Making Moves Matter:
Experimental Evidence on Incentivizing Bureaucrats through Performance-Based Postings

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Online Appendix

A.1 Simulation Procedure

To simulate the equilibrium effort e_i, we use data we collected at baseline on the preference vector $\mathbf{P}$. We also use administrative data from the control group to predict y_0, i.e. revenue levels in the absence of the treatment. Specifically, recall that our performance measure y_i is the change in log outcomes, i.e. $\Delta \log y_i$.[34] We regress

$$\Delta \log y_{igt} = \alpha_g + \beta_1 \log y_{t-1} + \beta_2 \log y_{t-2} + \beta_3 \log d_{t-1} + \beta_4 \log d_{t-2} + \epsilon_{igt} \tag{10}$$

where α_g is a group fixed effect, d_{t-1} and d_{t-2} are lags of the size of the tax base in the circle (i.e. net demand), and y_{t-1} and y_{t-2} are lags of log revenue. Results are in Appendix Table A.9. We take the predicted values from this equation to form a prediction of y_{0i}, i.e. the predictable part of consumption in the business-as-usual case, and use the residuals to estimate σ^2_ϵ.

We then simulate the model as follows.

Recall we parameterize the cost function $c(e_i) = \alpha e_i^2$, with α as an unknown cost of effort parameter. Using simulated method of moments, we estimate α such that the average equilibrium effort in our model matches the average change in effort induced by the experiment. Specifically, for a given starting value of the cost parameter α, we search for an equilibrium effort vector $\boldsymbol{e}$ in which the marginal change in expected utility from effort exactly equals the marginal cost of effort for every inspector. We then progressively update α (employing gradient descent) to minimize the difference between the average equilibrium effort and its empirical analog in the first year of the experiment.[35]

For a given α, the equilibrium effort vector is found by repeatedly simulating the left hand side of (4) and updating the effort vector until convergence, i.e. until this first-order condition is satisfied simultaneously for all inspectors. Let e_0 denote the starting effort vector and e_t denote the effort vector following update $\#t$.[36] For any $\mathbf{e_t}$ (including e_0) we draw 200 draws, indexed by k, from the joint distribution of $\mathbf{y}$ given $\mathbf{y_0}$ and $\mathbf{e_t}$. [37] Denote one such draw as $\mathbf{y^{kt}}$. For each draw k, order realizations of $\mathbf{y^{kt}_{-i}}$ from smallest to largest, and denote these as $z_1^{kt}....z_{J-1}^{kt}$, and let

[34] In the simulations, we use change in log revenue as the performance vector for all inspectors, regardless of whether they were randomized into the groups where incentives were based on revenue or tax base.

[35] To verify uniqueness of α, we start from different starting values and verify that the moment is minimized at the same α, suggesting a global minimum.

[36] We show below that the equilibrium effort vector is not sensitive to starting point $\mathbf{e_0}$

[37] Equilibrium effort changes by less than 1% for a given α when we draw 2000 draws of noise instead of 200; we use 200 as we need to do this many times in order to arrive at a level of α.

$z_0 = -\infty$ and $z_J = \infty$. Denote $u_i(j) = u_{ij}$, i.e the utility for inspector i of receiving his j'th ranked preference. We can then rewrite the left-hand side of the foc for an inspector i as

$$\frac{dEu}{de_i} = \sum_{\mathbf{j=1}}^{\mathbf{J}} u_i \left(r_i(z_{j-1}^{kt} - y_{i0} - e_{it} + \delta, \mathbf{y_{-i}^{kt}}, \mathbf{P}) \right) \left[\phi(z_{j-1}^{kt} - y_{i0} - e_{it}) - \phi(z_j^{kt} - y_{i0} - e_{it}) \right] \tag{11}$$

where δ is arbitrarily small. Although this expression is heavy on notation, it is actually quite easy to interpret: the expression $u_i \left(r_i(z_{j-1}^{kt} - y_{i0} - e_{it} + \delta, \mathbf{y_{-i}^{kt}}, \mathbf{P}) \right)$ denotes the utility inspector i receives from having an outcome y between z_{j-1}^{kt} and z_j^{kt} (taking the full assignment mechanism and preference vector into account), and the expression $\left[\phi(z_{j-1}^{kt} - y_{i0} - e_{it}) - \phi(z_j^{kt} - y_{i0} - e_{it}) \right]$ captures the marginal change in the probability of having an outcome y between y_{j-i}^{kt} and y_j^{kt} from a slight increase in effort e, evaluated at $e = e_t$. Note that this expression is just a generalization of equation (5) allowing for arbitrary preference vectors $\mathbf{P}$ and arbitrary $\mathbf{y}_0$. To account for inspectors' uncertainty about the realization of $\mathbf{y_{-i}}$, we average $\frac{dEu}{de_i}$ over the k draws of $\mathbf{y^{kt}}$. We then progressively update effort until convergence, i.e. until this average equals $2\alpha e_i$ for each inspector.[38]

In the simulation, full knowledge assumes that inspectors fully account for their fellow inspectors' preferences over circles and predicted performances $\mathbf{y_0}$ (albeit not the actual realization of $\mathbf{y_{-i}}$) when solving for an equilibrium. In other words, they are exactly able to determine the change in their expected utility from more/less effort as in (11), and each effort update corresponds to this expectation evaluated over 200 possible realizations of $\mathbf{y_{-i}}$. We then assume deviations from full knowledge: identical preferences and full knowledge of $\mathbf{y_0}$ are characterized by an inspector assuming that everyone shares her preferences over circles; thus, the inspector assumes she will be assigned to a circle exactly corresponding with her group rank (if her performance is 3rd ranked in her group, she will be assigned to her 3rd preferred circle) and her utility is strictly falling in rank. Random preferences and full knowledge of $\mathbf{y_0}$ are characterized by uncertainty about others' preferences over circles, which we account for by simulating the assignment r_i 1000 times for each inspector, each time re-shuffling the preference order of circles for all other inspectors in the group. No knowledge of $\mathbf{y_0}$ assumes that inspectors start by assuming all $\mathbf{y_0}$ =0 (including their own). All knowledge assumptions assume that inspectors are best-responding to the equilibrium *effort* exerted by others in their group, even when they might not have knowledge of predicted performance or preferences.

Appendix Table A.10 shows the estimated α parameters, based on different knowledge assumptions, as well as their estimated standard errors.

In the process described above, we verify uniqueness of α by starting from a series of different starting points and verifying that the moment is minimized at the same α every time; we also plot in Figure A.2 the moment as a function of α and verify the uniqueness of the minimum. To investigate uniqueness of the effort vector at the moment-minimizing alpha, we start from 1000 different, randomly drawn (from a normal distribution) initial effort vectors, and find that, for an average inspector, the standard deviation of equilibrium efforts is <2 percent of the mean effort

[38]Specifically, we update using the equation $e_t = 0.8e_{t-1} + 0.2\frac{dEu}{de}$.

over these 1000 runs. This implies that while the equilibrium effort vector need not be unique, the equilibrium level of effort e_i is extremely highly correlated among equilibria. This is documented in Figure A.3. We take the average value of e_i across these 1000 runs.

