



Equity Swaps

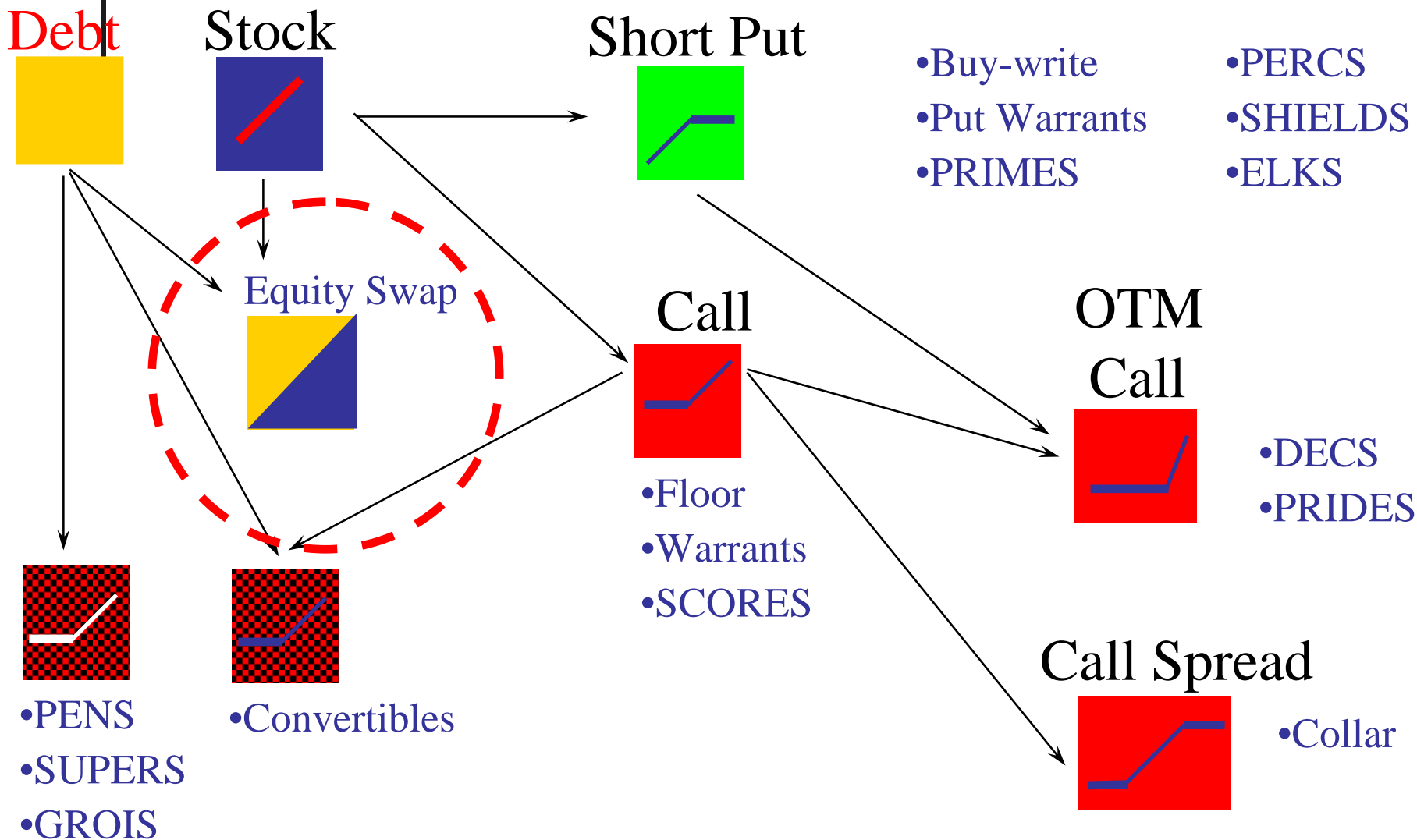
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Investment Analytics



Agenda

- Equity Swaps
- Applications
- Valuation

Roadmap: Equity Swaps





Swaps

- What are Equity Swaps
- How they are Traded
- Swaps Markets
- Applications of Equity Swaps
- Swap Pricing



