Risk and Return in Stocks and Bonds

Princeton Finance Lectures
November 3-5, 2008
John Y. Campbell
Princeton Finance Lectures

• Lectures should review a broad area
• Lectures should reflect recent research
• Lectures cannot ignore current events
  – Current data are informative!
• I will try to combine the historical academic approach with some reflections on the markets today
• Adding electric guitars to a symphony orchestra?
Estimating the Equity Premium

Princeton Finance Lecture 1

November 3, 2008

John Y. Campbell
Recent Intellectual History

• Sea change in the finance literature in the late 20th Century

• 1960’s and 1970’s: efficient market hypothesis interpreted as implying a constant equity premium, unpredictable excess stock returns
  – Best equity premium estimate is the historical average excess return

• Jensen (1978): “I believe there is no other proposition in economics which has more solid evidence supporting it than the Efficient Markets Hypothesis.”
Recent Intellectual History

• 1980’s to present: discovery of apparently significant regression predictors
  – Valuation ratios (dividend-price, earnings-price, smoothed earnings-price, book-market)
  – Interest rates (nominal short and long Treasury rates, term spread, defaultable yields, inflation rate)
  – Decisions of market participants (corporate financing, consumption)
  – Cross-sectional equity pricing

• Development of equilibrium models with time-varying equity premium
Recent Intellectual History


• Corporate decisions: Baker-Wurgler (2000)....

• Consumer decisions: Lettau-Ludvigson (2001)....

• Cross-sectional pricing: Eleswarapu-Reinganum (2004), Polk-Thompson-Vuolteenaho (2006)....
Recent Intellectual History

• Late 1990’s: high valuations and continued high returns decreased predictive power of valuation ratios
• But valuations hard to reconcile with constant discount rates and reasonable cash flow forecasts
• Many finance economists believe that the equity premium had fallen, not risen at this time
• 2000’s: partial rehabilitation of valuation ratios
Recent Intellectual History

• 1990’s: methodological concerns about predictive regressions
• Valuation ratios are persistent and their innovations are correlated with returns, causing
  – biased predictive coefficients (Stambaugh 1999)
  – over-rejection by standard $t$ test (Cavanagh-Elliott-Stock 1995)
• These problems are less relevant for interest rates and recently proposed predictor variables
  (persistent but less correlated with returns)
• Many recent papers address these problems
Using Finance Theory

• I will argue that the way forward is to use finance theory to guide econometric work.

• Theory gives us valuable information about the time-series properties of valuation ratios:
  – Stationary or unit root, not explosive
  – No trend

• Theory also tells us how to use cross-sectional information to generate new return predictors.
Using Finance Theory

• I will draw on several of my recent papers:
  – “Predicting Excess Returns Out of Sample: Can Anything Beat the Historical Average?”, with Sam Thompson, *RFS* 2008
  – “Bad Beta, Good Beta”, with Tuomo Vuolteenaho, *AER* 2004
Is D/P Stationary?

- A basic question is whether D/P is stationary.
- If so, then we can use the Campbell-Shiller loglinearization to put structure on the problem.
- I will start by assuming this, then consider what we can do if D/P has a unit root.
Is D/P Stationary?

• Campbell-Shiller (RFS 1988) loglinear return formulas:

\[
\begin{align*}
    r_{t+1} &= k + \rho p_{t+1} + (1 - \rho) d_{t+1} - p_t \\
    &= k + (d_t - p_t) + \Delta d_{t+1} - \rho (d_{t+1} - p_t).
\end{align*}
\]

\[
\begin{align*}
    d_t - p_t &= \frac{k}{1 - \rho} + E_t \sum_{j=0}^{\infty} \rho^j [r_{t+1+j} - \Delta d_{t+1+j}].
\end{align*}
\]
Is D/P Stationary?

• D/P is stationary if dividend growth and returns are stationary.
• But D/P is likely to be persistent because it reflects long-run expectations.
• In an extreme case D/P might have a unit root, but
  – It should not be explosive
  – It should not have a trend (mean change = 0)
• Any return predictability that is not perfectly correlated with dividend predictability will show up in D/P.
History of D/P

S&P 500 Dividend/ Price

Average D/P = 4.38%
D/P in 10/15/08 = 3.2%
Stambaugh Bias

- Stambaugh (JFE 1999) considers a two-equation system with return and predictor (log D/P).

