Online Appendix for: Land Lotteries, Long-term Wealth, and Political Selection

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1 1805 and 1807 lotteries

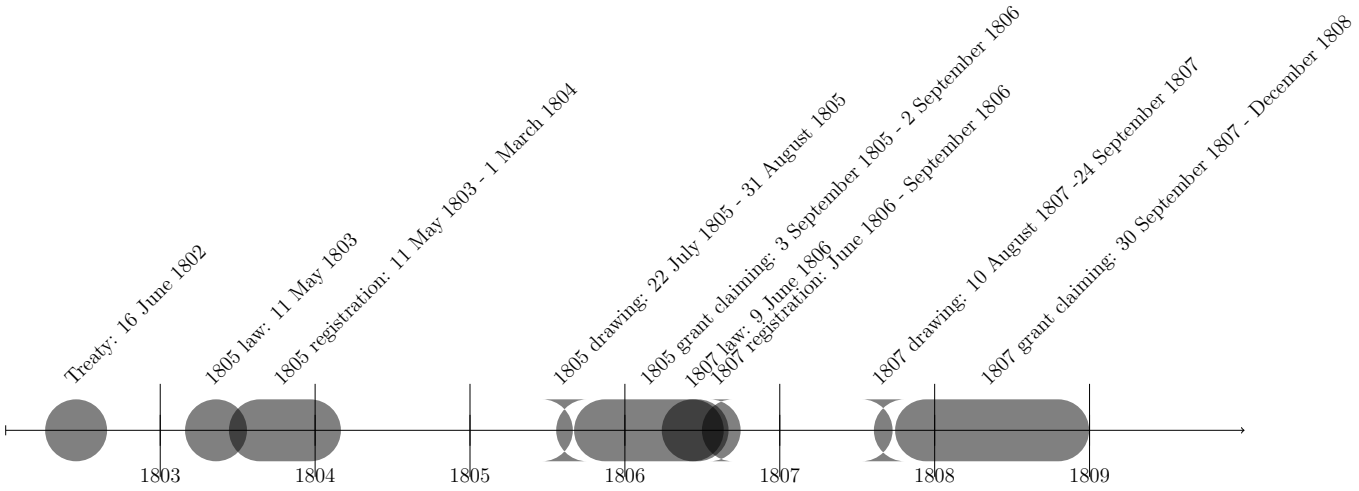
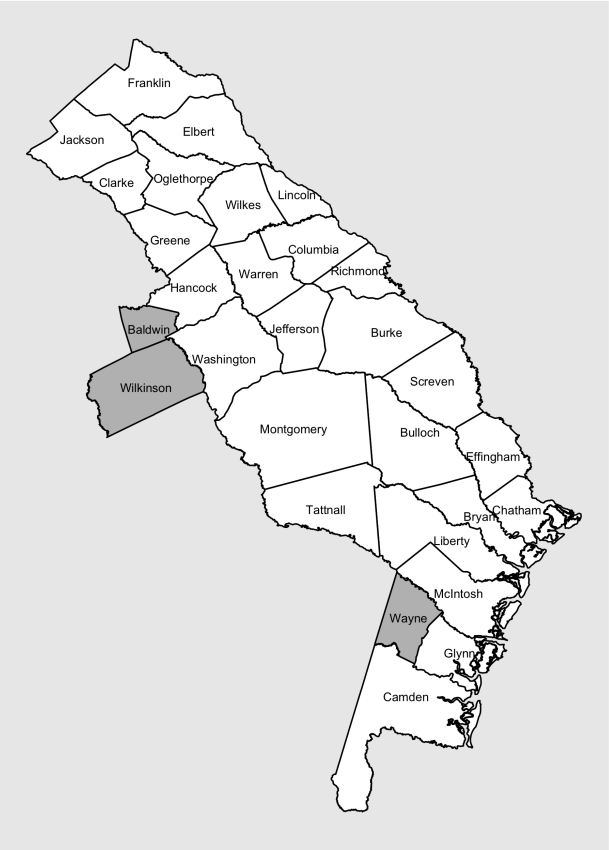


Figure 1: Timeline of 1805 and 1807 lottery events. (Graham, 2010, 2011).

Requirements	No. Draws (1805)	No. Draws (1807)
"Every free male white person, twenty-one years of age and upwards, being a citizen of the United States, and an inhabitant of this State, twelve months immediately preceding the passage of this act, or paid a tax towards the support of government (including such as may be absent on lawful business)" [1]	1	1
"Every free white male person of like description, having a wife, legitimate child or children, under twenty-one years of age"	2	2
"All widows having a legitimate child or children, under the age of twenty-one years, who have resided twelve months in this State, immediately preceding the passage of this act" [2]	2	1
"All families of orphans, under twenty-one years of age, having no parents living" [3]	1	1-2 [4]
"All families of orphans [with three years' residence], under twenty-one years of age, whose father is dead, "	N/A	1
"All free female white persons, who have arrived to the age of twenty-one years or upwards, who have resided in this State [for three years]"	1	N/A

Table 1: Lottery qualifications specified by Acts of 11 May 1803 and 9 June 1806 (Clayton and Adams, 1812). [1] The residency requirement is three years under 1807 lottery rules. An amendment to the 1807 rules also makes provision for persons laboring under accidents or misfortunes. [2] The 1807 lottery rules apply to all widows with three years residence in Georgia. [3] An amendment to the 1805 lottery rules entitles children whose father is dead and mother remarries to draw in the same manner. The 1807 lottery rules apply the three years residency requirement. [4] The 1807 lottery rules specify "families of orphans consisting of more than one" receive two draws and orphan families of "only one" receive one draw.

Figure 2: Original 1805 Lottery counties.



Notes: Map of Georgia with 1807 county boundaries (Long, 1995). The shaded counties are original counties created by the 1805 lottery.

Table 2: Counties created by 1805 and 1807 lotteries.

Panel A: 1805

Counties	No. Districts	Lot sizes (acres)	Lot length (chains square)	Lot orientation (degrees)	Grant fee ($)	Est. value of lot ($)
Baldwin	5	202.5	45	45 / 60	8.10	839.17
Wayne	3	490	70	13 / 77	19.60	842.64
Wilkinson	5	202.5	45	45 / 60	8.10	811.25

Panel B: 1807

Counties	No. Districts	Lot sizes (acres)	Lot length (chains square)	Lot orientation (degrees)	Grant fee ($)	Est. value of lot ($)
Baldwin	15	202.5	45	45 / 60	12.15	827.35
Wilkinson	23	202.5	45	45 / 60	12.15	799.82

Notes: counties and land lots specified by Acts of 11 May 1803 and 9 June 1806. Lot orientation is degrees from the meridian. Lot values are estimated by averaging the cash value of farms minus the value of farming implements and machinery by the number of (improved and unimproved) acres of land in farms (Haines, 2004; Bleakley and Ferrie, 2013). The 1850 values are deflated to 1805 dollars (Panel A) and 1807 dollars (Panel B) using a historical consumer price index (Officer and Williamson, 2012).

