Capital Markets & Investments

Mathematics GR 5280

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The Efficient Market Hypothesis

- In the 1950s "business cycle theorists" had an opinion that tracing evolution of the economic variables over time would clarify and predict the economy. This was one of the first practical uses of computers in economics.
- Assuming that the stock prices reflect the future economics of the company, the cycles of the economic variables need to translate into the stock price performance.
- Maurice Kendall* was the first one to run such computer experiments in 1953.
- The data provided no way to predict price movements.
- It became apparent that random price movements indicate a well-functioning or efficient market rather than irrational one.

* Maurice Kendall, "The Analysis of Economic Time Series, Part I: Prices", Journal of the Royal Statistical Society 96 (1953).

Kendall's Conclusions

a. In series of prices which are observed at fairly close intervals the random changes from one term to the next are so large as to swamp any systematic effects which may be present. The data behave almost like wandering series.

b. It is therefore difficult to distinguish by statistical methods between a genuine wandering series and one wherein the systematic element is weak.

c. Until some way has been found of circumventing this difficulty, trend fitting, and perhaps the fitting of any model, is a highly hazardous undertaking. It may be possible for an econometrician to test whether the data agree with a hypothesis suggested by prior analysis, but it may be impossible to discriminate between quite different hypotheses which all fit the data.

d. There is experimental evidence and theoretical support for the belief that aggregative index numbers behave more systematically than their components. This might be due to the reduction of the random elements by averaging and the consequent emergence of systematic constituents; but it could equally well be due to chance. If it is, there will appear spurious time-correlations in aggregative time-series and the use of index-numbers in economic work needs extensive reconsideration.

e. An analysis of stock-exchange movements revealed little serial correlation within series and little lag correlations between series. Unless individual stocks behave differently from the average of similar stocks, there is no hope of being able to predict movements on the exchange for a week ahead without extraneous information.

Random Walk and the Efficient Market Hypothesis

- Suppose Kendall had discovered that stock prices are predictable. Then investors can purchase stocks that the model predicts will increase in price and sell the stocks that the model predicts will decrease in price, making continuous profits.
- Suppose that the model predicts with almost certainly or simply great confidence that the stock XYZ currently trading at $100 will raise to $110 in 3 days.
- If investors who have access to this model and do not own the stock will be placing buy orders. The investors who already own the stock will not be placing any sell orders. The stock price will quickly go to $110, at which point the buying pressure will subside.
- The stock price will quickly or "immediately" reflect the "good news" coming from the model forecast. This should create a jump in the stock price from $100 to $110.

Random Walk and the Efficient Market Hypothesis

- Any information that could be used to predict stock performance should already be reflected in stock prices.
- If prices immediately increase or decrease only in response to new information, and the new information, by definition, is unpredictable, thus, the stock prices must move unpredictably. This is the essence of the argument that stocks should follow a random walk.
- Thus, randomly moving stock prices are a consequence of intelligent investors competing to discover relevant information on which to buy or sell the stocks before the rest of the market becomes aware of the information.
- There is a difference between the random changes of prices and the irrationality of price (levels). If prices are determined rationally, only the new information will cause them to change. A random walk will be a natural result of prices that reflect all current information.
- The notion that stocks already reflect all available information is referred to as the efficient market hypothesis (EMH).

Random Walk and the Efficient Market Hypothesis

- Figure 11.1 illustrates the response of stock prices to new information in an efficient market. The graph plots the price response of 194 firms – targets of takeover attempts.
- In most takeovers the acquiring firm pays a substantial premium over current market price. Therefore, public announcement of a takeover attempt should lead to a jump in stock price.
- The figure shows that there is no additional drift after the day of the announcement, i.e. prices reflect all the new information including the takeover price premium at the end of the day of the takeover announcement.

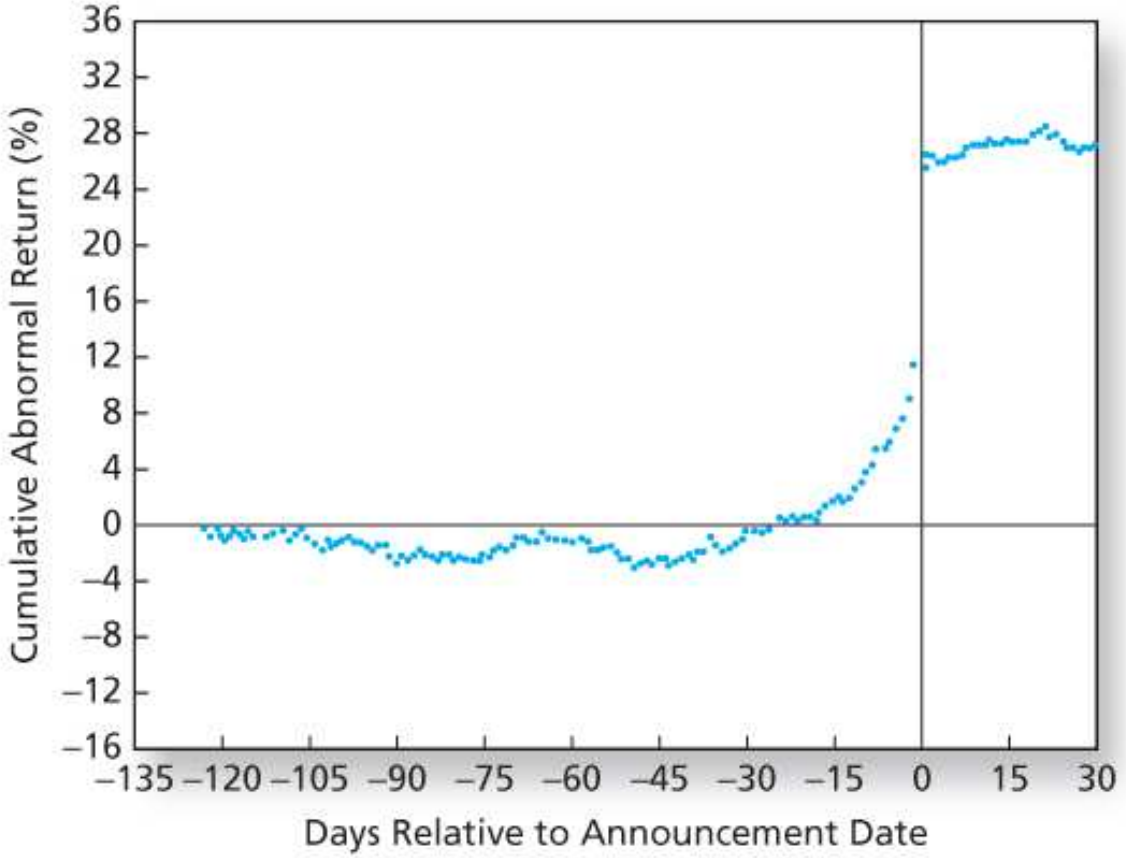


Figure 11.1 Cumulative abnormal returns before takeover attempts: target companies

Source: Arthur Keown and John Pinkerton, "Merger Announcements and Insider Trading Activity," *Journal of Finance* 36 (September 1981). Reprinted by permission of the publisher, Blackwell Publishing, Inc.

Rapid Response to New Information*

- A study by Busse and Green tracks real-time price changes to companies featured on CNBC's "Morning" or "Midday Call" segments.
- Minute 0 in Figure 11.2 is the moment when the stock is first mentioned. The top line is the average response of stock prices that receive positive reports, and the bottom line is when the stock receives negative report.
- Positive reports are "fully digested" within 5 minutes after the first mentioning, whereas the negative reports are "fully digested" within 15 minutes.

* J.A. Busse and T.C. Green, "Market Efficiency in Real Time", Journal of Financial Economics 65 (2002), pp. 415-37.

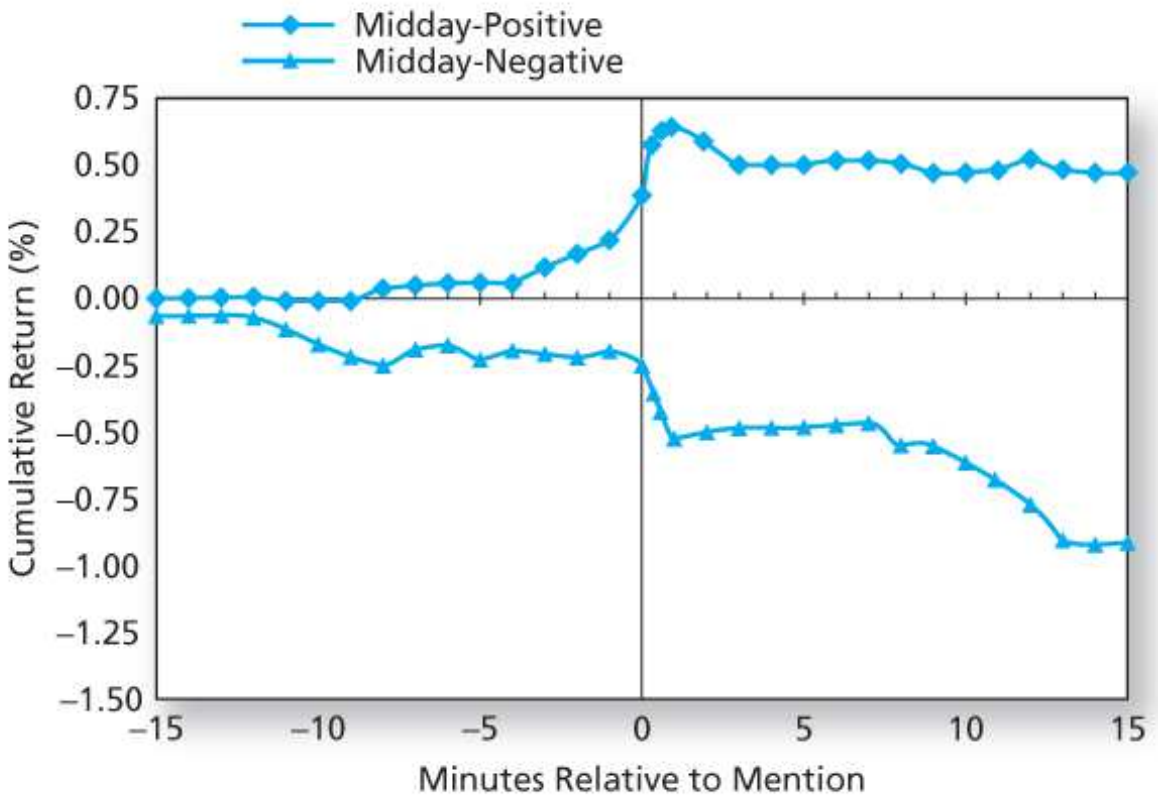


Figure 11.2 Stock Price Reaction to CNBC Reports. The figure shows the reaction of stock prices to on-air stock reports during the "Midday Call" segment on CNBC. The chart plots cumulative returns beginning 15 minutes before the stock report.

Source: Reprinted from J. A. Busse and T. C. Green, "Market Efficiency in Real Time," *Journal of Financial Economics* 65 (2002), p. 422. Copyright 2002 with permission from Elsevier Science.

Rapid Response to New Information*

- An example of a CNBC Midday Call segment hosted by Maria Bartiromo, and the simultaneous price response. The segment aired on 8/28/2000 at approximately 3:00PM.
- Background information:
  - Time 0 is when the ticker symbol first appears on the screen;
  - Transaction prices are plotted in red; mid-quotes (average of the bid and ask prices) are plotted in white;
  - There were 29 trades from -15 minutes to time 0;
  - There were 125 trades from 0 to 15 minutes, of which 29 trades occurred in the 1st minute;
  - The average trade size is roughly $70,000;
  - $1.7M traded from time -15 to 0;
  - $9M traded from 0 to 15 minutes, of which $2.4M in the 1st minute;
  - The BofA analyst Jerry Treppel's target price was 80; the stock closed above 80 within one month (9/21/2000);
  - ALZA Corp. was bought as a wholly owned subsidiary of Johnson & Johnson in June of 2001.

* J.A. Busse and T.C. Green, "Market Efficiency in Real Time", Journal of Financial Economics 65 (2002), pp. 415-37.

