

Introduction to Finance - II  
First quiz on real options

Read the questions carefully. Don't make them harder than they are! Answer succinctly and precisely. Show all of your work.

1. **(12 points)** The “traditional approach” to capital budgeting can be summarized: *The Net Present Value of a project is the sum of the discounted present value of its current and expected future cash flows.* Does the “real options” or dynamic optimization approach to capital budgeting contradict this maxim? If it does, what aspect of the traditional approach is wrong? If it does not, how does it differ from the “traditional approach?”
2. Intel is a large established manufacturer of computer chips. Intel's market cap of equity is \$216 billion. Its capital structure is 89% equity and 11% debt. It has A+ -rated debt, and its 30-year debt trades at a 82 basis point spread to the 30-year US Treasury Bond. The yield to maturity on the 30-year Treasury Bond is 3.5%. Intel's beta is 1.2, and the equity market risk premium is 4%. Intel's statutory tax rate is 32%.
  - (a) **(12 points)** Suppose Intel is considering rebuilding the fabrication production facilities that it owns in Chandler Arizona to use significantly less water and electricity, and generally modernize the facilities. What cost of capital should Intel use to evaluate this project? (I want the numerical value as well as the name.) Explain.
  - (b) **(12 points)** Suppose Intel is considering conducting a new R&D program to develop a new sub-atomic chip that could revolutionize computer processing if successful. This project is highly speculative, with a very low probability of ultimate success. What cost of capital should Intel use to evaluate this project? (I want the numerical value as well as the name.) Explain.
  - (c) **(12 points)** Suppose Intel is considering purchasing a 200-acre piece of land in Chandler Arizona on which it may build a new regional headquarters, or use to expand its fabrication facilities. What cost of capital should it use to evaluate this project? (I want the numerical value as well as the name.) Explain.
3. You work as a financial analyst for Applied Materials in Santa Clara, California. Thanks to some recent breakthroughs in sub-atomic engineering, the nature of integrated circuits is changing rapidly. The most recent breakthrough using photons to transmit electrical pulses has not yet been developed for large scale production. One of your chief engineers, Arvind Patel has a proposal to begin construction of a new plant that would bring this technology to that level. He has commissioned construction plans and says that a new plant could be built in one year, on land that Applied Materials already owns in Xi'an China. This land is a 50 acre site that the company just bought for \$75,000 per acre. The capital outlay for the plant is \$1 billion, which must be paid immediately. Once this plant is built Arvind projects that it will result in an annuity throwing off \$250 million per year (on a net, after-tax basis) for 8 years. (Modeled on an annual basis, the first cash inflow would be 1 year after construction is complete. If construction is complete in one year, the first payment from this annuity would be in two years.) Applied Materials' market capitalization of equity is \$60 billion, its capital structure is 92% equity and 8% debt. Its beta is 1.3 and its 30-year debt is rated A-, and trades at a 94 basis point spread to the 30-year US Treasury Bond. The yield to maturity on the 30-year US Treasury Bond is 3.75%. The stock market risk premium is 4.5%. Applied Materials' statutory tax rate is 27%.
  - (a) **(17 points)** What is the NPV of Arvind's proposed project?
  - (b) **(35 points)** You raise the concern that in this rapidly changing technological environment, there is a good chance that the new technology underpinning Arvind's proposed project will be obsolete in two years. To demonstrate this concern to your boss, Applied Materials' CFO, Dan Durn, you flesh out Arvind's original forecasts – retaining Arvind's expected value of the project's future cash flows – but identifying two scenarios. In Scenario 1, after 2 years, the competing technology flops so that the (net, after-tax) annuity from Arvind's project becomes \$500 million per year for 8 years following completion. In Scenario 2, after 2 years, the competing technology is successful, in which case Arvind's project becomes worthless. There is a 50% probability of each of these 2 scenarios. Show and explain the implications of your more detailed forecast for the original project.