Systematic Staleness (JoE 2024)

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The idea is to recreate the descriptive analysis presented in the paper, but with data from 2016. We have prices at the 1-minute frequency, and we would like to plot the time-series of systematic staleness, and its correlation with volume and volatility. The R files are included in the zipped folder.

We follow the descriptive analysis with data from 2016. Let $\Theta_{t,n}^{q,N} = \Theta_n^{(q)} = \alpha\sigma^{(q)}/n^{1/2}$, where $\alpha = 1/10$ and $\sigma^{(q)}$ is the estimated volatility over the day for the stock indexed. The smoother is $\mathcal{S}(\cdot) = \exp(-|\cdot|)$.

For each day $d = 1, \ldots, N_D$ in the sample, let $t_{j,n} = j/n, j = 0, \ldots, n$ be the (1 minute) partition for the day $[d-1, d]$

We compute, at every instant $t_{j,n}$

$$\zeta_{d,j} = \prod_{q=1}^{N_{d,j}} \exp\left(-\frac{|X_{j/n} - X_{(j-1)/n}|}{N_{d,j}\Theta_n^{(q)}}\right)$$

We estimate systematic staleness for day d:

$$\hat{p}_d^{(S)} := \frac{1}{n}\sum_{j=1}^{n} \zeta_{d,j}.$$

Since we are using 1-minute returns, we have $n = 390$. Our assets are $q = 1, \ldots, 100$. Our number of days is $N_D = 252$.

So in our case, we have

$$\zeta_{d,j} = \prod_{q=1}^{100} \exp\left(-\frac{|X_{j/n} - X_{(j-1)/n}|\sqrt{390}}{10\sigma^{(q)}}\right)$$

The analysis is performed using the following 100 stocks:

AAL, AAPL, ADBE, ADI, ADP, ADSK, AKAM, ALXN, AMAT, AMGN, AMZN, ATVI, AVGO, BIDU, BIIB, BMRN, CA, CELG, CERN, CHKP, CHTR, CMCSA, COST, CSCO, CSX, CTAS, CTRP, CTSH, CTXS, DISCA, DISCK, DISH, DLTR, EA, EBAY, ESRX, EXPE, FAST, FB, FISV, FOX, FOXA, GILD, GOOG, GOOGL, HAS, HOLX, HSIC, ILMN, INCY, INTC, INTU, ISRG, JBHT, JD, KHC, KLAC, LBTYA, LBTYK, LRCX, LVNTA, MAR, MAT, MCHP, MDLZ, MNST, MSFT, MU, MXIM, MYL, NCLH, NFLX, NTES, NVDA, ORLY, PAYX, PCAR, PCLN, PYPL, QCOM, QVCA, REGN, ROST, SBAC, SBUX, SHPG, SIRI, STX, SWKS, SYMC, TMUS, TRIP, TSCO, TSLA, TXN, ULTA, VIAB, VOD, VRSK, VRTX, WBA, WDC, XLNX, XRAY, YHOO.

