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Alperovych, Yan ; Cumming, Douglas; Czellar, Veronika; Groh, Alexander

DOI:
10.1016/j.jfineco.2021.05.012

Online Appendix

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Yan Alperovych[*]
alperovych@em-lyon.com

Douglas Cumming[†]
douglas.cumming@gmail.com

Veronika Czellar[‡]
veronika.czellar@edhec.edu

Alexander Groh[*]
groh@em-lyon.com

Abstract

We examine an international sample of 68,044 completed, or envisaged but abandoned, M&A transactions involving unlisted targets to determine the effect of rumors on deal-closing propensity and transaction value. Our focus on non-listed targets leaves only two reasons for the emergence of M&A transaction information leaks. First, a rumor may arise unintentionally due to carelessness in the negotiation process. Second, someone may spread a rumor on purpose to affect the likelihood of transaction closing and deal value. As an extension of the material presented in the published paper, this accompanying Online Appendix shows the impact of unintentional rumors is less pronounced than intentional rumors, and the effects of both types are consistent with the evidence presented in the main body of the published paper.

[*]EMLYON Business School

[†]Florida Atlantic University and Birmingham Business School (University of Birmingham), corresponding author

[‡]EDHEC Business School

1 The model with two types of strategic leaks

We argue that there are two principle origins of M&A transaction rumors about unlisted firms. First, a transaction rumor can be spread on purpose or second, it emerges accidentally. If deal negotiations are leaked intentionally, then the motivation is most likely to affect the deal closing likelihood and/or to manipulate the consideration. For example, employees or even incumbent management of the target may be hostile to the idea of ownership transfer. Alternatively, the buyer and seller are naturally interested in obtaining the best possible price in their respective interest. Recall that we do not observe the rumor source for about 62.66% of the leaked transactions. However, it is still possible to factor out the effects of intended rumors compared to unintended ones using the base-line model presented in the paper. The necessary model adjustments and empirical results are described in the following.

Let n be the number of sampled M&A transactions. For each transaction $i = 1, \dots, n$, we denote D_i the deal closing state taking the value of one if the transaction consummates and zero otherwise. Denote R_i the rumor variable taking the value of one if D_i was subject to a rumor and zero otherwise. If for each transaction a rumor can be spread on purpose, we can assume that there are two unobservable (for econometricians) *strategic rumor processes* S_i^1 and S_i^2 underlying the observable rumor variable R_i:

$$S_i^1 = \begin{cases} 1 & \text{if strategic rumor spread to manipulate the price for } i \text{ with } \mathbb{P}(S_i^1 = 1) = p_1 \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

$$S_i^2 = \begin{cases} 1 & \text{if strategic rumor spread to kill the deal for } i \text{ with } \mathbb{P}(S_i^2 = 1) = p_2 \\ 0 & \text{otherwise} \end{cases} \tag{2}$$

Note that under this formulation S_i^1 reflects the intention to manipulate the price but does not indicate the direction (up or down), while S_i^2 reflects the intention to kill the deal (hence we expect the direction). As there might be opposing intentions, i.e. some parties will want to increase the price (sellers) while others will want the opposite (acquirers), we keep the model agnostic. Eventually, the parameter estimate of p_1 will indicate which of the effects prevails. With this, we next assume that the $(R_i,\ D_i)$ are generated from the following model:

$$R_i = \begin{cases} 1 & \text{if } S_i^1 = 1 \text{ or } S_i^2 = 1 \text{ or } X_i b_1 + \varepsilon_{i,1} > 0 \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

$$D_i = \begin{cases} 1 & \text{if } X_i b_2 + \gamma R_i + \varepsilon_{i,2} > 0 \\ 0 & \text{otherwise} \end{cases} \tag{4}$$

for $i = 1, \ldots, n$, where $X_i = (1, x_{i1}, \ldots, x_{ik})$, is the i-th row of a $n \times (k+1)$ matrix of explanatory variables and $\varepsilon_{i,1}$ and $\varepsilon_{i,2}$ are independent and identically distributed standard normal variables (i.e. with zero mean and unit variance).

For an outside observer accidental and strategic rumors are indistinguishable and collapse into R_i. The accidental rumor in this setup materializes when (i) both S_i^1, S_i^2 are equal to 0 and (ii) the $X_i b_1 + \varepsilon_{i,1} > 0$. In accordance with our previous analyses, Eq. (4) shows that the deal closing D_i depends on the "generic" rumor R_i.

