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Financialization of Commodity Markets
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The Risks of Over-the-Counter Commodity Derivative Products

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Risks of OTC Commodity Derivatives

- Overview of OTC commodity derivative markets
- Similarities with other derivatives
  - Market risk
  - Counterparty credit risk
- Differences from other derivatives
  - Basis risks
  - Physical characteristics of underlying commodity
  - Behavior of underlying commodity price
- Characteristics of non-commercial market participants

What are derivatives?

- Derivatives are financial instruments that:
  - Transfer risk from one party to another
  - Derive their value from that of an underlying variable such as an interest rate, share or commodity price, index, or bond
- Three forms of derivatives activity
  - Futures (listed derivatives) are highly standardized exchange-traded agreements
  - Cleared derivatives, which are standard contracts that are privately negotiated but booked with a clearinghouse as a counterparty
  - Over-the-counter (OTC) derivatives, the terms of which are privately-negotiated and booked directly between two counterparties
- OTC derivatives business model
  - Manage risk through risk decomposition and hedging
  - OTC derivatives are typically transacted under a single, standard contract such as the ISDA Master Agreement

Overview of commodity markets

Financial markets vary by time and location

- The *money market* involves short-term borrowing and lending (periods of one year of less)
- The *currency market* connects money markets across national boundaries
- The *capital markets* involve medium- and long-term financing (periods of greater than one year)
  - Bond markets
  - Equity markets
- Financial derivatives transfer risk within and across these markets

