LECTURE 1: INTRODUCTION
EMPIRICAL REGULARITIES
Money, Bonds vs. Stocks


$0 $5 $10 $15 $20 $25 $30 $35 $40 $45 $50

SP500
US 1y Tsy
US 10Y Tsy
But what is the right horizon?
Compared to Recessions

Recession

SPX Index
Stock Market Predictability

• **Random walk hypothesis:**
  – Stock market prices evolve according to a random walk, and therefore cannot be predicted.

• **Changes in stock prices can only be attributed to:**
  – News on future cash flows
  – Change in “Risk premia” – the “dark matter” of finance
  – Shifts in Behavioral Bias
Testing Market Predictability

• Cross Section vs. Time-Series
  – Cross-Sectional studies refer to data collected at the same point in time, or regardless of differences in time
  – Time-Series studies refer to a sequence of data points and look at how the data changed through time

• To test market predictability:
  – Cross-Sectional studies look at whether some factors can explain the stock price changes, potentially in contradiction to the random walk hypothesis
  – Time-Series studies look at the existence of time-related patterns (e.g. trends, seasonality) or event-specific behavior that would invalidate the random walk hypothesis
Dividend/Price Ratio and Stock Prices

A regression of the S&P 500 index price growth on the dividend/price ratio shows that the D/P ratio is a good predictor of future price growth.

Campbell and Shiller (1986)
Stocks are more volatile than consumption growth.
In the cross section: return & risk

Table 2: Idiosyncratic Volatility and Expected Returns in G7 Countries

<table>
<thead>
<tr>
<th>Panel A: USD Denominated Returns</th>
<th>Canada</th>
<th>France</th>
<th>Germany</th>
<th>Italy</th>
<th>Japan</th>
<th>U.K.</th>
<th>U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.723</td>
<td>0.602</td>
<td>0.753</td>
<td>0.425</td>
<td>0.948</td>
<td>0.480</td>
<td>1.746</td>
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<tr>
<td>[3.68]</td>
<td>[1.13]</td>
<td>[1.87]</td>
<td>[0.76]</td>
<td>[1.25]</td>
<td>[1.03]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W-FF Idiosyncratic Volatility</td>
<td>-1.224</td>
<td>-1.439</td>
<td>-2.003</td>
<td>-1.572</td>
<td>-1.955</td>
<td>-0.871</td>
<td>-2.014</td>
</tr>
<tr>
<td>$\beta(MKT^W)$</td>
<td>0.344</td>
<td>0.059</td>
<td>0.277</td>
<td>-0.083</td>
<td>0.323</td>
<td>0.178</td>
<td>0.376</td>
</tr>
<tr>
<td>[2.20]</td>
<td>[0.44]</td>
<td>[1.93]</td>
<td>[0.32]</td>
<td>[0.76]</td>
<td>[0.42]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\beta(SMB^W)$</td>
<td>0.009</td>
<td>0.015</td>
<td>-0.083</td>
<td>0.116</td>
<td>0.050</td>
<td>0.032</td>
<td>-0.049</td>
</tr>
<tr>
<td>[0.12]</td>
<td>[0.17]</td>
<td>[-0.82]</td>
<td>[0.56]</td>
<td>[0.76]</td>
<td>[0.42]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\beta(HML^W)$</td>
<td>-0.070</td>
<td>-0.069</td>
<td>0.076</td>
<td>-0.221</td>
<td>-0.025</td>
<td>-0.077</td>
<td>-0.051</td>
</tr>
<tr>
<td>[-0.95]</td>
<td>[-0.94]</td>
<td>[1.00]</td>
<td>[-1.98]</td>
<td>[-0.35]</td>
<td>[-1.30]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>-0.253</td>
<td>-0.067</td>
<td>-0.044</td>
<td>-0.031</td>
<td>-0.132</td>
<td>-0.058</td>
<td>-0.157</td>
</tr>
<tr>
<td>[4.81]</td>
<td>[-1.08]</td>
<td>[-1.09]</td>
<td>[-0.47]</td>
<td>[-1.72]</td>
<td>[-1.16]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Book-to-Market</td>
<td>0.369</td>
<td>0.569</td>
<td>0.176</td>
<td>0.239</td>
<td>0.550</td>
<td>0.365</td>
<td>0.282</td>
</tr>
<tr>
<td>[3.68]</td>
<td>[4.59]</td>
<td>[1.35]</td>
<td>[1.48]</td>
<td>[3.84]</td>
<td>[4.46]</td>
<td></td>
<td></td>
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<tr>
<td>Lagged Return</td>
<td>0.014</td>
<td>0.001</td>
<td>0.003</td>
<td>0.001</td>
<td>-0.011</td>
<td>0.012</td>
<td>-0.001</td>
</tr>
<tr>
<td>[3.57]</td>
<td>[0.10]</td>
<td>[0.10]</td>
<td>[0.15]</td>
<td>[-2.85]</td>
<td>[4.07]</td>
<td></td>
<td></td>
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<tr>
<td>Adjusted $R^2$</td>
<td>0.118</td>
<td>0.108</td>
<td>0.114</td>
<td>0.147</td>
<td>0.124</td>
<td>0.078</td>
<td>0.046</td>
</tr>
</tbody>
</table>

