

# Online Appendix for “K Street on Main”

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# A1 Calculation of Network Density

To calculate state-year lobbying densities, we applied the following code to our lists of lobbyist-client pairings. The input files are lobbyist-client edge lists for each state-year, stored as .csv files. The code loops through the file names in our folder of cleaned lists, converts the two-mode edge lists to weighted, one-mode adjacency matrices, and then calculates network density for each matrix. The results are stored in the `densities` vector.

```
# Density Vectors By Year

path <- "C:/~/K Street on Main/Usable Lists"
out.file<-" "
file.names <- dir(path, pattern = ".csv")

densities <- matrix(NA, ncol=3)
for(i in file.names){
  df <- na.omit(read.csv(i, header=F)[,1:2])
  A <- spMatrix(nrow=length(unique(df$V1)),
               ncol=length(unique(df$V2)),
               i = as.numeric(factor(df$V1)),
               j = as.numeric(factor(df$V2)),
               x = rep(1, length(as.numeric(df$V1))) )
  row.names(A) <- levels(factor(df$V1))
  colnames(A) <- levels(factor(df$V2))
  Acol <- matrix(t(A) %*% A, ncol=length(unique(df$V2)), nrow=length(unique(df$V2)))
  densities <- rbind(densities, c(as.numeric((sum(Acol)-tr(Acol))/(length(unique(df$V2))*
    (length(unique(df$V2))-1))), substr(i,1,2), substr(i,3,6)))
}
```

## A2 Lobby Network Density Descriptive Information

Figure A1 tracks lobby network density across the 44 states that required lobbyists to register and name their clients during every legislative session in our data set, never allowed firms to register independently of clients and lobbyists, and that never required lobbyist employees to register (whether they lobbied or not). Figure A2 tracks lobby network density in the remaining six states: Arizona, California, Michigan, New Jersey, New York, and Pennsylvania. These six states are presented separately because their registration procedures resulted in artificially low or high density measures. (We controlled for these procedures in our regression analyses.) In both figures, lobby network density is represented by a solid line while logged numbers of lobbyists and clients are represented by dashed and dotted lines, respectively. Lobbyist and client totals are logged due to substantial interstate variation.

In general, rates of multi-client lobbying are stable in most states but fluctuate significantly in some. These changes are likely due to changes in our explanatory variables, such as turnover rates, and whether a legislature does not convene during a given year (see North Dakota's figures), among other factors. Numbers of organizations that hire lobbyists are known to fluctuate wildly depending on legislative agendas (Brasher, Lowery and Gray 1999; Strickland 2020).

Figure A3 consists of a box-and-whisker plot that reports trends in lobby network density over time. The figure excludes observations from the six states listed in Figure A2. The center lines within each box represent the median network density scores, quartiles, and outliers among states for each year. The median density score increased gradually over time. Variation across states also increased over time. Among the 44 states, density scores never exceeded 0.15.

To illustrate the distribution of our density observations, Figure A4 presents a Kernel density plot of our measures of lobby network density. We also provide a joyplot in Figure 5A that illustrates the distribution of our network measures for each year in our data set. From Figure 5A, we find that variance in density measures increased generally over time in the

states. To understand sources of variation better, and since lobby network density measures are observed within states, we estimated a random-effects analysis of variance, also known as a components-of-variance model. The estimated standard deviation for cross-state effects is 0.031, and the estimated standard deviation for within-state effects is 0.0203. Thus, a little more than 60 percent of variation in lobby network density can be attributed to differences between states, with the rest of the variation attributable to within-state differences.

### **A3 Legislative Turnover Descriptive Information**

Figures A6 and A7 illustrate turnover trends across individual years and states, respectively. (Recall that our measure of turnover is weighted by the size of each chamber within bicameral legislatures, except in the case of Nebraska’s unicameral legislature where only the Senate turnover rate is used.) Weighted turnover is measured as a percent of incumbents being replaced, as reported by Moncrief, Niemi, and Powell (2004). Figure A6 shows trends in turnover within individual states. There is substantial variation in turnover among both term-limited and non-term-limited legislatures. Figure A7 consists of a box-and-whisker plot that tracks trends in turnover across states. The center lines within each box represent the median turnover rates, quartiles, and outliers among states for each year. Turnover always ranges between five and 65 percent, with typical median values lying between 15 and 30 percent. As with lobby network density, variation across states has increased over time.

Figure A8 presents a histogram showing the frequency of our observations of turnover change within states. The statistics measure the shift in weighted turnover that occurred from one election to the next within each state. Generally, the histogram shows that states experienced substantial variation in turnover rates year after year, but that turnover rates remained stable most of the time (i.e., most shifts were not substantial). The biggest shifts in turnover within our data include a shift from 61.7 to 21.7 percent in Alaska between 1993 and 1995, and a shift from 19.6 to 59.6 percent in Michigan between 2001 and 2003.

