Institutional Finance

Financial Crises, Risk Management and Liquidity

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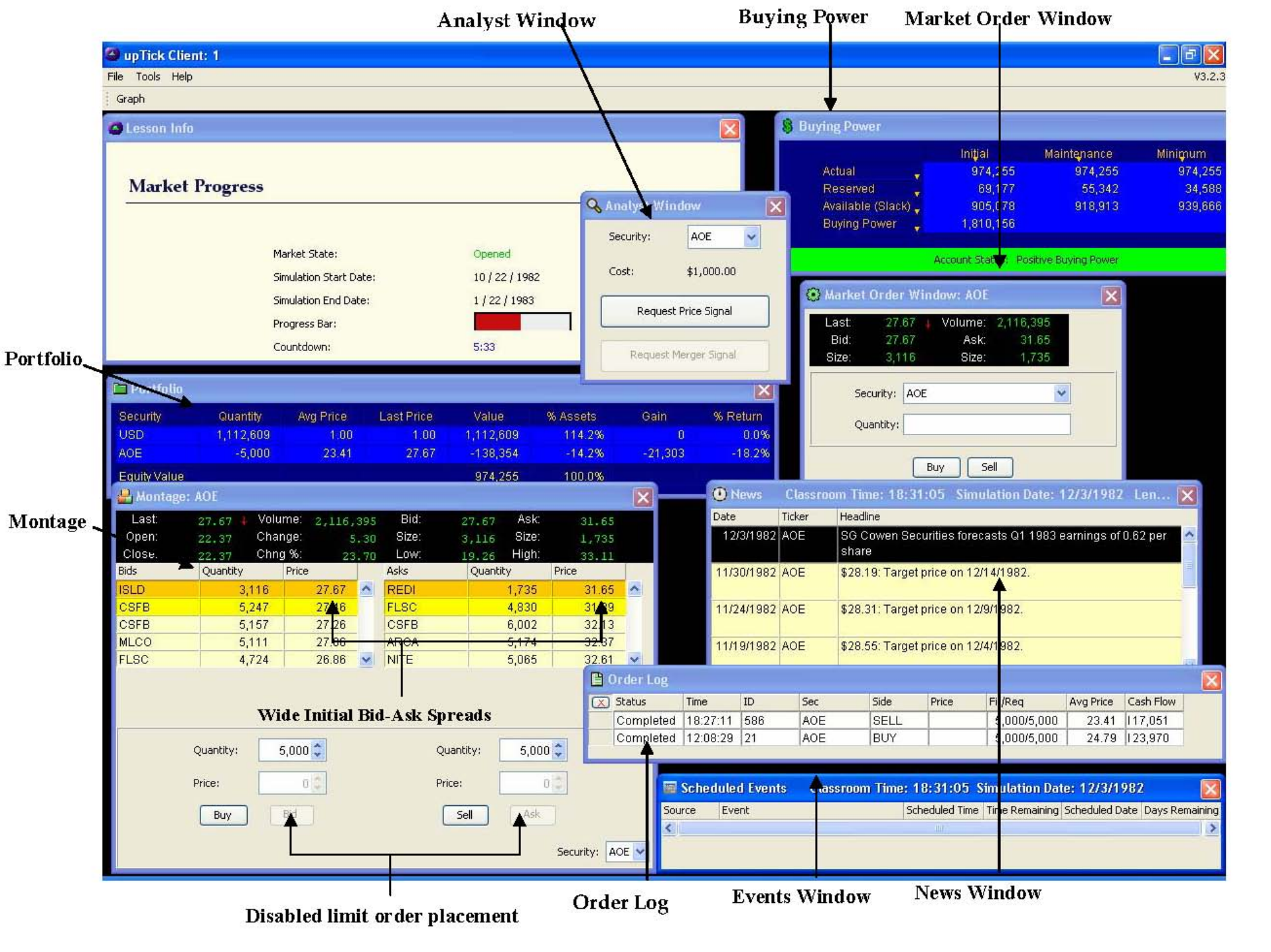
Introduction

