What’s Institutional Finance?

- **Traditional Finance**

  - Households 1
    - income will decline
    - positive endowment shock (unexpected pay raise)
  - Households 2
    - income will rise
    - negative endowment shock (unexpected health expense)

- **borrowing/lending**
- **insuring**
What’s Institutional Finance?

Traditional Finance – Endowment Economy

- Households 1
  - income will decline
  - positive endowment shock (unexpected pay raise)

- Households 2
  - income will rise
  - negative endowment shock (unexpected health expense)

At what price/interest rate?
Assumption: No frictions
What’s Institutional Finance?

Traditional Finance – Endowment Economy

- Income will decline
- Positive endowment shock (unexpected pay raise)

Single Representative Household

- Aggregate endowment income/shock (no trading)
- Intertemporal Elasticity of Substitution (incentive to smooth consumption)
- Risk aversion

- Income will rise
- Negative endowment shock (unexpected health expense)
What’s Institutional Finance?

Traditional Finance – Production Economy

- Households
- Firms

- borrowing/lending
- insuring

Single Representative Household

- Productivity shocks
- ...
Traditional “Banking Finance”

- **short term** lending (bank deposits)
- **long-term** lend (mortgage)

Frictions might emerge e.g. bank-runs
What's Institutional Finance?

- **Traditional “Banking Finance”**

  - Household 1
    - **short term** lending (bank deposits)
  - C-Banks
  - Household 2
    - **long-term** lend (mortgage)
  - Firm
  - Central Bank
    - Lender of Last Resort
What’s Institutional Finance?

Traditional “Banking Finance”

- Household 1
- Household 2
- Firm

- Banks
- Interbank market
- Central Bank

- lend (bank deposits)
- lend (mortgage)
What’s Institutional Finance?

- Modern “Institutional Finance”
  (originate and distribute banking model)

- Financial Markets:
  - C-Banks
  - I-Banks
  - Hedge Funds
  - Broker/Dealers
  - Money Market Funds
  - Mutual Funds
  - Pension Funds
  - Insurance Companies
  - Private Equity funds
  - Etc.

- Funding liquidity need for each institution

- frictions, frictions, frictions

Households
Firms

Households
Firms
What’s Institutional Finance?

- Financially intermediated finance
  - Focus on financial intermediaries (FIs)
    - “economic agents who specialize in the activity of buying and selling (at the same time) financial claims” (Freixas and Rochet, p. 15).
    - (Commercial) banks (savings institutions and credit unions): buy securities issued by borrowers (grant loans) and sell them to lenders (collect deposits)
  - Brokers/Dealers: trade securities for their own account (dealer) or on behalf of their customers (broker)
  - Related to Industrial Organization

- Transaction costs/ frictions –
  - “Friction-finance”
Commercial Banks still have a larger fraction
(universal banks)
Lending/Insuring vs. Trading

- Lending/Borrowing + Insuring
  - = trading assets/securities
    - Bond
    - Stock
    - Derivatives, e.g. CDS
- At what price/rate?
  - How are different asset prices linked?
  - How do institutional investors constraint affect asset prices?
    (not only utility function of representative agent matters)
No risk-free Arbitrage
Relative vs. Absolute Asset Pricing
How to deal with complexity?

- Subtasks
- Independence/separation results
- Simplify
  - form models - simplified pictures of reality
- Standardize

See Brunnermeier & Oehmke
“Complexity in Financial Markets”
Abstraction – Event tree

![Event Tree Diagram]

The diagram illustrates an event tree with branches extending from each event node, representing different possible outcomes or scenarios. The tree structure shows the progression and interactions of these events over time.
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 exist 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

<table>
<thead>
<tr>
<th>Static:</th>
</tr>
</thead>
<tbody>
<tr>
<td>acquire all positions at time $t$</td>
</tr>
<tr>
<td>no retrades necessary</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dynamic:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Future retrades are necessary for an arbitrage strategy</td>
</tr>
<tr>
<td>Retrades depend on price movements</td>
</tr>
</tbody>
</table>
Abstraction – Event tree, again
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: $PV \times (1+r) = FV$, 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

