**Market Efficiency**

* CAPM Assumptions Revisited
  + Perfect Capital Market
    - Competitive and info efficient market in which there are no market frictions (transaction costs and taxes)
    - No price impact (we are price takers)
    - Assuming no market frictions is a simplification
      * With no transaction costs, traders can take advantage of mispricings
      * Prices should quickly adjust to the “true value”
      * If transaction costs do exist, small mispricings may persist
* Types of efficiency
  + Allocational
    - Resources are allocated to their highest valued uses
  + Operational
    - Transaction costs are relatively low
  + Informational
    - Asset prices reflect new info quickly and correctly
    - Focused on in this chapter: “market efficiency” or “efficient market” means informational
* Efficient Markets Hypothesis (EMH)
  + Burton Malkiel’s definition: a capital market is said to be efficient if it fully and correctly reflects all relevant info in determining security prices
  + Formally: a market is said to be efficient with respect to some info set if security prices would be unaffected by revealing that info to all participants
    - Informally, the info is already “priced in”
* 3 Forms of EMH
  + Need to define the info set
  + Weak Form EMH
    - Includes the history of all security prices and returns
    - Referred to as including all historical publicly available information
  + Semi-Strong EMH
    - Includes all publicly available information
    - Referred to as including all present publicly available information
  + Strong Form EMH
    - All info (public and private) known to any market participant
    - Referred to as including all future publicly available information
  + Weak fits into semi-strong which fits into strong
* Violations of the EMH
  + Due to the nature of the relationship between the three forms, any violation of one firm violates any higher forms
  + Violation of the weak = violation of the semi-strong = violation of the strong
  + Violation of the semi-strong = violation of the strong
  + Violation of the strong is only a violation of the strong
* Weak Form EMH
  + Random Walk Theory
    - Changes in stock prices are statistically random (no pattern)
  + In an informationally efficient market, stock prices are only sensitive to new information
    - Arrives at random intervals
    - Changes in price must also be random
* Random Walk with Positive Trend
  + We don’t know when or how the price will change
  + Properties:
    - Expected price change is positive over time
    - Positive trend, but random around the trend
  + On a day-to-day basis, the expected price change is close to zero
* Weak Form Example
  + Coin toss game: you start with $100 and flip a fair coin every week
    - If heads: earn 3% on investment
    - If tails: lose 2.5% on investment
  + E(r) = (.5 x 3) + (.5 x -2.5) = 0.25%
* Implications of Weak Form EMH
  + Analysts try to earn abnormal returns by timing the market based on charting techniques
  + If markets are weak form, they should not be able to earn above average, risk-adjusted returns
    - We are not actually saying that they can’t make any returns
    - Their α must = 0
  + Weak form states that information in past market data does not predict returns
    - Aka all of the tools that they would be using (prices, returns, volume, etc.)
  + Illustrated:
* Semi-Strong Form Efficiency
  + Security prices reflect all publicly available info
    - Financial statements, annual reports, quarterly earnings reports, dividend announcements, and past changes in price and volume
  + Implications:
    - Casts doubt on usefulness of fundamental analysis
    - Analysts examine info to identify undervalued stocks
    - If semi-strong efficiency holds, analysts should not be able to produce above average, risk-adjusted returns
      * Their α should = 0
* Strong Form Efficiency
  + Prices reflect all information
    - Public and private
    - Includes information held by corporate insiders
  + Implications:
    - Even insiders would be unable to earn abnormal, risk-adjusted returns
      * Their α should = 0
* Can markets be perfectly efficient?
  + A paradox
  + EMH argues that all information is included in prices and abnormal returns cannot be consistently realized
    - Begs question: if no money is to be made, why would you collect info?
  + Can explain this based on the speed at which the market adjusts to info
    - Takes a small amount of time for market to price in the info
    - Professional analysts able to earn returns from researching securities but regular analysts are unable to do so
* Are markets efficient/can we ever tell?
  + Magnitude issue:
    - Can we detect abnormal performance in economic studies?
    - Signal-to-noise ratio low
  + Selection bias
    - Someone who truly devises a successful method of earning high returns won’t publicize it
  + Luck or skill?