Swaps

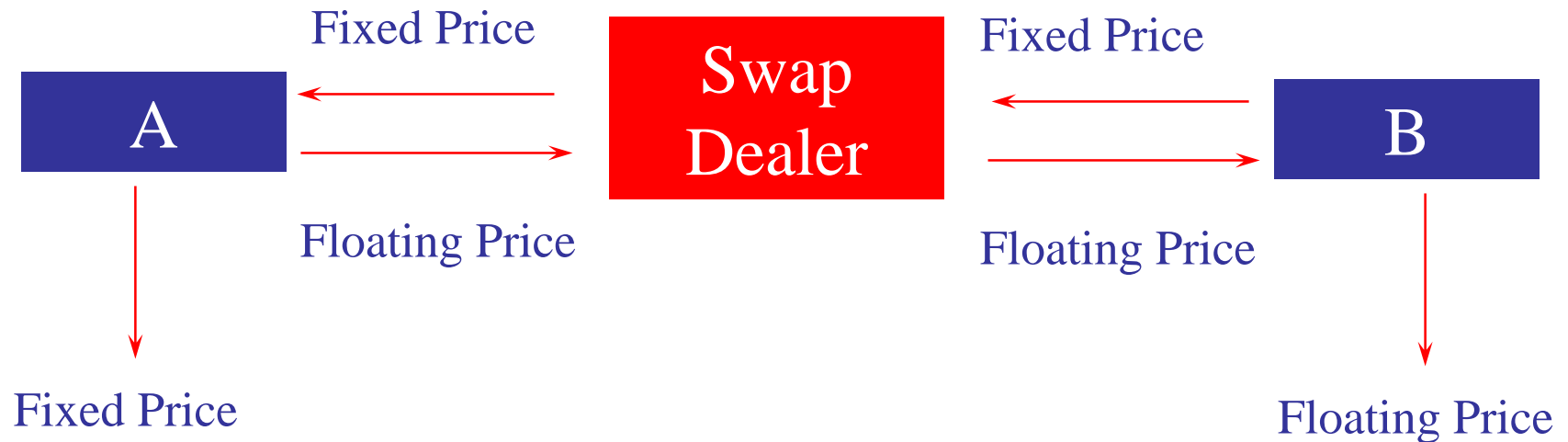
- Arrangements between counter-parties to exchange
- Swap Transaction
 - Principal:
 - Notional (not actually exchanged) - Interest rate, Equity swaps
 - Actual (principal actually exchanged) - Forex swaps
 - Service Payments:
 - Made at designated periods over life of swap (the “tenor”)
 - One party pays fixed price (rate) - “swap coupon”
 - Other party pays floating price - pegged to some floating index



Swap Dealer

- Matches counter-parties
- Prices swaps
- Makes market
- Acts as counter-party
- Warehouses swaps
- Trades own book
- Takes bid-offer spread

A Generic Swap Structure



- Counterparty A converts from fixed to floating
- Counterparty B converts from floating to fixed

Equity for Fixed Swap



- Swaps stock portfolio return for fixed income
 - Hedges a stock portfolio for the tenor of the swap
 - Alternative to selling index futures or shorting stock
- Index return
 - S&P500, Nikkei 225, DAX, CAC-40, FT-SE 100



Equity for Fixed Swap

- Principal

- Notional Principal typically \$50mm - \$100mm
- Fixed over tenor of swap - "*nonamortizing swap*"
- Tenors 1 - 3 year typical

- Service Payments

- Service payments quarterly
- Equity return can fluctuate
- Cash flows on equity leg can be +ve or -ve
- If -ve, dealer pays this as well as swap coupon



Payment Calculations

- Concurrent (typical):
 - Equity leg pays total return on index over current qtr
- In Arrears:
 - Uses return over previous qtr to calculate payments
 - First payment occurs 3 months after swap inception
 - First payment known at inception
- Equity payer pays:
 - $NP \times (R - I) / 4$
 - NP = Notional principal
 - R = annualized equity return
 - I = Fixed interest rate per annum

Equity for Fixed Swap Payoff

- Equity Payer:
 - Short index futures
 - Long a coupon bond

		Equity Markets	
		Rise	Fall
Interest Rates	Rise	- -	- +
	Fall	+ -	+ +

Equity for Floating Swap



- Swaps stock portfolio return for floating rate
 - Floating rate typically LIBOR based
- Index return
 - S&P500, Nikkei 225, DAX, CAC-40, FT-SE 100

Equity for Floating Swap

- Equity Payer:
 - Short index futures
 - Short a zero coupon bond

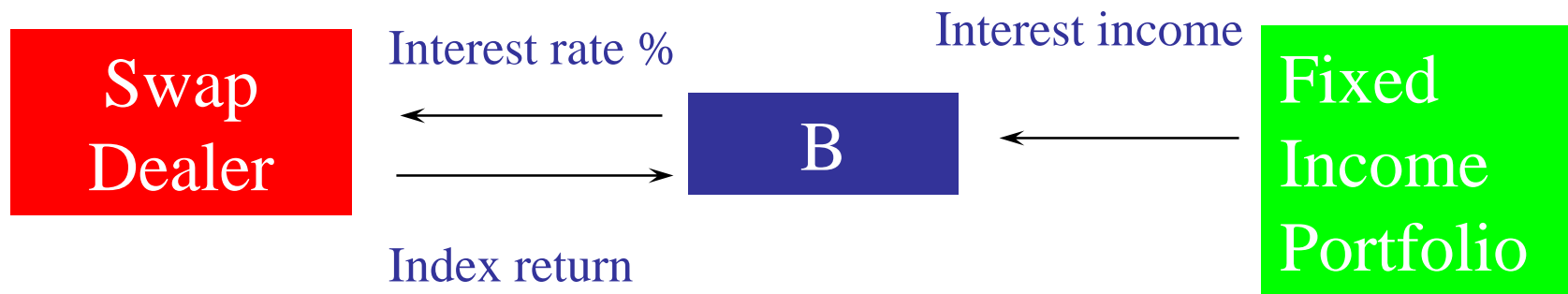
		Equity Markets	
		Rise	Fall
Interest Rates	Rise	+ -	+ +
	Fall	- -	- +



Equity Swap Payer

- Typical User: Stock Portfolio Manager
- Application: Hedging
- Advantages
 - Avoids restrictions of shorting stocks
 - Lower cost than cash transactions (borrowing stock to short)
 - Avoids cost of rolling futures
- Outlook: Bearish stock market, interest rates falling:
 - Strategy: Equity for fixed
- Outlook: Bearish stock market, interest rates rising:
 - Strategy: Equity for floating

