Credit Derivatives:
An Introduction to their Use and Pricing

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Overview

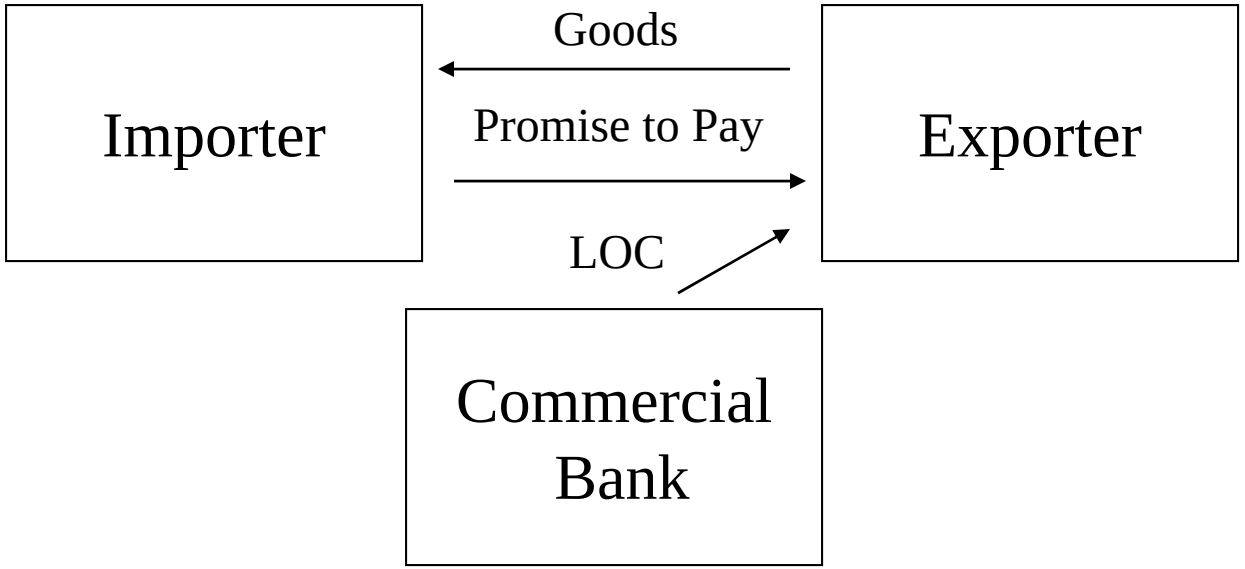
- Definitions and Historical Examples
- The Current Generation of Instruments
  - Defined
  - Examples
  - Pricing
- Development of the Market

Definitions (1)

- **Credit risk -** the risk that a counterparty or entity will fail to meet its contractual obligation to make a payment
- **Derivative -** a security whose value is derived from another underlying security, an index, or a commodity
- **Credit Derivative -** a security whose payoff is based upon the failure of an entity to make a contractually obligated payment

Historical Examples (1)

- Bank Letter of Credit, LOC (payment guarantee) or Standby Letter of Credit (performance guarantee).

