Sources of Women's Underrepresentation in US Politics: A Model of Election Aversion and Voter Discrimination

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Abstract

Research on women candidates in American elections has uncovered four key empirical facts: (*i*) women are under-represented among candidates, (*ii*) women are under-represented among office holders, (*iii*) conditional on winning, women perform better than men in office, and (*iv*) conditional on running, women and men win at equal rates. The literature posits two key explanatory mechanisms: election aversion and voter bias. We explore the implications of these mechanisms in a formal model of elections with endogenous entry. Election aversion alone is consistent with the first three facts but not the fourth. Voter bias alone can be consistent with all four facts, but under a standard distributional assumption is also consistent with only the first three. But the two mechanisms are inconsistent with fact (*iv*) in opposite directions. Thus a model incorporating both can explain all four facts. We also use the model to ask if a regression discontinuity approach using close elections distinguishes the two mechanisms; surprisingly, it does not.

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A central question in American politics is why so few women hold elected office. In the 116th Congress, for instance, women made up only about one-quarter of the U.S. House and Senate. Comparable proportions of women occupy other elected offices in the U.S., and women are significantly underrepresented in most other countries as well (Lawless, 2015).

For many years, scholars looked to voter discrimination as a likely explanation for this underrepresentation (e.g., Erskine, 1971; Ferree, 1974). Indeed, while public attitudes have become more positive toward female candidates in recent decades—the proportion of respondents expressing a willingness to vote for a female candidate for president increased from roughly one-third when the question was first asked in 1937 to about 90 percent today—substantial portions of the electorate still express doubt about women's suitability for politics. As recently as 2010, for example, 25% of respondents to the General Social Survey agreed that men are emotionally better suited to politics than women, 14% said that women are not "tough enough" for politics, and 16% agreed that "women don't make as good leaders as men" (Lawless, 2015). More generally, a robust literature shows that gender stereotyping still exerts a strong influence on voters' evaluations of female candidates (e,g,, Dolan, 2010; Fulton, 2014; Dittmar, 2015; Ditonto, 2017; Bauer, 2019; Branton et al., 2018; Cassese and Holman, 2018).

Public attitudes notwithstanding, the focus of the political science literature began to shift away from explanations grounded in overt discrimination by voters after a series of studies showed that, when women do run for office, they are just as likely to win as are men. Darcy and Schramm (1977) appear to be the first to have made this point, and a spate of subsequent studies by other authors confirmed and extended these findings (Burrell, 1994; Caucus, 1994; Seltzer, Newman and Leighton, 1997). The key insight of these studies is that, while female candidates win less often than men on average, accounting for the incumbency advantage erases this differential. In other words, conditional on running, female incumbents are just as likely to win as male incumbents are, and female challengers are as likely to win as male challengers, although incumbents are more likely to be male. These "startling" findings "surprised even savvy political operatives, and decidedly contradicted the widely held beliefs that women have a tougher time winning office" (Duerst-Lahti, 1998, p. 17).

Many scholars have taken the finding that (controlling for incumbency) female candidates win at the same rate as male candidates as evidence that voter bias against female candidates is not an important mechanism underlying women's under-representation. For instance, Lawless and Fox (2013, p. 1) offer this assessment of the state of the literature:

> Why do so few women hold positions of political power in the United States? For the last few decades, researchers have provided compelling evidence that when

> women run for office—regardless of the position they seek—they are just as likely as men to win their races. The large gender disparities in U.S. political institutions, therefore, do not result from systematic discrimination against female candidates. Rather, the fundamental reason for women's under-representation is that women do not run for office.

In light of these findings, the literature has proposed a variety of new mechanisms to explain women's underrepresentation in the pool of *candidates* even when voters do not discriminate. These include differences in political ambition between men and women (Fox and Lawless, 2005) and systematic under-estimation by women and over-estimation by men of their personal qualification for office (Fox and Lawless, 2011). This set of mechanisms came to be broadly labeled under the heading of *election aversion.* Subsequent work, using both lab and survey experiments, shows evidence consistent with election aversion in those settings (Kanthak and Woon, 2015; Preece, 2016).[1]

Without dismissing the election aversion mechanism, Anzia and Berry (2011) argued that the literature had been too quick to write off voter discrimination as an explanation of the electoral facts. They note, first, that if voters discriminate against women, then some potential female candidates will be deterred from running. In particular, women will only run if they are of sufficiently high quality to compensate for voter bias. This positive selection will at least partially offset voter bias in the female win rate, conditional on running.

Moreover, Anzia and Berry point out another empirical prediction of strategic entry deterrence in the face of voter discrimination: conditional on winning, female candidates will perform better than male candidates, since they will be positively selected into the pool of candidates and will have to be higher quality (on average) to overcome voter bias and win election. Anzia and Berry provide empirical evidence for this latter hypothesis. Using within district variation, they show that female congressional representatives, on average, secure more federal funds for their districts than do male congressional representatives, and that congresswomen sponsor and co-sponsor more legislation than do congressmen, and garner more co-sponsors for their legislation. (They note that this finding could also result from positive selection due to election aversion.) Subsequent research has produced additional evidence that female politicians outperform their male counterparts on average (e,g,, Fulton, 2012; Lazarus and Steigerwalt, 2018; Volden, Wiseman and Wittmer, 2013).

[1] Another explanation for women's underrepresentation as candidates focuses on bias by parties in the recruitment process (Sanbonmatsu, 2006, 2010). We explain below how our results on election aversion cover this mechanism as well.

All told, then, the literature establishes four key empirical findings and offers explanations based two possible mechanisms. The findings are:

1. Women are under-represented among candidates.
2. Women are under-represented among office holders.
3. Conditional on winning, women perform better than men.
4. Conditional on running (and controlling for incumbency), women and men win at equal rates.

The potential explanatory mechanisms are election aversion and voter discrimination.

Given the theoretical richness of these topics, formal theorists have not engaged the literature on women and politics sufficiently deeply.[2] The field does not have a workhorse formal model that incorporates the election aversion and voter discrimination mechanisms. Our project in this paper is to develop a formal model to explore these mechanisms and their implications relative to the empirical facts. To do so, we study a model of elections that endogenizes male and female potential candidates' strategic decision to enter politics. We consider variants of that model that include both election aversion on the part of female potential candidates and discrimination by voters against female candidates. Doing so generates results on which of the empirical findings each of these mechanisms can explain. The hope is that, in so doing, the model provides some guidance about how we should interpret the empirical literature and some suggestions for making progress on its canonical questions.

When the model incorporates election aversion but not voter discrimination, it predicts the following:

1. Women are under-represented among candidates.
2. Women are under-represented among office holders.
3. Conditional on winning, women perform better than men.
4. Conditional on running, women win at a *higher* rate than men.

So the model with election aversion, on its own, is consistent with the first three facts, but is inconsistent with the fourth.

[2] Though see Gagliarducci and Paserman (2020) and Gonzalez-Eiras and Sanz (2020) for empirical papers with related models. Neither of these models, however, treats the entry decision as endogenous.

When the model incorporates voter discrimination but not election aversion, it predicts the following:

1. Women are under-represented among candidates.

2. Women are under-represented among office holders.

3. Conditional on winning, women perform better than men.

With respect to the probability of election, there are competing effects. However, we show that under a standard distributional assumption (log-concavity of the distribution of abilities) it also predicts:

4. Conditional on running, women win at a *lower* rate than men.

So, under this distributional assumption, voter discrimination, on its own, is also consistent with the first three facts, but inconsistent with the fourth.

Surprisingly, then, we show that the empirical finding that some argue distinguishes between election aversion and voter discrimination in favor of election aversion does exactly the opposite. It is possible to explain men and women winning with equal probability in a model embodying the voter discrimination mechanism alone but not in a model embodying the election aversion mechanism alone.

Overall, our results suggest two possible ways of making sense of existing empirical findings, one involving just voter discrimination and the other combining voter discrimination and election aversion.

First, without log-concavity, it is possible to explain all four facts with voter discrimination alone, as we show via example in the appendix. This, of course, raises the question of whether or not log-concavity of the distribution of abilities is a good assumption. In theoretical models of this type, log-concavity is certainly a standard assumption. Moreover, many familiar distributions, such as the normal, exponential, and uniform, are log-concave (Bagnoli and Bergstrom, 2005). Descriptively, log-concavity is related to the density of the distribution being single-peaked and having sufficiently thin tails. We leave this as an open empirical and substantive question that the model highlights, but which we are not positioned to answer in this paper.

Second, our results show that under log-concavity, while election aversion and voter discrimination pull in the same direction with respect to the first three empirical findings (number of female candidates, number of female office holders, and performance conditional on winning), they pull in opposite directions with respect to the fact they are inconsistent with (win rates conditional on running). Election aversion tends to make women win more than men, conditional on running. Voter discrimination tends to make women win less often than men, conditional on running. This suggests that a model that incorporates both election aversion and voter discrimination can explain all four facts, even with log-concavity. The two mechanisms are reinforcing on facts 1–3, so a combined model still predicts that women will be under-represented among candidates and office holders, and will perform better conditional on winning. But they are off-setting on fact 4. So, unlike a model with either mechanism in isolation, a model that combines the two mechanisms can also entail the implication that women and men win at the same rates, conditional on running. We provide an example in the appendix showing that a model combining both mechanisms can in fact explain all four empirical findings.