Equity Receiver



- Converts fixed income to equity return
 - Gain equity exposure at lower cost than cash transactions
 - Guarantees index outperformance if FI income exceeds swap coupon



Applications (Receiver)

- **Asset Allocation**

- Change equity exposure & fixed income duration
- Avoids need for cash transactions
- Alternative is to use futures

- **Passive Fund - Index Tracking / Out-performance**

- Alternative to constructing replicating portfolio
- Use cash & equity swap to guarantee index return (or better)



Equity Swap Receivers

- More natural equity receivers than payers:
 - Passive index funds
 - Hedge Funds
 - Pension Funds
 - Insurance companies
 - Mutual funds



Rationale for Equity Swaps

- Cost Advantages
- Tax Advantages
- Leverage
- Restrictions on Investment



Cash vs Equity Swap (UK)

CASH

- 50 bp stamp duty
- Withholding tax on dividends (15%)
- Custody fees
- Restriction on shorting stock
- US Regulation T: leverage of 2:1 max.

Equity Swap

- ◆ No stamp duty
- ◆ No withholding tax
- ◆ No custody fees
- ◆ No restriction on effectively shorting stock
- ◆ Leverage of up to 20:1



Tax & Regulatory Factors

■ Pension Funds

- Tax-exempt status
- IRS UBIT letter on swaps
- Problem of Foreign Tax Credit usage
- ERISA regulations

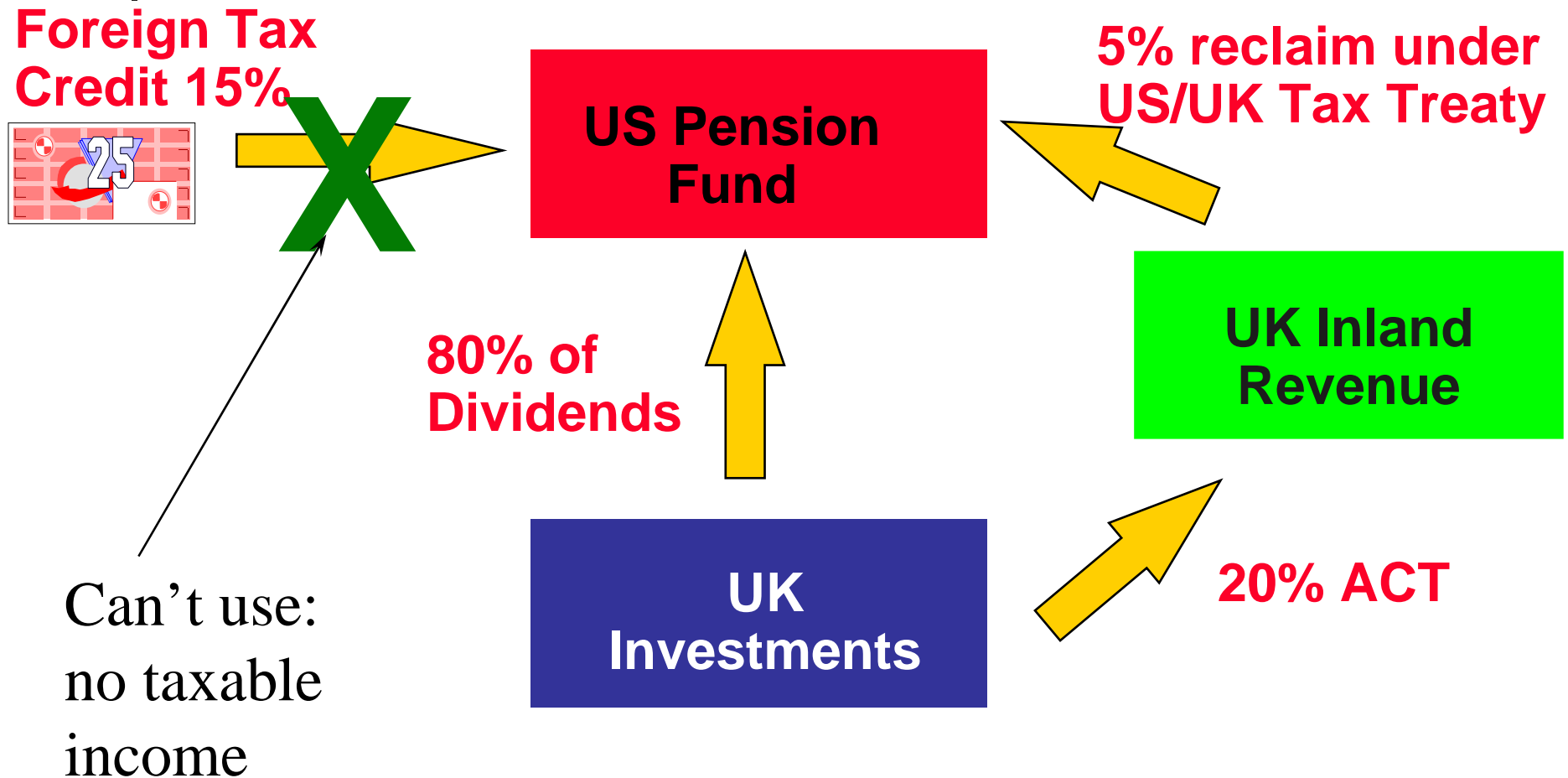
☞ Insurance Companies

- NAIC reserve Requirements:
 - 30% for stocks
 - 0.3% for fixed income

☞ Mutual Funds

- Pass-through tax status
- Foreign tax credits require over 50% foreign source income

