

Session 6: Market Efficiency

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Road Map

Market Efficiency

Searching For Alpha

Multi-Factor Models

Limits to Arbitrage

Definition

- In an **efficient market**, prices and expected returns of all assets are equal to their fair value
 1. Price = expected CF discounted at r_f + risk premium
where the prediction of CF hence the price incorporates all available information
 2. Expected return = r_f + risk premium
 3. $\alpha = 0$: it is impossible to find assets with abnormal expected return adjusted for the compensation for risk
 - ▶ All three statements are equivalent
- In an **inefficient market**, prices and expected returns sometimes differ from their fair value
 - ▶ Smart investors can find mispriced assets: over-priced assets with $\alpha < 0$, under-priced assets with $\alpha > 0$

Quiz

Yesterday, new results were released showing that company XYZ's revolutionary solar cells are 50% more efficient than current best technology. This is very good news for future earnings of XYZ

Q1. If markets are efficient, it is a good idea to buy company XYZ's stock today. True or false?

Q2. If markets are inefficient, it is a good idea to buy company XYZ's stock today. True or false?

Quiz

Company ABC announces that its sales are up 25% compared to last year. ABC stock price immediately loses 5%

Q3. In this particular instance, the market has been inefficient. True or false?

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Searching For Alpha

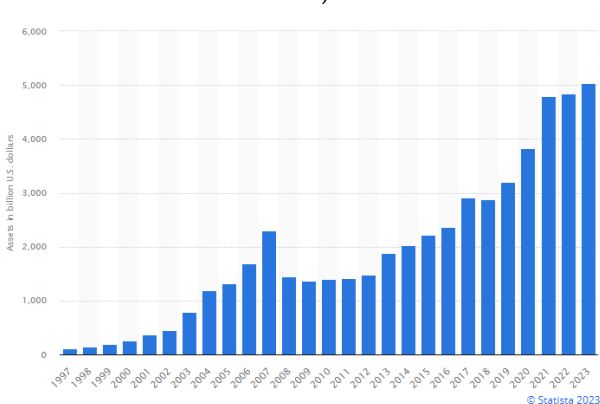
Multi-Factor Models

Limits to Arbitrage

Hedge Funds

- Hedge funds are in the business of searching for alpha: buy undervalued assets ($\alpha > 0$) and short-sell overvalued assets ($\alpha < 0$)

Assets Under Management (AUM) by hedge funds worldwide (billion USD)



Hedge Funds

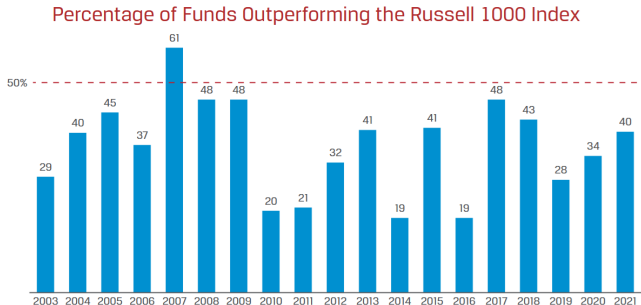


- Tomorrow morning's guest speaker: Pierre Henry-Labordere, quantitative researcher at Qube Research & Technologies (QRT)

Are Markets Efficient?

- Hedge funds have a raison d'être only if markets are inefficient
- If markets are efficient, there is no alpha

Performance of Mutual Funds



Source: Bank of America.

- Not so easy to generate alpha!
- But mutual funds' strategies are restricted (no short selling)

Performance of Hedge Funds

- Average hedge funds returns (per year), 1996–2012¹

	mean return	alpha	beta
Before fees	9.3%	7.3%	0.37
After fees	5.5%	3.6%	0.26

- Hedge funds generate alpha on average
- Hedge fund managers earn high compensation (fees)

¹Jurek and Stafford, 2015, “The Cost of Capital for Alternative Investments,” *Journal of Finance* [\[pdf\]](#)

Examples of $\alpha > 0$

- Academics and investors have found many strategies with $\alpha > 0$
- Stock with the following characteristics have been found to have positive alpha, and stocks with opposite characteristics negative alpha → long-short strategies
 - High book value/market value ratio of equity (value effect)
 - Low market capitalization (small size effect)
 - High return in previous year (momentum effect)
 - Low return in previous five years (long-term reversal)
 - Low return in previous week (short-term reversal)
 - Profitable companies (profitability anomaly)
 - Low investment
 - Low idiosyncratic volatility
 - etc.
- 300+ signals at www.openassetpricing.com

