Time Series and Cross-Sectional Predictability

Focus Session

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July 2006

The Facts

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 Lucas model with i.i.d consumption growth implies

   $$\text{Expected Excess Return} \;=\; \gamma \text{Variance of Consumption Growth}$$

   - Even assuming that γ is large, say $\gamma = 10$, we have

   $$\text{Expected Excess Return} \;=\; 10 \times (.02)^2 = 0.4\%$$

2. **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 γ that is too high: If we set $\gamma = 2$ we obtain $r = 6\%$.
   - Tension between equity premium puzzle (need γ high) and risk free rate puzzle (need γ low).

The Facts

3. **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

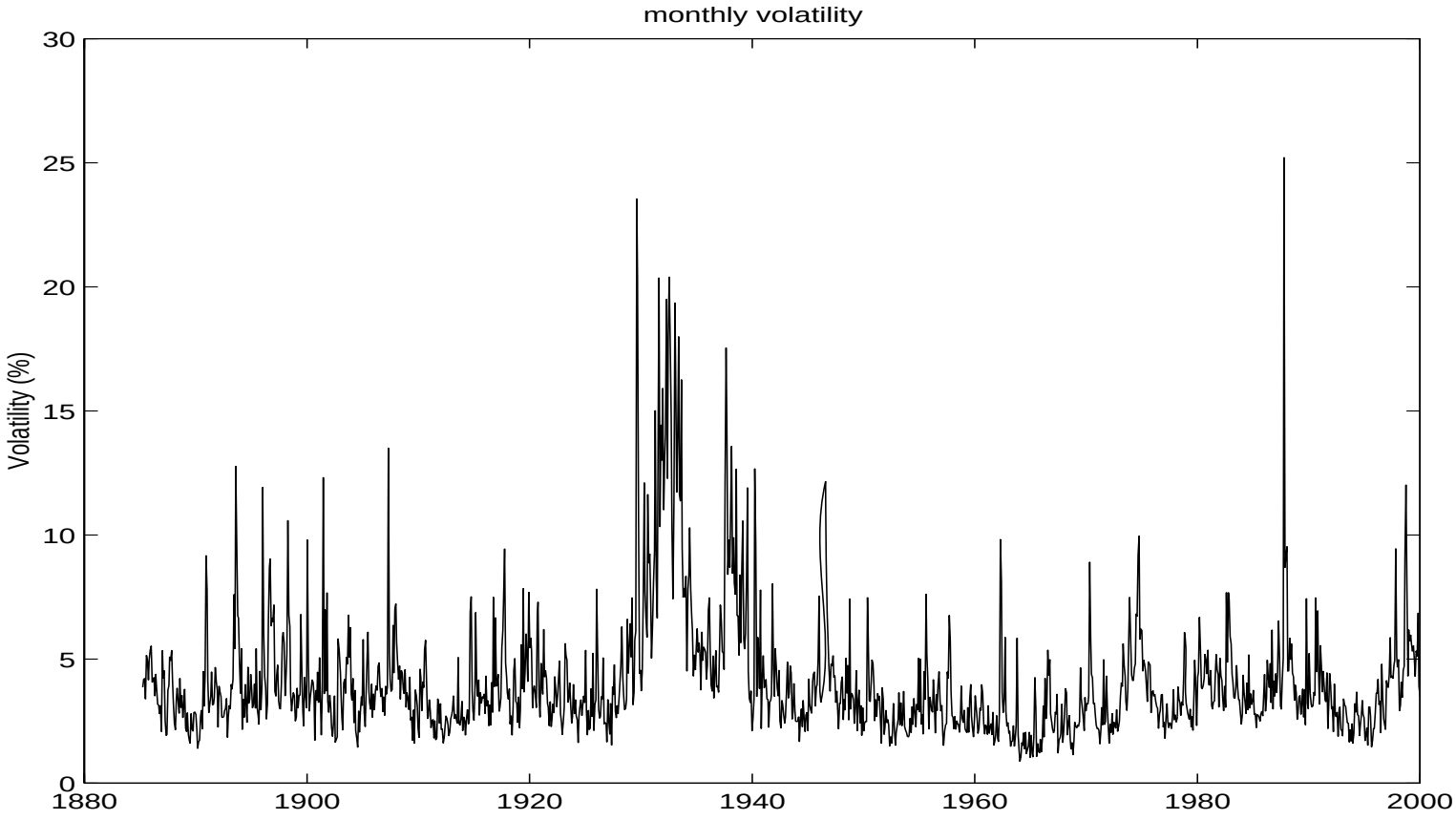
   $$\text{Volatility of } \frac{dP_t}{P_t} = \text{Volatility of } \frac{dD_t}{D_t}$$

