Risk In Alternative Assets[1]

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1) We cover hedge funds, private equity, and commercial real estate—not presents.

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Desired End State

(i) Provide a brief overview of the alternative asset industry

(ii) Provide poignant examples of how risk gets involved in these asset classes

Please note: I hope this lecture can help students find a job. During an interview, it's not just the technical skills a candidate brings to the table, it's also how knowledgeable they are about the role and industry.

A little bit about insurance and me

- "Insurers receive premiums upfront and pay claims later. In extreme cases, such as those arising from certain workers' compensation accidents, payments can stretch over decades. This collect-now, pay-later model leaves us holding large sums– money we call "**float**"– that will eventually go to others. Meanwhile, we get to invest this float for Berkshire's benefit. Though individual policies and claims come and go, the amount of float we hold remains remarkably stable in relation to premium volume. Consequently, as our business grows, so does our float."

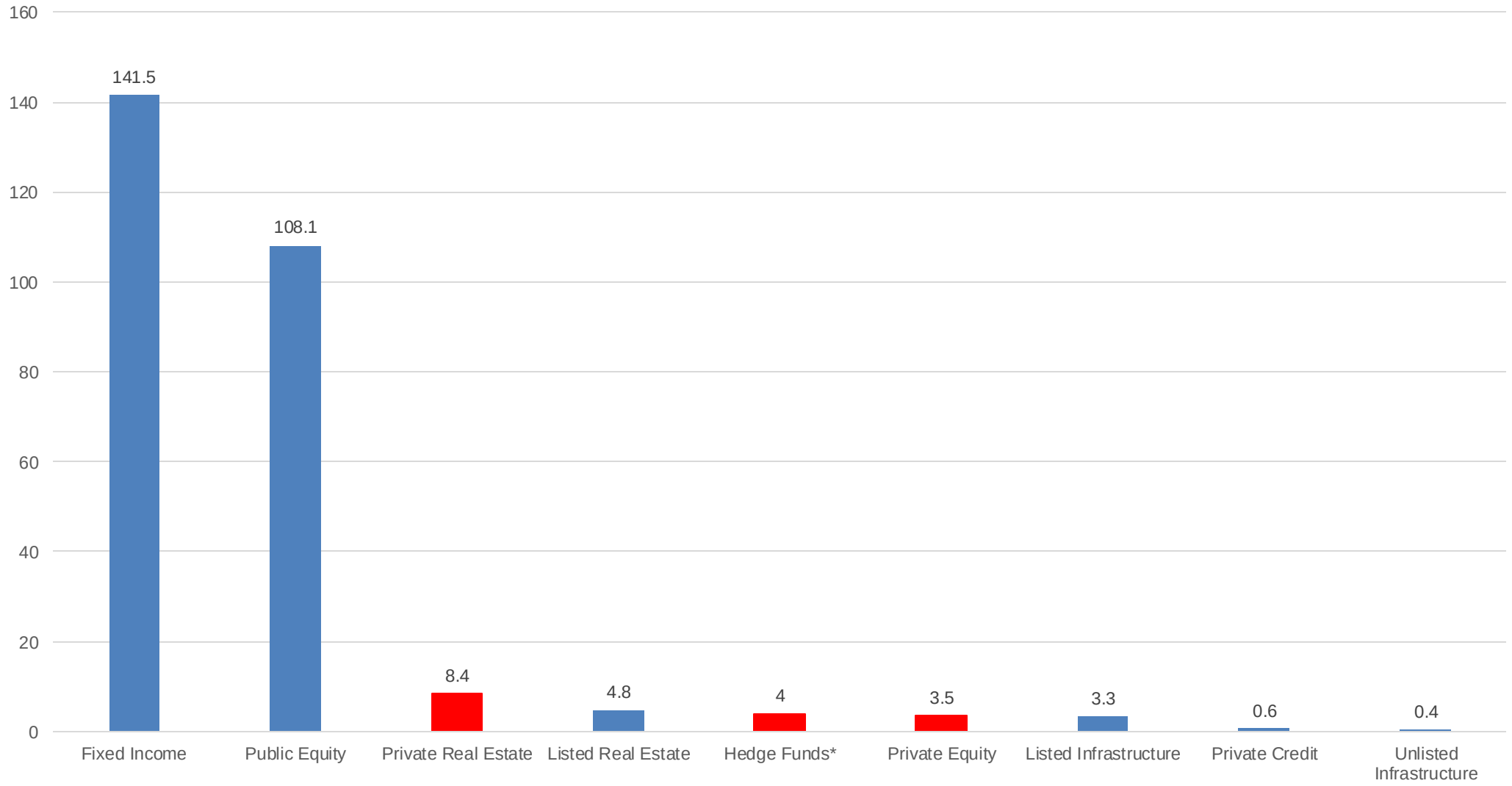
- Insurance generally falls into three categories: Life, Property and casualty (P&C) and Health.

- Generally, the claim process Buffett describes can be modeled with a Poisson distribution in a Monte Carlo simulation (**the Sell-side class Irena teaches is good prep for how these simulations work**).

- Insurance companies may invest in alternatives (alts). Other alt investors include sovereign wealth funds, endowments, high-net-worth individuals, etc.

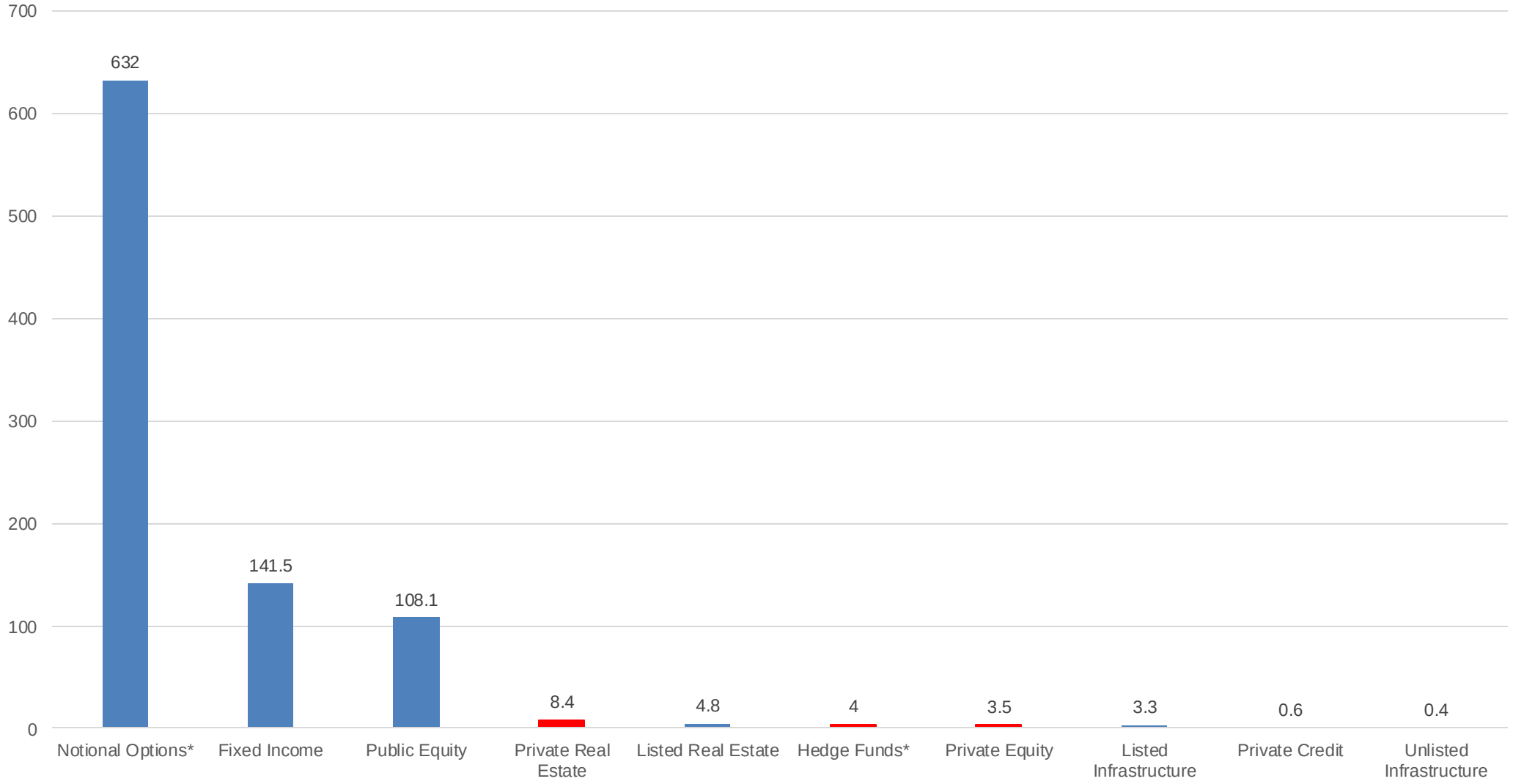
1) Warren Buffett investor letter: berkshirehathaway.com/letters/2009ltr.pdf.

A World of Assets[1,2]



1) Market size of the full and investable global-market portfolios (in USD trillions and relative weights of the asset classes). As of Dec. 31, 2023. Source: Bank for International Settlements, MSCI, Robert MacKay
2) Hedge Funds are included for reference, but may be double counting fixed income and public equity exposure. ~$4 trillion is an estimate.

A World of Assets[1,2]



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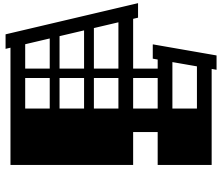
2) Hedge Funds are included for reference, but may be double counting fixed income and public equity exposure. ~$4 trillion is an estimate.
3) Notional options estimates are difficult to arrive at! The BIS is a good source, but some believe the notional value of options is in quadrillions.

Assets We Will Cover Today

Hedge Funds

Private Equity



Commercial Real Estate

What is a hedge fund?

- “Hedge funds are private pooled investment vehicles that can invest in a wide variety of products, including equities, fixed income, derivatives, foreign exchange, private capital, and real assets. It is the investment approach rather than the underlying investments that distinguish hedge funds.”
- Hedge funds can sometimes be considered ‘fast money’ because they face few restraints and dynamically respond to market events. Most hedge funds will go long and short in any asset class they trade; moreover, most funds apply leverage.
- The hedge fund origin story started in 1949 when Alfred Jones launched his first fund (using a structure Warren Buffett would later adopt). For the first 50 years, hedge funds were generally a cottage industry. A confluence of factors led to its rise: publicity, Dobbs-Frank, and developments in financial theory and risk management.

1) CFA Society: cfainstitute.org/insights/professional-learning/refresher-readings/2024/hedge-funds-l2#:~:text=Hedge%20funds%20are%20private%20pooled,investments%20that%20distinguish%20hedge%20funds.

Why invest in a hedge fund?

- The capital asset pricing model (CAPM) relates an investor's expected returns to the market risk we take:

$$E_i = \rho + \lambda b_i$$

- In this formulation, p represents our risk-free rate, lambda is the market return, and b represents the portfolio's covariance/variance.

$$b_i = \frac{\sigma_{im}^2}{(\sigma_m)^2}$$

- The arbitrage theory, as introduced by Ross, generalizes the above CAPM mindset and allows for potentially numerous factors (not just the market).[1] With sufficiently large n (usually 50+ assets) a portfolio's returns and variance are explained by these factors.

$$E_i = \rho + (E_m - \rho)\beta_i$$

1) Stephen A Ross "The arbitrage theory of capital asset pricing" (1976).

Why invest in a hedge fund?

- ‘Alpha’ are excess returns not captured by Ross’ linear factors.

- A strategy that can deliver returns above their factor expectation can improve the risk-adjusted return of a portfolio. While hedge funds generally take some factor risk, their performance is measured in factor adjusted terms.

- Limited Partners (LPs) in a fund are generally insurance companies, endowments, sovereign wealth funds, and large family offices.

