Topics in Dynamic Asset Pricing

Course Presentation.

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Course Objectives

• This course has two objectives:

  1. Introduce students to the frontier of research in asset pricing: we will cover a number of models and methodologies have been recently developed in the literature to address intriguing empirical regularities.

  2. Teach students how to write coherent research papers: over the eleven weeks I will assign three research ideas that students have to developed into research papers (I provide tips). the TA and I will “referee” such papers providing then feedback on how papers should be written.

• We start by reviewing some (but not all) intriguing empirical regularities.
A Simple Benchmark Model (Lucas Tree Model)

- Aggregate dividends $D_t$ are i.i.d.
  $$\frac{dD_t}{D_t} = \mu_d dt + \sigma_d dB_t$$

- $P_t$ = price of stock that is a claim on these dividends. $r_t$ = risk free rate of return.

- A representative agent has infinite life, power utility over consumption, chooses $C_t$ and asset allocation $\theta_t$ to
  $$\max_{C_t, \theta_t} E_0 \left[ \int_0^\infty e^{-\phi \tau} \frac{C_t^{1-\gamma}}{1-\gamma} d\tau \right]$$

- Equilibrium: $C_t = D_t$ and $\theta_t = 1 \implies$ SDF $= \lambda_t = e^{-\phi t}C_t^{-\gamma}$
  $$P_t = E_t \left[ \int_t^\infty \frac{\lambda_t}{\lambda_t} D_\tau d\tau \right] = \frac{D_t}{R - \mu_d}$$

- where $R$ = discount rate for risky stock
Implications of Benchmark Model

- A large number of empirical regularities clash with this standard paradigm.

1. **Equity premium puzzle**: Stocks have averaged returns of about 7% over treasuries.
   - This number is high compared to the volatility of consumption, of about 1-2%.
   - The canonical model implies
     \[
     \text{Expected Excess Return} = \gamma \times \text{Variance of Consumption Growth}
     \]
   - Even assuming that $\gamma$ is large, say $\gamma = 10$, we have
     \[
     \text{Expected Excess Return} = 10 \times (.02)^2 = 0.4%
     \]
   - We are an order of magnitude off.
2. Volatility Puzzle 1: Return volatility (about 16%) is too high compared to the volatility of dividends (about 7%).

- The same classic canonical model has
  \[ \frac{P_t}{D_t} = \text{Constant} \]

- This implies
  \[ \text{Volatility of} \quad \frac{dP_t}{P_t} = \text{Volatility of} \quad \frac{dD_t}{D_t} \]

- Something else must be time varying to make the volatility higher.

- Indeed, the canonical model would imply a constant P/D ratio, which we know it is not.
3. Volatility Puzzle 2: Return volatility is not only high, but it is time varying.

- Historically, (annualized) market return volatility fluctuated wildly, ranging between 60 - 70% in the 30s (and 2008-2009) to less that 5% in the middle of the 1960s.

![Daily Stock Returns: S&P500](image1)

![Quarterly Volatility: S&P500](image2)
5. Risk Free Rate Puzzle: The usual canonical model implies that the interest rate is given by

\[ r = \phi + \gamma \mu_c - \frac{1}{2} \gamma (\gamma + 1) \sigma_c^2 \]

- If \( \gamma = 10 \) for instance, using \( \mu_c = 2\% \), \( \sigma_c = 1\% \) and \( \phi = 2\% \) we find \( r = 21\% \).
- The problem is \( \gamma \) that is too high: If we set \( \gamma = 2 \) we obtain \( r = 6\% \).
- Note the tension between equity premium puzzle (need \( \gamma \) high) and risk free rate puzzle (need \( \gamma \) low).
6. **Predictability**: Stock returns are predictable by, say, the dividend price ratio, earnings price ratio, etc.