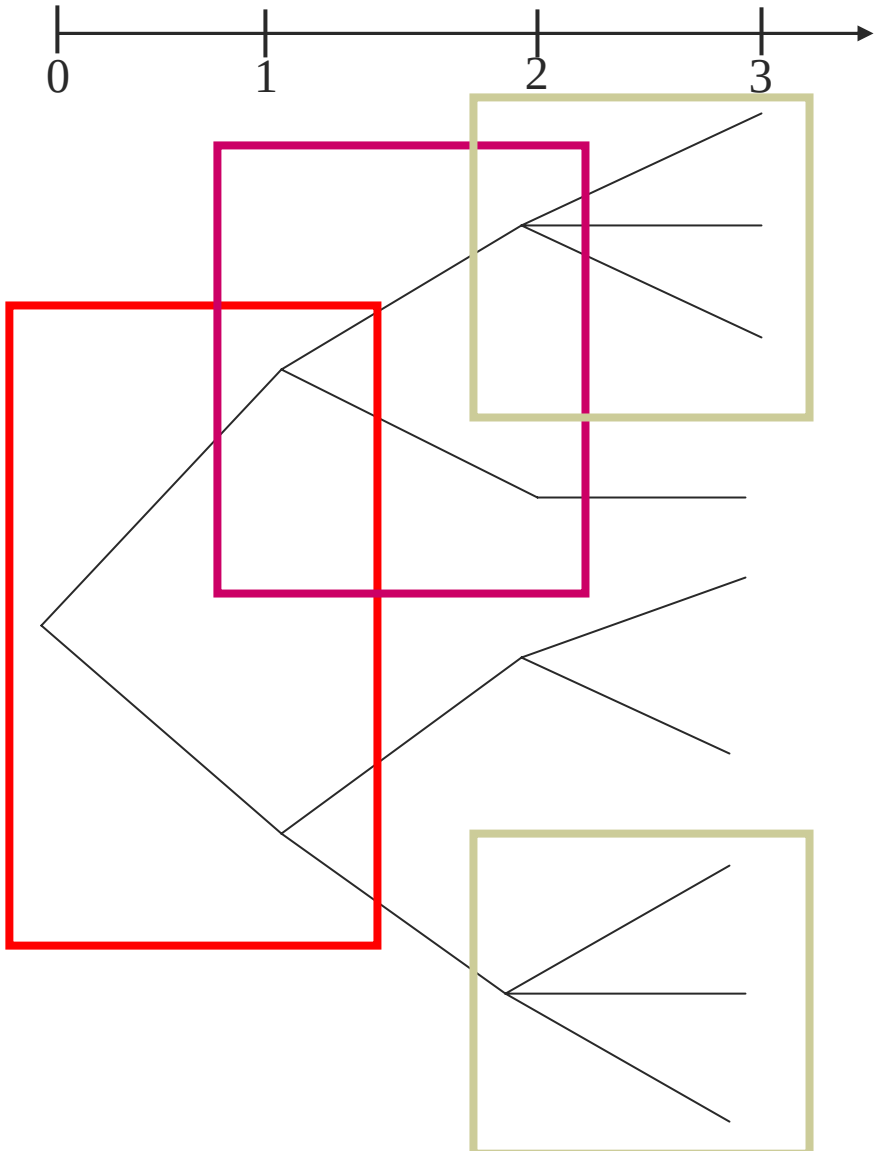
- Main Principles of Finance
  - One principle per lesson – see syllabus
  - Focus on institutional features (frictions matter)
- "UpTick" Trading software developed by
  - Joshua Coval (HBS)
  - Eric Stafford (HBS)
  - If software breaks down, we will switch to a standard lecture
- Student presentation