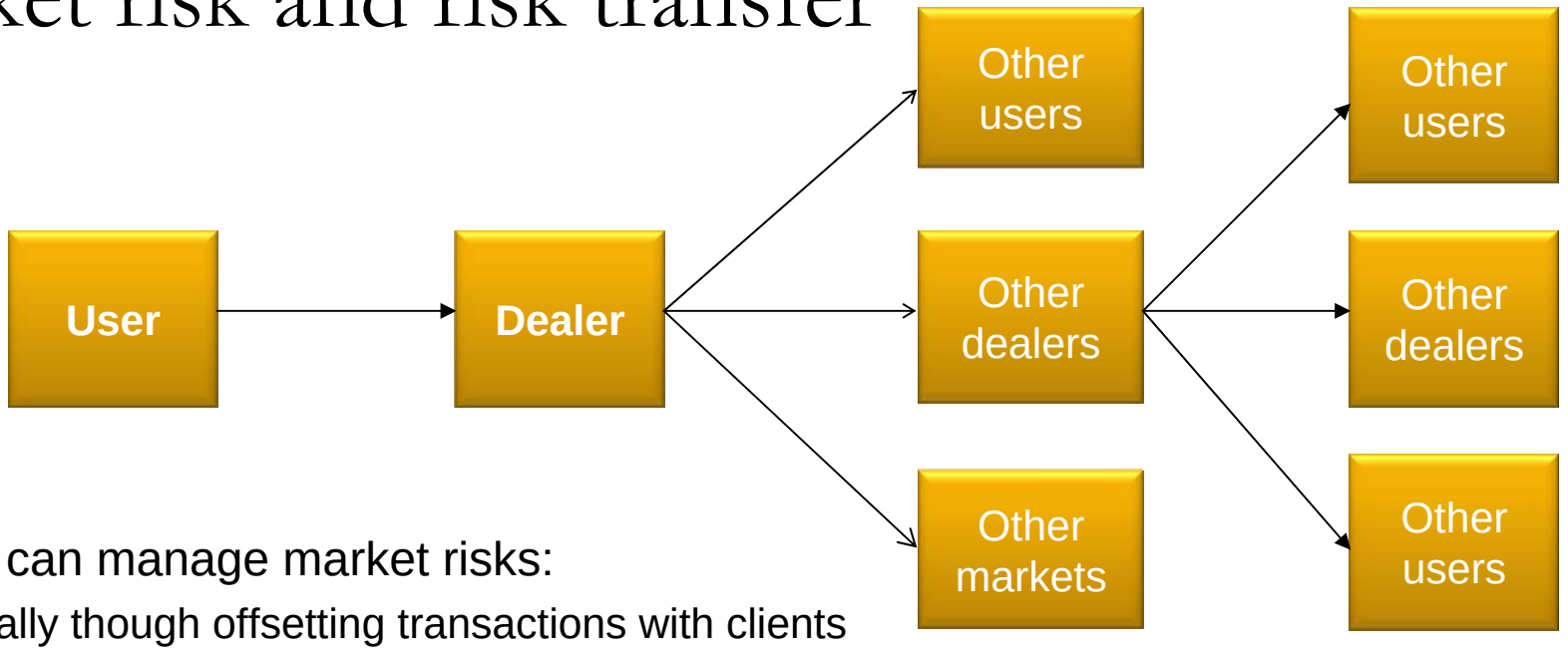
Commodity markets vary by product

- Metals
  - Precious (gold, silver, platinum)
  - Base (copper, nickel, aluminum)
- Energy
  - Petroleum products
  - Natural gas
  - Electricity
- Transportation/freight
- Others
  - Softs (coffee, cocoa, sugar)
  - Grains, oilseeds, and livestock
- Developing (weather, emissions)

Commodity derivatives market participants

- Commercial risk managers (Hedgers)
  - Commodity producers – Miners, upstream oil
  - Intermediaries – Refiners, traders, utilities
  - Consumers – Transportation fuel, building trade, jewelry
- Non-commercials (speculators)
  - Global macro hedge funds
  - Commodity trading advisors (often system trading)
  - Large pension and other index-tracking funds
  - Capital-guaranteed investment products
- Dealers
  - International and regional banking institutions
  - Energy trading companies
    - Non-regulated entities owned by utilities
    - Other physical traders (mostly owned by refiners and transporters)

Market risk and risk transfer



- Dealers can manage market risks:
  - Internally though offsetting transactions with clients
  - Externally though offsetting transactions with other dealers
- Dealers can manage their risks through offsetting transactions in futures markets and in the underlying commodity and money markets
  - Liquid markets are those in which participants can easily pass on their risks with little of no effect on the market
  - The existence of both hedgers and speculators is necessary to ensure liquidity
  - The ability of dealers to manage market risk depends on contractual performance by their counterparties

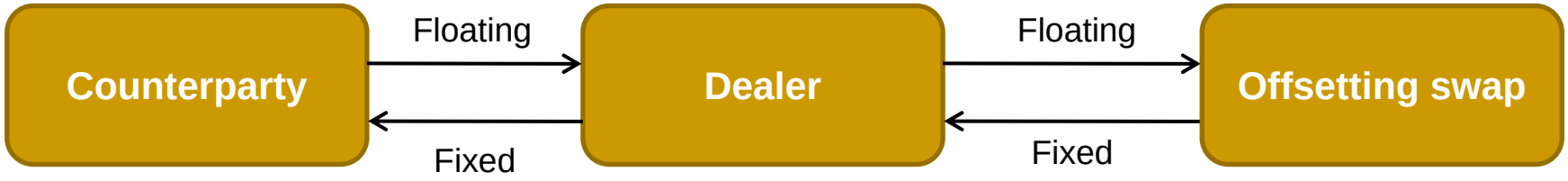
How dealers hedge market risks

- Dealer agrees to a swap with Counterparty in which it pays a floating Brent crude oil price and receives fixed
- Dealer exposed to rising crude oil prices