The Withholding Tax Trap





How Equity Swaps Help

■ Pension Funds

- Minimizes withholding tax on dividends
- Swap income not subject to UBIT (unrelated business income tax)
- Does not endanger tax-exempt status

■ Mutual Funds

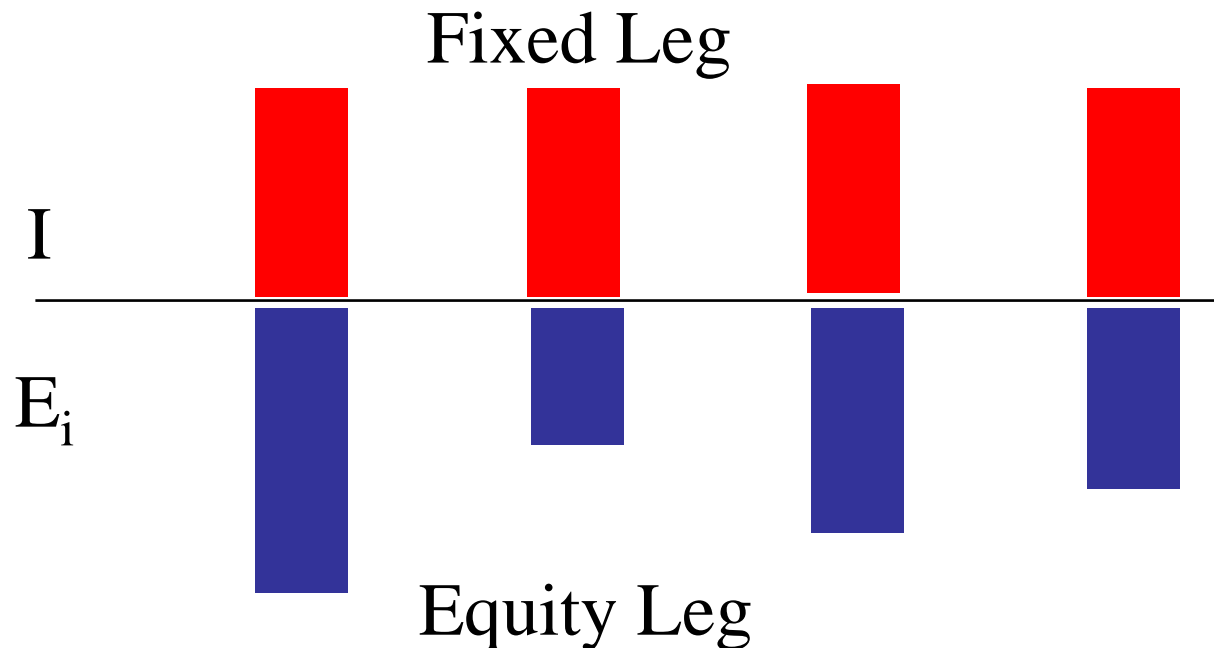
- Creates foreign income to allow use of foreign tax credits

■ Insurance Companies

- Allows minimum NAIC reserve requirements to be applied
- Increases max. leverage from 0.3% to 30% (x 100)
- Improves return on assets

Swap Pricing

- Find fixed rate I , such that PV of fixed payments = PV of equity leg cash flows



Swap Pricing Formula

- Fixed Rate Payments:
 - Equal payments, $I = NP \times c / N$
 - c is the *swap coupon* %
- Equity Leg Payments:
 - Variable payments $E_i = NP \times e_i$
 - e_i is the *forward rate of equity index returns* for period i
- Determine Swap Coupon, c , by:

$$NPV = \sum_1^N \frac{(E_i - I)}{(1 + r_i)} = 0$$



Futures Pricing Theory

- Futures Price at Time t:

- $f_t = S_0 (1 + E[r_t] - d \cdot t)$
 - S_0 is the index spot price
 - d is the dividend yield

- Proof from Expectations Theory:

- $E[r_t] = \frac{E[S_t] - S_0}{S_0} + d \cdot t$
- $f_t = E[S_t]$
- So $E[r_t] = \frac{f_t - S_0}{S_0} + d \cdot t$

