Financial Market Efficiency and Its Implications

Investment, Capital & Finance
Econ 422
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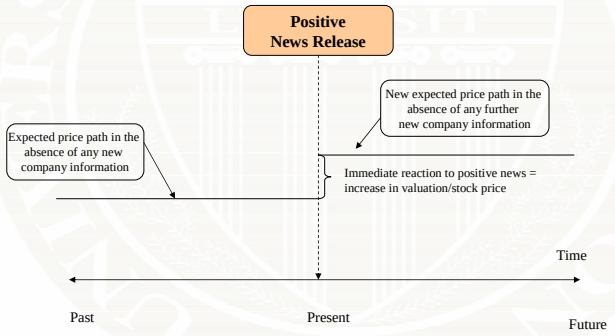
Financial Market Efficiency: The Efficient Market Hypothesis (EMH)

- Financial markets are efficient if *current* asset prices fully reflect all *currently available* relevant information.

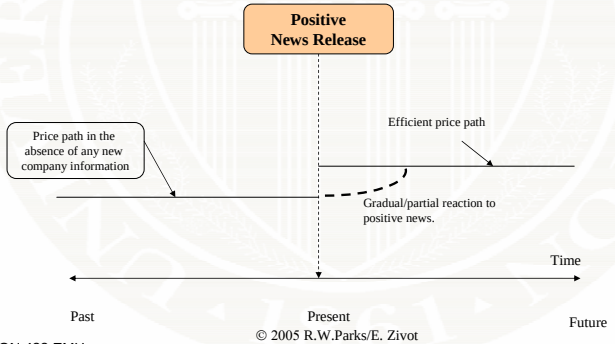
Implications of An Efficient Market

Financial markets will respond to new information immediately and completely:



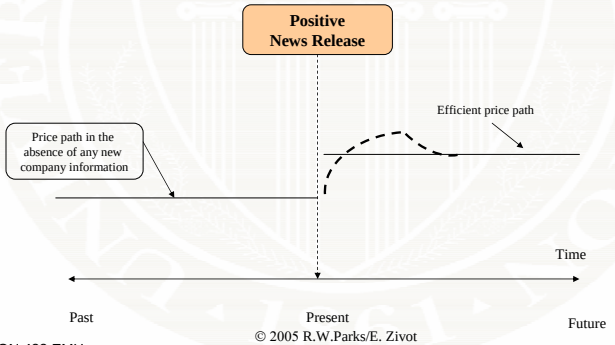
Implications of An Inefficient Market

Financial markets will not respond to new information immediately and completely. Instead financial markets may respond gradually and potentially incompletely for a period of time (*underreact*).



Implications of An Inefficient Market

Financial markets will not respond to new information immediately and completely. Financial markets may *overreact* then adjust gradually.



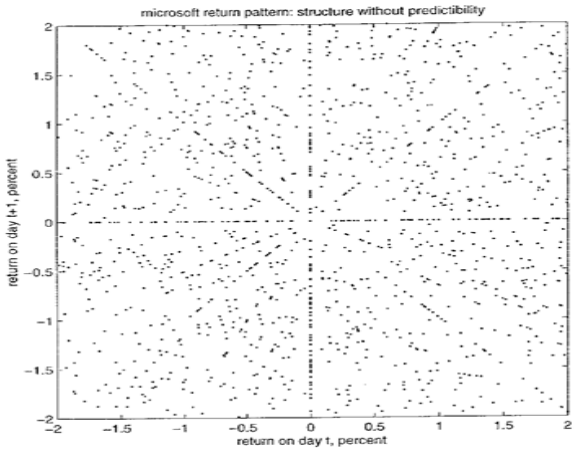
Some Implications of Market Efficiency

- The purchase or sale of any security at its prevailing market price is a *zero NPV transaction*.
  - » Because information is immediately reflected in market prices, assets are not systematically over- or under-valued. Investors should expect a normal (risk adjusted) rate of return.
  - » Firms should expect to receive a "fair" value for securities that they sell. Fair value is the present value of expected cash flows, with the appropriate adjustment for risk.