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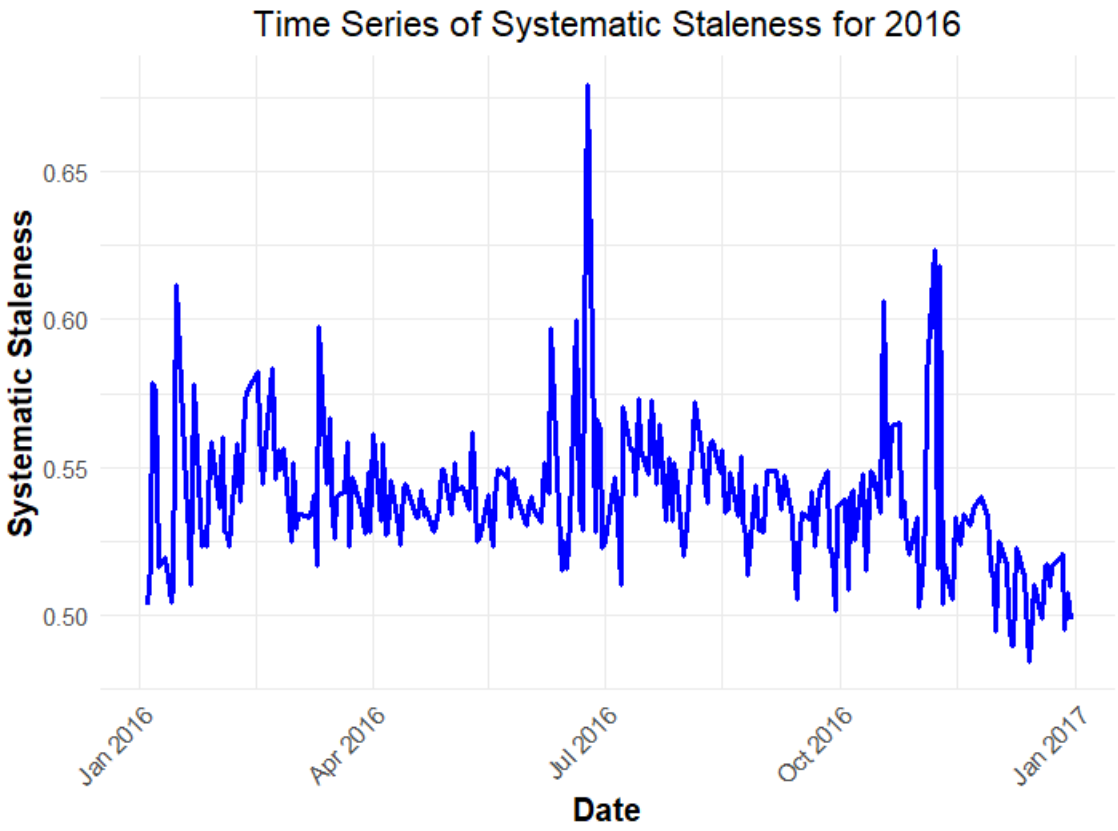

