Online Resource 1

From Oligopoly to Fragmentation: Market Structure and Law-Enforcement Disruption in the Ransomware-as-a-Service Economy

This file contains supplementary analyses referred to in the manuscript. All figures are computed on the same cleaned dataset (29,162 claims by 287 groups, January 2022 – September 2026).

S1 Comparison with a second leak-site tracker

We compare our data with the posts published by ransomwatch for January 2022 to December 2024, after applying the same brand normalisation and removing repeated posts of the same victim by the same group. Seven ransomwatch group names were mapped to the names used by ransomware.live (for example *hiveleak* to *hive*, *ragroup* to *raworld*). Over the window, ransomware.live contains 13,695 claims by 149 groups and ransomwatch 12,484 claims by 132 groups, with 127 groups in common. 74.8% of ransomware.live claims are found in ransomwatch under the same group and normalised victim name, and 81.5% of ransomwatch claims are found in ransomware.live. Quarterly HHI is correlated across the two sources (Pearson r = 0.96, Spearman ρ = 0.91), and both series decline (log-HHI trend −43% per year in ransomware.live and −34% per year in ransomwatch over 2022–2024; both $p < 0.001$, Newey–West standard errors).

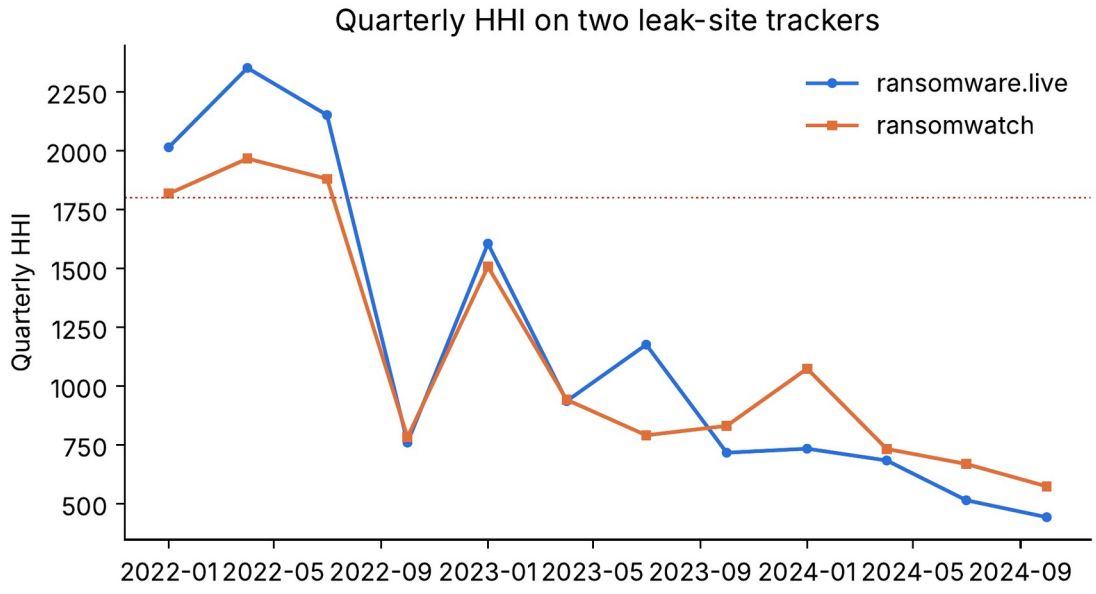


Fig. S1 Quarterly HHI of leak-site claims in ransomware.live and ransomwatch, 2022–2024. The dotted line marks the 1,800 threshold for highly concentrated markets

Table S1 Quarterly claims, active groups, HHI and leading group in the two sources

Quarter	Claims (ransomware.live)	Claims (ransomwatch)	Groups (ransomware.live)	Groups (ransomwatch)	HHI (ransomware.live)	HHI (ransomwatch)	Leader (ransomware.live)	Leader (ransomwatch)
2022Q1	698	751	26	27	2,014	1,817	lockbit	lockbit
2022Q2	638	720	25	27	2,351	1,966	lockbit	lockbit
2022Q3	546	596	26	27	2,151	1,880	lockbit	lockbit
2022Q4	906	766	35	31	760	783	lockbit	lockbit
2023Q1	802	868	28	30	1,605	1,507	lockbit	lockbit
2023Q2	1094	1118	41	41	936	942	lockbit	lockbit
2023Q3	1786	1465	47	46	1,176	791	alphv	lockbit
2023Q4	1373	1200	51	46	717	831	lockbit	lockbit
2024Q1	1075	1241	51	48	734	1,074	lockbit	lockbit
2024Q2	1646	1254	59	49	684	733	dispossessor	lockbit
2024Q3	1280	1086	58	50	515	669	ransomhub	ransomhub
2024Q4	1851	1419	61	50	443	574	ransomhub	ransomhub

S2 Concentration ratios by year

The concentration ratio CR is the share of claims of the top 1%, 5%, 10% and 20% of groups active in each year (for the top 1%, k = 1 in every year, so CR equals the leader's share reported in Table 2 of the manuscript). Over the whole period the corresponding figures are 23.3% (k = 3), 53.2% (k = 14), 67.5% (k = 29) and 81.6% (k = 57), with a Gini coefficient of 0.78.