Three Reasons for Finding Alpha

1. **p-hacking**

- ▶ Over-fitting when using plenty of data and trying plenty of strategies
- ▶ Alpha disappears out-of-sample

⇒ Back-testing

2. **Compensation for alternative risk**

- ▶ CAPM: Market risk (market beta) is the only priced risk
- ▶ In practice: Other risk factors may command a risk premium

⇒ Multi-factor models (more later)

3. **Mispricing**

- ▶ When not 1 and 2, there is a genuine trading opportunity

Brain-Teaser: Alpha Decay

- Academics have looked for and found many strategies with positive alpha. However, after academics publish their results, the alpha tends to disappear²

Q. How do you interpret this fact?



²McLean and Pontiff, 2016, "Does Academic Research Destroy Stock Return Predictability?" *Journal of Finance*

Brain-Teaser: Alpha Decay

1. p hacking: The strategy has positive alpha in-sample by luck, but zero alpha out-of-sample
2. Market efficiency: Once alpha is discovered, hedge funds trade on it, which drives alpha to zero
 - ▶ Hedge funds buy assets with positive alpha \Rightarrow price $\uparrow \Rightarrow$ future return $\downarrow \Rightarrow \alpha$ vanishes

\Rightarrow This self-correcting mechanism has two important implications

1. It is a powerful force towards efficient markets, explaining why it is difficult to generate α
2. For asset managers: α is not exogenous but depends on own and competitors' strategies (specificity of forecasting in finance)

Drivers of Inefficient Markets

Two broad types of drivers of market inefficiencies

1. **Flow-driven:** Some investors buy or sell for non-fundamental reasons \Rightarrow move the price while fair value hasn't changed \Rightarrow mispricing and abnormal future return
 - ▶ Ex.: A stock is added to a stock market index (such as S&P500) \Rightarrow index-replicating funds buy the stocks \Rightarrow price goes up for non-fundamental reason
2. **Behavioral:** Investors are subject to cognitive biases \Rightarrow mis-estimate fair value \Rightarrow mispricing
 - ▶ Ex.: Fads and bubbles, overconfidence, inattention, etc.

Flow-Driven Mispricing: A Classic Example

- Frazzini & Lamont (2008) “Dumb Money: Mutual Fund Flows and the Cross-Section of Stock Returns” *Journal of Financial Economics*
- Mutual funds experience regular inflow (new clients) and outflow (redeeming clients) and expand/shrink the size of their portfolio accordingly

⇒ These flows generate price pressure, which, if unrelated to fundamentals, predict future returns

Mutual fund outflow \Rightarrow sell \Rightarrow price \downarrow \Rightarrow future return \uparrow

Mutual fund inflow \Rightarrow buy \Rightarrow price \uparrow \Rightarrow future return \downarrow

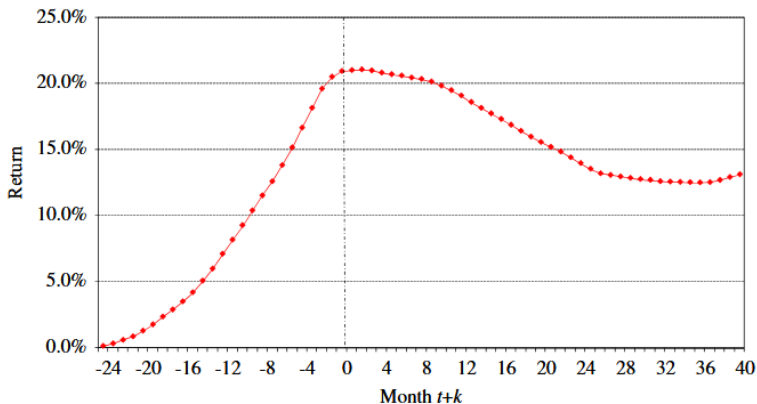
- Construct a long-short portfolio

Long stocks held by mutual funds experiencing outflows

Short stocks held by mutual funds experiencing inflows

Mutual Flow-Driven Mispricing

Average cumulative return in month $t+k$ on a long/short portfolio formed on three-month flow in month t (Frazzini & Lamont 2008, Fig. 2)



Flow-Driven Mispricing

- Many strategies are based on exploiting flow-driven price movements
- Either identifying past flow unrelated to fundamentals \Rightarrow trade in the direction opposite to the flow
 - ▶ Like in the previous example
- Or forecasting future flow \Rightarrow trade in the direction of the flow before it happens (“front running”)
 - ▶ In this case, it doesn't matter if the forecast flow is fundamental driven or not

