There is No Place Like Home: Theory and Evidence on Decentralization and Politician Preferences*

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Abstract

We construct a simple model in which politicians can choose to spend resources on themselves, on their home area, or on other geographic areas. The model implies that if politicians are sufficiently inclined to favor their home areas (or are particularly subject to social incentives by those in their home area), decentralization may increase social welfare and reduce corruption relative to unconstrained centralization. Furthermore, if strong home favoritism is accompanied by high levels of corruption, decentralization may also increase social welfare and reduce corruption relative to various alternative constitutional structures that limit politicians ability to direct resources to their home areas, such as delegating authority to civil servants or enforcing equal treatment rules. An incentive-compatible choice experiment in which 179 elected county councilors in rural Kenya chose among alternative water infrastructure projects reveals substantial home favoritism. We estimate that politicians value each person served in their home village more than twice as much as each person served outside their home village. Consistent with the model, politicians are more likely to value controlling the discretionary funding associated with the project when they do not control the location of the project.

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1 Introduction

From the late 1980s onward, decentralization has been a popular area of reform for policymakers interested in improving governance in developing countries. By 1998, over 60 developing and transition countries have implemented reforms that relinquish some combination of political, administrative, and fiscal powers to lower levels of government (Ebel 1998), and the pace of global decentralization reforms continued throughout the early 2000s. Examples of recent decentralization reforms include Indonesia, Ethiopia, and Kenya, which adopted a new constitution in 2010 creating elected county governments and transferring a considerable proportion of spending to county control. Some programs have devolved control of certain government functions to the level of individual villages. These include Panchayat Raj in India, programs in several developing countries in which the central government provides capitation grants to schools (**?**), and a range of community driven development programs.

A theoretical literature models decentralization as involving a tradeoff between better local information and risk of corruption and capture by local elites. (See, for example Bardhan (2002)). This type of model treats national-level politicians as the principals and local bodies as the agents. It implicitly treats the national government as representing the national interest and as not subject to bias or corruption.

In this paper, we seek to shed light on the debate over decentralization using a complementary model, which treats local and central government politicians symmetrically. We consider a citizen-candidate-inspired model (as in Besley and Coate (1997)) in which candidates cannot credibly commit and politicians therefore make policy decisions that reflect their own preferences. There is considerable evidence that the identity of a candidate affects that candidates policy choices (Chattopadhyay and Duflo 2004, Washington 2008). In many situations, including the Kenyan context we examine, ethnic and regional identity are politically salient. In line with these considerations, we assume politicians particularly value the welfare of residents of their home region. We assume further that politicians at all levels derive some utility from their own consumption of resources allocated for public use. They face stochastic penalties for corruption depending on the context, so in some situations they may be likely to be corrupt whereas in others they may not. We also consider the case in which politicians preferences dont place extra weight on home residents, but these residents provide social disincentives against failing to provide resources to the home area. We show that the models key results can be derived from either of these two sets of assumptions.

We compare social welfare and corruption under alternative constitutional structures. Under a centralized structure, one politician is responsible for all public good decisions, while under a decentralized structure, politicians in each of two areas are given funds only for their own area. Our model suggests that a key parameter is the extent of politicians favoritism: how much more do they favor the welfare of those in their home area relative to those outside their home area. The model suggests that if favoritism is small enough, decentralization will reduce welfare relative to centralization by imposing unnecessary constraints on spending. However, under centralization, favoritism causes politicians to favor lower-valued projects in their home area over higher-valued projects elsewhere. Decentralization eliminates this suboptimal targeting of resources, and when favoritism is sufficiently great, provides higher welfare than centralization.

One might imagine other constitutional approaches to reducing harmful effects of favoritism, such as combining a centralized constitution with rules requiring a geographical spread of spending or delegating authority over selection of project sites to disinterested civil servants. However, the model also suggests that politicians will be more likely to be corrupt when they cannot control the location of spending, so corruption may prevent these approaches from serving as an effective substitute for decentralization.

To assess the extent of favoritism and test the hypothesis that politicians are more likely to be corrupt when they cannot control project location, we conduct an incentive-compatible discrete choice experiment with 179 elected county councilors in rural Kenya.

We partnered with an organization installing a low-cost water treatment technology (dispensers for water treatment solution) at shared water sources. Politicians who participated in the study were entered into a public lottery through which 40 county council wards were chosen to receive a free dispenser and two years of free water treatment solution. In order to be entered into the lottery, councilors completed a discrete choice experiment in which they made choices about the types of dispenser packages that they would like to receive for the electoral wards they represented.

First, each councilor made a series of choices between pairs of dispenser packages that varied in terms of who would choose where to install the dispenser (the councilor himself, the non-profit organization installing the dispensers, or a centrally-appointed health official) and who would manage the funds allocated to cover the cost of refilling the dispenser with water treatment solution (the councilor or the non-profit installing the dispensers). Second, councilors chose which water sources in their ward should receive a dispenser if the ward was chosen to receive one and the councilor chose the locations. [1] Because there was a positive probability that any of their choices would be implemented, councilors had an incentive to make decisions that were consistent with their preferences regarding the implementation of public goods projects in their ward.[2]

We find that when local officials have control over geographic targeting, they tend to both choose sites that will yield greater welfare - e.g. by choosing areas with more potential users and with dirtier water - and sites in their home area. Councilors show strong favoritism, preferring project sites within their village over external sites with approximately four times as many users. This implies that welfare gains from additional decentralization could be substantial.

Consistent with the model, we also find that councilors are more likely to seek control over discretionary funding when they cannot engage in geographic targeting. The model results imply that, when home favoritism is great enough, decentralization will decrease corruption relative to either unconstrained centralization or systems that seek to constrain the decisions of central politicians so as to limit the adverse effects of home bias. ,,,, This paper is related to several strands of the existing literature.

1) A number of papers find favoritism in the provision of public goods, including Barkan and Chege (1989) Burgess, Jedwab, Miguel, Morjaria, and Miquel (2015), and Harris and Posner (2015), see also (cf. Besley, Pande, Rahman, and Rao 2004, Cleary 2007, Arvate 2013, Díaz-Cayeros, Magaloni, and Ruiz-Euler 2014). This study goes further in estimating the welfare loss that politicians are willing to accept to target local public goods to their home area. 2) A number of recent studies have examined politicians' decisions directly using laboratory-style experiments (cf. Bech 2003, Barr,

[1]Throughout the paper, we use male pronouns to describe county councilors and other Kenyan government officials; this decision reflects the incredibly low percentage of women holding public office in Kenya. 93 percent of the county councilors in our sample are male.

[2]See Camerer (1995) for discussion of the role of incentives in choice experiments.

Lindelow, and Serneels 2009, Alatas, Cameron, Chaudhuri, Erkal, and Gangadharan 2009, Butler and Broockman 2011, Spada and de Sá Guimarães 2013, Butler and Kousser 2015), but these have been focused on decisions likely to have minimal direct impact on constituents (for example, choices in a public goods game in the lab). These studies provide direct evidence on elected officials' decision processes, but not on their valuation of the attributes of local public goods. To our knowledge, this paper is the first to report the results of a choice experiment in which sitting politicians make decisions that are linked to actual public goods allocations in their constituencies. 3) This paper is related to other work on decentralization, including (Keefer and Khemani 2009, Golden and Min 2013, Kramon and Posner 2013). 4) We also contribute to the literature on corruption and whether it causes inefficient choice of projects (Bicchieri and Duffy 1997, Lambsdorff 2002, Shi and Svensson 2003, Kunicová and Rose-Ackerman 2005, Hernandez-Trillo and Jarillo-Rabling 2008). 5) Our results contribute to the literature on whether politicians target public goods to core supporters or swing voters Cox and McCubbins (1986), Lindbeck and Weibull (1987), and Dixit and Londregan (1996). 6) Relatedly, our findings also provide a potential explanation for the widespread finding of strong ethnic/regional voting in many contexts (Wantchekon 2003): in a citizen-candidate model, citizens might rationally vote for candidates from their identity group or home area if they expect some candidates to favor them over other members of other groups or residents of other areas.

The paper proceeds as follows. Section Two presents background on Kenyan politics and the adoption of a new decentralized constitution. Section Three presents a model of how the effects of different constitutional provisions regarding centralization and decentralization depend on the extent of home favoritism and the scope for corruption. Section Four discusses our experimental design. Section Five quantifies the extent of favoritism and presents evidence on the models prediction that councilors will be more inclined to seek control over funding when they cannot control project location. Section Six concludes.

2 Background on Kenyan Politics

In the pre-colonial period, the territory of present-day Kenya was populated by many different ethnic groups. Within these large scale groupings, there are many more sub-ethnic groupings, for example at the level of the subtribe, clan, and village. During the onset of colonial rule by the British, authorities set administrative boundaries based in part on perceived ethnicity, which influenced the location of province, district, location, sub-location, and village boundaries (Berman and Lonsdale 1992).

The run up to independence saw a vigorous debate over the Kenyan constitution (Anderson, 2005). A unitary structure was supported by the Kenya African National Union (KANU), which was led by Jomo Kenyatta and had strong support from the Kikuyu (the country's largest group, comprising approximately 20 percent of the population, concentrated in the Central region of the country) as well as the Luo (the second largest group, concentrated near Lake Victoria), and other groups. In contrast, a federal structure was favored by the Kenya Africa Democratic Union (KADU), which was led by Daniel arap Moi and enjoyed strong support from the Kalenjin communities in the Rift Valley (Anderson 2005).

KANU prevailed in this struggle, with Kenyatta becoming Kenyas first president. Throughout the 1960s, KADU was gradually marginalized, culminating in the creation of a one party state (Mueller 1984; Hornsby 2012). A highly centralized constitution was adopted, with no elected body at the provincial or district level, and only a very limited role for elected local government at the level of County Councils (Branch and Cheeseman 2006). Throughout the duration of KANU rule, County Councilors (the elected representatives in County Councils) controlled very little funding, exercised very little policymaking authority, and were widely considered to be highly corrupt and ineffective (Bienen 1974; Wood and Southall 1996).

Despite the adoption of a single-party state, there were typically attempts to maintain multi-ethnic coalitions under KANU rule (Widner 1991). Thus, for example, Moi became Vice President under Kenyatta, and politicians from a broad cross-section of regions and ethnic groups were typically put in charge of different Ministries and allowed the opportunity to channel resources toward their home areas, to distribute patronage to their supporters, and to extract resources for personal and political needs (Barkan and Chege 1989; Hornsby 2012; Burgess, Jedwab, and Miguel 2015; Harris and Posner 2015).

There was also considerable political competition within the party. With no political space to challenge the President or debate ideology, candidates competed in large part on the ability to deliver local public goods. Ministers were in a position to deliver these goods using national resources.

With the death of Kenyatta in 1978, power passed to Moi, who maintained, deepened, and formalized KANU's single party rule throughout the 1980s (Mueller 1984; Widner 1991). There was also considerable political competition within the party. With no political space to challenge the President or debate ideology, candidates competed in large part on the ability to deliver local public goods. Ministers were in a position to deliver these goods using national resources. A key component of distributive politics during KANU's single party rule was the Harambee system (Hornsby 2012). Under the Harambee system, residents of a local area contributed to the establishment of local public goods, such as schools. Local elites, including politicians, were expected to contribute generously and to lead these efforts. Political candidates competed in part based on the magnitude of their contributions. Contributions were often much greater than could be expected based on politicians salaries. Firms doing business with a particular Ministry could expect to receive requests to contribute to harambees in the Ministers constituency (Widner 1991).

The end of the cold war led to international pressure for multiparty elections and term limits on the presidency in 1992 (Throup and Hornsby 1998). Moi won the 1992 and 1997 elections (which were both marred by ethnic violence and allegations of rigging), but stepped down, in observance of term limits in 2002. In the 2002 election, the opposition candidate Mwai Kibaki (a Kikuyu) was elected over the KANU candidate, Uhuru Kenyatta (the son of the country's first president and a fellow Kikuyu). The 2007 election pitted Kibaki versus Raila Odinga (a Luo from Nyanza province). Although Kibaki was declared to be the winner of the election, Odinga contested the legitimacy of the result, leading to severe post-election violence that ended only with a power-sharing agreement (Mueller 2011).

As part of this power-sharing agreement, Kenya's major political actors agreed to draft a new constitution. This new constitution, which was passed by a referendum in 2010 and rolled out over the subsequent three years in the run-up to Kenya's 2013 election was designed to avoid the winner-take-all politics that led to violence in 2007 (Kramon and Posner 2011). As part of this aim, the constitution formally reintroduces decentralization in Kenya by devolving substantial authority and funds to 47 counties, which have elected governors and county assemblies. Under this system, Members of County Assemblies (MCAs) replaced County Councilors as the elected local representatives. Each MCA represents a ward, a local area comprising multiple villages and several thousand registered voters. Work on a new constitution was resumed as part of the settlement following the disputed 2007 election, and the severe post-election violence that threatened the country with civil war. The new constitution, designed to avoid winner-take-all politics, devolves substantial authority to 47 counties, which have elected governors and county assemblies, and which are supposed to receive a share of funding.

3 Model

In this model, we examine the behavior of politicians with respect to providing public goods under various governmental structures. Politicians are provided limited funds to complete a project at some subset of available project sites. Politicians may choose to divert funds to their own consumption, and may display favoritism toward providing projects in their home area. We consider welfare and corruption outcomes under each element in a space of possible government structures.

3.1 Assumptions

Consider a region with two areas, area i and area j. In each of these areas, there are two sites at which projects providing a public good can be completed. The value that residents of an area would derive from a project completed at a given site varies randomly from site to site. The quality of site nk (the nth site in area k) is represented by the random variable y_{nk}, where y's are independent and identically distributed, drawn from a distribution with continuous probability density function f. The support of each y is the interval $(0, \overline{y})$ for some $\overline{y} > 0$.

Politicians are given funds out of a total budget equivalent to the cost of two projects, and decide where and if to use these funds to complete projects. For each project's worth of funding, the politicians may choose either to complete a project at a site in their jurisdiction or to divert the whole project's funds to themselves. The politicians incur some stochastic cost $1 - \gamma$ for diverting the funds to themselves, so that for every unit of funds that politicians divert from a project, they receive γ units of funds. We can think of $1-\gamma$ as representing the political penalty for corruption or some degree of inefficiency in diverting the funds. We assume γ is drawn from a distribution with continuous probability density function g, and has support $(\underline{\gamma}, \overline{\gamma})$, with $\underline{\gamma} \leq 0$.

We primarily consider a model focused on preferences, in which politicians derive greater utility from welfare provided to residents of their home area than from welfare provided to residents of other areas. In particular, it is assumed that the politicians' objective functions put some weight on their own consumption, some weight on the welfare of residents of their home area, and some (lesser or equal) weight on the welfare of residents of other areas. Their own consumption and the welfare of residents of their home area are given a weight of one and the welfare of residents of other areas are weighted by $0 < \alpha \leq 1$. [3] We later show that a model focused on constraints, in which politicians are punished by those in their home area for failing to provide projects, yields almost identical results. In that model, it is assumed that politicians derive equal utility from projects of equal quality in either area, but incur some cost $c \geq 0$ for every projects worth of funds that they fail to provide in their home area. Politicians are either from area i (in which case i is their home area and j is their non-home area), area j (in which case j is their home area and i is their non-home area), or an area outside the given region (in which case both i and j are non-home areas).

3.2 Definitions

Each politician's utility U is given by

$$U = \gamma \mathbf{C} + \sum_{n=0}^{m} y_{nD} \mathbf{Q_{nD}} + \alpha \sum_{n=0}^{4-m} y_{nF} \mathbf{Q_{nF}}, \tag{1}$$

where y_{nD} is the value of a project at the nth site in the politician's home area (0D indexes no project site), y_{nF} the value of a project at the nth site in the politician's non-home area (0F indexes no project site), and both are independent random variables drawn from a distribution with PDF f as described above. $\mathbf{Q_{nD}}$, $\mathbf{Q_{nF}} \in \{0, 1\}$ indicate whether the politician has chosen to allocate

[3] This weighting of preferences need not necessarily imply that one unit of the politicians' own consumption provides utility equal to that of one unit of their home residents' welfare. We could think of politicians weighting their own consumption above that of home-area welfare, but having a distribution of gamma that is normalized to account for this

funds to complete a project in the corresponding location. $\mathbf{C} \in \{0,1,2\}$, indicates whether the politician has chosen to divert no project funds to himself, to divert one project's worth of funds, or to divert two project's worth of funds. As stated above, α represents the weight politicians put on residents of their non-home area. All y variables and γ are independent from each other, independent of constitutional structure, determined after the constitution is set but before politicians choose where to allocate resources, and known to politicians at the time of their decisions.

We define total social welfare ω to be the total value that residents of both areas receive from completed projects, so

$$\omega = (y_{1i}\mathbf{Q_{1i}} + y_{2i}\mathbf{Q_{2i}}) + (y_{1j}\mathbf{Q_{1j}} + y_{2j}\mathbf{Q_{2j}}), \tag{2}$$

where y_{1i} is the value of a project at the first site in area i, y_{2i} the value of a project at the second site in area i, and both are random variables drawn from a distribution with PDF f as described above. y_{1j} and y_{2j} are analogous variables (drawn from the same distribution) representing the value of projects at the first and second site in area j, respectively. $\mathbf{Q_{1i}}$, $\mathbf{Q_{2i}}$, $\mathbf{Q_{1j}}, \mathbf{Q_{2j}} \in \{0,1\}$, indicate whether a politician has chosen to allocate funds in the corresponding location. y_{1i}, y_{1j}, y_{2i}, and y_{2j}, are independent from each other and from γ.

We also define total corruption $\mathbb{C}$ by

$$\mathbb{C} = \sum_n \mathbf{C_n} \tag{3}$$

where $\mathbf{C_n}$ is the amount of funds diverted by politician n to him- or herself.

3.3 Constitutional Structures

We define a constitution as a set of rules which determine the following.

1. **Project Areas:** A constitution divides the four project sites into a partition of one, two, three, or four subsets. We will call these subsets "project areas."

2. **Decision makers:** A constitution assigns a decision maker to each project area. In the model, decision makers are defined by the home area with which they identify. Decision makes can either be politicians, for whom a subset of the project sites are in their home area, or civil servants, for whom all project sites are outside of their home area. Since we assume that the four project sites are divided evenly between two identity areas, this implies that there are three possible decision maker types: politician from area i, area j, or civil servant from neither area.

3. **Budget and Spending Rules:** A constitution divides the two projects' worth of funds among project areas. It may also specify a spending rule. Spending rules subdivide project areas into subareas and dictate minimum, maximum, or exact fund amounts to be spent in each subarea. We assume that spending rules cannot be conditional upon realized site qualities. That is, a constitution cannot mandate, for example, that politicians complete projects at the highest-quality available sites. Note also that spending rules cannot enforce that funds are not diverted from projects to corruption once project areas are determined.[4] Mandating exact spending in a subarea is equivalent to making that subarea its own independent project area, and thus the only meaningful spending rules are minimum and maximum spending requirements. Furthermore, minimum or maximum spending rules of zero or two units of funds are either trivial or equivalent to mandating exact spending, and thus we need only consider one-unit minimum and maximum spending requirements.

We will first lay out each element in the space of constitutions before presenting results on the welfare and corruption implications of each of these structures. [5]

[4]A model in which project funds are assigned to sites even when they are ultimately diverted to the politician's personal consumption corresponds with our empirical context. In this case, politicians determine where chlorine dispensers are placed, but may choose to keep chlorine refill funds for themselves, rendering the dispensers useless.

[5]Work on some remaining constitutions is in process, so this draft copy does not yet include results for the entire space of possible constitutions, but we do not think that this will materially affect the results. Most alternatives are trivially dominated by those considered here, and have comparative statics broadly similar to those which we outline below.

Decentralization to Identity Areas

Under decentralization to identity areas, two politicians, i and j, from areas i and j respectively, each control enough funds to complete one project. Politicians are responsible for only their home area, and thus will never allocate funds to their non-home area. We thus have that each politician's utility U is given by

$$U = \gamma \mathbf{C} + (\mathbf{Q_{1D}} y_{1D} + \mathbf{Q_{2D}} y_{2D}). \tag{4}$$

As the politicians only have enough funds to each complete one project, they face the budget constraint

$$1 = \mathbf{C} + \mathbf{Q_{1D}} + \mathbf{Q_{2D}}. \tag{5}$$

$\mathbf{Q_{1D}}$, $\mathbf{Q_{2D}}, y_{1D}, y_{2D}$, and γ are identical to the corresponding variables in the general case. $\mathbf{C} \in \{0, 1\}$ indicates whether the politician chooses to complete a project or divert the funds to himself.

Unconstrained Centralized Constitution

Under an unconstrained centralized constitution, a single politician has enough funds to complete two projects total, which can be completed at any of the two project sites in his home area and two project sites in his non-home area. He may choose to complete 2 of the four available projects, or complete one project and divert half of the funds to himself, or divert all of the funds. The politicians utility is given by

$$U = \gamma \mathbf{C} + (y_{1D} \mathbf{Q_{1D}} + y_{2D} \mathbf{Q_{2D}}) + \alpha (y_{1F} \mathbf{Q_{1F}} + y_{2F} \mathbf{Q_{2F}}). \tag{6}$$

The politician faces the budget constraint

$$2 = \mathbf{C} + \mathbf{Q_{1D}} + \mathbf{Q_{2D}} + \mathbf{Q_{1F}} + \mathbf{Q_{2F}}. \tag{7}$$

All variables are identical to the corresponding variables in the general case.

Constrained Centralization

Decentralization is one of a number of approaches to combatting tendencies for politicians in centralized states to inappropriately concentrate spending in their home area. We will consider three additional approaches: a centralized structure with a constitutional equal treatment clause (maximum spending clause), a centralized structure with a minimum spending clause, and a civil servant model of centralization. As we will demonstrate, both of these approaches perform well in the absence of corruption, but can lead to lower welfare and higher corruption than decentralization when corruption is present.

Centralization with Equal Treatment Clause

We consider a centralized structure with an equal treatment clause, in which a politician can complete at most one project in each area.