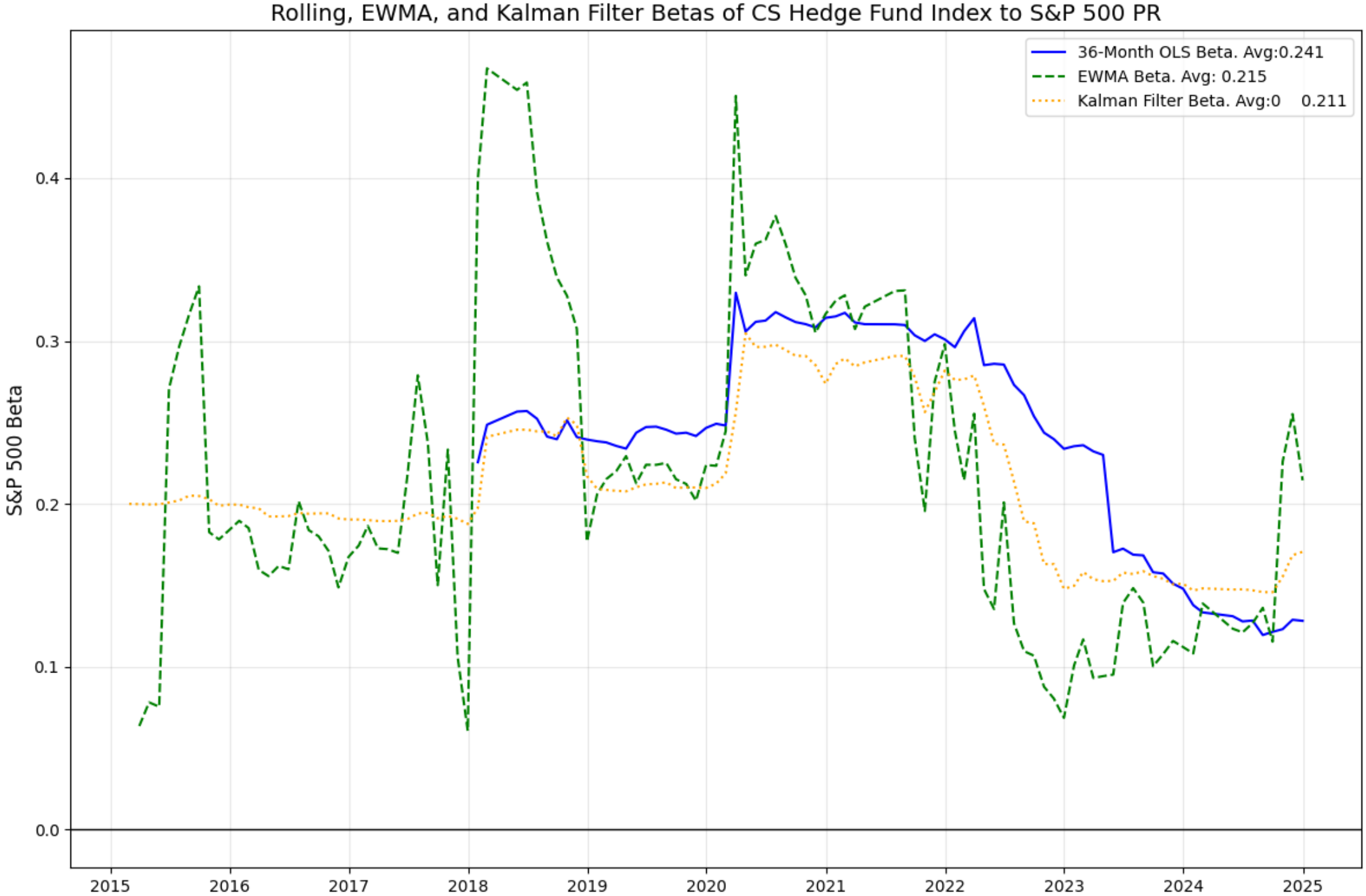
- Alpha issues: (i) strategies with non-linear payoffs, (ii) expected time-horizon (?), (iii) why is the market ‘inefficient’ to start with? Etc. etc…

Credit Suisse Study

- Exploring some of these concepts, lets look at the Credit Suisse hedge fund index.[1]

- Key notes:
  - Returns are generally reported monthly for most funds.
  - Survivorship and backfill biases exist in most hedge fund indices (particularly pre-2015).
  - Hedge funds report time-weighted returns are net of performance, management, and administrative fees.

1) Link to Data: lab.credit-suisse.com/#/en/index/HEDG/HEDG/performance


Rolling, EWMA, and Kalman Filter Betas of CS Hedge Fund Index to S&P 500 PR
36-Month OLS Beta. Avg:0.241
EWMA Beta. Avg: 0.215
Kalman Filter Beta. Avg:0 0.211
S&P 500 Beta
0.0
0.1
0.2
0.3
0.4
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025

Warren Buffett's Hedge Fund Bet

- In 2007, Warren Buffett made a bet with a Wall St. pundit specializing in hedge funds. Buffett believed that over the next 10 years, the S&P 500 would beat the fund-of-funds that the expert picked.

- A **fund-of-funds** is run by a manager who invests in other hedge funds. Sometimes these individuals are known as 'allocators' since they allocate capital to various hedge funds.

- What do you think happened?

- Based on what you already learned, what might be strange about this bet?

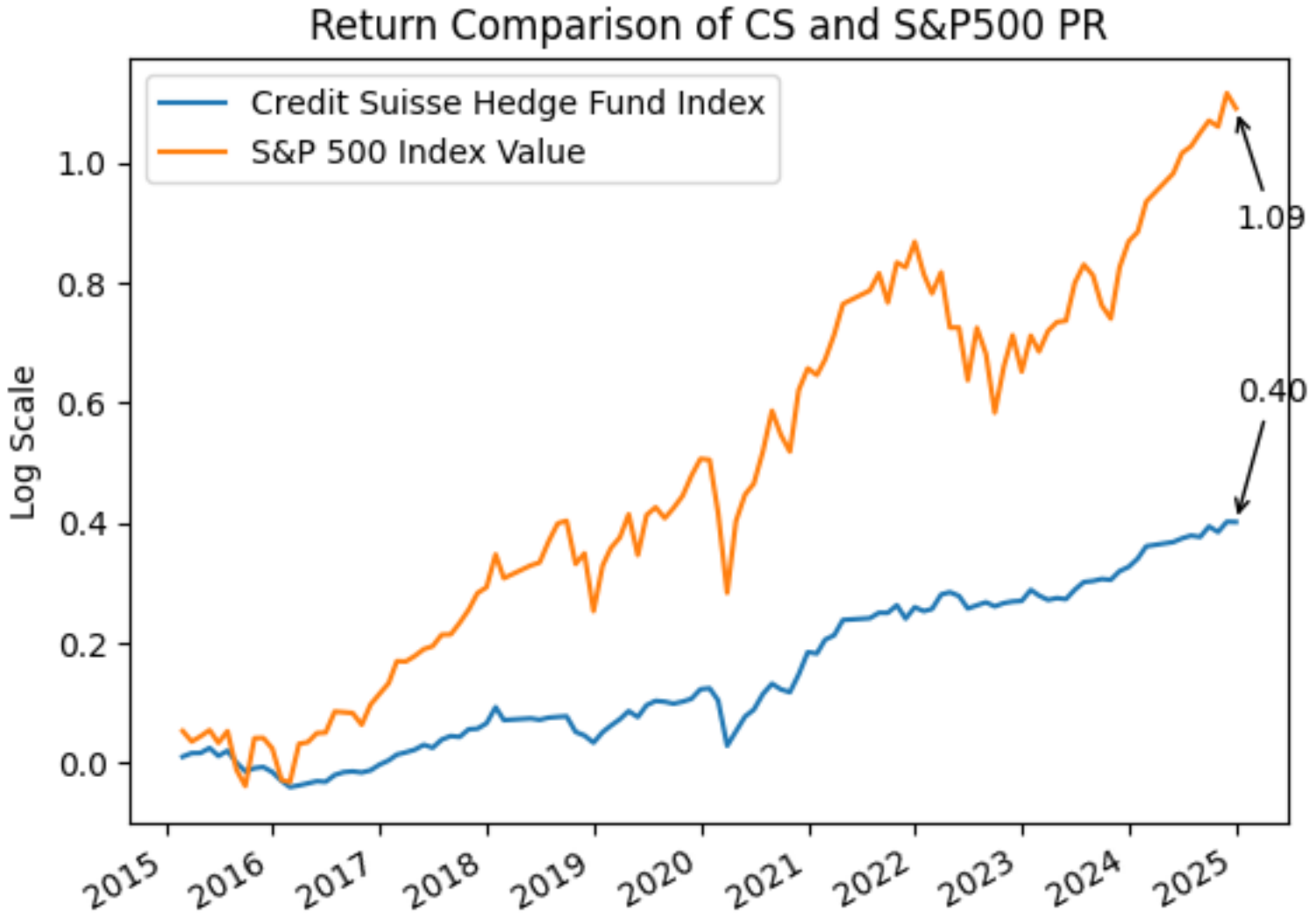
1) Warren Buffett investor letter: berkshirehathaway.com/letters/2017ltr.pdf.

Warren Buffett's Hedge Fund Bet: Outcome

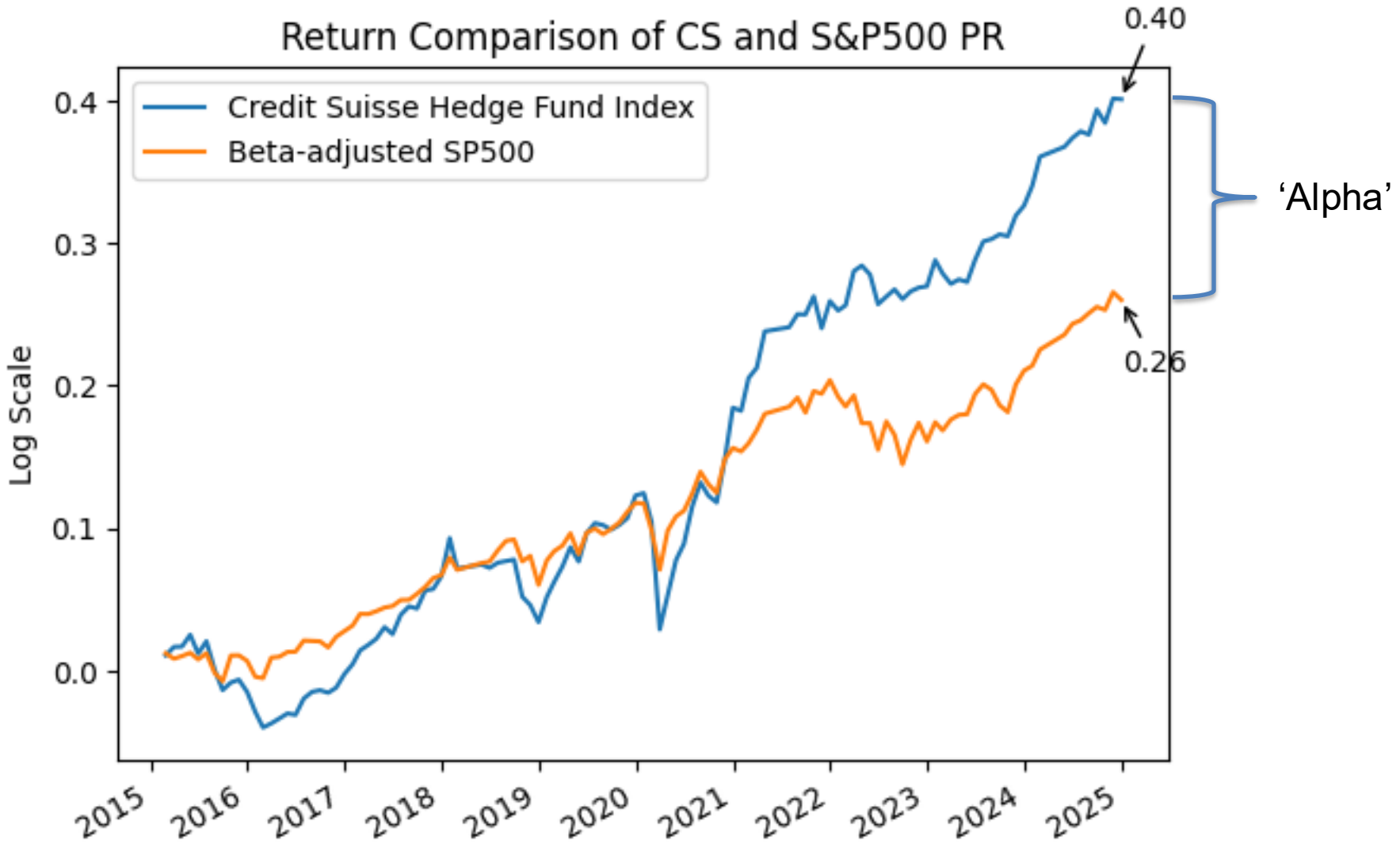
Year	Fund-of-Funds A	Fund-of-Funds B	Fund-of-Funds C	Fund-of-Funds D	Fund-of-Funds E	S&P Index Fund
2008	-16.5%	-22.3%	-21.3%	-29.3%	-30.1%	-37.0%
2009	11.3%	14.5%	21.4%	16.5%	16.8%	26.6%
2010	5.9%	6.8%	13.3%	4.9%	11.9%	15.1%
2011	-6.3%	-1.3%	5.9%	-6.3%	-2.8%	2.1%
2012	3.4%	9.6%	5.7%	6.2%	9.1%	16.0%
2013	10.5%	15.2%	8.8%	14.2%	14.4%	32.3%
2014	4.7%	4.0%	18.9%	0.7%	-2.1%	13.6%
2015	1.6%	2.5%	5.4%	1.4%	-5.0%	1.4%
2016	-3.2%	1.9%	-1.7%	2.5%	4.4%	11.9%
2017	12.2%	10.6%	15.6%	N/A	18.0%	21.8%
Final Gain	21.7%	42.3%	87.7%	2.8%	27.0%	125.8%
Average Annual Gain	2.0%	3.6%	6.5%	0.3%	2.4%	8.5%

1) Warren Buffett investor letter: berkshirehathaway.com/letters/2017ltr.pdf.

