VL10: ETFs and Futures

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Trading Places - Eddie Murphy
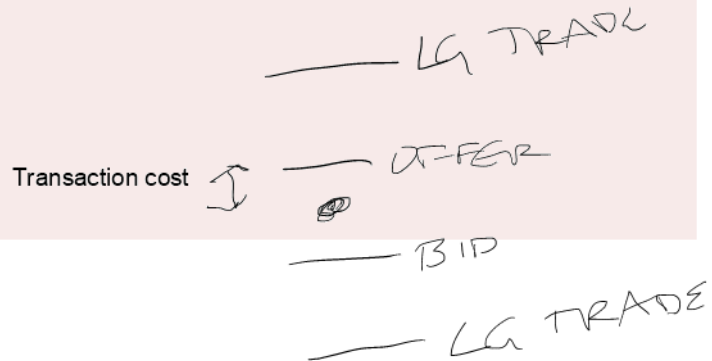
FRE 6103
Valuation for Financial Engineers

Outline

- Equity portfolio trading problems
- ETFs and equity portfolios
- Uses of S&P 500 futures contracts
  - S&P 500 is the widest followed equity index in the U.S.
- Pricing of futures and the GVE
- Implied dividends from equity index futures prices
- Arbitrage pricing bounds
- Simulating risk in futures and forwards

Some equity strategies…

Strategy	Challenge
A An investor holds no stocks currently but wants to speculate on the stock market as a whole rising or falling	Transaction cost - Commissions + Bid/Offer The costs of buying or selling all the stocks in the market quickly is prohibitively high, and good execution is unlikely
B A well-diversified equity investor owns a lot of stock now, but is concerned about the direction of the market in the short term due to trade wars. They want to own stocks in the long term but don't want to own them now	If they sold now and re-bought the stocks, this would be double the transaction costs! — LG TRADE Transaction cost — OFFER — BID — LG TRADE

SPDR® ETFs (courtesy State Street)

Special purpose depositary receipt

SPDR® Product Lineup

ETF Listing — March 31, 2020

Low-Cost Core

Ticker		Fund Name	Net Expense Ratio (%)
US Equities			
SPTM	•	SPDR Portfolio S&P 1500® Composite Stock Market	0.03
SPLG	•	SPDR Portfolio S&P 500®	0.03
SPMD		SPDR Portfolio S&P 400® Mid Cap	0.05
SPSM		SPDR Portfolio S&P 600® Small Cap	0.05
SPYG	•	SPDR Portfolio S&P 500 Growth	0.04
SPYV		SPDR Portfolio S&P 500 Value	0.04
SPYD		SPDR Portfolio S&P 500 High Dividend	0.07
International Equities			
SPGM		SPDR Portfolio MSCI Global Stock Market	0.09
SPDW	•	SPDR Portfolio Developed World ex-US	0.04
SPEU	•	SPDR Portfolio Europe	0.09
SPEM	•	SPDR Portfolio Emerging Markets	0.11
Fixed Income			
SPAB		SPDR Portfolio Aggregate Bond	0.04
SPSB		SPDR Portfolio Short Term Corporate Bond	0.07
SPIB		SPDR Portfolio Intermediate Term Corporate Bond	0.07
SPLB		SPDR Portfolio Long Term Corporate Bond	0.07
SPBO		SPDR Portfolio Corporate Bond	0.06
SPTS		SPDR Portfolio Short Term Treasury	0.06
SPTI		SPDR Portfolio Intermediate Term Treasury	0.06
SPTL		SPDR Portfolio Long Term Treasury	0.06
SPMB	▪	SPDR Portfolio Mortgage Backed Bond	0.06
SPHY		SPDR Portfolio High Yield Bond	0.15
SPIP		SPDR Portfolio TIPS	0.12

