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**EQUITY MARKET VOLATILITY IN THE COVID-19 ERA:
A FEW FACTS**

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PRESENTATION LOGISTICS

Today's presenter/host:

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Backup stream via YouTube at

<http://livestream.lukestein.com>

and Twitch ([twitch.tv/lcdstein](https://www.twitch.tv/lcdstein)) and Twitter/Periscope ([periscope.tv/lukestein](https://www.periscope.tv/lukestein))

- Session is being **recorded** for Cutler Center webpage and Babson Finance Association (BFA) Canvas page
Did we remember to start recording?
- Please **mute your microphone**
- Moderator will **collect questions (through Zoom chat)** throughout
- **Q&A will follow** presentation



1. Fast-moving environment
2. Preliminary analysis
3. Various sources, measures, visualizations
4. **More facts than explanations**

SMALL CAVEATS



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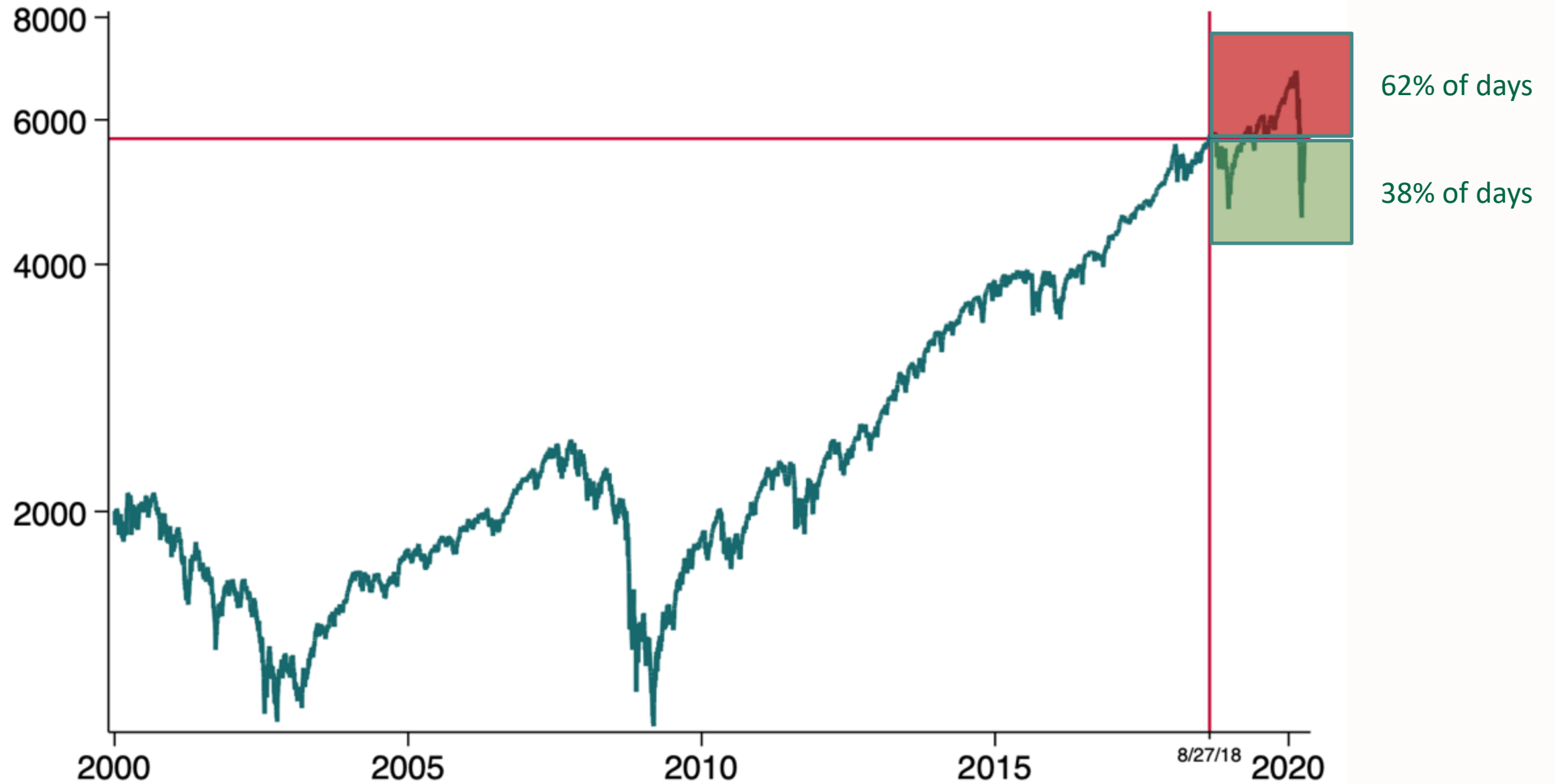
1. The US isn't the **world**
2. The US economy isn't the US
3. The stock market isn't the economy
4. **Large-cap stocks** (e.g., S&P 500) aren't the stock market

BIG CAVEATS



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S&P 500 total return index



Through 4/9/20. Vertical axis shows S&P 500 TR Index (i.e., incl. dividend reinvestment) on log scale.

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As of 4/7/2020

S&P 500 total return index since first hitting today's level



Through 4/9/20. Vertical axis shows S&P 500 TR Index (i.e., incl. dividend reinvestment) on log scale.

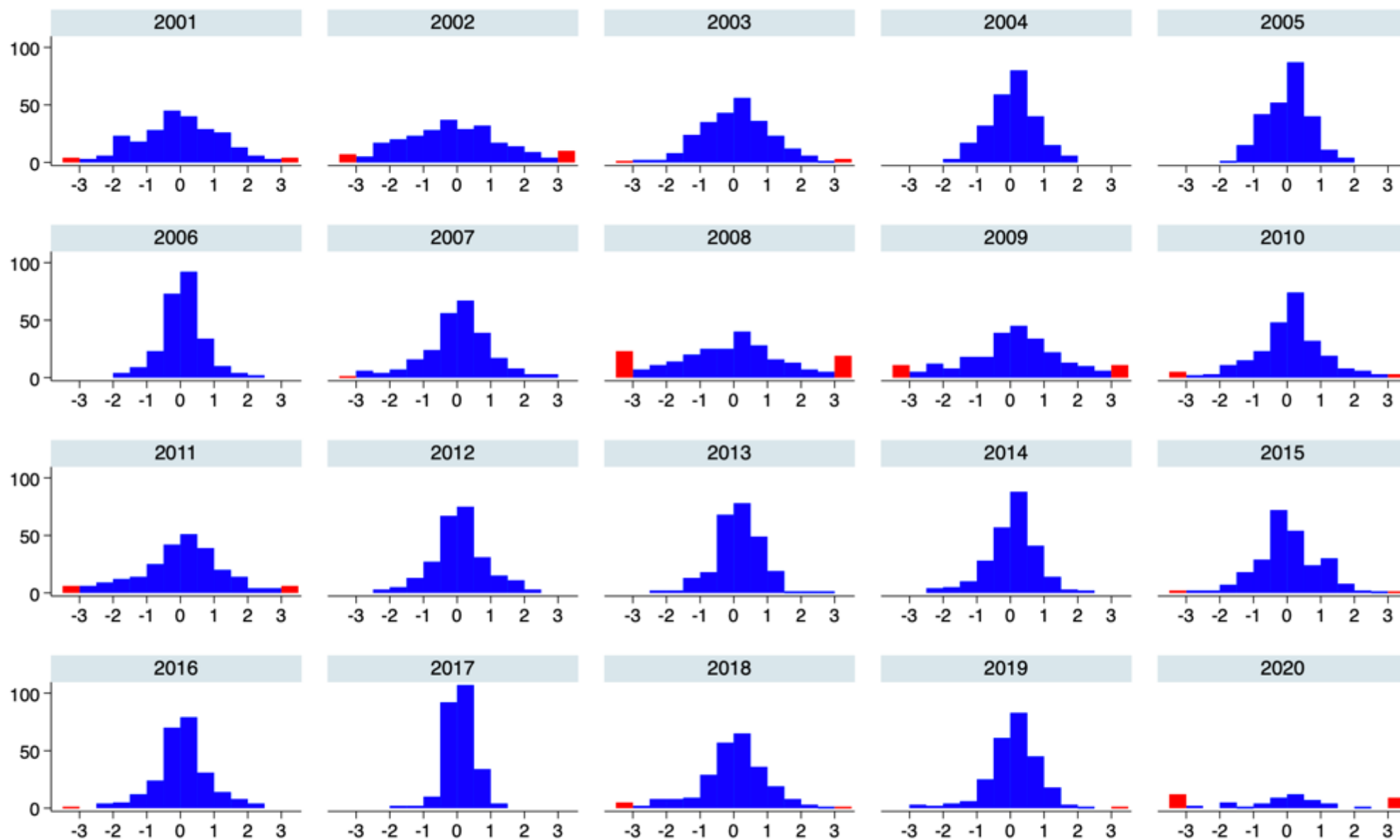
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VOLATILITY TRENDS



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Daily S&P 500 returns (%)



Red bars show all changes greater than $\pm 3\%$.

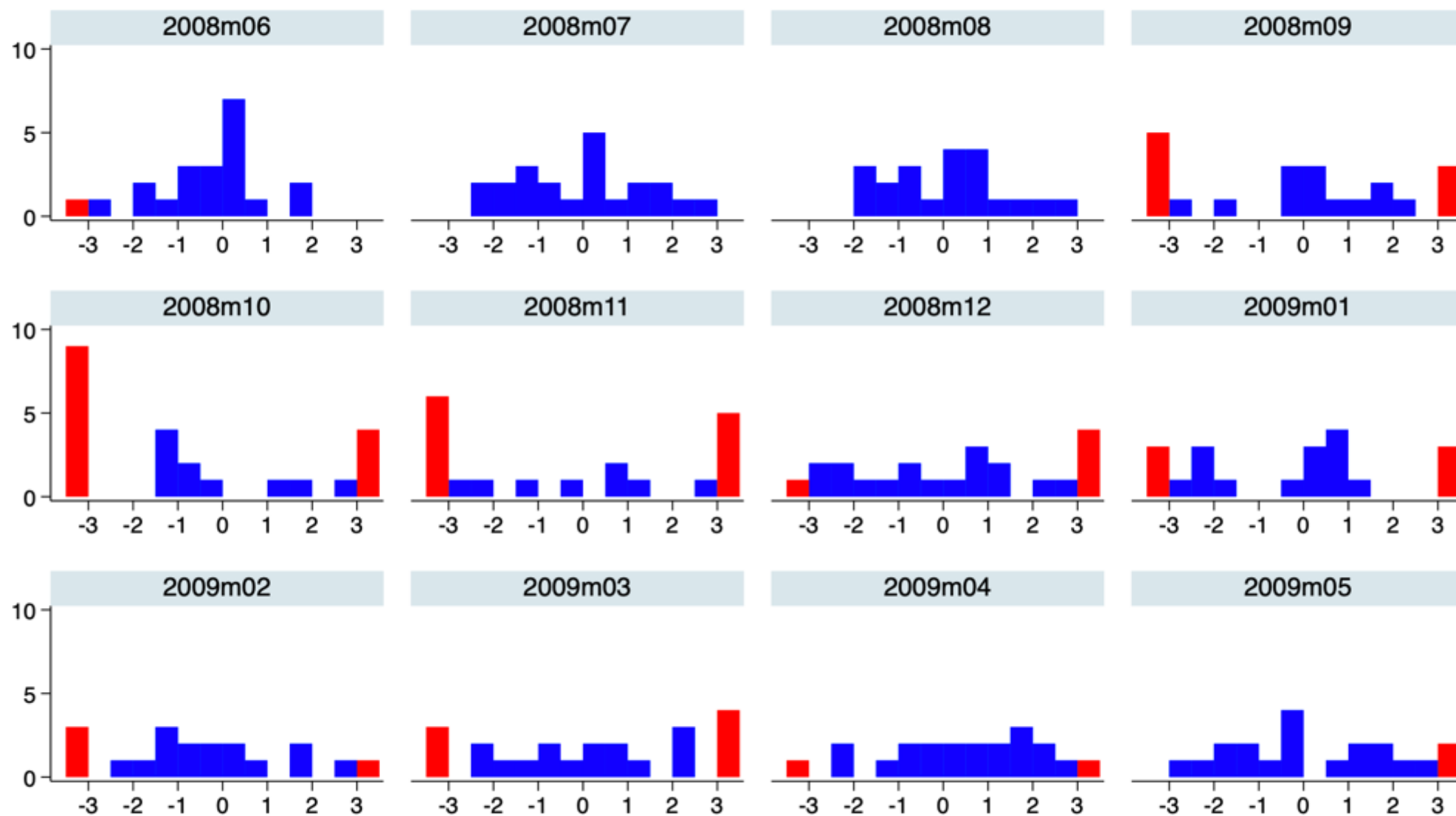
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As of 4/6/2020

1. **Extent** of the virus
2. **Effects** of the virus
 - Direct
 - Indirect
3. **Response** to the virus
 - Short-term
 - Long-term