Warren Buffett's Hedge Fund Bet: Revisited



Warren Buffett's Beta-Adjusted Hedge Fund Bet: Revisited



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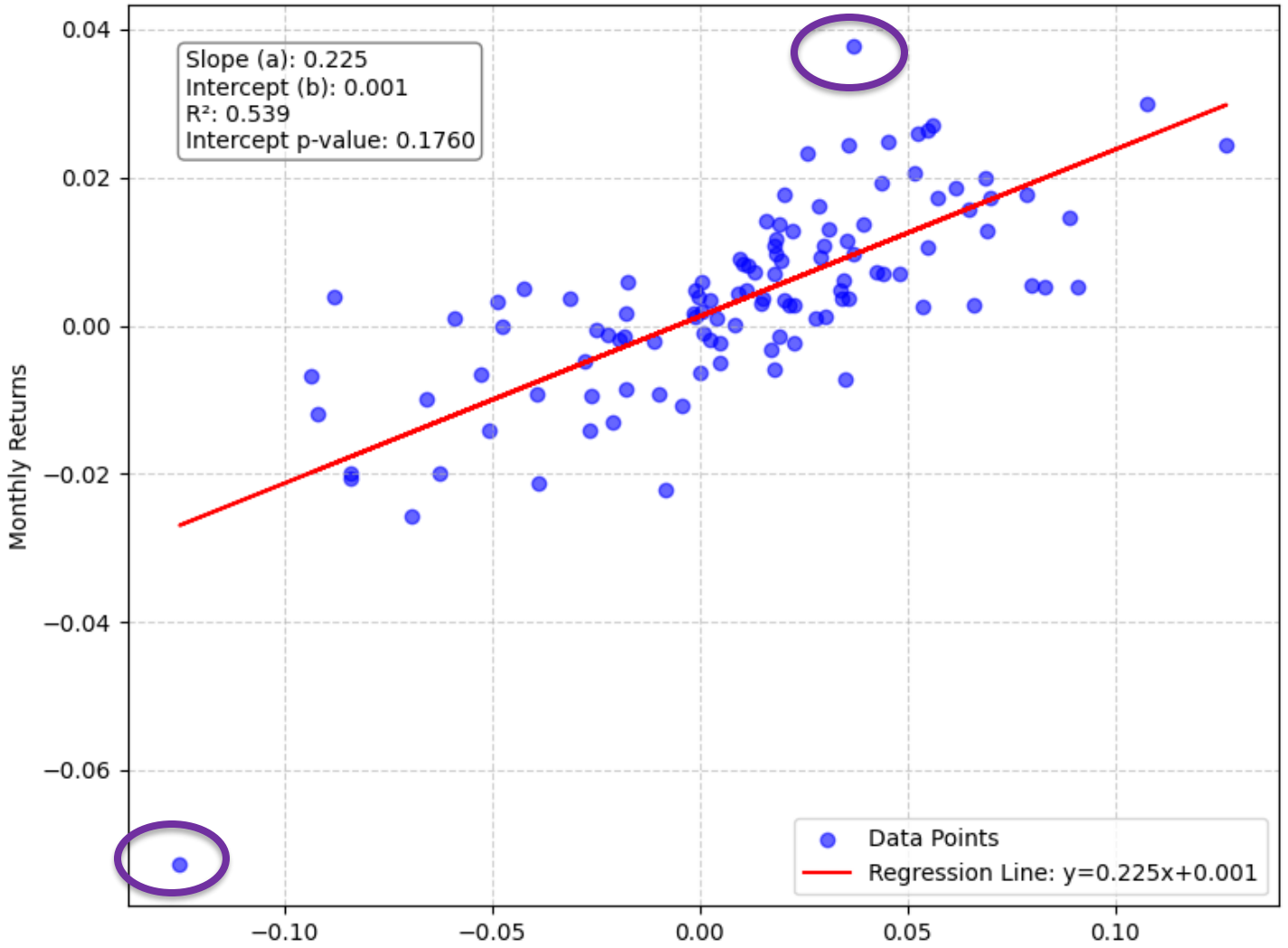

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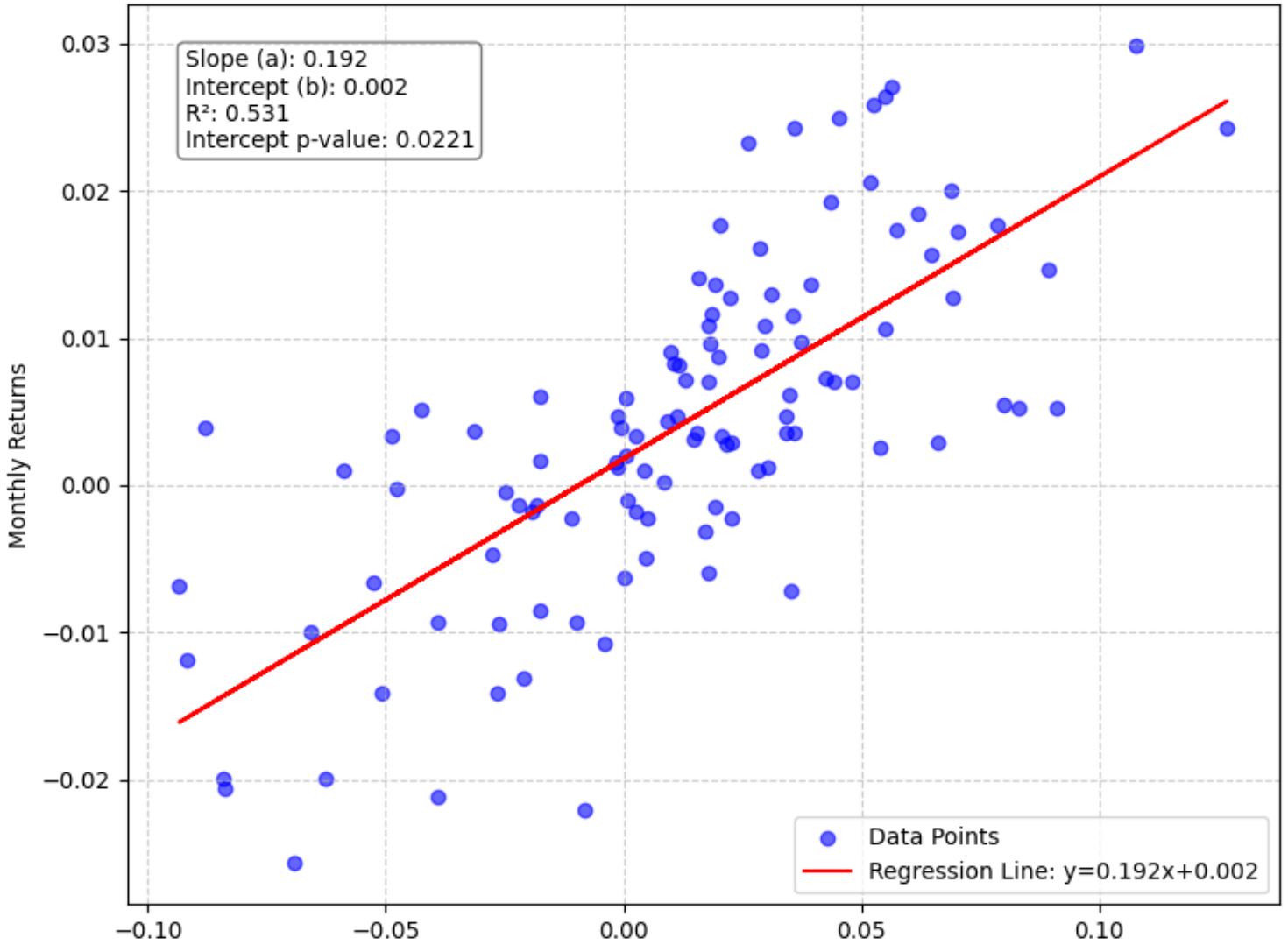

Warren Buffett's Beta-Adjusted Hedge Fund Bet: Issues with this approach?

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- Marketing gimmick?
- Is it fair to trim March 2020?
- Missing factor adjustments?
- Volatility comparison?
- Liquidity?
- Accessibility?
- Out-of-sample measurement?

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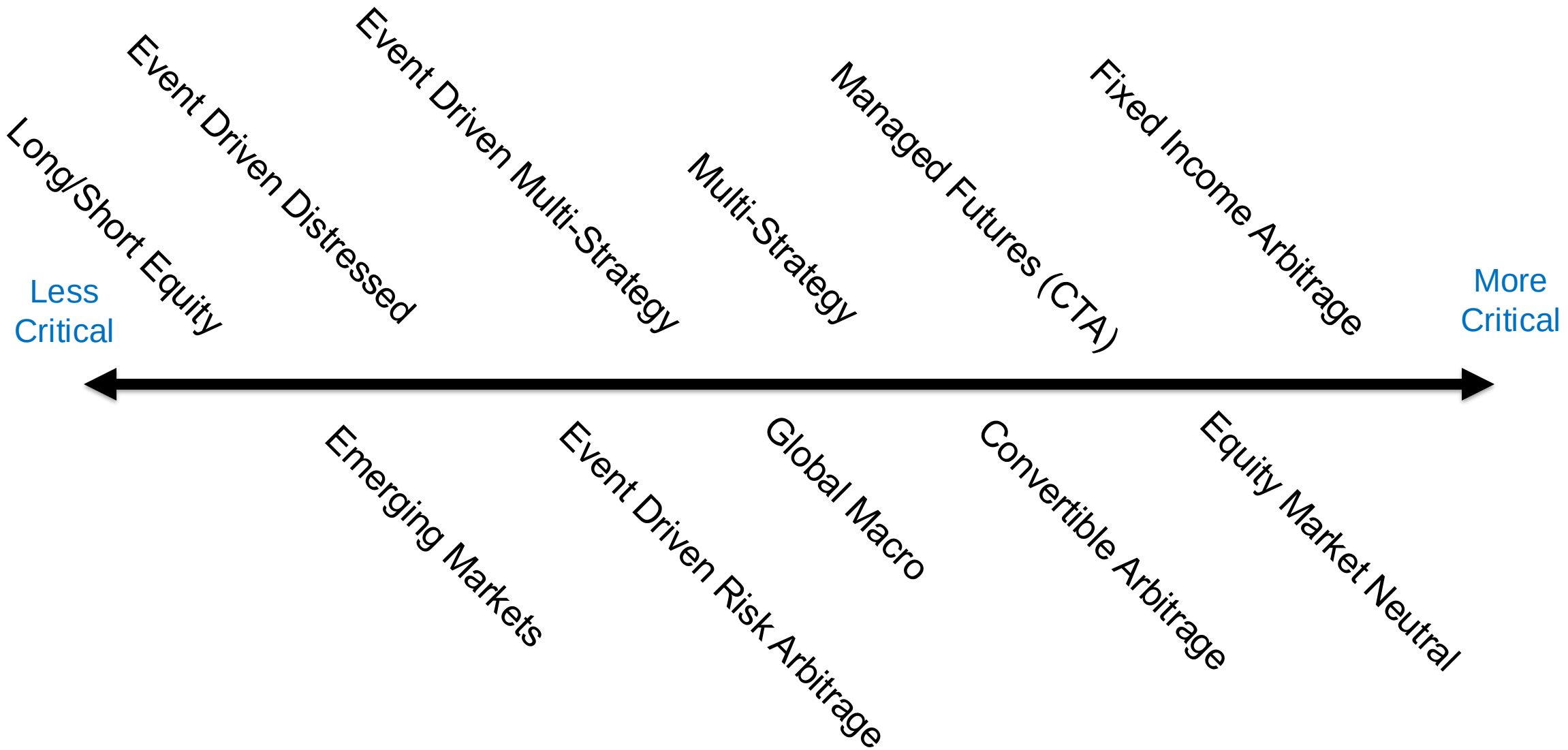
- ***Homework:*** Redo the beta-adjustment on the S&P 500. Study the three methods (OLS, EWM, Kalman) and determine which is best. Provide some justification for your choice. Fit the hyper-parameters for one of the methods empirically by doing **in-sample**, **out-of-sample testing** on the CS & S&P time series. Once selecting the method and hyperparameters, compare the CS and the **new** beta-adjusted S&P500 on several dimensions: annualized returns, annualized volatility, Sharpe, Sortino, VaR95, beta, and CVaR95. Is the comparison fair?

Dedicated Risk Roles in Hedge Fund Strategies



1) This is my subjective interpretation of the market and is not definitive. Feel free to ask ChatGPT for another opinion. All hedge funds have a need for analysts with a quantitative skill set.