One important role for a workhorse model is to probe whether various mechanisms are consistent with existing empirical findings. A second role is to facilitate exploring whether there are other empirical quantities that might help distinguish various mechanisms. To that end, we further ask whether these two mechanisms can be distinguished using a regression discontinuity design focused on close elections. At first blush, it might seem that close elections should distinguish these two mechanisms. One might think that if the reason for female under-representation is election aversion and not voter discrimination, then the expected quality (and, hence, future performance) of men and women who win very close elections is the same. If this is the case, we might expect to see no difference in performance once in office in a regression discontinuity. By contrast, if voters discriminate, we might expect women who win close elections to be higher quality than men who win close elections (since the women had to overcome the voters' bias to achieve a near-tie). If this is the case, we might expect to see women perform better once in office than men in an election regression discontinuity. Surprisingly, our model reveals that this intuition is knife edge. In general, both mechanisms predict that women will perform better once in office than men, even in a regression discontinuity design.

In what follows we first lay out a model of elections with endogenous candidate entry in which we can represent both the election aversion and voter discrimination mechanisms. We analyze equilibrium in two variants of the model, one with just election aversion and one with just voter discrimination, comparing the results to the empirical evidence. We then ask what these two variants of the model imply about what can be learned by studying close elections. We conclude with a discussion of the two ways in which the model can explain the existing empirical findings.

1 The Model

There is a continuum of potential male candidates and a continuum of potential female candidates, each of mass $\frac{1}{2}$.

Each potential candidate of gender γ has a cost of running, $c_\gamma \in (0, 1)$. The costs represent any feature of real world politicians that pulls against running—other career opportunities, dislike of campaigning, time away from family, and so on.

Each potential candidate i has an ability $\theta_i \in \mathbb{R}$. Ability in the model represents any feature of candidates that voters care about and that affects the politician's performance once in office. Higher numbers represent greater ability. Abilities are distributed according to a distribution F, with density f. The density is strictly positive on its support $[\underline{\theta}, \infty)$, where we allow for the possibility that $\underline{\theta} = -\infty$. We assume the distribution of abilities is the same for male and female potential candidates.

The costs and abilities are publicly observed.

A potential candidate who does not run makes a payoff of zero. A candidate gets a benefit of 1 for winning office. So a candidate with cost of running c makes a payoff of $1 - c$ for running and winning and a payoff of $-c$ for running and losing. Thus, the expected utility of running for a candidate with cost c and probability of winning p is $p - c$. This means a candidate will run if and only if the probability of winning is at least as high as the cost of running, $p - c \geq 0$.

At the beginning of the game, each potential candidate decides whether to stand for election. Candidates are then paired off at random to face each other in elections.[3]

Each election is decided by a representative voter. A voter's evaluation of a candidate depends on the sum of the candidate's ability (θ_i) and idiosyncratic noise (ν_i). It may also depend on the candidate's gender. The idiosyncratic noise, ν , represents anything unanticipated that might occur over the course of campaigning, such as gaffes, partisan swings, or scandals. We assume that for any two candidates i and j, $\nu_i - \nu_j$ is the realization of a random variable ϵ with density g. All random variables are independent.

We consider two cases. First, we consider a model with *election aversion*, which takes the form of higher costs of running for women than for men—i.e., $c_W > c_M$. (Importantly, as we show in an extension, a model where election aversion is modeled as underestimation by women of their own ability or discrimination against women by parties yields exactly

[3] Note that this implies the measure of elections is endogenous to the entry decisions. We make this assumption for expositional convience; all of the results remain true as statements about expectations conditional on running in a model with a fixed, finite number of elections and random assignment of available candidates to races.

the same results as the model with higher costs of running.) Second we consider a model with *voter bias*, which takes the form of voters receiving an additional positive payoff, b, from electing a male candidate rather than a female candidate.

We study subgame-perfect Nash equilibria (henceforth, *equilibria*). In both versions of the model, it is straightforward to see that candidates' entry decisions will be governed by a cutoff rule—a candidate will enter if and only if his or her ability is above some threshold.[4]

We now consider the two versions of the model in turn.

2 Election Aversion

To focus on election aversion without voter bias, suppose that women face higher costs of running than do men ($c_W > c_M$), but there is no bonus payoff from electing a man.

As dicussed above, a potential candidate will run if the probability that he or she wins is greater than the cost of running. There are two important facts to note. First, the probability a candidate wins is increasing in his or her ability. This means that potential candidates will run if and only if their ability is sufficiently high. That is, they use strategies that are "cutoff rules"—i.e., a potential candidate i runs if and only if their ability is greater than some $\hat{\theta}_i$. Second, because voters don't discriminate in this variant of the model, all candidates with the same ability have the same probability of winning, whether they are male or female.

Notice, if a candidate i's ability is exactly equal to their cutoff $\hat{\theta}_i$, then they must be exactly indifferent between running and not (i.e., their conditional probability of winning is exactly equal to the cost of running). Since the probability of winning is increasing in θ, this insures that potential candidates with abilities above the cutoff strictly prefer to run and potential candidates with abillity below the cutoff strictly prefer to stay out. Any other cutoff would not have this property, so there would be ability types who would want to change their behavior. This means that, right at the cutoff, a potential candidate's probability of winning must equal his or her cost of running.

Taken together, as illustrated in Figure 2.1, this set of arguments implies that, since women have higher costs of entry than men, women use a more stringent cutoff. That is, women require a higher probability of winning to be willing to run. (We formalize this claim in Lemma 6 in the Appendix.)

What does this mean in equilibrium? Every potential candidate uses a cutoff rule such

[4]This is consistent with an emerging empirical literature showing that female candidates are more likely to run in politically friendlier districts (Pearson and McGhee, 2013; Ondercin, 2017).

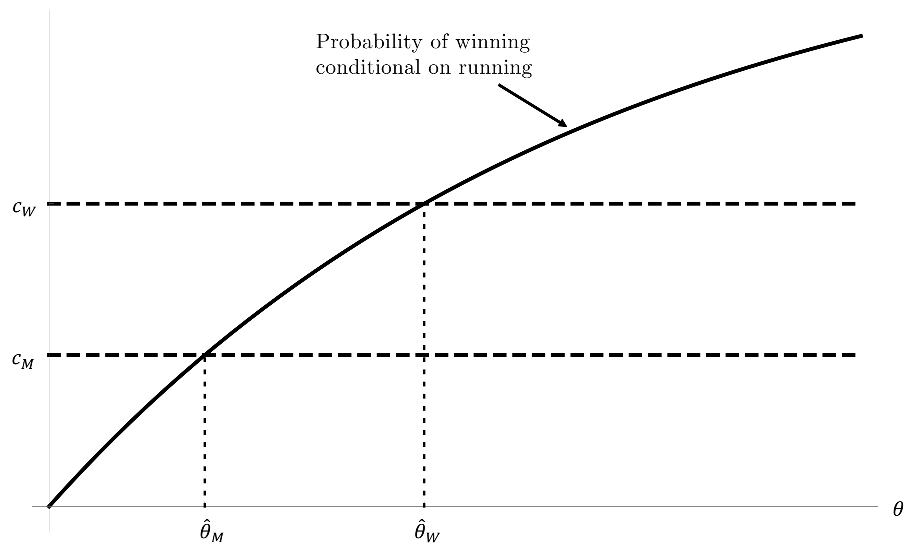

Figure 2.1: Cutoff rules with election aversion.

that they run if the conditional probability of winning is higher than the cost of running. Of course, the probability of winning depends on the cutoff rule all other potential candidates use. In equilibrium all women use the same cutoff rule ($\hat{\theta}_W$) and all men use the same cutoff rule ($\hat{\theta}_M$). A woman (resp. man) with ability right at the relevant cutoff is exactly indifferent between running or not, given that everyone else is using those same cutoff rules. And so, any potential candidate with an ability above the relevant cutuoff strictly prefers to run and any potential candidate with an ability below the relevant cutoff strictly prefers not to.

With this analysis in place, we can compare outcomes in the model to the four corresponding findings from the empirical literature.

The first empirical fact is that women are under-represented among candidates. In the model, because women use a more stringent cutoff rule than men, the pool of candidates has more men than women. So the model with pure election aversion is consistent with the first finding from the empirical literature.

