Local Information Advantage and Stock Returns — Evidence from Social Media [1]

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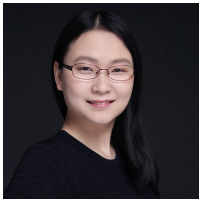

Yuqin Huang (CUFE)

Feng Li (PKU)

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Do we share anything in common?

Outline

My research focus

I **tackle large scale forecasting challenges** by developing

- AI driven forecasting methods for large spatial structures,
- detecting for non-structural, noisy and intermittent signals in spatialtemporal data,
- efficient forecast combination and reconciliation methods, and
- open source solutions for large scale data.

Spatial information asymmetry for stock forecasting: a tale of two tastes

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NEWS

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Asia | China | India

KFC sues Chinese firms over eight-legged chicken rumours

1 June 2015

KFC has over 4,000 restaurants in China

Spatial information asymmetry for stock forecasting: a tale of two tastes

阅读	评论	标题	作者	发帖时间
1281	5	上海机场、首都机场最新免税补充协议解读1228	相守湖畔	12-29 12:19
1575	2	中免跟上海机场的协议又重签了	乔令财经	12-28 08:55
536	0	上海机场(600009)：7家机构给予"买入"评级——签订免税补充协…	研报快读	12-28 14:16
2690	29	用数据说话	鳌江李二段	12-27 20:11
2119	11	浦东国际机场11月飞机起降量39170架次，同比增长126.26%；…	生意善贾田头草民	12-20 09:59
1440	4	外资成本这么低的吗	yuhun4248	12-20 17:37
1771	4	您还记得"2021年8月11的上海机场"吗?	北京四个石头	12-18 21:59
2112	21	随笔：又一天	看晚霞的无业游民	12-18 15:32
1117	5	民众愤怒：上海机场"区别对待"事件引发网络热议黔S2023-12-1…	股友329uZ99585	12-15 15:01
343	1	上海机场：浦东国际机场11月旅客量同比增长307%	完美的leng	12-14 15:41
1973	6	哈哈，还有故人么?	懒懒的看股	12-09 22:55
3455	12	营收增速翻倍，上海机场摆脱困境，这位置我已经看不懂了	地铁悟道第一人	12-08 17:11
2732	6	明年上机业绩会大幅度增长，按理说机构应该买入做预期，可明…	忠实的海勒	12-04 17:32
976	4	9家机构给予"买入"评级——旺季营收维持高增，盈利水平修复持续	研报快读	11-28 14:46
537	1	申能携手上海机场，绿色能源双丰收!	动态宝	11-24 17:25

Local investors and information advantage

- Local investors may enjoy an information advantage by gaining access to information earlier that distant investors (Chi & Shanthikumar, 2017).
- After receiving information about a firm, local investors may want to communicate more with others about this particular stock (Hirshleifer, 2020).
- The relative intensity of investors' posting activities likely reflects local investors' information advantage (Ferreira et al., 2017) .

Abnormal posting measure

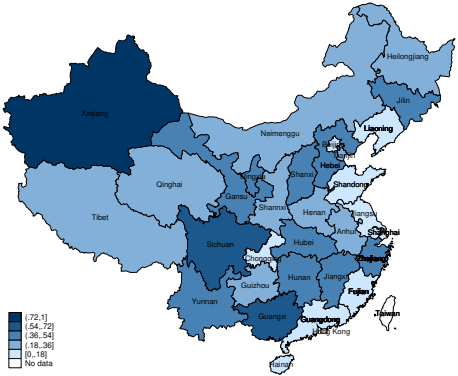
- We define **relative postings** (RP) to measure the relative strength of posting activities by locals and nonlocals. For firm i headquartered in city c, its relative postings measure in week t is calculated as:

$$RP_{i_c,t} = \ln\left(1 + P^{c}_{i_c,t}\right) - \ln\left(1 + P^{-c}_{i_c,t}\right)$$

  where $P^{c}_{i_c,t}$ ($P^{-c}_{i_c,t}$) is local (nonlocal) postings, that is, the total number of messages posted in week t by investors in (outside) city c.
- RP has a conceptional similarity to TF-IDF (Term Frequency-Inverse Document Frequency) in the NLP domain.
- To measure unusual changes in relative postings, we construct **abnormal relative postings** (ARP)

$$ARP_{i_c,t} = RP_{i_c,t} - \text{median}\left(RP_{i_c,t-1}, RP_{i_c,t-2}, \cdots, RP_{i_c,t-10}\right)$$

ARP-based portfolio performance



- Firms in every province are sorted into quintile portfolios based on their ARP measure.
- ARP-based trading strategy is more profitable in under-developed inland regions where firms are relatively opaque.