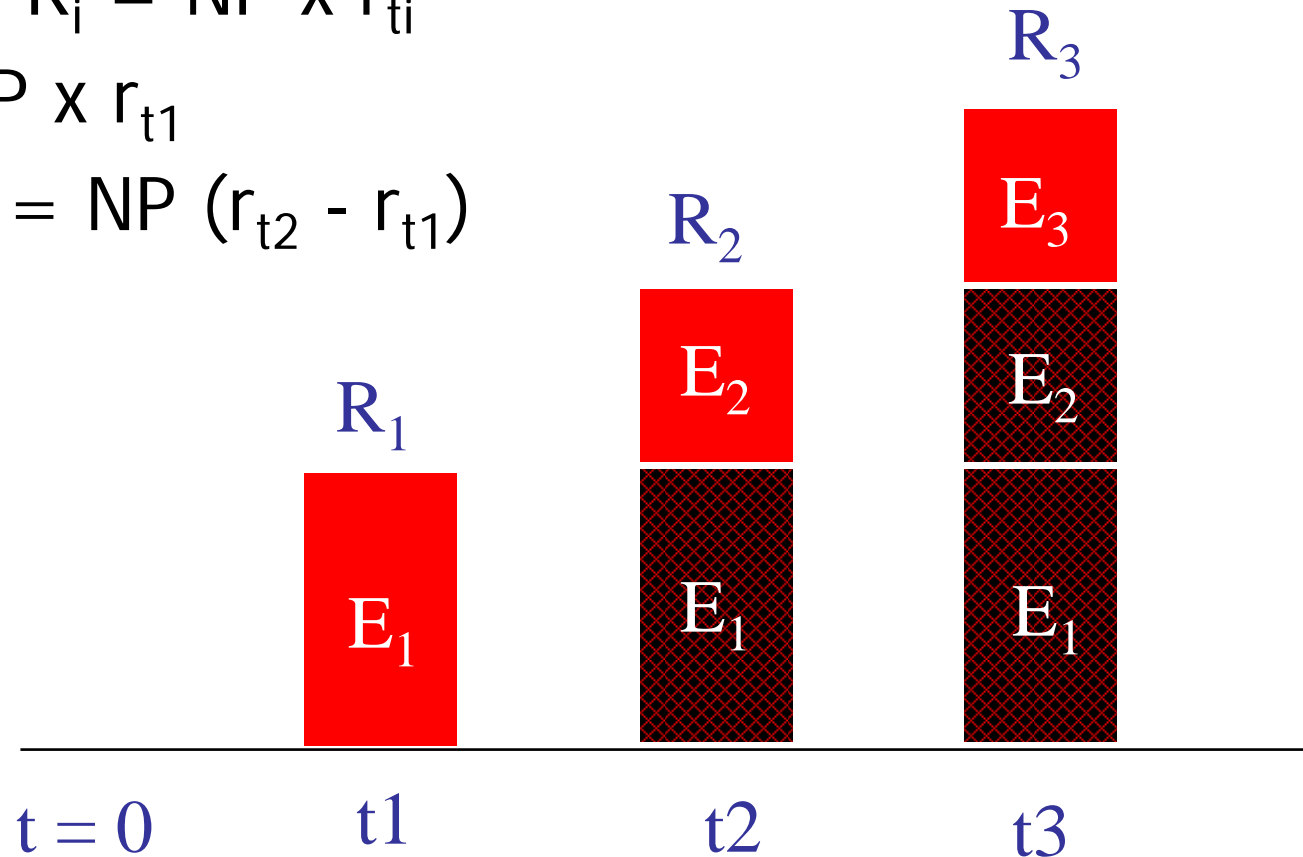


Equity Term Structure

- Now obtain unbiased estimate of r_t :
 - $E[r_t] = f_t / S_0 + (d \times t) - 1$
 - r_t is the *Spot Rate of Equity Index Returns* at time t
- The *Term Structure* of Equity Index Returns:
 - The series $[r_{t1}, r_{t2}, \dots, r_{tn}]$ is called the term structure
 - Like the term structure of interest rates

Term Structure & Cash Flows

- Total Return $R_i = NP \times r_{ti}$
- $E_1 = R_1 = NP \times r_{t1}$
- $E_2 = R_2 - R_1 = NP (r_{t2} - r_{t1})$



Determining the Swap Coupon

- NPV of Swap:

- $$\frac{E_1 - I}{(1 + r_{t1})} + \frac{E_2 - I}{(1 + r_{t2})} + \dots + \frac{E_{tN} - I}{(1 + r_{tN})} = 0$$

- r_{ti} and E_i are known

- Swap Coupon:

- $I = NP \times c / N$

- Find c so that NPV is zero



Example: Equity Swap

- Swap Details:
 - Notional Principal = \$100MM
 - Equity Index: S&P500
 - Tenor: 1 year
 - Resets: quarterly
 - Dividend Yield: 2.3% per annum

Setting up the Problem

Date	14/6/96	22/6/86	20/9/96	20/12/96	21/3/97	20/6/97
S&P500	667.92	668.75	674.65	680.85	687.95	694.65
Coupon Dates		<u>14/6/9</u>	<u>14/9/86</u>	<u>14/12/96</u>	<u>14/3/97</u>	<u>14/6/97</u>
Interpolated Prices		667.78	674.26	680.44	687.40	694.21
F/S			1.009	1.019	1.029	1.039
Spot Rates r_i			1.528%	3.028%	4.637%	6.236%
$R_i = NP \times \text{Spot Rate}$						
$E_i = R_i - R_{i-1}$						
Coupon Interest = $NP \times c / 4$						
Net Period Return = $E_i - I$						
Discount Factor $(1/(1+r_i))$						
NPV		<u>\$0</u>	<u>(29,456)</u>	<u>(57,250)</u>	<u>48,941</u>	<u>37,766</u>

Vary coupon rate c , using
Goal Seek to set NPV to zero



Lab: Pricing a Vanilla Swap

- Worksheet- Equity Swap
- Compute spot rates, etc.
- Use Goal Seek to set the coupon rate

