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Research article

Cross-company jump spillover and the role of news

Francesco Poli *, Massimiliano Caporin

Department of Statistical Sciences, University of Padova, Via C. Battisti 241, Padova, Italy

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A B S T R A C T

We study how jumps spillover and the cross-company impact of firm-specific unscheduled news on jumps between economic sectors. To this end, we employ high-frequency data of 220 constituents of the Russell 3000 index equally divided into eleven sectors. Using conditional jump probabilities, we find that jump spillover is a pervasive phenomenon enhanced when jumps cluster and that firm-specific news, especially from the financial sector, boosts the jump spillover effect. Volatility following spillover jumps is significantly higher than usual, except when firm-specific news is released around the jump provoking the spillover.

1. Introduction

Jump processes are employed to capture the large moves in asset price dynamics that are missed by continuous-time Brownian models. These events are of extreme importance for asset allocation, risk management, option pricing, and trading strategies, especially when many assets jump simultaneously or sequentially. In addition, recent technological advancements have resulted in an increased interconnectedness of the economic system as well as in a greater access to electronic trading systems, databases, and information. As a consequence, financial markets today display high correlation, which naturally reduces the benefits of diversification, especially during crises. Extreme and infrequent events that occur simultaneously among a large number of assets imply a higher correlation between them [36], which dampens the diversification potential for asset allocation [57,23,5].

Some authors have explored jump spillovers in international equity markets [11,12,46]. A strand of the literature deals with the creation of statistical tests that capture the occurrence of simultaneous or almost simultaneous jumps among assets [6,29,34]. Recently, Ding et al. [38] developed a model to detect community structures based on stock co-jump dependence. Simultaneous and intertemporal co-jumps are also related to the theme of contagion; see Forbes and Rigobon [41], Bae et al. [14], Allen et al. [8], Billio et al. [21], Bisias et al. [22], Hasman [44], Diebold and Yilmaz [37], Hautsch et al. [45], Acharia et al. [2], Acharya et al. [3], Acemoglu et al. [1], Adrian and Brunnermeier [4], Brownlees and Engle [27], and the references therein.

The availability of the news and its influence on the behavior of market players has increased exponentially in recent decades. Given the reactions to news announcements, the literature started to investigate the relationship between news and stock price jumps. Notable studies include Maheu and McCurdy [58], Bollerslev et al. [23], Lee and Mykland [56], Evans [40], Lahaye et al. [53],

* Corresponding author.
E-mail addresses: francesco.poli@unipd.it (F. Poli), massimiliano.caporin@unipd.it (M. Caporin).

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Rangel [59], Lee [55], Boudt and Petitjean [25], Bajgrowicz et al. [15], Caporin et al. [29], Jiang et al. [49], and Caporin and Poli [30]. See also Jiang et al. [48] and Lahaye et al. [53] in the context of bonds and exchange rates, respectively.

A number of studies deal with news spillover effects on events other than price jumps, such as big movements in debt, stock, and foreign exchange markets, national sovereign credit default swap spreads, spread volatility, and option prices [9,43,26,32,47,20,51,13,50,54].

To our knowledge, the themes of jump spillover between economic sectors and the cross-company news impact on jump probability have not been jointly investigated so far. This study focuses on how stock jumps propagate, distinguishing intra-sector and inter-sector dynamics, and the role of news. We aim to answer the following questions: *1) To what degree do stock jumps spillover? Which sectors spillover more, and which ones are more affected? 2) Does a sequence of two jumps have a cumulative impact on the jump spillover effect?* Jumps are time-clustered events, and we want to investigate this property from a spillover standpoint. We then address two further questions: *3) Does unscheduled company-specific news impact the jump probability of other stocks? 4) Is the jump spillover effect influenced by the release of company-specific news?* Finally: *5) What is the economic importance of the previous findings?*

We identify jumps at a 5-min frequency using the test of Andersen et al. [9] on 220 constituents of the Russell 3000 index equally divided into eleven sectors. For each empirical question, we compare the pairwise jump probabilities conditional on the event related to the question with the corresponding probabilities under the hypothesis of independence.

Regarding the first question, we observe that jump spillover is a pervasive phenomenon both across stocks belonging to the same sector and across those belonging to different sectors. Additionally, the average jump size—proxied by the absolute standardized return—of the simultaneous and conditional jumps is 10% higher than that of unconditional jumps. We do not find that specific sectors are particularly more prone to causing or being subject to spillover jumps.

Concerning the second question about the role of jump sequences, we find that they are highly likely to have a cumulative impact on the jump spillover effect, especially during turbulent market phases. Additionally, we observe no dominance relationships between sectors.

When analyzing the role of company-specific news—the third question—we do not find supportive evidence that company-specific news significantly provokes jumps for stocks different from those to which the news is related. However, we find a limited indication that news about companies belonging to the financial sector increases the jump probability of both other stocks in the same sector and those in the other sectors.

With respect to the fourth question, the relation between company-specific news and jump spillover, we highlight a striking result: the spillover effect is stronger when jumps are associated with company-specific news, especially news-related jumps of companies in the financial sector. A separate analysis involving only news in the form of quarterly EPS announcements confirms this phenomenon.

To answer the last question, we analyze the economic importance of spillover jumps by examining the distribution of the absolute returns, as a proxy for volatility, around jumps and spillover jumps. We find that the median volatility around jumps is significantly higher than that not around jumps from the interval before the jump to at least one hour after. The 95th percentile and the mean volatility in the hour following the jumps are much higher than usual for jumps associated with unscheduled company-specific news and for those preceded by another jump of the same stock—we can assume also in this case an important company-specific event, in many cases possibly a liquidity imbalance—and lower than usual, especially in the following 15 minutes, for those associated with scheduled macroeconomic news. Our results are consistent with the Ederington and Lee [39] model, which predicts a decrease (increase) in volatility as a consequence of scheduled (unscheduled) news announcements as a result of uncertainty resolution (creation).

With regard to spillover jumps, we observe different phenomena on the basis of their causes. The median volatility around spillover jumps due to jumps of other stocks and those due to two-jump sequences of other stocks is significantly higher than that not around jumps from 40 minutes before the spillover event to at least one hour after. Its 95th percentile is very high, not only after the spillover but also before the jumps and the two-jump sequences giving rise to the spillover, suggesting that spillovers, too, take place especially in times of high volatility. Volatility around spillover jumps due to jumps of other stocks in turn associated with company-specific news is instead much lower with respect to the baseline case. We interpret this phenomenon as a result of the fact that when news is focused on company A, its information content is mainly relevant to A, and the eventual jump spillover to company B will consist of a carry-over effect with lower amplitude. On the contrary, jumps not due to company-specific news that spillover are much more likely to correspond to sector- or market-wide phenomena and will result in a greater impact across the rest of the market. This leads us to believe that, as a consequence of unscheduled company-specific news announcements, the volatility rise predicted by the Ederington and Lee [39] model will be observed on the same assets to which the news is related but will not spread market-wide.

Our results seem to suggest that, as expected, company-specific news—typically not causing jumps in other stocks and, when it does, not increasing their volatility—gives rise to idiosyncratic risk, except for financial company news, which also increases systematic risk. A potential avenue for future research is naturally that of testing systematic and idiosyncratic risk related to spillover jumps and their causes.

The paper proceeds as follows: Section 2 describes the dataset and provides an overview at the univariate level of the jump autocorrelation properties and of the relation between jumps and news, Section 3 investigates the jump spillover phenomenon, Section 4 deals with the cross-company news' impact on jump probability, Section 5 explores the economic importance of jumps and spillover jumps, Section 6 presents some robustness analyses, and Section 7 concludes the paper.

2. Dataset and preliminary analysis

2.1. Stock selection, price data, and jump detection

The sample period ranges from June 1, 2007 to May 29, 2020.

We chose the Russell 3000 index as the research sample since it represents the widest available stock cross-section at our disposal. The sample period ranges from June 1, 2007 to May 29, 2020, the period for which we had data on prices, company-specific news, and macro-news. The limitations we have in accessing the news provider prevent us from extending the analyses to more recent years.

We retrieve the prices from the data provider Kibot. For each of the 11 economic sectors indicated in Kibot (we discard the miscellaneous sector from the 12 original ones), we select the 20 most capitalized stocks for which, in the sample period, both the prices and the news are continuously available. The selected companies are listed in Table A1 in Appendix A, and the sectors are: Basic Industries (BI), Capital Goods (CG), Consumer Durables (CD), Consumer Non Durables (CND), Consumer Services (CS), Energy (EN), Finance (FIN), Health Care (HC), Public Utilities (PU), Technology (TEC), and Transportation (TR).

For all companies, we have access to the open, high, low, and close prices, as well as to the number of traded shares, for each minute. This level of granularity allows us to disentangle the price jumps at the intraday level.

We employ five-minute returns, which is the most commonly adopted frequency for jump testing. Starting from the intraday close prices of a given asset on day t, denoted as $P_{t,\tau}$, where $\tau = 1, 2, \ldots, n = 78$ (n. of intraday intervals in a trading day), we compute the percentage log-returns $r_{t,\tau} = 100(\log P_{t,\tau} - \log P_{t,\tau-1})$ for $\tau = 2, \ldots, n$. For $\tau = 1$, instead, we use the open and close prices of the first intraday interval and we obtain $r_{t,1} = 100(\log P_{t,1} - \log P^O_{t,1})$, where $P^O_{t,1}$ is the open price of day t.