Forecast the excess return

- We forecast the excess return with Fama & MacBeth (1973) models

$$\boldsymbol{R}_{i,c,t+1} = \alpha + \beta \boldsymbol{ARP}_{i,c,t} + \delta \boldsymbol{X}_{i,t} + \epsilon_{i,t+1}$$

  by identifying $\boldsymbol{ARP}_{i,t}$ (**abnormal relative postings**) of firm i in week t related to its headquartered city c; and $\boldsymbol{X}_{i,t}$ is a vector of **firm-level characteristics**.
- Complex forecasting models with similar firm-level variables have been used (Li et al., 2010; Villani et al., 2012; Li & Villani, 2013) but are computationally intensive.

Forecasting at scale: the new normal

- **Large scale data generally require distributed solutions**.
  - IP address, city and firm match for each post is a standard MapReduce task.
  - Both RP and ARP calculations require iterating over all 300 million text data.
  - Without a distributed solution, this work would take weeks to finish (Just reading the 130 GB data into memory takes one hour).
- **Many simple models ensemble a powerful solution** instead of one complex model for everything.
- **Interpretability counts** when choosing appropriate models.

Variable	Definition
Posting Variables	
RP	Relative postings, defined as the logarithm of one plus the number of messages from local posters minus the logarith one plus the number of messages from nonlocal posters
ARP	Abnormal relative postings, defined as relative postings for a firm in one week minus the median value of its relative pos in the previous ten weeks
Other Variables	
AG	Asset growth, defined as the annual growth rate of total assets
ALMedia	Abnormal local media coverage, defined as local media coverage on a firm in a given week minus the median value local media coverage in the previous ten weeks
BM	Book-to-market ratio, defined as the book value of equity divided by market value of equity
EmpShare	Share of industry employees, defined as the total number of employees in an industry in a given city divided by the number of employees in the city
ILLIQ	Illiquidity measure, defined as the weekly average of the ratio of absolute daily price change to daily trading volume
IO	Institutional ownership, defined as percentage of shares outstanding owned by institutional investors
IVOL	Idiosyncratic volatility, defined as the standard deviation of residuals from the Carhart (1997) four-factor model
Log(Analysts)	Analyst coverage, defined as logarithm of one plus the number of analysts covering the firm in a given week
Log(GDP)	Logarithm of annual GDP per capita (RMB) of a city
NPR	Net purchase ratio, defined as the number of purchases minus the number of sales divided by the total number of transac by managers and large shareholders of a firm in a given week
PopDensity	Population density of the firm's headquarters city
$\text{Ret}_{t-4:t-1}$	Cumulative return from week $t-4$ to week $t-1$
$\text{Ret}_{t-52:t-5}$	Cumulative return from week $t-52$ to week $t-5$
ROA	Return on assets, defined as net income divided by total assets