The second empirical fact is that women are under-represented among office holders. In the model, because voters don't discriminate, once they stand for election, female and male candidates are evaluated against the same criteria. There are the same number of male and female candidates with ability above $\hat{\theta}_W$, and they win at equal rates. But there are also a group of male candidates with ability below that of any female candidate (i.e., those with

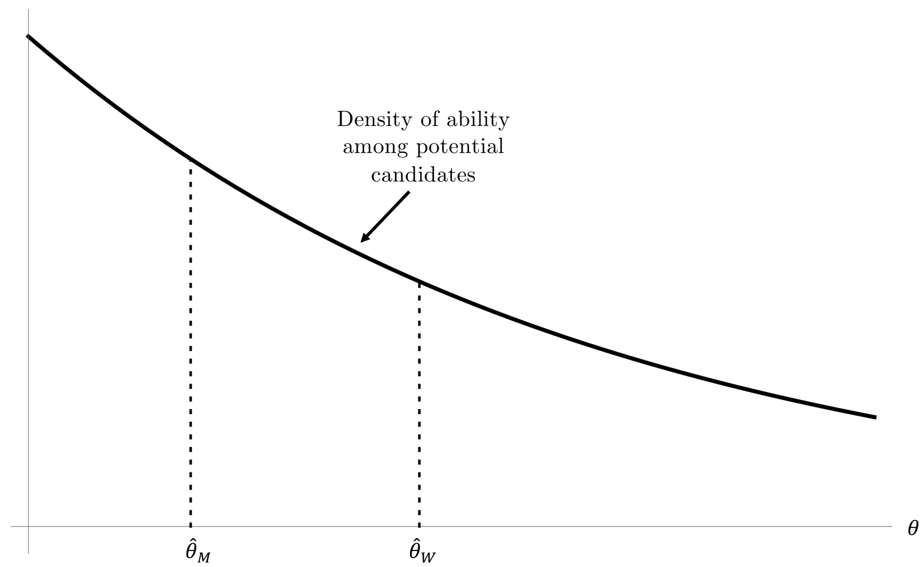

Figure 2.2: Density of abilities among males and females in pool of candidates.

ability between $\hat{\theta}_M$ and $\hat{\theta}_W$). These candidates also win with positive probabiilty. Hence, more men than women win office. So the model with pure election aversion is consistent with the second finding from the empirical literature.

The third empirical fact is that women perform better in office than men, conditional on winning. Because women use a more stringent cutoff rule, the distribution of abilities among female candidates is better than the distribution of abilities among male candidates.[5] As a result, the average female winner has higher ability than the average male winner.

To see this graphically, Figure 2.2 shows the distributions of abilities among male and female candidates. The way to see the result is as follows. The only candidates with ability below $\hat{\theta}_W$ are male. These candidates win with positive probability and they are worse than every female winner. Above $\hat{\theta}_W$ both male and female potential candidates run and they win with equal probabilities. For men, these winners get mixed in with the male winners with abilities below $\hat{\theta}_W$. For women, they do not. This is why the average female winner is of higher quality than the average male winner. So the model with pure election aversion is consistent with the third finding from the empirical literature.

The fourth empirical fact is that men and women win at the same rate, conditional on

[5]Formally, the distribution of abilities of female candidates first-order stochastically dominates the distribution of abilities of male candidates.

running. The probability a candidate wins is increasing in his or her ability and, for a fixed ability, is the same for men and women. And, as we've just discussed, the distribution of abilities among female candidates is better than the distribution of abilities among male candidates. This implies that female candidates are strictly more likely to win conditional on running than are male candidates. So the model with pure election aversion is inconsistent with the fourth finding from the empirical literature.

Taken together the model with pure election aversion implies: women run less often than men, women hold fewer offices than men, women are higher ability than men conditional on winning, and women have higher election rates than men conditional on running. The first three implications match existing empirical results. However, the fourth is inconsistent with the empirical fact that female and male candidates win with the same probability on average conditional on running. These results are summarized in the following proposition. (A more formal development and proofs of all numbered results are in the Appendix.)

Proposition 1 *Consider the variant of the model with pure election aversion. In any equilibrium:*

1. *There are fewer female candidates than male candidates.*

2. *There are fewer female election winners than male election winners.*

3. *Conditional on winning, women have higher average ability than men.*

4. *Conditional on running, women win with higher probability than men.*

2.1 Alternative Models of Election Aversion

The key feature of the model for establishing Proposition 1 was $\hat{\theta}_W > \hat{\theta}_M$—female potential candidates use a more stringent cutoff rule than male potential candidates. In the model above, this was true because women faced higher costs of running. But the same results would hold in other models that represent other aspects of election aversion.

For instance, suppose voters do not discriminate, but potential candidates are selected to run by a party that does discriminate. Such a party will use a lower cutoff rule for allowing a man to run than for allowing a woman to run. The results in Proposition 1 would thus continue to hold in such a model.

What if female and male candidates have the same cost of running, voters don't discriminate, parties don't discriminate, but female candidates systematically underestimate their own ability? (See Fox and Lawless, 2011, for a discussion.) More speicifically, suppose

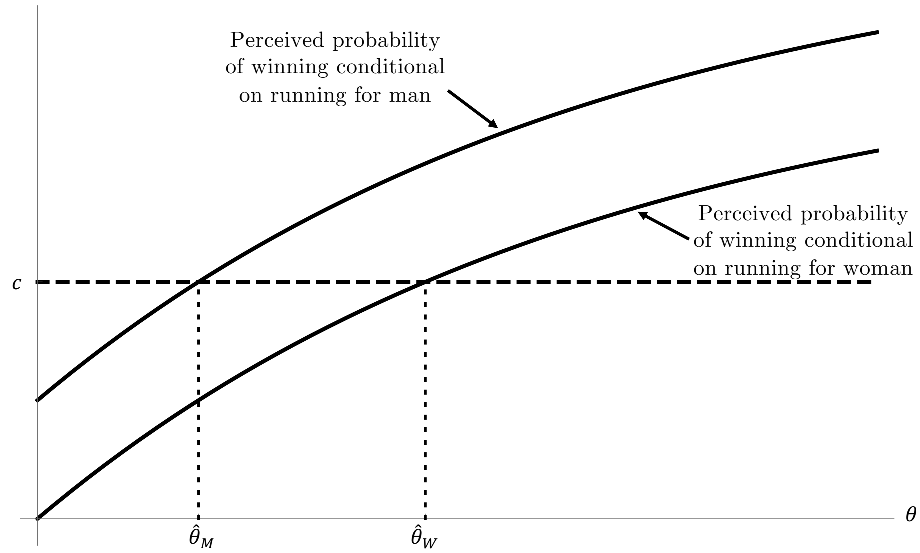

Figure 2.3: Cutoff rules when women underestimate their true ability.

voters correctly perceive the ability of every candidate, male candidates correctly perceive their own ability, but a female candidate of ability θ perceives her ability to be $\phi(\theta) < \theta$. Then female candidates perceive their probability of winning as being lower than it actually is. As illustrated in Figure 2.3, which is analagous to Figure 2.1, this results in women using a more stringent cutoff rule than men. Consequently, the results in Proposition 1 would continue to hold in this model as well.

3 Voter Bias

Now assume there is no election aversion, so all candidates face a common cost of running, c, but that voters are biased against female candidates. To represent the idea of voter bias, suppose that a voter's payoff from electing a male candidate with type θ and shock ν is $\theta + \nu + b$, with $b > 0$. By contrast, a voter's payoff from electing a female candidate with type θ and shock ν is simply $\theta + \nu$. The parameter b represents the amount of voter bias against female candidates.

Again, denote by $\hat{\theta}_W$ and $\hat{\theta}_M$ the cutoffs used by women and men to decide whether to run. As in the model with election aversion, women will use a more stringent cutoff rule here, but for a different reason. When voters are biased, a female candidate wins with lower probability than a male candidate of the same ability. Hence, the female potential

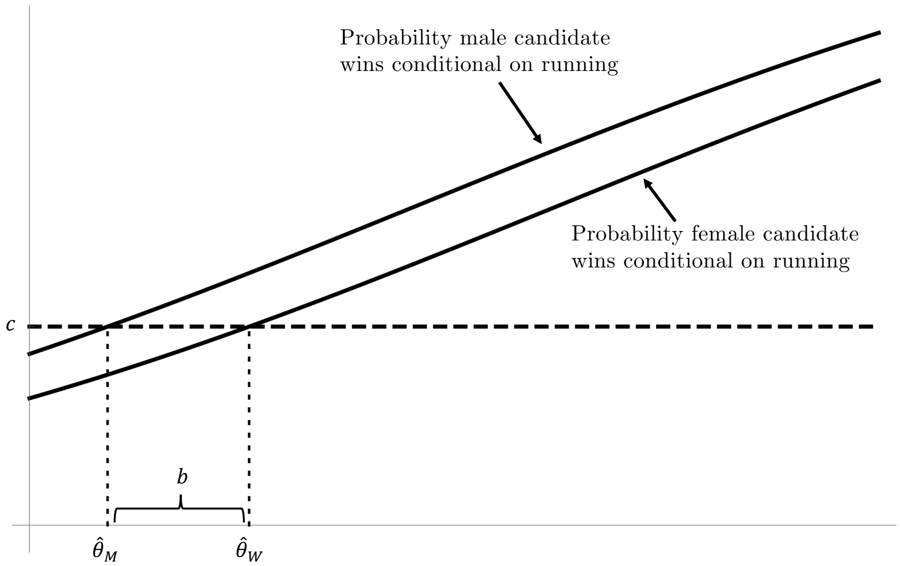

Figure 3.1: Cutoff rules with voter bias.

candidate who is indifferent between running and not will need to have a higher ability than the male potential candidate who is indifferent between running and not. Indeed, the difference between the female and male cutoffs will correspond exactly to the amount of voter bias, b.