Next, for each $i \in 1 \ldots, n$, we assume that the transaction multiple P_i at which the deal is closed is generated from:

$$\log P_i = \tilde{X}_i b_3 + \kappa_1 S_i^1 + \kappa_2 (1 - S_i^1)(1 - S_i^2) R_i + \varepsilon_{i,3}\,, \quad i = 1, \ldots, n\,, \tag{5}$$

where S_i^1 is the intentional rumor to manipulate the price and $(1 - S_i^1)(1 - S_i^2)R_i$ is an accidental rumor (this expression can only be different from 0 when there are no strategic rumors). The errors $\varepsilon_{i,3}$ are i.i.d. normal variables with zero mean and σ^2 variance, independent of $\varepsilon_{i,1}$ and $\varepsilon_{i,2}$. Note that this independence does not imply that one can directly estimate the effect of a rumor on the consideration because of a rumor's impact on deal closing. Only the joint estimation therefore yields a correct result because all three parts need to be evaluated simultaneously. By assumption that rumors are spread strategically to manipulate the deal outcome, P_i depends on strategic rumors S_i^1 and S_i^2, and on R_i. The $\tilde{X}_i = (1, x_{i1}, \ldots, x_{il})$, is the i-th row of a $n \times (l+1)$ matrix with l explanatory variables that include target firm, acquirer and other observable deal-related characteristics.

Although the P_i process generates the price, the latter only materializes if (and only if) the deal is consummated. Moreover, deal values of privately-held targets may or may not be observed. Accordingly, this needs to be accommodated in the joint estimation of the deal values conditional on rumor emergence and deal consummation. Thus, for each $i = 1, \ldots, n$, the deal value may or may not be available and is contingent on the deal being closed. Denote the availability of the consideration by B_i:

$$B_i = \begin{cases} 1 & \text{if } \tilde{X}_i b_4 + \zeta_1 R_i + \zeta_2 \log P_i + \varepsilon_{i,4} > 0 \\ 0 & \text{otherwise} \end{cases}\,, \tag{6}$$

where $\varepsilon_{i,4}$ are i.i.d. normal variables with zero mean and unit variance, independent of $\varepsilon_{i,1}$, $\varepsilon_{i,2}$ and $\varepsilon_{i,3}$. Note that B_i is now linked to the generic rumor R_i and to the price process P_i. As we argue in the paper, we are more likely to observe prices of larger transactions or of those transactions that were rumored (because of increased awareness of the deal). Finally, for each $i = 1, \ldots, n$, the observed transaction value becomes:

$$P_i^{obs} = \begin{cases} P_i & \text{if } B_i \times D_i = 1\,, \\ \text{unavailable} & \text{otherwise} \end{cases} . \tag{7}$$

We collect the $2k + 2l + 12$ parameters into the following vector θ, which has to be estimated from the data:

$$\theta = (b_1, b_2, b_3, b_4, \gamma, \kappa_1, \kappa_2, \sigma, p_1, p_2, \zeta_1, \zeta_2)' \,.$$

The complexity of the structural processes affecting price observations given rumors, deal closings and price levels themselves renders conventional estimation techniques such as maximum likelihood inappropriate as we illustrate in the body of the paper. Instead, the estimation of θ can be achieved using indirect inference. Only in a special case, when $\zeta_2 = 0$, the model can be estimated by maximum likelihood. However, ζ_2 controls the skewness of observed log-transaction multiples as argued in the paper. The presence of a positive (negative) ζ_2 leads to positively (negatively) skewed observed log-transaction multiples.

We estimate the structural parameters by indirect inference with auxiliary estimators defined by:

$$\hat{\mu} = (\hat{b}_1, \hat{b}_2, \hat{b}_3, \hat{b}_4, \hat{\gamma}, \hat{\kappa}_1, \hat{\kappa}_2, \hat{\sigma}, \hat{p}_1, \hat{p}_2, \hat{\zeta}_1, \hat{\nu})' \,.$$

Table A.1 presents the estimation results. Each column corresponds to a section of the model described above. The first two columns - Leak and Closing - show the parameter estimates for the R_i and D_i processes of Eq. (3) and (4) respectively. Column three (Price availability) shows the estimates for Eq. (6). The fourth column reports the estimates for Eq. (7).

The first two rows report the coefficients of interest in this analysis. The point estimate of p_1 at 5.14% is the unconditional probability of a rumor intended to manipulate the price of deal i. Similarly, the point estimate of p_2 at 5.63% is the unconditional probability of a rumor intended to kill the deal for deal i. Given that these parameters refer to deal i (and not to the rumors) we need to rescale them in order to obtain the economic interpretation.