Percentiles of W-FF Idiosyncratic Volatility

| 25th Percentile | 20.8 | 21.4 | 16.3 | 21.5 | 23.1 | 13.9 | 25.0 |
| 75th Percentile | 46.0 | 39.2 | 34.8 | 38.4 | 39.6 | 31.3 | 61.1 |

Economic Effect of Moving from the 25th to the 75th W-FF Idiosyncratic Volatility Percentiles

25% → 75%  -0.31%  -0.26%  -0.37%  -0.27%  -0.32%  -0.15%  -0.73%

Source: Ang, Hodrick, Xing, Zhang 2008
Adding stocks in alphabetic order

S&P 100 Stocks from 1990-2011
Measuring Risk differently

• When combining assets to a portfolio
  – Idiosyncratic component diversifies away
  – Covariance captures contribution of asset to portfolio’s risk

• Use Covariance as risk measure
Covariance with market

monthly return

The graph shows the covariance of various stocks with the market, represented by monthly returns.

- AAPL
- ABT
- AEP
- AMGN
- APC
- AXP
- BA
- BAX
- BHI
- BK
- BMY
- CAT
- CL
- CPB
- DD
- DELL
- DIS
- DOW
- EMC
- F
- FDX
- GD
- GE
- HAL
- HD
- HNZ
- IBM
- INTC
- JNJ
- KO
- LLY
- LOW
- MCD
- MDT
- MMM
- MSFT
- MRK
- MO
- ORCL
Covariance with consumption

annual return

[Graph showing covariance with consumption for various stocks, with annual return on the x-axis and percentage on the y-axis.]
Size and value effect of stock returns

AVERAGE RETURNS ON U.S. STOCKS DEPENDING ON SIZE AND B/M
Percent per month

High B/M is similar to low P/E, it means "value". The opposite is "growth".

Source: Mertens, Data from Fama and French (1992)
Value vs. Growth Stocks

- Large Value-Growth (%)
- Mid Value-Growth (%)
- Small Value-Growth (%)

Winner vs. Losers

- All shares are ranked each year on basis of five-year holding returns
  - Includes companies that de-list
- Assigned to portfolio by decile of performance
  - Graph shows average performance of equally weighted portfolios adjusted by equally weighted market portfolio
- Momentum or mean-reversion?
  - Short-run
  - Intermediate
  - Long-term
- Original article: DeBondt & Thaler 1985
Market Efficiency in Event Studies

$CAAR_T = \sum_{t=-30}^{T} AAR_t$

Important: Information has to become public at a single moment
Event Studies

**Objective:** Examine if new (company specific) information is incorporated into the stock price in one single price jump upon public release?

1. Calculate the daily excess returns $\Delta R_t = R_{it} - R_{mt}$ relative to the market or benchmark for 30 days prior and after release
   
   $$t = -30, -29, \ldots, -1, 0, 1, \ldots, 29, 30$$

2. For each relative date $t$, calculate average returns and cumulative returns across events

   $$\Delta AR_t = \frac{1}{N} \sum_{i=1}^{N} \Delta R_{it}$$

   $$CAAR_T = \sum_{t=-30}^{T} \Delta AR_t$$
Event Study: Earning Announcements

Event Study by Ball and Brown (1968)
Pre-announcement drift prior to earnings due to insider trading
→ against strong-form

Post-announcement drift
→ against semi-strong form
Event Study: Earning Announcement

Cumulative abnormal returns around earning announcements

(MacKinlay 1997)
Event Study: Stock Splits

Event Study on Stock Splits by Fama-French-Fischer-Jensen-Roll (1969)

Split is a signal of good profit

Pre-announcement drift can be due to selection bias (only firms whose price rose) or insider trading.

→ inconclusive

No post-announcement drift
→ for weak form
Event Study: Take-over Announcement

Cumulative abnormal return, percent

Days relative to announcement date

-16 -12 -8 -4 0 4 8 12 16 20 24 28 32 36
-135 -120 -105 -90 -75 -60 -45 -30 -15 0 15 30
Government Bonds

• The Expectations Hypothesis is the proposition that the long-term yield is determined only by the market’s expectations of future short-term yield.

• Let $Z(s, t)$ and $y(s, t)$ be the discount factor (zero-coupon price) and the yield for a zero-coupon price bought at $s$ that matures at $t$.