Figure A1: Density, Lobbyists, and Clients Among States Over Time

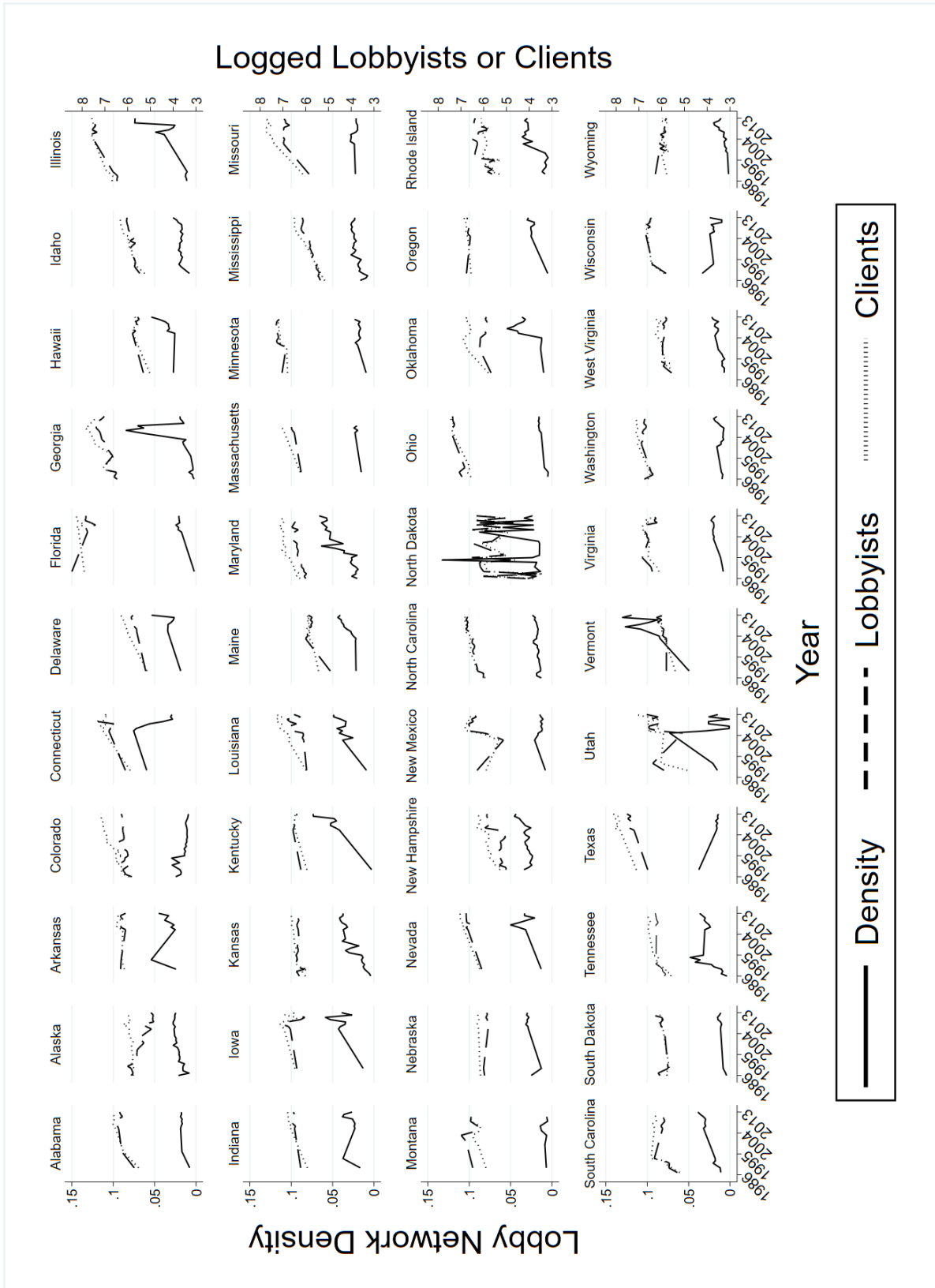


Figure A2: Density, Lobbyists, and Clients Among Six States Over Time

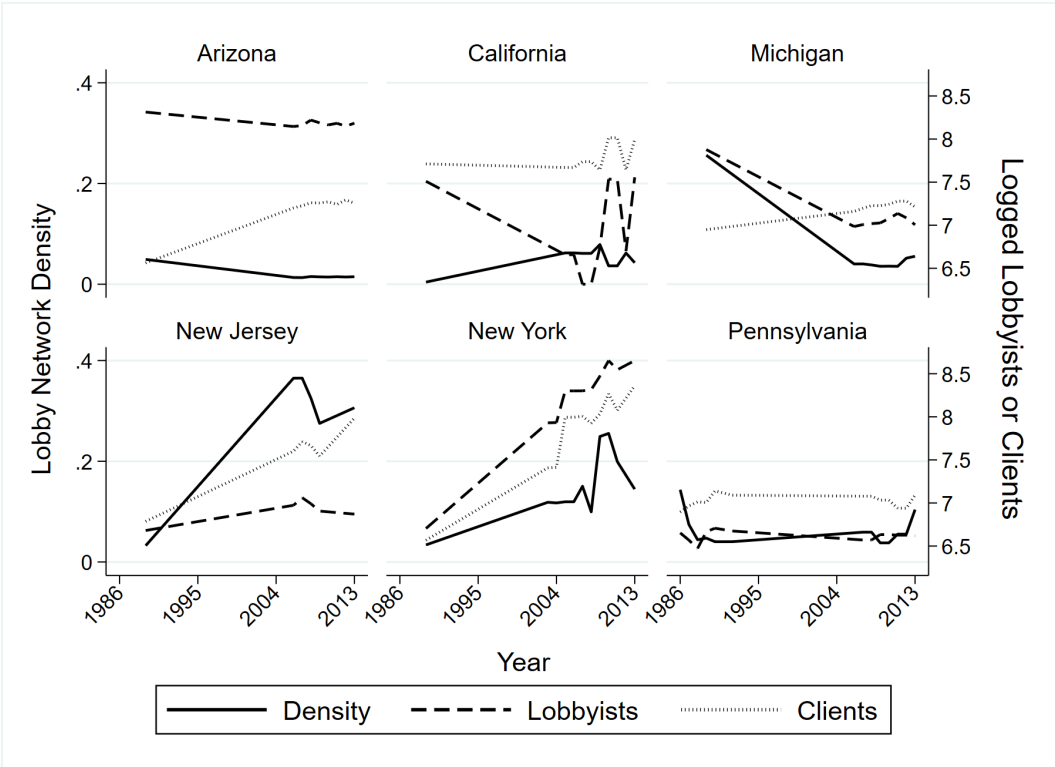


Figure A3: Lobby Network Density Among States By Year

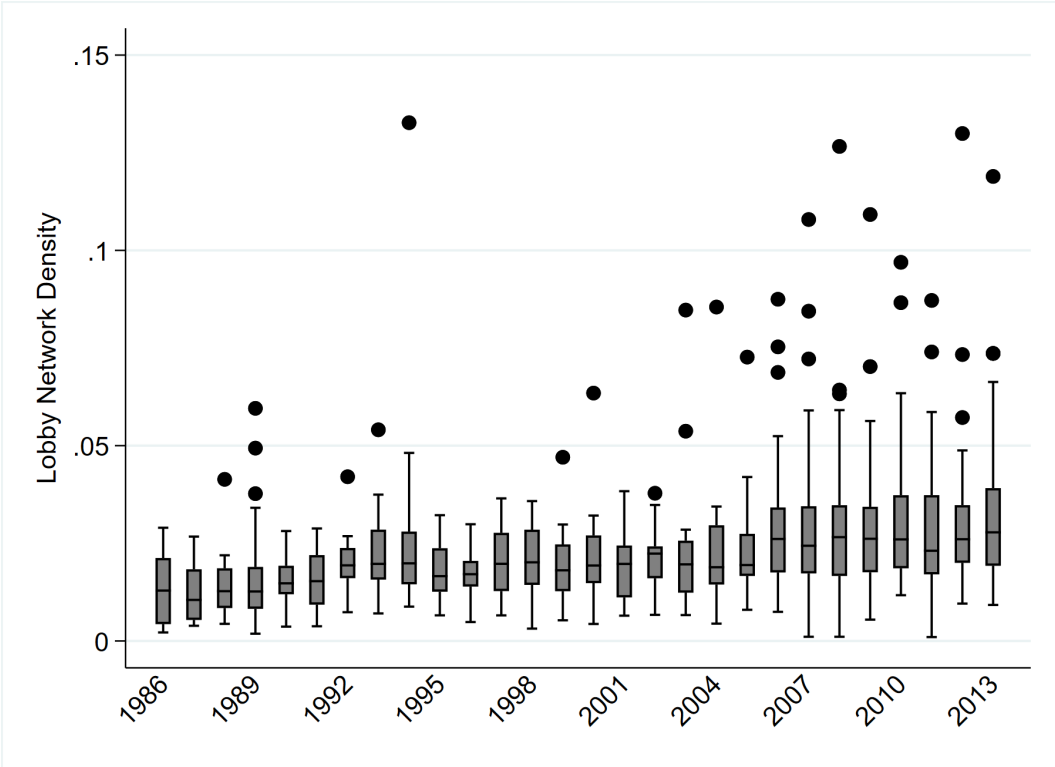
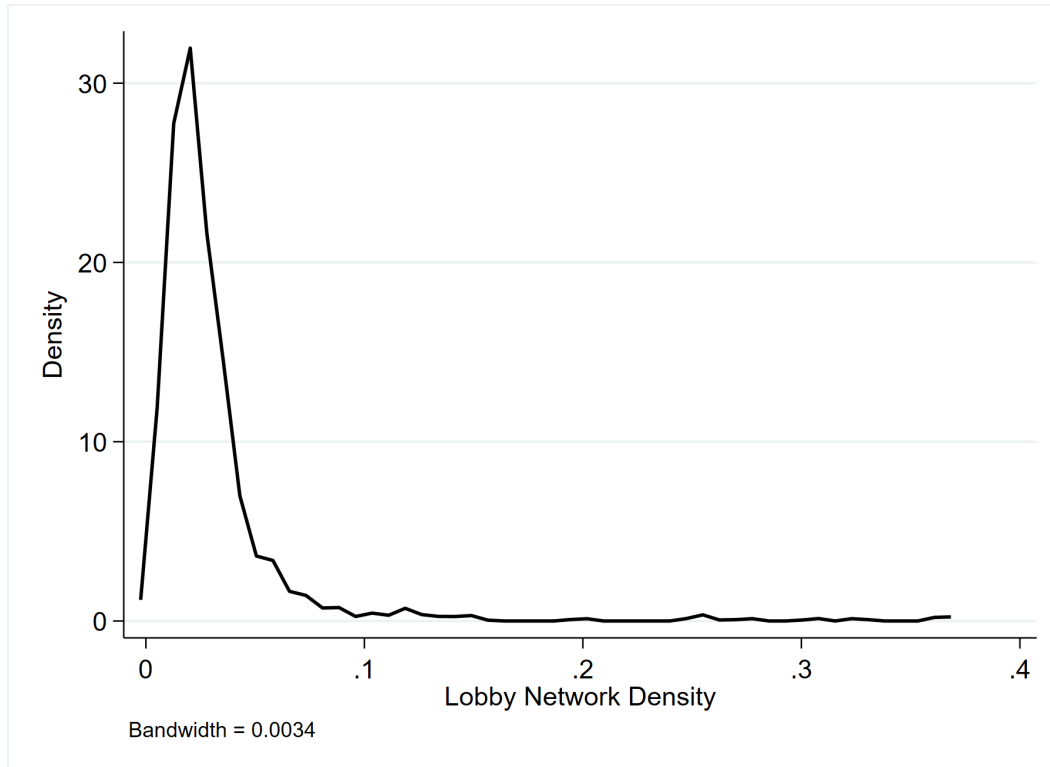


Figure A4: Kernel Density Plot of Lobby Network Density



Finally, Table A1 presents a correlation matrix for lobby and institutional variables. As should be expected, lobby network density, and numbers of lobbyists, clients, and lobbyist-client pairings are all strongly correlated (positively) with each other. The strongest other correlations presented are those between each of our three lobby variables (client, lobbyist, and pairing numbers) and spending on legislative staff (0.553, 0.359, and 0.489, respectively), and that for direct democracy and legislature size (-0.366). None of the correlations are strong enough to pose a challenge for our regression tests.