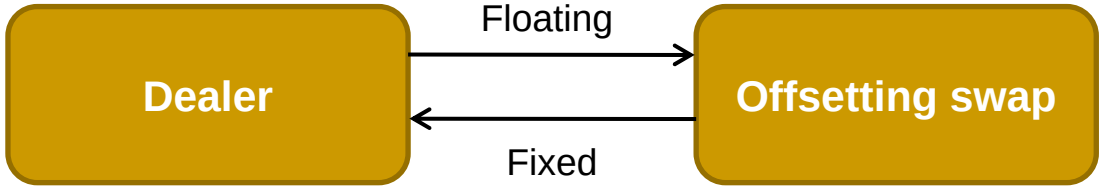
- Problem: Dealer does not wish to retain risk of rising crude oil prices
- Hedge strategy can consist of:
  - Buy underlying
  - Buy futures
  - Offsetting swap
  - Leave position open

The source of counterparty credit risk

Before counterparty defaults::



After counterparty defaults:



- Replacement cost concept assumes dealer runs a *balanced book*, i.e., that exposure is either hedged or matched by an offsetting exposure
- If counterparty defaults, dealer has an (unwanted) open market risk position, so dealer must:
  - Replace defaulted transaction at current market value (including bid-offer), or
  - Unwind hedge at current market value (including bid-offer spread)
- After replacement or unwind, dealer pursues recovery from defaulted counterparty
- Even if each exposure is not explicitly hedged by another, dealer will have to offset net open positions to bring portfolio back into balance

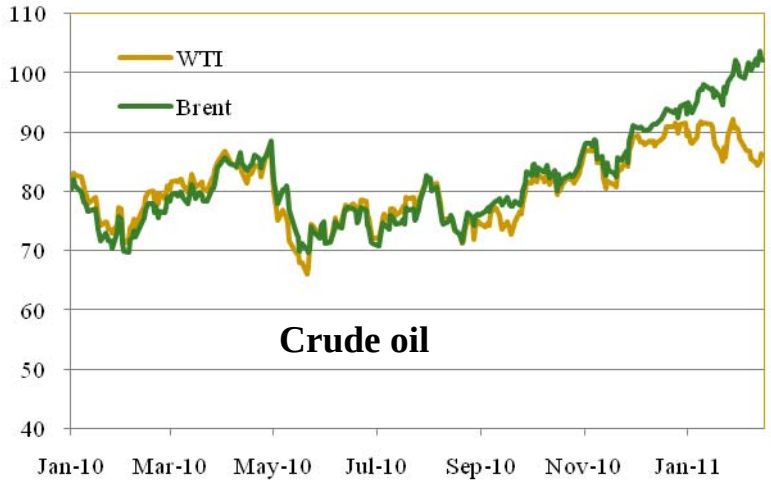
Counterparty risk mitigation

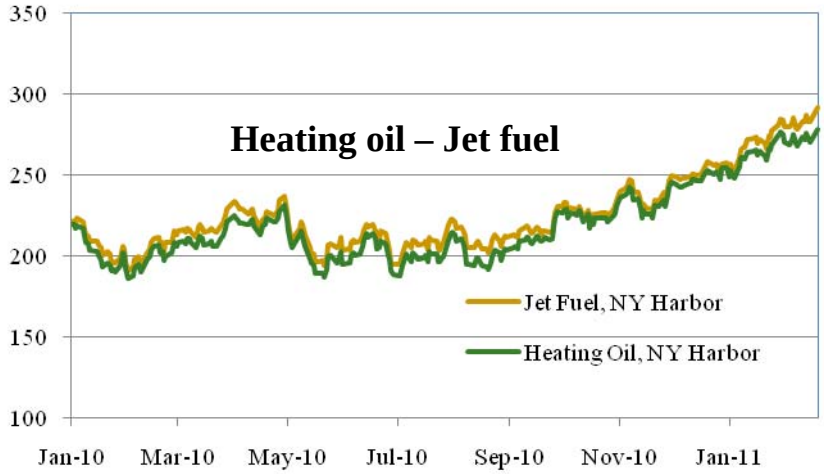
- Netting
  - *Payment netting* reduces payments due on the same date and in the same currency to a single net payment
  - *Close-out netting* following counterparty default
- Collateralization
  - Traditionally has been subject to negotiation between contracting parties
  - Extent of collateralization
    - 64% of commodity derivatives covered by collateral agreement
    - Hedge fund exposures “super-collateralized” but about 50% of corporate exposures covered by collateral
- Clearing
  - Parties execute deal bilaterally but then transfer to clearing house, which becomes central counterparty
  - Does not eliminate risk, but secures it with collateral
  - Interdealer commodity derivatives largely cleared since Lehman failure

