The Effect of Opportunity Costs on Candidate Supply

Guy Grossman and W. Walker Hanlon

January 21, 2009

1 Introduction

Small groups, such as the Ugandan farmer associations we investigate, are playing an increasingly vital role in creating growth in developing countries. The effectiveness of these small groups often depends heavily on their ability to select an effective manager. The problem of selecting the most effective manager from within the organization can be broken down into two parts. First, group members must decide whether to become candidates for the management position. Second, the group members must choose the manager from among the available set of candidates. This paper will offer a theory focusing on the first of these problems: the self-selection of the candidate pool.

In deciding whether to become candidates for a management position, group members must consider several factors. First, if a member is chosen to be the manager, they will be required to spend time and effort managing the organization's affairs, which will entail some opportunity cost. How large this opportunity cost is will depend on the income they could receive from spending that time elsewhere, as well as on the amount of time and effort they devote to managing the organization. In the case of the Ugandan farmer associations, member's opportunity cost could depend on the size of their plot or on what they could receive outside the agricultural sector.

Second, as a member of the group, the manager will receive some benefits from their own management. In addition to the direct benefits of holding office, both monetary and social, the manager may also benefit from the public good that they produce. The size of the benefits they receive will depend on their stake in the organization. These stakes may take many forms. In a farmer's cooperative, a member's stake in the organization depends heavily on the size of the plot they farm. The larger (or more productive) the plot farmed, the more they benefit from a negotiated increase in the sales price they receive, or a decrease in input prices, two of the primary tasks of the manager. When manager effort is non-contractible, these additional benefits may play an important role in motivating manager effort.

A group member's candidacy decision may also depend on their probability of election if there are costs, either monetary or social, to being a candidate. In small groups, candidacy costs are likely to be quite small, so for simplicity we ignore this aspect of the decision.

We define candidate quality as the value of the public good that a candidate will deliver if they are chosen to be the manager. Thus, a candidate's quality depends on a combination of ability and effort. The small size of our groups means that members know each other relatively well, and so ability is well observed. However, once a candidate becomes the manager, it is often difficult for members to observe their day-to-day effort. Once the candidate pool is determined, members will attempt to choose the candidate with the best combination of ability and expected effort for the job. This suggests that factors that motivate potential candidates to exert more effort will play an important role in the manager selection process. In particular, the size of an manager's stake in the public good produced by the organization may be an important factor in incentivizing effort, because the manager will benefit more from the public good they produce. In the context of the farmer associations we study, a manager with a larger farm will benefit more from the public good they produce and so put more effort in as a manager. Since other group members know a candidates farm size, they will take the resulting incentive effects into account when choosing the manager.

The goal of this paper is to understand how opportunity costs impact the quality of the candidate pool in small groups, and through this channel, the ultimate quality of the manager. We present a simple model of candidate self-selection that allows us to conduct comparative statics exercises. We simplify the voting behavior of members once the candidate pool is formed, as this is not the focus of our attention.

This paper builds on the work of several previous projects looking at similar issues. Caselli & Morelli (2004) was perhaps the first paper to focus attention on how the supply of candidates affected the quality of the ultimate office holders. They suggest that office holders differ in two dimensions: competence and honesty. In their model, more competent citizens have higher opportunity costs of holding office, while more honest citizens receive fewer rewards from holding office because they are less willing to use their position for personal gain. A main result of this paper is that, due to opportunity costs, more competent politicians may decide not to run for office. Similarly, more honest politicians may decide not to run because they will receive smaller benefits from office. Our model will build on these ideas.

One respect in which our model differs from Caselli & Morelli (2004) is that they are concerned with elections in large groups where citizens have imperfect information about candidates, while we focus on small groups where group members are fairly well informed about the abilities of other members. In this scenario, the role of voter error resulting from imperfect information is reduced, while the importance of the candidate pool is magnified. Thus, this is arguably a more compelling area in which to study the selection of the candidate pool. Another difference between the large and small group cases is that when the population is large, each individual candidate's stake in the public good is relatively small, while in small groups, each candidate's relative stake in the public good is much larger. Thus, the incentive effects of a candidate having a larger stake in the group will be much stronger for small groups.

Perhaps the most similar research to our work is Messner & Polborn (2004). They focus on how selection of the candidate pool affects outcomes in a small group situation, where candidate's actual ability is well known. This allows them to abstract from the voting problem and focus attention on selection of the candidate pool. They follow Caselli & Morelli (2004) in exploring the role of opportunity costs in affecting the quality of the candidate pool, though in Messner and Polborn's model there is only one office holder, rather than many offices to be filled, as in Caselli and Morelli. We will follow an approach that is similar to Messner & Polborn (2004) in many respects.

Where we differ from these previous studies is in our treatment of the opportunity costs faced by potential candidates. Both of the previous studies assume that higher quality citizens have, at least on average, higher opportunity costs, but they give little consideration to what these costs actually represent. Our contribution, in essence, is to 'unpack' these costs. We suggest that in addition to being correlated with ability, some opportunity costs may also be correlated with the gains potential candidates receive from the public good produced by the office holder. When office holders have to determine how much effort to put into their post, this becomes an important point that may significantly change the lessons drawn from these models.

Our theoretical results suggest that the characteristics of the opportunity costs faced by group members play a key role in determining outcomes. Pure opportunity costs that have no relationship the the public good are found to reduce the quality of the candidate pool and the manager quality. In terms of our farmer associations, off-farm income opportunities create opportunity costs of this kind. This result matches previous work. However, we also find that opportunity costs that are related to how much an individual benefits from the public good may increase the quality of the candidate pool and the value of the public good produced by the manager. In our example such opportunity costs may correspond to farm size or productivity. This result contrasts with previous work and suggests that nuance is required in considering the effect of opportunity costs on the candidate pool and manager quality.

2 Model

We begin this section by introducing the basic framework of our model. Each individual's opportunity cost of becoming the manager depends on their endowments. We divide these endowments based on whether they do or do not affect how individuals benefit from the public good. In keeping with our interest in farmer associations, we call these farm and off-farm income opportunities, respectively. We then describe how variation in these endowments affects the amount of effort that an individual will put into producing public goods for their group if they are elected manager. Next, we describe how individual's endowments will affect their candidacy decision given their optimal effort choice. Individual's candidacy decision is given as a function of the next best available candidate. Thus, we remain agnostic about the particular characteristics of the group members, an assumption that we will relax in Section 3.

A group is composed of N members indexed by $i \in [1, N]$. Group members differ in their ability, A_i, in their farm income opportunities, S_i, which may represent things like farm size or productivity, and in their off-farm income opportunities, K_i. It is likely that both S_i and K_i will be correlated with A_i. Each group will eventually choose at most one manager, who will divide her time between management, which produces public goods for the group, work on her own farm, and off-farm work. Other group members divide their time between work on their own farm and off-farm work. Each individual is endowed with one unit of available labor. The manager will allocate some portion $e \in [0, 1]$ of her time to producing public goods for the group, and the remainder to work on her own farm or on off-farm work. All other individuals will allocate all of their time to work on their farm or off-farm work, i.e. for individuals who are not the manager, $e = 0$.