Analyst Window
Buying Power
Market Order Window
upTick Client: 1
File Tools Help
V3.2.3
Graph
Lesson Info
Market Progress
Market State: Opened
Simulation Start Date: 10 / 22 / 1982
Simulation End Date: 1 / 22 / 1983
Progress Bar:
Countdown: 5:33
Analyst Window
Security: AOE
Cost: $1,000.00
Request Price Signal
Request Merger Signal
Buying Power
Initial Maintenance Minimum
Actual 974,255 974,255 974,255
Reserved 69,177 55,342 34,588
Available (Slack) 905,078 918,913 939,666
Buying Power 1,810,156
Account Status: Positive Buying Power
Market Order Window: AOE
Last: 27.67 Volume: 2,116,395
Bid: 27.67 Ask: 31.65
Size: 3,116 Size: 1,735
Security: AOE
Quantity:
Buy
Sell
Portfolio
Security Quantity Avg Price Last Price Value % Assets Gain % Return
USD 1,112,609 1.00 1.00 1,112,609 114.2% 0 0.0%
AOE -5,000 23.41 27.67 -138,354 -14.2% -21,303 -18.2%
Equity Value 974,255 100.0%
Montage: AOE
Last: 27.67 Volume: 2,116,395 Bid: 27.67 Ask: 31.65
Open: 22.37 Change: 5.30 Size: 3,116 Size: 1,735
Close: 22.37 Chng %: 23.70 Low: 19.26 High: 33.11
Bids Quantity Price
ISLD 3,116 27.67
CSFB 5,247
CSFB 5,157
MLCO 5,111
FLSC 4,724 26.86
Asks Quantity Price
REDI 1,735 31.65
FLSC 4,830
CSFB 6,002
ARCA 5,174
NITE 5,065 32.61
Quantity: 5,000
Price:
Buy
Bid
Quantity: 5,000
Price:
Sell
Ask
Security: AOE
News Classroom Time: 18:31:05 Simulation Date: 12/3/1982
Date Ticker Headline
12/3/1982 AOE SG Cowen Securities forecasts Q1 1983 earnings of 0.62 per share
11/30/1982 AOE $28.19: Target price on 12/14/1982.
11/24/1982 AOE $28.31: Target price on 12/9/1982.
11/19/1982 AOE $28.55: Target price on 12/4/1982.
Order Log
Status Time ID Sec Side Price Fi /Req Avg Price Cash Flow
Completed 18:27:11 586 AOE SELL 5,000/5,000 23.41 117,051
Completed 12:08:29 21 AOE BUY 5,000/5,000 24.79 123,970
Scheduled Events Classroom Time: 18:31:05 Simulation Date: 12/3/1982
Source Event Scheduled Time Time Remaining Scheduled Date Days Remaining
Portfolio
Montage
Wide Initial Bid-Ask Spreads
Disabled limit order placement
Order Log
Events Window
News Window

Philosophy of UpTick

- Price is affected by
  - historical real price data
  - trading of students
- Price is loosely anchored around real historical price data
  1. Computer traders/market makers find it more and more profitable to trade towards historical price the further price deviates from historical time series
  2. Signals reveal historical price x periods ahead
  3. Final liquidity value equals historical price
- Realistic trading screen
  - Montage - limit order book (shows bid-ask spread + market depth)
  - Event window
- Personal Calculator (Excel)