This is illustrated in Figure 3.1 and documented in Lemma 1.

Lemma 1 *In any equilibrium of the game with voter bias, the male and female entry cutoffs satisfy* $\hat{\theta}_M = \hat{\theta}_W - b$.

As in the model of election aversion, the fact that female potential candidates use a more stringent cutoff rule under voter bias immediately implies that there are more male candidates than female candidates. Hence, the model with voter bias is consistent with the first finding from the empirical literature—women are under-represented in the pool of candidates.

What about under-representation of women among office holders? Because of voter bias, for a fixed ability, θ, a male candidate is strictly more likely to win election than a female candidate. Since the distribution of male and female candidates with ability above $\hat{\theta}_W$ is the same, this implies that there are more male winners than female winners in this group. And, in addition, there is a group of male candidates with abilities lower than any female candidate (those with abilities between $\hat{\theta}_M$ and $\hat{\theta}_W$). Some of these lower ability male candidates also win, further contributing to the over-representation of men among office holders. So the model with pure voter bias is consistent with the second finding from the empirical literature.

Now consider the difference in expected ability of women and men, conditional on winning an election. To see that women are of higher ability conditional on winning, note that two things affect the expected ability of winning candidates. The first is the underlying quality distribution they are drawn from. Women in the pool of candidates are of higher average ability than are men in the pool of candidates. This is because women use a more stringent cutoff when deciding whether to run. The other factor that helps determine the expected ability of winning candidates is how high a hurdle they had to clear (on average) to get elected. When competition is stiffer, more of the relatively low ability candidates are weeded out. Thus stiffer competition leads to higher expected ability of winning candidates. Because of voter discrimination, women face a higher hurdle on average. Thus, both forces push in the direction of female winners having higher expected ability than male winners.

In thinking about the probability of winning conditional on running there are competing effects. On the one hand, the distribution of ability among female candidates is better than the distribution of ability among male candidates. This tends to make women more likely to be elected conditional on running. On the other hand, voters discriminate against female candidates, which tends to make them less likely to be elected conditional on running. We can't say, in general, how these two forces balance out. However, we can do so under a fairly standard assumption about the underlying distribution of abilities. If f is log-concave, then the second force dominates, so that female candidates are less likely to be elected conditional on running than are male candidates.

Taken together, then, the model with voter bias gives the following implications. Women run less often, are less likely to hold office than men, and are higher ability conditional on winning. There are competing effects with respect to probability of election. But, if f is log-concave, then women have lower election rates conditional on running. The first three implications are common between the model with voter bias and the model with election aversion. And both match existing empirical results. However, the fourth (when f is log-concave) is inconsistent with the empirical fact that female and male candidates win with the same probability on average conditional on running. Importantly, however, it is inconsistent with this empirical fact in the opposite direction from the model with election aversion. These results are summarized in the following proposition.

Proposition 2 *Consider the variant of the model with pure voter bias. In any equilibrium:*

1. *There are fewer female candidates than male candidates.*

2. *There are fewer female election winners than male election winners.*

3. *Conditional on winning, women have higher expected ability than men.*

Moreover, if f is log-concave, then

4. *Conditional on running, women win with lower probability than men.*

Proposition 2 leaves open the possibility that if f is not log-concave, then the model with voter bias and no election aversion can account for all four empirical facts. We return to this possibility in the conclusion.

4 Do Close Elections Distinguish the Mechanisms?

One important role for a workhorse model is to examine whether various mechanisms are consistent with existing empirical findings. Another role is to explore whether there are other empirical quantities that might help distinguish various mechanisms. In this section we use our model to do just that by asking whether these two mechanisms could be distinguished using a regression discontinuity design—that is, by focusing on close elections.

At first blush, it might seem that close elections should distinguish election aversion and voter bias. To see the idea, consider a setting in which there is no electoral noise (i.e., the variance of ν goes to zero). Then, in a model with just election aversion, a tie between a man and a woman occurs only in elections where $\theta_W = \theta_M$. As such, women and men would have the same expected ability conditional on a close election. By contrast, in a model with just voter discrimination, a tie between a man and a woman occurs in an election where $\theta_W = \theta_M + b$. In that case, women would have higher expected ability than men conditional on a close election. So, the argument goes, if an electoral regression discontinuity design found no difference in performance between men and women this would be evidence in favor of the election aversion mechanism, whereas if an electoral regression discontinuity design found that women performed better than men in office, that would be evidence in favor of the voter discrimination mechanism.

But, as intuitive as this argument is, the model actually reveals that it is knife edged. If there is any electoral noise (i.e., the variance of ν is positive), then both mechanisms predict the same thing—women are expected to perform better than men, conditional on a close election.

This result is particularly surprising in the case of election aversion. As we just saw, without noise, we would expect no difference between men and women conditional on a close election. How does the argument break down once there is electoral noise? With noise, the condition for a tie is $\theta_W + \nu_W = \theta_M + \nu_M$. As we saw in Figure 2.2, with election aversion, the distribution of abilities among female candidates is better than the distribution of abilities among male candidates. This implies that, when a woman and a man tie, it is more likely that the woman was higher ability than the man but that the noise favored the man than it is that the woman was lower ability than the man but that the noise favored the woman. Hence, even with pure election aversion, conditional on a close election, the distribution of abilities among female candidates is better than the distribution of abilities among male candidates.

In the case of voter bias, with electoral noise, there are competing forces, even in close elections. As in non-close elections, in close elections female candidates have overcome voter bias. But they have also faced systematically weaker opponents. As earlier, how these competing forces balance out depends on distributional assumptions. Here we can show that, if both f and g are log-concave, the competing forces balance out so that female winners of close elections are better on average than male winners of close elections. (Again, log-concavity is a sufficient, but not necessary, condition.)

These two facts are summarized in the following result.

Proposition 3

1. *In the model with election aversion, conditional on a tied election, women have higher expected ability than men.*

2. *In the model with voter bias, if f and g are log-concave, then conditional on a tied election, women have higher expected ability than men.*

So, unfortunately, despite the intuition with which we opened, it turns out that a regression discontinuity design cannot distinguish the two mechanisms. They both predict that women will perform better than men, conditional on winning a close election. That being said, it is worth noting that the evidence appears to be consistent with this implication. Using a regression discontinuity design, Anzia and Berry (2011) show that women perform better than men in congress, conditional on a close election. However, they are cautious in their interpretation of this result because their RD sample is small and they find covariate imbalance. Most notably, incumbents are more likely to win even in close elections, consistent with Caughey and Sekhon (2011).[6] Our model suggests that, even in a setting more appropriate for an RD analysis, the results would not help distinguish between election aversion and voter bias.

5 Conclusion

We have proposed a model of endongous electoral entry that we believe can serve as a workhorse for exploring issues of the under-representation of women (and, potentially, other groups) in politics. To demonstrate its utility, we used it to explore the extent to which two mechanisms advanced in the literature—election aversion and voter bias—can explain existing empirical findings.

Election aversion, we found, is consistent with three key facts: women are underrepresented among candidates, women are underrepresented among office holders, and women perform better than men in office. But election aversion alone cannot explain why men and women win at equal rates contingent on running. Rather, election aversion implies that women should win at higher rates than men.

Voter bias, we showed, is also consistent with women being underrepresented among candidates and office holders, and female office holders perform better in office. But the other implication of the voter bias mechanism depends on a distributional assumption. If the distribution of candidate abilities is log-concave, then voter bias alone cannot explain why men and women win at equal rates contingent on running. Rather, voter bias implies that women should win at a lower rate than men.

We also showed that both mechanisms are consistent with women performing better in office than men conditional on a close election.

These results leave open two possible avenues for explaining the existing empirical findings in terms of these two mechanisms.

One possibility is that log-concavity is not descriptively accurate and that all the existing empirical findings can be explained by voter bias alone. In Example 1 in the appendix, we show that this is indeed possible. In that example we assume there is voter bias but not election aversion. We choose a particular density (that is not log-concave) and show computationally that we can choose parameter values such that the model is consistent with all four empirical facts—women are under-represented among candidates, women are under-represented among office holders, women are higher expected ability than men conditional on winning (despite the absence of log-concavity), and women and men win at the same

[6] See Appendix B of Anzia and Berry (2011) for a discussion.

rate conditional on running. The fact that this is possible means that one empirical and substantive question that the model highlights as an open issue for future work concerns how to learn more about the shape of the underlying distribution of abilities.