A.2 Does PRSD increase the link between performance and allocation?

We can also check directly that the application of the PRSD indeed resulted in top performers being more likely to be allocated to their more desired locations at the end of the year . We explore this in Appendix Table A.12. We begin by showing – among treatment circles – that higher performers indeed got postings they preferred more. We normalize performance rank within group to a 0 - 1 scale, with 1 as the top performer, and similarly normalize preferences to a 0 - 1 scale, with 1 as the most preferred circle.

Columns 1 and 2 regress change in preference rank of circle on Year 1 performance and show that, among treatment circles, an inspector's performance increase indeed translates into him ending up in a more desirable circle. Recall that the treatment group inspectors were asked to reconfirm their baseline preferences before the final postings in Year 1 were made. As a result we have two preference measures - at baseline and at Year 1 - which we report in columns 1/3/5 and 2/4/6, respectively. In practice, the two measures are highly correlated and the results are similar. However, as noted earlier, more than half the inspectors prefer their initial circles (status quo), so there is mechanically little room to improve. In fact, our data shows that the maximum improvement a top-most performer can obtain is around +0.19 on average – very close to the magnitudes we estimates in Columns 1 and 2.

Alternatively, we can also focus on the inspectors who in fact are likely *not* to want to move given their preferences. In columns 3 and 4, we restrict attention to those inspectors for whom the status quo was the first choice, and find that better performing inspectors were more likely to have their preferences respected; for every rank improvement (roughly a 0.1 increase in the performance rank measure), an inspector is 4.3 percentage points more likely to remain in his preferred status quo circle. Columns 5 and 6 repeats the same exercise but now restricting to inspectors for whom their initial circle was in their top two choices and finds similar results.

We then ask whether this is relationship between allocations and performance is stronger in PRSD areas compared to the control (business as usual) circles. To investigate this, in columns 7-8 we repeat the same exercise as in Columns 3-6, but this time comparing the degree to which performance affects allocation for inspectors in treatment areas compared to those in control circles.[39] We do this just using the baseline preferences (since we do not obtain Year 1 preferences for the

[39] We unfortunately cannot run the analogous specification to that in Column 1. While we had elicited preferences of control inspectors at baseline (over an analogously created grouping of circles), we do not have their preferences for a new circle they might have moved to in Year 1 that was not in that grouping of 10 circles, since they could have been moved to any control circle. However, we can run Columns 7 and 8 since they require a weaker assumption – that an inspector who wanted to stay in their baseline circle would view a move (to any other circle) as not so desirable.

control group). To do so we estimate the regression

$$remain_i = \alpha + \beta_1 rank_i + \beta_2 rank_i \times TREAT_i + \epsilon_i$$

where $remain_i$ is a dummy for whether inspector i remained in the same circle in Year 2 as in Year 1 and $rank_i$ is inspector i's performance rank within group in Year 1, normalized from 0 (worst-rank) to 1 (top-rank).[40] Column 7 shows the results restricting attention to inspectors for whom their top choice was the status quo; column 8 shows the results for whom the status quo was one of the top two choices.

The coefficient on performance rank in both Columns 7 and 8 are essentially 0, while the interaction term (the increased sensitivity to rank in the treatment group) is positive and significant (and similar to the analogous coefficients in Columns 3 and 5). This shows that better ranked inspectors in the treatment group who prefer their status quo circles are significantly more likely to be able to retain it. Together these results confirm the channels through which our results operate - inspectors work harder as they correctly anticipate that if they perform better they are more likely to move to a better location or retain a more desired location they may already be in.

A.3 Does re-allocation reduce performance?

To estimate the effect of changing allocation per se – as distinct from the incentive effects of the transfer scheme, we use baseline the preference matrix $\mathbf{P}$ and predicted performance matrix $\mathbf{y}$ to construct an instrument for being transferred under the scheme.

We follow a related procedure to the simulations in Section 2.2. Specifically, as above, we draw 10,000 draws, indexed by k, from the joint distribution of $\mathbf{y}$ given $\mathbf{y_0}$. We then calculate the predicted probability an inspector moves circles as:

$$Pr\_AnyMove_{ik} = \sum_{\mathbf{j=0}}^{\mathbf{J-1}} \mathbf{1}\Big(r_i(z_{j-1}^k - y_{i0} + \delta, \mathbf{y^k_{-i}}, \mathbf{P})\Big) \Big[\Phi(z_j^k - y_{i0}) - \Phi(z_{j-1}^k - y_{i0})\Big] \tag{12}$$

We take the average of $Pr\_AnyMove_{ik}$ over all draws k to compute $Pr\_AnyMove_i$.

$Pr\_AnyMove_i$ simulates the probability that an inspector i is moved, under the assumption that $e = 0$. Note the close relationship between equation (12) and equation (11). There are two key differences. The first, and most important, difference is that equation (12) weights each possible rank position j by the probability it occurs $\Big[\Phi(z_j^k - y_{i0}) - \Phi(z_{j-1}^k - y_{i0})\Big]$, whereas equation (11) weights each possible rank position j by the *derivative* of the probability it occurs, given by $\Big[\phi(z_{j-1}^k - y_{i0}) - \phi(z_j^k - y_{i0})\Big]$ (note that Φ is a CDF whereas ϕ is a PDF). Thus equation (12) captures the probability an outcome occurs, whereas equation (11) calculates the marginal return

[40] Recall that treatment circles were either ranked by tax collected ("recovery group") or by tax assessed ("demand group"). However there is no such standard concept for control circles. Thus for control circles $rank_i$ could be defined using either recovery or demand; we therefore randomize half the control groups to define $rank$ based on recovery and half on demand. We have verified by re-randomizing this that alternative randomizations produce virtually identical results.

to shifting the probabilities by exerting a bit more effort. The second difference is that instead of using a utility function u, equation (12) weights each outcome by a dummy variable for whether the inspector is moved or not. While $Pr\_AnyMove_i$ from equation (12) may be correlated with $\frac{dE[u]}{de_i}$ from equation (11), they are not perfectly correlated, and, indeed, the correlation is .58.

We use the interaction of $Pr\_AnyMove_i$ with the experimental treatment as an instrument for an inspector being moved. Given the correlation with the incentives from the scheme, we also control for $\frac{dE[u_i]}{de_i}$ and its interaction with the experimental treatment. Specifically, to estimate the impact of a move, we use the year 2 data and estimate

$$\begin{aligned} \log y_{ct} &= \alpha_t + \gamma_t \log y_{c0} + \beta_1 TREAT_c \\ &+ \beta_2 TREAT_c \times \frac{dEu}{de_c} + \beta_3 \frac{dEu}{de_c} \\ &+ \beta_4 MOVE_c + \beta_5 Pr\_AnyMove_c + \epsilon_{ct} \end{aligned} \tag{13}$$

where $MOVE_c$ is a dummy for the inspector in circle c being different in Year 2 than it was in Year 1, and where we instrument for $MOVE_c$ with $TREAT_c \times Pr\_AnyMove_c$. Note that even though we use Year 2 outcome data in estimating equation (13), the $TREAT_c$ variable is defined using the Year 1 treatment status, since Year 1 treatments are what influence being moved in Year 2. We estimate this on all circles that participated in the Year 1 lottery, and, to make sure we are not capturing dynamic incentive effects, on the subset of Year 1 circles that were randomly allocated not to participate in the treatment in Year 2.

