

§1. EFFICIENT MARKETS AND BEHAVIORAL FINANCE

FIN 366: INVESTMENTS
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THE EFFICIENT MARKET HYPOTHESIS

The **Efficient Market Hypothesis** (EMH) is the idea that security prices quickly reflect and include all available information. As such, security prices are where they “should be.”

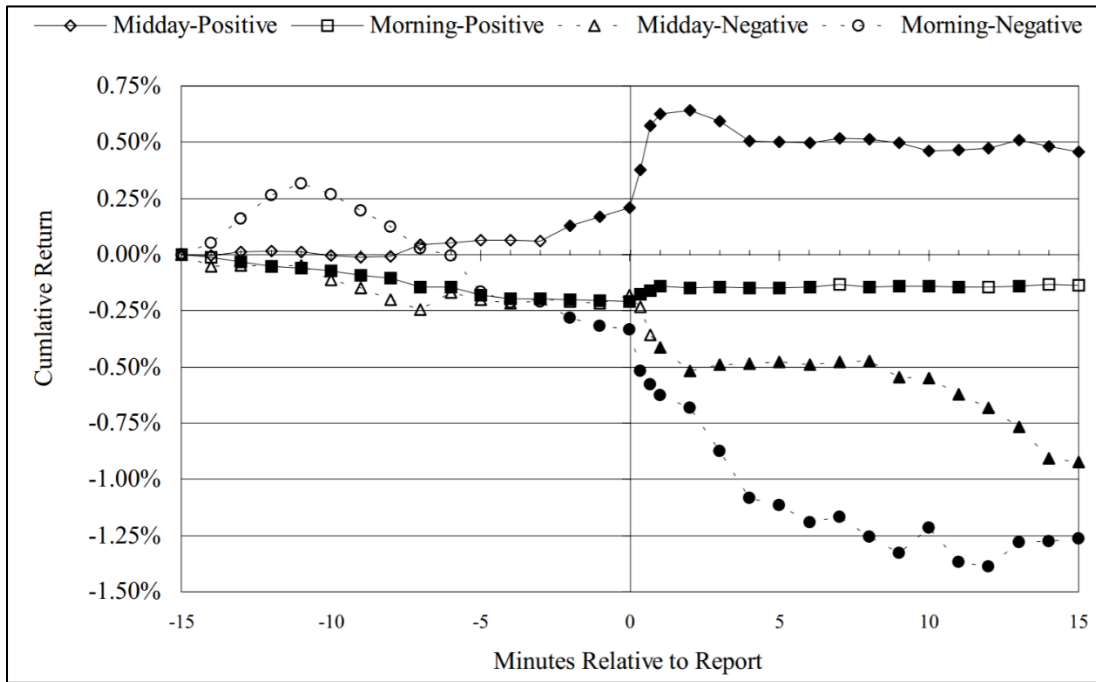
- Square (NYSE: SQ) shares **+6.4%** immediately upon announcing earnings and revenue significantly beat estimates in Q1 2021.
- Netflix (NASDAQ: NFLX) shares **-10%** quickly after announcing a gain of 3.98 million new subscribers when expecting 6.29 million new subscribers in Q1 2021, even though revenue was higher than estimates.



How might a stock move if a company announces significant growth in earnings, but not as much as analysts and investors predicted? Does the EMH tell us in which what direction stock prices should react?

Competition is the source of this efficiency: investors rush to buy stocks on good news and quickly sell on bad news. As a result, we expect prices to rise with an increase in demand and prices to fall with lower demand.

Figure 1: Stock Reactions to CNBC Reports (Busse & Green, 2002)



Random walk: price movements are unpredictable as investors compete to find relevant information to trade on before the rest of the market. This is a natural result given information continuously comes to markets.



What do random walks imply about our ability to predict prices? What about our ability to make trading gains?

VERSIONS OF THE EFFICIENT MARKET HYPOTHESIS

The EMH has various versions, based on how we define “all available information” of the EMH definition.