US Equities

Ticker		Fund Name	Net Expense Ratio (%)
Core			
SPTM	•	SPDR Portfolio S&P 1500 Composite Stock Market	0.03
SPLG	•	SPDR Portfolio S&P 500	0.03
SPMD		SPDR Portfolio S&P 400 Mid Cap	0.05
SPSM		SPDR Portfolio S&P 600 Small Cap	0.05
SPY	•	SPDR S&P 500	0.0945
MDY	•	SPDR S&P MidCap 400®	0.23
SLY	▪	SPDR S&P 600 Small Cap	0.05
DIA	•	SPDR Dow Jones® Industrial Average	0.16
SYE	▲	SPDR MFS Systematic Core Equity	0.60
Style			
SPYG	•	SPDR Portfolio S&P 500 Growth	0.04
SPYV	•	SPDR Portfolio S&P 500 Value	0.04
MDYG		SPDR S&P 400 Mid Cap Growth	0.15
MDYV		SPDR S&P 400 Mid Cap Value	0.15
SLYG		SPDR S&P 600 Small Cap Growth	0.15
SLYV		SPDR S&P 600 Small Cap Value	0.15
SYG	▲	SPDR MFS Systematic Growth Equity	0.60
SYV	▲	SPDR MFS Systematic Value Equity	0.60
Sector			
XLC	•	Communication Services Select Sector SPDR	0.13
XLP	•	Consumer Staples Select Sector SPDR	0.13
XLY	•	Consumer Discretionary Select Sector SPDR	0.13
XLE	•	Energy Select Sector SPDR	0.13
XLF	•	Financial Select Sector SPDR	0.13

< 10 bppa

- An ETF is a *trust* which holds a portfolio of securities
  - Abbr: Exchange Traded Fund
  - Passively managed (or rule-based)
- A *trust* is a simple form of a corporation
- Investors purchase shares in the trust for cash & receive dividends
- Instead of purchasing 500 stocks individually, they can own the entire index with one transaction
- ETFs can also be sold short
- ETFs charge relatively small fees

https://www.ssga.com/library-content/products/fund-docs/etfs/us/information-schedules/spdr-etf-listing.pdf

Mutual Funds vs ETFs

ETF

- Passively managed
  mechanical

- Able to short   trade like a stock
  (and no uptick tule)

- Low fees

- Trade continuously

Mutual Fund

- Most are actively managed
  seeking alpha

- No ability to short
  own or not own

- Most have higher fees

- Trade only at end of day
  NAV = net asset value

ETFs trade like individual stocks…

Bid-offer spread is $0.02/303.30
--> Liquid market

SPY SPDR S&P 500 ETF TRUST

$303.30 -8.75 (-2.80%)   Bid x Size **$303.28** x 500   Ask x Size **$303.30** x 600

Real-time quote: Jun 24, 2020, 12:09 PM ET

Snapshot Charts News Options Performance Tax & Income Risk & Ratings Portfolio Historical Quote

Morningstar on SPY Fund Report Prospectus
Last Reported 6/24/20

Largest ETF

Open	309.84	Market Cap	266.9 B	
Previous Close	312.05	Shares Outstanding	880.0 M	
Volume	56,342,662	Yield Dividend yield	1.83%	
Avg Volume (10 days)	121,446,777	SEC 30 Day Yield	1.99%	
Day Range	302.10 – 310.51	Quarterly Dividend No interest	1.3662	
52 – Week Range	218.26 – 339.08	Ex-Dividend Date	6/19/20	
	3/23/20 – 2/19/20	Dividend Payable Date	7/31/20	

1D 5D 3M 1Y 3Y 5Y

Advanced Chart

The SPY ETF over time tracks the market
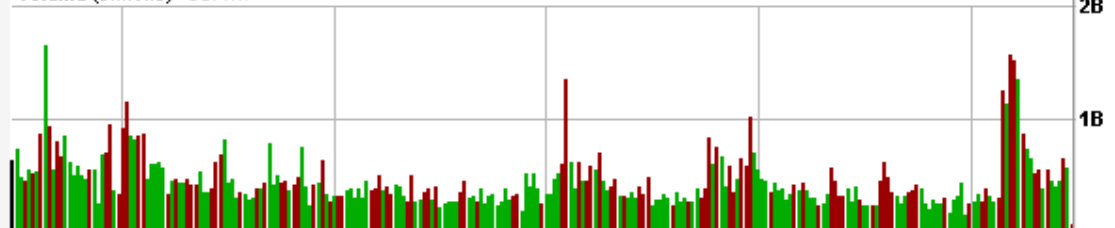
What are the ETF solutions?

