Market Efficiency

Bernt Arne Ødegaard

University of Stavanger

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Introduction – market efficiency

Market efficiency
How prices of assets traded in markets will reveal information about those assets.
Why important: From a Darwinian point of view. Capitalist system winner.
Component of capitalist system: Capital Markets.
Purpose of capital markets: Efficiently transfer funds between lenders (savers) and borrowers (producers).

Notions of market efficiency

Perfect capital Markets

- Frictionless: No transaction costs, no taxes....
- Perfect competition in all markets.
  - Product markets: All produce at minimum average cost.
  - Securities: Everybody price takers.
- Informational efficiency: All information costlessly revealed to all participants.
- All individuals rational expected utility maximizers.

Allocational efficiency

- Markets are said to be allocationally efficient when prices adjust to equate (risk–adjusted) rates of return for all producers and savers.

Operational Efficiency

- Weaker notion: The cost of transferring funds between lenders and borrowers.
  If zero, perfect operational efficiency
  More relevant: Reflect costs of transfer.

Definition

The capital markets are said to be *efficient* if the market prices of all securities fully reflect all available information.
In an efficient capital market:

1. Market prices provide an unbiased estimate of value, that is, securities are *fairly priced*.
2. Securities are zero-NPV investments.
3. Market prices adjust rapidly to new (i.e. unanticipated) information.
4. Investors cannot outperform (on a risk-adjusted basis) the market consistently over time.

Info

Market efficiency – empirical question.
How to define define – prices fully reflect *all available information*.
Do we mean the information

- available to the small investor, such as you and I, or
- the information available to the specialist on the floor of the NYSE, or
- the information available to corporate insiders (inside information)?

Notions of informational efficiency

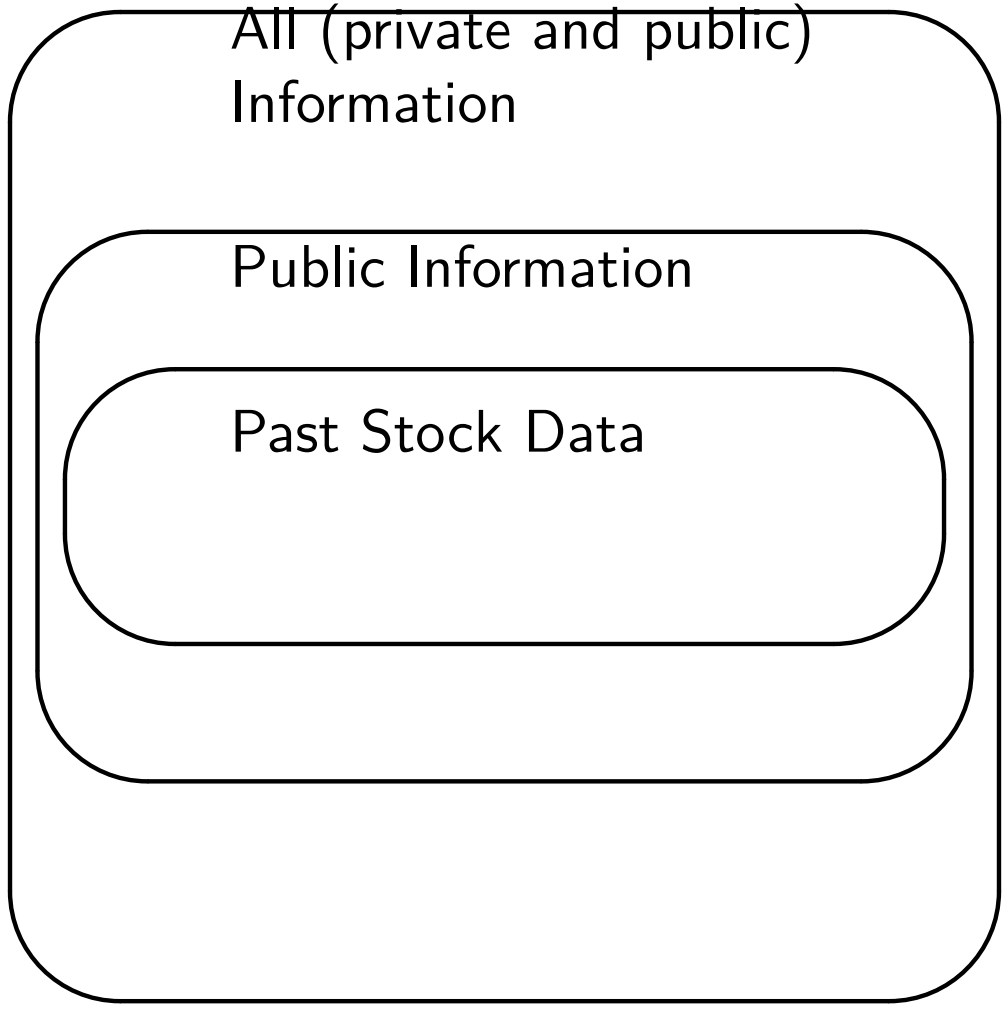
What information the market uses to set the security price.