	Ret_{t+1}			Ret_{t+2}	Ret_{t+4}	Ret_{t+6}	Ret_{t+8}	Ret_{t+12}
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ARP	0.91***	0.86***	0.81***	0.39***	0.38**	0.06	0.13	0.05
	(5.51)	(5.61)	(5.39)	(2.88)	(2.57)	(0.36)	(0.94)	(0.32)
Size		−0.14***	−0.05	−0.09*	−0.09*	−0.05	−0.08	−0.06
		(−3.11)	(−1.01)	(−1.72)	(−1.77)	(−1.12)	(−1.65)	(−1.33)
BM		0.06	0.04	−0.02	0.02	−0.00	−0.01	0.00
		(0.92)	(0.75)	(−0.29)	(0.34)	(−0.07)	(−0.14)	(0.04)
$Ret_{t-4:t-1}$		−0.05***	−0.03***	−0.05***	−0.04***	−0.02**	−0.02**	−0.01
		(−3.99)	(−2.95)	(−4.39)	(−3.87)	(−2.57)	(−2.18)	(−0.89)
$Ret_{t-52:t-5}$		−0.07***	−0.04	−0.04*	−0.05*	−0.04	−0.06**	−0.06*
		(−2.72)	(−1.49)	(−1.67)	(−1.71)	(−1.53)	(−2.12)	(−1.92)
AG			−0.06	−0.06	−0.11**	−0.15***	−0.16***	−0.14***
			(−1.18)	(−1.51)	(−2.56)	(−3.37)	(−4.13)	(−3.32)
ROA			0.10	−0.06	−0.62	−0.68	−0.40	−0.45
			(0.22)	(−0.13)	(−1.43)	(−1.46)	(−0.91)	(−0.99)
IVOL			−0.13***	−0.08**	−0.03	−0.03	−0.01	−0.03
			(−3.57)	(−2.22)	(−0.99)	(−0.81)	(−0.24)	(−0.85)
ILLIQ			0.38***	0.18***	0.11**	0.16***	0.07**	0.14***
			(8.09)	(4.80)	(2.42)	(3.62)	(1.98)	(3.93)
(Other variables truncated ...)								
Intercept	−0.06	0.91	0.44	0.82	1.06	0.47	0.86	0.80
	(−0.18)	(1.63)	(0.67)	(1.16)	(1.47)	(0.69)	(1.23)	(1.17)
Obs	303,361	303,361	303,361	293,425	279,472	275,838	272,375	265,509
Adj. R^2	0.05%	3.60%	6.39%	5.90%	5.67%	5.27%	5.07%	5.00%

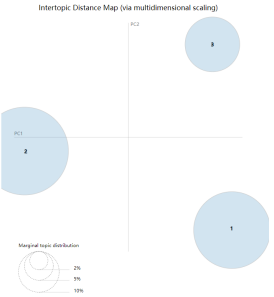
Sentiment in stock markets

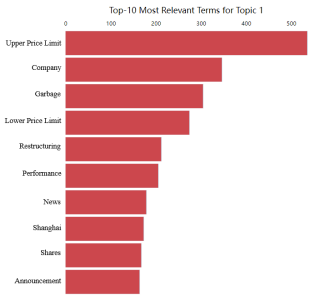
Sentiment of local and nonlocal postings

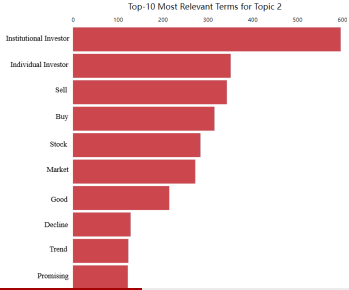
- **The sentiment score is efficiently calculated with the distributed MapReduce framework**.
- We first segment each sentence in a posting into words. Next, we identify sentiment words based on a prespecified sentiment dictionary.
- For words with a positive (negative) tone, we assign a base score of 1(-1). The base score is further weighted according to its modifier words, with weights of 4, 3, 2, and 0.5 for the extreme, strong, moderate, and mild degrees, respectively.
- If a negative word precedes a key sentiment word, we multiply the weighted sentiment score by -1.

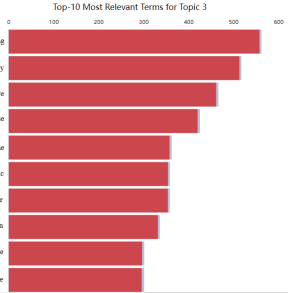
Year	Local Post Sentiment	Non-local Post Sentiment	Local – Non-local	p value
2007	0.0303	0.0155	0.0148***	0.000
2008	0.0383	0.0216	0.0167***	0.000
2009	0.0319	0.0160	0.0160***	0.000
2010	0.0533	0.0451	0.0083***	0.000
2011	0.1107	0.0646	0.0461***	0.000
2012	0.1556	0.0894	0.0662***	0.000
2013	0.1357	0.1063	0.0294***	0.000
All	0.0902	0.0541	0.0361***	0.000