2 Descriptive statistics

County	White males 16–25	White males 26-44	White males 45+	White male total pop.	White female total pop.	Slave pop. (%)
Bryan	57	64	26	286	242	0.813
Bulloch	158	151	97	871	758	0.141
Burke	726	743	242	3,356	3,167	0.312
Camden	104	131	60	496	440	0.437
Chatham	547	591	175	2,077	1,596	0.699
Columbia	478	516	256	2,848	2,473	0.360
Effingham	94	163	132	716	594	0.368
Elbert	637	689	348	3,709	3,546	0.279
Franklin	463	572	276	3,078	2,814	0.140
Glynn	68	116	60	445	334	0.583
Greene	593	857	295	3,716	3,381	0.340
Hancock	964	952	423	5,205	4,400	0.334
Jackson	563	654	243	3,266	3,062	0.181
Jefferson	311	421	219	2,066	1,942	0.289
Liberty	171	187	71	762	584	0.742
Lincoln	230	317	193	1,745	1,581	0.301
McIntosh	79	117	60	460	371	0.684

Montgomery	286	270	147	1,445	1,297	0.137
Oglethorpe	643	653	341	3,479	3,207	0.316
Richmond	360	370	132	1,503	1,225	0.492
Screven	274	310	82	1,253	1,000	0.254
Warren	605	562	313	3,263	2,989	0.247
Washington	660	678	322	3,739	3,442	0.259
Wilkes	716	830	444	4,184	3,848	0.382
Georgia	9,787	10,910	4,957	53,965	48,298	0.365

Table 3: Summary statistics on selected county-level characteristics in the 1800 Census. *Slave pop.* is the slave population over the total population.

County	Slave pop. (%)	Slave wealth Gini
Baldwin	0.548	0.668
Bryan	0.739	0.804
Bulloch	0.264	0.829
Burke	0.476	0.872
Camden	0.594	0.820
Chatham	0.635	0.843
Clarke	0.368	0.746
Columbia	0.561	0.670
Effingham	0.450	0.775
Elbert	0.440	0.761
Glynn	0.758	0.765
Greene	0.256	0.664
Hancock	0.534	0.680
Jackson	0.246	0.834
Jefferson	0.437	0.796
Liberty	0.711	0.769
Lincoln	0.455	0.708
McIntosh	0.720	0.830
Montgomery	0.373	0.855
Oglethorpe	0.517	0.670
Richmond	0.568	0.793
Screven	0.448	0.751
Tattnall	0.111	0.842
Warren	0.381	0.748
Washington	0.358	0.800
Wayne	0.363	0.800
Wilkes	0.548	0.664
Wilkinson	0.209	0.853
Georgia	0.412	0.789

Table 4: Summary statistics on selected county-level characteristics in the 1820 Census, for counties existing in 1807. *Slave pop.* is the slave population over the total population. *Wealth Gini* is the gini coefficient based on imputed slave wealth (see footnotes to Table OA-5 for the slave value imputation method). Highlighted counties were created by the 1805 and 1807 lotteries.

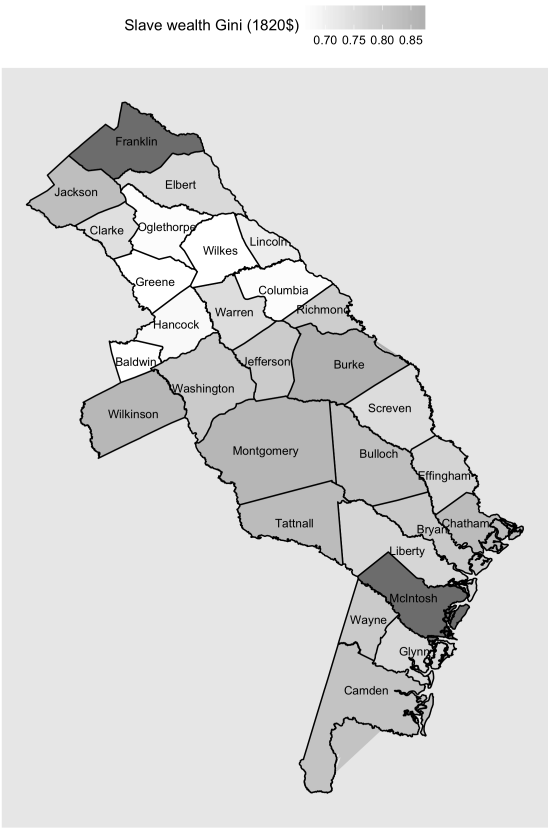


Figure 3: Gini coefficient based on 1820 slave wealth for counties existing in 1807. See footnotes to Table OA-5 for the slave value imputation method.

Table 5: Imputed slave values (1820$), by gender and age group.

	Male	**Female**
Under 14	331	303
14-25	700	642
26-44	425	389
45+	258	236

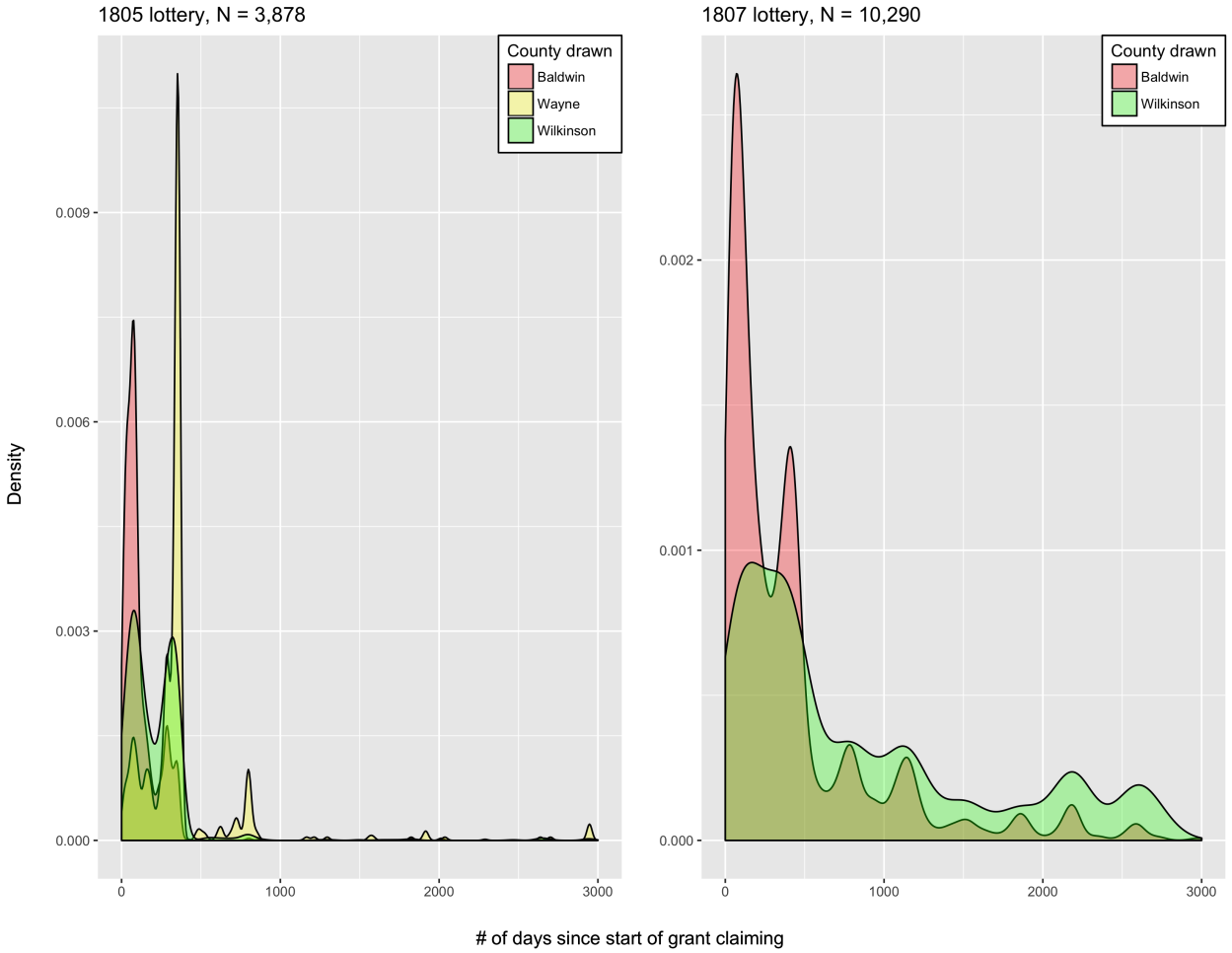
Notes: Phillips (1905) estimates the average value of male prime field hands (18-30 years old) in Georgia in 1821 is $700. I use the coefficients in Table II of Kotlikoff (1979) to adjust the average price according to age group and gender.