Figure A5: Lobby Network Density Among States By Year, Joyplot

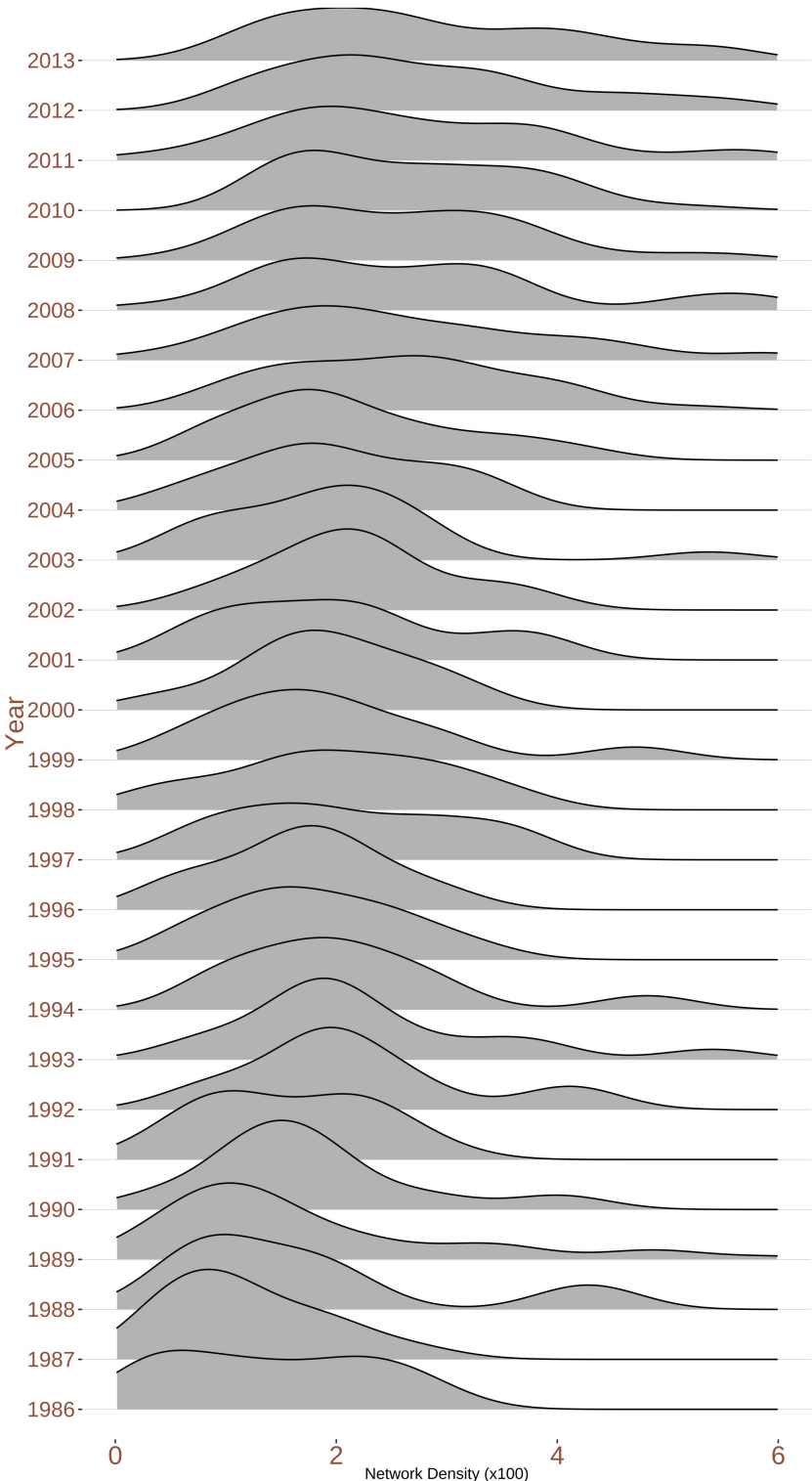




Figure A6: Turnover Among States Over Time

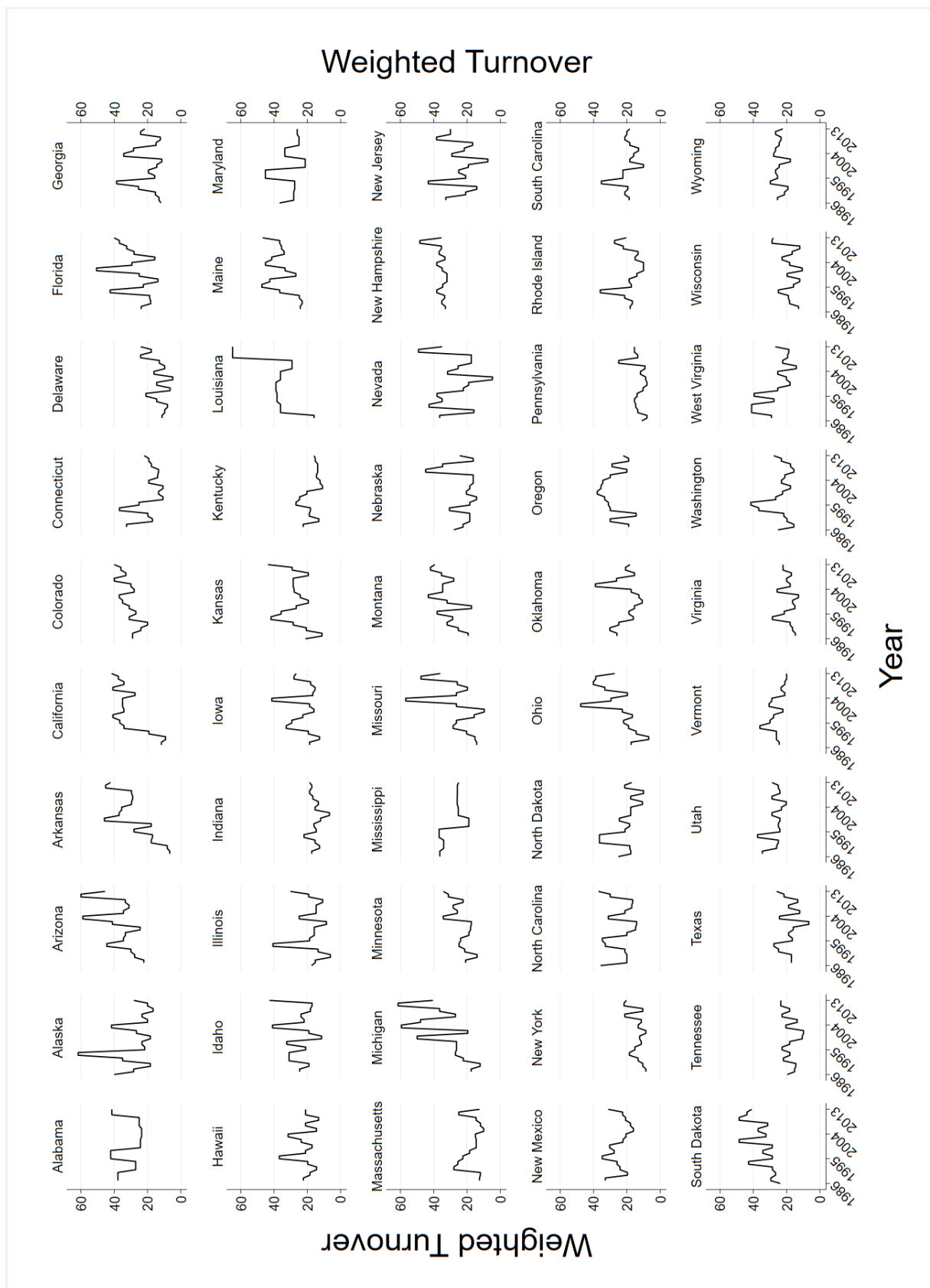


Figure A7: Turnover Among States by Year

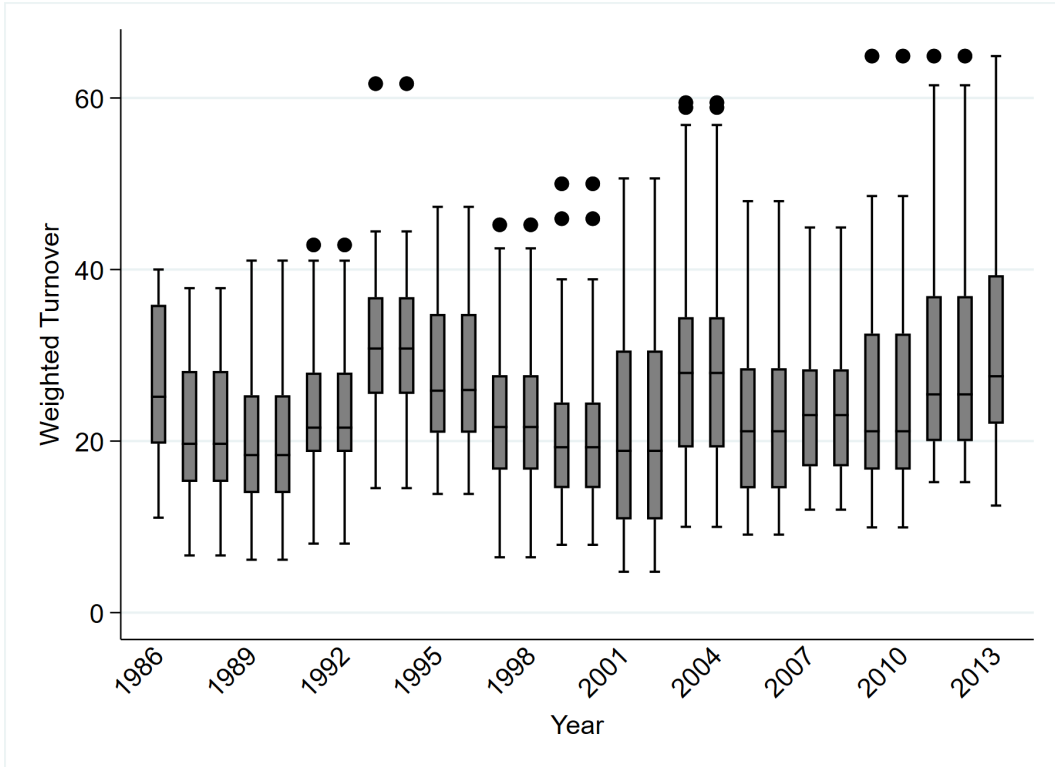


Figure A8: Histogram of Biennial Changes in Turnover within States

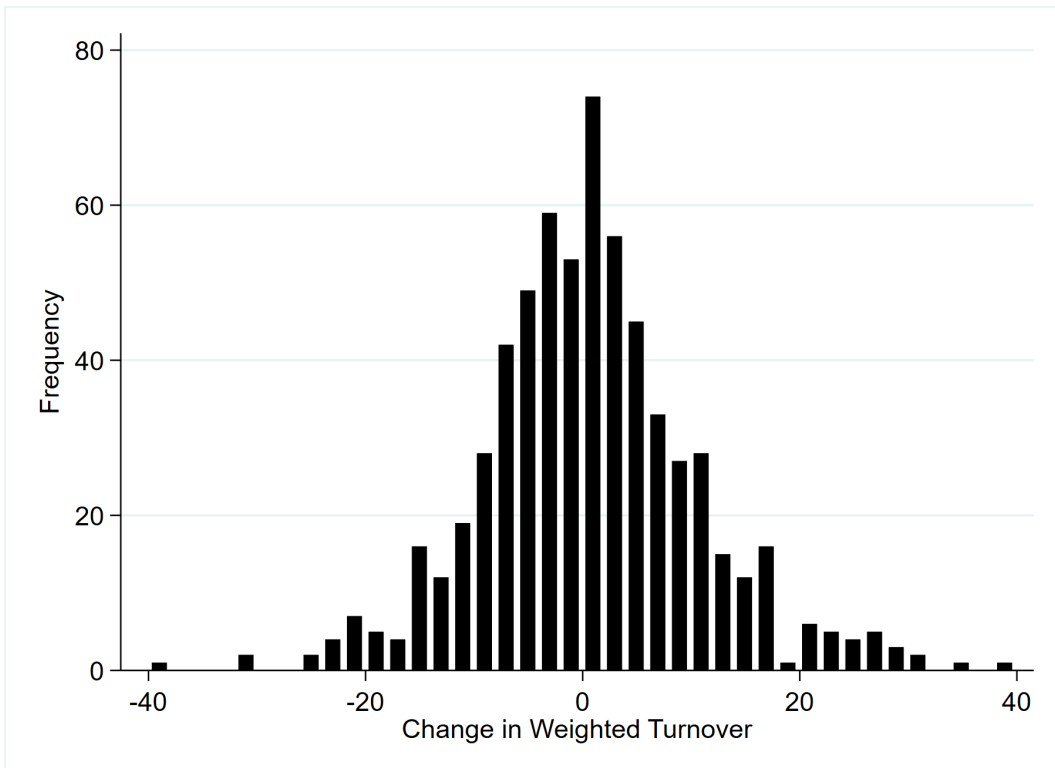


Table A1: Summary Statistics for all Model Variables

Variable	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
<i>Lobby Network Density</i>	684	3.076	3.707	0.099	1.505	3.390	36.507
<i>Legislative Turnover</i>	684	25.425	10.381	6.167	17.816	31.346	64.885
<i>Legislature Size</i>	684	154.696	66.843	60	113	177	424
<i>Staff Spending (in millions)</i>	684	599.311	736.308	57.198	226.800	648.181	5,521.2
<i>One-Party Dominance</i>	684	0.131	0.094	0.00004	0.051	0.196	0.374
<i>Direct Democracy</i>	684	0.509	0.500	0	0	1	1
<i>Not in Session</i>	684	0.032	0.177	0	0	0	1
<i>Lobbyist Definitions</i>	684	3.718	1.627	0	2	5	7
<i>Lobbyist Prohibitions</i>	684	1.088	1.106	0	0	2	4
<i>Lobbyist Reporting</i>	684	4.763	2.009	0	3	7	7
<i>Firms Register</i>	684	0.047	0.211	0	0	0	1
<i>Non-Expiring Registrations</i>	684	0.022	0.147	0	0	0	1
<i>Lobby Employees Register</i>	684	0.013	0.114	0	0	0	1

Table A2: Correlation Matrix Among Lobby and Institutional Variables

Variable	Density	Turnover	Legislature Size	Staff Spending	One-Party Dominance	Direct Democracy	Clients	Lobbyists
<i>Lobby Network Density</i>	1	-	-	-	-	-	-	-
<i>Legislative Turnover</i>	-0.095	1	-	-	-	-	-	-
<i>Legislature Size</i>	0.105	0.062	1	-	-	-	-	-
<i>Staff Spending (in millions)</i>	0.187	-0.011	-0.107	1	-	-	-	-