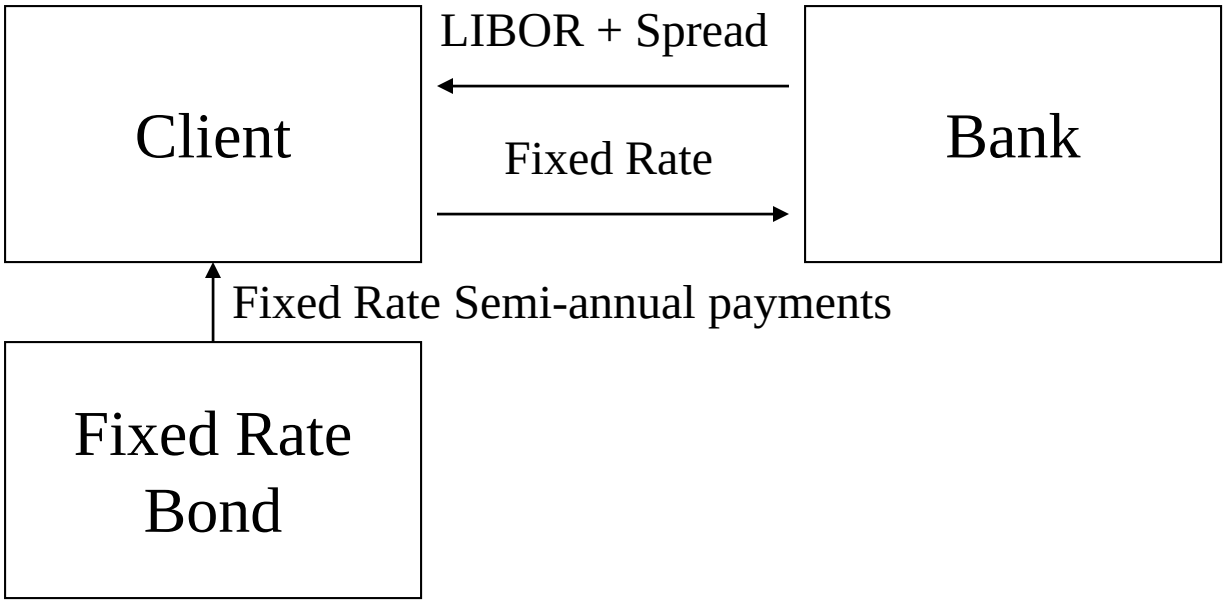


Definitions (2)

- Credit Derivatives also refer to instruments that change the payment structure or form of existing instruments in the marketplace to meet investor/seller needs.
  - "I like the name but I don't want the exposure to interest rates."
  - "I have no more room under the lending line but have the opportunity for a very profitable transaction."

Historical Examples (2)

- Asset Swap converts a fixed rate bond to a floating rate bond via an interest rate swap.

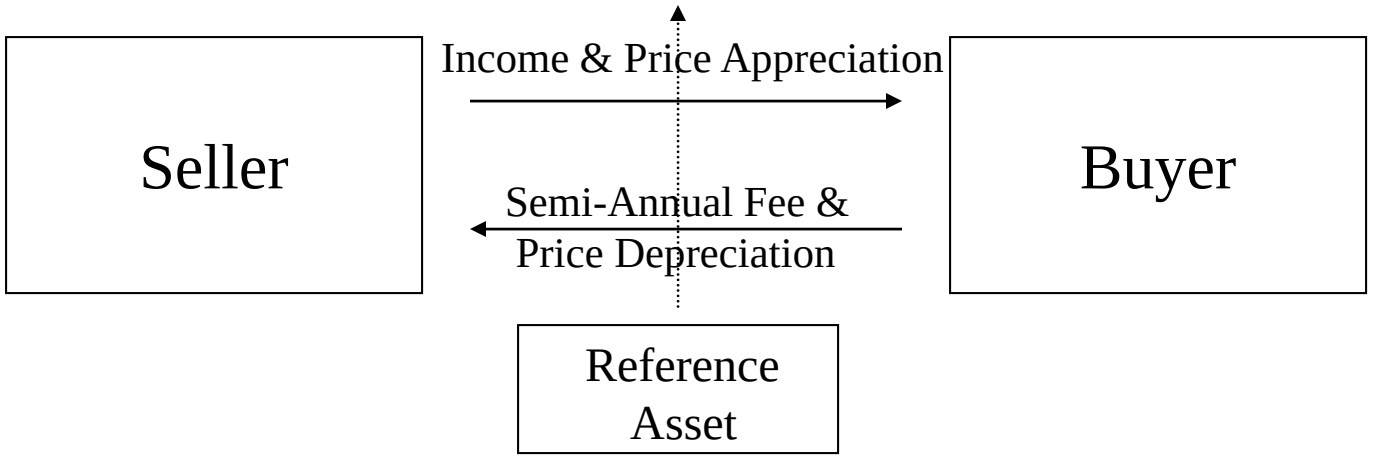


The Current Generation

- Total Rate of Return Swaps
- Default Swaps
- Credit Derivative Embedded Notes
- First to Default Baskets
- Spread Options
- Downgrade Options

Total Rate of Return Swaps

- For a period of time, the seller of the return provides ALL upside on a reference asset in return for an on-going payment and any downside compensation by the buyer.