High Level Concerns

Less Quantitative Strategies

- Is this manager's return stream due to luck? In other words, are we being 'fooled by randomness'?
- Often meaningful factor exposure risk
- Portfolio managers are human and are susceptible to emotions (and greed)
- Position sizing can be very concentrated. There's a balance made between diversification and conviction
- Increasing illiquid investments signal danger

More Quantitative Strategies

- Heavy leverage makes concerns like model risk profound
- Crowding can lead to unforeseen systematic risks that emerge in crises
- Operational risks due to poor implementation (i.e. Knight Capital)
- Model lifecycle management: What happens when a model falls out of statistical significance? Alpha Decay
- Capital constraints, liquidity, greed…

A Diversity of Diversities

After learning about Harry Markowitz's mean-variance optimization[1], some believe asset diversification is the only type (one can Google search 'financial diversification' to see various answers). I propose that diversification exists in multiple dimensions—all of which are important. Here are some examples:

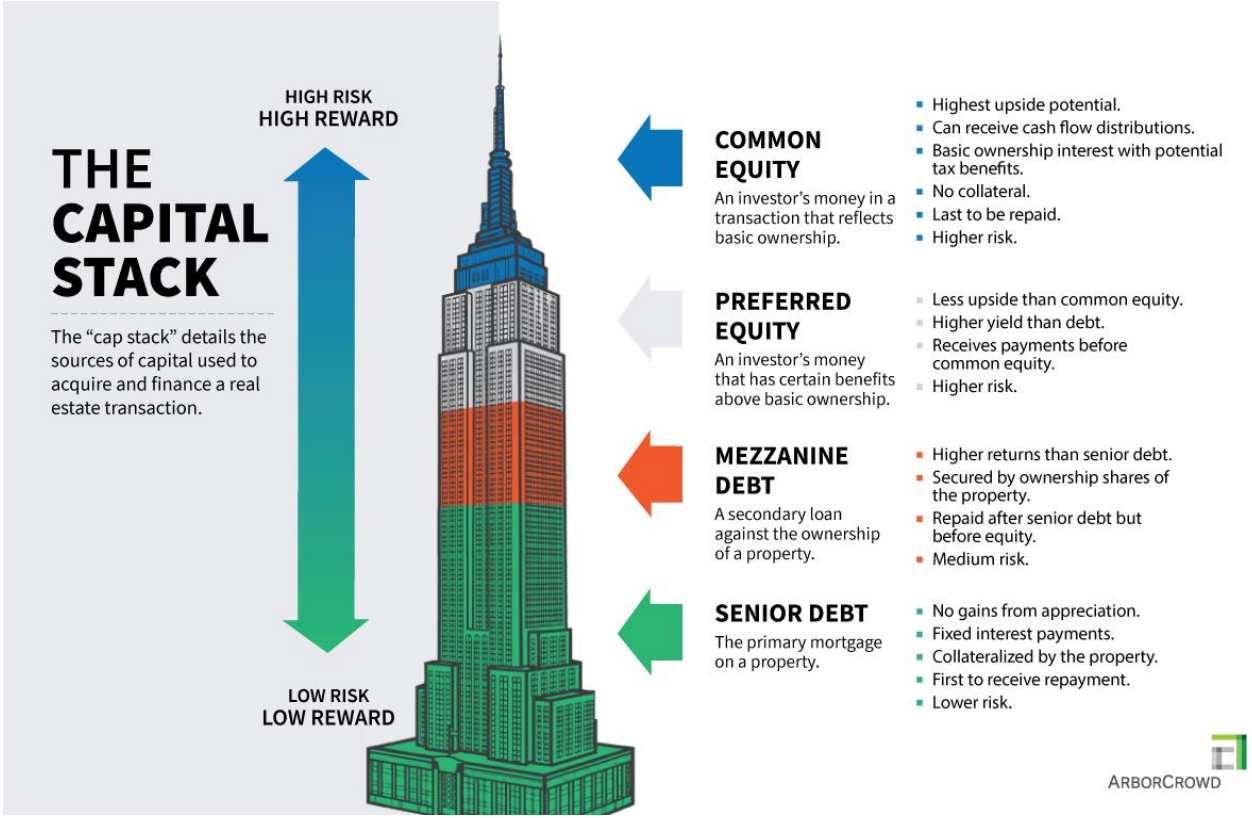
- Diversification of Strategies
- Diversification of Models (for quants)/People(for both quant and discretionary folk)
- Diversification of Time Horizons
- Diversification of Payout structure (carry & convexity)
- Diversification of Execution (trading mechanisms/exchanges)

Ultimately, I define diversity as making entropy your friend: this can imply less correlated return streams (lower portfolio vol) or take advantage of low-frequency events (i.e. The cocoa trade? The FNMA trade? Oil when it turned negative?). Experience informs us that diversification is generally good unless it leads to a degradation in conviction and performance. There can be trade-offs. "Everything in moderation. Even moderation."

1) Harry Markowitz: math.hkust.edu.hk/~maykwok/courses/ma362/07F/markowitz_JF.pdf

Fixed Income Arbitrage (FIA)

FIA: A strategy that focuses on arbitrage in the fixed-income markets and runs with high gross leverage (sometimes 40x+). There are many known ‘inefficiencies’ in the market, such as the yield spread between on-the-run and off-the-run bonds. Other examples include ‘capital stack’ inefficiencies: given where a security is in the capital stack, the risk-adjusted return may be out of line with another security in the stack (one may trade this by going long one security and shorting the other). No allocator will give money to a highly levered FIA strategy without a robust risk function. Reference LTCM for an example of when things go wrong.[1]



1) One of many case studies: courses.cit.cornell.edu/engrwords/proposals/Butler_et_al_LTCM_Proposal_v4.pdf

FIA Risk Considerations

- Risk in FIA can be wide-ranging. One may look at different nodes in the treasury curve and study the narrowing and widening of their gaps. Almost always, one must develop duration, VaR, and CVaR estimates using the data available. Some shops will also look at key rate duration sensitivities.

- This can be really hard. There are tens of thousands of U.S. stock tickers in the U.S. for reference. There are **millions of CUSIPs** (not all are actively traded though).

- Generally, one may look for ‘fair comparisons’ to currently traded securities. This entails combing through the graveyard of dead companies and CUSIPs to avoid **survivorship bias**.

- Cynical example: if you wanted to find a fair comp to United States treasuries today, is it fair to look at treasuries from the 1970s? If you have a long enough time horizon, should U.K. gilts from the 1800s be included? There is not one answer to this question and that answer depends on the time horizon of the trade and the liquidity of the assets among other things.

Equity Market Neutral (EMN)

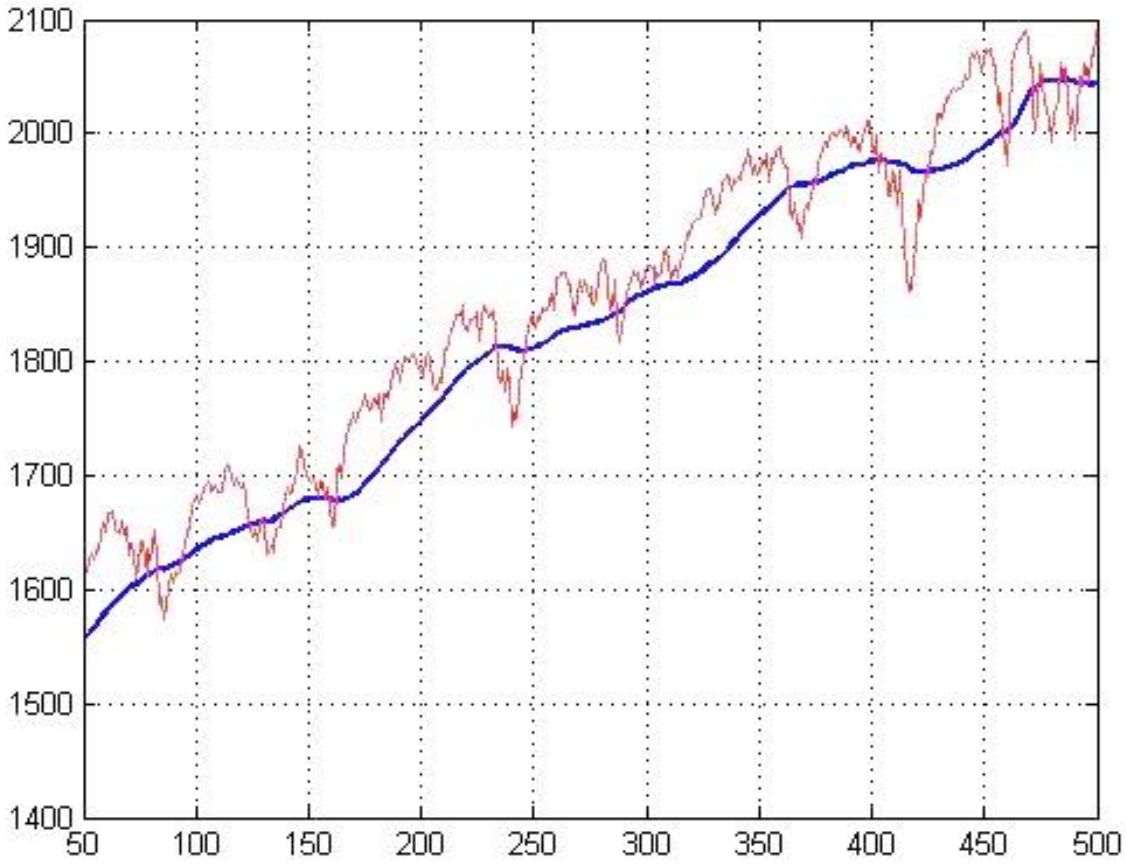
EMN: This invests in equities on the long and short side. Leverage can vary between 200-1000%, and strategies vary: some do stock picking and others make factor bets. ***Instead of neutralizing their dollar exposures*** ($200 long stock portfolio X1, $200 short stock portfolio X2), most managers seek to limit their ***factor exposure*** to equity markets. The way factors are measured—and the time horizon they are measured— varies by strategy. In a classic example, **pairs trading**, a manager may 'short the spread' between Pepsi and Coca-cola. If the stocks are co-integrated, then we are betting the spread will narrow after our entry. Some portfolio managers (PMs) make bets on factors (a la Fama-French). One famous factor bet favored by Fischer Black was long low-beta stocks and short high-beta stocks.[1]
Question: would this be a dollar - neutral strategy you think?

EMN Risk Considerations

- Risk in EMN is almost definitionally important. Some considerations in this field are factors, time horizons, liquidity, VaR, CVaR, etc…
- For EMN strategies based on factors, time horizon and generalization of results are key. If someone wants to bet on value stocks in South Korea (particularly cheap today), there are a few questions we should have in the back of our minds:
  - How long does value generally take to deliver results? How far down has value historically gone (drawdown %)? Does this factor generalize to South Korea?
  - Is this time different? Is there something about South Korea today that may make statistical comparisons less tenable?
  - If this goes wrong, what are our **stop-losses** and **liquidity** like, what's our **sizing**?
- For EMN strategies based on single-name stocks, **crowding**, single-name liquidity, and transaction costs, are greater concerns. If everyone is trading the Pepsi-Coke spread, then it may be a zero-sum game. Who is the liquidity taker and giver, and why? We may also find that the spread between those two companies expresses a tight correlation to the one between Boeing and Airbus—systematic risks emerge in the market's dynamics.

Managed Futures/CTAs

CTAs: This strategy generally relies on methods from signal processing to invest. If an asset class sells sharply and falls below its 200-day moving average, this may be a ‘buy-signal.’ CTAs generally invest in commodities and broad buckets of assets, such as Corn futures, WTI, SPY futures, Treasuries, etc. It’s unlikely that these managers will dabble in single-name equities or bonds. Aside from price-based signals, these managers may also incorporate fund-flow information and fundamental signals to invest. One example may be using advanced weather forecasting to speculate on natural gas futures. Unlike EMN, CTAs will take contemporaneous factor risk—they will intentionally ‘buy beta.’ Over a sufficiently long-time horizon, they should not have meaningful factor exposure (they bet on the momentum of direction, not the direction itself).

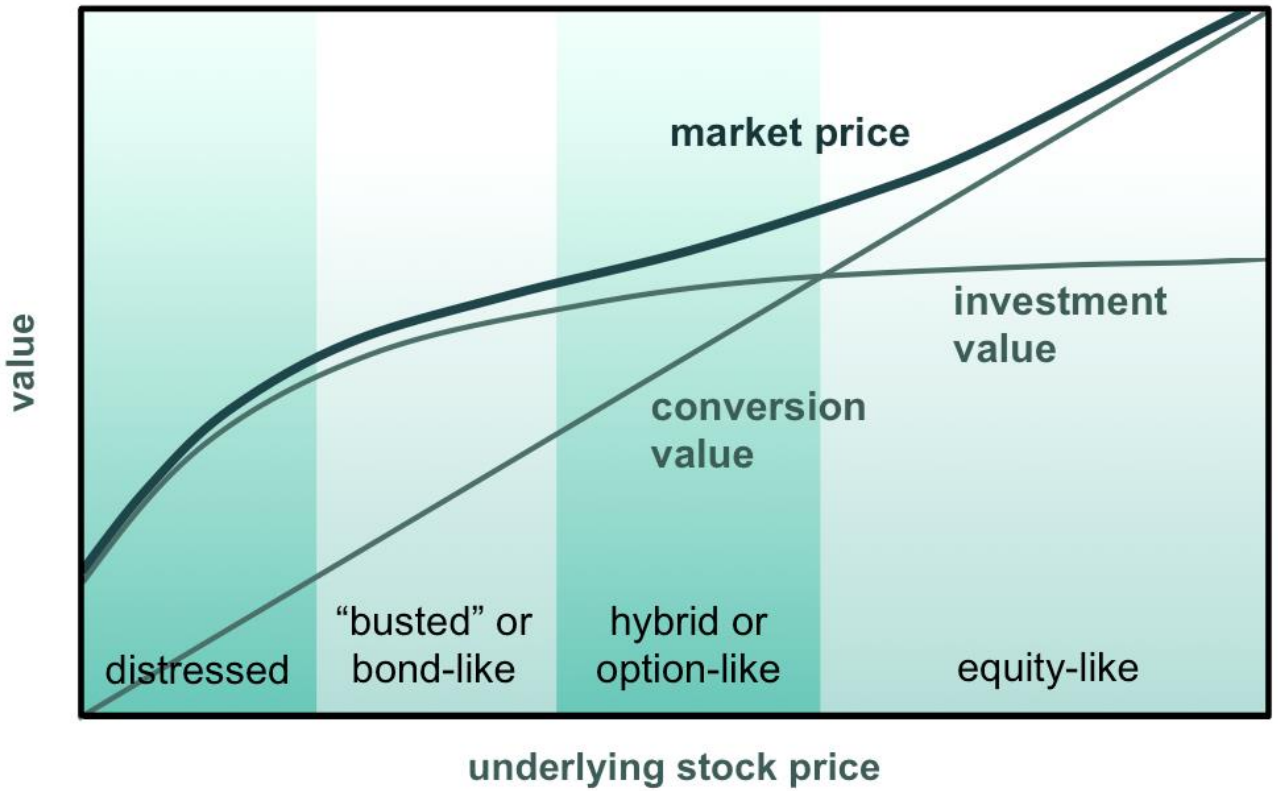


Managed Futures/CTA Risk Considerations

- Many of the risk considerations for EMN translate over to CTAs. Leverage is generally similar.
- They don’t bet on assets or even stocks, so the diversification of CTAs should be measured in other terms: what markets are traded, and how many different models are used? Are these models foundationally different or similar? What proportion of models are short-term vs. long-term? Etc. etc…
- Since the strategy will take factor exposure, it is important to monitor this and understand how much they are willing to take.
- While VaR and CVaR are important, risk managers will generally **focus on the distribution of returns in the tail**. Stop-losses may be applied to models on a discretionary basis (how much are we willing to lose if this model is wrong?)
- Historical stress test results and factor exposures must be continuously monitored.

