The New Alchemy: Turning Words into Signals

Federal Reserve Bank of Atlanta
23rd Annual Financial Markets Conference
May 7, 2018

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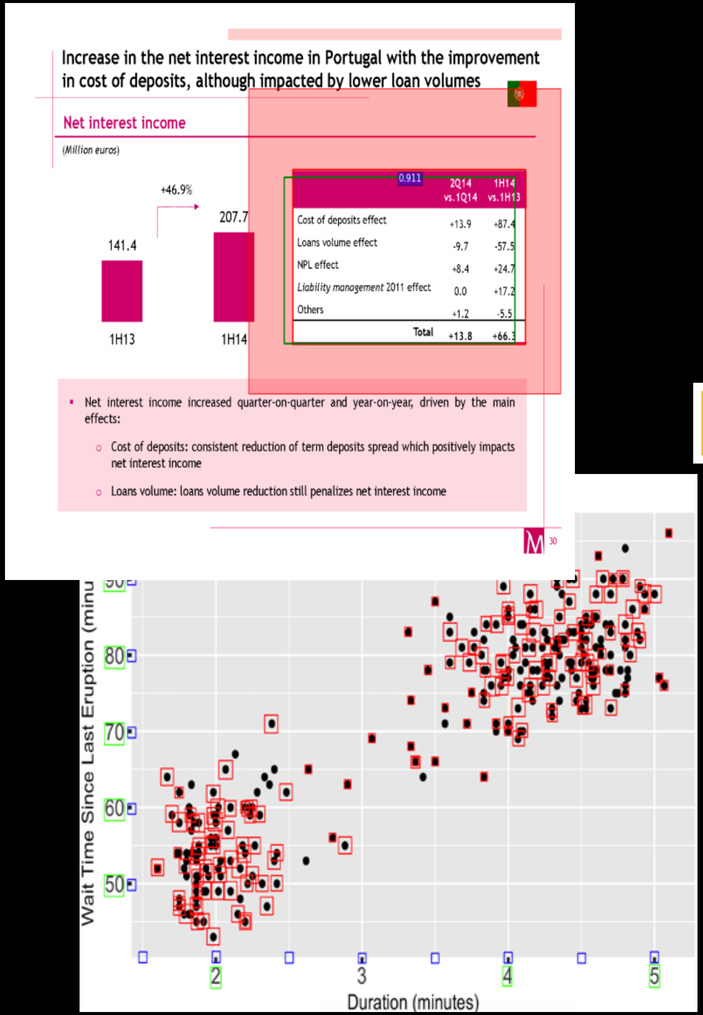
Outline

- **Understanding Natural Documents**
- News that Moves the Market
- Sentiment Signals

Understanding Natural Documents



Increase in the net interest income in Portugal with the improvement in cost of deposits, although impacted by lower loan volumes

Net interest income

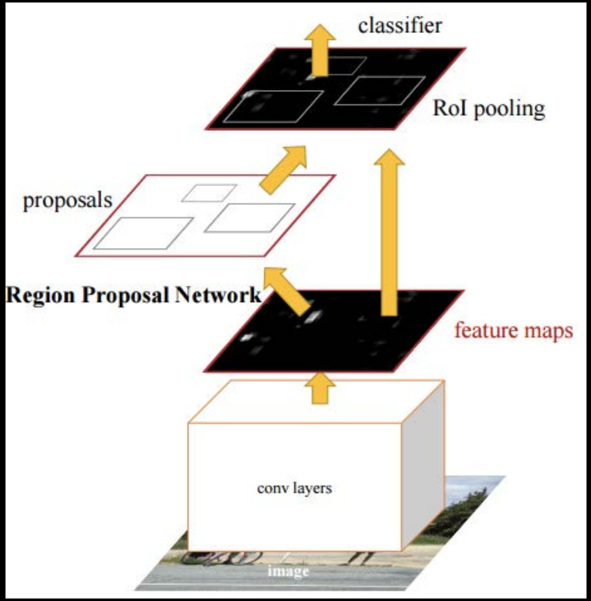
(Million euros)

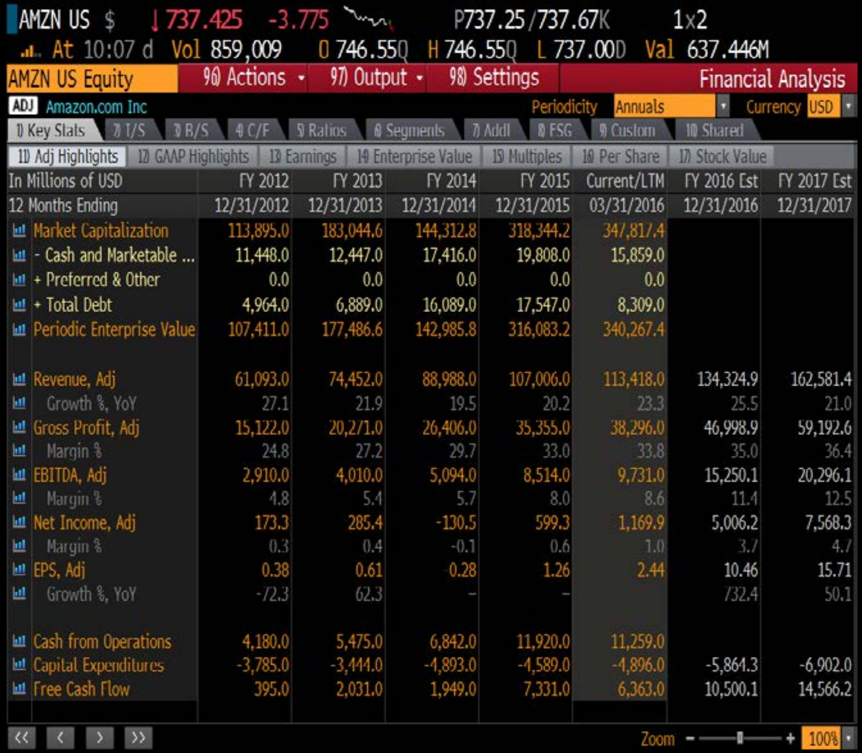
+46.9%
141.4
207.7
1H13
1H14
0.911

	2Q14 vs.1Q14	1H14 vs.1H13
Cost of deposits effect	+13.9	+87.4
Loans volume effect	-9.7	-57.5
NPL effect	+8.4	+24.7
Liability management 2011 effect	0.0	+17.2
Others	+1.2	-5.5
Total	+13.8	+66.3

- Net interest income increased quarter-on-quarter and year-on-year, driven by the main effects:
  - Cost of deposits: consistent reduction of term deposits spread which positively impacts net interest income
  - Loans volume: loans volume reduction still penalizes net interest income

30
Wait Time Since Last Eruption (minu
90
80
70
60
50
2
3
4
5
Duration (minutes)


classifier
RoI pooling
proposals
Region Proposal Network
feature maps
conv layers
image



AMZN US $ ↓737.425 -3.775 P737.25/737.67K 1x2
At 10:07 d Vol 859,009 O 746.55Q H 746.55Q L 737.00D Val 637.446M

AMZN US Equity
96) Actions
97) Output
98) Settings
Financial Analysis
ADJ
1) Key Stats
2) I/S
3) B/S
4) C/F
5) Ratios
6) Segments
7) Addl
8) ESG
9) Custom
10) Shared
11) Adj Highlights
12) GAAP Highlights
13) Earnings
14) Enterprise Value
15) Multiples
16) Per Share
17) Stock Value
Zoom
100%

