Risk that Reads

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1. Either what I am about to say is wrong, or profound
2. Biggest step forward in risk modeling for asset management since the creation of the multi-factor risk model in the 1970s.

Outline

1. Observations
2. Motivation/Applications
3. Quick Lit review
4. Adding news
5. Nothfield's Risk that Reads.
6. the end

Observations

Standard practice

1. Almost all are unconditional.
   (But today is not like every other day)
2. Windows or ewma of 60 days to $>$ 20 years.
3. Omits what we know about how the present is different from the past.

Observations

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Some complications

1. Volatility is unobserved. This complicates forecasts.
2. Persistance, mean reverting
3. Innovations may have an asymmetric impact on volatility
4. Exogenous variables may influence volatility
5. tails

Motivation

1. Missing is the conditional information set.
2. News explicitly as the information set that informs us of how the present is different from the past, we can improve our estimates of near time horizon risk levels

Working definition

News

The set of information coming to investors that tell us how the present is different from the past.

Announcements

Information that arrives on schedule. Volume and volatility are quiet just before and rise to adjust on arrival.

News news

Volume and volatility are unaware.

Applications

1. HFT and optimal execution algos
2. Prop desk and high turnover HF
3. Trading overlay on lower freq
4. Compliance Credit and counterparty
5. Compliance UCITs

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Northfield research indicates that conditioning with news can account for 10-15% of changes in portfolio risk estimates for horizons as far out as one year.

Lit: diBartolomeo, D. and Warrick, S. 2005

Making covariance based portfolio risk models sensitive to the rate at which markets reflect new information

- Option implied vol adjustments to stock vol
- security specific and factor adjustment
- idiosyncratic or industry factor
- Intuitive results after 11 September 2001

Lit: Hu, Pan and Wang, 2013

Early Peek Advantage?

- 2007 to 2013 Michigan survey released 2 seconds early
- E-mini S&P 500 futures trading
- 1,473 contracts per second at 9:54:58, (124 normally)
- drops 261 at 9:54:59
- price drift is zero after 14-16 ms

Lit: Kyle, Obizhaeva, Sinha and Tuzun (2012)

News Articles and the Invariance Hypothesis

- $W \doteq P \cdot V \cdot \sigma$ captures the amount of risk transfer taking place in the market in a day
- illiquidity $= \frac{1}{L_{jt}} = \left(\frac{C \cdot \sigma_{jt}^2}{m^2 \cdot P_{jt} \cdot V_{jt}} \right)^{1/3}$
- Business time $= \gamma_{jt} = \frac{\sigma_{jt}^2 \cdot L_{jt}^2}{m^2} = \left(\frac{W_{jt}}{m \cdot C} \right)^{2/3}$ number of bets time
- where $P_{jt} \cdot V_{jt}$ = dollar volume, σ_{jt} volatility, C (dollars) and m^2 (dimenisonless) scaling constants
- $\mu = \mu^* \cdot \left(\frac{W}{W^*} \right)^{\gamma}$ expected arrival rate of news.

Lit: Kyle, Obizhaeva, Sinha and Tuzun (2012)

News Articles and the Invariance Hypothesis

- Business time $= \gamma_{jt} = \frac{\sigma_{jt}^2 \cdot L_{jt}^2}{m^2} = \left(\frac{W_{jt}}{m \cdot C}\right)^{2/3}$ number of bets per time
- $\mu = \mu^* \cdot \left(\frac{W}{W^*}\right)^{\gamma}$
- invariance hypothesis - risk transferred is constant per unit of business time (not calendar time)
- Market microstructure invariance says C and m^2 are invariant constants, same for all assets
- $\gamma = 2/3$ empically estimated as .68
- Related papers show how to predict bid/asked spreads, trading costs

Lit: ABCD 2005

Practical Volatility and Correlation Modeling for Financial Market Risk Management Review the econometrics of volatility and correlation modeling stressing

- Aggregate portfolio level and asset level modeling. Noting that risk measurement generally only requires a portfolio level model, whereas risk management requires asset level modeling.
- They are quite direct in stating - for most financial risk management purposes, the conditional perspective is exclusively relevant...
- Their emphasis is on the use of higher frequency data in measuring volatility.