   - 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.

The Facts

4. **Volatility Puzzle 2:** Return volatility is not only high, but it is time varying.

   - Historically, monthly market return volatility fluctuated between 20 - 25 % in the 30s to less that 2% in the middle of the 1960s.



The Facts

5. **Predictability 1:** Stock returns are predictable by, say, the dividend price ratio.

   - Predictability regression: Excess Return$(t \to t+\tau) = \alpha + \beta \log\left(\frac{D_t}{P_t}\right) + \epsilon_{t,t+\tau}$

Table: Forecasting Regression

Sample		Horizon (qtrs)			
1948 - 2001		4	8	12	16
	log(D/P)	**.13**	.20	.26	.35
	NW t-stat	(2.13)	(1.65)	(1.34)	(1.29)
	Adj. R^2	.09	.10	.11	.14
Sample		Horizon (qtrs)			
1948 - 1994		4	8	12	16
	log(D/P)	**.28**	**.48**	**.63**	**.78**
	NW t-stat	(4.04)	(4.00)	(4.49)	(5.41)
	Adj R^2	.19	.32	.43	.54

   - Why does predictability depends on sample?
   - How is it affected by definition of dividends?
     - e.g. if D = dividends + repurchases $\Longrightarrow$ it works also in 1948 - 2001 (Menzly, Santos and Veronesi (2004))

The Facts

6. **Predictability 2**: From a basic canonical model, we have

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

- Data show that expected excess returns are time varying (predictability) and variance of stock return is time varying.
- Are they related?
  - Most of the empirical literature shows that there is very little relation between the two.
  - For instance, a simple regression

$$\text{Cumulated Returns } (t \to t+\tau) = \alpha + \beta \, (\text{Monthly Vol}) + \epsilon_{t,t+\tau}$$

The Facts

Table: Forecasting Regression

Sample		Horizon (qtrs)			
1925 - 1999		4	8	12	16
	Volatility	$-.32$	$-.30$	$.82$	1.59
	NW t-stat	$(-.32)$	$(-.20)$	$(.62)$	(1.28)
	Adj. R^2	$.00$	$.00$	$.00$	$.01$
Sample		Horizon (qtrs)			
1948 - 1994		4	8	12	16
	Volatility	$\mathbf{1.05}$	1.1	1.00	2.69
	NW t-stat	(1.56)	(0.81)	(0.87)	(1.41)
	Adj R^2	$.01$	$.01$	$.00$	$.02$

- 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 (Measurement? Multifactor?)

The Facts

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:

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

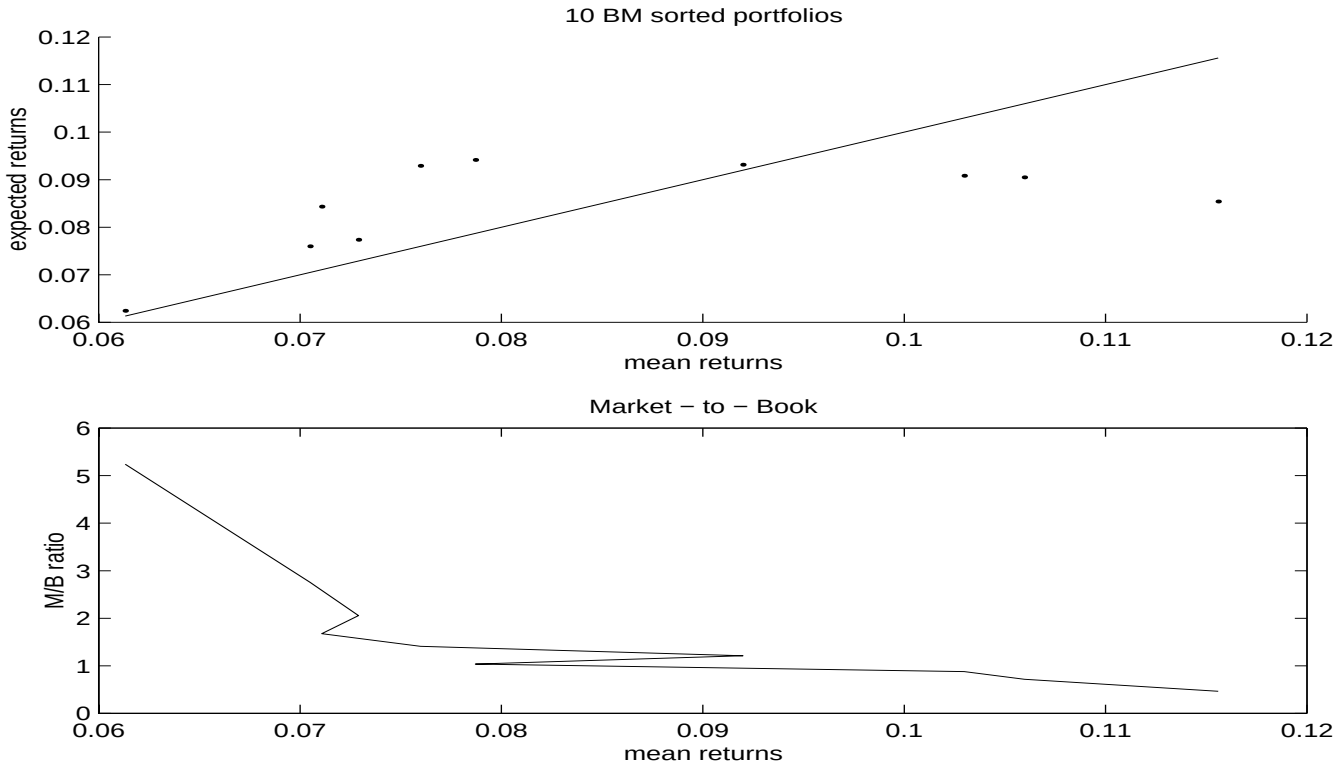
$$= \beta^i E\left[\text{Excess Return of Mkt Portfolio}\right]$$