- **Predictability regression**

  \[
  \text{Cumulated Returns} (t \rightarrow t + \tau) = \alpha + \beta x_t + \epsilon_{t,t+\tau}
  \]

  where \(x_t\) is a predictor observable at time \(t\).
<table>
<thead>
<tr>
<th>Predictor</th>
<th>Horizon (Quarters)</th>
<th>α</th>
<th>β</th>
<th>t(α)</th>
<th>t(β)</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log Div Yield</td>
<td>1</td>
<td>0.10</td>
<td>0.02</td>
<td>1.72</td>
<td>1.53</td>
<td>1.1%</td>
</tr>
<tr>
<td>Log Earn Yield (1 y)</td>
<td>1</td>
<td>0.09</td>
<td>0.03</td>
<td>2.32</td>
<td>1.99</td>
<td>1.1%</td>
</tr>
<tr>
<td>Log Earn Yield (10 y)</td>
<td>1</td>
<td>0.13</td>
<td>0.04</td>
<td>2.80</td>
<td>2.55</td>
<td>2.2%</td>
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<tr>
<td>Term Spread</td>
<td>1</td>
<td>0.01</td>
<td>0.46</td>
<td>0.74</td>
<td>1.05</td>
<td>0.3%</td>
</tr>
<tr>
<td>Return Variance</td>
<td>1</td>
<td>0.02</td>
<td>-0.15</td>
<td>2.47</td>
<td>-0.24</td>
<td>0.0%</td>
</tr>
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<td>1</td>
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<td>0.62</td>
<td>0.40</td>
<td>0.37</td>
<td>0.2%</td>
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<td>Book / Market</td>
<td>1</td>
<td>-0.02</td>
<td>0.06</td>
<td>-1.27</td>
<td>2.03</td>
<td>2.4%</td>
</tr>
<tr>
<td>Log Payout yield</td>
<td>1</td>
<td>0.15</td>
<td>0.07</td>
<td>2.44</td>
<td>2.28</td>
<td>1.7%</td>
</tr>
<tr>
<td>Log Div Yield</td>
<td>4</td>
<td>0.42</td>
<td>0.11</td>
<td>2.56</td>
<td>2.29</td>
<td>5.2%</td>
</tr>
<tr>
<td>Log Earn Yield (1 y)</td>
<td>4</td>
<td>0.35</td>
<td>0.11</td>
<td>3.08</td>
<td>2.59</td>
<td>3.9%</td>
</tr>
<tr>
<td>Log Earn Yield (10 y)</td>
<td>4</td>
<td>0.52</td>
<td>0.17</td>
<td>3.57</td>
<td>3.09</td>
<td>9.2%</td>
</tr>
<tr>
<td>Term Spread</td>
<td>4</td>
<td>0.02</td>
<td>2.12</td>
<td>0.65</td>
<td>1.94</td>
<td>1.6%</td>
</tr>
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<td>Return Variance</td>
<td>4</td>
<td>0.05</td>
<td>0.04</td>
<td>2.51</td>
<td>0.03</td>
<td>0.0%</td>
</tr>
<tr>
<td>Credit Spread</td>
<td>4</td>
<td>0.03</td>
<td>1.78</td>
<td>0.87</td>
<td>0.54</td>
<td>0.4%</td>
</tr>
<tr>
<td>Book / Market</td>
<td>4</td>
<td>-0.09</td>
<td>0.23</td>
<td>-1.46</td>
<td>2.93</td>
<td>8.0%</td>
</tr>
<tr>
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<td>4</td>
<td>0.73</td>
<td>0.32</td>
<td>3.89</td>
<td>3.47</td>
<td>10.2%</td>
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<td>Log Div Yield</td>
<td>12</td>
<td>1.12</td>
<td>0.29</td>
<td>4.37</td>
<td>3.75</td>
<td>14.2%</td>
</tr>
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<td>Log Earn Yield (1 y)</td>
<td>12</td>
<td>1.00</td>
<td>0.32</td>
<td>3.20</td>
<td>2.71</td>
<td>11.6%</td>
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<td>Log Earn Yield (10 y)</td>
<td>12</td>
<td>1.31</td>
<td>0.42</td>
<td>3.25</td>
<td>2.78</td>
<td>22.1%</td>
</tr>
<tr>
<td>Term Spread</td>
<td>12</td>
<td>0.02</td>
<td>8.53</td>
<td>0.18</td>
<td>2.16</td>
<td>9.3%</td>
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<td>2.43</td>
<td>-0.09</td>
<td>0.0%</td>
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<tr>
<td>Credit Spread</td>
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<td>4.13</td>
<td>1.00</td>
<td>0.73</td>
<td>0.7%</td>
</tr>
<tr>
<td>Book / Market</td>
<td>12</td>
<td>-0.17</td>
<td>0.53</td>
<td>-1.01</td>
<td>2.33</td>
<td>15.7%</td>
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<td>Log Payout yield</td>
<td>12</td>
<td>1.76</td>
<td>0.75</td>
<td>3.21</td>
<td>2.77</td>
<td>22.6%</td>
</tr>
</tbody>
</table>