The public good produced if individual j is the manager is given by the continuous function $M(A_j, e_j)$. Public goods production is increasing in both the manager's ability and the amount of effort they devote to public goods production.

$$\frac{\partial M}{\partial A_j} > 0 \quad \text{and} \quad \frac{\partial M}{\partial e_j} > 0$$

An individual i's payoff from working on their own farm is given by the continuous function $F(S_i, (1 - e_i), M_j)$ where M_j represents the public good produced by manager j and $(1 - e_i)$ represents the amount of time not devoted to group management [1]. Note that whenever $i \neq j$, $e_i = 0$. Farm income is increasing in an individual's farm income opportunities. Farm income is weakly decreasing in the effort that an individual devotes to

[1] Implicit in both the F() and G() functions is the assumption that all individuals face the same input and output prices. Since these are generally negotiated by the manager for the group, this assumption seems quite reasonable.

management, e_i, (holding the value of the public good constant) which equals zero for all individuals except the manager. Farm income is increasing in the value of the public good produced by the manager.

$$\frac{\partial F}{\partial S_i} > 0 \quad , \quad \frac{\partial F}{\partial e_i} \leq 0 \quad , \quad \frac{\partial F}{\partial M_j} > 0$$

An individual i's payoff from off-farm work is given by the continuous function $G(K_i, (1-e_i))$. Off-farm production is increasing in an individual's ability, their available human and physical capital, and weakly decreasing in the amount of effort they devote to managing the group's activities.

$$\frac{\partial G}{\partial K_i} > 0 \quad , \quad \frac{\partial G}{\partial e_i} \leq 0$$

Individually, farm and off-farm incomes are each weakly decreasing in the amount of effort devoted to management because when more effort is devoted to management, less effort is available to farm and off-farm work. The reason that farm production is only weakly decreasing in e_i is because individuals will allocate the time not devoted to management optimally between on and off-farm work. The only assumption we place on how this residual time $(1-e_i)$ is allocated is that the amount of effort put into either farm or non-farm work will never decrease in the amount of residual time. In other words, if the manager decides to put less time into management activities, this will never result in a decrease in the time put into either farm or off-farm work. At the least, the amount of time put into either farm or off-farm work will remain constant; generally it will increase. The partial derivate of the sum of farm and off-farm returns with respect to the effort devoted to management will be strictly decreasing, since effort devoted to management must come out of either one or the other of these activities.

$$\frac{\partial (F+G)}{\partial e_i} < 0$$

Each of the three activities, management, on-farm work, and off-farm work, suffer from diminishing returns in the amount of effort devoted to that activity.

$$\frac{\partial^2 M}{\partial e_i^2} < 0 \quad , \quad \frac{\partial^2 F}{\partial e_i^2} \leq 0 \quad , \quad \frac{\partial^2 G}{\partial e_i^2} \leq 0$$

There are three other key assumptions in our model. The first deals with the complementarity between capital (or opportunity) and labor.

Assumption 1 *The marginal benefit of putting time into farm work is increasing in S, while the marginal benefit of putting time into off-farm work are increasing in K.*

$$\frac{\partial^2 F}{\partial e_i \partial S_i} \leq 0 \quad , \quad \frac{\partial^2 G}{\partial e_i \partial K_i} \leq 0$$

The second key assumption stems from a crucial difference between an individual's income from farm and off-farm work. If an individual decides to put less time into farm work, they are generally able to hire someone to do the same work and can still enjoy capital's share of the benefits from this work. However, if an individual decides to reduce the time they put into off-farm labor, they lose all of the income they could have made from that activity. This suggests the following relationship between the marginal benefit of putting time into the off-farm sector relative to the marginal benefit from putting time into the farm sector.

Assumption 2 *A small increase in the amount of effort devoted to management activity reduces the marginal benefit of an additional unit of farm income opportunity more than it reduces the marginal benefit of an equal sized unit of additional off-farm income opportunity.*

$$\left|\frac{\partial^2 F}{\partial e_i \partial S_i}\right| < \left|\frac{\partial^2 G}{\partial e_i \partial K_i}\right| \quad \textit{for any} \quad M_j \tag{1}$$

There is also complementarity between the public good and farm income opportunities. When the public good produced by the manager is better, the return to an additional unit of farm income opportunity is increased. Conversely, when an individual has more farm income opportunity, their marginal benefit from an increase in the value of the public good increases. In practical terms, when the manager is able to negotiate a better price for selling farm output, this increases the marginal benefit of additional farm production.

Assumption 3 *The cross-partial derivative of farm income on the public good and farm size is positive.*

$$\frac{\partial^2 F}{\partial S_i \partial M} > 0$$

These will be important assumptions in determining how an individual's endowments affect the amount of effort they are willing to devote to management, the topic of the next section.

2.1 Manager's choice of effort level

The manager, which we denote with the subscript m, will choose effort in order to maximize the sum of her returns from all sources. In other words, she will solve the following problem.

$$max_{e_m} F(S_m, (1-e_m), M(A_m, e_m)) + G(K_m, (1-e_m))$$

The manager is optimizing a continuous function on the compact set $e_m \in [0, 1]$, so an optimal effort level will exist. The manager's optimal effort level equates her marginal product from management with that from farm and off-farm activities.

$$\frac{\partial F}{\partial M}\frac{\partial M}{\partial e_m} = -\left[\frac{\partial F}{\partial e_m} + \frac{\partial G}{\partial e_m}\right] \tag{2}$$

The solution to this problem will be unique when the following condition, which ensures the convexity of the objective function, holds.

$$\frac{\partial^2 F}{\partial M \partial e_m}\frac{\partial M}{\partial e_m} + \frac{\partial F}{\partial M}\frac{\partial^2 M}{\partial e_m^2} < -\left[\frac{\partial^2 F}{\partial e_m^2} + \frac{\partial^2 G}{\partial e_m^2}\right] \tag{3}$$

This condition will fail only if the left hand term is positive and large, i.e. only if the marginal return to management effort e_m is increasing despite the decreasing returns to management effort in producing the public good. Note that the second term is negative because $\partial^2 M/\partial e_m^2 < 0$ while the right hand side is positive. The above condition fails only if the marginal product of management is strongly decreasing in the amount of effort put into on-farm labor. However, we expect exactly the opposite – the marginal return to management should be increasing in the amount of effort put into on-farm labor (or decreasing in e_m). Thus, we can safely impose the following assumption, which ensures that the manager's optimal effort level is unique.

Assumption 4 *An individual's marginal benefit from the public good created by the manager is increasing in the amount of effort put into farm labor, which is weakly decreasing in the amount of effort devoted to management activities, e_i.*

$$\frac{\partial^2 F}{\partial M \partial e_i} \leq 0$$

Hereafter, we denote the manager's optimal effort level as e_i^* if individual i is the manager. Next, we want to explore how this optimal effort level is affected by changes in the manager's farm and off-farm income opportunities.