• The 1-year return on a 1-year bond

$$r_{1,1} = E_t \left[ \ln \frac{1}{Z(t, t + 1)} \right] = \ln \frac{1}{e^{-y(t,t+1)}} = y(t, t + 1)$$

• The 1-year return on a m-year bond bought at $t$ and sold at $t + 1$.

$$r_{1,m} = E_t \left[ \ln \frac{Z(t + 1, t + m)}{Z(t, t + m)} \right] = E_t \left[ \ln \frac{e^{y(t+1,t+m)(m-1)}}{e^{-y(t,t+m)m}} \right]$$

$$= my(t, t + m) - (m - 1)E_t[y(t + 1, t + m)]$$
By the EH, single-period holding on bonds of all maturities are equal in expectation. Therefore setting $r_{1,1} = r_{1,m}$ and rearranging we get

$$y(t, t + m) - y(t, t + 1) = (m - 1)E_t[y(t + 1, t + m) - y(t, t + m)]$$

According to the EH, the yield spread $y(t, t + m) - y(t, t + 1)$ has a positive relation with short-term changes in the long-term bond yield. However, this does not hold empirically

Source: Campbell 1995

### Table 2

Regression Coefficients

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>2</th>
<th>3</th>
<th>6</th>
<th>12</th>
<th>24</th>
<th>48</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-run changes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>in long yields</td>
<td>0.019</td>
<td>-0.135</td>
<td>-0.842</td>
<td>-1.443</td>
<td>-1.432</td>
<td>-2.222</td>
<td>-4.102</td>
</tr>
<tr>
<td></td>
<td>(0.194)</td>
<td>(0.285)</td>
<td>(0.444)</td>
<td>(0.598)</td>
<td>(0.996)</td>
<td>(1.451)</td>
<td>(2.083)</td>
</tr>
</tbody>
</table>
Corporate Bonds

A very popular model to value corporate debt is the Merton Model, which postulates that the assets of a firm follow a geometric Brownian motion process.

\[
\frac{dA_t}{A_t} = \mu \cdot dt + \sigma \cdot dW_t^P
\]

However, this model implies a credit spread to Treasuries that is consistently lower than the observed credit spreads.

Figure 1. Empirical spreads on industrial bonds of six years maturity.
Fixed income: Commercial paper

![Commercial Paper Graph]

- **ABCP**
- **Non-ABCP**

*Amount Outstanding, US $Billions*
Rollover risk: Composition of ABPC

ABS issuance

Source: JPMorgan
Important spreads
Derivatives

- What’s a Credit Default Swap?
ABX index

ABX 7-1 Prices
In the Black-Scholes model for options pricing, a European call option on a stock worth $S$ with strike $K$ and maturity $T$ today is worth:

$$S \Phi \left( \frac{\ln \frac{S}{K} + \frac{\sigma^2 T}{2}}{\sigma \sqrt{T}} \right) - K \Phi \left( \frac{\ln \frac{S}{K} - \frac{\sigma^2 T}{2}}{\sigma \sqrt{T}} \right)$$

back out the volatility for different strikes with observed option prices.

- Implied volatility
  - Model $\Rightarrow$ constant
  - Reality $\Rightarrow$ smile
The VIX

A graph showing the VIX index from December 26, 2003, to December 26, 2011.
Frictions

• In Physics
  – Drop of a stone = drop of a feather
  – Aviation wouldn’t work without frictions

• In Finance
  – Walrasian auctioneer
  – Asymmetric information
    • Margins/haircuts/
    • Limited risk bearing capacity, limited (risky) borrowing, ...
Beyond prices: Margins/Haircuts

- Margin/haircut/LTV determines max leverage ratio

Gorton-Metrick (2011) “Repo Run”
Copeland, Martin, Walker (2011)
Margins **very stable** in tri-party repo market
- contrasts with Gorton & Metrick (2011)
- no general run on certain types of collateral
  - [http://www.ny.frb.org/research/staff_reports/sr477.pdf](http://www.ny.frb.org/research/staff_reports/sr477.pdf)
Run (non-renewed financing) only on select **counterparties**
- Bear Stearns (anecdotally)
- Lehman (in the data)
Like 100% haircut...
(**counterparty specific**)
Liquidity mismatch: sensitivity of wealth shifts

Technological liquidity
- Reversibility of investment

Market liquidity
- Specificity of capital
  - Price impact of capital sale

Funding liquidity
- Maturity structure of debt
  - Can’t roll over short term debt
- Sensitivity of margins
  - Margin-funding is recalled

Liquidity Maturity mismatch

- Macro: real projects + market liquidity
  - Total supply in economy irreversibility + specificity
- Finance: financial claims market liquidity
  - How liquidity is distributed in economy – intermediation chain
    - Shifts in wealth distributions affects costs of liquidity (amplification)
Conclusion

- Risk & Return
  - What is risk?
- Fixed income – risky borrowing/lending
- Derivatives (CDS)
- Market efficiency
  - Asymmetric information
- Friction Finance
  - Margins/haircuts/LTV
Overview

• Frictionless Finance
  One period model Part I
  Multi-period model Part II

• Friction Finance Part III