1. Weak-form efficiency. Security prices reflect all available information contained in past prices. Technical analysis (i.e. charting) does not provide excess returns.
2. Semi-strong form efficiency. Security prices reflect all relevant publicly available information. Fundamental analysis does not provide excess returns.
3. Strong-form efficiency. *All* available information, public and private, is fully reflected in security prices. Inside information does not provide excess returns.

Introduced by Fama (1970)

Notions of informational efficiency

"The stronger the concept of efficiency, the more information available."



The Value of Information

A notion of the *value* of information is necessary to understand why it is so important in defining efficient markets.
A formal definition is in CW.
Some informal notes:
Information is only valuable if it will change your actions.

Example

If you are planning to paint your garage tomorrow. The weather forecast for the place you live is valuable, it may change your actions. The weather forecast for upper Mongolia is not a particularly valuable piece of information when planning tomorrows painting job.

The Value of Information

Given a piece of information:
How will you change your actions?
What is the difference in expected utility?

- before
- after

change in actions?
This is a measure of the value of information

Limits to efficiency

The Crossman-Stiglitz insight

consider a strict interpretation of the notion of *financial market efficiency*: that prices immediately reflect *all* available information.

The idea is that when new information hits the market, the "market" is able to process this information, agree on a new correct price, and the market price will immediately move to this new equilibrium price.

Leading to the classical notion(s) of market efficiency: Prices fully reveal all information/all public information/all information in past prices. (Fama, 1970).

The problem is that this ignores the *mechanism* by which prices moves in markets.

To move stock prices the stock needs to be *traded*.

Trading mainly happens when traders *disagree* about stock prices.

Limits to efficiency

It should *pay* to have a better estimate of the true value of stock. Suppose you behave as a fundamental value trader (think Graham-Dodd). Then you spend time analyzing the accounts of companies you potentially invest in. You may set up a valuation model of the company. You follow the news. A news item of the company may lead to an updating of the valuation model. Your updated valuation leads you to conclude that the stock is undervalued. You then want to *buy* the stock, thinking that it will eventually rise to reflect the true value of the company. These activities take time, and you may have to pay for the newsfeed with company-specific information.

With a strict interpretation of the efficient market hypothesis such activity will not pay. When you have decided that the stock is undervalued and want to buy, the EMH says the stock price has *already* moved up to reflect the new information.

The EMH in a sense ignores that participants in the market should be paid for their information-gathering activities.

But it is these types of information-gathering activities that lead to

Limits to efficiency

The EMH can not hold completely, it should be thought of as an approximation.
An alternative way of thinking about this is that it is a matter of the *frequency* the EMH applies to.
For annual/monthly/weekly stock prices it may be viewed as a good approximation.
But for daily and intraday price movements it may be farther from the true price process, at high frequencies there will be predictable price movements, etc.
Most researchers will accept that this is a very good intuitive argument, prices can not *immediately* reflect *all* information, new information will be gradually incorporated into the price.

Limits to efficiency

But once one tries to formalize this intuition, one runs into theoretical difficulties. It is hard to come up with a sustainable equilibrium when one tries to model the components of the above intuition:

- Heterogenously informed traders
- Information incorporated into stock prices through trading.
- Equilibrium amount of disagreement.

Modelling of such processes typically involve very stylized models of trade interaction between two types of traders

- Informed traders
- Uninformed (noise) traders

The informed traders are better informed (get a signal) about the true stock price.

Limits to efficiency

Depending on how the market is organized, this information is gradually reflected in the stock price.
To formalize their intuition, Grossman and Stiglitz (1980) builds such a stylized model.
For most people, understanding the model is not necessary, it is enough accept that one *can* build an equilibrium model of the trade process. Within the equilibrium of their model, the strict EMH can not be sustained, prices will never immediately reflect all information.

Testing for market efficiency

This idea that prices in financial markets reflect information of course something that people want to test, and that is a growth industry in financial research. There is no simple way to summarize this research, but in most cases one find support for some notion of market efficiency, that market prices reflect information.
We have traditionally differentiated between types of market efficiency based on what information the market uses to set the security price.

1. Weak-form efficiency. Security prices reflect all available information contained in past prices. E.g: Technical analysis (i.e. charting) does not provide excess returns.
2. Semi-strong form efficiency. Security prices reflect all relevant publicly available information. E.g: Fundamental analysis does not provide excess returns.
3. Strong-form efficiency. *All* available information, public and private, is fully reflected in security prices. E.g: Inside information does not provide excess returns.

