Risk Management

Are Bookies Risk Takers?

Disclaimer

- I do not advocate or condone betting and bookmaking.
- Bookmaking is illegal in Canada.

Are Bookies Risk Takers?

- Consider legal betting establishments and how point spreads or odds are established
- They are set to get the same amount of money on either side of the bet
- The Bookie makes money on either a difference in the quote (like a bid-ask spread) or a direct fee built into the payoff

Are Bookies Risk Takers?

- Bookies try to "balance the book" having the same amount of betting on either side of a risk
- If one Bookie gets an unusual amount of action on one side, they will "lay off" the bets by spreading it to another Bookie, the same as reinsurance

Bookies Are Not Risk Takers

- In this sense, Bookies operate just like banks and brokerage houses: Earning money on the spread in the middle.
- A balanced book is not taking any risk
- Bookies practice Risk Management

What Is Risk Management?

- The process of identifying, measuring and monitoring potential risks, and
  - taking steps to **AVOID** these risks; and
  - for those that are unavoidable, taking steps to **AMELIORATE** (lessen the impact of) these risks; and
  - **ALLOCATE** funds to cover the losses that could be incurred

What Is Risk Management?

- This is no different than good insurance practice
  - Avoid: Declining unacceptable risks
  - Ameliorate: Providing incentive to the insured to lessen risk
  - Allocate: Funding to pay claims based on actuarial principles

Financial Institutions

- Much of the development of Financial Risk Management practices and principles has occurred in financial institutions, particularly banks
- The principles are also very applicable to non-financial institutions

Managing Financial Risk

- **AVOID** - Having natural hedges: Offsetting positions within the overall portfolio
- **AMELIORATE** - This is the role of hedging
- **ALLOCATE** - Keeping the net amount of risk exposure to acceptable and affordable levels

RISK MEASUREMENT

Measures That Have Been Used

- Notional Value
- Gap Methodology
- Future Risk
- Duration
- DV01 - the Dollar Value of a 1 basis point adverse move
- Futures Equivalent
- Value at Risk

Notional Value

- Notional value is simply the total of all the underlying principal and pseudo-principal value of contracts outstanding
- During the 1980s, this was a very popular indicator of the volume of the business, used to convince clients that these markets (such as swaps) were real and significant

Notional Value

- Consider the following bank with a simple asset-liability structure in their portfolio as shown
- They have contracts owed to them totaling $14B and owe $13.4B in contracts sold short or owed to other parties

Exposure ($MM)	3 Mo	6 Mo	9 Mo	12 Mo	Total
Long (Assets)	4,800	2,700	2,200	4,300	14,000
Short (Liabilities)	5,300	2,400	2,600	3,100	13,400
Net	-500	300	-400	1,200	

Notional Value

- First, notional is easily manipulated depending on the point one is trying to make
- Is the notional exposure
  - $27.4B
  - $600MM
  - Some averaging?

Notional Value

- Summing notionals ignore natural hedges used as part of the risk management process
- Netting notionals assumes that the sensitivities of all positions are all the same

Notional Value

- Notional values caused many legislators to panic regarding the exposure faced by financial institutions
- However, notional values are great for selling newspapers and getting TV news viewers!

Notionals - Summary

- Used 2 ways:
  - Measure of total/absolute positions
  - Measure of netted positions
- Advantages:
  - Extreme simplicity
- Disadvantages:
  - Grossly overstates risk exposure
  - Misunderstood and misused by laypersons
  - Confusion over use: gross absolute positions vs. netted positions

Gap Methodology

- Gap Methodology has been used for decades in the treasury management function of financial institutions
- A “gapping period” or time horizon of usually one year is chosen
- Gap = Risk Sensitive Assets
  - Risk Sensitive Liabilities
  = RSA - RSL

Gap Methodology

- Consider the previous example
- The bank has RSA of $14B and RSL of $13.4B for a Gap of $600MM

Exposure ($MM)	3 Mo	6 Mo	9 Mo	12 Mo	Total
Long (Assets)	4,800	2,700	2,200	4,300	14,000
Short (Liabilities)	5,300	2,400	2,600	3,100	13,400
Net	-500	300	-400	1,200	600

Gap Methodology

- The potential impact on net interest income (NII) is measured:

$$\Delta NII = (Gap) \times (\Delta r)$$

- In this case, if the gap is positive, so an increase in rates will cause NII to increase
- Assume rates increase 100 basis points:

$$\Delta NII = (600MM) \times (1\%) = \$6MM$$

Gap Methodology

- However, a decrease in rates will cause NII to decrease
- Assume rates decrease 100 basis points:

$$\Delta NII = (600MM) \times (-1\%) = -\$6MM$$

Future Risk

- 100 basis point upward parallel shift of YC
- Advantages
  - Useful for understanding sensitivities
- Disadvantages
  - Does not measure exposure - 100 bp shift is arbitrary
  - Does not reflect volatility (sigma) of individual measurement points on yield curve
  - Correlations are all assumed to be 1.