County	Log value of farms ($)	Log value of farm equip. ($)	Log total # of farms	Log mean farm value ($)	Log total farm acres	Per acre farm value ($)	Slave pop. (%)	Real estate wealth Gini
Baldwin	13.407	10.341	5.481	7.879	12.343	2.761	0.565	0.594
Bryan	12.636	9.857	5.342	7.230	12.046	1.692	0.656	0.618
Bulloch	12.761	9.724	6.021	6.691	13.122	0.663	0.340	0.546
Burke	14.642	11.794	6.568	8.014	13.171	4.100	0.673	0.677
Camden	13.715	10.242	5.460	8.223	12.240	4.234	0.672	0.802
Chatham	14.513	12.251	4.883	9.520	11.866	12.643	0.587	0.723
Clarke	13.876	11.028	5.991	7.825	12.197	5.051	0.503	0.674
Columbia	14.213	11.682	6.192	7.938	12.613	4.559	0.692	0.555
Effingham	12.646	9.721	5.730	6.861	12.358	1.263	0.478	0.634
Elbert	14.262	11.443	6.690	7.511	12.655	4.691	0.484	0.649
Franklin	13.882	11.335	7.174	6.626	12.900	2.461	0.207	0.666
Glynn	13.544	10.353	4.522	8.980	11.574	6.877	0.858	0.801
Greene	14.385	11.266	6.238	8.101	12.444	6.659	0.633	0.606
Hancock	14.096	11.314	6.096	7.936	12.572	4.307	0.631	0.577
Jackson	13.505	10.856	6.304	7.127	12.203	3.418	0.301	0.523
Jefferson	14.118	11.483	6.288	7.756	12.603	4.227	0.588	0.613
Liberty	13.563	10.400	5.497	8.022	12.743	2.174	0.745	0.707
Lincoln	13.363	10.604	5.609	7.688	11.918	3.970	0.630	0.556
McIntosh	13.485	11.209	4.762	8.615	11.538	6.290	0.768	
Montgomery	11.678	9.094	5.124	6.475	12.140	0.582	0.285	0.683
Oglethorpe	14.437	11.561	6.319	8.060	12.606	5.888	0.642	0.560
Richmond	13.969	10.838	5.606	8.318	11.913	7.468	0.481	0.712
Screven	13.320	10.672	6.211	7.036	13.144	1.109	0.536	0.753
Tattnall	12.345	9.503	5.790	6.495	12.883	0.550	0.258	0.522
Warren	14.335	11.434	6.405	7.873	12.825	4.277	0.492	0.570
Washington	14.102	11.444	6.449	7.580	12.962	2.908	0.488	0.622
Wayne	11.419	8.525	5.147	6.215	11.226	1.146	0.271	0.631
Wilkes	14.112	11.332	6.148	7.899	12.571	4.378	0.684	0.629

Wilkinson	13.723	11.147	6.469	7.175	12.662	2.670	0.331	0.591
Georgia	18.377	15.589	10.854	7.459	16.943	3.938	0.421	0.660

Table 6: Summary statistics on selected county-level characteristics for counties existing in 1807 from the 1850 Census. *Log total farm acres* is the log of the sum of improved and unimproved acres of land in farms. *Log average farm value* is the log of the difference between farm value and equipment value, over the total number of farms. *Per acre farm value* is the difference between farm value and equipment value, over the sum of improved and unimproved acres of farm land. All dollar values are current (1850$). *Slave pop.* is the slave population over the total population. *Wealth Gini* is based on real estate values in sample drawn from the 1850 full-count Census, which s restricted to male heads of households aged 21 and over who living in Georgia at the time of the census, were born in Georgia, and have non-missing surnames and property value.

Figure 4: Time lag in filing grants for 1805 and 1807 fortunate drawers.



Notes: grants filed for land reverted to state are excluded. See OA-Fig. 1 for the dates of grant claiming specified by the Acts of 11 May 1803 and 9 June 1806. The legislature extended the grant deadline for each lottery on an annual basis for about a decade.

Table 7: Distribution of pretreatment counties of registration by sample.

Variable	Sample	N	Min.	Mean	Max.	S.d.
Bryan	1805 winners & losers	23,927	0	0	1	0.07
	1805 winners	3,707	0	0.01	1	0.08
	1807 winners	9,687	0	0.38	1	0.49
Bulloch			0	0.01	1	0.12
			0	0.01	1	0.12
			0	0.01	1	0.11
Burke			0	0.06	1	0.24
			0	0.07	1	0.25
			0	0.04	1	0.19
Camden			0	0.01	1	0.08
			0	0.01	1	0.08
			0	0.01	1	0.08
Chatham			0	0.02	1	0.14
			0	0.02	1	0.13
			0	0.02	1	0.16
Clarke			0	0.05	1	0.21
			0	0.05	1	0.21
			0	0.03	1	0.18
Columbia			0	0.05	1	0.22
			0	0.05	1	0.22
			0	0.03	1	0.16
Effingham			0	0.01	1	0.10
			0	0.01	1	0.10
			0	0.01	1	0.08
Elbert			0	0.06	1	0.24
			0	0.06	1	0.24
			0	0.03	1	0.18
Franklin			0	0.05	1	0.22
			0	0.05	1	0.21
			0	0.03	1	0.16
Glynn			0	0.01	1	0.1
			0	0.01	1	0.1
			0	0	1	0.07
Greene			0	0.08	1	0.28
			0	0.08	1	0.26
			0	0.04	1	0.2
Hancock			0	0.1	1	0.29
			0	0.1	1	0.3
			0	0.04	1	0.2
Jackson			0	0.05	1	0.22
			0	0.06	1	0.23
			0	0.03	1	0.17
Jefferson			0	0.04	1	0.2
			0	0.05	1	0.21
			0	0.02	1	0.15
Liberty			0	0.01	1	0.12
			0	0.01	1	0.12
			0	0.01	1	0.11
Lincoln			0	0.03	1	0.17
			0	0.03	1	0.17
			0	0.01	1	0.12
McIntosh			0	0	1	0.01
			0	0	0	0
			0	0	1	0.07
Montgomery			0	0.03	1	0.16
			0	0.02	1	0.15
			0	0.02	1	0.13
Oglethorpe			0	0.06	1	0.24
			0	0.06	1	0.24
			0	0.03	1	0.18
Richmond			0	0.02	1	0.15
			0	0.02	1	0.14
			0	0.01	1	0.11
Screven			0	0.02	1	0.14
			0	0.02	1	0.14
			0	0.01	1	0.12
Tattnall			0	0.01	1	0.11
			0	0.01	1	0.11
			0	0	1	0.03
Warren			0	0.05	1	0.23
			0	0.06	1	0.23
			0	0.03	1	0.17
Washington			0	0.07	1	0.25
			0	0.06	1	0.24
			0	0.04	1	0.19
Wilkes			0	0.08	1	0.27
			0	0.08	1	0.28
			0	0.04	1	0.20

Table 7: Samples include all lottery participants.

Table 8: Distribution of continuous versions of outcome variables of registration by sample.

