Lecture notes on risk management, public policy, and the financial system

Capital market efficiency

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- Asset prices in an efficient market
- Validating the efficient markets hypothesis
- Efficacy of active management
- Behavioral finance

What are efficient markets?

- **Efficient markets hypothesis** (EMH) maintains that current asset prices reflect all currently available information
  - Absence or near-absence of arbitrage opportunities
- Different definitions of "all information"

  Weak-form EMH: all the information in past prices
  Strong-form EMH: all public and private information
- Asset prices are generally close to "correct" price
  - Variously described as **equilibrium price** or **fundamental value**
  - E.g. CAPM predicts $\alpha_i = 0$ *in equilibrium*
- **Rational expectations** (more or less):
  - Investors' subjective expected value of future asset values equal to best statistical estimate given available information set
  - But choices nonetheless determined by risk preferences and entire distribution of outcomes
- Markets are permitted to clear

Efficiency can only be approximated in the real world

When there's steak on the table, eat steak trading desk maxim

- How fast should market prices adjust and how close should they be to equilibrium to validate EMH?
  - Market process time-consuming, requires costly information-gathering
  - Equilibrium price itself not observable and may be changing over time
- **Limits to arbitrage** and **slow arbitrage**:
  - Position-taking requires costly information-gathering and time that must be compensated
  - $\Rightarrow$Asset markets cannot be perfectly strong-form efficient (**Grossman and Stiglitz paradox**)
- Long-term reversion: "cheap" assets—with unusually low recent returns—often have high returns over subsequent several *years*
  - E.g. following overall market slumps, sold-off sectors and firms
- But prices act as signals even if not perfectly correct at any time
  - Tendency to equilibrium
  - But equilibrium never actually reached as world changes
- Fisher Black: efficiency if "price is within a factor of 2 of value."

Risk and market efficiency

- Most "arbitrage" opportunities involve some risk-taking
- Presence of time-varying **risk premiums** is
- Can be identified empirically using models, information variables related to risk that help predict returns
  - Excess returns then related to risk, not successful arbitrage
- But persistent riskless arbitrage opportunities *not* compatible with EMH

Empirical evidence on market efficiency

- Implications of market efficiency:
  - Changes in market prices not predictable (**random walk hypothesis**)
  - Impossibility of systematically earning "abnormal" returns—higher risk-adjusted returns than the market
- Empirical evidence on market efficiency drawn from several sources

  Time series behavior of asset returns: do past returns alone help predict future returns?

  Return forecasts based on information variables: do current variables other than past returns help predict future returns?
    - E.g. data on company fundamentals, economic data

  Efficacy of active management by mutual and hedge funds

  Event studies: surprises should have instantaneous but non-persistent impact on price
- Methodological difficulties introduced by trading costs, changes in risk and risk appetite over time

Efficiency and return time series behavior

- EMH implies past returns contain (close to) no information that could help forecast future returns
- **Law of iterated expectations:** knowledge grows over time
  - Future equilibrium price will be based on information available in the future
  - New information available in future is unknowable now
  - $\Rightarrow$Today's estimate of future price equals that based on current information
  - $\Rightarrow$Expected value of price return based on current information must be zero
- **Autocorrelation** or **serial correlation** of returns—correlation of returns in successive periods—near zero
  - Validates EMH: past returns contain almost no information that could help forecast future returns
- Returns in successive periods uncorrelated, but not independent
  - But higher moments, e.g. volatility, exhibit serial correlation

Joint hypotheses in tests of market efficiency

- The **joint hypothesis problem:** any test of market efficiency is bundled with a model of asset price determination
  - Non-rejection⇒non-rejection of *both* efficiency and pricing model
  - Rejection⇒rejection of *either* efficiency or pricing model (or both)
- Finding abnormal returns to a strategy may just reflect inadequacies of model
- Tests of any pricing model are also tests of efficiency
  - E.g. CAPM valid only if markets efficient
- Risk premiums, equilibrium prices vary over time
  - Pure random walk hypothesis requires constant expected returns
  - Excess returns are risk premiums, returns to priced factors
- Failures of efficiency tests→revised pricing models
  - Violation of variance bounds, predictive value of dividend yield: evidence of time-varying price of risk
  - Search for priced factors ("smart beta")

Active and passive investment management

Passive management: imprecise term used to describe range of investment strategies including

- Narrow definition: holding the value-weighted market portfolio ("the market") at all times
  - Strictly defined, encounters problems of defining market portfolio, e.g. human capital, other non-traded or illiquid assets
- Investing largely in value-weighted market portfolio but applying "tilts" based on multi-factor models
- Investing in index mutual funds or ETFs

Active management: deviating from passive management, based i.a. on

- Applying an investment strategy based on inefficiencies in capital markets
- Possession of information superior or more accurate than that incorporated into current asset prices
- Ability to identify asset managers capable of earning higher risk-adjusted excess return than the market

Does active management pay off for investors?

