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**Lecture 27: CAPM and Risk Premium**

1. Fixed payment loans
   1. Here’s a quick application from earlier in the course: Why a mortgage is really expensive.
   2. The *yield to maturity* is an interest rate that equates the present value of the payments received from an instrument with its value today.
   3. A common application of present value is the fixed payment loan: where a loan payment is due each time period and so the loaner calculates the payment by incorporating the opportunity cost of lending.
   4. The equation is a complex one to solve, but easy to understand:

FP

(1+r)

LV =

+

(1+r)2

+

(1+r)3

+…+

FP

FP

FP

(1+r)n

* + 1. Where *LV* is the loan value, *FP* is the fixed payment and *i* is the interest rate.
    2. Note the difference fixed payment loans make. With an interest rate of 7% and a LV of $100,000, the fixed payment over a 25 year period is $9,439.29 (or $235,982.25 total). The pendulum of compound interest rates swings both ways.

1. Investment
   1. The equation above is used to price all sort of long-term payments, not just houses. For example, it’s often used to price bonds.
      1. A bond is when the borrower pays the lender a fixed stream of money each period.
      2. How much should you be willing to pay for a bond? It depends on the interest rate and the flow of payments. It will be worth LV.
   2. For present value, we compare against the risk-free rate of return (usually the interest rate of a U.S. government bond).
   3. Investments are rarely risk-free. Investments fail to pay off. Loans are defaulted on. Businesses fail. There is thus a *risk-return trade off*. The riskier the investment, the higher the payoff if successful.
   4. The *risk premium* goes one step further. It is the difference between the expected payoff of a risky investment and the expected payoff of a less risky investment, or the amount a risk-averse agent will pay to avoid taking a risk.
      1. If the expected payoff of a risky investment (say, venture capitalism) is $10 million and the expected payoff of a safe investment (say, government bonds) is $9 million, then the risk premium is $1 million.
      2. Note these are *expected* payoffs. If agents were risk-neutral, the expected payoffs would be the same.
   5. It’s not unreasonable that people are risk averse. At the very least, risk makes it harder to plan which is a real cost to future earnings. Psychologically, people find certainty more comforting. Thus we are interested in removing risk, when possible.
      1. *Diversifiable risk*—risk which can be reduced by investing in many different types of projects. Since each project is independent, the likelihood of all of them failing is very low. But this also limits your earnings since, by the law of large numbers, ensures *something* will fail. Thus there should be no risk premium on a well diversified portfolio (because all/most the risk is gone).
      2. *Nondiversifiable risk*—Sometimes you can’t get rid of certain types of risk. A life insurance company can diversify risk by having many different police holders. But the threat of war is nondiversifiable since it will affect the average death rate. Thus life insurance companies don’t cover death from war. You can’t eliminate all risk, no matter how well you diversify. Nondiversifiable risk will always be there.
   6. Example: the housing crisis and a lesson in what’s diversified.
2. CAPM
   1. The *Capital Asset Pricing Model (CAPM)* measures the risk premium for a capital investment by comparing the expected return on that investment with the expected return on the entire stock market.
      1. In other words, if, instead of investing in this one company, you invested in all companies, will you make more money?
   2. CAPM can be summarized as:
      1. Where ri is the expected return on the investment,
      2. And rm is the expected return on the market,
      3. And rf is the expected risk-free rate of return
      4. And β is a constant that measures the sensitivity of an asset’s return to market movements (and, therefore, the assets nondiversifiable risk).
   3. β is a proportion of the sensitivity of the investment’s risk to market movements.
      1. If β is large, then the investment has a lot of nondiversifiable risk. The risk premium thus increases, causing expected returns to increase.
      2. If β is small, then the investment is similar to the risk-free rate; it has a little nondiversifiable risk. The risk premium falls, thus expected returns fall.