Competition as the Source of Efficiency

- Why the stock prices should reflect "all available information"? For example, if you are willing to spend your time and money on gathering information, it is possible that you may find something over- or under-looked by others?
- Grossman & Stiglitz* have argued that if good information costs money to uncover and analyze, the investment analysis using such information may lead to higher expected returns.
- The investors will be spending time and money to uncover new information only if such activity is likely to generate higher investment returns. Therefore, in market equilibrium, efficient information-gathering activity should be rewarded.
- This leads to degrees of efficiency for different markets. Emerging markets are less analyzed (or less transparent from the accounting standpoint) than the U.S. markets. Therefore, they may be less efficient. Small-cap stocks receive relatively less coverage by Wall Street analysts than the large-cap stocks, and therefore, may be less efficiently priced.

* Sanford J. Grossman and Joseph E. Stiglitz, "On the Impossibility of Informationally Efficient Markets", American Economic Review 70 (June 1980).

Who Can Afford Best Research?

- Assume, that an investment company manages a $5B portfolio.
- If a research program can increase the portfolio return by 0.1% per year, this $5M of extra money. Therefore, the company can spend up to that amount of $5M on that research.
- Professional portfolio managers are willing to spend large amounts of $$s on analysis, computers, databases, software.
- Given that, easy market inefficiency findings are, to say the least, rare. Only the largest managers can afford to pursue the most expensive research efforts.
- However, the best research is not necessarily the most expensive one!
- Competition for the best information (the most precious commodity on Wall Street) is very intense.

Galleon Insider Trading Case

- Galleon founder, Raj Rajaratnam and some of his colleagues, induced insiders at major corporations into sharing material non-public information with them. When doing that, insiders were violating their fiduciary duties to their employers. Thus, information on which the Galleon was making at least some of its trades was obtained illegitimately.
- This case is in the area of law which discusses how research should be conducted. The traders at Galleon do not have the fiduciary responsibility to protect corporate secrets of corporations.
- In that sense, this case is about "outsider" trading – trading by people who collected information from the insiders about the company performance, not trading by insiders themselves.
- There is another, opposite point of view on the role of the government here. For example, economist Milton Friedman claimed that: "You should have more insider trading, not less. You want to give people most likely to have knowledge about deficiencies of the company an incentive to make the public aware of that."
- In such venues as online stock discussion blogs, for example, there is a clear conflict between the need to make as much information available to make markets more efficient, and the focus on the regulations that require equal access to such information for all.

SAC Insider Trading Case

- Billionaire Steven A. Cohen's SAC Capital Advisors LP, the hedge fund accused of "fostering a culture of rampant insider trading". SAC was accused of "operating a conspiracy dating back to as early as 1999, reaping hundreds of millions of illicit profits".
- Cohen himself was not charged but was facing an administrative action filed by the U.S. SEC for his alleged failure to supervise the hedge fund's activities.
- Parts of the SAC statement: the hedge fund takes "responsibility for the handful of men who pleaded guilty and whose conduct gave rise to SAC's liability. The tiny fraction of wrongdoers does not represent the 3,000 honest men and women who have worked at the firm during the past 21 years".
- The SAC portfolio manager Michael Steinberg went on trial for engaging in insider trading in Dell Inc. and Nvidia Corp. based on illicit tips provided by Jon Horvath, his analyst. Horvath, who pleaded guilty and was cooperating with the US, was a witness against Steinberg. Steinberg sentenced to 3.5 years. However, recently (10/23/2015), on appeal, the U.S. dropped the insider-trading charges against him.
- Mathew Martoma, a former fund manager for a unit of SAC, went on trial for using inside information from two doctors who were involved in the clinical trial of an Alzheimer's drug to trade shares of Elan Corp. and Wyeth. Sentenced to 9 years in prison. He has appealed this decision in Appeals Court but the Court upheld the conviction.
- Former Manhattan US Attorney Preet Bharara called the hedge fund "a veritable magnet for market cheaters" and said the company had "zero tolerance for low returns but seemingly tremendous tolerance for questionable conduct."
- On 11/4/2013 SAC decided to plead guilty to securities fraud and wire fraud, pay a record $1.8B fine and shutter its investment advisory business.

Versions of the Efficient Market Hypothesis

- General (ambiguous) formulation: stock prices already reflect all available information. If we expand the meaning of the "all available information", we get three versions of EMH:
  1. **The weak form**. *The stock prices already reflect all information that can be derived from the past market trading data* (history of past prices, trading volume, short interest, etc.). In particular, it implies that trend analysis is fruitless.
  2. **The semi-strong form**. *The stock prices already reflect all publicly available information regarding the prospects of the firm* (in addition to past market trading data this includes: fundamental data, product line, quality of management, balance sheet composition, patents held, earnings forecasts, accounting practices, etc.).
  3. **The strong form**. *The stocks prices already reflect all information relevant to the firm* (including the ones above, and the information only available to insiders). This version is quite extreme. SEC is preventing the insiders from benefiting from insider information. Rule 10b-5 of the Security Exchange Act of 1934 sets limits on trading by insiders and requiring them to report their trades to the SEC.

Concept Check

a. If you observe that a high-level manager make superior returns on investments in their company's stock. Would this be a violation of the weak-form market efficiency? Would this be a violation of strong-form market efficiency?

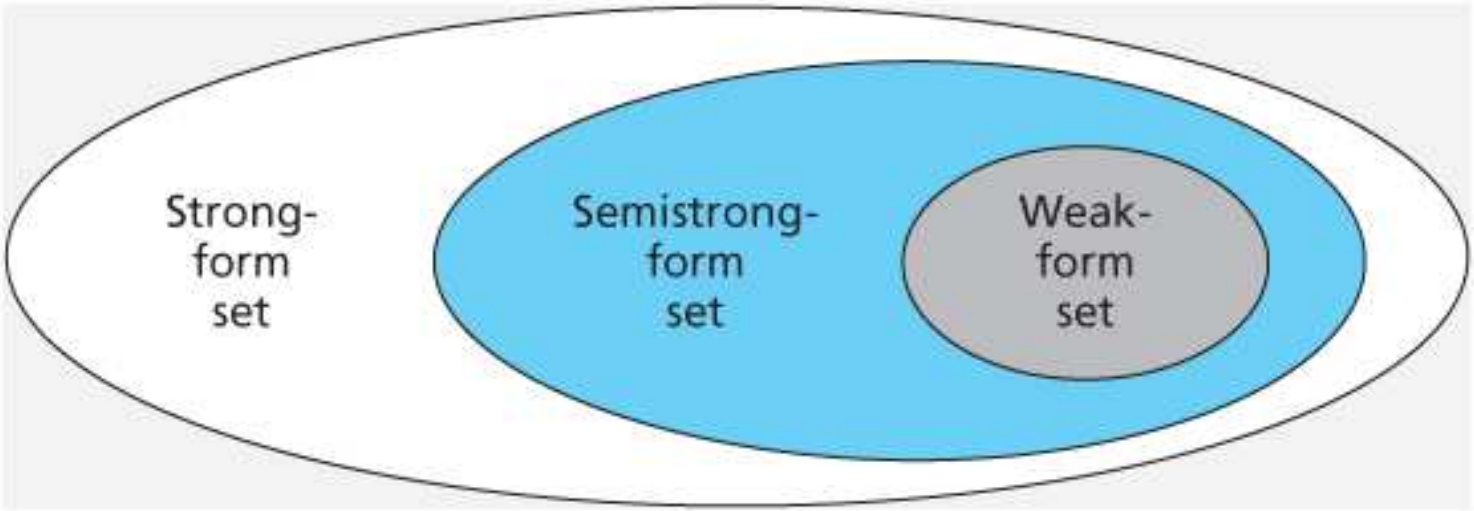
b. If the weak form of the EMH is valid, must the strong form also be valid as a consequence? Conversely, does strong-form efficiency imply weak-form efficiency?

Concept Check

a. No. Yes. A high-level manager is highly likely to have private information about the firm not (yet) publicly known. He may be able to trade profitably based on it. This ability does not violate the weak-form of EMH: these potential profits are not derived from the past trading data. But this ability does violate the strong-form EMH: that would mean that there exists private information not yet reflected in the prices.

b. No. Yes. Strong-form EMH→Semi-strong-form EMH→ Weak-form EMH.

Versions of the Efficient Market Hypothesis



Technical Analysis

- Technical analysis is a search for recurring and therefore predictable patterns in the historical prices. Technical analysts accept the fact that prices sometimes move in response to fundamental news, but they forecast the future price moves based on the past price moves alone.
- In case of trends, for example, the basis for their existence is that trading agents will have a delayed response to a particular piece of news due to their different levels of aggressiveness or risk-aversion. The delayed response to fundamental supply/demand factors is in contradiction with the EMH (any form).
- In the past technical analysts were frequently called "chartists", due to their focus on the historical analysis of the price charts.
- Some of the notions/concepts that classical technical analysts use: relative strength (indicator), support levels, resistance levels, trend (lines), Bollinger bands.

Technical Analysis

- One of the typical trend-following rules is the "channel rule": if the price is higher than highest High over the last 20 (for example) days, Buy, the long (or up-) trend starts; if the price is lower than the lowest Low of the past 20 days, Sell, the short (or down-) trend starts. Another trend-following indicator is called a "moving average cross-over": if a short-window moving average of historical prices crosses-over the long-window moving average, you Buy (up-trend starts), when the short-window moving average crosses-under the long-window moving average, you Sell (down-trend starts).
- Relative strength allows one to measure relative performance of one instrument (a stock, for example) against an index or an average of stocks. For example, if we take last 6-months of total return performance of all constituent stocks in the S&P 500 and divide them by the total return of the S&P 500 over the same period, and then, rank those ratios and divide them into quartiles. The upper quartile will have values of relative strength larger than 1, i.e. "winner" stocks. Conversely, the lower quartile may give you the "loser" stocks. One of the ideas of technical analysis is that winners will continue to outperform and losers will continue to underperform. Simple ratios of the stocks price to the index are sometimes being used for individual stock relative strength measurements.

Technical Analysis

- Support and resistance levels are often used to identify the price levels that the price is not likely to go beyond on the downside and upside. Various methods can be used for their calculation. Some reasoning behind the existence of support and resistance levels is related to "memory" of the market. For example, some of them rely on the pivot points. A pivot point is believed to be the price level of significance, that is reached, can be used for price forecasting. For example, breaking above the pivot point can be perceived as bullish, etc.
- Bollinger bands technical construct can be used as support and resistance for mean-reversion trading. If a stock price rises above its moving average plus 2 times (for example) its standard deviation, it is likely to go back down to the moving average. Similarly, if it dips below its moving average minus 2 times its standard deviation, it is likely to go back up to the moving average, i.e., mean-revert.

Technical Analysis

- The EMH implies that technical analysis has no predictive value. The past history of prices and trading volume is publicly available at no or minimal cost. Therefore, argues EMH, if any information can be derived from the past stock price data, it is already reflected in it.
- However, technical analysis disagrees with EMH and is looking for technical (or mechanical) rules (or patterns) that have "worked" (had predictive power) in the past*. From that, technical analysis believes, they have a good chance to "work" in the future.
- An interesting question is whether a technical rule that worked in the past and seems to work now will continue to work in the future once it becomes widely recognized. If one believes in efficient market logic, once a useful technical rule is discovered, it ought to be invalidated when the mass of traders start exploiting it. If true, this means that good technical rules and price patterns are "self-destructive".
- Keeping this in mind, a good technical analyst should continuously search for profitable trading rules, followed by the destruction by overuse of those successful rules found before.

* Andrew W. Lo and Jasmina Hasanhodzic, "The Evolution of Technical Analysis", John Wiley & Sons, Inc. 2010.