Variable	Sample	N	Min.	Mean	Max.	S.d.
Candidate (match prob.)	1805 winners & losers	21,732	0	0	0.33	0.03
	1805 winners	3,346	0	0	0.28	0.02
	1807 winners	7,797	0	0.07	0.33	0.03
Weighted slave wealth (1820$)	1805 winners & losers	5,252	0	1,128.5	31,815.08	2,076.78
	1805 winners	828	0	1,218.35	25,925.72	2,353.26
	1807 winners	9,308	0	163.3	30,173	1,034.66

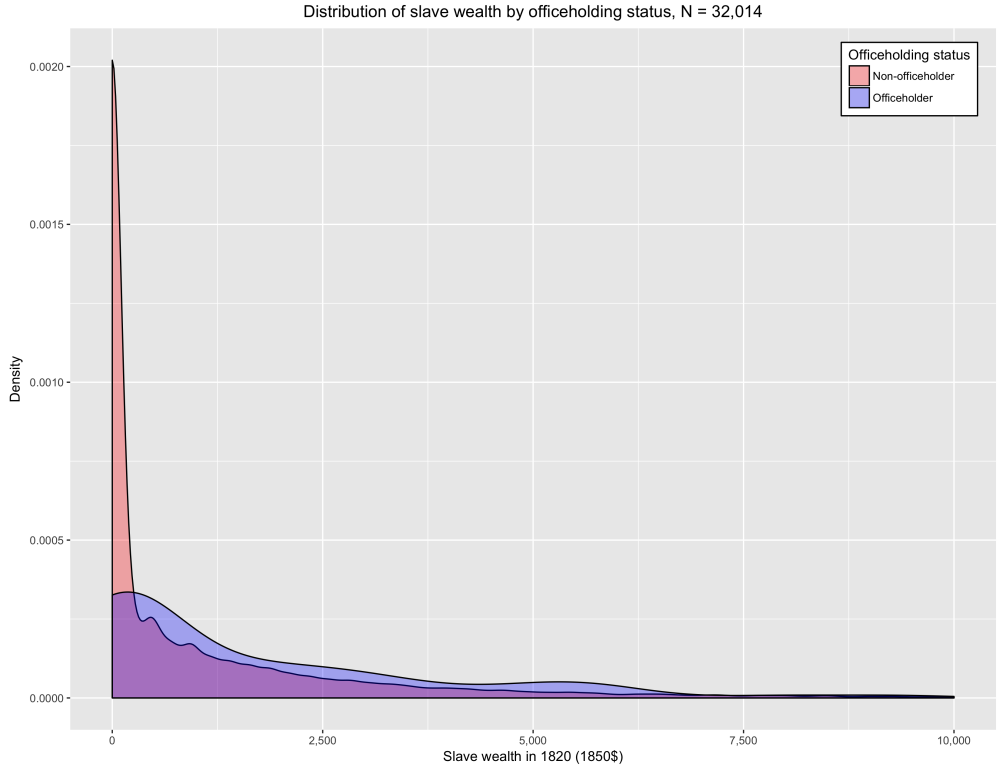


Figure 5: See notes to Table 2. Only values up to $10,000 are plotted.

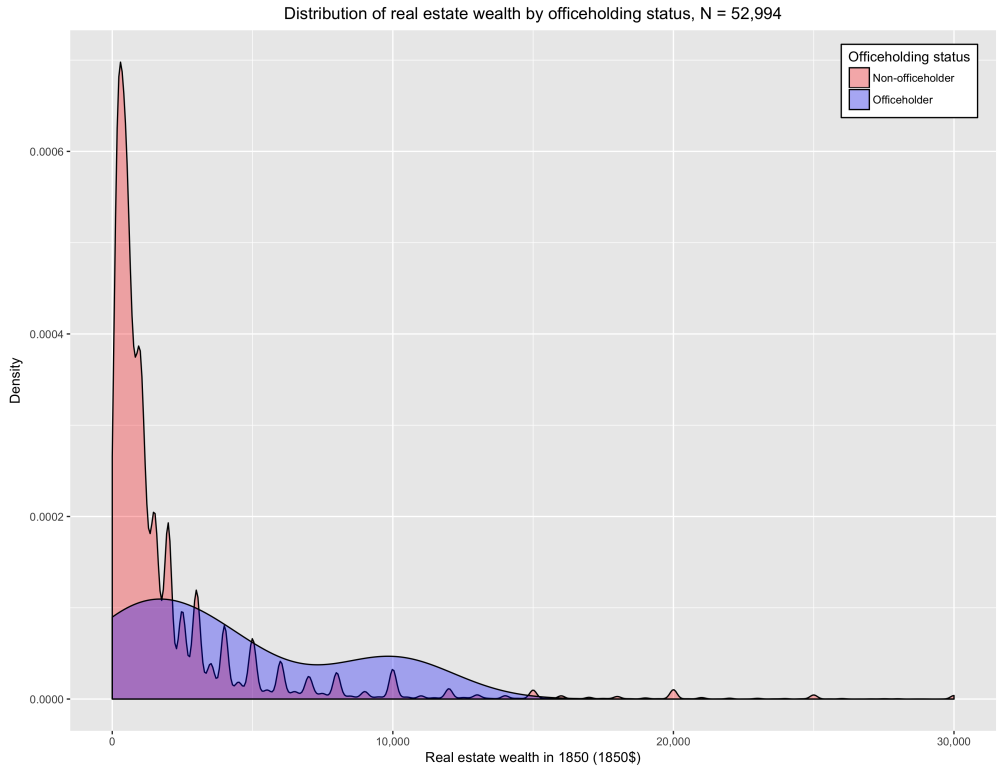


Figure 6: See notes to Table 2. Only values up to $30,000 are plotted.

3 Power analysis by simulation

The purpose of a power analysis by simulation is to estimate $\mathrm{P}(\text{Reject } \mathrm{H}_0 | \mathrm{H}_0 \text{ is false})$ at a fixed significance level ($\alpha = 0.05$) and sample size ($N = 21,732$) for different treatment effects $\Delta_{1,\ldots,j}$. In this case N is the size of the observed sample of participants, excluding women and orphans. The simulation proceeds as follows:

1. Take a random sample of size N without replacement from from the observed distribution of treatment assignments, weighted by the observed propensity score, to create a vector of simulated treatment assignments.

2. Simulate response values with Δ_j as the difference-in-means between the simulated treated and control units. Generate random values from the binomial distribution with the probability of success on each trial equal to the mean of the response in the observed sample.

3. Run linear model on the simulated data and extract the p value.

Repeat the simulation $\mathcal{I}$ times and calculate power of the test by dividing the count of the number of p values that are less than α over $\mathcal{I}$. Normally, 80% power is required to justify a study. Fig. 7 provides the results of power analysis simulations for the officeholding response.