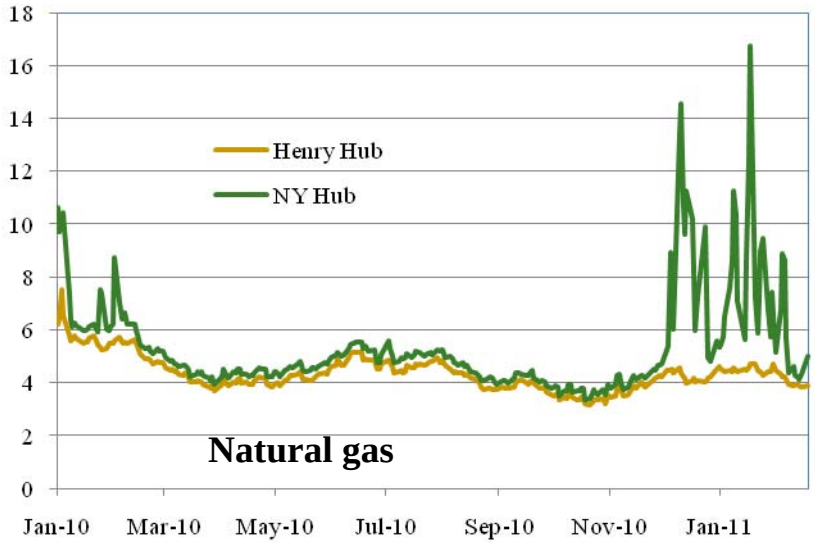
Basis risk

- Definition: The uncertainty that results from changes in the relationship between two or more prices
  - Most often, it means hedge and underlying price change differently
- Examples of basis risk
  - Spot and forward (or futures) prices change differently
  - Prices of different delivery dates change in different directions or by different amounts (*curve risk*)
  - Economically similar transactions are documented differently so different provisions (e.g., termination of agreements and valuation of terminated transactions) can produce different economic results on close-out (*documentation basis risk*)
  - Commodity markets – Mismatch between hedge and underlying:
    - Quality, grade, or size (product basis)
    - Location of delivery of underlying (locational basis)
    - Volumetric risk arises from mismatch between hedged volume and actual volume purchased or sold
  - Hedger often willing to accept basis risk in return for liquidity
    - E.g., airline might hedge jet fuel exposure with swap on heating oil because heating oil market more liquid than jet fuel market