Proposition 1 *Under the assumptions we have given, the manager's optimal effort level, e^*, is decreasing in their off-farm income opportunities.*

$$\frac{\partial e^*}{\partial K_m} < 0$$

> **Proof:** Because the marginal benefit of the manager's effort devoted to off-farm work is increasing in K_m, we know that an increase in K_m will lead to an increase in the right hand side of Equation 2. Thus, either the left hand side of 2 must increase, or the right hand side must decrease, to compensate. The left hand side of Equation 2 is decreasing in e^*, while the right hand side is increasing in e^*, so e^* must decrease in response to the increase in K_m. QED

The effect of increased S_m on the manager's effort decision is slightly more complicated. Increased farm income opportunities increase the benefits of putting effort into farm work, but also increase the benefits of management effort. In Equation 2, an increase in S_m causes an increase in both the left hand side, which will tend to increase e^*, and increase in the right hand side, which will tend to decrease e^*. Thus, whether an increase in S_m increases or decreases the manager's effort level is ambiguous.

One thing we can say is that even if one additional unit of S_m causes a decrease in the manager's effort level, this decrease will always be smaller than the decrease resulting from an equivalent increase in K_m. This follows from Assumption 1. This point is made more formally in the following theorem.

Proposition 2 *When Assumption 1 holds, the effect of the manager's farm size S_m on their optimal effort level is ambiguous. However, even if the manager's optimal effort level is decreasing in their farm size, this decrease will never be as large as the decrease resulting form an increase in their off-farm income potential.*

$$\frac{de^*}{dK_m} < \frac{de^*}{dS_m} \tag{4}$$

Proof: Rewriting Equation 2, we can see that the manager's optimal effort level e^* solves the following.

$$H \equiv \frac{\partial F}{\partial M}\frac{\partial M}{\partial e_m} + \frac{\partial F}{\partial e_m} + \frac{\partial G}{\partial e_m} = 0$$

From Equation 3, we know that $dH/de_m < 0$. Next, we take the derivative of the function H with respect to K_m, and then with respect to S_m.

$$\frac{dH}{dK_m} = \frac{\partial^2 G}{\partial K_m \partial e_m} \leq 0$$

$$\frac{dH}{dS_m} = \frac{\partial^2 F}{\partial S_m \partial e_m}\frac{\partial M}{\partial e_m} + \frac{\partial^2 F}{\partial K_m \partial e_m}$$

It follows from Assumption 1 that,

$$\frac{dH}{dK_m} < \frac{dH}{dS_m}$$

In other words, a small change in K_m reduces H at a more rapid rate than an equivalent small change in S_m. Since H is decreasing in e_m, this implies that there will have be a larger decrease in e^* to offset an increase in K_m than will be required to offset an equivalent decrease in S_m. QED

In this section, we have shown that an increase in the manager's off-farm income opportunities decreases the effort she puts into management. We have also shown that an increase in the manager's farm income opportunities may increase or decrease the effort she puts into management, but that it will never cause as large a reduction in management effort as an equivalent increase in off-farm income opportunities. These results have direct implications for the value of the public good produced by the manager, which we describe below.

Corollary 1 *The value of the public good created by a manager is decreasing in their off-farm income opportunities and may be increasing or decreasing in their farm income opportunities. The value of the public good will never be decreasing as rapidly in their farm income opportunities as it is in their off-farm income opportunities.*

$$\frac{dM(A_i, e_i)}{dK_i} < 0 \quad \textit{and} \quad \frac{dM(A_i, e_i)}{dK_i} < \frac{dM(A_i, e_i)}{dS_i}$$

These relationships will be important to group member's candidacy decision, the topic of our next section.

2.2 Group member's candidacy choice

In this section we explore how an individual's probability of candidacy is affected by their endowments taking as given the existence of some best alternative manager. We leave the question of how the best alternative manager is identified out of the set of members of the group, and how this affects an individual's candidacy decision, for later sections.

When there are no costs to being a candidate, group members will choose to be a candidate only if their payoff from being the manager exceeds their payoff from not becoming the manager. If an individual chooses not to become a candidate, then their payoff will depend on the public good delivered by the person who does become the manager. Define J_i to be the difference between individual i's payoff as the manager and their payoff as a regular group member, as below, where individual j is the best alternative candidate for manager. The exogenously given remuneration for the manager is R.

$$J_i \equiv F(S_i, (1 - e_i), M(A_i, e_i)) + G(K_i, (1 - e_i)) - F(S_i, 1, M(A_j, e_j)) - G(K_i, 1) + R \quad (5)$$

A group member will choose to become a candidate only if $J_i \geq 0$. Of course, whether this holds depends on the set of other potential candidates. Once groups have been formed, it is easy for an individual to simply look across all other group members and decide who the best alternative manager is. In this section, we are interested in how an individual's endowment affects their *ex ante* probability of choosing to be a candidate. The *ex ante* probability that some individual i will choose to be a manager is given below.

$$Pr\left[F(S_i,(1-e_i),M(A_i,e_i))+G(K_i,(1-e_i))-F(S_i,1,M(A_j,e_j))-G(K_i,1)+R\geq 0\right] \tag{6}$$

2.2.1 Effect of off-farm income opportunities

How is a member's probability of candidacy affected by her endowments? First we consider how off-farm income opportunities affect an individual's candidacy decision. Our result is described in the following proposition.

Proposition 3 *An individual's probability of candidacy is decreasing in her off-farm income opportunities.*

$$\frac{dJ_i}{dK_i}<0$$

Proof: The effect of a small increase in K_i on J_i is described below, where for notational simplicity the superscript 'M' is used to denote that she is the manager (and $e_i = e_i^*$) and 'I' denotes that she is not the manager (and $e_i = 0$).

$$\frac{dJ_i}{dK_i} = \frac{\partial F^M}{\partial e_i^*}\frac{de_i^*}{dK_i} + \frac{\partial F^M}{\partial M_i}\frac{\partial M^M}{\partial e_i^*}\frac{de_i^*}{dK_i} + \frac{\partial G^M}{\partial e_i^*}\frac{de_i^*}{dK_i} + \frac{\partial G^M}{\partial K_i} - \frac{\partial G^I}{\partial K_i}$$

Note that at $e_i = e_i^*$ implies,

$$\frac{\partial F^M}{\partial e_i^*} + \frac{\partial F^M}{\partial M_i}\frac{\partial M^M}{\partial e_i^*} + \frac{\partial G^M}{\partial e_i^*} = 0$$

So our expression simplifies to the following.

$$\frac{dJ_i}{dK_i} = \frac{\partial G(K_i,(1-e_i^*))}{\partial K_i} - \frac{\partial G(K_i,1)}{\partial K_i}$$

We have assumed that K_i and e_i are complements, so we can see that an increase in K_i will weakly increase the individual's return more when they are not the manager. The inequality will become strict whenever $e_i^* > 0$.

$$\frac{\partial G(K_i,(1-e_i^*))}{\partial K} \leq \frac{\partial G(K_i,1)}{\partial K} \quad \text{with strict inequality whenever} \quad e_i^* > 0$$

We can now see that an increase in an individual's off-farm income opportunities reduces the probability that they will choose to be a candidate for manager.