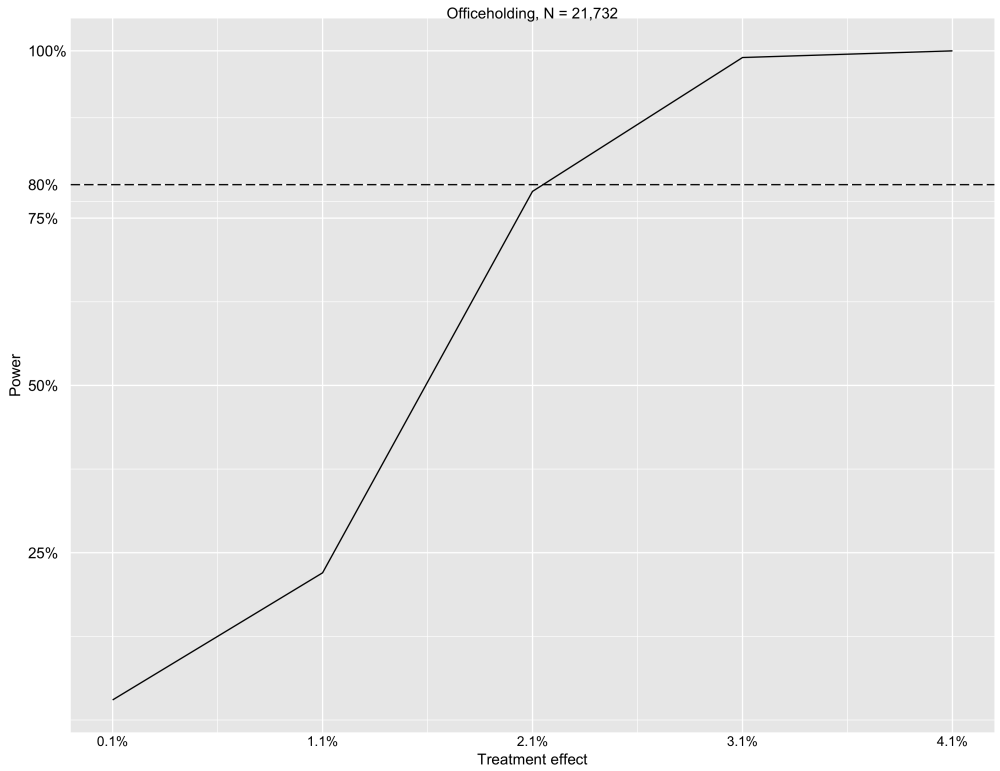
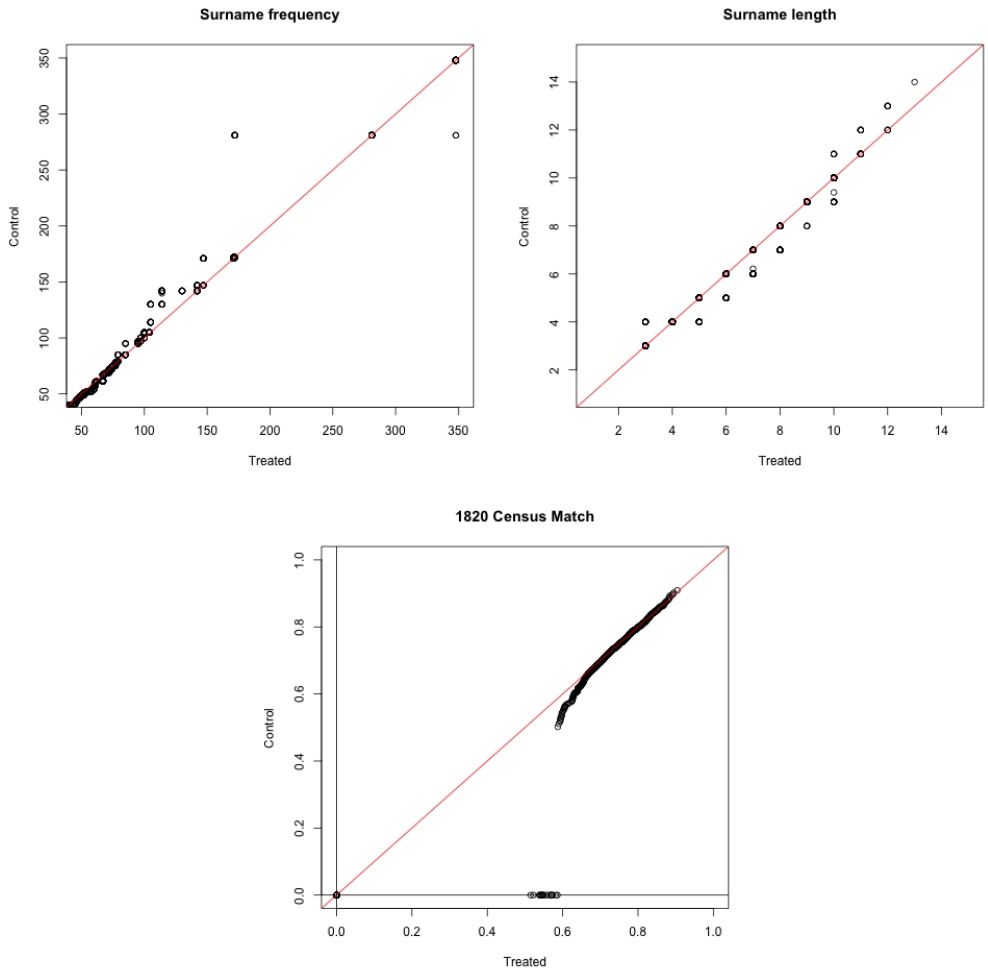


Figure 7: Power analysis by simulation ($\mathcal{I} = 100$ iterations) for continuous and binary response variables. The horizontal line indicates the 80% power that is normally required to justify a study.

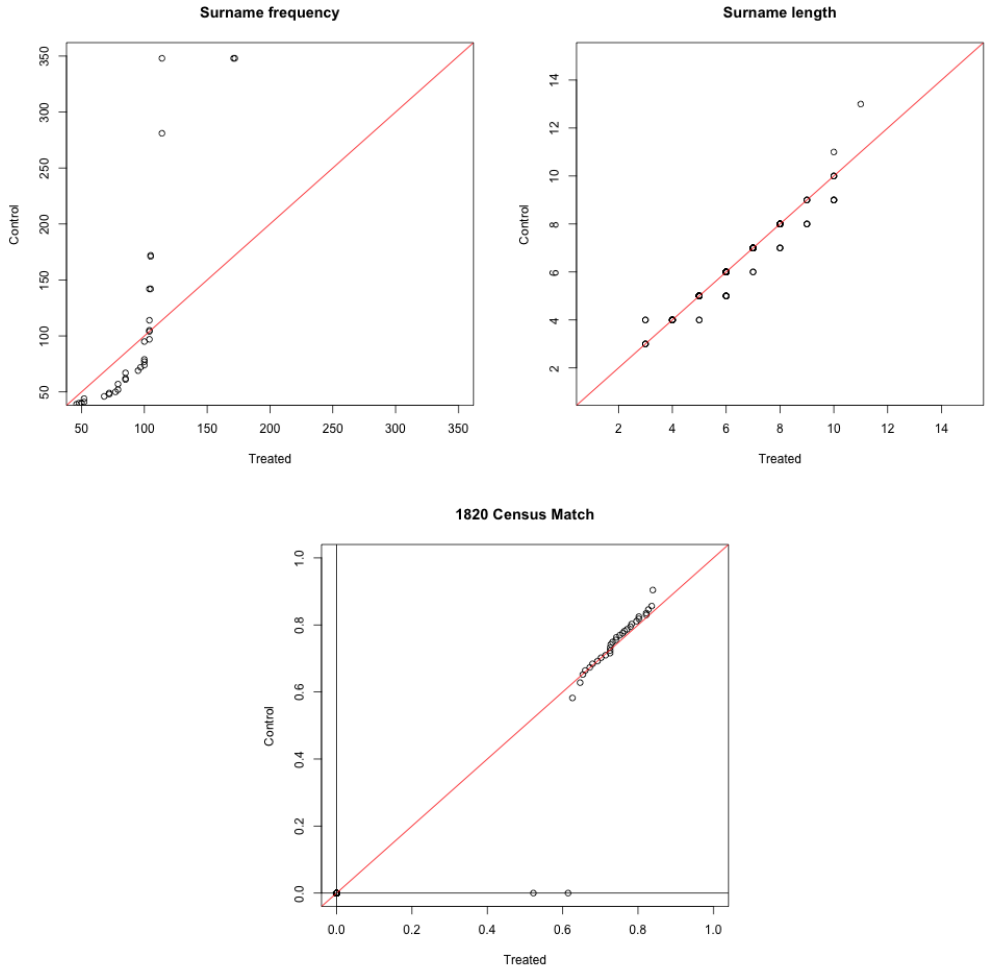
4 Balance of pretreatment covariates

Figure 8: Normal QQ plots of continuous pretreatment variables by treatment assignment for 1805 winners and losers ($N = 23,927$).