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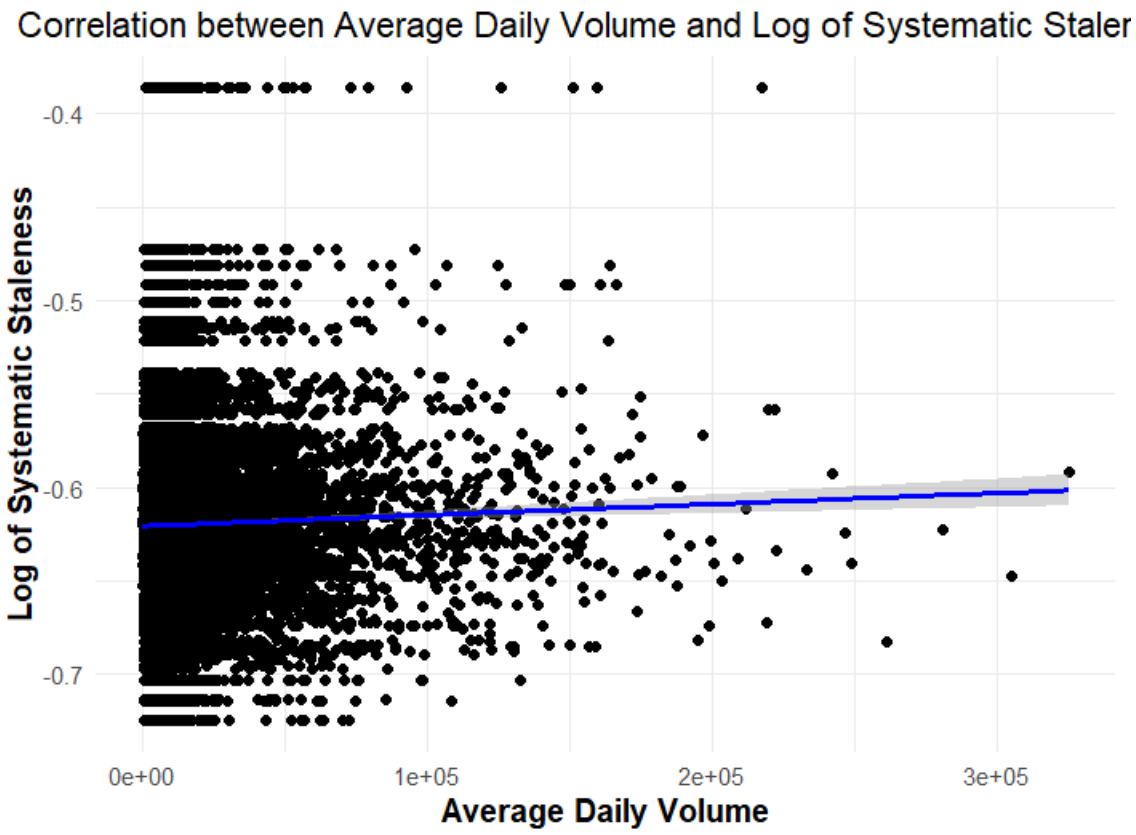
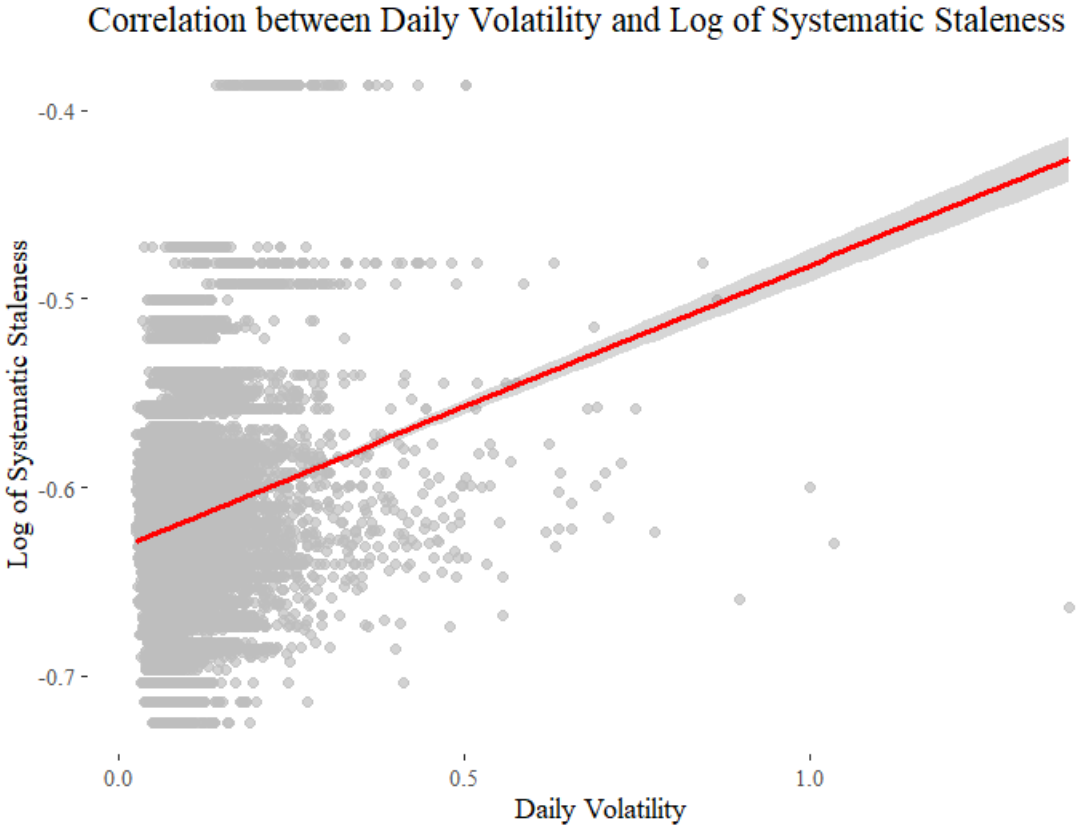
Now, using these 100 stocks, we plot systematic staleness along 2016.

Now we plot the correlation between systematic staleness and volume.


Correlation between Average Daily Volume and Log of Systematic Staler
Log of Systematic Staleness
-0.4
-0.5
-0.6
-0.7
0e+00
1e+05
2e+05
3e+05
Average Daily Volume


Correlation between Daily Volatility and Log of Systematic Staleness
Log of Systematic Staleness
-0.4
-0.5
-0.6
-0.7
0.0
0.5
1.0
Daily Volatility