As shown by Boudt et al. [24], the accurate identification of jumps requires proper treatment of the intraday volatility pattern. We thus adopt their weighted standard deviation (WSD) approach for estimating the intraday pattern and filter it out from the returns before testing for jump occurrence. We then proceed with identifying jumps when at least 75% of the intraday returns are not null. On the returns standardized by the estimated periodicity, we identify jumps with the test statistic proposed by Andersen et al. [9], according to which a given intraday return $r_{t,\tau}$ is classified as a jump if

$$|\widetilde{r}_{t,\tau}| > \Phi\left(1 - \frac{\beta}{2}\right)^{-1} \sqrt{\frac{1}{n}\widetilde{BPV}_t} \tag{1}$$

where $\widetilde{r}_{t,\tau}$ is the standardized return, $\beta = 1 - (1-\delta)^{1/n}$, $\delta = 10^{-5}$ as in Andersen et al. [9], and $\widetilde{BPV}$ is the bipower variation [18,19] computed in our case with the standardized returns, which is defined as

$$\widetilde{BPV}_t = \mu_1^{-2} \frac{n}{n-1} \sum_{\tau=2}^{n} |\widetilde{r}_{t,\tau-1}||\widetilde{r}_{t,\tau}| \tag{2}$$

where $\mu_1 = \sqrt{\frac{\pi}{2}}$.

We define jump sizes as the standardized returns identified as jumps according to Eq. (1).

Similarly, we define jump signs as the signs of the corresponding returns.

We are aware that other jump tests could lead to a different output in terms of jump identification. For instance, the daily bipower variation estimator employed by the test we adopt is calculated from high-frequency data over the whole day, while the alternative test of Lee and Mykland [56] employs a backward-looking estimator of bipower variation. We verified that, by identifying jumps with the Lee and Mykland [56] test, the results (not reported and available upon request) are qualitatively similar. Additionally, applying the threshold BPV of Corsi et al. [35] to mitigate bias in the standard BPV metric used in the Andersen et al. [9] test yields virtually identical results. The Andersen et al. [9] test being largely employed in the literature and the chosen confidence level being very strict, we keep this methodology. Our strict confidence level is also coherent with the threshold approach of Bajgrowicz et al. [15].[1] We anticipate that a robustness analysis using the unfiltered abnormally high absolute returns as alternative jump definition will confirm the main results of the paper.

In addition, we do not adopt staleness correction—see Kolokolov and Renò [52]—as the 220 stocks in our dataset are largely capitalized and traded. See Caporin [28] regarding the irrelevance of staleness correction for jump testing in the 450 most liquid stocks of a sample of equities traded on the U.S. stock exchanges.

2.2. Company-specific unscheduled news and macroeconomic scheduled news

For each company, we retrieve the company-specific unscheduled news stories released from the news provider Thomson Reuters-Thomson One. They are associated with their release date and time with one-minute precision.

[1] Bajgrowicz et al. [15] suggest to control for spurious jumps by adopting a universal threshold on the jump test statistic and to identify as jumps only those with test statistics being larger, in absolute value, of $\sqrt{2 \log N}$ with N being the number of days in the sample. They refer to jump testing at daily level while we perform intra-daily jump testing. Let us assume to compute the threshold by using as N the product of days and intra-daily intervals in our sample, that is, $N = 3272 \times 78$. The universal threshold becomes equal to 4.990. However, our choice of the confidence level for the Andersen et al. [9] test leads to a higher critical value of 5.792. Therefore, our jump identification is also coherent with the possible presence of spurious jumps, being stricter than the proposal of Bajgrowicz et al. [15].

We retrieve from Bloomberg 27 U.S. scheduled macroeconomic announcements that are released during market opening times. They are listed in Table B1 in Appendix B. They too are associated with their release date and time with one-minute precision, and both the announced and the expected values (median of Bloomberg survey forecasts) are available, allowing us to calculate the surprise.[2] Since units of measurement differ across economic variables, we divide surprises by their standard deviation across all observations to facilitate interpretation.

Following Balduzzi et al. [16], we construct the standardized surprise element S_t^i for the economic variable i at time t.[3] It is defined as

$$S_t^i = \frac{A_t^i - E_t^i}{\sigma_i} \tag{3}$$

where A_t^i is the announced value at time t, E_t^i is the expected value at time t, and σ_i is the standard deviation of the unexpected component $(A_t^i - E_t^i)$ of the announcements over the series of observations.

We also recover for each company the earnings per share (EPS) announcements from Bloomberg. They too are associated with their release date and time with one-minute precision. As with the macro-news, both the announced and the expected values are available, allowing us to calculate the EPS surprise. We construct the standardized surprise element S_t^i of a scheduled release for company i at time t, as for the macro-announcements. EPS announcements are available only from July 2009, and they are mainly released outside market opening hours. We will use them only in a robustness section.

2.2.1. Data pre-processing

News stories, tagged with companies for which the information is expected to have an impact and filtered for relevancy and redundancy by the provider, are provided in *.xlsx* files. We use *Python* to read the individual cells and produce *.mat* files, which are suitable for *Matlab*. Macroeconomic news items consist of a single *.csv* file that we process directly with Matlab. All analyses are then performed with *Matlab*.

2.3. Jumps and news summary statistics

Table 1, Panel A reports the jumps and news summary statistics for each sector and all the stocks in the sample. The cross-sectional mean of the probability of a jump day (interval) is 2.3% (0.03%), the jump size is on average positive, there are more positive than negative jumps, and the jump absolute size is equal to 6.3. We do not observe significant differences between sectors. The probability of a news day (interval) ranges from 0.8% (0.01%) for consumer durables to 4.7% (0.07%) for capital goods and is equal to 2.4% (0.03%) considering all stocks. Table 1, Panel B presents the same metrics for the release of macroeconomic news. For most days (73.7%), at least one macroeconomic news item is released.

Fig. 1 shows, for each intraday interval, the cross-sectional mean of the percentage frequency of jump occurrence, company-specific news release, and macroeconomic news release. The dots indicate the corresponding medians. The intraday jump frequency distribution presents two big peaks: one at 9:30, which is at market opening, and another at 14:00.[4]

Regarding the intraday company-specific news distribution, we observe peaks at the beginning of each hour, decreasing across the day (the highest peak is at 10:00, the second at 11:00, and so on until the lowest one at 15:00), and, to a lesser extent, at the beginning of each half-hour.

Macroeconomic news is instead released predominantly at 10:00 (at least one macroeconomic news item is released at that time for roughly half of the days), and, in lesser quantity, at 9:45, 14:00, and 15:00.

We observe a match between the frequency peaks of jumps, company-specific news, and macroeconomic news at 14:00 and, in smaller measure, at 10:00.

We close this preliminary evaluation by examining how the jump probability for single stocks changes given the following events: a jump of the same stock, the release of company-specific news about the same company, and the release of macroeconomic news. For this purpose, we compare the unconditional probability to the aforementioned conditional probabilities for events occurring in the previous and following 5-min interval, half-hour and hour.[5]

Table 2 reports the results and allows a number of elements to be pointed out.

Jump self-excitation: The jump probability conditional on a jump of the same stock in the previous interval, half-hour, and hour is much higher than the unconditional probability (0.034%), highlighting a strong jump autocorrelation effect, especially at the 5-min interval horizon (5.5%).

Effect of company-specific news: The probability of a jump conditional on the release of news about the same stock in the same interval is 0.92%, which indicates an important same-stock contemporaneous news effect. There is also a news effect in the following

[2] On Friday, Bloomberg surveys key market participants for their forecasts regarding the values of economic variables that will be released within the next week. The median of the survey is taken to be the forecast for the respective variable.

[3] Differently from the previous section, t now refers to the observation number, e.g. if there are 100 observations, $t = 1, 2, \ldots, 100$.

[4] The time series analysis of jump occurrence and the evaluation of the intraday jump size distribution do not offer particularly relevant insights. They are anyway reported on Figures C1 and C2 in Appendix C.

[5] For jumps we focus only on the previous events.

Table 1
Jumps and news summary statistics.

(A) Jumps and company-specific news

Sector	P(J day)	P(J)	P(Neg J)	J size	J |size|	Pos J size	Neg J size	% neg J	P(News day)	P(News)
BI	2.1%	0.030%	0.013%	0.96	6.21	6.27	-6.15	42.8%	1.4%	0.019%
CG	2.4%	0.034%	0.016%	0.59	6.29	6.29	-6.29	45.3%	4.7%	0.067%
CD	2.6%	0.036%	0.016%	0.72	6.03	6.09	-5.98	44.5%	0.8%	0.010%
CND	2.4%	0.034%	0.015%	0.92	6.32	6.39	-6.26	43.3%	1.4%	0.019%
CS	2.4%	0.031%	0.015%	0.35	6.35	6.36	-6.33	47.4%	1.9%	0.027%
EN	1.8%	0.024%	0.011%	0.85	6.19	6.27	-6.08	43.9%	2.7%	0.037%
FIN	2.2%	0.030%	0.014%	0.49	6.29	6.35	-6.22	46.7%	3.5%	0.047%
HC	2.4%	0.035%	0.016%	0.39	6.50	6.52	-6.50	47.2%	3.1%	0.042%
PU	2.3%	0.034%	0.015%	0.84	6.47	6.45	-6.48	43.4%	2.8%	0.037%
TEC	2.1%	0.030%	0.014%	0.40	6.36	6.39	-6.30	47.2%	2.9%	0.041%
TR	2.6%	0.036%	0.016%	0.64	6.21	6.25	-6.16	45.1%	1.5%	0.020%
All	2.3%	0.032%	0.015%	0.65	6.29	6.33	-6.25	45.2%	2.4%	0.033%

(B) Macroeconomic news

P(News day)	P(News)
73.7%	1.2%
N. days	N. obs.
3272	255216

Summary statistics for the jumps and the company specific news for the 220 stocks of the sample and for the macroeconomic news. Panel (A): for each sector and for all stocks (*All*), the table reports the cross-sectional mean of the single stocks' probability of a jump day P(J day), probability of a jump occurring on an intraday interval P(J), probability of a negative jump occurring P(Neg J), average jump size, average jump absolute size, average positive jump size, average negative jump size, proportion of negative jumps with respect to all jumps, probability of a news day P(News day) and the probability of a news item being released in a 5-min interval P(News). The jumps are detected using the methodology of Andersen et al. [9], based on a significance level of $\alpha = 0.001\%$ on the returns standardized with the procedure of Boudt et al. [24]. The jump size is equal to the standardized 5-min return on the interval identified as a jump. Panel (B): for the macroeconomic news, the table reports the probability of a news day P(News day) and the probability of a news item being released in a 5-min interval P(News). The sample period is June 1, 2007 to May 29, 2020.