    - Could be pure chance
* Random walks and autocorrelation
  + If the market is weak form, security returns in non-overlapping periods should be uncorrelated
    - Correlation between different time periods known as autocorrelation
  + If market is info efficient, then any info should be properly priced-in as soon as it’s released
    - Any movements in the future should be effectively random from our view today
    - We would expect any autocorrelation to be 0
* Types of Autocorrelation
  + Negative
    - Periods with positive (-) returns followed by periods with negative (+) returns
    - Reversal effect
    - “winners lose”
  + Positive
    - Periods with positive (-) returns followed by periods with positive (-) returns
    - Momentum effect
    - “winners win”
* Autocorrelation and Weak Form EMH
  + If either the reversal effect or the momentum effect exists, this implies a violation of the weak form EMH
  + Both effects imply that we can’t use a past return to predict a future return
  + If we find evidence against random walk, it’s evidence against weak form EMH
* Testing Weak Form EMH
  + Regress today’s return on yesterday’s return:
  + Two values we care about:
    - α measures trend/average return
    - γ measures autocorrelation (generally only care about this)
* Interpreting γ
  + 3 cases we are interested in:
    - γ = 0: current return is uncorrelated with previous return, implying a random walk
    - γ < 0: current return has a negative autocorrelation with previous return, suggesting reversal effect
    - γ > 0: current return has positive autocorrelation with previous return, suggesting momentum effect
* Using BA II Plus for γ
  + Data
    - X = return for each period
    - Y = next period’s return
    - Note: will end up with one less entry than we have total periods since we need two periods for each entry
  + Stat
    - LIN
    - b = γ
* Example: Autocorrelation Regression
  + Firm earned returns of 12%, 8%, 9%, 15%, and 11% in years 1-5. Ignoring statistical significance, what conclusions can we make about weak form EMH for this company?
* What does autocorrelation look like?
* Evidence on Weak Form Efficiency
  + For individual securities, γ is close to 0 (random walk)
  + For portfolios, γ shows evidence of positive autocorrelation at weekly frequencies
    - Momentum strategies
    - Effect is small in magnitude; economically meaningful?
      * Not always
  + Over long horizons (3-5 years), γ shows evidence of negative autocorrelation
    - Contrarian strategies
  + Means evidence of momentum over short term and reversals over long term
    - Referred to as mean reversion
* Momentum Effects
  + A long literature suggests that markets are weak form efficient
    - Most recent evidence related to momentum trading strategies challenge this
    - Have to consider whether any supposed deviations from efficiency are within arbitrage bonds
  + Evidence that portfolios display momentum effects over intermediate horizons (3-12 months)
    - Shows that both good and bad performance is persistent over this horizon
* Portfolio Tests of Weak Form EMH
  + Suggests that we shouldn’t be able to consistently earn abnormal returns using portfolios formed based on past returns
    - Momentum studies tell a different story
    - We will look at how these studies are constructed
  + In order to test EMH, the researcher must specify a model for expected returns
    - Market or single-index model frequently used in practice
    - FF 3 Factor Model commonly used as well
  + Methodology:
    - Choose portfolio formation date
    - Form portfolios using trading rule based on past price or return info
      * Typically split firms into groups sorted by the measure we are testing
        + Usually quintiles or deciles
      * Each month/quarter/year we rebalance portfolio based on that period’s sorting
        + Common: buy best group and short worst group
        + Best has the highest returns, worst has the lowest returns
      * Estimate abnormal return of each portfolio (αp) by running regression
* Momentum and Efficiency
  + The risk-adjusted return (αp) for a momentum strategy that is long winners and short losers is significantly positive
    - May not disprove EMH
  + 2 main ways to interpret results:
    - Mispricing: positive α implies markets are not weak form efficient
    - Risk premium: model of expected returns not complete
      * Momentum may be related to underlying risk factor not accounted for
  + Joint Hypothesis Problem: test of market efficiency is simultaneously a joint test of whether the asset pricing model is correct
  + Means any results we (don’t) find might simply be caused by an incorrect model
  + Also important: are these strategies profitable after trading costs?