Amazon.com Inc

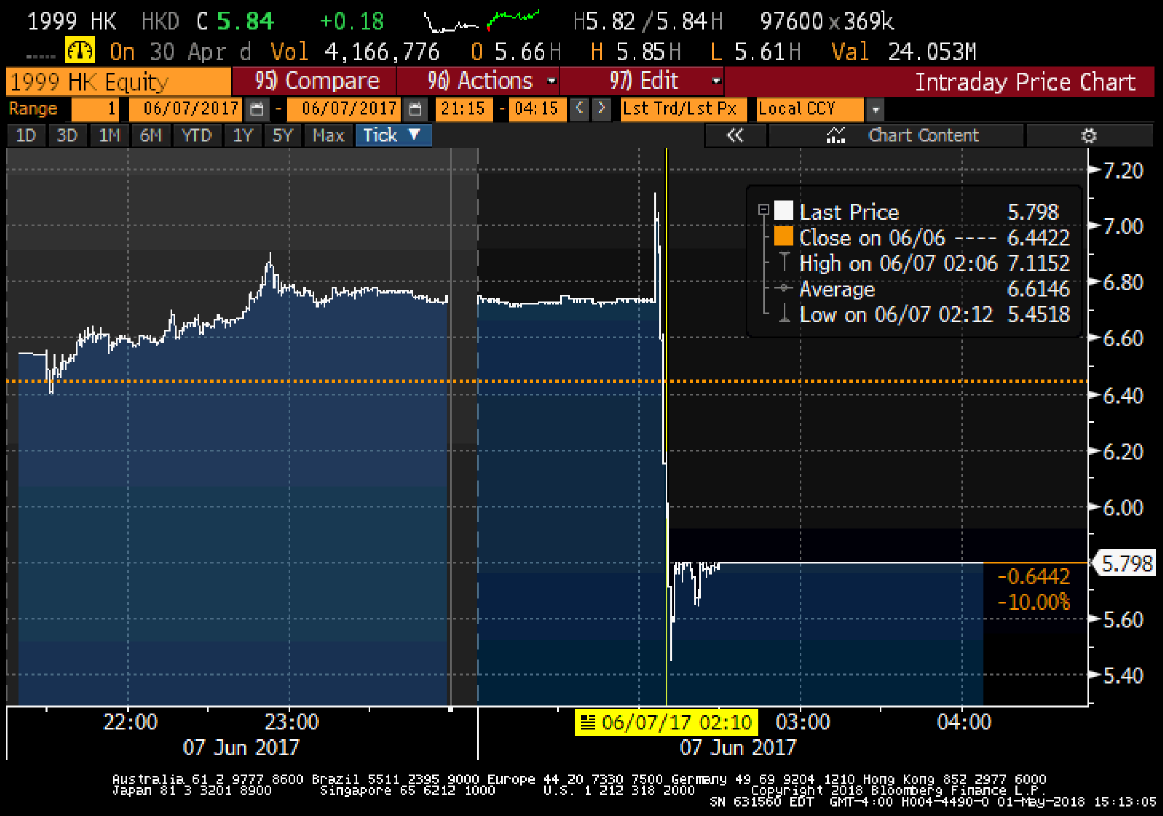
Periodicity Annuals Currency USD

In Millions of USD	FY 2012	FY 2013	FY 2014	FY 2015	Current/LTM	FY 2016 Est	FY 2017 Est
12 Months Ending	12/31/2012	12/31/2013	12/31/2014	12/31/2015	03/31/2016	12/31/2016	12/31/2017
Market Capitalization	113,895.0	183,044.6	144,312.8	318,344.2	347,817.4		
- Cash and Marketable ...	11,448.0	12,447.0	17,416.0	19,808.0	15,859.0		
+ Preferred & Other	0.0	0.0	0.0	0.0	0.0		
+ Total Debt	4,964.0	6,889.0	16,089.0	17,547.0	8,309.0		
Periodic Enterprise Value	107,411.0	177,486.6	142,985.8	316,083.2	340,267.4		
Revenue, Adj	61,093.0	74,452.0	88,988.0	107,006.0	113,418.0	134,324.9	162,581.4
Growth %, YoY	27.1	21.9	19.5	20.2	23.3	25.5	21.0
Gross Profit, Adj	15,122.0	20,271.0	26,406.0	35,355.0	38,296.0	46,998.9	59,192.6
Margin %	24.8	27.2	29.7	33.0	33.8	35.0	36.4
EBITDA, Adj	2,910.0	4,010.0	5,094.0	8,514.0	9,731.0	15,250.1	20,296.1
Margin %	4.8	5.4	5.7	8.0	8.6	11.4	12.5
Net Income, Adj	173.3	285.4	-130.5	599.3	1,169.9	5,006.2	7,568.3
Margin %	0.3	0.4	-0.1	0.6	1.0	3.7	4.7
EPS, Adj	0.38	0.61	0.28	1.26	2.44	10.46	15.71
Growth %, YoY	-72.3	62.3	–	–		732.4	50.1
Cash from Operations	4,180.0	5,475.0	6,842.0	11,920.0	11,259.0		
Capital Expenditures	-3,785.0	-3,444.0	-4,893.0	-4,589.0	-4,896.0	-5,864.3	-6,902.0
Free Cash Flow	395.0	2,031.0	1,949.0	7,331.0	6,363.0	10,500.1	14,566.2

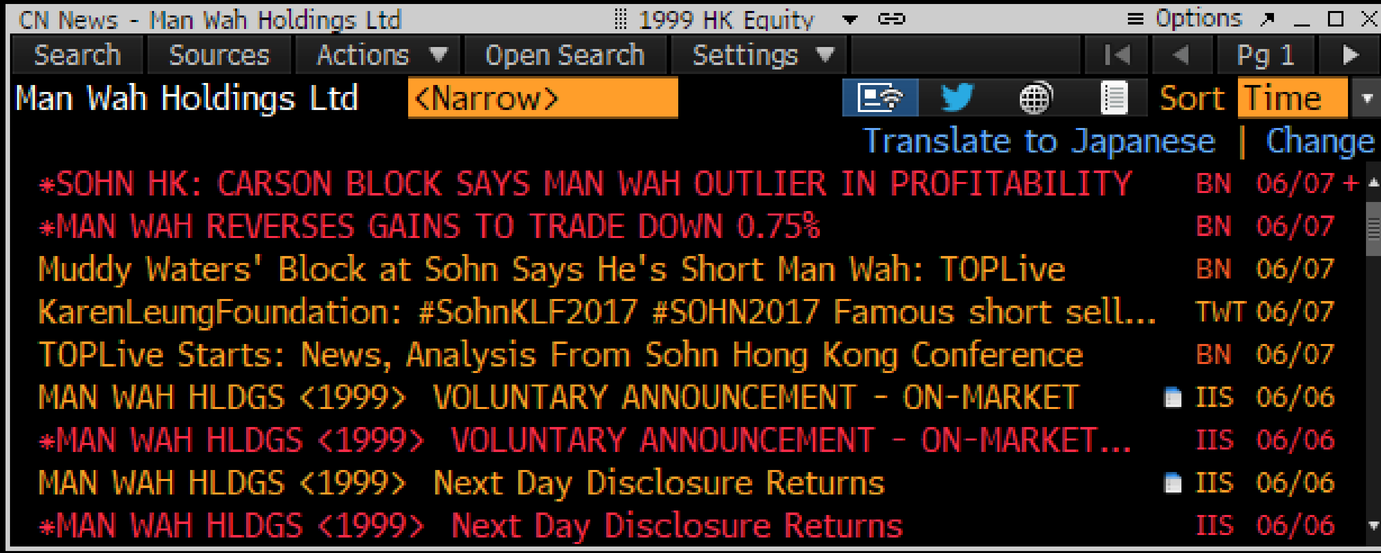
Outline

- Understanding Natural Documents
- **News that Moves the Market**
- Sentiment Signals

News Moves Markets



Australia 61 2 9777 8600 Brazil 5511 2395 9000 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2018 Bloomberg Finance L.P.
SN 631560 EDT GMT-4:00 H004-4490-0 01-May-2018 15:13:05


CN News - Man Wah Holdings Ltd
1999 HK Equity
Options
Search
Sources
Actions
Open Search
Settings
Pg 1
Man Wah Holdings Ltd
<Narrow>
Sort Time
Translate to Japanese | Change

*SOHN HK: CARSON BLOCK SAYS MAN WAH OUTLIER IN PROFITABILITY	BN	06/07
*MAN WAH REVERSES GAINS TO TRADE DOWN 0.75%	BN	06/07
Muddy Waters' Block at Sohn Says He's Short Man Wah: TOPLive	BN	06/07
KarenLeungFoundation: #SohnKLF2017 #SOHN2017 Famous short sell...	TWT	06/07
TOPLive Starts: News, Analysis From Sohn Hong Kong Conference	BN	06/07
MAN WAH HLDGS <1999> VOLUNTARY ANNOUNCEMENT - ON-MARKET	IIS	06/06
*MAN WAH HLDGS <1999> VOLUNTARY ANNOUNCEMENT - ON-MARKET...	IIS	06/06
MAN WAH HLDGS <1999> Next Day Disclosure Returns	IIS	06/06
*MAN WAH HLDGS <1999> Next Day Disclosure Returns	IIS	06/06

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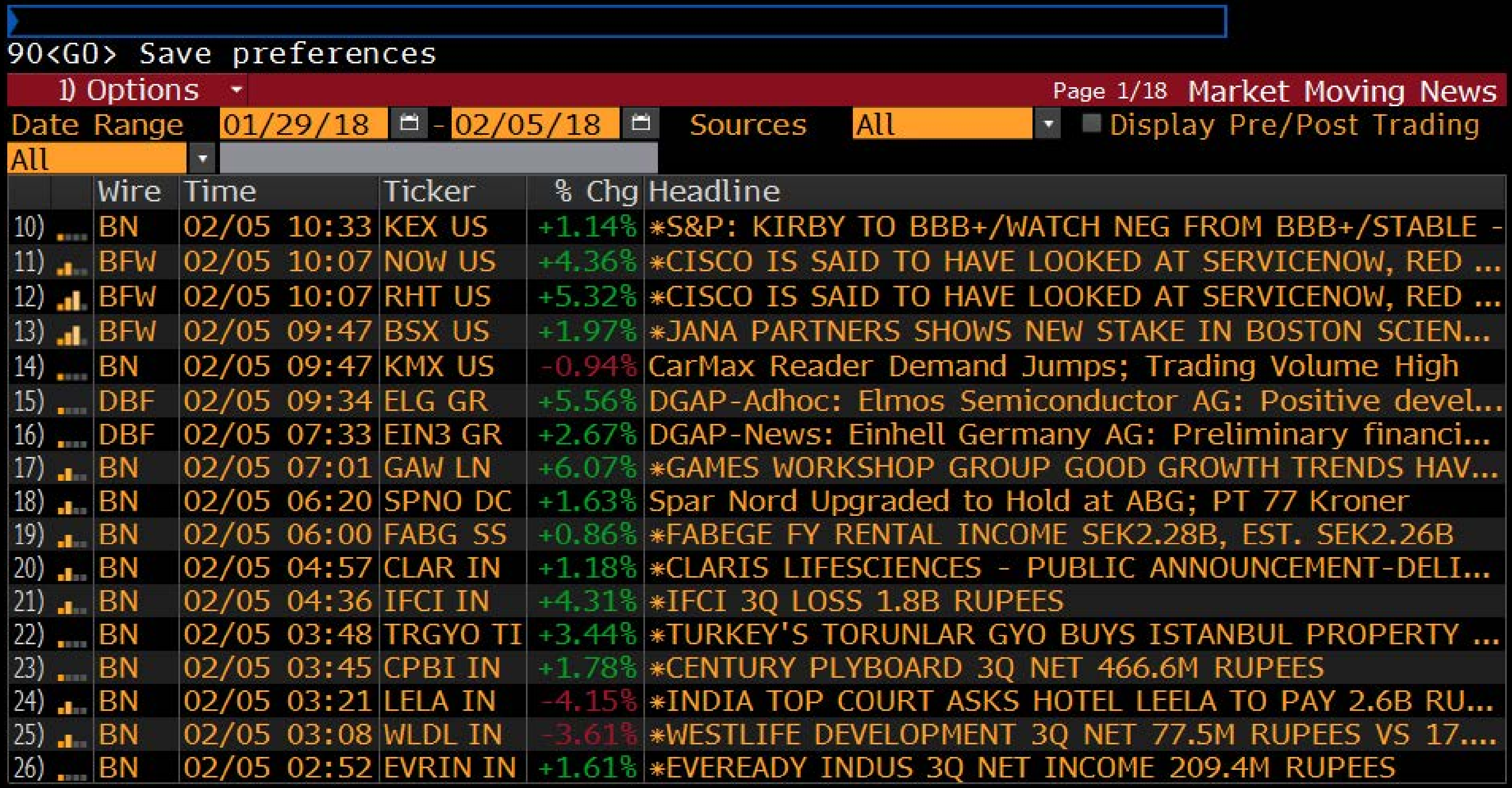
Monitoring News