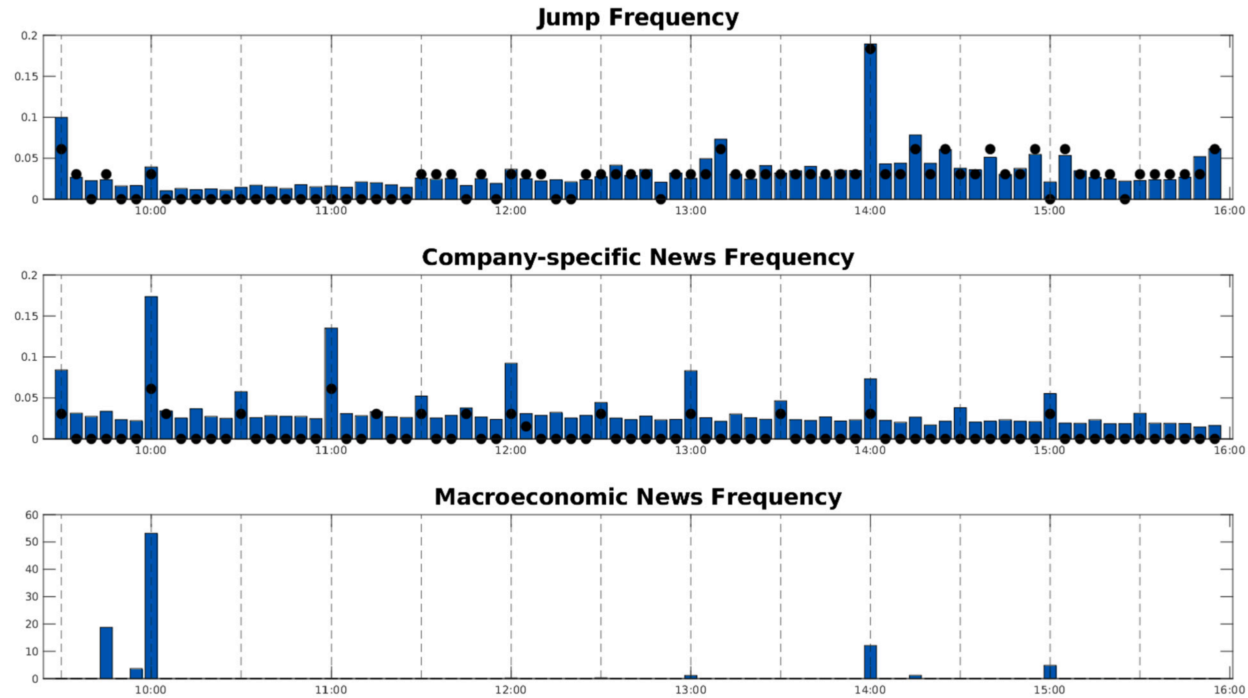

Fig. 1. Intraday jump, company-specific news, and macroeconomic news frequency.

For each intraday interval, cross-sectional mean of the assets' jump frequency, company-specific news release frequency, and macroeconomic news release frequency (all in percentage). The dots indicate the corresponding medians. The time reported on the x-axis indicates the beginning of each interval, e.g. 10:00 indicates the interval from 10:00 to 10:05.

Table 2
Probability of jumps conditional on jumps and news.

$P(J_t\|J_{t-12:t-1})$	$P(J_t\|J_{t-6:t-1})$	$P(J_t\|J_{t-1})$				
0.94%	1.66%	5.51%				
$P(J_t\|N^{cs}_{t-12:t-1})$	$P(J_t\|N^{cs}_{t-6:t-1})$	$P(J_t\|N^{cs}_{t-1})$	$P(J_t\|N^{cs}_{t})$	$P(J_t\|N^{cs}_{t+1})$	$P(J_t\|N^{cs}_{t+1:t+6})$	$P(J_t\|N^{cs}_{t+1:t+12})$
0.15%	0.24%	0.48%	0.92%	0.11%	0.17%	0.14%
$P(J_t\|N^{macro}_{t-12:t-1})$	$P(J_t\|N^{macro}_{t-6:t-1})$	$P(J_t\|N^{macro}_{t-1})$	$P(J_t\|N^{macro}_{t})$	$P(J_t\|N^{macro}_{t+1})$	$P(J_t\|N^{macro}_{t+1:t+6})$	$P(J_t\|N^{macro}_{t+1:t+12})$
0.03%	0.08%	0.24%	1.20%	0.06%	0.03%	0.03%
$P(J_t)$						
0.034%						
N. obs.						
176688						

First row: cross-sectional mean of probability of jumps conditional on the occurrence of a jump in the previous hour, in the previous half-hour, and in the previous 5-min interval. Second row: cross-sectional mean of probability of jumps conditional on the release of company-specific news for the same company in the previous hour, in the previous half-hour, in the previous 5-min interval, in the same 5-min interval, in the following 5-min interval, in the following half-hour, and in the following hour. Third row: cross-sectional mean of probability of jumps conditional on the release of macroeconomic news in the previous hour, in the previous half-hour, in the previous 5-min interval, in the same 5-min interval, in the following 5-min interval, in the following half-hour, and in the following hour. Probabilities of jumps conditional on an event are computed as n. of jumps coinciding with the event divided by n. of events. Last row: cross-sectional mean of unconditional probability of jumps, computed as n. of jumps divided by n. of intraday intervals. The n. of observations equals the n. of days times the n. of intraday intervals in one day minus the first 12 and the last 12, i.e. 3272 x (78-24) = 176688.

half-hour and hour, and even an effect in the previous half-hour and hour. Tt is possible that some market players exploit private information before it is publicly released or that some news in our dataset was announced with a delay compared to other providers.[6]

Effect of macroeconomic news: The jump probability conditional on the release of macroeconomic news in the same interval is 1.20%, which shows a strong effect of contemporaneous macroeconomic news. The table also indicates an effect in the following minutes.

Overall, the evidence based on our data and sample period is consistent with previous studies.[7]

3. Spillover jumps

In this section, we investigate the jump spillover phenomenon between stocks, aiming to answer the questions: *To what degree do jumps spillover?* and *Does a sequence of two jumps have a cumulative impact on the jump spillover effect?*

Using the methodology from Asgharian and Bengtsson [11], we compare the pairwise simultaneous jump frequencies and jump probabilities conditional on the event related to the question (a jump or a sequence of two jumps of other stocks) with the corresponding probabilities under the hypothesis of independence.

Given the strong dependence of jumps from macroeconomic news shown above—macro-level news is obviously like to shatter the whole market at nearly the same time— we filter this effect in the rest of the paper, using conditioning events not surrounded by macro-news releases.

3.1. To what degree do jumps spillover?

We define the (implied) jump frequency of company i as the number of inferred jump times divided by the number of observations:

$$J_{freq,i} = \frac{\sum_{t=1}^{T} \sum_{\tau=1}^{n} J_{i,t,\tau}}{T \times n} \tag{4}$$

where T is the n. of days, n is the n. of intraday intervals in each day, and $J_{i,t,\tau} = 1$ if there is a jump for company i on day t and intraday interval τ, and 0 otherwise. We then define the simultaneous jump frequency between companies i and j as follows:

$$J_{sim,i,j} = \frac{\sum_{t=1}^{T} \sum_{\tau=1}^{n} J_{i,t,\tau} J_{j,t,\tau}}{T \times n} \tag{5}$$

[6] In Appendix E, we compare the unconditional jump day probability with the jump day probability conditional on an EPS day of the same stock. Table E1 shows that, in terms of cross-sectional means, the release of EPS announcements doubles the jump day probability, from 2.24% to 4.45%. As expected, EPS announcements have a strong impact on the jump probability at univariate level.

[7] See, among others, Fulop et al. [42], Ait-Sahalia et al. [6], and Carr and Wu [31] with regard to the jump self-excitation property and Bollerslev et al. [23], Lee and Mykland [56], Lee [55], Boudt and Petitjean [25], Bajgrowicz et al. [15], Caporin et al. [29], and Caporin and Poli [30] with regard to the effect of company-specific and macroeconomic news on jumps. Bajgrowicz et al. [15] claim that the other studies incorrectly classify bursts of volatility as jumps, but find that those bursts of volatility are generated especially by press releases following FOMC meetings and announcements related to share repurchase programs.