Convertible Arbitrage

Convertible arbitrage can be viewed as a cousin of FIA; the relative value of convertible bonds a company issues and their equity are assessed. Convertible bonds are bonds generating a positive yield that can be converted to shares of the underlying company. Sometimes, a company will have the option to ‘call’ bonds at a pre-determined price. In the capital stack, the converts have priority in the waterfall of payments over the equity—they are ‘safer’ than the equity. Managers will usually buy the converts and short the stock to neutralize their exposure to the company. Due to the inherent optionality of the bonds, these managers often focus on the ‘greeks’: gamma, delta, vega, etc… Supposedly, Ken Griffen of Citadel fame got his start trading converts in his college dorm room.



Convertible Arbitrage Risk Considerations

- I once heard a manager say that ‘they solved for risk in their fund.’ I’m still rolling my eyes at this one. In a dire situation (GFC), where the gap between the shorted equities and converts widens too much, the fund may be closed out of their positions prematurely.

- Risk managers must focus on **liquidity** (not many entities actively trade converts). **Basis risk** exists between the converts and shorted equities; this basis must be continually monitored and (potentially) traded on.

- **Basis risk example:** Suppose a fund has 100 of converts in Company XYZ and has shorted 100 dollars of shares to net out the assessed risk. If the stock trades down 50%, then their converts may have devalued by 20%, and we are left with a gap: 80 long and 50 short. We would have to short another 30 dollars worth of the equity to arrive back to our desired neutral dollar positioning.

- Because convert liquidity is limited, most hedge funds rely on the market’s equity liquidity to form their trades—if this suddenly dries up, the strategy will be more tenuous.

Multi-Strategies (Multi-strats)

Multi-strats are one of the highest visibility hedge fund strategies; large names like Citadel, Millenium, Point72, and Ballyasny are included in this group. As the name suggests, these funds invest in multiple hedge fund strategies and take advantage of the diversification this offers them by using additional leverage. Often, Multi-strats will have **numerous discretionary equity long/short teams** (called ‘Pods’) working on different market sectors. There may be a healthcare pod, for instance. Where most hedge funds run between 20-50 employees, multi-strats can run into the strategies. At the center of this beast is a risk team(army?) that play a role in managing the capital portfolio managers can deploy. Most of these hedge funds explicitly target generating positive returns every quarter (i.e. shorter time horizons).

Multi-strat Risk Considerations

- Risk teams will **spend a lot of time working with portfolio managers**. Where quants have models, discretionary managers will have theses (and biases). A risk manager will be part of the team that assesses the PM's hit rate, their factor tilts, their behavioral biases, what they had for breakfast that morning, etc. etc…

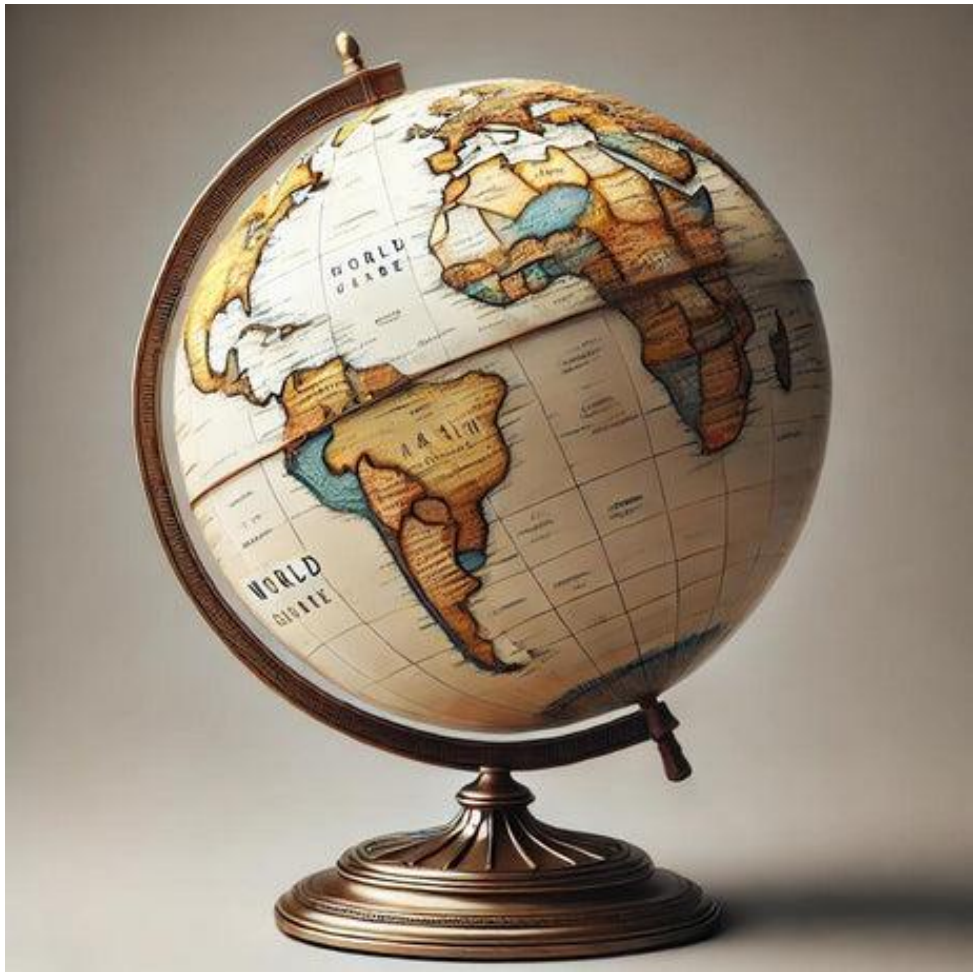
- Multi-strats are often **bridging the quantitative and discretionary** world to make money. Given the **substantial leverage** and the numerous products, risk will focus on anything and everything.

- It is less likely these funds will make explicit factor bets that have multi-year time horizons. They generally **cut capital quickly** if a PM does not make money and will not make a Fama-French-style bet.

- Given their size (tens of billions), liquidity is a central concern. Limited **liquidity** and time horizons ultimately lead to capacity constraints.

Global Macro (Macro)

Global Macro is sometimes considered the discretionary cousin of managed futures/CTAs. While the quants focus on signal processing, macro funds make macroeconomic analyses and have qualitative and quantitative inputs into discretionary decisions. A typical trade might be the **carry trade**, where an investor borrows money in a currency with low interest rates (China and Europe today are good examples; historically, Japan is a good example) and invests that capital in treasuries in a higher-rate country (like the U.S.). Ultimately, carry trades depend on interest overcoming inflation and FX moves. Another example might be directional, a manager may believe that a country is destined for success or doomed for failure and may go long/short the sovereign debt because of it. Managers will also make calls on the shape of the curve bull/bear steepening/flattening.



Macro Risk Considerations

- **Liquidity** is crucial for EM macro. For DM macro, trade sizing and duration are key considerations. Duration is non-trivial in macro because of the multiple yield curves that exist. We ultimately have assess this market-by-market and come up with high level evaluations of the overall portfolio.

- Often, macro funds will follow a multi-PM model, where a PM will focus on a specific area of the market (South American, for instance, or CME traded commodities). Risk will play a similar role in these shops as in multi-strats. The team help assess performance, capital allocations, and the overall risk profile of the firm.

- Single PM macro hedge funds are less likely to have a need for independent risk management. Most **prime brokers** will provide risk services as part of their package; generally, single PMs do not ask for much more than this.

1) Prime brokers provide the brokerage services to a hedge fund. Generally (but not exclusively) they are large banks.

Event Driven Multi-Strategies (EV Multi-Stats)

EV Multi-strats have a central decision-maker within the fund. This decision maker will make most (if not all) investment decisions. The structure lends itself to **discretionary** decision-making and lower leverage (generally, <200%). The portfolio's focus is usually on the equity sleeve; moreover, position sizing can be concentrated and the overall net exposure to the equity and fixed-income market can range from 0% to 100%. Unlike EMN or multi-strats, these **managers will dynamically take factor bets and time the market.** In certain situations, there may be other PMs working under a manager. These are not the most quantitatively sophisticated hedged funds; however, they usually have some extremely bright individuals and—particularly for multi-PM funds—will require risk assets.

EV Multi-Strat Risk Considerations

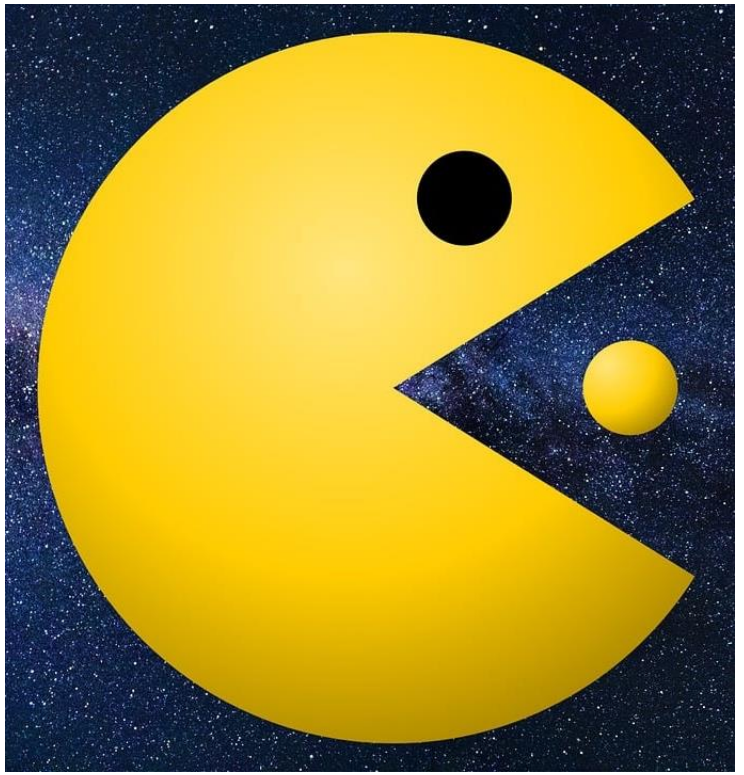
- Fundamental risk analysis based on what-if considerations. Often, these managers will think in ‘bull case,’ ‘base case,’ ‘bear case,’ and ‘severe worst case’ scenarios. Assigning probabilities to these outcomes, one may be able to speculate on the expected value and implied volatility of a deal.

- **Liquidity** considerations for funds and **legal constraints** if the PM becomes an activist or seeks a board seat. If a PM takes a board seat, there will be additional legal constraints to buying or selling shares because that position gets access to confidential information. In these situations, time horizons become meaningfully extended and liquidity cannot be considered only in relation to trading volume.

- Determining the overall portfolio risk profile in a multi-PM EV fund may take a small team of risk analysts. These will play a similar role as in a multi-strat. For the lead PM, the risk team advises on the risks—they do not make executive decisions or second-guess portfolio management. Based on their analyses, they will advise this central PM on the risks in the portfolio and may make recommendations about how much capital to allocate to each of the other PMs.

Risk Arbitrage

Risk arb focuses on the merger space. When a company purchases another, the offer will be in shares of the acquiring company, cash, or some blend of shares and cash. **Mergers take months to be consummated** because they require shareholder approval, regulatory approval, and (in practice) management approval. Moreover, there is usually additional due diligence conducted after the initial announcement by both firms. A company being acquired will generally trade at a discount to the price being offered (there are some exceptions). If the risk arb fund believes that a share-based deal will be consummated, they may buy shares in the company being acquired and short shares in the company doing this acquisition. In this way, they hedge out the company-specific risk and just focus on the spread. Generally, these deals have **binary outcomes** and are well suited to some basic quantitative analysis. Position sizing can be concentrated; managers may size a merger up to 10-20%.



Risk Arbitrage Risk Considerations

- Risk considerations will be given to position **sizing** and **crowding**. If multiple 'pods' are invested in a deal as well as stand-alone risk arb funds, then the investor base is not particularly diverse. If the deal is not consummated and was a hedge fund darling, then the 'downside' scenario underwritten may not fully capture the crowded exit that will ensue. On one side of the trade, we have merger specialists trying to get out, on the other, mutual funds and equity long/short funds, who may buy after updating their underwriting (which takes some time).

- In a severe market selloff, a manager may find that multiple merger deals fail to close due to the prevailing economic conditions. While there are not many systematic risks in this space, those that exist would be of central focus (for example: the FTC).

- Risk in this field may spend time focusing on the other managers by reviewing their SEC filings, such as **13F-Holdings Reports** and making inferences based on market behavior (bid-ask, volatility, volume, trading dynamics, etc.) It's a well-defined strategy, and many PMs have similar portfolios. To do well, a PM must generate strong risk-adjusted returns on an absolute *and relative* basis.