Under such a constitutional structure, the politician maximizes

$$\gamma \mathbf{C_D} + (\mathbf{Q_{1D}} y_{1D} + \mathbf{Q_{2D}} y_{2D}). \tag{8}$$

and

$$\gamma \mathbf{C_F} + \alpha \left(\mathbf{Q_{1F}} y_{1F} + \mathbf{Q_{2F}} y_{2F} \right) \tag{9}$$

subject to budget constraints

$$1 = \mathbf{C_D} + \mathbf{Q_{1D}} + \mathbf{Q_{2D}}. \tag{10}$$

and

$$1 = \mathbf{C_F} + \mathbf{Q_{1F}} + \mathbf{Q_{2F}}. \tag{11}$$

Minimum Spending Clause

Consider a centralized constitution with a minimum spending clause, in which a politician is provided two projects worth of funds to allocate among all four sites, but is required to allocate at least one unit of funds to a site outside of his home area. The second project could then be allocated in either area. In this structure, the politician maximizes

$$\gamma \mathbf{C} + \mathbf{Q_{1D}} y_{1D} + \mathbf{Q_{2D}} y_{2D} + \alpha \left(\mathbf{Q_{1F}} y_{1F} + \mathbf{Q_{2F}} y_{2F} \right) \tag{12}$$

subject to

$$2 = \mathbf{C} + \mathbf{Q_{1D}} + \mathbf{Q_{2D}} + \mathbf{Q_{1F}} + \mathbf{Q_{2F}} \tag{13}$$

and

$$1 \leq \mathbf{C} + \mathbf{Q_{1F}} + \mathbf{Q_{2F}}. \tag{14}$$

Civil Servant Model

So far we have been considering constitutional structures in which decision makers either make decisions for their home area (decentralization) or for their home area and for other areas (centralization). However, there is another logical possibility. One could imagine a system in which decision makers do not have authority over their home area but only over areas that are not their homes. While this may sound far-fetched, it is actually not far away from something that is an important part of overall governance. We will call this the civil servant model.

In this arrangement, decisions about where to site new schools in a district, for example, would be made by a district educational officer who is a career civil servant. In many countries civil servants are assigned to areas away from their home and are frequently rotated because of concerns that they might be subject to conflict of interest. In Kenya prior to the adoption of the new constitution, civil servants at the District Officer level and above were not permitted to serve in their home area, and had their locations rotated periodically. In the contemporary US, city managers are often hired from outside of the city for which they work. There also instances of civil servants hired internationally, for example, Canadian Bank of England Governor Mark Carney.

Under a civil servant model, the civil servant maximizes

$$U = \gamma \mathbf{C} + \alpha \left(y_{1i} \mathbf{Q_{1i}} + y_{2i} \mathbf{Q_{2i}} + y_{1j} \mathbf{Q_{1j}} + y_{2j} \mathbf{Q_{2j}} \right) \tag{15}$$

subject to

$$2 = \mathbf{C} + \mathbf{Q_{1i}} + \mathbf{Q_{2i}} + \mathbf{Q_{1j}} + \mathbf{Q_{2j}}. \tag{16}$$

Decentralization Across Identity Units

So far we have assumed the geography of political units followed that of identity groups, but the model suggests that to the extent that there are preexisting identity groups and people disproportionately value welfare of others within these identity groups, it will be efficient to structure decentralized units so as to group people according to the boundaries of these identity groups. In particular, decentralized constitutions in which project sites are partitioned such that two sites are assigned to the same project area if and only if they both fall within the boundaries of the same identity group outperform other decentralized constitutions.[6] To see this, we consider a region with four sites, one each in the Northeast, Northwest, Southeast, and Southwest. Residents of the region identify with either the West or the East. We assume that politician W is from the West, and politician E is from the east. We note that our initial consideration of decentralization corresponds to a division in which politician W is responsible for both projects in the West and politician E is responsible for both projects in the East.

Decentralization across identity units is a constitutional structure in which each politician is given one unit of funds to allocate between one site in their home area and one site outside of their home area. For example, imagine politician W is responsible for regions in the South, and politician E is responsible for projects in the North. Politician E thus maximizes

$$U_E = \gamma \mathbf{C} + \mathbf{Q_{NE}} y_{NE} + \alpha(\mathbf{Q_{NW}} y_{NW})$$

subject to

$$1 = \mathbf{C} + \mathbf{Q_{NE}} + \mathbf{Q_{NW}}.$$

[6]Because the model is static, we implicitly assume that identity is static. However, identity might change over time, and drawing boundaries to coincide with identity groups might reinforce existing identities. This draft considers only decentralized constitutions in which sites are partitioned into four groups of one or two groups of two, but we conjecture that this principle generalizes to other decentralized partitions of four project sites.

And politician W maximizes

$$U_W = \gamma \mathbf{C} + \mathbf{Q_{SW}} y_{SW} + \alpha(\mathbf{Q_{SE}} y_{SE})$$

subject to

$$1 = \mathbf{C} + \mathbf{Q_{SW}} + \mathbf{Q_{SE}}.$$

Decentralization Within Identity Units

Consider a constitutional structure in which each site is its own project area, and four politicians are each assigned to a site in their home area. Within the geographical framework described above, this would correspond to two West politicians being responsible for the NW and SW sites respectively, and two East politicians being responsible for the NE and SE sites respectively. To keep the total budget to two, we assume that funds are distributed randomly, with each politician having a $\frac{1}{2}$ probability of receiving one unit of funds and a $\frac{1}{2}$ probability of receiving no funds. If we assumed each politician were given one unit of funds, all welfare and corruption outcomes under this constitution would be exactly double what they are below. Under this constitution, each politician maximizes

$$U = \gamma \mathbf{C} + \mathbf{Q_{1D}} y_{1D} \tag{17}$$

Subject to

$$I = \mathbf{C} + \mathbf{Q_{1D}}, \tag{18}$$

where I is a random variable equal to one with probability $\frac{1}{2}$ and zero otherwise.

3.4 Results

Decentralization to Identity Areas and Unconstrained Centralization

Moving from decentralization to identity areas to unconstrained centralization has two effects. Centralizing broadens the politicians choice set, thus increasing expected welfare, but in the presence of home bias it may lower expected social welfare by allowing the central authority to select the second-best home project over the best non-home project, even when the second-best home project provides less welfare. For α large, the first effect dominates, while for α small the second effect dominates. Thus, as we demonstrate below, decentralization provides higher expected welfare than centralization when home favoritism is sufficiently high, and lower expected welfare when home favoritism is sufficiently low.

A similar result holds for expected total corruption. The broader choice-set effect of centralization decreases expected total corruption (when faced with more choices, the politician is more likely to find projects that he prefers to corruption). The home bias effect increases expected total corruption (non-home projects are less likely to be preferred to corruption than home projects are). Thus when home-favoritism is high, expected total corruption is higher under centralization than under decentralization, and when home-favoritism is low, expected total corruption is lower under centralization than under decentralization.

To prove this, we first calculate expected welfare and expected corruption under both constitutional structures, and use this calculation to prove several necessary lemmas. Appendix A includes the derivations of the expressions for these values given below.

Under decentralization to identity areas, expected welfare and corruption are given by

$$E(\omega_{decentralized}) = 4\int_0^{\overline{y}} xG(x)F(x)f(x)dx$$
$$\mathrm{E}\left(\mathbb{C}_{decentralized}\right) = 2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)^2 g(x)dx.$$

Under unconstrained centralization we have

$$
\begin{aligned}
E(\omega_{centralized}) = {} & 2\int_0^{\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right)^2 f(x)dx \\
& + 4\int_0^{\overline{y}} xG(x)F(x)F\left(\frac{x}{\alpha}\right) f(x)dx - 4\int_0^{\overline{y}} xG(x)F(x)F\left(\frac{x}{\alpha}\right)^2 f(x)dx \\
& + 2\int_0^{\overline{y}} xG(\alpha x)F(\alpha x)^2 f(x)dx \\
& + 4\int_0^{\overline{y}} xG(\alpha x)F(x)F(\alpha x)f(x)dx - 4\int_0^{\overline{y}} xG(\alpha x)F(x)F(\alpha x)^2 f(x)dx \\
\mathrm{E}\left(\mathbb{C}_{decentralized}\right) = {} & 2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)F\left(\frac{x}{\alpha}\right)\left[F\left(\frac{x}{\alpha}\right) + F(x) - F\left(\frac{x}{\alpha}\right)F(x)\right] g(x)dx.
\end{aligned}
$$

Note that when $\overline{\gamma} \leq 0$, total expected corruption is zero under all constitutions. We assume for the lemmas that follow that $\overline{\gamma} > 0$.

Lemma 1.1. *If $\alpha = 1$, then expected welfare is higher and expected total corruption is lower under a centralized structure than under a decentralized structure.*

Proof: see appendix. When $\alpha = 1$, there is no home-favoritism effect, so the broader choice set effect leads to higher-quality projects, which lead to higher expected welfare and lower expected corruption.

Lemma 1.2. *If $\alpha = 0$, then expected welfare is higher and expected total corruption is lower under a decentralized structure than under a centralized structure.*

Proof: see appendix. When $\alpha = 0$, the politician's choice set is effectively the same under unconstrained centralization as under decentralization: he will only build projects in his home area. But under unconstrained centralization the politician must complete two projects (or divert funds). Thus the politician must assign funds to both the best and second best options in his home area, whereas in decentralization, each politician assigns funds to the best option in his home area.

Lemma 1.3. *Expected welfare under centralization is strictly increasing, and expected total corruption strictly decreasing, in α for $0 < \alpha < 1$. Expected welfare and corruption under decentralization are unaffected by α.*

Proof: see appendix. As α increases, the home-favoritism effect becomes weaker. Home favoritism affects centralization, but does not affect decentralization.

Lemma 1.4. *Expected welfare under centralization is continuous in* α *on the interval* $[0, 1]$.

Proof: see appendix.

Proposition 1. *There exists some* $\alpha^* \in (0, 1)$ *such that for* $\alpha > \alpha^*$, *expected welfare is higher under an unconstrained centralized constitution than under a basic decentralized constitution, for* $\alpha < \alpha^*$ *expected welfare is higher under a decentralization than under centralization, and for* $\alpha = \alpha^*$ *expected welfare is identical under both constitutions.*

When $\overline{\gamma} > 0$, *there exists some* $\hat{\alpha} \in (0, 1)$ *such that for* $\alpha > \hat{\alpha}$, *expected total corruption is lower under centralization than under decentralization, for* $\alpha < \hat{\alpha}$, *expected total corruption is lower under decentralization than under centralization, and for* $\alpha = \hat{\alpha}$, *expected total corruption is identical under both constitutions. If* $\overline{\gamma} \leq 0$, *expected total corruption is 0 under all constitutional structures and for any value of* α.

Proof. By lemma 1.1, when $\alpha = 1$,

$$E(\omega_{centralized}) - E(\omega_{decentralized}) > 0.$$

By lemma 1.2, when $\alpha = 0$,

$$E(\omega_{centralized}) - E(\omega_{decentralized}) < 0.$$

By lemma 4 and the intermediate value theorem, there is then some $\alpha^* \in (0, 1)$ for which

$$E(\omega_{centralized}) - E(\omega_{decentralized}) = 0,$$

and thus expected welfare is equal under both structures. By lemma 3 and the fact that $\frac{d}{d\alpha}E(\omega_{decentralized}) = 0$,

$$\frac{d}{d\alpha}\big(E(\omega_{centralized}) - E(\omega_{decentralized})\big) > 0$$

for $\alpha \in (0, 1)$. Thus by the mean value theorem, $E(\omega_{centralized}) - E(\omega_{decentralized})$ is positive for $1 \geq \alpha > \alpha^*$ and negative for $0 \leq \alpha < \alpha^*$.

That $\overline{\gamma} \leq 0$ implies that expected total corruption is 0 follows directly from the fact that payoffs from all projects are almost always positive. Assume for the rest of the proof that $\overline{\gamma} > 0$.

By lemma 1.1, when $\alpha = 1$,

$$E(\mathbb{C}_{centralized}) - E(\mathbb{C}_{decentralized}) < 0.$$

By lemma 1.2, when $\alpha = 0$,

$$E(\mathbb{C}_{centralized}) - E(\mathbb{C}_{decentralized}) > 0.$$

By lemma 1.4 and the intermediate value theorem, there is then some $\hat{\alpha} \in (0, 1)$ for which

$$E(\mathbb{C}_{centralized}) - E(\mathbb{C}_{decentralized}) = 0,$$

and thus expected total corruption is equal under both structures. By lemma 1.3 and the fact that $\frac{d}{d\alpha}E(\omega_{decentralized}) = 0$,

$$\frac{d}{d\alpha}\big(E(\mathbb{C}_{centralized}) - E(\mathbb{C}_{decentralized})\big) < 0$$

for $\alpha \in (0, 1)$. Thus by the mean value theorem, $E(\mathbb{C}_{centralized}) - E(\mathbb{C}_{decentralized})$ is negative for $1 \geq \alpha > \hat{\alpha}$ and positive for $0 \leq \alpha < \hat{\alpha}$. □

Equal Treatment Clause

Under an equal treatment clause,

$$E(\omega) = 2\int_0^{\overline{y}} xG(x)F(x)f(x)dx + 2\int_0^{\overline{y}} xG(\alpha x)F(x)f(x)dx \tag{19}$$

$$E(\mathbb{C}) = \int_{\underline{\gamma}}^{\overline{\gamma}} F(x)^2 g(x)dx + \int_{\underline{\gamma}}^{\overline{\gamma}} F\left(\frac{x}{\alpha}\right)^2 g(x)dx. \tag{20}$$

Proposition 2. *In the absence of corruption ($\overline{\gamma} \leq 0$), a centralized constitution with an equal treatment clause is equivalent to a basic decentralized constitution.*

Proof. Suppose $\overline{\gamma} \leq 0$, then for all $x \in [0, \overline{y}]$, $G(x) = G(\alpha x) = 1$. So

$$E(\omega) = 4\int_0^{\overline{y}} xF(x)f(x)dx \tag{21}$$

under both decentralization and centralization with an equal treatment clause. Furthermore, for $x > \overline{\gamma}$, $F(x) = F\left(\frac{x}{\alpha}\right) = 0$. Thus expected total corruption is zero under both decentralizaton and centralization with an equal treatment clause. □

Proposition 3. *When corruption and favoritism are present ($\overline{\gamma} > 0$ and $\alpha < 1$) a centralized constitution with an equal treatment clause generates lower expected social welfare and greater* *expected total corruption than a basic decentralized constitution.*

Proof. We claim

$$\int_0^{\overline{y}} xG(\alpha x)F(x)f(x)dx < \int_0^{\overline{y}} xG(x)F(x)f(x)dx. \tag{22}$$

To see this, note that $G(\alpha x) < G(x)$ for $0 < x < \frac{\overline{\gamma}}{\alpha}$ and $G(\alpha x) = G(x)$ for $x > \frac{\overline{\gamma}}{\alpha}$.

We claim further that

$$\int_{\underline{\gamma}}^{\overline{\gamma}} F\left(\frac{x}{\alpha}\right)^2 g(x)dx > \int_{\underline{\gamma}}^{\overline{\gamma}} F(x)^2 g(x)dx. \tag{23}$$

To see this, note that $F\left(\frac{x}{\alpha}\right) > F(x)$ for $x \in (0, \frac{\overline{y}}{\alpha})$ and $F\left(\frac{x}{\alpha}\right) = F(x)$ for all x outside of this interval. □

Civil Servant Model

Under a civil servant model,

$$E(\omega) = 12\int_0^{\overline{y}} xG(\alpha x)F(x)^2 f(x)dx - 8\int_0^{\overline{y}} xG(\alpha x)F(x)^3 f(x)dx$$
$$E(\mathbb{C}) = 4\int_{\underline{\gamma}}^{\overline{\gamma}} F\left(\frac{x}{\alpha}\right)^3 g(x)dx - 2\int_{\underline{\gamma}}^{\overline{\gamma}} F\left(\frac{x}{\alpha}\right)^4 g(x)dx$$

Proposition 4. *In the absence of corruption, welfare and corruption outcomes under the civil servant model are equivalent to those under an unconstrained centralization model in which $\alpha = 1$. Thus the civil servant model maximizes expected social welfare relative to other constitutions when corruption is not present.*

Proof. Noting that $G(x) = G(\alpha x) = 1$ for $x > \overline{\gamma}$, observe that $\overline{\gamma} \leq 0$ implies that expected social welfare is equivalent to the unconsttraned centralization case with $\alpha = 1$ and expected corruption is zero under all structures. □

Proposition 5. *Given any f and α, there exists some g such that the civil servant model provides minimal expected social welfare relative to other constitutions.* [7]

Proof: see appendix. The intuition for this proposition is that sufficiently high levels of home favoritism will lead civil servants to favor corruption over projects that a politician from the given

[7] There are possible constitutions which always perform weakly worse than the civil servant model. However, because these constitutions are trivially dominated by a civil servant model, they are not considered in the papers main results.

area would complete. Formally, g can be constructed such that the probability that a politician will divert resources from projects outside his home area is arbitrarily close to one, while the probability that he diverts from a high-quality home project (one with payoff above $\alpha\overline{y}$) is arbitrarily close to zero.

These results suggest that delegation to civil servants may work well in checking tendencies for home favoritism under a centralized constitution in societies with strong control over corruption (such as the contemporary U.K., for example), but less well in societies with weaker control over corruption.

Minimum Spending Clause

To calculate expected welfare under a minimum spending clause, we consider the expected payoff from each project site.

Each home site will receive a project if and only if its payoff to the politician is higher than that of the other home site, at least one non-home site, and corruption. Each non-home site will receive a project if its payoff to the politician is higher than that of corruption and either the other non-home site or both home sites. Thus expected welfare is

$$2\int_0^{\overline{y}} G(x)F(x)F(\frac{x}{\alpha})[2-F\left(\frac{x}{\alpha}\right)]f(x)dx+2\int_0^{\overline{y}} G(\alpha x)F(x)f(x)dx+2\int_0^{\overline{y}} G(\alpha x)[1-F(x)]F(\alpha x)^2 f(x)dx \tag{24}$$

Proposition 6. *In the absence of corruption ($\overline{\gamma} \leq 0$), expected welfare is higher under the civil servant model than under a minimum spending clause.*

Proof in appendix A.

Proposition 7. *In the absence of corruption ($\overline{\gamma} \leq 0$), expected welfare under a minimum spending clause is higher than expected welfare under decentralization to identity units when $\alpha > 0$.*

Proof in appendix A.

Proposition 8. *Expected welfare is higher under a minimum spending clause than under an equal treatment clause whenever $\alpha > 0$.*

Proof. Noting that the difference between expected welfare under a minimum spending clause and under an equal treatment clause is equal to the difference between expected welfare under a minimum spending clause in the absence of corruption and decentralization to identity units, the proof is immediate from the proof of proposition 7. □

Proposition 9. *For any α, f, and g, there exists a constitutional structure which provides higher expected welfare than a minimum spending clause.*

Proof in appendix A.

Optimal Geographic Divisions

Proposition 10. *Decentralization combining identity groups leads to lower expected social welfare and higher expected total corruption than basic decentralization when home favoritism is present ($\alpha < 1$).*

Proof: see Appendix. The proposition follows from the suboptimal project allocations and higher rates of corruption that result from home favoritism.

Proposition 11. *Decentralization with geographic divisions smaller than the unit of identity leads to lower expected social welfare and higher expected corruption than basic decentralization.*

Proof: see Appendix. Once home favoritism is eliminated, limiting politicians' choice sets lowers expected project quality without the counteracting force pushing welfare upwards and corruption downwards that comes from putting an area under the control of a home politician.

Proposition 12. *If a politician does not have control over the location of projects, then expected total corruption is weakly higher than it would be if he had control over project locations. Expected total corruption is strictly higher if the process determining these locations does not match his preferences (that is, it places projects in a way that does not maximize his utility) and $\overline{\gamma}$ is sufficiently large.*

Proof. Suppose the constitutional structure is such that the politician is responsible for n projects and has m sites to choose from. A process of determining locations gives, for each possible set of site qualities $\mathbf{v} \in [0, \overline{y}]^m$, n project sites to which the politician's choices are limited. That is, the politician may still choose to divert resources to himself, but any project that he chooses to complete must be at one of these n sites.

Suppose site values are realized, and n projcect sites are chosen by a process outside of the politician's control. Let x_i denote the politician's utility gain from completing a project at the i'th site chosen by the external process, so that $x_i = y_i$ if site i is in the politician's home region, and $x_i = \alpha y_i$ if site i is outside the politician's home region. Then the politician will divert resources from whichever projects provide lower utility than corruption, and total expected corruption is given by $\sum_{i=1}^{n} 1 - G(x_i)$.

Let $\{x'_1, x'_2, ...x'_n\}$ denote the utility gain to the politician from completing each of the n available projects that would provide him maximal utility. Note that we can order x's such that $x'_i \geq x_i$ for all i. Suppose that the x's are ordered such that this property holds. If the politician had control over project locations, he would complete each of these n projects if and only if they provide more utility than corruption. For every project which he does not complete, he diverts funds to himself. Thus expected total corruption is given by $\sum_{i=1}^{n} 1 - G(x'_i)$.

$G(x_i) \leq G(x'_i)$ for all i, so $\sum_{i=1}^{n} 1 - G(x_i) \geq \sum_{i=1}^{n} 1 - G(x'_i)$, and expected total corruption is weakly higher when the politician doesn't have control over the location of projects.

Suppose that for at least one $j \in \{1, ..., n\}$, $x_j < x'_j \leq \bar{\gamma}$. Then $G(x_j) < G(x'_j)$ and thus $\sum_{i=1}^{n} 1 - G(x_i) > \sum_{i=1}^{n} 1 - G(x'_i)$ □

3.5 Politician Constraints

The above model provides an explanation of our empirical results in terms of politician preferences, but the results could also be seen as reflecting constraints. Suppose that politicians are not home biased, so that they are indifferent ex-ante between projects of equal site quality in any two areas. Suppose further that residents of a politician's home area can punish him more severely for acting against their interests than can resident of other areas.[8] A model in which councilors face higher costs of corruption when diverting resources from projects assigned to the home area (in contrast with the symmetric costs of corruption assumed above) would reflect such a situation. However, while such a model is in line with the empirical finding that councilors are more likely to value control of funds when they do not control project location, it is at odds with the finding of home favoritism in project placement. If politicians were indifferent between areas, but faced higher costs of corruption at home, they would tend to favor away sites because of their higher expected payoff

[8] One could imagine, for example, that failure to do right by the home area would diminish a politicians social standing among his friends, family and neighbors.

from corruption. Suppose instead that a politician's home constituents punish him whenever he uses funds for something other than completing a project in his home area. That is, the politician faces punishment for diverting resources to himself or using funds that could have been used at home to complete a project away. As shown in appendix B, these villager-punishment assumptions predict the empirical findings of home favoritism in project placement and the higher premium on controlling project funds when politicians control project placement. Appendix B further demonstrates that such villager-punishment assumptions produce results almost identical to those in the preceding section.