1. **Weak-Form**
2. **Semistrong-Form**
3. **Strong-Form**

WEAK-FORM MARKET EFFICIENCY

All available information consists of historical market trading data. If this readily available past data is informative about where the stock price would go, investors could easily exploit signals the data shows.

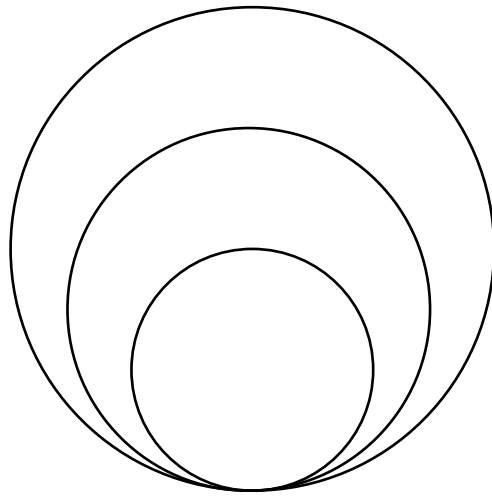
SEMISTRONG-FORM MARKET EFFICIENCY

All available information consists of historical market trading data, as well as firm characteristics (or its **fundamentals** like revenue, profitability, assets, cash flow, and growth prospects). Such data is readily available to investors.

STRONG-FORM MARKET EFFICIENCY

All available information consists of all relevant information about the firm: public data and private data, or **inside information**, that has yet to even be made available to investors and the public.

Figure 2: EMH Information Sets



If markets are strong-form efficient, are they also weak-form efficient? If markets are weak-form efficient, are they also semistrong-form efficient?

INVESTMENT ANALYSIS TECHNIQUES

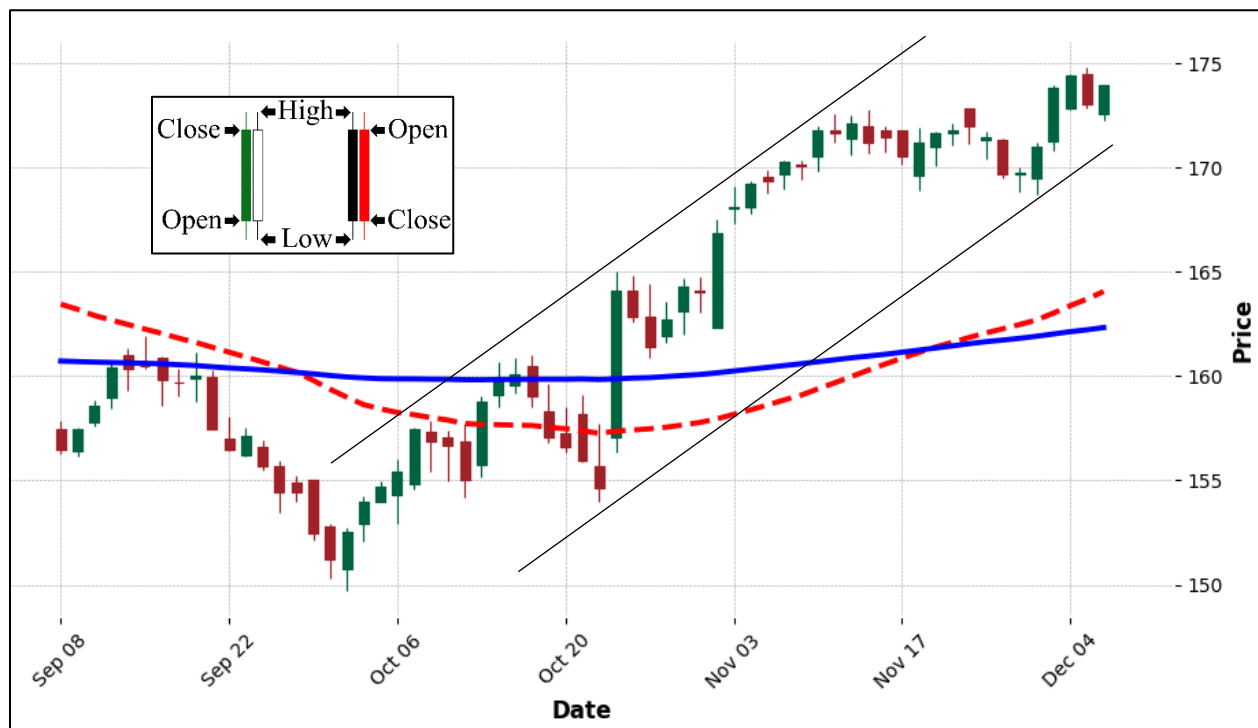
We will define three investment methods, then we consider the implications of the EMH on the effectiveness of these techniques.

