Forwards, futures and swaps
Financial Futures

BKM Ch. 22 and 23

Overview

- BKM 22: The basics of futures/forwards and how they are priced.
  - Sections 22.1-22.4
  - Practice problem sets 4, 7, 9, 10, 16
- BKM 23: Applications.
  - Sections 23.1-23.3
  - I may discuss swaps in class (23.4), but you are not responsible for them on the final exam.
  - Problem sets 7, 12, 17
Spots, forwards and futures

- Most trades consist of preliminary agreement followed by *settlement* (delivery and payment).
- Spot trade
  - Settlement is (nearly) immediate.
- Forward trade
  - Settlement is deferred until some maturity date.
  - Terms of the trade are negotiated and customized.
  - Trading is over-the-counter.
- Futures trade
  - Settlement is deferred until some maturity date.
  - Futures contracts are standardized.
  - Contracts are exchange-traded.

Three ways of exchanging US$ for €

- **Spot trade**: immediate settlement.
  - At a bank, I buy 500 € at a price of $1.28 per €.
- **Forward trade**: deferred settlement
  - A hedge fund calls the bank’s foreign exchange (FX) desk, and ...
  - Agrees to purchase of €437,000 at a price of $1.30 per € for settlement on April 15.
  - “We bought € forward”
    - or “We went long € forward against the $.”
Futures trade: deferred settlement

- The Chicago Mercantile Exchange lists standardized € futures contracts
  - A contract is a legal agreement that calls for the delivery of €125,000.
  - There are contracts that mature in December, March, June, and September.
- I instruct my broker to “buy” one June contract.
- “I went long June €”

Futures contracts

- Generally specify delivery of
  - a particular underlying
  - on a particular maturity date
- Contracts are available on:
  - agricultural commodities (wheat, corn, ...)
  - energy (oil, gas, electricity, ...)
  - metals (gold, silver, ...)
  - financial assets (bills, bonds, stocks, FX, ...)
US futures exchanges

- The CME Group Inc. owns four futures exchanges.
  - Chicago Mercantile Exchange (CME, “Merc”)
    - Cattle, hogs, S&P Index Futures, Eurodollars, etc.
  - Chicago Board of Trade (CBOT, “Board of Trade”)
    - Corn, wheat, oats, US T-Bonds and Notes
  - Nymex (old New York Mercantile Exchange)
    - Energy (including petroleum), coffee, cocoa, sugar
  - Comex
    - Metals
- Trading
  - Traditionally open outcry (“pit trading”)
  - Few pits remain: trading has shifted to the Globex electronic system.

The Comex Gold Contract

- Underlying commodity is gold
  - “... assaying not less than .995 fineness, cast either in one bar or in three one-kilogram bars, and bearing a serial number and identifying stamp of a refiner approved and listed by the Exchange.”
- size: 100 (troy) ounces
  - 1 ozt. ≈ 1.1 “regular” (avoirdupois) oz.
- price quotes are $/ozt.
  - Gold (spot) ≈ $1,255 (December 2013)
  - Contract represents about $125,500 worth of gold.
Gold futures trading (cmegroup.com, Friday, 29 Nov 2013)

<table>
<thead>
<tr>
<th>Month</th>
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<th>High</th>
<th>Low</th>
<th>Change</th>
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A hypothetical transaction

- Alan “buys” (takes a long position in) the January 2014 contract at a price of $1,240.
  - He agrees to pay $, and take delivery of gold at maturity.
- The other side (“Beth”) is the short side.
  - She agrees to make delivery of gold (and receive $)
- For every long position there is a short position.
  - Zero net supply (like options)
  - # long positions = # short positions = open interest
Profits and losses

- **Alan**: Profit to long side (per ozt)
  - (spot price of gold at maturity) – $1,240
  - At maturity
    - If gold spot is $1,260, Alan makes $20/ozt. (total of $2,000)
    - If gold spot is $1,210, Alan loses $30/ozt. (total of $3,000)
- **Beth**: Profit to short side (per ozt)
  - $1,240 – (spot price of gold at maturity)
- Gains and losses over long and short positions net to zero.