Some Implications of Market Efficiency (continued)

- If financial markets are efficient, then there is no "best time" to purchase an asset. Apparent past price patterns are not predictive for future prices.
- If financial markets are efficient, asset price changes are serially random.
  - » Cannot predict the future price based on observing the history of past prices

Random Walk Return Data



Serial Randomness of Price Changes

- A special case of the idea that asset price changes are serially random is the *Random Walk Hypothesis*.
- If stock prices follow a random walk then

$$P_{t+1} = P_t + \text{expected gain} + \varepsilon_{t+1}$$
$$\text{or} \quad \Delta P_{t+1} = \text{expected gain} + \varepsilon_{t+1}$$
$$\text{where } \varepsilon_{t+1} \sim iid\ (0, \sigma^2).$$
$$\Rightarrow E[\Delta P_{t+1}] = \text{expected gain} + E[\varepsilon_{t+1}]$$
$$= \text{expected gain}$$
$$\text{since } E[\varepsilon_{t+1}] = 0$$

Generating a Random Walk Series

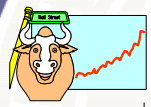
Coin Toss Game

E(r) =.5(.03)+.5(-.025)=.0025

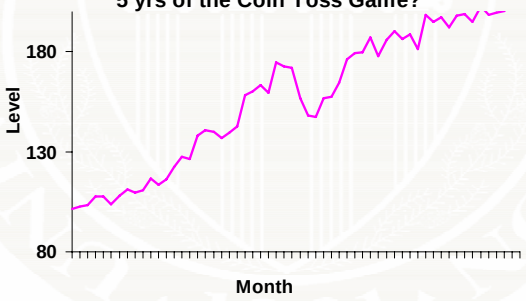
Comparing Artificial Random Walk Series with Stock Prices Series

- One of the series is a plot of the S&P Index for 5 years, the other is an artificially generated random walk series.
- Can you tell which is which?
- Real stock data seems to behave quite like a random walk series.
- Price changes are serially random.

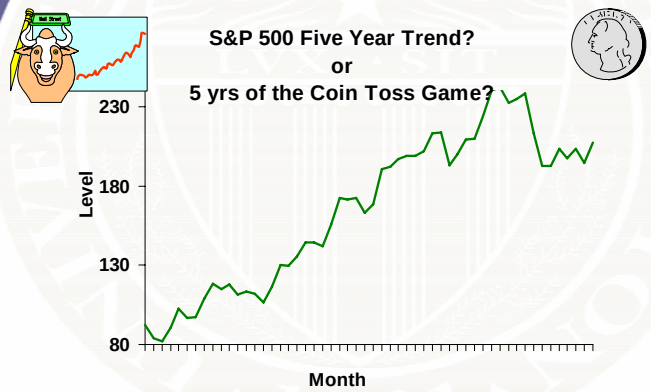
Random Walk Theory



S&P 500 Five Year Trend?
or
5 yrs of the Coin Toss Game?



Random Walk Theory



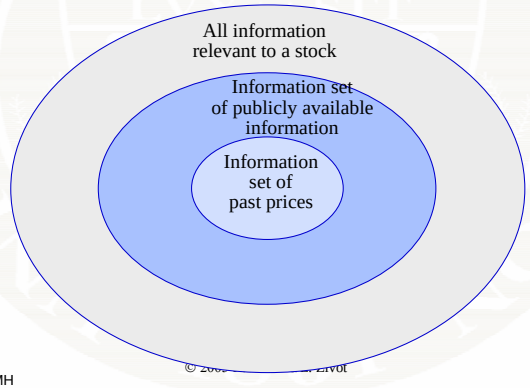
A Closer Look at Stock Price Changes

- The random walk model isn't quite right for stock prices.
- A random walk involves innovations that are from the same distribution, i.e. the same mean and variance.
- The variance of innovation in real data appears to change over time.
- The model works better in natural logs. Then the expected gain is a rate of return.

Three Forms of the Efficient Market Hypothesis

- Weak Form Efficient Market
  - » Prices reflect information about past stock prices or returns
  - » Random Walk Hypothesis is a special case
- Semi-strong Form Efficient Market
  - » Prices reflect all publicly available information
- Strong Form Efficient Market
  - » Prices reflect all available information

Relationship among Three Different Information Sets



Tests of the Efficient Market Hypothesis

- The EMH would be rejected if you could find information whose use would allow you to make better forecasts of expected returns than those made by the market.
- The weak, semi-strong, strong classification indicates the kind of data that will be considered.
- A test always requires some form of model about the way that equilibrium asset prices are formed.

Weak Form Tests

- Filter Tests
- Serial Correlation Tests

Filter Tests

- Based on the assumption that equilibrium prices are always set such that $E(r_{i,t+1}) > 0$.
- Compares an EMH view with an alternative view in which markets adjust incompletely and gradually to "news." Thus there is some persistence in the direction of price changes following the news.

