6 Appendix

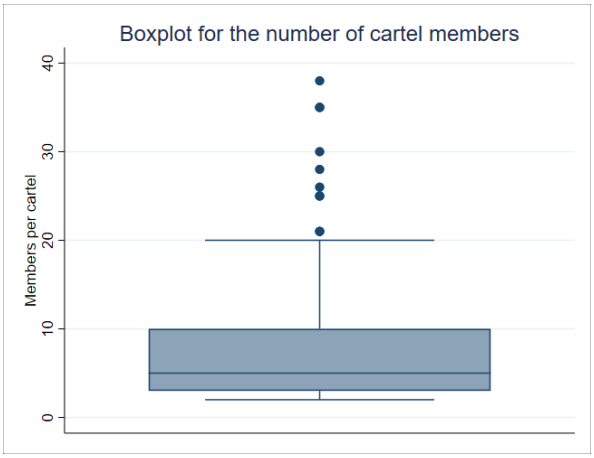

Figure F1: Boxplot for the number of members in a cartel

Dependent variable: Presence of a third party *quadratic specification*					
	(1)	(2)	(3)	(4)	(5)
log(#Cartelists)	-1.005	-0.949	-0.170	-0.172	-0.837
	(0.85)	(0.83)	(0.94)	(0.92)	(0.94)
$\log(\#\text{Cartelists})^2$	0.424**	0.408**	0.243	0.243	0.389*
	(0.20)	(0.20)	(0.22)	(0.22)	(0.24)
Constant	-1.310	-1.095	-2.073**	-1.976*	0.322
	(0.82)	(0.77)	(1.02)	(1.04)	(1.19)
Fixed Effects					
Year	-	✓	-	✓	-
Industry	-	-	✓	✓	-
Year × Industry	-	-	-	-	✓
BIC	98.300	115.043	106.384	121.413	104.254
F-Test	0.000	0.003	0.000	0.001	0.014
N	181	159	136	121	94

Estimation method: Probit. Dependent variable: Binary indicator for the presence of a third party. Heteroskedasticity-robust standard Errors in brackets. Significance levels: $*p < 0.10$, $**p < 0.05$, $***p < 0.01$. Quadratic specification for the regression presented in Table 6 of the manuscript. The mostly insignificant coefficients hint at the linear specification being more suitable.

Table A1: Relationship between the number of cartelists and the presence of a third party

Group	Obs.	Mean	Std. Err.	Std. Dev.	90% Conf. Int.	
$\mathbb{1}_{Third\ Party} = 0$	162	5.590	0.372	4.733	4.975	6.205
$\mathbb{1}_{Third\ Party} = 1$	14	8.493	1.852	6.928	5.214	11.772
Combined	176	5.821	0.375	4.981	5.200	6.442
Difference		-2.903	1.889	-6.228	0.423	
H_0 : diff= 0			Satterthwaite's degrees of freedom= 14.068			
H_{alt} : diff< 0		H_{alt} : diff≠ 0		H_{alt} : diff> 0		
$Pr(T < t) = 0.073$		$Pr(\|T\| > \|t\|) = 0.147$		$Pr(T > t) = 0.927$		

Two sample T-test with unequal variances to account for the variation in variance between cartels without and with an involved third party (see also Ruxton, 2006, for the application of the 'unequal variance' T-test). An alternative to the t-test is the nonparametric Mann-Whitney U Test (1947). It requires less functional form assumptions than the t-test and leads to test statistic of $z = -1.805$, which corresponds to a p-value of $p = 0.0711$ for the full sample.

Table A2: Cartel duration and the presence of a third party: Full sample

Appendix B: Jackknife Standard Error Computation

Dependent variable: Cartel duration in years *linear specification*					
	(1)	(2)	(3)	(4)	(5)
log(#Cartelists)	0.175	0.170	0.123	0.119	0.033
	(0.12)	(0.13)	(0.13)	(0.14)	(0.19)
Constant	1.002***	0.985***	1.012***	1.059***	1.289***
	(0.23)	(0.32)	(0.34)	(0.36)	(0.26)
Fixed Effects					
Year	-	✓	-	✓	-
Industry	-	-	✓	✓	-
Year × Industry	-	-	-	-	✓
R^2	0.012	0.046	0.166	0.186	0.343
BIC	529.152	554.092	567.706	594.287	589.690
F-Test	0.163	0.417	0.000	0.000	.
N	164	164	164	164	164

Estimation method: OLS. Dependent variable: Logarithmic cartel sanctions in million USD. Jackknife standard errors in brackets. Significance levels: $*p < 0.10$, $**p < 0.05$, $***p < 0.01$. Jackknife bootstrap estimations for the regressions presented in Table 2 in the manuscript.

