Market efficiency

- "Market efficiency" main topic in Malkiel and Shiller
- Different from other concepts of efficiency
  - Such as Pareto efficiency of a competitive economy
  - Or mean-variance efficiency of portfolio choice
  - These are mathematically defined, but not market efficiency
- Definition: Three forms of market efficiency:
  - Weak m. e.: Prices of one asset accurately reflect all information that can be derived by examining market data for that asset, such as past prices, trading volume, short sales, etc.
  - Semi-strong m. e.: Prices accurately reflect all publicly available information for the same and other assets, including past prices, fundamental data on firms' production, management, balance sheets, patents, accounting, earning forecasts, etc. (including info mentioned under weak m. e.)
  - Strong m. e.: Prices accurately reflect all information that is known by anyone, including inside information (including info mentioned under semi-strong m. e.)
- Malkiel and Shiller have different points of view
- Get an overview, no reason to memorize all details

Market efficiency: Information sets

- Definition based on three information sets:
  1. Asset's own history of prices (and returns).
  2. All publicly available information.
  3. All existing information.
- The first is subset of the second, which is subset of third.

Example:

- Firm makes new invention, cheaper production technique.
- First some engineers get the news. Info restricted to these.
- They realize that invention increases earnings potential.
- Assume: Easy to estimate value increase for the firm.
- If engineers do not trade in shares, share price unaffected.
- Info exists, but has no effect. Not strong efficiency.
- If engineers start buying shares: Share price increases.
- Strong efficiency conflicts with laws against insider trading?

Semi-strong efficiency

- Alternative definition (Malkiel, p. 60), fits best with "semi-strong": Efficient markets do not allow investors to earn above-average returns without accepting above-average risks.
- If not: Some trading rule will give "excess returns."
- Using publicly available info only.
- Perhaps info on many shares, macroeconomic variables, ...
- (No conflict with laws against insider trading.)
- "Excess returns" requires comparison, based on, e.g., CAPM.
- To disprove semi-strong eff.: Come up with trading rule.
- But if you know such a rule: Would perhaps prefer to use it?
- May exist lots of evidence which is never published.

Weak efficiency

- To disprove: Trading rule based on one time series.
- Known as technical analysis. See newspapers.

Testing for "excess returns"

- Empirical tests for market efficiency: Excess returns?
- Market efficiency rules out systematic excess returns.
- "Excess" means "above normal," "extraordinary."
- How to test for this empirically?
- Could look for *obviously* very large or small returns.
  - E.g., rates of return of minus 23 per cent in a week for the stock market as a whole.
  - Look if these appear systematically in some situations.
  - If so, doubt market efficiency.
- More commonly, compare to model predicted rates of return.
  - Typically CAPM or some extension of it.
  - Could also rely on other models, inconsistent with CAPM.
  - Test joint hypothesis: Model *and* market efficiency.
  - If rejected: Either model rejected or market efficiency rejected or both.
  - Not desirable. Would prefer not to rely on specific model.
- Third alternative: Look for other phenomena.
  - Phenomena which occur in price time series, but which cannot be explained (rationally) by information arriving in market.

Information paradox

If markets are efficient, there is no reason for anyone to use resources to gather information about firms' earnings potentials (or "fundamental values"), since these will be reflected in market prices already. But then, no one will gather information, and it is hard to believe that markets are efficient.

- Non-efficiency also paradox: Then it pays to gather info.
- If it pays, many will do it.
- But then one moves towards efficiency.

Resolve: How to describe an equilibrium situation?

- Assume: Costly to gather information.
- Simplifying assumption: Either "informed" or not.
- (More realistic: Different degrees of being informed.)
- Equilibrium: Cost equal to expected gain from gathering it.
- Investors self-select into two groups: Informed and uninformed.
- No-one earns *net* excess returns.

Anomalies

- Anomalies: Irrational events or patterns in (share) prices.
- Cannot be explained under rationality and market efficiency.
- Example (single event): Crash in Oct. '87, decrease by 23%.
- Were prices really that wrong before crash?
- Malkiel (p. 73f) try to rationalize decrease by drop in expected growth rate of dividends. Not quite convincing.
- Example (pattern): Prices fall around weekends.
- Actually observed in some markets in some periods.
- When recognized by traders: Possible to earn excess returns.
- Trading rule: Buy Friday, sell Tuesday.
- Obstacle to this trading rule: Transaction costs.
- Typically brokers demand fees both for buying and selling.
- If transaction costs large, they can explain many anomalies.
- Or at least, anomalies then compatible with efficiency.
- Transaction costs must be small if anomalies used as proof.
- "Excess returns" should exceed transaction costs.

Fundamentals

- Stock market analysts try to estimate fundamental values.
- Can be based on CAPM; need extension to many periods.
- Assume var-cov matrix and $E(r_M)$ are the same every period.
- Distinguish between stock price P_t and dividend payout D_t.
- Simplify notation: Drop subscript j for stock no. j.

$$P_t = \frac{E_t(D_{t+1} + P_{t+1})}{1 + r_a}$$

where $r_a = r_f + \lambda \operatorname{cov}(r_j, r_M)$, cf. p. 7 of 1 Sept., and E_t is expectation conditional on information available at time t.

$$P_t = \frac{E_t(D_{t+1})}{1 + r_a} + \frac{E_t \frac{E_{t+1}(D_{t+2}+P_{t+2})}{1+r_a}}{1 + r_a}$$

Need law of iterated expectations: When information set at t is included in information set at $t+1$, then $E_t[E_{t+1}(P_{t+2})] = E_t(P_{t+2})$. This implies

$$P_t = \sum_{\tau=1}^{\infty} \frac{E_t(D_{t+\tau})}{(1 + r_a)^\tau}$$

which is the fundamental value of this corporation (if we assume that the sum converges), cf. Shiller, top of p. 85.