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>0.5</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Bond</td>
<td>-B\text{Long}</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Short Bond</td>
<td>-B\text{Short}</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Futures</td>
<td>0</td>
<td>-F</td>
<td>100</td>
</tr>
</tbody>
</table>

### Suppose you want $100 in one year

<table>
<thead>
<tr>
<th></th>
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<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Bond</td>
<td>-B\text{Long}</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

*Buy 1 long-term bond*

### Alternatively

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>0.5</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short Bond</td>
<td>-B\text{Short} x F/100</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>Futures</td>
<td>0</td>
<td>-F</td>
<td>100</td>
</tr>
<tr>
<td>Net</td>
<td>-B\text{Short} x F/100</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

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

\[ B_{\text{Short}} \times F/100 = B_{\text{Long}} \]
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

<table>
<thead>
<tr>
<th>Arbitrage Trade</th>
<th>0</th>
<th>0.5</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sell 1 Long Bond</td>
<td>94.50</td>
<td>0.00</td>
<td>-100.00</td>
</tr>
<tr>
<td>Buy 0.98 Short Bonds</td>
<td>-93.10</td>
<td>98.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Buy 1 Futures</td>
<td>0.00</td>
<td>-98.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Net</td>
<td>1.40</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>
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/£
What is the market price for a security?

- **Ask:** the market price to buy
- **Bid or offer:** the market price to sell
- **Prices at which market orders are executed**

If we view the midpoint as the “fair value”, then
\[
\frac{1}{2} \times (\text{Ask-Bid}) = \text{transaction cost per unit traded}
\]

- 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?

- Transaction 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: $B_{\text{Long}} = B_{\text{Short}} \times \frac{F}{100}$

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

- Total cost of buying the Long Bond synthetically:

$$B_{\text{Synthetic ASK}}^{1-\text{yr}} = \frac{F^{\text{ASK}}}{100} \cdot B_{6-\text{mo}}^{\text{ASK}}$$
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
Positive size is limited

- Long an asset
  - m% * p * x \cdot \text{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
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 – Funding Liquidity

$• No constraints

**Initial Margin (50%)**
- Reg. T 50%
- Can’t acquire new 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%)**
- Immediate liquidated of position
Introduction to UpTick Software

- **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** (Masters students)
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)
Simulation – Law of One Price

Bond Schedule Map

- June 2000
  - June ’01 Bond Fut. Contract Trades
  - June 2001 Bond Trades
  - Dec ’01 Bond Fut. Contract Trades
  - December 2001 Bond Trades
- June 2001
  - June 2002 Bond Trades
  - Jun ’02 Bond Fut. Contract Trades
- December 2000
  - December 2002 Bond Trades
  - Dec ’02 Bond Fut. Contract Trades
- June 2002
  - December 2002 Bond Trades
- December 2001
  - December 2002 Bond Trades
Three simulations

1. Equal liquidity for all three assets
   o 12-month bond
   o 6-month bond
   o Future

2. 12-month bond is less liquid

3. 6-month bond is less liquid
   + negative endowment in 6-month bond
Actual vs. synthetic 6-month bond

Short-term Bond:
- actual
- synthetic

Illiquid long-term bond

average account

computer traders

students

Bid
Ask

>$4
More about the simulations

- It’s better to study synthetic short-term bond or futures contract (since every 6 months they converge to 100)

- **Big jumps** are created by *computer traders*.
  - Students should have noticed that short-term bond has to go to 100 after 6 months (expect a jump and trade very aggressively)

- Mispricing was sometimes up to $4 – be more aggressive.

- **Quantity of trades**
  - Average quantity for which the bid and ask was valid was 600 contracts
  - For roughly the next 200 contracts the price moved by 21 bp (.21 %)
  - Often there was significant mispricing (600 contracts make $1 and for another 1200 contracts make .8$ since price moves only .21%)

- **Effect of Cross-margining:**
  - Creates incentive to perfectly hedged because one can take larger positions