Basis risk examples





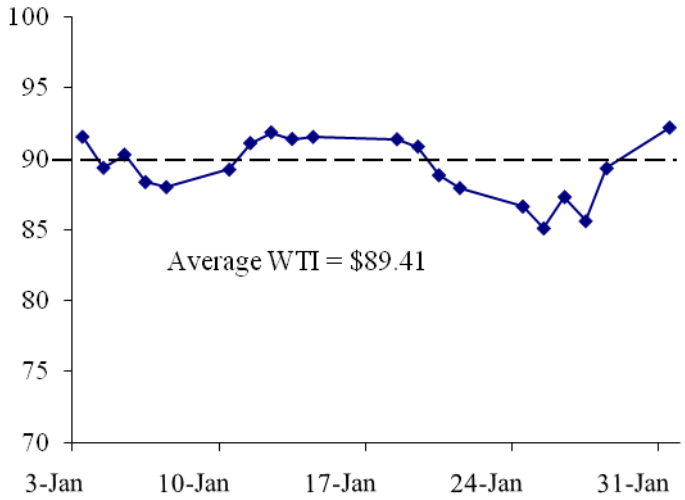


Result of hedging with swap

- Refiner and Dealer enter into a 12-month commodity price swap:
  - Notional Quantity = 25,000 barrels per month (*ratable* volume)
  - Fixed price = US$90 per barrel
  - Floating price = Average West Texas Intermediate (WTI) price for previous month
- Obligations under swap:
  - Refiner agrees to pay Dealer a fixed price of $90/bbl per month on an agreed-upon notional amount of 25,000 barrels per month.
  - Dealer agrees to pay Refiner the average monthly Nymex WTI settlement price of crude oil on the same underlying amount
- Client assumes *basis risk*
  - Changes in reference price index (here, WTI) might not match actual expenditures
  - Actual purchases might not occur evenly over the month, so average price paid over a month might differ from average WTI price
  - Actual price paid might not be the same as WTI index
- In following example, assume client pays WTI price for crude oil

Basis risk illustrated

WTI prices for January 2011



Refiner made following crude oil purchases during January 2011

Date	Price paid	Quantity	Expenditure
5-Jan	90.3	5,000	$451,500
12-Jan	91.86	5,000	459,300
25-Jan	85.14	10,000	851,400
27-Jan	85.64	5,000	428,200
	Total	25,000	$ 2,190,400

- Fixed price = $90.00
- January 2011 average WTI crude oil benchmark price was $89.41/bbl
- Cost of crude oil purchased during January 2011 (lower left) was $2,190,400 (or average price of $87.62/bbl)
- Swap cash flows:

  Fixed: 25,000 * $90.00 = ($2,250,000)

  Floating: 25,000 * $89.41 =$2,235,250

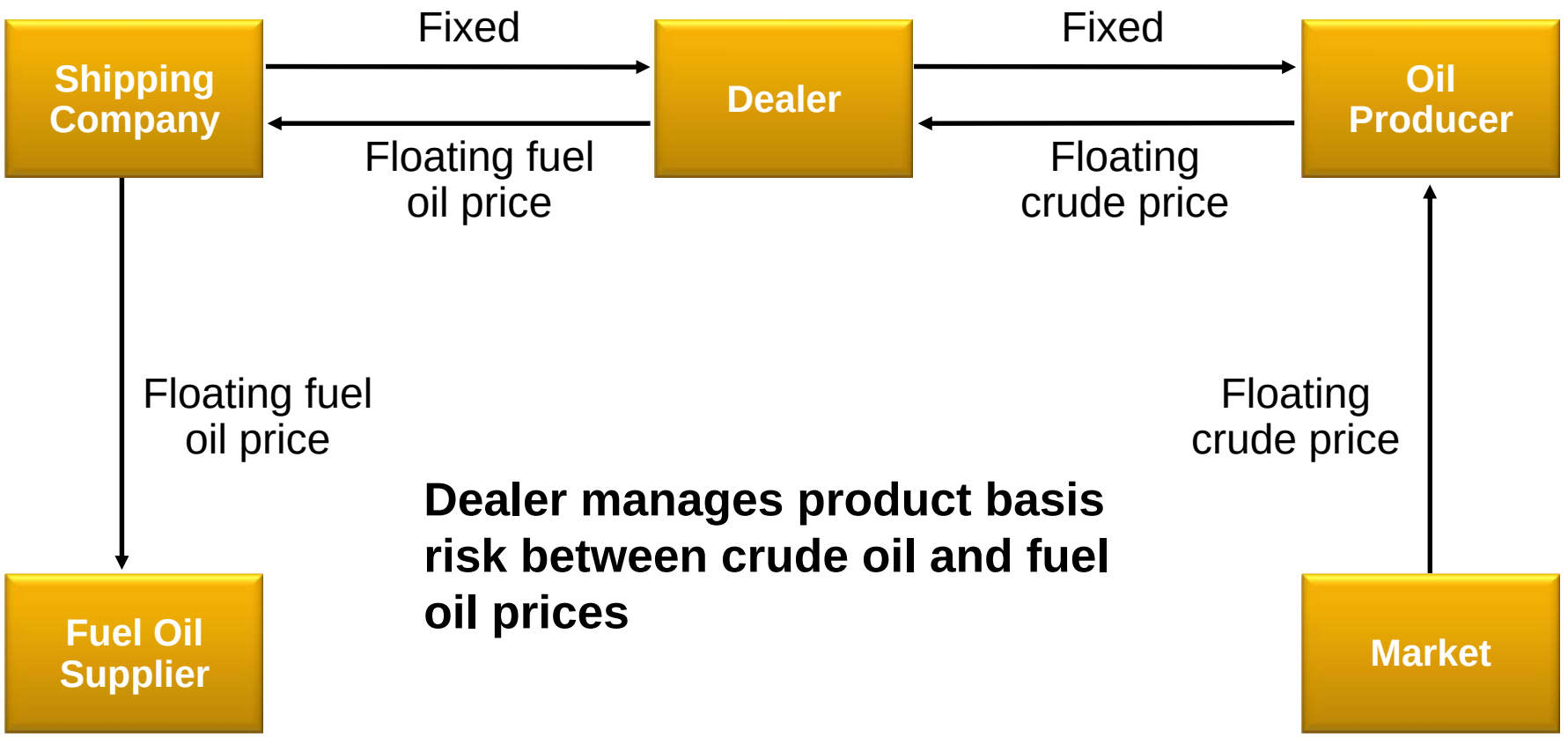
  Net = ($14,750), Refiner pays Dealer (1 February settlement)
- Adding expenditures and swap cash flow gives a total of $2,205,150 for an effective average price paid of **$88.21/bbl**