Spanning the Space of Constitutions

There are a number of possible constitutions which were not considered above. All of them are weakly dominated. That is, for any constitution that we have not considered and any α, at least one of the constitutions above provides weakly higher expected welfare. Appendix C lists all of these constitution, proves that they are weakly dominated, and provides a handful of additional propositions on these constitutions.

4 Study Design and Context

4.1 County Councilors' Role in Local Government in Kenya

We conducted an incentive-compatible discrete choice experiment with elected councilors from nine Kenyan county councils in 2012.[9] County councilors were the elected representatives for rural electoral wards in the system of local government that existed from independence until the implementation of the country's new constitution in 2013.[10] Prior to the adoption of the new

[9] The study location was determined by the organization installing the dispensers, Innovations for Poverty Action. The location was chosen to avoid areas where other dispenser-related research projects were ongoing, areas that had recently experienced political violence or terrorism (for example, during Kenya's post-election crisis in 2008), and areas that did not have ecological conditions suitable for dispensers (for example, regions that were too arid and did not have reliable shared water sources).

[10] One of the key elements of the new constitution was the devolution of (some) authority to county-level governments. Specifically, the new constitution states that the central government must transfer 15 percent of its revenue to the counties; it also devolved to the counties responsibility for services including the provision of primary health care and the management of internal transportation issues (Kramon and Posner 2011).

constitution, public goods provision in Kenya was highly centralized. However, county councilors had certain responsibilities for local-level taxation and spending: they set property tax rates and other fees, allocated funding for managing rural market centers and trust land, and determined levels of local cost-sharing for central government infrastructure efforts in the water, transportation, education, and health sectors (Southall and Wood 1996).

Public perception of county councilors in Kenya has historically been poor. In a 2011 Transparency International report, county councils were rated as one of the most corrupt institutions in the country (Transparency International 2011). The Kenyan media frequently describe local politicians as driven primarily by a desire to use public funds to benefit themselves (Gichana 2011, Onyango 2012, Standard Digital Counties Team 2014). Data from the most recent Afrobarometer Survey indicates that the overwhelming majority of Kenyas citizens perceive local councilors as being corrupt: 50 percent indicated that either most or all local government councilors were corrupt, and an additional 42 percent reported that some councilors were corrupt (Afrobarometer Data 2015). However, corruption at the local level tends to operate on a relatively small scale, in contrast to the high profile cases of central government corruption involving the theft or misallocation of millions of dollars (Transparency International 2011).

4.2 Experimental Design and Procedures

Our experimental design built on a scale-up initiative spearheaded by the international non-governmentalorganization Innovations for Poverty Action (IPA). [11] As part of that initiative, IPA allocated funding to install and maintain approximately 40 chlorine dispensers in county council wards in our study area. The dispenser is a device which releases a measured dose of diluted chlorine solution that can be easily added to a container of water immediately after it is collected; Kremer, Miguel, Mullainathan, Null, and Zwane (2011) find that the installation and resupply of dispensers at shared water sources leads to a dramatic increase in the fraction of households with detectable chlorine in their water, even years after the dispenser is installed. [12]The allocation of

[11] Although IPA is primarily a research organization it was involved in scaling up dispensers at the time; this part of its operations was later spun off to Evidence Action.

[12]For more information, see "Chlorine Dispensers for Safe Water," available online at `http://www.poverty-action.org/work/projects/safewater`.

free dispensers through the program was determined through a public lottery, which was conducted in May of 2012. We built on this program by eliciting the preferences of county councilors through a discrete choice experiment. Within the experiment, councilors chose among dispenser packages that varied in terms of the system for selecting the dispenser location and for managing chlorine refills. Councilors also selected an eligible water source within their district to receive a dispenser. Before a councilor made any decisions, the enumerator explained that IPA did not have enough funding to install water treatment dispensers in all of the participating wards, and that a public lottery would be used to decide which 40 wards would receive dispensers. [13]

4.2.1 Choosing a Dispenser Package

The discrete choice experiment consisted of two parts. In the first part of the experiment, councilors made a series of 20 choices between two alternative water treatment dispenser packages. In each of the 20 decisions, councilors were asked to choose which of two dispenser packages they would prefer to receive for their ward. Figure 1 presents an example of a decision problem from the experiment. Complete instructions, including a listing of all the decision problems, are included in the Online Appendix.

Two attributes were varied across dispenser packages: the party choosing where the dispenser would be installed, and the party that would receive the money to manage the chlorine refills. Dispenser location could be determined in one of three ways: the councilor himself could decide where to put the dispenser, a centrally-appointed public health bureaucrat (the District Public Health Officer) could decide, or the staff of the international organization installing the dispensers (IPA) could decide. If the councilor or the District Public Health Officer was in charge of selecting a location for the dispenser, he was allowed to choose any public water source in the ward that served at least 10 households.

Refilling the dispenser was either the responsibility of the implementing organization's program staff or the councilor himself. If the councilor selected a package that put him in charge of refilling the chlorine, the implementing organization provided him with a sum of 650 Kenyan shillings (7.77

[13] Participating councilors were invited to either attend this lottery or to send a representative, and were also informed that, after the fact, they would be able to watch a video recording of the lottery on the internet.

USD at the time) each month to cover the cost of either transporting or hiring someone to transport the chlorine from the market town to the dispenser site. Since some people regularly travel to these locations, this is not very burdensome. Moreover, dilute chlorine lasts a year or longer from the date of manufacturing if unopened. While this is a modest amount of money relative to many narratives about large-scale elite capture and corruption, small, high-frequency transactions typify the sorts of situations in which petty corruption tends to occur; the amount of discretionary funding available through our experiment is also comparable to what Kenyan county councilors encounter in the course of their engagement with decentralized funds and NGO projects (Asaka, Aila, Odera, and Abongo 2011, National Taxpayers Association 2016).[14]

Our experiment included 6 different dispenser packages (i.e. all the possible combinations of attributes described above). In each of the 20 decision problems that the councilors faced, they were asked to indicate which of two dispenser packages they preferred. They were also allowed to indicate that they were indifferent between the two packages or that they preferred not to receive either of the packages offered. Since the set of dispenser packages under consideration had only six elements, we were able to offer each councilor every possible combination of choices between two dispenser packages. Our sequence of 20 choice problems included all 15 possible pairs of (two of the six) dispenser packages, presented in a random order, plus an additional 5 questions that were chosen at random from the menu of 15 and presented with the order of the two packages swapped.

Councilors were informed that each of their 20 dispenser package selections had a 5 percent (1 in 20) chance of being implemented if their ward was chosen to receive a dispenser through the public lottery. After the selection of the 40 wards that would receive a dispenser, an additional lottery was conducted to determine which of the 20 dispenser package questions would decide which dispenser the wards would receive. If the councilor chose not to select either of the two dispenser packages offered in that choice set, then no dispenser would be installed in his ward. If the councilor indicated that he was indifferent between the two packages offered in that choice problem, the package to be implemented would be selected through a third lottery with a 50 percent chance of each package being chosen.

[14] Over the course of the full two-year project, the total value of the chlorine contract is 16,500 shillings (approximately 197 USD), which is substantially larger than the typical bribe paid to a member of a county councils (Transparency International 2011).

4.2.2 Choosing a Dispenser Location

After making this series of dispenser package choices, councilors were asked to choose the water source in their ward where they would like to have a water treatment dispenser installed. In the event that the councilor's ward was randomly chosen to receive a dispenser *and* the dispenser package that the councilor chose allowed the councilor to choose the dispenser location, a water treatment dispenser would be installed at the water source identified by the councilor. To assist the councilors in selecting a water source, we provided each respondent with a booklet containing information on each of the water sources in his ward, using data from a water source survey (which we describe in more detail below).

4.3 Data Sources

We complement the data from our discrete choice experiment with two additional data sources. The first is a census of shared water sources in the county council wards included in our sample. We enumerated the set of possible locations for dispenser installation by conducting a survey of village elders in 2011, the aim of which was to create a listing of all the shared water sources in the county council wards in our sample.[15] For each of 7,618 shared water sources in 3,164 villages, the survey recorded the name and local nicknames of each water source as well as other basic information the type of source (e.g. a river or stream, a public standpipe, a borehole or shallow well, etc.), the number of months that each source is dry, the approximate number of households using the source, whether the source is privately owned, whether users have to pay for water from the source, and the ethnicities and wealth levels of the households using the source. Data from the water source survey was provided to councilors when they were asked to choose which source should receive a dispenser.[16]

We measure the political characteristics of the wards in our sample using the official results of the 2007 election that were compiled by the Electoral Commission of Kenya (ECK).[17] For every

[15]At the time of the survey, chiefs and assistant chiefs were the centrally-appointed administrators of the two smallest administrative units locations and sub-locations. Sub-locations were also informally divided into villages. Chiefs and assistant chiefs appointed a village elder to serve as their representative in each village.

[16]The water source booklets indicated the name of each water source, the village and sublocation in which it was located, the type of source (e.g. protected spring), the approximate number of families using the source, the number of the months that the source runs dry, and whether or not the source is clear.

[17]We were given the electoral returns by James Long and Jeremy Horowitz, who obtained them from the ECK.

local electoral ward in the country, the ECK reports the total number of registered voters, the total number of votes cast, the party affiliation of each candidate, and total number of votes that each candidate received.

4.4 Subject Pool: Councilors and Wards in the Sample

Table 1 presents descriptive statistics characterizing the 179 councilors and wards in our sample. The vast majority – 93 percent – of councilors in our sample are male, reflecting the low proportion of women holding elected office in Kenya.[18] 90 percent have completed secondary school and 25 percent have some post-secondary education. In addition to holding elected office, approximately half of the sample are also farmers, while a third are also business owners. Only 35 percent reported that their salary from being a councilor accounted for more than half of their household income. 61 percent of the councilors in our sample were in their first term in office, and the median number of years of experience in politics is 5. 73 percent were affiliated with one of the three main political parties in the 2007 election (PNU, ODM, and ODM-K).[19] We observe substantial variation in the political characteristics of the wards in our sample. The number of registered voters varies from 682 voters in the smallest ward to over 16,000 in the largest, and voter turnout in the 2007 election ranges from 35 percent of registered voters to 97 percent.

Table 2 reports summary statistics on the water sources in the wards in our sample.[20] The number of water sources within a ward ranges from 3 to 209; the median is 40 sources; while the average number of households using each source within a ward ranges from 23 to 740. Across all wards in the sample, the most common shared water sources are streams and rivers, accounting for an average of 37 percent of sources per ward. As discussed above, rivers are typically not ideal places to install water treatment dispensers because users can collect water from many different access points (only one of which could receive a dispenser through the program). On average,

The copy of the returns that we used was printed on March 17, 2008.

[18] The limited variation in individual characteristics observed in our sample precludes the analysis of the associations between individual characteristics and preferences for public goods.

[19] At the time of the experiment, Kenya's three main political parties were the Party of National Unity (PNU), which was the party of President Mwai Kibabi; the Orange Democratic Movement (ODM); and the Orange Democratic Movement-Kenya (ODM-K).

[20] In our analysis of dispenser location decisions, we omit 22 wards where the councilor's first choice for where to locate a dispenser was not a source listed in the water source booklet.

33 percent of sources in each ward are improved sources such as public standpipes and taps, borehole wells, and protected springs.[21] Improved sources have better water quality on average than unimproved sources, so installing water treatment dispensers at these is expected to have relatively lower benefits than installation at unimproved sources. However, cloudy water is also not ideal because it requires more chlorine to achieve a given level of water quality.

5 Analysis and Results

In this section, we first describe our approach to the analysis. We then quantify home favoritism by comparing the weight councilors place on providing a dispenser to households within their home area (village) versus elsewhere, and test the impact of having control over geographic targeting on councilors preferences for control over discretionary funds associated with dispenser management.

5.0.1 Framework for Analysis

We analyze councilors decisions of where to install water treatment dispensers, and their valuation of water treatment dispenser attributes in an additive random utility framework.[22] Without loss of generality, we assume that the level of utility councilor n derives from installing dispenser package j in location k is given by:

$$U_{n,j} = V_{n,j,k} + \epsilon_{n,j,k}. \tag{25}$$

$V_{n,j,k}$ is the explicitly-modeled representative utility associated with the attributes of dispenser package j when installed at location k and $\epsilon_{v,j,k}$ is an unobserved stochastic component. As is standard in additive random utility models, $\epsilon_{v,j,k}$ is assumed to be distributed EV1. The probability that dispenser package $j \in J$ is chosen by councilor n and installed at location $k \in K$ is then given by

$$P_{n,j} = \frac{e^{V_{n,j}}}{\sum_{l \in J} \sum_{m \in K} e^{V_{n,l,m}}} \tag{26}$$

[21] Our classification of improved sources is based WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation definition (UNICEF and World Health Organization Joint Monitoring Programme for Water Supply and Sanitation 2015).

[22] See Train (2003) for a detailed discussion of additive random utility models.

which is strictly positive. Thus, packages that are associated with higher representative utility are more likely to be chosen, but all packages are chosen with positive probability.

In the first part of the empirical analysis we use this framework to estimate the utility to councilors associated with installing a water treatment dispenser at a source with particular attributes, in particular sources within versus outside of the councilors home area. We then describe councilors preferences for control over geographic targeting and access to discretionary funding by analyzing their choices between alternative dispenser packages.

5.1 Quantifying Favoritism

We begin our analysis by examining councilors geographic targeting choices in order to test for and quantify the extent of favoritism towards home areas. Councilors decisions about where to install dispensers allow us to analyze the factors underlying their targeting choices in a conditional logit framework. Here, the choice set is the listing of a wards shared water sources enumerated in the water source survey, and we allow the probability that a water source was chosen to receive a dispenser to depend on source attributes.[23] This analysis is descriptive: because we do not control the choice set facing each councilor or the correlations among attributes, we cannot estimate the causal impact of any individual characteristic on the likelihood that a water source is chosen to receive a dispenser. Nonetheless, our results provide unique descriptive evidence on councilors' decision-making regarding the allocation of local public goods.

We can use the results reported in Table 3 to estimate the parameter α from the model, representing the weight that politicians put on the welfare of residents of non-home areas relative to that of residents of their home area. Suppose that the utility gain provided by a dispenser to each user of a given water source can be represented by the utility function $U_k' = V_k' + \epsilon_k$. Assume V_k' is linear in the variables from Table 3 that are unrelated to the number of users. Formally, $V_k' = \beta_0 + \sum_{i=1}^{6} \beta_i I_i$, where $\{I_i | 1 \leq i \leq 6\}$ is the set of indicator variables {Point source, Improved source, ... Source does not dry up}. ϵ_k is an unobserved stochastic component (observed by the

[23]We also include controls for the page on which a source appeared in the Water Source Booklet, since sources listed early in the booklet may have been particularly salient to councilors. The median number of water sources in a ward is 40, but 7.6 percent of wards had more than 100 water sources. The booklet listed between 3 and 5 water sources per page. Sources were sorted alphabetically by sublocation and village.

politician, but unobserved by the econometrician) assumed to be distributed EV1. Note that user utility can also be represented by $e^{U'_k}$, and define the total welfare provided by a project as the sum of the welfare provided to all of the project's users. Then the model gives that a politician's utility U_k from providing a project at site k is $(\alpha + [1-\alpha]I_0)n_k e^{U'_k}$ where n is the number of users of source k and I_0 is an indicator variable equal to one if k is in the politician's home area, and zero otherwise. Drawing on column 4 of Table 3, note that the preferences represented by U can also by represented by $.663[lnU_k - \alpha - \beta_0] = .663(-ln\alpha I_0 + \sum_{i=1}^{6} \beta_i I_i + \epsilon_k)$. Given that .663 is the coefficient on the log number of users variable, we see that the righthand side of this expression takes the form of the specification in column 4 of Table 3, and thus we can use the results in column 4 to estimate α. Specifically, we have $\alpha = e^{-\frac{.925}{.663}} = 0.248$.

If we assumed instead that the utility provided to a councilor by placing a dispenser in a given source is linear in users in the councilor's village and users outside the councilors village, we could use Column 1 to derive a similarly low estimate of α. Dividing the coefficient on the number of potential users within the councilors home village by the number residing outside the village gives an estimate of the relative weight that a councilor gives to users inside and outside his village. Using the values reported in Column 1 (0.045 and 0.019 respectively), this calculation suggests that providing the amenity to a constituent in the councilors own village is .42 times as important to the councilor as providing it to a constituent elsewhere in the ward. Our data does not allow for a full calibration of the model, as our setting may not provide an accurate approximation of councilors opportunities for corruption (represented by the distribution g in the model). For example, politicians may have believed that the study would track corruption, increasing its expected costs relative to those in a more natural setting.

Results shown in Columns 3 and 4 indicate that favoritism is specific to the councilors village itself, rather than the larger administrative unit of the sub-location. Controlling for the number of source users, sources in councilors' villages are significantly more likely to be chosen to receive a dispenser, whereas the influence of home sub-location is not statistically significant. Across specifications, we can consistently reject the hypothesis that users inside and outside councilors' home area carry equal weight at the 95 percent confidence level. Thus, our results area consistent with the hypothesis that councilors seek to target core supporters in their home areas (Dixit and

Londregan 1996, Golden and Min 2013), even within small and ethnically homogeneous electoral wards, and help to explain the tendency to vote for coethnics and candidates from one's home area observed in many African contexts (Wantchekon 2003).

We also see evidence in this table that on other dimensions, councilors targeting decisions are aligned with maximizing the social benefit of the dispenser. Home favoritism aside, the number of households using a source is an important factor in explaining councilors' targeting decisions regardless of the sources location: coefficients on this variable are significant at the 99% level in all specifications. Councilors also preferentially select point sources (*i.e.* those which have one precise access point) that do not meet the WHO/UNICEF definition of improved (meaning they do not adequately protect water from outside contamination) — specifically, dams and shallow wells. Finally, they are less likely to choose water sources that are privately owned, though they are no more likely to choose free water sources than those that charge a fee for use. Each of these preferences suggest a motivation to locate dispensers at sites where they will do the most good: publicly accessible point sources at which many people collect their water, and where the quality of water is relatively poor. Other characteristics of the water coming from the source (e.g. whether the source runs dry at any point in the year) do not explain councilors' choices.

5.2 Decentralization and the Preference for Control over Funds

In order to test the models prediction that politicians will be more likely to be corrupt if they do not control the geographic targeting of the public good, we use the random utility framework to estimate the change in utility that results from varying the attributes of the dispenser package, relative to a benchmark package where the implementing organization chooses the dispenser location and handles the restocking of chlorine. Specifically, we estimate the change in utility associated with devolving the decision about where to locate the dispenser to either (i) the councilor or (ii) the District Public Health Officer; the impact on utility of allowing the councilor manage the funds allocated for chlorine provision; and the utility value of combining these two modifications to the basic dispenser package.[24]

[24]So, for example, councilor n's utility from a dispenser package which allows him to manage chlorine provision and choose the dispenser's location is:

$$U_{n,j} = \phi_n + \alpha_n^{councilor} + \beta_n^{councilor} + \gamma_n^{councilor \times councilor} + \epsilon_{n,j} \tag{27}$$

We estimate a mixed logit model that allows preference parameters to vary across councilors. We assume that all preference parameters are normally distributed, and we estimate the mean and the standard deviation of each parameter via simulated maximum likelihood. This approach allows us to test the extent to which there is meaningful variation in preferences over dispenser attributes across councilors in our sample. Table 4 reports the mean and standard deviation of the estimated distribution of preference parameters, along with the associated standard errors. In the last column of Table 4, we use the estimated mean and variance of the parameter distribution to calculate the fraction of councilors in our sample who derive positive utility from each dispenser attribute we consider.

Councilors use the ability to choose the location of chlorine dispensers in a variety of ways. First, they are more likely to choose water sources with higher numbers of users, sources that are publicly owned, and sources with only one access point (guaranteeing all users will have easy access to the dispenser). [25] These patterns suggest that local councilors in rural Kenya are interested in using local public goods projects to enhance social welfare.

The results show substantial heterogeneity in councilors' preferences over public goods: the standard deviations on all parameters are significantly different from zero. Coefficient estimates indicate that 81 percent of councilors value the opportunity to have a dispenser installed in their ward, and that 84.2 percent prefer dispenser packages that allow them to choose the where to install the dispenser. When the implementing NGO decides the dispenser's location, approximately equal numbers of councilors derive positive and negative utility from the opportunity to manage the chlorine funds. (To see this note that the mean of the distribution of the utility associated with allowing the councilor to manage the funds allocated for chlorine refills is not significantly different

where ϕ_n is the utility derived from receiving the benchmark dispenser package (where the implementing organization chooses the dispenser location and handles the restocking of chlorine), $\alpha_n^{councilor}$ is the increase (or decrease) in utility that results if the councilor is responsible for choosing the dispenser location, $\beta_n^{councilor}$ is the change in utility resulting from allowing the councilor to manage the funds allocated for restocking the chlorine, and $+\gamma_n^{councilor \times councilor}$ is the change in utility from the combination of targeting responsibility and management of restocking funds. If counselor n indicates that he prefers not to receive Package A or Package B, then his realized utility will be: $U_{n,j} = \epsilon_{n,j}$. Councilors also had the option of indicating that they were indifferent between Packages A and B; in that case, if the councilor was selected to receive a dispenser, one of the two packages (Package A or Package B) was chosen at random through a lottery.

[25]Installing chlorine dispensers at water sources with a single access point, for example, wells or springs, means that everyone drawing water from the source will have ready access to chlorine. Sources such as rivers and lakes can be accessed in many locations; thus, though such sources may serve more users overall, installing dispensers at such sources (at a single access point) may mean that fewer users can easily access the chlorine.

from zero.)