**Futures vs. options**

**Figure 22.2** Profits to buyers and sellers of futures and options contracts
Counterparty risk in futures markets

- Futures have deferred settlement.
  - At settlement, one side will have a loss.
- How do we know the losing side won't walk away from their obligation?
- Tools for managing counterparty risk:
  - Clearing house (similar to options markets)
  - Margin deposits (similar to options markets)
  - Marking to market (daily resettlement)

Margin

- Alan and Beth both have to post margin.
  - Recall: with options, only the option seller has to post margin.
- As of 1 Dec 2014, the initial margin on the Nymex gold contract is $7,975 per contract
- The maintenance margin is $7,250 per contract.
- The Exchange sets the margin, and can change it at any time.
Marking to market ("daily resettlement")

- An accounting procedure that forces both sides of the contract to take their profits/losses daily.
  - This prevents large unrealized “paper” losses from arising.

Daily resettlement: Example

- At 10 am on 29 Nov 2014,
  - Alan takes a long position in the Jan 2014 gold contract at a price of $1,240.
  - Beth takes the short side.
- Both Alan and Beth post margin.
- Suppose that at the end of the day, the contract is trading at $1,230
- Beth has a “paper” profit on the contract:
  - $(1,240 - 1,230) \times 100 = $1,000$
- Alan has a “paper” loss of $1,000.
Marking-to-market converts the “paper” profits and losses into real P&L:
- $1,000 is moved from Alan’s margin account into Beth’s margin account.
- The price of their contract is reset from 1,240 to 1,230.

If on the next day, the contract ends trading at 1,235,
- Alan has a \((1,235 - 1,230) \times 100 = 500\) profit
- $500 is moved from Beth’s margin account into Alan’s
- The contract is repriced at $1,235.

On each day
- Profits and losses are realized in cash.
- Repricing “restarts” the contract with a new base for determining subsequent P&L.

Daily settlement and futures vs. forwards

If we’re using a forward contract that calls for delivery at time \(T\), and we go long at a forward price \(F_0\), our profits are \(P_T - F_0\). This is realized at time \(T\).

If we’re using a futures contract, our total profits are also \(P_T - F_0\), but these are realized (in part) each day.

Futures and forwards differ in the timing of profits (but not the total profits).

Usually in finance, we pay close attention to timing.
- We never combine cash flows occurring at different times without making some sort of present/future value adjustment.

In the present material, we’re not as meticulous: we focus on total profits (or losses), irrespective of timing.
- We treat futures contracts as if they were forward contracts.
### Maintenance margin

- The maintenance margin on the gold contract is $7,250.
- Suppose that at the end of trading on Dec. 3, the contract price is 1,200.
- Alan has a loss of \((1,240 - 1,200) \times 100 = $4,000\).
- $4,000 is moved from Alan’s margin account to Beth’s.
- The balance on Alan’s margin account = $7,975 - $4,000 = $3,975.
- This is below the maintenance margin.
  - Alan must put in an additional $7,250 - $3,975 = $3,275.

### Closing out a position early

- Most contracts do not ultimately end up with a delivery of the underlying.
- Alan can get out early by going short a Jan 2014 contract.
  - This short position offsets his original long position.
- Beth can take a long position (offsetting her original short).
- Beth and Alan don’t have to coordinate this.
  - Recall that the counterparty is the clearing house.
  - Alan can take his short position against anyone who wants to take a long position.
Problem: The Kryptonite contract

- Underlying is 100 grams of Kryptonite.
- Prices are quoted in $/g.
- The initial margin is $8,000; the maintenance margin is $6,000.
- Cathy goes long one contract at $822
  - At what price will she get a margin call?
    \[ \text{loss of } 822 \times 20 \text{ g} = 16,400 \text{ g}. \] $802
- David goes short one contract at $822
  - At what price will he get a margin call?
    $22 + 20 = 842

Problem (continued)

- Cathy and David make their trades on Monday (at 822)
  - Monday’s settlement price is $826
  - Tuesday’s settlement price is $834
  - Wednesday’s settlement price is $830
- What are the flows to/from their margin accounts on these days?
  - Mon: \((826 - 822) \times 100 = 400\) Cathy pays $400, David receives $400
  - Tue: \((834 - 826) \times 100 = 800\) David pays $800, Cathy receives $800
  - Wed: \((830 - 834) \times 100 = -400\) Cathy pays $400, David receives $400

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The settlement (“settle”) price

- The end-of-day price used to mark positions to market.
- For an actively-traded contract, it is usually the same as (or very close to) the last trade price.
- For a contract that didn’t trade, the settlement price is set by a committee (taking into account trade prices in active contracts).
- For the 2018 and 2019 gold contracts, the settlement price changes even though there is no trading.