90<GO> Save preferences

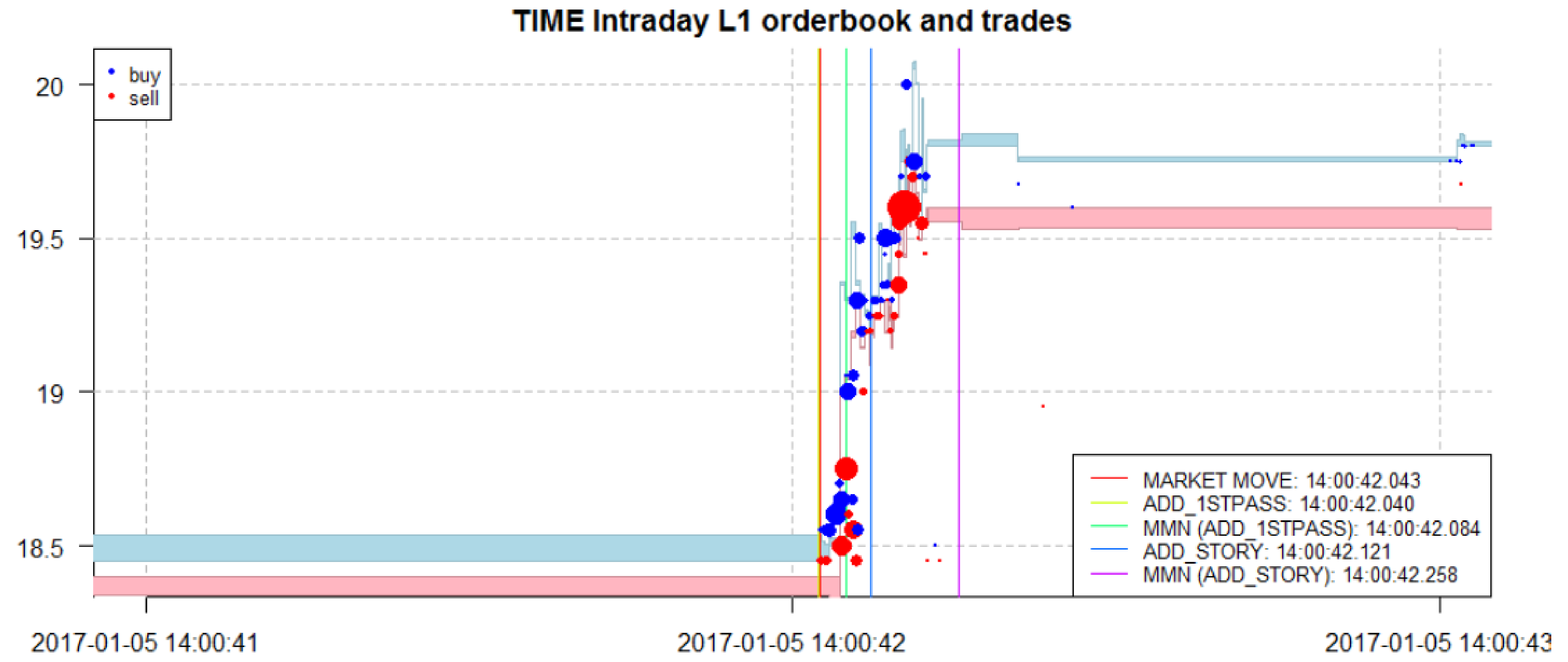
1) Options ▾ | Page 1/18 Market Moving News

Date Range 01/29/18 - 02/05/18 Sources All ▾ ☐ Display Pre/Post Trading

All ▾

	Wire	Time	Ticker	% Chg	Headline
10)	BN	02/05 10:33	KEX US	+1.14%	*S&P: KIRBY TO BBB+/WATCH NEG FROM BBB+/STABLE -
11)	BFW	02/05 10:07	NOW US	+4.36%	*CISCO IS SAID TO HAVE LOOKED AT SERVICENOW, RED ...
12)	BFW	02/05 10:07	RHT US	+5.32%	*CISCO IS SAID TO HAVE LOOKED AT SERVICENOW, RED ...
13)	BFW	02/05 09:47	BSX US	+1.97%	*JANA PARTNERS SHOWS NEW STAKE IN BOSTON SCIEN...
14)	BN	02/05 09:47	KMX US	-0.94%	CarMax Reader Demand Jumps; Trading Volume High
15)	DBF	02/05 09:34	ELG GR	+5.56%	DGAP-Adhoc: Elmos Semiconductor AG: Positive devel...
16)	DBF	02/05 07:33	EIN3 GR	+2.67%	DGAP-News: Einhell Germany AG: Preliminary financi...
17)	BN	02/05 07:01	GAW LN	+6.07%	*GAMES WORKSHOP GROUP GOOD GROWTH TRENDS HAV...
18)	BN	02/05 06:20	SPNO DC	+1.63%	Spar Nord Upgraded to Hold at ABG; PT 77 Kroner
19)	BN	02/05 06:00	FABG SS	+0.86%	*FABEGE FY RENTAL INCOME SEK2.28B, EST. SEK2.26B
20)	BN	02/05 04:57	CLAR IN	+1.18%	*CLARIS LIFESCIENCES - PUBLIC ANNOUNCEMENT-DELI...
21)	BN	02/05 04:36	IFCI IN	+4.31%	*IFCI 3Q LOSS 1.8B RUPEES
22)	BN	02/05 03:48	TRGYO TI	+3.44%	*TURKEY'S TORUNLAR GYO BUYS ISTANBUL PROPERTY ...
23)	BN	02/05 03:45	CPBI IN	+1.78%	*CENTURY PLYBOARD 3Q NET 466.6M RUPEES
24)	BN	02/05 03:21	LELA IN	-4.15%	*INDIA TOP COURT ASKS HOTEL LEELA TO PAY 2.6B RU...
25)	BN	02/05 03:08	WLDL IN	-3.61%	*WESTLIFE DEVELOPMENT 3Q NET 77.5M RUPEES VS 17....
26)	BN	02/05 02:52	EVRIN IN	+1.61%	*EVEREADY INDUS 3Q NET INCOME 209.4M RUPEES

Market Moving News : High Speed Data Feed



Building A Market Moving News Classifier

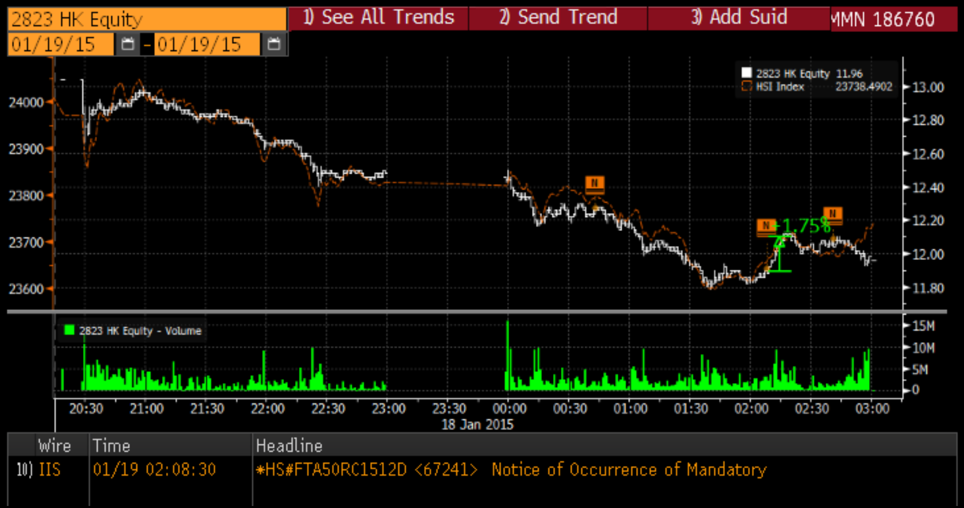
- Supervised learning setup
  - Training data: news stories + positive/negative labels
    - Did this precipitate a price reaction?
    - Positive labels are MMN events
  - Model will provide a probability of price/volume move given a headline