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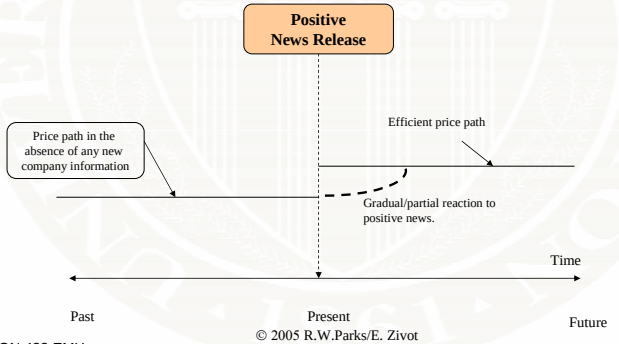


Filter Tests (continued)

- Technical traders hold this non-EMH view. Mimic their approach using filter rules: If the price rises by more that x%, buy and hold until the price falls by more than y%, then sell and go short.
- The EMH approach: Expected returns are positive. Buy and hold.
- Apply these two approaches to historical data. Which would give the better results?

Filter Tests: Results

- Tiny filters ranging from 0.5% to 1.5% show slightly better returns than buy and hold provided that you ignore transaction costs.
- These small filters involve intraday trading.
- Even floor traders' trading costs of about 0.1% completely eliminate the extra return.
- When looked at net of trading costs (even very low costs), buy and hold beats technical trading.

Serial Correlation Tests

- In the RV Review we defined a correlation coefficient between two random variables x, and y as

$$\rho_{x,y} = \frac{\text{cov}(x,y)}{\sigma_x \sigma_y}$$

- Serial correlation involves looking at the correlation coefficient between a series and the same series lagged some number of periods.

Serial Correlation Tests (cont.)

- Assume that expected returns are constant.
- Consider a series of stock returns

  $r_{i1}, r_{i2}, \ldots, r_{iT-1}, r_{iT}$
- The returns lagged one period are

  $r_{i0}, r_{i1}, r_{i2}, \ldots, r_{iT-1}$
- The correlation between the returns and the lagged returns is

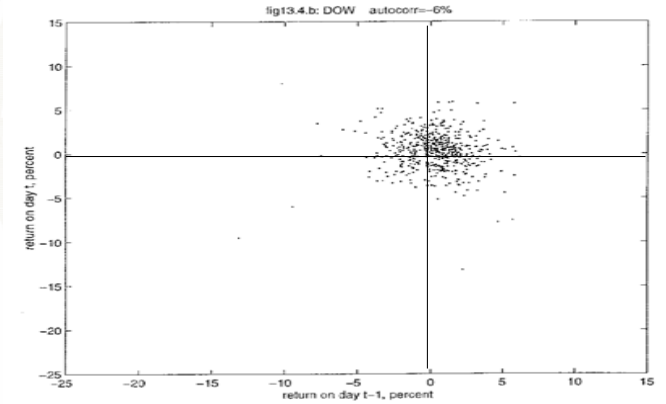
$$\rho_{r_t, r_{t-1}} = \frac{\text{cov}(r_t, r_{t-1})}{\sigma_{r_t} \sigma_{r_{t-1}}} = \frac{\text{cov}(r_t, r_{t-1})}{\sigma^2_{r_t}}$$

(If the return series is stationary then $\sigma_{r_t} = \sigma_{r_{t-1}}$.)

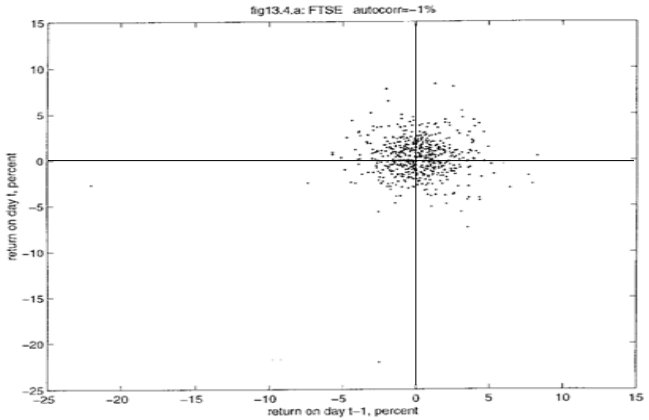
The Logic of Serial Correlation Tests

- Suppose that the serial correlation between returns lagged one period is significantly positive.
- That would mean that if you observed an above (or below) average return at time t, that on average the return at time t+1 would be above (or below) average.
- You could use this information to make above average returns.
- This would not be consistent with the EMH.