1. **Technical Analysis**
2. **Fundamental Analysis**
3. **Quantitative Analysis**

TECHNICAL ANALYSIS

Technical analysis is the search for recurrent and predictable stock price patterns for “buy” and “sell” signals that are informative about the future. **Technicians** or **chartists** rely on information in stock price charts.

Figure 3: OHLC (Candlestick) Chart



Open-High-Low-Close (OHLC) or Candlestick Charts

Open-High-Low-Close (OHLC) or Candlestick charts are popular figures showing intraday (within a day) and interday (across day) stock price movements. Popular among technicians, these charts are useful for a broader audience because they show price movements occurring throughout the day and over time.

Unshaded or green vertical bars indicated the stock has risen on that day. Shaded or red vertical bars indicated the stock has fallen on that day.

- **Open:** the price at which the stock began trading on that day.
- **Close:** the price at which the stock ends trading on that day.
- **High:** the highest price the stock reaches in a day.
- **Low:** the lowest price the stock falls to in a day.

Technical Indicators

There are hundreds of **technical indicators** that supposedly signal future stock price movements based on patterns in how the stock price previously moved. Are these indicators always good predictors of future stock price movements?

- **Crossovers** occur when stock price moving averages and may be interpreted as buy or sell signals. (Moving average: average price over previous x days.) **Golden Crosses** are when the graph of the stock's shorter term (generally 50-day) moving average crosses its longer term (generally 200-day) moving average chart from below, representing a *buy* signal. **Death Crosses** are when the graph of the stock's shorter term moving average crosses its longer-term moving average from above, representing a *sell* signal.
- A **resistance level** is a price threshold where it is seemingly difficult for a stock to rise above while a **support level** is a price threshold below which a stock is seemingly unlikely to fall below.



Visit [Python Code: Candlestick \(OHLC\) Chart](https://josephfarizo.com/fin366.html) at josephfarizo.com/fin366.html and execute the code to generate charts for a stock of your choice.

FUNDAMENTAL ANALYSIS

Fundamental analysis is the use of a firm's earnings prospects, dividend forecasts, and financial condition to identify and buy **undervalued** securities (with low prices relative to their characteristics) and sell **overvalued** securities (with high prices relative to their characteristics). It seeks to determine a share's **intrinsic value** (or *true value*) based on firm fundamentals (such as cash flow, return on assets, return on equity, and other financial statement information), macroeconomic conditions, and industry outlook.

- **Discounted cash flow models** value the share of a company by considering the present value of its future dividend payments or free cash flows.
- **Ratio analysis** determines how the company compares to its industry, competitors, or its own past by looking at liquidity, leverage, profitability, turnover, and value.



Recall there are numerous ratios, including the popular ROA, ROE, Debt to Equity, Current Ratio, Cash Coverage, and EPS measures.²

QUANTITATIVE ANALYSIS

Quantitative analysis is the use of mathematical and statistical methods to make trading decisions. Trades are executed based on **algorithms** that follow rule-based strategies such as buying when a stock's price falls below a certain amount and then selling when it rises or trading stocks that deviate from historical correlations.²

Machine learning (ML) is the process of using computers to examine large amounts of data and infer patterns between a set of inputs (i.e., economic data, industry data, firm characteristics, correlations) and outputs (i.e., stock returns) without direct human intervention. ML may be used to write algorithms.

IMPLICATIONS OF THE EMH ON INVESTMENT ANALYSIS

What does market efficiency imply about the ability of technical analysis, fundamental analysis, and quantitative trading to generate consistent trading gains?