2.2.2 Effect of farm income opportunities

Understanding the effect of an increase in individual's farm income opportunities on their probability of candidacy is not as straightforward as the previous exercise. We begin with the effect of a small increase in S_i on J_i, given below, where again we use the superscripts 'M' and 'I' to signify payoffs when the individual is and is not the manager, respectively.

$$\frac{dJ_i}{dS_i} = \frac{\partial F^M}{\partial e_i^*}\frac{de_i^*}{dS_i} + \frac{\partial F^M}{\partial M_i}\frac{\partial M^M}{\partial e_i^*}\frac{de_i^*}{dS_i} + \frac{\partial F^M}{\partial S_i} + \frac{\partial G^M}{\partial e_i^*}\frac{de_i^*}{dS_i} - \frac{\partial F^I}{\partial S_i}$$

As before, we can use the definition of e^* to simplify.

$$\frac{dJ_i}{dS_i} = \frac{\partial F(S_i,(1-e_i^*),M(A_i,e_i^*,V))}{\partial S_i} - \frac{\partial F(S_i,1,M(A_j,e_j^*,V))}{\partial S_i}$$

An individual's marginal return to their farm income opportunities is increasing in the amount of effort devoted to farm work. Alone, this effect would suggest that an individual's probability of candidacy is decreasing in their farm income opportunities. However, this is not the only effect working in this case. An individual's marginal return to farm income opportunities is also affected by the value of the public good. If an individual is a better choice for manager than their next best alternative, so that $M(A_i, e_i^*, V) > M(A_j, e_j^*, V)$, then their probability of candidacy may be increasing in their farm income opportunities. This is because group members with larger farms benefit more from the extra public goods that they are able to produce if they are a better manager than the alternative.

Overall, the effect of farm income opportunities on an individual's probability of candidacy is ambiguous. One thing we can say is that an increase in farm income possibilities will never reduce and individual's probability of candidacy as much as an equivalent increase in off-farm income opportunities. This point is made formally below.

Proposition 4 *The effect of an increase in an individual's farm income opportunities on the probability of candidacy may be positive or negative. However, when Assumption 1 holds, an individual's probability of candidacy will always decrease more from an increase in their off-farm income opportunities than it will from an equivalent increase in their farm income opportunities as long as the public good produced by the individual is more valuable than the public good produced by the next best manager.*

$$\frac{dJ_i}{dK_i} < \frac{dJ_i}{dS_i} \quad \textit{when} \quad M(A_i, e_i^*) > M(A_j, e_j^*)$$

Proof: We begin by expanding the function J, using the simplifications from the previous two proofs.

$$\frac{dJ_i}{dK_i} - \frac{dJ_i}{dS_i} = \frac{\partial G(K_i,(1-e_i^*))}{\partial K_i} - \frac{\partial G(K_i,1)}{\partial K_i} - \frac{\partial F(S_i,(1-e_i^*),M_i)}{\partial S_i} + \frac{\partial F(S_i,1,M_j)}{\partial S_i}$$

$$= \frac{\partial G(K_i,(1-e_i^*))}{\partial K_i} - \frac{\partial G(K_i,1)}{\partial K_i} - \frac{\partial F(S_i,(1-e_i^*),M_i)}{\partial S_i} + \frac{\partial F(S_i,1,M_i)}{\partial S_i} - \frac{\partial F(S_i,1,M_i)}{\partial S_i} + \frac{\partial F(S_i,1,M_j)}{\partial S_i}$$

$$= \int_0^{e_i^*} \left(\frac{\partial^2 G(K_i,(1-e^i))}{\partial K_i \partial e_i} - \frac{\partial^2 F(S_i,(1-e^i),M_i)}{\partial S_i \partial e_i} \right) de_i \ - \int_{M_j}^{M_i} \frac{\partial^2 F(S_i,(1-e^i),M)}{\partial S_i \partial M} dM \ < \ 0$$

That the first integral is negative follows from Assumption 2, which states that an increase in the amount of effort devoted to management decreases the marginal benefit from additional off-farm income opportunities more than the marginal benefit from farm income opportunities. That the value under the second integral is positive follows from $M_i > M_j$ and Assumption 3.

2.3 Voting and group outcomes

In this section, we consider how the behaviors we have described translate into an actual candidate pool and manager choice. Our approach will be to solve backwards. We first consider member's voting behavior given an available pool of candidates and then turn to how the actual pool of candidates is determined given that everyone knows the voting outcome once the candidate pool is formed. In the following section, we consider how exogenous factors will affect the quality of the candidate pool and the manager that the group selects.

Every group member's ability, farm, and off-farm income opportunities, are perfectly observed by all other members of their small group. Also, the voting incentives of all group members are perfectly aligned; they all want the highest value public good possible. Closely aligned incentives and the availability of ample information about other members are key features of the small group situation we are concerned with.

Once the candidate pool is determined, members will be able to deduce the value of the public good that each candidate will produce. They simply pick the candidate who will deliver the highest value public good [2]. One implication of this voting behavior is that there is no chance that a less qualified candidate will be chosen over a more qualified one due to voter error or lack of information.

Having specified member's voting behavior, we can now consider how the candidate pool is formed. To do this, we order all group members in an increasing line according to the value of the public good that they will produce given their endowments and adjust the individual indexes (i) accordingly. So individual i=1 will deliver the lowest value public good out of all group members, and individual i=N will deliver the highest value public good.

Next, note that, as a result of the voting system, an individual's candidacy decision does not depend on the candidacy decisions of anyone ordered above them. To see why, suppose individual i is trying to decide whether to be a candidate. If some individual $j > i$ decides to be a candidate, then individual i is indifferent between being a candidate or not, since they will never be elected. If no individual ordered above i decides to be a candidate, then individual i will face a relevant candidacy choice. So, if i makes their candidacy decision assuming that none of the individuals ordered above them will run, then they will always reach their optimal solution. Thus, each individual's candidacy decision is made as if they know that none of the individual's above them will join the candidate pool.

We can now construct an algorithm that obtains the candidate pool given a set of group members. We begin with individual i=1 and work our way up. The member who will produce the lowest value public good (i=1) will face the following decision, where the the value of the public good produced if no one decides to be a candidate for manager is zero.

$$\text{Run if} \quad F(S_1, (1-e_1^*), M(A_1, e_1^*)) + G(K_1, (1-e_1^*)) + R \geq F(S_1, 1, 0) + G(K_1, 1)$$

Based on this, individual 1 either chooses to run or not to run. Given their decision, individual 2 will behave as follows.

If individual 1 decided to run,

$$\text{Run if} \quad F(S_2, (1-e_2^*), M(A_2, e_2^*)) + G(K_2, (1-e_2^*)) + R \geq F(S_2, 1, M(A_1, e_1^*)) + G(K_2, 1)$$

If individual 1 decided not to run,

$$\text{Run if} \quad F(S_2, (1-e_2^*), M(A_2, e_2^*)) + G(K_2, (1-e_2^*)) + R \geq F(S_1, 1, 0) + G(K_1, 1)$$

[2] If two candidate's endowments result in them delivering a public good of the same value, then voter's randomize between them, though because we are dealing with continuous distributions of ability, farm, and off-farm income opportunities, such a result is unlikely, so we do not consider it further.

For the i'th individual, if we denote the next best individual as j, then they will behave as follows.

$$\text{Run if} \quad F(S_i, (1-e_i^*), M(A_i, e_i^*)) + G(K_i, (1-e_i^*)) + R \geq F(S_i, 1, M(A_j, e_j^*)) + G(K_i, 1)$$

Applying this algorithm to any group of individuals, we are able to construct the candidate pool. The manager will then be the person in the candidate pool who will deliver the highest valued public good.