- Little evidence of "beating market," adjusted for risk, trading costs
- Dimensions of predictive ability in active management

  Asset price forecasting or stock picking
  Market timing: forecasting the general return level of all risky assets
- Challenge of identifying persistence, luck/false positives
  - Can identifiable active managers predictably outperform over the long term?
- Skill-based excess returns accrue only to manager as fees rise and opportunities exploited
- Some managers may have skill, but investors lack ability to identify them *ex ante*
  - Managers may trade solely to suggest they have superior information
- Absence of successful trading rules, in spite of evidence of autocorrelation of functions of returns, long-term predictability
- Successful active management improves *risk-adjusted* returns

Measuring active management performance

- Framework: Compare active managers' monthly or annual returns to performance of model—set of benchmarks **x**
  - E.g. CAPM or Fama-French model set benchmarks
- Via time series regression of j managers' returns on factor model

$$r_{jt} - r_{ft} = \alpha_j + \mathbf{x}_t\boldsymbol{\beta} + \varepsilon_{jt}, \qquad t = 1, \ldots, T$$

- $r_{jt} - r_{ft}$ measured **gross** or **net** of costs
  - Costs include administrative, salary and trading expenses of manager
  - But exclude load, other sales charges or commissions that further reduce investor return
- Result is a distribution of estimated $\hat{\alpha}_j$
  - Active manager out(under)performs$\rightarrow \hat{\alpha}_j > 0 (< 0)$

Testing for active management outperformance

- Many active managers achieve superior returns, many underperform
  - Expect to observe $\hat{\alpha}_j \gtrless 0$ for most j—consistent with efficiency?
  - How discern if significant fraction of managers "beat the market"?
- t-statistic $t(\hat{\alpha}_j)$: normalize $\hat{\alpha}_j$ by its standard error $\sigma(\hat{\alpha}_j)$

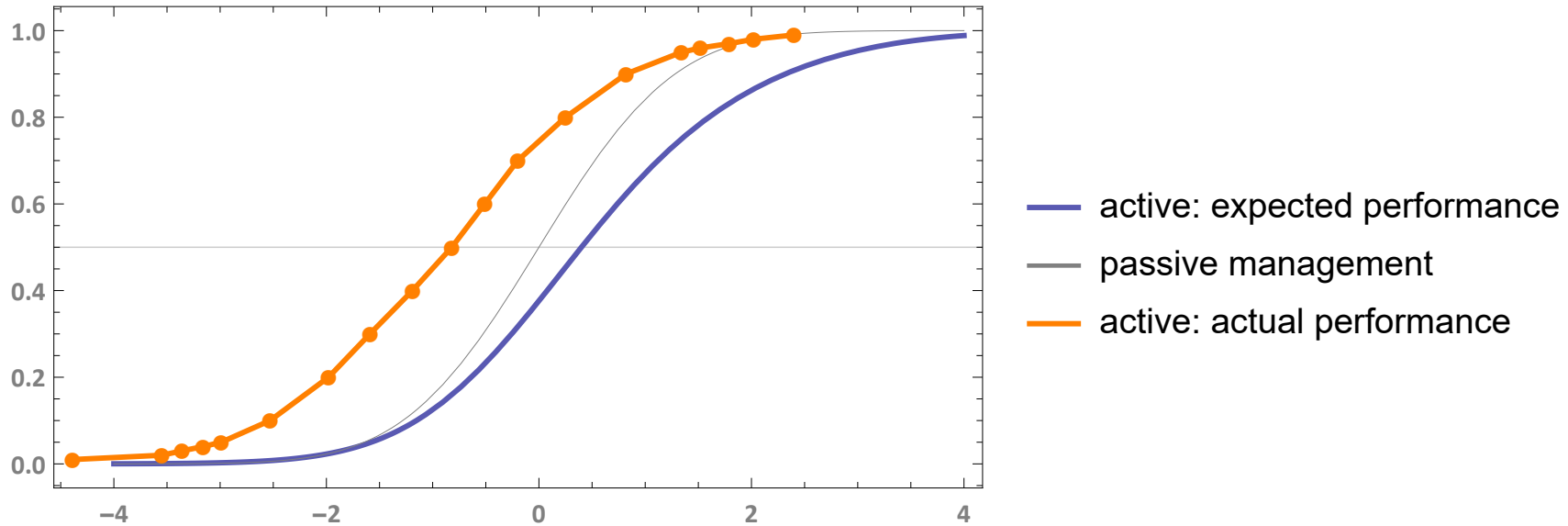
$$t(\hat{\alpha}_j) = \frac{\hat{\alpha}_j}{\sigma(\hat{\alpha}_j)}$$

