

Supplementary Materials for Modeling citations and cartels

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1 Additional Figures

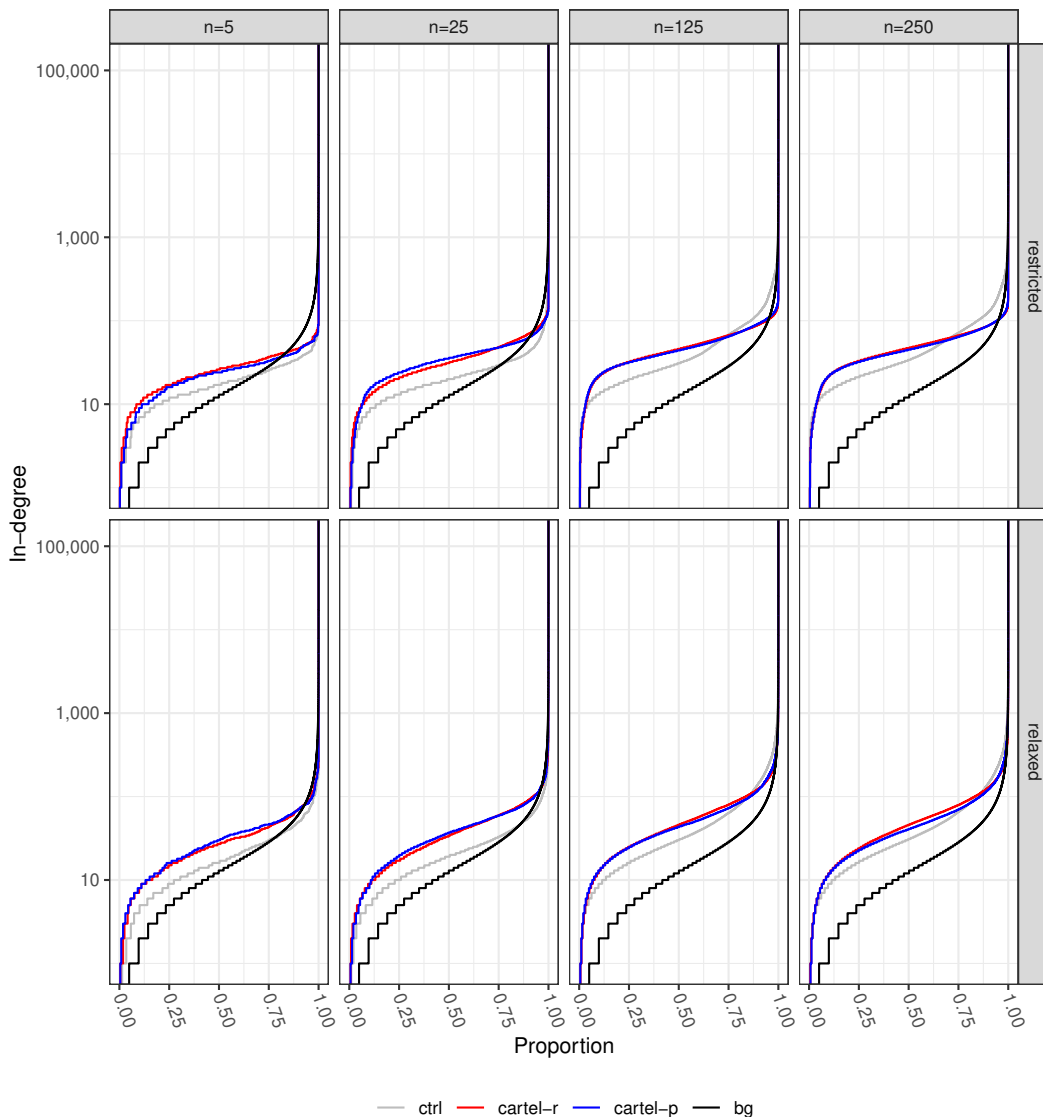


Figure S1. Publication in-degree grouped by author cartel memberships. Cartels show left-shifted curves. *bg* denotes the background authors, meaning all agent nodes that are not part of *ctrl*, *cartel-r*, or *cartel-p*. The x-axis shows the proportion of nodes that are at least *y* in-degree according to the y-axis.

2 Additional Tables

Table S1. Summary statistics of in-degree percentiles of cartel members. Here we show the different percentiles of publication in-degrees grouped by members (citations for publications by each member are summed)