\[
\begin{align*}
  r_{t+1} &= \alpha + \beta x_t + u_{t+1}, \\
  x_{t+1} &= \mu + \phi x_t + \eta_{t+1}.
\end{align*}
\]

\[
\gamma = \frac{\sigma_{u\eta}}{\sigma^2_{\eta}}.
\]

\[
E[\hat{\beta}(1) - \beta(1)] = \gamma E[\hat{\phi} - \phi].
\]
Stambaugh Bias

- Downward bias in AR coefficient $\phi$, and negative correlation $\gamma$, imply upward bias in predictive coefficient $\beta$.
- Correcting for this weakens the evidence for return predictability.
- But what if we use our knowledge that D/P is not explosive?
D/P Is Not Explosive

• Lewellen (JFE 2004): Condition on estimated persistence and worst possible case for true persistence.

\[
E[\hat{\beta} - \beta \mid \hat{\phi}, \phi] = \gamma[\hat{\phi} - \phi].
\]

\[
\hat{\beta}(1)_{adj} = \hat{\beta}(1) - \gamma(\hat{\phi} - 1).
\]
D/P Is Not Explosive

- Because estimated persistence is very close to one, required bias correction is small and predictability survives.
- Samples with spurious return predictability are also samples with spurious mean reversion. In the data, we don’t see mean reversion so we can’t have spurious return predictability.
D/P and Dividend Growth

- Cochrane ("The Dog That Did Not Bark", RFS 2008) connects this with dividend predictability.

\[ r_{t+1} = k + (d_t - p_t) + \Delta d_{t+1} - \rho(d_{t+1} - p_{t+1}). \]

It follows that if we regress \( r_{t+1}, \Delta d_{t+1}, \) and \( d_{t+1} - p_{t+1} \) onto \( d_t - p_t \), the coefficients \( \beta, \beta_d, \) and \( \phi \) are related by

\[ \beta = 1 - \rho \phi + \beta_d. \]

If we have prior knowledge about \( \phi \), then \( \beta \) and \( \beta_d \) are linked. For example, if \( \rho = 0.96 \) and \( \phi \leq 1 \), then

\[ \beta_d \leq \beta - 0.04. \]

It must be negative if \( \beta = 0 \).
D/P and Dividend Growth

• If D/P doesn’t predict returns, it will be explosive unless it predicts dividend growth.
• Since D/P cannot be explosive, the absence of predictable dividend growth strengthens the evidence for predictable returns.
• Samples with spurious return predictability are also samples with spurious predictability of dividend growth. In the data, we don’t see predictable dividend growth so we can’t have spurious return predictability.
De-Noising the Return

• Campbell and Yogo (JFE 2006): If we knew persistence, we could reduce noise by adding the innovation to the predictor variable to the predictive regression.

\[ r_{t+1} = \alpha' + \beta x_t + \gamma(x_{t+1} - \phi x_t) + \nu_{t+1}. \]

• In fact we don’t know persistence, but can construct a confidence interval for it by inverting a unit root test.
• By doing this we “de-noise” the return and get a more powerful test. High returns must be partly unexpected if they were accompanied by falling dividend yields.
Bayesian Approach

• Several recent papers have made similar points using a Bayesian approach
  – Wachter and Warusawitharana (2008, forthcoming *JEconometrics*)
  – Pastor and Stambaugh (2008, forthcoming *JF*)
What if D/P Has a Unit Root?

• The big issue in the recent literature is the high persistence of D/P.

• If D/P actually has a unit root, then the Campbell-Shiller loglinearization breaks down.

• But theory helps us in this case too:
  – Since D/P has no trend, the mean change in D/P is zero. We can use this to get a more precise, and lower, estimate of the unconditional mean stock return (Fama and French JF 2002).
  – We can derive a simple valuation model in the spirit of the original Gordon growth model.
Back to the Gordon Growth Model

• Assume, as in the Gordon growth model, that the dividend is known one period in advance.
• Assume that the log dividend yield follows a random walk with normal innovations.
• Assume that the two-period ahead dividend growth rate is conditionally normal.

\[
\frac{D_{t+1}}{P_t} = \exp(x_t), \quad \frac{D_{t+1}}{D_t} = 1 + G_t = \exp(g_t).
\]

\[x_t = x_{t-1} + \varepsilon_t.\]
Back to the Gordon Growth Model

- Use the definition of return and the formula for the conditional expectation of a lognormal random variable.

