq 3$

Consider a diverse committee of $n \geq 3$, again deciding collectively by majority rule. I will first illustrate with $n = 3$ and will then argue that the results extend to any odd positive integer $n \geq 3$.

With three committee members, heterogeneity implies that either two players are Blue and one Green or that two players are Green and one Blue. I focus the exposition on the first case, taking player i and player j to be Blue and player k to be Green. The assumptions on ν_i, ν_j, ν_k are the same as in the homogeneous committee case.

The comparison of expected utility from voting Blue and expected utility from voting Green for a Blue player conditional on being pivotal is the same as in the homogeneous committee case and is therefore omitted. For the Green player it is:

$$EU_k^G(B) > EU_k^G(G)$$
$$\nu_i(1-\nu_j)(q-d_i) + (1-\nu_i)\nu_j(q-d_i) > \nu_i(1-\nu_j)(q+d_i) + (1-\nu_i)\nu_j(q+d_i)$$
$$(q-d_i) > (q+d_i)$$
$$d_i \leq 0$$

Again what is worth noting here is that a committee member is pivotal when half of the others have voted Blue and the other half have voted Green. Hence if players only consider what to do based on the situation when they are pivotal, they only need to compare their individual utility from voting Blue with their individual utility from voting Green.

The best responses of a Blue player i to any strategies $s_j(d_j)$ and $s_k(d_k)$ are threshold rules: there exists some $\hat{d}_i$ such that i's best response is to choose $a_i = 0$ if $d_i \leq \hat{d}_i$ and to choose $a_i = 1$ if $d_i > \hat{d}_i$. The best response of a Green player k to any strategies $s_i(d_i)$ and $s_j(d_j)$ is a threshold rule: there exists some $\hat{d}_k$ such that k's best response is to choose $a_k = 0$ if $d_k > \hat{d}_k$ and to choose $a_k = 1$

if $d_k \leq \hat{d}_k$.

Hence it is a best response for a Blue player i to vote Blue if and only if $d_i > 0$. For the Green player k it is a best response to vote Blue if and only if $d_k \leq 0$.

Proposition 6. *Interior Equilibrium $n \geq 3$ Players Heterogeneous Committee*

In equilibrium a Blue player has a threshold type $\hat{d}_i = 0$ such that the optimal strategies are:

$s_i(d_i) = 0$ *if* $d_i \leq \hat{d}_i$

$s_i(d_i) = 1$ *if* $d_i > \hat{d}_i$.

In equilibrium a Green player has a threshold type $\hat{d}_k = 0$ such that:

$s_k(d_k) = 0$ *if* $d_k > \hat{d}_k$

$s_k(d_k) = 1$ *if* $d_k \leq \hat{d}_k$.

Proposition 6 gives the equilibrium type thresholds in the n player heterogeneous committee case. The thresholds are the same for all players. However, note that the players from the Blue group vote for the Blue candidate if their type is above the threshold whereas the Green players vote for the Blue candidate if their type is below the threshold. Note that the equilibrium threshold in the n player heterogeneous committee case under majority rule is the same as in individual decision making and in the n player homogeneous committee case.

Corollary 4. *Discrimination Three Players Heterogeneous Committee*

Discrimination in favor of the majority group arises in the interior equilibrium in the three player heterogeneous committee case, i.e. $P(\tilde{B}) > P(\tilde{G})$ (when two Blue and one Green player make a decision).

The magnitude of discrimination is:

$$\frac{P(\tilde{B}) - P(\tilde{G})}{P(\tilde{B}) + P(\tilde{G}} = \frac{(b^2 + (-a)^2)(b+a)}{(b-a)^2(b-a)}$$

5 Comparisons and Discussion

Table 1 summarizes selective findings on the question of discrimination arising in alternative set-ups. The analysis shows that the decision making set-up has an effect on whether discrimination arises and on its magnitude. In a situation in which an individual has a higher probability of hiring an own group than an other group candidate, a committee could either mitigate or exacerbate the individuals' discriminatory tendencies. Depending on the exact parameters of the decision making situation, in a homogeneous committee of two deciding under unanimity rule several outcomes are possible. When the importance of qualifications is relatively low compared to the bias, discrimination in favor of the own group arises in a unique interior equilibrium with the resulting probabilities of hiring the Blue or the Green candidate given in Table 1. When a committee member gives higher importance to qualifications than to own group bias, multiple equilibria arise. In this case the Pareto superior equilibrium (which is also focal in terms of group identities) involves choosing the own group with probability one. In the case of a heterogeneous committee of two, if the importance of qualifications is relatively low, no discrimination arises in the unique interior equilibrium. The reason is not that individuals stop discriminating. In fact, there are still more types of each player that choose the own over the other group candidate. However, in a heterogeneous committee, individual discriminatory behavior (in the interior equilibrium) is canceled out by the aggregation of opposite biases. If the importance of qualifications is high, there are again multiple equilibria, some of them involving a high probability of choosing the Blue and the other a high probability of choosing the Green candidate. Standard equilibrium selection criteria, however, do not allow us to distinguish among them. Hence a priori there is no prediction of one group being discriminated against and in that sense diversity in committees leads to ex-ante fairness.

In the n-player majority rule case, a homogeneous committee will favor the own over the other group. Moreover the difference in probabilities of an own and an other group candidate being chosen (accounting for the probability of coordinating on a candidate) will be greater than in individual decisions, as all committee members' biases reinforce each other. A further conjecture is that the higher the number of committee members in the homogeneous committee case under majority rule, the more discrimination in favor of the own group candidate can be expected. A three-player heterogeneous committee will favor the majority group candidate under majority rule, but the amount of discrimination will be smaller than in the three-player homogeneous committee case.

The key message emerging from this analysis is that diversity in committees may help mitigate discrimination and in some situations achieve ex-ante fairness in expected outcomes.

6 Conclusion

Motivated by the observation that most economic models of discrimination focus on a situation in which an individual makes a decision, but that many decisions are taken by groups, this paper presents a model of discrimination in collective decisions. The analysis focuses on how the decision making set-up, with a particular interest in committee composition (homogeneous versus diverse) affects whether individual discriminatory biases are exacerbated or mitigated in a collective decision. The key finding is that homogeneous committees may be expected to discriminate in favor of the own group whereas diverse committees may help to mitigate or entirely eliminate discrimination. Further research can focus on extending the framework presented here to allow for a variety of additional factors driving discrimination, such as different qualifications of candidates from different groups, reputation concerns of committee members, differential ability to interpret signals from own and other group candidates. The model delivers empirically testable predictions and can be tested experimentally.