		cartel size	min	Q1	median	Q3	90th	99th	max
Restricted	ctrl	5	0	12	18	26	35	63	127
	cartel-r	5	0	17	26	37	47	75	117
	cartel-p	5	0	15	25	33	44	67	99
	bg-agent	5	0	5	12	28	59	301	85165
Restricted	ctrl	25	0	14	20	30	42	133	929
	cartel-r	25	0	21	32	48	70	115	150
	cartel-p	25	0	24	36	48	63	112	163
	bg-agent	25	0	5	12	28	59	300	116612
Restricted	ctrl	125	0	20	31	67	120	446	2452
	cartel-r	125	0	32	46	67	90	132	207
	cartel-p	125	0	32	44	65	93	141	315
	bg-agent	125	0	5	12	28	59	297	104242
Restricted	ctrl	250	0	21	34	71	125	432	2618
	cartel-r	250	0	33	47	67	88	131	239
	cartel-p	250	0	32	45	64	88	136	487
	bg-agent	250	0	4	12	27	58	297	101918
Relaxed	ctrl	5	0	9	17	30	50	144	216
	cartel-r	5	0	15	27	43	70	177	339
	cartel-p	5	0	15	30	47	69	166	271
	bg-agent	5	0	5	12	28	59	300	94273
Relaxed	ctrl	25	0	10	20	33	56	164	793
	cartel-r	25	0	17	34	60	90	219	15920
	cartel-p	25	0	19	37	59	86	206	1601
	bg-agent	25	0	5	12	27	59	301	100676
Relaxed	ctrl	125	0	16	30	63	141	587	8835
	cartel-r	125	0	24	45	79	124	330	1604
	cartel-p	125	0	24	43	72	119	347	3585
	bg-agent	125	0	4	12	27	59	296	98196
Relaxed	ctrl	250	0	16	31	64	142	584	13440
	cartel-r	250	0	23	45	79	127	323	3701
	cartel-p	250	0	22	40	69	120	389	4594
	bg-agent	250	0	4	12	27	58	296	97891

Table S2. Summary statistics of in_degree for cartel nodes under different counterfactual simulations. Percentiles shown are inferred for cartel nodes through the empirical cumulative distribution function (ecdf) for background nodes (non-cartel agents)

	model	crtl_size	crtl_n_bg	n_crtl	crtl_indeg_min	crtl_indeg_q1	crtl_indeg_median	crtl_indeg_mean	crtl_indeg_q3	crtl_indeg_max	ptile_min	ptile_q1	ptile_median	ptile_mean	ptile_q3	ptile_max	tag
1	cartel-p	5	2104260	450	0	15.25	25	25.81	33	99	0.07	0.58	0.73	0.67	0.80	0.95	restr
2	cartel-p	25	2102460	2250	0	24.00	36	37.71	48	163	0.07	0.72	0.82	0.75	0.87	0.98	restr
3	cartel-p	125	2093460	11250	0	32.00	44	50.44	65	315	0.07	0.79	0.86	0.81	0.91	0.99	restr
4	cartel-p	250	2082210	22500	0	32.00	45	49.80	64	487	0.07	0.79	0.86	0.81	0.91	0.99	restr
5	cartel-r	5	2104260	450	0	17.00	26	27.94	37	117	0.07	0.62	0.74	0.69	0.82	0.96	restr
6	cartel-r	25	2102460	2250	0	21.00	32	37.00	48	150	0.07	0.68	0.79	0.74	0.87	0.97	restr
7	cartel-r	125	2093460	11250	0	32.00	46	50.75	67	207	0.07	0.79	0.86	0.81	0.92	0.98	restr
8	cartel-r	250	2082210	22500	0	33.00	47	50.93	67	239	0.07	0.80	0.87	0.81	0.92	0.99	restr
9	crtl	5	2104260	450	0	12.00	18	19.98	26	127	0.07	0.51	0.63	0.60	0.74	0.97	restr
10	crtl	25	2102460	2250	0	14.00	20	26.19	30	929	0.07	0.56	0.67	0.64	0.78	1.00	restr
11	crtl	125	2093460	11250	0	20.00	31	59.19	67	2452	0.07	0.67	0.79	0.76	0.92	1.00	restr
12	crtl	250	2082210	22500	0	21.00	34	62.15	71	2618	0.07	0.68	0.81	0.77	0.92	1.00	restr
13	cartel-p	5	2104260	450	0	15.25	25	25.81	33	99	0.07	0.58	0.73	0.67	0.80	0.95	relex
14	cartel-p	25	2102460	2250	0	24.00	36	37.71	48	163	0.07	0.72	0.82	0.75	0.87	0.98	relex
15	cartel-p	125	2093460	11250	0	32.00	44	50.44	65	315	0.07	0.79	0.86	0.81	0.91	0.99	relex
16	cartel-p	250	2082210	22500	0	32.00	45	49.80	64	487	0.07	0.79	0.86	0.81	0.91	0.99	relex
17	cartel-r	5	2104260	450	0	17.00	26	27.94	37	117	0.07	0.62	0.74	0.69	0.82	0.96	relex
18	cartel-r	25	2102460	2250	0	21.00	32	37.00	48	150	0.07	0.68	0.79	0.74	0.87	0.97	relex
19	cartel-r	125	2093460	11250	0	32.00	46	50.75	67	207	0.07	0.79	0.86	0.81	0.92	0.98	relex
20	cartel-r	250	2082210	22500	0	33.00	47	50.93	67	239	0.07	0.80	0.87	0.81	0.92	0.99	relex
21	crtl	5	2104260	450	0	12.00	18	19.98	26	127	0.07	0.51	0.63	0.60	0.74	0.97	relex
22	crtl	25	2102460	2250	0	14.00	20	26.19	30	929	0.07	0.56	0.67	0.64	0.78	1.00	relex
23	crtl	125	2093460	11250	0	20.00	31	59.19	67	2452	0.07	0.67	0.79	0.76	0.92	1.00	relex
24	crtl	250	2082210	22500	0	21.00	34	62.15	71	2618	0.07	0.68	0.81	0.77	0.92	1.00	relex