Solution: Pricing a Vanilla Swap

Date	14/6/96	22/6/86	20/9/96	20/12/96	21/3/97	20/6/97
S&P500	667.92	668.75	674.65	680.85	687.95	694.65
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Interpolated Prices	667.78	674.26	680.44	687.40	694.21	
F/S		1.009	1.019	1.029	1.039	
Spot Rates r_i		1.528%	3.028%	4.637%	6.236%	
$R_i = NP \times \text{Spot Rate (000s)}$		1,528.4	3,027.8	4,637.4	6,235.8	
$E_i = R_i - R_{i-1}$ (000s)		1,528.4	1,499.4	1,609.6	1,598.5	
Coupon Interest = $NP \times c / 4$ (000s)		1,558.3	1,558.3	1,558.3	1,558.3	
Net Period Return = $E_i - I$		(29,907)	(58,984)	51,210	40,121	
Discount Factor $(1/(1+r_i))$		0.9849	0.9706	0.9557	0.9413	
Coupon = 6.2334%						
NPV	\$0	(29,456)	(57,250)	48,941	37,766	

Lab: Off-Market Swaps

- At Market Swap

- NPV = 0, Coupon = 6.2334%

- Buy Down, Coupon = 6%

- What would the equity receiver pay up front?
- Equivalently: How much less than the S&P return would the equity receiver get?

- Buy Up, Coupon = 7%

- How much would the equity receiver get up front?
- Equivalently: How much more than the S&P return would the equity receiver get?



Solution: Off-Market Swaps

- Buy Down, Coupon = 6%
 - Fixed payer (equity receiver) would pay \$224,792 up front
 - Or receive S&P - 0.2334%
- Buy Up, Coupon = 7%
 - Fixed payer (equity receiver) would get \$738,343 up front
 - Or receive S&P + 0.7666%



Floating Rate Equity Swaps

- Valuation procedure:
- Equity Leg: as before
- Interest Rate Leg: similar procedure
 - Use LIBOR rates to back out:
 - Spot rates
 - Forward rates
 - Calculate expected interest cost
 - Use forward rates
 - Discount cash flows using spot rates



Portfolio Hedging with Swaps

- Hedging a Portfolio
 - Manager has portfolio size P , beta b
 - Equity swap (pays S&P500, receives fixed)
 - Equity swap hedge: $NP = P \times b$
- Example: $P = \$24\text{MM}$, beta = 1.2
 - Equity Swap NP = $\$24\text{MM} \times 1.2 = \28.8MM
 - Suppose S&P500 declines 5%
 - Loss on portfolio = $5\% \times \$24\text{MM} \times 1.2 = \1.44MM
 - Gain on swap = $\$28.8 \times 5\% = \1.44MM



Market Timing with Swaps

- Portfolio Manager anticipates bullish conditions over next year:
 - Wants to increase portfolio beta from b to b^*
- Enters Equity Swap:
 - Pays fixed, receives S&P500
 - $NP = (b^* - b) \times \text{Portfolio Value}$
 - Note: hedging is a special case with $^* = 0$



Benefits of Swap Hedging

- Swap vs. Cash
 - Faster (single transaction)
 - Less costly than multiple cash transactions
 - No problems effectively shorting stock
- Swap vs. Futures
 - Avoids having to roll over on expiry
 - Less costly than transacting multiple futures contracts

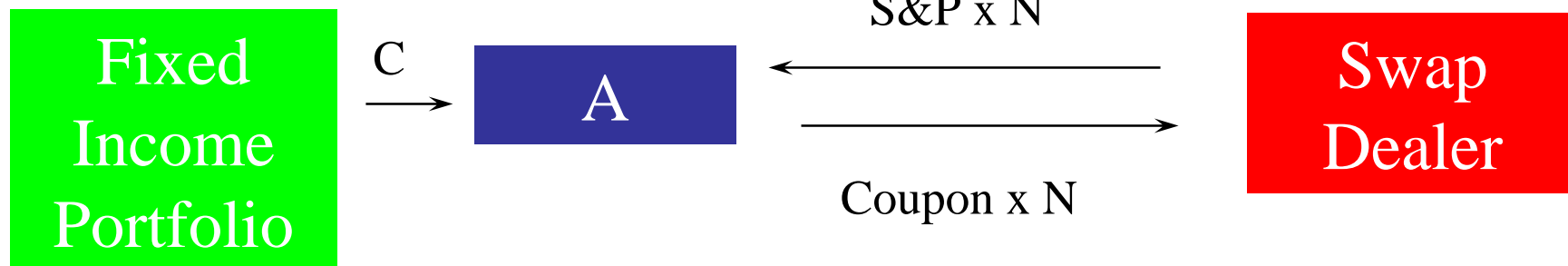


Extensions of Equity Swaps

- Power Swaps
- Inverse Equity Floaters
- Fixed/Inverse Equity Floaters
- Chooser Swaps
- Relative Performance Swaps
- Rainbow Swaps