Total Rate of Return Swaps

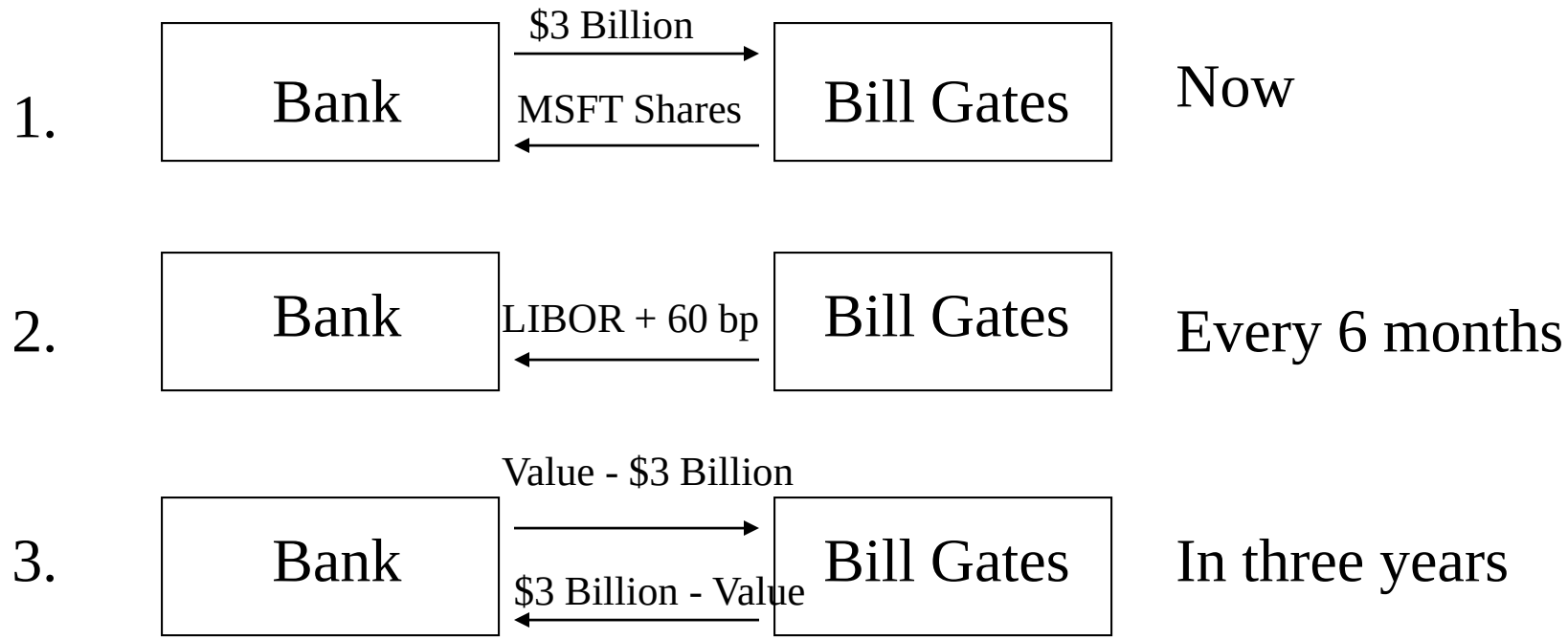
- Example: With all of the recent market turmoil, Bill Gates grows restive regarding his goal of exceeding Europe's GDP with his net worth and decides he needs to diversify. He wants to liquidate $3 Billion in stock to invest in something else (the Western division of the NFC?) However, Bill wants to eat his cake and have it, too. Therefore he desires to still profit if Microsoft rises over the next three years. What does Bill do?

Total Rate of Return Swaps

- At his friendly neighborhood section 20 subsidiary of a commercial bank, Bill learns about the beauty of TROR swaps:
  - First, Bill sells the bank $3 Billion in Microsoft stock
  - Second, the bank sells Bill a 3 year, $3 Billion notional TROR swap requiring semi-annual payments from Bill at LIBOR + 60 bps on the notional (~$75 million)
  - At the end of three years any gain/loss is settled

Total Rate of Return Swaps

- In wiring diagram form:

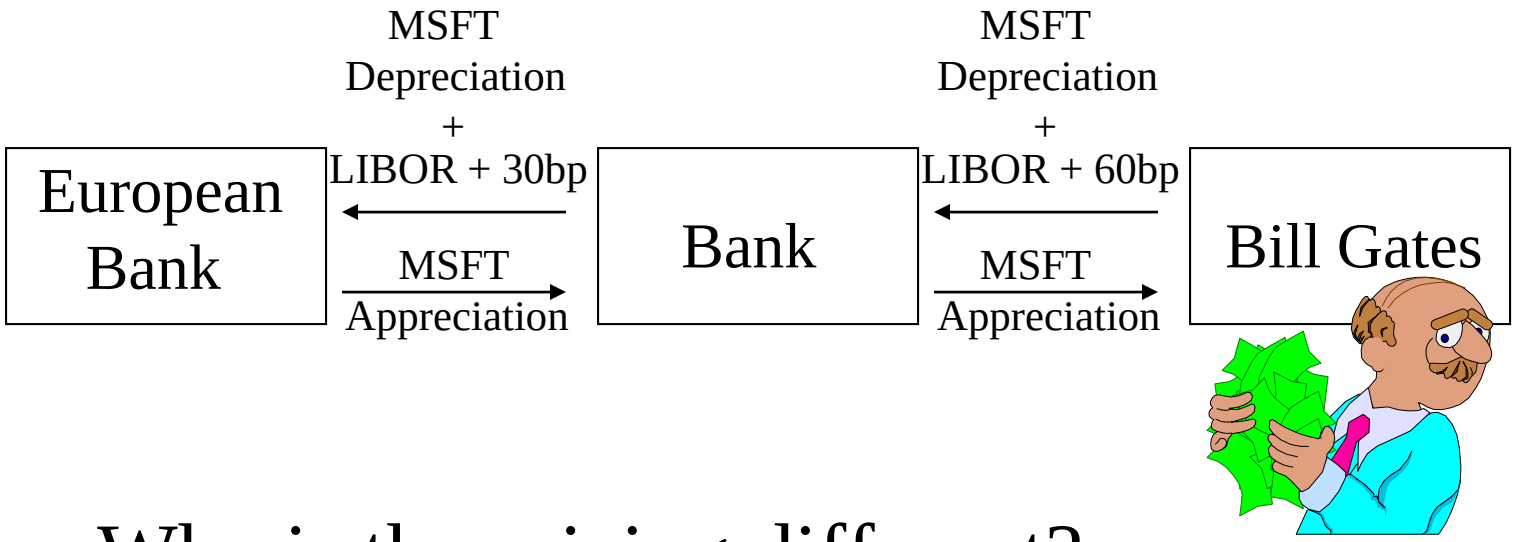


Total Rate of Return Swaps

- After initiation of the deal, the section 20 subsidiary receives pressure from the Treasury division of the parent bank. $3 Billion of non-income producing securities on the balance sheet do not provide impressive balance sheet returns to the parent. What should the section 20 subsidiary do?

Total Rate of Return Swaps

- Get it off the balance sheet.



- Why is the pricing different?

Total Rate of Return Swaps

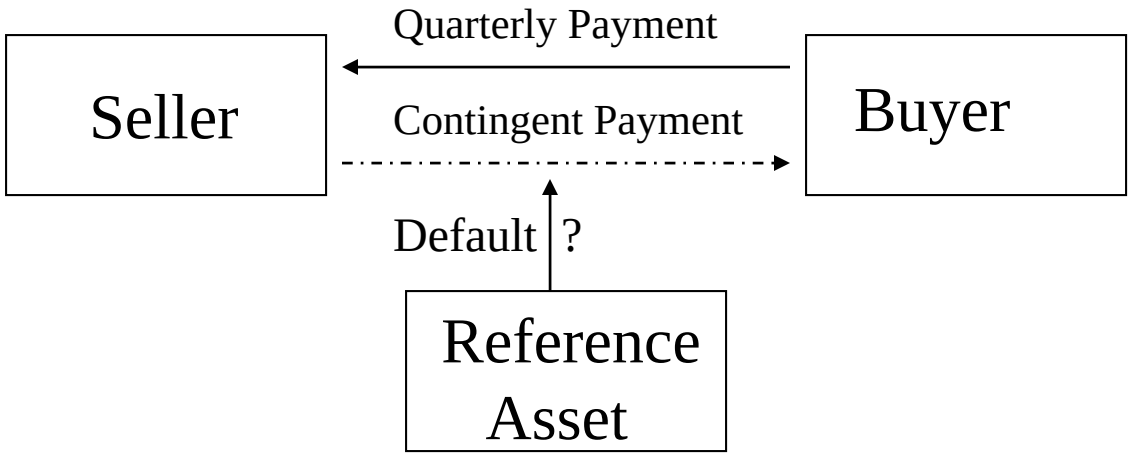
- Because “Pricing” of TROR Swaps is a misnomer
- Pricing is ENTIRELY based upon the credit quality of the buyer of TROR and its ability to pay the downside should the reference asset decline
- Similar to a secured loan where equity is collateral

Total Rate of Return Swaps

- A TROR Swap provides an off-balance sheet funding vehicle. An asset can be monetized (sold for accounting purposes) yet the economic return can be retained for as long as desired through an off-balance sheet contract (not sold for legal purposes).
- Structurally, TROR Swap is similar to an off-balance sheet repurchase agreement.

Default Swaps

- For a specified period of time, in return for an ongoing payment, a seller of protection offers to purchase an underlying reference asset at par or another agreed upon amount from the buyer of protection, in an event of default of the reference asset issuer.