Strategy	Solution
A An investor holds no stocks currently but wants to speculate on the stock market as a whole rising or falling	Rising: BUY SPY ETF Falling: Sell or go short SPY ETFs
B A well-diversified equity investor owns a lot of stock now, but is concerned about the direction of the market in the short term due to trade wars. They want to own stocks in the long term but don't want to own them now Hedging portfolio risk (S&P 500)	Hold the equity portfolio Sell short ETFs (SPY) * Wait a while * Repurchase SPY (we kept our equities and their dividends)

Which is better?

Feature\Product	Stocks	ETFs
Flexibility	highest flex	flexibility in choice, not composition
Diversification	tend to be less diversified	highly diversified
Funding requirement	cash	cash
Dividends	yes	yes, up to 3 month delay
Bid-offer spreads	can be high	almost always low
Commissions	tend to be higher	lower
Ongoing fees	none	small (< 10 bppa)
Transparency	perfect	almost perfect
P/L realization*	on sale or on closing short	same

*P/L = profit or loss

Can futures contracts also be used to take equity risk?

The largest ~~commodity~~ (futures) exchanges now

- Chicago Mercantile Exchange *(CME)* Group
- Inter Continental Exchange *(ICE)* Group
- London International Financial Futures & Options Exchange *(LIFFE)*
- London Metal Exchange *(LME)*
- Multi Commodity Exchange *(MCX)* of India
- Tokyo Commodity Exchange *(TOCOM)*
- Sydney Futures Exchange *(SFE)*
- Dubai Gold and Commodities Exchange *(DGCX)*
- Bursa Malaysia Berhad
- Singapore Commodity Exchange
- Shanghai Futures Exchange

Dalian Futures Exchange

CME Group Contracts

Interest rate	Equity	Energy	FX
Eurodollars	E-mini S&P 500	Crude Oil (WTI)	EUR/USD
10-Year Treasury Note	E-mini NASDAQ-100	Natural Gas	JPY/USD
5-Year Treasury Note	E-mini Dow $5	RBOB Gasoline	GBP/USD
2-Year Treasury Note	E-mini Russell 2000	NY Harbor ULSD	AUD/USD
30 Day Federal Funds	Nikkei 225 (YEN)	Crude Oil (Brent)	CAD/USD
Ultra T-Bond	E-mini S&P MidCap 400		MXN/USD
Ultra 10-Year	Nikkei 225 (USD)		
SOFR Futures	S&P 500		CHF/USD
MAC Swap Futures	E-mini S&P Select Sector Futures		

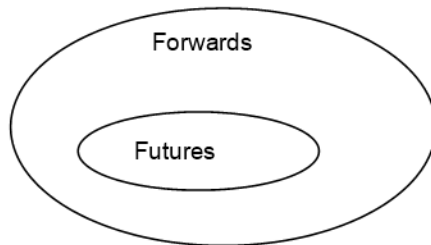| Agricultural	Metals	International
Corn	Gold	Oman Crude Oil (Futures)
Soybeans	Copper	Dubai Crude Oil (Platts) (Futures)
Chicago SRW Wheat	Silver	Hard Red Spring Wheat (Futures)
Soybean Meal		KOSPI 200 Index (Futures)
Soybean Oil	Platinum	USD/KRW FX (Futures)
Live Cattle	Palladium	Crude Palm Oil (Futures)
Lean Hogs		FTSE Kuala Lumpur Index (Futures)
KC HRW Wheat		

What is a futures contract?

not a security

Forward contract - Any contract for a future transaction when the terms are specified today.

assignable

A standardized and tradable contract…
that commits the buyer (long) and the seller (short)
to a purchase and sale on a future date
with terms specified today.

If you think oil will rise....
Buy oil?
Costs: Capital (interest), transport, storage, insurance, compliance, evaporation
Long oil futures?
Oil prices up implies I make money
I can close position before Dec 21

NOTE: I NEVER TOUCHED A DROP OF OIL. I HAD NO EXPENSES.

Forwards

Futures

Example:
Oil futures

API gravity, Sulfur content

1000 barrels
Light Sweet

West Texas Intermediate Crude Oil   WTI

Delivered in Cushing Oklahoma

Physical settlement:
Make delivery (short), Take delivery (long)

On Dec 21, 2020

At $41 per barrel   only negotiable item

Spot market:
Buyer and seller

Futures:
Long and short

Or
S&P 500

Delivery: Cash-settled (final profit or loss determines settlement, no delivery of shares)

Why do people trade S&P futures?