Lit: ABCD 2005

Practical Volatility and Correlation Modeling for Financial Market Risk Management We remind the reader of what Anderson, Bollerslev, Christofferson and Diebold stated as the prize:

> *The near log-normality of realized volatility, together with the near-normality of returns standardized by realized volatility, holds promise for relatively simple-to-implement lognormal-normal mixture models in financial risk management.*

Lit Heterogenous Autoregressive model of Realized Volatility Corsi (2003)

$$RV_{t+1} = \beta_0 + \beta_D RV_t + \beta_W RV_{t-5,t} + \beta_M RV_{t-22,t} + \epsilon_t$$

- Additive processes with heterogeneous components can generate those stylized facts!
- Es, Le Baron (2001): combination of only 3 AR(1) can display apparent long memory
- daily, weekly and monthly term

Longer horizon versions alter the left hand side. A HAR-RV-J version adds a jump to the above design. A nonlinear version forecast the RV 1/2 rather than RV, or a log version. Unsurprisingly, β_D is most important for a one day forecast, the β_w for a weekly forecast and β_M for the monthly. The β_J are significantly negative suggesting that the jumps are short lived burst of volatility.

Lit HAR-RV-CJ model of Andersen, Bollerslev and Diebold (2005).

$$RV_{t+h} = \beta_0 + \beta_{CD} C_t + \beta_{CW} C_{t-5,t} + \beta_{CM} C_{t-22,t} + \dots$$
$$+ \beta_{JD} J_t + \beta_{JW} J_{t-5,t} + \beta_{JM} J_{t-22,t} + \epsilon_{t+h}$$

This nests the Corsi model but allows for differing behavior for the continuous diffusion (which we expect is persistent) and the jumps.
Emphasis realized volatility (RV) on very liquid instruments. The S&P 500 futures, USD/DEM spot, and the 30 year T-bond futures. Return to Christoffersens admission in ABCD that RV designs may be viable only for the most liquid instruments.

Lit HAR-RNG-CJ Scott

$$V_{t+h} = \beta_0 + \beta_{RNGD} RNG_t + \beta_{RNGW} RNG_{t-5,t} + \beta_{RNGM} RNG_{t-22,t} + ..$$
$$+ \beta_{JD} J_t + \beta_{JW} J_{t-5,t} + \beta_{JM} J_{t-22,t} + \epsilon_{t+h}$$

Proposes replacing the RV measure with range estimates, specifically we consider the intra-day Garman Klass as the C_t diffusion term and the overnight jump as our J_t term in the above. This of course limits the jumps, they are no longer associated with intra-day macro data announcements. It will capture firm level announcements as these are most often announced after hours.