Default Swaps

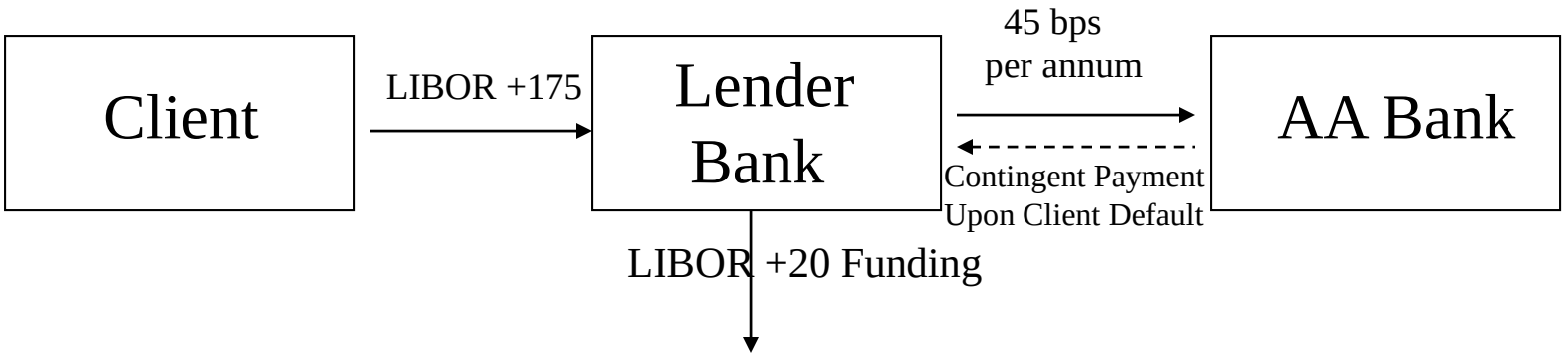
- Subset of TROR swap payout (to TROR seller) on reference asset
- Different Types of Default Swaps
  - Physical vs. Cash Settlement of Reference Asset
    - Risk of squeeze in cash market
  - Binary Payment
    - Risk of Legal Default Definition

Default Swaps

- Example: As a result of numerous transactions with a single client done below hurdle, in the expectation of cross-selling opportunities, when a great opportunity suddenly comes along, the bewildered lender discovers he has no room left in his credit line to do the deal. The lender remembers a presentation given by the bank's credit derivative area and hastily calls for help. What does the credit derivative recommend he do?

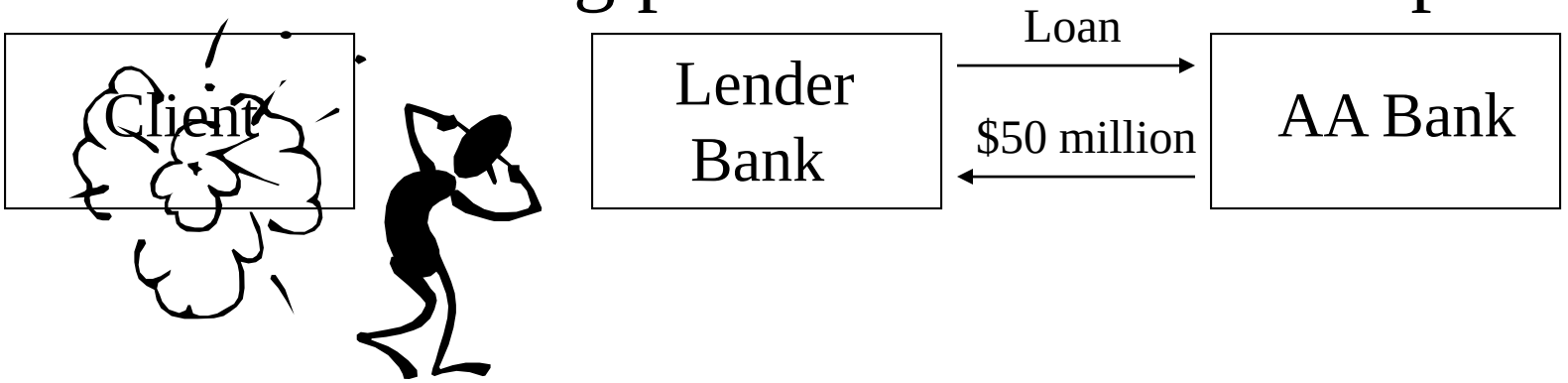
Default Swaps

- By purchasing 2 year default protection from another name, preferably a highly rated Financial Institution, for the equivalent notional of the new transaction, the lender will be able to do the deal. Assume $50 million notional.



Default Swaps

- In the event of default, the lending bank would pass the loan (physical settlement) to the bank selling protection and receive par.



- The protection selling bank would now try to recover on the loan.

