Topics in Dynamics Asset Pricing

Pietro Veronesi
Graduate School of Business
University of Chicago

1 Introduction

- 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 ten weeks I will assign research ideas that students have to developed into research papers (I provide tips). I will "referee" such papers providing then feedback on how papers should be written.

        – By the end of the course, students will learn what it takes to write a good paper, the type of assumptions we must make to "solve the model", when we need to resort on numerical methods, and, importantly, how we confront the model with the data.

- We start by reviewing some intruiguing empirical regularities.

1.1   Empirical Regularities

- The number of empirical regularities observed in the data and that clash with the standard paradigm is vast.

- To cite a few:

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%.

    - As we will see, a standard classic model (Lucas model) of stock prices under constant opportunity set implies

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

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

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

    - 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

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

- 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.

3. **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.

monthly volatility
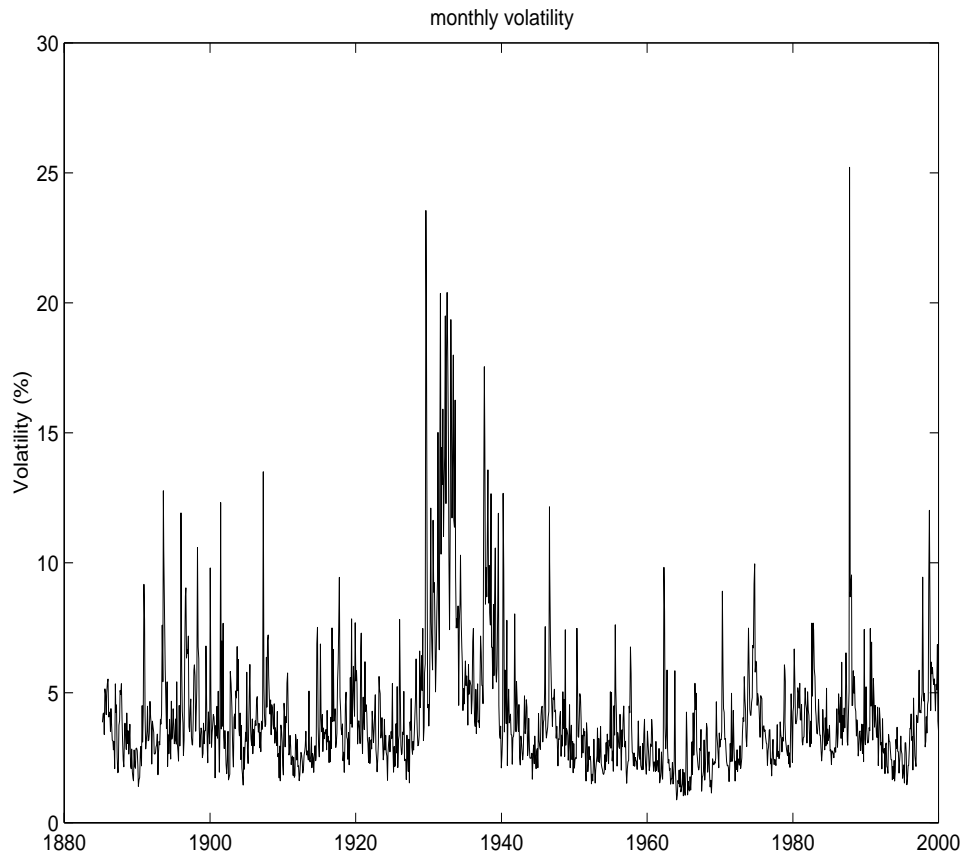
4. **Risk Free Rate Puzzle:** The usual canonical model implies that the interest rate is given by

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

- where ϕ is the time discount rate, μ_c is the expected growth rate of consumption, and σ_c is the volatility of consumption.

- 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 $r = 6\%$.

- Note the tension between equity premium puzzle (need γ high) and risk free rate puzzle (need γ low).

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

- A regression of:

Cumulated Returns $(t \rightarrow t+\tau) = \alpha + \beta \log\left(\dfrac{D_t}{P_t}\right) + \epsilon_{t,t+\tau}$

- yield the following result

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

- 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?

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

Expected Excess Return $= \gamma$Variance of Stock Return

- (you can see this from the previous equations)
- 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

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

- yield the following result

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	**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.

7. **Cross-sectional Predictability Puzzle**: Some type of stocks yield an average return that is not consistent with the canonical model.