The other possible avenue, which is open even if the distribution of abilities is log-concave, is that the empirical facts are best explained by a combination of the two mechanisms. As we've seen, each mechanism is consistent with the same three facts: there are fewer female than male candidates, there are fewer female than male office holders, and women are higher ability conditional on winning or conditional on a close election. However, under log-concavity, neither model on its own is consistent with the empirical finding that, conditional on running, women and men win at the same rates. But they are inconsistent with this empirical fact in different ways. Election aversion predicts women win more often than men, conditional on running. Voter bias predicts women win less often than men, conditional on running. It is intuitive, then, that a model incorporating both mechanisms could be consistent with all of the empirical facts, even while neither on its own is. The two mechanisms reinforce one another with respect to the share of candidates who are male vs. female, the share of office holders who are male vs. female, and the quality differential of male vs. female elected officials. At the same time, the two mechanisms pull in opposite directions with respect to the probability of winning conditional on running. If they off-set, then a model that incorporates both mechanisms will be consistent with all three facts, whereas a model incorporating either one on its own cannot be. Example 2 in the appendix shows that it is indeed possible for such a combined model to explain all of the existing empirical findings.

A Proofs

A.1 Preliminary Results

We being with some formal development that applies to both variants of the model.

Recall that each candidates has ability θ, independently drawn from distribution F with strictly positive density f. As we observed in the main text, an equilibrium will involve two cutoffs, $\hat{\theta}_M$ and $\hat{\theta}_W$. The interpretation is that a male candidate runs if and only if his ability θ is greater than or equal to $\hat{\theta}_M$, and a female candidate runs if and only if her ability is greater than or equal to $\hat{\theta}_W$.

Given these entry decisions, we can calculate the share of women and men in the pool of candidates. If women potential candidates use the cutoff $\hat{\theta}_W$, then the number of female candidates is:

$$\lambda_W = \frac{1}{2}\left(1 - F(\hat{\theta}_W)\right). \tag{1}$$

Similarly, the number of male candidates is:

$$\lambda_M = \frac{1}{2}\left(1 - F(\hat{\theta}_M)\right). \tag{2}$$

The total number of candidates is:

$$\lambda = \lambda_W + \lambda_M. \tag{3}$$

So the share of female candidates is $\frac{\lambda_W}{\lambda}$ and the share of male candidates is $\frac{\lambda_M}{\lambda}$.

If potential candidates with gender $\gamma \in \{W, M\}$ use cutoff $\hat{\theta}_\gamma$, the probability a candidate has ability less than or equal to θ conditional on being of gender γ is:

$$F^\gamma(\theta) = \begin{cases} 0 & \text{if } \theta < \hat{\theta}_\gamma \\ \frac{F(\theta)-F(\hat{\theta}_\gamma)}{1-F(\hat{\theta}_\gamma)} & \text{if } \theta \geq \hat{\theta}_\gamma. \end{cases}$$

The associated density is:

$$f^\gamma(\theta) = \begin{cases} 0 & \text{if } \theta < \hat{\theta}_\gamma \\ \frac{f(\theta)}{1-F(\hat{\theta}_\gamma)} & \text{if } \theta \geq \hat{\theta}_\gamma. \end{cases} \tag{4}$$

It will also be useful to be able to discuss the distribution of ability plus noise, $\theta + \epsilon$, conditional on running. The usual convolution formula for sums of independent random variables gives the cdf for the sum:

$$H^\gamma(\theta) \equiv \int F^\gamma(\theta - \epsilon) g(\epsilon)\, d\epsilon. = \int G(\theta - \epsilon) f^\gamma(\epsilon)\, d\epsilon.$$

This cdf is strictly increasing in θ since G is. H^γ has a density given by:

$$h^\gamma(\theta) = \int f^\gamma(\theta - \epsilon) g(\epsilon)\, d\epsilon.$$

We will use several facts about how these distributions are stochastically ordered. Let $\tilde{x}$ and $\tilde{y}$ be random variables with distributions F_x and f_y, respectively, and densities f_x and f_y, respectively. Recall that $\tilde{x}$ *(strictly) first-order stocahstically dominates* $\tilde{y}$ if $F_x(z) \leq F_y(z)$ for all z (with strict inequality for some z). In this case, for any nondecreasing function u, we have $\int u(z)\, dF_x(z) \geq \int u(z)\, dF_y(z)$, with strict inequality if u is strictly increasing on an interval containing a z where $F_x(z) < F_y(z)$.

We start with a pair of general results.

Lemma 2 *Suppose $\tilde{x}$ and is a random variable with distribution F and density f that is strictly positive on $[\underline{x}, \infty)$, and $\tilde{y}$ is a random variables with distribution G and density g that is strictly positive on $[\underline{y}, \infty)$. If $\underline{x} > \underline{y}$ and, for all $z > z'$,*

$$f(z)g(z') \geq f(z')g(z), \tag{5}$$

then $z > \underline{y}$ implies $F(z) < G(z)$.

Proof. Notice first that, for $z \in (\underline{y}, \underline{x}]$, we have $G(z) > 0 = F(z)$. Thus is suffices to show the inequality for $z > \underline{x}$.

Integrate to get:

$$\begin{aligned}
f(z)G(z) &= \int_{-\infty}^{z} f(z)g(z')\,dz' \\
&= \int_{\underline{y}}^{z} f(z)g(z')\,dz' \\
&> \int_{\underline{x}}^{z} f(z)g(z')\,dz' \\
&\geq \int_{\underline{x}}^{z} f(z')g(z)\,dz' \\
&= \int_{-\infty}^{z} f(z')g(z)\,dz' \\
&= F(z)g(z),
\end{aligned}$$

where the strict inequality is from $\underline{x} > \underline{y}$ and the weak inequality is from 5.

A similar argument gives:

$$(1 - F(z))g(z) = \int_{z}^{\infty} f(z'')g(z)\,dz'' \geq \int_{z}^{\infty} f(z)g(z'')\,dz'' = f(z)(1 - G(z)).$$

Since $z > \underline{x}$, neither $G(z)$ nor $1 - G(z)$ are zero. Thus we can combine these two displayed inequalities to get

$$\frac{1 - F(z)}{1 - G(z)} \geq \frac{f(z)}{g(z)} > \frac{F(z)}{G(z)}.$$

Cross-multiply to get:

$$G(z) - F(z)G(z) > F(z) - F(z)G(z),$$

or $F(z) < G(z)$ ■

Lemma 3 *For $\theta > \theta'$,*

$$f^W(\theta)f^M(\theta') \geq f^W(\theta')f^M(\theta).$$

Proof. There are four cases.

1. If $\theta < \hat{\theta}_W$, then both sides of the inequality are zero.

2. If $\theta > \hat{\theta}_W$ and $\theta' < \hat{\theta}_M$, then both sides of the inequality are zero.

3. If $\theta > \hat{\theta}_W$ and $\theta' \in [\hat{\theta}_M, \hat{\theta}_W)$, then the left-hand side of the inequality is positive and the right-hand side is zero.

4. If $\theta > \hat{\theta}_W$ and $\theta' \geq \hat{\theta}_W$, then the two sides of the inequality are both positive and they are equal.

■

Lemmas 2 and 3 immeditely yield:

Corollary 1 *If $\hat{\theta}_W > \hat{\theta}_M$, then, for all $\theta > \hat{\theta}_M$, we have $F^W(\theta) < F^M(\theta)$.*

Lemma 4 *Suppose $\tilde{x}$ and $\tilde{y}$ are random variables and $\tilde{x}$ (strictly) first-order stochastically dominates $\tilde{y}$. If ε is a random variable that is independent of $\tilde{x}$ and $\tilde{y}$, then $\tilde{x} + \varepsilon$ (strictly) first-order stochastically dominates $\tilde{y} + \varepsilon$.*

Proof. Let F_x, F_y, and F_ε be the CDFs of the random variables. Using the convolution formula to get the CDFs of $\tilde{x} + \varepsilon$ and $\tilde{y} + \varepsilon$, we to show that, for all z:

$$\int F_x(z - \varepsilon)\, dF_\varepsilon(\varepsilon) \leq \int F_y(z - \varepsilon)\, dF_\varepsilon(\varepsilon).$$

Which is true because $\tilde{x}$ (striclty) first-order stochastically dominates $\tilde{y}$ implies $F_x(z - \varepsilon) \leq F_y(z - \varepsilon)$, for all z and ε. ■

A.2 Election Aversion

This section proceeds as follows. First, we characterize the equilibrium cutoffs and show that $\hat{\theta}_W > \hat{\theta}_M$. Second, we derive the distributions of ability conditional on election and on a tie, and show that the distribution of abilities for women is better in each case. Third, we use these results to prove Proposition 1.