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Appendix: Proofs

Lemma 1.

Proof. Denote with $\hat{d}_i$ the bias threshold above which the Blue individual chooses the Blue candidate and below which they choose the Green candidate. In Section 4.1 I showed that $\hat{d}_i = 0$. Denote the cumulative distribution function of d_i by F. The probability that d_i will take a value smaller or equal to $\hat{d}_i$ is given by $F(\hat{d}_i)$. The probability that d_i will take a value larger than $\hat{d}_i$ is given by $1 - F(\hat{d}_i)$. It is then straightforward to compare the probabilities of a Blue and of a Green candidate being chosen, respectively:

$$\Pr(\tilde{B}) = \Pr(d_i > \hat{d}_i) = 1 - F(\hat{d}_i) = \frac{b - \hat{d}_i}{b - a} = \frac{b - 0}{b - a}$$
$$\Pr(\tilde{G}) = \Pr(d_i \leq \hat{d}_i) = F(\hat{d}_i) = \frac{\hat{d}_i - a}{b - a} = \frac{0 - a}{b - a}$$

$$\Pr(\tilde{B}) = \frac{b}{b - a} > \Pr(\tilde{G}) = \frac{-a}{b - a}$$
$$\Pr(\tilde{B}) - \Pr(\tilde{G}) = \frac{b + a}{b - a}$$

In the above comparison note that $b > 0$, $a < 0$, and $|a| < |b|$ by assumption. In the case when $a = 0$ (the distribution of tastes is such that there is only favoritism of the own group and negative discrimination of the other group, but no negative discrimination against the own group and no positive discrimination in favor of the other group), the own group candidate will be hired with probability one in individual decisions. □

Lemma 2.

Proof. Note again that the probability a Blue player i votes for the Blue candidate is ν_i, which is given by the probability that their type is above the threshold $\hat{d}_i = q - 2\nu_j q = 1 - F(q - 2\nu_j q)$. Likewise $\nu_j = \Pr(d_j > \hat{d}_j) = 1 - F(q - 2\nu_i q)$.

Suppose to the contrary that $\nu_i > \nu_j$. This would imply:

$$1 - F(q - 2\nu_j q) > 1 - F(q - 2\nu_i q) \Leftrightarrow F(q - 2\nu_i q) > F(q - 2\nu_j q)$$

A necessary condition for the latter to hold is $q - 2\nu_i q > q - 2\nu_j q$. This would imply $\nu_i < \nu_j$, a contradiction.

□

Proposition 1.

Proof. The proof is omitted as it follows from the analysis in the main text. □

Proposition 2.

Proof. I first consider whether and when corner equilibria arise. Recall that in a homogeneous committee with Player i Blue and Player j Blue, the following holds:

$$EU_i^B(B) \geq EU_i^B(G)$$
$$d_i \geq q - 2\nu_j q$$

(1) Can $\hat{d}_i = \hat{d}_j = a$ be equilibrium thresholds? This would imply $\nu_i = 1$ and $\nu_j = 1$. The above expression becomes $d_i \geq -q$. Recall that $\Pr d_i \geq \hat{d}_i = 1 - F(\hat{d}_i)$, which here implies $1 - F(-q) = 1$ in case both thresholds are a or $F(-q) = 0$. This will be the case when $-q \leq a$ or equivalently $q \geq -a$. The same holds for Player j.

(2) Can $\hat{d}_i = \hat{d}_j = b$ be equilibrium thresholds? This would imply $\nu_i = 0$ and $\nu_j = 0$. The above expression becomes $d_i \geq q$. Recall that $\Pr d_i \geq \hat{d}_i = 1 - F(\hat{d}_i)$, which here implies $1 - F(q) = 0$ in case both thresholds are b or $F(q) = 1$. This will be the case when $q \geq b$. The same holds for Player j.

From Lemma 2 we know that there are no asymmetric equilibria, so we have exhausted the potential corner solutions.

(3) Now look for interior solutions, i.e. $a < \hat{d}_i < b$.

The probability ν_i that player i votes Blue can be rewritten as $\Pr\{s_i(d_i) = 1\} = \Pr\left\{d_i > \hat{d}_i\right\} = 1 - F(\hat{d}_i) = \frac{b-\hat{d}_i}{b-a}$. The probability that Player j votes Blue ν_j can be rewritten as $\Pr\{s_j(d_j) = 1\} = \Pr\left\{d_j > \hat{d}_j\right\} = 1 - F(\hat{d}_j) = \frac{b-\hat{d}_j}{b-a}$. The implication of the latter expression being a probability is that $\hat{d}_j \leq b$. Likewise from $F(\hat{d}_j) = \frac{\hat{d}_j - a}{b-a}$ it follows that $\hat{d}_j \geq a$. Together this implies that $a \leq \hat{d}_j \leq b$.

$$\hat{d}_i = q - 2\nu_j q$$
$$\hat{d}_i = q - 2q\frac{b-\hat{d}_j}{b-a}$$
$$\hat{d}_i = \frac{q(b-a) - 2q(b-\hat{d}_j)}{b-a}$$
$$\hat{d}_i = \frac{bq - aq - 2bq + 2q\hat{d}_j}{b-a}$$
$$\hat{d}_i = \frac{-bq - aq + 2q\hat{d}_j}{b-a}$$
$$\hat{d}_i = \frac{-q(b+a) + 2q\hat{d}_j}{b-a}$$

Analogically $\hat{d}_j = \frac{-q(b+a)+2q\hat{d}_i}{b-a}$. This shows that in the homogeneous committee case the best response of each player is increasing in the threshold of the other player as the slope of the best response correspondence is $\frac{2q}{b-a} > 0$. Moreover, the slope is less than one when $q < \frac{b-a}{2}$ and greater than one when $q > \frac{b-a}{2}$. In the latter case, the two players' actions are "strong" strategic complements whereas in the former case they are less complementary.