If markets are weak-form efficient, technical analysis and algorithms that use historical prices will not be effective. If markets are semistrong-form efficient, fundamental analysis and algorithms that use firm fundamentals will not be effective. If markets are strong-form efficient, not even trading on inside information would be effective.

The EMH implies that the millions of traders, analysts, technicians, and algorithms have identified “mispricings” and immediately traded on the information – bidding up prices to where they should be based on all available information. At times, there will be winners who identify opportunities first, but by strict interpretations of the EMH, it is impossible to consistently beat the market through skilled or informed trading.

THE ROLE OF INVESTMENT MANAGEMENT IN EFFICIENT MARKETS

Given the EMH “invalidates” many of the techniques associated with valuing and trading securities, what is the role of investment management? **Diversification**, or the spreading of investment risk across several securities, requires good investment management. Understanding tax implications of investing decisions, as well as client age and risk tolerance are vital.

And crucially, *security analysis and investment management drive efficiency in the first place.*



If everyone believes markets are efficient and no one actively traded, what will happen to assets' ability to reflect information?

TESTING MARKET EFFICIENCY

The EMH does not rouse enthusiasm in professional money managers. It implies that much of the work behind generating returns and attempting to “beat the market” is a wasted effort. Whether markets are actually efficient is a difficult question to answer.

1. **Magnitude:** Very small inefficiencies may be difficult to detect, but they can still yield very large returns for larger money managers.



EXAMPLE: If a manager invests \$100 million of their clients' money in “inefficiencies” yielding an additional 0.1% per year, that is \$100,000 in cash flow annually.

2. **Selection Bias:** If someone discovers proof of an inefficiency, why publish their proof when they can trade on their information and profit? Inefficiencies that work may not be reported.

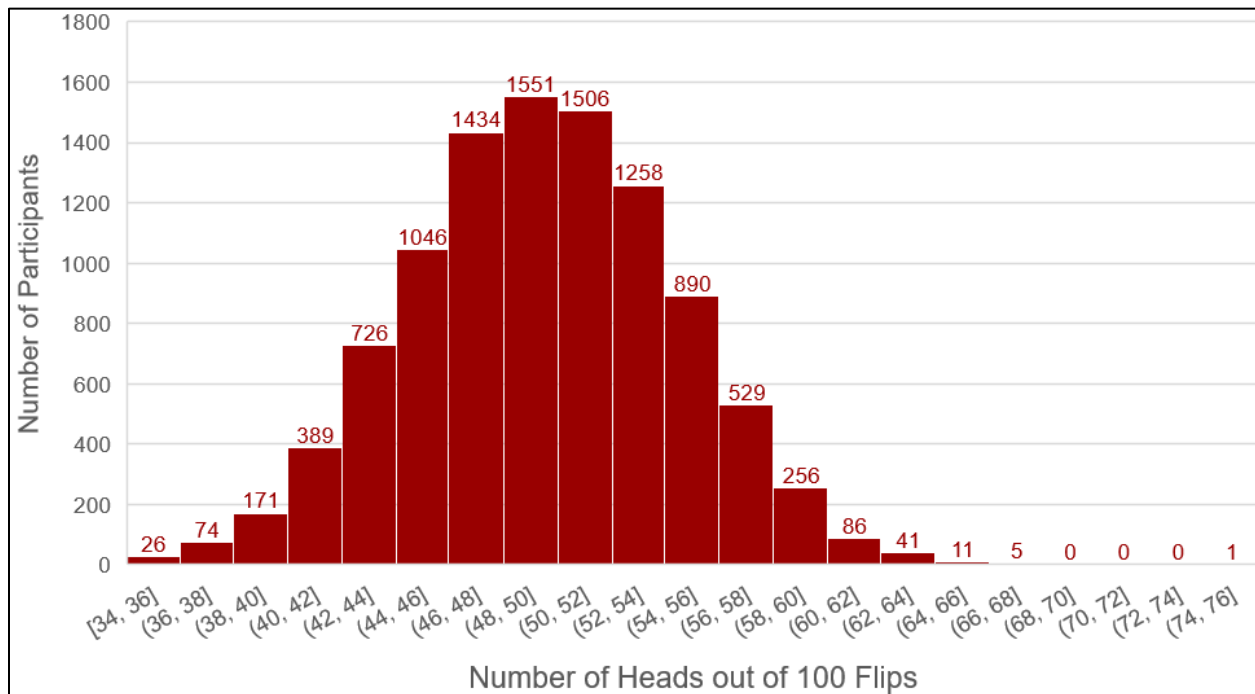
3. **Luck:** Positive returns could be due to luck.