What will the manager and candidate pool generated using this process look like? This is a hard question to answer without having a concrete set of group members. The candidacy decision depends crucially on the spacing between the values of the public goods generated by different people. Variation in the spacing of these values depends on both the distribution of endowments and the number of group members. In the next section, we select a set of group members from a hypothetical endowment distribution and, after applying the algorithm we have just outlined, study the resulting candidate pool and manager quality.

3 Simulated results

In the previous section, we described how, given a set of group members, each with a particular set of endowments, we can determine the candidate pool and the manager. In this section, we take a step back and suppose that the group members have not yet been chosen. Instead, we are faced with distributions of potential abilities, off-farm income opportunities, and farm sizes. We randomly draw the characteristics of N individuals from these distributions and then determine the candidate pool and manager choice that results from this group of individuals. Repeating the process many times, we can identify patterns in how the endowment distributions and other model parameters affect the candidate pool and the quality of the manager.

To begin this process, we need to assume particular functional forms. For simplicity we will use the following functions, which have been derived from simple Cobb-Douglas production functions for farm, off-farm, and public good production. The details of this derivation are described in Appendix A. Built into the functional forms for the F and G functions is an optimal allocation of the effort not devoted to management between farm and off-farm work.

$$F = \frac{S(1-e)^{1-\alpha} M^{1/\alpha}}{(K + SM^{1/\alpha})^{1-\alpha}} \qquad G = \frac{K(1-e)^{1-\alpha}}{(K + SM^{1/\alpha})^{1-\alpha}} \qquad M = \alpha^{\alpha} A_i^{\beta} e_i^{1-\beta}$$

In order to be sure that a unique optimal solution to each individual's choice of effort in the event they are the manager (i.e., to satisfy Assumption 4), we require $\alpha + \beta \geq 0$. To see why this conditions is necessary, refer to Appendix B.

We use simple uniform distributions for ability, farm, and off-farm income opportunities. Each individual's ability is chosen from a continuous uniform (0,1) distribution. An individual's farm and off-farm income opportunities depend on both ability and on other factors.

$$S = b_s + c_s A + (1 - c_s)\epsilon_s$$
$$K = b_k + c_k A + (1 - c_k)\epsilon_k$$

Where $A \sim unif(0, 1)$ and the independent shocks on farm size and off-farm income opportunities depend on $\epsilon_s \sim unif(0, 1)$ and $\epsilon_k \sim unif(0, 1)$. The parameters $b_s \geq 0$ and $b_k \geq 0$ shift the distributions for S and K while the parameters $c_s \in (0, 1)$ and $c_k \in (0, 1)$ give the correlation between A and S and A and K, respectively.

The b_k parameter represents exogenous factors that affect the (ex ante) off-farm income opportunities for all group members. Possible real-world parallels for this parameter include proximity to a city, commercial center, or important trade route. Similarly, b_s represents exogenous factors that affect ex ante farm income opportunities. This may represent the availability and fertility of land in the area, fluctuations in world agricultural prices, etc.

Once the characteristics of each of the individuals in a group have been drawn from the given distributions, we solve the model as described in the previous sections. In order to get some idea of what we can expect from each set of parameter values, we repeat the procedure one hundred times for each set of parameters values and consider the average results.

Our first set of simulation results, in Figure 1, describe how the outcomes are affected by increases in the b_k parameter.[3] The results in the top left figure suggest that larger b_k parameters result in, on average, a manager that delivers a less valuable public good. The top right figure indicates that a reduction in manager effort is the key factor in reducing manager quality. The rank of the manager, which orders each group member by the value of the public good they would deliver as a manager (with 10 being the best), is not strongly affected by increases in off-farm income opportunities. Neither is the average ability of the manager. Thus, a fall in manager effort appears to be the crucial channel relating off-farm income opportunities and manager quality.

[3] These results were calculated with parameters $\alpha = .6$, $\beta = .4$, $b_s = 0$, and $c_k = c_s = .5$. Appendix C shows that similar results are obtained for a variety of other parameter values.

Figure 1: Effects of Off-farm Income Opportunities on the Manager

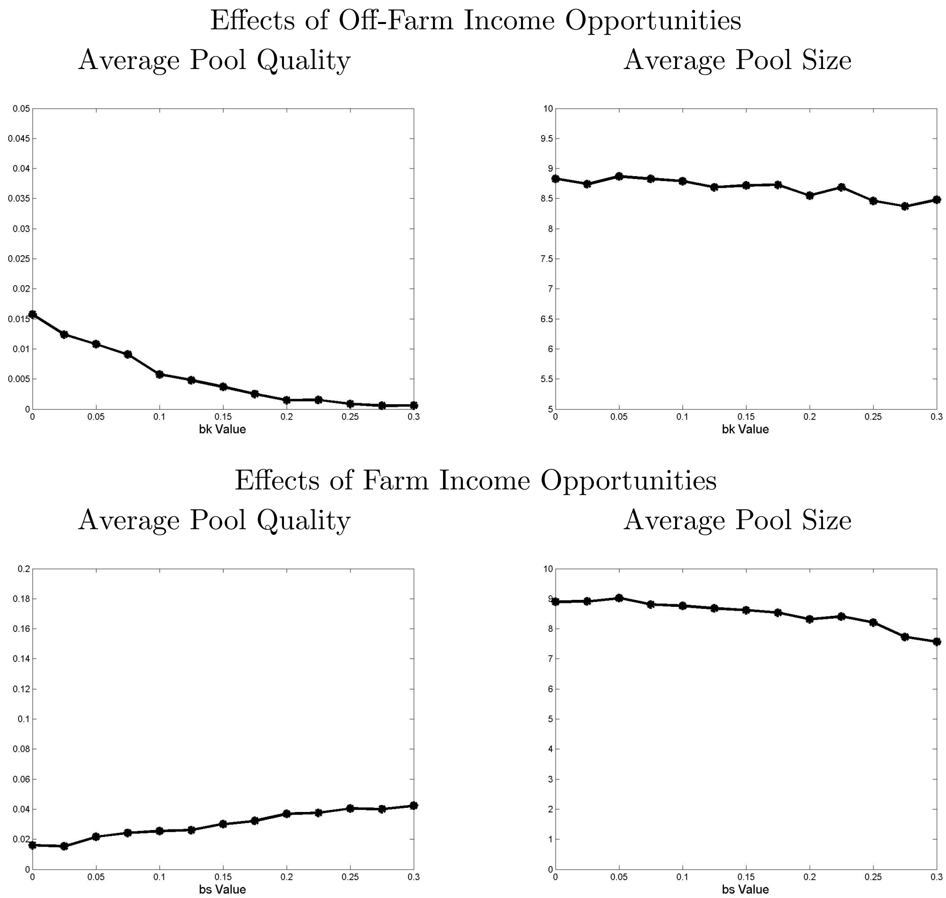
Figure 2: Effects of Farm Income Opportunities on the Manager

The above results contrast sharply with the effects found when the ex ante farm income opportunities are increased, described in Figure 2.[4] We see that increases in farm income opportunities result in an increase in manager quality. Again, this is driven by increases in manager effort. Manager ability is relatively constant with only a slight decline. Interestingly, the rank of the manager falls, suggesting that selection of the candidate pool is becoming even more important. Presumably the better managers are opting out of candidacy because they can benefit from the higher valued public goods produced by individuals with less ability.

