

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.

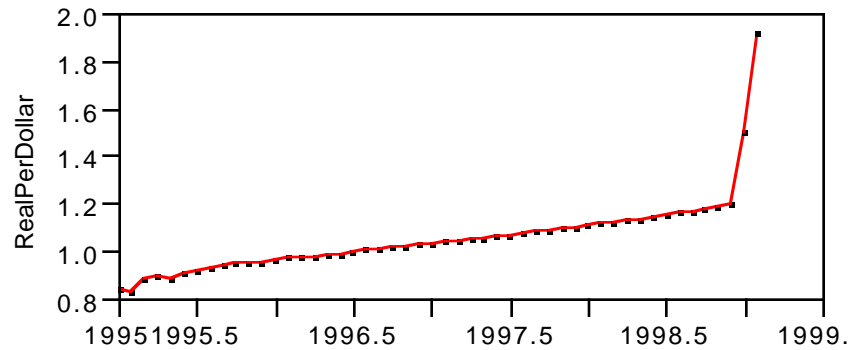
Hedge Funds

- 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.

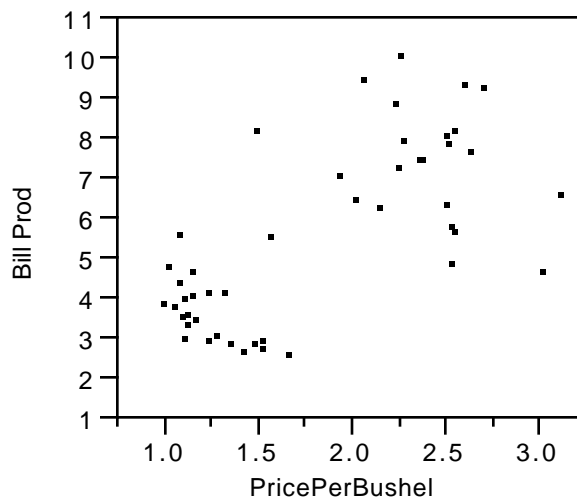
Hedging in Presence of More Uncertainty

- 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.

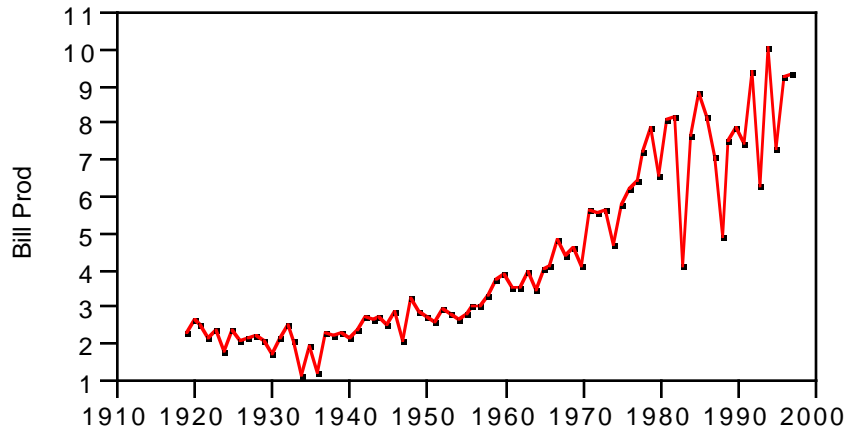
An Important Aside: Spurious Correlation

- What is the relationship of price to quantity for corn.
- Over last 50 years, we see a positive association. (corr = 0.64)

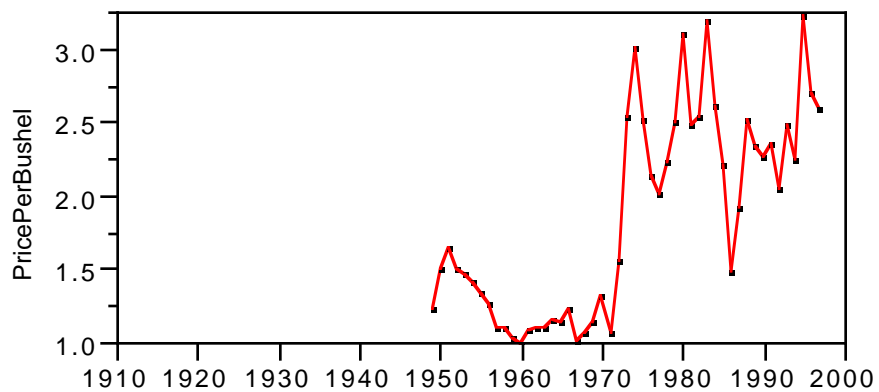


- Is the association really positive?
- Time series plots of the two sequences

- Production (Billions of bushels produced in US)

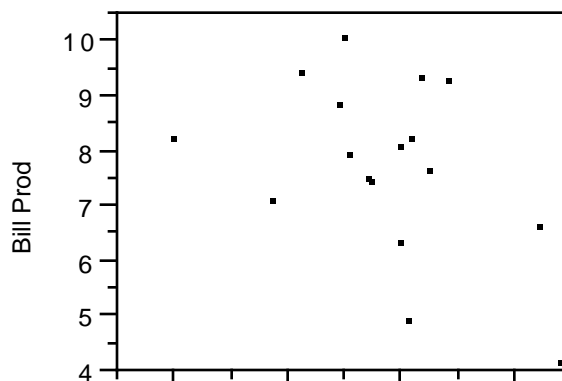


- Price (\$'s per bushel)



- 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.