- Defining a positive MMN event
  - What constitutes a market move (anomaly)?
  - Aligning news headlines to that move (relevance)

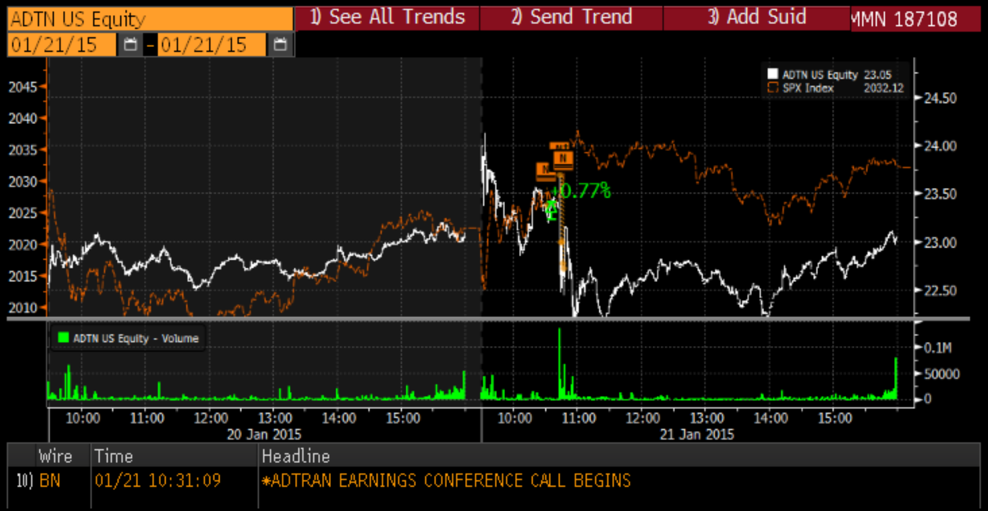
- Find stories tagged with the ticker in the [-5min, +2min] window around the beginning of the anomaly

- +2 minutes because we might not have the breaking story, but might have similar stories

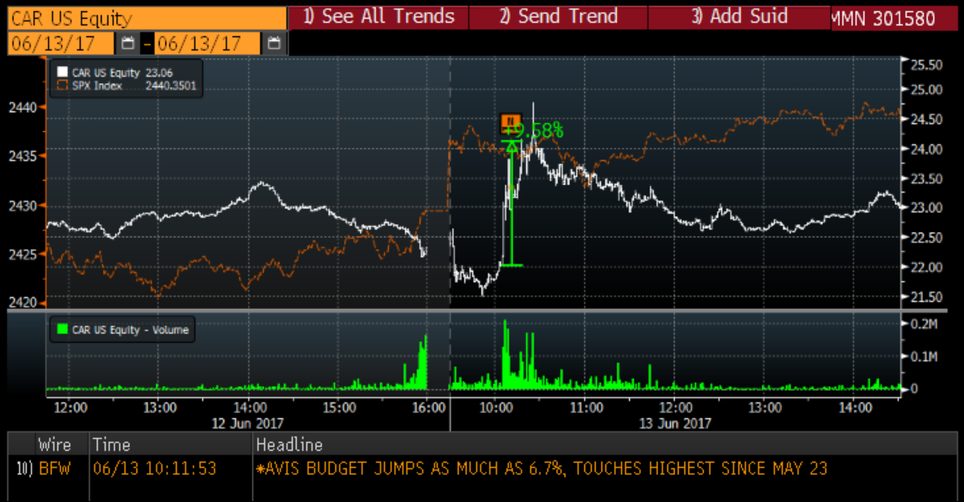
Negative Examples


2823 HK Equity
1) See All Trends
2) Send Trend
3) Add Suid
MMN 186760
01/19/15
01/19/15
2823 HK Equity 11.96
HSI Index 23738.4902
24000
23900
23800
23700
23600
13.00
12.80
12.60
12.40
12.20
12.00
11.80
-1.75%
2823 HK Equity - Volume
15M
10M
5M
0
20:30
21:00
21:30
22:00
22:30
23:00
23:30
00:00
00:30
01:00
01:30
02:00
02:30
03:00
18 Jan 2015

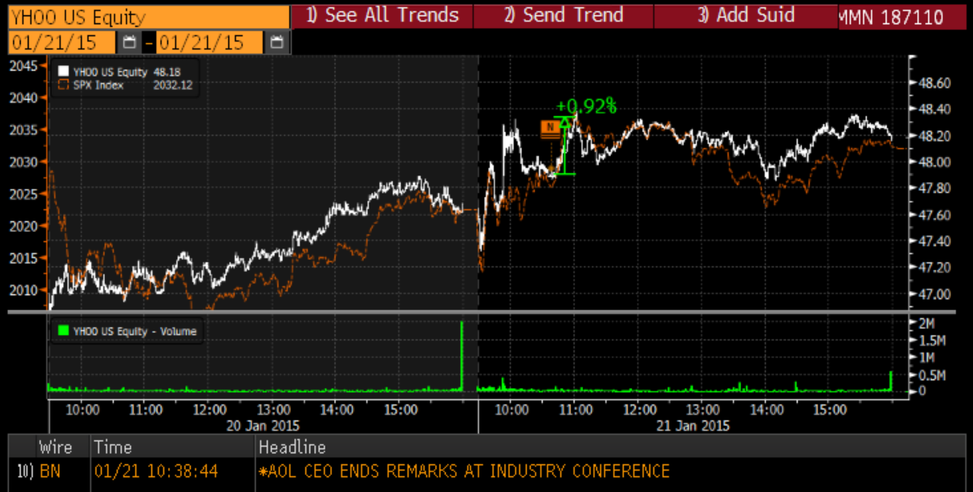
Wire	Time	Headline
10) IIS	01/19 02:08:30	*HS#FTA50RC1512D <67241> Notice of Occurrence of Mandatory


ADTN US Equity
1) See All Trends
2) Send Trend
3) Add Suid
MMN 187108
01/21/15
01/21/15
ADTN US Equity 23.05
SPX Index 2032.12
2045
2040
2035
2030
2025
2020
2015
2010
24.50
24.00
23.50
23.00
22.50
+0.77%
ADTN US Equity - Volume
0.1M
50000
0
10:00
11:00
12:00
13:00
14:00
15:00
20 Jan 2015
10:00
11:00
12:00
13:00
14:00
15:00
21 Jan 2015

Wire	Time	Headline
10) BN	01/21 10:31:09	*ADTRAN EARNINGS CONFERENCE CALL BEGINS


CAR US Equity
1) See All Trends
2) Send Trend
3) Add Suid
MMN 301580
06/13/17
06/13/17
CAR US Equity 23.06
SPX Index 2440.3501
2440
2435
2430
2425
2420
25.50
25.00
24.50
24.00
23.50
23.00
22.50
22.00
21.50
+9.58%
CAR US Equity - Volume
0.2M
0.1M
0
12:00
13:00
14:00
15:00
16:00
12 Jun 2017
10:00
11:00
12:00
13:00
14:00
13 Jun 2017

Wire	Time	Headline
10) BFW	06/13 10:11:53	*AVIS BUDGET JUMPS AS MUCH AS 6.7%, TOUCHES HIGHEST SINCE MAY 23


YHOO US Equity
1) See All Trends
2) Send Trend
3) Add Suid
MMN 187110
01/21/15
01/21/15
YHOO US Equity 48.18
SPX Index 2032.12
2045
2040
2035
2030
2025
2020
2015
2010
48.60
48.40
48.20
48.00
47.80
47.60
47.40
47.20
47.00
+0.92%
YHOO US Equity - Volume
2M
1.5M
1M
0.5M
0
10:00
11:00
12:00
13:00
14:00
15:00
20 Jan 2015
10:00
11:00
12:00
13:00
14:00
15:00
21 Jan 2015

Wire	Time	Headline
10) BN	01/21 10:38:44	*AOL CEO ENDS REMARKS AT INDUSTRY CONFERENCE

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Is this Market Moving News?