<i>One-Party Dominance</i>	-0.140	0.012	0.032	-0.224	1	-	-	-
<i>Direct Democracy</i>	-0.176	0.207	-0.359	0.088	0.054	1	-	-
<i>Clients</i>	0.332	0.027	0.100	0.553	-0.128	0.020	1	-
<i>Lobbyists</i>	0.312	-0.024	-0.047	0.359	-0.145	-0.008	0.763	1
<i>Lobbyist-Client Pairings</i>	0.622	-0.048	0.090	0.489	-0.112	-0.065	0.806	0.815

Note: correlations across all observations are presented.

## A4 Inclusion of Client, Lobbyist, and Pairing Totals

Numbers of organizations hiring lobbyists have increased over time in nearly every American state (Strickland 2020). One may wonder whether these increases in lobbying influence measures of lobby network density. If demand for lobbyists increases consistently while, in the short-term, growth in lobbyist numbers occurs more slowly, it may be possible that network density measures mechanical effects of broader trends (i.e., as increasing numbers of clients are represented by stable numbers of lobbyists). To control for this possibility, we re-estimate the models presented in the main text but include client and lobbyist totals in our models. The results are presented in Table A3. We also re-estimate our models with client, lobbyist, and pairing totals. Those results are presented in Table A4. The results presented in both tables show that legislative turnover is a consistent, negative predictor of rates of multi-client lobbying or network density. All our findings remain substantively unchanged and in some cases even grow stronger.

Table A3: Legislative Turnover and Multi-client Lobbying

	Model 1	Model 2	Model 3	Model 4
<i>Legislative Turnover</i>	-0.037* (0.016)	-0.041* (0.018)	-0.039*** (0.011)	-0.044** (0.017)