Settlement at maturity

- Settlement in kind (settlement by actual delivery): the underlying commodity is delivered
  - The Comex gold contract settles by delivery of gold.
- Settlement in cash: profits and losses are imputed using some reference spot price.
  - Transfers are made in cash (as in daily resettlement).
  - Used when the underlying is intangible or inconvenient to trade.
Settlement in cash: CME S&P 500 E-mini futures contract

- The underlying is the S&P 500 index
- “E-mini” a “small” contract, electronically traded.
- The size of the contract is $50 \times S&P$ index
  - With the index around 1800, the contract represents about $90,000$ in stock.
- Settlement
  - Profits to long position
    - $50 \times (\text{Index level at maturity} - \text{original futures price})$

Cash settlement

- Also used for (European) index options
  - An S&P index option with an exercise price of 1,750 and a size (multiplier) of 100.
  - At maturity, if $index > 1,750$, holder of the call receives $100 \times (index - 1,750)$ from the call seller.
- VIX options, etc.
Problem

- The E-mini Dow contract has a value of $5 \times \text{Dow Jones Industrial Average}$.
- I went short one contract at 15,700. At settlement, the DJIA is at 15,985.
- My profit/loss is:

\[
\begin{align*}
\text{Profit/Loss} &= 15,985 - 15,700 \\
&= 285 \\
&= 285 \text{ points} \times $5 = 1,425
\end{align*}
\]

Cash settlement is so easy, why not use it for everything?

- The settlement price might be subject to manipulation.
- Suppose we have a large long position in a cash-settled futures contract where the underlying is a thinly traded stock or commodity.
  - Could we make a large purchase in the underlying, to move the settlement price in our favor?
  - Could the short side of the contract make a large sale in the underlying?
Using futures for speculation

- If you think that the price of the underlying is going to move, you can go long/short the futures contract instead of trading in the spot market.
- By trading in futures...
  - You don’t have to put as much money.
  - You don’t have to take/make delivery.
  - You often get better liquidity.
    - Futures markets are usually more liquid than spot markets.

Speculating with stock index futures (adapted from BKM Ch. 22 Problem 7)

- I have $4,510 to invest. I can either
  - Put all $4,510 in the SPY (S&P 500 ETF), or
  - Use the $4,510 as initial margin to go long an S&P 500 E-mini.
  - The size of the contract is $50 \times S&P 500 \text{ index}.
  - Assume zero basis: $F_t = S_t = 1,800$.
- If the S&P index rises by 5%, what is the % gain on the initial $4,510 investment? $(1,890 - 1,800) \times 50 = $4,500$ Approx 100%
Using futures for hedging

- Suppose that a firm uses or produces a commodity.
  - Price uncertainty causes risk.
    - Airline profits are very sensitive to the price of fuel.
- A user of the commodity can hedge by going long the futures.
- A producer can hedge by going short.
- Either way: the price is locked in.

Adapted from BKM Ch. 22 Problem 9b

- I have some 10-year Treasury notes that I’d like to sell right now. For tax reasons, it’s better to defer the sale for two months. But over the next two months, the price of the notes might change.
- How can I hedge the price risk using T-note futures?
  
  go short T-note futures contract
Hedging complications: basis risk

- Basis = Futures price – Spot price
- When the futures are being used to hedge uncertainty in the spot, the hedge is only good if the basis is (relatively) constant day to day.
  - “There is low tracking error”
- Volatility in the basis is called basis risk

How are futures prices determined?

- Three pricing principles
  - Convergence
  - Spot-futures parity principle
  - Expectations hypothesis
- In the following examples
  - $P_t$ is the spot/cash price of the underlying
  - $F_t$ is the futures price
  - $T$ is the maturity
**Convergence**

- \( F_T = P_T \)
- “There’s no difference between a spot trade and a futures trade with maturity ‘one second’ in the future.”
- The basis \( (= F_t - P_t) \) might be non-zero if \( t < T \), but as maturity draws nearer, \( F_t \) and \( P_t \) will converge.
  - ... holding identical delivery terms in the cash and futures markets.