However, the interactions between dispenser attributes indicate that the responsibility for managing funds allocated for restocking chlorine is less attractive for the overwhelming majority (87.3 percent) of councilors when the councilor himself decides the dispenser location (or when the DPHO does).[26] This result suggests that, in accordance with the model, when councilors are responsible for determining the dispenser location, they are less likely to prefer a management arrangement that allows them to control (and potentially divert) public funds. Rather, they are more likely to select an option in which an NGO is tasked with managing these funds. If a politician is more likely to divert funds when he cannot control the project location, then decentralized control over resource allocation will increase welfare and reduce corruption relative to a centralized governance structure.

This specification also includes a variable that controls for any additional (dis)utility from lotteries between dispensers. We find evidence that on average, councilors derive less utility from the lottery between dispenser packages than from the packages themselves.[27]

Next, in Table 5, we explore the association between outcomes that are related to the distributive implications of politicians controlling targeting and the political characteristics of councilors and their wards. We find evidence that greater political participation (as proxied by higher voter turnout) is associated with an increased likelihood of choosing a water source in the top quartile in terms of the number of users within that ward. Further, councilors from one of the three main political parties in the 2007 election are also more likely to choose water sources accessed by larger numbers of users. We interpret this as evidence that political competition – both within wards and among political parties – does tend to discipline politicians and push them toward more socially desirable public goods outcomes. Interestingly, we find little evidence that the political characteristics of wards and councilors explain the tendency to target the public good to one's own sublocation or village.

[26]One interpretation of the result on the significance of the interaction between DPHO targeting and councilor control over funds is that a subset of councilors expect that the local DPHO would honor the councilors request concerning where to target the dispenser, given that the councilor was the one to bring this amenity to the district by agreeing to participate in the research.

[27]This is not consistent with expected utility maximization (since the expected utility of the lottery is the weighted average of the associated preference parameters) but is consistent with a range of behavioral economic models of attitudes toward risk (cf. Kősegi and Rabin 2006, Andreoni and Sprenger 2011)

Finally, we explore the extent to which political characteristics explain the observed preference heterogeneity by allowing the utility of each attribute to depend on the observable characteristics of a councilor or his ward. Specifically, we allow the utility associated with particular dispenser package attributes to be a linear function of the political characteristics (ward size, voter turnout, the councilor's party affiliation, and his term in office).Results are reported in the Online Appendix. [28] Overall, we find that our measures of the political characteristics of wards and councilors explain very little of the observed preference heterogeneity, though the evidence suggests that candidates from the major political parties place a relatively higher value of opportunities for targeting, while those in their first-term in office are more averse to allowing the District Public Health Officer to decide where to install the dispenser.

6 Conclusion

Much of the existing theoretical literature on decentralization considers the tradeoff between better local information and risks of local elite capture and associated corruption. In this paper, we propose that taking into account politicians favoritism toward those in their home area may have important implications for how decentralization affects welfare and corruption. We develop a theoretical model of politician behavior that demonstrates that when politicians favor their home areas, decentralization can increase social welfare relative to centralization. The model implies that in environments where controls over corruption are weak, alternatives to decentralization which seek to control the effects of favoritism by limiting politicians discretion over where public goods are situated may not be effective because they will lead to greater corruption than under decentralization.

We then present results from an incentive-compatible discrete choice experiment with 179 Kenyan county councilors, low-level elected representatives in Kenya's system of local government. By incentivizing our experiment with local public goods (water treatment solution dispensers that

[28] Because the two ward-level political measures we consider have different magnitudes and distributions, we include the quartiles for each variable rather than levels. In Columns 1 and 2, we include absolute quartiles of registered voters and voter turnout; in Columns 3 and 4 we control for county council-level differences in political characteristics by constructing within-county quartiles. All specifications also include controls for alternatives that are lotteries. These results should be viewed as suggestive, both because of the large number of hypotheses being tested and because political characteristics are not exogenous.

would be installed in councilors' electoral wards), our design allows us to quantify the relative weights placed on benefits to core supporters versus other constituents, demonstrating favoritism. When given the opportunity to select a location for a water treatment dispenser, councilors make location decisions consistent with a concern for social welfare, allocating dispensers to unimproved water sources that serve large numbers of users. We estimate that they value benefits to users in their home areas approximately four times as much as benefits to users in other parts of their constituencies.

Consistent with the model, counselors are more likely to value the opportunity to control part of the funds associated with the public good when they do not have control over the location of the public good.

Together, these empirical findings support the models conclusion that, at least in the context of ward-level councilors in the part of Kenya studied, devolving control over allocative decisions to the local level can reduce corruption and increase social welfare. While the extent to which these results generalize to higher levels of politics is highly uncertain, they do suggest an important potential additional benefit of decentralization.

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Appendix A: Proofs

Derivation of Expected Welfare and Corruption

Below, we derive expected welfare and expected corruption under decentralization to identity units and unconstrained centralization. Derivations of these values under other constitutions follow essentially the same steps. Under a basic decentralized constitution, expected welfare in area i given by

$$\mathrm{E}\left(max\{y_{1i}, y_{2i}\} \mid max\{y_{1i}, y_{2i}\} > \gamma\right) P\left(max\{y_{1i}, y_{2i}\} > \gamma\right)$$

Noting that the PDF of $max\{y_{1i}, y_{2i}\}$ is given by $2f \cdot F$, where F is the CDF F(x)=$\int_0^x f(x)dx$, we have that this is equal to

$$P(max\{y_{1i}, y_{2i}\} > \gamma) \int_0^{\overline{y}} x \frac{P\left((max\{y_{1i}, y_{2i}\} > \gamma \mid (max\{y_{1i}, y_{2i}\} = x\right) 2f(x)F(x)}{P\left(\{max\{y_{1i}, y_{2i}\} > \gamma\right)} dx$$
$$= 2\int_0^{\overline{y}} xG(x)F(x)f(x)dx. \tag{28}$$

Thus total expected welfare (summing expected welfare across both areas) is

$$E(\omega_{decentralized}) = 4\int_0^{\overline{y}} xG(x)F(x)f(x)dx. \tag{29}$$

To calculate expected corruption in the decentralized case, note that each politician will divert one project's worth of resources if and only if the payoff for corruption is higher than the payoff for either project in their home area. That is, politician k will divert one project's worth of resources if $\gamma > max\{x_{1k}, x_{2k}\}$, and will divert no resources otherwise. Thus expected total corruption (summing expected corruption across both areas) is

$$\mathrm{E}\left(\mathbb{C}_{decentralized}\right) = 2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)^2 g(x)dx. \tag{30}$$

To calculate expected welfare under an unconstrained centralized constitution, we first calculate the expected welfare provided by the first project site in the politician's home area, E($\mathbf{Q_{1D}} y_{1D}$). The politician will complete a project at site 1D iff his utility from completing this project will be higher than his utility from completing a project in either of at least two other sites or from diverting the funds. Formally, $\mathbf{Q_{1D}} y_{1D} = y_{1D}$ if and only if y_{1D} is the first- or second-largest element of $\{y_{1D}, y_{2D}, \alpha y_{1F}, \alpha y_{2F}\}$ and $y_{1D} > \gamma$, and is equal to zero otherwise.

This condition can be partitioned into four mutually exclusive events.

$$\begin{aligned}
&\text{Event 1}: y_{1D} > y_{2D},\ y_{1D} > \alpha y_{1F},\ y_{1D} > \alpha y_{2F} \text{ and } y_{1D} > \gamma \\
&\text{Event 2}: y_{1D} < y_{2D},\ y_{1D} > \alpha y_{1F},\ y_{1D} > \alpha y_{2F} \text{ and } y_{1D} > \gamma \\
&\text{Event 3}: y_{1D} > y_{2D},\ y_{1D} < \alpha y_{1F},\ y_{1D} > \alpha y_{2F} \text{ and } y_{1D} > \gamma \\
&\text{Event 4}: y_{1D} > y_{2D},\ y_{1D} > \alpha y_{1F},\ y_{1D} < \alpha y_{2F} \text{ and } y_{1D} > \gamma
\end{aligned}$$

Expected welfare provided by the first project site in the politician's home area is given by

$$\sum_{n=1}^{4} P(\text{Event n}) \int_0^{\overline{y}} x \frac{P(\text{Event n} \mid y_{1D} = x) f(x)}{P(\text{Event n})} dx \tag{31}$$

$$= \sum_{n=1}^{4} \int_0^{\overline{y}} x P(\text{Event n} \mid y_{1D} = x) f(x) dx \tag{32}$$

$$= \int_0^{\overline{y}} x G(x) F(x) F\left(\frac{x}{\alpha}\right)^2 f(x) dx + \int_0^{\overline{y}} x G(x) \left[1 - F(x)\right] F\left(\frac{x}{\alpha}\right)^2 f(x) dx \tag{33}$$

$$+ 2 \int_0^{\overline{y}} x G(x) F(x) F\left(\frac{x}{\alpha}\right) \left[1 - F\left(\frac{x}{\alpha}\right)\right] f(x) dx. \tag{34}$$

Omitting similar steps for calculating the expected welfare provided by the other three project sites, we have that expected welfare under centralization is

$$\begin{aligned}
E(\omega_{centralized}) = {} & 2 \int_0^{\overline{y}} x G(x) F(x) F\left(\frac{x}{\alpha}\right)^2 f(x) dx + 2 \int_0^{\overline{y}} x G(x) F\left(\frac{x}{\alpha}\right)^2 \left[1 - F(x)\right] f(x) dx \\
& + 4 \int_0^{\overline{y}} x G(x) F(x) F\left(\frac{x}{\alpha}\right) \left[1 - F\left(\frac{x}{\alpha}\right)\right] f(x) dx \\
& + 2 \int_0^{\overline{y}} x G(\alpha x) F(x) F(\alpha x)^2 f(x) dx + 2 \int_0^{\overline{y}} x G(\alpha x) F(\alpha x)^2 \left[1 - F(x)\right] f(x) dx \\
& + 4 \int_0^{\overline{y}} x G(\alpha x) F(x) F(\alpha x) \left[1 - F(\alpha x)\right] dx
\end{aligned}$$

which can be simplified to

$$\begin{aligned}
& 2 \int_0^{\overline{y}} x G(x) F\left(\frac{x}{\alpha}\right)^2 f(x) dx + 4 \int_0^{\overline{y}} x G(x) F(x) F\left(\frac{x}{\alpha}\right) f(x) dx \\
& - 4 \int_0^{\overline{y}} x G(x) F(x) F\left(\frac{x}{\alpha}\right)^2 f(x) dx \\
& + 2 \int_0^{\overline{y}} x G(\alpha x) F(\alpha x)^2 f(x) dx + 4 \int_0^{\overline{y}} x G(\alpha x) F(x) F(\alpha x) f(x) dx \\
& - 4 \int_0^{\overline{y}} x G(\alpha x) F(x) F(\alpha x)^2 f(x) dx.
\end{aligned}$$

To calculate expected total corruption under centralization we note that the politician will divert two projects' worth of resources if γ is greater than his payoff from completing any projects, will divert one project's worth of resources if there is exactly one project that will provide him higher payoff than corruption, and will divert no resources otherwise. Omitting steps that are directly analogous to those used for calculating expected welfare under centralization, we derive that expected total corruption under centralization is given by

$$\mathrm{E}\left(\mathbb{C}_{centralized}\right) = 2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)^2 F\left(\frac{x}{\alpha}\right)^2 g(x)dx +$$
$$2\int_{\underline{\gamma}}^{\overline{\gamma}} \left[1 - F(x)\right] F(x) F\left(\frac{x}{\alpha}\right)^2 g(x)dx + 2\int_{\underline{\gamma}}^{\overline{\gamma}} \left[1 - F\left(\frac{x}{\alpha}\right)\right] F(\frac{x}{\alpha}) F(x)^2 g(x)dx. \quad (35)$$

This expression simplifies to

$$2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x) F\left(\frac{x}{\alpha}\right) \left[F\left(\frac{x}{\alpha}\right) + F(x) - F\left(\frac{x}{\alpha}\right) F(x)\right] g(x)dx. \quad (36)$$

Proofs

Lemma 1.1: If $\alpha = 1$, then expected welfare is higher under a centralized structure than under a decentralized structure.

Proof. When $\alpha = 1$, we have that

$$E(\omega_{centralized}) = 12\int_0^{\overline{y}} xG(x) F(x)^2 f(x)dx - 8\int_0^{\overline{y}} xG(x) F(x)^3 f(x)dx. \quad (37)$$

$E(\omega_{centralized}) - E(\omega_{decentralized})$ is thus equal to

$$12\int_0^{\overline{y}} xG(x) F(x)^2 f(x)dx - 8\int_0^{\overline{y}} xG(x) F(x)^3 f(x)dx - 4\int_0^{\overline{y}} xG(x) F(x) f(x)dx. \quad (38)$$

which we rewrite as

$$\int_0^{\overline{y}} xG(x) \left(12F(x)^2 - 8F(x)^3 - 4F(x)\right) f(x)dx. \quad (39)$$

For notational convenience, we define $H(x) = 12x^2 - 8x^3 - 4x$. We can rewrite the above expression as

$$\int_0^{F^{-1}\left(\frac{1}{2}\right)} xG(x) H(F(x)) f(x)dx + \int_{F^{-1}\left(\frac{1}{2}\right)}^{\overline{y}} xG(x) H(F(x)) f(x)dx. \quad (40)$$

Define the function θ by $\theta(x) = F^{-1}(1 - F(x))$. Then

$$\begin{aligned}
\int_{F^{-1}\left(\frac{1}{2}\right)}^{\overline{y}} xG(x) H(F(x)) f(x)dx &= \int_{\theta\left(F^{-1}\left(\frac{1}{2}\right)\right)}^{\theta(0)} xG(x) H(F(x)) f(x)dx \\
&= -\int_{\theta(0)}^{\theta\left(F^{-1}\left(\frac{1}{2}\right)\right)} xG(x) H(F(x)) f(x)dx \\
&= -\int_0^{F^{-1}\left(\frac{1}{2}\right))} \theta(x) G(\theta(x)) H(F(\theta(x))) f(\theta(x)) \frac{d\theta}{dx} dx.
\end{aligned}$$

We note that for any x, $H(1 - x) = -H(x)$, so for all $x \in [0, \overline{y}]$,

$$H(F(\theta(x))) = H(1 - F(x)) = -H(F(x)).$$

Furthermore we have that, for $x \in (0, \overline{y})$, $\frac{d\theta}{dx} = \frac{-f(x)}{f(\theta(x))}$. So

$$-\int_0^{F^{-1}\left(\frac{1}{2}\right)} \theta(x)G(\theta(x))H(F(\theta(x))f(\theta(x))\frac{d\theta}{dx}dx$$
$$= -\int_0^{F^{-1}\left(\frac{1}{2}\right)} \theta(x)G(\theta(x))H(F(x))f(x)dx \quad (41)$$

and

$$E(\omega_{centralized}) - E(\omega_{decentralized}) =$$
$$\int_0^{F^{-1}\left(\frac{1}{2}\right)} [xG(x)H(F(x))f(x)] - [\theta(x)G(\theta(x))H(F(x))f(x)]\, dx. \quad (42)$$

For $x \in \left(0, F^{-1}\left(\frac{1}{2}\right)\right)$, $\theta(x) > x$. It follows that $G(\theta(x)) \geq G(x) > 0$.

H(x) is negative for $x \in \left(0, \frac{1}{2}\right)$.

To see this, we note that H has zeroes at 0, $\frac{1}{2}$, and 1. We have $H'(x) = 24x - 24x^2 - 4$ so $H'(x) < 0$ at $x = 0$. By continuity of $H'(x)$, $H'(x) < 0$ on the interval $[0, a)$ for some $a > 0$. Thus by the mean value theorem, $H(x) < 0$ on $(0, a)$. Since H is a 3-degree polynomial, the roots 0, $\frac{1}{2}$, and 1 are unique, so there are no zeroes on $(0, \frac{1}{2})$. Thus by the intermediate value theorem H is negative on this interval.

Thus for $x \in \left(0, F^{-1}(\frac{1}{2})\right)$,

$$\theta(x)G(\theta(x))H(F(x))f(x) < xG(x)H(F(x))f(x) < 0$$

so

$$[xG(x)H(F(x))f(x)] - [\theta(x)G(\theta(x))H(F(x))f(x)] > 0.$$

Thus

$$\int_0^{F^{-1}\left(\frac{1}{2}\right)} [xG(x)H(F(x))f(x)] - [\theta(x)G(\theta(x))H(F(x))f(x)]\, dx > 0 \quad (43)$$

and expected welfare is higher under centralization than under decentralization. □

Lemma 1.2: If $\alpha = 0$, then expected welfare is higher under a decentralized structure than under a centralized structure.

Proof. Under a centralized structure, when $\alpha = 0$, the politician will never build projects outside his home area. At each site in his home area, he will complete a project iff the value of that project is greater than γ. Thus expected welfare is given by

$$2\int_0^{\overline{y}} xG(x)f(x)dx. \quad (44)$$

So

$$E(\omega_{centralized}) - E(\omega_{decentralized}) = 2\int_0^{\overline{y}} xG(x)f(x)\,[1 - 2F(x)]\,dx. \quad (45)$$

Defining the function J by $J(x) = 1 - 2x$ and θ as in the proof of lemma 1.1, we have

$$2\int_0^{\overline{y}} xG(x)f(x)\left[1-2F(x)\right]dx = 2\int_0^{F^{-1}\left(\frac{1}{2}\right)} xG(x)f(x)J(F(x))dx + 2\int_{\theta\left(F^{-1}\left(\frac{1}{2}\right)\right)}^{\theta(0)} xG(x)f(x)J(F(x))dx.$$

Furthermore,

$$\int_{\theta\left(F^{-1}\left(\frac{1}{2}\right)\right)}^{\theta(0)} xG(x)f(x)J(F(x))dx = -\int_{\theta(0)}^{\theta\left(F^{-1}\left(\frac{1}{2}\right)\right)} xG(x)f(x)J(F(x))dx = -\int_0^{F^{-1}\left(\frac{1}{2}\right)} \theta(x)G(\theta(x))f(\theta(x))J(F(\theta(x)))\frac{d\theta}{dx}dx.$$

Applying the fact that $J(1-x) = -J(x)$ for all x, and that $\frac{d\theta}{dx} = \frac{-f(x)}{f(\theta(x))}$ for all $x \in (0, \overline{y})$ gives that

$$\int_0^{F^{-1}\left(\frac{1}{2}\right)} \theta(x)G(\theta(x))f(\theta(x))J(F(\theta(x)))\frac{d\theta}{dx}dx = \int_0^{F^{-1}\left(\frac{1}{2}\right)} \theta(x)G(\theta(x))f(x)J(F(x))dx. \quad (46)$$

We still have $xG(x)f(x) < \theta(x)G(\theta(x))f(x)$ for $x \in \left(0, F^{-1}\left(\frac{1}{2}\right)\right)$. Furthermore J(x) is positive for $x \in \left(0, \frac{1}{2}\right)$, so for $x \in \left(0, F^{-1}\left(\frac{1}{2}\right)\right)$,

$$[xG(x)f(x)J(F(x))] - [\theta(x)G(\theta(x))f(x)J(F(x))] < 0. \quad (47)$$

Thus

$$2\int_0^{F^{-1}\left(\frac{1}{2}\right)} [xG(x)f(x)J(F(x))] - [\theta(x)G(\theta(x))f(x)J(F(x))]\,dx < 0 \quad (48)$$

and expected welfare is higher under decentralization than under centralization. □

Lemma 1.3: Expected welfare under centralization is strictly increasing in α for $0 < \alpha \leq 1$.