WHAT ARE WE SEEING? UNCERTAINTY

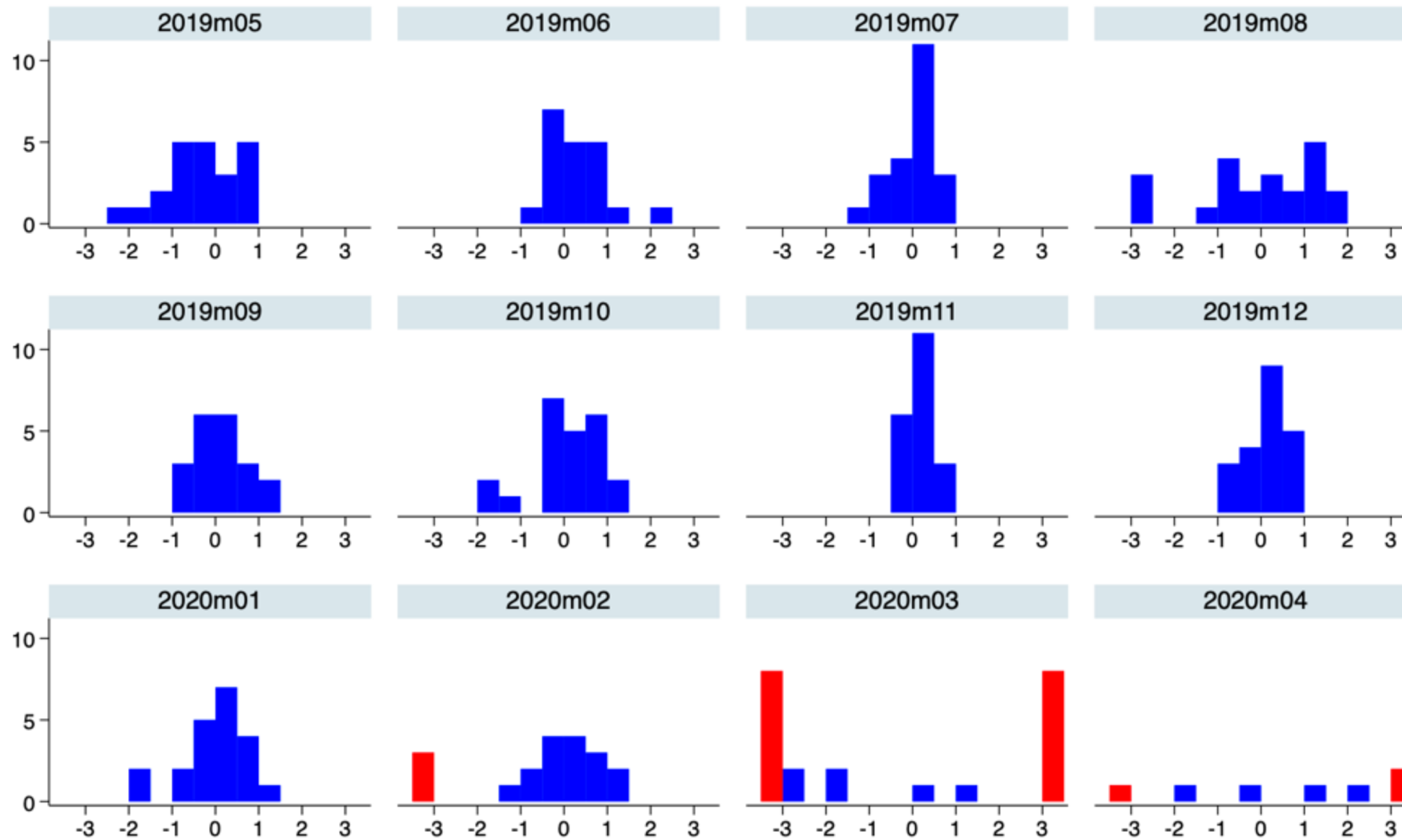
Daily S&P 500 returns (%) June 2008–May 2009



Red bars show all changes greater than $\pm 3\%$ ($n=59$).

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Daily S&P 500 returns (%)



Through 4/9/20. Red bars show all changes greater than $\pm 3\%$ (n=22).

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S&P 500 total return (daily)

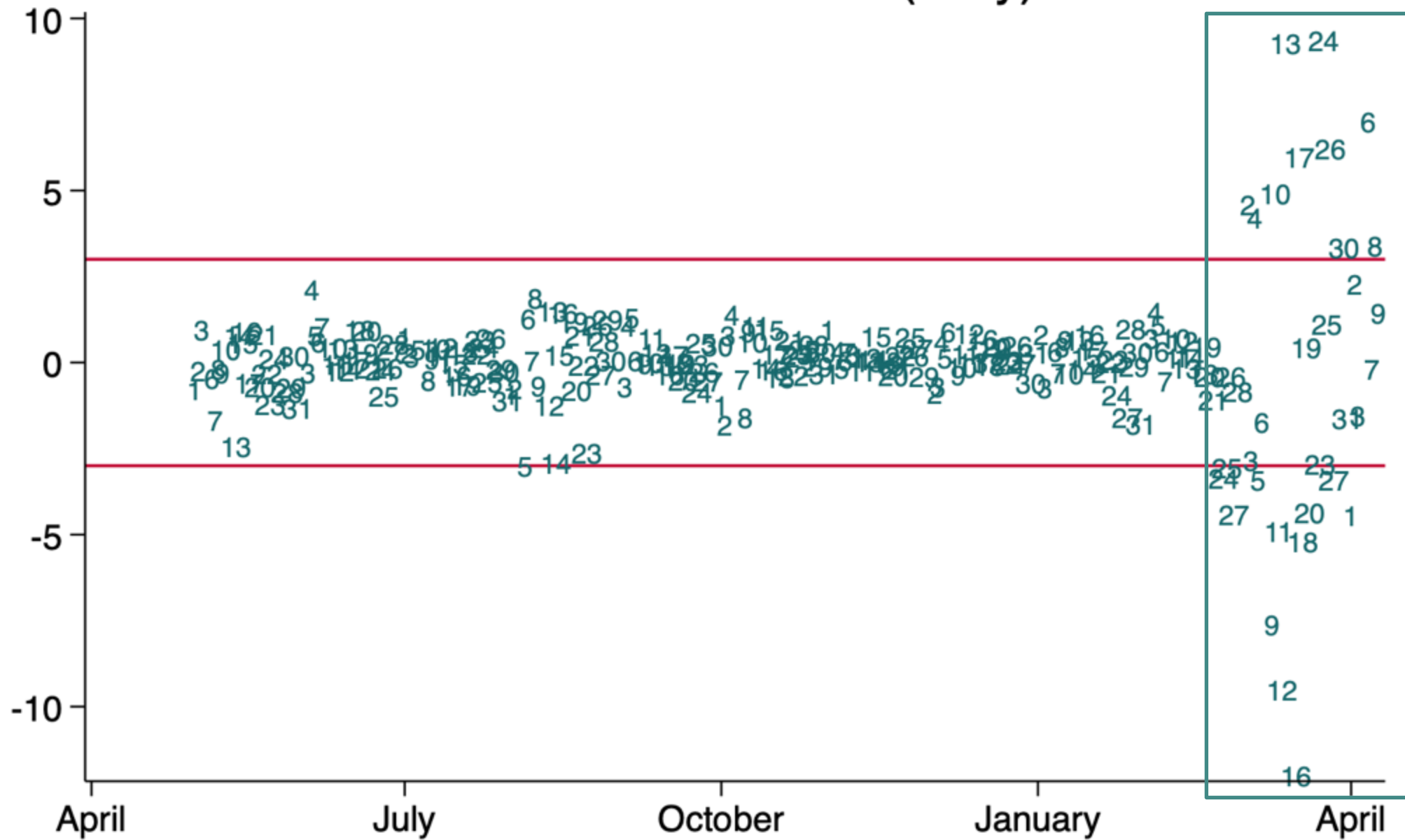
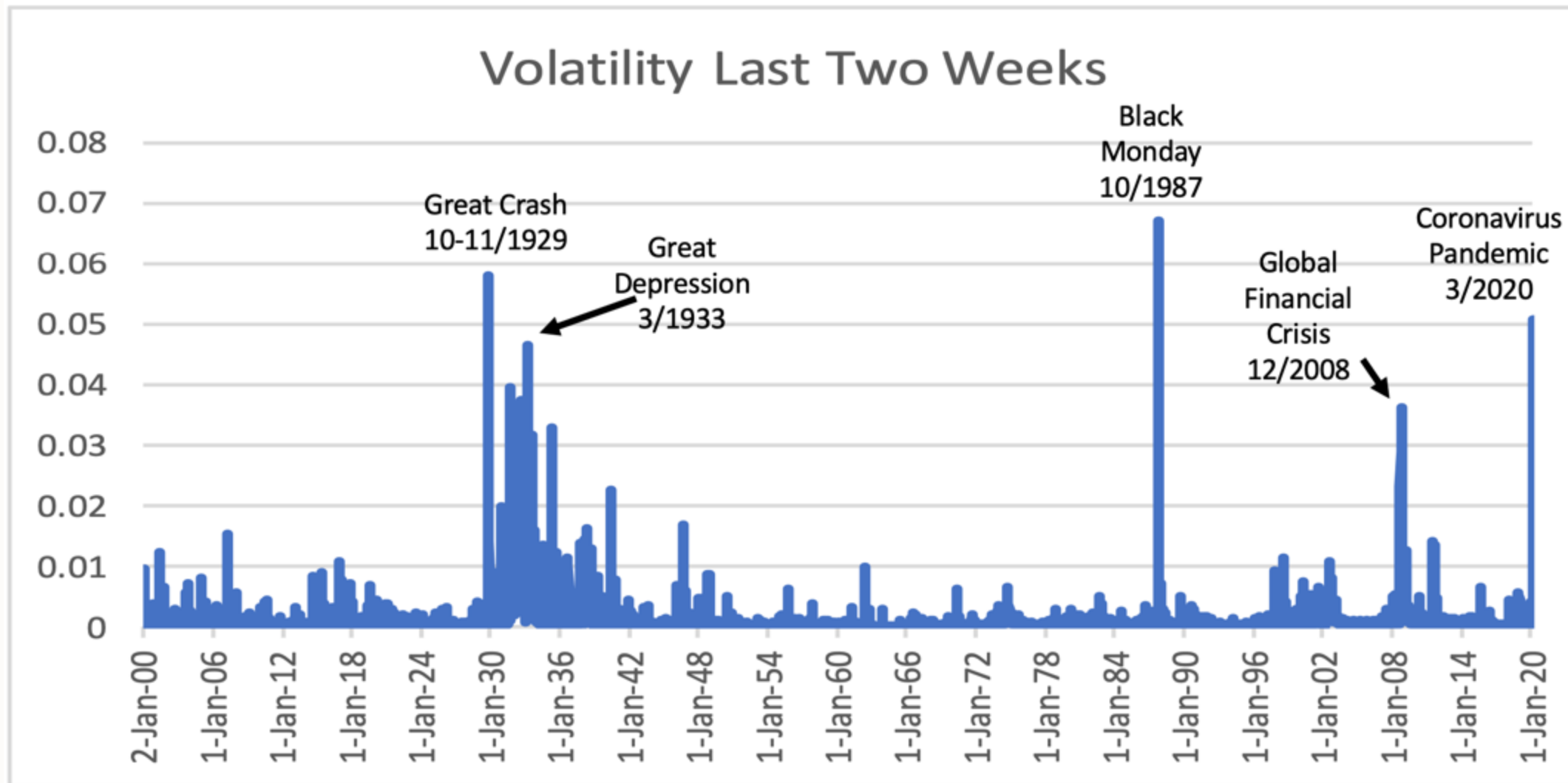


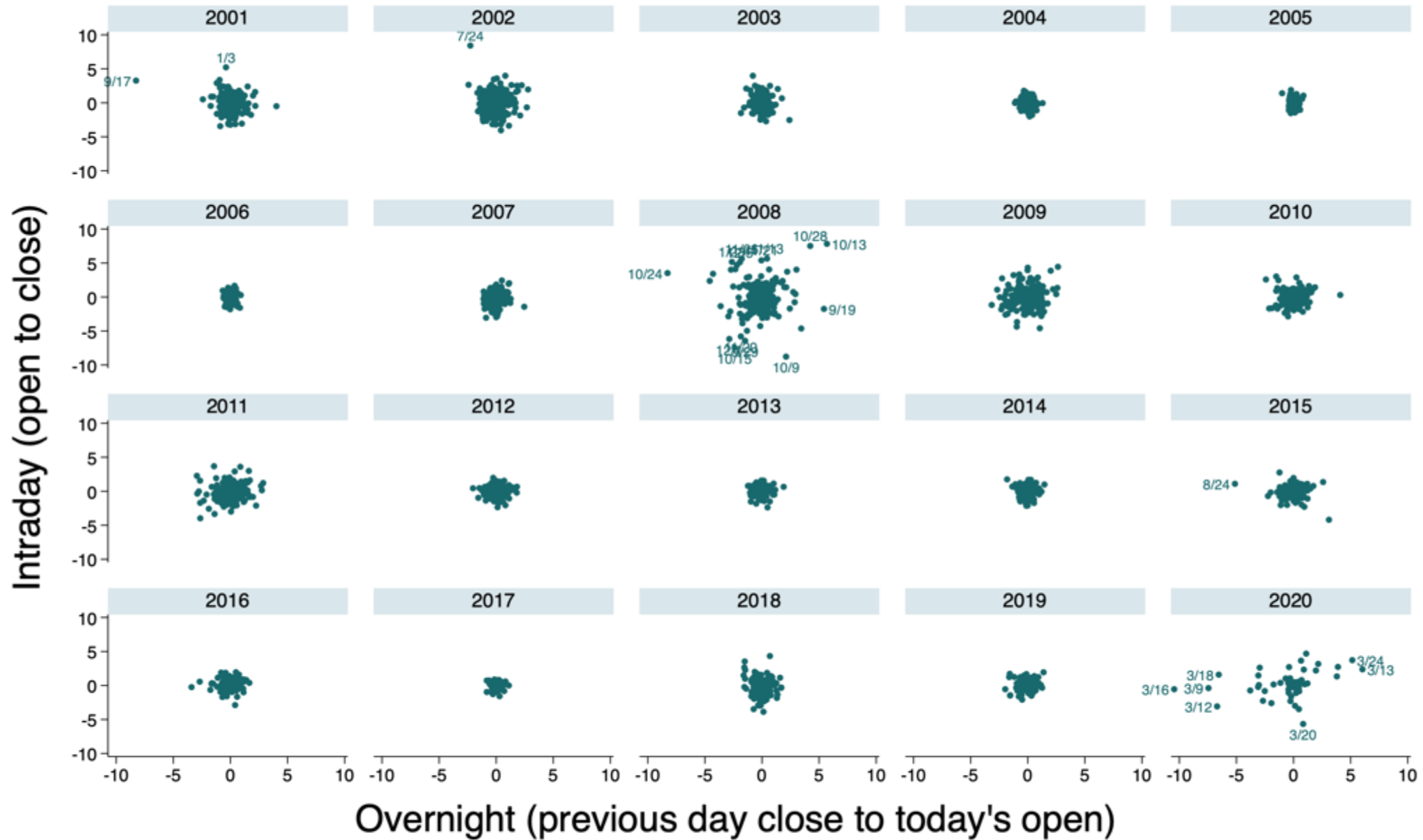
Figure 1. Realized U.S. Stock Market Volatility, January 1900 to March 2020



Notes: Sample period, 1/1/1900-3/23/2020. From 12/1925-Present, returns are computed using Yahoo Finance's 'adjusted close' series for the S&P 500 (^GSPC). Before that, returns are from the Global Financial Data extension of the Dow Jones Index. Volatility last two weeks is the sum of squared returns over the past 10 trading days.