**Spot-futures/forward parity theorem**

- \( F_t = P_t + \text{cost of carry} \)
- “Fixing a price today and taking delivery at \( T \)” = “buying the underlying today and storing (carrying) it until \( T \)”
- Cost of carry
  - Financing (borrowing) costs
  - + Physical storage costs
  - – income earned by the underlying
Application to a stock index futures contract

- The spot price today is $S_0$, the current level of the index.
- If we want to own stock at maturity $T$:
  - We could lock in the price with a forward contract, agreeing to pay $F_0$ today at maturity, or
  - We could borrow cash equal to $S_0$ today, buy the stock and hold it until $T$. At time $T$ we’d pay
    \[
    \frac{S_0(1 + r)}{\text{Pay back the loan with interest}} - \frac{D}{\text{Offset for dividends received}}
    \]
- The parity relation is $F_0 = S_0(1 + r) - D$
- Also written as $F_0 = S_0(1 + r - d)$ where $d$ is the dividend yield.

In-class problem

- The current level of the S&P index is 2,100
- The dividend yield is 3%
- The borrowing rate is 1%
- What is the implied futures price? $T = 1$ year
  \[
  F_0 = 2,100 \times (1 + 0.01 - 0.03) = 2,100 \times 0.98 = 2,058
  \]
The fair-value [basis]

- Recall basis = \( F_t - P_t \)
  - Parity principle: basis = cost of carry
- We estimate the cost of carry, and invoke the parity principle to label it the “fair value” basis.
- For stock index futures, cost of carry = borrowing cost – dividends.
- Next slides from indexarb.com

For the “near” contract (December 2013)

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<th>Index Arbitrage Program Trading Premium Values</th>
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<th>No Programs</th>
<th>Buy Programs</th>
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<td>NASDAQ 100 (SM)</td>
<td>Dow Jones Ind. Avg. (SM)</td>
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<td></td>
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<tr>
<td>Fair Value (Premium) (PV)</td>
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<td>-17.06</td>
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Updated: Saturday, Nov-30-2013 4:20pm ET

The [Dec 13] S&P 500 index contract should be priced at \( F_t = index - 1.26 \)
**Calculation of the “−1.26”: The fair value decomposition**

<table>
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<tr>
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<th>Dividends (Divisor Adjusted)</th>
<th>Fair Value (FV)</th>
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<td>0.44</td>
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**Stock index futures: arbitrages of parity violations**

- If \( F_t > S_t + borrowing \text{ cost} - dividends \)
  - The futures is overpriced relative to the spot index.
  - Today: sell the futures, buy the index with borrowed funds.
  - At maturity: settle the futures, sell the index, repay the loan, collect dividends.

- If \( F_t < S_t + borrowing \text{ cost} - dividends \)
  - The futures is underpriced relative to the spot index.
  - Today: buy the futures, sell short the index, invest short-sale proceeds.
  - At maturity: settle the futures, buy the index and settle the short position, pay dividends, collect the proceeds (with interest).
Adapted from BKM Ch. 22 Problem 16

- The S&P portfolio pays a dividend yield of 1% annually. Its current value is 1300. The T-bill rate is 4%. Suppose the one-year futures price is 1,330.
- According to spot-futures parity, is the contract fairly priced?
  \[ F_0 = \frac{1300 \times (1 + 0.04 - 0.01)}{1 + 0.04} = 1339 \]
- What sort of arbitrage would exploit the discrepancy?

