From: **Bruce O Knuteson** knuteson@mit.edu
Subject: Re: income inequality
Date: June 4, 2021 at 12:32 PM
To: [redacted]@ft.com

Dear [redacted]

Thanks for your questions. The "tl;dr" answer to most of them is "incentives." Longer responses follow.

- In as simple terms as possible - and any vivid metaphors you can think of are welcome - what do you think is causing this pattern?

> [Ref. 1, Section III] The obvious, mechanical explanation of [the attached plots] is somebody trading in a way that pushes prices up before or at market open (thus causing the blue curve) and then trading in a way that pushes prices down between market open and market close (thus causing the green curve). The striking consistency of these plots points to the actions of a few quantitative trading firms rather than the uncoordinated, manual trading of millions of people. Computers are consistent. People are not.
>
> [Ref. 3, first sentence] The Strategy is very simple: construct a large, suitably leveraged, market-neutral equity portfolio and then systematically expand it in the morning and contract it in the afternoon, day after day.
>
> The first 1.5 pages of Ref. 2 provide other metaphors for the Strategy, including a portfolio breathing and a cartoon picture.

- Why is it problematic?

> [Ref. 2, Section IV] The tens of trillions of dollars your use of the Strategy has created out of thin air have mostly gone to the already-wealthy: company executives and existing shareholders benefitting directly from rising stock prices; owners of private companies and other assets, including real estate, whose values tend to rise and fall with the stock market; and those in the financial industry and elsewhere with opportunities to “privatize the gains and socialize the losses,” as those in the business of doing so like to say. These gains to capital over the last three decades have contributed directly and significantly to the current level of wealth inequality in the United States and elsewhere. As a general matter, widespread mispricing leads to misallocation of capital and human effort, and widespread inequality negatively affects our social structure and the perceived social contract.

- If this is an easy a trade as you suggest for a few big quant firms, why aren't many similar firms also intentionally employing the Strategy? [question edited for specificity; please rephrase if I misinterpreted]

> There are barriers to entry. A firm needs to be generally market neutral and sufficiently large. Most firms probably still do not yet have the quantitative understanding of market impact you would want to have if implementing the Strategy is your primary plan.
>
> The Strategy is also illegal, of course. Losing money on daily round-trip trading in a way that moves prices to your benefit is market manipulation. Trading in this manner with money from outside investors without disclosing it is fraud.