EXAMPLE: Assume 10,000 fund managers are each given a fair coin to flip. They each flip the coin 100 times. Most will flip heads around 50 times. Some managers may flip heads as much as 75 times.

If there are 10,000 fund managers that manage money for 100 months each, some can outperform in 75 of those 100 months by sheer luck!

Figure 4: Coin Flip Simulations (10,000 participants, each 100 flips)



 Try simulating your own random coin flips and developing your own distribution in the Excel file [Coin Flip Simulations](http://josephfarizo.com/fin366.html) available at josephfarizo.com/fin366.html.

ANOMALIES

Anomalies are patterns of return that seem to contradict the EMH. If prices follow random walks, the past should not be informative of the future. However, we observe:

1. **Momentum:** Tendency of poorly (well) performing stock portfolios to continue performing poorly (well) in the short term. Underreaction?
2. **Small Firm Effect:** Small firms have historically had greater returns. Risk?
3. **Neglected Firm Effect:** Tendency of less well-known firms to have higher returns. Liquidity (the ability to quickly sell without significant loss in value) constraints?
4. **Bubbles:** How can we justify seemingly irrational increase in asset prices (housing in 2008, NFTs and crypto post-COVID, dot-com in 2001)? Are these bubbles only irrational after the fact?
5. **Value and Growth Stocks:** Over the last century, value stocks have outperformed growth stocks. **Value stocks** are those with a low price or market value relative to some measure of fundamental value while **growth stocks** are those with a high price relative to some measure of fundamental value.

Table 1: Value Ratios

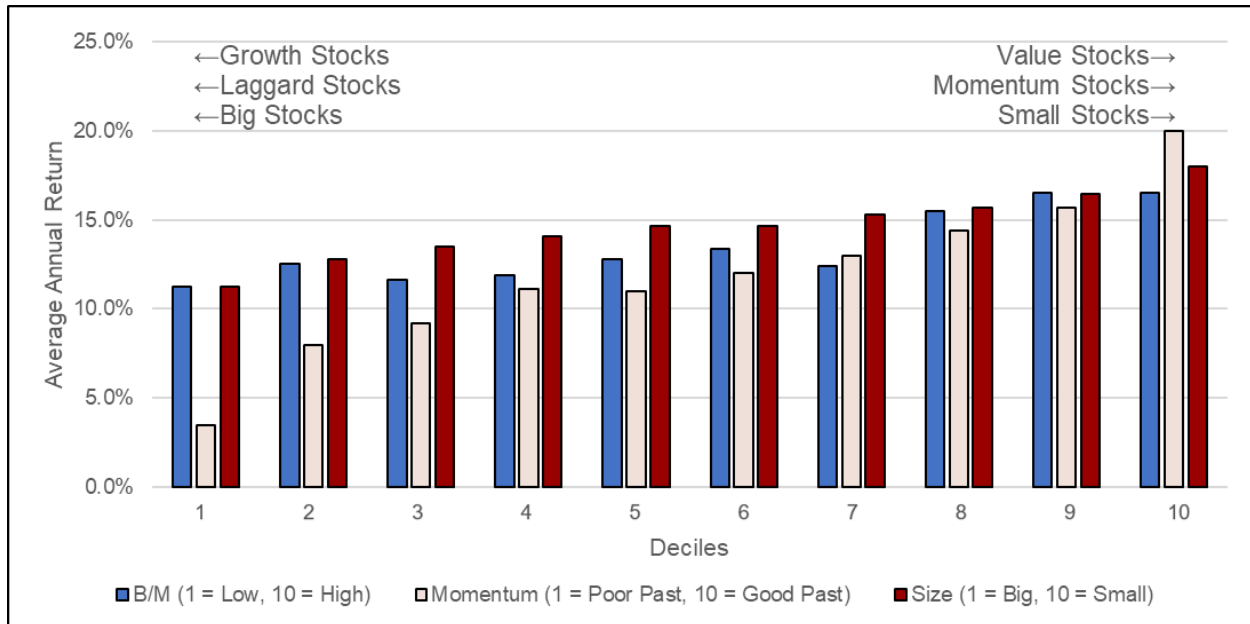
Ratio	Definition	Rule
Book to Market	$\frac{\text{Book Value of Equity}}{\text{Market Value of Equity}}$	Value: High Growth: Low
Price to Earnings (PE or P/E)	$\frac{\text{Stock Price Per Share}}{\text{Earnings Per Share}}$	Value: Low Growth: High
Price to Sales (PS or P/S)	$\frac{\text{Stock Price Per Share}}{\text{Revenue Per Share}}$	Value: Low Growth: High
Dividend Yield	$\frac{\text{Dividends Per Share}}{\text{Price Per Share}}$	Value: High Growth: Low