Adding News

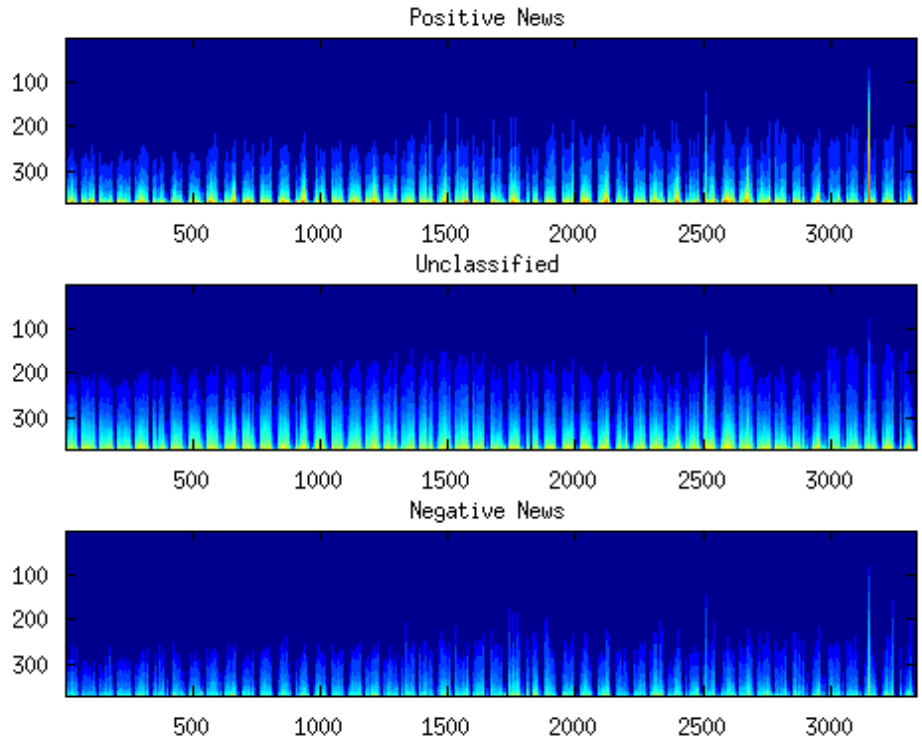

Figure : News classified as positive, neutral and negative over February 2004 to 2013.

Adding News

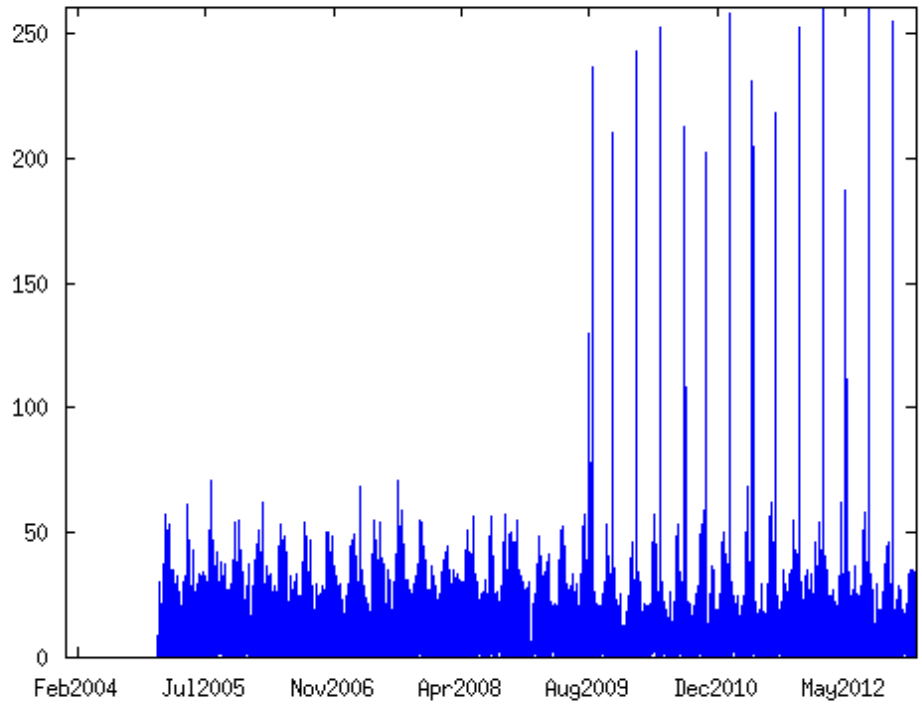

Figure : Full sample count of news events. Note that seasonal earnings news is apparent.