Fundamental Analysis

- Fundamental analysis is using such fundamental parameters as: earnings and dividend prospects of the company, expectations of future interest rates, etc. to determine future stock prices. For example, a discounted future cash flow is one of the models such analyst can use: present value of all future payments that you as a stockholder will receive, such as price appreciation, dividends, splits, additional rights offerings, etc. If such forecasted value exceeds the current value of the stock price – fundamental analyst will recommend to Buy the stock now.
- Fundamental analysts usually starts by studying the past earnings of the stock and analysis of the company balance sheet. They further supplement such analysis with the analysis of the company's management, relative competitiveness within the industry, and the prospects of the industry as a whole. The idea of such research is to uncover such information which is not yet fully recognized by the investment community.

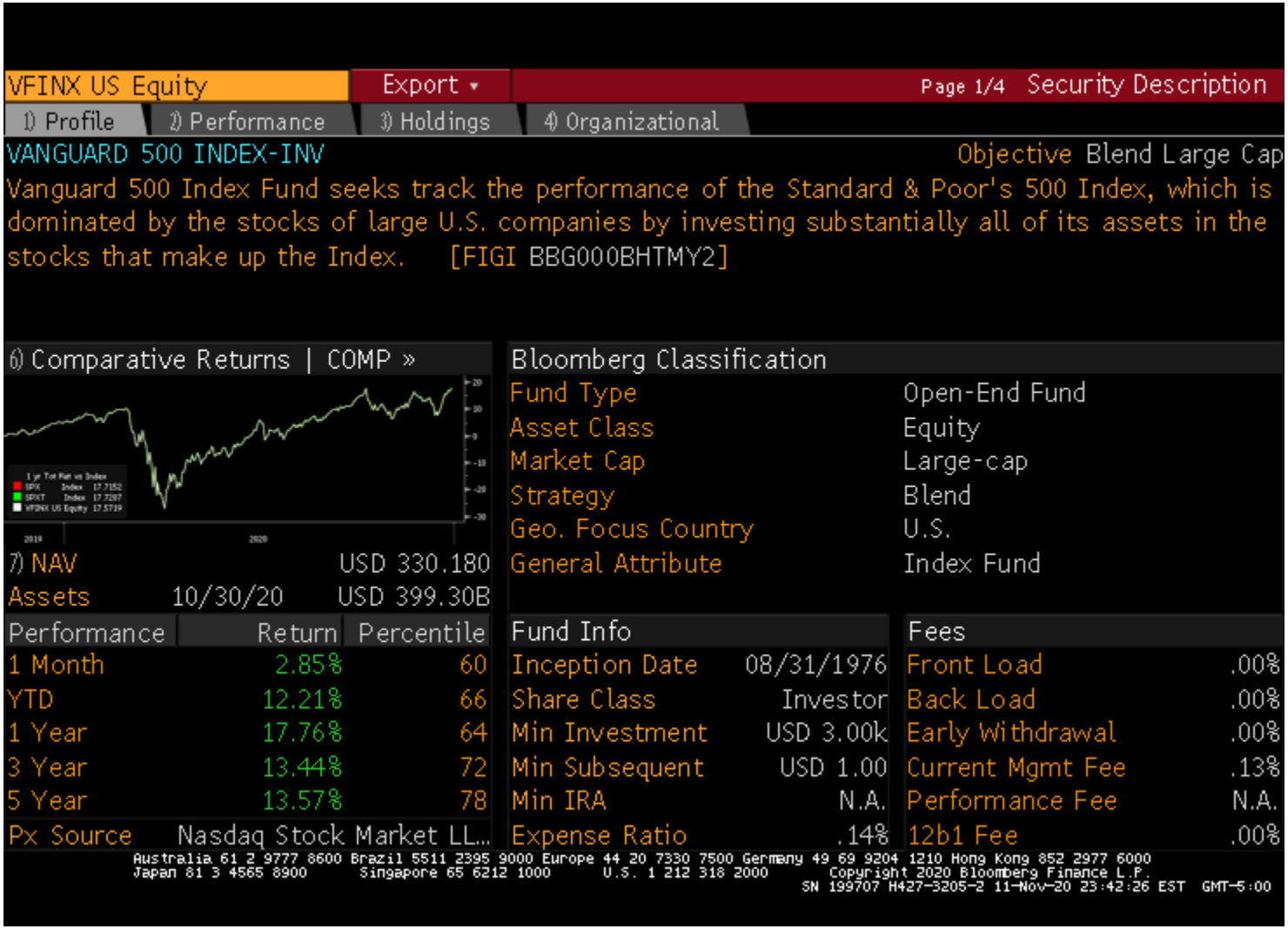
Fundamental Analysis

- The EMH predicts that fundamental analysis also does not work. If the analyst relies on the publicly available earnings and industry information, his analysis will lead to the same results as other analysts, and therefore, has no additional value. Discovery of good firms does investor no good if the marketplace already knows about it and such companies already trade at a premium price. If the investor pays this extra price he will not realize any superior returns and will not be rewarded for his research.
- The idea is not to just uncover good firms but to find firms that are better than what everyone else estimates of them to be. Sometimes, poorly ran firms may be a good buy if the marketplace thinks of then a lot worse than what they actually are.
- For those reasons, fundamental analysis is difficult.

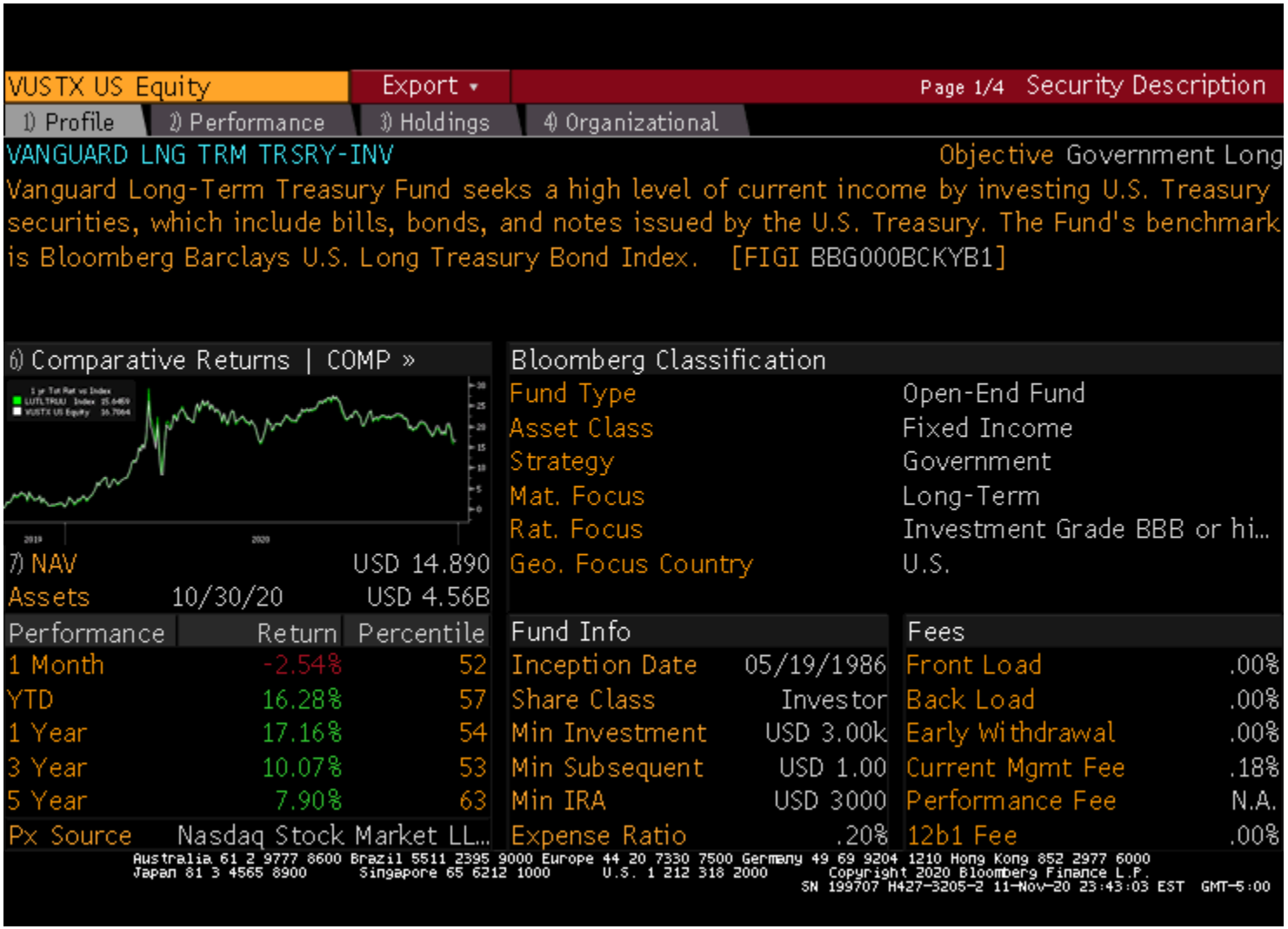
Active vs. Passive Portfolio Management

- It feels from the above that casual efforts to design a trading strategy or to pick stocks is not likely to work well. Instead, serious analysis, unconventional techniques are likely to be rewarded. Additionally, active portfolio management research is economically feasible only for investors with large capital.
- As small investors are not in a favored position to conduct active portfolio management, their better choice will be to invest into mutual funds.
- Can small investors be sure that the additional benefits (above-market return) that they will get by investing in mutual funds is worth the fees that they will have to pay to mutual funds for the active management?
- Proponents of the EMH say that active portfolio management is a wasted effort: you are unlikely to justify the expenses that you will incur. They advocate passive buy-and-hold investment strategy: invest into a well-diversified portfolio of securities without any attempt to find over- and under- valued securities.
- One common strategy is to invest into an index fund, for example VFINX:
  - Holds stocks in proportion of the their weight in the S&P 500 index;
  - Broad diversification with low management fees (no research to “pick stocks”).

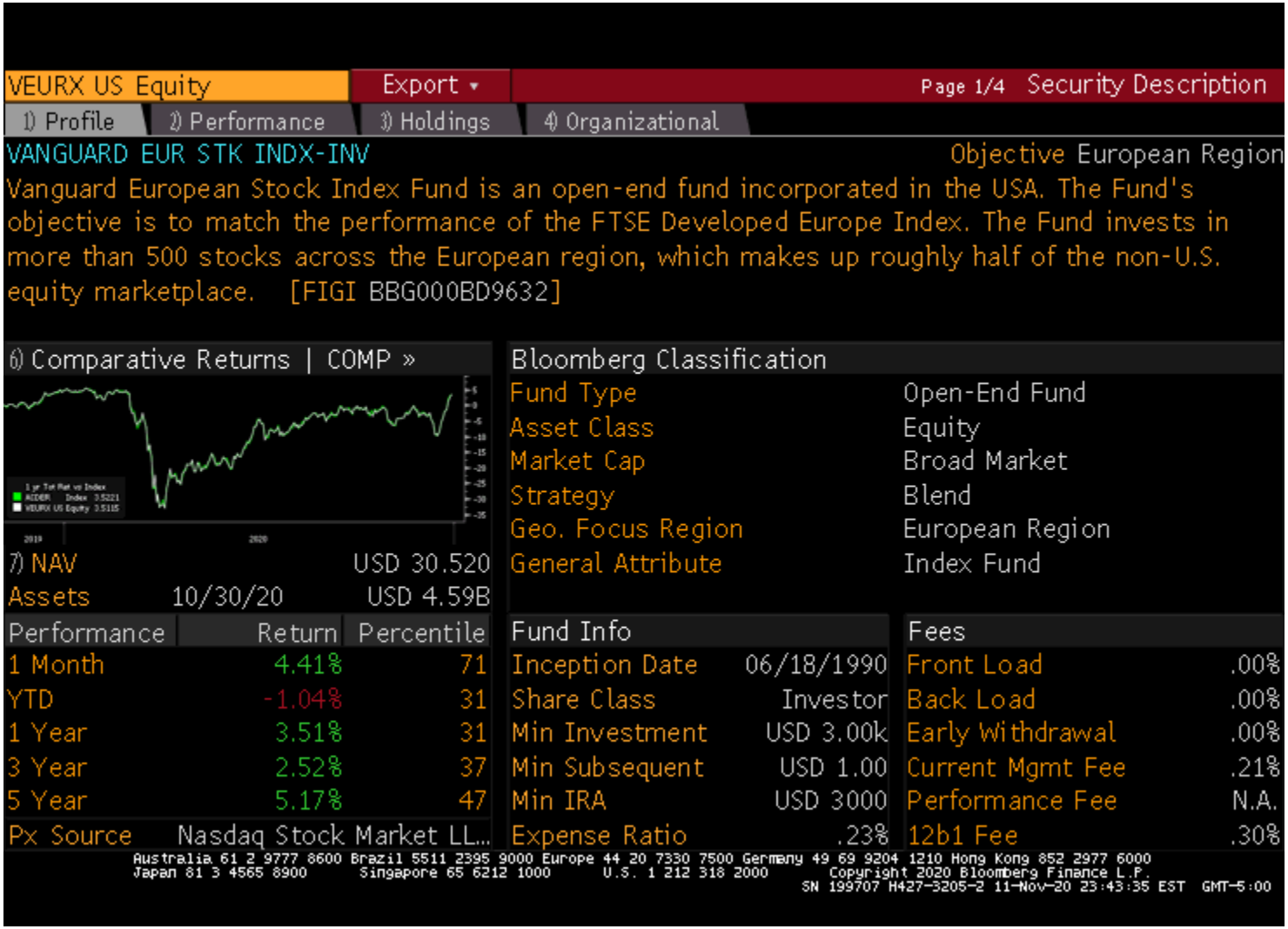
Cheapest Index Funds: Large Cap U.S. Stocks