Source: Baker, Bloom, Davis, Kost, Sammon, and Viratyosin

Daily SPY price changes (%)



Data source: Alpha Vantage. Through 4/6/20.

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STRATEGIES

The Stock Market Works by Day, but It Loves the Night



Minh Uong/The New York Times

By Jeff Sommer

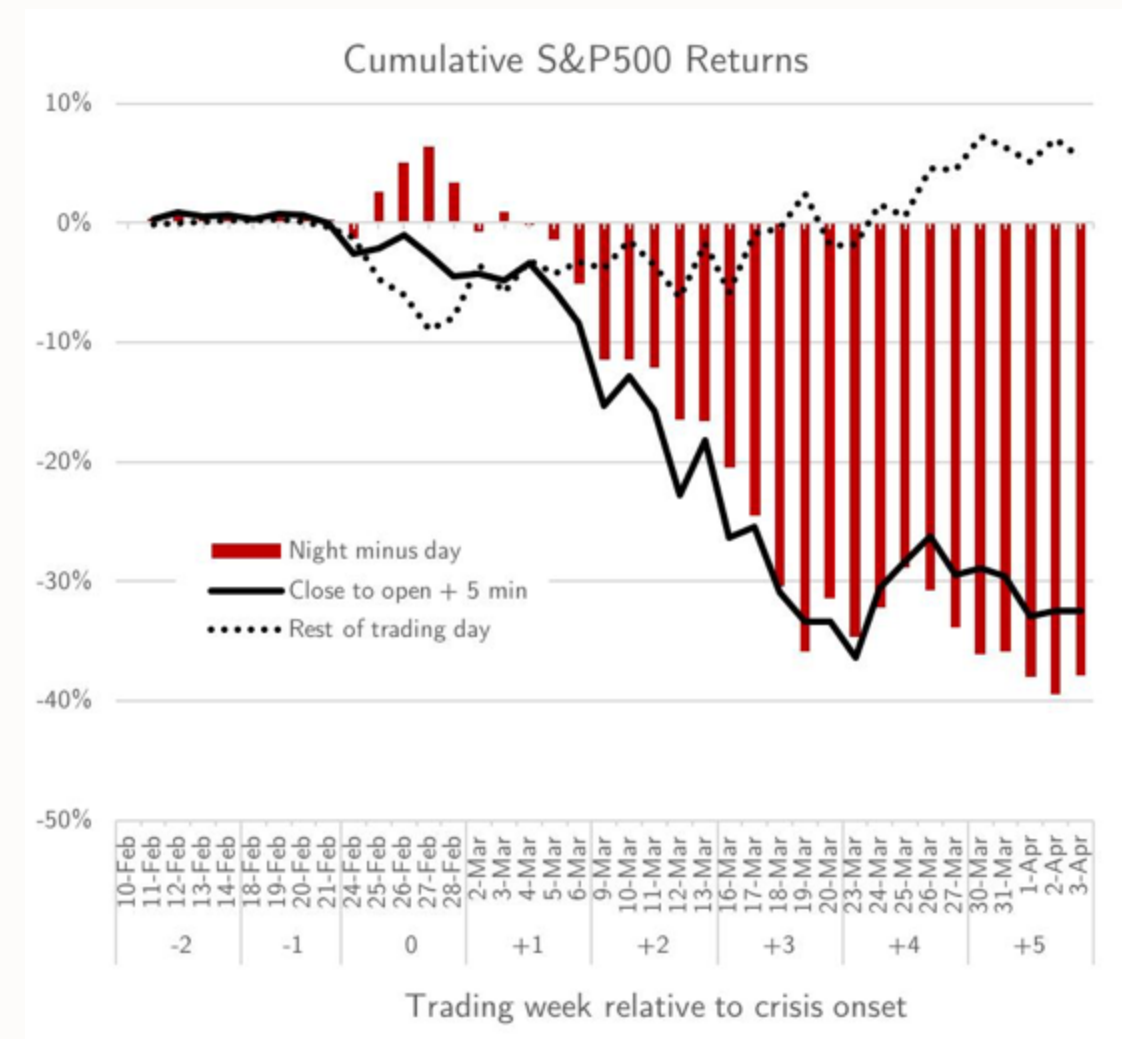
Feb. 2, 2018



The daytime is for losers. Overnight is when the big money is made in the stock market — not by trading but by getting a good night's sleep.

That's because of a gap between daytime and overnight returns in the American stock market. The real profits for investors have

Cf. Cooper, Cliff, Gulen (2008)



Source: Scott W. Bauguess

LOOKING FORWARD: IMPLIED VOLATILITY AND THE VIX



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- To understand “the market”'s forecast of X , find an asset whose price now is related to how X turns out
 - Prices are determined by supply and demand
 - Caution: Supply and demand may be determined by things other than X !
- The price of options increases with volatility, all else equal
 - Prices can't be [too?] predictable...
 - But *only* for “durable” assets
- VIX uses options on the S&P 500 (23–37 day)

Not nearly everything you wanted to know about the VIX and other volatility indices

Published on March 9, 2020 [Edit article](#) | [View stats](#)



Luke Stein
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1 article

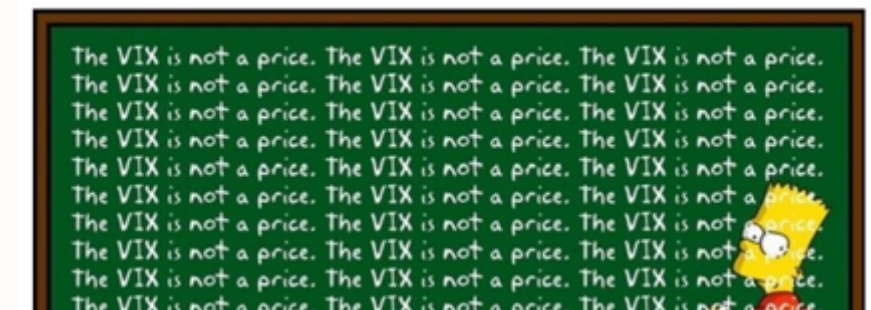
The FIX is (not) in

Suppose you had a side hustle catching snails on the weekend and delivering them to a restaurant catering to French tourists. You'd love to get some sense each Saturday of how many tourists are likely to arrive over the next week so you know how much time to spend snailing. 🐌

You're in luck: It turns out that there's an arcane organization (the Coalition of Bakery Oven Examiners, or CBOE) who publish just such a forecast, called the FIX (i.e., the “French visitors IndeX”). Their forecast isn't perfect, but it's on their website so 🙌. What do French tourists have to do with bakery ovens? Who knows and who cares?! You've got your forecast and it helps you with your snailing.

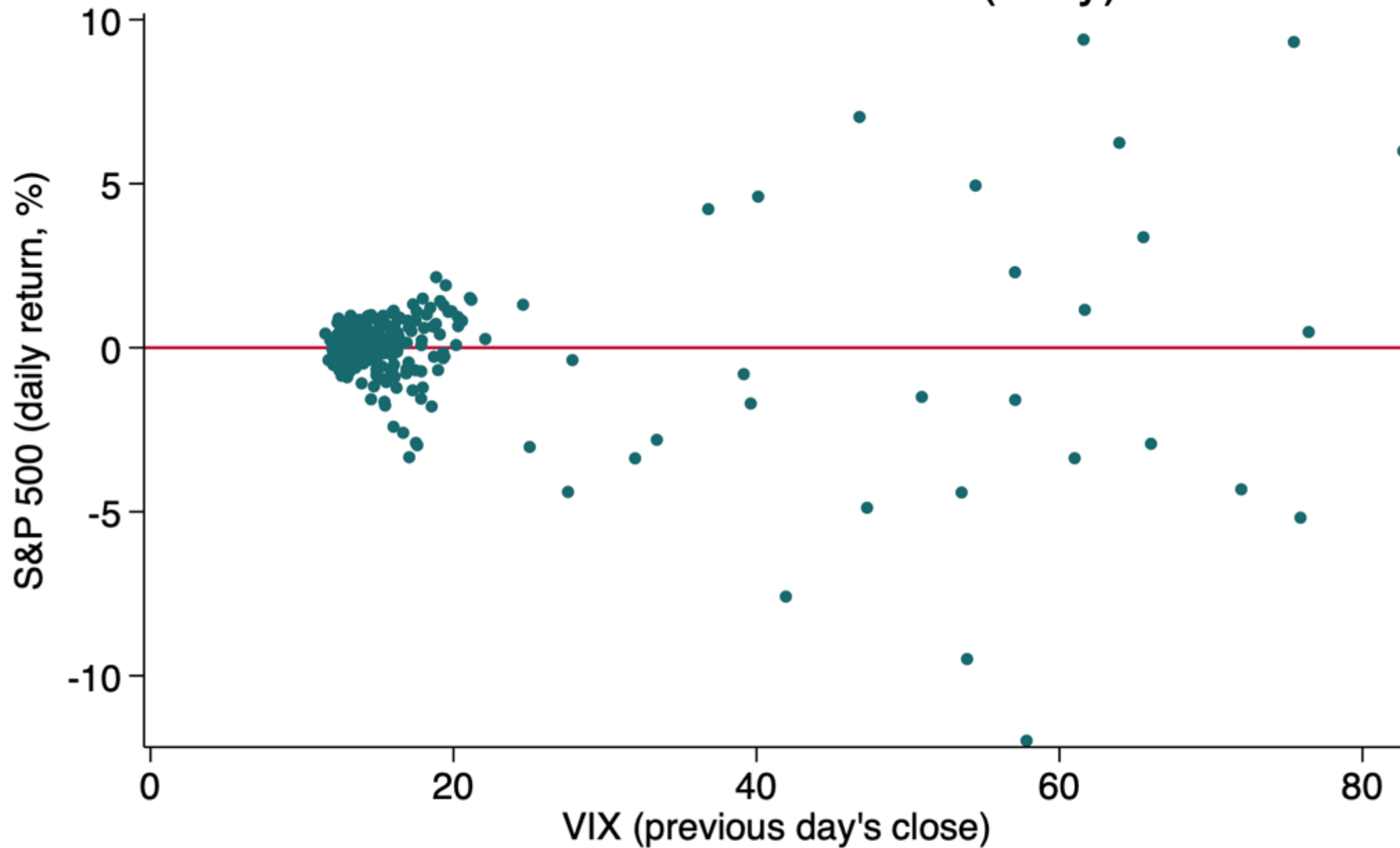
But seeing the FIX forecast, you get an idea for a *new* side hustle. The French go on vacation in August. The FIX will go up then. You can predict it in advance, and presumably profit! 💰

But... you can't make money predicting the FIX, because **the FIX is not a price**.



Source: <https://www.linkedin.com/pulse/nearly-everything-you-wanted-know-vix-other-volatility-luke-stein/>

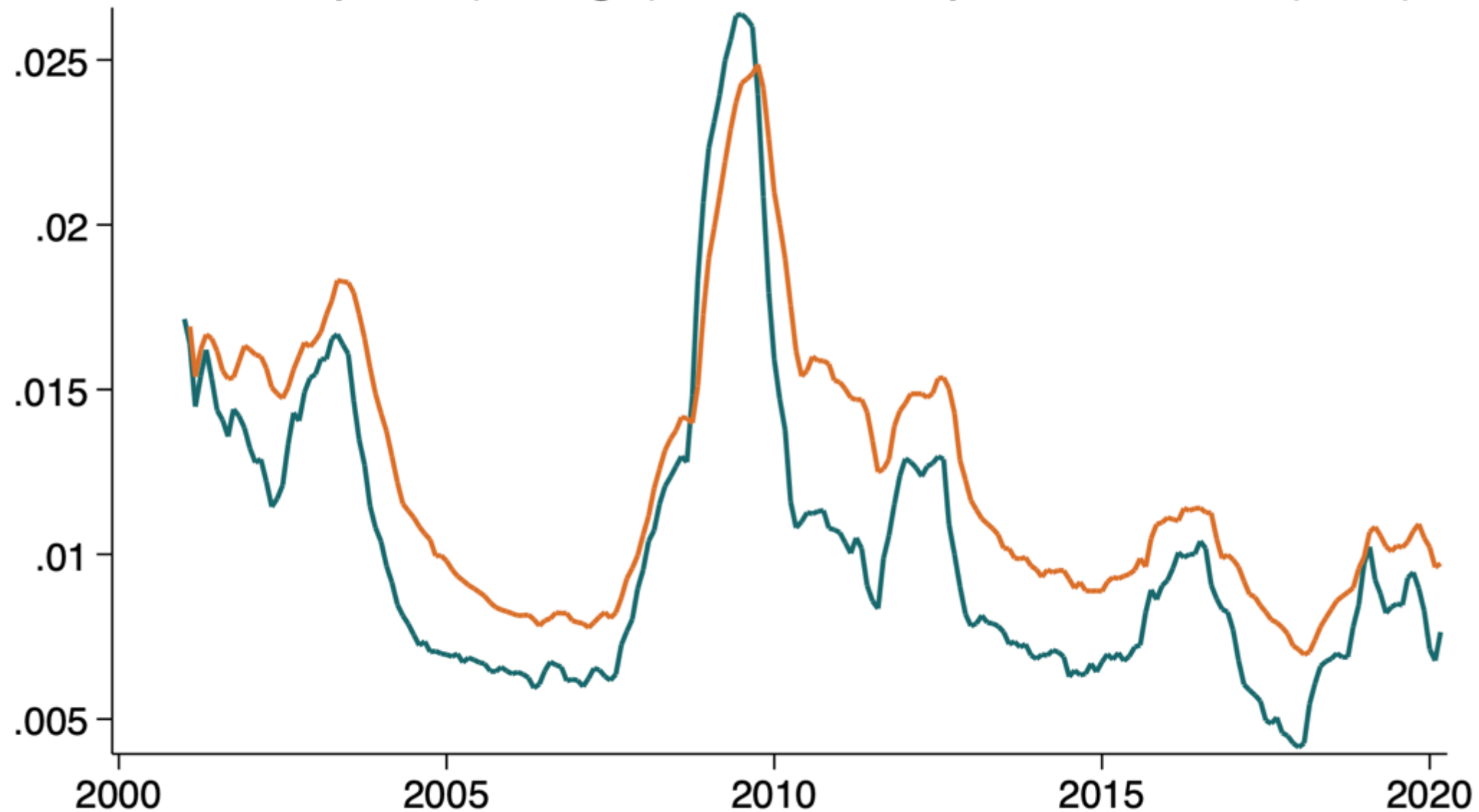
VIX vs. S&P 500 return (daily)



One year through 4/6/20.