*JAPAN POST PRESIDENT SAYS CO. WILL `TONE DOWN' ON M&AS: NIKKEI

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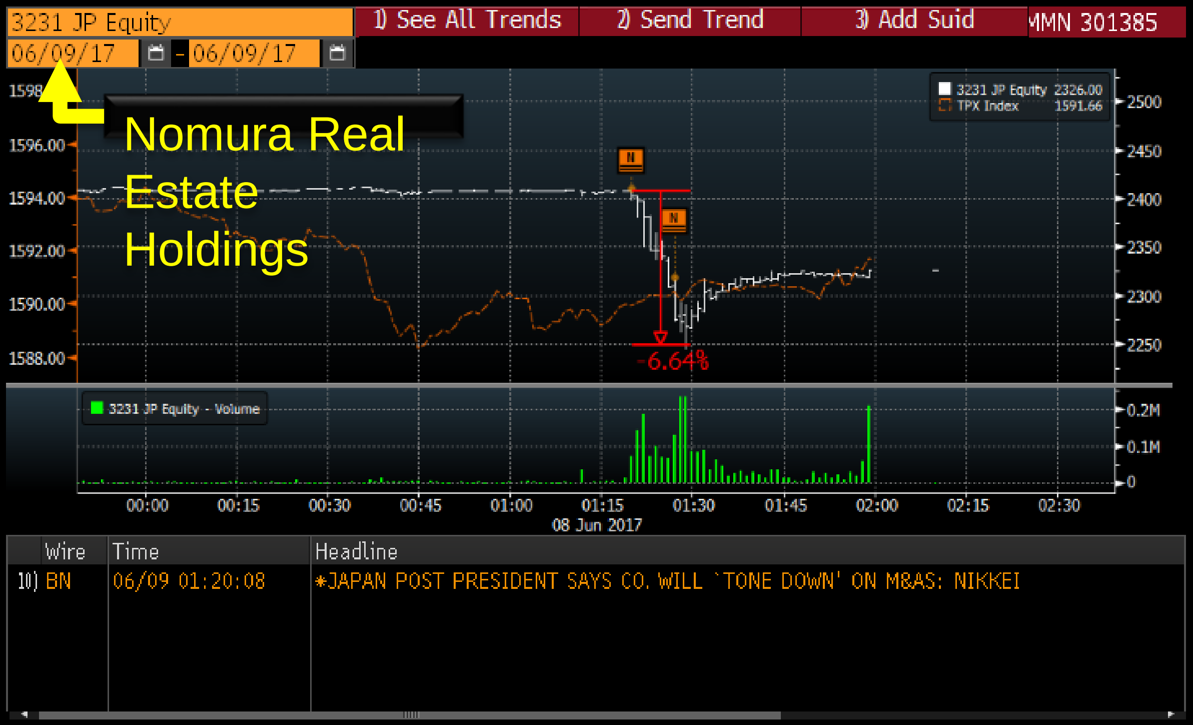
*JAPAN POST PRESIDENT SAYS CO. WILL `TONE DOWN' ON M&AS: NIKKEI

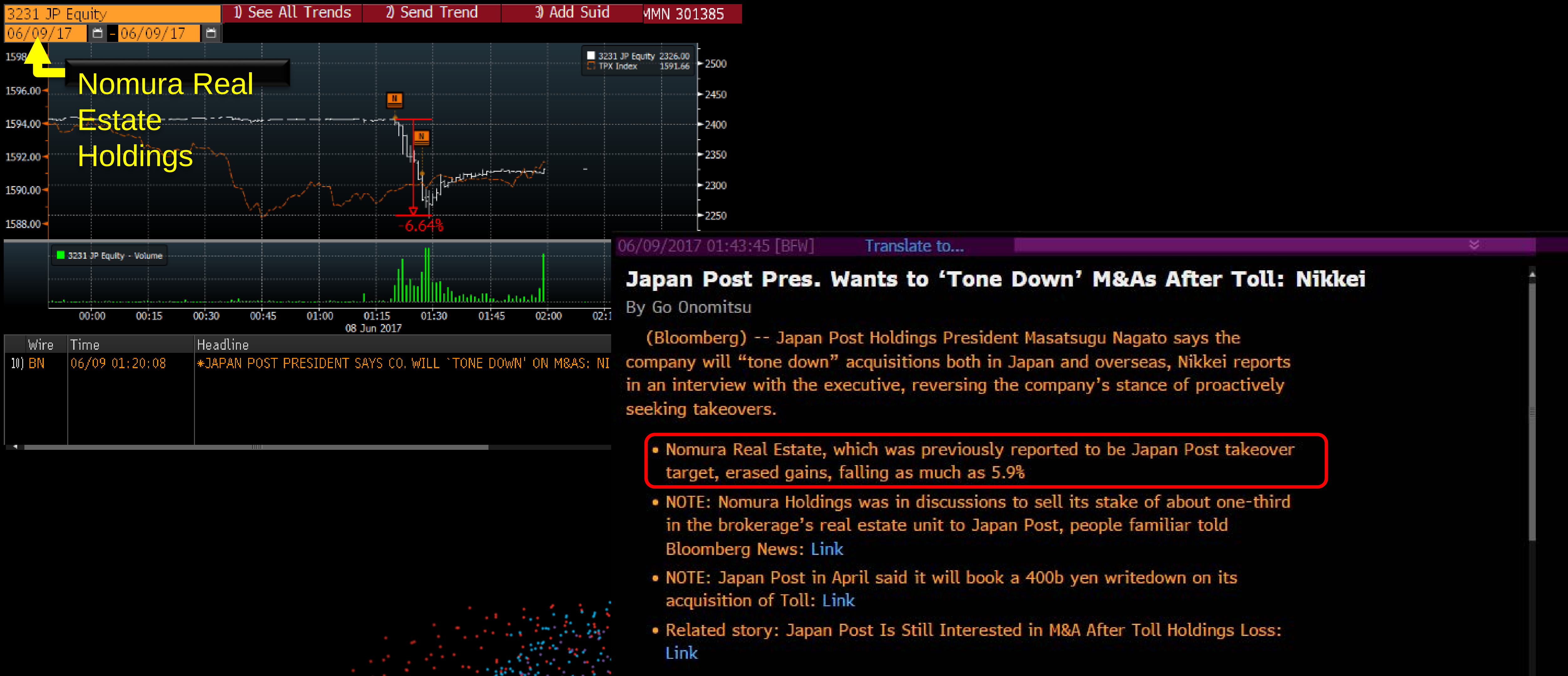

3231 JP Equity
1) See All Trends
2) Send Trend
3) Add Suid
MMN 301385
06/09/17 - 06/09/17
3231 JP Equity 2326.00
TPX Index 1591.66
1598
1596.00
1594.00
1592.00
1590.00
1588.00
2500
2450
2400
2350
2300
2250
N
N
-6.64%
3231 JP Equity - Volume
0.2M
0.1M
0
00:00
00:15
00:30
00:45
01:00
01:15
01:30
01:45
02:00
02:15
02:30
08 Jun 2017

Nomura Real Estate Holdings

	Wire	Time	Headline
10)	BN	06/09 01:20:08	*JAPAN POST PRESIDENT SAYS CO. WILL `TONE DOWN' ON M&AS: NIKKEI

Is this Market Moving News?

*JAPAN POST PRESIDENT SAYS CO. WILL `TONE DOWN' ON M&AS: NIKKEI


3231 JP Equity
1) See All Trends
2) Send Trend
3) Add Suid
MMN 301385
06/09/17 - 06/09/17
Nomura Real Estate Holdings
3231 JP Equity 2326.00
TPX Index 1591.66
1598
1596.00
1594.00
1592.00
1590.00
1588.00
2500
2450
2400
2350
2300
2250
N
N
-6.64%
3231 JP Equity - Volume
00:00
00:15
00:30
00:45
01:00
01:15
01:30
01:45
02:00
02:1
08 Jun 2017
Translate to...

Wire	Time	Headline
10) BN	06/09 01:20:08	*JAPAN POST PRESIDENT SAYS CO. WILL `TONE DOWN' ON M&AS: NI

06/09/2017 01:43:45 [BFW]

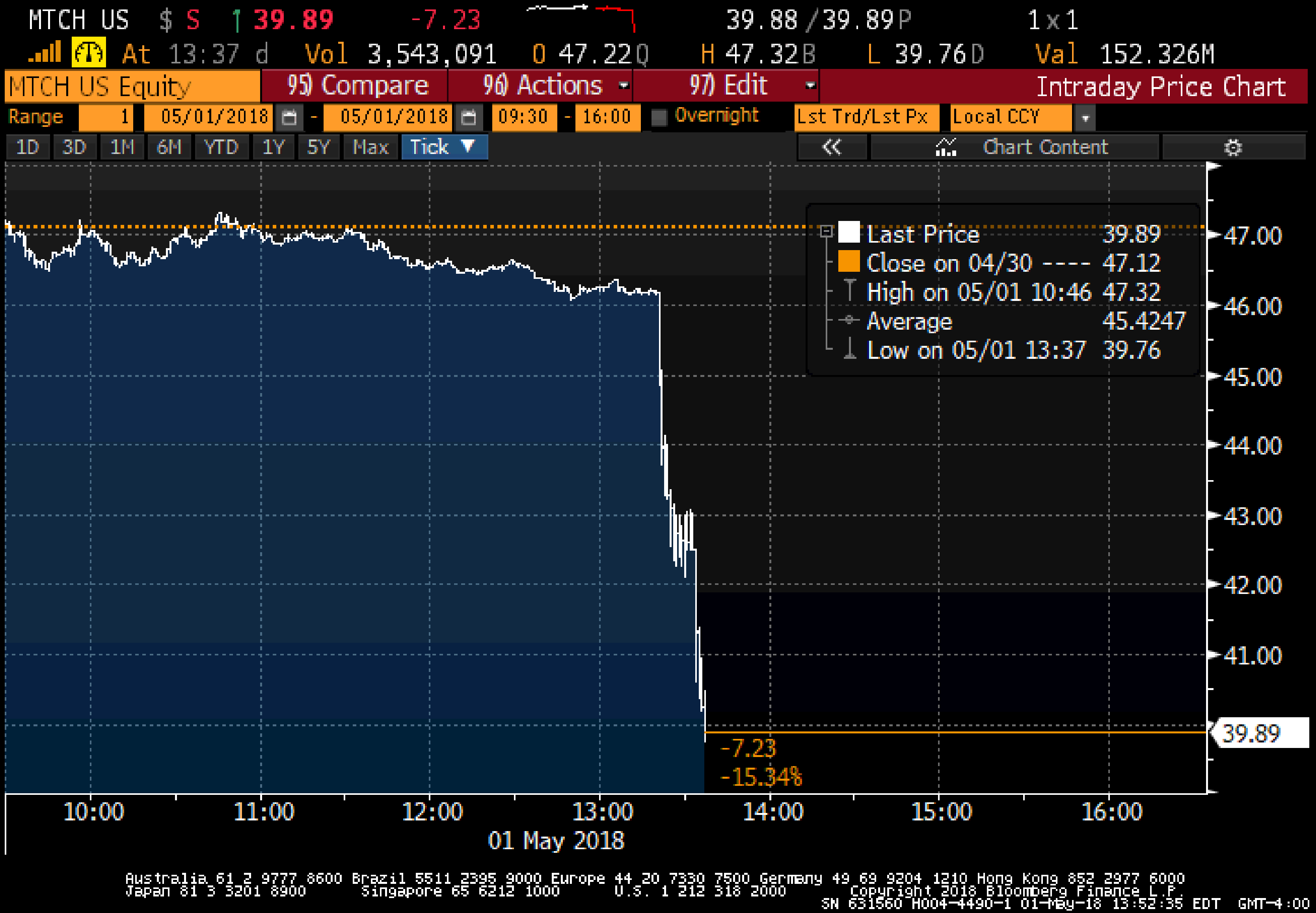
Japan Post Pres. Wants to 'Tone Down' M&As After Toll: Nikkei