Default Swaps

- Where does the price come from?
- Clearly, it must compensate the protection seller for
  - risk of reference asset defaulting
  - profit
  - administrative costs
  - smaller risk of both counterparty (protection buyer) defaulting and reference asset improving

Default Swaps

- Since the first risk will be the driver of market pricing (the last three will be covered by the bid-ask spread) we will focus upon measuring the reference asset risk of default.
- First and second generation models focused upon modeling a firm's assets to predict its default. Beginning with Jarrow and Turnbull's March 1995 Journal of Finance paper, market spread models have become more prevalent.

Default Swaps

- If we compare riskless and risky bonds, shouldn’t the difference be the risk of default?
- If so, the price difference between two identical tenor risky and riskless bonds (zeros) should represent the market implied cost of protection from default of the risky bond issuer.

Default Swaps

- Making the bold and questionable leap to risk neutrality we can summarize our prior assumption as follows:

$$\text{Risky PV \$1} = \text{Riskless PV (\$1*(1- pdef)} + \text{Recovery* pdef)}$$

- Rearranging,

$$\text{pdef} = ((\text{Risky Zero/Riskless Zero}) - 1)/(\text{Recovery} - 1)$$

Default Swaps

- Ascribing the price difference to the expected default loss is similar to stating the following about spread

$$\text{Spread} = \text{pdef} * (1 - \text{Recovery})$$

- Will still need to assume a fixed recovery rate to solve for default likelihood from spread.

Default Swaps

- What is wrong with this?
  - Liquidity
  - Taxes
  - Risk Premiums
- Why do it?
  - Often gives a reasonable starting point
  - Limited option free corporate bond data
  - Currently nothing better

Default Swaps

- Pricing Procedure
  - Using option free bonds and notes of similar seniority, build a risky yield curve
  - Bootstrap a risky zero curve
  - Repeat with a risk free curve
  - Use formula and seniority based constant recovery to build a term structure of default likelihood
  - Use default likelihoods to:
    - solve for break even protection fee
    - mark an agreed protection fee to market

Default Swaps

- Example: 3 month risky zero 99.5%, 3 month riskless zero 99.75%, Recovery 50%, 3 month pdef:

$$\text{pdef} = ((\text{Risky Zero}/\text{Riskless Zero}) - 1)/(\text{Recovery} - 1)$$

$$\left(.995/.9975 - 1\right)/(.5 - 1) = .005$$

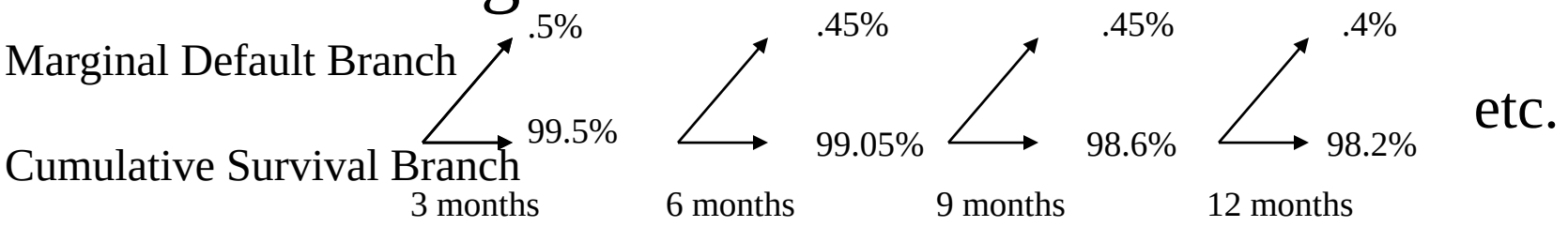
- Thus, probability of surviving for three months is 99.5%

Default Swaps

- If six month default likelihood is 0.95% then 6 month survival likelihood is 99.05%. This can be used to determine the likelihood of default between months 4 and 6:

$$\text{default likelihood} = 1 - 0.005 - .9905 = .0045$$

- continuing:



Default Swaps

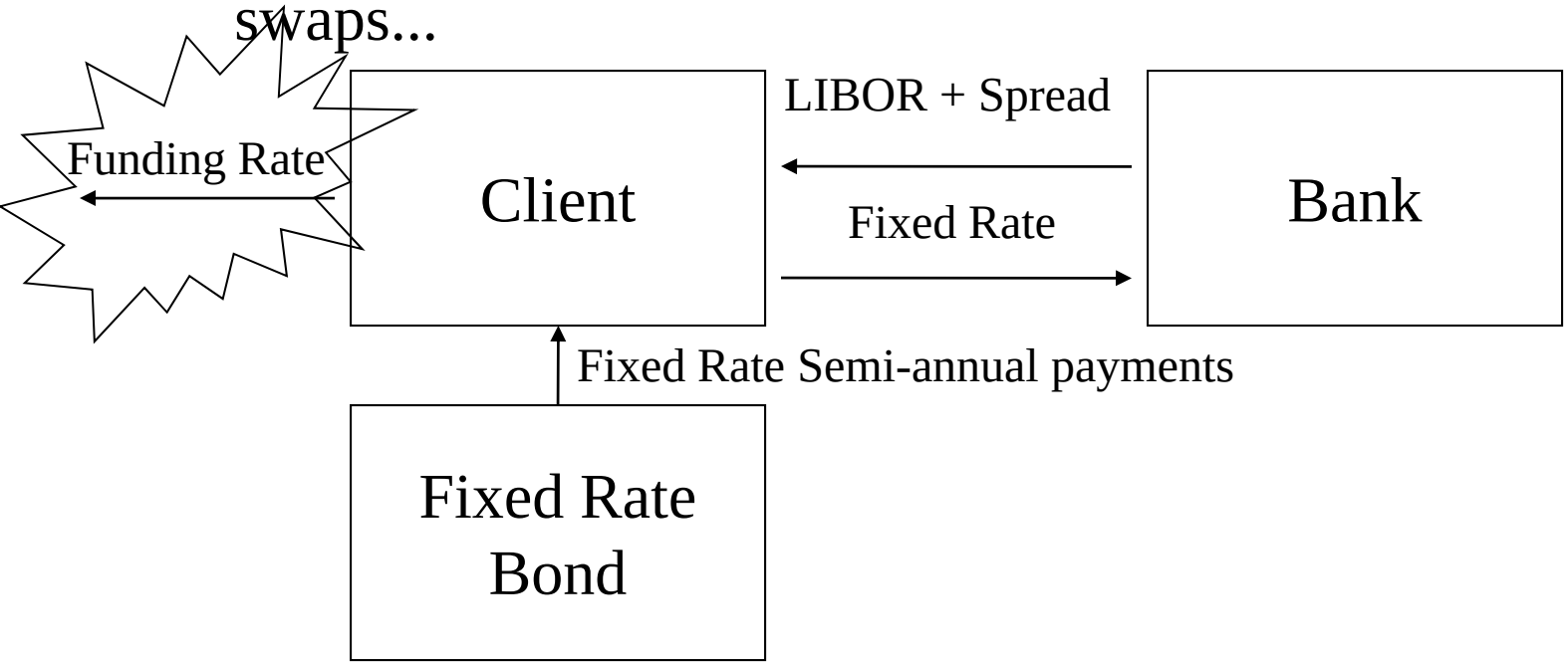
- With the tree of default likelihood and a recovery assumption for the transaction reference asset, we can solve for break even protection fee over n periods:

$$0 = \sum_{i=1}^{n} \text{Risk Free Discount Factor} * \left(\text{marginal pdef} * (1 - \text{Recovery}) - \text{cumulative epsurv} * \frac{\text{annual fee in bp}}{\text{periods per year}} \right)$$

- This will be adjusted for profit (liquidity, risk premium, administrative cost) as well as any counterparty risk.
  - Not a good idea to buy protection on Korean corporates from Korean banks!

Default Swaps

- What is the risk free curve for pricing? Theoretically, one would argue Treasury rates, but let's return to asset swaps...



Default Swaps

- The only difference between the aforementioned transaction and the client selling a default swap for the remaining term of the bond at:

  LIBOR + Spread - Funding Rate

  is the uncertainty of the swap unwind profit or loss (LIBOR changes) in the event of default. The client will end up with the recovery on the corporate bond either way.
- Thus, funding rate (LIBOR) drives the choice of risk free curve and the asset swap market is an indicator of pricing.

Default Swaps

- How well does this work? Example: Phillip Morris notes/bonds rated A by S&P and A2 by Moody's as of 10/8/98 used to price a 5 year default swap:
  - Broker1 45/65bp bid/ask indication in early September, no current pricing, estimate 60/85bp. Broker2 screen dated 9/25 at 60/80bp
  - Bloomberg Asset swap on 5 yr bond 46 bp
  - Model: Treasury + 1, 5 and 7 yr bonds 129 bp
  - Model: LIBOR + 1, 5 and 7 yr bonds 44.5 bp
  - Model: Treas. + CreditMetrics A/A2 Ind 1,2,3,5 yr spreads 95 bp
  - Model: LIBOR + CreditMetrics A/A2 Ind 1,2 yr spreads 38 bp
  - KMV 1 yr constant default likelihood (0.08%) as of August 4 bp