Note: t-statistics computed using Newey West standard errors
Table 2: Return Predictability – “cay” Sample: 1952 - 2010

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Horizon (Quarters)</th>
<th>(\alpha)</th>
<th>(\beta)</th>
<th>(t(\alpha))</th>
<th>(t(\beta))</th>
<th>(R^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log Div Yield</td>
<td>1</td>
<td>0.10</td>
<td>0.02</td>
<td>2.02</td>
<td>1.75</td>
<td>1.5%</td>
</tr>
<tr>
<td>Log Earn Yield (10 y)</td>
<td>1</td>
<td>0.07</td>
<td>0.02</td>
<td>1.64</td>
<td>1.34</td>
<td>0.9%</td>
</tr>
<tr>
<td>cay</td>
<td>1</td>
<td>0.01</td>
<td>0.87</td>
<td>2.42</td>
<td>3.88</td>
<td>4.3%</td>
</tr>
<tr>
<td>Term Spread</td>
<td>1</td>
<td>0.00</td>
<td>0.66</td>
<td>0.34</td>
<td>1.61</td>
<td>1.3%</td>
</tr>
<tr>
<td>Book / Market</td>
<td>1</td>
<td>0.00</td>
<td>0.02</td>
<td>0.16</td>
<td>0.86</td>
<td>0.4%</td>
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<td>Investment/Capital</td>
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<td>-3.88</td>
<td>2.98</td>
<td>-2.69</td>
<td>3.0%</td>
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<tr>
<td>Log Payout yield</td>
<td>1</td>
<td>0.09</td>
<td>0.04</td>
<td>1.57</td>
<td>1.36</td>
<td>0.9%</td>
</tr>
<tr>
<td>Log Div Yield</td>
<td>4</td>
<td>0.43</td>
<td>0.11</td>
<td>2.33</td>
<td>1.99</td>
<td>6.6%</td>
</tr>
<tr>
<td>Log Earn Yield (10 y)</td>
<td>4</td>
<td>0.30</td>
<td>0.09</td>
<td>2.05</td>
<td>1.65</td>
<td>4.2%</td>
</tr>
<tr>
<td>cay</td>
<td>4</td>
<td>0.05</td>
<td>3.61</td>
<td>2.92</td>
<td>3.97</td>
<td>16.6%</td>
</tr>
<tr>
<td>Term Spread</td>
<td>4</td>
<td>0.02</td>
<td>2.29</td>
<td>0.58</td>
<td>2.21</td>
<td>3.6%</td>
</tr>
<tr>
<td>Book / Market</td>
<td>4</td>
<td>0.00</td>
<td>0.10</td>
<td>-0.03</td>
<td>1.15</td>
<td>2.1%</td>
</tr>
<tr>
<td>Investment/Capital</td>
<td>4</td>
<td>0.47</td>
<td>-11.78</td>
<td>2.57</td>
<td>-2.19</td>
<td>6.1%</td>
</tr>
<tr>
<td>Log Payout yield</td>
<td>4</td>
<td>0.47</td>
<td>0.19</td>
<td>2.41</td>
<td>2.10</td>
<td>5.5%</td>
</tr>
<tr>
<td>Log Div Yield</td>
<td>12</td>
<td>1.06</td>
<td>0.26</td>
<td>3.30</td>
<td>2.94</td>
<td>16.1%</td>
</tr>
<tr>
<td>Log Earn Yield (10 y)</td>
<td>12</td>
<td>0.73</td>
<td>0.20</td>
<td>2.32</td>
<td>1.91</td>
<td>9.9%</td>
</tr>
<tr>
<td>cay</td>
<td>12</td>
<td>0.14</td>
<td>8.59</td>
<td>4.12</td>
<td>6.70</td>
<td>38.1%</td>
</tr>
<tr>
<td>Term Spread</td>
<td>12</td>
<td>0.07</td>
<td>4.99</td>
<td>1.30</td>
<td>3.28</td>
<td>6.6%</td>
</tr>
<tr>
<td>Book / Market</td>
<td>12</td>
<td>0.07</td>
<td>0.15</td>
<td>0.57</td>
<td>0.78</td>
<td>1.9%</td>
</tr>
<tr>
<td>Investment/Capital</td>
<td>12</td>
<td>1.28</td>
<td>-31.38</td>
<td>4.29</td>
<td>-3.80</td>
<td>16.7%</td>
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<tr>
<td>Log Payout yield</td>
<td>12</td>
<td>1.12</td>
<td>0.44</td>
<td>3.63</td>
<td>3.15</td>
<td>12.0%</td>
</tr>
</tbody>
</table>