A second set of results consider the effect of changes in b_k and b_s on the average quality and size of the candidate pool. The average quality of the candidate pool is found by

[4]These results were calculated with parameters $\alpha = .6$, $\beta = .4$, $b_k = 0$, and $c_k = c_s = .5$. Appendix C shows that similar results are obtained for a variety of other parameter values.

Figure 3: Effects on the Candidate Pool



averaging over the values of the public good that each candidate would produce if they were the manager. As Figure 3 shows, these results largely parallel the manager results. Increases in off-farm income opportunities decrease the average quality of the candidate pool, though there is very little effect on the size of the candidate pool. Increases in on-farm income opportunities increase the quality of the candidate pool but also have little effect on the pool size. These results are important in the event that voters may make a mistake and elect a candidate other than the most qualified.

4 Empirical specifications- WORK IN PROGRESS

Testing this model can be approached either through testing individual or group outcomes. These correspond to the individual results presented in Section 2 and Section 3 respectively. We begin by discussing approaches to testing the individual-level predictions of the model.

4.1 Empirical specifications for individual-level tests

The model has predictions for how an individual's effort and the value of the public good they produce, if they are the manager, are affected by changes in their farm and off-farm income opportunities. However, because only one individual in each group becomes the manager, it is very difficult to test these predictions. It will be more fruitful to consider the model's predictions regarding each individual's probability of candidacy, as described by Propositions 3 and 4. These propositions suggest that an individual's probability of candidacy will be decreasing in their off-farm income. Also, while their probability of candidacy may be increasing or decreasing in their on-farm income, an increase in on-farm income will never decrease their probability of candidacy as much as an increase in off-farm income.

Suppose we begin with the following basic empirical specification, where C_{ij} is an indicator function for whether individual i in group j chooses to become a candidate, K_{ij} is the individual's off-farm income opportunities, S_{ij} is the individual's farm income opportunities, D_j represents group fixed effects, and X_{ij} represents a vector of the individual's other relevant characteristics.

$$C_{ij} = \alpha + \beta_k K_{ij} + \beta_s S_{ij} + X_{ij}\lambda + D_j + \epsilon_{ij} \tag{7}$$

The model makes the following two predictions.

$$\beta_k < 0 \qquad \beta_k < \beta_s$$

Implementing an empirical specification of this type requires overcoming two different but related hurdles. First, we must identify the relevant variables in the data. We can identify an individual's candidacy choice in two ways. The manager must have choses to be a candidate, so that is one sure indicator. We can also derive a second indicator by asking group members whether they considered being a candidate for manager. Other indicators may also be possible. Data on individual's farm and off-farm income streams will be collected as part of our data gathering process. We will also collect individual data on education, experience, etc. These data will be important in addressing omitted variable bias issues.

The classic problem with empirical work of this kind arises from omitted variable bias. If either of our explanatory variables of interest, K_{ij} and S_{ij} are correlated with the error term, then our estimates of β_k and β_s may be biased. Since both of these variables are likely to be correlated with individual ability, this is a very real concern. Three approaches to this problem suggest themselves.

One approach to dealing with the omitted variable bias arising through the positive correlation between both farm and off-farm income and ability is to figure the direction of the bias. We expect that higher ability will make an individual more likely to be a candidate for office. Ability should also be positively correlated with both farm and off-farm income. Thus, the coefficients on both farm and off-farm income should be biased upwards. Under these assumptions, a finding that the estimated coefficient $\tilde{\beta}_k$ is significantly less than zero is sufficient evidence to confirm the first of our two predictions. Furthermore, we expect that the correlation between off-farm income potential and ability should be larger than the correlation for farm income potential because farm income potential is also likely to be affected by exogenous factors such as inheritance. Under this assumption, our estimate of β_k should have a larger upward bias than our estimate of β_s, and $\tilde{\beta}_k < \tilde{\beta}_s$ significant is sufficient evidence that $\beta_k < \beta_s$.

If our first approach is not satisfied, or not sufficiently convincing, a second approach is to attempt to sufficiently control for ability. 'Moving' ability out of the error term by controlling for factors such as education and experience should reduce any omitted variable bias suffered by our coefficient estimates. Considering the direction of the remaining bias, as in the previous approach, can then be applied. This approach differs from the previous one only in that our parameter estimates should be more precise.

If the previous two approaches are not sufficiently convincing, an alternative is to look for instruments for K_{ij} and S_{ij}.

4.2 Empirical specifications for group-level tests

Results from Section 3 can be tested using group-level results for the chosen manager. Our simulations suggest that manager effort is generally decreasing in a group's ex ante off-farm income opportunities, and generally increasing in ex ante farm income opportunities. Similarly, manager quality is decreasing in a group's ex ante off-farm income opportunities, and generally increasing in ex ante farm income opportunities.

Suppose we start with the following empirical specifications, where e_j is the effort of the manager of group j, M_j is the quality of the public good produced by the manager of group j, S_j and K_j represent average farm and off-farm income opportunities in the group, respectively, and X_j contains a vector of other group characteristics that affect manager effort or public good quality.

$$e_j = \alpha + \beta_k K_j + \beta_s S_j + X_j \lambda + \epsilon_{ej} \tag{8}$$

$$M_j = a + b_k K_j + b_s S_j + X_j \gamma + \epsilon_{Mj} \tag{9}$$

The model makes the following predictions.

$$\beta_k < 0 \quad \beta_s > 0$$
$$b_k < 0 \quad b_s > 0$$

We may also want to test a second, weaker set of predictions.

$$\beta_k < \beta_s \qquad b_k < b_s$$

Our group-level tests confront difficulties that are similar to those addressed in the individual-level tests. As before, we must identify variables that can act as proxies for some of our unobserved variables of interest. We collect indicators of manager effort from our manager questionnaire, as well as other indicators of manager effort. The value of the public good can be found by considering the input costs and output sales prices negotiated by managers. On and off-farm income opportunity data come from individual income reports. Importantly, we hope to gather exogenous group-specific data that can be used as instruments for K_j and S_j. These data will likely relate to geographic factors such as proximity of nearest town, commercial center, or road, growing conditions, crop type, etc.