To find the crossing point of the two best response correspondences:

$$
\begin{aligned}
\hat{d}_i &= \frac{-bq - aq + 2q\frac{-bq-aq+2q\hat{d}_i}{b-a}}{b-a} \\
\hat{d}_i(b-a)^2 &= -bq(b-a) - aq(b-a) - 2bq^2 - 2aq^2 + 4q^2\hat{d}_i \\
\hat{d}_i(b-a)^2 - 4q^2\hat{d}_i &= -bq(b-a) - aq(b-a) - 2bq^2 - 2aq^2 \\
\hat{d}_i[(b-a)^2 - 4q^2] &= -bq(b-a) - aq(b-a) - 2bq^2 - 2aq^2 \\
\hat{d}_i(b-a+2q)(b-a-2q) &= (b-a)(-bq-aq) + 2q(-bq-aq) \\
\hat{d}_i(b-a+2q)(b-a-2q) &= (b-a+2q)(-bq-aq) \\
\hat{d}_i(b-a-2q) &= (-bq-aq) \\
\hat{d}_i &= \frac{-q(b+a)}{(b-a-2q)}
\end{aligned}
$$

Likewise $\hat{d}_j = \frac{-q(b+a)}{b-a-2q}$.

There are three subcases: 3.1. $a < \hat{d}_i < 0$; 3.2. $0 < \hat{d}_i < \frac{b+a}{2}$; 3.3. $\frac{b+a}{2} < \hat{d}_i < b$.

3.1: Start with $a < \hat{d}_i < 0$.

$$
\begin{aligned}
\hat{d}_i = \frac{-q(b+a)}{b-a-2q} &< 0 \\
\Rightarrow b-a-2q &> 0 \\
b-a &> 2q \\
q &< \frac{b-a}{2}
\end{aligned}
$$

$$
\begin{aligned}
\frac{-q(b+a)}{b-a-2q} &> a \\
-q(b+a) &> a(b-a-2q) \\
-bq - aq &> ab - a^2 - 2aq \\
q(a-b) &> a(b-a) \\
-q(b-a) &> a(b-a) \\
-q &> a \\
q &< -a
\end{aligned}
$$

Therefore $a < \hat{d}_i < 0$ holds when $0 < q < -a$. The first bound comes from the assumption that $q > 0$. The second bound is sufficient as it is always true that $-a < \frac{b-a}{2}$ and hence $-2a < b-a$ due to $-a < b$ (by the initial assumption). In this case the types below the threshold hire own group candidates and the types above the threshold hire other group candidates. Discrimination arises as there are more types who hire own than other group candidates. This is the unique equilibrium when it exists.

3.2. Next consider $0 < \hat{d}_i < \frac{b+a}{2}$.

$$\begin{aligned}\frac{-q(b+a)}{b-a-2q} &> 0\\ \Rightarrow b-a-2q &< 0\\ b-a &< 2q\\ q &> \frac{b-a}{2}\end{aligned}$$

$$\begin{aligned}\frac{-q(b+a)}{b-a-2q} &< \frac{b+a}{2}\\ -2q(b+a) &> (b+a)(b-a-2q)\\ -2bq-2aq &> b^2-ab-2bq+ab-a^2-2aq\\ b^2 &< a^2\end{aligned}$$

The second condition cannot be satisfied if $\hat{d}_i > 0$.

3.3. $\frac{b+a}{2} < \hat{d}_i < b$

$$\begin{aligned}\frac{-q(b+a)}{b-a-2q} &> \frac{b+a}{2}\\ -2q(b+a) &< (b+a)(b-a-2q)\\ -2bq-2aq &< b^2-ab-2bq+ab-a^2-2aq\\ b^2 &> a^2\\ |b| &> |a|\end{aligned}$$

$$\begin{aligned}\frac{-q(b+a)}{b-a-2q} &< b\\ -q(b+a) &> b(b-a-2q)\\ -bq-aq &> b^2-ab-2bq\\ bq-aq &> b^2-ab\\ q(b-a) &> b(b-a)\\ q &> b\end{aligned}$$

If $q > b$ holds then there exists an interior equilibrium such that more types hire other group than own group candidates.

Part (i) of Proposition 4 follows from (3.1) and (3.2) above.

Parts (ii) and (iii) follow from (1), (2), and (3.3).

□

Lemma 3.

Proof. The equilibrium thresholds $\hat{d}_i = \hat{d}_j = a$ imply that the own group candidate is hired with probability one. The equilibrium thresholds $\hat{d}_i = \hat{d}_j = b$ imply that the other group candidate is hired with probability one. As the expected payoff from the own group candidate $q + \frac{b+a}{2}$ is higher than the expected payoff from the other group candidate $q - \frac{b+a}{2}$ (on average over all types) due to the assumption that players are more likely to be biased in favor of the own over the other group, the equilibrium where the own group candidate is chosen with probability one Pareto dominates the equilibrium where the other group candidate is chosen with probability one. By the same logic the equilibrium where the own group candidate is chosen with probability one Pareto dominates the interior equilibrium where the other group player is hired with higher probability, which coexists with the two corner equilibria for $q > b$. □

Corollary 1

Proof. In the interior equilibrium: $\hat{d}_i = \hat{d}_j = \frac{-q(b+a)}{b-a-2q}$. The probabilities of the Blue and the Green candidate being chosen, respectively are:

$$P(\tilde{B}) = Pr\left\{d_i > \hat{d}_i\right\} Pr\left\{d_j > \hat{d}_j\right\}$$

$$P(\tilde{B}) = \frac{b-\hat{d}_i}{b-a}\frac{b-\hat{d}_j}{b-a}$$

$$P(\tilde{B}) = \frac{(b+\frac{q(b+a)}{b-a-2q})(b+\frac{q(b+a)}{b-a-2q})}{(b-a)(b-a)}$$