<i>Legislature Size</i>	0.001 (0.003)	0.001 (0.003)	-0.068*** (0.021)	-0.075* (0.033)
<i>Staff Spending (in millions)</i>	-2.341** (0.786)	-2.237** (0.704)	-3.636*** (0.657)	-3.712*** (0.895)
<i>One-Party Dominance</i>	-1.583 (1.565)	-0.535 (1.659)	-1.886 (1.224)	-1.301 (1.917)
<i>Direct Democracy State</i>	-0.378 (0.391)	-0.389 (0.386)	0.255 (1.054)	-0.102 (2.366)
<i>Not in Session</i>	2.004 (1.111)	-1.373*** (0.386)	1.457** (0.519)	-2.082 (2.428)
<i>Lobbyist Definitions</i>	0.133 (0.358)	0.172 (0.364)	0.335 (0.202)	0.345 (0.286)
<i>Lobbyist Prohibitions</i>	0.454 (0.388)	0.628 (0.423)	-0.005 (0.459)	-0.066 (0.677)
<i>Lobbyist Reporting</i>	0.224 (0.150)	0.246 (0.154)	0.383* (0.169)	0.484* (0.238)
<i>Definitions * Prohibitions</i>	-0.006 (0.107)	-0.013 (0.119)	0.120 (0.100)	0.142 (0.149)
<i>Definitions * Reporting</i>	-0.019 (0.058)	-0.026 (0.061)	-0.101* (0.045)	-0.120 (0.066)
<i>Firms Register</i>	13.079*** (3.539)	12.779*** (2.972)	7.583*** (0.940)	10.943*** (1.330)
<i>Non-Expiring Registrations</i>	9.165*** (2.223)	9.821*** (1.019)	18.982*** (1.605)	14.423*** (2.554)
<i>Lobby Employees Register</i>	-0.178 (2.230)	-0.694 (2.044)	-4.454* (1.979)	-2.710 (3.558)
<i>Clients (in thousands)</i>	0.619 (0.870)	0.292 (0.846)	0.808 (0.493)	0.662 (0.663)
<i>Lobbyists (in thousands)</i>	0.226 (0.843)	0.626 (0.790)	0.890* (0.400)	0.618 (0.515)
Constant	2.512** (0.926)	2.134* (0.806)	10.909*** (3.051)	11.026 (4.824)
Fixed Effects?			✓	✓
Observations	684	352	684	352
No. of States	49	49	49	49
R <sup>2</sup>	0.623	0.671	0.795	0.797
Adjusted R <sup>2</sup>	-	-	0.764	0.742

Note: \*p<0.05; \*\*p<0.01; \*\*\*p<0.001 on two-tailed tests.