Proof. For $\alpha \neq 0$, leibniz' rule gives that expected welfare under centralization is differentiable with respect to alpha, with derivative:

$$\begin{aligned}
&-4\int_0^{\overline{y}} x^2\alpha^{-2}G(x)F\left(\frac{x}{\alpha}\right)f\left(\frac{x}{\alpha}\right)f(x)dx - 4\int_0^{\overline{y}} x^2\alpha^{-2}G(x)F(x)f\left(\frac{x}{\alpha}\right)f(x)dx\\
&+8\int_0^{\overline{y}} x^2\alpha^{-2}G(x)F(x)F\left(\frac{x}{\alpha}\right)f\left(\frac{x}{\alpha}\right)f(x)dx\\
&+4\int_0^{\overline{y}} x^2G(\alpha x)F(\alpha x)f(\alpha x)f(x)dx + 4\int_0^{\overline{y}} x^2G(\alpha x)F(x)f(\alpha x)f(x)dx\\
&-8\int_0^{\overline{y}} x^2G(\alpha x)F(x)F(\alpha x)f(\alpha x)f(x)dx\\
&+2\int_0^{\overline{y}} x^2g(\alpha x)F(\alpha x)^2f(x)dx + 4\int_0^{\overline{y}} x^2g(\alpha x)F(\alpha x)F(x)f(x)dx\\
&-4\int_0^{\overline{y}} x^2g(\alpha x)F(\alpha x)^2F(x)f(x)dx.
\end{aligned}$$

To sign this expression, we regroup as follows

$$4\Bigg(\int_0^{\overline{y}} x^2 G(\alpha x) f(\alpha x) f(x) \left[F(\alpha x) + F(x) - 2F(x)F(\alpha x)\right] dx$$
$$- \int_0^{\overline{y}} x^2 \alpha^{-2} G(x) f\left(\frac{x}{\alpha}\right) f(x) \left[F\left(\frac{x}{\alpha}\right) + F(x) - 2F(x)F\left(\frac{x}{\alpha}\right)\right] dx\Bigg)$$
$$+ 4\int_0^{\overline{y}} x^2 g(\alpha x) F(\alpha x) F(x) \left[1 - F(\alpha x)\right] f(x) dx + 2\int_0^{\overline{y}} x^2 g(\alpha x) F(\alpha x)^2 f(x) dx.$$

To sign the first two lines of this expression, we note that for any $x > \alpha\overline{y}$, $f\left(\frac{x}{\alpha}\right) = 0$. So

$$\int_0^{\overline{y}} x^2 \alpha^{-2} G(x) f\left(\frac{x}{\alpha}\right) f(x) \left[F\left(\frac{x}{\alpha}\right) + F(x) - 2F(x)F\left(\frac{x}{\alpha}\right)\right] dx \tag{49}$$
$$= \int_0^{\alpha\overline{y}} x^2 \alpha^{-2} G(x) f\left(\frac{x}{\alpha}\right) f(x) \left[F\left(\frac{x}{\alpha}\right) + F(x) - 2F(x)F\left(\frac{x}{\alpha}\right)\right] dx. \tag{50}$$

Making a change of variables from x to αx gives

$$\int_0^{\alpha\overline{y}} x^2 \alpha^{-2} G(x) f\left(\frac{x}{\alpha}\right) f(x) \left[F\left(\frac{x}{\alpha}\right) + F(x) - 2F(x)F\left(\frac{x}{\alpha}\right)\right] dx$$
$$= \int_0^{\overline{y}} (\alpha x)^2 \alpha^{-2} G(\alpha x) f\left(\frac{\alpha x}{\alpha}\right) f(\alpha x) \left[F\left(\frac{\alpha x}{\alpha}\right) + F(\alpha x) - 2F(\alpha x)F\left(\frac{\alpha x}{\alpha}\right)\right] \frac{d(\alpha x)}{dx} dx$$
$$= \alpha \int_0^{\overline{y}} x^2 G(\alpha x) f(x) f(\alpha x) \left[F(x) + F(\alpha x) - 2F(\alpha x)F(x)\right] dx.$$

Thus the derivative of expected welfare under centralization with respect to α is equal to

$$4(1-\alpha)\int_0^{\overline{y}} x^2 G(\alpha x) f(\alpha x) f(x) \left[F(\alpha x) + F(x) - 2F(x)F(\alpha x)\right] dx$$
$$+ 4\int_0^{\overline{y}} x^2 g(\alpha x) F(\alpha x) F(x) \left[1 - F(\alpha x)\right] f(x) dx + 2\int_0^{\overline{y}} x^2 g(\alpha x) F(\alpha x)^2 f(x) dx.$$

The last line of this expression is trivially non-negative. Since $F(x) < 1$ for all $x < \overline{y}$, $F(\alpha x) + F(x) > F(\alpha x)F(x) + F(x)F(\alpha x)$ for $x \in (0, \overline{y})$. Thus the first line of this expression is positive for $\alpha < 1$, so the whole expression is positive. Thus expected welfare under centralization is strictly increasing in α for all $0 < \alpha < 1$. □

Lemma 1.4: Expected welfare under centralization is continuous in α on the interval $[0, 1]$.

Proof. Differentiability of expected welfare under centralization with respect to α on $(0, 1]$ (see proof of lemma 1.3) implies continuity. As shown in the proof of lemma 1.2, expected welfare under centralization for $\alpha = 0$ is given by

$$2\int_0^{\overline{y}} x G(x) f(x) dx.$$

$\lim_{\alpha\to 0} E(\omega_{centralized})$ is equal to

$$
\begin{aligned}
&2\lim_{\alpha\to 0}\Bigg(\int_0^{\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right)^2 f(x)dx \\
&+2\int_0^{\overline{y}} xG(x)F(x)F\left(\frac{x}{\alpha}\right) f(x)dx - 2\int_0^{\overline{y}} xG(x)F(x)F\left(\frac{x}{\alpha}\right)^2 f(x)dx\Bigg) \\
&+\lim_{\alpha\to 0}\Bigg(2\int_0^{\overline{y}} xG(\alpha x)F(\alpha x)^2 f(x)dx + 4\int_0^{\overline{y}} xG(\alpha x)F(\alpha x)F(x)f(x)dx \\
&-4\int_0^{\overline{y}} xG(\alpha x)F(x)F(\alpha x)^2 f(x)dx\Bigg).
\end{aligned}
$$

The second parenthetical term is continuous with respect to α at 0 by differentiability, which follows from Leibniz' rule, and thus approaches zero as α approaches zero. Thus

$$
\begin{aligned}
&\lim_{\alpha\to 0} E(\omega_{centralized}) \\
&\qquad = 2\lim_{\alpha\to 0}\left(\int_0^{\overline{y}} xG(x)\left[F\left(\frac{x}{\alpha}\right)^2 + 2F(x)F\left(\frac{x}{\alpha}\right) - 2F(x)F\left(\frac{x}{a}\right)^2\right] f(x)dx\right) \quad (51)
\end{aligned}
$$

We claim that this expression is equal to $2\int_0^{\overline{y}} xG(x)f(x)dx$.
We have

$$
\begin{aligned}
&\int_0^{\overline{y}} xG(x)\left[F\left(\frac{x}{\alpha}\right)^2 + 2F(x)F\left(\frac{x}{\alpha}\right) - 2F(x)F\left(\frac{x}{a}\right)^2\right] f(x)dx && (52)\\
&= \int_0^{\alpha\overline{y}} xG(x)\left[F\left(\frac{x}{\alpha}\right)^2 + 2F(x)F\left(\frac{x}{\alpha}\right) - 2F(x)F\left(\frac{x}{a}\right)^2\right] f(x)dx && (53)\\
&+ \int_{\alpha\overline{y}}^{\overline{y}} xG(x)f(x)dx && (54)\\
&= \int_0^{\alpha\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right)^2 f(x)dx + 2\int_0^{\alpha\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right)F(x)f(x)dx && (55)\\
&- 2\int_0^{\alpha\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right)^2 F(x)f(x)dx + \int_{\alpha\overline{y}}^{\overline{y}} xG(x)f(x)dx. && (56)
\end{aligned}
$$

The first three integrals in this expression are all bounded above by $\alpha\overline{y}F(\alpha\overline{y})$ and below by 0. Thus they all approach zero as α approaches zero. So

$$\lim_{\alpha\to 0} E(\omega_{centralized}) = \lim_{\alpha\to 0}\int_{\alpha\overline{y}}^{\overline{y}} xG(x)f(x)dx \quad (57)$$

By the fundamental theorem of calculus, there is some continuous ϕ such that for all z, $\int_z^{\overline{y}} xG(x)f(x)dx = \phi(\overline{y}) - \phi(z)$. Thus

$$
\begin{aligned}
\lim_{\alpha\to 0} E(\omega_{centralized}) &= \lim_{\alpha\to 0}\Big(\phi(\overline{y}) - \phi(\alpha\overline{y})\Big) && (58)\\
&= \phi(\overline{y}) - \phi(0) && (59)\\
&= \int_0^{\overline{y}} xG(x)f(x)dx. && (60)
\end{aligned}
$$

Thus $\lim_{\alpha\to 0} E(\omega_{centralized}) = 2\int_0^{\overline{y}} xG(x)f(x)dx$, And expected welfare under centralization is continuous at $\alpha = 0$. $\square$

Lemma 2.1 When $\alpha = 1$, expected total corruption is lower under centralization than under decentralization.

Proof. We have that

$$\mathrm{E}\left(\mathbb{C}_{centralized}\right) = 4\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)^3 g(x)dx - 2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)^4 g(x)dx. \tag{61}$$

Thus

$$\mathrm{E}\left(\mathbb{C}_{centralized}\right) - \mathrm{E}\left(\mathbb{C}_{decentralized}\right) = \int_{\underline{\gamma}}^{\overline{\gamma}} \left[4F(x)^3 - 2F(x)^4 - 2F(x)^2\right] g(x)dx. \tag{62}$$

Defining $K(x) = 4x^3 - 2x^4 - 2x^2$ and noting that $F(x) = 0$ for $x < 0$, this expression is equal to

$$\int_0^{\overline{\gamma}} K\left(F(x)\right) g(x)dx. \tag{63}$$

We claim that $K(x) < 0$ for $x \in (0,1)$. To see this, note that $K'(x) = H(x)$, where H(x) is as defined in the proof of lemma 1.1. As shown in the proof of lemma 1.1, H(x) is negative for $x \in \left(0, \frac{1}{2}\right)$ and positive for $x \in \left(\frac{1}{2}, 1\right)$. Furthermore K(0)=K(1)=0. Thus by the mean value theorem, $K(x) < 0$ for $x \in (0,1)$. Thus the integrand is negative for $x \in (0, min\{\overline{y}, \overline{\gamma}\})$ and zero outside of this interval. Thus $\mathrm{E}\left(\mathbb{C}_{centralized}\right) - \mathrm{E}\left(\mathbb{C}_{decentralized}\right) < 0$. $\square$

Lemma 2.2 When $\alpha = 0$, expected total corruption is higher under centralization than under decentralization.

Proof. When $\alpha = 0$, a politician under a centralized structure will divert one project's worth of resources for each home project that provides payoff lower than γ. Thus expected total corruption under centralization is

$$\mathrm{E}\left(\mathbb{C}_{centralized}\right) = 2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)g(x)dx \tag{64}$$

and

$$\mathrm{E}\left(\mathbb{C}_{centralized}\right) - \mathrm{E}\left(\mathbb{C}_{decentralized}\right) = 2\int_{\underline{\gamma}}^{\overline{\gamma}} [F(x) - F(x)^2]g(x)dx. \tag{65}$$

Since $F(x) > F(x)^2$ for $x \in (0, \overline{y})$ and $F(x) = F(x)^2$ for all other x, the integrand is positive for $x \in (0, min\{\overline{y}, \overline{\gamma}\})$ and zero for x outside of this interval. Thus

$$\mathrm{E}\left(\mathbb{C}_{centralized}\right) - \mathrm{E}\left(\mathbb{C}_{decentralized}\right) > 0. \tag{66}$$

$\square$

Lemma 2.3: Expected total corruption under centralization is decreasing in α for $\alpha \in (0,1)$.

Proof. For $\alpha \neq 0$, leibniz' rule gives that expected welfare under centralization is differentiable with respect to α with derivative

$$-\frac{4}{\alpha^2}\int_{\underline{\gamma}}^{\overline{\gamma}} xF(x)F\left(\frac{x}{\alpha}\right) f\left(\frac{x}{\alpha}\right) g(x)dx - \frac{2}{\alpha^2}\int_{\underline{\gamma}}^{\overline{\gamma}} xF(x)^2 f\left(\frac{x}{\alpha}\right) g(x)dx \tag{67}$$

$$+\frac{4}{\alpha^2}\int_{\underline{\gamma}}^{\overline{\gamma}} xF(x)^2 F\left(\frac{x}{\alpha}\right) f\left(\frac{x}{\alpha}\right) g(x)dx. \tag{68}$$

Since $xF(x)F\left(\frac{x}{\alpha}\right)f\left(\frac{x}{\alpha}\right)g(x) \geq xF(x)^2F\left(\frac{x}{\alpha}\right)f\left(\frac{x}{\alpha}\right)g(x)$ for all x, the sum of the first and third integrals in this expression is non-positive. Thus the whole expression is negative. □

Lemma 2.4: Expected total corruption under centralization is continuous in α for $\alpha \in [0,1]$.

Proof. Continuity for $0 < \alpha \leq 1$ follows from differentiability. To show continuity at $\alpha = 0$, consider the collection of functions f_n for $n \in \mathbb{N}$ given by

$$f_n = F(x)F\left(\frac{x}{\frac{1}{n}}\right)\left[F\left(\frac{x}{\frac{1}{n}}\right) + F(x) - F\left(\frac{x}{\frac{1}{n}}\right)F(x)\right]g(x). \tag{69}$$

We note that for any $x > 0$, there exists $M \in \mathbb{N}$ such that for all $n > M$, $\frac{x}{\frac{1}{n}} > \overline{y}$ and thus $F\left(\frac{x}{\frac{1}{n}}\right) = 1$. Thus f_n converges pointwise to $F(x)g(x)$. We note further that this sequence is dominated by $F(x)g(x) + F(x)^2g(x)$. Thus it follows by the dominated convergence theorem that

$$\lim_{n\to\infty}\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)F\left(\frac{x}{\frac{1}{n}}\right)\left[F\left(\frac{x}{\frac{1}{n}}\right) + F(x) - F\left(\frac{x}{\frac{1}{n}}\right)F(x)\right]g(x)dx$$
$$= \int_{\underline{\gamma}}^{\overline{\gamma}} F(x)g(x)dx. \tag{70}$$

It follows that

$$\lim_{\alpha\to 0} \mathrm{E}\left(\mathbb{C}_{centralized}\right) = \lim_{\alpha\to 0} 2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)F\left(\frac{x}{\alpha}\right)\left[F\left(\frac{x}{\alpha}\right) + F(x) - F\left(\frac{x}{\alpha}\right)F(x)\right]g(x) \tag{71}$$
$$= 2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)g(x)dx. \tag{72}$$

Thus $\mathrm{E}\left(\mathbb{C}_{centralized}\right)$ is continuous in α for $\alpha = 0$, and thus for all $\alpha \in [0,1]$. □

Proposition 6: Given any f and α, there exists some g such that the civil servant model provides minimal expected social welfare relative to other government structures.

The proof consists of constructing one example of a continuous g such that the expected payoff from one home project site is higher than the expected payoff from four away project sites. A construction like this one could be used to generate $G(\alpha\overline{y})$ arbitrarily close to zero and $G(\alpha\overline{y} + \epsilon) = 1$ for ϵ arbitrarily small.

Proof. Let

$$\beta = \int_{\frac{\alpha+1}{2}\overline{y}}^{\overline{y}} xf(x)dx. \tag{73}$$

Note that $\beta > 0$ by the continuity of f. Let $\overline{\gamma} = \frac{\alpha+1}{2}\overline{y}$ and $\underline{\gamma} = 0$. Consider g(x) linear on the intervals $[0, \alpha\overline{y}]$, $[\alpha\overline{y}, \frac{1+3\alpha}{4}\overline{y}]$, and $[\frac{1+3\alpha}{4}\overline{y}, \frac{\alpha+1}{2}\overline{y}]$. Define

$$g(\alpha\overline{y}) = \frac{\beta}{4\alpha\overline{y}^2} \tag{74}$$

$$g\left(\frac{1+3\alpha}{4}\overline{y}\right) = \frac{32\alpha\overline{y}^2 - 4\beta\alpha\overline{y} + \beta - \alpha\beta}{\left(8\alpha\overline{y}^2\right)(1-\alpha)} \tag{75}$$

Note that $\int_{-\infty}^{\infty} g(x)dx = 1$ and g is continuous. We have $G(\alpha\overline{y}) = \frac{\beta}{8\overline{y}}$. Thus the expected social welfare from a project outside the politician's home area is

$$\int_0^{\overline{y}} xG(\alpha x)f(x)dx < \overline{y}G(\alpha\overline{y}) \tag{76}$$

$$< \frac{\beta}{8}. \tag{77}$$

Moreover, expected welfare under a civil servant model is

$$\int_0^{\overline{y}} xG(\alpha x)[12F(x)^2 - 8F(x)^3]f(x)dx. \tag{78}$$

$12F(x)^2 - 8F(x)^3 \leq 1$ for all x, so

$$\int_0^{\overline{y}} xG(\alpha x)[12F(x)^2 - 8F(x)^3]f(x)dx \leq 4\int_0^{\overline{y}} xG(\alpha x)f(x)dx \tag{79}$$

$$< \frac{\beta}{2}. \tag{80}$$

Expected social welfare from one home project is

$$\int_0^{\overline{y}} xG(x)f(x)dx = \int_0^{\frac{\alpha+1}{2}\overline{y}} xG(x)f(x)dx + \int_{\frac{\alpha+1}{2}\overline{y}}^{\alpha\overline{y}} xG(x)f(x)dx \tag{81}$$

$$= \int_0^{\frac{\alpha+1}{2}\overline{y}} xG(x)f(x)dx + \beta \tag{82}$$

$$> \beta. \tag{83}$$

Thus any constitutional structure in which at least one politician is responsible for at least one site from his home area (this describes all of the constitutional structures discussed above) provides higher expected social welfare given g than the civil servant model. □

Proposition 7: Decentralization combining identity groups leads to lower expected social welfare and higher expected total corruption than unconstrained decentralization when home favoritism and corruption is present ($\alpha < 1$).

Proof. In either region, expected social welfare under decentralization combining identity groups is given by

$$\mathrm{E}_{constrained} = \int_0^{\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right)f(x)dx + \int_0^{\overline{y}} xG(\alpha x)F(\alpha x)f(x)dx. \tag{84}$$

We note that when $\alpha = 1$,

$$\mathrm{E}(\omega_{constrained}) = 2\int_0^{\overline{y}} xG(x)F(x)f(x)dx \tag{85}$$

$$= \mathrm{E}(\omega_{unconstrained}). \tag{86}$$

For $\alpha < 1$, we have

$$\frac{\partial}{\partial\alpha}\left(\mathrm{E}(\omega_{constrained})\right) = -\frac{1}{\alpha^2}\int_0^{\overline{y}} x^2 G(x) f\left(\frac{x}{\alpha}\right) f(x)dx + \int_0^{\overline{y}} x^2 G(\alpha x) f(\alpha x) f(x)dx \tag{87}$$

$$+ \int_0^{\overline{y}} x^2 g(\alpha x) f(\alpha x) f(x)dx \tag{88}$$

$$= -\frac{1}{\alpha^2}\int_0^{\alpha\overline{y}} x^2 G(x) f\left(\frac{x}{\alpha}\right) f(x)dx + \int_0^{\overline{y}} x^2 G(\alpha x) f(\alpha x) f(x)dx \tag{89}$$

$$+ \int_0^{\overline{y}} x^2 g(\alpha x) f(\alpha x) f(x)dx \tag{90}$$

$$= -\frac{1}{\alpha^2}\alpha \int_0^{\overline{y}} (\alpha x)^2 G(\alpha x) f(x) f(\alpha x)dx + \int_0^{\overline{y}} x^2 G(\alpha x) f(\alpha x) f(x)dx \tag{91}$$

$$+ \int_0^{\overline{y}} x^2 g(\alpha x) f(\alpha x) f(x)dx \tag{92}$$

$$= -\alpha \int_0^{\overline{y}} x^2 G(\alpha x) f(x) f(\alpha x)dx + \int_0^{\overline{y}} x^2 G(\alpha x) f(\alpha x) f(x)dx \tag{93}$$

$$+ \int_0^{\overline{y}} x^2 g(\alpha x) f(\alpha x) f(x)dx \tag{94}$$

$$> 0. \tag{95}$$

Thus by the mean value theorem, $E(\omega_{constrained}) - E(\omega_{unconstrained}) < 0$ for $\alpha < 1$.
In either region, expected total corruption is given by

$$E\left(\mathbb{C}_{constrained}\right) = \int_{\underline{\gamma}}^{\overline{\gamma}} F(x)F(\frac{x}{\alpha})g(x)dx. \tag{96}$$

$F(\frac{x}{\alpha}) > F(x)$ for all $0 < x < \alpha\overline{y}$, and $F(\frac{x}{\alpha}) = F(x)$ for all other x. Thus when corruption is present ($\overline{\gamma} > 0$), we have

$$E\left(\mathbb{C}_{constrained}\right) = \int_{\underline{\gamma}}^{\overline{\gamma}} F(x)F(\frac{x}{\alpha})g(x)dx \tag{97}$$

$$> \int_{\underline{\gamma}}^{\overline{\gamma}} F(x)^2 g(x)dx \tag{98}$$

$$= E\left(\mathbb{C}_{unconstrained}\right). \tag{99}$$

□

Proposition 8: Decentralization with geographic divisions smaller than the unit of identity leads to lower expected social welfare and higher expected corruption) than decentralization in which geographic units correspond with identity units.

Proof. Under geographic divisions smaller than the unit of identy, each sub-region (NW, SW, NE, SE) has expected social welfare given by

$$\frac{1}{2}\int_0^{\overline{y}} xG(x)f(x)dx \tag{100}$$

and expected total corruption given by

$$\frac{1}{2}\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)g(x)dx. \tag{101}$$

Thus overall expected social welfare is

$$E(\omega_{constrained}) = 2\int_0^{\overline{y}} xG(x)f(x)dx \tag{102}$$

and overall expected total corruption is

$$E(\mathbb{C}_{constrained}) = 2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)g(x)dx. \tag{103}$$

When corruption is present ($\overline{\gamma} > 0$,)

$$E(\mathbb{C}_{constrained}) = 2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)g(x)dx \tag{104}$$

$$> 2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)^2 g(x)dx \tag{105}$$

$$= E(\mathbb{C}_{unconstrained}). \tag{106}$$

To see that expected social welfare is lower under small geographic divisions than under unconstrained decentralization, note first that

$$E(\omega_{constrained}) - E(\omega_{unconstrained}) = 2\int_0^{\overline{y}} xG(x)[1-2F(x)]f(x)dx. \tag{107}$$

As shown in the proof of lemma 1.2, this expression is negative, so $E(\omega_{unconstrained}) > E(\omega_{constrained})$. □

Minimum Spending Clause

Proposition 6
In the absence of corruption ($\overline{\gamma} \leq 0$), expected welfare is higher under the civil servant model than under a minimum spending clause.

Proof.

Lemma 12.1. *Expected welfare under a minimum spending clause is increasing in* α *for* $0 < \alpha < 1$.

Proof. We have

$$\begin{aligned}
\frac{\partial}{\partial\alpha}E(\omega) &= 4\int_0^{\overline{y}} x^2[1-F(x)]F(\alpha x)f(\alpha x)f(x)dx \\
&- \frac{4}{\alpha^2}\int_0^{\overline{y}} x^2F(x)f\left(\frac{x}{\alpha}\right)f(x)dx + \frac{4}{\alpha^2}\int_0^{\overline{y}} F(x)F\left(\frac{x}{\alpha}\right)f\left(\frac{x}{\alpha}\right)dx \\
&= 4\int_0^{\overline{y}} x^2[1-F(x)]F(\alpha x)f(\alpha x)f(x)dx - \frac{4}{\alpha^2}\int_0^{\overline{y}} x^2F(x)[1-F\left(\frac{x}{\alpha}\right)]f\left(\frac{x}{\alpha}\right)f(x)dx \\
&= 4(1-\alpha)\int_0^{\overline{y}} x^2[1-F(x)]F(\alpha x)f(\alpha x)f(x)dx \\
&> 0
\end{aligned}$$

□

Lemma 12.2. *Expected welfare is higher under the civil servant model than under a minimum spending clause when* $\alpha = 1$.