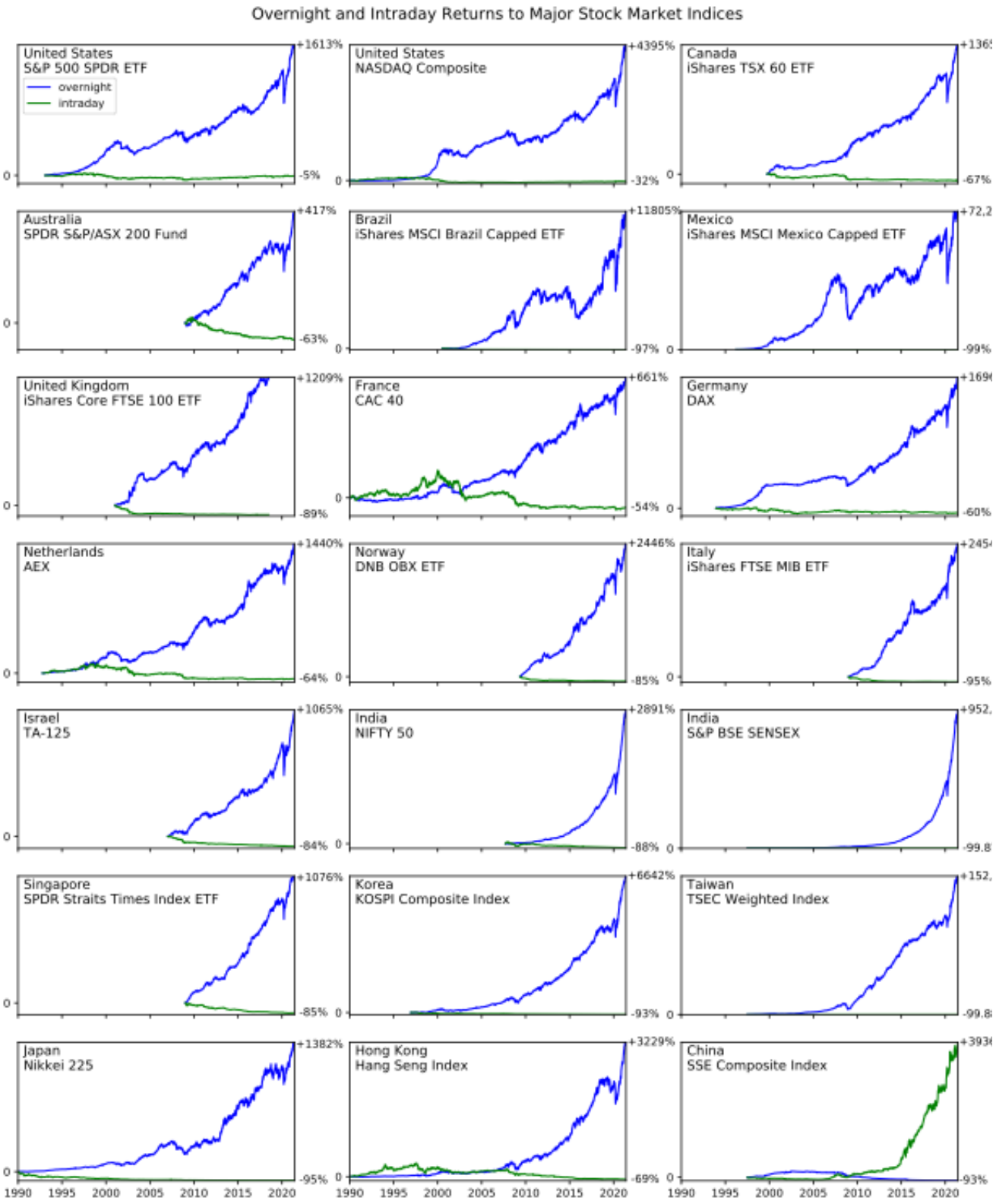
- If this was as problematic as you suggest, why has not one financial watchdog in any country understood and publicized the cause? [question edited to acknowledge that many financial watchdogs investigate privately and that these investigations can take years]

> Everybody likes it when the market goes up. [Ref. 3, Section II]: Even with a generally market-neutral book, your daily round-trip trading can create a drift in prices in the overall stock market. If this drift in prices is downward, people will be angry, there will be congressional hearings, and you will be discovered quickly. If the drift in prices is upward, people will be happy, there will be no congressional hearings, and you can run the Strategy for decades.
>
> The SEC's stated mission is to protect investors, maintain fair, orderly, and efficient markets, and facilitate capital formation. Many other financial watchdogs have similar mission statements. No institution is going to voluntarily admit it has failed in its core mission for the past three decades. That just isn't how institutions work.
>
> There are other, more mundane reasons -- the limited technical expertise of the watchdogs, their unwillingness to use their authority to obtain the information they need, the resources required to seriously investigate established firms, and so on and so forth -- but these problems are secondary.
>
> The primary problem here is not one of understanding. Most adults on the planet can distinguish positive numbers from negative numbers and view striking return patterns in financial markets with appropriate suspicion. (The Strategy itself is not trivial, but in the grand scheme of things it isn't really that hard, either.) The primary problem here is one of incentives. Most of the adults in a position to do something about this issue have strong incentives not to [4].

Regards,
Bruce

[1] Strikingly Suspicious Overnight and Intraday Returns (arXiv, SSRN)

[1] Strikingly Suspicious Overnight and Intraday Returns (arXiv, SSRN)
[2] Celebrating Three Decades of Worldwide Stock Market Manipulation (arXiv, SSRN)
[3] How to Increase Global Wealth Inequality for Fun and Profit (arXiv, SSRN)
[4] More charitably: Most of the adults in a position to do something about this issue have many ways they could spend their time, and their incentives are such that this never quite makes the top of their list.