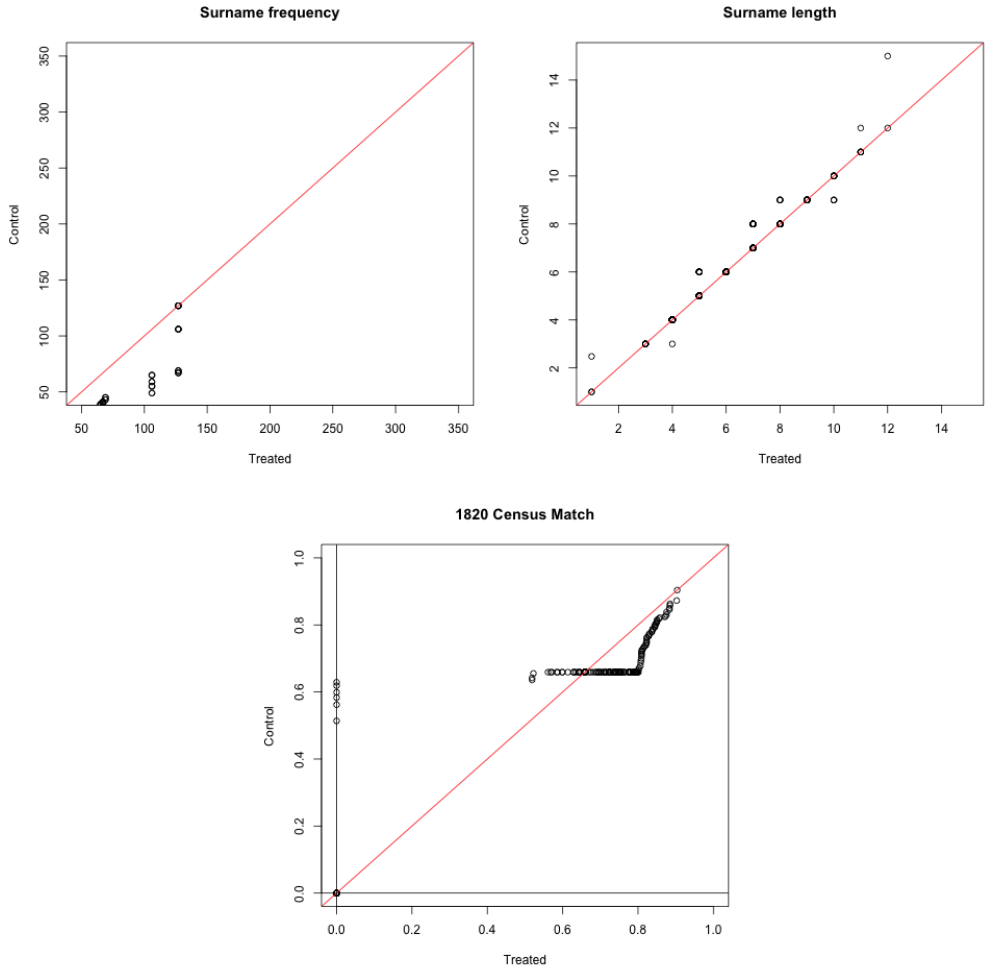
Notes: *Surname frequency* is the number of times surnames appear in the lottery records. *Surname length* is the character length of surnames. *1820 Census Match* is the probability of being linked successfully to the 1820 Census.

Figure 9: Normal QQ plots of continuous pretreatment variables by treatment assignment for 1805 winners ($N = 3,707$).



Notes: Treated winners won two prizes and and control winners won one prize. See notes to Fig. OA-8.

Figure 10: Normal QQ plots of continuous pretreatment variables by treatment assignment for 1807 winners ($N = 9,687$).



Notes: Treated winners won two prizes and and control winners won one prize. See notes to Fig. OA-8.

5 Record linkage

Table 9: Record classification ensemble.

Algorithm	Parameters	MSE	Weight
Super Learner	default	0.02	-
Generalized boosted regression	default	0.02	0.05
GLM with elasticnet regularization	$\alpha = 0$	0.02	0
GLM with elasticnet regularization	$\alpha = 0.25$	0.02	0
GLM with elasticnet regularization	$\alpha = 0.5$	0.02	0
GLM with elasticnet regularization	$\alpha = 0.75$	0.02	0
GLM with elasticnet regularization	$\alpha = 1$	0.02	0.52
Neural network	default	0.13	0
Random forests	default	0.02	0.32
Random forests	# variables sampled = 1	0.04	0.09
Random forests	# variables sampled = 5	0.02	0
Random forests	# variables sampled = 10	0.03	0

Notes: cross-validated risk and weights used for each algorithm in Super Learner prediction ensemble for record classification model. *MSE* is the ten-fold cross-validated mean squared error for each algorithm. *Weight* is the coefficient for the Super Learner, which is estimated using non-negative least squares based on the Lawson-Hanson algorithm. α is the elasticnet mixing parameter, where $\alpha = 0$ is the ridge penalty and $\alpha = 1$ is the lasso penalty. # variables sampled = 1 is the number of predictors sampled for splitting at each node.

6 Estimation of treatment effects

Under the Neyman (1923) potential outcomes framework, each $i = \{1, ..., N\}$ participants have two potential outcomes, Y_{1i} and Y_{0i}, which represent participant i's response to treatment and control groups, respectively. $Z_i \in \{0, 1\}$ indicates i's treatment assignment and $\boldsymbol{Z}$ indicates the treatment assignments for all N participants. The observed response is thus a function of treatment assignment and potential outcomes, $Y_i = Z_i Y_{1i} + (1 - Z_i)Y_{0i}$.

Let Y^T be the average response in the treatment group and Y^C be the average response in the control group. The intention-to-treat (ITT) estimator for the sample average treatment effect is the difference between these two sample quantities:

$$\delta^*_{\text{ITT}} = Y^T - Y^C = \frac{1}{N} \sum_{i=1}^{N} \left(\frac{Z_i Y_{1i}}{N_t/N} - \frac{(1 - Z_i)Y_{0i}}{N_c/N} \right), \tag{1}$$

where N_t and N_c are the number of treated and control participants, respectively. The probability of receiving treatment is determined by the number of draws registered by participant i, and the total number of registered draws (tickets) and prizes:

$$\mathrm{P}(Z_i = 1) = \begin{cases} \frac{\#\text{Prizes}}{\#\text{Tickets}} & \text{if } i \text{ has one draw} \\ 2\left(\frac{\#\text{Prizes}}{\#\text{Tickets}}\right) & \text{if } i \text{ has two draws.} \end{cases} \tag{2}$$

The potential outcomes framework implicitly makes the following assumption:

Assumption 1. *Stable unit treatment value assumption (SUTVA). (i.) No interference: $Y_{i\boldsymbol{Z}}$ varies with Z_i, but does not vary with other elements of $\boldsymbol{Z}$. (ii.) No hidden variations in treatment: $Y_{i\boldsymbol{Z}}$ for all i and $\boldsymbol{Z}$ is well-defined.*

Interference undermines the framework because it creates more than two potential outcomes per participant, depending on the treatment assignment of other participants (Rubin, 1990). No hidden variations in treatment is required to ensure that each participant has the same number of potential outcomes (Imbens and Rubin, 2015). Assumption 1 (i.) is violated in the estimation of the treatment effect on officeholding if, for instance, treatment confers treated participants a competitive advantage over control participants in head-to-head contests for elective office. Assumption 1 (ii.) is violated if, for instance, variation in the quality of land prizes creates more than two potential outcomes per participant.

The potential outcomes framework explicitly requires random assignment:

Assumption 2. *Random treatment assignment:* $\mathrm{P}(Z_i|Y_{i\boldsymbol{Z}}) = \mathrm{P}(Z_i)$ *for all* i.

Assumption 2 will not hold if $\mathrm{P}(Z_i = 1)$ is affected by factors exogenous to Eq. (2).

7 Estimates

Table 10: Robustness: ITT treatment effects on candidacy.