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Daily S&P 500 Return Standard Deviation 1-mo implied (orange) and subsequent realized (blue)



Note: 12-month moving average. Calculated at calendar month level.

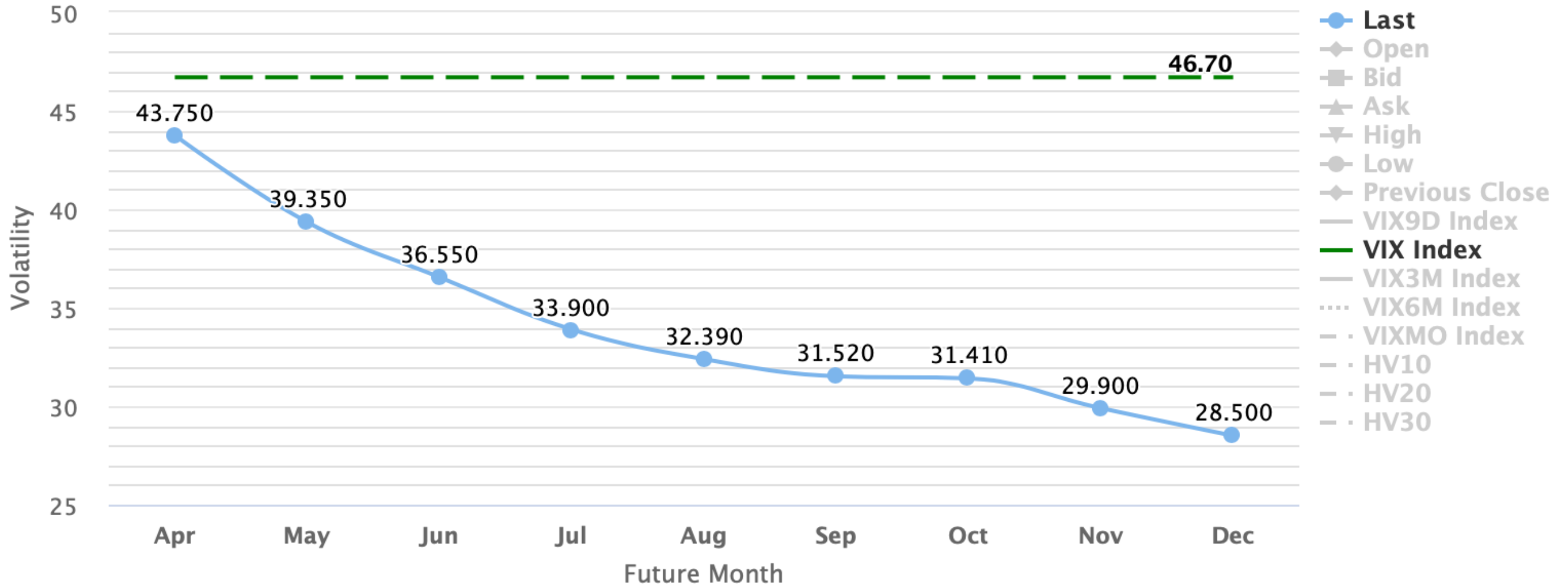
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As of 3/2020

VIX Futures Term Structure

Source: CBOE Delayed Quotes

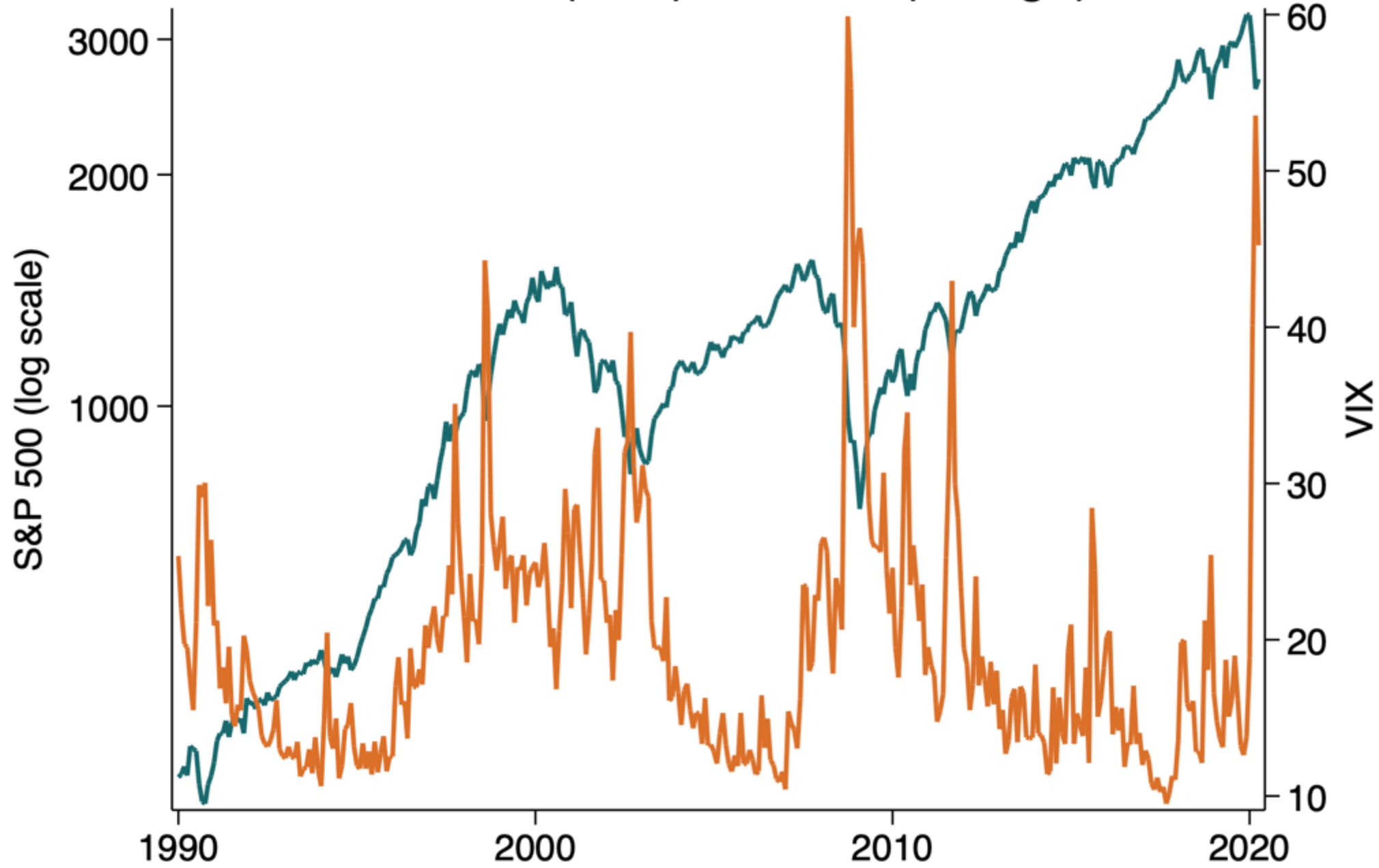
vixcentral.com



vixcentral.com

As of 4/7/2020

S&P 500 (blue) and VIX (orange)



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Monthly data as of 4/1/2020

Markets

The Booming Short-Volatility Bet That Lost 46% in a Single Month

By Yakob Peterseil

April 3, 2020, 7:37 AM MST

- ▶ Barclays says shorting S&P 500 variance fell apart in March
- ▶ Trade thrived as banks unloaded risk to hedge funds, managers

A booming but opaque volatility trade beloved by hedge funds just erased two decades of performance in a single month.

Betting against price swings in the S&P 500 Index via an over-the-counter instrument known as a variance swap returned minus 46% in the month through March 20, according to Barclays Plc. While perennially popular, the trade has ballooned in recent years as banks unloaded their volatility exposure to hedge funds and other asset managers hungry for yield.

Exactly how much was riding on such wagers is not known, but the short-volatility complex overall is estimated at as much as \$1.5 trillion.

Note: *Variance* not
volatility

Payoffs proportional
to excess ($\sum_i R_i^2$),
not its squareroot

<https://www.bloomberg.com/news/articles/2020-04-03/the-booming-short-volatility-bet-that-lost-46-in-a-single-month>

Benn Eifert
@bennpeifert

The systematic strategy of selling the volatility spike eventually runs into the turn of the cycle



6:02 AM · Mar 8, 2020 · Twitter for iPhone

Benn Eifert @bennpeifert · Mar 10

This is illustrative of the difference between the 20-year backtest starting in 2012, which motivated these programs, and their performance now that they are the most crowded strategies in the entire derivatives universe

Pat Hennessy, CMT @pat_hennessy · Mar 10

Covered call and put-write strategies were actually down more than the \$SPX YTD as of yesterday's close. Half of the upside with all of the downside! Brilliant - here's \$100bn!

[Show this thread](#)



15 31 147

Benn Eifert @bennpeifert · Mar 10

The problem is not the desire to generate income against an equity portfolio, or the desire to capture risk premium — it's doing the same thing as every other big institutional investor. Derivatives markets aren't large enough for a 20% risk allocation from global pension funds.

1 8 43

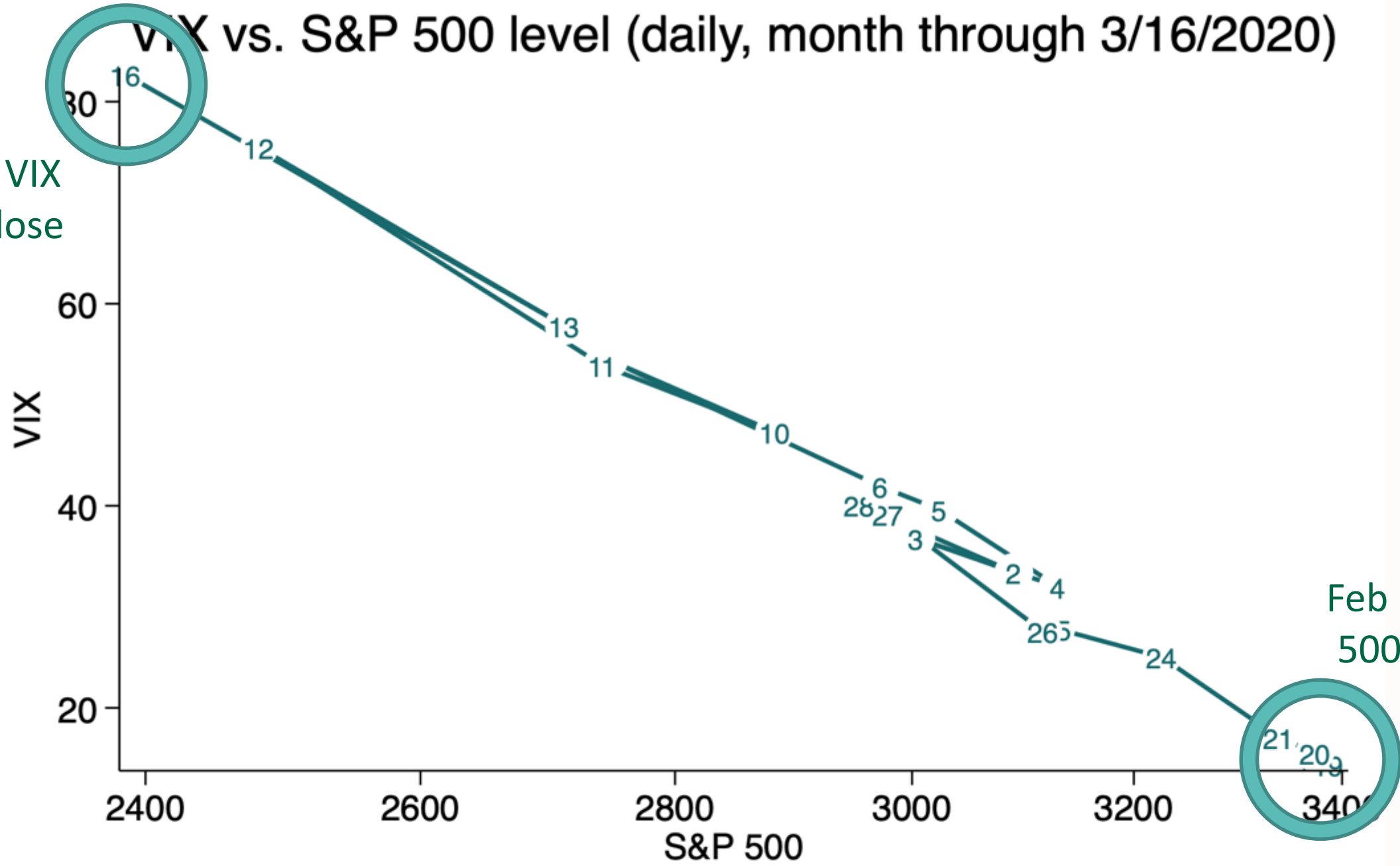
VOLATILITY AS A HEDGE



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VIX vs. S&P 500 level (daily, month through 3/16/2020)