   - The canonical mode 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

10 BM sorted portfolios

Market – to – Book
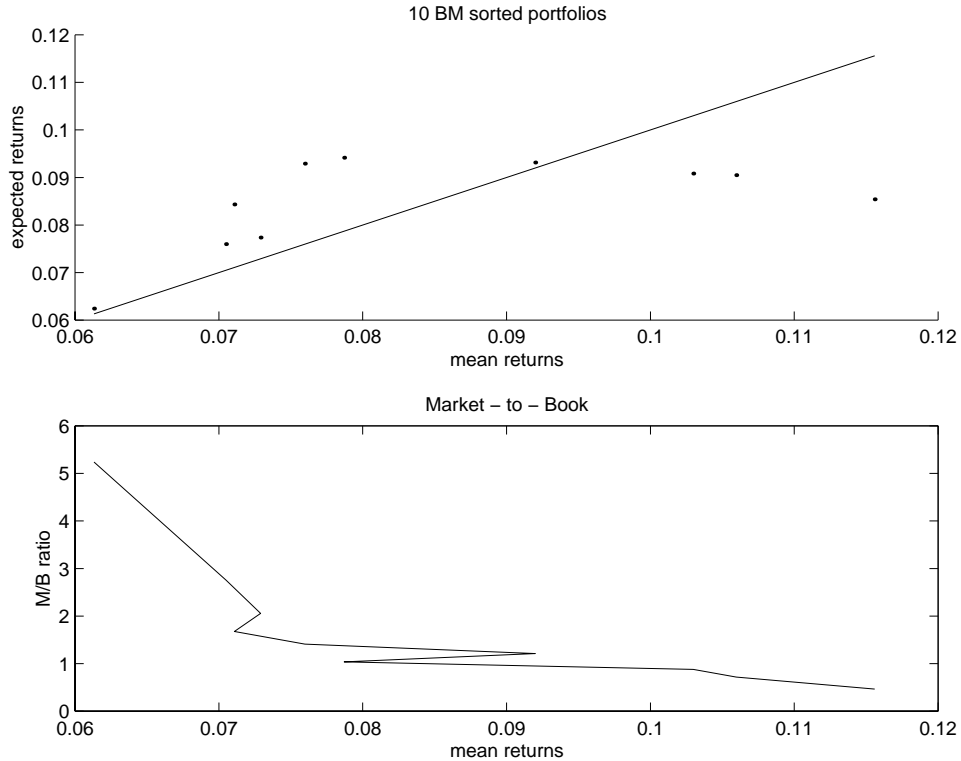
- The top panel shows the the average return on B/M sorted portfolio on the x-axis, and the one implied by the CAPM (= beta × Average Return of Market Portfolio) on the y-axis

- They should line up, but they don't

- The bottom panel simply reports the average M/B of these portfolios.

- Similarly (and worse) if one uses Size and Book-to-Market portfolios (the so-called Fama French 25 portfolios)

25 Size – BM sorted portfolios

Market – to – Book
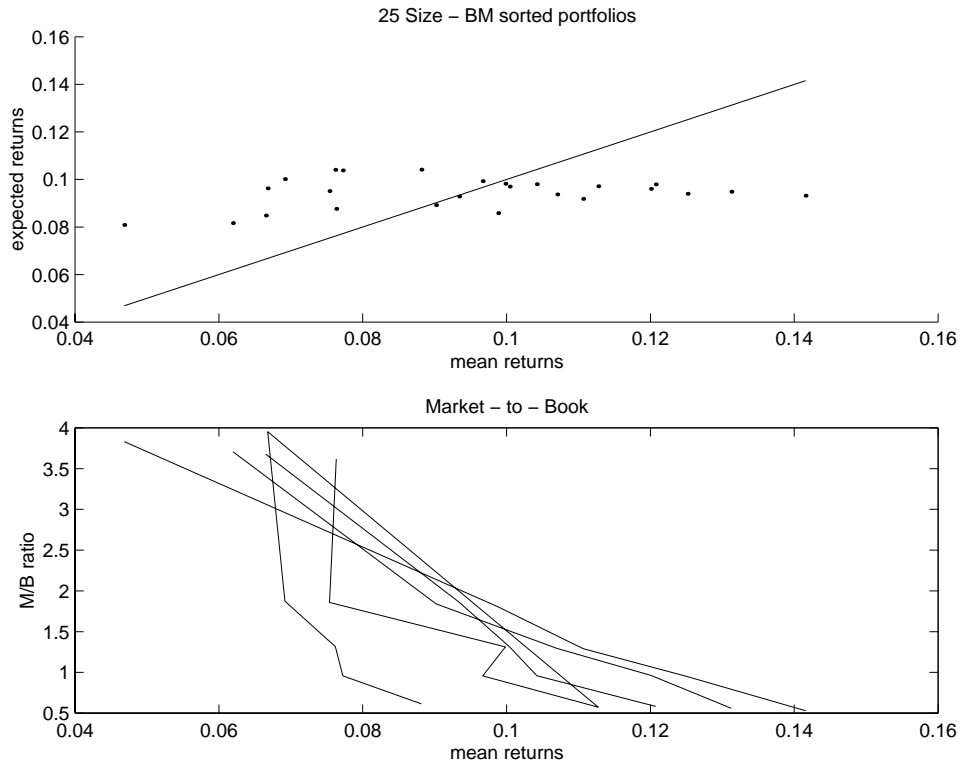
- Adding to this, momentum portfolios (sorted by past winners and losers) show similar and perhaps more striking pattern.

8. **Portfolio Allocation Puzzle 1:** The typical stockholders holds too little in stocks compared to what a canonical model would require.