Lemma 5 *The pair $(\hat{\theta}_W, \hat{\theta}_m)$ are equilibrium cutoffs if and only if:*

$$\frac{\lambda_W}{\lambda} \int F^W(\hat{\theta}_W - \epsilon) g(\epsilon)\, d\epsilon + \frac{\lambda_M}{\lambda} \int F^M(\hat{\theta}_W - \epsilon) g(\epsilon)\, d\epsilon = c_W \tag{6}$$

$$\frac{\lambda_W}{\lambda} \int F^W(\hat{\theta}_M - \epsilon) g(\epsilon)\, d\epsilon + \frac{\lambda_M}{\lambda} \int F^M(\hat{\theta}_M - \epsilon) g(\epsilon)\, d\epsilon = c_M \tag{7}$$

Proof. Fix cutoffs $(\hat{\theta}_W, \hat{\theta}_M)$.

A candidate with ability θ and preference shock μ defeats an opponent with ability θ' and preference shock ν' if and only if:

$$\theta + \nu \geq \theta' + \nu'.$$

Recalling that $\epsilon = \nu' - \nu$, we can rewrite this condition as:

$$\theta \geq \theta' + \epsilon.$$

Recall that ϵ has density g. Thus the probability that a candidate of type θ wins, conditional on being selected, is:

$$\Pr(\text{Elected} \mid \theta) = \frac{\lambda_W}{\lambda} \int F^W(\theta - \epsilon) g(\epsilon)\, d\epsilon + \frac{\lambda_M}{\lambda} \int F^M(\theta - \epsilon) g(\epsilon)\, d\epsilon, \tag{8}$$

where λ_W, λ_M, and λ are as in Equations 1–3.

A potential candididate of gender γ runs if and only if $\Pr(\text{Elected} \mid \theta) - c_\gamma \geq 0$. Since each F^γ is continuous and strictly increasing in θ, so is $\Pr(\text{Elected} \mid \theta)$. Thus $(\hat{\theta}_W, \hat{\theta}_M)$ are equilibrium cutoffs if and only if $\Pr(\text{Elected} \mid \hat{\theta}_\gamma) = c_\gamma$ for both γ. ■

Lemma 6 *In the model with election aversion,* $\hat{\theta}_W > \hat{\theta}_M$.

Proof. Substitute in the definitions of λ_W and λ_M from Equations 1 and 2, and subtract Equation 7 from Equation 6 to get:

$$\frac{1}{2\lambda} \int \Big(F(\hat{\theta}_W - \epsilon) - F(\hat{\theta}_M - \epsilon) \Big)\, g(\epsilon)\, d\epsilon = c_W - c_M.$$

Since the right-hand side is positive and $\lambda > 0$, the integral must be positive, which requires $\hat{\theta}_W > \hat{\theta}_M$. ■

Now we derive the relevant conditional densities. Conditional on winning an election, the ability of a candidate of gender γ has a distribution with density:

$$f^\gamma(\theta \mid \text{Elected}) = \frac{\Pr(\text{Elected} \mid \theta) f^\gamma(\theta)}{\int \Pr(\text{Elected} \mid \tilde{\theta}) f^\gamma(\tilde{\theta})\, d\tilde{\theta}}. \tag{9}$$

Lemma 7 *Fix* $\theta > \theta'$.

$$f^W(\theta \mid \mathit{Elected}) f^M(\theta' \mid \mathit{Elected}) \geq f^W(\theta' \mid \mathit{Elected}) f^M(\theta \mathit{Elected}).$$

Proof. Substituting from Equation 9, the inequality is equivalent to:

$$f^W(\theta)f^M(\theta') \geq f^W(\theta')f^M(\theta).$$

The result now follows from Lemma 3. ■

Conditioning on a tie between a woman and a man is more delicate, since ties have probability zero. Thus Bayes' rule does not apply directly. Instead, we define $f^\gamma(\theta \mid \text{Tie})$ as follows:

$$f^\gamma(\theta \mid \text{Tie}) = \lim_{\delta \to 0} f^\gamma(\theta \mid -\delta < \theta - \theta' - \epsilon < \delta).$$

This yields:

$$f^W(\theta \mid \text{Tie}) = \frac{h^M(\theta)f^W(\theta)}{\int h^M(\tilde{\theta})f^W(\tilde{\theta})\, d\tilde{\theta}}$$

and

$$f^M(\theta \mid \text{Tie}) = \frac{h^W(\theta)f^M(\theta)}{\int h^W(\tilde{\theta})f^M(\tilde{\theta})\, d\tilde{\theta}}.$$

Lemma 8 *For $\theta > \theta'$,*

$$f^W(\theta \mid \mathit{Tie})f^M(\theta' \mid \mathit{Tie}) \geq f^W(\theta' \mid \mathit{Tie})f^M(\theta \mid \mathit{Tie}).$$

Proof. There are four cases.

1. If $\theta < \hat{\theta}_W$, then both sides of the inequality are zero.

2. If $\theta > \hat{\theta}_W$ and $\theta' < \hat{\theta}_M$, then both sides of the inequality are zero.

3. If $\theta > \hat{\theta}_W$ and $\theta' \in [\hat{\theta}_M, \hat{\theta}_W)$, then the left-hand side of the inequality is positive and the right-hand side is zero.

4. If $\theta > \hat{\theta}_W$ and $\theta' \geq \hat{\theta}_W$, then the two sides of the inequality are both positive and they are equal.

■

Now we can prove Proposition 1.

Proof of Proposition 1.

1. Lemma 6 immediately implies $\lambda_W < \lambda_M$.

2. From Equation 8, the probability of being elected conditional on θ, Pr(Elected | θ), does not depend on gender. The measure of winners of gender γ, then, is:

$$\lambda^\gamma \int_{\hat{\theta}_\gamma}^{\infty} \Pr(\text{Elected} \mid \theta) f^\gamma(\theta)\, d\theta.$$

Canceling λ^γ and the denominator of f^γ, this can be rewritten:

$$\frac{1}{2} \int_{\hat{\theta}_\gamma}^{\infty} \Pr(\text{Elected} \mid \theta) f(\theta)\, d\theta.$$

Now the result follows from $\hat{\theta}_M < \hat{\theta}_W$.

3. Lemmas 2 and 7 imply that $F^W(\theta \mid \text{Elected}) < F^M(\theta \mid \text{Elected})$ for all $\theta > \hat{\theta}_M$. Thus $\int \tilde{\theta}\, dF^W(\tilde{\theta} \mid \text{Elected}) > \int \tilde{\theta}\, dF^M(\tilde{\theta} \mid \text{Elected})$.

4. A candidate with ability θ wins with probability Pr(Elected | θ), defined in Equation 8. This probability is strictly increasing in θ. The result then follows from Lemmas 2 and 3.

■

A.3 Voter Bias

This section proceeds as follows. First, we characterize the equilibrium cutoffs and show that $\hat{\theta}_W = \hat{\theta}_M + b$ (Lemma 1 from the main text). Second, we derive a stochastic order result under the addtional assumption that f is logconcave. Third, we prove the remaining results from the main text.

Lemma 9 *The pair $(\hat{\theta}_W, \hat{\theta}_M)$ are equilibrium cutoffs in the voter-bias model if and only if:*

$$\frac{\lambda_W}{\lambda} \int F^W(\hat{\theta}_W - \epsilon) g(\epsilon)\, d\epsilon + \frac{\lambda_M}{\lambda} \int F^M(\hat{\theta}_W - b - \epsilon) g(\epsilon)\, d\epsilon = c \tag{10}$$

$$\frac{\lambda_W}{\lambda} \int F^W(\hat{\theta}_M + b - \epsilon) g(\epsilon)\, d\epsilon + \frac{\lambda_M}{\lambda} \int F^M(\hat{\theta}_M - \epsilon) g(\epsilon)\, d\epsilon = c \tag{11}$$

The proof closely follows that of Lemma 5, modified to account for the effect of bias on the probability of winning.
Proof. Fix cutoffs $(\hat{\theta}_W, \hat{\theta}_M)$.