Testing

Fama (1991) returns to his classical Fama (1970) paper and summarizes where we have ended up 20 years later. He concludes that markets were on the main efficient. This paper serves as a useful starting point to discuss the empirical research.
The form of the Efficient Market Hypothesis does still not explicitly account for the trading costs/information effects discussed by e.g Grossman and Stiglitz (1980). Uses EMH as a benchmark and then discusses whether departures can be explained by these types of effects.
The three categories above were changed, to better fit what had happened on the empirical front in the last 20 years.

Testing efficiency

1. Tests for return predictability
   - Time series predictability.
   - Cross-sectional predictability (tests of asset pricing models)
2. Event studies
3. Tests for private information
   - Insider trading
   - Security analysts
   - Portfolio managers

Joint hypothesis problem

> *We can only test whether information is properly reflected in prices in the context of a pricing model that defines the meaning of properly.*
>
> *(Fama, 1991, pg 1576)*

If we e.g. find that returns are predictable, may only be judged to be a departure from market efficiency when we discover that the "true" asset pricing model does not allow for the particular predictability discovered.

Tests of (time–series) predictability.

- Are future stock prices predictable from past stock prices?
- If so, does this violate market efficiency?
- Does the predictability allow investors to make excess profits?

If the market is weak form efficient, then it should not be possible to predict future stock price movements from past prices. Technical analysis, however, attempt to do just that. They believe that stock prices follow particular patterns, and that these patterns tend to repeat themselves over time. In an efficient market, stock price changes should be uncorrelated over time (i.e. serially uncorrelated), and trading rules designed to exploit the patterns of past prices should not provide excess returns.

Tests of (time–series) predictability.

The null hypothesis in the predictability literature has evolved over time.
Started out with the *Random Walk hypothesis* in various guises.
These are tests of whether returns are uncorrelated over time. Any predictability is a violation of market efficiency.

$$P_t = \mu + P_{t-1} + \epsilon_t$$

where
P_t is the price of the asset at time t, μ is the drift, and
ϵ_t is random.
The strong version of the random walk says ϵ_t is iid.
Weaker versions: less restrictions on ϵ_t.

Tests of serial correlation

If the market is weak form efficient, stock prices will follow a *random walk*. This means that stock price changes, or percentage changes, should be serially uncorrelated. That is, we require:

$$\text{corr}(r_{t-s}, r_t) = 0 \text{ for all } s$$

Early evidence supported this hypothesis, but newer evidence do find significant amounts of autocorrelation in short–period returns. Observe that much of the time the autocorrelation is not equal to zero, but not enough to say everything is inefficient, still the question of whether the pure random walk is a sensible null.

Tests of filter rules

Technical analysts believe that the market responds to new information, and therefore, that price movements will persist. When prices have moved up in the recent past, one can expect them to continue to move up, and there is likewise a persistence in downward price movements. Technical analysts have a special language of their own to describe the expected movements of stock prices as a function of the recent price observations of the stock, examples are: heads and shoulders.

Filter rules are close in spirit to the various trading rules proposed by technical analysts. A filter rule can be described as follows: If the price of the security moves up at least y percent, buy and hold the security until its price moves down by y percent from a subsequent high, at which time simultaneously sell the security and go short. The short position is maintained until the price rises at least y percent above a subsequent low, at which time one covers the short position and goes long.

A classical study used filter rules on the 30 Dow-Jones stocks over the period 1956-62. The buy and hold policy had a return of

Nonlinearities in stock returns.

Serial correlation is a "linear" (simple) relation between subsequent return observations. A nonlinear relation is a more complication functional relation between past and future returns. Current research indication evidence of nonlinearities in stock returns
We do however need large computers and lot of data to exploit these nonlinearities. Mutual Funds have been formed that try to use these models, and we have some evidence that this make money.
To answer the question whether we can view this as evidence of market inefficiencies, we need to ask: Are the expected profits so large that they more than justify the expenditure in computers and expensive "experts"?

Adjusting the null

It has now become clear that there is a significant amount of predictability in stock returns. But that does not mean we have violated efficient markets, it only means we have rejected versions of the EMH that predict that prices follow random walks.
Is it possible to find economic models that predict time varying expected returns? If so, can reject random walk, but still have an efficient market.

Event Studies

How stock prices react to “new” information.
Methodology.

[Event studies - see separate notes]

(cross sectional predictability)

What does Fama say about return predictability in the context of an asset pricing model?