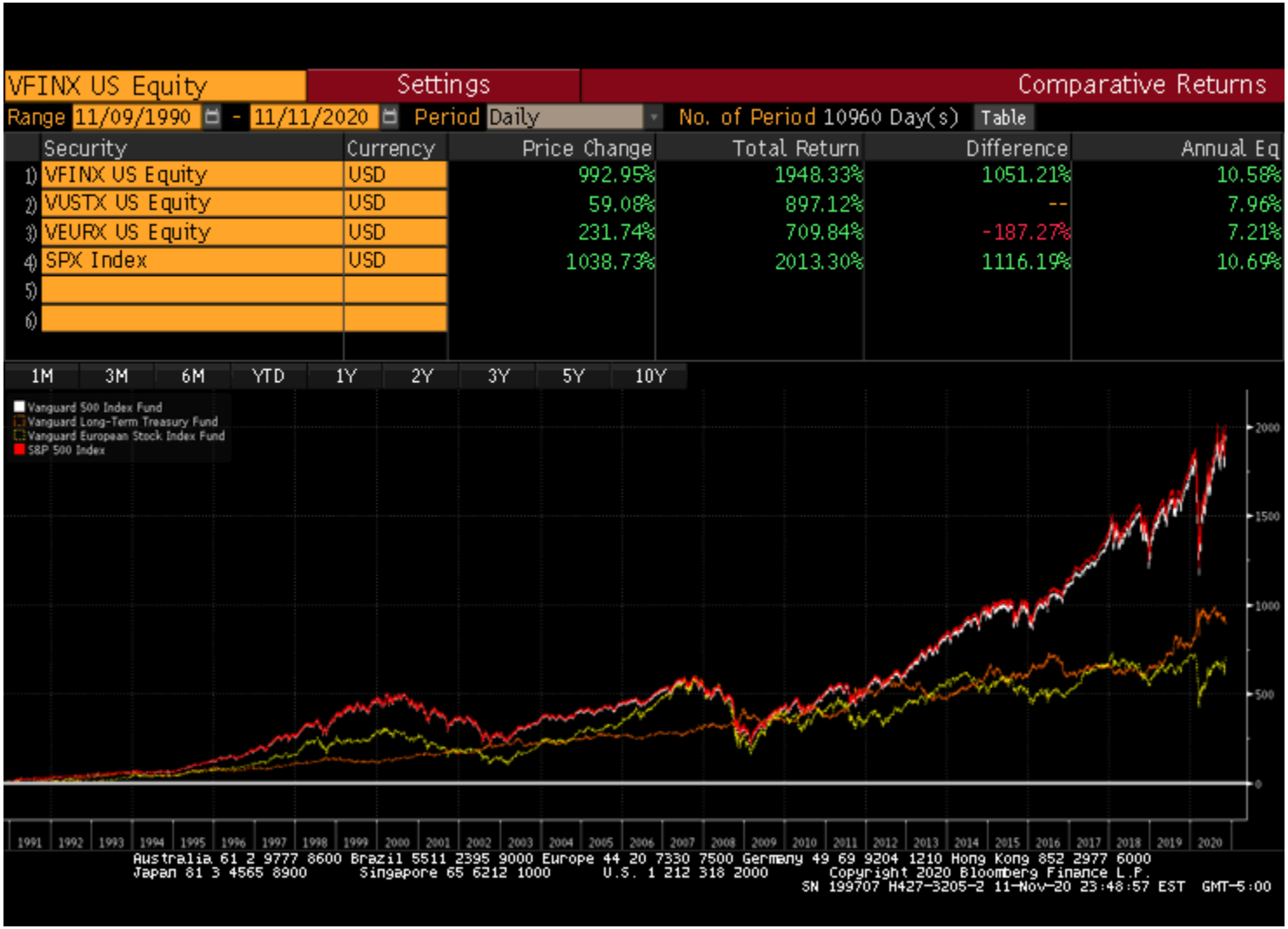
Cheapest Index Funds: Long Term U.S. Treasuries



Cheapest Index Funds: Developed Europe Stocks



Cheapest Index Funds: 30-Yr Performance Comparison



Concept Check

- What will happen to market efficiency if all investors were to follow a passive investment strategy?
  - If everyone will be following a passive investment strategy, sooner or later prices will fail to reflect new information, which will create profit opportunities for active investors who uncover them. As they will be implementing their trading strategies, prices again will be driven to their fair values.

Portfolio Management in an Efficient Market

If the markets are efficient, why then not pick stocks by having a blindfolded monkey throw darts at copy of WSJ, as* suggested by Malkiel? Even in the efficient markets, portfolio management is useful to:

1. Help select a well-diversified portfolio which brings down firm-specific risks to the levels tolerable by an investor.
2. To account in the portfolio for the tax rates of that particular investor. High-tax-bracket investors will generally prefer tax-exempt municipal bonds despite their low yield. They may want to tilt their portfolios towards stock portfolios with more capital gains as opposed to interest/dividend income, that is low dividend stocks.
3. A particular investor's portfolio can be tailored to his risk profile (risk-aversion). For example, a Lehman Brothers executive should have invested more of his additional funds in non-related to his company and may be even non-financial stocks. 30% of shares of LEH was owned by its 24,000 employees in September 2008, worth around $10B.
4. Investors of varying age might have varying portfolios with respect to risk. For example, older investors who are essentially living off savings might need to choose to avoid long-term bonds and stocks altogether. Younger investors should be more inclined towards long-term bonds and stocks.

* Burton G. Malkiel, "A Random Walk Down Wall Street: Completely revised and Updated Edition", W.W. Norton & Co., 2003.

Resource Allocation Function

- Deviations from the market efficiency offers profit opportunities to better-informed traders at the expense of less-informed ones.
- Deviations from informational market efficiency may also result in inefficient capital/resource allocation. In capitalist economy investments in real assets (plant, equipment, know-how, etc.) are guided by the prices of financial assets. In other words, capital markets guide allocation of real resources.
- Companies with over-priced securities may be able to borrow too cheaply, and conversely, companies with under-priced securities may have to pass on their investments because of too high cost of borrowing.
- An example: dot.com bubble in the late 1990s, when the prospects of internet and telecommunication firms was grossly over-estimated by the securities markets and led to significant over-investment into those companies.

Event Studies (Conditional Price Response)

- If security prices reflect all currently available information, then price changes must reflect new information. Then one should be able to measure the effect of an event by examining the price changes when the event occurs.
- ***Event study*** is a technique of empirical research that allows to measure the impact of a particular event on the stock price. In more scientific terms, one can measure a price response conditional on the event taking place.
- Isolating the price change due to the event may not be so trivial, the on any day the stock prices change for a variety of reasons. One needs a proxy for the stock price in the absence of the event. Then, the ***abnormal return*** due to the event is the difference between the stock's actual return and the proxy (or benchmark).
- Several benchmarks are used in practice. A simple one is to use a broad market index as a proxy. A refinement of that would be constructing and using a sub-index composed of stocks chosen to be "similar" to the original in some characteristics (firm size, beta, recent performance, industry, price/book ratio, etc.) Another approach would be to use CAPM or three-factor model with Fama-French factors.

Event Studies (Conditional Price Response)

- If we use market returns as a proxy, then we use the single-index model which breaks the stock return into a market factor and firm-specific factor:

$$r_t = a + b \cdot r_{Mt} + e_t, \text{ where :}$$

$$r_{Mt} \text{ is the market's return during the period;}$$

$$e_t \text{ is part of return due to the firm - specific events.}$$

- Here the firm-specific return may be interpreted as the unexpected return which results from the event happening.
- Once the ***a*** and ***b*** are estimated, the abnormal return is:

$$e_t = r_t - (a + b \cdot r_{Mt}).$$

- The residual is the abnormal return due to the event in question, i.e. the stock's return over what one would predict based on broad market movements in the period.

Event Studies (Conditional Price Response)

- Suppose it was estimated that ***a=0.05%*** and ***b=0.8***.
- On a certain day the market goes up by *1%*.
- The previous model would predict that the stock should go up by: ***0.05%+0.8*1%=0.85%***.
- Let us assume that the stock actually went up by ***2%*** on that day.
- The we can infer that firm-specific news that day caused an abnormal stock return of ***2%-0.85%=1.15%***.

Event Studies (Conditional Price Response)

- We saw earlier in Figure 11.1 the abnormal returns of stocks after the acquisition attempt. We have estimated such returns from the announcement date, i.e. when the moment when the information about the event becomes known.
- We also saw a possible problem with such measurement: it may be measuring an incomplete response, as some of the response may have come prior to the public announcement due to the ***leakage*** of information.
- A better indicator may be the ***cumulative abnormal return (CAR)***, which includes the total response: both pre- and post-announcement.
- Based on the analysis of Figure 11.1 we can conclude that prices have started an upward drift 30 days before the public announcement of possible acquisition.
- Such event studies are regularly used by the SEC to measure the magnitude of the illegal activities.

Event Studies (Conditional Price Response)

- Suppose that a stock price of a market cap ***$100M*** company falls by -***4%*** on the day of the news of company's accounting scandal.
- The broad market did well on that day, and if not for the scandal, in line with the broad market, the stock price would have risen by +***2%*** on this day.
- Therefore, the impact of the scandal was -***6%*** drop in value.
- The damages sustained from the scandal were ***$100M*6%=$6M***.

Concept Check

- Suppose that we observe a negative CAR ***after*** an announcement date for a stock. Is that a violation of EMH?
- Yes. Predictably declining CAR after the announcement date do violate the EMH. If one can predict this, a profit opportunity exists: Sell or Sell Short the affected stock on the event date before the prices are predicted to fall.

Does EMH hold?

- If the EMH is true, most of the activities of active portfolio managers (such as search of over- and under-valued securities) is a wasted effort, is harmful because of additional costs, and leads to sub-optimally diversified portfolios.
- Not surprisingly, the EMH was never "widely" accepted on Wall Street, but the debate of the value-added of the security analysis in investment performance is still and most likely will ever be ongoing.
- There is three factors that complicate making reliable conclusions in this debate:
  1. The magnitude issue;
  2. The selection bias issue;
  3. The lucky event issue.

Does EMH hold?

- The magnitude issue.

  As we discussed, a +0.1% performance improvement on a $5B portfolio will produce $5M. If the cost of that improvement was a salary of one quant ($100K), this is definitely worthwhile. The break-even point is $100M portfolio. Only managers of large portfolios earn enough trading profits to make research cost worthwhile. So, a question “Are markets efficient?” should be re-posed as “Are they inefficient enough?” or “How efficient are the markets?”.

Does EMH hold?

- The selection bias issue.