Table 3
Average pairwise simultaneous jump frequency and conditional jump spillover probability, all stocks.

(A) Simultaneous jumps

Sim. J freq.	Sim. J freq. H_0	% stat. sign.	Sim. J abs. size	J abs. size H_0
0.002%	0.00001%	97.6%	6.9	6.3

(B) Jumps cond. on jumps of other stocks in same interval

Cond. J prob.	Cond. J prob. H_0	% stat. sign.	Cond. J abs. size	J abs. size H_0
9.1%	0.031%	97.6%	6.9	6.3

(C) Jumps cond. on jumps of other stocks in previous interval

Cond. J prob.	Cond. J prob. H_0	% stat. sign.	Cond. J abs. size	J abs. size H_0
1.6%	0.032%	74.1%	7.0	6.4

Panel (A): average pairwise simultaneous jump frequency among all the combinations of stocks i and j such that $i \neq j$, corresponding jump frequency under the null hypothesis of independence, percentage of combinations of stocks whose simultaneous jump frequency is significant at the 5% level (according to footnote 8 on pag. 7), pairwise average across all combinations of stocks i and j such that $i \neq j$ of mean absolute size of jumps of stock i that are simultaneous with jumps of stock j, and corresponding absolute size under the null hypothesis of independence. Panel (B): average pairwise jump spillover probability of stock i conditional on a jump of stock j in the same 5-min interval among all the combinations i and j such that $i \neq j$, corresponding jump probability under the null hypothesis of independence, percentage of combinations of stocks whose conditional jump spillover probability is significant at the 5% level (according to footnote 9 on pag. 7), pairwise average across all combinations i and j such that $i \neq j$ of mean absolute size of jumps of stock i conditional on a jump of stock j in the same interval, and corresponding absolute size under the null hypothesis of independence. Panel (C): average pairwise jump spillover probability of stock i conditional on a jump of stock j in the previous 5-min interval among all the combinations i and j such that $i \neq j$, corresponding jump probability under the null hypothesis of independence, percentage of combinations of stocks whose conditional jump spillover probability is significant at the 5% level (according to footnote 9 on pag. 7), pairwise average across all combinations i and j such that $i \neq j$ of mean absolute size of jumps of stock i conditional on a jump of stock j in the previous interval, and corresponding absolute size under the null hypothesis of independence. For all Panels, the effect of macroeconomic news is filtered by using only jumps occurring in intervals that are neither preceded nor followed by macro-news releases.

and the jump spillover probability of company i conditional on the jumps of company j in the same interval as follows:

$$J_{prob,i|j} = \frac{\sum_{t=1}^{T}\sum_{\tau=1}^{n} J_{i,t,\tau} J_{j,t,\tau}}{\sum_{t=1}^{T}\sum_{\tau=1}^{n} J_{j,t,\tau}} \tag{6}$$

Table 3, Panel A reports the average pairwise simultaneous jump frequency among all the combinations of stocks i and j such that $i \neq j$, the corresponding jump frequency under the null hypothesis of independence, the percentage of combinations whose simultaneous jump frequency is significant at the 5% level,[8] the average pairwise absolute size of the simultaneous jumps, and the corresponding absolute size under the null hypothesis of independence. Panels B and C report the same metrics as Panel A with regard to the jump spillover probability conditional on a jump in the same and in the previous interval, respectively.[9]

We see that, for almost all combinations of stocks, the jumps are not independent, and that the absolute size of both the simultaneous and the conditional jumps is roughly 10% higher than the unconditional absolute size.

We replicate the analysis included in Table 3 for each pair of sectors, finding a confirmation of our previous results. Moreover, we observe that jumps are not independent either across the same sector or across different sectors. We do not find specific economic sectors that are particularly more prone to causing or being subject to spillover jumps.[10]

We additionally explore the extent to which jumps spillover in any of the 5-minute intervals within the following half-hour and one-hour periods. Extending the time window, we observe an increase in the spillover probability, consistent with spillovers with longer lags, but no remarkable intra- or inter-sector patterns (results are unreported).

[8] We test whether the estimated frequencies are greater than what they would be under the null hypothesis that the different stocks' jump processes are completely independent, as in Asgharian and Bengtsson [11]. Under the null hypothesis, the simultaneous jump frequency of two stocks is estimated as the product of the stocks' jump frequencies and the variable $Z = \frac{(p_{i,j} - p_0)}{\sqrt{(p_0(1-p_0))/N}}$, where $p_{i,j}$ is the simultaneous jump frequency between the two stocks, p_0 is the simultaneous jump frequency under the null hypothesis of independence, and N is the number of observations, is distributed as a standard normal. We perform a one-sided test at the 5% level.

[9] If the jump processes of i and j are independent, $J_{prob,i|j} = J_{freq,i|j} = J_{freq,i}$.

[10] See Tables D1, D2 and D3 in Appendix D.

Table 4
Average pairwise jump spillover probability conditional on a sequence of two jumps, all stocks.

Mean cond. J prob.	Mean cond. J prob. H_0	% stat. sign.	Cond. J abs. size	J abs. size H_0	Median cond. J prob.	Prob. conditioning event
1.3%	0.032%	6.3%	7.4	6.4	0.000%	0.0016%

Average pairwise jump spillover probability of stock i conditional on a sequence of two jumps of stock j in the two previous 5-min intervals among all the combinations i and j such that $i \neq j$, average jump probability under the null hypothesis of independence, percentage of combinations of stocks whose conditional jump spillover probability is significant at the 5% level (according to footnote 9 on pag. 7), pairwise average across all combinations i and j such that $i \neq j$ of mean absolute size of jumps of stock i conditional on a jump of stock j in the previous interval, corresponding absolute size under the null hypothesis of independence, median pairwise conditional jump spillover probability, and average probability of conditioning event, i.e. a sequence of two jumps such that, from the interval before the first jump to the interval after the second jump, no macro-news is released.

3.2. Does a sequence of two jumps have a cumulative impact on the jump spillover effect?

Considering that jumps are time-clustered events, we are interested in investigating whether a sequence of two jumps has a cumulative impact from a spillover standpoint.[11]

We compare the pairwise jump probability conditional on a sequence of two jumps of other stocks in the previous two intervals with the corresponding probabilities under the hypothesis of independence.

Table 4 reports the same metrics as Table 3 with regard to the pairwise jump spillover probability conditional on a sequence of two jumps between stocks. In addition, it reports the median pairwise conditional jump spillover probability and the average probability of the conditioning event, i.e. a sequence of two jumps not surrounded by macroeconomic news.

For most of the stock combinations, the jumps are independent of previous two-jump sequences of other stocks (the median is equal to zero). However, the average conditional jump spillover probability is much higher than the unconditional one (1.3% vs. 0.032%), indicating that there is a lot of heterogeneity and that, even if the percentage of significant cases is only 6.3%, in those cases, the spillover effect is strong. The absolute size of the conditional jumps is roughly 10% higher than that of all jumps, as for the case of jumps conditional on previous *single* jumps of other stocks.

When focusing on results aggregated for each pair of sectors, we find a confirmation of the heterogeneity. Moreover, we find that the spillover amplification due to a sequence of two jumps seems to be mostly due to double jumps of the consumer non-durables sector.[12] We will show in Section 6.3 that the cumulative impact of a sequence of two jumps is prevalent during turbulent market phases.

This result is in line with the Hawkes jump-diffusion model of Ait-Sahalia et al. [6], where jumps tend to appear in clusters, both in time and across (world) markets. According to our evidence, time (self-excitation) and space (cross-excitation) propagation take place at stock level, too.

4. Cross-company news' impact on jump probability

We now investigate whether the release of company-specific news has a cross-company effect on the jump probability, either directly by giving rise to other stocks' jumps or indirectly by first provoking jumps of the same stock and then transmitting to other stocks' jumps. We keep the methodology employed above, including the filtration of the macro-news effect.

4.1. Does company-specific news provoke spillover jumps?

We study the extent to which the release of unscheduled company-specific news gives rise to jumps of companies different than those to which the news is related.

Table 5, Panels A and B report the same metrics of Table 3 with regard to the pairwise jump spillover probability conditional on news in the same and the previous interval, respectively.[13] We see that company-specific news does not usually cause jumps for other companies or makes the jump sizes of the other companies higher or lower than usual.

Aggregating the results for each pair of sectors, we anyway notice that news about companies belonging to the financial sector slightly increases the jump probability of both other stocks belonging to the same sector and of those belonging to the other sectors.[14]

4.2. Does company-specific news influence the jump spillover effect?

We investigate the hypothesis that company-specific news boosts or lessens the jump spillover phenomenon, i.e. that the spillover probability of jumps of company B conditional on jumps of company A is influenced by the release of news about A.

[11] Gande and Parsley [43] employ this concept in the context of the effect of a sovereign credit rating change of one country on the sovereign credit spreads of other countries.

[12] See Table D4 in Appendix D for the detailed results.

[13] We verified that the release of news in the next interval ($t+1$) is not relevant for all the analysis of the section, we therefore do not find evidence of cross-company news anticipation by market players. In addition, we employ as conditioning events company-specific news not surrounded by macro-news to avoid spurious results, but we verified that the results are virtually unchanged.

[14] See Tables D5 and D6 in Appendix D.

Table 5
Jump spillover probability conditional on news of other stocks, all stocks.