Note: t-statistics computed using Newey West standard errors
Implications of Benchmark Model

- This result raises a number of issues, such as:

(a) Why are stock return predictable?

(b) Why the regression coefficients (and significance) depend on the time interval used?

(c) What are the implication for an investor who is allocating his wealth between stocks and bonds to maximize his life time utility?

(d) Why stock return volatility does not predict future excess returns? After all, the canonical model has

\[
\text{Expected Excess Return} = \gamma \text{Variance of Stock Return}
\]

- Using more sophisticated models for volatility, some studies find a significantly positive relation, but some others find a significant negative relation. There is still a considerable debate.
7. Cross-sectional Predictability Puzzle: Some type of stocks yield an average return that is not consistent with the canonical model.

- The canonical model implies that expected excess returns of asset $i$ is given by:

$$E \left[ \text{Excess Return}_i^t \right] = \gamma \text{Cov} \left( \text{Return}_i^t, \text{Consumption Growth} \right)$$

$$= \beta^i E \left[ \text{Excess Return of Mkt Portfolio} \right]$$

- where

$$\beta^i = \frac{\text{Cov} \left( \text{Return}_i^t, \text{Return Mkt Portfolio} \right)}{\text{Var} \left( \text{Return Mkt Portfolio} \right)}$$

- Portfolios of stocks that are sorted by Book-to-Market Ratio or by Size and Book to Market do not satisfy this relation.

- For instance, using Book-to-Market sorted portfolios, we obtain the following
• The top panel shows the the average return on B/M sorted portfolio on the x-axis, and the one implied by the CAPM ($\ = \beta \times $ Average Return of Market Portfolio) on the y-axis.

• They should line up, but they don’t
Implications of Benchmark Model

- It is even worse if one uses Size and Book-to-Market portfolios (the so-called FF 25 portfolios).

- Adding to this, momentum portfolios (sorted by past winners and losers) show similar and perhaps more striking pattern.
8. Tech “Bubble”: Typical to talk about technology bubbles (e.g. late 1990s)
Implications of Benchmark Model

- Was it a bubble?
- Why do stock prices tend to go up and then down around technological revolutions?
- Examples:
  - the early 1980s (biotechnology, PC)
  - the early 1960s (electronics)
  - the 1920s (electricity, automobiles)
  - the early 1900s (radio)
9. Presidential Cycle. Why are average excess returns higher during democratic presidencies?

<table>
<thead>
<tr>
<th></th>
<th>Sample: 1927 - 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rep</td>
</tr>
<tr>
<td>Average Excess Returns</td>
<td></td>
</tr>
<tr>
<td>(%/year)</td>
<td>0.79</td>
</tr>
<tr>
<td>Average Real Div Growth</td>
<td></td>
</tr>
<tr>
<td>(%/year)</td>
<td>4.17</td>
</tr>
<tr>
<td>Average P/D Ratio</td>
<td></td>
</tr>
<tr>
<td></td>
<td>32.00</td>
</tr>
<tr>
<td>Average Volatility</td>
<td></td>
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<td>(%/year)</td>
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<td>Median Excess Return</td>
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<tr>
<td>(%/year)</td>
<td>7.75</td>
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<tr>
<td>Median Nominal Dividend Growth</td>
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<tr>
<td>(%/year)</td>
<td>7.00</td>
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<td>Median P/D Ratio</td>
<td></td>
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<td>Median Volatility</td>
<td></td>
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<tr>
<td>(%/year)</td>
<td>12.08</td>
</tr>
</tbody>
</table>

See also: Santa Clara and Valkanov “Political Cycles and the Stock Market” Journal of Finance, 2003
10. Political events and Risk Premia. Why put options are especially expensive around elections or global summits?
Benchmark Portfolio Allocation Model

- Consider now the model above for stock returns with same preferences, but now we do not impose market clearing ($\theta = 1$).