Future Risk

- Same example as before, but assume the following yield curve
- We can simply re-price the net positions:

$$FR = \Sigma(Net)e^{-(r - 0.01)T} - \Sigma(Net)$$

Maturity	3 Mo	6 Mo	9 Mo	12 Mo
(Years)	0.25	0.50	0.75	1.00
Zero Yield Curve	5.00%	5.50%	5.80%	6.00%

Exposure ($MM)					Total
Long (Assets)	4,800	2,700	2,200	4,300	14,000
Short (Liabilities)	5,300	2,400	2,600	3,100	13,400
Net	-500	300	-400	1,200	

Future Risk

Maturity	3 Mo	6 Mo	9 Mo	12 Mo
(Years)	0.25	0.50	0.75	1.00
Zero Yield Curve	5.00%	5.50%	5.80%	6.00%

Exposure ($MM)					Total
Long (Assets)	4,800.00	2,700.00	2,200.00	4,300.00	14,000.00
Short (Liabilities)	5,300.00	2,400.00	2,600.00	3,100.00	13,400.00
Net	-500.00	300.00	-400.00	1,200.00	
Priced @+100bp	-498.75	298.50	-397.01	1,188.06	
Gain/Loss	1.25	-1.50	2.99	-11.94	-9.20

- A 100 bp increase in the yield curve would cause a loss of $9.2 Million in the portfolio

Duration

- Measures sensitivity of a position in zero-coupon equivalents
- Advantages
  - Useful for neutralizing first order risk
- Disadvantages
  - Does not reflect exposure
  - Does not reflect volatility (sigma) of individual measurement points on yield curve
  - Correlations are all assumed to be 1.

Duration

Exposure ($MM)	3 Mo	6 Mo	9 Mo	12 Mo	Total
Long (Assets)	4,800	2,700	2,200	4,300	14,000
Short (Liabilities)	5,300	2,400	2,600	3,100	13,400
Net	-500	300	-400	1,200	600
(Net)x(Duration)	-125	150	-300	1,200	1.54

- This simply tells us that the portfolio has a first order (D) risk equivalent to a $600MM position with a duration of 1.54 years

DV01

- Also known as Basis Point Value or PV01
- Advantages
  - Useful for understanding sensitivities
- Disadvantages
  - Does not reflect volatility (sigma) of individual measurement points on yield curve
  - Correlations are all assumed to be 1.

Calculation of DV01:

1. Price the position (FV) at the current interest rate: $P_0 = (FV)e^{-rT}$
2. Price the position at a rate 1 basis point below the current rate: $P_1 = (FV)e^{-(r-.0001)T}$
3. The difference in the value of the positions is the DV01 $= P_1 - P_0$

$= (FV)e^{-(r-.0001)T} - (FV)e^{-rT}$

$\approx (FV)e^{.0001T}$

Calculation of DV01: Example

Maturity	3 Mo	6 Mo	9 Mo	12 Mo
(Years)	0.25	0.50	0.75	1.00
Zero Yield Curve	5.00%	5.50%	5.80%	6.00%

Exposure ($MM)					Total
Long (Assets)	4,800.00	2,700.00	2,200.00	4,300.00	14,000.00
Short (Liabilities)	5,300.00	2,400.00	2,600.00	3,100.00	13,400.00
Net	-500.00	300.00	-400.00	1,200.00	
Priced @-1bp	-500.01	300.02	-400.03	1,200.12	
Gain/Loss (1000s)	-12.50	15.00	-30.00	120.01	92.51

- Each basis point changes the portfolio value by $92,510

Futures Equivalents

- Merely a conversion of DV01 into the number of futures contracts that would have the same amount of risk
- Futures Contracts are the 90 day BA traded in Montreal and 90 day EuroDollar traded on CME
- The spread between these two contracts is sometimes called the BED Spread