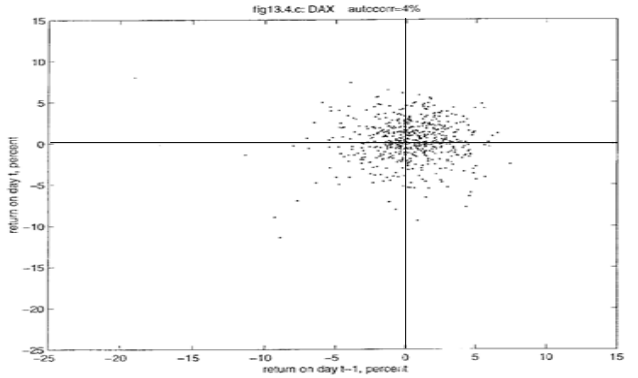
Serial Correlation Test
Dow Jones Industrial Average



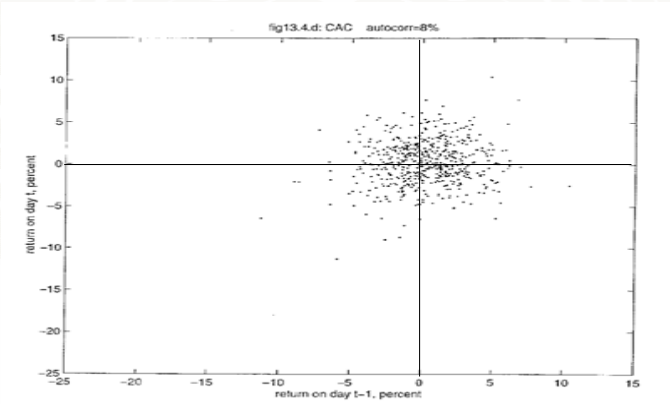
Serial Correlation Test
FTSE 100 (UK index)



Serial Correlation Test
DAX (German index)



Serial Correlation Test
CAC (French Index)



Tests of Semi-Strong Form Efficiency

- Is publicly available information quickly and fully incorporated into asset prices?
- Event study methodology
- Abnormal return
  = actual return - expected return.

Abnormal return from the market model

CAPM regression using excess returns (return - T-bill) :

$$r_{it} = \alpha_i + \beta_i r_{mt} + \varepsilon_{it}$$

Fitted or estimated form of the CAPM :

$\hat{r}_{it} = \hat{\alpha}_i + \hat{\beta}_i r_{mt}$ = normal expected return

Abnormal return = Observed return - normal expected return

$$AR_{it} = r_{it} - (\hat{\alpha}_i + \hat{\beta}_i r_{mt})$$

See spreadsheet example.

Cumulative Abnormal Returns

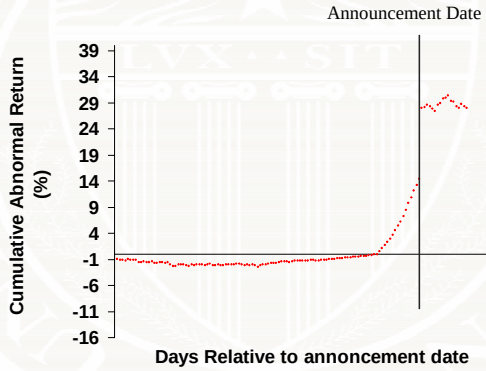
$$\text{CAR}_t = \sum_{\tau=T_1}^{t} AR_t$$

Since the expected value of each AR_t is zero according to the market model,
the expected value of CAR_t is also zero.
There should be no tendancy
for the CAR to build up.

Semi-Strong Form Test
Takeover Announcements
Keown&Pinterton (1981)

- Average Cumulative abnormal returns for a sample of 194 takeover targets.
- Some price run-up prior to the announcement.
- Big price jump with the announcement
- No further abnormal price movements after the announcement.

Semi-Strong Form Test
Takeover Announcements for 194 Firms

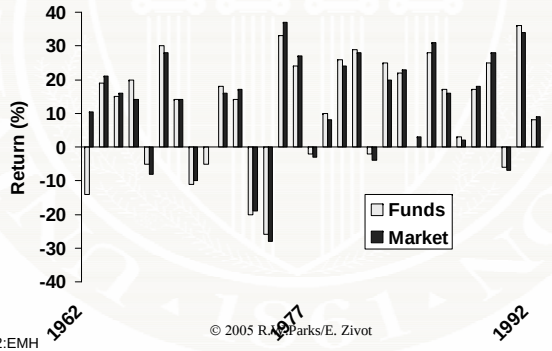


Tests of Strong Form Efficiency

- Professionally managed portfolios devote resources to discovering and using private information.
- Does their portfolio performance reflect the non-public information?

Strong Form Tests
Mutual Fund Performance

Average Annual Risk Adjusted Return on 1493 Mutual Funds and the Market Index



Summary of Mutual Fund Performance

- Mutual funds, on average, earned a *lower risk adjusted return* (using the CAPM) than the benchmark market index fund *after expenses* and roughly the *same risk adjusted return* as the market index *before expenses*.
- Strong justification for passive index investment

Implications for Corporate Financial Managers

- Can financial managers "fool" investors?
- Can financial managers "time" security sales?
- Are there price pressure effects?