1 Introduction

1.1 Goal of Asset Pricing

- What is the goal of asset pricing?
  - Since any asset can be viewed as (essentially) just a risky stream of future payments, we want to know the value of a claim to those uncertain future payments.
  - That is, we want to find prices.
- We can also ask: For a given level of risk, what is a fair return?
  - Because a lower price implies a higher rate of return, we can view also asset pricing theory as explaining why some assets pay higher average returns than others.

1.2 Asset Pricing in General

- So where do prices and returns come from?
- The return on any asset can be viewed as a return for waiting and a return for bearing risk:

$$\text{Return} = \text{Waiting } (1\%) + \text{Risk } (8\%).$$

- The effects of time are not difficult to work out.
  - Over the past 50 years or so, the real return on US stocks has been about 9%, but only 1% of this has been due to interest rates.
- That means that 8% is a premium earned for holding risk.
  - *Uncertainty*, or *corrections for risk*, make asset pricing interesting and challenging.

1.3 Stylized Facts... aka "The Teaser"...

- Before getting into the theory, it's useful to have some knowledge about some key facts in finance.
  - Average returns on broad indices are around $8-9$ percent, but stock returns are also very volatile - $\sigma(R) \approx 17$ percent per year.
  - The average risk-free rate is around 1 percent, but it is not very volatile - $\sigma(R)$ is around 2 percent in annual data.
    - $\Longrightarrow$ The equity premium is large (around $7-8$ percent).
  - Returns on long-term bonds (2.5 percent) are not much higher than short-term bonds (1 percent), but the former are much more volatile - σ is about 7.5 percent per year.
  - Stock returns show little serial correlation - $\rho = 0.08$ in quarterly data, $\rho = -0.04$ in annual data; while the risk-free rate shows persistence - $\rho = 0.6$ in annual data.
  - Stock returns are also predictable over business-cycle and longer-term horizons.

- For a typical regression
$$R^e_{t\to t+k} = \alpha + \beta \frac{D_t}{P_t} + \varepsilon_{t+k}$$
  - Slope coefficients are positive: when prices are high compared to dividends, future returns are, on average, low.

Horizon k	1 year	2 years	3 years	4 years
β	3.83	7.42	11.57	15.81
t-stat	2.47	3.13	4.04	4.35
R^2	0.07	0.11	0.18	0.20

- There regressions were initially a challenge to "efficient markets", since returns are forecastable.
  - Other variables also predict returns - e.g., the term premium, the short-term interest rate, and macro variables like the investment/capital ratio.
- Is this a problem? Not really...
- The D_t/P_t is very persistent - that is what really drives the predictability of returns...
  - Think about it this way: suppose you predict that the temperature in C-ville will rise about 1/3 of a degree per day in spring...
  - That forecast explains almost nothing for the day-to-day variations in temperature, but tracks almost all of the rise from January to July... So the R^2 will rise with the horizon.
- So it makes sense that predictability happens over long horizons if you think that daily returns are just slightly predictable by some slow moving variable - it adds up!
- There is a big debate on the economic and statistical significance of this.
- On the statistical side:
  - The persistence of D_t/P_t makes the regression somewhat spurious.
  - The t-stats need to be adjusted.
  - The long-horizon forecasts are not much more significant than the 1 year forecasts, despite larger R^2's.
  - The regressions are unstable and have little out-of-sample forecasting power.
- On the economic side:
  - If you believed changes in expected returns really were this large over time, investors should time the market and invest in stocks when returns are expected to be high and invest in bonds when returns are expected to be low.
- There is also large heterogeneity in average stock returns across firms.
  - The size anomaly: Small firms have higher returns on average.
  - The value premium: Firms with low Tobin's q (or low E/P, low D/P, low B/M, etc.) have higher returns on average.
  - The momentum anomaly: Firms with positive returns tend to keep having positive returns (for a short time).

  - It could be that the differences are due to risk, but it seems to not be explained by standard risk measures (e.g., the CAPM).

- What else?
  - We will talk mostly about stocks, bonds, and currencies in this class...
  - But the general ideas we cover apply to all asset classes, including:
    * Real estate, corporate bonds, commodities, venture capital, etc.
  - There are, of course, aspects that are specific to each asset class - including transaction costs, taxes, costs of shorting, etc. - but in general, the same theory applies.

1.4 Stochastic Discount Factor Framework

- Because good empirical work is always guided by theory, we will start there...
- The central asset pricing equation is

$$p_t = E_t\left[m_{t+1}x_{t+1}\right]$$

  with

$$m_{t+1} = f\left(\text{data, parameters}\right)$$

  where p_t is the asset price, x_{t+1} is the asset payoff, and m_{t+1} is the stochastic discount factor.

- The idea is that price equals expected discounted payoff.
- This course uses the concept of the stochastic discount factor to unify all asset pricing.
  - Stocks, bonds, futures, options, etc. can all be examined within one framework.
- All asset pricing models (CAPM, Black-Scholes, etc.) use the SDF framework
  - The only difference between asset pricing models is the choice of the stochastic discount factor, or the m.

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1.5.1 Two Approaches

- Asset pricing has two extremes: absolute pricing and relative pricing.
- Absolute pricing prices assets by their exposure to fundamental sources of macroeconomic risk.
  - This approach is most common in academic settings, with the consumption-based and GE models as examples.
  - One of the most interesting research questions today is how to understand and measure the sources of aggregate or macroeconomic risk.
- Relative pricing asks what we can learn about an asset's value, given the price of some other asset.
  - We don't ask where those reference prices came from, and we use little information about fundamental risk factors.
  - This approach has limited scope, but may offer precision - the Black-Scholes option pricing model is the classic example.

1.5.2 Views / Uses of Asset Pricing

- In the real world, we observe the prices and returns of many assets. What can we do with them?
  - Do asset pricing models describe the way the world works? If the world does not obey the model's predictions, we can decide the model needs improvement.
  - Do asset pricing models describe the way the world *should* work? If we decide the world is wrong and that some assets are mispriced, there are trading opportunities for the shrewd investor!
- Some prices of assets are not observed - think about new financial securities, potential investment projects, or complex derivatives.
  - We can then use our theories to establish what their prices *should* be.

2 This Course

- This course is an introduction to empirical asset pricing.
- The first half of the course will introduce you to the SDF methodology for pricing assets and some empirical puzzles arising from that theory.
- The second half of the course covers estimating and evaluating asset pricing models (GMM Methodology).
- Some of the topics we will cover include the time-series and cross-sectional behavior of asset prices, the predictability and excess volatility of returns, concepts of market efficiency and the implications for macroeconomics, testing and evaluating classic models of finance (CAPM, ICAPM, CCAPM), evaluating systematic risk factors (e.g., size, value, and momentum), and estimating dynamic term structure models.