1) 13F Holdings Reports: quarterly financials filed with the SEC that reveal hedge funds' long positions. May include stocks, warrants, and options.

Distressed Credit

Distressed Credit is a strategy focused on the **high-yield debt** market. Managers will often generate most of their returns through the long side of the portfolio. The short side will generally contain indexes, such as the BofA Merrill Lynch High Yield Index, and single-name shorts. Many credit managers rely heavily on traditional financial analysis and intentionally invest in names likely to be restructured. Most companies today do not have Chapter 7 defaults (liquidation bankruptcies). Creditors, seeing value in the company, will restructure the capital stack and try to keep the underlying business alive as opposed to selling the underlying pieces. Distressed credit investors will generally own the company after the restructuring process. Credit investors often think in terms of ‘book value’ or ’liquidation value’ of an asset as the worst-case scenario. **Liquidity is limited,** and human traders are essential for executing transactions.

Distressed Credit Risk Considerations

- These strategies will limit their beta to the ML HY market (<0.5) and manage the gross tightly (<200%). Distressed creditors want to be the lender of last resort to a company; often this ‘last resort’ is needed during a market dislocation (for example, COVID-19 for cruise lines and airlines). Credit funds manage their book to be positioned to take advantage of such events.

- Liquidity is extremely limited—particularly in the restructuring process. This has profound implications for measuring returns and risk. Returns look smooth because the assets may not always be actively priced in the market and maybe **appraisal-based**. To understand factor exposures, a practitioner must **unsmooth returns** or use another heuristic method. One may confront some jarring questions: what does owning a brick-and-mortar store in CT implicate for my portfolio’s overall risk? Also, what’s the time horizon?

- Many hedge fund managers (particularly in Credit) believe creating ‘alpha’ is not a smooth and continuous process. There may be discrete opportunities at moments of market panic. It’s important to consider the far left-tail of outcomes, though. For instance, they want to buy cruise lines from panicked sellers, but they also want the market to recover to sell these assets back (eventually). If cruise lines never recover, these managers could be left holding the proverbial bag.

- Many managers actively track the economy and employ economists to help guide portfolio construction; many managers view the economy as their principal risk.

Equity L/S and EM Equity L/S

Equity Long/Short managers are generally discretionary '**stock pickers**' who spend their careers studying the universe of stocks 'generalists' or a specific sector 'sector-specialists.' This is the most common hedge fund strategy. Managers make investment decisions based on financial analysis of company filings, industry experience, and other quantitative and qualitative inputs. These funds have a central decision maker who may have a team(s) of analysts. Gross exposure is generally less than 200% and net exposure is less than 50%. Some analysts have backgrounds in investment banking or buy-side mutual funds. Analysts and managers **try to find 'diamonds in the rough,'** identifying opportunities in the market that others have missed. Emerging market managers play a similar game but focus on overseas markets. For instance, there used to be a burgeoning community of hedge funds that focused on China. Based on the country, shorting may be difficult or impossible; in these instances, managers may manage factor risk by shorting futures or leveraging options.

Equity L/S Risk Considerations

- Risk considerations scale to the manager. Equity market beta and net exposure are the primary risks an equity long/short manager runs. However, liquidity, stop-losses, position sizing, factor management, and crowding may be part of the risks actively tracked (among other things).

- Some managers will **dynamically change their beta** to the equity market and their gross based on perceived market opportunities. These managers who market-time are the ones that may need additional input from risk—making discretionary calls on the market is a tough ordeal; however, some managers have a reputation for doing just this. Other managers will keep their beta to their target equity market within a range (0.4-0.5) and '**set it and forget it**.'

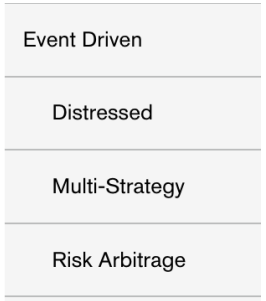
- Managers who are sector specialists are more likely to run with lower net exposures and turn over their holdings faster. These managers will look at technical indicators such as the Relative Strength Index (RSI). Many of these managers assess their factor loadings to momentum, growth stocks, small-caps, etc. , and intentionally try to limit their exposure. **With a smaller pool of assets, sector specialists must work harder than generalists to limit their portfolio volatility**.

- Checks and balances are important for hedge funds with a single PM. Stop-losses, drawdown limits, or some mechanism triggered by losses can help sanity-check a PM. Managers who do extraordinarily well may run up risk only to suffer an Icarian fate. Psychologically, this game is tough, and PMs, like all humans, may be fooled by randomness.

HF Homework Problem

- With all the CS time series, come up with a **naïve portfolio allocation** (1/n). Measure the annualized returns, annualized vol, historical simulation VaR95, historical simulation CVaR95, and Sharpe from 1/1/2019 through 12/31/2024.

- When doing this exercise, **remove the dedicated short strategy** (it is now extinct), also make sure to remove the aggregate index and event driven ‘super strategy’ as those would be double counting:



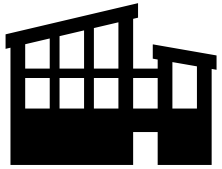
- On a proforma basis **add 5%** to the equity L/S allocation. How much does this change the portfolio based on the measures previously computed? What is the new annualized vol?

Break

Assets We Will Cover Today

Hedge Funds

Private Equity



Commercial Real Estate

Private Equity and Venture Capital

- "Private equity operates with investors **[LPs]** and uses funds to invest in private companies or buy out public companies. By doing so, general partners **[GPs]** can obtain control over management and other operational changes to increase profitability in hopes to later sell [at a higher value]"

- Venture capital is a type of private equity that focuses on early-stage companies. Sometimes a VC fund will work with a founder to develop a company from inception.

- PE and VC firms have portfolios of companies that are **appraisal-based**. Instead of being able to reference exchanges for market valuation information, investors must get third-party appraisals from the PE group. These appraisals happen quarterly.

- LPs and GPs usually form multi-decade relationships. GP investments span 5-8 years on average, so the investment process requires a longer-duration investor.

- PE funds depend on **commitments** to invest. Instead of calling 100% of investments on day 1, PE funds will call capital as they close different deals. Commitment is the total amount of capital that can be called from an LP.

Note: https://www.cfainstitute.org/programs/cfa-program/careers/private-equity

PE and VC Strategies

- Private Equity firms face few regulations and have tremendous autonomy. Most deals in this space fall into one of a few categories:

- **LBO:** Leveraged Buy-Outs occur when a PE company takes out substantial debt to acquire a publicly traded firm. Usually, the PE group will seek several changes at the target company, including potentially new management, cost reductions, spin-offs etc. If the GP is reputable and the company has a solid cash flow, the debt in an LBO can be financed cheaply. The end goal for the PE group is to sell the company at a multiple of the acquisition price.

- **Roll Up:** A rollup seeks to acquire multiple small firms in an industry and consolidate them. (Example: Restaurant chains, car mechanics, HVAC businesses). A GP will find cost savings (technological enhancements, reducing locations, etc.) and build pricing power in that target industry. Generally, the target for a rollup is a high cash flow-generating business that can be leveraged.

- **Buy-and-build:** A PE strategy where a GP acquires a company with distinctive competitive advantages (like IT security expertise or sports data analytics), then rapidly scales its business model through management changes, enhanced marketing, strategic hiring, and external expertise. The goal is to transform the target into an industry leader by leveraging its core strengths while creating value through operational improvements and strategic acquisitions in a fragmented market.

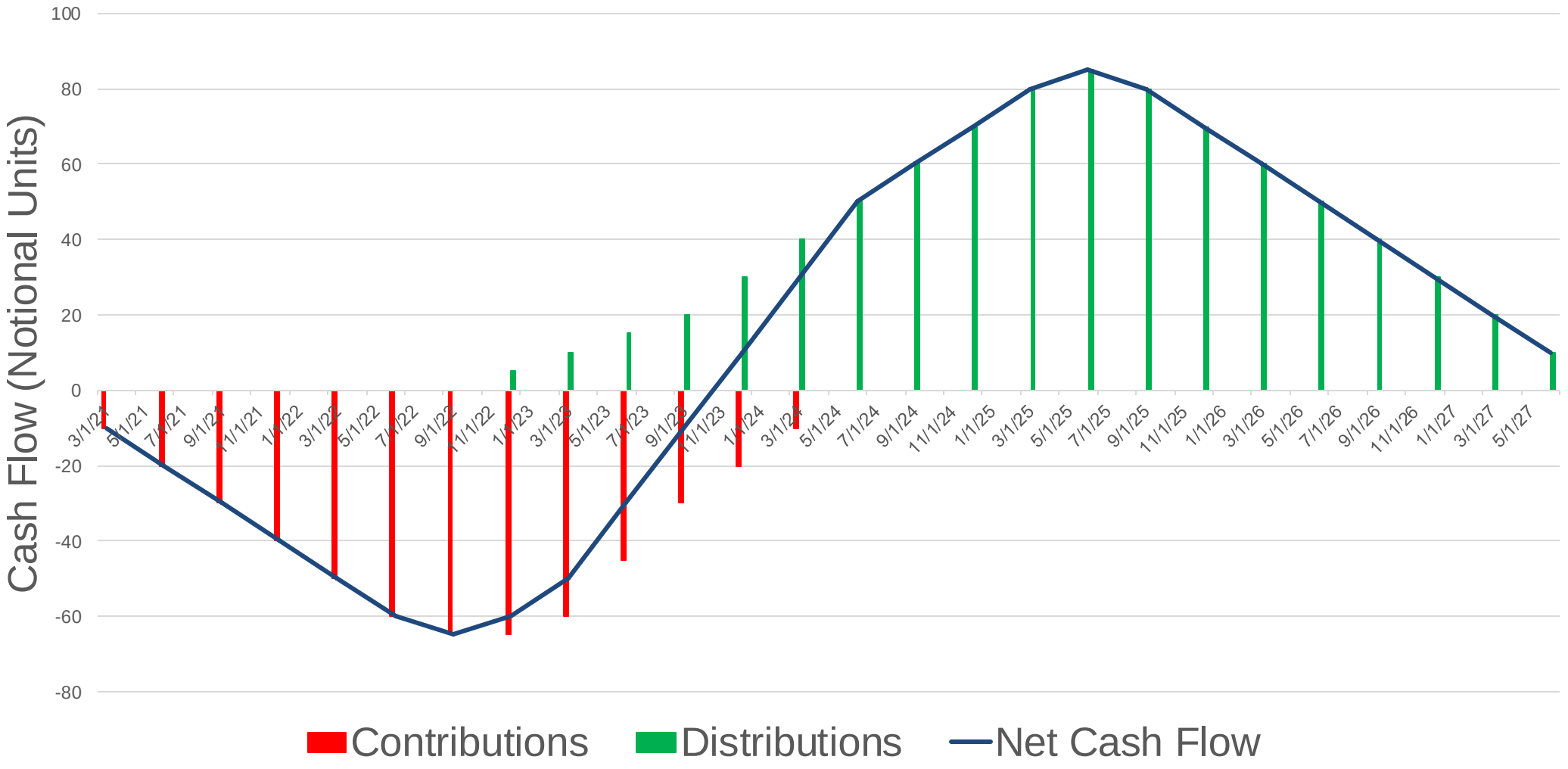
PE and VC Strategies

- A VC fund will look to find business opportunities that can **grow 5x or even 10x+.** Famous companies like SpaceX, Palantir, Databricks, Stripe, Claude, Anthropic etc. etc. were funded by GPs with very long-term (10-year plus) business proposals.

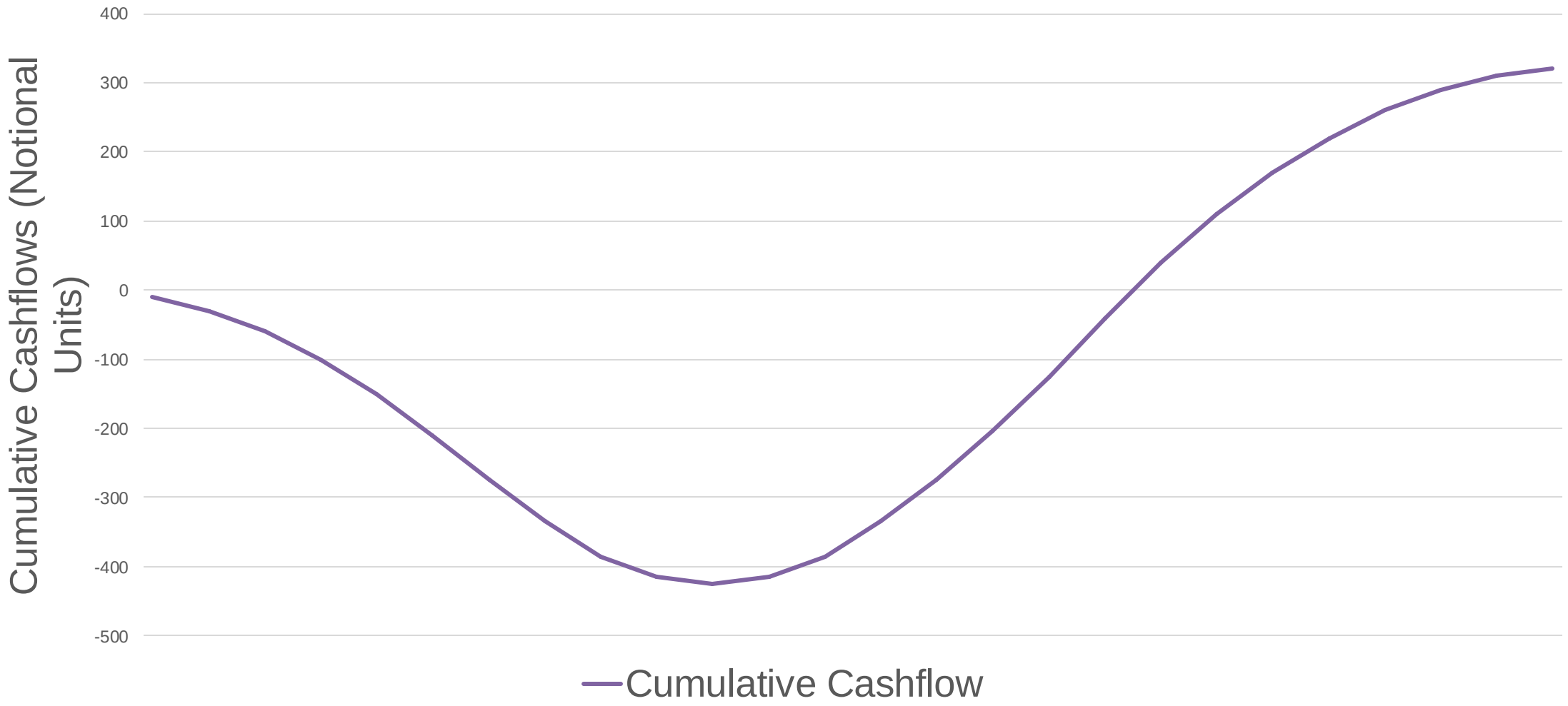
- While we see the winners from these investments, we do not see the failed companies (survivorship bias). Often a VC company **will bundle many investments** (40+) into a single fund to take advantage of the far-right tail and stabilize returns.