Expected spot prices

- The parity principle relates the futures price to the spot price \( F_t \) vs. \( S_t \) at any given time \( t \).
- Also, at any given time, markets hold a belief about the expected (at-maturity) spot price.
  - This is denoted \( E(P_T) \).
- The expectations hypothesis (applied to forward markets) asserts that
  - \( F_t = E_t P_T \)
  - Today’s expectation of the spot price at maturity.
- The expectations hypothesis of the term structure is a special case of this, where the underlying is a one-period zero-coupon bond.
Problems

- An E-Minnie futures contract is for $100 \times \text{Disney share price}$. Surprise announcement: Disney is increasing its dividends. All else equal, what happens to the basis?
- Correction: The basis is $F_0 - S_0 = rS_0 - D$, so an increase in $D$ will cause the basis to drop.
- What is the beta of a short position in an S&P 500 index contract? *The index has a beta of 1, so a short position has a beta of -1.*

Chapter 23

- 23.1 Currency futures
- 23.2 Stock index futures
- 23.3 Interest rate futures
- 23.4 Swaps
Currency forwards and futures

- In addition to spot trades, banks make markets in forward foreign exchange (FX).
- The CME trades FX futures contracts.
  - The Euro contract is traded electronically and calls for the delivery of €125,000. Monthly expiration cycles.

Futures/forward currency pricing: the carry trade

- Interest rates differ across currencies (2 Dec 2013)
- The carry trade:
  - Borrow the low-rate currency
  - Convert into the high-rate currency
  - Invest at the high rate
  - At maturity, convert back into low-rate currency

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Borrow in the US; invest in Spain for one year

- Suppose that the €/$ exchange rate is $E_0 = 1.5/€$, $r_{US} = 0.3\%$ and $r_{SP} = 1.4\%$.  
- **Borrow** $100$ in the US at $0.3\%$  
- **Convert** $100 \rightarrow 100/1.5 = 66.67 \text{ €}$, and invest at $1.4\%$  
- In one year, the € investment will grow to $66.67 \times (1.014) = 67.60$.  
- **Convert back to $** (assuming that the exchange rate is still $1.5/€$).  
  $67.60 \times 1.5 = 101.41$  
- **Repay** the loan for $100 \times (1.003) = 100.30$  
- Have $101.41 - 100.30 = 1.11$ net gain

But what if the exchange rate in one year is not 1.5?

- Eliminate the exchange rate risk by locking in the exchange rate now.  
- Right now we can either  
  - **Sell** € one year forward from our bank, or  
  - Enter into a **short** one-year € futures contract at the CME.  
- We’ll assume that both are quoting the same rate: $F_0$
Then our risk-free gain per $ is
\[ \frac{\$1}{E_0} \times (1 + r_{SP}) \times F_0 - (1 + r_{US}). \]

If arbitrageurs drive this gain to zero, we’ll have
\[ F_0 (1 + r_{SP}) = E_0 (1 + r_{US}). \]
This is covered interest parity, and is usually expressed as
\[ F_0 = E_0 \left( \frac{1 + r_{US}}{1 + r_{SP}} \right). \]

BKM Ch. 23 Problem 10.

Suppose that the spot Euro exchange rate is $1.50/€, and that the one-year forward exchange rate is $1.55/€. Is the interest rate higher in the US or in the Euro-zone?

\[
\frac{1.55}{1.50} = \frac{1 + r_{US}}{1 + r_{\varepsilon}} > 1 \\
\frac{1.55}{1.50} > 1 + \frac{r_{US}}{1 + r_{\varepsilon}} \implies r_{US} > r_{\varepsilon}
\]
The spot price of the UK£ is currently $2.00/£. If the US interest rate is \( r_{US} = 4\% \) and the UK rate is \( r_{UK} = 6\% \), what must be the forward price of the £ for delivery in one year?

\[
F_0 = \frac{\$2.00 \times 1.04}{1.06} = 1.962
\]

Covered interest parity, beyond one year

If \( F_0 \) is the forward price for delivery \( T \) years ahead, then

\[
F_0 (1 + r_{SP})^T = E_0 (1 + r_{US})^T
\]

or, equivalently

\[
F_0 = E_0 \frac{(1+r_{US})^T}{(1+r_{SP})^T}
\]
The modern (uncovered) carry trade.

- Barclays Bank has designed an ETN (Exchange-Traded Note) linked to the performance of a carry trade. From the website:
  - The iPath® Optimized Currency Carry ETN is designed to provide investors with exposure to the Barclays Optimized Currency Carry Index™.
  - The Barclays Optimized Currency Carry Index™ (the "Index") is designed to reflect the total return of an "Intelligent Carry Strategy," which ... seeks to capture the ... returns from a strategy of investing in high-yielding currencies with the exposure financed by borrowings in low-yielding currencies ...
  - The pool of currencies to which the Index may apply these ... includes the U.S. dollar, the euro, the Japanese yen, the Canadian dollar, the Swiss franc, the British pound sterling, the Australian dollar, the New Zealand dollar, the Norwegian krone and the Swedish krona.