\[
1 + R_{t+1} = \frac{P_{t+1} + D_{t+1}}{P_t} = \frac{D_{t+1}}{P_t} + \frac{D_{t+2}}{D_{t+1}} \frac{D_{t+1}}{P_t} \left( \frac{D_{t+2}}{P_{t+1}} \right)^{-1} \\
= \exp(x_t) \left[ 1 + \exp(g_{t+1} - x_{t+1}) \right].
\]
\[ E_t(1 + R_{t+1}) = \exp(x_t) \left[ 1 + \mathbb{E}_t \exp(g_{t+1} - x_{t+1}) \right] \]

\[ = \frac{D_{t+1}}{P_t} + \exp(\mathbb{E}_tg_{t+1}) \exp\left(\sigma_g^2/2 + \sigma_x^2/2 - \sigma_{gx}\right) \]

\[ = \frac{D_{t+1}}{P_t} + \exp(\mathbb{E}_tg_{t+1}) \exp(\text{Var}_t(p_{t+1} - p_t)/2) \]

\[ \approx \frac{D_{t+1}}{P_t} + \exp(\mathbb{E}_tg_{t+1}) + \frac{1}{2}\text{Var}_t(r_{t+1}). \]
Back to the Gordon Growth Model

• As in the Gordon model, the expected return is the level of D/P (not the log) plus expected dividend growth

• The variance effect is subtle
  – In the original Gordon model, returns and dividend growth have the same volatility
  – In that case the expected return is level of D/P plus arithmetic average dividend growth
  – In the data, stock returns are much more volatile
  – In that case the expected return is level of D/P plus geometric average dividend growth plus one-half stock return volatility (not dividend volatility)
Back to the Gordon Growth Model

• Equivalently, the level of D/P plus geometric average dividend growth estimates the geometric average stock return, as in Siegel, *Stocks for the Long Run*

• Empirically, this approach has the advantage that we do not have to estimate the unconditional mean stock return from the noisy historical data

• Instead, we can use historical average growth, along with the current level of D/P.
Back to the Gordon Growth Model

- Campbell-Thompson (*RFS* 2008) extends this approach:
  - Derives growth from ROE and payout ratio
  - Looks at other valuation ratios
  - Does not make the volatility adjustment

\[
\hat{R}_{DP} = \frac{D}{P} + (1 - \frac{D}{E})ROE. \\
\hat{R}_{EP} = \left(\frac{D}{E}\right) \frac{E}{P} + (1 - \frac{D}{E})ROE, \\
\hat{R}_{BM} = ROE \left[1 + \frac{D}{E} \left(\frac{B}{M} - 1\right)\right].
\]
History of P/Smoothed E

S&P 500 Price / 10-Year Average of Earnings

Year

Price Earnings Ratio

Average P/E = 16.3

1901  1929  1966

P/E in 10/15/08 = 15.2
### Campbell-Thompson Table 2

Sample ends in 2005:12

<table>
<thead>
<tr>
<th>Panel A: Monthly Returns</th>
<th>Sample Begin</th>
<th>Forecast Begin</th>
<th>In-Sample t statistic</th>
<th>In-Sample R squared</th>
<th>Out-of-Sample R-squared with Different Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td>Unconstrained</td>
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<tr>
<td>Dividend/price</td>
<td>1872m2</td>
<td>1927m1</td>
<td>1.25</td>
<td>1.12%</td>
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<td>1966m6</td>
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<td>1.97</td>
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<td>Book-To-Market + growth - real rate</td>
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<td>1966m6</td>
<td>1.68</td>
<td>0.36</td>
<td>-0.45</td>
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### Panel B: Annual Returns

<table>
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<tr>
<th></th>
<th>Sample Begin</th>
<th>Forecast Begin</th>
<th>In-Sample t statistic</th>
<th>In-Sample R squared</th>
<th>Out-of-Sample R-squared with Different Constraints</th>
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<td>1966m6</td>
<td>2.03</td>
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## C-T Table 2 Updated

Sample ends in 2008:10

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<th>Sample Begin</th>
<th>Forecast Begin</th>
<th>In-Sample t-statistic</th>
<th>In-Sample R squared</th>
<th>Out-of-Sample R-squared with Different Constraints</th>
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<td>Positive slope, Pos. Forecast, Bounded slope, Fixed coef.</td>
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<td>Panel A: Monthly Returns</td>
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<table>
<thead>
<tr>
<th>Panel B: Annual Returns</th>
<th>Sample Begin</th>
<th>Forecast Begin</th>
<th>In-Sample R squared</th>
<th>Out-of-Sample R-squared with Different Constraints</th>
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<td>Positive slope, Pos. Forecast, Bounded slope, Fixed coef.</td>
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<td>Book-To-Market + growth - real rate</td>
<td>1936m6</td>
<td>1956m6</td>
<td>1.45</td>
<td>3.34</td>
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C-T Table 2 Updated with Variance Adjustment