   - The tradition model (Samuelson - Merton model) of portfolio allocation with constant investment opportunity set implies an allocation to stocks equal to

   $$\text{fraction of wealth in stocks} \quad = \frac{\text{Excess Return}}{\gamma \times \text{Variance of Returns}}$$

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

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Table: Portfolio Allocation

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	Risk Aversion				
	2	4	6	8	10
Investment	136%	68%	45%	34 %	27 %

   - In contrast, depending on estimates, typical household holds betwee 6 % to 20 % in equity. Conditional on participating to the stock market, these number increase to about 40% of financial assets.

9. **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.

10. **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).

11. **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.

1.2 Models

- These empirical regularities are intriguing, and the finance literature has put forward a number of models and stories to "explain" them.

- In this course, we explore such models, and try to understand how far they get in explaining these empirical facts, and what their pros and cons are.

- Specifically, we will cover a number of topics, such as the following (preliminary outline, readings are in the syllabus):

  1. **The "Canonical Model" with complete markets and power utility**

     (a) The classical portfolio allocation problem (TN 1)
        - The Bellman Equation Approach
        - The Martingale Approach
        - A "simple" extension: Time varying opportunity set and asset allocation in complete markets.

     (b) Equilibrium stock returns and interest rate. (TN 2)
        - Aggregation theorem and the construction of a representative agent
        - The characterization of equilibrium stock returns and interest rates.
        - The source of the puzzles.

  2. **Incomplete Information and Learning in Financial Markets** (TN 3)
        - Market participants do not have full information about the parameters of the economy. For instance, they may not know the long term growth of dividends, or the coefficient β in a predictive regression.

– They must learn about them as they observe realized dividends / outputs / earnings and the like.

– Can this uncertainty about the underlying economy help in resolving the puzzles? Why? What else can we do?

3. **Preferences: Recursive Utility and Habit Formation** (TN 4)

– Power utility is a very restrictive assumption. For instance, it equates relative risk aversion with the inverse of the elasticity of intertemporal substitution.

– Recursive utility breaks this link and helps addressing some of the empirical regularities, such as the risk - free rate puzzle. It is widely used in asset allocation problems as well.

– Habit persistence also introduces time dependence in preferences. Depending on specification, it help solving a number of the puzzles we looked at above. When it introduces time varying risk preferences, it also has implications about predictability that are quite interesting, indeed.

– Application: Hetergenous preferences and habit persistence. If many agents have habit persistence preferences, but different utility functions, equilibrium equity returns display interesting features, a step forward towards the resolution of some of the puzzles.

4. **Ambiguity Aversion and Robust Decision Making** (TN 5)

– Agents may be uncertain about the true data generating process, and want to take decisions that are

"robust" to small model mispecifications.

– The assumption leads agents to utilize a max-min operator: Maximize utility under the "worst case" that can happen within a class of models.

– What does this assumption buys us?

5. **Multiple Assets, Labor Income and Market Clearing Conditions** (TN 6)

– When there are multiple assets, market clearing conditions bite.

– We study recent models that disentangle consumption from labor income and look at different assets.

– It turns out that market clearing conditions are powerful in yielding numerous predictions and solve some of the puzzles.

6. **Investments and Equilibrium Returns** (TN 7)

– Value of an asset = Value of asset in place + growth options

– Is it possible that these two components vary in such a way to explain some of the intruiguing puzzles of the cross-section?

7. **Incomplete Markets** (TN 8)

– How do we solve a portfolio problem with constraints?

– What are the equilibrium conditions of market incompleteness? Can they resolve the puzzles?

8. **Applications of Incomplete Markets** (TN 9)

– With portfolio allocation constraints, are there "limits of arbitrage?"

- What does limited stock market participation imply for stock returns? If not everyone can participate, those that do will support higher risk. Is that a good story for some of the puzzles?
- Manager compensation and stock returns: Managers compensation depend on their performance compared to a broad index. What are the implication for equilibrium stock returns? It turns out that some "comovement" arises naturally.

9. **Asymmetric Information and Differences of Opinions** (TN 10)

- Agents have differences in information about the fundamentals of the economy. So, somebody may be able to exploit somebody else. Is the risk premium affected by the presence of these heterogenous agents?
- Agents may just have different opinions. What are the implication of differences of opinions on stock returns? When market frictions are added, then "equilibrium mispricing" and "bubble" like features show up.

1.3   Requirements

- Homework:

  - I will assign four research ideas during these weeks.
  - These are ideas that you won't find in any paper
  - Your assignments will be to develop such research ideas into coherent papers. This will involve (a) solving a model; (b) obtain predictions; (c) check the predictions in the data, through testing or calibration.

- The paper must have the form of a paper, with an introduction, body of the paper, data analysis, conclusion, appendix.

- I (and perhaps Vito Gala) will be the referee: this way you will get a feedback on what I did not like of the paper and how it should be written.

- You can work in groups, but with a limit of 3 per group.

- Midterm

  - There will be a midterm around week 7 or 8. Essentially 1 1/2 hour on the material covered in class.

- Final Paper

  - There is a final paper you can develop. This is a paper of your choice.

- Grading assigns 30%, 30%, 5%, 35% to homeworks, midterm, class participation, and final project.