   - where

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

   - 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

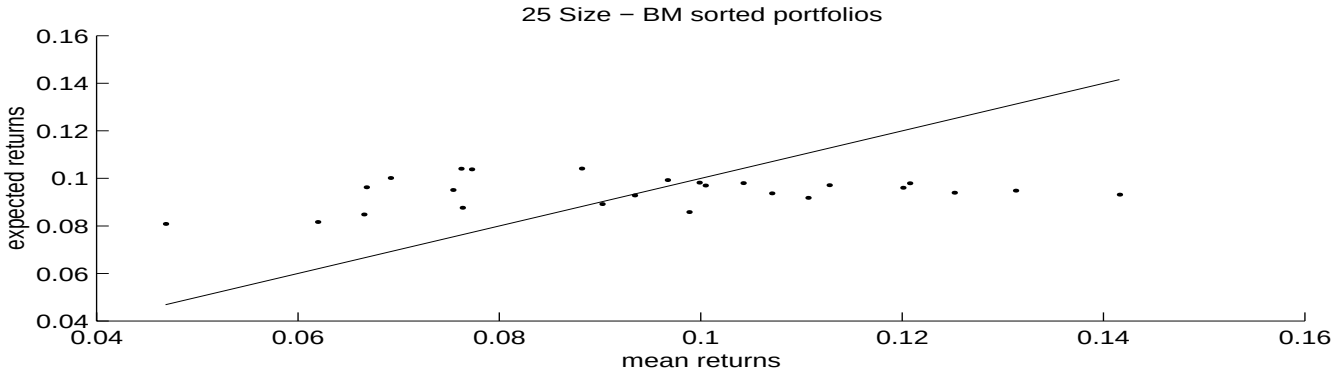
The Facts

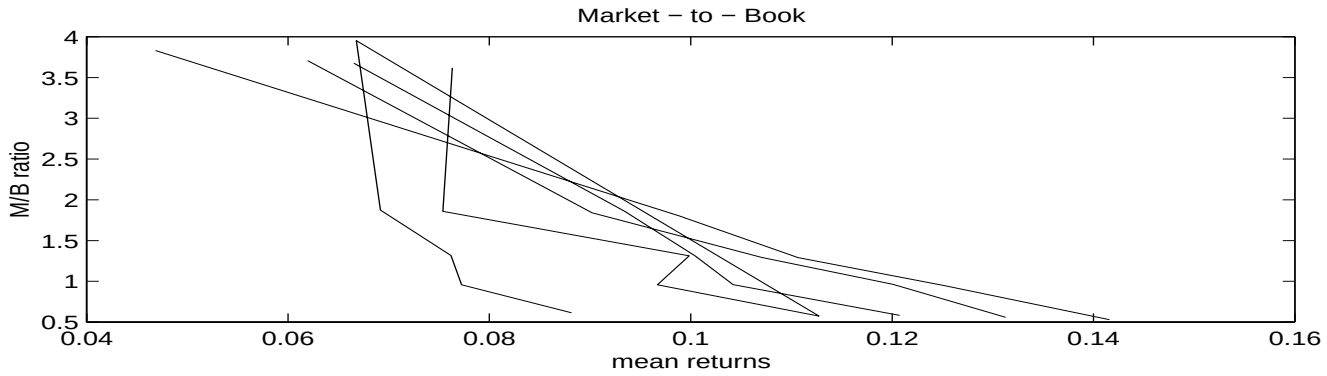


- The top panel shows the average return on B/M sorted portfolio on the x-axis, and the one implied by the CAPM (= beta $\times$ Average Return of Market Portfolio) on the y-axis
- They should line up, but they don't

The Facts

- 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.

The Explanations

1. Equity Premium Literature:
   (a) Peso Problem and Survival of Markets
      - E.g. Rietz (1987), Brown, Goetzman and Ross (1995), Veronesi (2004), Barro (2006)

   (b) Prospect Theory
      - Bernatzi and Thaler (1989), Barberis Huang and Santos (2001)

   (c) Habit formation preferences
      - E.g. Sundaresan (1989), Constantinides (1990), Abel (1990), Detemple and Zapatero (1991), Campbell and Cochrane (1999), Menzly, Santos and Veronesi (2004)

   (d) Preferences for robustness and ambiguity aversion
      - E.g. Anderson, Hansen, and Sargent (2000) , Maenhout (2004), Epstein and Chen (2002)

   (e) Recursive Preferences and Long Run Risk
      - E.g. Epstein Zin (1989), Weil (1990), Bansal and Yaron (2004)

The Explanations

2. Value Premium Puzzle Literature

   (a) Multifactor models:

   - E.g Fama and French (1993)

   (b) Conditional CAPM:

   - e.g. Lettau and Ludvigson (2001), Gomes, Kogan and Zhang (2003).

   (c) Cash Flow Risk:

   - Campbell and Vuoltenaaho (2003), Bansal, Dittmar, and Lundblad (2005), Parker and Julliard (2005).