The first stage – which estimates the degree to which we can predict $MOVE_c$ with $TREAT_c \times Pr\_AnyMove_c$ – is presented in Appendix Table A.15, and the results from estimating equation (13) are presented in Appendix Table A.16. The results in Table A.15 show that the instrument has substantial predictive power – moving from $Pr\_AnyMove_i$ from 0 to 1 increases the probability of a move by 76 percent in treatment groups, but only 13 percent in control groups.

Panel A of Table A.16 shows the reduced form results. The coefficient on $TREAT_c \times Pr\_AnyMove_c$ is negative on total and current revenue, both for all circles and for the case where we exclude Year 2 circles. To interpret magnitudes, we focus on Panel B, which gives the instrumental variable results, where we instrument for $MOVE_c$ with $TREAT_c \times Pr\_AnyMove_c$. Overall, the estimates suggest a negative effect of movements on total revenue – a 39 percent decline overall, or 6 percent if we focus on the cleanest estimates in column (4) where year 2 treatments are excluded. While these estimates are borderline statistically significant, they are quite noisy. OLS estimates in Panel (C) also show negative effects(a 5 percent decline overall; 6 percent if we focus on the Year 2 excluded group).

Though the magnitudes in this section are a bit uncertain, they all point in the direction that reallocations do cause disruptions, which reduce revenue as people are moved. That said: the results in the previous section suggest that – at least in this context – the scheme did not cause substantially more disruptions than were experienced in the status quo. This suggests that at least in this framework, where movements are quite frequent in the status quo, the movements induced by the scheme induced very little net losses in total.

A.4 Tables and Figures

Table A.1: Balance

	Year 1 Randomization				Year 2 Randomization				Pooled			
	Control	Treatment	Revenue	Demand	Control	Treatment	Revenue	Demand	Control	Treatment	Revenue	Demand
Log Recovery	15.770	-0.064	-0.114	-0.007	15.815	-0.233	-0.489	0.151	15.790	-0.114	-0.222	0.019
	(.)	(0.085)	(0.110)	(0.104)	(.)	(0.149)	(0.203)	(0.152)	(.)	(0.074)	(0.099)	(0.087)
		[0.706]	[0.531]	[0.931]		[0.061]	[0.028]	[0.399]		[0.219]	[0.102]	[0.801]
Log Recovery Rate	-0.183	-0.000	0.000	-0.001	-0.191	0.039	0.056	0.013	-0.187	0.011	0.017	0.004
	(.)	(0.027)	(0.040)	(0.031)	(.)	(0.037)	(0.056)	(0.033)	(.)	(0.022)	(0.033)	(0.025)
		[0.989]	[0.998]	[0.969]		[0.166]	[0.150]	[0.725]		[0.577]	[0.522]	[0.868]
Log Non-Exemption Rate	-0.263	0.053	0.041	0.067	-0.263	-0.001	0.019	-0.032	-0.263	0.037	0.032	0.042
	(.)	(0.021)	(0.024)	(0.027)	(.)	(0.045)	(0.064)	(0.054)	(.)	(0.020)	(0.025)	(0.025)
		[0.022]	[0.166]	[0.029]		[0.965]	[0.713]	[0.502]		[0.086]	[0.257]	[0.160]
FY 12-13 Log Growth Rate	0.088	-0.019	0.010	-0.050	0.091	-0.014	-0.033	0.017	0.089	-0.017	-0.002	-0.036
	(.)	(0.018)	(0.027)	(0.019)	(.)	(0.023)	(0.027)	(0.035)	(.)	(0.015)	(0.021)	(0.017)
		[0.281]	[0.658]	[0.020]		[0.564]	[0.386]	[0.611]		[0.295]	[0.921]	[0.076]
RI P-val, joint significance		0.674	0.548	0.677		0.065	0.029	0.403		0.230	0.104	0.743
N		410	410	410		257	257	257		667	667	667

Notes: This table presents balance tests for the randomization into the different treatments. Columns labelled Control reflect control group means. Values in the treatment columns are the coefficients of a regression of the baseline value of the variable indicated in the row on a treatment dummy (or the set of subtreatment dummies), controlling for the relevant randomization strata. Robust standard errors in parentheses. Randomization inference based p-values in brackets. * $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table A.2: Main results, separately by current years taxes and arrears

	Year 1			Year 2			Pooled		
	(1) Total	(2) Current	(3) Arrears	(4) Total	(5) Current	(6) Arrears	(7) Total	(8) Current	(9) Arrears
Treatment	0.049	0.048	0.065	0.092	0.069	-0.074	0.061	0.054	0.026
	(0.022)	(0.023)	(0.056)	(0.042)	(0.040)	(0.119)	(0.020)	(0.021)	(0.052)
	[0.009]	[0.023]	[0.259]	[0.036]	[0.142]	[0.594]	[0.002]	[0.004]	[0.653]
Baseline	0.892	0.892	0.796	0.946	0.952	0.808	0.944	0.951	0.812
	(0.018)	(0.024)	(0.028)	(0.019)	(0.019)	(0.051)	(0.019)	(0.019)	(0.052)
N	405	405	396	251	251	244	656	656	640
Mean growth in controls	0.117	0.154	-0.048	0.309	0.408	-0.337	0.203	0.268	-0.177

Notes: Tax revenue (columns 1, 4, and 7) is comprised of revenue from the current years tax due (columns 2, 5, and 8), plus revenue collected from previous years' unpaid taxes (denoted 'arrears', columns 3, 6, and 9); the dependent variable in each column is the log of the respective tax measure. Estimation is by OLS. The unit of observation is a circle, as defined at the time of randomization. Specification controls for baseline values (FY 2013). Robust standard errors in parentheses. Standard errors are clustered by circle. Randomization inference based p-values in brackets.

Table A.3: Margins, reduced form

	(1) Revenue	(2) Tax Base	(3) Non-Exemption Rate	(4) Recovery Rate
Panel A: Any treatment				
Treatment	0.054	0.052	0.008	-0.006
	(0.019)	(0.026)	(0.013)	(0.012)
Panel B: Sub-treatment				
Revenue	0.075	0.078	0.017	-0.021
	(0.027)	(0.039)	(0.017)	(0.017)
Demand	0.029	0.020	-0.004	0.012
	(0.022)	(0.029)	(0.016)	(0.015)
N	656	657	656	656
Mean of control group	16.073	16.463	-0.286	-0.106
Revenue = Demand (p-value)	0.160	0.215	0.314	0.120

Notes: OLS regessions of various margins on treatment assignment. The unit of observation is a circle, as defined at the time of randomization. Sample consists of pooled year 1 and year 2 observations. Year 1 sample includes all circles and Year 2 consists of circles that were in the control group in year 1. Specification controls for baseline value. Robust standard errors in parentheses. Standard errors are clustered by circle.