Mar 16, 2020: VIX all-time high close



Feb 19, 2020: S&P 500 all-time high close

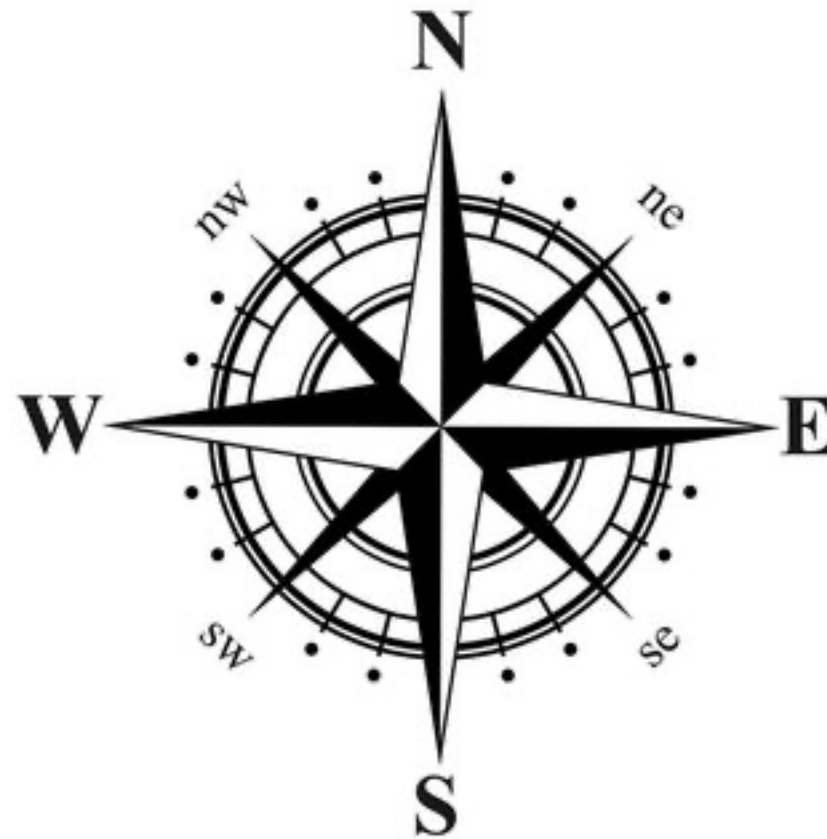
Label is calendar day. Horizontal axis is log scale.
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Uncertainty

(Raises questions)

Bad

(Relative to expectations)



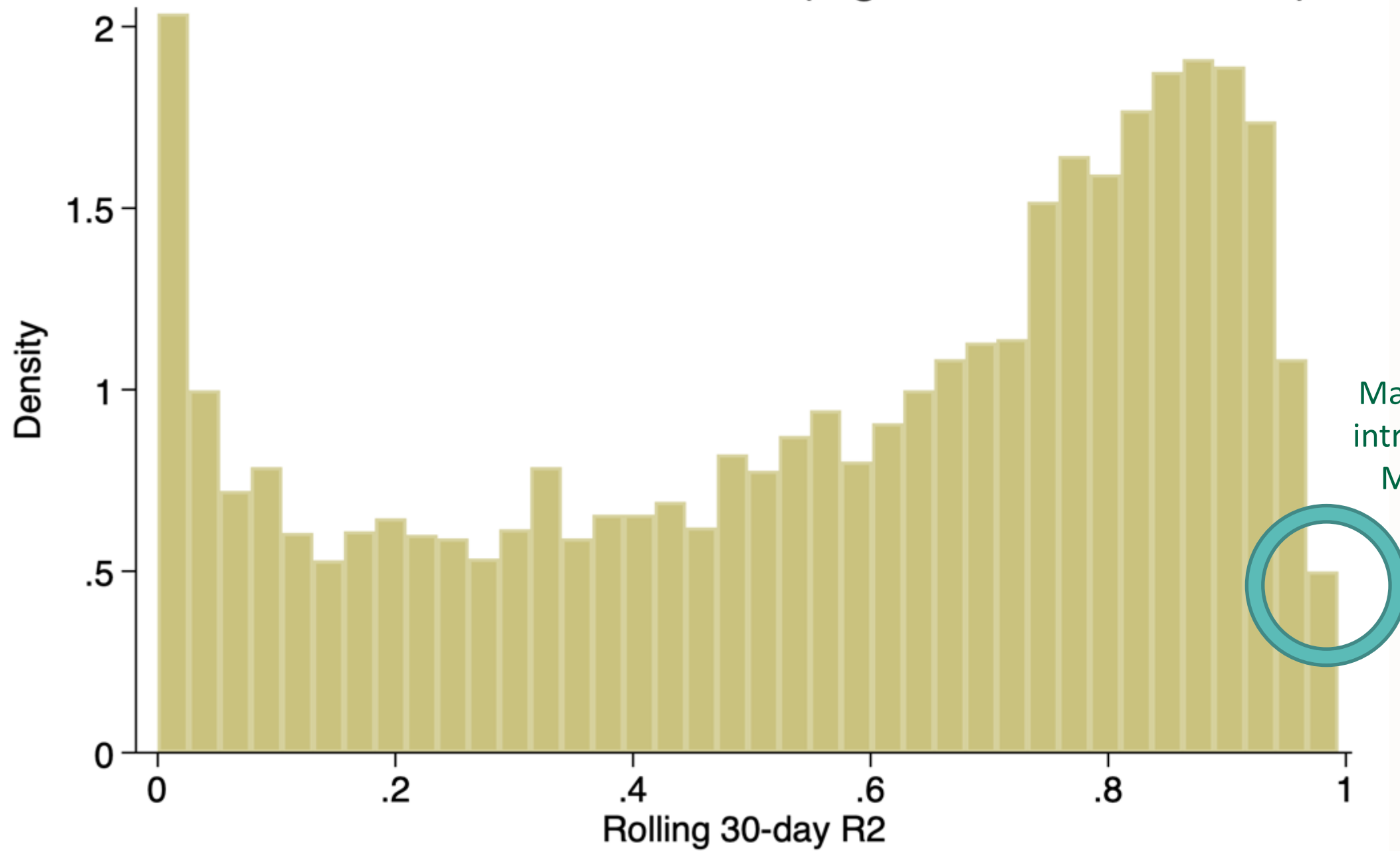
Good

(Relative to expectations)

Resolution

(Answers questions)

R2 of VIX on S&P 500 level (log Total Return Index)

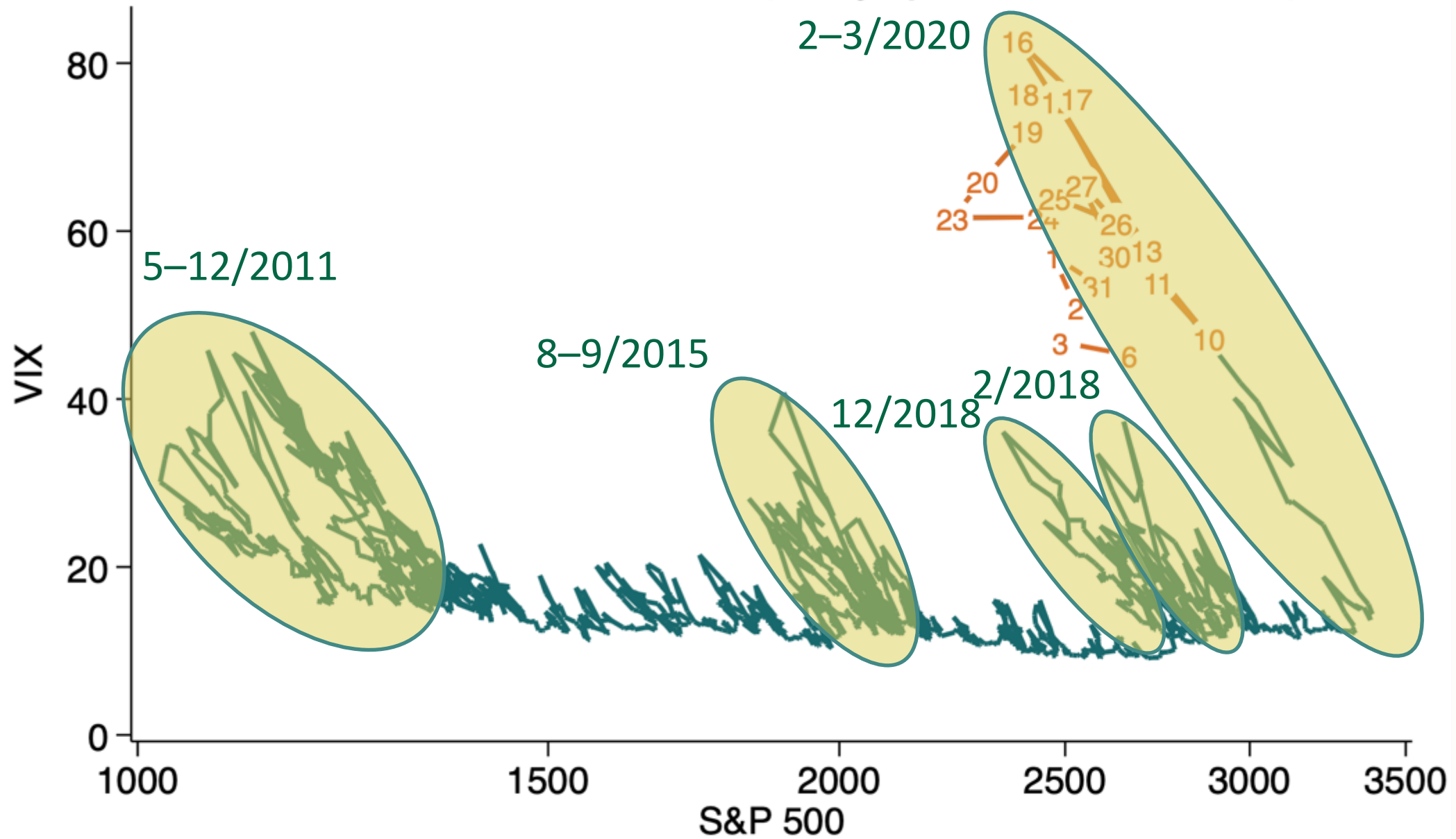


Max ever (since VIX introduced in 1990):
March 16, 2020!

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As of 3/16/2020

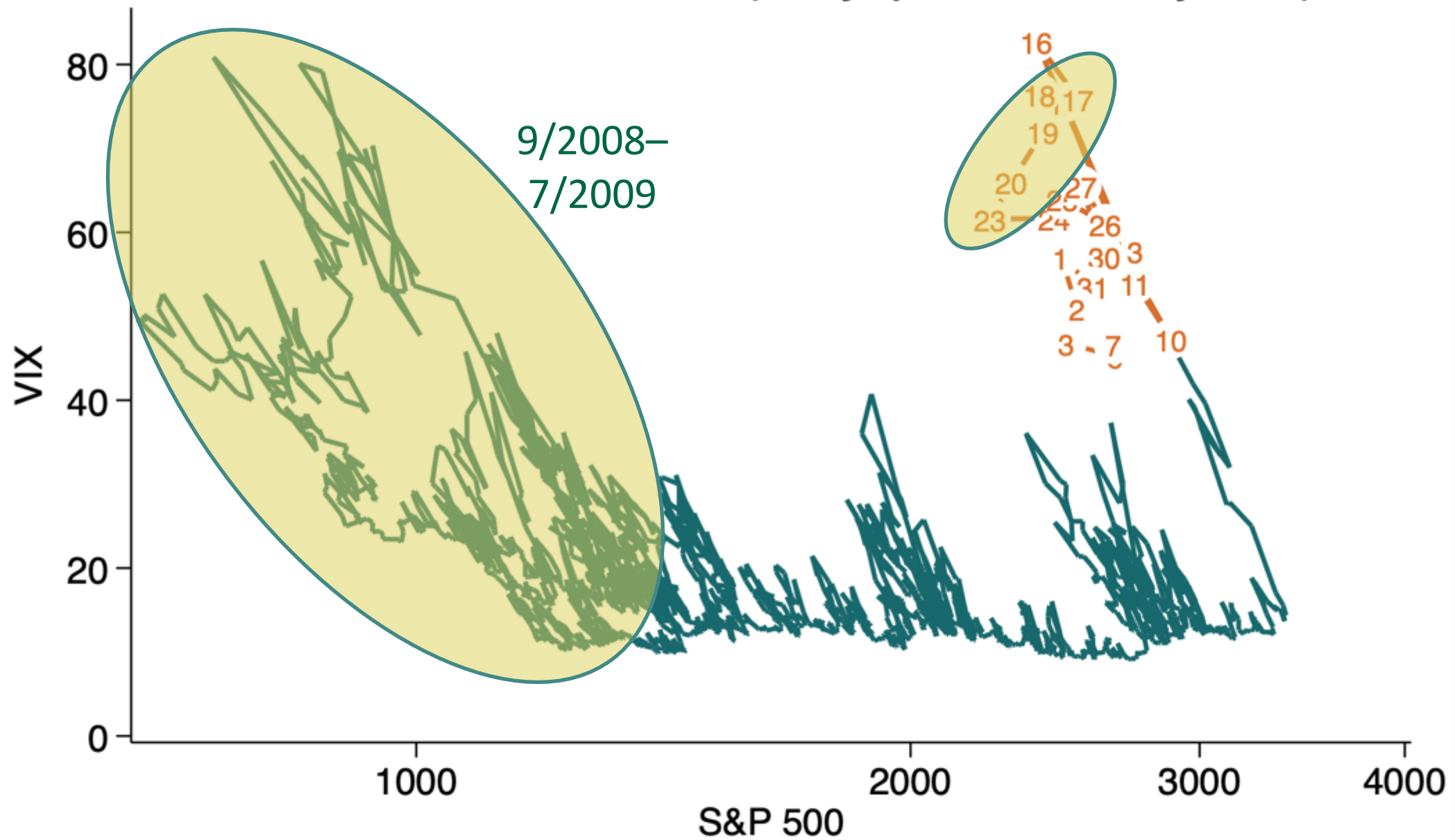
VIX vs. S&P 500 level (daily, previous decade)



Through 4/6/20. Orange labels are calendar day (last month). Horizontal axis is log scale.

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VIX vs. S&P 500 level (daily, previous 15 years)



Through 4/7/20. Orange labels are calendar day (last month). Horizontal axis is log scale.