Proof. When $\alpha = 1$,

$$E(\omega_{minspend}) = 2\int_0^{\overline{y}} xG(x)F(x)f(x)dx + 6\int_0^{\overline{y}} xG(x)F(x)^2 f(x)dx - 4\int_0^{\overline{y}} xG(x)F(x)^3 f(x)dx. \tag{108}$$

Thus the difference between expected welfare under the civil servant model and expected welfare under a minimum spending clause is

$$2\int_0^{\overline{y}} xG(x)[3F(x)^2 - 2F(x)^3 - F(x)]f(x)dx \tag{109}$$

Note that for any x, $3x^2 - 2x^3 - x = \frac{1}{4}H(x)$, where $H(x)$ is as defined in the proof of lemma 1.1. Thus the result follows directly from the proof of lemma 1.1. □

The proposition follows immediately from the preceding lemmas. □

Proposition 7 In the absence of corruption ($\overline{\gamma} \leq 0$), expected welfare under a minimum spending clause is higher than expected welfare under decentralization to identity units when $\alpha > 0$.

Proof. Note that expected welfare under a minimum spending clause is continuous in alpha for $0 < \alpha < 1$ by differentiability. We claim that expected welfare under a minimum spending clause approaches expected welfare under decentralization to identity units as α approaches zero. To see this note first that

$$2xF(x)F(\frac{x}{\alpha})[2 - F\left(\frac{x}{\alpha}\right)]f(x) + 2x[1 - F(x)]F(\alpha x)^2 f(x) \tag{110}$$

is positive and bounded above by

$$E(\omega) = x\left[4F(x) + 2(1 - F(x))\right]f(x)dx \tag{111}$$

for all α. Now consider the sequence of functions f_n for $n \in N$, given by

$$f_n = 2xF(x)F\left(\frac{x}{\frac{1}{n}}\right)\left[2 - F\left(\frac{x}{\frac{1}{n}}\right)\right]f(x) + 2\int_0^{\overline{y}} x[1 - F(x)]F\left(\frac{1}{n}x\right)^2 f(x). \tag{112}$$

For any $x > 0$, there exists $M \in \mathbb{N}$ such that for all $n > M$, $\frac{x}{\frac{1}{n}} > \overline{y}$ and thus $F\left(\frac{x}{\frac{1}{n}}\right) = 1$. Furthermore, by the continuity of F, for any $\epsilon > 0$ there exists $x' \in (0, \overline{y})$ such that $F(x') < \epsilon$ for all $x < x'$. For any $x \in (0, \overline{y})$, there exists some $M \in \mathbb{N}$ such that for all $n > M$, $\frac{x}{n} < x'$, and thus $F\left(\frac{x}{n}\right) < 0$. Thus $\{f_n\}$ converges pointwise to

$$2xF(x)f(x). \tag{113}$$

Thus by the bounded convergence theorem

$$\lim_{n\to\infty}\int_0^{\overline{y}} f_n dx = \int_0^{\overline{y}} \lim_{n\to\infty} f_n dx \tag{114}$$

$$= 2\int_0^{\overline{y}} xF(x)f(x)dx. \tag{115}$$

It follows that

$$\lim_{\alpha\to 0} E(\omega_{min}) = 4\int_0^{\overline{y}} xF(x)f(x)dx \tag{116}$$

$$= E_(\omega_{decentralized}). \tag{117}$$

By the mean value theorem and the fact that expected welfare under a minimum spending clause is increasing in α, expected welfare under a mininimum spending clause is greater than expected welfare under decentralization to identity units for all $\alpha > 0$. □

Proposition 8 Expected welfare is higher under a minimum spending clause than under an equal treatment clause whenever $\alpha > 0$.

Proof. Noting that the difference between expected welfare under a minimum spending clause and under an equal treatment clause is equal to the difference between expected welfare under a minimum spending clause in the absence of corruption and decentralization to identity units, the proof is immediate from the proof of proposition 7. □

Proposition 13. *For any α, f, and g, there exists a constitutional structure which provides higher expected welfare than a minimum spending clause.*

Proof. Note first that when $\alpha = 1$, the proposition holds by lemma **??**. Assume for the rest of the proof that $\alpha < 1$ We show that a minimum spending clause provides expected social welfare higher than or equal to that provided by decentralization to identity units only if it provides lower expected social welfare than a civil servant structure.

If a minimum spending clause provides weakly higher expected social welfare than decentralization, we have

$$2\int_0^{\overline{y}} G(x)F(x)F(\frac{x}{\alpha})[2 - F\left(\frac{x}{\alpha}\right)]f(x)dx + 2\int_0^{\overline{y}} G(\alpha x)F(x)f(x)dx + 2\int_0^{\overline{y}} G(\alpha x)[1 - F(x)]F(\alpha x)^2 f(x)dx - 4\int_0^{\overline{y}} G(x)F(x)f(x)dx \geq 0, \quad (118)$$

Where the lefthand side of this expression is the difference in expected welfare between a minimum spending clause and decentralization. We can rearrange this expression as

$$\left(2\int_0^{\overline{y}} G(x)F(x)F(\frac{x}{\alpha})[2 - F\left(\frac{x}{\alpha}\right)]f(x)dx + 2\int_0^{\overline{y}} G(\alpha x)[1 - F(x)]F(\alpha x)^2 f(x)dx - 2\int_0^{\overline{y}} G(x)F(x)f(x)dx\right) + \left(2\int_0^{\overline{y}} G(\alpha x)F(x)f(x)dx - 2\int_0^{\overline{y}} G(x)F(x)f(x)dx\right). \quad (119)$$

By a straightforward extension of the proof of lemma 16.1 (which demonstrates that expected welfare under a minimum spending clause is increasing in α [NOTE: would be fairly redundant to prove this, since it's just the same proof but treating the alpha in G(alpha x) as constant, but could do it for completeness], we can derive

$$\begin{aligned} &2\int_0^{\overline{y}} G(x)F(x)F(\frac{x}{\alpha})[2 - F\left(\frac{x}{\alpha}\right)]f(x)dx + 2\int_0^{\overline{y}} G(\alpha x)[1 - F(x)]F(\alpha x)^2 f(x)dx \\ &< 2\int_0^{\overline{y}} G(x)F(x)^2[2 - F(x)]f(x)dx + 2\int_0^{\overline{y}} G(\alpha x)[1 - F(x)]F(x)^2 f(x)dx \\ &= 2\int_0^{\overline{y}} G(x)[2F(x)^2 - F(x)^3]f(x)dx + 2\int_0^{\overline{y}} G(\alpha x)[F(x)^2 - F(x)^3]f(x)dx. \quad (120)\end{aligned}$$

By equations 119 and 120, we derive

$$2\int_0^{\overline{y}} G(x)[2F(x)^2 - F(x)^3 - F(x)]f(x)dx + 2\int_0^{\overline{y}} G(\alpha x)[F(x)^2 - F(x)^3]f(x)dx$$
$$+ 2\int_0^{\overline{y}} [G(\alpha x) - G(x)]F(x)f(x)dx > E(\omega)_{min} - E(\omega)_{decentralized}. \quad (121)$$

Subtracting expected welfare under a minimum spending clause from expected welfare under a civil servant structure gives

$$4\int_0^{\overline{y}} xG(\alpha x)[3F(x)^2 - 2F(x)^3]f(x)dx - 2\int_0^{\overline{y}} G(x)F(x)F(\frac{x}{\alpha})[2 - F\left(\frac{x}{\alpha}\right)]f(x)dx \quad (122)$$
$$- 2\int_0^{\overline{y}} G(\alpha x)[1 - F(x)]F(\alpha x)^2 f(x)dx - 2\int_0^{\overline{y}} G(\alpha x)F(x)f(x)dx. \quad (123)$$

By (120), this expression is greater than

$$4\int_0^{\overline{y}} xG(\alpha x)[3F(x)^2 - 2F(x)^3]f(x)dx - 2\int_0^{\overline{y}} G(x)[2F(x)^2 - F(x)^3]f(x)dx \quad (124)$$
$$- 2\int_0^{\overline{y}} G(\alpha x)[F(x)^2 - F(x)^3]f(x)dx - 2\int_0^{\overline{y}} G(\alpha x)F(x)f(x)dx. \quad (125)$$

Splitting $4\int_0^{\overline{y}} xG(\alpha x)[3F(x)^2 - 2F(x)^3]f(x)dx$ gives that the above expression is equal to

$$\left[2\int_0^{\overline{y}} xG(\alpha x)[3F(x)^2 - 2F(x)^3]f(x)dx + 2\int_0^{\overline{y}} xG(\alpha x)[2F(x)^2 - F(x)^3]f(x)dx\right. \quad (126)$$
$$\left.+ 2\int_0^{\overline{y}} xG(\alpha x)[F(x)^2 - F(x)^3]f(x)dx\right] \quad (127)$$
$$- 2\int_0^{\overline{y}} G(x)[2F(x)^2 - F(x)^3]f(x)dx - 2\int_0^{\overline{y}} G(\alpha x)[F(x)^2 - F(x)^3]f(x)dx \quad (128)$$
$$- 2\int_0^{\overline{y}} G(\alpha x)F(x)f(x)dx \quad (129)$$
$$= 2\int_0^{\overline{y}} xG(\alpha x)[3F(x)^2 - 2F(x)^3 - F(x)]f(x)dx \quad (130)$$
$$+ 2\int_0^{\overline{y}} x[G(\alpha x) - G(x)][2F(x)^2 - F(x)^3]f(x)dx \quad (131)$$
$$= \left[2\int_0^{\overline{y}} xG(\alpha x)[2F(x)^2 - F(x)^3 - F(x)]f(x)dx + 2\int_0^{\overline{y}} xG(\alpha x)[F(x)^2 - F(x)^3]\right] \quad (132)$$
$$+ 2\int_0^{\overline{y}} x[G(\alpha x) - G(x)][2F(x)^2 - F(x)^3]f(x)dx \quad (133)$$

We claim that $2F(x)^2 - F(x)^3$ is strictly less than $F(x)$ for all $x \in (0, \overline{y})$. To see this, note that $Q(x) = 2x^2 - x^3 - x = -x(x-1)^2$ has roots only at 0 and 1. Furthermore, Q(x) is negative when $x = \frac{1}{2}$, and thus by continuity and the fact that it has no roots on this interval, is negative for all $x \in (0, 1)$.
From this fact, we derive both

$$\int_0^{\overline{y}} xG(\alpha x)[2F(x)^2 - F(x)^3 - F(x)]f(x)dx \geq \int_0^{\overline{y}} xG(x)[2F(x)^2 - F(x)^3 - F(x)]f(x)dx \quad (134)$$

and

$$2\int_0^{\overline{y}} x[G(\alpha x) - G(x)][2F(x)^2 - F(x)^3]f(x)dx \geq 2\int_0^{\overline{y}} [G(\alpha x) - G(x)]F(x)f(x)dx \tag{135}$$

by the fact that $G(\alpha x) \leq G(x)$ for all x. Thus

$$E(\omega)_{civilservant} - E(\omega)_{min} > 2\int_0^{\overline{y}} xG(\alpha x)[2F(x)^2 - F(x)^3 - F(x)]f(x)dx \tag{136}$$

$$+ 2\int_0^{\overline{y}} xG(\alpha x)[F(x)^2 - F(x)^3] \tag{137}$$

$$+ 2\int_0^{\overline{y}} x[G(\alpha x) - G(x)][2F(x)^2 - F(x)^3]f(x)dx \tag{138}$$

$$\geq 2\int_0^{\overline{y}} G(x)[2F(x)^2 - F(x)^3 - F(x)]f(x)dx \tag{139}$$

$$+ 2\int_0^{\overline{y}} G(\alpha x)[F(x)^2 - F(x)^3]f(x)dx \tag{140}$$

$$+ 2\int_0^{\overline{y}} [G(\alpha x) - G(x)]F(x)f(x)dx. \tag{141}$$

Thus by (118)

$$E(\omega)_{civilservant} - E(\omega)_{min} > E(\omega)_{min} - E(\omega)_{decentralized} \tag{142}$$

$$\geq 0. \tag{143}$$

□

7 Appendix B: Politician Constraints

Assume politicians are indifferent between sites of equal quality regardless of their area. Assume further that politicians incur some cost $c \geq 0$ in the form of punishment from home villagers for each project's worth of funds which they divert to themselves or put toward a project in a non-home area. Under these assumptions, each politician's utility U is given by

$$U = (\gamma - c)\mathbf{C} + \sum_{n=0}^{m} y_{nD}\mathbf{Q_{nD}} + \sum_{n=0}^{4-m} [y_{nF} - c]\mathbf{Q_{nF}}, \tag{144}$$

where all variables are defined as above. This assumption yields results very similar to those in the body of the paper.

Proposition 14. *There exists some $c_h \geq c_l \in (0, \overline{y})$ such that for $c > c_h$, expected welfare is higher under a decentralized structure than under a centralized structure and for $c < c_l$, expected welfare is higher under a centralized structure than under a decentralized structure.*

When there is no punishment from home villagers (c=0), centralization provides higher expected welfare than decentralization by the fact that the centralized politician faces a broader choice set than each decentralized politician. As punishment (c) increases, project sites in the non-home area are overlooked for increasingly low-value sites in the home area, resulting in a reduction in expected welfare. Under the villager punishment assumption, an increase in c also decreases the value of corruption relative to projects in the home area. Because the expected welfare from the two home sites in a centralized structure is lower than the expected welfare from the four home sites in a decentralized structure, for c sufficiently high this effect increases expected utility under decentralization more than it does under centralization.

It will again be useful to calculate expected welfare under both constitutional structures before proving proposition 9.

Under a decentralized structure, expected welfare in area i is given by

$$E(max\{y_{1i}, y_{2i}\}|max\{y_{1i}, y_{2i}\} > \gamma - c)P(max\{y_{1i}, y_{2i}\} > \gamma - c)$$
$$= 2\int_0^{\overline{y}} xG(x+c)F(x)f(x)dx. \quad (145)$$

Thus total expected welfare (summing expected welfare across both areas) is

$$4\int_0^{\overline{y}} xG(x+c)F(x)f(x)dx. \quad (146)$$

To calculate expected welfare under a centralized structure, we first calculate the expected welfare provided by the first project site in the politician's home area. This project site will pay off y_{1D} when one of three mutually exclusive events occurs.

Event 1 : $y_{1D} > y_{1F} - c,\ y_{1D} > y_{2F} - c$ and $y_{1D} > \gamma - c$
Event 2 : $y_{1D} > y_{2D},\ y_{1D} < y_{1F} - c,\ y_{1D} > y_{2F} - c$ and $y_{1D} > \gamma - c$
Event 3 : $y_{1D} > y_{2D},\ y_{1D} > y_{1F} - c,\ y_{1D} < y_{2F} - c$ and $y_{1D} > \gamma - c$

The expected welfare provided by the first project site in the politician's home area is thus–by a derivation very similar to that given in the basic decentralization and unconstrained centralization subsection of the models results–given by

$$\int_0^{\overline{y}} xG(x+c)F(x+c)^2 f(x)dx + 2\int_0^{\overline{y}} xG(x+c)F(x)F(x+c)f(x)dx$$
$$-2\int_0^{\overline{y}} xG(x+c)F(x)F(x+c)^2 f(x)dx.$$

Omitting similar steps for the other project sites, we have that total expected welfare under centralization is given by

$$2\int_0^{\overline{y}} xG(x+c)F(x+c)^2 f(x)dx + 4\int_0^{\overline{y}} xG(x+c)F(x)F(x+c)f(x)dx$$
$$-4\int_0^{\overline{y}} xG(x+c)F(x)F(x+c)^2 f(x)dx$$
$$+2\int_0^{\overline{y}} xG(x)F(x-c)^2 f(x)dx + 4\int_0^{\overline{y}} xG(x)F(x)F(x-c)f(x)dx$$
$$-4\int_0^{\overline{y}} xG(x)F(x)F(x-c)^2 f(x)dx.$$

Lemma 14.1. *If c=0, then expected welfare is higher under a centralized structure than under a decentralized structure.*

Proof. Note that when c=0, welfare outcomes under both government structures are identical to those considered in lemma 1.1, and thus the result follows from lemma 1.1. □

Lemma 14.2. *If* $c = \max\{\overline{y}, \overline{\gamma}\}$*, then expected welfare is higher under a decentralized structure than under a centralized structure.*

Proof. Note that for $x \leq \overline{y}$, F(x-c)=0 and for $x \geq 0$, F(x+c)=G(x+c)=1. Thus expected welfare under centralization is given by

$$2\int_{0}^{\overline{y}} xf(x)dx. \tag{147}$$

Expected welfare under decentralization is given by

$$4\int_{0}^{\overline{y}} xF(x)f(x)dx. \tag{148}$$

The proof of lemma 1.2 (with G(x) dropped from relevant integrands) demonstrates the rest of the result. □

Lemma 14.3. *The difference between expected welfare under centralization and expected welfare under decentralization is continuous in c for all $c \geq 0$.*

Proof. Since f and g are continuous everywhere, all integrands in the expressions for expected welfare under centralization and decentralization are continuously differentiable with respect to c. Thus by Liebniz' rule, the expressions themselves are differentiable with respect to c, and thus are continuous in c. □

Proposition 9 follows immediately from lemmas 9.1, 9.2, and 9.3.

Proposition 15. *There exist some $c_h^* \geq c_l^* \in (0, \overline{\gamma})$ such that for $\overline{\gamma} > c > c_h^*$, expected corruption is higher under a centralized structure than under a decentralized structure and for $c < c_l^*$, expected welfare is higher under a decentralized structure than under a decentralized structure.*

Expected corruption under decentralization is given by

$$2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x-c)^2 g(x)dx. \tag{149}$$

Expected corruption under centralization is given by

$$2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x-c)^2F(x)^2g(x)dx + 2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x-c)[1-F(x-c)]F(x)^2g(x)dx$$
$$2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x-c)^2F(x)[1-F(x)]g(x)dx \tag{150}$$

which is equal to

$$2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x-c)F(x)[F(x)+F(x-c)-F(x)F(x-c)]g(x)dx. \tag{151}$$

Lemma 15.1. *When c=0, expected corruption is lower under centralization than under decentralization.*

Proof. When c=0, expected total corruption under decentralization is

$$2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)^2g(x)dx, \tag{152}$$

and expected total corruption under centralization is

$$4\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)^3g(x)dx - 2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)^4g(x)dx. \tag{153}$$

These are the expressions for expected corruption when $\alpha = 1$, and thus the proposition follows directly from the proof of lemma 1.1. □

Lemma 15.2. *There exists some $c_h^* \in (0, \overline{\gamma})$ such that for $\overline{\gamma} > c > c_h^*$, expected corruption is higher under a centralized structure than under a decentralized structure.*

Proof. We break the proof down into two cases to highlight that $\overline{y}$ is an upper bound on c_h^*, but note that the proof of the second case generalizes to the proof of the first case.

Case 1: $\overline{\gamma} > \overline{y}$.

Take $\overline{\gamma} > c \geq \overline{y}$. Then projects will never be completed in the centralized politician's non-home area, and expected corruption under centralization is given by

$$2 \int_{\overline{y}}^{\overline{\gamma}} F(x-c)g(x)dx \tag{154}$$

and

$$E(\mathbb{C})_{centralized} - E(\mathbb{C})_{decentralized} = 2 \int_{\overline{y}}^{\overline{\gamma}} [F(x-c) - F(x-c)^2]g(x)dx. \tag{155}$$

The integrand of this expression is positive for $c < x < \overline{y} + c$ and zero for all other x, and thus the expression is positive.

Case 2: $\overline{\gamma} \leq \overline{y}$.

We can write the difference in expected total corruption between both structures as

$$E(\mathbb{C})_{centralized} - E(\mathbb{C})_{decentralized} = \\ 2 \int_{\underline{\gamma}}^{\overline{\gamma}} F(x-c)[F(x)^2 - F(x-c)]g(x)dx + 2 \int_{\underline{\gamma}}^{\overline{\gamma}} F(x-c)^2[F(x) - F(x)^2]g(x)dx \tag{156}$$

The second term in this expression is always non-negative. We claim that the first term is positive for c sufficiently close to $\overline{\gamma}$. To see this, choose some arbitrary $0 < \dot{\gamma} < \overline{\gamma}$. By the fact that $F(x-c)$ is continuous and $F(\overline{\gamma} - c) = 0$ when $c = \overline{\gamma}$, there is some $\dot{c} < \overline{\gamma}$ such that $F(\overline{\gamma} - c) < F(\dot{\gamma})$ whenever $\dot{c} < c < \overline{\gamma}$. Since F(x-c) is decreasing in x, $F(\overline{\gamma} - c) < F(\dot{\gamma})$ implies that $F(x-c) < F(\dot{\gamma})$ for all x in $(\underline{\gamma}, \overline{\gamma})$. We claim that for any c such that $\overline{\gamma} > c > \max \dot{c}, \tilde{\gamma}$,

$$2 \int_{\underline{\gamma}}^{\overline{\gamma}} F(x-c)[F(x)^2 - F(x-c)]g(x)dx > 0. \tag{157}$$

We have

$$2 \int_{\underline{\gamma}}^{\overline{\gamma}} F(x-c)[F(x)^2 - F(x-c)]g(x)dx = 2 \int_{c}^{\overline{\gamma}} F(x-c)[F(x)^2 - F(x-c)]g(x)dx. \tag{158}$$

Since $c > \dot{\gamma}$, $F(x)^2 > F(c)^2 > F(\dot{\gamma})^2$ for all $x > c$. Since $c > \dot{c}$, $F(x-c) < F(\dot{\gamma})$ for all $x > c$. Since $\underline{\gamma} \leq 0 < c < \overline{\gamma}$, $F(x-c)g(x) > 0$ for all $x \in (c, \overline{\gamma})$. Thus

$$2 \int_{\underline{\gamma}}^{\overline{\gamma}} F(x-c)[F(x)^2 - F(x-c)]g(x)dx > 0. \tag{159}$$

□

Lemma 15.3. *The difference between expected total corruption under centralization and expected total corruption under decentralization is continuous in c for all $c \geq 0$.*

Proof. This lemma follows immediately from the continuity of f and g and Leibniz' law. ☐

Proof. Proposition 10 follows immediately from lemmas 10.1, 10.2, and 10.3. ☐

7.1 Constrained Centralization

7.1.1 Centralization with Equal Treatment Clause

We note that under an equal treatment clause we have

$$E(\omega) = 2\int_0^{\overline{y}} xG(x+c)F(x)f(x)dx + 2\int_0^{\overline{y}} xG(x)F(x)f(x)dx \tag{160}$$

$$E(\mathbb{C}) = \int_{\underline{\gamma}}^{\overline{\gamma}} F(x+c)^2 g(x)dx + \int_{\underline{\gamma}}^{\overline{\gamma}} F(x)^2 g(x)dx. \tag{161}$$

Proposition 16. *In the absence of corruption ($\overline{\gamma} \leq 0$), a centralized constitution with an equal treatment clause is equivalent to a decentralized constitution.*

Proof. Suppose $\overline{\gamma} \leq 0$, then for all $x \in [0, \overline{y}]$, $G(x) = G(x+c) = 1$. So

$$E(\omega) = 4\int_0^{\overline{y}} xF(x)f(x)dx \tag{162}$$

under both decentralization and centralization with an equal treatment clause. Furthermore, for $x < \overline{\gamma}$, $F(x) = F(x+c) = 0$. Thus expected total corruption is zero under both decentralization and centralization with an equal treatment clause. ☐

Proposition 17. *When corruption and villager punishment are present ($\overline{\gamma} > 0$ and $c > 0$) a centralized constitution with an equal treatment clause generates lower expected social welfare and greater expected total corruption than a decentralized constitution.*

Proof. We claim

$$\int_0^{\overline{y}} xG(x+c)F(x)f(x)dx > \int_0^{\overline{y}} xG(x)F(x)f(x)dx. \tag{163}$$

To see this, note that $G(x+c) > G(x)$ for $0 < x < \overline{\gamma}$ and $G(x+c) = G(x) = 1$ for $x > \overline{\gamma}$.