About S&P 500 Futures and Options

S&P 500 futures and options offer a capital-efficient means to manage exposure to the leading large –cap companies of the U.S. stock market. Based on the underlying Standard & Poor's 500 stock index, which is made up of 500 individual stocks representing the market capitalizations of large companies, the S&P 500 Index is a leading indicator of large-cap U.S. equities.

- Speculators *love futures!*
  - Go long if they think the market will rise, or go short when they expect the market to fall (like stock or ETFs)
  - Use very little capital. Only a small fraction of the position value is collected in collateral.
  - Low cost active trading allows traders to liquidate positions quickly and efficiently
- Hedgers

  Case B from earlier
  - Someone who owns stocks might temporarily short futures to hedge their portfolio risk
  - Profits on their stocks are offset by losses on the futures and vice-versa
- Market-makers (traders)
  - Seek to trade frequently, collecting short-term profits, arbitrage benefits and fees

How do futures work on a daily basis?

June   Se   13   Dec
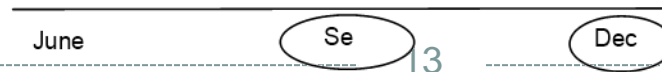
- On 6/24/20, the Sep 2020 CME S&P 500 futures contract traded at 3118

- There are similar _futures_ contracts with longer *maturities*

- If you take a *long position* in S&P futures, then you will profit if the S&P rises
  - Your profit is $250 per $1 rise in the S&P 500 futures price   Like 250 shares of S&P

- If you take a *short position*, you will profit if the S&P falls

- The S&P futures price *tracks* the index closely   even better than S&P index! (some index stocks do not trade actively)

- To enter a futures position, you must place *collateral* with your broker, but you do not need to pay for the value of the stocks. Minimum collateral is about 2% of position value.   Institutional traders may use bonds or other collateral instead of cash. (Prime Broker)

- Your profit/loss is immediately received or paid at the end of every trading day into or from your *margin account.*

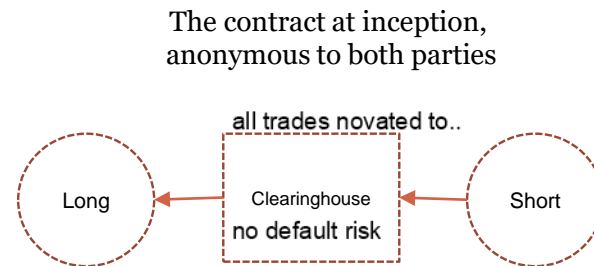- When you want to close the trade, you take an *offsetting position*

Close long --> Go short.   Close short --> Go long.

Futures Structure

- Standardized public exchange-traded contract
- Agreement to buy or sell something in the future at a price determined today
  - Some contracts are *cash-settled,* not delivered
- Expected **not** to deliver   Delivery important as a THREAT.
  - Only delivers 2-3% of the time
- *Central counterparty* minimizes default risk
  - The central counterparty in futures is called the *clearinghouse*
  - The clearinghouse is the "long to every short and the short to every long"
  - Changes in value of position are immediately received or paid
  - Daily margining increases the security of the clearinghouse

The contract at inception, anonymous to both parties

all trades novated to..

Long ← Clearinghouse no default risk ← Short

Long 1 offsets, "books out" or reverses the trade by shorting the same contract prior to expiration

Long 1 — Clearinghouse — Short 1 — Long 2

If you have a loss, and insufficient funds, you have 24 hours to make margin payment.
If you fail to pay, your transaction wil be TERMINATED. (Determine final price, close position, will try to recover losses)
Brokerage may be responsible for those losses. If the brokerage cannot pay, then exchange owners (banks & fin inst) will pay
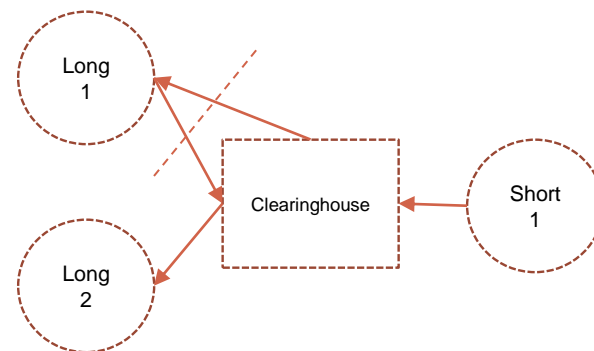
Recap technical terms