- *Growth Stock* examples: Salesforce, Tesla, Amazon, Adobe, and Costco (higher P/E ratios)
- *Value Stock* examples: Berkshire Hathaway, Coca-Cola, McDonalds (lower P/E ratios)

There is no precise “rule” as to what constitutes a value or growth stock, and stocks can change from one classification to another. These measures of *value* or *growth* are considered relative to the market overall. Could this anomaly be risk for holding out-of-favor stocks that the market does not “want”?

Perhaps anomalies are discovered through **data mining** or digging through long data histories to uncover **spurious correlations** that exist purely by chance.³ With enough data and a long enough period, something is bound to appear anomalous.

Figure 5: Performance by Value, Momentum, and Size (1927 – 2022)



View the data yourself in the Excel file [Size, Value, and Momentum Portfolios](http://josephfarizo.com/fin366.html) at josephfarizo.com/fin366.html.

BEHAVIORAL FINANCE

Behavioral finance is the study of how investors make financial decisions, blending human psychology with economics. It holds that systematic irrationalities in human behavior characterize investors' decisions, leading to potentially exploitable trading strategies. Such irrationalities may result in share prices that do not reflect true or intrinsic values.

1. **Prospect Theory:** people assess losses and gains asymmetrically – a loss of \$100 is more painful than a gain of \$100 is enjoyable. When given the choice between receiving \$50 or flipping a coin whereby heads wins \$100 and tails wins \$0, most will choose to accept \$50 even though the expected value of both options is the same.

2. **Overconfidence:** overestimating the precision of forecasts.

3. **Conservatism:** too slow to update beliefs and underact to new information.

4. **Confirmation bias:** overweighting evidence that supports preconceived notions.

The above ideas and biases may contribute to the anomalies we have discussed. If investors are making consistent, predictable, and irrational choices, then market efficiency suffers as investors fail to quickly include new information in their valuation of assets. Mispricing could persist.



If all other investors except you are slow to react to new information when it becomes available, what opportunity would that provide?

A major point in the argument between EMH and behavioral finance is on whether share prices in markets are *correct* and reflect intrinsic values, not just whether investors can consistently profit from irrationalities (of which there is limited evidence).⁴

Managers and investors alike would be well served to understand these irrationalities and investing pitfalls.

ARE MARKETS EFFICIENT?

Are markets efficient? A better question may be *how efficient are they?*

- In general, prices quickly react to new information.
- Consistently yielding positive risk-adjusted returns is difficult.
- Anomalies and possibilities still exist.

Markets are generally quite efficient, and most likely show some version of semistrong efficiency. However, an overly strict adherence to these principles is unwarranted. Mispricings may temporarily exist, and investors on the hunt for such mispricings aid market efficiency by trading.