- VC portfolios can be viewed as a portfolio of **long call options**. Because of the zero-lower-bound, volatility in long-term (10 year+) outcomes, increases the value of the portfolio. VC funds are very sensitive to interest rates and, based on my experience, few GPs will explicitly hedge out that risk.

PE and VC Cash Flow Profile



PE and VC Cash Flow Profile



Returns in PE and VC

- Given the profile of cashflows, time-weighted returns are not used in this space. The “20%” on 10 million dollars is not comparable to the “-10%” on 100 million dollars. The industry has descended on three main metrics for computing returns:
  - **TVPI:** Total Value Paid In. Computed as the sum of the value of the company and all the distributions divided by the total contributions paid.
  - **IRR:** Internal Rate of Return. Computed based on the cashflows to and from an LP.
  - **MD TWR:** Modified Dietz Time Weighted Return: Sometimes MD TWRs will be used; however, this is not the industry standard.

- None of the valuation metrics is perfect.
  - TVPIs are **computed from since inception** and do not help understand quarter-over-quarter returns.
  - IRRs are generally **not unique**: there may be multiple IRRs for a single stream of cash flows.
  - MD TWRs are difficult in practice because these returns are **not necessarily comparable** in a time series where the portfolio dramatically changes in value. This performance calculation should only be used for a fund-of-funds once it achieves steady-state or a permanent investment vehicle.

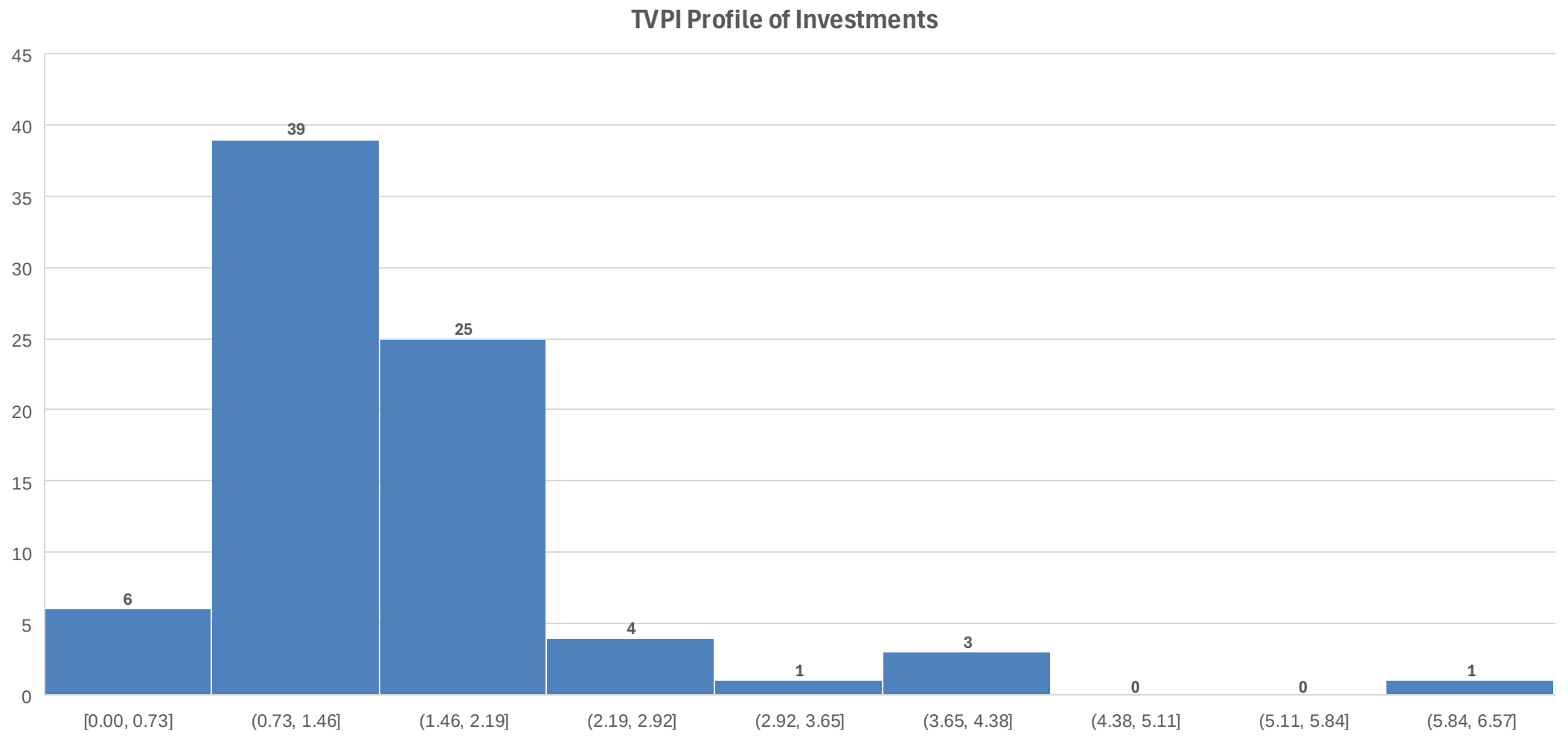
Risk Considerations in PE and VC

- Modeling these asset classes is almost definitionally difficult. One may opt to use a return time series and de-smooth it or make some baseline assumptions about the asset class (i.e. its leveraged equity). Based on these assumptions, one can model it as 1.2x the Russell 2k Industrial index, for instance.

- Benchmarking: Assessing a fund's returns can be difficult. Ideally, we want to isolate the **vintage year** the fund started and the strategy of the fund. Once we do this, we can compare the fund to its peers using the Cambridge Associates database and make a relative comparison. Alternatively, we can use a **Public Market Equivalent (PME) Measure** (there are several flavors of this) to compare the PE investment to a public equity index.

- **Empirical measurements are difficult in the space.** VaR, CVaR, vol require the market pricing mechanism to be fairly accurate. In place of this, we often conduct analyses by going to where the most data is: the performance of GP's individual investments.

An Example GP Portfolio of Returns



Homework

- An Excel file will be included for homework with the returns of a hypothetical GP. Assuming the assets are equally weighted, use bootstrapping to construct proforma portfolios. **Bootstrapping** is the process of selecting 'n' random values from a greater pool of 'N.' In this instance, we will select **10 funds** from the 100 possible funds.

- Once a sample is taken, record its average TVPI. Repeat this exercise >10,000 times. What's the average TVPI of the hypothetical portfolio sampled? What's the best portfolio? What's the worst? What's VaR95 and CVaR95 based on the simulation?

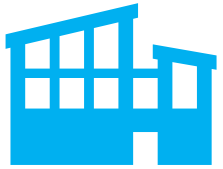
- Suppose the GP is going to launch a fund with **20 investments**, doing the above exercise again, how do our statistics change?

- Remove unrealized investments from sample pool. What do the statistics for the hypothetical fund of 20 look like now?

Assets We Will Cover Today

Hedge Funds

Private Equity



Commercial Real Estate

Commercial Real Estate

- Traditional commercial real estate includes **apartments**, **hotels, offices, industrial,** and **retail**. As the market evolves, additional property types have been added: cell towers, self-storage, undeveloped land, life sciences, etc… These are generally small relative to the rest of the commercial real estate universe (<15% in aggregate).

- Commercial RE, like PE, is appraisal-based. Generally, properties are externally re-appraised quarterly or yearly. The average hold time for a property is 5-10 years.

- Publicly traded REITs are similar to their private counterparts but generally have more leverage and more growth-oriented exposure (i.e. cell towers and self-storage).

CRE Overview: Apartments

Lease Terms: Short ~1 year

Barriers to Entry: Location is critically important in residential real estate, but so is the property itself. Construction times may be ~2 years (~6 yrs in certain zip codes). In CRE, the ratio of land to building value is usually around 1-to-1. The role of regulation cannot be understated.

Unique Economic Drivers: Surprisingly, one of the largest drivers of property values is not population, but GDP per capita. An influx of wealthy home buyers is likely to drive up prices.

Commercial real estate valuations are directly related to interest rates, which underpin financing and construction costs. However, apartments are generally the **least sensitive** within CRE because of the short lease terms and the ability of property owners to pass the costs to the tenants.

Note: Warbasse Houses in Brooklyn, NY (pictured right) may have forced NYCB to raise liquidity. Regional banks generally have more CRE exposure. WSJ article: https://www.wsj.com/finance/banking/the-coney-island-apartment-complex-that-nearly-sparked-a-banking-panic-2cd657e8

CRE Overview: Office

Lease Terms: Medium ~4-10 years. In certain instances, tenants will have multi-decade lease agreements. In others, the lease term may be reviewed every two years.

Barriers to Entry: Construction timeline is between industrial and apartments (~2 yrs.) Office locations are generally in prime areas near the center of cities or towns. The building vs. land dynamic is idiosyncratic to the property.

Unique Economic Drivers: Office demand is historically driven by job growth. However, since COVID-19, the divide between work-from-home and work-from-office employees has dramatically changed this paradigm. We are currently seeing a bifurcation in the market, where premier "**Class A**" office real estate is trading at a historically significant premium to "**Class B**."

By value, New York City contains over 15% of the U.S. market.

CRE Overview: Industrial

Lease Terms: Long 5-10 year leases. Often tenants will have the option to have fixed rate renewals. For the property owner, this is comparable to receiving a **fixed-rate swap**.

Barriers to Entry: Construction time is usually short (<18 mos.) primary barriers to entry are **land availability** and **proximity** to ports and major transportation conduits (highways, trains, etc.)

Unique Economic Drivers: Property value is based on economic growth and traffic. Generally, higher volume in the local area = high demand. There are relatively few distinguishing qualities between properties.

In America, ~43% of industrial based on market value is based along ports in **California** and **New Jersey**. Industrial plays a critical role in supporting a trade-driven economy. Generally, when we talk about industrials we mean storage, not manufacturing.

Note: In 2021, U.S. consumption rose and ports saw record traffic due to commerce. The average LA industrial building went up >50%, but brick and mortar stores suffered. Real estate can be volatile(!)

CRE Overview: Retail

Lease Terms: Medium 1-5 year leases. Retail tenants will often have **anchor-satellite constructions** where an anchor tenant may have a relatively cheap long-term lease and the other tenants in a complex will have shorter-term more expensive leases **(per square foot).**

Barriers to Entry: Land availability and **accessibility to residential population centers.** Construction is usually quick ~18 months.

Unique Economic Drivers: Historically, retail prices are in-line with **consumer spending.** The higher the volume of spending, the more valuable the real estate. Historically (mid 2010s), there was a secular change of shop online vs. on site. That change has been priced in.

Property owners are incentivized in bring in attractions that drive foot traffic. Like office, we are seeing a bifurcation in the space; generally, if people travel they want an experience.

Commercial Real Estate Returns

- The standard way to compute returns in Commercial Real Estate is a formula published by NCREIF (The National Council of Real Estate Investment Fiduciaries):

- **Net Income Return** = Net Operating Income /(Beginning Market Value + ½ Capital Improvements – ½ Partial Sales – 1/3 Net Operating Income)

- **Capital Appreciation Return** = [(Ending Market Value – Beginning Market Value) + partial Sales – Capital Improvements] / (Beginning Market Value + ½ Capital Improvements – ½ Partial Sales – 1/3 Net Operating Income)

- **Total Returns** = **Income Return** + **Capital Appreciation Return.** It's a bit of a Frankenstein concoction, but it's the industry standard!