Stock index futures

- Underlying is a stock index
  - US: S&P 500, Dow Jones (DJIA) etc.
  - Non-US: FTSE-100 (UK); DAX-30 (Germany); CAC-40 (France); Nikkei (Japan), etc.
- Settled in cash
- Extensively arbitraged against cash market
  - The prices are reliable: deviations from forward-spot parity are small.
- Widely used for speculation and hedging.
Using stock index futures

- Stock index futures are very similar to stock index ETFs (exchange traded funds) \( ^\text{SPY} \)
  - The futures have lower margin, longer trading hours, and are (for some investors) cheaper to short.

- Strategies
  - Synthetic stock
  - Market timing
  - Hedging market risk

Uses of stock index futures

- Synthetic stock
  - As an alternative to buying the S&P index:
    - Long the futures contract
    - Invest cash in T-bills

- Market timing
  - Attempting to profit from short-term movements in index
  - Requires ability to rapidly shift into and out of stock.
  - This is easier to do in the futures contract.
Hedging market risk ("alpha capture")

- We have identified a stock (ABC) that has positive alpha.
- Buying ABC (by itself) exposes us to market risk.
- Use index futures to remove market risk (leaving idiosyncratic risk and alpha).

Single index model:

\[ R_{ABC} = \beta_{ABC} \times R_M + \alpha_{ABC} + e_{ABC} \]

\[ (\beta_{ABC} = 1.5) \]

\[ R_{ABC} - 1.5 \times R_M = \alpha_{ABC} + e_{ABC} \]

Long $100$ worth of ABC
Short $150$ worth of M

Futures contract
US interest rate futures contracts

- US Treasury securities are the underlyings.
- Allow speculation or hedging of interest rate risk at various maturities.

<table>
<thead>
<tr>
<th>Underlying</th>
<th>Size</th>
<th>Settlement</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-yr T-Notes</td>
<td>$200,000 par value</td>
<td>Kind</td>
</tr>
<tr>
<td>5-yr T-Notes</td>
<td>$100,000 par value</td>
<td>Kind</td>
</tr>
<tr>
<td>10-yr T-Notes</td>
<td>$100,000 par value</td>
<td>Kind</td>
</tr>
<tr>
<td>30-yr T-bonds</td>
<td>$100,000 par value</td>
<td>Kind</td>
</tr>
</tbody>
</table>

Hedging by an underwriter

- An investment bank is trying to sell an inventory of corporate bonds.
  - Risk: if interest rates rise they will have a loss on our bond holdings.
- Hedge by going short the T-bond contract.
- Rationale
  - \( y_{Corporate} = y_{Govt} + credit\ \text{spread} \)
  - If the credit spread is constant, then yields of government and corporate bonds should move together, and prices of government and corporate bonds should move together.
  - If yields increase, we'll have a loss on the corporate bonds we have in inventory.
  - We'll have an offsetting gain on our short T-bond contract.
Using the T-bond future: Hedging by borrowers and investors

- A pension fund that is due to receive an inflow of cash can lock in a long-term bond rate by going long the futures contract, and taking delivery of the bonds.
- A corporate treasurer who wishes to lock in a borrowing rate can go short the T-bond future. (If yields go up, there will be a loss associated with increased borrowing expense and a gain on the T-bond contract.)
Swaps (Section 23.4)

- **Swaps**
  - “Swaps are contracts that exchange assets, liabilities, currencies, securities, equity participations and commodities” (Investopedia).
  - “Swaps are multiperiod extensions of forward contracts.” (BKM)
- Most swaps are defined by periodic settlement in which one side pays a predetermined (fixed) amount in exchange for variable market-driven amount.
- Used to restructure existing investments and obligations without trading or renegotiating the investment/obligation.
An interest rate swap

- The settlement payments represent the interest payment on a hypothetical loan.
- The size of the loan is the *notional* value of the swap.
- One side of the contract (the *payer*) typically agrees to pay a fixed interest rate to the other side (the *receiver*).
- The receiver makes a floating payment to the (fixed) payer.