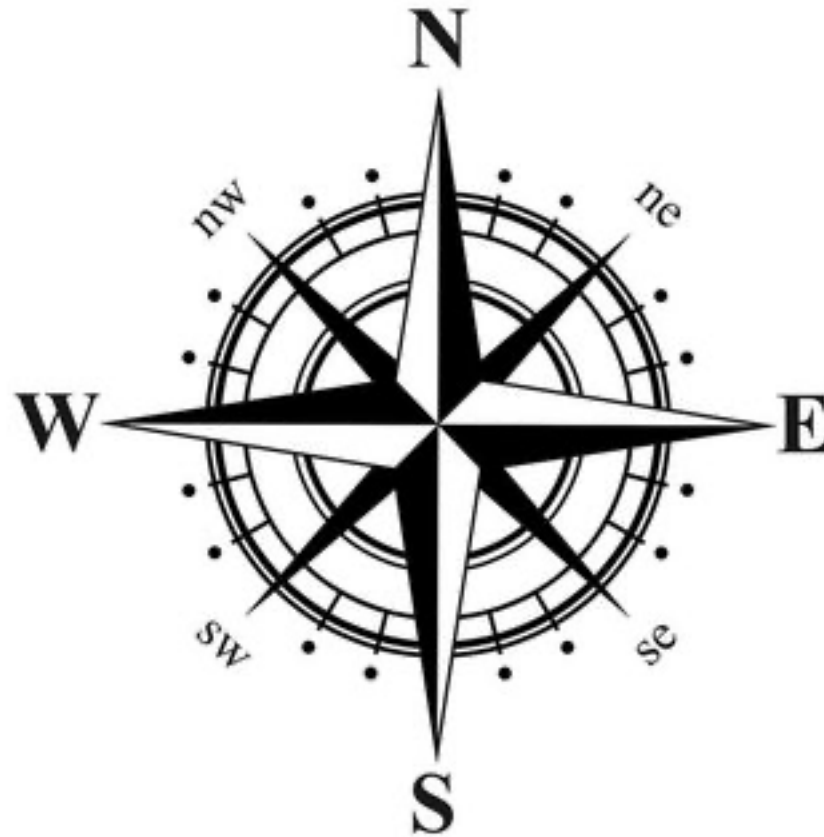
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Uncertainty

(Raises questions)

Bad

(Relative to expectations)



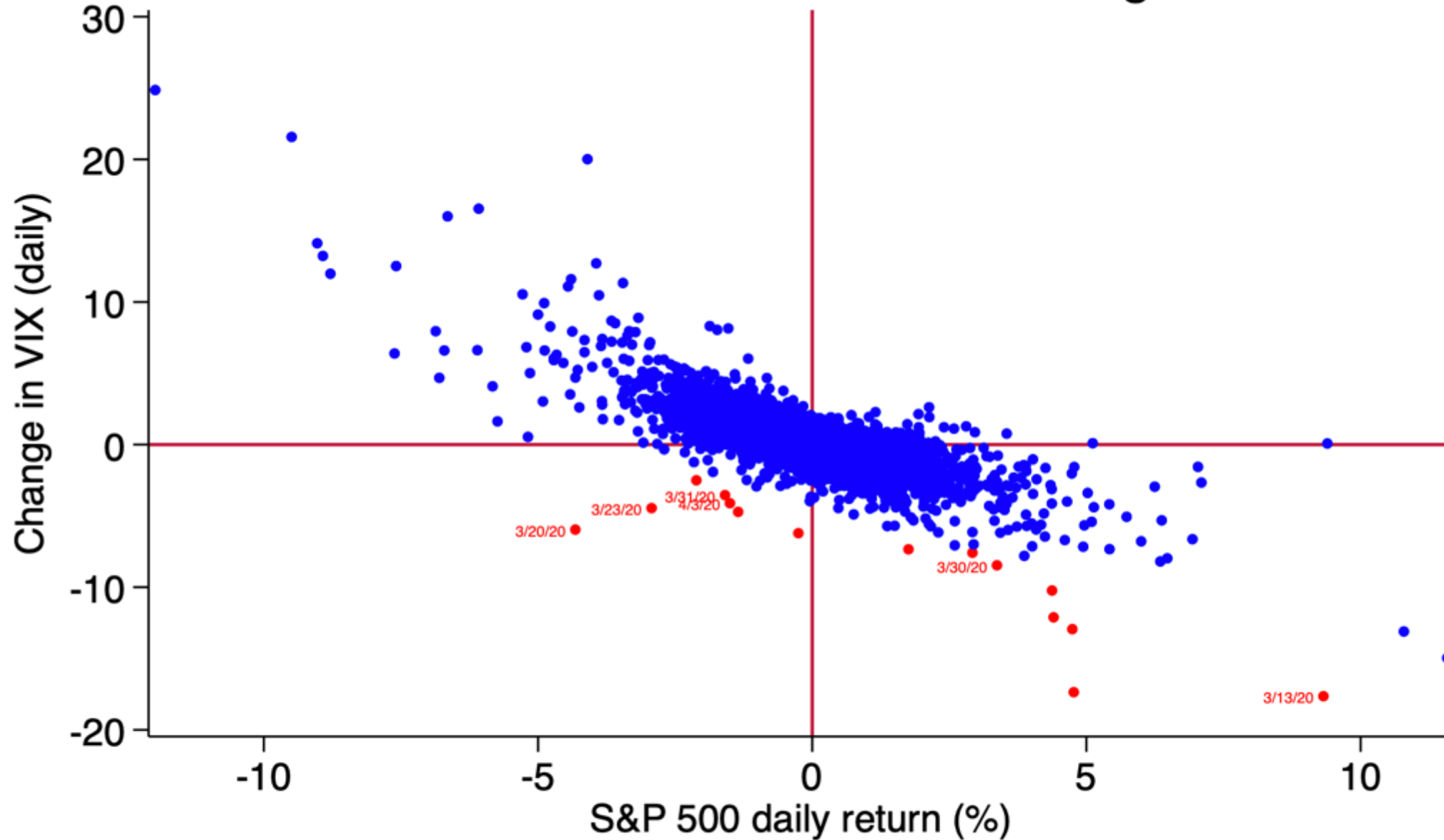
Good

(Relative to expectations)

Resolution

(Answers questions)

S&P 500 returns and VIX changes

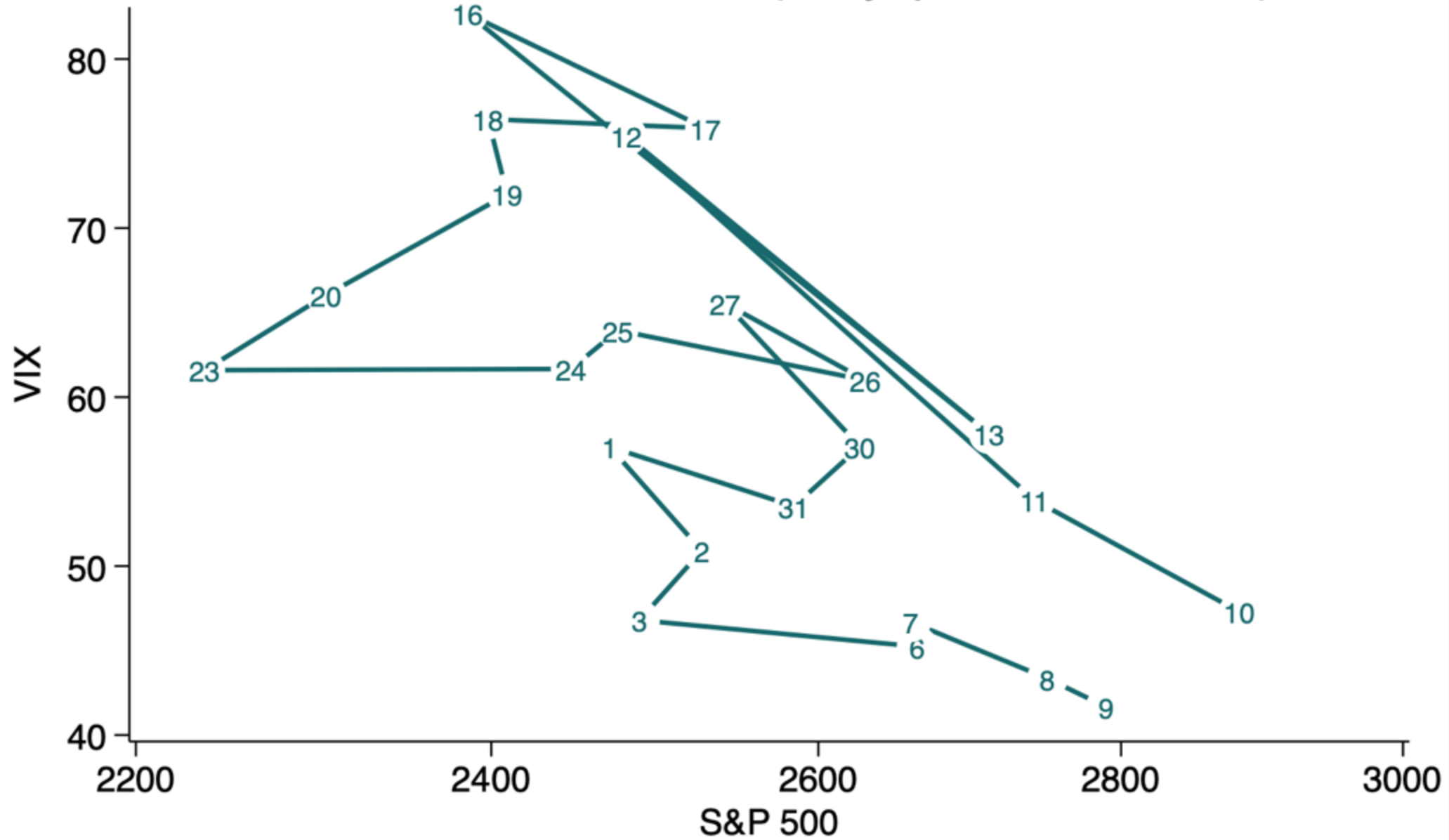


Through . Red dots are the fifteen "weirdest" daily VIX declines based on residual from linear regression on contemporaneous daily S&P 500 return.

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As of 4/6/2020

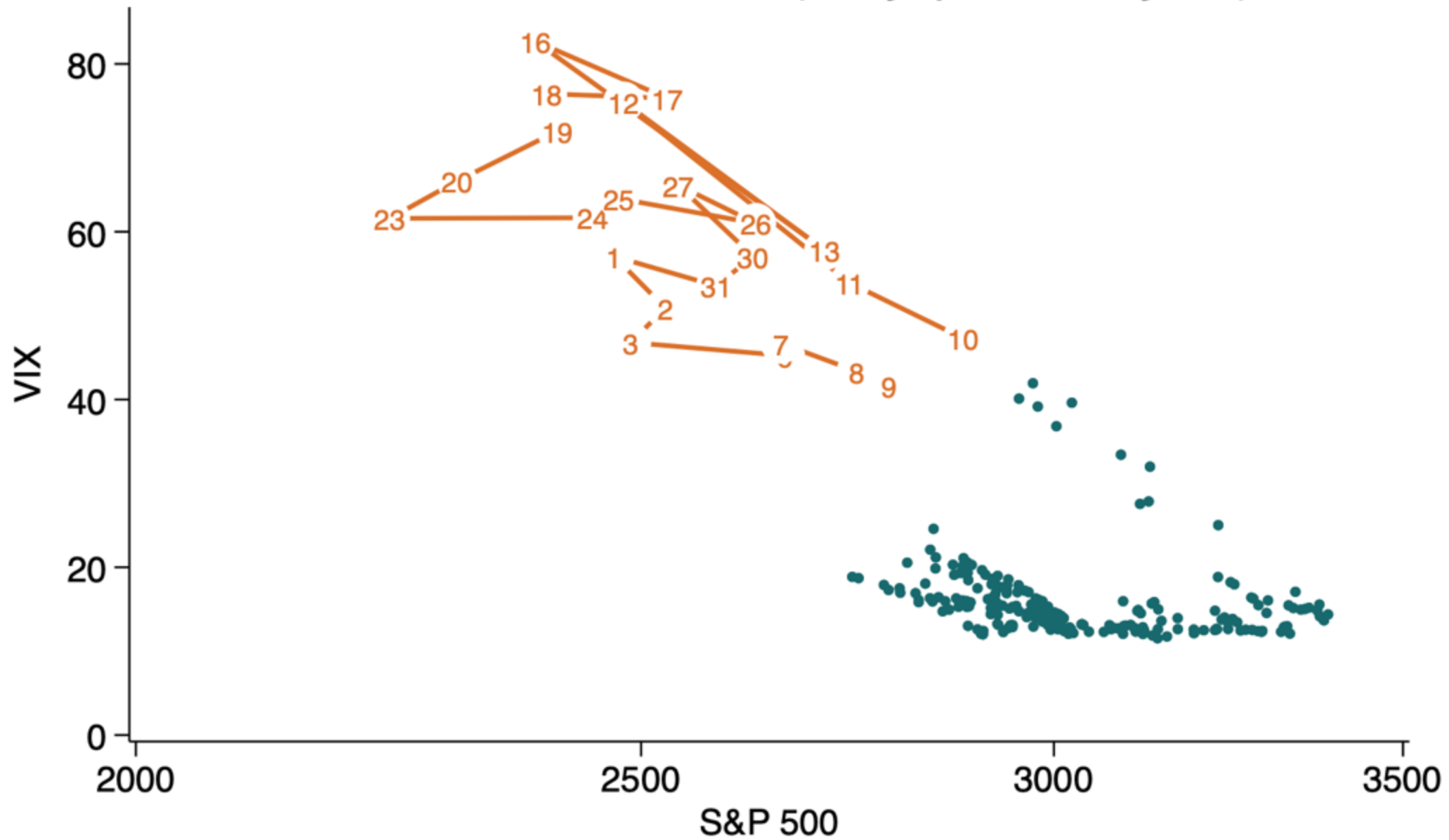
VIX vs. S&P 500 level (daily, previous month)



Through 4/9/20. Label is calendar day. Horizontal axis is log scale.

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VIX vs. S&P 500 level (daily, previous year)



Through 4/9/20. Orange labels are calendar day (last month). Horizontal axis is log scale.

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WHERE DO WE GO FROM HERE?