By Go Onomitsu

(Bloomberg) -- Japan Post Holdings President Masatsugu Nagato says the company will "tone down" acquisitions both in Japan and overseas, Nikkei reports in an interview with the executive, reversing the company's stance of proactively seeking takeovers.

- Nomura Real Estate, which was previously reported to be Japan Post takeover target, erased gains, falling as much as 5.9%
- NOTE: Nomura Holdings was in discussions to sell its stake of about one-third in the brokerage's real estate unit to Japan Post, people familiar told Bloomberg News: Link
- NOTE: Japan Post in April said it will book a 400b yen writedown on its acquisition of Toll: Link
- Related story: Japan Post Is Still Interested in M&A After Toll Holdings Loss: Link

MTCH from 05/01 – what happened?



MTCH US $ S 39.89 -7.23 39.88/39.89P 1x1

At 13:37 d Vol 3,543,091 O 47.22Q H 47.32B L 39.76D Val 152.326M

MTCH US Equity
95) Compare
96) Actions
97) Edit
Intraday Price Chart

Range 1 05/01/2018 - 05/01/2018 09:30 - 16:00 ☐ Overnight Lst Trd/Lst Px Local CCY

1D
3D
1M
6M
YTD
1Y
5Y
Max
Tick
Chart Content

⬜	Last Price	39.89
🟧	Close on 04/30 ----	47.12
	High on 05/01 10:46	47.32
	Average	45.4247
	Low on 05/01 13:37	39.76

47.00
46.00
45.00
44.00
43.00
42.00
41.00
39.89
-7.23
-15.34%
10:00
11:00
12:00
13:00
14:00
15:00
16:00
01 May 2018

Australia 61 2 9777 8600 Brazil 5511 2395 9000 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2018 Bloomberg Finance L.P.
SN 631560 H004-4490-1 01-May-18 13:52:35 EDT GMT-4:00

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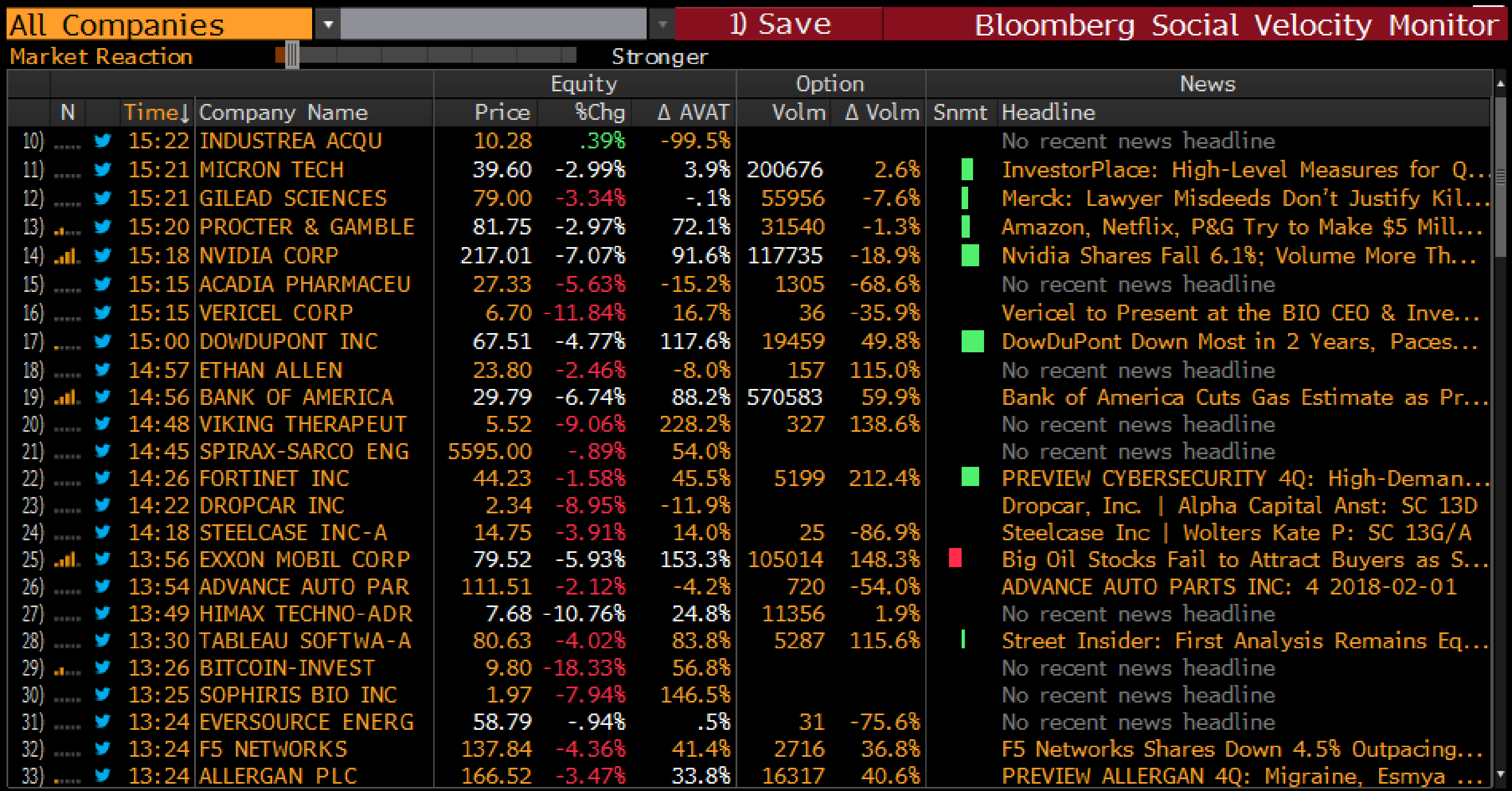
Outline

Natural Documents

News that Moves the Market

Sentiment Signals

Monitoring Sentiment



				Equity			Option		News	
	N	Time↓	Company Name	Price	%Chg	Δ AVAT	Volm	Δ Volm	Snmt	Headline
10)		15:22	INDUSTREA ACQU	10.28	.39%	-99.5%				No recent news headline
11)		15:21	MICRON TECH	39.60	-2.99%	3.9%	200676	2.6%	🟩	InvestorPlace: High-Level Measures for Q...
12)		15:21	GILEAD SCIENCES	79.00	-3.34%	-.1%	55956	-7.6%	🟩	Merck: Lawyer Misdeeds Don’t Justify Kil...
13)		15:20	PROCTER & GAMBLE	81.75	-2.97%	72.1%	31540	-1.3%	🟩	Amazon, Netflix, P&G Try to Make $5 Mill...
14)		15:18	NVIDIA CORP	217.01	-7.07%	91.6%	117735	-18.9%	🟩	Nvidia Shares Fall 6.1%; Volume More Th...
15)		15:15	ACADIA PHARMACEU	27.33	-5.63%	-15.2%	1305	-68.6%		No recent news headline
16)		15:15	VERICEL CORP	6.70	-11.84%	16.7%	36	-35.9%		Vericel to Present at the BIO CEO & Inve...
17)		15:00	DOWDUPONT INC	67.51	-4.77%	117.6%	19459	49.8%	🟩	DowDuPont Down Most in 2 Years, Paces...
18)		14:57	ETHAN ALLEN	23.80	-2.46%	-8.0%	157	115.0%		No recent news headline
19)		14:56	BANK OF AMERICA	29.79	-6.74%	88.2%	570583	59.9%		Bank of America Cuts Gas Estimate as Pr...
20)		14:48	VIKING THERAPEUT	5.52	-9.06%	228.2%	327	138.6%		No recent news headline
21)		14:45	SPIRAX-SARCO ENG	5595.00	-.89%	54.0%				No recent news headline
22)		14:26	FORTINET INC	44.23	-1.58%	45.5%	5199	212.4%	🟩	PREVIEW CYBERSECURITY 4Q: High-Deman...
23)		14:22	DROPCAR INC	2.34	-8.95%	-11.9%				Dropcar, Inc. | Alpha Capital Anst: SC 13D
24)		14:18	STEELCASE INC-A	14.75	-3.91%	14.0%	25	-86.9%		Steelcase Inc | Wolters Kate P: SC 13G/A
25)		13:56	EXXON MOBIL CORP	79.52	-5.93%	153.3%	105014	148.3%	🟥	Big Oil Stocks Fail to Attract Buyers as S...
26)		13:54	ADVANCE AUTO PAR	111.51	-2.12%	-4.2%	720	-54.0%		ADVANCE AUTO PARTS INC: 4 2018-02-01
27)		13:49	HIMAX TECHNO-ADR	7.68	-10.76%	24.8%	11356	1.9%		No recent news headline
28)		13:30	TABLEAU SOFTWA-A	80.63	-4.02%	83.8%	5287	115.6%	🟩	Street Insider: First Analysis Remains Eq...
29)		13:26	BITCOIN-INVEST	9.80	-18.33%	56.8%				No recent news headline
30)		13:25	SOPHIRIS BIO INC	1.97	-7.94%	146.5%				No recent news headline
31)		13:24	EVERSOURCE ENERG	58.79	-.94%	.5%	31	-75.6%		No recent news headline
32)		13:24	F5 NETWORKS	137.84	-4.36%	41.4%	2716	36.8%		F5 Networks Shares Down 4.5% Outpacing...
33)		13:24	ALLERGAN PLC	166.52	-3.47%	33.8%	16317	40.6%		PREVIEW ALLERGAN 4Q: Migraine, Esmya ...