Variance of stock prices vs. variance of fundamentals

- Shiller: Test market efficiency from variance estimates.
- Look at time series of stock prices and of "fundamentals."
- Fundamentals: Present value of subsequent dividend payouts.
- Starting in 1860. For each corporation which survives long enough:
  - For each year, calculate PV of dividends from then onwards.
  - (Use some forecast for dividends after 2004.)
  - Estimate variance of this time series, compare with variance of stock price.
- Hypothesis: Variance of stock price $<$ variance of fundamentals.
- Rejected by data.
- Hypothesis is derived from efficient market idea:
- Price today should be optimal forecast of fundamentals, with no noise.
- Realization of fundamentals will contain noise, i.e., it is sometimes above, sometimes below the forecast which was made.

$$\sum_{\tau=1}^{\infty} \frac{D_{t+\tau}}{(1+r_a)^\tau} = \sum_{\tau=1}^{\infty} \frac{E_t(D_{t+\tau})}{(1+r_a)^\tau} + U_t$$

Random walk

- Typical specification of efficient market hypothesis:
- Logarithm of stock prices follows a random walk.
- Definition: P_{t+1}/P_t is independent of previous P_t/P_{t-1}, $P_{t-1}/P_{t-2}, \ldots$. Also, $E_t(P_{t+1}/P_t) - 1$ is constant for all t (— this is called the *drift* of this stock price).
- Connection to efficient markets:
  - Relative change in coming period is due to new information.
  - If it were correlated with previous changes, it would be partly predictable.
  - Then it would not be new information.
  - Then one could make excess returns by predicting price changes and make trading rule.

Serial correlation, mean reversion, etc.

- Signs of the following would contradict market efficiency:
  - Positive serial correlation, also known as momentum: Increases in stock price is followed by further increase, decrease by further decrease. (But: Need to know length of cycle to prescribe trading rule.)
  - Negative serial correlation, such as mean reversion (prices tend to return to a long-run mean value): Increase is followed by decrease, and vice versa. Trading rule: Sell after increase, buy after decrease.
- Both of these may be studied on different time scales.

Bubbles

- Suppose a company pays dividends 10 NOK per share each year.
- Suppose the beta of the shares implies a RADR of 5 per cent, $r_a = 0.05$.
- If you believe these two numbers will last forever, fundamental value per share is

$$P_t = \sum_{\tau=1}^{\infty} \frac{E_t(D_{t+\tau})}{(1+r_a)^\tau} = \sum_{\tau=1}^{\infty} \frac{10}{1.05^\tau} = 200.$$

- Suppose many people start to believe that the profits of the company will be higher in the future.
- The information is circulated that there will be higher future dividends, even though it cannot be verified.
- Although the company continues to pay 10 NOK per share, people are willing to pay more for the shares if they believe in higher future values.
- More specifically, suppose someone believes share will pay 30 NOK per share, starting 10 years from now.
- The additional flow has the value 245 NOK per share; total value is thus 445 NOK per share.
- This would be a rational price as long as the prediction about the future is not clearly contradicted by facts.
- Even if you believe it is irrational: High probability of earning good returns as long as everyone else believes in it.

Event studies

- Empirical studies used to test market efficiency.
- Some types of events are suspected to have "anomalous" characteristics.
- Example: Study what happens to stock price in a company around the date when
  - it is announced that the company is a takeover target, or
  - the company makes announcement about its earnings.
- Malkiel (p. 64) claims that such anomalies have existed, but tend to disappear over time.
- Logical: As soon as everyone knows about, e.g., weekend effect, many will buy on Fridays, sell on Tuesdays.
- Leads to higher share prices on Fridays, counteracting previously observed weekend effect.
- However, it remains an empirical question whether anomalies actually tend to disappear.

Consequences of market efficiency

- In previous lectures, have assumed agents have homogeneous beliefs, i.e., believe in same means, variances, covariances.
- In reality different beliefs, partly due to different information.
- Many investors pick investments based on superior knowledge (they hope).
- Equilibrium model of this phenomenon: Information is costly (see p. 5).
- Assume you invest in firm because it has some superior technology.
- At that point in time, you know this better than other people.
- After some time technology is used in practice, free knowledge.
- You still believe this firm will be doing fine.
- However: Now this is public knowledge, reflected in share price.
- No longer any reason for you to have much invested in that share.
- Conclude: Investment based on specific information about a firm should rely on information advantages relative to publicly available information, not just on well based optimism about firm.

Conclusions about market efficiency

- Hypothesis about (semi-strong) efficiency should neither be accepted nor rejected as uninteresting.
- Many reasons to believe in strong forces towards market efficient outcome.
- But also clear signs of irrationality, in particular over some time periods.
- Instead of "is the market efficient?" these are more relevant questions:
  - How efficient is the market?
  - How and why does the market react to new information?
  - What are the mechanisms that bring market prices in line with fundamental values?