Term	Definition
Future/futures	"One futures contract" not "one future contract"
Maturity	Last trading day of contract : Must make delivery, take delivery or cash settle (if it is a cash settled contract)
Long vs buy	Long = agree to buy in future
Short vs sell	Short = agree to sell in future
Index tracking	How well do futures mimic the index performance?
Collateral	Deposit - 2-3%
Margin account	Bank account, held at clearinghouse (C/H)
Offsetting position	If long, go short. If short, go long.
(Central) counterparty	Single counterparty to all.
Clearinghouse	Central counterparty for futures.
Delivery/Cash settlement	Specified term of the contract regarding end of contract trading.

Futures simulation

see Derivatives Debacles for
examples of failed institutions

S&P Weekly Futures Price During COVID
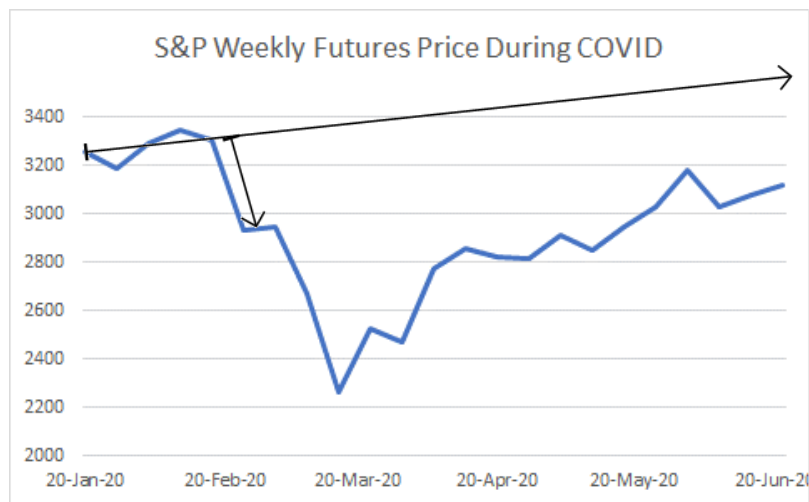
Total losses if position closed 6/22/20	33425
Divided by 250	133.7
Initial futures price	3254.2
Closing futures price	3120.5
Change in contract price	-133.7

Total long P/L =
(Closing futs price – Initial futs price) × 250

Margin Account - Long 1 S&P 500 Futures Contract on Jan 20, 2020

Price at inception	3254.2
First day	-69.7
in Dollars	-17425

Position value = 3254.2 x 250 = $800K
Margin is 2%, or $16,271.

50x leverage

Mark-to-market   (2% of posn)

Date	June 2020 Futures	P/L	Account	Min	Deposit
20-Jan-20	3254.2	0	16,271	16,271	(16,271)
27-Jan-20	3184.5	-17,425	-1,154	15,923	17,077 *
3-Feb-20	3288.1	25,900	41,823	16,441	0
10-Feb-20	3341.6	13,375	55,198	16,708	0
17-Feb-20	3300.8	-10,200	44,997	16,504	0
24-Feb-20	2932.4	-92,100	-47,103	14,662	61,765 *
2-Mar-20	2944.3	2,975	17,637	14,722	0
9-Mar-20	2665.7	-69,650	-52,013	13,329	65,342 *
16-Mar-20	2264.7	-100,250	-86,922	11,324	98,245 *
23-Mar-20	2523.1	64,600	75,924	12,616	0
30-Mar-20	2471	-13,025	62,899	12,355	0
6-Apr-20	2769.8	74,700	137,599	13,849	0
13-Apr-20	2853.8	21,000	158,599	14,269	0
20-Apr-20	2817.3	-9,125	149,474	14,087	0
27-Apr-20	2815.5	-450	149,024	14,078	0
4-May-20	2911.6	24,025	173,049	14,558	0
11-May-20	2850.3	-15,325	157,724	14,252	0
18-May-20	2941.5	22,800	180,524	14,708	0
25-May-20	3029.9	22,100	202,624	15,150	0
1-Jun-20	3179.4	37,375	239,999	15,897	0
8-Jun-20	3028.8	-37,650	202,349	15,144	0
15-Jun-20	3072.9	11,025	213,374	15,365	0
22-Jun-20	3120.5	11,900	225,274	15,603	0