We claim further that

$$\int_{\underline{\gamma}}^{\overline{\gamma}} F(x+c)^2 g(x)dx > \int_{\underline{\gamma}}^{\overline{\gamma}} F(x)^2 g(x)dx. \tag{164}$$

To see this, note that $F(x+c) > F(x)$ for $x \in (-c, \overline{y})$ and $F(x+c) = F(x)$ for all x outside of this interval. ☐

7.1.2 Civil Servant Model

We note that under a civil servant model we have

$$E(\omega) = 12\int_0^{\overline{y}} xG(x)F(x)^2 f(x)dx - 8\int_0^{\overline{y}} xG(x)F(x)^3 f(x)dx$$

$$E(\mathbb{C}) = 4\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)^3 g(x)dx - 2\int_{\underline{\gamma}}^{\overline{\gamma}} F(x)^4 g(x)dx$$

Proposition 18. *In the absence of corruption, welfare and corruption outcomes under the civil servant model are equivalent to those under an unconstrained centralization model in which $c = 0$. Thus the civil* *servant model maximizes expected social welfare relative to other government structures when corruption is not present.*

Proof. Noting that $G(x+c) = G(x) = 1$ for $x > \overline{\gamma}$, observe that $\overline{\gamma} \leq 0$ implies that expected social welfare is equivalent to the unconstrained centralization case with $c = 0$ and expected corruption is zero under all structures. □

Proposition 19. *Given any f and c, there exists some g such that the civil servant model provides minimal expected social welfare relative to other government structures.*

The proof consists of constructing one example of a continuous g such that the expected payoff from one home project site is higher than the expected payoff from four away project sites. A construction like this one could be used to generate $G(\overline{y})$ arbitrarily close to zero and $G(\overline{y}+\epsilon) = 1$ for ϵ arbitrarily small.

Proof. Let

$$\beta = \int_{\overline{y}-\frac{c}{2}}^{\overline{y}} xf(x)dx. \tag{165}$$

Note that $\beta > 0$ by the continuity of f. Let $\overline{\gamma} = \overline{y} + \frac{c}{2}$ and $\underline{\gamma} = 0$. Consider g(x) linear on the intervals $[0, \overline{y}], [\overline{y}, \overline{y} + \frac{c}{4}]$, and $[\overline{y} + \frac{c}{4}, \overline{y} + \frac{c}{2}]$. Define

$$g(\overline{y}) = \frac{\beta}{2\overline{y}^2} \tag{166}$$

$$g(\overline{y} + \frac{c}{4}) = 2c - \frac{\beta c}{2\overline{y}} + \frac{\beta}{2\overline{y}^2} \tag{167}$$

Note that g is constructed such that $\int_{-\infty}^{\infty} g(x)dx = 1$ and g is continuous. We have $G(\overline{y}) = \frac{\beta}{4\overline{y}}$. Thus the expected social welfare from a project outside the politician's home area is

$$\int_0^{\overline{y}} xG(x)f(x)dx < \overline{y}G(\overline{y}) \tag{168}$$

$$< \frac{\beta}{4}. \tag{169}$$

Moreover, expected welfare under a civil servant model is

$$\int_0^{\overline{y}} xG(x)[12F(x)^2 - 8F(x)^3]f(x)dx. \tag{170}$$

$12F(x)^2 - 8F(x)^3 \leq 4$ for all x, so

$$\int_0^{\overline{y}} xG(x)[12F(x)^2 - 8F(x)^3]f(x)dx \leq 4\int_0^{\overline{y}} xG(x)f(x)dx \tag{171}$$

$$< \beta. \tag{172}$$

Expected social welfare from one home project is

$$\int_0^{\overline{y}} xG(x+c)f(x)dx = \int_0^{\overline{y}-\frac{c}{2}} xG(x+c)f(x)dx + \int_{\overline{y}-\frac{c}{2}}^{\overline{y}} xG(x)f(x)dx \tag{173}$$

$$= \int_0^{\overline{y}+\frac{c}{2}} xG(x+c)f(x)dx + \beta \tag{174}$$

$$> \beta. \tag{175}$$

Thus any constitutional structure in which at least one politician is responsible for at least one site from his home area (this describes all of the constitutional structures discussed above) provides higher expected social welfare given g than does the civil servant model. □

Appendix C

Spanning the Space of Constitutions

There are a number of possible constitutions which are not considered in the body of the paper. In this section, we show that each of these constitutions provides lower expected welfare than at least one of those in the body of the paper.

Basics

Proposition 20. *If a project area contains n project sites, welfare maximization requires that that area receives no more than n units of funds whenever* $\alpha \neq 0$.

Proof. The project area will have some $n' \leq n$ sites with quality high enough to provide the decision maker higher utility than corruption. Since any site can only have one project (one unit of funds), all funds beyond n' units will either be diverted to the decision maker or (in the case of negative payoff for corruption) not spent at all. Thus when the area is allocated $m \geq n'$ units of funding, $m - n'$ units of funding will be providing zero social welfare. Thus for any $m > n$, the expected welfare provided by the mth unit of funds provided to an area with n project sites is 0. In contrast, whenever $\alpha \neq 0$, there is a nonzero chance that even the worst-quality site in a decision-maker's project area will have $x > \gamma$, and will thus receive a project and provide welfare x even when m=n. Thus for any $m \leq n$, the expected welfare provided by the mth unit of funds is nonzero.

Since the model assumes that there are more project sites than units of funding, one area receiving more funds than it has project sites implies that at least one other area is receiving fewer funds than it has project sites. Thus shifting one unit of funds from the overfunded area to the underfunded area will result in strictly higher expected welfare. □

Proposition 21. *For any project area contained entirely within an identity area (that is, all sites in the project area are located in the same identity area), welfare is weakly highest and corruption weakly lowest when the decision-maker is a politician from this area.*

Proof. Suppose the area is allocated m funds and contains n project sites. By proposition 20, we need only consider cases in which $m \leq n$. Let P(x) be the probability that a site of value x is one of the m highest value project sites. Then expected welfare with a local politician is

$$m \int_0^{\overline{y}} xG(x)P(x)dx. \tag{176}$$

Expected welfare with an away politician or a civil servant is

$$m \int_0^{\overline{y}} xG(\alpha x)P(x)dx. \tag{177}$$

Since $G(\alpha x) \leq G(x)$ for all $\alpha \in [0, 1]$, the second expression is weakly smaller than the first. □

Proposition 22. *For any f, g, and* α, *any constitution which splits project sites into one area with two sites and two areas with one site provides weakly lower welfare than at least one other constitution. When* $\alpha > 0$, *the inequality is strict.*

Proof. Note that by 21, we need only consider constitutions in which both one-site areas are controlled by home politicians when showing that this class of constitutions provides lower expected welfare than others.

The expected welfare provided by a one-site project area with one unit of funds is $\int_0^{\overline{y}} xG(x)f(x)dx$. Consider a two-site project area with one unit of funds. If both sites are in the same identity area, then assigning a local politician to the area increases expected welfare by proposition 11. If both sites are in the same identity area and a politician is given control over the project area, expected welfare is

$$\int_0^{\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right)f(x)dx + \int_0^{\overline{y}} xG(\alpha x)F(\alpha x)f(x)dx \tag{178}$$

as discussed in the description of "decentralization across identity areas" in the body of the paper. This expression is increasing in α for $\alpha \in (0,1)$, by the proof of proposition 10. When $\alpha = 0$, expected welfare in this project area is

$$\int_0^{\overline{y}} xG(x)f(x)dx, \tag{179}$$

and is thus equal to that in the single-site project area. By a dominated convergence argument similar to those given above, expected welfare in this two-site across-identity project area is continuous in α for $\alpha = 0$, and thus for $\alpha \in [0,1)$ by differentiability. Thus by the mean value theorem, expected welfare in this project area is higher than expected welfare in a one-site project area for all $\alpha \in (0,1.]$ □

Note: I think this proposition could maybe just go in the section in the body of the paper about decentralization within identity units. We can just combine this with the existing result on decentralization within identity units to show that whenever you have two project sites on their own, you're weakly better off combining them.

Three-Site Project Areas

Up to this point, we have ignored constitutions which divide the project sites into one area with three sites and one area with one site. We consider these constitutions below.

Remark 23. *All constitutions which impose spending rules on a project area with three project sites are equivalent to another constitution with no spending rules and project areas with fewer than three sites.*

Minimum Spending Clause

Imposing a minimum spending clause on a one-site subarea is equivalent to making that subarea its own project area. That is, a one-site subarea with a minimum spending clause will receive exactly one unit of funds iff its project site provides the decision maker with payoff greater than or equal to that of corruption. This is also the case with a one-site project area provided one unit of funds. Thus we consider only cases in which a minimum spending clause is made for a two-site subarea of the three-site area.

If the three-site area is given one unit of funds, then giving a subarea a minimum spending clause is equivalent to giving that subarea an exact spending requirement of one. If the three-site area is given two units of funds, then any subarea of two sites must have at least one project allocated to it regardless of constraints (since at most one project can be allocated to the remaining site), and thus a minimum spending clause is redundant.

Equal Treatment Clause

If the three-site area is given one unit of funds, then imposing a nonzero spending ceiling on any subarea is redundant. As discussed in the body of the paper, each constitution with a spending ceiling of zero for some subarea is equivalent to at least one other constitution without any such zero ceilings.

Mandating maximum spending in a one-site subarea is always redundant. Furthermore, in a three-site project area given two units of funds, giving a maximum spending requirement to a two-site subarea guarantees that one project must be allocated to the other site in the project area, and thus is equivalent to making that site its own project area (see above).

Having established remark 23, any constitution below in which one project area contains three sites will be assumed to have no spending rules.

Proposition 24. *For any f, g, and α, any constitution which splits project sites into one area with three sites and one area with one site provides lower welfare than at least one other constitution.*

Proof.

Lemma 24.1. *Expected welfare under a 3 and 1 constitution is weakly increasing in α, regardless of which of the sites are in the decision-maker's home area and which are not.*

Proof. Note that for a one-site area, expected welfare is unaffected by α if the site is in the decision maker's home area, and is weakly increasing in α if it is outside the decision maker's home area, with derivative $\int_0^{\overline{y}} xg(\alpha x)F(x)f(x)dx$. We now consider the three-site area.
If a civil servant is given control of of the three-site area, expected welfare from that area is unaffected by changes in α when $\overline{\gamma} \leq 0$, and is weakly increasing in α (due to decreased expected corruption) when $\overline{\gamma} > 0$.

Now suppose a politician for whom two of the three sites are in his home area is given control of the three-site area. Then expected welfare from the politician's first-choice project in this area is given by

$$2\int_0^{\overline{y}} xG(x)F(x)F(\frac{x}{\alpha})f(x)dx + \int_0^{\overline{y}} xG(\alpha x)F(\alpha x)^2 f(x)dx. \tag{180}$$

The derivative of this expression with respect to α is (omitting steps that will be familiar to the reader from earlier proofs)

$$2(1-\alpha)\int_0^{\overline{y}} xG(\alpha x)F(\alpha x)f(\alpha x)f(x)dx + \int_0^{\overline{y}} x^2 g(\alpha x)F(\alpha x)^2 f(x)dx > 0. \tag{181}$$

Expected welfare from the politician's second-choice project in this area is given by

$$2\int_0^{\overline{y}} xG(x)F(x)f(x)dx + 2\int_0^{\overline{y}} xG(x)F(\frac{x}{\alpha})[1-2F(x)]f(x)dx + 2\int_0^{\overline{y}} xG(\alpha x)[F(\alpha x) - F(\alpha x)^2]f(x)dx. \tag{182}$$

The derivative of this expression with respect to α is

$$2(1-\alpha)\int_0^{\overline{y}} x^2 G(\alpha x)[f(\alpha x) - 2F(\alpha x)f(\alpha x)]f(x)dx + 2\int_0^{\overline{y}} x^2 g(\alpha x)[F(\alpha x) - F(\alpha x)^2]f(x)dx. \tag{183}$$

Adding the derivatives of expected welfare from the first and second project with respect to alpha gives

$$2(1-\alpha)\int_0^{\overline{y}} x^2 G(\alpha x)[f(\alpha x) - F(\alpha x)f(\alpha x)]f(x)dx + \int_0^{\overline{y}} x^2 g(\alpha x)[2F(\alpha x) - F(\alpha x)^2]f(x)dx > 0. \tag{184}$$

Thus expected welfare is weakly increasing in α regardless of whether the three-site area is given 1 or 2 units of funds.
Lastly, suppose a politician for whom one of the three sites is in his home area and two of the three sites are outside of his home area is given control of the three-site area. Then expected welfare from the politician's first-choice project in this area is given by

$$2\int_0^{\overline{y}} xG(\alpha x)F(x)F(\alpha x)f(x)dx + \int_0^{\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right)^2 f(x), \tag{185}$$

which has derivative with respect to alpha

$$2(1-\alpha)\int_0^{\overline{y}} x^2 G(\alpha x)F(x)f(\alpha x)f(x)dx + 2\int_0^{\overline{y}} x^2 g(\alpha x)F(x)F(\alpha x)f(x)dx > 0. \tag{186}$$

Expected welfare from the politician's second-choice project in this area is given by

$$2\int_0^{\overline{y}} xG(\alpha x)[F(x)+F(\alpha x)[1-2F(x)]]f(x)dx + 2\int_0^{\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right) - F\left(\frac{x}{\alpha}\right)^2 \quad (187)$$

which has derivative with respect to alpha

$$2(1-\alpha)\int_0^{\overline{y}} x^2 G(\alpha x)[1-2F(x)]f(\alpha x)f(x)dx + 2\int_0^{\overline{y}} x^2 g(\alpha x)[F(x)+F(\alpha x)-2F(x)F(\alpha x)]. \quad (188)$$

Adding the derivatives of expected welfare from the first and second project with respect to alpha gives

$$2(1-\alpha)\int_0^{\overline{y}} x^2 G(\alpha x)[1-F(x)]f(\alpha x)f(x)dx + 2\int_0^{\overline{y}} x^2 g(\alpha x)[F(x)+F(\alpha x)-2F(x)F(\alpha x)] > 0. \quad (189)$$

Thus expected welfare is weakly increasing in α regardless of whether the three-site area is given 1 or 2 units of funds. □

Lemma 24.2. *A system in which a decision maker is given one unit of funds to spend in a three-site project area and another decision maker is given one unit of funds to spend in a one-site project area provides strictly lower welfare than decentralization to identity units.*

Proof. When $\alpha = 1$, expected welfare under the first system is

$$\int_0^{\overline{y}} xG(x)[3F(x)^2+1]f(x)dx, \quad (190)$$

and thus the difference between expected welfare under this system and decentralization to identity units is

$$\int_0^{\overline{y}} xG(x)[3F(x)^2-4F(x)+1]f(x)dx. \quad (191)$$

Note that

$$\int_0^{\overline{y}} [3F(x)^2-4F(x)+1]f(x)dx = 0. \quad (192)$$

We claim that $3F(x)^2-4F(x)+1$ is positive for $x < F^{-1}\left(\frac{1}{3}\right)$ and negative for $x > F^{-1}\left(\frac{1}{3}\right)$. To see this, note that

$$3F(x)^2-4F(x)+1 = (3F(x)-1)(F(x)-1). \quad (193)$$

Thus the expression's only roots on the interval $[0,\overline{y}]$ are $F^{-1}\left(\frac{1}{3}\right)$ and $\overline{y}$. Note that the expression is decreasing in x at $F^{-1}\left(\frac{1}{3}\right)$, with derivative $6F(x)f(x)-4f(x) = -\frac{7}{2}f(x)$. Thus $3F(x)^2-4F(x)+1$ is positive for $x < F^{-1}\left(\frac{1}{3}\right)$ and negative for $x > F^{-1}\left(\frac{1}{3}\right)$. Thus by the monotonicity of G(x),

$$xG(x)[3F(x)^2-4F(x)+1] < F^{-1}\left(\frac{1}{3}\right)G\left(F^{-1}\left(\frac{1}{3}\right)\right)[3F(x)^2-4F(x)+1] \quad (194)$$

for $x < F^{-1}\left(\frac{1}{3}\right)$ and

$$xG(x)[3F(x)^2-4F(x)+1] < F^{-1}\left(\frac{1}{3}\right)G\left(F^{-1}\left(\frac{1}{3}\right)\right)[3F(x)^2-4F(x)+1] \quad (195)$$

for $x > F^{-1}\left(\frac{1}{3}\right)$. Thus

$$\int_0^{\overline{y}} xG(x)[3F(x)^2 - 4F(x) + 1]f(x)dx < \int_0^{\overline{y}} F^{-1}\left(\frac{1}{3}\right) G\left(F^{-1}\left(\frac{1}{3}\right)\right)[3F(x)^2 - 4F(x) + 1]f(x)dx \quad (196)$$

$$= F^{-1}\left(\frac{1}{3}\right) G\left(F^{-1}\left(\frac{1}{3}\right)\right)\int_0^{\overline{y}}[3F(x)^2 - 4F(x) + 1]f(x)dx \quad (197)$$

$$= 0. \quad (198)$$

Thus when $\alpha = 1$, expected welfare under the three-site/ one-site constitution is lower than under decentralization to identity units. The lemma thus follows for all α by lemma 24.1 and the fact that expected welfare under decentralization to identity units is unaffected by α. □

Lemma 24.3. *A system in which a decision maker is given two units of funds to allocate among a three-site project area provides lower expected welfare than decentralization to identity units.*

Proof. When $\alpha = 1$, expected welfare under the first system is

$$\int_0^{\overline{y}} xG(x)[6F(x) - 3F(x)^2]f(x)dx, \quad (199)$$

and the difference between expected welfare under the two systems is

$$\int_0^{\overline{y}} xG(x)[2F(x) - 3F(x)^2]f(x)dx. \quad (200)$$

Note that

$$\int_0^{\overline{y}} [2F(x) - 3F(x)^2]f(x)dx = 0. \quad (201)$$

The only zeros of $2F(x) - 3F(x)^2$ on $[0, \overline{y}]$ are 0 and $F^{-1}\left(\frac{2}{3}\right)$, and with derivative $2f(x) - 6F(x)f(x)$ it is decreasing at $F^{-1}\left(\frac{2}{3}\right)$. Thus it is positive on $[0, F^{-1}\left(\frac{2}{3}\right))$ and negative on $(F^{-1}\left(\frac{2}{3}\right), \overline{y}]$. Thus

$$\int_0^{\overline{y}} xG(x)[2F(x) - 3F(x)^2]f(x)dx < \int_0^{\overline{y}} F^{-1}\left(\frac{2}{3}\right) G\left(F^{-1}\left(\frac{2}{3}\right)\right)[2F(x) - 3F(x)^2]f(x)dx \quad (202)$$

$$= F^{-1}\left(\frac{2}{3}\right) G\left(F^{-1}\left(\frac{2}{3}\right)\right)\int_0^{\overline{y}}[2F(x) - 3F(x)^2]f(x)dx \quad (203)$$

$$= 0. \quad (204)$$

Thus decentralization to identity units provides higher welfare when $\alpha = 1$. Lemma 24.1 and the fact that expected welfare under decentralization to identity units is unaffected by α complete the proof. □

□

Spending Rules on Four-Site Project Area

The Civil Servant Model, Equal Treatment Clause, and Minimum Spending Clause constitutions which we consider in the body of the paper are only a subset of the possible constitutions imposing spending rules on a decision maker with control over all four project sites. The rest are considered below.