On Jun 4, 2021, at 6:14 AM, [redacted]@ft.com> wrote:

Ok here are some questions:

- In as simple terms as possible - and any vivid metaphors you can think of are welcome - what do you think is causing this pattern?
- Why is it problematic?
- If this is an easy a trade as you suggest for a few big quant firms, why isn't everyone trying to take advantage of the overnight drift?
- If this was as problematic as you suggest, why has not one financial watchdog in any country ever looked at it?

From: Bruce Knuteson <knuteson@mit.edu>
Subject: Re: income inequality
Date: June 3, 2021 at 10:59:12 AM EDT
To: [redacted]@ft.com, [redacted]@ft.com, [redacted]@ft.com
Cc: [redacted]@ny.frb.org, [redacted]@cbs.dk, [redacted]@cbs.dk

Dear [redacted]

Can you identify a single historical example of such a strikingly suspicious return pattern in a financial market that turned out to be fine? If so, please do share. If not, your first sentence is disingenuous.

The "NY Fed's explanation," while an interesting and worthy paper, is not even an attempted explanation of the attached plots. I have forwarded to you separately a thread with other members of the NY Fed making the same point. Specifically, nowhere in 68 pages do the authors claim an explanation for the attached plots. The authors are instead correct and responsible in focusing their attention on an interesting (and potentially related) pattern in the S&P 500 futures market. I cc the authors so they can point us to the specific page(s) in their article on which they claim an explanation for the attached plots, just in case I missed it.

You mischaracterize the only plausible explanation for these plots so far proposed. That explanation involves at most a few long-lived quant firms (not "scores" of them) and invokes no explicit conspiracy among those firms.

As I have said previously, I am happy to consider by email questions you may have. A contract with a previous employer (D.E. Shaw & Co.) unfortunately constrains what I can say on this topic. Email provides me with sufficient time to ensure my response manifestly satisfies this constraint. Real-time communication does not.

Regards,
Bruce

<suspicious_index_returns_19900101-20210531.pdf>

On Jun 3, 2021, at 7:23 AM, [redacted]@ft.com> wrote:

Hi Bruce, as we discussed I kicked the tyres on this and I just don't think this is "glaringly problematic" as much as "weird phenomenon with several interesting but technical and behavioral explanations".

I'm aware of your theory on what is causing this, but I just find the NY Fed's explanation a bit more plausible than a grandiose quant conspiracy spanning scores of firms over several decades.

That said, I've long wanted to write something about this phenomenon in some way. Maybe we can have a chat sometime about it?

From: Bruce Knuteson <knuteson@mit.edu>
Subject: Re: income inequality
Date: June 2, 2021 at 1:39:28 PM EDT
To: [redacted]@ft.com>, [redacted]@ft.com>, [redacted]@ft.com>

Dear [redacted]

I reattach easily reproducible, glaringly obviously problematic return patterns in the world's major stock market indices and in the stocks many of America's largest public companies, updated with data through the end of May.

Your readers expect you to tell them about suspicious return patterns in their investments.

Regards,
Bruce

<suspicious_index_returns_19900101-20210531.pdf>

<largest_us_companies_20100101-20210531.pdf>

From: Bruce Knuteson <knuteson@mit.edu>
Subject: Re: income inequality
Date: Januar 6, 2021 at 8:38:12 AM EST
To: [redacted]@ft.com, [redacted]@ft.com, [redacted]@ft.com>

Dear [redacted]

Neither "the dynamics of option hedging" nor "EOD index fund buying" explains why these plots show large negative intraday returns (ranging from -56% to -99.85% outside the US and China) and why these plots are so astonishingly consistent.

The fact that "markets are only open for about 19% of the time" misses the point that most price movement happens intraday [1], not overnight, as [redacted] and I discussed on 2018-Sep-04 [redacted], and it does not explain why these plots show consistently large negative intraday returns.

Your readers deserve to know about suspicious return patterns in their investments.

Thanks and regards,
Bruce

[1] The attached histogram shows overnight and intraday returns to SPY. The intraday (green) distribution is wider than the overnight (blue) distribution. Prices move more intraday than they do overnight.

<suspicious_index_returns_19900101-20201231.pdf>

<overnight_intraday_return_distribution_spy_1993-2020.pdf>

On Jan 6, 2021, at 3:32 AM, [redacted]@ft.com> wrote:

Sent a bit early but the explanation I got from someone who has also looked at this was below my half-written email.

