Introduction to Hedging

Administrative Things

- Assignment 7

Today’s Topics

- Principal components (from previous notes for Lecture 20)
  - Regression – converting two investments into uncorrelated pair.
  - Principal components – making several uncorrelated investments.
- Reducing risk
  - You are in a position that leads to risk, more risk perhaps than is preferred.
  - Hedging is a collection of methods for reducing risk to a desired level.
- Statistical methods and issues
  - Regression for analysis and forming uncorrelated investments (again)
  - Spurious correlation and time trends

Review from Last Time

- Allocating your market investment
  - Just buy the value-weighted market index.
  - Analysis of market with VW index and 10 decile “investments”
    1. You can pick the market plus any one of the deciles.
    2. You can pick the market plus any combination of the deciles.
- Maximizing utility again leads one to buy in proportion to $E(\text{Return}) / \text{Var}(\text{Return})$ and the proportions are set individually for uncorrelated investments.
Hedge Funds

- Hedge funds have nothing to do with hedging!
- Privately held funds
  - Little regulation or outside controls
  - Invitation only (Euphemism for cold call?)
- Designed for “sophisticated”, wealthy investors
  - Typical minimum investments of $1,000,000.
  - Investors have a hard time saying that they are not informed.
- Extremely volatile and speculative
  - How to beat the returns on the market.
  - What’s a Ponzi scheme?

Hedging in Currency Markets – First Look

- Situation of a computer manufacturer in Brazil.
  - Has an account in local bank whose current value in $US is $1,000,000
  - Account is currently in local currency, reals.
  - Over coming summer, will be building up systems for local market.
  - These systems will require $1,000,000 in Intel CPUs.
- Currency risk
  - Suppose that current exchange rate is 1.0 Real/$US.
  - What happens if the exchange rate increases to 2.0 Real/$US?
  - What happens if the exchange rate drops to 0.5 Real/$US?
  - Plot of value (in $’s) of the money held in the local bank.
  - Recall that variation in value implies risk. Need sense of scale of variation.
Inflation has been a recent problem in Brazil.

- New currency (Real) introduced to handle legacy of hyperinflation.
- Impact recent international financial crises on exchange rate.

- Exchange rate was “steady” (albeit growing) for about 4 years, then recently soared in January and February of 1999.

Does the manufacturer want to deal with this sort of risk?

- No. Not an area of expertise.
- The computer maker has other issues to confront
  - local competition, import regulations, union negotiations
- Would prefer to avoid the chance of only being able to purchase half of the needed CPUs because of currency fluctuations like this.

How to avoid the risk?

- Buy ‘em now!
  - Low risk, lock in the purchase. Certainly able to buy them now.
  - Carrying costs for storing and maintaining an inventory of these valuable, little things. Risk of theft.
  - Technological change, new devices in the summer. (ie, could get an equal number of a better chip later)
- Move the money to the US now.
  - Open an account in a NY bank and convert the Reals to US dollars at the current exchange rate.
- Earn interest at close to the risk-free rate so hedged against US inflation.
- Downside to this approach (assuming that it is legal)?
  - Other methods?

**Hedging in Currency Markets – Graphical Look**

- First look is easy because the money is available now.
- Suppose that you do not have the $1,000,000 in cash on hand now.
  - You instead have Brazilian accounts receivable.
  - Current value is $1,000,000 instead of cash in the bank.
- This time there will be more costs to remove the risk.
- Impact of uncertainty on value of assets
  - Graph Value of assets at end of transaction on Currency exchange rate (Reals/$) from 0.5 to 2.0 Real/$US.
  - Scale of variation is important
    - This might be a lot of variation for a small firm, but ignorable for GM.
  - Anticipated versus unanticipated variation in the exchange rate.
- Goal of hedging is to remove the variation on the Y-axis while keeping the mean as large as possible.
  - How to hedge this risk?
  - Borrow $1,000,000 in US funds and invest.
- Impact of uncertainty on value of loan
  - Graph Value of $’s invested in US on Currency exchange rate in Real/$US.
- Opposite slope of the previous.
- Premium appears in sense that this line is shifted relative to value of the other if the Real/$US = 1.