Commodity price benchmarks

- Precious metals
  - London Gold and Silver Fixings (London Bullion Markets Assn)
- Base metals
  - London Metals Exchange (LME)
  - NY Mercantile Exchange (NYMEX)
- Shipping
  - Baltic Dry Index
  - Platt's
- Electricity
  - DJ COB
  - PJM
  - UK Power Exchange
- Crude oil
  - West Texas Intermediate (WTI)
  - Brent (North Sea)
- Natural gas
  - Henry Hub (US)
  - NBP (UK)
  - Zeebrugge Hub (Europe)
- RBOB gasoline (NYMEX)
- Composite commodity indices
  - S&P-Goldman Sachs Commodity Index (GSCI)
  - Dow Jones-UBS Commodity Index (formerly DJ-AIGCI)

Basis risk exists to the extent that actual prices paid diverge from commodity price benchmarks

Role of the dealer in commodity swaps



Factors affecting commodity prices

- Storage costs (along with financing costs and spot prices)
  - Physical storage
  - Transportation
  - Insurance
  - Waste or loss
- Physical attributes of commodities
  - Storable (e.g., oil)
  - Non-storable (e.g., electricity), must be consumed immediately
- Other factors
  - Bid-offer spreads
  - Restrictions on short selling or other underlying market transactions
- Market structure
  - Regulation
  - Physical constraints on movement (e.g., natural gas, electricity)
  - Industrial user demand for commodities
- Price behavior
  - Mean reversion
  - Seasonality
- Basis (difference between spot and forward prices) converges to zero as contract approaches maturity, other things equal