    - Many studies find trading rules that generate much smaller abnormal returns (that would be wiped out by trading costs)
* Alternative: Auto-Regressive Processes
  + Suppose we want to find middle ground: the market doesn’t follow random walk, but acts like one
  + Might suggest that the market follows an AR(1) process
    - Fight order auto-regressive
    - Type of model adds some mean-reversion
    - Simplified:
    - Where:
* Random Walk vs. AR(1)
  + RW equation:
  + AR(1) equation:
  + Random walk is a special case of AR(1) where ρ = 1
* Testing Semi-Strong Efficiency: Event Studies
  + Aim to test if stock prices react quickly and efficiently to new info
    - Measure abnormal returns around certain informational events
  + Tests for things like overreaction, underreaction, delayed reactions
  + Examples of event studies: dividend announcements, earnings announcements, mergers, changes in CEOs, security offerings
* Event Study Methodology
  + Identify a sample of events (e.g. merger announcements)
  + For each, collect a time series of security returns (and market index returns) surrounding the event date (designated t=0)
    - Event date is usually an announcement
  + Form “portfolios” by aligning the time series for each security in “event time”
    - Ex. You might analyze data from 10 trading days before and after a merger announcement (-10 ≤ t ≤ 10)
* Event Studies: the Timeline
* Event Studies Calculation
* Cumulative Abnormal Return
* Example: Cumulative Abnormal Return
  + You collected data on 3 firms whose CEOs were miraculously cured of a disease. You calculated the set of alphas in the following table:
  + What is the cumulative abnormal return on the event day (day 0)?
* Event Studies: Steve Jobs Example
  + October 2003: Jobs diagnosed with cancer, no public announcement was made
  + July 2004: Jobs entered hospital
    - Next day, Apple employees informed, leaked to the press
    - Apple stock fell 2.4%
* Event Studies
  + Mergers
    - Bad for the acquirers, good for the target company
    - Keown and Pinkerton (1981)
    - Supports semi-strong efficiency
* Event Study Methodology
  + If the sample size (N) is large, any cross-sectional correlation between alphas should be event-related
  + If the market is semi-strong efficient, we expect αt = 0 for t > 0
  + Aka the market response to new info should be quick and accurate
* Joint Hypothesis Problem
  + Event studies are a test of a joint hypothesis
    - Rejection of the hypothesis may be attributable to the failure of either or both of the joint hypotheses
  + Recall:
    - We need to calculate alphas in order to start this analysis, so we have used a pricing model
    - We aren’t going to be able to separate the accuracy of the EMH from the accuracy of our pricing model
* Post-Earnings Announcement Drift
  + What happens when good news is made public?
    - Efficient markets: stock price should increase immediately
    - The increase should be the correct size, there shouldn’t be any other adjustment from this information
  + Rendleman, Jones, Latane (1982)
    - Found evidence that the market adjusts to earnings info gradually
    - Firms placed into deciles based on their earnings surprise
    - Define “Standardized Unexpected Earnings” (SUE)
* Testing Semi-Strong Efficiency: Performance Evaluation Tests
  + Evaluation tests examine whether professional money managers can outperform on a risk-adjusted basis
  + In general, the results show that active managers do not, on average, outperform broad-based indices or passively managed index funds after costs
* Pricing Anomalies
  + January effect: January has higher positive returns relative to the rest of the months
  + IPO performance
    - Large underpricing on the day of issuance
    - Long-term underperformance
* Interpreting Anomalies
  + Mispricing: market inefficiencies with profit opportunities
  + Mispricing, but still inside arbitrage bounds
    - These are not profitable after costs
  + Risk premiums
    - Joint hypothesis problem
    - Need a better model for expected returns
  + Data mining concerns
  + Behavioral interpretations to explain inefficient mispricings
* Why not just throw darts?
  + The implications of market efficiency are often misinterpreted
    - “throwing darts” is one such common misconception
    - Any returns earned will be commensurate with risk
    - An investor still needs to pay attention to his/her portfolio decisions
  + Benefits of portfolio management in an efficient market:
    - Diversification: eliminate firm-specific risk
    - Choosing an appropriate level of systematic risk
    - Maximize expected return for target risk level
    - Tax-management
    - Asset allocation changes with age