Topical analysis of local posts

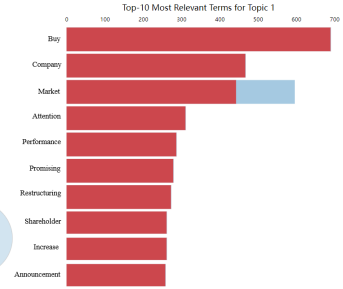


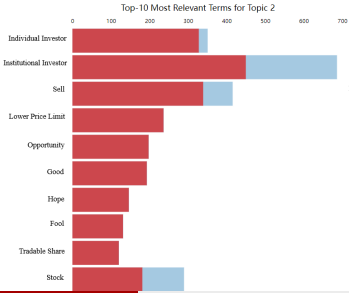


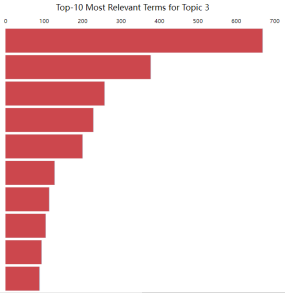




Topical analysis of nonlocal posts







```
# Trains a LDA model with Spark.
from pyspark.ml.clustering import LDA
# Loads data.
dataset = spark.read.format("csv").load("stockdata/*.csv")
lda = LDA(k=4, maxIter=100)
model = lda.fit(dataset)
ll = model.logLikelihood(dataset)
lp = model.logPerplexity(dataset)
# Describe topics.
topics = model.describeTopics(3)
print("The topics described by their top-weighted terms:")
topics.show(truncate=False)
# Shows the result
transformed = model.transform(dataset)
transformed.show(truncate=False)
```

Stock returns: messages with different topics

Topic	Fundamentals (1)	Trading (2)	Noises (3)	Insider (4)
ARP	1.18***	0.68***	0.80	0.33
	(5.96)	(3.08)	(0.19)	(1.47)
Size	-0.05	-0.05	-0.05	-0.05
	(-1.05)	(-1.08)	(-0.99)	(-1.03)
BM	0.05	0.05	0.04	0.05
	(0.84)	(0.82)	(0.79)	(0.83)
$Ret_{t-4:t-1}$	-0.03***	-0.03***	-0.04***	-0.03***
	(-2.84)	(-2.81)	(-3.05)	(-2.95)
$Ret_{t-52:t-5}$	-0.04	-0.04	-0.04	-0.04
	(-1.60)	(-1.57)	(-1.51)	(-1.56)
AG	-0.06	-0.06	-0.06	-0.06
	(-1.21)	(-1.25)	(-1.16)	(-1.12)
ROA	0.12	0.11	0.12	0.10
	(0.26)	(0.25)	(0.25)	(0.23)
IVOL	-0.13***	-0.13***	-0.13***	-0.13***
	(-3.57)	(-3.53)	(-3.56)	(-3.52)
ILLIQ	0.38***	0.38***	0.38***	0.38***
	(8.17)	(8.16)	(8.23)	(8.15)
IO	0.04	0.04	0.04	0.04
	(0.27)	(0.29)	(0.25)	(0.24)
NPR	0.33*	0.35**	0.36**	0.36**
	(1.91)	(2.03)	(2.09)	(2.12)
(Other variables truncated ...)				
Intercept	0.42	0.44	0.43	0.42
	(0.65)	(0.67)	(0.65)	(0.64)
Obs	303,361	303,361	303,361	303,361
Adj. R^2	6.45%	6.45%	6.39%	6.39%

Parallel processing

```
#!/bin/bash -l

#SBATCH -J Stocks
#SBATCH -n 6          # Number of nodes
#SBATCH -p MCMC       # Partition Used.
#SBATCH -t 10-00:00 # Runtime in D-HH:MM
#SBATCH --mail-type=FAIL
#SBATCH --mail-user=feng.li@cufe.edu.cn
#SBATCH --array=1-100%16 # Run a job array

for STOCK in shanghai shenzhen chuangyeban zhongxiaoban
do
    srun python3 main.py ${STOCK} ${STOCK}.csv  $SLURM_ARRAY_TASK_ID
done
```

Working in progress

- Financial forecasting
  - Spatial information for local and nonlocal to hierarchy with neighborhoods.
  - Financial forecasting with unconscious biases.
- Forecasting methods
  - Infinite forecasting combinations
  - Forecasting with latent hierarchical structures

Thank you!

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