  It is very difficult to fairly evaluate the portfolio managers ability to generate winning strategies because of selection bias. If a strategy is known, it is likely to no longer work. Justification for that is that if it were to continue to be very profitable, it would not be known, but rather keep being used to make money. If we assume rationality of portfolio managers – they will be only interested to share their wisdom with the world if the strategy no longer presents the profit opportunities and the only last way to capitalize on it is to "publish it". This makes all "published" strategies heavily biased to work better in the past, and less so or not work at all at present and in the future.

Does EMH hold?

- The lucky event issue.

  Every month once monthly performance results are in, hedge-fund and/or CTA publications would publish "rankings" of managers. It is assumed that the top-10 managers are "winners" or best managers into which makes most sense to invest now. Like the manager #6 in the next table (which "by total co-incidence", happens to be my investment program, "Systematic Alpha Futures"). However natural this conclusion "feels", and however much I want this sometimes, it is far from obvious.

  Imagine the following experiment. 10,000 people sit down to flip a fair coin 50 times in a row, one flip together at a time. How many super-flippers will get 75% or more of Heads of those 10,000 people after the last 50-th flip? Are they really super-flippers?

  Some of the investment strategies may be just "lucky" to get a good return in a particular period.

Manager Rankings**

Show: established [E] | Programs: over the last month | Ranked By: Return | > RANK

DATE RANGE: 10/12

		Program	Inception	Snapshot	ROR	YTD	WDD	AUM ($M)
1	ⓘ	SHARPE+SIGNA LLC: SHARPE+SIGNA Managed Currency Series *QEP*	06/2010		8.14%	11.92%	0.00%	87.50
2	ⓘ	Dominion Capital Management, Inc.: Sapphire Program *QEP*	05/2005		5.09%	8.37%	0.00%	92.00
3	ⓘ	Red Oak Commodity Advisors, Inc.: Fundamental Trading Program	12/1989		4.13%	3.10%	0.00%	106.00
4	ⓘ	Trigon Investment Advisors, LLC: Trigon FX Program *QEP*	08/2000		3.57%	2.35%	-2.12%	121.95
5	ⓘ	Emil Van Essen, LLC: Emil van Essen Spread Trading Program *QEP*	12/2006		2.92%	-12.57%	0.00%	431.00
6	ⓘ	Systematic Alpha Management LLC: Systematic Alpha Futures Program *QEP*	06/2004		2.56%	11.09%	0.00%	69.00
7	ⓘ	BEAM Bayesian Efficient Asset Management: Multi-Strategy *QEP*	03/2010		2.53%	-4.85%	0.00%	599.59
8	ⓘ	JE Moody & Company LLC: JEM Commodity Relative Value Program *QEP*	05/2006		1.39%	-0.60%	0.00%	365.00
9	ⓘ	Paskewitz Asset Management, LLC: Contrarian 3X Stock Index Program *QEP*	12/2003		0.99%	3.53%	-0.52%	151.00
10	ⓘ	Rhicon Currency Management (UK) Ltd.: Rhicon Strategic Program *FRN*	01/2004		0.98%	-0.67%	-1.11%	280.00
11	ⓘ	Mesirow Financial Commodities Management LLC: Financial Absolute Return Commodity Program *QEP* *CLSD*	06/2005		0.82%	0.17%	0.00%	639.20
12	ⓘ	Trigon Investment Advisors, LLC: Trigon Discretionary Macro Program *QEP*	08/2007		0.69%	-0.80%	-0.14%	443.96
13	ⓘ	Molinero Capital Management LLP: Global Markets Program *QEP*	07/2005		0.67%	-9.71%	-3.26%	142.00
14	ⓘ	Revolution Capital Management, LLC: Mosaic Institutional Program *QEP*	09/2009		0.12%	-10.96%	-0.72%	524.00
15	ⓘ	Vegasoul Capital Management (Asia) Limited: Vegasoul Fund *FRN*	06/2005		0.07%	-0.51%	-0.92%	346.00
16	ⓘ	Greenwave Capital Management, LLC: Greenwave Flagship Futures Only *QEP*	07/2008		0.02%	0.51%	0.00%	215.00

Super-Coin-Flippers Experiment

# of people:	**10,000**
# of flips:	**50**
75% correct:	**37.5**

n	Heads k	Tails n-k	C(n,k)	p^k*(1-p)^(n-k)	
50	50	0	1	0.00000000000009%	0.0000000000001%
50	49	1	50	0.00000000000009%	0.0000000000044%
50	48	2	1,225	0.00000000000009%	0.0000000001088%
50	47	3	19,600	0.00000000000009%	0.0000000017408%
50	46	4	230,300	0.00000000000009%	0.0000000204547%
50	45	5	2,118,760	0.00000000000009%	0.0000001881837%
50	44	6	15,890,700	0.00000000000009%	0.0000014113777%
50	43	7	99,884,400	0.00000000000009%	0.0000088715169%
50	42	8	536,878,650	0.00000000000009%	0.0000476844031%
50	41	9	2,505,433,700	0.00000000000009%	0.0002225272144%
50	40	10	10,272,278,170	0.00000000000009%	0.0009123615792%
50	39	11	37,353,738,800	0.00000000000009%	0.0033176784697%
50	38	12	121,399,651,100	0.00000000000009%	0.0107824550266%

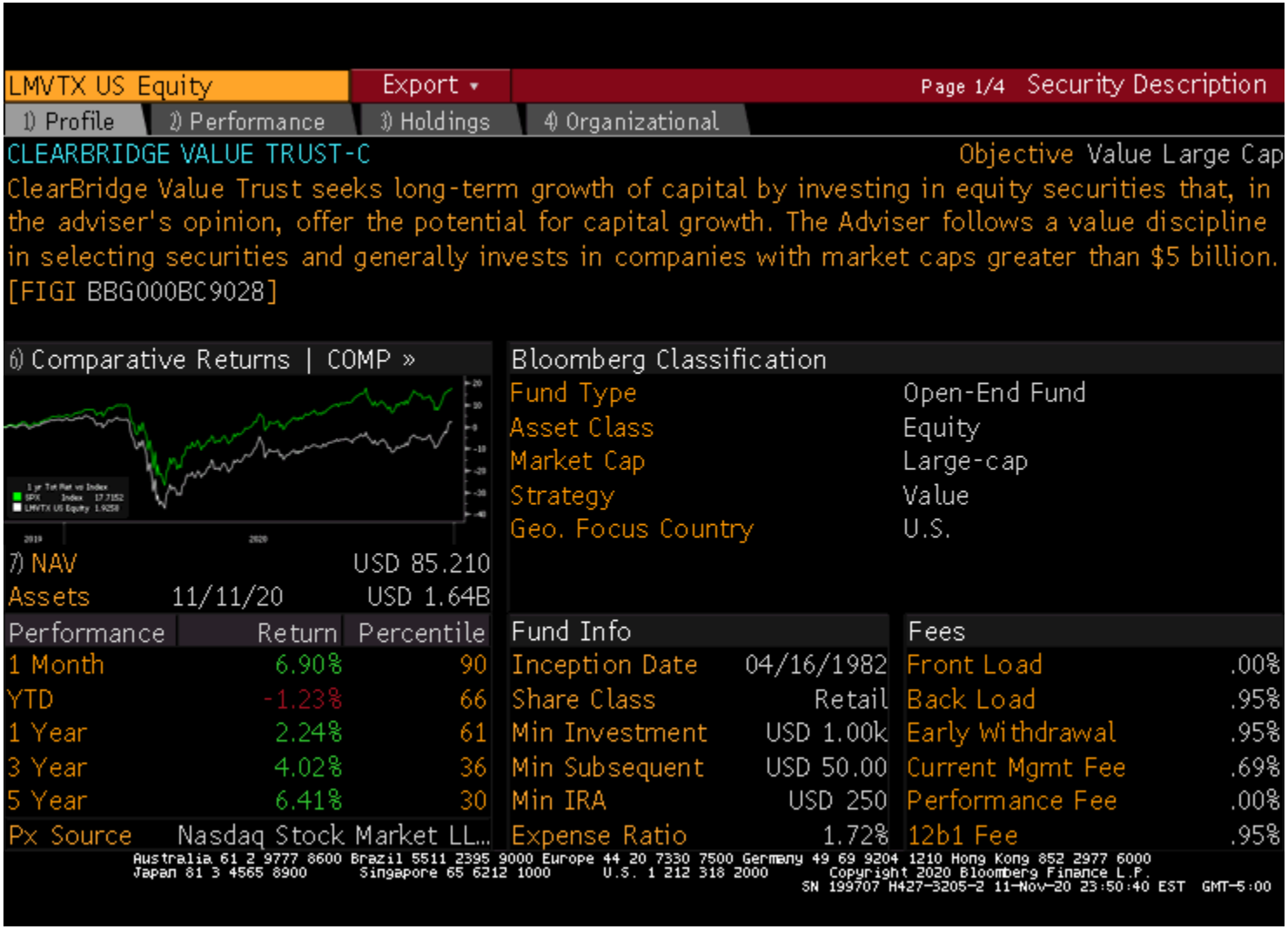
probability: **0.015%**

of "super-flippers": **1.53**

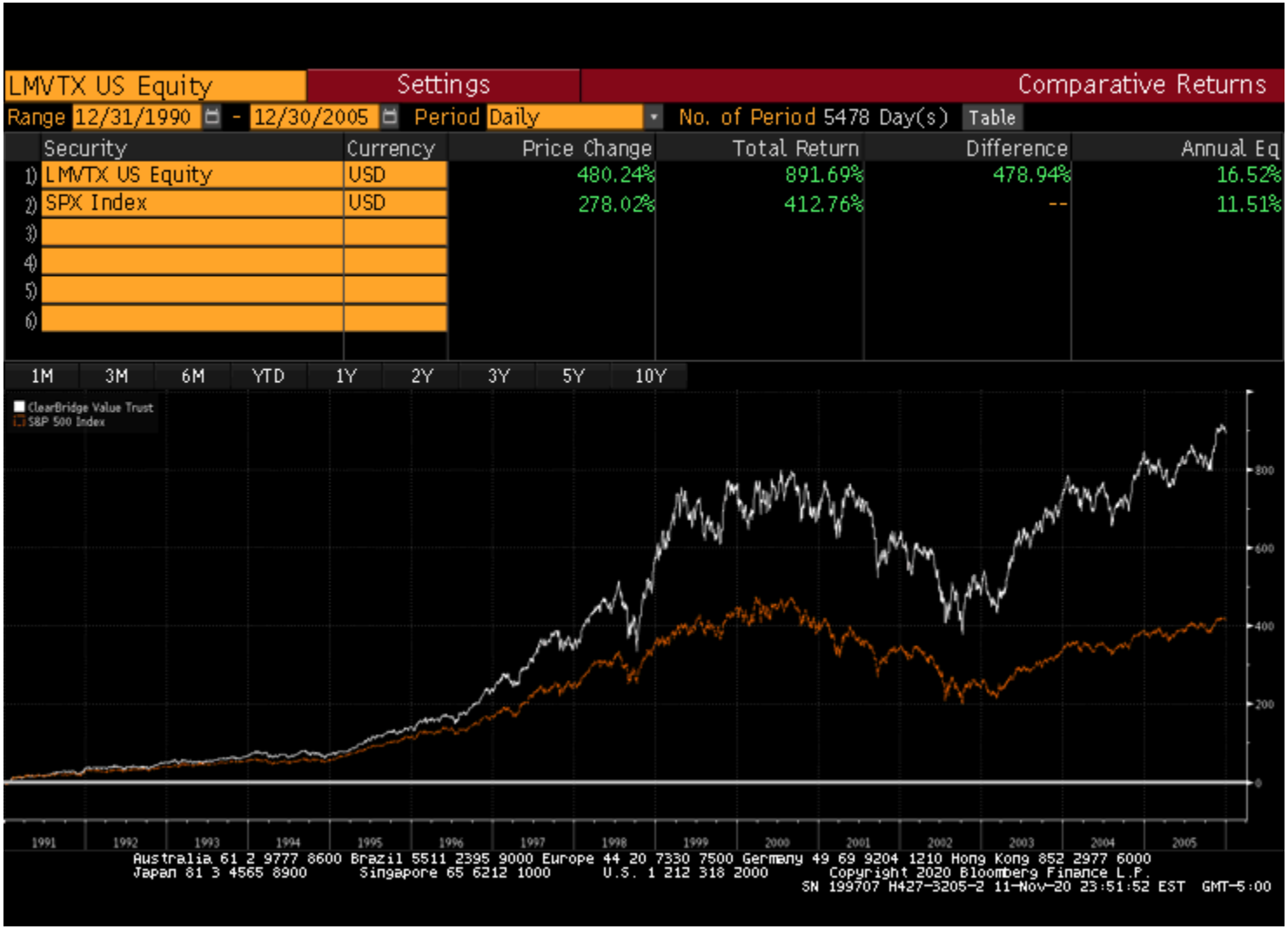
Concept Check

- CrearBridge Value Trust-C (f.k.a. Legg Mason Value Trust) mutual fund outperformed the S&P 500 index in 15 years ending 12/31/2005 by about **+5.01%** per year. The outperformance was observed in each(!) of the 15 years in-sample. Is that sufficient to conclude that this fund's strategy is superior to the market?
- No, not necessarily. Even such strong out-performance could still be generated by chance, especially considering the subsequent 11-year out-of-sample under-performance by about **-6.84%** per year. The under-performance was observed in all but two (87%!) years. Exceptional past performance of a small number of managers is possible by chance even in an efficient market.