- Active manager performance matches benchmark$\Rightarrow$ $t(\hat{\alpha}_j) \sim \mathcal{N}(0,1)$
- Active manager outperformance$\Rightarrow$distribution of $t(\hat{\alpha}_j)$
  - Has mean > 0 $\Rightarrow$most active managers outperform
  - And/or skewed to positive values$\Rightarrow$significant fraction of managers outperform

Evidence on active management outperformance

- The $t(\hat{\alpha}_j)$ don't look like a sample from $\mathcal{N}(0,1)$
- Mean of distribution of $t(\hat{\alpha}_j)$ using gross returns close to zero
- Mean of distribution of $t(\hat{\alpha}_j)$ using net returns < 0
- Distribution of $t(\hat{\alpha}_j)$ using gross or net returns skewed to large *negative* values
- Interpretation:
  - Typical active manager barely recoups management costs, doesn't outperform market
  - Typical active manager underperforms market once management costs accounted for
  - Active managers perform worse than if performance relative to benchmarks were entirely random

Evidence on active management outperformance



Stylized representation of the empirical results in the Jensen (1968), Fama and French (2010) and other papers comparing active mutual fund returns to benchmark models. The plots represent the densities or empirical distributions of t-statistics of fund managers' returns. Returns are measured on the x-axis in standard deviations of managers' excess returns over returns on value-weighted market portfolio, with excess returns measured net of investment management costs. The purple plot displays the expected empirical result if active management results in outperformance: a positive mean or a skew to outperformance. The orange plot displays the actual empirical result: active management has a *negative* mean and a skew to surprisingly large *underperformance*. The vertical grid lines mark the means of the two distributions. The gray displays results for the benchmark—the indexers.

Individual active manager efficacy

- It takes a very, very long time to assess one manager's performance
- Claims by active asset managers that they can "beat the market" are weak
- Many years of observations required to establish individual active manager efficacy with high confidence
- Suppose a market index used as benchmark
  - Manager claim: "beating the market" by α, e.g. 2 percent annually

$$y = \alpha + \beta x,$$

  with y, x the manager and benchmark excess return over risk-free
  - Square of **standard error** $s^2(\hat{\alpha})$ of $\hat{\alpha}$ in regression estimate:

$$s^2(\hat{\alpha}) = (1-\bar{R}^2)s^2(y)\left[\frac{1}{T} + \frac{\bar{x}^2}{\sum_t^T (x_t - \bar{x})^2}\right] = \frac{(1-\bar{R}^2)s^2(y)}{T}\frac{1+\bar{x}^2}{s^2(x)}$$

Validating individual manager efficacy: example

- Represent single manager by HFRX Global Hedge Fund Index
  - Using past 30 years of data (moments at monthly rate):

$\bar{R}^2$	0.5
$s^2(y)$	0.045
$\bar{x}^2$	0.006
$s^2(x)$	0.015

  - Individual active manager likely has higher $s^2(y)$
- Test hypothesis $\alpha = 3$ percent annually or 25 bps/month
  - Would barely cover typical activist fees
  - Against null hypothesis $\alpha = 0$
  - Assume T large, use normal distribution, solve for T:

$$1.96 = \frac{\hat{\alpha}}{s(\hat{\alpha})} = \frac{0.0025}{\sqrt{\frac{0.5 \times 0.05}{12T}\left(1 + \frac{0.006^2}{0.015^2}\right)}},$$

- 60 years needed for significance at 95 percent confidence level

Slow arbitrage and active management

- Some evidence that "patient capital" may earn excess returns
  - Institutional asset management rather than mutual funds
- Portfolios with significant differences from benchmarks and low turnover

Anomalies in asset prices and market behavior

Deviations of price from fundamental value: many securities, far fewer meaningfully independent influences on them

- **Data mining:** sifting through large amounts of data to find anomalies that pass significance tests

Excess volatility of asset prices compared to cash flows

- Source of volatility may be **time-varying** risk premiums related to macroeconomic conditions
- Model of risk, e.g. CAPM, required to adjudicate empirically

Large trading volumes: many securities, far fewer meaningfully independent influences on them

- **Noise trading** may be necessary for pricing and efficiency
- But in efficient market, how is anyone remunerated for the effort of information gathering?

Market efficiency and behavioral finance

- **Behavioral finance**: study of possible departures from efficiency attributable to non-rational behavior in
  - Evaluation of information, e.g. **overconfidence**
  - Ranking of outcomes, e.g. **loss aversion**
- Persistent anomalies in patterns of asset prices and market behavior interpreted as departures from rationality, evidence against efficiency
  - But anomalies not systematically exploitable⇒consistent with efficiency
- The clash of religions: excess volatility can be explained as result of
  - "Irrational" fluctuations in sentiment
  - Changes in risk appetites consistent with a reasonable posited utility function