Table A.4: Treatment Effect on Tax Revenue, controlling for all baseline variables from Appendix Table A.1

	Year 1 (Y1 Q4)			Year 2 (Y2 Q4)			Pooled		
	(1) Total	(2) Current	(3) Arrears	(4) Total	(5) Current	(6) Arrears	(7) Total	(8) Current	(9) Arrears
Treatment	0.034	0.033	0.058	0.080	0.067	-0.060	0.052	0.047	0.022
	(0.018)	(0.018)	(0.051)	(0.042)	(0.038)	(0.116)	(0.019)	(0.019)	(0.051)
	[0.071]	[0.094]	[0.298]	[0.062]	[0.163]	[0.643]	[0.004]	[0.012]	[0.687]
Baseline	0.928	0.933	0.808	0.931	0.935	0.789	0.941	0.947	0.803
	(0.013)	(0.014)	(0.029)	(0.018)	(0.018)	(0.045)	(0.020)	(0.018)	(0.048)
N	405	405	396	251	251	244	656	656	640
Mean growth in controls	0.117	0.154	-0.048	0.309	0.408	-0.337	0.203	0.268	-0.177

Notes: OLS regressions of log of tax revenue on treatment assignment. The unit of observation is a circle, as defined at the time of randomization. Specification controls for baseline values (FY 2013). Robust standard errors in parentheses. Standard errors are clustered by circle. Randomization inference based p-values in brackets.

Table A.5: Treatment Effect on Tax Revenue, with additional Year 2 circles

	Year 1			Year 2			Pooled		
	(1) Total	(2) Current	(3) Arrears	(4) Total	(5) Current	(6) Arrears	(7) Total	(8) Current	(9) Arrears
Treatment	0.049	0.048	0.065	0.076	0.043	0.077	0.058	0.046	0.069
	(0.022)	(0.023)	(0.056)	(0.036)	(0.035)	(0.098)	(0.019)	(0.020)	(0.050)
	[0.009]	[0.023]	[0.259]	[0.037]	[0.230]	[0.556]	[0.003]	[0.008]	[0.249]
Baseline	0.892	0.892	0.796	0.959	0.966	0.809	0.958	0.966	0.809
	(0.018)	(0.024)	(0.028)	(0.015)	(0.015)	(0.037)	(0.015)	(0.015)	(0.037)
N	405	405	396	363	363	356	768	768	752
Mean growth in controls	0.117	0.154	-0.048	0.313	0.404	-0.322	0.223	0.290	-0.197

Notes: Tax revenue (columns 1, 4, and 7) is comprised of revenue from the current years tax due (columns 2, 5, and 8), plus revenue collected from previous years' unpaid taxes (denoted 'arrears', columns 3, 6, and 9); the dependent variable in each column is the log of the respective tax measure. Estimation is by OLS. The unit of observation is a circle, as defined at the time of randomization. Specification controls for baseline values (FY 2013). Robust standard errors in parentheses. Standard errors are clustered by circle. Randomization inference based p-values in brackets.

Table A.6: Heterogeneity in treatment effects using alternative cost functions ($c = \alpha c^{\frac{3}{2}}$ and $c = \alpha c^3$)

	Cost function $\alpha c^{3/2}$		Cost function αc^3	
	(1)	(2)	(3)	(4)
Panel A: Full knowledge of P, Y				
Treatment * Model-predicted effort	0.022	0.016	0.053	0.062
	(0.052)	(0.065)	(0.049)	(0.062)
Treatment * Tax base at baseline		0.019		-0.004
		(0.062)		(0.059)
Treatment * Recovery rate at baseline		-0.048		-0.093
		(0.209)		(0.203)
Model-predicted effort	-0.016	-0.025	-0.019	-0.025
	(0.023)	(0.026)	(0.019)	(0.021)
Panel B: Random P, full knowledge of Y				
Treatment * Model-predicted effort	0.081	0.171	0.070	0.165
	(0.043)	(0.105)	(0.032)	(0.094)
Treatment * Tax base at baseline		-0.073		-0.078
		(0.072)		(0.070)
Treatment * Recovery rate at baseline		-0.273		-0.371
		(0.273)		(0.330)
Model-predicted effort	-0.020	-0.045	-0.018	-0.046
	(0.038)	(0.044)	(0.037)	(0.045)
Panel C: Assume identical P, full knowledge of Y				
Treatment * Model-predicted effort	0.031	0.054	0.022	0.048
	(0.027)	(0.059)	(0.029)	(0.048)
Treatment * Tax base at baseline		0.017		0.008
		(0.048)		(0.046)
Treatment * Recovery rate at baseline		-0.180		-0.233
		(0.282)		(0.301)
Model-predicted effort	0.006	0.001	0.006	-0.002
	(0.025)	(0.025)	(0.029)	(0.030)
Panel D: Full knowledge of P, no knowledge of Y				
Treatment * Model-predicted effort	-0.042	-0.051	0.014	0.011
	(0.056)	(0.069)	(0.058)	(0.064)
Treatment * Tax base at baseline		0.042		0.023
		(0.062)		(0.061)
Treatment * Recovery rate at baseline		-0.044		-0.042
		(0.173)		(0.185)
Model-predicted effort	-0.015	-0.020	-0.016	-0.018
	(0.021)	(0.023)	(0.019)	(0.019)
N	249	249	249	249
Mean of control group	16.268	16.268	16.268	16.268

Notes: OLS regessions of log recovery on treatment assignment, with group fixed effects (Y2). The unit of observation is a circle, as defined at the time of randomization. In Columns 1 and 2, the model-predicted effort is the Nash equilibrium level of effort under cost function $\alpha c^{3/2}$. In Columns 3 and 4, effort corresponds to the equilibrium effort under cost function αc^3. Columns 2 and 4 include tax base and recovery rate at baseline and their interactions with treatment assignment in the specification. Robust standard errors in parentheses. Standard errors are clustered by circle.