On Wed, 6 Jan 2021 at 09:31, [redacted]@ft.com> wrote:

> Hi Bruce, have done some digging into this.
>
> I'm aware of your theory as to the driver, but most other people I talk to say it is driven by technical factors - primarily the dynamics of option hedging and EOD index fund buying - and the fact that the market open only accounts for a quarter of a full day. Factor in things like weekends, markets are only open for about 19% of the time. Given skew and path dependency, this phenomenon isn
>
> Part of this is the fact that markets are only open for 27% of the trading day, which is to say that the 9:30 - 16:00 trading day only covers a small fraction of the hours in the day. Add in weekends and the market is only open 19.3% of the hours in the week, not accounting for holidays. *On average* intraday returns are +0.00291% per day, versus +0.04005% for overnight. But because of skew and path dependency, those average gains for the day deliver a negative overall return for open-close (eg, if you go down 20% then up 20%, you're still down 4% from where you started). Okay so if we account for the fact that the day is shorter, what happens? When scaling each period by (24/[hours]), average daily returns for the trading day rise to +0.05820% versus +0.05591% for overnight. But the distribution of overnight returns is way tighter (see chart below, number of days for a particular return scaled to 24 hour change for overnight in light blue, during the day in dark blue) and because of that the series rises over time as opposed to falling.

On Jan 4, 2021, at 9:21 AM, Bruce O Knuteson <knuteson@mit.edu> wrote:

Dear [redacted]

I attach updated plots from [1], including those referenced in footnote 18.

Your readers deserve to know about suspicious return patterns in their investments.

Again, you need not mention me or the explanation I consider most likely if you would prefer not to. A two page, nontechnical summary of the features of these plots that have prevented the construction of any plausible innocuous explanation is provided in [1]. You can ask your favorite regulators [redacted] if they know whose trading is responsible; if not, whether they think these plots indicate a problem; and if not, why not.

Rising stock prices increase inequality, and suspicious return patterns in financial markets indicate a problem.

Thanks and regards,
Bruce

[1] [redacted]

[1] https://ssrn.com/abstract=3705017

<suspicious_index_returns_19900101-20201231.pdf>

<suspicious_returns_us_individual_stocks_20100101-20201231.pdf>

From: Bruce Knuteson <knuteson@mit.edu>
Subject: Re: income inequality
Date: October 12, 2020 at 1:48:29 PM EDT
To: [redacted]@ft.com>
Cc: [redacted]@ft.com>, [redacted]@ft.com>

Dear [redacted]

I attach updated plots from Strikingly Suspicious Overnight and Intraday Returns.

If you have not yet figured out whose trading is responsible, perhaps you could bring these extraordinary plots to the attention of your readers.

They deserve to know about suspicious return patterns in their investments.

Thanks and regards,
Bruce

Bruce Knuteson
http://bruceknuteson.com

<suspicious_index_returns.pdf>

From: Bruce Knuteson <knuteson@mit.edu>
Subject: Re: [redacted]
Date: August 30, 2020 at 7:05:46 PM EDT
To: [redacted]@ft.com>

Dear [redacted]

Thank you for your quick response.

I would be happy to consider by email any questions you have. (A contract with D.E. Shaw & Co. constrains what I can say on this topic. Email provides me with sufficient time to ensure my response manifestly satisfies this constraint; real-time communication unfortunately does not.)

As far as I am aware (and please of course let me know if I missed something):

- The trading described in [1] remains the only plausible explanation so far advanced for these extraordinary plots.
- There are zero historical examples of highly suspicious return patterns in financial markets that turned out to be innocuous.

Thanks and regards,
Bruce

[1] Celebrating Three Decades of Worldwide Stock Market Manipulation (arXiv, SSRN)

On Aug 30, 2020, at 5:13 PM, [redacted]@ft.com> wrote:

It's certainly an interesting if controversial theory. Do you have time to talk about in some more detail sometime soon? Keen to hear why you think manipulation must be the cause.