- In this case, the utility maximization problem of an investor with investment horizon $T$ is

  $$ J (W_0, 0) = \max_{\{(C_t), (\theta_t)\}} E_0 \left[ \int_0^T e^{-\phi t} \frac{C_t^{1-\gamma}}{1-\gamma} dt \right] $$

- subject to the budget constraint

  $$ dW_t = \{W_t (\theta_t(\mu - r) + r) - C_t\} dt + W_t \theta_t \sigma dB_t $$

- The solution to this program yields an investment in stocks equal to

  $$ \text{Fraction of Wealth Invested in Stocks} = \theta_t = \frac{\text{Excess Return on the Stock Market}}{\gamma \text{Variance of Stock Returns}} $$
1. **Portfolio Allocation Puzzle 1**: The typical stockholder holds too little in stocks compared to what a canonical model would require.

- Using unconditional averages, Excess Stock Return = 7% and Volatility of Returns = .16 %, we obtain

<table>
<thead>
<tr>
<th>Risk Aversion</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>136%</td>
<td>68%</td>
<td>45%</td>
<td>34%</td>
<td>27%</td>
</tr>
</tbody>
</table>

- In contrast, depending on estimates, typical household holds between 6% to 20% in equity. Conditional on participating to the stock market, these number increase to about 40% of financial assets.
2. **Portfolio Allocation Puzzle 2:** The canonical model with constant investment opportunity set implies that the portfolio allocation should not depend on the age of investor.

   - This is in contrast with the behavior of investors: Investors increase their holdings in equity for the first 1/2 of their life cycle, and decrease it afterwards.

3. **Portfolio Allocation Puzzle 3:** Many investors do not participate in the stock market, while the canonical model would imply always some participation to the market (at worse, short the market).

4. **Portfolio Allocation Puzzle 4:** Many investors invest in own company stocks, especially in their retirement plan. Diversification arguments clearly points at “shorting” the stock, if anything.
Benchmark Model: No Trading and Wealth Inequality

- Representative agents models don’t have implications about trading or cross-sectional differences in wealth inequality, which are important features of the data.

A. S&P 500 Growth Forecast

B. P/E Ratio and Volatility

C. Dispersion and Volume

D. Wealth Inequality
Benchmark Model: No Trading and Wealth Inequality

• What forces determine trading and wealth inequality dynamics?
  – Asymmetric information
  – Differences of beliefs
  – Heterogeneity in preferences

• Can we reconcile standard representative agent models with such trading dynamics?
  – Aggregation becomes difficult. But progress in recent times.
Nominal Long Term Bonds in Benchmark Model

- I now introduce an exogenous inflation process, and obtain nominal long term bond prices.
- The log dividend (consumption) $c = \log(C)$ and log CPI $q_t = \log Q_t$ grow according to the joint stochastic model

\[
\begin{align*}
dc_t &= g dt + \sigma_c dW_{c,t} \\
dq_t &= i_t dt + \sigma_q dW_{q,t} \\
di_t &= (\alpha - \beta i_t) dt + \sigma_i dW_{i,t}
\end{align*}
\]  

$-i_t$ is the expected inflation rate $i_t = E_t[q_t]/dt$.
- The First Order Condition is (recall $\lambda_t = e^{-\phi t} C_t^{-\gamma}$)

\[
Z(i_t, t; T) = E \left[ \frac{\lambda_T Q_t}{\lambda_t Q_T} \right]
\]

- yielding

\[
Z(i_t, t; T) = e^{A_0(\tau) - A_\beta(\tau) i_t}
\]
- where $A_\beta(\tau)$ and $A_0(\tau)$ are two function of time to maturity $\tau = T - t$
Implications of Benchmark Model