(A) Jumps cond. on news of other stocks in same interval

Cond. J prob.	Cond. J prob. H_0	% stat. sign.	Cond. J abs. size	J abs. size H_0
0.030%	0.031%	2.0%	6.2	6.3

(B) Jumps cond. on news of other stocks in previous interval

Cond. J prob.	Cond. J prob. H_0	% stat. sign.	Cond. J abs. size	J abs. size H_0
0.038%	0.032%	2.3%	6.4	6.4

Panel (A): average pairwise jump probability of stock i conditional on news of stock j in the same 5-min interval among all the combinations i and j such that $i \neq j$, corresponding jump probability under the null hypothesis of independence, percentage of combinations of stocks whose conditional jump probability is significant at the 5% level (according to footnote 9 on pag. 7), pairwise average across all combinations i and j such that $i \neq j$ of mean absolute size of jumps of stock i conditional on news of stock j in the previous interval, and corresponding absolute size under the null hypothesis of independence. Panel (B): average pairwise jump probability of stock i conditional on news of stock j in the previous 5-min interval among all the combinations i and j such that $i \neq j$, corresponding jump probability under the null hypothesis of independence, percentage of combinations of stocks whose conditional jump probability is significant at the 5% level (according to footnote 9 on pag. 7), pairwise average across all combinations i and j such that $i \neq j$ of mean absolute size of jumps of stock i conditional on news of stock j in the same interval, and corresponding absolute size under the null hypothesis of independence. For all Panels, the effect of macroeconomic news is filtered by using as conditioning events only news items occurring in intervals that are neither preceded nor followed by macro-news releases.

Table 6
Average jump spillover probability conditional on company-specific news-related jumps of other stocks, all stocks.

Mean cond. J prob.	Mean cond. J prob. H_0	% stat. sign.	Cond. J abs. size	J abs. size H_0	Median cond. J prob.	Prob. conditioning event
1.0%	0.032%	1.0%	7.0	6.4	0.000%	0.00028%

Average pairwise jump spillover probability of stock i conditional on the event consisting of a jump of stock j in *t-1* and the release of at least one company-specific news item of stock j from *t-2* to *t-1* among all the combinations of stocks i and j such that $i \neq j$, average jump probability under the null hypothesis of independence, percentage of combinations of stocks whose conditional jump spillover probability is significant at the 5% level (according to footnote 9 on pag. 7), pairwise average across all combinations i and j such that $i \neq j$ of mean absolute size of jumps of stock i conditional on a jump of stock j in the previous interval, corresponding absolute size under the null hypothesis of independence, median pairwise conditional jump spillover probability, and average probability of conditioning event, i.e. a jump, the release of at least one company-specific news item about the same company from the previous to the same interval, and such that no macroeconomic news is released from the previous to the next interval.

We define a *company-specific news-related jump* as the event consisting of a stock jump and the release of at least one news item about the same company from the previous to the same interval.[15] We then compare the pairwise probabilities of a jump conditional on the occurrence of a company-specific news-related jump of other stocks in the previous interval—and not surrounded by macro-news—with the corresponding probabilities under the hypothesis of independence.

Table 6 reports the same metrics as Table 3 with regard to the pairwise jump spillover probability conditional on a company-specific news-related jump between stocks, as well as the median pairwise conditional jump spillover probability and the average probability of the conditioning event.

We notice that the probability of a company-specific news-related jump is extremely low, that is, 0.00028%: only 2.8 observations every million consist of this event.

Similarly to the case when the conditioning event was a double jump—see Table 4 in Section 3.2, where the probability of the conditioning event was 0.0016%—for most of the stock combinations, the jumps are independent of company-specific news-related jumps of other stocks (the median is equal to zero), but the average conditional jump spillover probability is much higher than the unconditional one (1.0% vs. 0.032%), indicating that there is a lot of heterogeneity. However, the percentage of significant cases is only 1.0% (vs. 6.3% in Table 4). The average absolute size of the conditional jumps is also almost 10% higher than that of all jumps.

Table 7, Panel A presents the conditional probabilities of Table 6 aggregated for each couple of sector combinations. It highlights a striking result: the average conditional jump spillover probability is almost always zero, except when the conditioning event belongs to the financial sector. In this case, the conditional probability ranges between 5.5% for the basic industries and transportation sectors to 9.3% for (jumps across different stocks of) the financial sector. News-related jumps in the financial sector are therefore likely to spillover through this mechanism. It is interesting to compare this evidence with that of the baseline case in Panel B, which reports the jump spillover probability conditional on jumps of other stocks in the previous interval without further conditioning the latter ones on news. In the baseline case, the probabilities conditional on the financial sector are virtually indistinguishable from those

[15] As in Section 4.1, we verified that the release of news in the next interval (*t+1*) is not relevant for all the analysis of the section.

Table 7
Average pairwise spillover jump probability conditional on a jump/company-specific news-related jump on the previous interval.

(A) J prob. cond. on news-related jumps

	BI	CG	CD	CND	CS	EN	FIN	HC	PU	TEC	TR
BI							5.5%				
CG							8.6%	0.5%			
CD	0.7%				0.7%		6.8%				
CND			0.8%		1.4%		8.2%				
CS							7.7%				
EN							8.2%				0.5%
FIN							9.5%				
HC							8.6%	1.0%			0.5%
PU							9.1%				
TEC							8.6%				0.9%
TR				1.0%			5.5%				0.5%

(B) J prob. cond. on jumps

	BI	CG	CD	CND	CS	EN	FIN	HC	PU	TEC	TR
BI	1.0%	1.4%	0.9%	1.4%	1.2%	1.1%	1.3%	1.1%	1.5%	1.4%	0.8%
CG	1.5%	2.3%	1.3%	2.1%	2.0%	1.7%	2.2%	1.9%	2.3%	2.2%	1.2%
CD	1.1%	1.5%	1.0%	1.6%	1.4%	1.3%	1.6%	1.3%	1.7%	1.5%	0.9%
CND	1.5%	2.0%	1.4%	2.2%	1.9%	1.6%	2.0%	1.8%	2.3%	2.1%	1.2%
CS	1.2%	1.7%	1.1%	1.7%	1.6%	1.4%	1.8%	1.4%	1.9%	1.8%	1.0%
EN	1.2%	1.7%	1.1%	1.6%	1.6%	1.7%	1.8%	1.4%	1.8%	1.7%	1.0%
FIN	1.1%	1.7%	1.1%	1.7%	1.7%	1.4%	2.3%	1.4%	1.7%	1.7%	1.0%
HC	1.3%	1.9%	1.2%	2.0%	1.8%	1.6%	2.1%	1.7%	2.0%	2.0%	1.1%
PU	1.6%	2.2%	1.6%	2.4%	2.1%	1.9%	2.1%	2.0%	2.9%	2.4%	1.4%
TEC	1.4%	2.0%	1.2%	1.9%	1.8%	1.7%	2.1%	1.6%	1.9%	2.1%	1.2%
TR	0.9%	1.3%	0.8%	1.2%	1.2%	1.1%	1.5%	1.1%	1.3%	1.3%	1.0%

Panel (A): for each couple of sectors S_I in row I and S_J in column J, average pairwise jump spillover probability of stock $i \in S_I$ conditional on jumps of stock $j \in S_J$ in the previous interval, among all the combinations $i \in S_I$ and $j \in S_J$ (diagonal entries: stocks $i, j \in S_I, i \neq j$). Zero values are replaced with blank spaces. Panel (B): as Panel (A), using company-specific news-related jumps as conditioning events. The effect of macroeconomic news is filtered by using as conditioning events only the jumps such that no macro-news is released from the previous to the next interval.

conditional on the other sectors and their values are around 2%, much lower than those in Panel A. However, the percentage of significant cases for Panel A is low (∼8%).[16] The news-related jumps—the conditioning event—being very rare, the heterogeneity of the conditional probability across stock combinations is indeed very strong.

We can thus say that our evidence is in favor of the hypothesis that company-specific news boosts the jump spillover effect and that this is mostly due to news about companies belonging to the financial sector. We attribute the relevance of the financial sector to its systemic role in the economic system,[17] and we hypothesize that jumps surrounded by news of financial companies can be perceived as signals of financial instability and lead to higher effective risk aversion, which ultimately manifests itself in the form of jumps in the rest of the market.

5. Economic importance of spillover jumps

In this section, we explore the economic importance of the previous findings by analyzing the distribution of the absolute returns, as a proxy for volatility, around jumps and spillover jumps. With the aim of providing an economic outcome in actual terms, we employ the original returns. (Unreported results obtained by using the standardized returns are very similar to those reported further on.)

We distinguish between four mutually exclusive types of jump and three mutually exclusive types of spillover jump:

- *plain jump*: a jump not preceded by another jump of the same stock and such that no news about the same stock or macroeconomic news is released from the previous to the following interval
- *jump associated with macroeconomic news*: a jump not preceded by another jump of the same stock and such that no news about the same stock and at least one macroeconomic news item is released from the previous to the following interval

[16] See Tables D2 and D7 in Appendix D for complete results including the percentage of significant cases and the conditional jump size.

[17] See, on the themes of contagion in financial markets, systemic risk, and the systemic role of the financial sector, Bae et al. [14], Allen et al. [8], Billio et al. [21], Bisias et al. [22], Hasman [44], Diebold and Yilmaz [37], Hautsch et al. [45], Acharia et al. [2], Acharya et al. [3], Acemoglu et al. [1], Adrian and Brunnermeier [4], Brownlees and Engle [27], and the references therein.