Example: A agrees to pay fixed and receive floating from B

- Suppose that the notional amount is $100M and the fixed rate is 3%.
  - At the end of each quarter, A owes B
    \[ 100 \text{ Million} \times \frac{3}{4} = 0.75 \text{ Million (}$750,000) \]
- The floating payment is usually pegged to LIBOR as of the beginning of the quarter.
- The swap agreement calls for B to pay (floating) LIBOR. Suppose that at the beginning of the quarter LIBOR=2%.
  - At the end of the quarter, B owes A \[ 100M \times \frac{2}{4} = 0.5M \]
  - A makes a net payment to B of $0.25M.
Some important points

- The notional amount of the loan is never transferred or otherwise realized.
  - It is simply a number used for computation.
- The net payment (which can go in either direction) is usually small relative to each of the offsetting payments.
  - In the example, $0.25M < $0.5M < $0.75M

What need do interest rate swaps fill?

- Swaps enable borrowers and investors to easily restructure debt.
- Example
  - Suppose that a firm borrowed money by issuing fixed-rate non-callable bonds.
  - The firm wants to restructure the debt so as to pay a floating interest rate.
  - To exchange the actual borrowings, the firm would have to repurchase the fixed-rate bonds and issue floating-rate bonds.
  - It can effectively accomplish the same thing by entering into a swap.
  - In the swap, the firm agrees to receive fixed (and pay floating).
When someone initiates a swap, who takes the other side?

- How do $A$ and $B$ find each other?
- $A$ negotiates the swap with a dealer (a bank), an intermediary.
  - The dealer agrees to receive fixed and pay floating.
- But the dealer will quickly try to locate someone else (like $B$) who wants to receive fixed and pay floating.
  - The dealer will try to negotiate a swap with them.

The size of the swaps market

- As of June 2012, the total notional value of all swaps is about $693T$ (Trillion).
- In 2012, the world GDP was about $70T$.
  - “Oh no. It would take everyone in the world working for almost ten years to pay off all of those swaps.”
Remember ...

- The notational amounts are not obligations.
- The net cash flows on the swaps are a small fraction of the notional value.
- The notional totals don't take into account the netting of offsetting trades.

Netting of offsetting trades

- Consider two trades in a futures market
  - A goes long one contract against B.
  - A goes short one contract against B
  - A and B are flat; the open interest is zero.
- Consider two trades in the interest rate swap market.
  - A agrees to pay fixed on $100M to B (who pays floating to A)
  - B agrees to pay fixed on $100M to A (who pays floating)
  - The total notional outstanding is $200M
  - In the swaps market, every trade increases the total notional.
From the Bank for International Settlements (June 2013)

- Total notional value of swaps: $693T
- Total gross market value of replacing all existing swaps at current market prices: $20T
- Total credit exposure (gross market values after legally enforceable bilateral netting): $3.9T
  - [http://www.bis.org/publ/otc_hy1311.pdf](http://www.bis.org/publ/otc_hy1311.pdf)
- Conclusion: the total amount of money at risk is large, but not crushing.

The London Interbank Offered Rate (LIBOR)

- Bank A wants to borrow money from another bank. The rate that it is quoted for the loan is the offered (“asked”) rate.
  - LIBOR is an average of the these rates for large banks.
- Historically (and still currently) administered by the British Banker’s Association (BBA)
  - The BBA takes a telephone poll of dealers and reports a trimmed mean.
The problems

- If the bank is perceived as being in trouble, lenders will charge a high rate.
  - If bank $A$ reports a high rate, it will be construed negatively (weakening the bank financially and politically)
  - Bank $A$ might try to report a rate lower than it’s really seeing.
- Some of the bank’s income (on net loans, net swaps, etc.) is tied to LIBOR.
  - Bank $A$ might try to push the rate up or down (depending on its net position)
- Bank $A$ will be more successful in pushing LIBOR up or down if it can negotiate (collude) with other submitting banks.
- This was illegal. In April, 2015, Deutsche Bank had to pay a $2.5 Billion fine, and fired seven traders.