CRITICAL THINKING QUESTIONS

1. What causes stock prices to follow random walks? What does it mean when we say, “stock prices react to news”? What is causing this “reaction”?
2. What does it mean if a stock’s price “reflects” information or “has news *baked-in*”?
3. A firm announces that its revenue and earnings are up, and that its revenue and earnings are projected to rise well into the future. Upon this announcement, the share price immediately and quickly *falls*. Why might this be? Is this a breakdown of market efficiency?
4. How do the versions of EMH differ on their definition of “all available information”?
5. What version of the EMH (if any) does the technical trader who thinks it is possible to “beat the market” believe in?
6. Why does weak-form market efficiency invalidate technical analysis?
7. You calculate that a share of a company’s stock is worth \$26 by discounting that firm’s cash flows to the present. You open your Robinhood brokerage app and see that shares are trading at \$18. Is this share undervalued or overvalued? Should you buy?
8. Can a trader believe that markets are weak-form efficient while *not* being semistrong-form efficient?
9. Can a trader believe that markets are semistrong-form efficient while not being weak-form efficient?
10. If a trader believes that markets are weak-form efficient, what do they think about technical indicators? What if they believe markets are semistrong-form efficient?
11. If markets are weak-form efficient but not semistrong efficient, would it be possible to make money by trading through technical analysis? What about with fundamental analysis?
12. In what ways are technical analysis and quantitative trading techniques similar?
13. If semistrong-form market efficiency invalidates fundamental analysis, does it also invalidate technical analysis?
14. If markets are perfectly strong-form efficient, what would we expect of a firm’s stock price if they announce surprise good news to the public?
15. How might increasing technology and the ability for more investors to keep up to date with financial news affect the ability of stock prices to quickly reflect new information? What might this mean for market efficiency?
16. Why does market efficiency imply the need for *some* investors to engage in security analysis?
17. Explain how security analysis drives market efficiency and, in doing so, becomes ineffective for generating trading gains?
18. A friend tells you “You should purchase shares of FLSL Corp. Last week, they announced an exclusive \$800 billion deal with the US government to develop an encrypted communications network. Their shares will rise as a result.” How do you critique your friend’s claim?
19. A dealer is trying to sell you a 99-year-old car. They tell you “This antique is worth \$36,000 today, but it’s going to be 100 years old next year. It will likely be worth double then.” Do you agree that the price of the car would increase significantly when it turns 100 next year, assuming the market for antique cars is efficient?
20. A retailer selling food, clothing, and appliances generates high profits for 50 years in a row. What does this tell us about market efficiency or anomalies?

21. A fund manager consistently yields high trading gains for 50 years in a row. What does this tell us about market efficiency or anomalies?
22. If we assume markets are reasonably efficient, what is the role for investment management and financial analysis techniques?
23. What does history tell us about the returns to portfolios of value stocks, poor past performers, and small firms? How can investors rely on this information moving forward?
24. How might the neglected firm effect be the result of “compensation for *illiquidity*”?
25. What might classify a share as “undervalued” or a “value stock” based on its P/E ratio? What about its book-to-market ratio?
26. What is the difference between book value and market value of equity? Why do these differ?
27. A firm’s stock price is \$10 dollars per share, and its last quarter earnings per share was \$2. In its industry, the average PE ratio is 8. Is this stock relatively *undervalued* or *overvalued* within its industry? How might an investor use this information to make a trading decision?
28. In what ways is it difficult to assess whether markets are efficient?
29. What is a firm’s *intrinsic value* and what does the behavioral critique say about how irrationalities affect a security’s price in relation to its intrinsic value?
30. The EMH and behavioral finance can both say that it is difficult to consistently earn positive and consistent trading gains. Where, then, does the EMH and behavioral finance differ?
31. **CHALLENGE** The **disposition effect** is a behavioral anomaly whereby investors are more likely to sell stocks that have increased in value than they are to sell stocks that have dropped in value. How is this related to prospect theory? What effect might the presence of this anomaly have on stock prices reflecting all information?
32. **CHALLENGE** The **Dogs of the Dow** strategy entails annually constructing a portfolio of stocks that pay high dividends relative to their stock price. Explain why, in the context of market efficiency, this seemingly prudent investment strategy of buying high-dividend stocks does not always “win” or “beat the market.”
33. **CHALLENGE** **Heuristics** are rules-of-thumb or shortcuts that investors rely on to make decisions, given they have limited ability to fully process all information. How might this affect market efficiency?