Sample \ Specification	Candidate + covariates	Candidate (match prob.)	Candidate (match prob.) + covariates
1805 winners & losers	-0.001 [-0.007, 0.003]	-0.0004 [-0.001, 0.0005]	-0.0003[-0.001, 0.0005]
1805 winners	0.02 [0.0005, 0.05]	0.003 [-0.0014, 0.007]	0.003 [-0.001, 0.007]
1807 winners	0.009 [0.001, 0.01]	-0.01[-0.01, -0.007]	-0.008 [-0.01, -0.005]

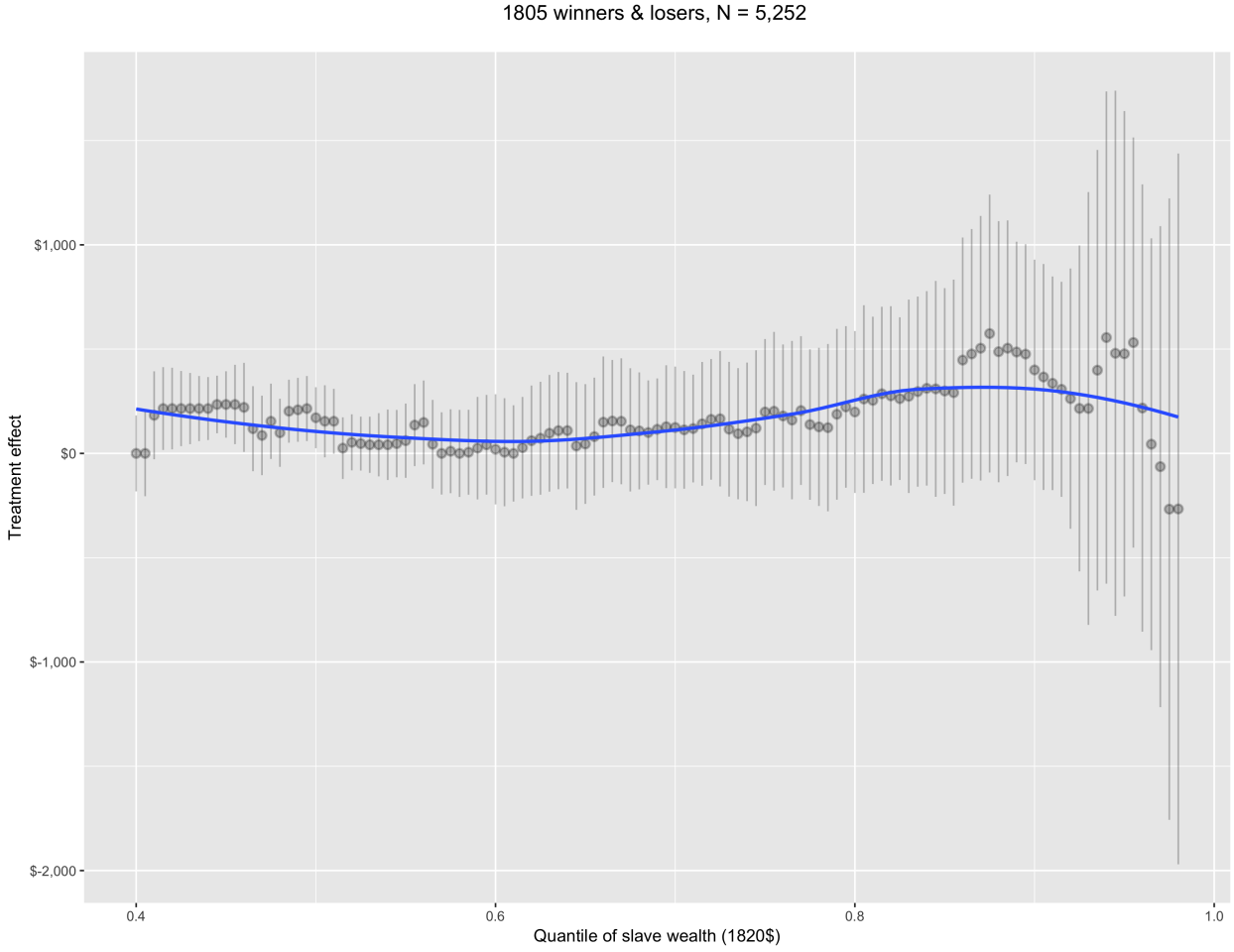
Table 10: Notes: *Candidate (match prob.)* is the candidate match probability. Covariates included are those that yield $p < 0.10$ in Fig. 1. Summary statistics for the alternative outcome variable is reported in Table OA-8.

Table 11: Robustness: ITT treatment effects on slave wealth (1820$).

Sample \ Specification	Slave wealth + covariates	Weighted slave wealth	Weighted slave wealth + covariates
1805 winners & losers	160.72 [-46.91, 368.37]	114.48 [-41.54, 270.52]	117.49 [-38.41, 273.40]
1805 winners	-194.12 [-1,294.85, 906.61]	-153.56 [-978.07, 670.93]	-179.16 [-1,007.1, 648.76]
1807 winners	183.74 [60.07, 307.42]	216.08[122.9, 309.26]	149.41 [57.52, 241.3]

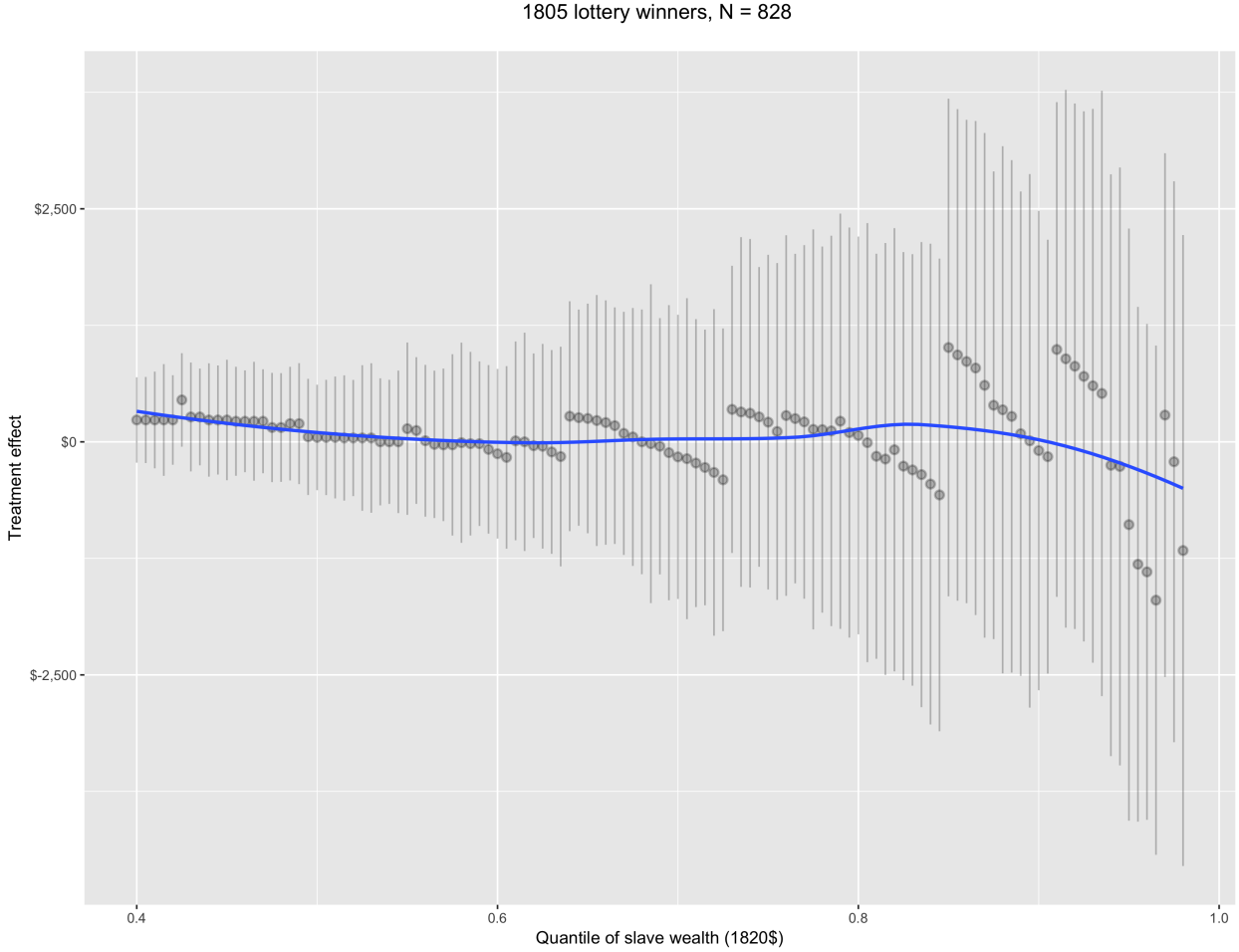
Table 11: Notes: *Slave wealth (weighted)* is the same measure weighted by the census match probability. See notes to Table OA-10.