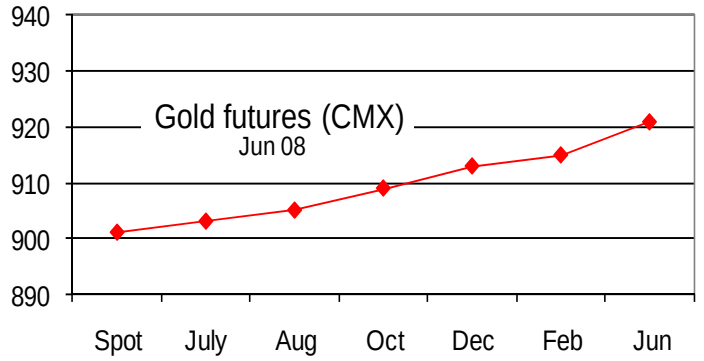
Forward rates for storable commodities

- Costs of holding a commodity
  - Financing (R)
  - Physical storage (C_S)
- Introducing *convenience yield* (Y_C)
  - Inventory value; i.e., benefit of holding a commodity instead of derivative
  - Analogous to lease rates, dividends, and foreign currency interest rates
- Relationship between forward and spot price:

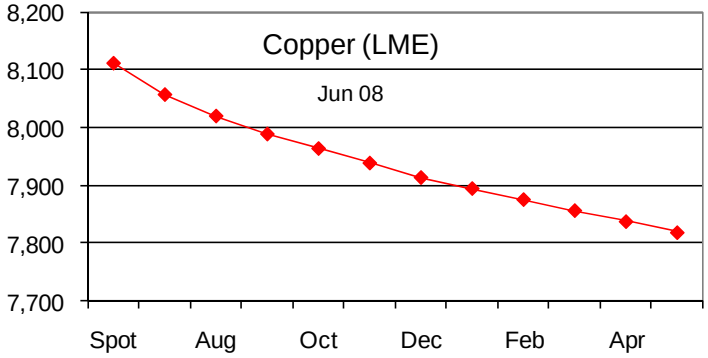
  $FWD = SPOT \times (1 + R + C_S - Y_C)$

  - *Contango:* If $Y_C = 0$, FWD > SPOT
    - More accurately, if $Y_C < (R + C_S)$
  - *Backwardation*: If $Y_C > (R + C_S)$, then FWD < SPOT

Market in contango



Backwardated market



Contango and backwardation

- Contango
  - If forward price is significantly greater than spot price, cash and carry arbitrage will bring them back into line
  - Forward price generally does not exceed spot price plus carry costs
  - But, limits on short selling might cause price to stay below arbitrage price
- Backwardation
  - Typically found in markets where storage is difficult (high inventory costs) so users consume quantities immediately (oil, copper, hogs)
  - Low inventory levels lead to high price volatility
  - Producers are price sensitive (low inventories mean that prices bear brunt of supply shortages or gluts)

Convenience yield is “the flow of services and benefits that accrues to the owner of a physical commodity but not to the owner of a contract for future delivery of a commodity This can come in the form of having a secure supply of raw materials and hence, eliminating the costs associated with stock-outs.” (*Risk* 2006)

Pricing challenges in commodity markets

- Electricity
  - Electricity is a non-storable commodity, so cost of carry model cannot be used to determine forward prices
    - Arbitrage across time through storage not possible
    - Borrowing electricity for shorting not possible
    - Extreme volatility of spot prices because inventories not available to smooth price fluctuations resulting from sudden changes in demand (e.g., outages)
    - High seasonality (e.g., summer spikes) and intraday fluctuation (peak hours)
  - Most pricing occurs through basis or correlation with other traded products (especially natural gas)
- Weather
  - Weather is not a tradable commodity
  - Payoff on a weather derivative is not based on an underlying price, but on an underlying series of weather events
  - Most price discovery occurs through futures markets

Non-commercial market participants

- Speculators tend to focus on single dates instead of average periods
- They are more frequently based around futures for price transparency and valuation
- They make extensive use of electronic trading platforms
- They are more familiar with exotic derivatives
- It is unusual for them to want physical delivery
- Often commodities are included with other asset classes
- The derivatives are often embedded in other financial instruments

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