Futures Equivalents

- Each of these contracts has a tick value of $25
- DV01 divided by $25 is Futures Equivalent
- Useful for determining the number of contracts needed to offset a risk position

Future Equivalent

- Using the same example as before
- Each bp changes portfolio value by $92.5K
- This would require 92,500/25 = 3700 contracts to offset the risk

Value at Risk

J. P. Morgan - 4:15 Report

- One of the earliest proponents of VAR was J. P. Morgan
- Chairperson Dennis Weatherspoon wanted a 1-page report showing the potential for losses over the next 24 hours
- This report was to be delivered by 4:15 p.m. - 15 minutes after the close of trading

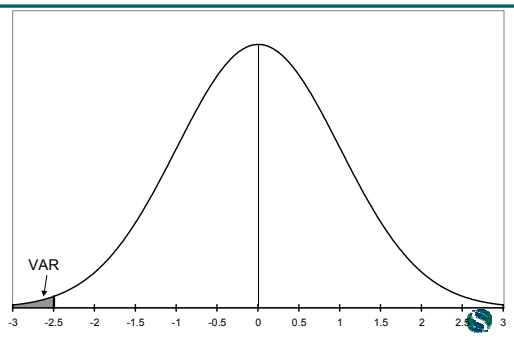
J. P. Morgan - 4:15 Report

- Needed something
  (1) Simple,
  (2) Comprehensive
  (3) Theoretically sound
- Value at Risk (VAR, VaR, and sometimes DAR) has these characteristics

Value at Risk

- VAR looks at the distribution of changes of the value of the portfolio, based on sound Modern Portfolio Theory (MPT) as developed by Harry Markowitz and refined by others
- It provides a dollar value measure of the potential loss based on the firm's risk appetite

VAR



Other VAR Benefits

- It is not distribution dependent
- It can be estimated using simulation
- It can be applied to other areas of risk management, such as Credit Risk

VAR - Example

- Suppose the standard deviations (annual) and correlations in the previous example are:

Maturity	3 Mo	6 Mo	9 Mo	12 Mo
(Years)	0.25	0.50	0.75	1.00
Zero Yield Curve	5.00%	5.50%	5.80%	6.00%
σ_r (Basis Points)	50	40	35	30
Correlations 3 Mo	1.00	0.85	0.80	0.75
6 Mo		1.00	0.95	0.85
9 Mo			1.00	0.95
12 Mo				1.00

VAR - Example

- Suppose our risk appetite requires that we has sufficient capital to cover all but 0.25% of possible one-day portfolio moves.
- This implies a Z-value of -2.80, or the largest daily move we will fund is -2.80σ
- Another way of viewing this is that if the VAR exceeds this number, we will take action to reduce our exposure.

VAR - Example

Maturity	3 Mo	6 Mo	9 Mo	12 Mo
(Years)	0.25	0.50	0.75	1.00
Zero Yield Curve	5.00%	5.50%	5.80%	6.00%
σ_r (Basis Points)	50	40	35	30
Daily Vol @-2.80σ	0.0882	0.0706	0.0617	0.0529
YC @-2.80σ	5.0882%	5.5706%	5.8617%	6.0529%
Exposure ($MM)				
Long (Assets)	4,800.00	2,700.00	2,200.00	4,300.00
Short (Liabilities)	5,300.00	2,400.00	2,600.00	3,100.00
Net	-500.00	300.00	-400.00	1,200.00
Priced @-2.80σ	-499.89	299.894	-399.815	1199.37
Position VAR ($M)	110.24	-105.88	185.06	-634.63

VAR - Example

$$VAR^2 = 110.24^2 + (-105.88)^2 + (185.06)^2 + (-634.63)^2$$
$$+ 2(110.24)(-105.88)(0.85) + 2(110.24)(185.06)(0.80)$$
$$+ 2(110.24)(-634.63)(0.75) + 2(-105.88)(185.06)(0.95)$$
$$+ 2(-105.88)(-634.63)(0.85) + 2(185.06)(-634.63)(0.95)$$
$$= 222,086.2$$
$$VAR = \$471.26$$

- If a one-day 2.80σ adverse movement took place, the portfolio value would decline by $471,000

VAR Usage

- In practice, we are not only concerned about one-day price movements
- It would not be unusual to see a 10-day VAR computed

Stress Testing & Scenario Analysis

- What has been demonstrated considers normal, daily price movements
- Risk Managers often also stress test to see the impacts of extremely unusual events such as an unexpected Fed. Rate hike or a devaluation of a significant currency.