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<th></th>
<th>Sample Begin</th>
<th>Forecast Begin</th>
<th>In-Sample t statistic</th>
<th>In-Sample R squared</th>
<th>Unconstrained Pos. Forecast</th>
<th>Pos. intercept, bounded slope</th>
<th>Fixed coeffs</th>
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<tr>
<td><strong>Panel A: Monthly Returns</strong></td>
<td></td>
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<tr>
<td>Dividend/price</td>
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<td>1927m1</td>
<td>1.37</td>
<td>1.25%</td>
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<td>1927m1</td>
<td>1.35</td>
<td>0.93</td>
<td>-0.08</td>
<td>0.10</td>
<td>0.13</td>
</tr>
<tr>
<td>Earnings/price + growth</td>
<td>1892m2</td>
<td>1927m1</td>
<td>1.78</td>
<td>0.45</td>
<td>-0.07</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Smooth earnings/price + growth</td>
<td>1892m2</td>
<td>1927m1</td>
<td>1.93</td>
<td>1.00</td>
<td>0.07</td>
<td>0.21</td>
<td>0.18</td>
</tr>
<tr>
<td>Book-To-Market + growth</td>
<td>1936m6</td>
<td>1956m6</td>
<td>0.90</td>
<td>0.10</td>
<td>-0.61</td>
<td>-0.61</td>
<td>-0.53</td>
</tr>
<tr>
<td>Dividend/price + growth - real rate</td>
<td>1891m5</td>
<td>1927m1</td>
<td>1.38</td>
<td>0.74</td>
<td>-0.08</td>
<td>0.15</td>
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<td>Earnings/price + growth - real rate</td>
<td>1892m2</td>
<td>1927m1</td>
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<td>0.32</td>
<td>-0.03</td>
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<tr>
<td>Smooth earnings/price + growth - real rate</td>
<td>1892m2</td>
<td>1927m1</td>
<td>1.86</td>
<td>0.72</td>
<td>0.09</td>
<td>0.20</td>
<td>0.16</td>
</tr>
<tr>
<td>Book-To-Market + growth - real rate</td>
<td>1936m6</td>
<td>1956m6</td>
<td>0.93</td>
<td>0.11</td>
<td>-0.76</td>
<td>-0.76</td>
<td>-0.63</td>
</tr>
</tbody>
</table>

|                      |              |                |                       |                     | Out-of-Sample R-squared with Different Constraints |
|----------------------|--------------|----------------|-----------------------|                     |                                                 |
|                      |              |                |                       |                     | Positive slope,                                 |
|                      |              |                |                       |                     | Pos. Forecast,                                  |
|                      |              |                |                       |                     | Pos. intercept, bounded slope                   |
|                      |              |                |                       |                     | Fixed coeffs                                    |

| **Panel B: Annual Returns** |              |                |                       |                     |                                                |                                                |              |
| Dividend/price       | 1872m2       | 1927m1         | 2.75                  | 10.94%              | 6.08%                                      | 5.36%                                      | 4.11%         | 2.80%        |
| Earnings/price       | 1872m2       | 1927m1         | 3.00                  | 7.38                | 5.51                                      | 5.58                                      | 4.61          | 6.15         |
| Smooth earnings/price| 1861m2       | 1927m1         | 3.13                  | 13.75               | 8.35                                      | 6.47                                      | 6.72          | 8.30         |
| Dividend/price + growth | 1891m2    | 1927m1         | 1.75                  | 8.99                | 2.36                                      | 2.86                                      | 2.54          | 4.31         |
| Earnings/price + growth | 1892m2    | 1927m1         | 1.36                  | 4.05                | 1.52                                      | 1.94                                      | 1.63          | 3.71         |
| Smooth earnings/price + growth | 1892m2 | 1927m1         | 1.73                  | 10.11               | 3.03                                      | 3.20                                      | 3.11          | 5.29         |
| Book-To-Market + growth | 1936m6    | 1956m6         | 1.58                  | 3.94                | -4.22                                     | -1.46                                     | -3.09         | 3.31         |
| Dividend/price + growth - real rate | 1891m5 | 1927m1         | 1.42                  | 7.30                | 2.64                                      | 3.00                                      | 2.71          | 1.98         |
| Earnings/price + growth - real rate | 1892m2   | 1927m1         | 1.07                  | 2.92                | 1.77                                      | 1.82                                      | 1.80          | 1.83         |
| Smooth earnings/price + growth - real rate | 1892m2 | 1927m1         | 1.51                  | 7.52                | 3.13                                      | 3.13                                      | 3.16          | 3.26         |
| Book-To-Market + growth - real rate | 1936m6    | 1956m6         | 1.72                  | 4.15                | -2.79                                     | -2.20                                     | -2.61         | 2.42         |
What Is the Equity Premium Today?