- *jump preceded by another jump*: a jump preceded by another jump of the same stock and such that no news about the same stock or macroeconomic news is released from the previous to the following interval
- *jump associated with company-specific news*: a jump not preceded by another jump of the same stock and such that at least one news item about the same stock is released from the interval before to the same interval of the jump and no macroeconomic news is released from the previous to the following interval
- *plain spillover jump*: a jump not preceded by another jump of the same stock, such that no news about the same stock or macroeconomic news is released from the previous to the following interval, and preceded by a jump of at least another stock
- *spillover jump due to a two-jump sequence*: a jump not preceded by another jump of the same stock, such that no news about the same stock or macroeconomic news is released from the previous to the following interval, and preceded by a sequence of two jumps of at least another stock
- *spillover jump due to a company-specific news-related jump*: a jump not preceded by another jump of the same stock, such that no news about the same stock or macroeconomic news is released from the previous to the following interval, and preceded by one jump of at least another stock in turn such that at least one news item about the other stock is released from the interval before to the same interval of the jump of the other stock

Fig. 2 reports the distribution of the absolute returns in the time range from 60 min before to 60 min after jumps and spillover jumps distinguishing their type. The figure shows, for each 5-min interval, the median and the 5% and 95% quantiles of the absolute returns pooling the observations around all events and all stocks. In addition, it shows a dot if the null hypothesis of the Mann-Whitney test, according to which the series of absolute returns on an interval around jumps or spillover jumps come from the same distribution as the ones not around jumps, is rejected at the 95% confidence level.

Volatility around jumps With regard to the absolute returns around the four types of jumps (Panels A, B, C, and D), the dots indicate that in all cases, the median is significantly higher than the median of those not around jumps from the interval before the jump to at least one hour after. The 95% quantile of the absolute returns and, as a consequence, their mean in the hour following the jumps is, with respect to the plain jumps (Panel A), respectively much higher for those preceded by another jump of the same stock (Panel C) and for those associated with company-specific news (Panel D) and lower, especially in the following 15 minutes, for those associated with scheduled macroeconomic news (Panel B).[18] Assuming for the jumps preceded by another jump an important company-specific event, in many cases possibly due to a liquidity imbalance, we are able to say that our results are consistent with the Ederington and Lee [39] model, which predicts a decrease (increase) in volatility as a consequence of scheduled (unscheduled) news announcements as a result of uncertainty resolution (creation). We also notice that for the jumps preceded by another jump, the median of the absolute returns is significantly higher than that of the absolute returns not around jumps (and the 95% quantile is consistently very high) in the intervals -3 and -2, i.e. in the two intervals preceding the first of the two consecutive jumps. This suggests that jump clustering takes place especially in times of high volatility, consistent with the jump size clustering observed by [55].

Volatility around spillover jumps With regard to spillover jumps (Panels E, F, and G), it is interesting to observe different phenomena on the basis of their causes. Spillover jumps due to jumps of other stocks (Panel E) and due to two-jump sequences of other stocks (Panel F) are surrounded by absolute returns whose median is significantly higher than that of returns not around jumps from 40 minutes before the event to at least one hour after, and their 95% quantile is very high—comparable to that of jumps due to a previous jump of the same stock—not only after the spillover event but also before the jump/two-jump sequence that causes the spillover, suggesting that spillovers take place especially in times of high volatility, similarly to what was observed for jumps preceded by another jump of the same stock. Spillover jumps due to jumps of other stocks in turn associated with company-specific news are instead characterized by a radically different behavior: absolute returns around them are significantly higher than those not around jumps only during the interval of the spillover event and the preceding one, and extremely low in the remaining intervals. The release of unscheduled company-specific news around a jump that gives rise to the spillover therefore leads, with respect to the baseline case, to a lower volatility persistence subsequent to the spillover. We interpret this phenomenon as a result of the fact that when news is focused on company A, its information content is mainly relevant to A, and the eventual jump spillover to company B will consist of a carry-over effect with lower amplitude. On the contrary, jumps not due to company-specific news that spillover are much more likely to correspond to sector- or market-wide phenomena, and will result in a greater impact across the rest of the market. This leads us to believe that, as a consequence of unscheduled company-specific news announcements, the volatility rise predicted by the Ederington and Lee [39] model will be observed on the same assets to which the news is related but will not spread marketwide.

The previous results seem to suggest that, as expected, company-specific news—typically not causing jumps in other stocks and, when it does, not increasing their volatility—gives rise to idiosyncratic risk, except for financial company news, which also increases systematic risk. A potential avenue for future research is naturally that of testing systematic and idiosyncratic risk related to spillover jumps and their causes.

[18] Evans [40], using S&P 500 E-Mini futures, also finds a significant volatility persistence after jumps at intraday (and daily) levels. However, while the author finds higher coefficients for jumps related to macro-news, in our case for this jump category the median and the 95% quantile are respectively comparable and lower than those of plain jumps.

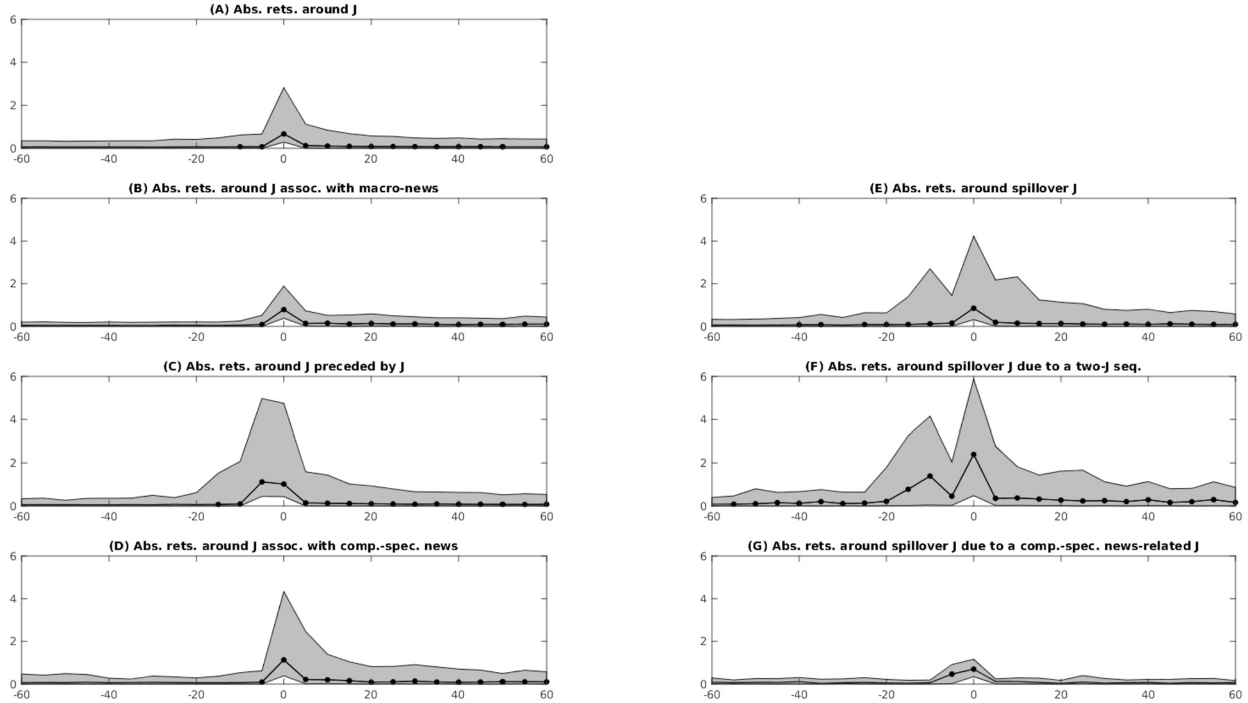

Fig. 2. Absolute returns around jumps and spillover jumps.

Panel (A): absolute returns around jumps not preceded by another jump of the same stock and such that no company-specific news about the same stock or macroeconomic news is released from the interval before to the interval following the jump. Panel (B): absolute returns around jumps not preceded by another jump of the same stock and such that no company-specific news about the same stock and at least one macroeconomic news item is released from the interval before to the interval after the jump. Panel (C): absolute returns around jumps preceded by another jump of the same stock and such that no company-specific news about the same stock or macroeconomic news is released from the interval before to the interval following the jump. Panel (D): absolute returns around jumps not preceded by another jump of the same stock and such that at least one company-specific news item about the same stock is released from the interval before to the same interval of the jump and no macroeconomic news is released from the interval before to the interval following the jump. Panel (E): absolute returns around jumps not preceded by another jump of the same stock, such that no company-specific news about the same stock or macroeconomic news is released from the interval before to the interval following the jump, and preceded by at least another jump of another stock. Panel (F): absolute returns around jumps not preceded by another jump of the same stock, such that no company-specific news about the same stock or macroeconomic news is released from the interval before to the interval following the jump, and preceded by at least a sequence of two jumps of another stock. Panel (G): absolute returns around jumps not preceded by another jump of the same stock, such that no company-specific news about the same stock or macroeconomic news is released from the interval before to the interval following the jump, and preceded by at least one jump of another stock in turn such that at least one company-specific news item about the other stock is released from the interval before to the same interval of the jump of the other stock. For each 5-min interval from one hour before (-12 intervals) to one hour after (+12 intervals) the jump, the black line represents the median absolute return of the pooled returns around the jumps of all stocks, the shaded region corresponds to the range between the 5% and 95% quantiles, and a black dot indicates that the null hypothesis of the Mann-Whitney test, according to which the series of absolute returns on an interval around jumps comes from the same distribution as the ones not around jumps, is rejected at the 95% confidence level.