Abstraction – Event tree



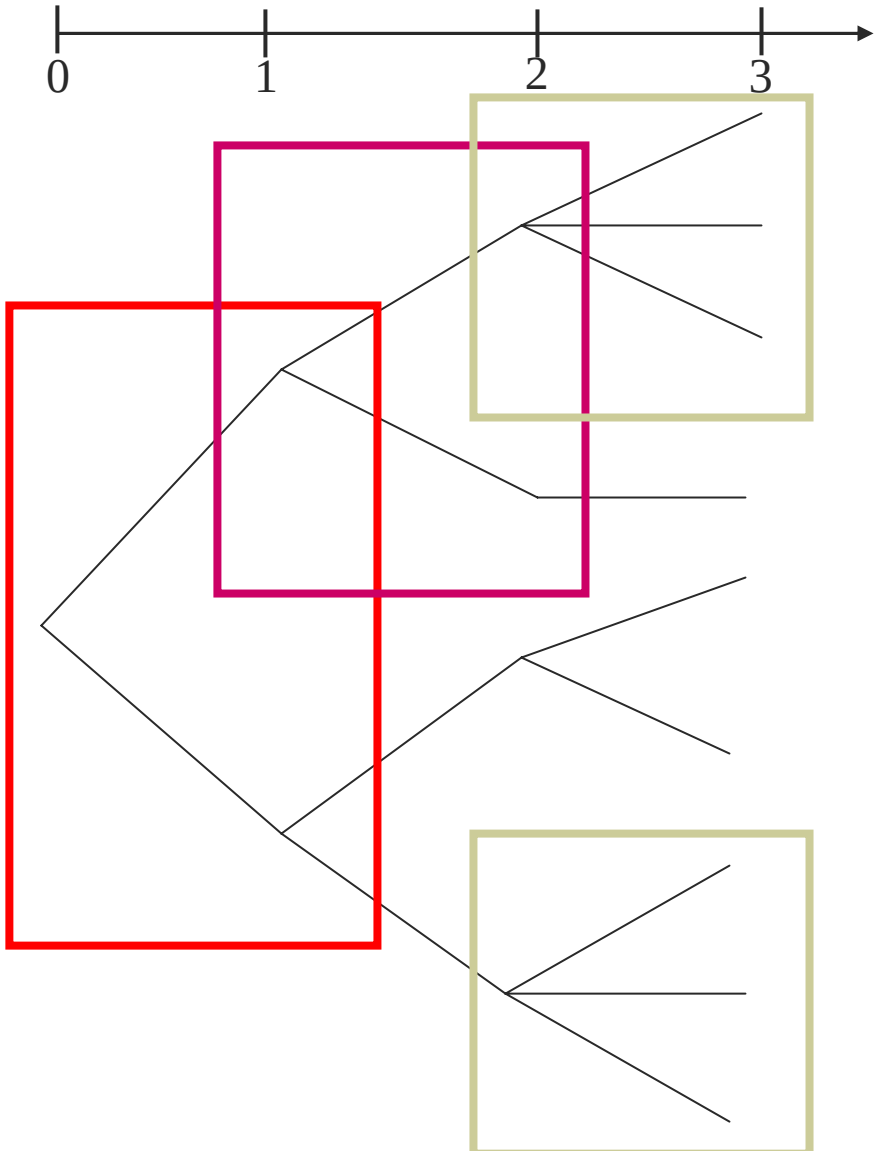
Law of one Price,No risk-free Arbitrage

- Law of one price (LOOP)
  - Securities (strategies) with the same payoff in the future must have the same price today.
  - Price of actual security = price of synthetic security
- No (risk-free) Arbitrage
  - There does not exists an arbitrage strategy that costs nothing today, but yields non-negative and a strictly positive future payoff in at least one future state/event AND
  - There does not exist an arbitrage strategy that yields some strictly positive amount today and has non-negative payoffs at later point in time.
- No Arbitrage ⇳ LOOP

Arbitrage Strategy

- **Static:**
  - acquire all positions at time *t*
  - no retrades necessary
- **Dynamic:**
  - Future retrades are necessary for an arbitrage strategy
  - Retrades depend on price movements