* Margin calls

$259K

Pricing futures on the S&P 500

CME Group　　MARKETS　DATA　SERVICES　EDUCATION

First nearby futures →

Second nearby futures →

…and so on

MONTH	OPTIONS	CHARTS	LAST	CHANGE	PRIOR SETTLE	OPEN	HIGH	LOW	VOLUME	HI / LOW LIMIT	UPDATED
SEP 2020	OPT	.il	3106.30	-12.20	3118.50	3126.80	3126.80	3106.30	5	No Limit / 2901.00	08:37:40 CT 24 Jun 2020
DEC 2020	OPT	.il	-	-	3108.60	-	-	-	0	No Limit / 2891.00	08:30:00 CT 24 Jun 2020
MAR 2021	OPT	.il	-	-	3103.00	-	-	-	0	No Limit / 2885.50	08:30:00 CT 24 Jun 2020
JUN 2021	OPT	.il	-	-	3096.20	-	-	-	0	No Limit / 2878.50	08:30:00 CT 24 Jun 2020
SEP 2021	OPT	.il	-	-	3087.60	-	-	-	0	No Limit / 2870.00	08:30:00 CT 24 Jun 2020
DEC 2021	OPT	.il	-	-	3079.00	-	-	-	0	No Limit / 2861.50	08:30:00 CT 24 Jun 2020
MAR 2022	OPT	.il	-	-	3070.40	-	-	-	0	No Limit / 2853.00	08:30:00 CT 24 Jun 2020
JUN 2022	OPT	.il	-	-	3061.80	-	-	-	0	No Limit / 2844.50	08:30:00 CT 24 Jun 2020
DEC 2022	OPT	.il	-	-	3044.70	-	-	-	0	No Limit / 2827.00	08:37:40 CT 24 Jun 2020
DEC 2023	OPT	.il	-	-	3010.30	-	-	-	0	No Limit / 2793.00	08:30:00 CT 24 Jun 2020
DEC 2024	OPT	.il	-	-	2975.30	-	-	-	0	No Limit / 2758.00	08:30:00 CT 24 Jun 2020

Legend: OPT Options　.il Price Chart　　　　About This Report

What are the actual S&P futures prices?

S&P FUTURES by MATURITY DATE

Today   6/24/2020

	Years	Futures
Sep-20	0.27	3,118.50
Dec-20	0.52	3,108.60
Mar-21	0.77	3,103.00
Jun-21	1.02	3,096.20
Sep-21	1.27	3,087.60
Dec-21	1.52	3,079.00
Mar-22	1.77	3,070.40
Jun-22	2.02	3,061.80
Dec-22	2.52	3,044.70
Dec-23	3.52	3,010.30
Dec-24	4.52	2,975.30

from www.cmegroup.com

S&P 500 Futures on 6/24/20

$y = 3129.7e^{-0.011x}$

exponent = -1.1%x

Years to maturity
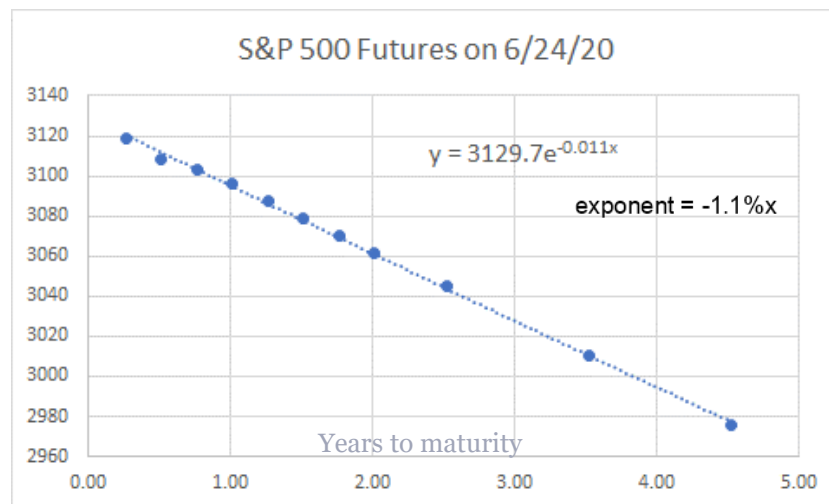
Does this mean I can buy the S&P in the future for less than the spot price?