Sentiment Analysis

Sentiment analytics data is provided in two ways:

1. **Story-level sentiment**
   - Generated in real time upon the arrival of news stories or tweets
   - Score: 1 for positive, -1 for negative, and 0 for neutral
   - We generate three way confidences - interpreted as probability

2. **Company level sentiment**
   - Weighted average of story-level sentiments – aggregated at daily and intra-day intervals

Sentiment Aggregation Methods

We take all stories tagged with a particular company:

1. Each news story or tweet is scored with “confidences” C_+, C_-, C_n for positive, negative and neutral sentiment respectively
2. Story specific sentiment (polarity score): $S^i = C_+^i - C_-^i$
3. Sentiment Average:

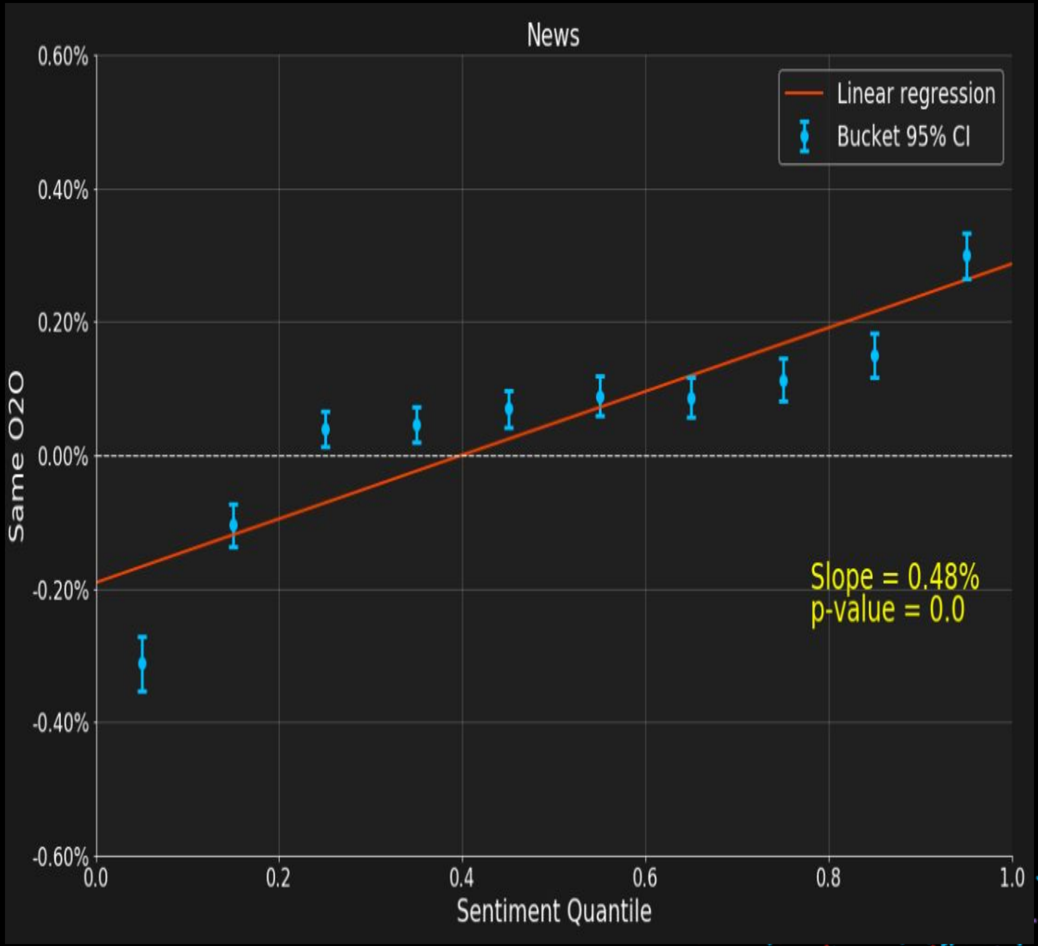
$$\mu = \frac{\sum_{i=1}^{N} S^i}{N} = \frac{\sum_{i=1}^{N}(C_+^i - C_-^i)}{N} = \overline{C_+} - \overline{C_-}$$

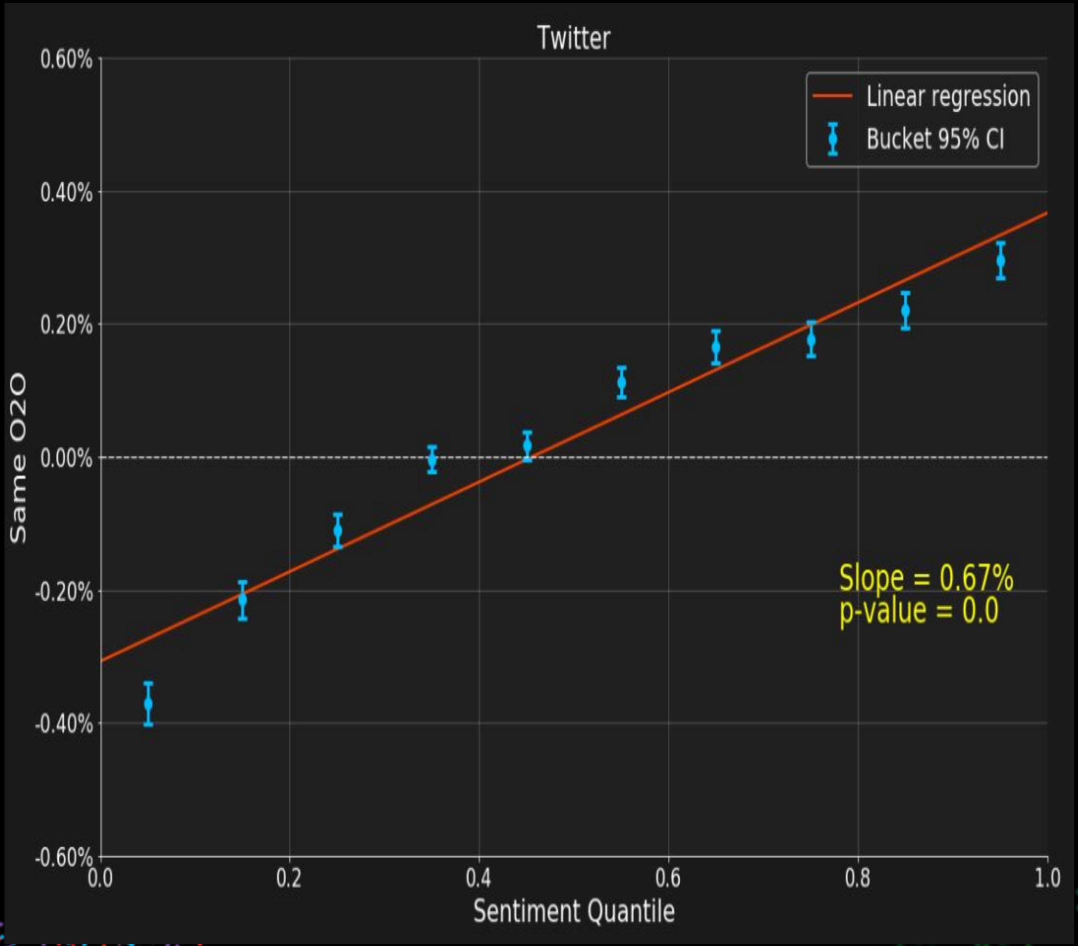
4. Sentiment dispersion = Inter-story variance + story-specific dispersion

Simplifies to: $\overline{C_+} + \overline{C_-} - \mu^2$

Sentiment vs. Contemporaneous Return

The daily sentiment score is constructed using story level sentiment data over the 24 hours period, and calculated around 9:05 AM every day