Omitted variable bias will occur in this specification if our variables of interest, K_j and S_j are correlated with the error terms. This may occur if there are other factors that are related to both a group's farm and off-farm income opportunities and the manager's effort of the value of the public good they produce. Such factors may come in a variety of forms.[More]

A Functional Form Derivation and Verification

We assume the following functional forms, where c is a constant that is equal to α^α (for reasons that we will see later).

$$M = cA^{\beta}e^{1-\beta}$$

$$F = S^{\alpha}[(1-e)\gamma]^{1-\alpha}M$$

$$G = K^{\alpha}[(1-e)(1-\gamma)]^{1-\alpha}$$

First, we allow individuals to optimize their allocation of effort between farm and off-farm work.

$$\max_{\gamma} S^{\alpha}[(1-e)\gamma]^{1-\alpha}M + K^{\alpha}[(1-e)(1-\gamma)]^{1-\alpha}$$

The first order condition is:

$$(1-\alpha)S^{\alpha}(1-e)^{1-\alpha}\gamma^{-\alpha}M - (1-\alpha)K^{\alpha}(1-e)^{1-\alpha}(1-\gamma)^{-}\alpha = 0$$

Solving gives,

$$\gamma = \frac{SM^{1/\alpha}}{K + SM^{1/\alpha}}$$

The second order condition confirms that this is indeed an optimal solution.

$$-\alpha(1-\alpha)S^{\alpha}(1-e)^{1-\alpha}\gamma^{-\alpha-1} - \alpha(1-\alpha)K^{\alpha}(1-e)^{1-\alpha}(1-\gamma)^{-\alpha-1} < 0$$

Now our equations for F an G are:

$$F = \frac{S(1-e)^{1-\alpha}M^{1/\alpha}}{(K + SM^{1/\alpha})^{1-\alpha}}$$

$$G = \frac{K(1-e)^{1-\alpha}}{(K + SM^{1/\alpha})^{1-\alpha}}$$

Now we need to confirm that these equations conform to the assumptions we have made. We consider each assumption in the order in which it is introduced in the main text of this paper. To begin, we show that the value of the public good is increasing in an individual's ability and in the amount of effort the manager puts into their job.

$$\frac{\partial M}{\partial A} = c\beta A^{\beta-1}e^{1-\beta} > 0$$

$$\frac{\partial M}{\partial e} = c(1-\beta)A^{\beta}e^{-\beta} > 0$$

Next, we want to show that, holding all else constant, the value of farm income is increasing in farm size, decreasing in effort devoted to management, and increasing in the value of the public good.

$$\frac{\partial F}{\partial S} = \frac{(1-e)^{1-\alpha} M^{1/\alpha}(K + \alpha S M^{1/\alpha})}{(K + SM^{1/\alpha})^{2-\alpha}} \geq 0$$

$$\frac{\partial F}{\partial e} = \frac{-(1-\alpha)S(1-e)^{-\alpha} M^{1/\alpha}}{(K + SM^{1/\alpha})^{1-\alpha}} \leq 0$$

$$\frac{\partial F}{\partial M} = \frac{S(1-e)^{1-\alpha} M^{(1-\alpha)/\alpha}(K + \alpha S M^{1/\alpha})}{(K + SM^{1/\alpha})^{2-\alpha}} \geq 0$$

Similarly, we need to show that, with all else constant, the value of off-farm income is increasing in the opportunities for off-farm work and decreasing in the amount of effort devoted to management.

$$\frac{\partial G}{\partial K} = \frac{(1-e)^{1-\alpha}(\alpha K + SM^{1/\alpha})}{(K + SM^{1/\alpha})^{1-\alpha}} \geq 0$$

$$\frac{\partial G}{\partial e} = \frac{-(1-\alpha)K(1-e)^{-\alpha}}{(K + SM^{1/\alpha})^{1-\alpha}} \leq 0$$

We now show that the marginal public good return to management effort are diminishing, while the marginal returns to farm and off-farm labor are diminishing in the amount of labor not devoted to management effort.

$$\frac{\partial^2 M}{\partial e^2} = -c\beta(1-\beta)A^{\beta} e^{-\beta-1} \leq 0$$

$$\frac{\partial^2 F}{\partial e^2} = \frac{-\alpha(1-\alpha)S(1-e)^{-\alpha-1} M^{1/\alpha}}{(K + SM^{1/\alpha})^{1-\alpha}} \leq 0$$

$$\frac{\partial^2 G}{\partial e^2} = \frac{-\alpha(1-\alpha)K(1-e)^{-\alpha-1}}{(K + SM^{1/\alpha})^{1-\alpha}} \leq 0$$

To satisfy Assumption 1 cross-partial derivative of farm and off-farm income on effort and farm size or off-farm income potential, respectively, are negative.

$$\frac{\partial^2 F}{\partial e \partial S} = \frac{-(1-\alpha)(1-e)^{-\alpha} M^{1/\alpha}(K + \alpha S M^{1/\alpha})}{(K + SM^{1/\alpha})^{2-\alpha}} \leq 0$$

$$\frac{\partial^2 G}{\partial e \partial K} = \frac{-(1-\alpha)(1-e)^{-\alpha}(\alpha K + SM^{1/\alpha})}{(K+SM^{1/\alpha})^{2-\alpha}} \leq 0$$

Assumption 2 requires that the marginal effect of an increase in management effort on on-farm income is smaller than the marginal effect on off-farm income. This is an important assumption and also the most difficult to build into our equations.

We need,

$$\left|\frac{\partial^2 F}{\partial e_i \partial S_i}\right| < \left|\frac{\partial^2 G}{\partial e_i \partial K_i}\right| \quad \text{for any} \quad M_j$$

$$\left|-\frac{(1-\alpha)(1-e)^{-\alpha}M^{1/\alpha}(K+\alpha SM^{1/\alpha})}{(K+SM^{1/\alpha})^{2-\alpha}}\right| < \left|\frac{(1-\alpha)(1-e)^{-\alpha}(\alpha K + SM^{1/\alpha})}{(K+SM^{1/\alpha})^{2-\alpha}}\right|$$

$$M^{1/\alpha}(K+\alpha SM^{1/\alpha}) < \alpha K + SM^{1/\alpha}$$

$$SM^{1/\alpha}(\alpha M^{1/\alpha} - 1) < K(\alpha - M^{1/\alpha})$$

$$\frac{\alpha M^{1/\alpha} - 1}{(\alpha - M^{1/\alpha})} < \frac{K}{SM^{1/\alpha}}$$

Thus, Assumption 2 will always be satisfied when the left hand side is negative. This will occur whenever $M < \alpha^\alpha$. We can ensure that this holds by setting $c = \alpha^\alpha$ and constraining $A \in (0, 1)$.

Assumption 3 requires that the the marginal effect of the public good on farm income is increasing in farm size.

$$\frac{\partial^2 F}{\partial S \partial M} = \frac{(1-e)^{1-\alpha}M^{(1-\alpha)/\alpha}}{\alpha(K+SM^{1/\alpha})^{3-\alpha}}\left(K^2 + (3\alpha-1)KSM^{1/\alpha} + (1-\alpha)S^2M^{2/\alpha} + \alpha^2 S^2 M^{2/\alpha}\right)$$

We can be sure that this assumption will be satisfied whenever $\alpha \geq 1/3$, so we impose this restriction on our parameter set.