1. The instantaneous nominal rate $r_t$ is given by the constant real rate + inflation risk premium + expected inflation

$$r_t = \lim_{T-t \to 0} y(t; T) = -\lim_{\tau \to 0} \frac{A_0(\tau) - A_1(\tau) i_t}{\tau} = c + i_t$$

- where

$$c = \left( \rho + \gamma g - \frac{1}{2} \gamma^2 \sigma_c^2 \right) - \gamma \sigma_c \sigma_q \rho_{qc} - \frac{1}{2} \sigma_q^2$$

2. The whole yield curve depends on the current expected inflation $i_t = E[dq_t]/dt$.

$$y(t; T) = -\frac{\log(Z(i_t, t; T))}{\tau} = -\frac{A_0(\tau)}{\tau} + \frac{A_\beta(\tau)}{\tau} i_t$$

- In particular, all of the yields are perfectly correlated.

3. The Term Spread (Slope) is

$$y_\infty - r_t = \left( \frac{\alpha}{\beta} - i_t \right) - \frac{1}{\beta} \left( \gamma \sigma_i \sigma_c \rho_{ic} + \sigma_i \sigma_q \rho_{iq} \right) - \frac{\sigma_i^2}{2\beta^2}$$

- Note that since $\rho_{ic} < 0$ (typically), $\gamma \sigma_i \sigma_c \rho_{ic} / \beta < 0$. Higher risk or risk aversion, the higher the long end of the yield curve.
Expected Inflation and GDP growth
4. The model requires a large risk aversion to produce reasonable yield curves and a reasonable market price of risk $\lambda$

- Using data on inflation and GDP growth ($= C$), we obtain the following parameters for the processes

<table>
<thead>
<tr>
<th>$\alpha$</th>
<th>$\beta$</th>
<th>$g$</th>
<th>$\sigma_y$</th>
<th>$\sigma_q$</th>
<th>$\sigma_i$</th>
<th>$\rho_{yq}$</th>
<th>$\rho_{yi}$</th>
<th>$\rho_{iq}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0160</td>
<td>0.3805</td>
<td>0.02*</td>
<td>0.02*</td>
<td>0.0106</td>
<td>0.0073</td>
<td>-0.1409</td>
<td>-0.2894</td>
<td>0.8360</td>
</tr>
</tbody>
</table>

* The estimates of GDP growth were $g = 0.0321$ and $\sigma_y = 0.0098$, which made it hard to generate sensible yield functions. The parameters assumed are closer to consumption growth

- Using utility parameters $\rho = 0.1$ and $\gamma = 104$ we get a real rate $c = 0.02$. $\xi = -0.5931$

- Risk free rate puzzle kicks in:
  - For “reasonable” $\gamma$, the interest rate is too high.
  - Lowering $\gamma$ to $\gamma \approx 0.5$ generates also reasonable yield curves, but they are not upward sloping in average. Moreover, the market price of risk is too low.
Implications of Benchmark Model

5. The volatility of bond yields changes \((\sigma(dy))\) is constant over time but depends on maturity:

\[
\sigma_y(t;T) = \frac{1 - e^{-\beta \tau}}{\beta \tau} \sigma_i
\]

6. The bond risk premium is also constant, and given by

\[
E \left[ \frac{dZ}{Z} \right] / dt - r_t = \sigma_Z \xi
\]

where

- \(\sigma_Z = \text{vol of } dZ/Z = -A_\beta(\tau) \sigma_i\)
- \(\xi = \gamma \sigma_c \rho_{ic} + \sigma_q \rho_{iq}\) is Market Price of (inflation) Risk
  - No time varying risk premium and no predictability
Bond return volatility and yields are positively or negatively correlated.
The Treasury Bond Market Betas

- Bond return became negative beta assets in the last two decades.
Bond Predictability. Fama Bliss (1987)

- Fama and Bliss classic paper show that bond return are predictable by the forward spread.

  holding period excess log return = $\alpha + \beta \left( f_t^{(n)} - y(t,1) \right) + \epsilon_t$

- where $n =$ horizon (in years)