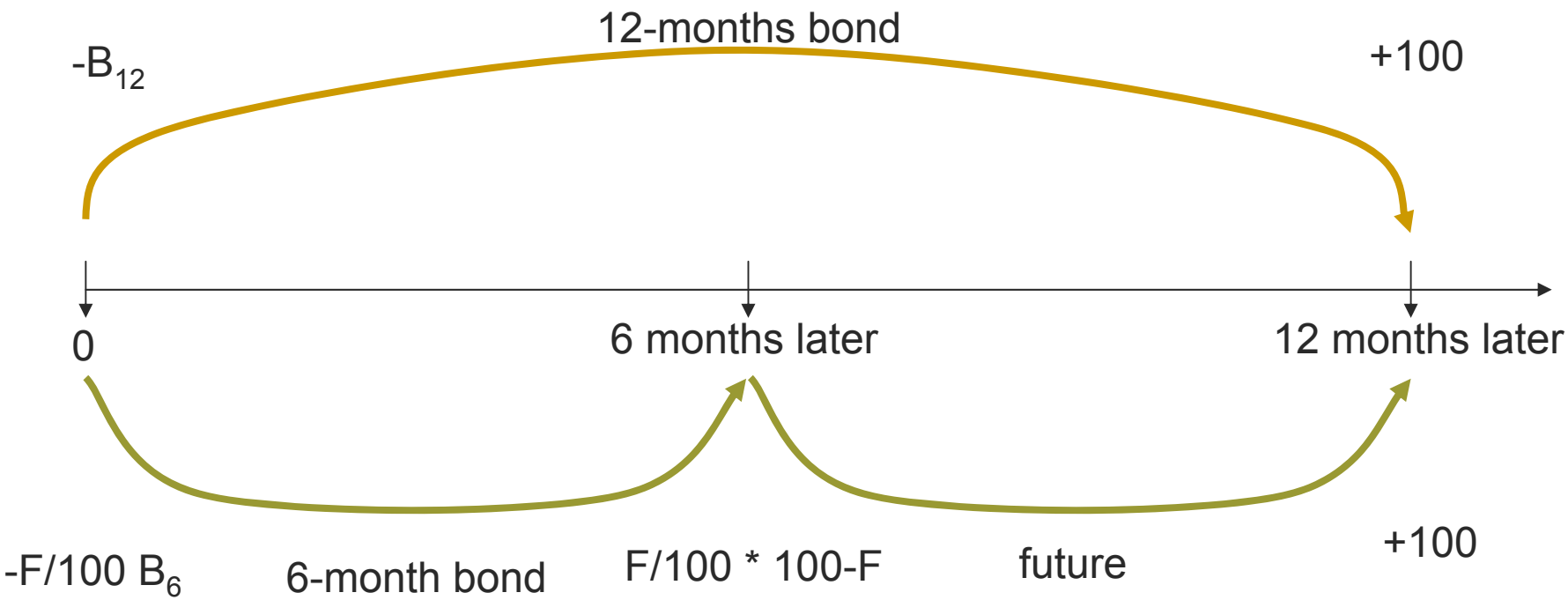
Abstraction – Event tree, again



Bond - Simplest Event Tree

- A zero-coupon bond pays $100 at maturity with no intermediate cashflows
- The future value (FV=$100) and the present value (PV=bond price, B) are related by the following equation: PV x (1+R) = FV, where R is the periodic interest rate
- Equivalently, PV = FV / (1+R)
- The bond price is: B = $100 / (1+R)

Bond Pricing Example



$$1+r_{0,12} = (1+r_{0,6})(1+ r_{6,12})$$

Law of One Price

Payoffs to purchasing the securities

	0	0.5	1
Long Bond	$-B_{Long}$	0	100
Short Bond	$-B_{Short}$	100	
Futures	0	-F	100

Suppose you want $100 in one year

	0	0.5	1
Long Bond	$-B_{Long}$	0	100

Buy 1 long-term bond

Alternatively

	0	0.5	1
Short Bond	$-B_{Short}$ x F/100	F	
Futures	0	-F	100
Net	$-B_{Short}$ x F/100	0	100

2 ways of getting the same payoffs should have the same price:

$$B_{Short} \times F/100 = B_{Long}$$

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9/14/2006

Synthetic Long-term Bond

- The pricing relation: $B_{12} = B_6 \times F/100$, can be rearranged to solve for any of the securities
  - The RHS represents a **"synthetic" long-term bond** (1 futures contract and F/100 short-term bonds)
- For example, $F = B_{12} / B_6 \times 100$
- If this pricing relation does not hold, then there is a risk-free profit opportunity
  – a risk-free arbitrage

Bond Pricing Example

- What if you observe the following prices:
  - Long Bond = $94.50
  - Short Bond = $95.00
  - Futures = $98.00
- Synthetic LBond = BShort x F/100 = $93.10

Arbitrage Trade

	0	0.5	1
Sell 1 Long Bond	94.50	0.00	-100.00
Buy 0.98 Short Bonds	-93.10	98.00	0.00
Buy 1 Futures	0.00	-98.00	100.00
Net	1.40	0.00	0.00

Example in International Setting

- Any one of the following four securities:
  - Domestic bond
  - Foreign bond
  - Spot currency contract
  - Currency futures contract

  can be replicated with the other three.
- Create a synthetic $/£ futures contract using:
  - US bond = $95
  - UK bond = £96
  - Pounds spot = $1.50/£

Bid-Ask Spread limits arbitrage

- What is the market price for a security?
  - Ask – the market price to buy
  - Bid or offer – the market price to sell
  - These are the prices at which a **market order** will be executed
- If we view the midpoint as the "fair value", then ½ x (Ask-Bid) = transaction cost per unit traded
  - A round-trip market order transaction will pay the full spread
- If the transaction size exceeds quantity being offered at the best bid or ask?
  - T-cost is an increasing function of order size
- UpTick records the difference between a trade's average transaction price and mid-price prevailing immediately prior to the trade as the trade's transaction cost.