“Superior” Mutual Fund: ClearBridge Value Trust



15-yr Out-Performance In-Sample 1990-2005



15-yr Out-Performance In-Sample 1990-2005

LMVTX US Equity | Settings | Comparative Returns

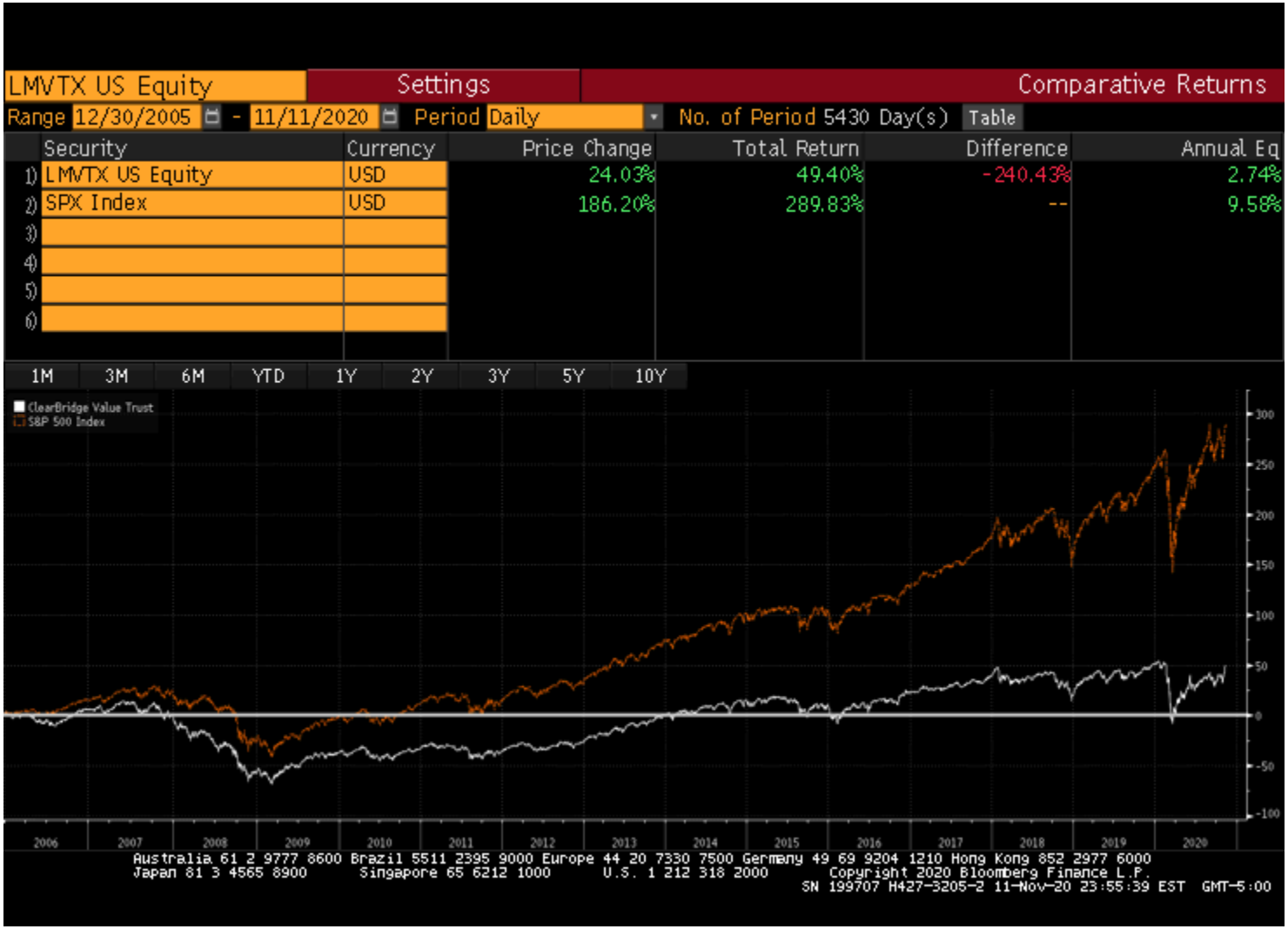
Range 12/31/1990 - 12/30/2005 Period Yearly No. of Period 15 Year(s) Chart

	LMVTX US Equity			SPX Index					
Date↓	Price	Divs	Return	Price	Divs	Return	Price	Divs	Return
12/30/2005	68.70	--	891.69%	1248.29	22.16	412.76%			
12/31/2004	65.23	--	841.60%	1211.92	19.38	388.77%			
12/31/2003	58.26	--	740.99%	1111.92	17.23	340.83%			
12/31/2002	40.59	--	485.92%	879.82	16.12	242.62%			
12/31/2001	50.06	.26	622.62%	1148.08	15.38	339.80%			
12/29/2000	55.44	14.47	696.63%	1320.28	16.32	399.15%			
12/31/1999	75.27	2.46	757.85%	1469.25	16.63	449.13%			
12/31/1998	61.58	1.41	577.03%	1229.23	16.05	353.69%			
12/31/1997	42.74	2.35	357.32%	970.43	15.37	252.90%			
12/31/1996	32.99	1.69	233.69%	740.74	14.73	164.65%			
12/29/1995	25.19	1.41	141.05%	615.93	13.71	115.29%			
12/30/1994	19.04	.09	71.25%	459.27	13.14	56.51%			
12/31/1993	18.87	.38	68.91%	466.45	12.52	54.48%			
12/31/1992	17.32	.16	51.81%	435.71	12.40	40.35%			
12/31/1991	15.70	.38	36.23%	417.09	12.04	30.41%			
12/31/1990	11.84	.79	.00%	330.22	--	.00%			

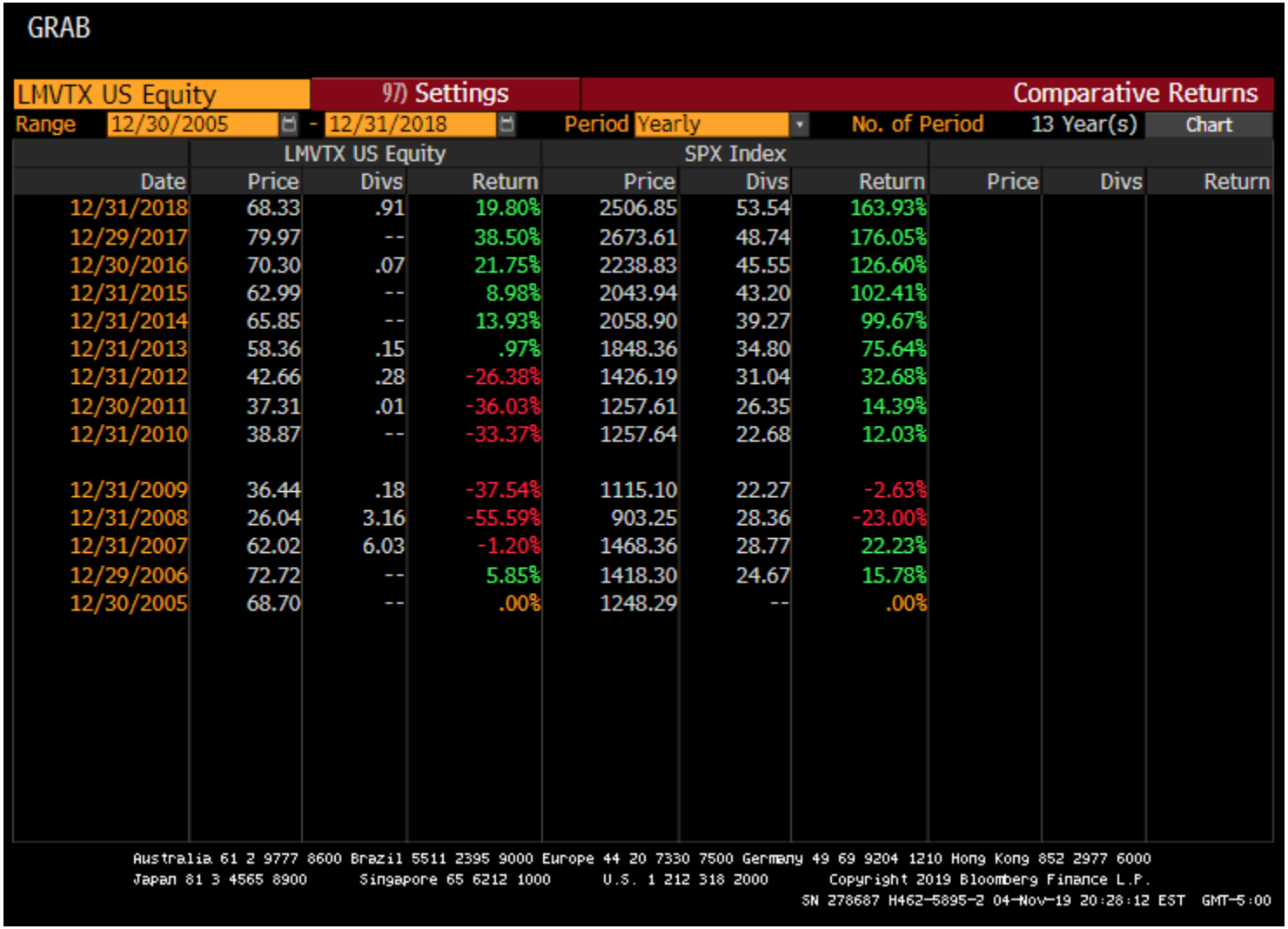
15-yr Out-Performance In-Sample 1990-2005

	LMVTX				SPX				100%
Year	Price	Divs	Cum Ret	TR	Price	Divs	Cum Ret	TR	LMVTX Beats
2005	68.70	0.00	891.69%	5.32%	1248.29	22.16	412.76%	4.91%	1
2004	65.23	0.00	841.60%	11.96%	1211.92	19.38	388.77%	10.88%	1
2003	58.26	0.00	740.99%	43.53%	1111.92	17.23	340.83%	28.67%	1
2002	40.59	0.00	485.92%	-18.92%	879.82	16.12	242.62%	-22.10%	1
2001	50.06	0.26	622.62%	-9.29%	1148.08	15.38	339.80%	-11.89%	1
2000	55.44	14.47	696.63%	-7.14%	1320.28	16.32	399.15%	-9.10%	1
1999	75.27	2.46	757.85%	26.71%	1469.25	16.63	449.13%	21.04%	1
1998	61.58	1.41	577.03%	48.04%	1229.23	16.05	353.69%	28.56%	1
1997	42.74	2.35	357.32%	37.05%	970.43	15.37	252.90%	33.34%	1
1996	32.99	1.69	233.69%	38.43%	740.74	14.73	164.65%	22.93%	1
1995	25.19	1.41	141.05%	40.76%	615.93	13.71	115.29%	37.56%	1
1994	19.04	0.09	71.25%	1.39%	459.27	13.14	56.51%	1.31%	1
1993	18.87	0.38	68.91%	11.26%	466.45	12.52	54.48%	10.07%	1
1992	17.32	0.16	51.81%	11.44%	435.71	12.40	40.35%	7.62%	1
1991	15.70	0.38	36.23%	36.23%	417.09	12.04	30.41%	30.41%	1
1990	11.84	0.79	0.00%		330.22	0.00	0.00%		