• Apply the smoothed-earnings version of this methodology to estimate geometric stock return

\[ \hat{R}_{EP} = \left( \frac{D}{E} \right) \frac{E}{P} + (1 - \frac{D}{E}) \text{ROE}, \]

• Apply to US and world data through Sept 2008
• Calculate geometric equity premium by subtracting average of US and UK inflation-indexed bond yields
Profitability

Smoothed Real Return on Equity
(3-Year Smoothed Earnings / Current Book Value) - Inflation
Payout Rate

Smoothed Dividend Payout Ratio
(Current Dividend / 3-Year Smoothed Earnings)

World
US
Real Interest Rate

Inflation-Indexed Government Bond Yields

- **UK**
- **US**
US Equity Premium

Equity Premium -- US

- Assume Constant Real ROE of 6%, Constant Dividend Payout Ratio of 50%
- Use 3-Year Smoothed Real ROE and Dividend Payout Ratio
World Equity Premium

Equity Premium -- World

- Assume Constant Real ROE of 6%, Constant Dividend Payout Ratio of 50%
- Use 3-Year Smoothed Real ROE and Dividend Payout Ratio
What Is the Equity Premium Today?

• If one forecasts ROE and payout with long-run historical average levels, US (world) geometric equity premium was 4.0% (4.6%) at the end of September

• Recent ROE data give a much higher and unrealistic number
Comparisons with Other Estimates

• Dimson, Marsh, and Staunton (2006) report 1900-2005 geometric averages of 5.5% for the US and 4.7% for the world
  – Forward-looking method gives a lower number for the US, but comparable for the world

• Graham and Harvey (2007) survey CFO’s of US corporations and report that the median geometric equity premium forecast in November 2006 was 3.4%
What Is the Equity Premium Today?

• October market decline has increased 3-year smoothed E/P by about 1.4% to 7.8%
• This increases the real stock return forecast by about 0.7%
• However, the TIPS yield has also increased by about 0.7% in October, so there is little net change in the forecast
• Volatility adjustment is about 1.25% in normal times, greater today (VIX²/2 ≈ 18%!)
New Return Predictors

• Finance theory also suggests ways to derive new return predictors from the cross-section of stock prices

• Polk-Thompson-Vuolteenaho (JF 2006):
  – If the CAPM is true, a high equity premium implies low prices (value) for stocks with high betas
  – Equivalently, value stocks should have high betas
  – This was true in the mid-20th Century, but not today, suggesting a decline in the equity premium
  – Relative valuations of high-beta stocks can be used to predict the market return.
PTV Cross-Sectional Predictor

![Graph showing the PTV predictor and smoothed earnings yield over time.](image)
From CAPM to ICAPM

• If returns are predictable, then the CAPM does not hold unless investors have log utility.
• Merton’s ICAPM says that stocks that covary with declines in the expected market return (“discount rate news”) should have lower average returns than stocks that covary with market profitability (“cash flow news”), controlling for market beta.
• The ICAPM can explain the value effect if growth stocks covary more with discount rates than do value stocks.
• Then past returns on growth stocks, relative to value stocks, should predict the aggregate market return.
From CAPM to ICAPM

- The value spread, the relative valuation of value and growth stocks, summarizes the past history of relative returns on these stocks.
- Eleswarapu and Reinganum (JBusiness 2004) find that the value spread for small stocks predicts the aggregate stock return.
- Campbell and Vuolteenaho (AER 2004) use the small-stock value spread in a VAR model to estimate and test the ICAPM.
  - More on this tomorrow.
Current Events

• In late 2007 and the first half of 2008,
  – Value stocks underperformed growth stocks
  – Low-beta stocks fell just as much as high-beta stocks

• In September and October 2008,
  – Growth stocks underperformed
  – High-beta stocks did particularly badly

• The former pattern suggests negative cash flow news (worsening profit outlook)

• The latter suggests an increasing equity premium (aka “panic”)
Conclusion

• Campbell, Lo, and MacKinlay (1997):
  – “What distinguishes financial economics is the central role that uncertainty plays in both financial theory and its empirical implementation”

• Theory tells us why stock returns are so hard to predict

• But it also holds out the promise of better prediction than we can achieve by purely statistical forecasting methods.
Remaining Lectures

• Tomorrow I will discuss consumption-based asset pricing models
  – Recent revival of interest
  – Applications to stocks and real bonds
  – Where is this literature headed?

• On Wednesday I will discuss the pricing of nominal Treasury bonds in relation to stocks and real bonds
  – Treasuries as a hedge in the current financial crisis
  – Extension to currencies