Arbitrage with Bid-Ask Spread

- The law of one price holds exactly only for transactable prices (i.e. within the bounds)
- Pricing relation: BLong = BShort x F/100

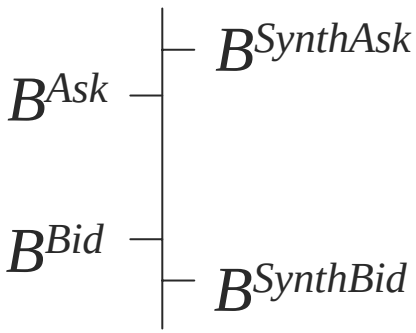
$$B_{1-yr}^{Synthetic} = \frac{F}{100} \cdot B_{6-mo}$$

- Total cost of buying the Long Bond synthetically:

$$B_{1-yr}^{SyntheticASK} = \frac{F^{ASK}}{100} \cdot B_{6-mo}^{ASK}$$

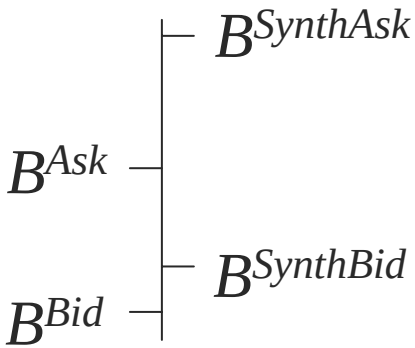
Arbitrage with Bid-Ask Spread

Case 1



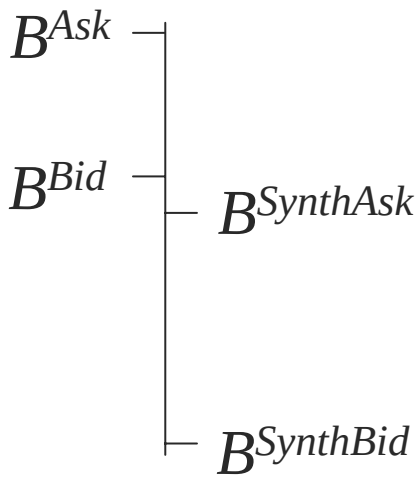
- Buy and sell direct
- No arbitrage

Case 2



- Buy direct; Sell synthetic
- No arbitrage

Case 3



- Buy synthetic; sell direct
- Arbitrage

Margins limit arbitrage

- Positive size is limited
  - Long an asset
    - m% * p * x ≥ marked-to-market wealth
  - Short an asset
    - Sell asset, receive p = $100
    - Put p + m*p in margin account
    - Use up m*p of your own financial wealth
- Cross-Margining
  - Netting: Only perfectly negatively correlated assets
  - Portfolio margin constrained
    - If better hedge one can take larger positions

More on Margins

- How much leverage should your broker allow you?
  - Depends on interest they charge ←→ risk they are willing to bear
- Most brokers charge an interest rate that is close to the Federal Funds rate (riskfree rate)
- Hence, from broker's perspective the loan must be close to riskfree (very small probability of you defaulting)
  - Broker requires **equity cushion** sufficient to keep the loan close to riskfree, subject to constraints imposed by the Federal Reserve and exchanges
  - **Cross-margining/Netting:** Most brokers give preferred margin terms to clients with low total portfolio risk
  - upTick requires 50% margin to initiate most equity and bond positions
  - upTick evaluates the overall risk of portfolios
    rebates some of the reserved equity for perfectly offsetting positions

More on Margins

- No constraints

Initial Margin (50%) — Reg. T 50 %

- Can't add to your position;
- Not received a margin call.