Default Swaps

- Example 2: Nine West 7 yr bond rated BA2 (Moody's) and BB- (S&P) as of 10/8/98 for pricing a one year default swap.
  - NO broker screen or verbal indication (one quote: "We've never even seen that one before.")
  - Bloomberg asset swap on 7 yr bond 236 bp
  - Model: Treasury + 7 yr bond 319 bp
  - Model: LIBOR + 7 yr bond 232 bp
  - Model: Treas.+CreditMetrics BA2/BB- Ind 1-5 yr spreads 245 bp
  - Model: LIBOR+CreditMetrics BA2/BB- Ind 1-5 yr spreads 199 bp
  - KMV 1 yr constant default likelihood (1.51%) as of August 78 bp

Credit Derivative Embedded Notes

- By adding a default swap to a collection of Treasury securities one can produce a note.
- Enables investors who cannot make loans or write protection directly to exercise a view regarding various credits.
- JP Morgan's Broad Index Secured Trust Offering (BISTRO) transaction used this approach to hedge the economic credit risk of a $10 Billion pool of loans.

First to Default Baskets

- Similar to a default swap only is written on several names any one of which triggers the protection and the bond is passed.
- Pricing entails deriving a pairwise correlation structure to measure the time specific joint default likelihood of all combinations of names in the basket.

First to Default Baskets

- Using individual default likelihoods derived as above along with pairwise equity or spread correlations one can fit a multivariate normal distribution or simulate default to solve for joint default likelihood at various points.
- Probability of one or more for three names:

$$\text{pdef(a)} + \text{pdef(b)} + \text{pdef(c)} - \text{pdef(a \& b)} - \text{pdef(a \& c)} + \text{pdef(b \& c)} + \text{pdef(a \& b \& c)}$$

Spread Options

- A contract entitling the owner to buy or sell a bond for a fixed spread above an index for a period of time.
  - Credit spread call or put
  - American or European
  - European put payout in event of default must be specified

Spread Options

- Example: On June 2, 1997, in order to protect itself, a hedge fund that had a position in Boston Chicken 7.75% May 2004 convertible bonds purchased a 1 year European Credit Spread Put at 225 over Treasury. On that day the yield of the Boston Chicken bond was 8.62%, 205 bps above the approximate 7 year Treasury rate of 6.57%.

Spread Options

- Example (cont.) On expiry, June 2, 1998, the price of the Boston Chicken bond was 24.84 (yield of 41.44%)! The strike price of a 6 year semi-annual coupon 7.75% bond at 225 plus 6 year Treasury rate of 5.52 is approximately par. The net payout of the option is almost 75% of notional! Note that a fixed spread strike is still a moving strike price for the bond.

Spread Options

- Pricing requires modeling:
  - Underlying index rate (term Treasury yield)
  - Spread of bond
    - Market spread
    - Name specific spread
    - Correlation of bond yield to underlying index
  - Default of underlier
    - Timing
    - Recovery

Spread Options

- European Style best performed using simulation.
  - Can fit Treasury process using Treasury option prices
  - Spread volatility, correlation and default event will require historical data (little or no pricing information)
- American Style will require trees or a simulation with a derived exercise boundary
  - Will require capturing path dependent evolution of variables particularly default and recovery
- ULTIMATE solution is an economic model.

Downgrade Option

- Similar to a spread option but exercise occurs depending upon a change in rating agency (S&P or Moody's) rating.
- Example: As a result of not performing a "Best Efforts" underwriting, a Financial Institution is stuck with a lot of paper for an S&P rated BBB industrial firm. A pension fund is willing to buy the paper at a fire sale price, but is unable to hold non-investment grade assets. What should the seller do?

Downgrade Option

- The Financial Institution wraps the paper with a downgrade option. It will buy back the paper at a specified spread over Treasury in the event S&P downgrades the paper to non-investment grade.
- Pricing will require a process for the downgrade in addition to all processes for spread. Rating agency downgrades can lag spread and equity movements by up to a year or more.

Development of the Market

- During stable times, little trouble finding default swap sellers, primarily a dearth of buyers.
- Currently, very little activity
- Arbitrage type plays, balance sheet renting and Canadian regulatory trades have driven growth to date.
- Ultimate growth rests upon Financial Institutions managing credit risk on a quantitative basis. Current risk models (CreditMetrics, CreditRisk+, CreditView) and return model (PortMan) are steps in this direction but institutional inertia is the major impediment.