Addressing Illiquidity

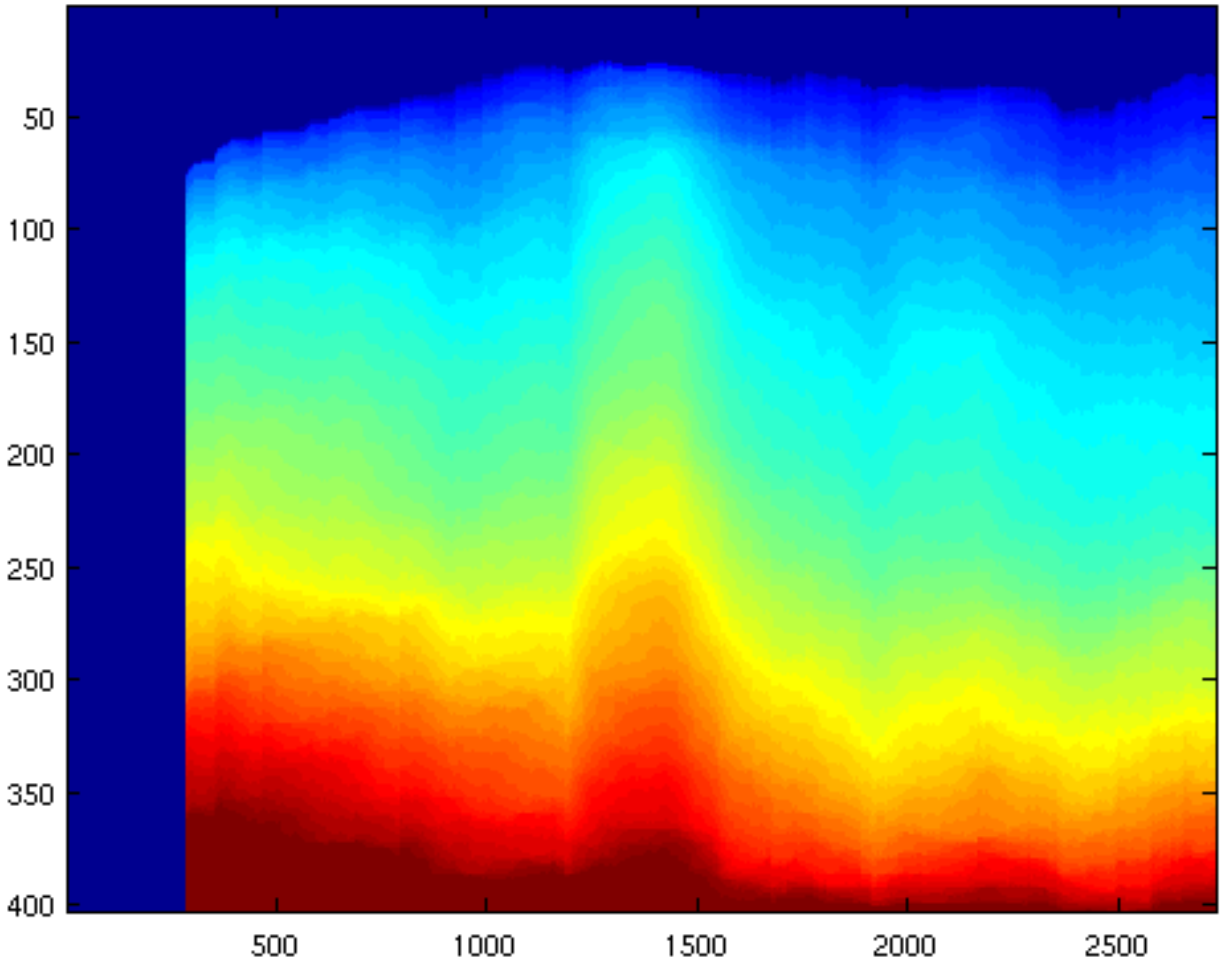

Figure : Full sample image of log illiquidity.

	full	top 10	upper 40	lower 40	bottom 10
EAJ	0.067^{***}	0.071^{***}	0.067^{***}	0.065^{***}	0.084^{***}
C_{SP500}	0.131^{***}	0.070^{***}	0.114^{***}	0.152^{***}	0.157^{***}
J_{SP500}	-0.006^{*}	0.004	-0.041^{***}	0.007	0.021^{*}
VIX	0.323^{***}	0.496^{***}	0.435^{***}	0.426^{***}	0.402^{***}
C_{VIX}	0.004^{***}	-0.004^{**}	0.000	0.008^{***}	0.010^{***}
J_{VIX}	-0.009^{***}	-0.007^{***}	-0.009^{***}	-0.011^{***}	-0.008^{***}
C_1	0.100^{***}	0.134^{***}	0.051^{***}	0.069^{***}	0.140^{***}
C_5	0.067^{***}	0.091^{***}	0.111^{***}	0.084^{***}	0.085^{***}
C_{22}	0.429^{***}	0.345^{***}	0.425^{***}	0.393^{***}	0.348^{***}
J_1	0.021^{***}	-0.036^{***}	0.030^{***}	-0.032^{***}	0.018^{**}
J_5	-0.189^{***}	-0.269^{***}	-0.223^{***}	-0.223^{***}	-0.152^{***}
J_{22}	0.273^{***}	0.123^{***}	0.099^{***}	0.256^{***}	0.303^{***}
$Volm$	0.002^{***}	0.003^{***}	0.004^{***}	0.003^{***}	0.002^{***}
$IndConst$	0.000^{***}	0.000^{**}	0.000^{***}	0.001^{***}	0.001^{***}
$IndC_1$	0.066^{***}	0.001	0.081^{***}	0.009	0.100^{***}
$IndC_5$	0.065^{***}	0.166^{***}	0.149^{***}	0.108^{***}	-0.167^{***}
$IndC_{22}$	0.029^{***}	-0.066^{**}	-0.102^{***}	0.118^{***}	0.059^{**}
$IndJ_1$	-0.060^{***}	-0.091^{***}	-0.110^{***}	-0.044^{***}	-0.042^{***}
$IndJ_5$	-0.002	0.078^{***}	0.042^{***}	-0.046^{***}	0.148^{***}
$IndJ_{22}$	-0.031^{***}	0.109^{***}	0.076^{***}	-0.063^{***}	-0.111^{***}
$IndVolm$	0.001^{***}	0.000	0.000^{*}	0.001^{***}	0.001^{***}
$resL1$	0.217^{***}	0.237^{***}	0.268^{***}	0.256^{***}	0.154^{***}
$resL2$	0.807^{***}	0.827^{***}	0.846^{***}	0.829^{***}	0.672^{***}
R-sq	0.547	0.554	0.579	0.556	0.534
Rbar	0.547	0.554	0.579	0.556	0.534
nobs	858823	58660	253261	271565	69220