6. Robustness checks

6.1. EPS announcements

Earnings per share are a very important source of information; we therefore devote to them a separate section in Appendix E. As already mentioned in the dataset description, EPS data are available only from July 2009, and they are mainly released outside market opening hours. As a consequence, we use here the dataset from June 1, 2009 to May 29, 2020.

We first verify whether EPS announcements have a cross-company *direct* effect on the jump probability, with a methodology resembling that of Section 4.1 but at a daily level. We define a jump day as a day where at least one intraday jump is detected, and an EPS day as a trading day for which from the market closing time of the previous trading day to the market closing time of that day EPS are announced. Consistent with the results of that section, we find that the effect is limited and not significant.

We then investigate the hypothesis that EPS announcements boost the jump spillover phenomenon, returning to the high-frequency setting used in Section 4.2 with an exception: we build the explanatory variable *EPS-related jump* conditioning intraday jumps on the release of EPS news from the previous working day to the same working day. The evidence we find is in favor of the hypothesis that EPS news augments the jump spillover effect, and this phenomenon turns out to be due especially to EPS concerning companies of the financial sector, which, again, is consistent with Section 4.2. We consider these results as indicative of both a confirmation of the jump transmission enhancement exerted by company-specific news and the relevance of EPS announcements from a cross-company standpoint.

6.2. Distinguishing the jump sign

Given the strong dependence between contemporaneous and subsequent jumps of different stocks, in Appendix F we shed some light on how the jump sign is related to these dynamics.

6.2.1. Univariate jump self-excitation

We start by looking at how the univariate jump self-excitation is related to the jump sign. Table F1 shows the cross-sectional mean of the conditional probability of a positive/negative jump given a previous positive/negative jump. We can notice that the main driver of the jump self-excitation is a *negative-positive bounce back*, i.e. a negative jump followed by a positive one, where the related conditional probability is equal to 5.6%, while the three other sign combinations (positive-positive, positive-negative, and negative-negative) are associated with a much smaller conditional probability (1.9%, 2.2%, and 1.3%, respectively).

It is possible that other forces, such as outliers in high-frequency data, can generate the observed bounce-back effects, which suggests it is a microstructure noise story [7]. Pockets of extremely persistent high-frequency returns [10,33] could instead explain the same-sign autocorrelation dynamics. Our robust jump identification method and our choice of one of the most commonly employed sampling frequency of 5 minutes to handle microstructure effects, however, make us believe that the observed phenomena mainly involve what most of the literature considers genuine jumps.

6.2.2. Spillover jumps

Table F2 reports the average pairwise stock jump spillover probability conditional on jumps of other stocks in the previous interval (Panels A–D) and in the same interval (Panels E–H), like Table 3, Panels B and C, but distinguishing the jump sign. The table suggests that the mechanism governing the spillover phenomenon between subsequent jumps is primarily due to negative jumps provoking positive jumps for other stocks. It thus seems that negative-positive bounce backs are the most frequently occurring event characterizing both the univariate jump self-excitation and the spillover phenomenon.

In relation to the dependence between contemporaneous jumps, instead, it is clearly visible that it is mainly driven by jumps with the same sign across different stocks. This was expected, considering that simultaneous jumps across two or more stocks whose activity is related are likely to be caused by news about one or all of them and that systemic jumps are likely to be driven by macroeconomic news or global events, such as wars or pandemics [29], and that in both cases, the effect of the news is usually either positive or negative for all the companies involved.

In relation to both subsequent and contemporaneous spillover jumps, we extended the analysis to sectors. We did not notice any peculiar within- or across-sector dynamics and left the results unreported.

As for the univariate self-excitation, other economics might be behind this phenomenon. We believe the exploration of microstructure noise and drift bursts in a multivariate context to be a potential avenue of future research.

6.2.3. Returns around jumps and spillover jumps

We explore possible patterns of jumps and spillover jumps on the basis of their sign in Figure G1 in Appendix G. We find that both positive and negative jumps are followed by jumps of either sign, with a prevailing reversal effect in both cases and especially after negative jumps. The spillover phenomenon can also take place with a sign corresponding or contrary to the first jump, but, differently from the univariate case, the same-sign effect prevails.

6.3. Sub-sample from post EU sovereign debt crisis until pre Covid crisis

The sample contains the global financial crisis (from December 2007 to June 2009), the EU sovereign debt crisis (from July 2009 to December 2012), and the beginning of the COVID crisis (from December 2019). Therefore, we perform in Appendix H a robustness check using the sub-sample that ranges from after the EU sovereign debt crisis until before the COVID crisis (from January 2013 to November 2019).

Table H6 (vs. Table 4) shows that the cumulative impact of a sequence of two jumps on the jump spillover phenomenon decreases in the post-crisis period and the related statistical significance goes almost to zero. We conclude that this cumulative impact is prevalent during turbulent phases.

Table H12 (vs. Table D7), instead, indicates that during the post-crisis period the amplification effect produced by news of the financial sector on the jump spillover phenomenon is even higher. This key finding is therefore not due to an unusual high attention to financial news during turbulent times.

6.4. Abnormally high returns as alternative jump definition

In Appendix I we use, as alternative definition of jumps, the 0.03% highest absolute returns for each stock. This value is chosen to allow a fair comparison with the jumps identified by the Andersen et al. [9] test, whose unconditional probability is 0.032%, see Table 1.

Table I1 shows that, according to this alternative definition, cutting the first and the last hour of each trading day the unconditional jump probability drops to 0.008%, that is much smaller than that of jumps identified by the Andersen et al. [9] test in the same time window (0.034%, see Table 2). This is not surprising considering that, being absolute returns not filtered from the periodicity, jumps identified with this alternative method take place especially during opening and closing of trading hours.

The main results of the paper are confirmed. In particular, Table I6 (vs. Table 4) indicates that the cumulative impact of a sequence of two jumps is even higher. Additionally, Figure I1 provides a distribution of volatility around jumps and spillover jumps consistent with that of Fig. 2.

6.5. Multi-jump spillover

To gain further insight into systematic jump risk and diversification, we extend our analysis beyond pairwise testing within sectors. In Table J1 in Appendix J, Panels A, B, and C, we present the cross-sectional average probability for a stock within a sector to cause a spillover jump for at least one, two, and three stocks, respectively, within the same sector and across the other sectors. We do not observe any significant intra- or inter-sector dynamics, except for slightly higher spillovers on average within the same sectors, particularly for Financial and Public Utilities.

7. Conclusion

We address the theme of jump spillover between economic sectors and the cross-company news' impact on the jump probability, providing several interesting insights.

At first, focusing only on the jump frequencies and the dependence between jumps, we show that jump spillover is a pervasive phenomenon, appearing both within and between sectors. In addition, the occurrence of jump spillover is very heterogeneous across sectors. Proceeding to the analysis of jump sequences, we observe that they lead to a cumulative impact on the jump spillover effect, especially during turbulent times.

However, the most interesting evidence emerges when focusing on company-specific news and its relation to company jumps and jump spillover. In fact, we first document that company-specific news is relevant in causing jumps only for the company to which the news is related. Nevertheless, we note a striking result: company-specific news boosts the jump spillover effect, and this is mostly due to news about companies belonging to the financial sector.

Finally, we explore the economic importance of the news-jumps relation and of the jump spillover effect by analyzing the distribution of a volatility proxy around jumps and spillover jumps. We show that the median volatility around jumps is significantly higher than that not around jumps in a time range of up to one hour from the jump occurrence, and that it is higher for jumps associated with company-specific news compared to those associated with macro-news. Volatility around spillover jumps presents a similar distribution, except for being lower when the jump spillover results from news about another company.

Our results provide additional evidence extending the studies of Ederington and Lee [39] and [55]. They show, in particular, that as a consequence of unscheduled company-specific news, a rise in volatility will be observed only in the same assets to which the news is related. This finding might be of interest for market monitoring and trading around news announcements. A potential avenue for future research is naturally that of testing systematic and idiosyncratic risk related to spillover jumps and their causes.

We also believe that further research should be devoted to the analysis of the cross-company transmission of information and extreme events, without restricting attention to jumps only. Other potential avenues for research can be including the role of news in the community detection approach of Ding et al. [38] based on co-jump dependence, understanding if spillover jumps can be explained by fundamental vs. non-fundamental comovement, extending Barberis et al. [17], and exploring risk hedging methods through sector portfolios' basket options.

CRediT authorship contribution statement

Francesco Poli: Writing – original draft, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Massimiliano Caporin:** Writing – review & editing, Supervision, Methodology, Funding acquisition.

Declaration of competing interest

Declarations of interest: none.

Data availability statement

We will make available, upon request, jump sizes and signs. We will share news data with those who have access to the news providers, upon proof.

Supplementary material

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e34440.