Finally, we must show that Assumption 4 is satisfied.

$$\frac{\partial^2 F}{\partial M \partial e} = \frac{-(1-\alpha)S(1-e)^{2-\alpha}M^{(1-\alpha)/\alpha}(K+\alpha SM^{1/\alpha})}{(K+SM^{1/\alpha})^{2-\alpha}}$$

B Proof of Parameter Restrictions for a Unique Optimal Manager Effort Level

If an individual i is the manager, they will choose their effort level by solving the following optimization problem.

$$\max_{e_i} \frac{S(1-e)^{1-\alpha}M^{1/\alpha}}{(K+SM^{1/\alpha})^{1-\alpha}} + \frac{K(1-e)^{1-\alpha}}{(K+SM^{1/\alpha})^{1-\alpha}}$$
$$= \max_{e_i} \frac{(1-e)^{1-\alpha}(K+SM^{1/\alpha})}{(K+SM^{1/\alpha})^{1-\alpha}}$$
$$= \max_{e_i}(1-e)^{1-\alpha}(K+SM^{1/\alpha})^{\alpha}$$

The first order condition is,

$$-(1-\alpha)(1-e)^{-\alpha}(K+S\alpha A^{\beta/\alpha}e^{(1-\beta)/\alpha})^{\alpha}+(1-\beta)(1-e)^{1-\alpha}(K+S\alpha A^{\beta/\alpha}e^{(1-\beta)/\alpha})^{\alpha-1}(S\alpha A^{\beta/\alpha})e^{\frac{1-\alpha-\beta}{\alpha}} = 0$$

The second order condition is,

$$\begin{aligned}
&-\alpha(1-\alpha)(1-e)^{-\alpha-1}(K+S\alpha A^{\beta/\alpha}e^{(1-\beta)/\alpha})^{\alpha} \\
&-(1-\alpha)(1-e)^{-\alpha}(K+S\alpha A^{\beta/\alpha}e^{(1-\beta)/\alpha})^{\alpha-1}S\alpha A^{\alpha/\beta}(1-\beta)e^{\frac{1-\alpha-\beta}{\alpha}} \\
&-(1-\alpha)(1-e)^{-\alpha}(1-\beta)(K+S\alpha A^{\beta/\alpha}e^{(1-\beta)/\alpha})^{\alpha-1}S\alpha A^{\beta/\alpha}e^{\frac{1-\alpha-\beta}{\alpha}} \\
&-(1-\alpha)(1-e)^{1-\alpha}(K+S\alpha A^{\beta/\alpha}e^{(1-\beta)/\alpha})^{\alpha-2}\,(1-\beta)^2\,\alpha(SA^{\beta/\alpha}e^{\frac{1-\alpha-\beta}{\alpha}})^2 \\
&+(1-\alpha-\beta)\,(1-e)^{1-\alpha}(K+S\alpha A^{\beta/\alpha}e^{1-\beta})^{\alpha-1}(1-\beta)SA^{\beta/\alpha}e^{\frac{1-\beta-2\alpha}{\alpha}} \leq 0
\end{aligned}$$

We can be sure that this is satisfied whenever $\alpha+\beta \geq 1$ so that the last term is negative.

C Robustness of Simulation Results

In Section 3 we described simulation results using one set of parameter values ($\alpha = .6$, $\beta = .4$, etc.). In this section we present results for a number of other potential parameter values to show how well our results hold up under these alternatives.

References

Caselli, F., & Morelli, M. 2004. Bad Politicians. *Journal of Public Economics*, **88**(3-4), 759–782.

Messner, M, & Polborn, MK. 2004. Paying politicians. *Journal of Pubic Economics*, **88**(12), 2423–2445.

Figure 4: Effects of Off-Farm Income Opportunities on the Manager

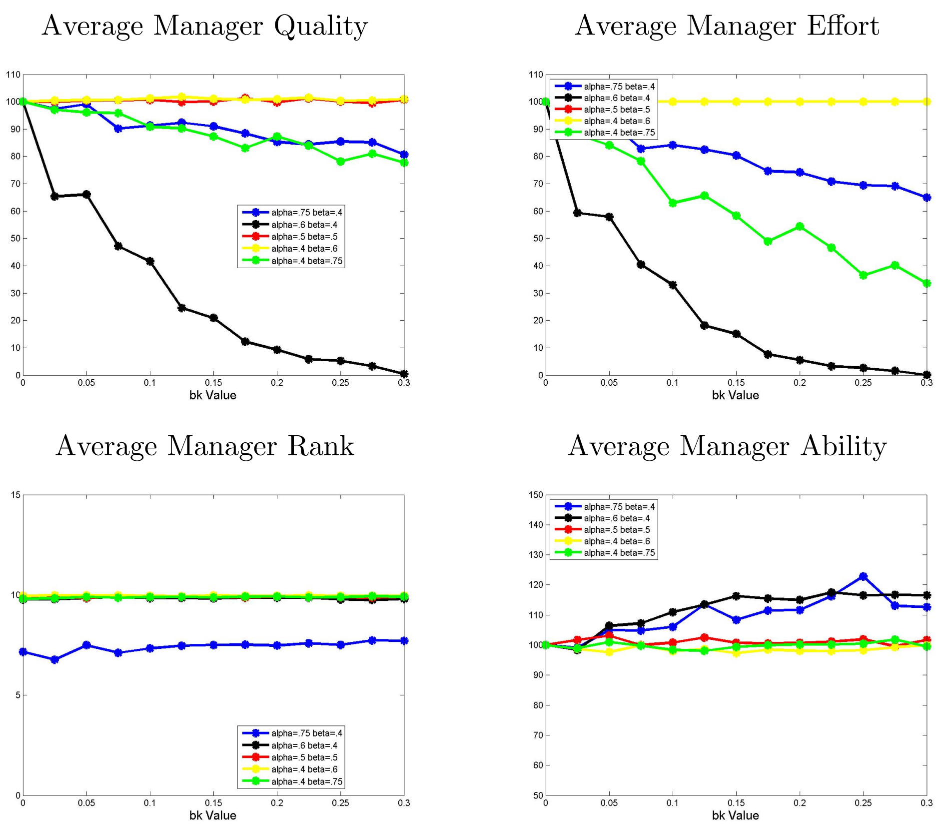
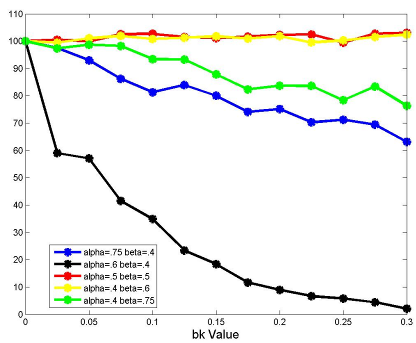


Figure 5: Effects of Farm Income Opportunities on the Manager

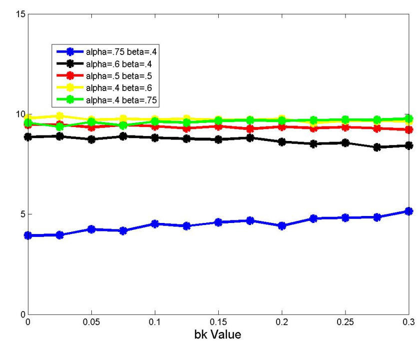
Figure 6: Effects on the Candidate Pool

Effects of Off-Farm Income Opportunities

Average Pool Quality

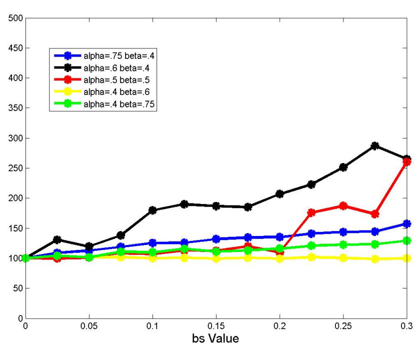


Average Pool Size



Effects of Farm Income Opportunities

Average Pool Quality



Average Pool Size