Hedging

Types of Hedges

- Natural Hedges - naturally occurring offsetting risks
- Structural Hedges - discussed later
- Perfect Hedges (Futures & Forwards)
- Cross Hedges (Futures and Forwards)
- Option Hedges
- Swaps

Perfect Hedges

- A hedge is “perfect” when the exact commodity at risk is available as a forward or futures contract
- There are degrees of perfection
  - Delivery date variations
  - Delivery point variations
  - Substitution risks

Cross Hedges

- When the exact commodity at risk is not available in a hedging instrument, the hedger will use a cross-hedge
- Example: Buttonville Airways wants to hedge jet fuel. It may have to hedge with crude oil, heating oil or gasoline.

Option Hedging

- Only hedge the adverse risk, but as a result there is a cost to doing so.
- Hedging gain will be reduced by the premium
- If the risk was favourable, still have to pay the premium.

Foreign Exchange Risk

- The risk of a change in the currency exchange rate which will have an impact on the profitability of a business
- Devaluation of the local currency (i.e. Canadian dollars)
  - Benefits exporters
  - Hurts/discourages importers

Exchange Rate Factors

- Relative Interest Rates
- Relative Purchasing Power
- Money Supply
- Growth of GDP
- Balance of Payments

Exchange Rate Risk

- Transaction Exposure
  - Impact on income and cash flows from changes in exchange rate
- Economic Exposure
  - Overall economic impact of currency fluctuations on the value of the firm
  - Includes the transaction exposure, above.
  - Includes competitiveness

Exchange Rate Risk

- Translation Exposure
  - Impact on Balance Sheet from translating values at varying exchange rates
  - results in “Foreign Exchange Adjustment” in the equity section of the Balance Sheet
  - No direct economic or cash flow consequences

Economic Exposure

- Short Term Transaction Exposures
  - Results from occasional, irregular transactions involving foreign currencies
  - Usually hedged individually
- Long Term Exposures
  - Regular transactions involving foreign currencies as an importer or exporter
  - Overseas operations
  - Requires long-term hedging strategy

Short Term Exposures

- Short term, occasional exposures are best hedged with forwards, futures or options

Forward & Futures Hedging

Michelle Agostini imports food items from the U.S. She enters into a forward contract to buy US$ at a rate of CDN$1.52. What would be the gain or loss at each of the following rates:

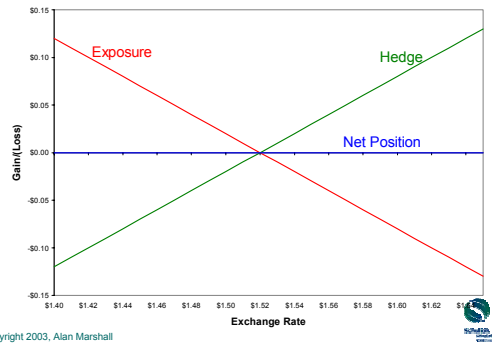
(a) 1.45
(b) 1.52
(c) 1.60

Forward & Futures Hedging

Michelle Agostini imports food items from the U.S. She enters into a forward contract to buy US$ at a rate of CDN$1.52. What would be the gain or loss at each of the following rates:

	Spot	Contract	Gain/(Loss)
(a)	1.45	1.52	(0.07)
(b)	1.52	1.52	0.00
(c)	1.60	1.52	0.08

Forward & Futures Hedging



Forward & Futures Hedging

Susan Lee exports software to the U.S. She enters into a forward rate agreement to sell US$ at a rate of CDN$1.52. What would be the gain or loss at each of the following rates:

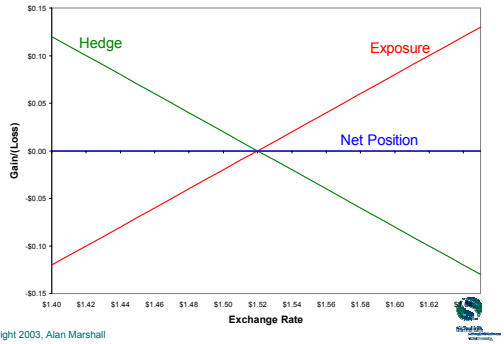
(a) 1.45
(b) 1.52
(c) 1.60

Forward & Futures Hedging

Susan Lee exports software to the U.S. She enters into a forward rate agreement to sell US$ at a rate of CDN$1.52. What would be the gain or loss at each of the following rates:

	Spot	Contract	Gain/(Loss)
(a)	1.45	1.52	0.07
(b)	1.52	1.52	0.00
(c)	1.60	1.52	(0.08)

Forward & Futures Hedging



Call Option Hedging

Doug Drew is buying a stamping machine from a U.S. supplier. He would like to purchase an OTC call option from the bank with a strike price of CDN$1.52 to US$1.00. The premium is 2% of the strike price. What would be the gain or loss on the contract if the F/X rate at expiry was:

(a) 1.45 (b) 1.52 (c) 1.60

Call Option Hedging

On a call option:

➡ If Market FX Rate > Strike Price

Gain/(Loss) =

Market FX Rate - Strike Price - Premium

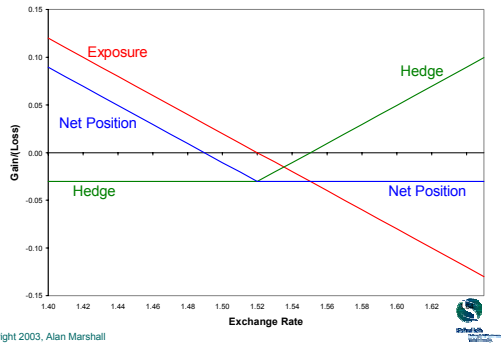
➡ If Market FX Rate ≤ Strike Price

Loss = - Premium

Call Option Hedging

	Market FX Rate	Strike Price	Gain, if any	Premium Paid	Net Gain/(Loss)
(a)	1.4500	1.5200	0.0000	0.0304	(0.0304)
(b)	1.5200	1.5200	0.0000	0.0304	(0.0304)
(c)	1.6000	1.5200	0.0800	0.0304	0.0496

Call Option Hedging



Put Option Hedging

Will Wynn exports computer graphics cards to the U.S. He would like to purchase an OTC put option from the bank with a strike price of CDN$1.52 to US$1.00. The premium is 2% of the strike price. What would be the gain or loss on the contract if the F/X rate at expiry was:

(a) 1.45 (b) 1.52 (c) 1.60

Put Option Hedging

On a put option:

- If Market FX Rate < Strike Price

  Gain/(Loss) =

  Strike Price - Market FX Rate - Premium

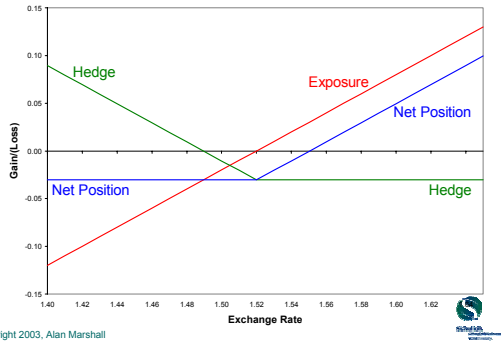
- If Market FX Rate ≥ Strike Price

  Loss = - Premium

Put Option Hedging

	Market FX Rate	Strike Price	Gain, if any	Premium Paid	Net Gain/(Loss)
(a)	1.4500	1.5200	0.0700	0.0304	0.0396
(b)	1.5200	1.5200	0.0000	0.0304	(0.0304)
(c)	1.6000	1.5200	0.0000	0.0304	(0.0304)

Put Option Hedging



Long Term Exposures

- Regular transactions involving foreign currencies as an importer or exporter
- Overseas operations
- Requires long-term hedging strategy

Long Term Hedge Choices

- Offsetting financing
  - Structural Hedge
- Parallel loans
- Swaps

Offsetting Financing

- Consider Newsprint Producers:
  - Revenues are in U.S. dollars
    - Gain if C$ declines relative to the US$ but lose if the C$ climbs relative to the US$
  - Can offset this long-term transactional exposure by financing (borrowing) in US$
    - creates some costs that are denominated in $US
  - If the $CDN strengthens, aart of the loss in sales revenue, will be offset by lower effective interest expense.