Power Swaps

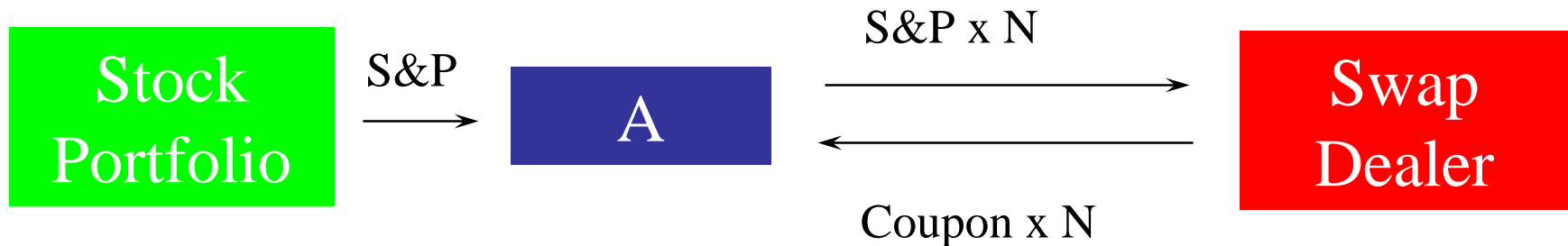
- To increase market exposure
 - Strongly bullish view on market direction



- Choose $NP = N \times \text{Portfolio Size}$
- Net return = $(N \times \text{S\&P}) - (N-1) \times C$
 - Assuming FI portfolio matches coupon

Inverse Equity Floaters

- Strongly bearish view on market direction

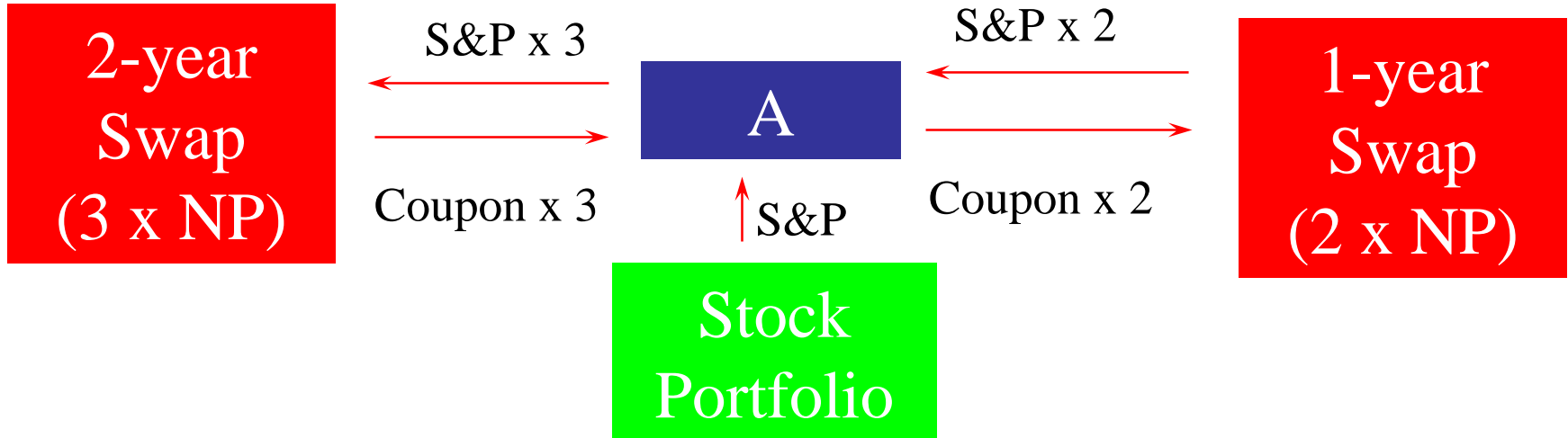


- Choose $NP = N \times \text{Portfolio Size}$
- Net return = $(N \times C) - (N-1) \times \text{S\&P}$
 - Assuming stock portfolio matches S&P

Fixed/Inverse Equity Floaters

- Scenario:

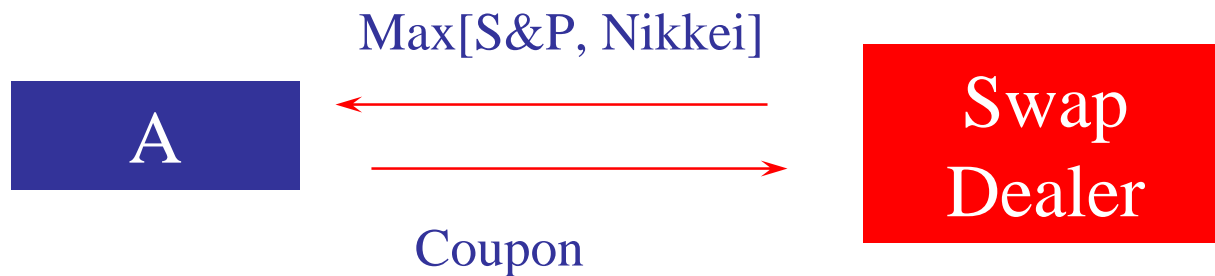
- Expect S&P returns remain stable for next year, then fall