On Aug 30, 2020, at 4:27 PM, Bruce O Knuteson <knuteson@mit.edu> wrote:

Dear [redacted]

Have you figured out whose trading caused more than all of the positive returns to the world's major stock market indices (except

Have you figured out whose trading caused more than all of the positive returns to the world's major stock market indices (except China's) over the past 30 years to occur overnight?

I attach an updated plot from "Celebrating Three Decades of Worldwide Stock Market Manipulation" (arXiv, SSRN).

Over the past decade, [redacted]

Thanks and regards,
Bruce

Bruce Knuteson
http://bruceknuteson.com

[redacted]

On Jul 13, 2020, at 6:37 PM, Bruce O Knuteson <knuteson@mit.edu> wrote:

Dear [redacted]

Have you figured out whose trading caused more than all of the positive returns to the world's major stock market indices (except China's) over the past 30 years to occur overnight?

I reattach a few plots from "Celebrating Three Decades of Worldwide Stock Market Manipulation" (arXiv, SSRN).

If not, perhaps you could bring these extraordinary return patterns to the attention of your readers.

I think they would find this interesting.

Thanks and regards,
Bruce

Bruce Knuteson
http://bruceknuteson.com

<suspicious_index_returns.png>

On Feb 17, 2020, at 6:16 PM, Bruce O Knuteson <knuteson@mit.edu> wrote:

Dear [redacted]

Have you been able to figure out whose trading caused more than all of the positive returns to the world's major stock market indices over the past 30 years to occur overnight?

If not, perhaps you might consider bringing these extraordinary return patterns to the attention of your readers. I attach a few plots from "Celebrating Three Decades of Worldwide Stock Market Manipulation" (available on arXiv and SSRN).

There is no need to mention me or the explanation I consider most likely if you would prefer not to. Your story could be a global version of Jeff Sommer's February 2018 New York Times article, which notes the remarkable return pattern in the S&P 500 index shown in the top left plot of those attached.

I think your readers would find this interesting.

Thanks and regards,
Bruce

Bruce Knuteson
http://bruceknuteson.com

<suspicious_index_returns.png>

On Mar 4, 2019, at 3:16 AM [redacted]@ft.com> wrote:

[redacted]

Thank you! And I am copying in a colleague who follows this closely.
[redacted]

On Mon, Mar 4, 2019 at 1:06 AM Bruce O Knuteson <knuteson@mit.edu> wrote:

> Dear [redacted]
>
> I enjoyed reading your [redacted] article on [redacted]
>
> I would like to draw your attention to something you may find relevant.
>
> More than all of the positive returns to the world's stock markets over the past quarter century occurred at market open.
>
> I attach Figure 1 of How to Increase Global Wealth Inequality for Fun and Profit.
>
> As a general matter, (i) rising stock prices increase inequality, and (ii) highly suspicious return patterns in financial markets indicate the presence of market manipulation and/or fraud.
>
> Thanks and regards,
> Bruce
>
> Bruce Knuteson
> http://bruceknuteson.com

<suspicious_index_returns.png>

From: Bruce Knuteson <knuteson@mit.edu>
Subject: Re: [redacted]
Date: November 18, 2018 at 6:54:17 PM EST
To: [redacted]@ft.com>

Dear [redacted]

You may also wish to check out Figure 1 of How to Increase Global Wealth Inequality for Fun and Profit.

Thanks and regards,
Bruce

On Oct 1, 2018, at 11:02 PM, [redacted]@ft.com> wrote:

Yes I've been meaning to dig into this a little bit further, but I never end up having time. Was unaware of the NYT article, thanks for alerting me!

Sent from my iPhone

On 29 Sep 2018, at 00:42, Bruce O Knuteson <knuteson@mit.edu> wrote:

> Dear [redacted]
>
> I wonder whether you might be interested in writing about the difference between overnight and intraday returns on the NASDAQ Composite index. Over the past quarter century (1993-01-29 to 2018-09-30) the cumulative overnight (intraday) return to the NASDAQ Composite index is +2,939% (-62%).
>
> Your story could be similar in form to Jeff Sommer's February 2018 New York Times article, which notes the similarly puzzling overnight versus intraday return pattern in the S&P 500 index.
>
> There would be no need to mention me or the explanation I have proposed. For someone to quote, you could begin with Michael Kelly (quoted in the aforementioned New York Times article), who studied this effect in a NASDAQ index ETF.
>
> I attach for reference an updated version of the NASDAQ Composite index plot*, but a similar plot obtained from your own analysis would be more suitable for such a story.
>
> I think your readers would be interested in hearing about this extraordinary return pattern.
>
> Thanks and regards,
> Bruce
>
> <nasdaq_day_and_night.png>
> *This plot (covering dates from 1993-01-29 to 2018-09-30) was made using the code linked at

https://bruceknuteson.github.io/spy-day-and-night/, with symbol "^IXIC".

On Sep 4, 2018, at 2:19 PM, Bruce O Knuteson <knuteson@mit.edu> wrote:

Dear [redacted]

If all minutes of each 24 hour day counted roughly the same (an assumption implicit in your email), the variance of prices from 9:30am to 4:00pm would be 37% (= 6.5 hours / (24 - 6.5 hours)) of the variance of prices from 4pm to 9:30am. Unfortunately, in reality, the variance of prices of 9:30am to 4:00pm is roughly twice the variance of prices from 4pm to 9:30am, falsifying the hypothesis that all minutes of each 24 hour day count roughly the same.

Please let me know if this makes sense? Your analyst's explanation is a version of "higher returns are expected due to the bearing of additional risk", with his/her calculation implicitly assuming that the risk of each minute in a 24 hour day is the same. As a factual matter, this assumption is just wrong: the variance of prices of 9:30am to 4:00pm is roughly twice the variance of prices from 4pm to 9:30am. No version of "higher returns are expected due to the bearing of additional risk" can explain the S&P 500 plot.

More obviously, perhaps, no version of "higher returns are expected due to the bearing of additional risk" can explain the NASDAQ plot. Over the past quarter century (1993-01-29 to 2018-08-31), the cumulative overnight (intraday) return to the NASDAQ Composite index is +2,938% (-62%).

Thanks and regards,
Bruce

<spy_day_and_night.png>
<nasdaq_day_and_night.png>

On Sep 4, 2018, at 1:20 PM, [redacted]@ft.com> wrote:

Yes. In part it's the fact that US markets are only open for 27% of the global trading day. Ie the 9.30-4pm window is only a small fraction of the overall tradable hours, and add in weekends and the US stock market is only open for less than a fifth of the possible trading hours. Here's what an analyst who crunched the numbers for me sent me:

On average intraday returns are +0.00291% per day, versus +0.04005% for overnight. But because of skew and path dependency, those average gains for the day deliver a negative overall return for open-close (eg, if you go down 20% then up 20%, you're still down 4% from where you started). Okay so if we account for the fact that the day is shorter, what happens? When scaling each period by (24/[hours]), average daily returns for the trading day rise to +0.05820% versus +0.05591% for overnight. But the distribution of overnight returns is way tighter (see chart below, number of days for a particular return scaled to 24 hour change for overnight in light blue, during the day in dark blue) and because of that the series rises over time as opposed to falling.

<image (6).png>

On 4 September 2018 at 13:03, Bruce O Knuteson <knuteson@mit.edu> wrote:

> Dear [redacted]
>
> Have you been able to make any progress in figuring out whose 9:30am trading is largely responsible for America's increased wealth inequality over the past quarter century?
>
> As a general matter, highly suspicious return patterns in financial markets typically indicate the presence of market manipulation and/or fraud.
>
> Plots are re-attached. Details are available.
>
> Thanks and regards,
> Bruce
>
> Bruce Knuteson
> http://bruceknuteson.com
>
> <spy_day_and_night.png>
>
> <nasdaq_day_and_night.png>

<nasdaq_day_and_night.png>

On Jun 3, 2018, at 8:06 PM, Bruce O Knuteson <knuteson@mit.edu> wrote:

Dear [redacted]

Over the last 25 years (1993-01-29 to 2018-05-31), the cumulative overnight (intraday) return to the S&P 500 index is +1,107% (-18%). Over the same period, the cumulative overnight (intraday) return to the NASDAQ Composite index is +2,875% (-64%). Plots are attached; details are available; and the cause of this highly suspicious return pattern is noted as an unsolved mystery in a February 2018 New York Times article.