The proportion of rumored transactions in the data that goes into the model[1] is $\mathbb{P}(R = 1) = 23.55\%$ (6,799 rumored deals out of 28,869 M&A transactions). We also

[1] We lose observations because of missing data for various controls.

Table A.1: Indirect inference (II) parameter estimates for two strategic rumors.

Note: The table presents the results of the indirect inference estimates of the model with two strategic rumors, consisting of four parts, each represented by a column. All models include country, industry, and time fixed effects (FE). Asymptotic standard errors are reported in parentheses.

	Leak	Closing	Price availability	Ln(Price)
p_1: $\mathbb{P}(S^1 = 1)$	0.051***			
	(0.012)			
p_2: $\mathbb{P}(S^2 = 1)$	0.056***			
	(0.014)			
γ: Leak		−0.946***		
		(0.004)		
ζ_1: Leak			0.411***	
			(0.019)	
ζ_2: Log-price			1.076***	
			(0.043)	
κ_1: S^1				0.721***
				(0.272)
κ_2: Accidental leak				−0.248
				(0.275)
Leak-IV	1.127***	−0.223***	−0.115***	−0.190***
	(0.030)	(0.012)	(0.029)	(0.064)
Number of sources			0.421***	1.116***
			(0.019)	(0.028)
Age	−0.042***	0.003	0.052***	−0.121***
	(0.004)	(0.003)	(0.004)	(0.001)
Assets	0.292***	−0.006***	0.055***	0.272***
	(0.005)	(0.000)	(0.005)	(0.014)
Toehold	−1.233***	−0.113***	0.581***	0.684***
	(0.019)	(0.002)	(0.012)	(0.037)
Number of acquirers	0.560***	−0.416***	−0.196*	−0.133
	(0.066)	(0.051)	(0.114)	(0.140)
Acquirer experience	−0.000	0.015***	−0.016***	0.003***
	(0.001)	(0.000)	(0.001)	(0.001)
Financial acquirer	−0.346***	0.043	−0.218***	0.082
	(0.051)	(0.051)	(0.082)	(0.097)
Strategic acquirer	−0.363***	0.077	−0.019	−0.213**
	(0.056)	(0.053)	(0.089)	(0.105)
Individual acquirer	−0.618***	0.277***	−0.035	−0.152*
	(0.041)	(0.047)	(0.075)	(0.091)
Government acquirer	0.556***	−0.144**	0.033	−0.159
	(0.070)	(0.060)	(0.101)	(0.171)
Local deal	−0.062***	−0.020***	0.180***	−0.320***
	(0.003)	(0.002)	(0.011)	(0.004)
Same industry	0.133***	−0.032***	−0.035***	−0.072***
	(0.007)	(0.002)	(0.007)	(0.009)
Buyout	0.116***	0.355***	−0.185***	0.034***
	(0.002)	(0.004)	(0.012)	(0.009)
HHI	0.078***	−0.110***	−0.060***	−0.368***
	(0.014)	(0.006)	(0.016)	(0.015)
M&A market	−0.027	0.025	0.074*	0.191***
	(0.038)	(0.018)	(0.042)	(0.047)
σ				1.617***
				(0.023)
Observations				28,869
Closed deals				19,790
Rumored deals				6,799
Closed deals with prices				6,007

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

have four possible situations: (i) rumors are spread to manipulate the price, (ii) rumors are spread to kill the deal, (iii) both of the strategic rumors are spread simultaneously, and (iv) rumors are accidental. Using the model estimates we extract the proportions of each of the rumor types. For instance, the proportion of rumors of type (i) should be 20.60%, while the proportion of rumors of type (ii) is 22.68%. The computation and details are collected in Table A.2 below.

Table A.2: Summary of the rumor types.

Note: The table presents the back-of-the-envelope calculations of rumors types using the following point estimates from Table A.1: $\hat{p}_1 = 0.0514$, $\hat{p}_2 = 0.0563$, $\mathbb{P}(R = 1) = 0.2355$.

		% of Rumors
S^1: Rumor to manipulate the price	$\hat{p}_1 \times (1 - \hat{p}_2)/\mathbb{P}(R = 1)$	20.60
S^2: Rumor to kill the deal	$(1 - \hat{p}_1) \times \hat{p}_2/\mathbb{P}(R = 1)$	22.68
S^1 & S^2	$\hat{p}_1 \times \hat{p}_2/\mathbb{P}(R = 1)$	1.23
Accidental rumors	Remainder	55.50

As argued in the paper, generic rumors (R_i) reduce the probability of deal closing with the similar order of magnitude. Both rumors and the consideration itself affect the price availability/observability as expected, thus providing additional robustness for the results presented in the paper.