Table A.7: Heterogeneity in treatment effects in Year 2 using alternate utility functions ($\tilde{e}$ estimated using $u = r^2$ and $u = r^3$)

	Utility function u = r^2		Utility function u = r^3	
	(1)	(2)	(3)	(4)
Panel A: Full knowledge of P, Y				
Treatment * Model-predicted effort	0.040	0.042	0.036	0.034
	(0.048)	(0.060)	(0.047)	(0.056)
Treatment * Tax base at baseline		0.005		0.010
		(0.062)		(0.062)
Treatment * Recovery rate at baseline		-0.073		-0.061
		(0.199)		(0.195)
Model-predicted effort	-0.023	-0.028	-0.025	-0.028
	(0.019)	(0.020)	(0.018)	(0.019)
Panel B: Random P, full knowledge of Y				
Treatment * Model-predicted effort	0.073	0.172	0.070	0.167
	(0.033)	(0.100)	(0.032)	(0.098)
Treatment * Tax base at baseline		-0.078		-0.074
		(0.071)		(0.069)
Treatment * Recovery rate at baseline		-0.359		-0.370
		(0.325)		(0.335)
Model-predicted effort	-0.017	-0.045	-0.016	-0.044
	(0.037)	(0.045)	(0.037)	(0.045)
Panel C: Assume identical P, full knowledge of Y				
Treatment * Model-predicted effort	-0.008	-0.011	-0.026	-0.038
	(0.039)	(0.055)	(0.038)	(0.056)
Treatment * Tax base at baseline		0.013		-0.007
		(0.075)		(0.079)
Treatment * Recovery rate at baseline		-0.069		-0.076
		(0.192)		(0.194)
Model-predicted effort	0.020	0.024	0.018	0.027
	(0.025)	(0.028)	(0.026)	(0.029)
Panel D: Full knowledge of P, no knowledge of Y				
Treatment * Model-predicted effort	0.002	-0.003	0.002	-0.003
	(0.057)	(0.066)	(0.054)	(0.063)
Treatment * Tax base at baseline		0.027		0.027
		(0.063)		(0.063)
Treatment * Recovery rate at baseline		-0.042		-0.040
		(0.181)		(0.180)
Model-predicted effort	-0.019	-0.021	-0.020	-0.021
	(0.019)	(0.019)	(0.018)	(0.019)
N	249	249	249	249
Mean of control group	16.268	16.268	16.268	16.268

Notes: OLS regessions of log recovery on treatment assignment, with group fixed effects (Y2). The unit of observation is a circle, as defined at the time of randomization. In Columns 1 and 2, the model-predicted effort is the Nash equilibrium level of effort under quadratic utility function. In Columns 3 and 4, effort corresponds to the equilibrium effort under cubic utility function. Columns 2 and 4 include tax base and recovery rate at baseline and their interactions with treatment assignment in the specification. Robust standard errors in parentheses. Standard errors are clustered by circle.

Table A.8: Heterogeneity in treatment effects by simulated marginal returns to effort (under $\alpha \pm 2se$)

	$\alpha + 2se.$		$\alpha - 2se.$	
	(1)	(2)	(3)	(4)
Panel A: Full knowledge of P, Y				
Treatment * Model-predicted effort	0.038	0.042	0.038	0.043
	(0.051)	(0.066)	(0.051)	(0.066)
Treatment * Tax base at baseline		0.004		0.004
		(0.061)		(0.061)
Treatment * Recovery rate at baseline		-0.078		-0.078
		(0.207)		(0.207)
Model-predicted effort	-0.017	-0.025	-0.017	-0.025
	(0.021)	(0.023)	(0.021)	(0.023)
Panel B: Random P, full knowledge of Y				
Treatment * Model-predicted effort	0.076	0.176	0.077	0.176
	(0.036)	(0.103)	(0.036)	(0.103)
Treatment * Tax base at baseline		-0.081		-0.081
		(0.073)		(0.073)
Treatment * Recovery rate at baseline		-0.339		-0.339
		(0.310)		(0.310)
Model-predicted effort	-0.018	-0.046	-0.018	-0.046
	(0.037)	(0.045)	(0.038)	(0.045)
Panel C: Assume identical P, full knowledge of Y				
Treatment * Model-predicted effort	0.025	0.051	0.025	0.051
	(0.027)	(0.051)	(0.027)	(0.051)
Treatment * Tax base at baseline		0.011		0.011
		(0.046)		(0.046)
Treatment * Recovery rate at baseline		-0.218		-0.217
		(0.297)		(0.297)
Model-predicted effort	0.006	-0.001	0.006	-0.001
	(0.027)	(0.028)	(0.027)	(0.028)
Panel D: Full knowledge of P, no knowledge of Y				
Treatment * Model-predicted effort	-0.009	-0.014	-0.009	-0.014
	(0.060)	(0.069)	(0.060)	(0.070)
Treatment * Tax base at baseline		0.031		0.031
		(0.062)		(0.062)
Treatment * Recovery rate at baseline		-0.043		-0.043
		(0.181)		(0.181)
Model-predicted effort	-0.014	-0.018	-0.015	-0.018
	(0.019)	(0.020)	(0.019)	(0.020)
N	249	249	249	249
Mean of control group	16.268	16.268	16.268	16.268

Notes: OLS regessions of log recovery on treatment assignment, with group fixed effects (Y2). The unit of observation is a circle, as defined at the time of randomization. In Columns 1 and 2, the model-predicted effort is the Nash equilibrium level of effort under $\alpha + 2se.$. In Columns 3 and 4, effort corresponds to the equilibrium effort under $\alpha - 2se.$. Columns 2 and 4 include tax base and recovery rate at baseline and their interactions with treatment assignment in the specification. Robust standard errors in parentheses. Standard errors are clustered by circle.

Table A.9: Base Growth Predictions, with Group FE

	(1) Group 1	(2) Group 2	(3) Group 5	(4) Group 6	(5) Group 40
2013 Log Recovery (Total)	-0.314	-0.275	-0.271	-0.286	-0.280
	(0.122)	(0.114)	(0.119)	(0.119)	(0.118)
2012 Log Recovery (Total)	0.162	0.137	0.129	0.145	0.134
	(0.118)	(0.111)	(0.116)	(0.118)	(0.115)
2013 Log Net Demand (Total)	0.097	0.064	0.072	0.065	0.076
	(0.084)	(0.081)	(0.085)	(0.086)	(0.084)
2012 Log Net Demand (Total)	0.021	0.047	0.031	0.034	0.032
	(0.078)	(0.075)	(0.078)	(0.080)	(0.078)
R^2	0.250	0.233	0.279	0.285	0.283
N	235	234	235	234	236

Notes: OLS regessions of performance on time-lagged performance, using group fixed effects. The unit of observation is a circle, as defined at the time of randomization. Robust standard errors in parentheses. Standard errors are clustered by group. * p<0.10, ** p<0.05, *** p<0.01

Table A.10: Estimated α parameters under different knowledge assumptions

Preferences	Baseline performance (y0)	Alpha
Full knowledge	Full knowledge	8.720
		(0.249)
Random preferences	Full knowledge	7.784
		(0.077)
Identical preferences	Full knowledge	19.339
		(0.053)
Full knowledge	No knowledge	9.073
		(0.246)

Notes: Estimated alpha parameters. Standard errors in parentheses.