	full	top 10	upper 40	lower 40	bottom 10
EAJ	0.070***	0.070***	0.076***	0.064***	0.085***
C_{SP500}	0.142***	0.090***	0.131***	0.165***	0.165***
J_{SP500}	-0.001	0.020**	−0.016***	0.005	0.021*
VIX	0.325***	0.480***	0.427***	0.428***	0.403***
C_{VIX}	0.004***	-0.002	0.001	0.007***	0.010***
J_{VIX}	−0.009***	−0.007***	−0.008***	−0.011***	−0.009***
C_1	0.090***	0.093***	0.051***	0.067***	0.133***
C_5	0.066***	0.093***	0.104***	0.080***	0.090***
C_{22}	0.421***	0.360***	0.419***	0.377***	0.344***
J_1	0.019***	−0.062***	0.005	−0.019***	0.026***
J_5	−0.186***	−0.259***	−0.226***	−0.220***	−0.158***
J_{22}	0.268***	0.129***	0.089***	0.245***	0.295***
$Volm$	0.002***	0.003***	0.004***	0.003***	0.002***
$IndC$	0.000***	0.000**	0.001***	0.001***	0.000**
$IndC_1$	0.044***	−0.035**	0.020***	−0.019**	0.092***
$IndC_5$	0.070***	0.205***	0.177***	0.111***	−0.145***
$IndC_{22}$	0.034***	−0.084**	−0.082***	0.130***	0.044
$IndJ_1$	−0.059***	−0.071***	−0.101***	−0.039***	−0.037***
$IndJ_5$	-0.008	0.057***	0.031***	−0.049***	0.133***
$IndJ_{22}$	−0.027***	0.107***	0.076***	−0.069***	−0.106***
$IndVolm$	0.001***	0.000	0.000***	0.001***	0.001***
$NegConst$	−0.000***	−0.003***	−0.002***	−0.001***	-0.000
$NegC_1$	0.072***	0.187***	0.106***	0.086***	0.062***
$NegC_5$	0.060***	0.213***	0.097***	0.093***	−0.053*
$NegC_{22}$	0.026***	-0.009	−0.062***	0.085***	0.022
$NegJ_1$	0.076***	0.201***	0.348***	−0.020**	−0.066***
$NegJ_5$	-0.006	−0.091***	-0.015	0.001	0.101***
$NegJ_{22}$	-0.009	−0.176***	0.007	0.023	0.041
$NegVolm$	0.001***	0.002***	0.001***	0.001***	0.001***
$resL1$	0.209***	0.245***	0.233***	0.238***	0.150***
$resL2$	0.792***	0.833***	0.826***	0.810***	0.662***
R-sq	0.548	0.558	0.587	0.557	0.535
Rbar	0.548	0.558	0.587	0.557	0.535
nobs	858823	58660	253261	271565	69220

Parting thoughts