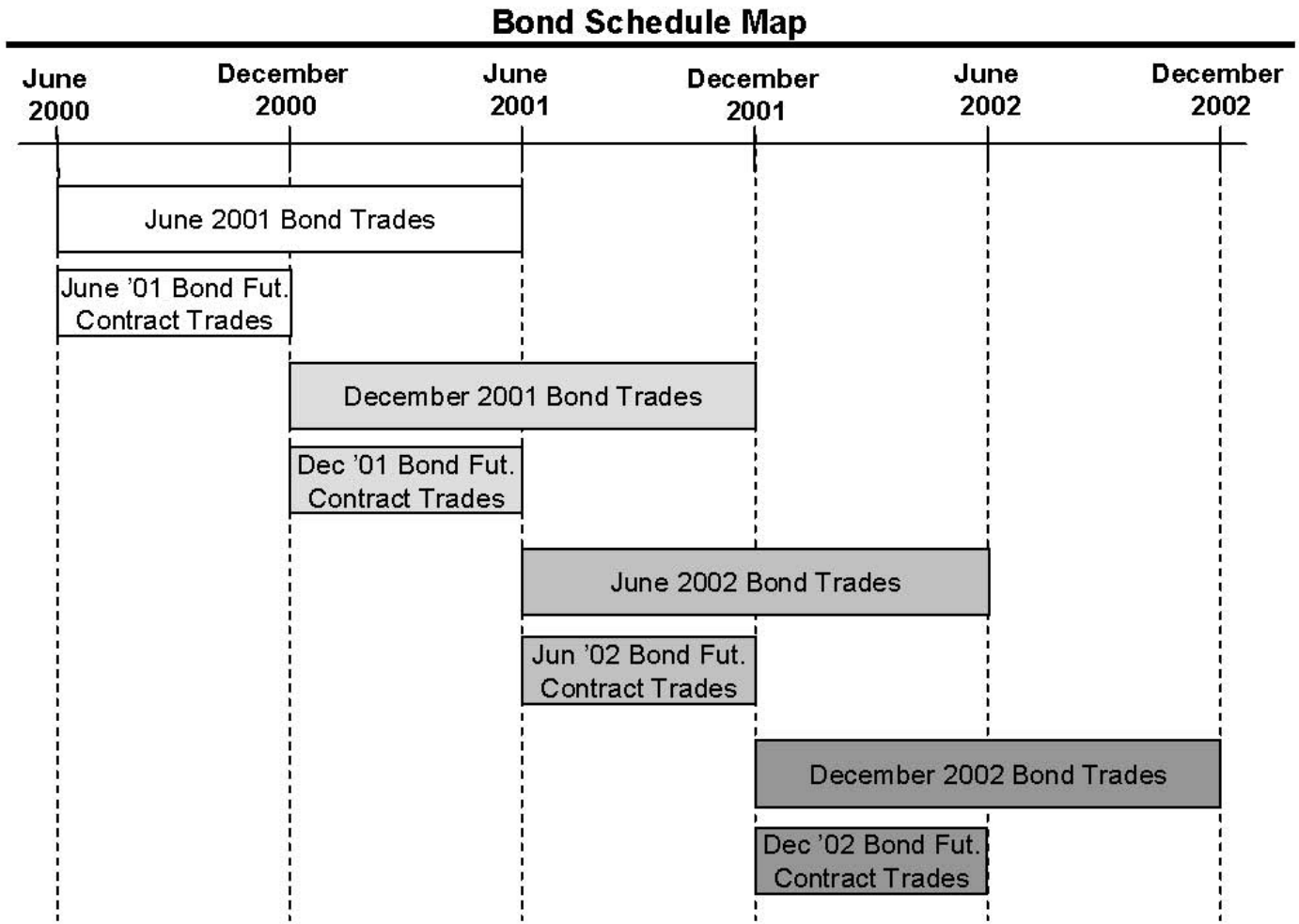
Maintenance Margin (35%) — NYSE/NASD 25% long, 30% short

- Fixed amount of time to get to a specified point above the maintenance level before your position is liquidated.
- Failure to return to the initial margin requirements within the specified period of time results in forced liquidation.

Minimum Margin (25%)

- Position is always immediately liquidated

Simulation – Law of One Price



Three simulations

1. Equal liquidity for all three assets
   - 12-month bond
   - 6-month bond
   - Future
2. 12-month bond is less liquid
3. 6-month bond is less liquid
   + negative endowment in 6-month bond