Table A.11: Top 3 choices and circles

	Y1 Preferences (Treatment)				Allocation		Difference in allocation			
	(1)		(2)		(3)		(4)		(5)	
	All circles		Top inspectors' circles		Treated inspectors		Treatment - Control (Revenue)		Treatment - Control (Tax base)	
	b / se	Mean	b / se	Mean	b / se	Mean	b / se	Mean	b / se	Mean
Log of tax base (Current)	0.187	15.870	0.239	15.873	0.158	15.906	0.058	16.055	0.286	16.050
	(0.045)		(0.079)		(0.116)		(0.191)		(0.149)	
Log of tax base (Arrears)	0.138	14.254	0.161	14.228	0.157	14.224	-0.121	14.492	0.113	14.552
	(0.079)		(0.141)		(0.232)		(0.426)		(0.270)	
Growth in tax base (Current)	-0.002	0.101	-0.002	0.099	0.003	0.094	-0.017	0.113	0.021	0.109
	(0.007)		(0.011)		(0.018)		(0.032)		(0.027)	
Growth in tax base (Arrears)	-0.008	-0.321	-0.040	-0.335	0.017	-0.361	0.126	-0.362	-0.061	-0.317
	(0.034)		(0.048)		(0.174)		(0.334)		(0.107)	
Log of revenue (Current)	0.209	15.565	0.270	15.566	0.183	15.605	0.143	15.737	0.303	15.735
	(0.055)		(0.093)		(0.121)		(0.197)		(0.160)	
Log of revenue (Arrears)	0.144	13.848	0.196	13.814	0.163	13.821	0.093	14.023	0.071	14.086
	(0.064)		(0.127)		(0.225)		(0.417)		(0.239)	
Growth in revenue (Current)	0.006	0.142	0.014	0.140	0.015	0.138	0.009	0.172	0.032	0.158
	(0.007)		(0.014)		(0.024)		(0.033)		(0.041)	
Growth in revenue (Arrears)	-0.007	-0.331	-0.055	-0.351	-0.024	-0.359	0.106	-0.353	-0.152	-0.312
	(0.028)		(0.045)		(0.178)		(0.333)		(0.134)	
Any unofficial payment	0.005	0.395	0.006	0.395	0.039	0.404	0.042	0.387	0.134	0.375
	(0.016)		(0.033)		(0.052)		(0.074)		(0.084)	
Log of unofficial payment rate	-0.093	0.704	-0.041	0.728	0.015	0.705	0.007	0.692	-0.145	0.698
	(0.034)		(0.052)		(0.081)		(0.134)		(0.150)	
Log average p.c. expenditure	0.089	8.614	0.154	8.611	0.101	8.631	0.141	8.652	0.210	8.625
	(0.029)		(0.035)		(0.059)		(0.094)		(0.108)	
Properties for commercial use	-0.026	0.322	-0.050	0.325	-0.033	0.328	-0.040	0.367	-0.058	0.356
	(0.011)		(0.020)		(0.032)		(0.057)		(0.048)	
Properties for residential use	0.045	0.424	0.074	0.419	0.052	0.413	0.054	0.377	0.099	0.381
	(0.019)		(0.032)		(0.033)		(0.059)		(0.055)	
Num of properties (in hundreds)	-3.562	65.585	-3.948	68.221	-4.427	63.547	-36.763	75.349	-66.419	74.123
	(2.436)		(3.665)		(4.452)		(38.739)		(50.658)	
Log of average property value	0.155	7.630	0.201	7.608	0.123	7.631	-0.241	7.869	0.715	7.809
	(0.073)		(0.138)		(0.248)		(0.447)		(0.264)	
N	1382		469		147		237		252	

Notes: Columns 1 and 2 present OLS regressions of circles attributes on a dummy variable that takes the value of 1 for circles that were ranked as TOP 3. Sample consists in all treated circles and treated circles of TOP 3 inspectors, respectively. Column 3 shows regressions of circles characteristics on an indicator that takes the value of 1 if the treated inspector that ended up in that circle ranked among the TOP 3 of his group. Columns 4 and 5 report the difference in allocation between inspectors in the treatment and control group. Inspectors in Column 4 are ranked based on their performance in recovery (growth in recovery rate). In Column 5, based on their performance in demand (growth in tax base).

Table A.12: Relationship between movements and performance

	Change in rank		Stay in status quo					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			Top choice	Top choice	Top two choices	Top two choices	Top choice	Top two choices
	Base prefs	Y1 prefs	Base prefs	Y1 prefs	Base prefs	Y1 prefs	Base prefs	Base prefs
Y1 Rank	0.171	0.229	0.428	0.432	0.391	0.346	0.002	0.011
	(0.102)	(0.111)	(0.204)	(0.166)	(0.172)	(0.149)	(0.024)	(0.023)
Y1 Treatment * Y1 Rank							0.426	0.380
							(0.205)	(0.172)
N	129	131	71	94	80	100	174	203

Notes: Columns 1 and 2 present OLS regressions of the change in an inspector's preference rank on their performance-based group rank. Columns 3 to 8 show the results from regressing the probability of staying in a top choice circle on inspector's performance-based group rank. The sample in Columns 3 to 6 consists of Y1 treated inspectors. In Columns 7 and 8 the sample comprises both treated and control inspectors.

Table A.13: Do preferences depend on continuing status?

	(1)	(2)	(3)	(4)
	Own circle is favorite	Own circle is favorite	Own circle rank	Own circle rank
Continuing	0.140	0.146	0.038	0.031
	(0.085)	(0.079)	(0.051)	(0.047)
	[0.113]	[0.073]	[0.468]	[0.527]
Own circle is favorite, baseline		0.344		
		(0.083)		
Own circle rank, baseline				0.389
				(0.115)
N	108	107	108	107
Mean of non-continuing group	0.660	0.660	0.854	0.854

Notes: OLS regessions on continuing treatment assignment. Sample is restricted to Y1 treatment inspectors only. The unit of observation is an inspector. Robust standard errors in parentheses. Randomization inference based p-values in brackets.

Table A.14: How does the serial dictatorship change allocations?

	(1)	(2)	(3)	(4)
	Any move	Any move	Days in circle	Days in circle
Y2 Treatment	-0.024		5.571	
	(0.086)		(43.078)	
	[0.790]		[0.900]	
Y1 Treatment	0.124	0.094	-72.673	-56.584
	(0.069)	(0.053)	(35.210)	(26.698)
	[0.066]	[0.074]	[0.034]	[0.022]
Y1 AND Y2 Treatment	-0.042		26.955	
	(0.119)		(59.980)	
	[0.701]		[0.636]	
N	365	365	365	365
Y1 Treatment = Y2 Treatment (p-value)	0.114		0.103	
Mean of control group	0.548	0.543	391.048	392.065

Notes: OLS regessions of number of days in circle or dummy for any move on various treatment regressors. LHS variables are calculated over the time period from the beginning of FY2014 to the date of the execution of transfers. The unit of observation is a circle, as defined at the time of randomization. Sample excludes any circles that have been merged or split after ballot. Specification controls for baseline values. Robust standard errors in parentheses. Standard errors are clustered by circle. Randomization inference based p-values in brackets.

Table A.15: Predicting movements

	All circles	Y2 Treatment excluded
	(1)	(2)
	Any move	Any move
Y1 Treatment * Pr(Any move)	0.571	1.343
	(0.363)	(0.459)
Y1 Treatment * dEudy	0.053	-0.016
	(0.134)	(0.190)
Pr(Any move)	0.193	0.156
	(0.195)	(0.217)
dEudy	-0.183	-0.166
	(0.071)	(0.079)
Y1 Treatment	-0.364	-0.765
	(0.194)	(0.231)
N	404	275
Mean of Y1 Control group	0.516	0.517
Y1 Treatment * Pr(Any move) = 0 (F statistic)	2.478	8.564

Notes: First stage regessions of any move dummy on various regressors. The unit of observation is a circle, as defined at the time of randomization. Robust standard errors in parentheses. Standard errors are clustered by circle.