Consider a female candiate with ability θ and preference shock ν. She defeats a female opponent with ability θ' and preference shock ν' if and only if:

$$\theta + \nu \geq \theta' + \nu'.$$

She defeats a male opponent with ability θ' and preference shock ν' if and only if:

$$\theta + \nu \geq \theta' + b + \nu'.$$

Thus, the probability a female candidate with ability θ wins is:

$$\Pr(\text{Elected} \mid \theta, W) = \frac{\lambda_W}{\lambda} \int F^W(\theta - \epsilon) g(\epsilon)\, d\epsilon + \frac{\lambda_M}{\lambda} \int F^M(\theta - b - \epsilon) g(\epsilon)\, d\epsilon. \tag{12}$$

A similar argument shows that the probability a male candidate of type θ wins is:

$$\Pr(\text{Elected} \mid \theta, M) = \frac{\lambda_W}{\lambda} \int F^W(\theta + b - \epsilon) g(\epsilon)\, d\epsilon + \frac{\lambda_M}{\lambda} \int F^M(\theta - \epsilon) g(\epsilon)\, d\epsilon. \tag{13}$$

A potential candididate of gender γ runs if and only if $\Pr(\text{Elected} \mid \theta, \gamma) - c \geq 0$. Since each F^γ is continuous and strictly increasing in θ, so are each $\Pr(\text{Elected} \mid \theta, \gamma)$. Thus $(\hat{\theta}_W, \hat{\theta}_M)$ are equilibrium cutoffs if and only if $\Pr(\text{Elected} \mid \hat{\theta}_\gamma, \gamma) = c$ for both γ. ■

Proof of Lemma 1. The left-hand sides of Equations 10 and 11 are equal if

$$\hat{\theta}_W = \hat{\theta}_M + b.$$

Moreover, for any $\hat{\theta}_M$, there is at most one $\hat{\theta}_W$ such that Equation 11 holds. Therefore, any solution to this system of equations must have $\hat{\theta}_W = \hat{\theta}_M + b$. ■

Lemma 10 *If f is log-concave, then $z > z'$ implies:*

$$f^M(z - b) f^W(z') \geq f^M(z' - b) f^W(z),$$

with strict inequality if $z' \geq \hat{\theta}_W$.

Proof. If $z' < \hat{\theta}_W$, then Lemma 1 implies both sides of the inequality are zero. So suppose

$z > z' \geq 0$, and define the function $\ell(z)$ by:

$$\ell(z) = \frac{f^M(z-b)}{f^W(z)}.$$

The result follows from the claim that ℓ is strictly increasing.

To prove that claim, note that:

$$\ell(z) = \frac{(1 - F(\hat{\theta}_W))}{(1 - F(\hat{\theta}_M))} \cdot \frac{f(z-b)}{f(z)}.$$

Take logs and differentiate the right-hand side to get:

$$\frac{f'(z-b)}{f(z-b)} - \frac{f'(z)}{f(z)} > 0,$$

where the inequality follows from logconcavity and $b > 0$. ■

Lemma 11 *Suppose f and g are logconcave. Then h^W and h^M are logconcave.*

Proof. Logconcavity of f implies logcavity of f^W and of f^M, by Bagnoli and Bergstrom (2005, Theorem 7). Logconcavity of f^W (f^M) and of g implies logconcvity of h^W (h^M), by Miravete (2011, Lemma 2).[7] ■

Corollary 2 *Suppose f and g are logconcave. Then the function $z \mapsto \frac{h(z)}{h(z+b)}$ is increasing.*

Lemma 12 *Suppose f and g are logconcave. Then the function $z \mapsto \frac{h^M(z-b)}{h^W(z)}$ is increasing.*

Proof. Let $\tilde{x}$ be a random variable with density $f^M(x-b)$, and let $\tilde{y}$ be a random variable with density $f^W(y)$. Lemma 10 says $\tilde{x}$ dominates $\tilde{y}$ in the likelihood ratio order. Thus $\tilde{x} + \epsilon$ likelihood ratio dominates $\tilde{y} + \epsilon$ (Keilson and Sumita, 1982, Theorem 2.1(d)). ■

For the next results, we will need an expression for the expected ability of a candidate of gender γ, conditional on that candidate having ability greater than or equal to some number α. Denote that quality by $\mathbb{E}^\gamma[\theta \mid \theta \geq \alpha]$.

[7] Miravete (2011) has compact support as a maintained assumption, but the arguments do not rely on that fact. See Miravete (2002).

Denote the maximum of $\hat{\theta}_\gamma$ and α by $\hat{\theta}_\gamma \vee \alpha$. Then:

$$\mathbb{E}^\gamma[\theta \mid \theta \geq \alpha] = \int_{\hat{\theta}_\gamma \vee \alpha}^{\infty} \tilde{\theta} \frac{f(\tilde{\theta})}{1 - F(\hat{\theta}_\gamma \vee \alpha)} \, d\tilde{\theta}.$$

Immediately from this equation, we get:

Lemma 13 *1. $\mathbb{E}^\gamma[\theta \mid \theta \geq \alpha]$ is increasing in α, strictly so if $\alpha > \hat{\theta}_\gamma$.*

2. Suppose $\alpha < \hat{\theta}_W$. Then:

$$\mathbb{E}^W[\theta \mid \theta \geq \alpha] > \mathbb{E}^M[\theta \mid \theta \geq \alpha].$$

3. Suppose $\alpha \geq \hat{\theta}_W$. Then:

$$\mathbb{E}^W[\theta \mid \theta \geq \alpha] = \mathbb{E}^M[\theta \mid \theta \geq \alpha].$$

To win election, a woman's ability must be greater than some *hurdle*. This hurdle depends on whether she faces a woman or man opponent. If she faces a woman of ability θ, the hurdle is $\theta + \epsilon$. If she faces a man, the hurdle is $\theta + b + \epsilon$. Thus, the hurdle a woman faces has CDF:

$$\tilde{H}^W(\theta) = \lambda_W \int F^W(\theta - \epsilon) g(\epsilon) \, d\epsilon + \lambda_M \int F^M(\theta - b - \epsilon) g(\epsilon) \, d\epsilon.$$

Similarly, the hurdle a man faces has CDF:

$$\tilde{H}^M(\theta) = \lambda_W \int F^W(\theta + b - \epsilon) g(\epsilon) \, d\epsilon + \lambda_M \int F^M(\theta - \epsilon) g(\epsilon) \, d\epsilon.$$

Denote the densities associated with each of these as $\tilde{h}^W$ and $\tilde{h}^M$.

Lemma 14 *$\tilde{H}^W$ strictly FOS-dominates $\tilde{H}^M$.*

Proof. Define a function $\mathcal{H} : \mathbb{R}^3 \to \mathbb{R}$ by

$$\mathcal{H}(\theta, \beta_1, \beta_2) = \lambda_W \int F^W(\theta + \beta_1 - \epsilon) g(\epsilon) \, d\epsilon + \lambda_M \int F^M(\theta - \beta_2 - \epsilon) g(\epsilon) \, d\epsilon.$$

Since $\int F^\gamma(z - \epsilon) g(\epsilon) \, d\epsilon$ is strictly increasing in z, $\mathcal{H}$ is strictly increasing in β_1 and strictly decreasing in β_2.

But $\tilde{H}^W = \mathcal{H}(\cdot, 0, b)$ and $\tilde{H}^M = \mathcal{H}(\cdot, b, 0)$. Thus, for all z, $\tilde{H}^W(z) < \tilde{H}^M(z)$. ■

We can now prove Proposition 2.

Proof of Proposition 2.

1. Follows immediately from Lemma 1.

2. The measure of winners of gender γ is:

$$\lambda^\gamma \int_{\hat{\theta}_\gamma}^{\infty} \Pr(\text{Elected} \mid \theta, \gamma) f^\gamma(\theta)\, d\theta.$$

   Canceling λ^γ and the denominator of f^γ, we can rewrite this as

$$\frac{1}{2} \int_{\hat{\theta}_\gamma}^{\infty} \Pr(\text{Elected} \mid \theta, \gamma) f(\theta)\, d\theta.$$

   The result now follows from the following chain of inequalities:

$$\begin{aligned} \int_{\hat{\theta}_M}^{\infty} \Pr(\text{Elected} \mid \theta, M) f(\theta)\, d\theta &> \int_{\hat{\theta}_W}^{\infty} \Pr(\text{Elected} \mid \theta, M) f(\theta)\, d\theta \\ &> \int_{\hat{\theta}_W}^{\infty} \Pr(\text{Elected} \mid \theta, W) f(\theta)\, d\theta, \end{aligned}$$

   The first inequality follows from $\hat{\theta}_M > \hat{\theta}_W$. The second inequality follows from the fact that, for a fixed θ, $\Pr(\text{Elected} \mid \theta, W) < \Pr(\text{Elected} \mid \theta, M)$, which is immediate from a comparison of Equations 12 and 13.

3. The expected ability of a woman winner is $\int \mathbb{E}^W[\theta \mid \theta > \alpha] \tilde{h}^W(\alpha)\, d\alpha$. The expected ability of a man winner is $\int \mathbb{E}^M[\theta \mid \theta > \alpha] \tilde{h}^M(\alpha)\, d\alpha$. We have:

$$\begin{aligned} \int \mathbb{E}^W[\theta \mid \theta > \alpha] \tilde{h}^W(\alpha)\, d\alpha &> \int \mathbb{E}^W[\theta \mid \theta > \alpha] \tilde{h}^M(\alpha)\, d\alpha \\ &> \int \mathbb{E}^M[\theta \mid \theta > \alpha] \tilde{h}^M(\alpha)\, d\alpha, \end{aligned}$$

   where the first inequality is Lemma 14 and the second inequality if Lemma 13.