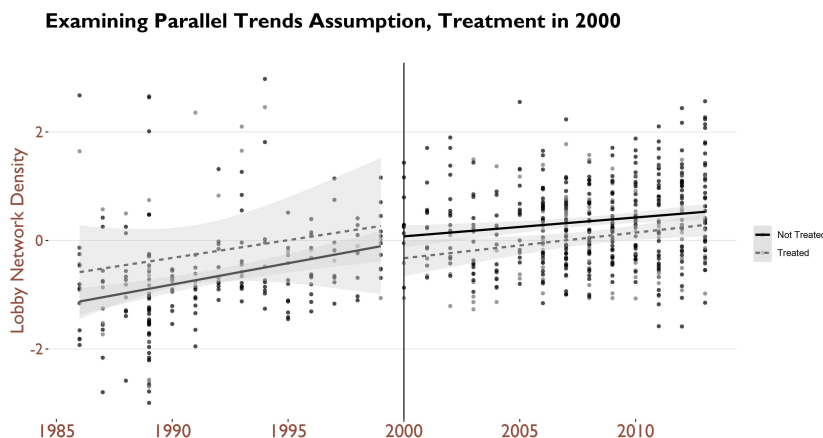
Table A4: Legislative Turnover and Multi-client Lobbying

	Model 1	Model 2	Model 3	Model 4
<i>Legislative Turnover</i>	-0.043** (0.015)	-0.048** (0.016)	-0.036*** (0.009)	-0.046*** (0.013)
<i>Legislature Size</i>	0.003 (0.002)	0.004 (0.002)	-0.049** (0.017)	-0.048 (0.025)
<i>Staff Spending (in millions)</i>	-1.498** (0.550)	-1.194* (0.522)	-2.793*** (0.531)	-2.432*** (0.697)
<i>One-Party Dominance</i>	-2.807* (1.376)	-1.833 (1.414)	-3.209*** (0.988)	-2.943* (1.484)
<i>Direct Democracy State</i>	-0.308 (0.329)	-0.226 (0.311)	-0.811 (0.851)	-1.316 (1.827)
<i>Not in Session</i>	1.234 (0.845)	-1.272*** (0.305)	0.735 (0.419)	-1.508 (1.874)
<i>Lobbyist Definitions</i>	0.345 (0.300)	0.387 (0.307)	0.286 (0.163)	0.129 (0.221)
<i>Lobbyist Prohibitions</i>	0.434 (0.305)	0.590 (0.323)	-0.055 (0.370)	0.318 (0.523)
<i>Lobbyist Reporting</i>	0.081 (0.103)	0.099 (0.106)	0.340* (0.136)	0.336 (0.184)
<i>Definitions * Prohibitions</i>	-0.033 (0.033)	-0.046 (0.090)	0.064 (0.080)	-0.005 (0.115)
<i>Definitions * Reporting</i>	-0.027 (0.048)	-0.034 (0.051)	-0.059 (0.036)	-0.028 (0.051)
<i>Firms Register</i>	5.916* (2.379)	5.074** (2.020)	3.901*** (0.784)	4.917*** (1.116)
<i>Non-Expiring Registrations</i>	8.454*** (1.579)	8.787*** (0.839)	15.719*** (1.304)	11.098*** (1.985)
<i>Lobby Employees Register</i>	7.095*** (2.106)	5.929** (2.224)	3.217 (1.649)	3.804 (2.786)
<i>Lobbyists (in thousands)</i>	-3.179*** (0.819)	-2.532** (0.820)	-1.747*** (0.354)	-1.809*** (0.435)
<i>Clients (in thousands)</i>	-0.915 (0.721)	-1.435 (0.736)	-2.787*** (0.444)	-3.484*** (0.594)
<i>Pairings (in thousands)</i>	1.064*** (0.225)	1.059*** (0.205)	1.002*** (0.056)	1.136*** (0.083)
Constant	3.827*** (0.792)	3.297*** (0.671)	10.126*** (2.457)	10.326*** (3.722)
Fixed Effects?			✓	✓
Observations	684	352	684	352
No. of States	49	49	49	49
R <sup>2</sup>	0.756	0.794	0.867	0.880
Adjusted R <sup>2</sup>	-	-	0.847	0.847

Note: \*p<0.05; \*\*p<0.01; \*\*\*p<0.001 on two-tailed tests.

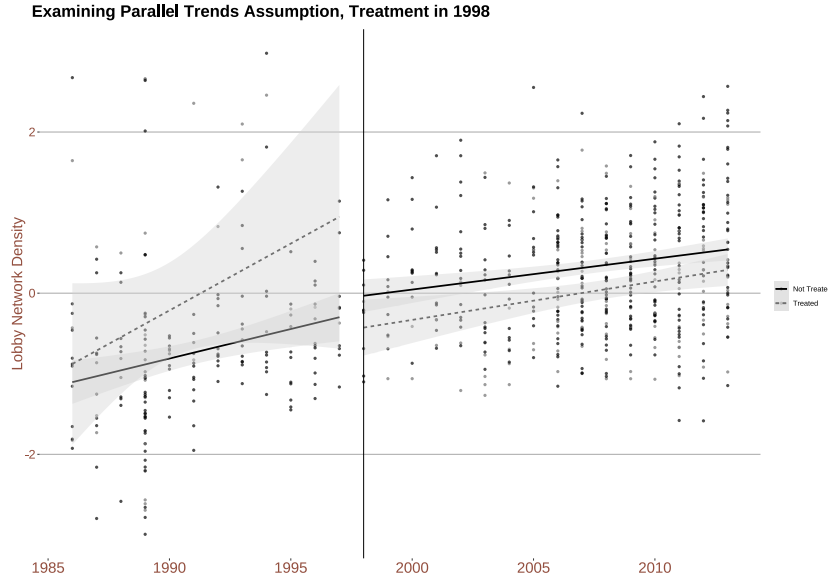
## A5 Examination of Parallel Trends Assumption