ANALYTICAL QUESTIONS

1. Use the figure below to answer the following questions. The 50-day moving average is the red dotted line. The 200-day moving average is the solid blue line.



- If an investor sold this stock at the death cross and bought this stock at the golden cross, would they have made money? How much would they have made/lost?
 - What does your answer from (a) imply about technical indicators?
 - A quant trader writes an algorithm on June 1 that will buy this stock after it falls for 5 consecutive days and sells the stock after it rises 5 consecutive days (before the end of July). Would this algorithm have made money on this stock?
2. From the table below, which of these stocks (all from the same industry) appears to be the best *value*? Why?

Ticker	Book to Market	PE	PS	Div Yield
AMCR	3.43	14.74	0.97	5.08%
BALL	4.03	29.97	1.29	1.39%
PKG	3.60	18.85	1.87	3.05%

3. Below are the actual average returns of all stocks in ten B/M deciles from 2019 through 2022. From 1927 – 2022, value stocks (in the higher B/M deciles) on average have outperformed growth stocks (in lower B/M deciles). Does the table below show this is always the case? What does this imply about *random walks*?

Historical Value Weighted Returns										
Year	Low B/M Decile	2	3	4	5	6	7	8	9	High B/M Decile
2022	-30%	-22%	-18%	-8%	-10%	-14%	-2%	8%	0%	-4%
2021	24%	23%	29%	18%	13%	32%	26%	37%	40%	45%
2020	48%	32%	21%	13%	7%	9%	-16%	-2%	3%	-11%
2019	34%	42%	23%	32%	28%	31%	18%	26%	29%	22%

CFA QUESTIONS

Answers are in the *Notes & References* section below.⁵

1. An analyst estimates that a security's intrinsic value is lower than its market value. The security appears to be:
 - a. Undervalued
 - b. Fairly valued
 - c. Overvalued
2. Suppose that the future cash flows of an asset are accurately estimated. The asset trades in a market that you believe is efficient based on most evidence, but your estimate of the asset's intrinsic value exceeds the asset's market value by a moderate amount. The *most likely* conclusion is that you have:
 - a. Overestimated the asset's risk.
 - b. Underestimated the asset's risk.
 - c. Identified a market inefficiency.
3. If markets are efficient, the difference between the intrinsic value and market value of a company's security is:
 - a. Negative
 - b. Zero
 - c. Positive
4. Technical analysts assume that markets are:
 - a. Weak-form efficient
 - b. Weak-form inefficient
 - c. Semi-strong form efficient
5. Researchers have found that value stocks have consistently outperformed growth stocks. An investor wishing to exploit the value effect should purchase the stock of companies with above average:
 - a. Dividend yields
 - b. Market-to-book ratios
 - c. Price-to-earnings ratios

NOTES & REFERENCES

¹ Return on Assets (ROA) = Net income / Assets, Return on Equity (ROE) = Net income / Equity, Debt to Equity = Debt / Equity, Current Ratio = Current Assets / Current Liabilities, Cash Coverage = (Earnings Before Interest and Taxes + Depreciation) / Interest Expense, EPS = Net Income / Number of Shares Outstanding

² WSJ Article on Trading Algorithms: <https://www.wsj.com/graphics/journey-inside-a-real-life-trading-algorithm/>

³ The correlation between “letters in the winning word of the Scripps National Spelling Bee” and “number of people killed by venomous spiders” from 1999 to 2009 was 80.57%. See <https://tylervigen.com/spurious-correlations>.

⁴ This is a point made in a conversation between Eugene Fama and Richard Thaler (both winners of the Nobel Prize in Economic Sciences). You can watch this discussion here: <https://www.youtube.com/watch?v=bM9bYOBuKF4>.

⁵ CFA Question answers: 1) C, 2) B, 3) B, 4) B, 5) A