Finally, strategic price manipulating rumors have a positive loading ($\hat{\kappa}_1 = 0.721$, significant at 1% level) while accidental rumors have a negative loading ($\hat{\kappa}_2 = -0.248$, not significant) on the transaction multiple. Moreover, given the positive coefficient of κ_1 it appears that among the two generic parties (sell- and buy-sides) that might spread rumors to manipulate the price towards their interest, the sell-side effect prevails. Put differently, it is likely that the majority of strategic rumors intended to manipulate the price is spread by the sell-side with an intention to move the price up. This price increase, for deals that consummate, is about 72%. However, to derive the economic importance of this effect, we refer to the following identity:

$$\mathbb{P}(S_i^1 = 1|D_i = 1) = \frac{\mathbb{P}(S_i^1 = 1 \cap D_i = 1)}{\mathbb{P}(D_i = 1)} = \frac{\mathbb{P}(D_i = 1|S_i^1 = 1) \times \mathbb{P}(S_i^1)}{\mathbb{P}(D_i = 1)}$$

The estimate of $\mathbb{P}(S_i^1)$ is 0.0513; the unconditional probability $\mathbb{P}(D_i = 1)$ in the model data is 0.6855 (19,790/28,869). From the model we predict the probability of deal closing given a leak intended to manipulate the consideration $\mathbb{P}(D_i = 1|S_i^1 = 1) = 0.4395$. With these numbers, we calculate that 3.29% (0.4395 $\times$ 0.0513 / 0.6855) of our sample trans-

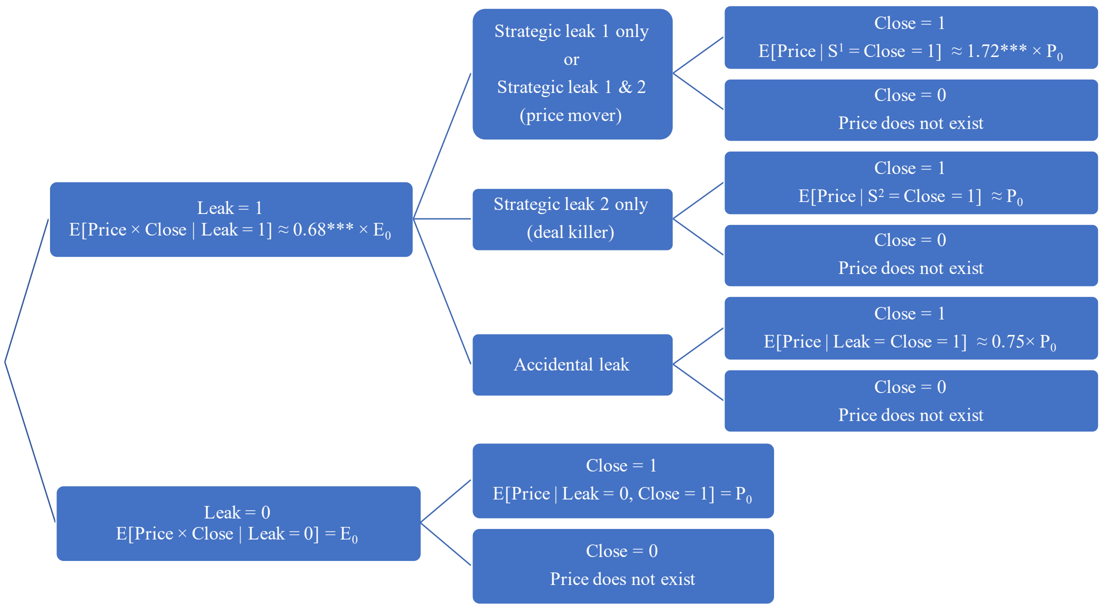
Table A.2: Relative price of rumors.

Note: The table reports the ex-ante calculation of the expected deal price. For a visual representation refer to Figure A.1.

	Damage
Mean	-0.3218^{***}
Standard error	(0.0023)

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Figure A.1: Combined effect of rumors on prices.



actions are concerned by such a boost of the deal consideration. This is consistent with the large skewness of transaction multiples that we observe in the univariate statistics.

Finally, we determine the overall expected effect of M&A transaction rumors conditional on a transaction being closed similar to the calculation presented in the paper. Accordingly, the overall *expected* loss is 32.18% of the aggregate transaction value in our sample (see Table A.2). The asymptotic standard error of this estimate is 0.0023 revealing its significance at the 1% level. Figure A.1 illustrates. Note that the effect is virtually identical to the result presented in the paper.