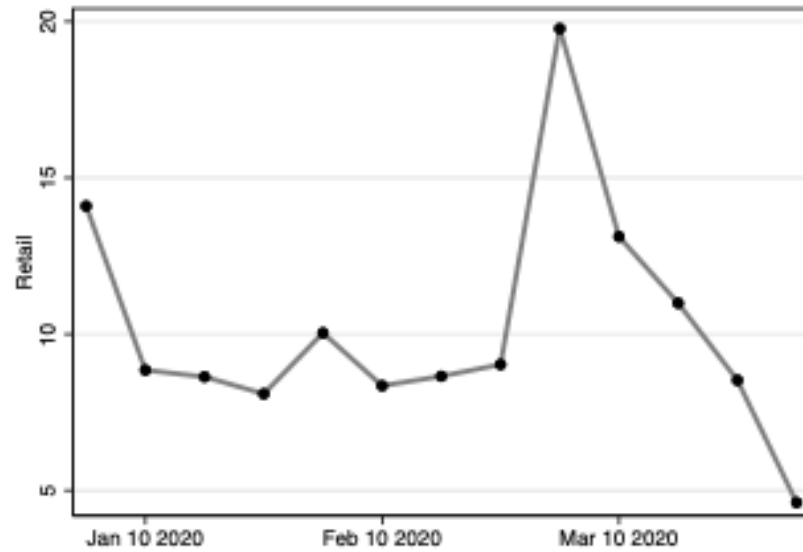


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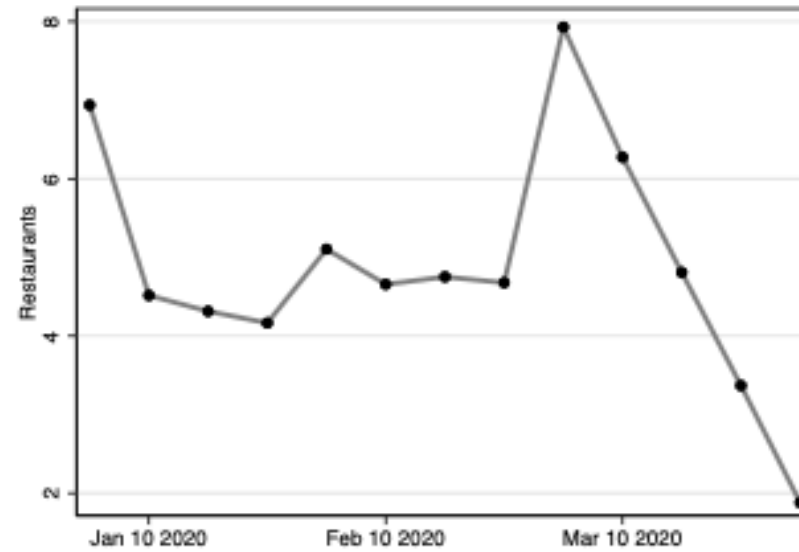
Figure 4: Household Spending Response Across Categories

Notes: This graph displays the response of household spending across a number of categories of spending. Spending is measured in daily dollars. Estimates are taken as the change in household spending from the first week of February to the first week of March. Source: Non-Profit Fintech.

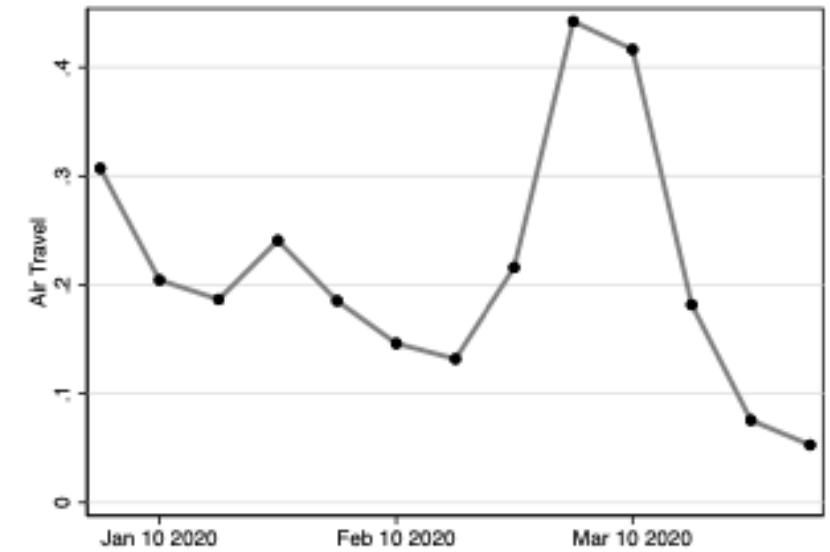
Retail Spending



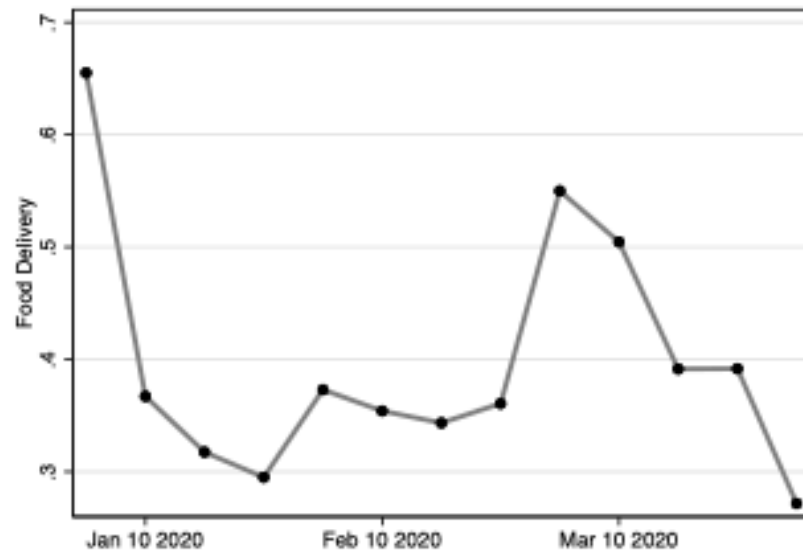
Restaurant Spending



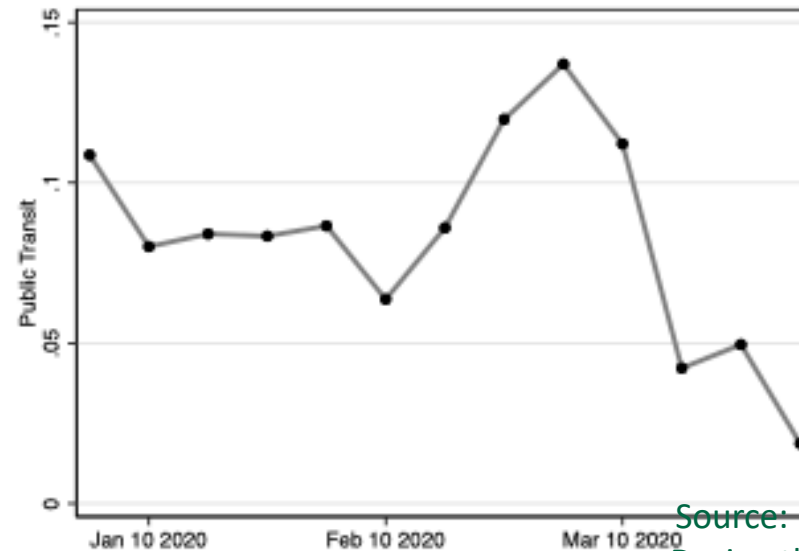
Air Travel Spending



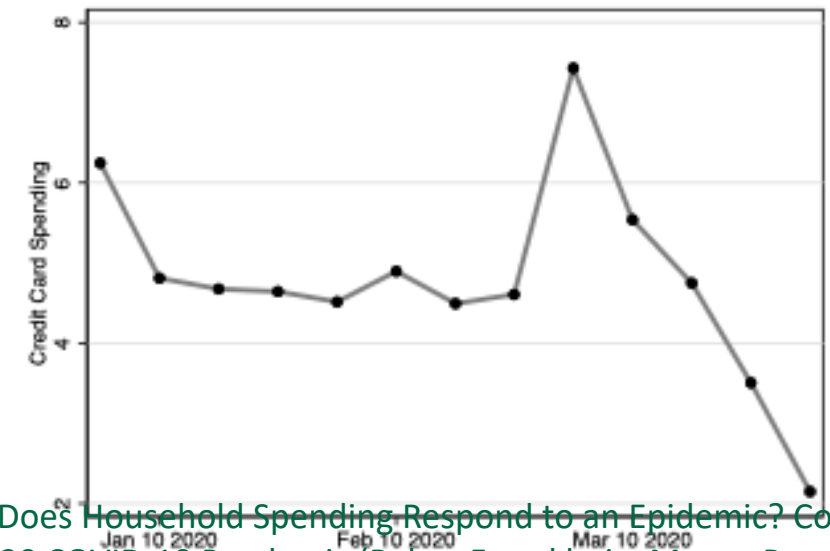
Food Delivery Spending



Public Transit Spending

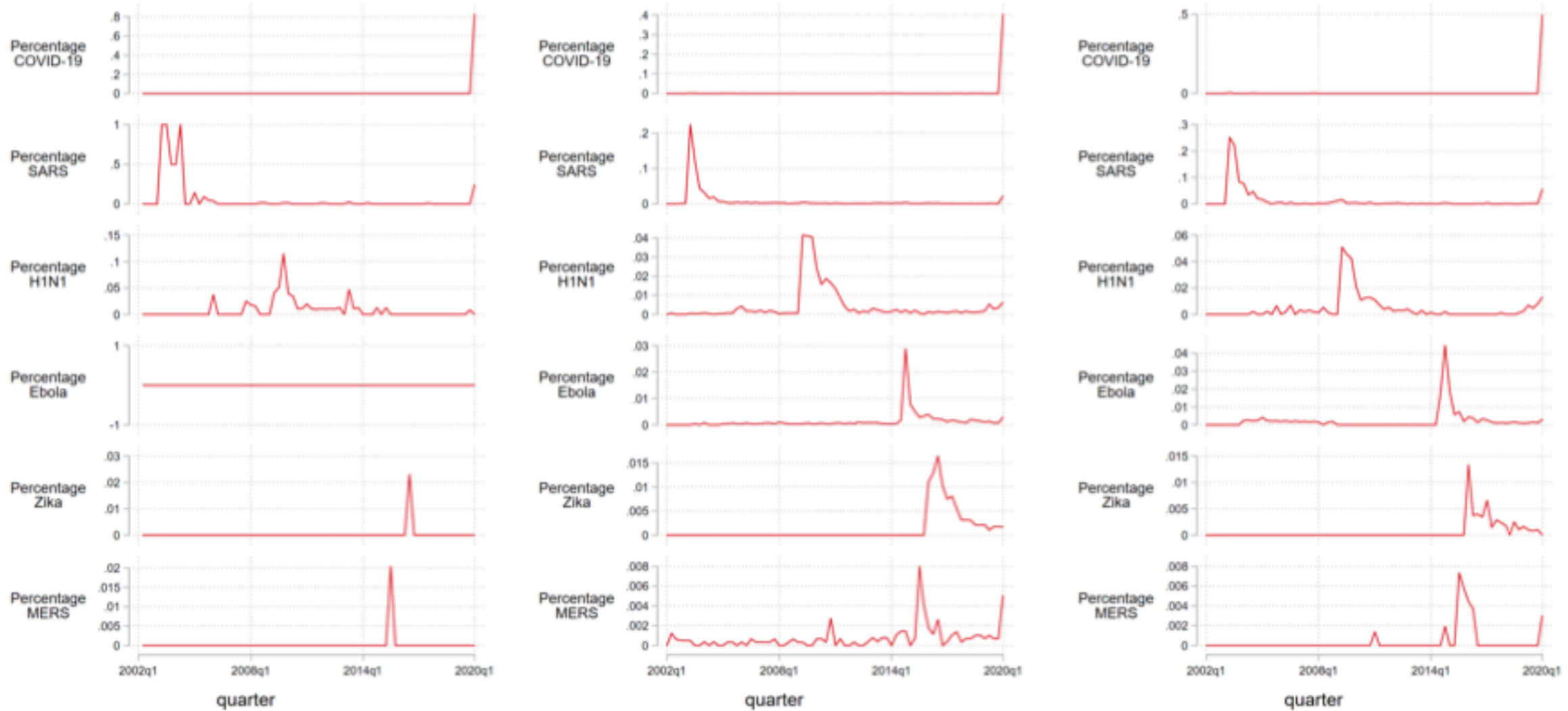


Credit Card Spending



Source: How Does Household Spending Respond to an Epidemic? Consumption During the 2020 COVID-19 Pandemic (Baker, Farrokhnia, Meyer, Pagel, Yannelis)

Appendix Figure 1: Percentage Earnings Calls Discussing Epidemic Diseases



(a) China

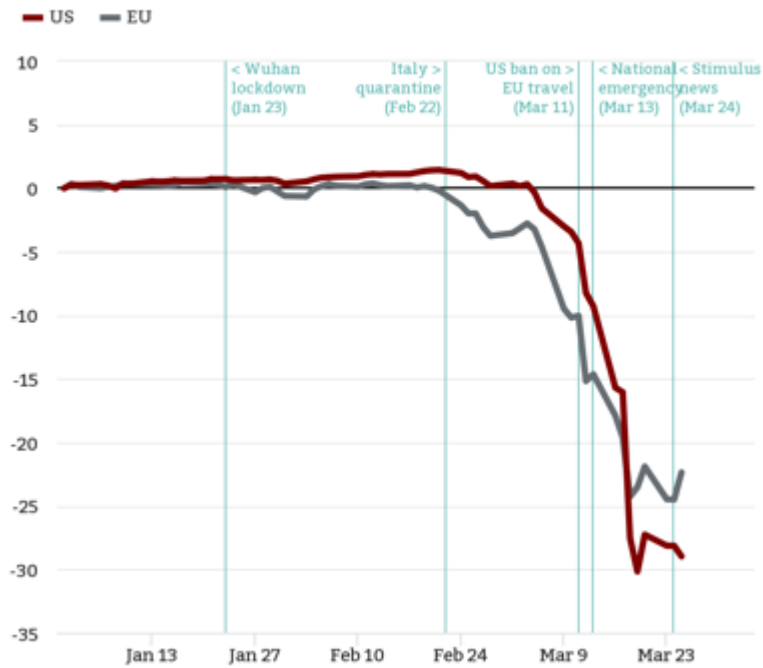
(b) United States

(c) Europe

Source: Firm-Level Exposure to Epidemic Diseases: COVID-19, SARS, and H1N1 (Hassan, Hollander, van Lent, Tahoun)