- **CAP Rates:** NOI/Beginning Value (this is commonly referenced in the industry)

Commercial Real Estate

- Real estate **offers a lot of cash flow (~100-300 bps of yield above the 10-year),** making the asset class particularly valuable for companies with meaningful liabilities to offset (like insurance). Moreover, real estate has important **tax advantages**; the asset class may be one of the most tax-friendly alternatives. In an oversimplification, properties often allow for the depreciation of capital expenditures to be used as an offset to net operating income. This business is very regional, and the rules around capital expenditures and depreciation change based on the market.

- Left-tail idiosyncratic risks can be significant (house fire, mold, water damage, etc.). To offset this tail, **insurance** will usually be taken to cover significant damage.

- Many of the non-catastrophic **risks that remain are related to the sector and market**. For instance, currently, office is a sector under severe strain after the remote work movement. LA is seeing property prices surge after supply has been compromised. **Most price movements we see are related to the supply and demand dynamics of the specific market**.

- Even after appropriately unsmoothing return series for asset-weighted real estate markets, assessing risk can be difficult due to the tendency for markets to correlate together in shocks.

Commercial Real Estate Valuations

- For quantitative analyses, individual properties can be **time-consuming and difficult to assess**. For a specific property, say a retail unit in a Denver suburb, there may be **few direct comparisons** to that property that have sold in the last 1-3 years. **Price discovery** is a non-trivial in this market, and we are more likely to get accurate asset values when trading volume is high. When comparing two properties we often do the comparison in **price-per-square-foot**.

- The **operating metrics** of the current tenants may be the best signal for the property's value. In most cases, investors rely on 'old school' financial modeling with a **discounted cash flow (DCF)** approach when making a new acquisition.[1] During a DCF, an analyst will forecast a **terminal valuation**, a future rent roll based on some **growth rate assumptions** and will apply a **discount rate** that is based on the forward interest-rate curve. The DCF can be used to compute **a Net Present Value (NPV).** The same framework can also be used to compute an **IRR(discount rate)** if the 'cost' is known.

- **Replacement Cost/Liquidation Value:** Based on current market dynamics, replacement cost measures how much it would cost to replace an asset (i.e. tearing a building down and rebuilding). This method is more commonly used in PE, where an asset can be marked at 'book value.'

1) Arguably DCF dates as far back as interest (3000BC) but there are varying accounts. Here's one: Susie Brackenborough, et al., The Emergence of Discounted Cash Flow Analysis in the Tyneside Coal Industry c.1700-1820.

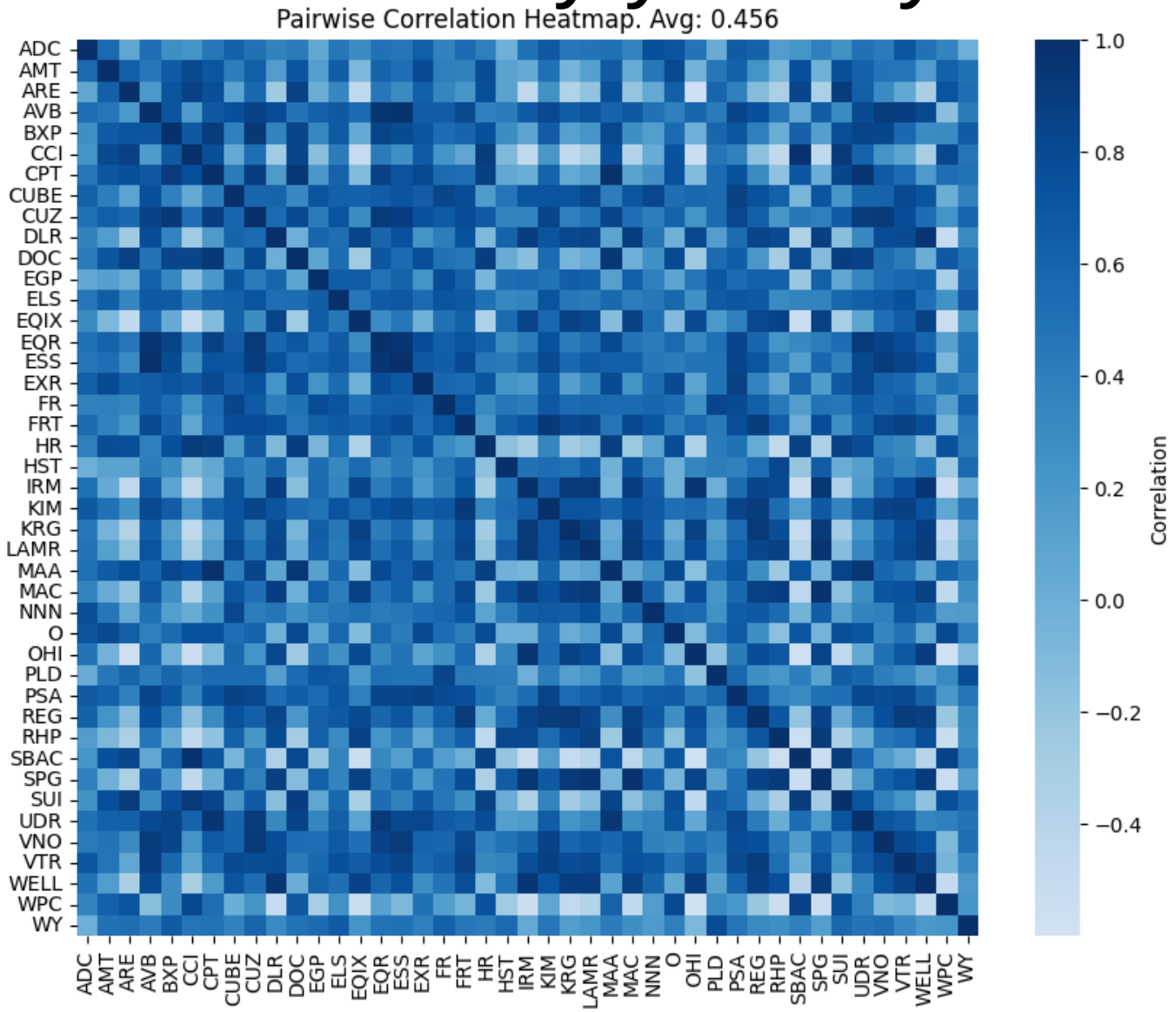
Commercial Real Estate Valuations

- Please note that these three valuation methods apply to most alternative assets (In my persional experience: Private Equity, Private Credit, Private Real Estate, etc.).

- Appraisals and/or analysts may use any one or **some combination** of the above three methods for valuing an asset. For instance, I've seen appraisals which are 50% DCF value + 50% replacement value.

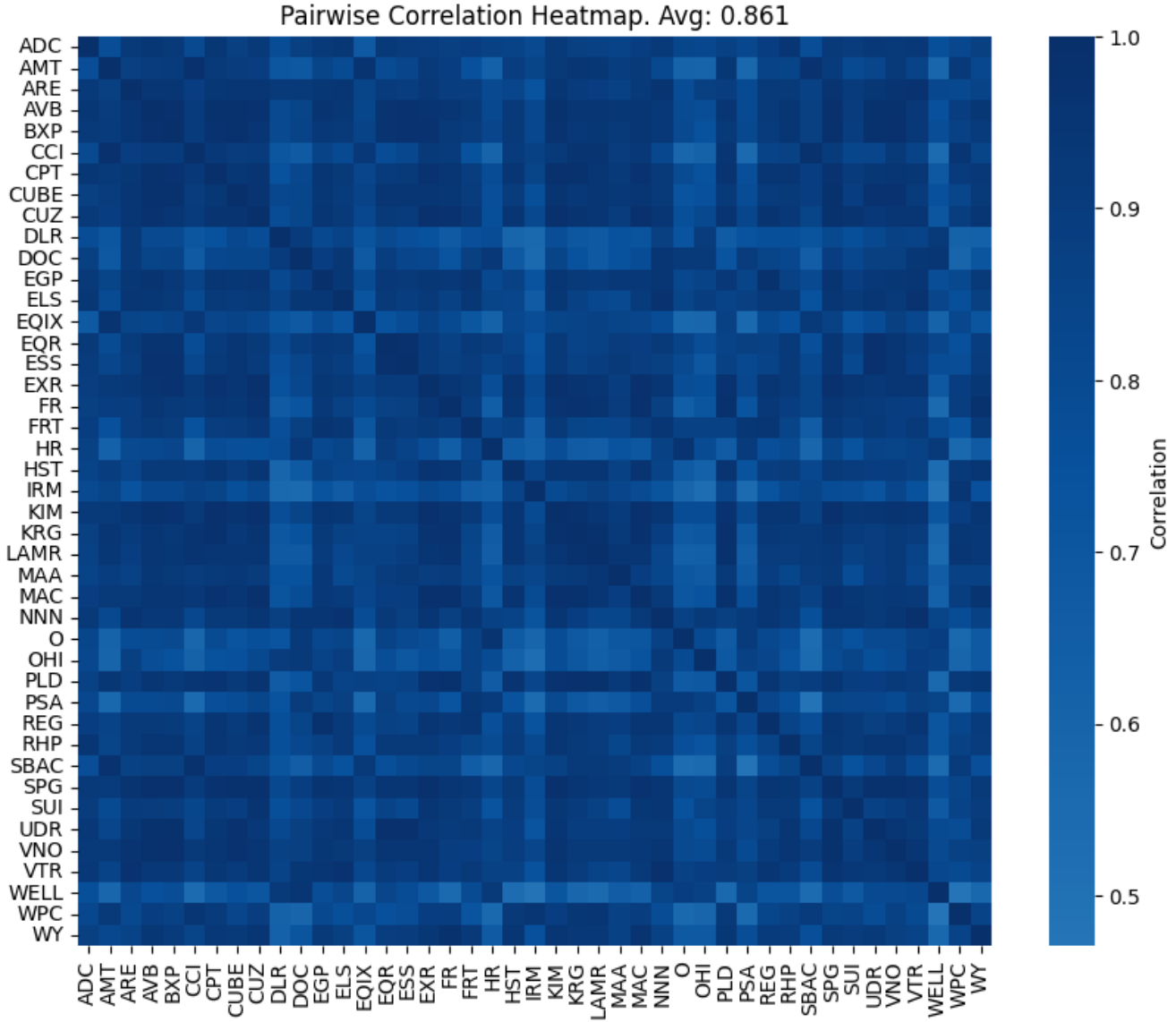
- On top of the difficulty with valuations, it's important to remember that the correlations between real estate markets are not **stationary**. We look at REITs as an example:

Stationary you say?



1) Select US REITs from Jan 2023 to Jan 2025.

Stationary you say? Yikes



1) Select US REITs from Jan 2007 to Jan 2009.

Attempting to Apply Quantitative Methods in Private Assets

- Attempts like Zillow's (2021)[1] show some of the limits of quantitative methods for **property-level** quantitative analysis. To be clear: no one is saying it's impossible, it's just not easy.

- Quantitative methods are more likely to be applied to entire **markets (cities)** and **sectors**. Economists play an outsized role in this 'forecasting.' For instance, next year, will San Francisco Office or New York Office outperform?

- Diversification can take a **categorical** nature: cities, zip codes, sectors, etc. One should also look deeper than categorical classifications and assess how properties **empirically** behave.

1) https://www.bloomberg.com/news/articles/2021-10-17/zillow-pauses-home-purchases-as-snags-hit-tech-powered-flipping

Commercial Real Estate

Other **dimensions of diversification** in real estate:

- Diversification across **sectors** and **metro areas** (already discussed).
- Diversification in entry points/**vintage years**: In alternative assets with limited liquidity, we will often think of diversification in terms of when dollars are deployed (i.e. that's a 2017 vintage fund).
- Diversification in **tenants**: Once a property is purchased, the types of tenants will determine its sensitivity to economic shocks.
- Diversification in **payoff structure**: some properties produce no income (land leases), and others produce lots of income (apartments). It's important to match your liability structure with your assets. How well does income cover debt payments?
- The other consideration is **duration**. Real estate has many fixed-income characteristics and may struggle in a rising interest-rate environment. The duration of real estate usually appears in the lease terms. Real estate with short-term renewals (apartments are usually annual) are less sensitive to rates. Real estate with long-term fixed renewals is very sensitive to rates. For instance, industrial and office can have 10-year lease terms.

Where does this leave us?

- There's no silver bullet to managing real estate risk. Knowing the portfolio is 90% of the job.
- One may do stress tests, pro forma analyses, and benchmark attributions. Some stress testing will be firm-wide, and others will be group-specific.
- When there is a failure in the market (i.e. Silicon Valley Bank), the first question we are asked is 'What is your exposure?' Having that **information centralized** and **accessible** is key.
- Risk advises the portfolio manager. It is not my job to solicit Florida Retail or Texas Apartments. Sensitivities within the book on an absolute basis and relative to the benchmark are where I focus. If we are materially underweight Boston office, then the portfolio manager should know this will be a source of tracking error between us and the benchmark.

Real Estate Homework

- With the real estate return series provided, unsmooth the data using the **Geltner Method (assuming the time series is AR(1))**. Python's statsmodels.graphics.tsaplots.plot_pacf can help with this. Do the same exercise assuming statistically significant lags for

- T-1/T-2
- T-1/T-2/T-3
- T-1/T-2/T-3,T-4

- Comparing the original and unsmoothed time series, how do variance statistics compare? How does the maximum drawdown compare?

- How many lags would you feel comfortable unsmoothing before running into issues with **statistical significance?** (To be clear, I do not mean a stand-alone regression, I mean how many lags would you feel comfortable unsmoothing in aggregate. Is T-1/T-2/T-3,T-4 dubious for instance?) What role does seasonality play with the time series if any?