$$P(\tilde{B}) = \frac{\frac{[b(b-a-2q)+q(b+a)]^2}{(b-a-2q)^2}}{(b-a)^2}$$

$$P(\tilde{B}) = \frac{(b^2-ab-2bq+bq+aq)^2}{(b-a-2q)^2(b-a)^2}$$

$$P(\tilde{B}) = \frac{(b^2-ab-bq+aq)^2}{(b-a-2q)^2(b-a)^2}$$

$$P(\tilde{B}) = \frac{[b(b-a)-q(b-a)]^2}{(b-a-2q)^2(b-a)^2}$$

$$P(\tilde{B}) = \frac{(b-q)^2(b-a)^2}{(b-a-2q)^2(b-a)^2}$$

$$P(\tilde{B}) = \frac{(b-q)^2}{(b-a-2q)^2}$$

$$
\begin{aligned}
P(\tilde{G}) &= Pr\left\{d_i \leq \hat{d}_i\right\} Pr\left\{d_j \leq \hat{d}_j\right\} \\
P(\tilde{G}) &= \frac{\hat{d}_i - a}{b-a}\frac{\hat{d}_j - a}{b-a} \\
P(\tilde{G}) &= \frac{(\frac{-q(b+a)}{b-a-2q} - a)(\frac{-q(b+a)}{b-a-2q} - a)}{(b-a)^2} \\
P(\tilde{G}) &= \frac{(\frac{[-q(b+a)-a(b-a-2q)]^2}{(b-a-2q)^2}}{(b-a)^2} \\
P(\tilde{G}) &= \frac{[-bq - aq - ab + a^2 + 2aq]^2}{(b-a-2q)^2(b-a)^2} \\
P(\tilde{G}) &= \frac{(-bq + aq - ab + a^2)^2}{(b-a-2q)^2(b-a)^2} \\
P(\tilde{G}) &= \frac{[-q(b-a) - a(b-a)]^2}{(b-a-2q)^2(b-a)^2} \\
P(\tilde{G}) &= \frac{[(-q-a)(b-a)]^2}{(b-a-2q)^2(b-a)^2} \\
P(\tilde{G}) &= \frac{(q+a)^2(b-a)^2}{(b-a-2q)^2(b-a)^2} \\
P(\tilde{G}) &= \frac{(q+a)^2}{(b-a-2q)^2}
\end{aligned}
$$

For $0 < q < -a$, there is a unique interior equilibrium and the probabilities of the Blue and the Green candidate being chosen are given above. We only need to compare the numerators as the denominator is the same:

$$
\begin{aligned}
(b-q)^2 &> (a+q)^2 \Leftrightarrow \\
b^2 - 2bq + q^2 &> a^2 + 2aq + q^2 \Leftrightarrow \\
b^2 - a^2 &> 2aq + 2bq \Leftrightarrow \\
(b+a)(b-a) &> 2q(b+a) \Leftrightarrow \\
(b-a) &> 2q \\
q \leq \frac{b-a}{2}
\end{aligned}
$$

The above always is always satisfied in this equilibrium, as this equilibrium exists only when $q < -a$ and $q \leq \frac{b-a}{2}$ is guaranteed to hold when $q < -a$.

For $-a < q < b$, a unique corner equilibrium arises in which $P(\tilde{B}) = 1$ and $P(\tilde{G}) = 0$.

For $q > b$, if Pareto dominance is used as an equilibrium selection criterion, $P(\tilde{B}) = 1$ and $P(\tilde{G}) = 0$ in the corner equilibrium selected (as above).

□

Amount of discrimination in a two-player homogeneous committee (before normalizing for probability of coordinating):

$$
\begin{aligned}
P(\tilde{B}) - P(\tilde{G}) &= \frac{(b-q)^2}{(b-a-2q)^2} - \frac{(q+a)^2}{(b-a-2q)^2} \\
&= \frac{b^2 - 2bq + q^2 - q^2 - 2aq - a^2}{(b-a-2q)^2} \\
&= \frac{(b^2 - a^2) - 2q(b+a)}{(b-a-2q)^2} \\
&= \frac{(b+a)(b-a) - 2q(b+a)}{(b-a-2q)^2} \\
&= \frac{(b-a-2q)(b+a)}{(b-a-2q)^2} \\
&= \frac{b+a}{b-a-2q}
\end{aligned}
$$

Comparison with the amount of discrimination in the individual decision making benchmark (before normalizing for probability of coordinating):

$$
\frac{b+a}{b-a-2q} > \frac{b+a}{b-a}
$$

According to the above comparison there is more discrimination in the case of a two-player homogeneous committee than in individual decisions. (This is because this equilibrium exists only when $b - a > 2q$). This makes sense as in this equilibrium each player has a lower threshold above which they hire the own group candidate than in individual decisions. However, note that this does not take into account the probability of coordinating.

Probability of coordinating in a two player homogeneous committee:

$$
\begin{aligned}
P(\tilde{B}) + P(\tilde{G}) &= \frac{(b-q)^2}{(b-a-2q)^2} + \frac{(q+a)^2}{(b-a-2q)^2} \\
P(\tilde{B}) + P(\tilde{G}) &= \frac{(b-q)^2 + (q+a)^2}{(b-a-2q)^2}
\end{aligned}
$$

Comparison with individual decisions:

$$\frac{P(\tilde{B}) - P(\tilde{G})}{P(\tilde{B}) + P(\tilde{G})} = \frac{\frac{(b-q)^2-(q+a)^2}{(b-a-2q)^2}}{\frac{(b-q)^2+(q+a)^2}{(b-a-2q)^2}} ? \frac{b+a}{b-a}$$
$$\frac{[(b-q)^2 - (q+a)^2](b-a-2q)^2}{[(b-q)^2 + (q+a)^2](b-a-2q)^2} ? \frac{b+a}{b-a}$$
$$\frac{(b-q)^2 - (q+a)^2}{(b-q)^2 + (q+a)^2} ? \frac{b+a}{b-a}$$
$$\frac{b^2 - 2bq + q^2 - q^2 - 2aq - a^2}{b^2 - 2bq + q^2 + q^2 + 2aq + a^2} ? \frac{b+a}{b-a}$$
$$\frac{b^2 - a^2 - 2q(b+a)}{b^2 + a^2 + 2q^2 - 2q(b-a)} ? \frac{b+a}{b-a}$$
$$\frac{(b+a)(b-a) - 2q(b+a)}{b^2 + a^2 + 2q^2 - 2q(b-a)} ? \frac{b+a}{b-a}$$
$$\frac{(b-a) - 2q}{b^2 + a^2 + 2q^2 - 2q(b-a)} ? \frac{1}{b-a}$$
$$(b-a)^2 - 2q(b-a) ? b^2 + a^2 + 2q^2 - 2q(b-a)$$
$$b^2 + a^2 - 2ab - 2bq + 2aq ? b^2 + a^2 + 2q^2 - 2bq + 2aq$$
$$-2ab ? 2q^2$$
$$-ab ? q^2$$
$$\sqrt{-ab} ? q$$

Amount of discrimination in a 2-player homogeneous committee (in the interior equilibrium), normalized by probability of coordinating) is greater than amount of discrimination in individual decisions when $q < \sqrt{-ab}$. For this interior equilibrium to exist need $q < -a$.

$$-a ? \sqrt{-ab}$$
$$(-a)^2 ? (\sqrt{-ab})^2$$
$$(-a)(-a) \& - ab$$
$$(-a) < b$$

The above shows that discrimination in the interior equilibrium in a 2-player homogeneous committee is always smaller than the amount of discrimination in individual decisions. This is in spite of the fact that in this equilibrium the individual players' threshold is always lower than in individual decisions. It is driven by the probability of coordinating.