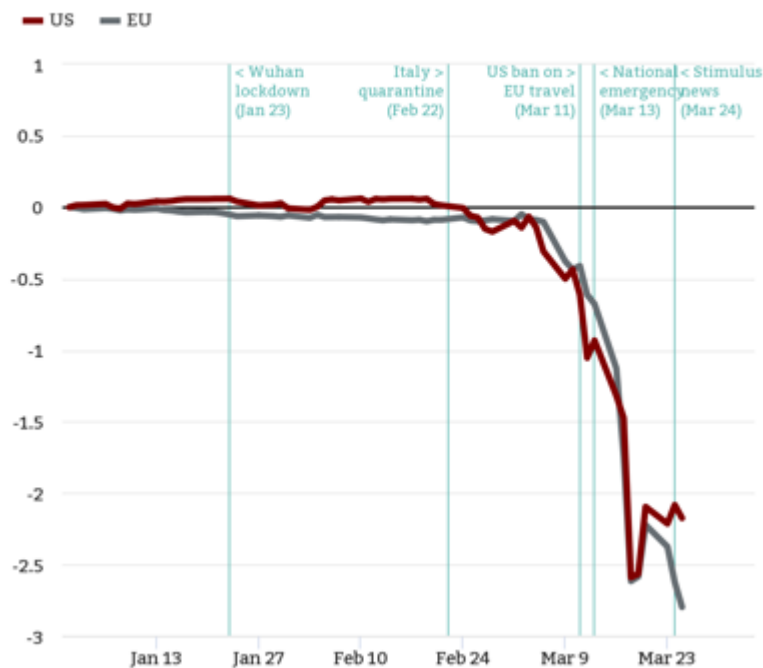
Change in 1-year dividend-growth expectations

Percentage point difference from Jan. 1



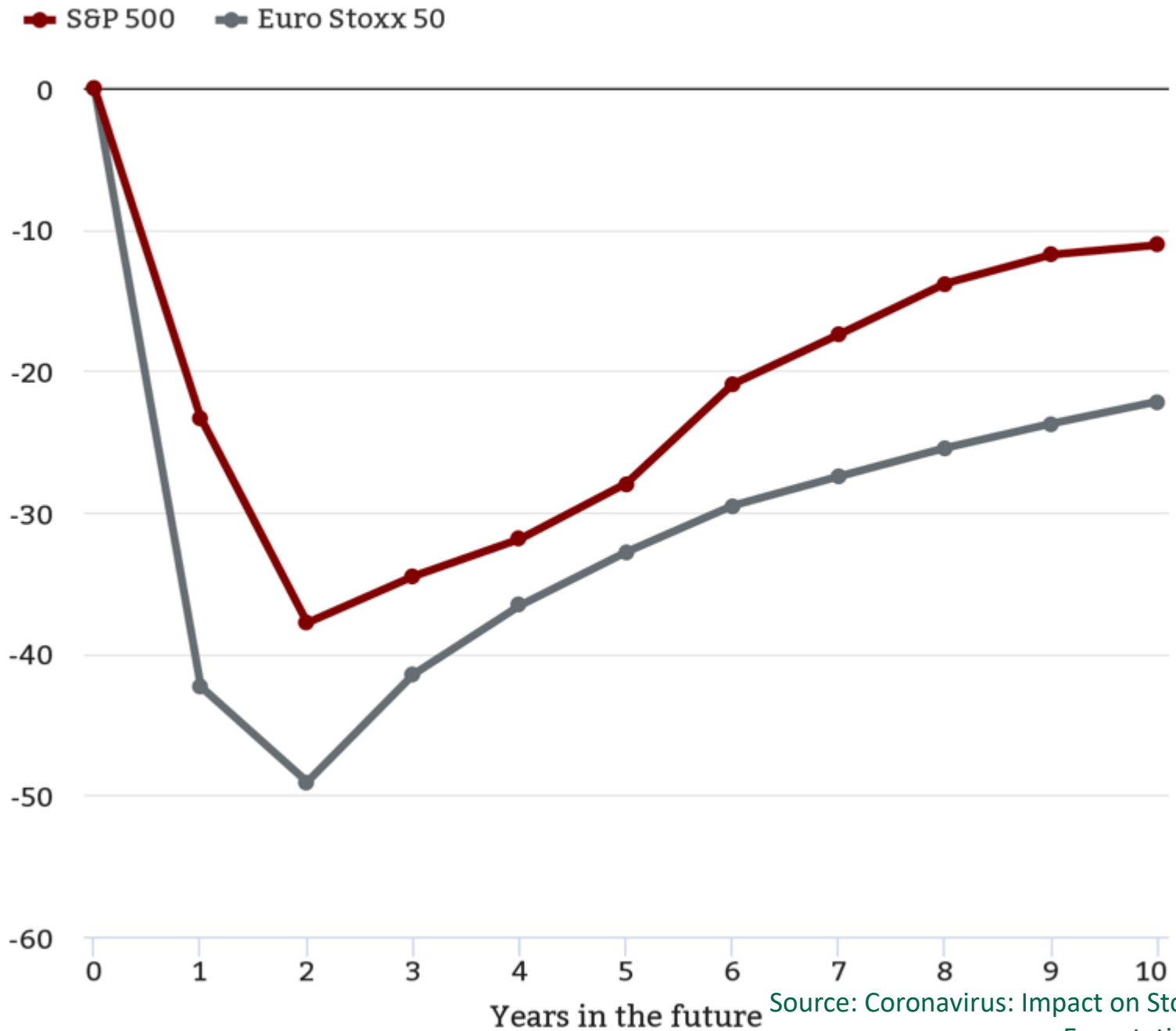
Change in 1-year GDP-growth expectations

Percentage point difference from Jan. 1



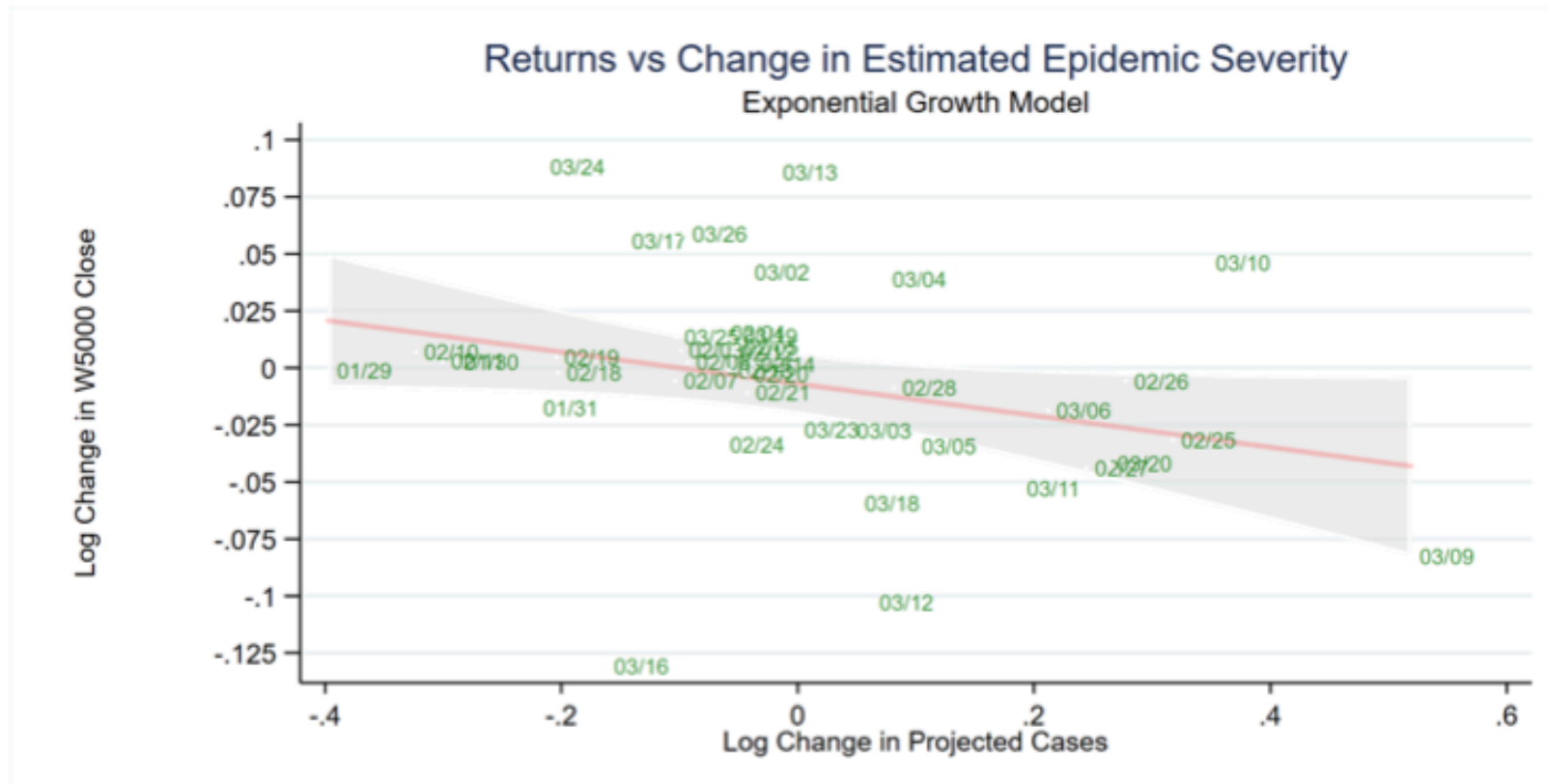
Lower bound of the change in expected dividends

Percentage point change from Jan. 15, 2020



Source: Coronavirus: Impact on Stock Prices and Growth Expectations (Gormsen, Koijen)

Figure 14: Change in Predicted COVID-19 Cases ($\Delta \widehat{C}_{it}^{-2,-1}$) vs Aggregate Market Returns

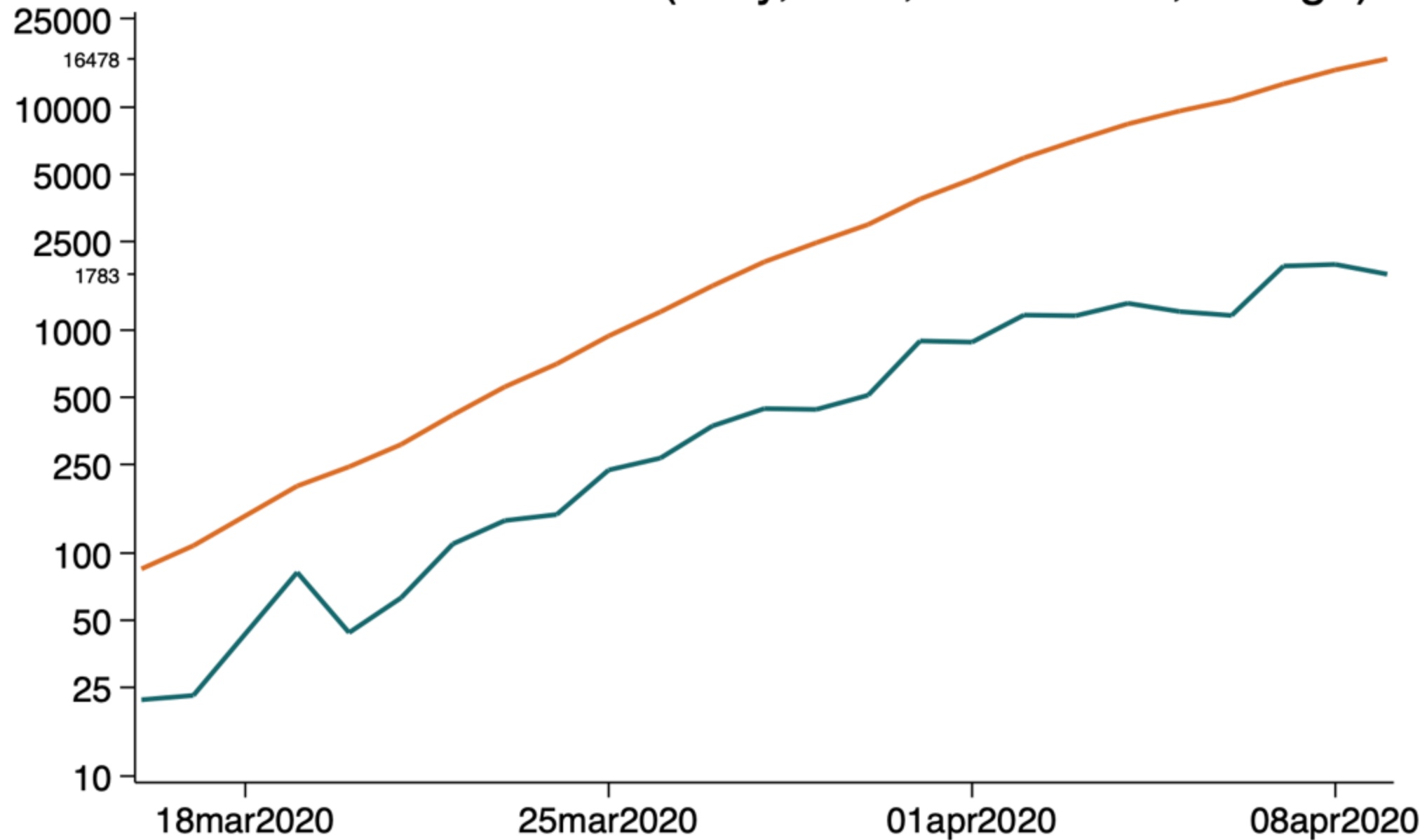


Source: Johns Hopkins Coronavirus Resource Center, Yahoo Finance and authors' calculations. Figure displays the daily log change in the Wilshire 5000 index against the log change in predicted cases under the exponential model for day t based on day $t-1$ and day $t-2$ information. Data currently extend to Friday March 27, 2020.

“We show that unanticipated changes in predicted infections during the SARS and COVID-19 pandemics forecast aggregate equity market returns. We model cumulative infections as either exponential or logistic, and re-estimate the parameters of these models each day of the outbreak using information reported up to that day. For each trading day t we compute the change in predicted infections using day $t-1$ versus day $t-2$ information. Regression results imply that a doubling of such predictions is associated with a 4 to 11 percent decline in aggregate market value. This result implies a decline in returns' volatility as the trajectory of the pandemic becomes clearer.”

Source: Aggregate and Firm-Level Stock Returns During Pandemics, in Real Time (Alfaro, Chari, Greenland, Schott)

US COVID-19 Deaths (daily, blue; cumulative, orange)



Through 4/9/20. Source: Johns Hopkins CSSE.

Luke Stein @lukestein

Source: Frank Donnarumma
@frankman1000

Italy and Spain have turned the corner, with numbers of new cases now in decline, following in China's footsteps

Daily confirmed cases, by number of days since 30 daily cases first recorded
Stars represent national lockdowns ★



FINANCIAL TIMES

FT graphic: John Burn-Murdoch / @jburnmurdoch
Source: FT analysis of European Centre for Disease Prevention and Control Worldometers; FT research. Data updated April 07, 19:00 GMT
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Source: Frank Donnarumma
@frankman1000