References

[1] D. Acemoglu, A. Ozdaglar, A. Tahbaz-Salehi, Systemic risk and stability in financial networks, Am. Econ. Rev. 105 (2) (2015) 564–608.
[2] V. Acharya, R. Engle, M. Richardson, Capital shortfall: a new approach to ranking and regulating systemic risks, Am. Econ. Rev. 102 (3) (2012) 59–64.
[3] V.V. Acharya, L.H. Pedersen, T. Philippon, M. Richardson, Measuring systemic risk, Rev. Financ. Stud. 30 (1) (2017).
[4] T. Adrian, M.K. Brunnermeier, CoVaR, Am. Econ. Rev. 106 (7) (2016) 1705–1741.
[5] Y. Ait-Sahalia, J. Cacho-Diaz, T. Hurd, Portfolio choice with jumps: a closed-form solution, Ann. Appl. Probab. 19 (2009) 556–584.
[6] Y. Ait-Sahalia, J. Cacho-Diaz, R.J.A. Laeven, Modeling financial contagion using mutually exciting jump processes, J. Financ. Econ. 17 (2015) 585–606.
[7] Y. Ait-Sahalia, J. Jacod, J. Li, Testing for jumps in noisy high frequency data, J. Econom. 168 (2) (2012) 207–222.
[8] L. Allen, T.g. Bali, Y. Tang, Does systemic risk in the financial sector predict future economic downturns?, Rev. Financ. Stud. 25 (10) (2012) 3000–3037.
[9] T.G. Andersen, T. Bollerslev, D. Dobrev, No-arbitrage semi-martingale restrictions for continuous-time volatility models subject to leverage effects, jumps and i.i.d. noise: theory and testable distributional implications, J. Econom. 138 (2007) 125–180.
[10] T.G. Andersen, Y. Li, V. Todorov, B. Zhou, Volatility measurement with pockets of extreme return persistence, J. Econom. 237 (2, Part C) (2023) 105048.
[11] H. Asgharian, C. Bengtsson, Jump spillover in international equity markets, J. Financ. Econom. 4 (2) (2006) 167–203.
[12] H. Asgharian, M. Nossman, Risk contagion among international stock markets, J. Int. Money Financ. 30 (2011) 22–38.
[13] F. Audrino, A. Tetereva, Sentiment spillover effects for US and European companies, J. Bank. Finance 106 (2019) 542–567.
[14] K.-H. Bae, A.G. Karolyi, R.M. Stulz, A new approach to measuring financial contagion, Rev. Financ. Stud. 16 (2003) 717–763.
[15] P. Bajgrowicz, O. Scaillet, A. Treccani, Jumps in high-frequency data: spurious detections, dynamics, and news, Manag. Sci. 62 (2016) 2198–2217.
[16] P. Balduzzi, E.J. Edwin, T.C. Green, Economic news and bond prices: evidence from the U.S. treasury market, J. Financ. Quant. Anal. 36 (4) (2011) 523–543.
[17] N. Barberis, A. Shleifer, J. Wurgler, Comovement, J. Financ. Econ. 72 (2) (2005) 283–317.
[18] O.E. Barndorff-Nielsen, N. Shephard, Power and bipower variation with stochastic volatility and jumps, J. Financ. Econom. 2 (2004) 1–37.
[19] O.E. Barndorff-Nielsen, N. Shephard, Econometrics of testing for jumps in financial economics using bipower variation, J. Financ. Econom. 4 (2006) 1–30.
[20] K. Bhanot, N. Burns, D. Hunter, M. Williams, News spillovers from the Greek debt crisis: impact on the Eurozone financial sector, J. Bank. Finance 38 (2014) 51–63.
[21] M. Billio, M. Getmansky, A.W. Lo, L. Pelizzon, Econometric measures of connectedness and systemic risk in the finance and insurance sectors, J. Financ. Econ. 104 (3) (2012) 535–559.
[22] D. Bisias, M. Flood, A.W. Lo, S. Valavanis, A survey of systemic risk analytics, Annu. Rev. Financ. Econ. 4 (76) (2012) 119–131.
[23] T. Bollerslev, T.H. Law, G. Tauchen, Risk jumps and diversification, J. Econom. 144 (2008) 234–256.
[24] K. Boudt, C. Croux, S. Laurent, Robust estimation of intraweek periodicity in volatility and jump detection, J. Empir. Finance 18 (2011) 353–367.
[25] K. Boudt, M. Petitjean, Intraday liquidity dynamics and news releases around price jumps: evidence from the DJIA stocks, J. Financ. Mark. 17 (2014) 121–149.
[26] M. Brenner, P. Pasquariello, M. Subrahmanyam, On the volatility andcomovement of U.S. financial markets around macroeconomic news announcements, J. Financ. Quant. Anal. 44 (2009) 1265–1289.
[27] C.T. Brownlees, R. Engle, SRISK: a conditional capital shortfall measure of systemic risk, Rev. Financ. Stud. 30 (1) (2017) 48–79.
[28] M. Caporin, The role of jumps in realized volatility modeling and forecasting, J. Financ. Econom. (2022) 1–26.
[29] M. Caporin, A. Kolokolov, R. Renò, Systemic co-jumps, J. Financ. Econ. 126 (3) (2017) 563–591.
[30] M. Caporin, F. Poli, News and intraday jumps: evidence from regularization and class imbalance, N. Am. J. Econ. Finance (2022) 62.
[31] P. Carr, L. Wu, Leverage effect, volatility feedback, and self-exciting market disruptions, J. Financ. Quant. Anal. 52 (5) (2017) 2119–2156.
[32] C. Christiansen, A. Ranaldo, Realized bond-stock correlation: macroeconomic announcement effects, J. Futures Mark. 27 (2007) 439–469.
[33] K. Christiesen, R. Oomen, R. Renò, The drift burst hypothesis, J. Econom. 227 (2022) 461–497.
[34] V. Corradi, W. Distaso, M. Fernandes, Testing for jump spillovers without testing for jumps, J. Am. Stat. Assoc. 115 (531) (2020) 1214–1226.
[35] F. Corsi, D. Pirino, R. Renò, Threshold bipower variation and the impact of jumps on volatility forecasting, J. Econom. 159 (2) (2010) 276–288.
[36] S. Das, R. Uppal, Systemic risk and international portfolio choice, J. Finance 59 (6) (2004) 2809–2834.
[37] F.X. Diebold, K. Yilmaz, On the network topology of variance decompositions: measuring the connectedness of financial firms, J. Econom. 182 (1) (2014) 119–134.
[38] Y. Ding, Y. Li, G. Liu, X. Zheng, Stock co-jump networks, J. Econom. (2023).
[39] L.H. Ederington, J.H. Lee, The creation and resolution of market uncertainty: the impact of information releases on implied volatility, J. Financ. Quant. Anal. 31 (1996) 513–539.
[40] K.P. Evans, Intraday jumps and US macroeconomic news announcements, J. Bank. Finance 35 (2011) 2511–2527.
[41] K. Forbes, R. Rigobon, No contagion, only interdependence: measuring stock market co-movements, J. Finance 57 (2002) 2223–2261.
[42] A. Fulop, J. Li, J. Yu, Self-exciting jumps, learning, and asset pricing implications, Rev. Financ. Stud. 28 (3) (2015) 876–912.
[43] A. Gande, D.C. Parsley, News spillovers in the sovereign debt market, J. Financ. Econ. 75 (2005) 691–734.
[44] A. Hasman, A critical review of contagion risk in banking, J. Econ. Surv. 27 (2013) 978–995.
[45] N. Hautsch, J. Schaumburg, M. Schienle, Financial network systemic risk contributions, Rev. Finance 19 (2015) 685–738.
[46] F. Jawadi, W. Louhichi, A.I. Cheffou, Testing and modeling jump contagion across international stock markets: a nonparametric intraday approach, J. Financ. Mark. 2015 (26) (2015) 64–84.
[47] G.J. Jiang, E. Konstantinidi, G. Skiadopoulos, Volatility spillovers and the effect of news announcements, J. Bank. Financ. 36, 2260–2273.
[48] G.J. Jiang, I. Lo, A. Verdelhan, Information shocks, liquidity shocks, jumps, and price discovery: evidence from the US treasury market, J. Financ. Quant. Anal. 46 (2011) 527–551.
[49] H. Jiang, S.Z. Li, H. Wang, Pervasive underreaction: evidence from high-frequency data, J. Financ. Econ. 141 (2021) 573–599.
[50] G. Kapetanios, E. Konstantinidi, M. Neumann, G. Skiadopoulos, Jumps in option prices and their determinants: real-time evidence from the E-mini S&P 500 options market, J. Financ. Mark. 46 (2019) 1–26.
[51] S.-J. Kim, L. Salem, E. Wu, The role of macroeconomic news in sovereign CDS markets: domestic and spillover news effects from the U.S., the Eurozone and China, J. Financ. Stab. 18 (2015) 208–224.
[52] A. Kolokolov, R. Renò, Jumps or staleness?, Working paper, University of Verona, 2021.
[53] J. Lahaye, S. Laurent, C.J. Neely, Jumps, cojumps and macro announcements, J. Appl. Econom. 26 (2011) 893–921.
[54] J. Lahaye, C. Neely, The role of jumps in volatility spillovers in foreign exchange markets: meteor shower and heat waves revisited, J. Bus. Econ. Stat. 38 (2) (2020) 410–427.
[55] S.S. Lee, Jumps and information flow in financial markets, Rev. Financ. Stud. 25 (2012) 439–479.
[56] S.S. Lee, P.A. Mykland, Jumps in financial markets: a new nonparametric test and jump dynamics, Rev. Financ. Stud. 21 (2008) 2535–2563.
[57] F. Longin, B. Solnik, Extreme correlation of international equity markets, J. Finance 56 (2) (2001) 649–676.
[58] J.M. Maheu, T.H. McCurdy, News arrival, jump dynamics, and volatility components for individual stock returns, J. Finance 2004 (59) (2004) 755–793.
[59] J.G. Rangel, Macroeconomic news, announcements, and stock market jump intensity dynamics, J. Bank. Finance 35 (2011) 1263–1276.