Lemma 4.

Proof. How do the equilibrium thresholds change with changes in q?

Note that $b-a-2q=0 \Rightarrow q=\frac{b-a}{2}$, i.e. there is a discontinuity at this value. Otherwise:

$$\frac{\partial \hat{d}_i}{\partial q} = \frac{-(b+a)(b-a-2q)+q(b+a)(-2)}{(b-a-2q)^2}$$
$$\frac{\partial \hat{d}_i}{\partial q} = \frac{(b+a)(a-b+2q-2q)}{(b-a-2q)^2}$$
$$\frac{\partial \hat{d}_i}{\partial q} = \frac{-(b+a)(b-a)}{(b-a-2q)^2}$$
$$\frac{\partial \hat{d}_i}{\partial q} = \frac{-(b^2-a^2)}{(b-a-2q)^2} < 0$$
$$\frac{\partial \hat{d}_i}{\partial q} < 0$$
$$\frac{\partial \hat{d}_j}{\partial q} < 0$$

What happens if the distribution of the bias approaches symmetric around the mean with incomplete information about the other's type?

$$\hat{d}_i = \frac{-q(b+a)}{(b-a-2q)}$$
$$\hat{d}_i = \frac{-q(\mu+x+\mu-x)}{(\mu+x-\mu+x-2q)}$$
$$\hat{d}_i = \frac{-q2\mu}{2x-2q}$$
$$\hat{d}_i = \frac{-q\mu}{x-q}$$
$$\hat{d}_{i\mu\to 0} = \frac{-q\mu}{x-q}$$
$$\hat{d}_{i\mu\to 0} = 0$$

Then the thresholds $\hat{d}_i = 0$ and $\hat{d}_j = 0$, i.e. committee members in a homogeneous committee hire own group candidates if their bias is above zero and other group candidates if there bias is below zero.

$$
\begin{aligned}
P(\tilde{B}) &= \frac{(-q+b)^2}{(b-a-2q)^2} \\
P(\tilde{B}) &= \frac{(-q+\mu+x)^2}{(\mu+x-\mu+x-2q)^2} \\
P(\tilde{B}) &= \frac{(-q+\mu+x)^2}{(2x-2q)^2} \\
P(\tilde{B})_{(\mu\to 0)} &= \frac{(-q+x)^2}{(2x-2q)^2} \\
P(\tilde{B})_{(\mu\to 0)} &= \frac{(x-q)^2}{4(x-q)^2} \\
P(\tilde{B})_{(\mu\to 0)} &= \frac{1}{4} \\
P(\tilde{G}) &= \frac{(-q-a)^2}{(b-a-2q)^2} \\
P(\tilde{G}) &= \frac{(-q-\mu+x)^2}{(\mu+x-\mu+x-2q)^2} \\
P(\tilde{G}) &= \frac{(-q-\mu+x)^2}{(2x-2q)^2} \\
P(\tilde{G})_{(\mu\to 0)} &= \frac{(-q+x)^2}{(2x-2q)^2} \\
P(\tilde{G})_{(\mu\to 0)} &= \frac{(x-q)^2}{4(x-q)^2} \\
P(\tilde{G})_{(\mu\to 0)} &= \frac{1}{4} \\
P(\tilde{B})_{(\mu\to 0)} &= P(\tilde{G})_{(\mu\to 0)}
\end{aligned}
$$

So if there is no asymmetry in the biases towards own and other group members $b \to a$, then there is no discrimination.

□

Proposition 3.

Proof. The proof is omitted as it follows from the analysis in the main text. □

Proposition 4.

Proof. I first consider whether and when corner equilibria arise. Recall that in a heterogeneous committee with Player i Blue and Player j Green, the following hold:

$$
\begin{aligned}
EU_i^B(B) &\geq EU_i^B(G) \\
d_i &\geq q - 2\nu_j q
\end{aligned}
$$

$$EU_j^G(B) \geq EU_j^G(G)$$
$$d_j < 2\nu_i q - q$$

1) Can $\hat{d}_i = a$ and $\hat{d}_j = b$ be equilibrium thresholds? Since types below the threshold vote for the other group and types above the threshold vote for the own group, this would imply $\nu_i = 1$ and $\nu_j = 1$. The above expression for i becomes $d_i > -q$. That is, $1 - F(-q) = 1$, $F(-q) = 0$, $-q \leq a$ or $q \geq -a$. The expression for j becomes $d_j < q$. That is, $F(q) = 1$ or $q \geq b$.

2) Can $\hat{d}_i = b$ and $\hat{d}_j = a$ be equilibrium thresholds? Since types below the threshold vote for the other group and types above the threshold vote for the own group, this would imply $\nu_i = 0$ and $\nu_j = 0$. The above expression for i becomes $d_i \geq q$. That is, $1 - F(\hat{d}_i) = 0$, $F(\hat{d}_i) = 1$ or $F(q) = 1$. This is the case when $q \geq b$. For player j: $d_j < -q$ and $F(\hat{d}_j) = 0$ so $F(-q) = 0$. This holds when $-q \leq a$ or $q \geq -a$.

3) Can $\hat{d}_i = \hat{d}_j = a$ be equilibrium thresholds? Since types below the threshold vote for the other group and types above the threshold vote for the own group, this would imply $\nu_i = 1$ and $\nu_j = 0$. The above expression for i becomes $d_i \geq q$ or $q \leq a$. For the Green player j, the expression becomes $d_j < q$, which again holds only if $q \leq a$. But by initial assumption $q > 0$ and $a \leq 0$, so this is not possible.