   (d) EZ Preferences and Long-Run Risk:

   - Hansen, Heaton and Li (2005), Kiku (2006)

   (e) Composition Effect:

   - Santos and Veronesi (2005), Lettau and Wachter (2005).

   (f) Various Behavioral

   - Rosenberg, Reid and Lanstein (1985), DeBondt and Thaler (1987), Lakonishok, Shleifer, and Vishny (1994), Hong and Stein (2006).

The Link between Time Series and Cross Sectional predictability

- The voluminous "Equity Premium Puzzle" literature developed separately from the equally voluminous "Value Premium" Puzzle literature.
- This is unfortunate:
  - Explanations of one set of facts have equilibrium implications for the second set of facts.
- Consider any theory, rational or behavioral, for the aggregate variation of stock returns
  - What implications does it have for the cross-section of stock returns?
    - In particular, does it imply that the CAPM fails?
  - If so, does a multifactor model, or the conditional CAPM works under the proposed theory?
  - Are the predictions *quantitatively* plausible?
- Similarly, take any successful explanations for the cross-section:
  - What implications does it have for the equity premium, interest rates, Sharpe ratio?
  - What implications does it have for the *conditional* variation of returns?

The Link between Time Series and Cross Sectional predictability

- These questions are important because

  1. They inform on the set of "stories" that are plausible.
     - As a simple example: the Peso Problem explanation of the equity premium has nothing to say about the return differential between value and growth stocks.
     - This does not mean of course that the Peso Problem explanation is not true, but that it cannot be the whole story about the variation in stock returns.

  2. They impose additional constraints that may help in empirical tests.
     - E.g. Conditional CAPM tests show that some factors line up value and growth stocks
     - Are the coefficients in the cross-sectional estimate economically plausible?
       - $\Longrightarrow$ Pitfall in using cross-sectional R^2 and t-stats to declare victory
       - The magnitudes must be in line with the economic model as well.

  3. They yield insights on the variation of premia across asset classes;
     - E.g. The equity premium is time varying, and so is the value spread.
     - Are they related? If so, how? What aggregate factor drives both?
     - Is this index of a time varying market price of risk, or a time varying aggregate risk?

Going one step further: The link to fundamentals

- Some explanations of the cross-section of stock returns declare victory if they find, *empirically*, that value stocks covary more with a given factor than others.
  - Is this satisfactory?
  - Is this an explanation of the value premium puzzle?
    - It is definitely an empirical explanation, but it then raises additional questions.
- For instance:
  - Why do HML and SMB price value and size portfolios?
    - Is this a hardwired result or are these genuine risk factors?
    - Indeed, what is a theory for HML and SMB?
  - Recent research show that value stocks covary with future expected consumption growth.
    - Why should value stocks have higher covariance with future consumption growth?
    - What is the link at the fundamental level between returns on value stocks and future expected consumption growth?
  - Similarly, value stocks are found to have a higher cash flow risk
    - Why should they? Is this endogenous? How is this related to firms' life cycle?

Going one step further: The link to fundamentals

- Only general equilibrium models can provide satisfactory answers to these questions.
  1. We need an empirically plausible model for firms' cash flows:
     - E.g. Multiple trees or production technologies.
     - $\Longrightarrow$ the source of fundamental risk.
  2. We need a model for investor/consumer behavior:
     - $\Longrightarrow$ source of the market price of fundamental risk.
     - $\Longrightarrow$ implications for aggregate market portfolio.
  3. We need to impose market clearing and sum up cash flows to determine aggregate consumption:
     - Market clearing conditions may be powerful sources of variation;
     - They may yield "unexpected" results because of endogenous variation in the stochastic discount factor and endogenous correlation structure.
- The papers in today's section will enlighten on these links between fundamentals, time series predictability, and cross-sectional predictability.
- Yet, much more is left to be done....