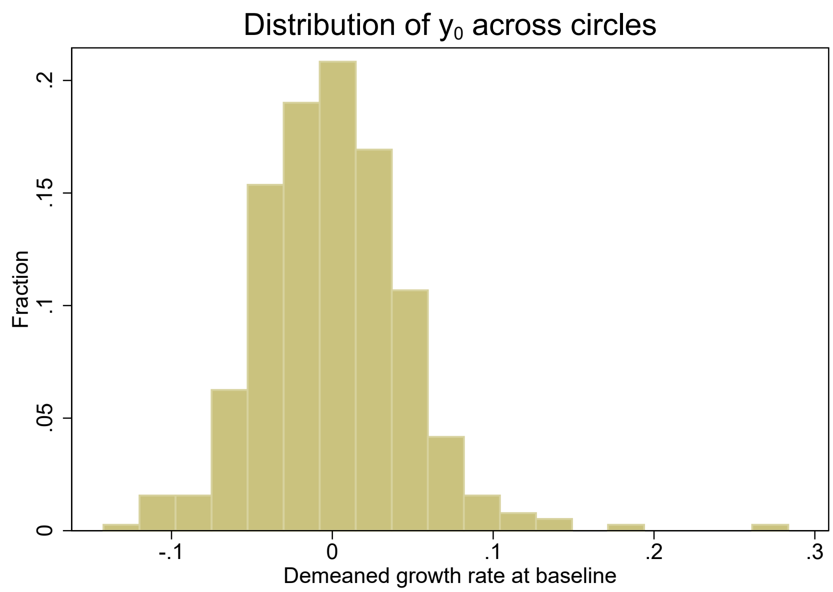
Table A.16: Estimating the disruption effects from movements

	All circles			Y2 Treatment excluded		
	(1) Total	(2) Current	(3) Arrears	(4) Total	(5) Current	(6) Arrears
Panel A: Reduced form						
Y1 Treatment * Pr(Any move)	-0.194	-0.022	0.225	-0.265	-0.269	1.924
	(0.173)	(0.173)	(0.604)	(0.251)	(0.252)	(0.837)
Y1 Treatment * dEudy	0.092	0.008	0.159	0.134	0.147	0.007
	(0.085)	(0.084)	(0.245)	(0.087)	(0.085)	(0.282)
Pr(Any move)	-0.009	-0.003	0.171	0.074	0.115	0.029
	(0.097)	(0.094)	(0.341)	(0.097)	(0.094)	(0.377)
dEudy	0.049	0.109	-0.215	0.010	0.058	-0.215
	(0.042)	(0.042)	(0.107)	(0.042)	(0.042)	(0.119)
Y1 Treatment	0.108	0.075	-0.203	0.166	0.143	-1.085
	(0.083)	(0.081)	(0.304)	(0.106)	(0.108)	(0.431)
Panel B: IV						
Any move dummy	-0.323	-0.037	0.384	-0.178	-0.182	1.582
	(0.340)	(0.299)	(1.007)	(0.181)	(0.180)	(0.850)
Y1 Treatment * dEudy	0.112	0.010	0.145	0.132	0.143	0.015
	(0.114)	(0.099)	(0.262)	(0.093)	(0.089)	(0.352)
Pr(Any move)	0.048	0.004	0.111	0.101	0.143	-0.209
	(0.143)	(0.129)	(0.473)	(0.104)	(0.109)	(0.639)
dEudy	0.000	0.104	-0.129	-0.011	0.039	0.111
	(0.071)	(0.064)	(0.287)	(0.052)	(0.051)	(0.292)
Y1 Treatment	-0.017	0.061	-0.068	0.013	-0.012	0.008
	(0.080)	(0.074)	(0.190)	(0.081)	(0.078)	(0.307)
Panel B: OLS						
Any move dummy	-0.048	-0.043	0.104	-0.060	-0.035	0.034
	(0.026)	(0.027)	(0.072)	(0.028)	(0.028)	(0.078)
Y1 Treatment * dEudy	0.053	0.011	0.197	0.089	0.090	0.472
	(0.061)	(0.059)	(0.168)	(0.065)	(0.066)	(0.205)
Pr(Any move)	-0.053	0.006	0.206	0.052	0.082	0.342
	(0.078)	(0.080)	(0.274)	(0.089)	(0.089)	(0.336)
dEudy	0.051	0.103	-0.201	0.010	0.063	-0.283
	(0.042)	(0.040)	(0.097)	(0.040)	(0.040)	(0.109)
Y1 Treatment	0.017	0.060	-0.095	0.042	0.023	-0.262
	(0.051)	(0.054)	(0.162)	(0.054)	(0.052)	(0.210)
N	401	401	390	274	274	269
Mean of Y1 Control group	16.238	16.117	13.775	16.268	16.146	13.823

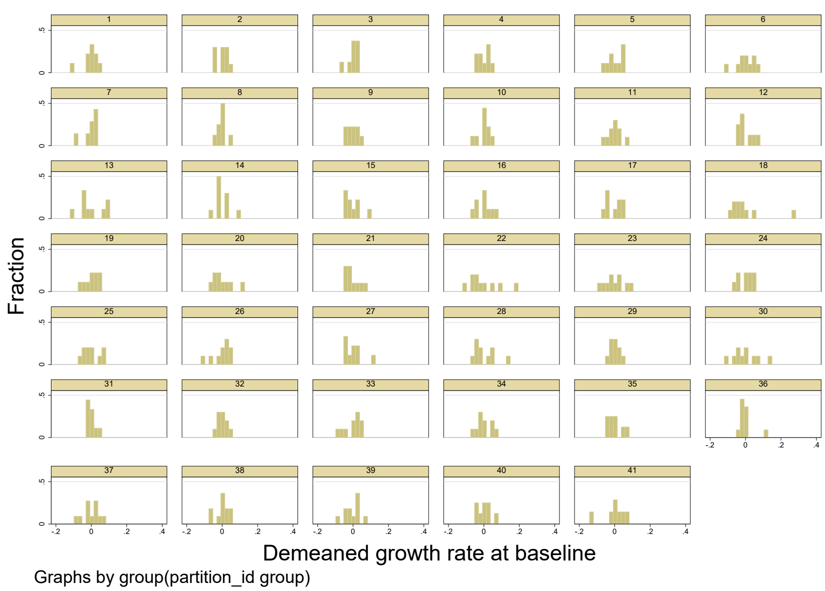
Notes: Reduced form, IV, and OLS regessions of Y2 log total recovery on various regressors. The unit of observation is a circle, as defined at the time of randomization. Robust standard errors in parentheses. Standard errors are clustered by circle.