4) Can $\hat{d}_i = \hat{d}_j = b$ be equilibrium thresholds? This would imply $\nu_i = 0$ and $\nu_j = 1$. The above expression for the Blue player i becomes $d_i \geq -q$, which would hold if $q \leq -b$. For the Green player j, the expression becomes $d_j < -q$, which would again hold if $q \leq -b$. But by initial assumption $q > 0$ and $b > 0$, so this is not possible.

5) Now look for interior solutions, i.e. $a < \hat{d}_i < b$ and $a < \hat{d}_j < b$.

The probability that Pl. i votes BLUE ν_i can be rewritten as $Pr\{s_i(d_i) = 1\} = Pr\left\{d_i > \hat{d}_i\right\} = \frac{b-\hat{d}_i}{b-a}$. The probability that Pl. j votes BLUE ν_j can be rewritten as $Pr\{s_j(d_j) = 1\} = Pr\left\{d_j \leq \hat{d}_j\right\} = 1 - \frac{b-\hat{d}_j}{b-a} = \frac{\hat{d}_j-a}{b-a}$.

$$\hat{d}_i = q - 2\nu_j q$$
$$\hat{d}_i = q - 2q\frac{\hat{d}_j - a}{b-a}$$
$$\hat{d}_i = \frac{q(b-a) - 2q\hat{d}_j + 2aq}{b-a}$$
$$\hat{d}_i = \frac{bq - aq - 2q\hat{d}_j + 2aq}{b-a}$$
$$\hat{d}_i = \frac{bq + aq - 2q\hat{d}_j}{b-a}$$

$$\hat{d}_j = 2\nu_i q - q$$

$$\hat{d}_j = 2q\frac{b - \hat{d}_i}{b - a} - q$$

$$\hat{d}_j = \frac{2q(b - \hat{d}_i) - q(b - a)}{b - a}$$

$$\hat{d}_j = \frac{2bq - 2q\hat{d}_i - bq + aq}{b - a}$$

$$\hat{d}_j = \frac{bq + aq - 2q\hat{d}_i}{b - a}$$

To find the crossing point of the two best response correspondences insert one into the other.

$$\hat{d}_i = \frac{bq + aq - 2q\hat{d}_j}{b - a}$$

$$\hat{d}_i = \frac{bq + aq - 2q\frac{bq+aq-2q\hat{d}_i}{b-a}}{b - a}$$

$$\hat{d}_i(b - a)^2 = bq(b - a) + aq(b - a) - 2q(bq + aq - 2q\hat{d}_i)$$

$$\hat{d}_i(b - a)^2 - 4q^2\hat{d}_i = bq(b - a) + aq(b - a) - 2q(bq + aq)$$

$$\hat{d}_i(b - a + 2q)(b - a - 2q) = (bq + aq)(b - a - 2q)$$

$$\hat{d}_i = \frac{bq + aq}{b - a + 2q}$$

This is assuming $b - a - 2q \neq 0$ or $b - a \neq 2q$, $\frac{b-a}{2} \neq q$.

$$\hat{d}_j = \frac{bq + aq - 2q\hat{d}_i}{b - a}$$

$$\hat{d}_j = \frac{bq + aq - 2q\frac{bq+aq}{b-a+2q}}{b - a}$$

$$\hat{d}_j = \frac{(bq + aq)(b - a + 2q) - 2q(bq + aq)}{(b - a + 2q)(b - a)}$$

$$\hat{d}_j = \frac{(bq + aq)(b - a + 2q - 2q)}{(b - a + 2q)(b - a)}$$

$$\hat{d}_j = \frac{(bq + aq)(b - a)}{(b - a + 2q)(b - a)}$$

$$\hat{d}_j = \frac{(bq + aq)}{(b - a + 2q)}$$

There are three subcases: 5.1. $a < \hat{d}_i < 0$; 5.2. $0 < \hat{d}_i < \frac{b+a}{2}$; 5.3. $\frac{b+a}{2} < \hat{d}_i < b$.

5.1: Start with $a < \hat{d}_i < 0$. This requires that $\hat{d}_i < 0$ and hence that:

$$\begin{aligned} b - a + 2q &< 0 \\ 2q &< a - b \\ q &< \frac{a-b}{2} \end{aligned}$$

Thus, this case is not possible as $\hat{d}_i < 0 \Rightarrow b - a + 2q < 0$ which is not possible as $q > 0$ while the RHS is negative. An analogical result holds for player j. Hence in a heterogeneous committee the case where types of each player who are negatively biased against the own group hiring the own group candidate cannot be part of equilibirum.

5.2. Next consider $0 < \hat{d}_i < \frac{b+a}{2}$. $\hat{d}_i > 0 \Rightarrow b - a + 2q > 0$.

$$\begin{aligned} b - a + 2q &> 0 \\ 2q &> a - b \\ q &> \frac{a-b}{2} \end{aligned}$$

The above always holds.

$$\begin{aligned} \hat{d}_i = \frac{q(b+a)}{b-a+2q} &< \frac{b+a}{2} \\ 2q(b+a) &< (b+a)(b-a+2q) \\ 2bq + 2aq &< b^2 - ab + 2bq + ab - a^2 + 2aq \\ a^2 &< b^2 \\ |a| &< |b| \end{aligned}$$

This also always holds.

5.3. Consider $\frac{b+a}{2} < \hat{d}_i < b$. This implies $\hat{d}_i > 0 \Rightarrow b - a + 2q > 0$.

$$\begin{aligned} b - a + 2q &> 0 \\ 2q &> a - b \\ q &> \frac{a-b}{2} \end{aligned}$$

The above always holds.

$$\begin{aligned}
\hat{d}_i = \frac{q(b+a)}{b-a+2q} &< b \\
q(b+a) &< b(b-a+2q) \\
bq + aq &< b^2 - ab + 2bq \\
aq - bq &< b(b-a) \\
-q(b-a) &< b(b-a) \\
-q &< b
\end{aligned}$$

The above always holds.