<table>
<thead>
<tr>
<th>$n$</th>
<th>$\alpha$</th>
<th>$\beta$</th>
<th>$t(\alpha)$</th>
<th>$t(\beta)$</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.0018</td>
<td>0.7850</td>
<td>0.6020</td>
<td>2.8129</td>
<td>10.94%</td>
</tr>
<tr>
<td>3</td>
<td>-0.0002</td>
<td>1.2246</td>
<td>-0.0446</td>
<td>3.5671</td>
<td>17.50%</td>
</tr>
<tr>
<td>4</td>
<td>-0.0031</td>
<td>1.5325</td>
<td>-0.4309</td>
<td>3.4255</td>
<td>17.19%</td>
</tr>
<tr>
<td>5</td>
<td>0.0014</td>
<td>1.0862</td>
<td>0.1316</td>
<td>1.8760</td>
<td>6.97%</td>
</tr>
</tbody>
</table>

- However, evidence from Euro, UK, Japan is much less clearcut. What’s different there?

- Cochrane and Piazzesi (2003) show that there is a single combination of forwards that explain bond excess returns.
  - What is an economic model that generates that effect?
  - Intriguingly, Cochrane Piazzesi factor works also outside US, while Fama Bliss regressions do not. What is the factor capturing?
This Course Covers (subject to change, though)

- Foundations: Complete markets, state price densities, consumption/portfolio allocation, the martingale method.

- (Some) portfolio allocation models with
  - Time varying investment opportunities
  - Incomplete information (learning)

- Habit formation and time varying risk preferences
  - Time-series and cross-sectional predictability

- Heterogeneous preferences, beliefs, and trading
  - Heterogenous risk aversion
  - Heterogeneous habits
  - Heterogeneous beliefs

- Incomplete information, learning and stock and bond returns
  - Valuation with uncertainty in long term growth.

- Politics and asset prices
  - Political news and returns

- Market incompleteness and constraints
Requirements

- **Big Homework Assignments (30%)**:  
  - I will assign three research ideas / projects during the terms.  
  - Your assignments will be to develop such research ideas into coherent papers. This will involve  
    (a) solving a model; (b) obtain predictions; (c) compare predictions with the data.  
  - The paper must have the form of a paper, with an introduction, body of the paper, data analysis, conclusion, appendix.  
  - The TA and I will be the referees: Give you feedback to improve writing.  
  - You can work in groups, but with a limit of 3 per group.

- **Weekly Mini Homework Assignments (10%)**:  
  - Every class, I will write on the board some assignments related to missing steps in the notes.  
  - You must turn in a sheet with the missing steps. This is individual work (no group).

- **In-class Exam (30%)**  
  - There will be a “midterm” on Tuesday February 18. Essentially 1 1/2 hour on the material covered in class.

- **Term Paper (25%)**  
  - A paper on the topics covered in class, due by the beginning on Spring quarter.

- **Class participation (5%)**.
<table>
<thead>
<tr>
<th>Week</th>
<th>Tuesdays</th>
<th>Fridays</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Jan 7. 3:30-6:30 pm</td>
<td>Jan 10. 8:30-11:30 am</td>
<td></td>
</tr>
<tr>
<td>Week 2</td>
<td>Jan 14. No class</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 3</td>
<td>Jan 21. 3:30-6:30 pm</td>
<td>Jan 31. 8:30-11:30 am</td>
<td>Paper #1</td>
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<tr>
<td>Week 4</td>
<td>Jan 28. 3:30-6:30 pm</td>
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<td></td>
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<tr>
<td>Week 5</td>
<td>Feb 3. No class</td>
<td></td>
<td>Paper #2</td>
</tr>
<tr>
<td>Week 6</td>
<td>Feb 11. 3:30-6:30 pm</td>
<td></td>
<td>Paper #3</td>
</tr>
<tr>
<td>Week 7</td>
<td>Feb 18. 3:30-6:30 pm (midterm)</td>
<td>Feb 21. 8:30-11:30 am</td>
<td>(Exam week)</td>
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<td>Week 8</td>
<td>Feb 25. No class</td>
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<tr>
<td>Week 9</td>
<td>March 3. 3:30-6:30 pm</td>
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</tr>
<tr>
<td>Week 10</td>
<td>March 10. No class</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 11</td>
<td>March 17 - 3:30-6:30 pm</td>
<td>March 20 - 8:30-11:30 am</td>
<td></td>
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