While our analyses of term limits and lobby density are robust to several alternative tests, it remains necessary to ensure that the data we use exhibit patterns consistent with the parallel trends assumption. First, as the figure depicts, the pre-treatment trends in lobby network density do not appear significantly different between treated and control units. It is worth noting that the staggered timing of treatment in this case renders typical tests and depictions a bit more complicated. Nevertheless, below, we have selected the year by which the majority of treated units had received treatment (2000) and constructed our pre-trends graph accordingly.



Given that there exists no “official” year of treatment (since each state made its own policy decision in its own time), it is generally worth exploring whether a similar visualization obtains for other possible years of treatment. However, in this case, executing such an analysis is a bit more difficult than usual. First, because our unit of analysis is legislative *session* (and not year), the number of time units available as treatment units is smaller than usual. Second, the total number of units that adopted term limits is relatively small: 16 out of 50 states. Taken together, these factors mean that selecting a “too early” or “too late” cutoff year for examining parallel trends would actually leave quite a number of treated or untreated units to incorrectly influence the trend lines in the graph.





This issue is partially assuaged by the fact that the majority of term-limit enactments occurred for either the 1998 or 2000 elections: 5 for 1998 and 5 more for 2000. As a result, we do examine parallel trends using a treatment cutoff year of 1998 in the figure above. On the other hand, this clustering means that other years simply have too little data in either the pre- or post-treatment-era treatment/control groups to examine the parallel trends assumption in earnest.

Consequently, we seek to substantiate these visual trends with several additional tests. First, we adopt a flexible, event-study style specification, wherein we independently examine the magnitudes of not only pre- and post-treatment shifts, but also treatment  $\pm 1$  time unit,  $\pm 2$  time units, and so on. The results of this analysis (based on the “weakest” specification in the main text, Model 7) are depicted in the table below. Results were generated with the ‘did’ package in R, which implements Callaway and Sant’Anna’s (2020) methodology for estimating differences-in-differences models with differential treatment timing. The results do not exhibit evidence consistent with pre-trend concerns. According to this particular specification, the ATT is felt most acutely in the immediate aftermath of term-limit enactment. Nevertheless, from a pre-trend perspective, this result lends additional confidence to the main results presented in the paper.

Table A5: **Dynamic treatment effects for term-limits DID analysis**

<b>Event Time</b>	<b>ATT</b>	<b>Std. Error</b>	<b>95% Confidence Int.</b>
-5	-0.0798	0.9785	[-2.3355, 2.1758]
-2	-0.3250	0.6618	[-1.8506, 1.2006]
-1	-0.2128	0.5919	[-1.5772, 1.1516]
<i>Treatment</i>	-0.7293	0.2432	[-1.2900, -0.1686]
1	-1.0965	0.4158	[-2.0550, -0.1380]
2	-0.4573	0.2222	[-0.9696, 0.0549]
3	-0.3027	0.7678	[-2.0726, 1.4672]
4	0.0099	0.7037	[-1.6124, 1.6321]

Finally, we examine the treatment leads and lags for the term-limit treatment. The results of this investigation are reported in Table A6. As found in the table, none of the interactions between our year dummies and treatment indicators rise to standard levels of statistical significance. This suggests that treated and control units do not appear to be significantly different pre-treatment.

Table A6: Treatment over Time (Leads and Lags)

	<i>Dependent variable:</i>
	Lobby Network Density
<i>Term Limit State</i>	0.238 (1.519)
<i>Term Limit State*1987</i>	0.470 (1.845)
<i>Term Limit State*1988</i>	0.989 (2.471)
<i>Term Limit State*1989</i>	1.543 (1.460)
<i>Term Limit State*1991</i>	1.060 (2.035)
<i>Term Limit State*1992</i>	0.492 (2.469)
<i>Term Limit State*1993</i>	1.408 (2.032)
<i>Term Limit State*1994</i>	0.320 (2.475)
<i>Term Limit State*1995</i>	0.055 (2.475)
<i>Term Limit State*1996</i>	0.066 (2.469)
<i>Term Limit State*1997</i>	-0.580 (2.492)
<i>Term Limit State*1998</i>	-0.356 (2.492)
<i>Term Limit State*1999</i>	-1.372 (1.902)
<i>Term Limit State*2000</i>	-1.962 (2.050)
<i>Term Limit State*2001</i>	-0.809 (2.049)
<i>Term Limit State*2002</i>	-1.049 (1.753)
<i>Term Limit State*2003</i>	-1.163 (1.658)
<i>Term Limit State*2004</i>	-1.021 (1.718)
<i>Term Limit State*2005</i>	-0.866 (1.643)
<i>Term Limit State*2006</i>	-1.549 (1.468)
<i>Term Limit State*2007</i>	-1.182 (1.460)
<i>Term Limit State*2008</i>	-0.918 (1.465)
<i>Term Limit State*2009</i>	-1.099 (1.463)
<i>Term Limit State*2010</i>	-1.539 (1.473)
<i>Term Limit State*2011</i>	-1.347 (1.462)
<i>Term Limit State*2012</i>	-0.919 (1.473)
<i>Term Limit State*2013</i>	-1.375 (1.467)
Constant	0.862 (0.881)
Observations	694
R <sup>2</sup>	0.754
Adjusted R <sup>2</sup>	0.712
Residual Std. Error	1.976 (df = 591)
F Statistic	17.777*** (df = 102; 591)

Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01  
 State-level fixed effects results suppressed for table pagination.

## A6 References

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