4. The probability a candidate of type θ and gender γ wins conditional on running, is $\Pr(\text{Elected} \mid \theta, \gamma)$, defined in Equations 12 and 13.

We can write the probability of election, conditional on gender, as:

$$\Pr(\text{Elect} \mid W) = \frac{\lambda_W}{\lambda}\int_{\hat{\theta}_W}^{\infty} H^W(\theta) f^W(\theta)\, d\theta + \frac{\lambda_M}{\lambda}\int_{\hat{\theta}_W}^{\infty} H^M(\theta - b) f^W(\theta)\, d\theta$$
$$\Pr(\text{Elect} \mid M) = \frac{\lambda_W}{\lambda}\int_{\hat{\theta}_M}^{\infty} H^W(\theta + b) f^M(\theta)\, d\theta + \frac{\lambda_M}{\lambda}\int_{\hat{\theta}_M}^{\infty} H^M(\theta) f^M(\theta)\, d\theta.$$

Combining terms, using the fact that $\hat{\theta}_W = \hat{\theta}_M + b$, and doing a change of variables to put them on the same support, we can rewrite these as:

$$\Pr(\text{Elect} \mid W) = \frac{1}{\lambda}\int_{\hat{\theta}_M + b}^{\infty} \left(\lambda_W H^W(\theta) + \lambda_M H^M(\theta - b)\right) f^W(\theta)\, d\theta$$
$$\Pr(\text{Elect} \mid M) = \frac{1}{\lambda}\int_{\hat{\theta}_M + b}^{\infty} \left(\lambda_W H^W(\theta) + \lambda_M H^M(\theta - b)\right) f^M(\theta - b)\, d\theta.$$

The result now follows from the fact that $\lambda_W H^W(\theta) + \lambda_M H^M(\theta - b)$ is increasing in θ and that Lemma 10 implies that $f^W(z)$ first-order stochastically dominates $f^M(z - b)$.

■

A.4 Regression Discontinuity

We make use of the following:

Lemma 15 *In the model with voter bias, $\theta > \theta'$ implies $f^W(\theta \mid Tie) f^M(\theta' \mid Tie) \geq f^W(\theta' \mid Tie) f^M(\theta \mid Tie)$.*

Proof. There are four cases.

1. If $\theta < \hat{\theta}_W$, then both sides of the inequality are zero.

2. If $\theta > \hat{\theta}_W$ and $\theta' < \hat{\theta}_M$, then both sides of the inequality are zero.

3. If $\theta > \hat{\theta}_W$ and $\theta' \in [\hat{\theta}_M, \hat{\theta}_W)$, then the left-hand side of the inequality is positive and the right-hand side is zero.

4. If $\theta > \hat{\theta}_W$ and $\theta' \geq \hat{\theta}_W$, then the two sides of the inequality are both positive, and we can rewrite the target inequality as:

$$\frac{f^W(\theta \mid \text{Tie})}{f^M(\theta \mid \text{Tie})} \geq \frac{f^W(\theta' \mid \text{Tie})}{f^M(\theta' \mid \text{Tie})}. \tag{14}$$

To establish this, define a function ℓ by:

$$\ell(z) = \frac{f^W(\theta \mid \text{Tie})}{f^M(\theta \mid \text{Tie})}.$$

Substitute from the definitions of the two densities to get:

$$\begin{aligned}\ell(z) &= K\frac{h^M(z-b)f^W(z)}{h^W(z+b)f^M(z)} \\ &= K\frac{h^M(z-b)}{h^W(z)}\frac{h^W(z)}{h^W(z+b)}\frac{f^W(z)}{f^M(z)},\end{aligned}$$

where K is a constant. The function $z \mapsto \frac{h^M(z-b)}{h^W(z)}$ is increasing by Lemma 12. The function $z \mapsto \frac{h^W(z)}{h^W(z+b)}$ is increasing by Corollary 2. The function $z \mapsto \frac{f^W(z)}{f^M(z)}$ is increasing by Lemma 2. All three of these functions are positive on $[\hat{\theta}_W, \infty)$, so ℓ is increasing on that interval.

■

Proof of Proposition 3.

1. In the model with election aversion, Lemmas 2 and 8 imply that $F^W(\theta \mid \text{Tie}) < F^M(\theta \mid \text{Tie})$ for all $\theta > \hat{\theta}_M$. Thus $\int \tilde{\theta}\, dF^W(\tilde{\theta} \mid \text{Tie}) > \int \tilde{\theta}\, dF^M(\tilde{\theta} \mid \text{Tie})$.

2. In the model with voter bias, conditioning on a tie, the densities of candidate ability by gender are:
$$f^W(\theta \mid \text{Tie}) = \frac{h^M(\theta-b)f^W(\theta)}{\int h^M(\tilde{\theta}-b)f^W(\tilde{\theta})\, d\tilde{\theta}}$$
and
$$f^M(\theta \mid \text{Tie}) = \frac{h^W(\theta+b)f^M(\theta)}{\int h^W(\tilde{\theta}+b)f^M(\tilde{\theta})\, d\tilde{\theta}}.$$
Lemmas 2 and 15 imply that $F^W(\theta \mid \text{Tie}) < F^M(\theta \mid \text{Tie})$ for all $\theta > \hat{\theta}_M$. Thus $\int \tilde{\theta}\, dF^W(\tilde{\theta} \mid \text{Tie}) > \int \tilde{\theta}\, dF^M(\tilde{\theta} \mid \text{Tie})$.

■

B Computational Examples

Example 1 ***Pure Voter Bias without Log-Concavity***

Consider the model with voter bias but no election aversion. Suppose the distribution of θ is Pareto with minimum 0.1 and shape parameter q. This distribution has a density that fails to be log-concave for all values of q. The noise ϵ is distributed standard normal, and so does have a log-concave density. Let $b = 0.25$ and $c = 0.2$.

If $q = 3.7$, then a man who runs wins with marginal probability in the interval $(0.4503, 0.4504)$, while a woman who runs wins with a larger marginal probability, in the interval $(0.4508, 0.4509)$.[8] If $q = 3.8$, then a man who runs wins with marginal probability in the interval $(0.4477, 0.4478)$, while a woman who runs wins with a smaller marginal probability, in the interval $(0.4470, 0.4471)$. Thus a continuity argument ensures us that for some $q \in (3.7, 3.8)$, men and women win with identical probability, conditional on running.

Example 2 ***Combined Model with Log-Concavity***

Consider a version of the model with both election aversion and voter bias. Suppose the distribution of both θ and ϵ are distributed standard normal, and so have log-concave densities. Let $b = 0.25$.

If women and men use cutoffs $\hat{\theta}_W = 1.12$ and $\hat{\theta}_M = 0.5$, respectively, then the probability that a woman wins (conditional on running) if her ability is exactly $\theta = \hat{\theta}_W = 1.12$ is in the interval $(0.38, 0.39)$ and the probability a man wins (conditional on running) if his ability is exactly $\theta = \hat{\theta}_M = 0.5$ is in the interval $(0.265, 0.27)$. Thus a continuity argument shows that there is a pair (c_W, c_M) with $0.38 < c_W < 0.39$ and $0.265 < c_M < 0.27$ such that there is an equilibrium with $\hat{\theta}_W = 1.12$ and $\hat{\theta}_M = 0.5$. Given such an equilibrium, we can calcuate the probability a man wins conditional on running minus the probability a woman wins conditional on running. Doing so shows that it is contained in $(0.004, 0.005)$. So, at this equilibrium, men win at a slightly higher rate than women.

If women and men use cutoffs $\hat{\theta}_W = 1.14$ and $\hat{\theta}_M = 0.5$, respectively, then the probability that a woman wins (conditional on running) if her ability is exactly $\theta = \hat{\theta}_W = 1.14$ is in the interval $(0.39, 0.4)$ and the probability a man wins (conditional on running) if his ability is exactly $\theta = \hat{\theta}_M = 0.5$ is in the interval $(0.26, 0.265)$. Thus a continuity argument shows that there is a pair (c_W, c_M) with $0.39 < c_W < 0.4$ and $0.26 < c_M < 0.265$ such that there is an equilibrium with $\hat{\theta}_W = 1.12$ and $\hat{\theta}_M = 0.5$. Given such an equilibrium, we can calcuate the probability a man wins conditional on running minus the probability a woman wins conditional on running. Doing so shows that it is contained in $(-0.0005, -0.0004)$. So, at this equilibrium, men win at a slightly lower rate than women.

Continuity now immediately implies that there is some (c_W, c_M) such that there is an

[8] Mathematica code for all calculations available from the authors' website.

equilibrium with $\hat{\theta}_W \in (1.12, 1.14)$ and $\hat{\theta}_M = 0.5$ where women and men win at the exact same rate. In such an equilibrium, women are clearly under-represented in the pool of available candidates and have higher average ability conditional on winning. Hence, this example shows that a model with both election aversion and voter bias can account for all three empirical facts.

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