Under-Performance 15-yrs Out-of-Sample 2005-2020



Under-Performance 15-yr Out-of-Sample 2005-2020



GRAB

LMVTX US Equity | 97) Settings | Comparative Returns

Range 12/30/2005 - 12/31/2018 Period Yearly No. of Period 13 Year(s) Chart

	LMVTX US Equity			SPX Index					
Date	Price	Divs	Return	Price	Divs	Return	Price	Divs	Return
12/31/2018	68.33	.91	19.80%	2506.85	53.54	163.93%			
12/29/2017	79.97	--	38.50%	2673.61	48.74	176.05%			
12/30/2016	70.30	.07	21.75%	2238.83	45.55	126.60%			
12/31/2015	62.99	--	8.98%	2043.94	43.20	102.41%			
12/31/2014	65.85	--	13.93%	2058.90	39.27	99.67%			
12/31/2013	58.36	.15	.97%	1848.36	34.80	75.64%			
12/31/2012	42.66	.28	-26.38%	1426.19	31.04	32.68%			
12/30/2011	37.31	.01	-36.03%	1257.61	26.35	14.39%			
12/31/2010	38.87	--	-33.37%	1257.64	22.68	12.03%			
12/31/2009	36.44	.18	-37.54%	1115.10	22.27	-2.63%			
12/31/2008	26.04	3.16	-55.59%	903.25	28.36	-23.00%			
12/31/2007	62.02	6.03	-1.20%	1468.36	28.77	22.23%			
12/29/2006	72.72	--	5.85%	1418.30	24.67	15.78%			
12/30/2005	68.70	--	.00%	1248.29	--	.00%			

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Under-Performance 15-yr Out-of-Sample 2005-2020

	LMVTX				SPX				87%
Year	Price	Divs	Cum Ret	TR	Price	Divs	Cum Ret	TR	SPX Beats
2020	85.21	0.00	49.40%	-1.23%	3572.66		289.83%	12.34%	1
2019	86.27	0.00	51.26%	26.25%	3230.78	58.02	247.01%	31.48%	1
2018	68.33	0.91	19.80%	-13.50%	2506.85	53.54	163.93%	-4.39%	1
2017	79.97	0.00	38.50%	13.76%	2673.61	48.74	176.05%	21.82%	1
2016	70.30	0.07	21.75%	11.72%	2238.83	45.55	126.60%	11.95%	1
2015	62.99	0.00	8.98%	-4.34%	2043.94	43.20	102.41%	1.37%	1
2014	65.85	0.00	13.93%	12.83%	2058.90	39.27	99.67%	13.68%	1
2013	58.36	0.15	0.97%	37.15%	1848.36	34.80	75.64%	32.37%	
2012	42.66	0.28	-26.38%	15.09%	1426.19	31.04	32.69%	15.99%	1
2011	37.31	0.01	-36.03%	-4.00%	1257.61	26.35	14.39%	2.11%	1
2010	38.87	0.00	-33.37%	6.67%	1257.64	22.68	12.03%	15.06%	1
2009	36.44	0.18	-37.54%	40.64%	1115.10	22.27	-2.63%	26.45%	
2008	26.04	3.16	-55.59%	-55.05%	903.25	28.36	-23.00%	-37.00%	1
2007	62.02	6.03	-1.20%	-6.66%	1468.36	28.77	22.23%	5.57%	1
2006	72.72	0.00	5.85%	5.85%	1418.30	24.67	15.78%	15.78%	1
2005	68.70	0.00	0.00%		1248.29		0.00%		

Weak Form Tests: Returns Over Short Horizons

- Early tests of EMH were of the weak form, trying to predict future prices from the past price behavior.
- Serial correlation (positive or negative) measures linear statistical relationship between price changes, of future return based on the past for a certain frequency of data sampling (daily, weekly, etc).
- Positive serial correlation means that significant returns tend to be followed by returns of the same sign in the next observation period: positive – followed by positive, negative – by negative. This property sometimes is also called trending, trend-following or positive momentum.
- Negative serial correlation means that significant returns tend to be followed by returns of the opposite sign in the next observation period: positive – followed by negative, negative – by positive.

Weak Form Tests: Returns Over Short Horizons

- Both *Conrad and Kaul*[*] and *Lo and MacKinlay*[**] investigated weekly returns of NYSE stocks and do find positive serial correlation over short horizons. However, the correlation coefficients tend to be quite small. These studies do demonstrate weak price trends over short periods, it is not enough evidence to demonstrate the existence of trading opportunities.
- Jegadeesh and Titman[***] found tradeable intermediate-horizon momentum in stocks using 3- to 12-months holding periods. Portfolios of best performing stocks in the recent past tend to significantly out-perform the average stocks. Same in principle, but weaker in magnitude relationship was found for the worst performing stocks in the recent past, which tend to under-perform the average stocks.

[*] Jennifer Conrad and Gautam Kaul, "Time-Variation in Expected Returns", Journal of Business 61 (October 1988), pp. 409-25.

[**] Andrew W. Lo and A. Craig MacKinlay, "Stock Market Prices Do Not Follow Random Walks: Evidence from a Simple Specification Test", Review of Financial Studies 1 (1988), pp. 41-66.

Table I

Returns of Relative Strength Portfolios

The relative strength portfolios are formed based on J-month lagged returns and held for K months. The values of J and K for the different strategies are indicated in the first column and row, respectively. The stocks are ranked in ascending order on the basis of J-month lagged returns and an equally weighted portfolio of stocks in the lowest past return decile is the *sell* portfolio and an equally weighted portfolio of the stocks in the highest return decile is the *buy* portfolio. The average monthly returns of these portfolios are presented in this table. The relative strength portfolios in Panel A are formed immediately after the lagged returns are measured for the purpose of portfolio formation. The relative strength portfolios in Panel B are formed 1 week after the lagged returns used for forming these portfolios are measured. The t-statistics are reported in parentheses. The sample period is January 1965 to December 1989.

		Panel A				Panel B			
J		$K=$ 3	6	9	12	$K=$ 3	6	9	12
3	Sell	0.0108	0.0091	0.0092	0.0087	0.0083	0.0079	0.0084	0.0083
		(2.16)	(1.87)	(1.92)	(1.87)	(1.67)	(1.64)	(1.77)	(1.79)
3	Buy	0.0140	0.0149	0.0152	.0156	0.0156	0.0158	0.0158	0.0160
		(3.57)	(3.78)	(3.83)	(3.89)	(3.95)	(3.98)	(3.96)	(3.98)
3	Buy-sell	0.0032	0.0058	0.0061	0.0069	0.0073	0.0078	0.0074	0.0077
		(1.10)	(2.29)	(2.69)	(3.53)	(2.61)	(3.16)	(3.36)	(4.00)
6	Sell	0.0087	0.0079	0.0072	0.0080	0.0066	0.0068	0.0067	0.0076
		(1.67)	(1.56)	(1.48)	(1.66)	(1.28)	(1.35)	(1.38)	(1.58)
6	Buy	0.0171	0.0174	0.0174	0.0166	0.0179	0.0178	0.0175	0.0166
		(4.28)	(4.33)	(4.31)	(4.13)	(4.47)	(4.41)	(4.32)	(4.13)
6	Buy-sell	0.0084	0.0095	0.0102	0.0086	0.0114	0.0110	0.0108	0.0090
		(2.44)	(3.07)	(3.76)	(3.36)	(3.37)	(3.61)	(4.01)	(3.54)
9	Sell	0.0077	0.0065	0.0071	0.0082	0.0058	0.0058	0.0066	0.0078
		(1.47)	(1.29)	(1.43)	(1.66)	(1.13)	(1.15)	(1.34)	(1.59)
9	Buy	0.0186	0.0186	0.0176	0.0164	0.0193	0.0188	0.0176	0.0164
		(4.56)	(4.53)	(4.30)	(4.03)	(4.72)	(4.56)	(4.30)	(4.04)
9	Buy-sell	0.0109	0.0121	0.0105	0.0082	0.0135	0.0130	0.0109	0.0085
		(3.03)	(3.78)	(3.47)	(2.89)	(3.85)	(4.09)	(3.67)	(3.04)
12	Sell	0.0060	0.0065	0.0075	0.0087	0.0048	0.0058	0.0070	0.0085
		(1.17)	(1.29)	(1.48)	(1.74)	(0.93)	(1.15)	(1.40)	(1.71)
12	Buy	0.0192	0.0179	0.0168	0.0155	0.0196	0.0179	0.0167	0.0154
		(4.63)	(4.36)	(4.10)	(3.81)	(4.73)	(4.36)	(4.09)	(3.79)
12	Buy-sell	0.0131	0.0114	0.0093	0.0068	0.0149	0.0121	0.0096	0.0069
		(3.74)	(3.40)	(2.95)	(2.25)	(4.28)	(3.65)	(3.09)	(2.31)

Weak Form Tests: Returns Over Long Horizons

- Tests of long-time horizon returns (over years) have found evidence of pronounced negative long-term serial correlation in the performance of the aggregate market. "Fads hypothesis" asserts that stock market over-reacts to relevant news. These studies need not be interpreted as evidence of stock market fads. They may indicate that the risk premium varies over time. For example, when risk premium rises, the stock market would fall. The apparent market overshooting and correction may be a rational response to the changes in discount rates.
- Other studies suggest that over long periods extreme performance in individual securities tends to reverse itself. *DeBondt and Thaler*[*] and Chopra, *Lakonishok, and Ritter*[**] found strong tendencies for poorly performing stocks in one period to experience sizeable reversals over the subsequent period, while the best performing stocks in a given period to follow with poor performance in the following period.

[*] Werner F. M. DeBondt and Richard Thaler, "Does the Stock Market Overreact?", Journal of Finance 40 (1985), pp. 793-805.

[**] Navin Chopra, Josef Lakonishok, and Jay R. Ritter, "Measuring Abnormal Performance: Do Stocks Overreact?", Journal of Financial Economics 31 (1992), pp. 235-68.

Predictability of Broad Market Returns

- Several studies have registered that some measurable properties of stocks can predict market returns.
- *Fama and French*[*] showed that the overall market tends to go higher when the dividend/price ratio, the dividend yield, is higher.
- *Campbell and Shiller*[*] found that the earnings yield can also predict the stock market returns.
- If the conclusions of these papers are indeed correct, this is a violation of the EMH. More probably, however, these variables are proxies for the variable market risk premium.

[*] Eugene F. Fama and Kenneth R. French, "Dividend Yields and Expected Stock Returns", Journal of Financial Economics 22 (October 1988), pp. 3-25.

[**] John Y. Campbell and Robert Shiller, "Stock Prices, Earnings and Expected Dividends", Journal of Finance 43 (July 1988), pp. 661-76.

Semi-Strong Tests: Market Anomalies

- Fundamental analysis uses other (accounting, balance sheet, corporate management) public information about a company to create portfolios than technical analysis (historical trading information).
- The question of whether publicly available fundamental information beyond trading history can improve investment performance if the test of the semi-strong form of EMH.
- Surprisingly, even such simple fundamental statistical variables such as price/earnings ratio, market capitalization, earnings per share, etc. seem to have predictive power and lead to better risk-adjusted returns.
- Such phenomena are impossible to reconcile with the EMH, and they are referred to as *efficient market* ***anomalies***.

P/E Effect

- Basu* has discovered portfolios of low price-earnings (P/E) ratio stocks have provided higher returns than high P/E portfolios. Such phenomenon seems to hold even after adjustment for portfolio beta. One of the possible reasons other than the break of EMH, is that stocks are not properly adjusted for risk.
- Adjustment for risk is a difficult procedure to implement, as once you introduce a certain adjustment for risk procedure, then you are really jointly testing the EMH and your risk adjustment procedure.