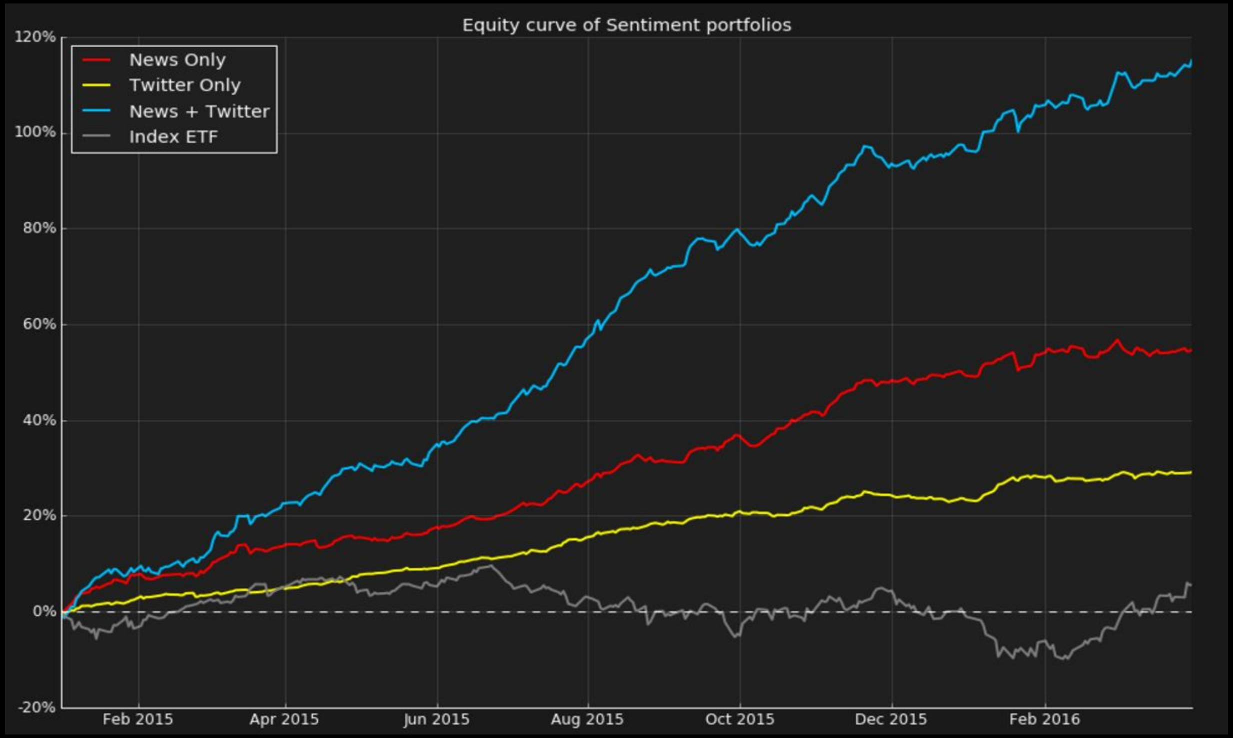
Strategy: Daily long-short

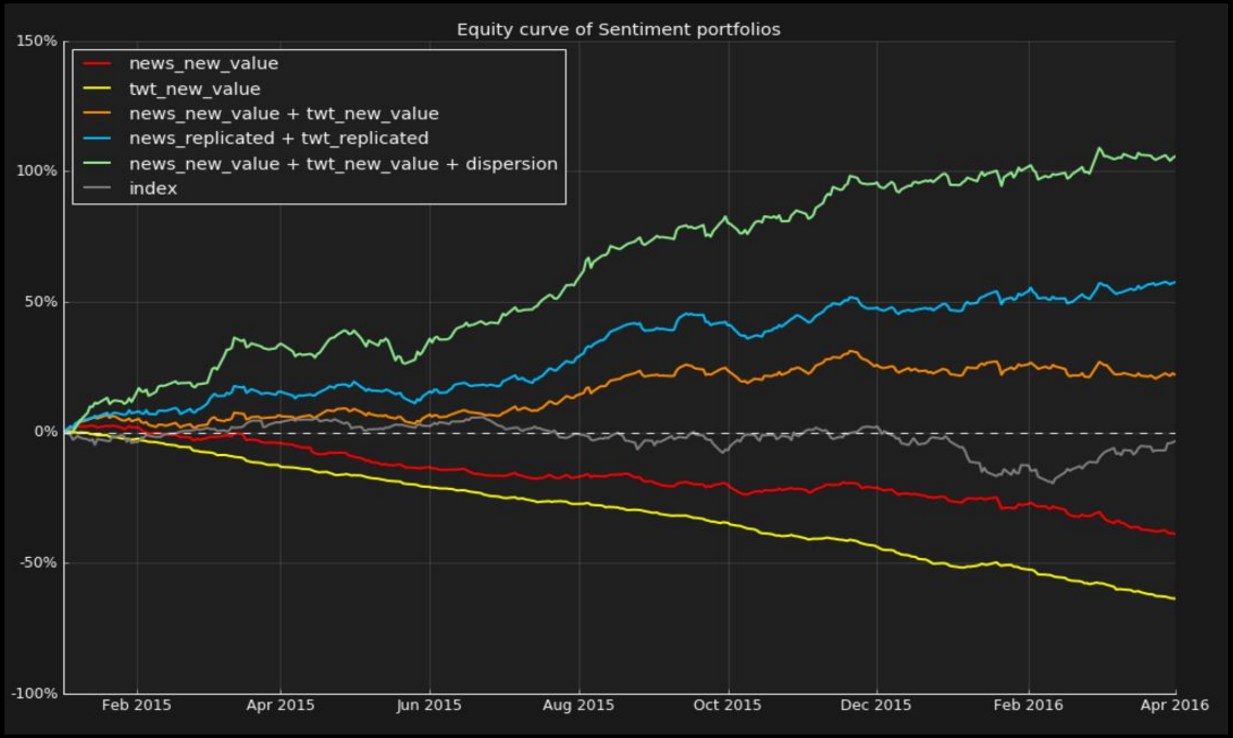
Does the market efficiently price in sentiment information?

- Strategy
  - Each day before market open, rank all stocks by their daily sentiment
  - Three variations:
    1. **HML 1/3:** Long top 1/3 and short bottom 1/3 stocks
    2. **HML 5%:** Long top 5% and short bottom 5% stocks
    3. **Prop:** Positions proportional to the difference of sentiment scores from its cross-sectional mean
  - Create portfolio at market open and close out at market close

We backtest the strategy for Russell 2000 stocks from Jan-01-2015 to Jul-31-2016

Russell 2000 – combining news and social





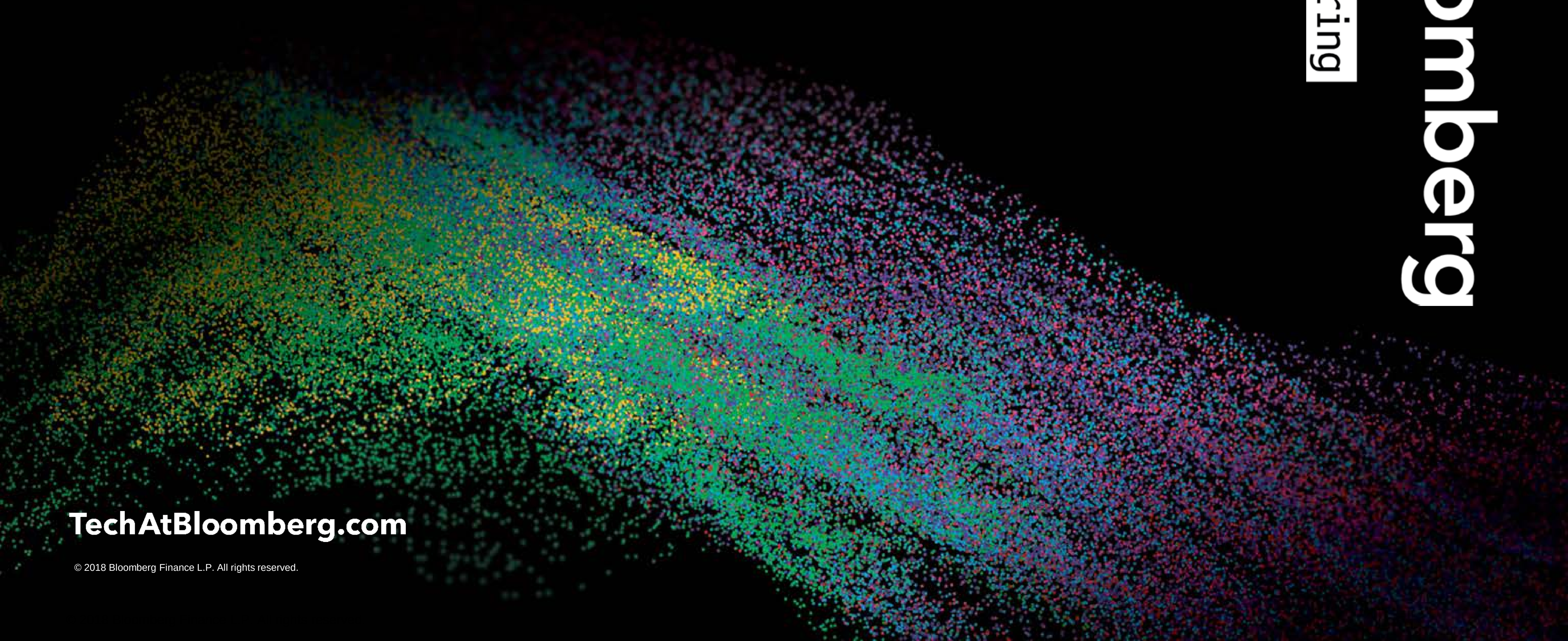
With Transaction Costs

More Broadly

Data for Good Exchange & CPEDS

Shift Commission on Work, Workers, and Technology

Thank You!



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