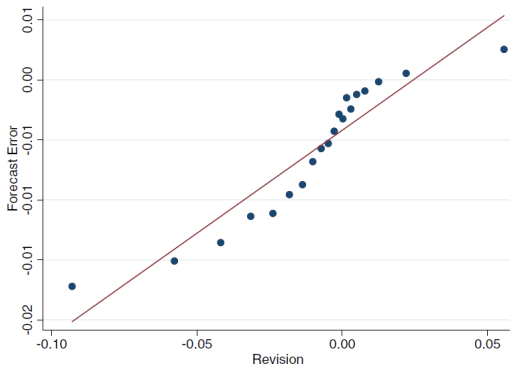
Example of Behavioral Mispricing

- Bouchaud, Krüger, Landier & Thesmar (2019) “Sticky Expectations and the Profitability Anomaly” *Journal of Finance*
- Financial analysts issue forecasts of companies' earnings
- If forecasts were Bayesian, forecast errors (realized earnings minus forecast earnings) should not be predictable
- But if analysts under-react to information, their forecasts adjust too slowly

Good fundamental news (e.g., true value +1) \Rightarrow analysts adjust only +0.5 \Rightarrow an upward forecast revision predicts the new forecast is too low

Under-Reaction

- Forecast errors (realized earnings minus forecast) as a function of forecast revision (forecast minus previous forecast) (Bouchaud & al 2019, Fig. 1)



- Authors argue under-reaction generate the momentum effect (high past stock return predicts high future return) and profitability anomaly (high profit predicts high future return)

Over-Reaction

- Over-reaction has been identified in other contexts, leading to reversal instead of momentum
- Both momentum and reversal co-exist, e.g. at different frequencies

Data-Driven Approach

- In practice, quantitative investors don't always know the drivers of the mispricing → they're interesting in forecasting
- Other strategies exploit advantage in data, speed, compute → the source of the return predictability is more explainable

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Multi-Factor Models

Limits to Arbitrage

Multi-Factor Models

- **Multi-factor models** extend the CAPM to multiple risk factors
- Multi-factor models posit that assets' risk premia depend on their exposure to multiple factors
- Example: two-factor model that accounts for the momentum effect
 - ▶ Factor 1: market portfolio
 - Excess return: $r_{mktf} = r_m - r_f$
 - Risk premium: $E[r_{mktf}]$ around 8% over past 40 years
 - ▶ Factor 2: momentum long-short portfolio
 - Long stocks with high past returns/short stocks with low past returns
 - Excess return: $r_{mom} = r_{high-past-ret} - r_{low-past-ret}$
 - Risk premium: $E[r_{mom}]$ around 6% over past 40 years

Example (cont'd)

- Risk premium of asset i is given by

$$E(r_i - r_f) = \underbrace{\alpha_i}_{\text{"abnormal" compensation}} + \underbrace{\beta_{i,mktrf} \times E[r_{mktrf}]}_{\text{compensation for exposure to market factor}} + \underbrace{\beta_{i,mom} \times E[r_{mom}]}_{\text{compensation for exposure to momentum factor}}$$

- $\beta_{i,mktrf}$ and $\beta_{i,mom}$ are asset i 's factor exposures, which can be estimated by estimating the multi-factor model regression

$$r_{i,t} - r_{f,t} = \alpha_i + \beta_{i,mktrf} r_{mktrf,t} + \beta_{i,mom} r_{mom,t} + \epsilon_{i,t}$$

- α_i : abnormal compensation above and beyond compensation for exposure to the risk factors included in the model

Multi-Factor Models

- Factor models can accommodate any number of risk factors
 - ▶ Factors can be portfolio returns
 - ▶ Factors can be anything else (ex: inflation, market volatility)
- Strength: more general and flexible than CAPM
- Weakness: selection of factors is indeterminate

Popular Factor Models

- CAPM: one-factor model
 - ▶ **Market:** excess return on the market portfolio
- Fama-French 3-factor model
 - ▶ Market factor
 - ▶ **Value:** return on portfolio long value stocks/short growth stocks (HML)
 - ▶ **Size:** return on portfolio long small stocks/short large stocks (SMB)
- Carhart 4-factor model
 - ▶ 3 Fama-French factors
 - ▶ **Momentum:** return on portfolio long past winners/short past losers
- Data on factor returns available at Kenneth French's [data library](#)

Performance Evaluation of Asset Managers

Q1. How do you assess the management skill of a fund manager with the following performance evaluated using different factor models?