Two-Site Subareas

Proposition 25. *Imposing a minimum-spending requirement on a subarea containing only a centralized politician's two home sites leads to lower expected welfare than unconstrained centralization.*

Proof. Under this constitution, each home site will receive a project if and only if its payoff to the politician is higher than that of corruption and either the other home site or both non-home sites. Each non-home site will receive a project if and only if its payoff to the politician is higher than that of the other non-home site, at least one home site, and corruption. Thus expected welfare is

$$E(\omega_{minhome}) = 2\int_0^{\overline{y}} xG(x)F(x)f(x)dx \tag{205}$$

$$+ 4\int_0^{\overline{y}} xG(\alpha x)F(x)F(\alpha x)f(x)dx - 2\int_0^{\overline{y}} xG(\alpha x)F(x)F(\alpha x)^2 \tag{206}$$

$$+ 2\int_0^{\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right)^2 f(x)dx - 2\int_0^{\overline{y}} xG(x)F(x)F\left(\frac{x}{\alpha}\right)^2 f(x)dx \tag{207}$$

and the difference in expected welfare between unconstrained centralization and this form of minimum-spending clause is

$$E(\omega)_{centralized} - E(\omega)_{minhome} = 4\int_0^{\overline{y}} xG(x)F(x)F\left(\frac{x}{\alpha}\right) f(x)dx \tag{208}$$

$$- 2\int_0^{\overline{y}} xG(x)F(x)F\left(\frac{x}{\alpha}\right)^2 f(x)dx \tag{209}$$

$$+ 2\int_0^{\overline{y}} xG(\alpha x)F(\alpha x)^2 f(x) - 2\int_0^{\overline{y}} xG(\alpha x)F(x)F(\alpha x)^2 f(x)dx \tag{210}$$

$$- 2\int_0^{\overline{y}} xG(x)F(x)f(x)dx. \tag{211}$$

By a dominated convergence argument very similar to those used above, the limit of this expression as α approaches zero is zero. Furthermore, the derivative of this expression with respect to α is

$$4(1-\alpha)\int_0^{\overline{y}} x^2 G(\alpha x)[1-F(x)]F(\alpha x)f(\alpha x)f(x)dx + 2\int_0^{\overline{y}} xg(\alpha x)F(\alpha x)^2[1-F(x)]f(x)dx. \tag{212}$$

This expression is positive for $\alpha \in (0,1)$. Thus by the mean value theorem, $E(\omega)_{centralized} - E(\omega)_{minhome} > 0$ for $\alpha \in (0,1]$. □

Proposition 26. *A centralized constitution which imposes a minimum-spending requirement on a subarea containing one project site from the politician's home area and one site from outside his home area provides lower expected welfare than at least one other constitution for all* α.

Proof. We claim that whenever such a constitution generates weakly higher expected welfare than centralization, it generates strictly lower expected welfare than decentralization to identity units. To see this, we first calculate expected welfare under this constitution, which we shall refer to as a "minimum spending clause" for the rest of this proof, though it is distinct from the "minimum sending clause" constitution presented in the body of the paper. The politician will complete a project in the home site within the subarea with the minimum spending clause if and only if it provides him with payoff higher than that of corruption and either the other site in the same subarea or both sites in the unconstrained subarea. A project will be completed at the non-home site in the constrained subarea if and only if its payoff to the politician is higher than that of corruption and either the other site in the constrained subarea or both sites in the unconstrained subarea. Each site in the unconstrained subarea will receive a project if and only if its payoff to the politician is higher than that of corruption, the other site in the unconstrained subarea, and at least one site in the constrained subarea. Thus expected welfare $E(\omega)_{minspend}$ is

$$\int_0^{\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right)^2 f(x)dx + 2\int_0^{\overline{y}} xG(x)F(x)F\left(\frac{x}{\alpha}\right) f(x)dx \tag{213}$$

$$-2\int_0^{\overline{y}} xG(x)F(x)F\left(\frac{x}{\alpha}\right)^2 f(x)dx \tag{214}$$

$$+\int_0^{\overline{y}} xG(\alpha x)F(\alpha x)^2 f(x)dx + 2\int_0^{\overline{y}} xG(\alpha x)F(x)F(\alpha x)f(x)dx \tag{215}$$

$$-2\int_0^{\overline{y}} xG(\alpha x)F(x)F(\alpha x)^2 f(x)dx \tag{216}$$

$$+\int_0^{\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right) f(x)dx + \int_0^{\overline{y}} xG(\alpha x)F(\alpha x)F(x)dx. \tag{217}$$

Therefore the difference between expected welfare under centralization and under a minimum spending clause is

$$\int_0^{\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right)^2 f(x)dx + 2\int_0^{\overline{y}} xG(x)F(x)F\left(\frac{x}{\alpha}\right) f(x)dx \tag{218}$$

$$-2\int_0^{\overline{y}} xG(x)F(x)F\left(\frac{x}{\alpha}\right)^2 f(x)dx \tag{219}$$

$$+\int_0^{\overline{y}} xG(\alpha x)F(\alpha x)^2 f(x)dx + 2\int_0^{\overline{y}} xG(\alpha x)F(x)F(\alpha x)f(x)dx \tag{220}$$

$$-2\int_0^{\overline{y}} xG(\alpha x)F(x)F(\alpha x)^2 f(x)dx \tag{221}$$

$$-\int_0^{\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right) f(x)dx + \int_0^{\overline{y}} xG(\alpha x)F(\alpha x)F(x)dx. \tag{222}$$

Note that this is equal to

$$E(\omega)_{minspend} - 2\left[\int_0^{\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right) f(x)dx + \int_0^{\overline{y}} xG(\alpha x)F(\alpha x)F(x)dx\right]. \tag{223}$$

Thus, whenever expected welfare under a minimum spending clause is weakly lower than expected welfare under unconstrained centralization, we have

$$E(\omega)_{minspend} \leq 2[\int_0^{\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right) f(x)dx + \int_0^{\overline{y}} xG(\alpha x)F(\alpha x)F(x)dx]. \tag{224}$$

By the fact that

$$\frac{\partial}{\partial\alpha}2\left[\int_0^{\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right) f(x)dx + \int_0^{\overline{y}} xG(\alpha x)F(\alpha x)F(x)dx\right] > 0 \tag{225}$$

for all $\alpha \in (0,1)$,

$$2\left[\int_0^{\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right) f(x)dx + \int_0^{\overline{y}} xG(\alpha x)F(\alpha x)F(x)dx\right] < 4\int_0^{\overline{y}} xG(x)F(x)f(x)dx \tag{226}$$

$$= E(\omega)_{decentralized} \tag{227}$$

for all $\alpha \in [0, 1)$ by the fact that $E(\omega)_{minspend} = 4\int_0^{\overline{y}} xG(x)F(x)f(x)dx$ when $\alpha = 1$. Thus, for $\alpha \in [0, 1)$

$$E(\omega)_{minspend} \geq E(\omega)_{centralized} \tag{228}$$

$$\implies E(\omega)_{minspend} < E(\omega)_{decentralized}. \tag{229}$$

Furthermore, when $\alpha = 1$, note that the difference between expected welfare under centralization and under a minimum spending clause is half of the difference between expected welfare under unconstrained centralization and decentralization to identity units. As demonstrated by lemma 1.1, the latter difference is positive, and thus the former is as well. Thus the first line in the above implication is false, so the implication holds for $\alpha = 1$ in addition to $\alpha \in [0, 1)$. □

Proposition 27. *Imposing a minimum-spending requirement on a civil servant leads to weakly lower expected welfare.*

Proof. Expected welfare under a civil servant with a minimum-spending requirement is

$$6\int_0^{\overline{y}} xG(\alpha x)F(x)^2 f(x)dx - 4\int_0^{\overline{y}} xG(\alpha x)F(x)^3 f(x)dx + 2\int_0^{\overline{y}} xG(\alpha x)F(x)f(x)dx. \tag{230}$$

The difference between expected welfare under an unconstrained civil servant model and this value is

$$6\int_0^{\overline{y}} xG(\alpha x)F(x)^2 f(x)dx - 4\int_0^{\overline{y}} xG(\alpha x)F(x)^3 f(x)dx - 2\int_0^{\overline{y}} xG(\alpha x)F(x)f(x)dx. \tag{231}$$

Replacing G(x) with $G(\alpha x)$ as necessary, the proof of lemma 1.1 proves that this expression is positive. Thus expected welfare under an unconstrained civil servant model is higher than under a civil-servant model with a minimum-spending requirement. □

Proposition 28. *A centralized constitution with an equal treatment clause with subareas containing one of the politician's home sites and one of his non-home sites provides expected welfare equivalent to that of decentralization across identity areas.*

Proof. Each site will receive a project if and only if its payoff to the politician is higher than that of corruption and the other site in its subarea. Thus each subarea provides expected welfare

$$\int_0^{\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right) f(x)dx + \int_0^{\overline{y}} xG(\alpha x)F(\alpha x)f(x)dx. \tag{232}$$

Thus total expected welfare under this constitution is

$$2\left[\int_0^{\overline{y}} xG(x)F\left(\frac{x}{\alpha}\right) f(x)dx + \int_0^{\overline{y}} xG(\alpha x)F(\alpha x)f(x)dx\right]. \tag{233}$$

□

Proposition 29. *Imposing an equal treatment clause on a civil servant leads to weakly lower expected welfare.*

Proof. Expected welfare under a civil servant model with an equal treatment clause is

$$4\int_0^{\overline{y}} xG(\alpha x)F(x)f(x)dx. \tag{234}$$

Subtracting this from expected welfare under an unconstrained civil servant model gives

$$12\int_0^{\overline{y}} xG(\alpha x)F(x)^2 f(x)dx - 8\int_0^{\overline{y}} xG(\alpha x)F(x)^3 f(x)dx - 4\int_0^{\overline{y}} xG(\alpha x)F(x)f(x)dx. \tag{235}$$

As discussed in proposition 27, this expression is positive. □

Three-Site Subareas

Remark 30. *Each centralized constitutions which imposes a spending rule on a three-site subarea generates outcomes equivalent to a constitution considered above.*

Imposing an equal treatment clause which splits a centralized project area into one three-site and one one-site subarea is equivalent to a constitution in which a three-site area is controlled by one decision maker and a one-site area is controlled by another. Imposing a minimum spending clause on the three-site subarea is redundant: at least one project must be assigned to any three-site subarea, since at most one project can be assigned to the excluded site. Imposing a minimum spending clause on the one-site subarea is equivalent to imposing an equal treatment clause, as a one-site subarea can never receive more than one unit of funds.

Table 1: Summary Statistics — Councilors and Wards

Variable:	Mean	S.D.	Median	Min.	Max.	N
Female	0.07	0.25	0	0	1	179
Age	46.88	9.99	46	28	73	179
Married	0.91	0.29	1	0	1	179
Kikuyu	0.68	0.47	1	0	1	179
Christian	0.96	0.21	1	0	1	179
Completed secondary school	0.90	0.30	1	0	1	176
Some post-secondary education	0.25	0.43	0	0	1	176
Farmer	0.53	0.50	1	0	1	177
Business owner	0.34	0.48	0	0	1	177
More than half of HH income from being councilor	0.35	0.48	0	0	1	175
Years in politics	8.34	5.49	5	1	30	178
Member of major political party	0.73	0.45	1	0	1	179
Member of PNU party	0.58	0.49	1	0	1	179
Member of ODM party	0.03	0.17	0	0	1	179
Member of ODM-K party	0.12	0.32	0	0	1	179
Heard about chlorine dispensers	0.10	0.30	0	0	1	177
Number of registers voters in ward	8065.66	3138.85	7874	682	16359	179
Voter turnout	79.12	8.64	81.64	34.72	97.26	176

The Kikuyu ethnic group is Kenya's largest, accounting for approximately 22 percent of Kenya's population. They are the dominant ethnic group in the study region. At the time of the experiment, Kenya's three main political parties were the Party of National Unity (PNU), the party of President Mwai Kibabi; the Orange Democratic Movement (ODM); and the Orange Democratic Movement-Kenya (ODM-K).

Table 2: Summary Statistics of Wards & Water Sources — Source Selection Sample

Variable:	Mean	S.D.	Median	Min.	Max.	N
Number of water sources in ward	48.52	34.28	40	3	209	157
Proportion streams and rivers	0.37	0.21	0.38	0	0.92	157
Proportion shallow wells	0.12	0.14	0.08	0	0.68	157
Proportion borehole wells	0.08	0.12	0.03	0	0.82	157
Proportion standpipes or taps	0.15	0.19	0.07	0	0.97	157
Proportion protected springs	0.07	0.12	0.02	0	0.88	157
Proportion unprotected springs	0.02	0.07	0	0	0.56	157
Proportion of water sources protected	0.33	0.21	0.31	0	1	156
Proportion of private water sources	0.13	0.14	0.09	0	0.63	157
Proportion of free (no charge) water sources	0.81	0.19	0.86	0.07	1	157
Has year-round source	0.99	0.08	1	0	1	157
Average number of dry months (among sources in ward)	0.63	0.55	0.50	0	2.83	157
Average number of users (HHs) per source in ward	138.27	120.28	102.7	25.52	739.13	157
Maximum number of users at any source in ward	564.85	398.91	470	40	1200	157
Minimum number of users at any source in ward	23.78	22.19	20	10	150	157

The Source Selection Sample excludes 22 councilors who wished to install the dispenser at a water source that identified in our census of shared water sources. If one of those councilors was chosen to receive a dispenser for his ward, staff at the organization installing the dispensers ascertained whether the preferred sources was listed in our roster under another name, or whether it was not in fact an eligible shared (i.e. publicly accessible) water source.

clearpage

Table 3: Conditional Logit Model of Water Source Selection

Specification:	LOGIT (1)	LOGIT (2)	LOGIT (3)	LOGIT (4)	LOGIT (5)	LOGIT (6)
Users in councilor's village	0.045***	.	.	.	0.039***	.
	(0.011)				(0.012)	
Users outside councilor's village	0.019***	.	.	.	0.019***	.
	(0.004)				(0.004)	
Number of users (tens of HHs)	.	.	0.02***	.	.	.
			(0.004)			
Log users in councilor's village	.	1.087***	.	.	.	1.419***
		(0.161)				(0.364)
Log users outside councilor's village	.	0.635***	.	.	.	0.619***
		(0.108)				(0.11)
Log users of water source	.	.	.	0.663***	.	.
				(0.107)		
In councilor's village	.	.	0.877**	0.925**	0.415	-1.187
			(0.405)	(0.403)	(0.515)	(1.123)
In councilor's sublocation	.	.	0.095	0.131	0.12	0.133
			(0.316)	(0.318)	(0.318)	(0.321)
Point (but not improved) source	0.67***	0.694***	0.651***	0.672***	0.668***	0.702***
	(0.246)	(0.246)	(0.245)	(0.245)	(0.246)	(0.246)
Improved source	0.399	0.421	0.412	0.433	0.401	0.421
	(0.27)	(0.268)	(0.269)	(0.267)	(0.27)	(0.268)
Privately owned	-1.176***	-1.082***	-1.177***	-1.058***	-1.182***	-1.075***
	(0.382)	(0.387)	(0.382)	(0.387)	(0.382)	(0.387)
Users must pay to use source	0.265	0.261	0.248	0.226	0.268	0.257
	(0.3)	(0.296)	(0.297)	(0.295)	(0.299)	(0.297)
Water from source is clear	-0.005	0.024	-0.013	0.03	-0.012	0.028
	(0.223)	(0.224)	(0.223)	(0.224)	(0.224)	(0.224)
Source does not dry up	0.28	0.244	0.267	0.235	0.28	0.249
	(0.244)	(0.244)	(0.243)	(0.243)	(0.244)	(0.244)
Observations	7438	7438	7438	7438	7438	7438

Standard errors in parentheses. All specifications also include controls for the page on which a source appeared in the Water Source Booklets presented to councilors.

Table 4: Mixed Logit Model of Water treatment dispenser Package Choices

	COEFFICIENT	S.D.	Proportion POSITIVE
Ward receives a dispenser	3.382***	3.854***	0.810
	(0.236)	(0.238)	
Councilor decides location	1.923***	1.916***	0.842
	(0.145)	(0.120)	
District Public Health Officer (DPHO) decides location	-0.039	2.282***	0.493
	(0.152)	(0.141)	
Councilor manages chlorine funds	0.019	2.773***	0.503
	(0.166)	(0.148)	
Councilor decides location × councilor manages funds	-1.016***	0.892***	0.127
	(0.165)	(0.308)	
DPHO decides location × councilor manages chlorine funds	-0.437***	0.364**	0.115
	(0.161)	(0.177)	
Lottery	-2.871***	2.007***	0.076
	(0.198)	(0.149)	

Standard errors in parentheses.

Table 5: Regressions of Targeting Outcomes on Characteristics of Councilors and Wards

Dependent Variable:	CHOSE TO INSTALL DISPENSER AT A WATER SOURCE IN...					
	TOP QUARTILE IN TERMS OF USERS		COUNCILOR'S OWN SUBLOCATION		COUNCILOR'S OWN VILLAGE	
Specification:	PROBIT	OLS	PROBIT	OLS	PROBIT	OLS
	(1)	(2)	(3)	(4)	(5)	(6)
Registered voters in ward (in thousands)	0.035	0.014	-0.005	-0.002	-0.038	-0.009
	(0.031)	(0.014)	(0.043)	(0.012)	(0.056)	(0.01)
Voter turnout	0.042***	0.009***	-0.01	0.004	0.018	0.005
	(0.014)	(0.003)	(0.017)	(0.005)	(0.024)	(0.003)
First term in office	0.263	0.063	0.176	0.056	0.22	0.024
	(0.212)	(0.075)	(0.26)	(0.057)	(0.298)	(0.029)
Member of major political party	0.552*	0.191**	0.049	-0.042	-0.039	-0.04
	(0.299)	(0.085)	(0.125)	(0.047)	(0.365)	(0.051)
Constant	-4.787***	-0.709***	-0.085	-0.065	-2.803	-0.262
	(1.049)	(0.218)	(1.250)	(0.471)	(1.866)	(0.277)
County Fixed Effects	No	Yes	No	Yes	No	Yes
Observations	154	154	154	154	154	154

Robust standard errors clustered at the county level. WITH MANY USERS indicates that the councilor chose a water source in the top quartile of users for his ward. Even-numbered columns include county-level fixed effects.

Additional Tables and Figures

Table 6: Conditional Logit Model of Heterogeneity in Dispenser Package Choices

Specification:	Logit (1)	Logit (2)	Logit (3)	Logit (4)
Ward receives a dispenser	1.682***	1.713***	2.233***	2.317***
	(0.309)	(0.328)	(0.337)	(0.357)
... × registered voters (quartile)	-0.175**	-0.204***	-0.345***	-0.371***
	(0.069)	(0.073)	(0.071)	(0.075)
... × voter turnout (quartile)	0.003	0.013	-0.002	-0.015
	(0.069)	(0.074)	(0.068)	(0.073)
... × first term in office	0.8***	0.735***	0.729***	0.66***
	(0.156)	(0.166)	(0.158)	(0.169)
... × major party candidate	0.012	-0.072	-0.026	-0.118
	(0.18)	(0.19)	(0.181)	(0.192)
Councilor decides location	0.884***	0.876***	0.546**	0.474
	(0.237)	(0.321)	(0.254)	(0.344)
... × registered voters (quartile)	0.045	0.096	0.047	0.091
	(0.054)	(0.073)	(0.054)	(0.074)
... × voter turnout (quartile)	-0.107**	-0.111	0.016	0.04
	(0.054)	(0.074)	(0.053)	(0.073)
... × first term in office	-0.353***	-0.197	-0.337***	-0.173
	(0.124)	(0.169)	(0.125)	(0.171)
... × major party candidate	0.227*	0.397**	0.259*	0.439**
	(0.135)	(0.183)	(0.135)	(0.183)
Public health official decides location	-0.26	-0.389	-0.343	-0.586
	(0.227)	(0.349)	(0.244)	(0.374)
... × registered voters (quartile)	0.032	0.088	-0.019	0.027
	(0.052)	(0.078)	(0.052)	(0.079)
... × voter turnout (quartile)	0.103**	0.066	0.195***	0.211***
	(0.052)	(0.079)	(0.052)	(0.078)
... × first term in office	-0.529***	-0.421**	-0.558***	-0.44**
	(0.119)	(0.181)	(0.12)	(0.183)
... × major party candidate	0.218*	0.38*	0.227*	0.404**
	(0.131)	(0.201)	(0.131)	(0.202)
Councilor manages chlorine funds	0.37*	0.3	0.358*	0.186

Continued on next page

Table 6 – *Continued from previous page*

Specification:	Logit (1)	Logit (2)	Logit (3)	Logit (4)
	(0.198)	(0.299)	(0.212)	(0.322)
. . . × registered voters (quartile)	-0.098**	-0.034	-0.1**	-0.043
	(0.045)	(0.068)	(0.045)	(0.069)
. . . × voter turnout (quartile)	0.054	0.036	0.072	0.098
	(0.045)	(0.068)	(0.045)	(0.068)
. . . × first term in office	-0.304***	-0.147	-0.341***	-0.173
	(0.103)	(0.157)	(0.104)	(0.159)
. . . × major party candidate	-0.418***	-0.224	-0.426***	-0.217
	(0.113)	(0.172)	(0.114)	(0.172)
Councilor decides location × councilor manages chlorine funds	.	0.023	.	0.143
		(0.448)		(0.481)
. . . × registered voters (quartile)	.	-0.105	.	-0.093
		(0.102)		(0.103)
. . . × voter turnout (quartile)	.	0.002	.	-0.052
		(0.102)		(0.101)
. . . × first term in office	.	-0.334	.	-0.349
		(0.235)		(0.237)
. . . × major party candidate	.	-0.354	.	-0.373
		(0.257)		(0.257)
Public health official decides location × councilor manages chlorine fund	.	0.219	.	0.424
		(0.458)		(0.491)
. . . × registered voters (quartile)	.	-0.107	.	-0.091
		(0.103)		(0.105)
. . . × voter turnout (quartile)	.	0.061	.	-0.03
		(0.104)		(0.103)
. . . × first term in office	.	-0.233	.	-0.254
		(0.238)		(0.241)
. . . × major party candidate	.	-0.318	.	-0.346
		(0.264)		(0.264)
Control for lotteries	Yes	Yes	Yes	Yes
Attribute Interactions	No	Yes	No	Yes
Observations	13824	13824	13824	13824

Standard errors in parentheses. Columns 1 and 2 (3 and 4) include quartiles (within-county quartiles) of continuous characteristics, interacted with dispensers package attributes. Columns 2 and 4 also include interactions between dispenser package attributes (who chooses the location and who manages chlorine refills) and councilor and ward characteristics.

Figure 1: Sample Decision Problem from Experiment

Plan A		**Plan B**	
Installed where?	DCE chooses location	**Installed where?**	You choose location
Chlorine delivered how?	DCE is in charge of chlorine delivery to dispenser	**Chlorine delivered how?**	You receive 650 Ksh. per month to arrange for delivery of chlorine to dispenser

DCE stands for "Dispenser Choice Evaluation." This acronym was used to refer to the project in interactions with county councilors.