* Sanjoy Basu, "The Investment Performance of Common Stocks in Relation to Their Price-Earnings Ratios: A Test of the Efficient Market Hypothesis", Journal of Finance 32 (June 1977), pp. 663-82; and "The Relationship between Earnings Yield, Market Value, and Return for NYSE Common Stocks: Further Evidence", Journal of Financial Economics 12 (June 1983).

Small-Firm-in-January Effect

- First discovered by Banz*, showed that historical performance of portfolios formed by dividing the NYSE stocks into 10 deciles according to their capitalization, leads to higher average annual returns for small-firm portfolios. The observed difference in annual performance between portfolio 10 (largest) and 1 (smallest) was about 8.57%. Naturally, smaller-cap portfolios tend to be riskier, but even after adjusting for the risk using the CAPM, there was a significant out-performance remaining.
- Later studies (Keim**, Reinganum***, and Blume and Stambaugh****) showed that such effect occurs almost all in January, in fact in the first 2 weeks of January.

* Rolf Banz, "The Relationship between Return and Market Value of Common Stocks", Journal of Financial Economics 9 (March 1981).

** Donald B. Keim, "Size related Anomalies and Stock Return Seasonality: Further Empirical Evidence", Journal of Financial Economics 12 (June 1983).

*** Marc R. Reinganum, "The Anomalous Stock Market Behavior of Small Firms in January: Empirical Tests for Tax-Loss Effects", Journal of Financial Economics 12 (June 1983).

**** Marshall E. Blume and Robert F. Stambaugh, "Biases in Computed Returns: An Application to the Size Effect", Journal of Financial Economics, 1983.

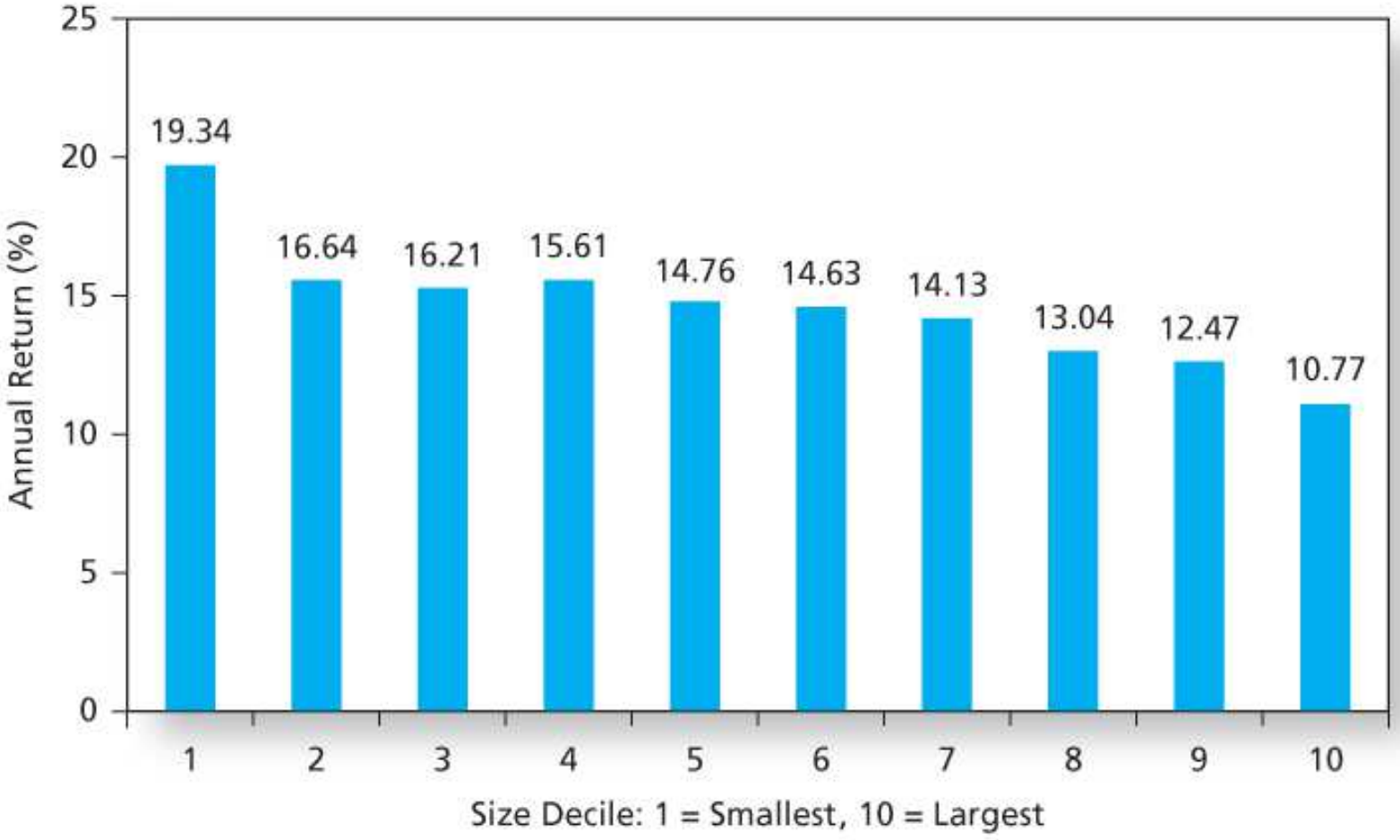

Figure 11.3 Average annual return for 10 size-based portfolios, 1926–2008

Source: Authors' calculations, using data obtained from Professor Ken French's data library at **http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.**

Neglected-Firm Effect and Liquidity Effects

- Another interpretation of the Small-Firm-in-January effect was given by Arbel and Strebel*: small firms tend to be neglected by the large institutional traders, information about them is less available. Informational deficiency makes smaller firms more risky, and, therefore, command higher returns. Arbel** has found that the January effect was the largest for neglected firms.
- Merton*** has found that neglected firms might be expected to earn higher equilibrium returns as a compensation for the risk associated with the limited information. In that sense, the neglected-company premium is not strictly a market inefficiency, but is a type of risk premium.
- Amihud and Mendelson**** related both small-company and neglected-company effects to higher trading costs, as they are less liquid. However, it does not explain why should this be concentrated in January. Although high trading costs can indeed reduce or wipe out an apparent profit opportunity.

* Avner Arbel and Paul J. Strebel, "Pay Attention to Neglected Firms", Journal of Portfolio Management, Winter 1983.
** Avner Arbel, "Generic Stocks: An Old product in a New Package", Journal of Portfolio Management, Summer 1985.
*** Robert C. Merton, "A Simple Modelof Capital Market Equilibrium with Incomplete Information", Journal of Finance 42 (1987), pp. 483-510.
**** Yakov Amihud and Haim Mendelson, "Asset Pricing and the Bid-Ask Spread", Journal of Financial Economics 17 (December 1986), pp. 223-50; and "Liquidity, Asset Prices, and Financial Policy", Financial Analysts Journal 47 (November/December 1991), pp. 56-66.

Book-to-Market Ratios

- Fama and French* found that the ratio of the book value of the firm's equity to the market value of equity is a powerful predictor of cross-sectional returns of stocks. They have divided firms into 10 decile groups by their book-to-market ratio values. The highest book-to-market ratio had an average annual return of 16.68%, whereas the lowest –10.51%. Such dependence of returns on book-to-market ratio was found to be independent of beta.
- Moreover, they have showed that after adjusting for size and book-to-market effects, beta seemed to have no power to explain returns, in contradiction to CAPM.
- This is an important challenge to the EMH: systematic risk seems to not matter, whereas book-to-value ratio matters.

* Eugene F. Fama and Kenneth R. French, "The Cross Section of Expected Stock Returns", Journal of Finance 47 (1992), pp. 427-65.

Earnings Announcement Price Drift

- EMH's principle is that any new information gets reflected very rapidly, almost "instantaneously". Stock prices response to EPS announcements was found by many authors[*,**] to be significantly delayed.
- The response to earnings announcement can be compared to the previous expectation of earnings. The difference is "earnings surprise".
- Divining the earnings surprises into deciles allows one to measure the dramatic differences in cumulative price response to earnings surprises, both positive and negative.
- The post-announcement price drift continues for up to 90 days after the announcement. Such predictabilities should not be possible in the efficient markets.

[*] R. Ball and P. Brown, "An Empirical Evaluation of Accounting Income Numbers", Journal of Accounting Research 9 (1968), pp. 159-78.

[**] V. Bernard and J. Thomas, "Evidence That Stock Prices Do Not Fully Reflect the Implications of Current Earnings for Futures Earnings", Journal of Accounting and Economics 13 (1990), pp. 305-40.

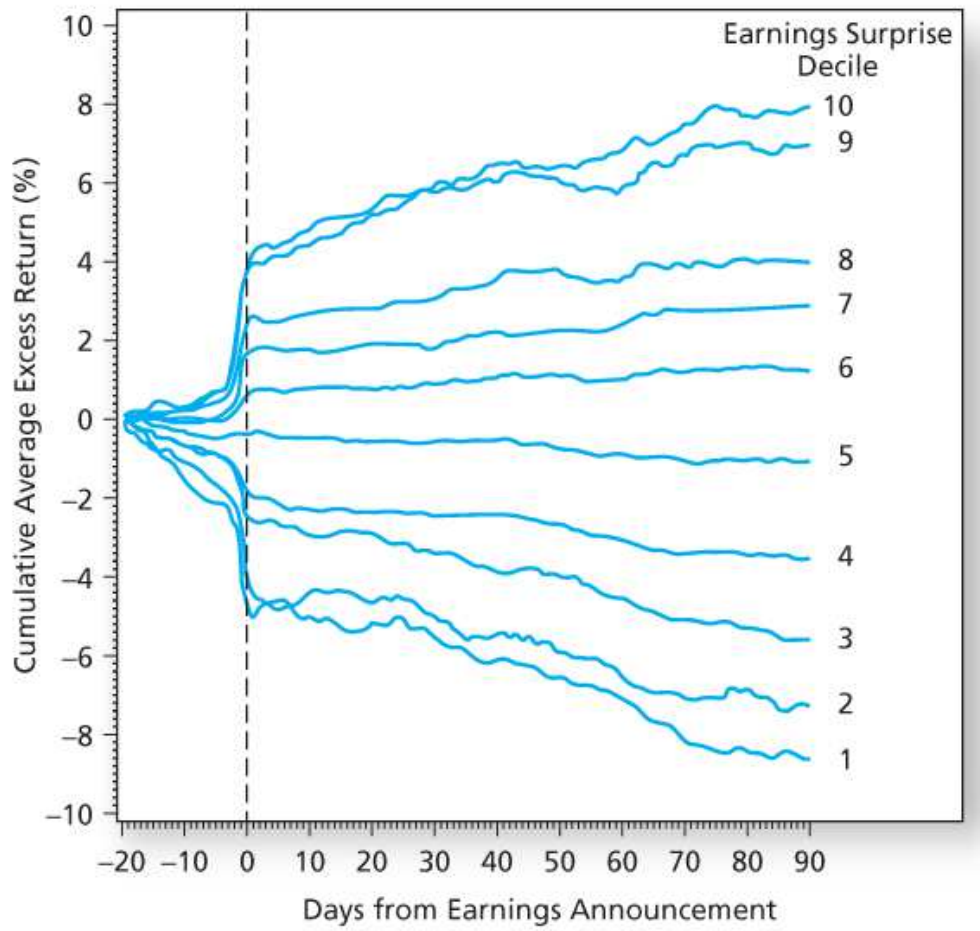

Figure 11.5 Cumulative abnormal returns in response to earnings announcements

Source: Reprinted from R.J. Rendleman Jr., C. P. Jones, and H. A. Latané, "Empirical Anomalies Based on Unexpected Earnings and the Importance of Risk Adjustments," *Journal of Financial Economics* 10 (1982), pp. 269–287. Copyright 1982 with permission from Elsevier Science.

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