	CAPM	Fama-French	Carhart
constant	.0085*** (.0028)	.0078*** (.0028)	.00064 (.0022)
mktrf	.31*** (.062)	.34*** (.064)	.56*** (.051)
hml (value)		.22** (.092)	.57*** (.073)
smb (size)		.034 (.098)	.039 (.076)
mom			.95*** (.051)
s.e. in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$			

Performance Evaluation of Asset Managers

Q2. Should you pay high fees to invest in this fund?

Performance Evaluation of Asset Managers

Q2. Should you pay high fees to invest in this fund?

- No, investing in common risk factors is (relatively) easy/cheap
 - ▶ Still requires to estimate factor exposures, construct and rebalance portfolio, manage transaction costs
- So-called **factor investing** or **smart beta** investing

Performance Evaluation of Asset Managers

- By contrast, a fund manager with positive alpha after controlling for factor exposures can charge high fees
- ...subject to the caveats already mentioned
 1. Has the strategy been properly back-tested?
 2. Is it exposed to other risk factors?

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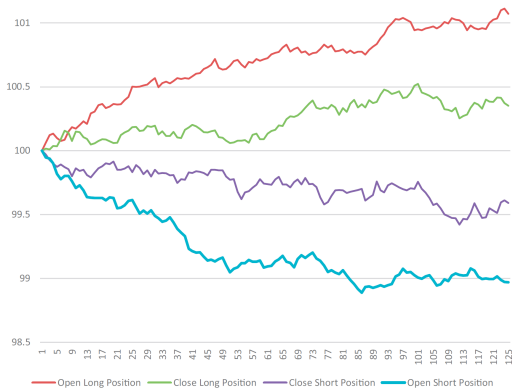
Limits to Arbitrage

Limits to Arbitrage

- Why don't smart investors ("arbitrageurs") eliminate all the mispricings by trading on them?
- Limits to arbitrage
 1. Limited capital
 2. Fire sales

Limits to Arbitrage #1: Limited Capital

- Arbitrageurs have limited capital \Rightarrow they cannot trade on all positive alpha strategies
- For example, hedge funds close their positions before they have zero alpha to redeploy their capital to more profitable trades³



Alpha following orders

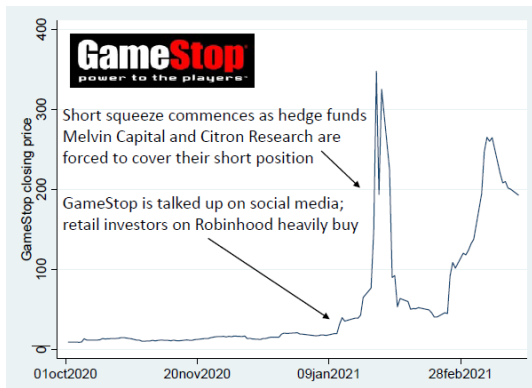
This figure displays cumulative four-factor alphas for 125 trading days following orders that open or close a position.

³von Beschwitz, Lunghi and Schmidt, 2022, Fundamental Arbitrage under the Microscope: Evidence from detailed Hedge Fund Transaction Data, *Review of Asset Pricing Studies* [pdf]

Limits to Arbitrage #2: Fire Sales

- Suppose you find that stocks heavily purchased by retail traders (“meme stocks”) are overpriced \Rightarrow portfolio short meme stocks/long market has $\alpha > 0$
- The strategy may temporarily lose money if meme stocks over-pricing amplifies
- “Fire sales” feedback loop
 - ▶ The strategy temporarily loses money
 - ▶ Fund investors or lenders withdraw their money after initial losses
 - ▶ Which forces funds to unwind positions at the worst possible time, exacerbating the losses, and so on

GameStop Short Squeeze



⇒ Hedge funds had to cover short positions at large losses

Read more at <https://johanhombert.github.io/blog/20210128-gamestop>

Or listen the story [here](#)

Finance Ideas and Nobel Laureates

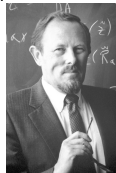
Harry Markowitz

Diversification, portfolio theory
(Nobel 1990)



William Sharpe

CAPM, Sharpe ratio
(Nobel 1990)



Eugene Fama

Efficient markets
(Nobel 2013)



Robert Shiller

Bubbles
(Nobel 2013)



Richard Thaler

Behavioral finance
(Nobel 2017)