Figure A.1: The distribution of y_0

(a) Distribution of y_0 across circles



(b) Distribution of y_0 across circles by group



Notes: y_0 is given by the demeaned growth rate of the recovery rate at the baseline.

Figure A.2: Uniqueness of alpha

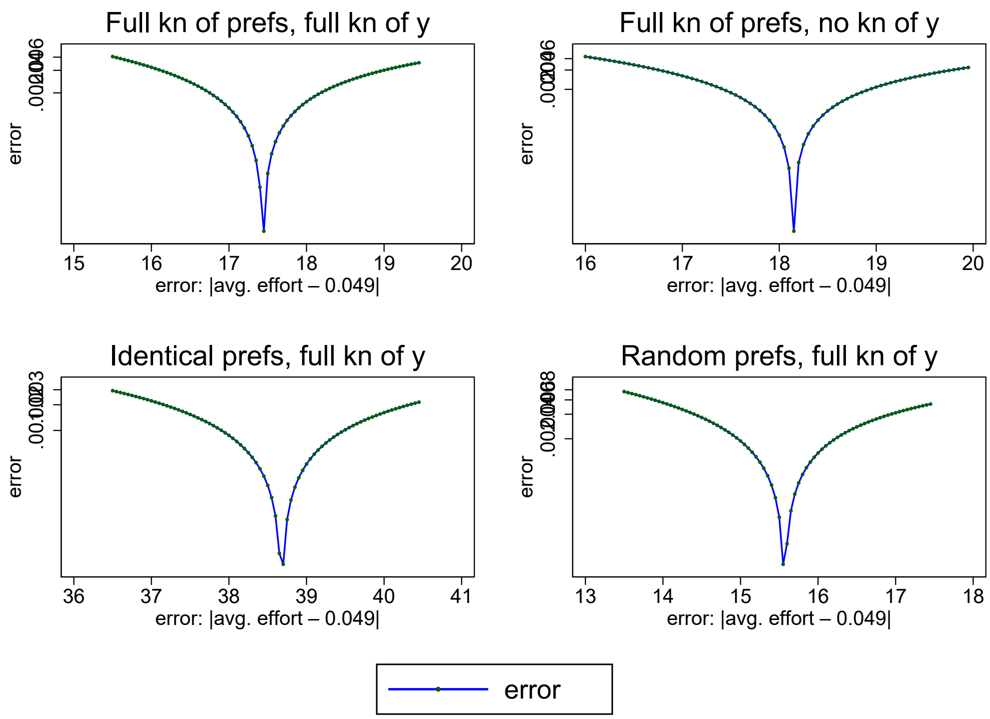


Figure A.3: Uniqueness of the effort vector at the moment-minimizing alpha

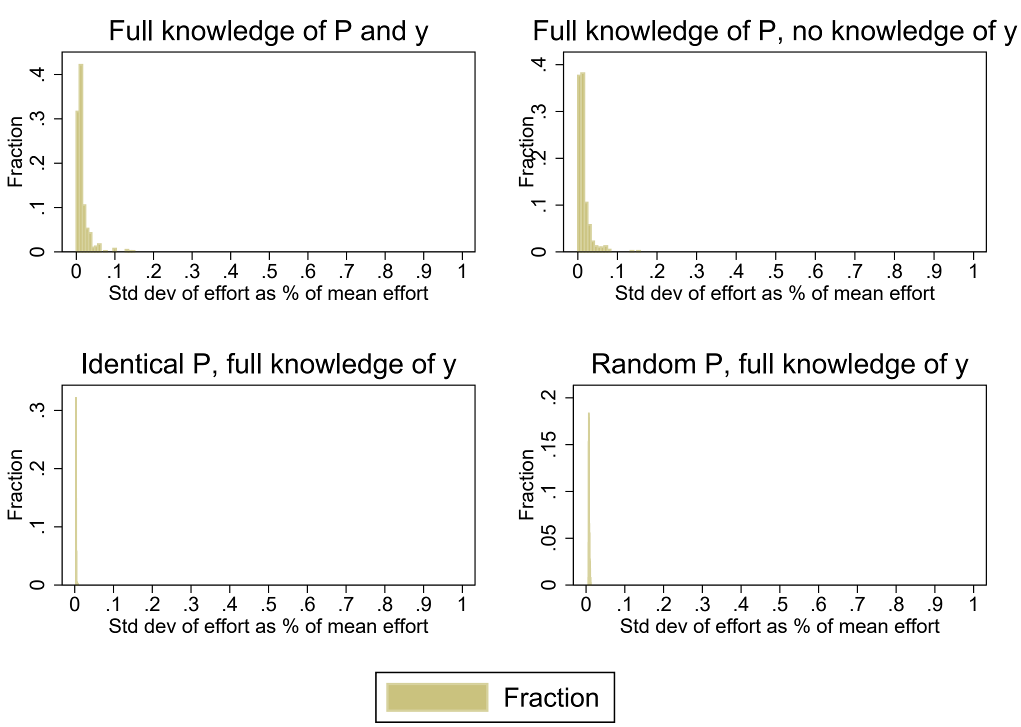
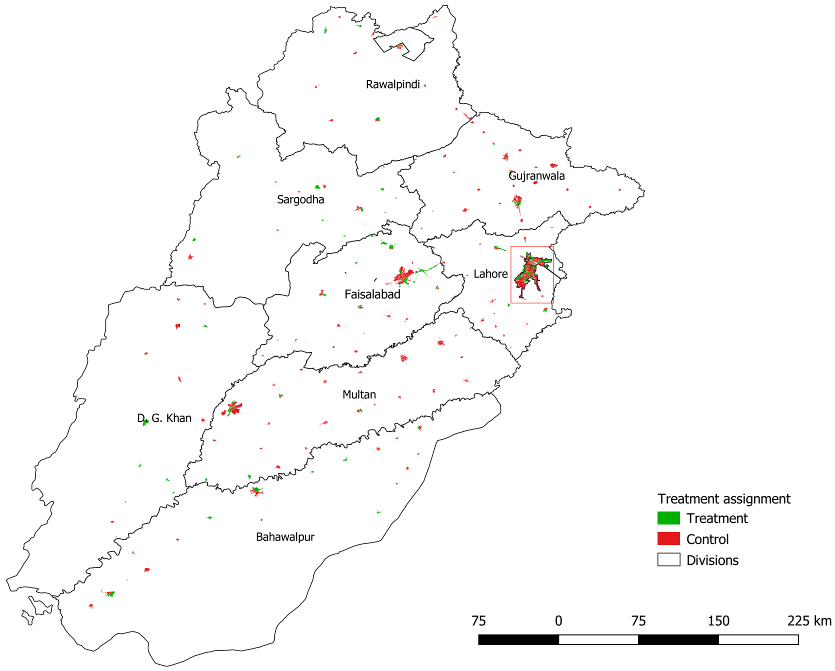


Figure A.4: Map of sample showing Year 2 treatments

(a) Province of Punjab, showing treatment and control circles



(b) Lahore Divisions A and B, showing treatment and control circles separately by group