□

Corollary 2

What are the probabilities of a Blue and of a Green candidate to be chosen in the interior equilibrium?

$$P(\tilde{B}) = Pr\left\{d_i > \hat{d}_i\right\} Pr\left\{d_j \leq \hat{d}_j\right\}$$

$$P(\tilde{B}) = \frac{b-\hat{d}_i}{b-a}\frac{\hat{d}_j - a}{b-a}$$

$$P(\tilde{B}) = \frac{b - \frac{q(b+a)}{b-a+2q}}{b-a}\frac{\frac{q(b+a)}{b-a+2q} - a}{b-a}$$

$$P(\tilde{B}) = \frac{\frac{b(b-a+2q)-bq-aq}{b-a+2q}}{(b-a)}\frac{\frac{bq+aq-a(b-a+2q)}{b-a+2q}}{(b-a)}$$

$$P(\tilde{B}) = \frac{\frac{b^2-ab+2bq-bq-aq}{b-a+2q}}{(b-a)}\frac{\frac{bq+aq-ab+a^2-2aq)}{b-a+2q}}{(b-a)}$$

$$P(\tilde{B}) = \frac{\frac{b^2-ab+bq-aq}{b-a+2q}}{(b-a)}\frac{\frac{a^2-ab+bq-aq}{b-a+2q}}{(b-a)}$$

$$P(\tilde{B}) = \frac{[b(b-a)+q(b-a)][-a(b-a)+q(b-a)]}{(b-a)^2(b-a+2q)^2}$$

$$P(\tilde{B}) = \frac{(b+q)(b-a)(q-a)(b-a)}{(b-a)^2(b-a+2q)^2}$$

$$P(\tilde{B}) = \frac{(b+q)(q-a)}{(b-a+2q)^2}$$

$$P(\tilde{G}) = Pr\left\{d_i \leq \hat{d}_i\right\} Pr\left\{d_j > \hat{d}_j\right\}$$
$$P(\tilde{G}) = \frac{\hat{d}_i - a}{b-a}\frac{b - \hat{d}_j}{b-a}$$
$$P(\tilde{G}) = \frac{\frac{q(b+a)}{b-a+2q} - a}{b-a}\frac{b - \frac{q(b+a)}{b-a+2q}}{b-a}$$
$$P(\tilde{G}) = \frac{\frac{q(b+a)-a(b-a+2q)}{b-a+2q}}{(b-a)}\frac{\frac{b(b-a+2q)-bq-aq}{b-a+2q}}{(b-a)}$$
$$P(\tilde{G}) = \frac{\frac{bq+aq-ab+a^2-2aq}{b-a+2q}}{(b-a)}\frac{\frac{b^2-ab+2bq-bq-aq}{b-a+2q}}{(b-a)}$$
$$P(\tilde{G}) = \frac{(bq-aq-ab+a^2)(b^2-ab+bq-aq)}{(b-a+2q)^2(b-a)^2}$$
$$P(\tilde{G}) = \frac{[q(b-a)-a(b-a)][b(b-a)+q(b-a)]}{(b-a+2q)^2(b-a)^2}$$
$$P(\tilde{G}) = \frac{(q-a)(b-a)(b+q)(b-a)}{(b-a+2q)^2(b-a)^2}$$
$$P(\tilde{G}) = \frac{(q-a)(b+q)}{(b-a+2q)^2}$$

To compare the equilibrium probabilities of hiring a BLUE and a GREEN candidate, I need to compare only the numerators (the denominators are the same).

$$\frac{(b+q)(q-a)}{(b-a+2q)^2} = \frac{(q-a)(b+q)}{(b-a+2q)^2}$$
$$P(\tilde{B}) = P(\tilde{G})$$

The LHS is equal to the RHS. Therefore in a two-player heterogeneous committee under unanimity rule, the probability of hiring the own group candidate is the same as the probability of hiring the other group candidate.

Lemma 5.

How do the equilibrium thresholds depend on changes in q?

$$\frac{\partial \hat{d}_i}{\partial q} = \frac{(b+a)(b-a+2q) - q(b+a)2}{(b-a+2q)^2}$$
$$\frac{\partial \hat{d}_i}{\partial q} = \frac{(b+a)(b-a+2q) - 2q(b+a))}{(b-a+2q)^2}$$
$$\frac{\partial \hat{d}_i}{\partial q} = \frac{(b+a)(b-a+2q-2q)}{(b-a+2q)^2}$$
$$\frac{\partial \hat{d}_i}{\partial q} = \frac{(b+a)(b-a)}{(b-a+2q)^2}$$
$$\frac{(b^2-a^2)}{(b-a+2q)^2} > 0$$
$$\frac{\partial \hat{d}_i}{\partial q} > 0$$
$$\frac{\partial \hat{d}_j}{\partial q} > 0$$

Corollary 3

Proof. In all of this $\hat{d}_i = 0$.

Probability that the majority of individuals in a committee of n BLUE committee members votes BLUE:

Here $\hat{d}_i = 0$.

$$P(\tilde{B}) = \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (Pr\left\{d_i > \hat{d}_i\right\})^k (Pr\left\{d_i \leq \hat{d}_i\right\})^{n-k} =$$
$$P(\tilde{B}) = \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (1 - F(0))^k (F(0))^{n-k} =$$
$$P(\tilde{B}) = \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (1 - \frac{(0-a)}{b-a})^k (\frac{0-a}{b-a})^{n-k} =$$
$$P(\tilde{B}) = \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (\frac{b-a+a}{b-a})^k (\frac{-a}{b-a})^{n-k}$$
$$P(\tilde{B}) = \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (\frac{b}{b-a})^k (\frac{-a}{b-a})^{n-k}$$

Probability that the majority of individuals in a committee of n BLUE committee members votes GREEN:

$$P(\tilde{G}) = \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (Pr\left\{d_i \leq \hat{d}_i\right\})^k (Pr\left\{d_i > \hat{d}_i\right\})^{n-k}$$

$$P(\tilde{G}) = \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (F(0))^k (1 - F(0))^{n-k}$$

$$P(\tilde{G}) = \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (\frac{0-a}{b-a})^k (1 - \frac{0-a}{b-a})^{n-k}$$

$$P(\tilde{G}) = \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (\frac{-a}{b-a})^k (\frac{b-a+a}{b-a})^{n-k}$$

$$P(\tilde{G}) = \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (\frac{-a}{b-a})^k (\frac{b}{b-a})^{n-k}$$

$$P(\tilde{B}) = \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (\frac{b}{b-a})^k (\frac{-a}{b-a})^{n-k} > P(\tilde{G}) \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (\frac{-a}{b-a})^k (\frac{b}{b-a})^{n-k}$$