Parallel Loans

- Two companies in different countries with subsidiaries in the other firm's homeland make loans to each other's subsidiaries

Example

- Canuck Ltd. lends $100MM to BritCo Canada
- BritCo lends £50MM to Canuck (UK) Ltd.

Parallel Loans

Problems

- Credit/Default Risk
- Inflates the balance sheets of both companies

Currency Swap

- If the two parallel loans are combined into a single instrument, the result is a Currency Swap

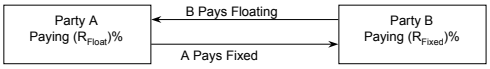
Swaps

- An agreement between two parties to exchange the cash flows associated with some notional principal

Swap Types

- Interest rate
  - Sometimes called "Plain Vanilla Swap"
- Currency
  - Fixed for Fixed - both involve fixed interest rates
  - Cross-Currency Swaps - one rate is fixed, other is floating
- Equity Swap
  - Equity returns for interest, fixed or floating
- Commodity Swap - discussed later

Interest Swap



- Actually, one party pays the net difference to the other
  - Principal is **NOTIONAL**, and is not actually exchanged
- Party A and B are still responsible to their lenders for the payments

Interest Swap Illustrated

- Suppose two Canadian Companies face the following borrowing costs:

	QualCo.	MoriskCo	Spread
Rating	AAA	BBB	
Borrow Fixed	7.50%	8.75%	125 bp
Borrow Floating	Prime + 0.25%	Prime + 1%	75 bp

Interest Swap Illustrated

	QualCo.	MoriskCo	Spread
Rating	AAA	BBB	
Borrow Fixed	7.50%	8.75%	125 bp
Borrow Floating	Prime + 0.25%	Prime + 1%	75 bp
Borrowings			
QualCo - Fixed	(7.50%)		
MoriskCo - Floating		(Prime + 1%)	

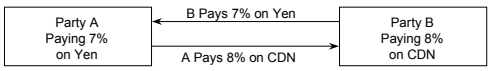
Interest Swap Illustrated

	QualCo.	MoriskCo	Spread
Rating	AAA	BBB	
Borrow Fixed	7.50%	8.75%	125 bp
Borrow Floating	Prime + 0.25%	Prime + 1%	75 bp
Borrowings			
QualCo - Fixed	(7.50%)		
MoriskCo - Floating		(Prime + 1%)	
Swap			
QualCo Receives	7.50%		
QualCo Pays	(Prime)		
MoriskCo Receives		Prime	
MoriskCo Pays		(7.50%)	

Interest Swap Illustrated

	QualCo.	MoriskCo	Spread
Rating	AAA	BBB	
Borrow Fixed	7.50%	8.75%	125 bp
Borrow Floating	Prime + 0.25%	Prime + 1%	75 bp
Borrowings			
QualCo - Fixed	(7.50%)		
MoriskCo - Floating		(Prime + 1%)	
Swap			
QualCo Receives	7.50%		
QualCo Pays	(Prime)		
MoriskCo Receives		Prime	
MoriskCo Pays		(7.50%)	
Net Position	Prime	8.50%	
Savings	25 bp	25 bp	

Currency Swap



- This allows companies to exchange (hence hedge) currency exposures
- If one of these loans was at a floating rate, this would be a cross-currency swap

Intermediary

- Left out of the previous examples is the fact that normally there is a financial institution in between the two counter parties making a commission on the transaction
- Commissions are about 3-5 basis points of the notional principal

Swap Variations

- Amortizing Swap
  - Notional Principal reduces according to a schedule
- Step-Up Swap
  - Notional Principal increases according to a schedule, corresponding to increased volume
- Deferred Swaps or Forward Swaps
  - Exchange of payments begins in the future

Swap Variations

- Extendable Swap
  - One party has the option to extend the term
- Puttable Swap
  - One party has an early termination option
- Swaptions
  - Options on swaps giving one party the right to enter into a predetermined fixed for floating rate swap

Commodity Swap

- Notional is a fixed amount of a commodity
- Swap payments are relative to the price of the commodity

Commodity Swap Example

- Suppose that Silicon Circuits uses 10,000 ounces of gold annually
- It could enter into a swap by agreeing
  - to pay $3 Million annually
  - receive $(10{,}000)(S_{GOLD})$ each year
    - S_{GOLD} is the spot price prevailing for gold each year
- Effectively fixes the cost of gold at $300/oz.