Table B1: Linear Relationship between the number of cartel members and cartel duration: Jackknife standard error computation

Dependent variable: Cartel duration in years *quadratic specification*					
	(1)	(2)	(3)	(4)	(5)
log(#Cartelists)	-0.126	-0.247	-0.006	-0.004	-0.265
	(0.58)	(0.57)	(0.62)	(0.60)	(0.76)
log(#Cartelists)^2	0.080	0.110	0.034	0.033	0.080
	(0.15)	(0.15)	(0.15)	(0.15)	(0.18)
Constant	1.239**	1.313**	1.118*	1.160*	1.550**
	(0.51)	(0.55)	(0.60)	(0.61)	(0.72)
Fixed Effects					
Year	-	✓	-	✓	-
Industry	-	-	✓	✓	-
Year × Industry	-	-	-	-	✓
R^2	0.014	0.049	0.166	0.186	0.345
BIC	533.944	558.606	572.746	599.333	594.471
F-Test	0.307	0.417	0.000	0.000	.
N	164	164	164	164	164

Estimation method: OLS. Dependent variable: Logarithmic cartel sanctions in million USD. Jackknife standard errors in brackets. Significance levels: $*p < 0.10$, $**p < 0.05$, $***p < 0.01$

Table B2: Quadratic Relationship between the number of cartel members and cartel duration: Jackknife standard error computation

Dependent variable: Cartel sanctions in million USD *linear specification*					
	(1)	(2)	(3)	(4)	(5)
log(#Cartelists)	0.673***	0.681***	0.653***	0.646**	0.471
	(0.23)	(0.24)	(0.24)	(0.26)	(0.35)
Constant	0.875**	1.351***	-1.081	-0.377	0.969**
	(0.44)	(0.48)	(1.53)	(1.25)	(0.49)
Fixed Effects					
Year	-	✓	-	✓	-
Industry	-	-	✓	✓	-
Year × Industry	-	-	-	-	✓
R^2	0.047	0.136	0.172	0.215	0.420
BIC	809.807	823.467	852.058	873.613	879.097
F-Test	0.004	0.005	0.001	0.000	.
N	180	180	180	180	180

Estimation method: OLS. Dependent variable: Logarithmic cartel sanctions in million USD. Jackknife standard errors in brackets. Significance levels: $*p < 0.10$, $**p < 0.05$, $***p < 0.01$.

Table B3: Linear relationship between the number of cartel members and the amount of sanctions: Jackknife standard error computation

Dependent variable: Cartel sanctions in million USD *quadratic specification*					
	(1)	(2)	(3)	(4)	(5)
log(#Cartelists)	3.446***	3.275***	3.159***	3.084***	3.191**
	(0.98)	(0.97)	(1.01)	(1.03)	(1.24)
log(#Cartelists)^2	-0.737***	-0.688***	-0.668***	-0.648**	-0.726**
	(0.24)	(0.24)	(0.25)	(0.26)	(0.31)
Constant	-1.303	-0.666	-2.913*	-2.178*	-1.406
	(0.90)	(0.88)	(1.49)	(1.26)	(1.15)
Fixed Effects					
Year	-	✓	-	✓	-
Industry	-	-	✓	✓	-
Year × Industry	-	-	-	-	✓
R^2	0.088	0.170	0.202	0.242	0.420
BIC	807.117	821.407	850.585	872.410	876.215
F-Test	0.001	0.001	0.001	0.000	.
N	180	180	180	180	180

Estimation method: OLS. Dependent variable: Logarithmic cartel sanctions in million USD. Jackknife standard errors in brackets. Significance levels: $*p < 0.10$, $**p < 0.05$, $***p < 0.01$.

Table B4: Quadratic relationship between the number of cartel members and the amount of sanctions: Jackknife standard error computation

Dependent variable: Presence of a third party *linear specification*	
	(1)
log(#Cartelists)	0.750***
	(0.27)
Constant	-2.859***
	(0.63)
Fixed Effects	
Year	-
Industry	-
Year × Industry	-
BIC	96.720
F-Test	0.005
N	181

Estimation method: Probit. Dependent variable: Binary indicator for the presence of a third party. Jackknife standard errors in brackets. Significance levels: $*p < 0.10$, $**p < 0.05$, $***p < 0.01$. Jackknife standard error computation for column (1) in Table 6. Jackknife estimation only possible for the probit regression without fixed effects.

Table B5: Relationship between the number of cartelists and the presence of a third party; Jackknife standard error computation