- Year 1: $(3C - 3xS\&P) + (-2C + 2xS\&P) + S\&P = C$
- Year 2: $3C - 2xS\&P$

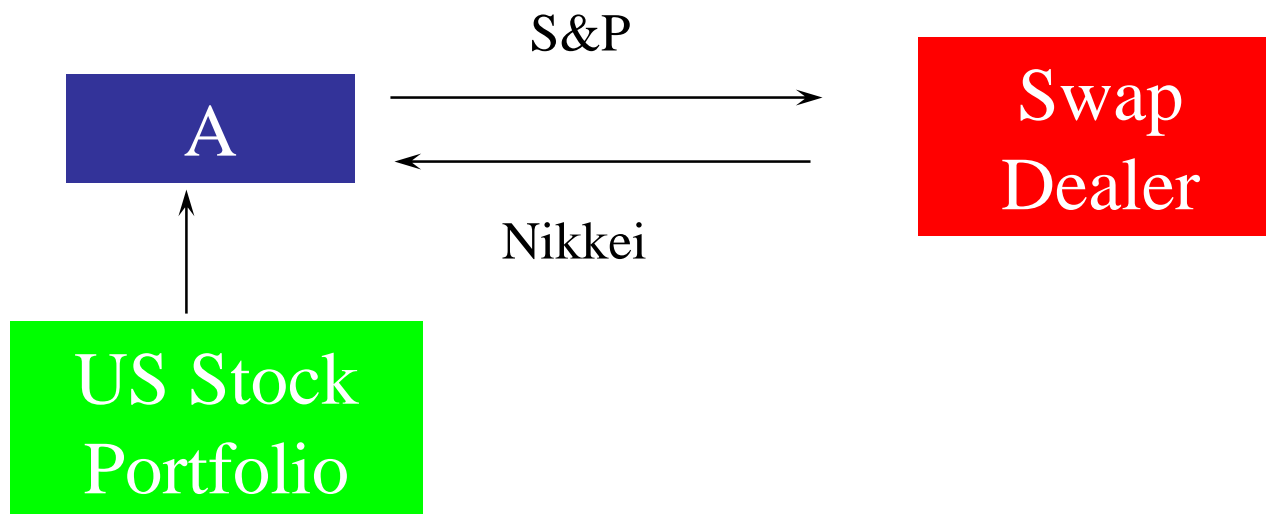
Chooser Swaps

- Equity return pegged to greater of two indices
- Higher swap coupon



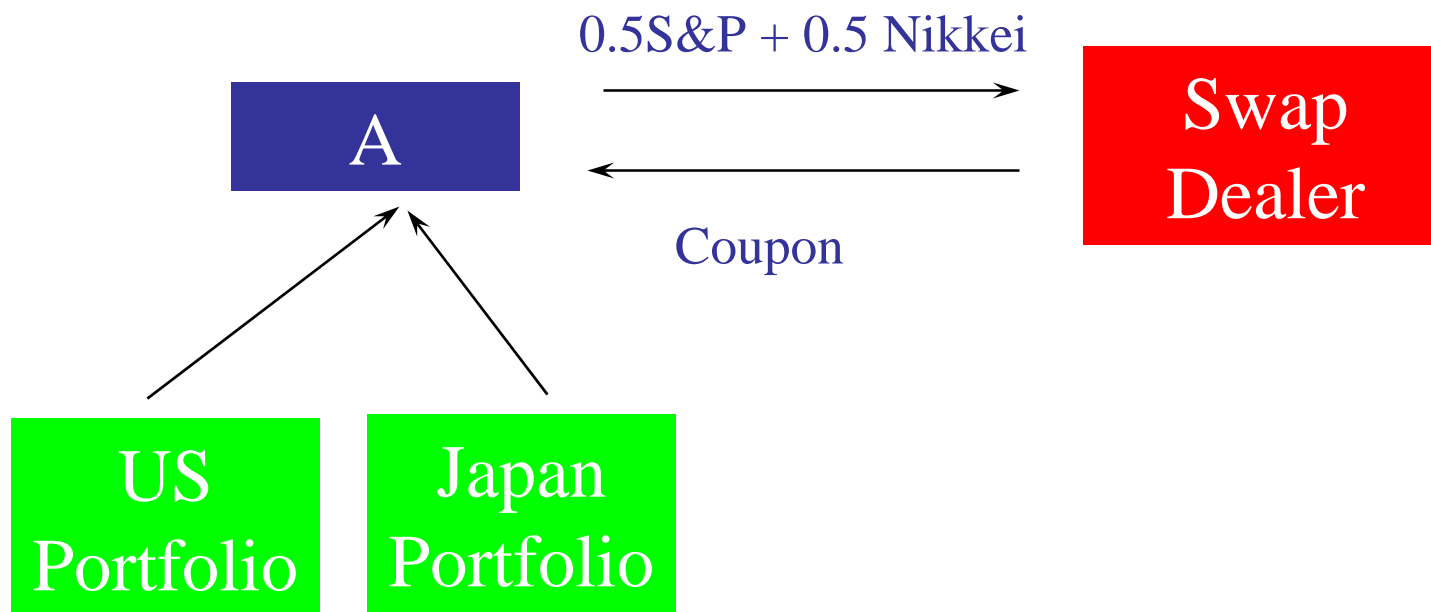
Outperformance Swaps

- Two Equity Legs:
- Applications:
 - Take view on relative performance of equity markets
 - Transport alphas from one equity market to another



Rainbow Swaps

- Equity leg combines returns from several indices
- Used for hedging aggregate equity portfolios





Summary – Equity Swaps

- Important component of many structured products
- Modifies exposure amongst different asset classes
- Significant tax/regulatory & cost benefits
- Wide range of applications