Figure 11: Quantile regression treatment effect estimates on slave wealth.



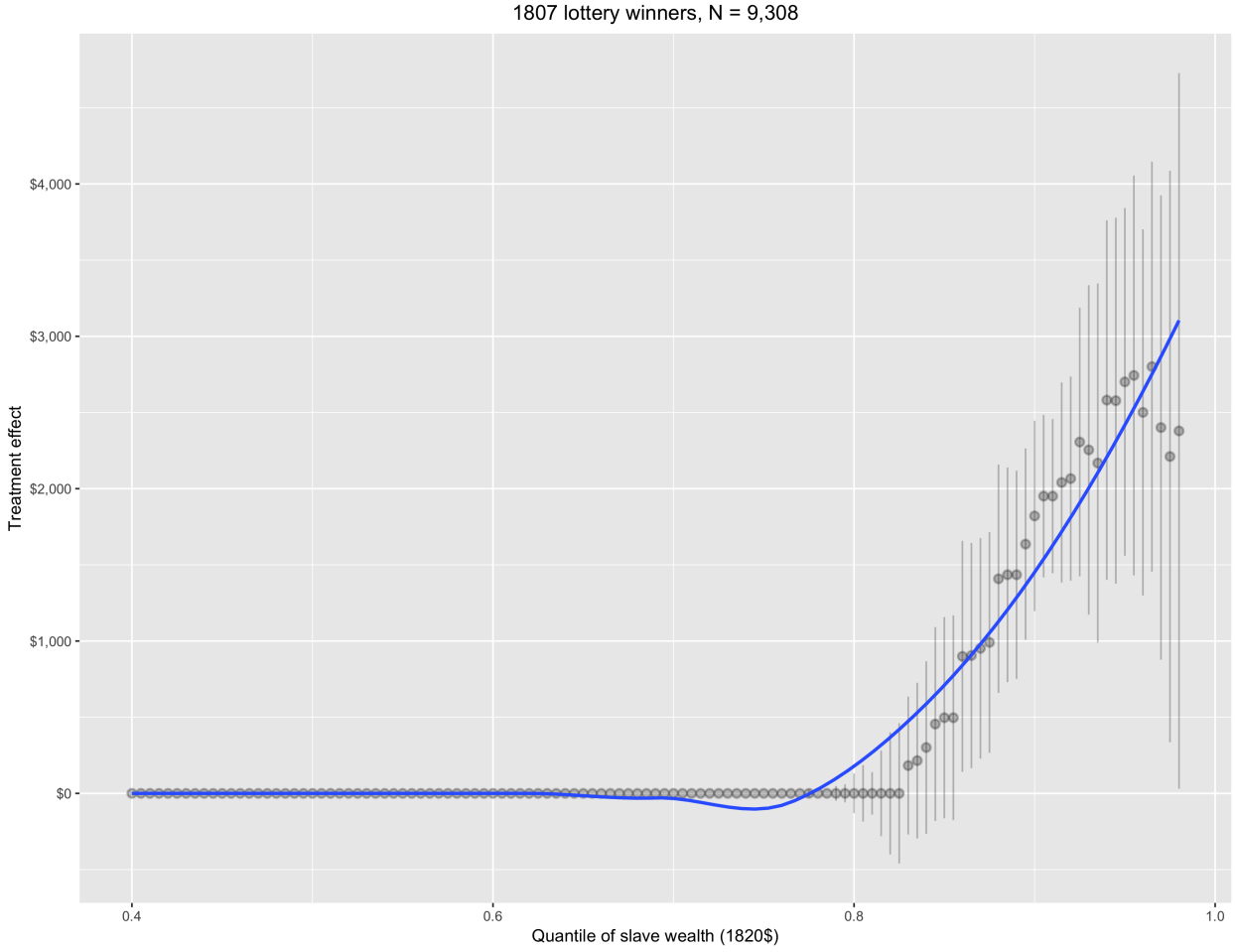
Notes: Estimates from a quantile regression of the treatment effect on imputed slave wealth for participants linked to the 1820 Census. See footnotes to Table OA-5 for the slave value imputation method. The points are quantile-specific estimates of the treatment effect and the error bars represent 95% confidence intervals constructed from bootstrapped standard errors. Quantiles above 0.98 are omitted for display purposes. The line is a LOESS-smoothed estimate of the treatment effect.

Figure 12: Quantile regression treatment effect estimates on slave wealth.



See notes to Fig. OA-11.

Figure 13: Quantile regression treatment effect estimates on slave wealth.



See notes to Fig. OA-11.

References

Bleakley, H. and J. P. Ferrie (2013). Up from poverty? The 1832 Cherokee Land Lottery and the long-run distribution of wealth.

Clayton, A. S. and T. W. Adams (1812). *A Compilation of the Laws of the State of Georgia: Passed by the Legislature Since the Political Year 1800, to the Year 1810, Inclusive*. Adams & Duyckinck.

Graham, P. K. (2010). *Georgia Land Lottery Research*. Georgia Genealogical Society.

Graham, P. K. (2011). *1807 Georgia Land Lottery Fortunate Drawers and Grantees*. Genealogy Company.

Haines, M. R. (2004). The Inter-university Consortium for Political and Social Research. Historical, Demographic, Economic, and Social Data: The United States, 1790-2000 [computer file]. ICPSR02896-v2. Hamilton, NY: Colgate University.

Imbens, G. W. and D. B. Rubin (2015). *Causal Inference in Statistics, Social, and Biomedical Sciences*. Cambridge University Press.

Kotlikoff, L. J. (1979). The structure of slave prices in New Orleans, 1804 to 1862. *Economic Inquiry 17*(4), 496–518.

Long, J. H. (1995). Atlas of historical county boundaries. *The Journal of American History 81*(4), 1859–1863.

Neyman, J. (1923). On the application of probability theory to agricultural experiments. *Annals of Agricultural Sciences 51*(1). Reprinted in Splawa-Neyman et al. (1990).

Officer, L. H. and S. Williamson (2012). The Annual Consumer Price Index for the United States, 1774-2010.

Phillips, U. B. (1905). The economic cost of slaveholding in the cotton belt. *Political Science Quarterly 20*(2), 257–275.

Rubin, D. B. (1990). Comment: Neyman (1923) and causal inference in experiments and observational studies. *Statistical Science 5*(4), 472–480.

Splawa-Neyman, J., D. M. Dabrowska, T. P. Speed, et al. (1990). On the application of probability theory to agricultural experiments. *Statistical Science 5*(4), 465–472.