The above holds as $k > n - k$ by definition and $b > -a$ by definition.

$$\begin{aligned}
P(\tilde{B}) + P(\tilde{G}) &= \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (\frac{b}{b-a})^k (\frac{-a}{b-a})^{n-k} + \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (\frac{-a}{b-a})^k (\frac{b}{b-a})^{n-k} \\
&= \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (\frac{b}{b-a})^{k+n-k} (\frac{-a}{b-a})^{n-k+k} \\
&= \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (\frac{b}{b-a})^{n} (\frac{-a}{b-a})^{n} \\
&= \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (\frac{b-a}{b-a})^{n} \\
&= \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (1)^{n} \\
&= 1
\end{aligned}$$

$$\frac{P(\tilde{B}) - P(\tilde{G})}{P(\tilde{B}) + P(\tilde{G})}$$

$$= \frac{P(\tilde{B}) - P(\tilde{G})}{1} = \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (\frac{b}{b-a})^k (\frac{-a}{b-a})^{n-k} - \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (\frac{-a}{b-a})^k (\frac{b}{b-a})^{n-k}$$

Consider the case where $n = 3$.

$$\begin{aligned}
P(\tilde{B}) &= \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (\frac{b}{b-a})^k (\frac{-a}{b-a})^{n-k} \\
&= \binom{3}{2} \left(\frac{b}{b-a}\right)^2 \left(\frac{-a}{b-a}\right) + \binom{3}{3} \left(\frac{b}{b-a}\right)^3 \\
&= 3 \left(\frac{b}{b-a}\right)^2 \left(\frac{-a}{b-a}\right) + \frac{b^3}{(b-a)^3} \\
&= \frac{3b^2(-a)}{(b-a)^2} + \frac{b^3}{(b-a)^3}
\end{aligned}$$

$$\begin{aligned}
P(\tilde{G}) &= \sum_{k=\frac{n+1}{2}}^{n} \binom{n}{k} (\frac{-a}{b-a})^k (\frac{b}{b-a})^{n-k} \\
&= \binom{3}{2} \left(\frac{-a}{b-a}\right)^2 \left(\frac{b}{b-a}\right) + \binom{3}{3} \left(\frac{-a}{b-a}\right)^3 \\
&= 3 \left(\frac{-a}{b-a}\right)^2 \left(\frac{b}{b-a}\right) + \frac{(-a)^3}{(b-a)^3} \\
&= \frac{3(-a)^2 b}{(b-a)^2} + \frac{(-a)^3}{(b-a)^3}
\end{aligned}$$

$$\frac{P(\tilde{B}) - P(\tilde{G})}{P(\tilde{B}) + P(\tilde{G})}$$

$$\begin{aligned}
&= \binom{3}{2} \left(\frac{b}{b-a}\right)^2 \left(\frac{-a}{b-a}\right)^1 + \binom{3}{3} \left(\frac{b}{b-a}\right)^3 - \binom{3}{2} \left(\frac{-a}{b-a}\right)^2 \left(\frac{b}{b-a}\right)^1 - \binom{3}{3} \left(\frac{-a}{b-a}\right)^3 \\
&= 3 \left(\frac{b(-a)}{b-a}\right) \left(\frac{b}{b-a} - \frac{-a}{b-a}\right) + \left(\frac{b}{b-a}\right)^3 - \left(\frac{-a}{b-a}\right)^3 \\
&\frac{3(-ba)(b+a)}{(b-a)^2} + \frac{b^3 - (-a)^3}{(b-a)^3}
\end{aligned}$$

□

Table 1: Discrimination in Alternative Set-ups

1 Blue	**2 Blue**	**1 Blue, 1 Green**	3 **Blue, majority rule**	2 **Blue,** 1 **Green, majority rule**
$P(\tilde{B}) = \frac{b}{b-a}$	$P(\tilde{B}) = \frac{(b-q)^2}{(b-a-2q)^2}$	$P(\tilde{B}) = \frac{(b+q)(q-a)}{(b-a+2q)^2}$	$P(\tilde{B}) = 3\frac{b+a}{(b-a)^2}\frac{b^3-(-a)^3}{(b-a)^3}$	$P(\tilde{B}) = (\frac{b}{b-a})^2(\frac{-a}{b-a}) + (\frac{b}{b-a})^3 + 2(\frac{b}{b-a})(\frac{-a}{b-a})^2$
$P(\tilde{G}) = \frac{-a}{b-a}$	$P(\tilde{G}) = \frac{(-a-q)^2}{(b-a-2q)^2}$	$P(\tilde{G}) = \frac{(b+q)(q-a)}{(b-a+2q)^2}$	$P(\tilde{G}) = \frac{3(-a)^2 b}{(b-a)^2} + \frac{(-a)^3}{(b-a)^3}$	$P(\tilde{G}) = (\frac{-a}{b-a})^2(\frac{b}{b-a}) + (\frac{-a}{b-a})^3 + 2(\frac{-a}{b-a})(\frac{b}{b-a})^2$
$\frac{P(\tilde{B})-P(\tilde{G})}{P(\tilde{B})+P(\tilde{G})} = \frac{b+a}{b-a}$	$\frac{P(\tilde{B})-P(\tilde{G})}{P(\tilde{B})+P(\tilde{G})} = \frac{(b-q)^2-(-q-a)^2}{(b-q)^2+(-q-a)^2}$	$\frac{P(\tilde{B})-P(\tilde{G})}{P(\tilde{B})+P(\tilde{G})} = 0$	$\frac{P(\tilde{B})-P(\tilde{G})}{P(\tilde{B})+P(\tilde{G})} = \frac{3(-ba)(b+a)}{(b-a)^2} + \frac{b^3-(-a)^3}{(b-a)^3}$	$\frac{P(\tilde{B})-P(\tilde{G})}{P(\tilde{B})+P(\tilde{G})} = [\frac{b^2+(-a)^2}{(b-a)^2}]\frac{b+a}{b-a}$

Notes. The above analysis of the collective decision making situations includes only the stable interior equilibria.