Summarize results

- Early evidence: Positive relation returns & beta
- Roll critique: Without the market portfolio, can not claim to have tested CAPM
- Anomalies: Other variables beside beta important in explaining returns.
  - Size (Banz (1981))
  - Seasonality
  - E/P ratios
  - Leverage
- Bottom Line: (Asset pricing models) ((Fama, 1991, pg 1593))

  The SLB model also passes the test of practical usefulness. Before it became a standard part of MBA investments courses, market professionals had only a vague understanding of risk and diversification. . . . The SLB model gave a summary measure of risk, market β, interpreted as market sensitivity, that rang mental bells. Indeed, in

Tests of Strong-Form Efficiency.

If the market is strong-form efficient,
can not earn excess returns using *private* information.
Hard to test, can not measure private information.
Some evidence:
Return on corporate insider portfolios consistently outperform a simple buy-and-hold policy.
Specialists on the floor of the exchange earn a 88%-190% on their invested capital.
(Explain the high prices on a post at the exchange?).

The classical strong form efficiency definition.
If the market is strongly efficient, then it should not be possible to earn excess returns or public or *private* information. Clearly this is a strong requirement, and one which no one really believes is true. There have been few tests of strong form efficiency, essentially because it requires knowing who has the private information.

One group of people who do have superior private information about companies and their future prospects are the managers of those corporations. Not surprisingly, studies that have tracked the returns earned by corporate insiders have documented that they do consistently outperform a simple buy-and-hold policy. This may be why strict monitoring of the trades of corporate insiders (and their families) is done by the exchanges and the SEC.
Counterevidence: Eckbo and Smith (1998) looks at Norwegian data.

Another group that does well are the specialists on the floor of the exchange. They earn a somewhat surprising 88%-190% on their invested capital (which may explain the high prices on a post at the exchange).

If the market is strongly efficient, then it should not be possible for professional mutual fund and portfolio managers to consistently outperform the market (on a risk-adjusted basis).
There has been a large set of studies of this, and the conclusion is that on a risk adjusted basis, there are no evidence that mutual fund managers can consistently outperform the market.

In corporate finance we are interested in the interaction between the capital market and a firm (Corporate Financing).
The issue of whether markets are efficient is relevant because of the implications for the price at which a firm is financed.
Any firm will interact with the capital market to finance their operations. (The "right hand side.") If markets were not efficient, this would have consequences for the prices at which a firm is financed.
The main lesson from the efficient market literature: There are no financial illusions. It is not possible to *fool* the financial markets.
As one example, consider the question of choice of accounting procedures. We all know that by choosing the "right" accounting procedure, we can to a large extent decrease and increase reported earnings. An example we have already seen, the choice of depreciation procedure.
But as long as the exact accounting procedure is given in the annual report, any Financial Analyst worth his money can go in and undo the effect of these accounting procedures.

Summary – market efficiency

- An efficient market processes the information available and incorporates it into security prices.
  Implications:
  - A stocks abnormal return in a period can depend on information released in that period.
  - With public information only, can not expect to make abnormal profits.
- What information is available? Weak, Semi-strong and strong efficiency.
  Empirical support for weak and semi-strong efficiency.
  Public information is incorporated into prices.
- Some empirical evidence against efficient markets.
- Implications for corporate finance:
  - The price of a company's stock can not be affected by a change in accounting. (Except the tax consequences)
  - Finance managers cannot time issues of bonds and stocks using publicly available info.
  - A firm can sell as many bonds or shares of stock as it desires without depressing prices.

Six Lessons of market efficiency

Markets have no memory.
Past information is already incorporated into today's prices, do not think it will affect future events.
Trust market prices.
Unless you have more information than the market, the market price is the best indicator of a security's value.
There are no financial illusions.
You can not *fool* the market by e.g. Creative Accounting.

Six Lessons of market efficiency ctd

The do-it-yourself alternative.
The market will not pay for something it can do on its own.
Example: Merger. Investors can buy stocks in two companies on their own, do not need the companies to merge.
Seen one stock, seen them all.
Large quantities of securities can be bought and sold at current prices without affecting prices much, *as long as these transactions do not reveal inside information.*
Reading the entrails.
Because markets are efficient, security prices contain information about the markets expectations about the future. Hence security price indices are good "Economic Indicators."

Rolf W Banz. The relationship between return and market value of common stocks. *Journal of Financial Economics*, 9:3–18, 1981.

B Espen Eckbo and David C Smith. The conditional performance of insider trades. *Journal of Finance*, 53:467–498, April 1998.

Eugene F Fama. Efficient capital markets: A review of theory and empirical work. *Journal of Finance*, 25:383–417, 1970.

Eugene F Fama. Efficient capital markets: II. *Journal of Finance*, 46(5): 1575–1618, December 1991.

Sanford Grossman and Joseph Stiglitz. On the impossibility of informationally efficient markets. *American Economic Review*, 1980.