Table S2 Concentration ratios and Gini coefficient by year

Year	Groups	CR3	k (5%)	CR (top 5%)	k (10%)	CR (top 10%)	k (20%)	CR (top 20%)	Gini
2022	59	46.3%	3	46.3%	6	61.4%	12	76.8%	0.732
2023	69	40.0%	3	40.0%	7	60.1%	14	76.3%	0.709
2024	95	25.4%	5	35.7%	10	52.2%	19	71.1%	0.683
2025	123	28.4%	6	42.8%	12	58.2%	25	74.8%	0.707
2026	144	29.8%	7	45.0%	14	58.8%	29	74.1%	0.715

S3 Concentration with rebrands merged

Strict definition: Royal and BlackSuit; Cyclops and Knight; Eldorado and BlackLock; Hunters International and World Leaks. Broad definition: the strict links plus BlackSuit and Chaos; Hive and Hunters International; Knight and RansomHub; INC, Lynx and Sinobi. Sources are given in Section 5.2 of the manuscript.

Table S3 Mean quarterly HHI and trend by unit of analysis

Unit	Units	Mean HHI 2022–23	Mean HHI 2024–26	Trend per year
Brand	287	1,464	565	-28.3%
Organisation (strict)	283	1,464	565	-28.3%
Organisation (broad)	278	1,464	599	-26.7%

Table S4 Quarterly HHI by unit of analysis

Quarter	Brands	Organisations (strict)	Organisations (broad)
2022Q1	2,014	2,014	2,014
2022Q2	2,351	2,351	2,351
2022Q3	2,151	2,151	2,151
2022Q4	760	760	760
2023Q1	1,605	1,605	1,605
2023Q2	936	939	939

Quarter	Brands	Organisations (strict)	Organisations (broad)
2023Q3	1,176	1,177	1,177
2023Q4	717	717	717
2024Q1	734	734	737
2024Q2	684	684	684
2024Q3	515	515	526
2024Q4	443	443	454
2025Q1	643	643	671
2025Q2	475	480	510
2025Q3	517	517	627
2025Q4	697	697	790
2026Q1	583	583	660
2026Q2	472	472	481
2026Q3	452	452	453

S4 Brand survival: full sensitivity analysis

Table S5 Kaplan–Meier estimates by exit threshold, minimum size and unit of analysis (brands entering after January 2022)

Unit	Exit (days)	Min. claims	n	Exits	Median (months)	Survival at 12 months	Median, 2022–23 entrants	Median, 2024–26 entrants	Log-rank p
Brand	60	3	239	149	8.8	0.456	9.4	8.4	0.179
Brand	60	5	216	132	10.1	0.484	11.4	10.0	0.343
Brand	60	10	174	97	17.6	0.568	20.0	14.8	0.223
Brand	90	3	239	141	9.1	0.464	9.4	8.8	0.559
Brand	90	5	216	125	11.4	0.49	11.4	10.1	0.849
Brand	90	10	174	90	19.2	0.576	20.0	15.4	0.743
Brand	180	3	239	122	13.6	0.506	9.4	14.5	0.478
Brand	180	5	216	110	15.4	0.527	11.4	14.9	0.352

Unit	Exit (days)	Min. claims	n	Exits	Median (months)	Survival at 12 months	Median, 2022–23 entrants	Median, 2024–26 entrants	Log-rank p
Brand	180	10	174	80	20.3	0.608	20.0	17.6	0.601
Organisation (strict)	60	3	235	145	9.1	0.466	11.4	8.8	0.116
Organisation (strict)	90	3	235	137	9.4	0.474	11.4	9.1	0.374
Organisation (strict)	180	3	235	118	14.5	0.518	11.4	14.5	0.679
Organisation (broad)	60	3	230	141	9.1	0.465	11.9	8.1	0.103
Organisation (broad)	90	3	230	134	9.1	0.473	11.9	8.8	0.349
Organisation (broad)	180	3	230	116	14.5	0.511	11.9	14.5	0.76