Have you been able to figure out whose 9:30am trading caused more than all of the positive returns to the U.S. stock market over the past quarter century?

Thanks and regards,
Bruce

<spy_day_and_night.png>

<nasdaq_day_and_night.png>

On Jul 10, 2017, at 9:22 PM, Bruce O Knuteson <knuteson@mit.edu> wrote:

Hi [redacted]

I am not sure I understand your second paragraph. “Most gains typically happen in the morning” sounds to me more like a restatement of the 1993-2007 puzzle than an explanation.

It seems the only explanation on the table is the one linked from https://bruceknuteson.github.io/spy-day-and-night/.

That is very, very bad news.

Thanks,
Bruce

On Jul 10, 2017, at 7:01 PM, [redacted]@ft.com> wrote:

No I haven't. I asked some people when you sent it to me this spring, but no one had a good answer and I then got dragged into some other stories, so I never did it.

The best I heard was simply people becoming aware of it, and **most gains typically happen in the morning**. So in a sustained bull market leading up to the crisis you'd expect the evening to morning gains to be the strongest. Obviously markets have been pretty strong since 09 as well so i wonder if people are just arbitraging away somehow?

[redacted]
Financial Times
[redacted]
Sent from my phone[redacted]

On 10 Jul 2017, at 15:12, Bruce O Knuteson <knuteson@mit.edu> wrote:

> Dear [redacted]
>
> Have you managed to obtain a definitive answer as to what caused this remarkable plot?
>
> Thanks and regards,
> Bruce
>
> Bruce Knuteson
> http://bruceknuteson.com
>
> <spy_day_and_night.png>

On Apr 25, 2017, at 6:12 PM, Bruce O Knuteson <knuteson@mit.edu> wrote:

Hi [redacted]

To understand why the effect (apparently) went away, one probably needs to understand why it was ever there in the first place.

As far as I am aware, Information, Impact, Ignorance, Illegality, Investing, and Inequality contains the only explanation ever proposed for this effect.

Sherlock Holmes's "Once you eliminate the impossible, whatever remains, no matter how improbable, must be the truth" is a bit simplistic — but this striking plot has been around for nearly a decade, and the literature contains no alternative explanations.

Regards,
Bruce

On Apr 25, 2017, at 5:41 PM, [redacted]@ft.com> wrote:

Hi Bruce, apologies for late reply. So this day-and-night effect has dissipated after the crisis? Do you have any inkling of why?

On 24 April 2017 at 16:08, Bruce O Knuteson <knuteson@mit.edu> wrote:

> Dear [redacted]
>
> I attach an updated version of the plot.
>
> In relative terms, since 2008-01-01, both the blue and green curves have increased by ~40%: the blue curve has risen from ~$6.56 to ~$9.20, and the green curve has risen from ~$0.66 to $0.92.
>
> In absolute terms, the current difference between the blue and green curves corresponds to a difference in market cap of roughly eighteen trillion dollars.
>
> The code to make this plot is available.
>
> Regards,
> Bruce
>
> <spy_day_and_night.png>
>
> On Mar 27, 2017, at 11:43 PM, Bruce O Knuteson <knuteson@mit.edu> wrote:
>
> You are very welcome [redacted]
>
> The pattern stopped a few months after the 2007 quant [redacted]
>
> On Mar 27, 2017, at 11:22 PM, [redacted]@ft.com> wrote:
>
> This is fascinating, thanks for sending. Do you know if anyone has updated the study to see if the pattern has held since then?
>
> On 27 March 2017 at 22:06, Bruce O Knuteson <knuteson@mit.edu> wrote:
>
> > Dear [redacted]
> >
> > I enjoyed reading your [redacted] article on [redacted]
> >
> > As you may know, all of the positive returns to the S&P 500 index from 1993 to 2007 occurred at market open. I attach Figure 1 from https://ssrn.com/abstract=1004081.
> >
> > You may find it worth your time to investigate the cause of this extraordinary return pattern.
> >
> > Best regards,
> > Bruce
> >
> > Bruce Knuteson
> > http://bruceknuteson.com