➢ “Add” the two curves
- Get a constant function, with slightly smaller value than would have occurred had not hedged.
- All variation in net value of assets is removed.
- Similar in many ways to “making a book” in gambling.

**Hedging in Presence of More Uncertainty**

➢ Situation of large Midwestern farmer in US
- Expects to produce 100,000 bushels of corn.
- Price/bushel is between $2-3/bushel.

➢ Sources of uncertainty
- Variation in the price of corn when it is ready for harvest and sale.
  - Chicago Board of Trade (www.cbot.com/mri/botpag.htm)
- Variation in the quantity produced by the farm
  - Impact of weather, insects, farming techniques, seeds, etc.
- Price and quantity are probably related, but how?
  - They are probably negatively correlated, i.e. higher prices occur at times of less production
  - We’ll consider two scenarios: zero and positive correlation.

➢ Futures contracts and hedging
- Farmer can sell futures contracts for delivery at some time in the future of corn at a market-driven delivery price set at the time of the contract.
- Locks in the delivery price of a set amount of corn (fixed price and quantity).
• Futures market has two sides: buyers (“bakers”) and sellers (“farmers”).
  - Contract price in equilibrium should be near the farmer’s expected price.
  - Expect a small transaction cost, so delivery price is probably lower than
    the farmer’s expected price.
  - If there are too many bakers, the price could be above the expected price.
• Who buys them?
  - A natural purchaser is anyone who uses corn as a raw material, such as a
    bakers, popcorn manufacturers, or food distributors.
• Speculation (“Trading Places”)
  - Anyone can buy or sell them.
  - I will stick to the farmers/bakers rather than the commodity speculators.
  ➢ Farmer’s question
  • How many futures contracts to sell.

An Important Aside: Spurious Correlation
  ➢ What is the relationship of price to quantity for corn.
  ➢ Over last 50 years, we see a positive association. (corr = 0.64)
Is the association really positive?

Time series plots of the two sequences

* Production (Billions of bushels produced in US)

* Price ($’s per bushel)

So, why the positive correlation?

* “Brush” the plot using categories selected from the histogram.

* Both series are trending upward over time.

* Within a small time period, the correlation is positive. (1980-1997)
• Value of the correlation for this 18 year period is –0.43.

• This “localized” correlation for a short time period removes the effect of the time trends and shows the more expected association of price and quantity.

➢ Other examples of spurious correlation

• Very common in time series as noted earlier in course.

Several Scenarios for Hedging the Farm

➢ Consider four situations

• No hedge

  Farmer sells what is produced at market price.

• “Fully hedged”

  Farmer sells futures contracts for expected production.

• Minimum variance

  Farmer sells enough futures contracts to obtain minimum variation in total value of sold crop.

• Match to risk aversion

  Choose the number of futures contracts to match a level of risk aversion.

➢ Impact of price-quantity relationship on farmer with no hedge in place

• If price and quantity are unrelated

  a graph of the total value of the crop on the price of corn per bushel has a relatively steep, positive slope.

• If the price and quantity are positively correlated,

  a graph of the total value of the crop on the price of corn per bushel has a less steep, positive slope.

• The positive correlation reduces some of the variation in the total value of the crop produced by the farmer.

➢ Impact of price-quantity relationship on farmer who is “fully hedged”.
• Farmer sells 100,000 futures contracts, matching his expected total production.

• If price and quantity are unrelated
  a graph of the total value of the crop on the price of corn per bushel has a relatively steep, negative slope.

  The farmer has to buy corn at the high price when his production fails to meet the 100,000 bushels required for delivery.

• If the price and quantity are positively correlated,
  a graph of the total value of the crop on the price of corn per bushel has a less steep, negative slope.

• Equal variation, just in the opposite direction.

• No reduction in variation. This is not a hedged position at all.

  Slopes in opposite directions suggest a better scheme with less variation

• Sell the right amount of futures contracts to cancel the variation in the non-hedged position.

• The question is then to find the right number of contracts.

Next Time

  Hedging to find the minimum variance number of futures contracts.