Isn't this a bargain? Don't we expect the market to rise?

How should these contracts be priced?

Futures pricing intuition

- If I buy stock, the price reflects the risk and expected return of the stock in the future
- With a long futures position, I am committing to take that risk, so there is no risk adjustment
- Since I don't pay cash with futures, this is a benefit causing the futures price to exceed the stock price
- Since I don't receive dividends with futures, this is a deduction from the futures price

- Let r = risk-free interest rate (continuously compounded)
- Let δ = dividend payment rate on stocks (also continuous)

- Then $F(0,T) = S_0 e^{(r-\delta)T}$ (futures price at time 0 for contract maturing at T)

Implied dividend rate

Date	Yield	
Jun 25, 2020	1.93%	estimate
Dec 31, 2019	1.83%	
Dec 31, 2018	2.09%	
Dec 31, 2017	1.84%	
Dec 31, 2016	2.03%	
Dec 31, 2015	2.11%	
Dec 31, 2014	1.92%	
Dec 31, 2013	1.94%	
Dec 31, 2012	2.20%	
Dec 31, 2011	2.13%	
Dec 31, 2010	1.83%	

- The exponential growth rate estimated in the graph is the value of r − δ, or −1.10%

- We can use the long-term treasury yield to estimate r and solve for δ

- Some historical annual dividend yields for the S&P 500 are shown in the table on the right.

Implied r-δ = -1.10%
5-year treasury bond r = 0.33%
Solve for δ = 1.43%

This is the implied dividend yield!
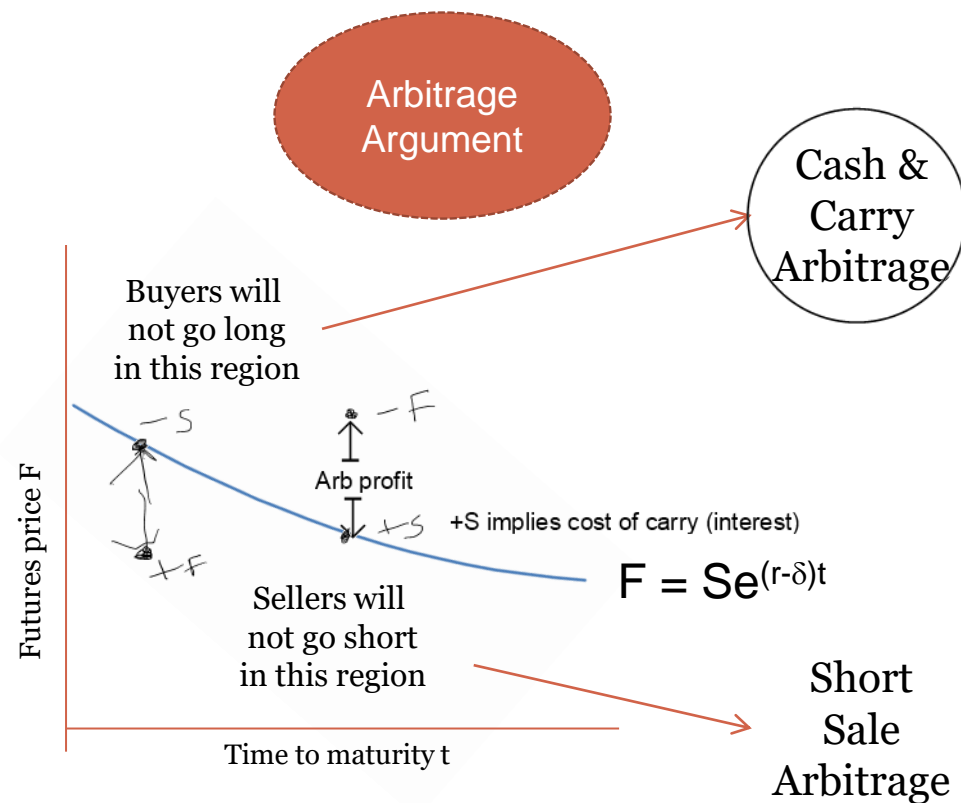
https://www.multpl.com/s-p-500-dividend-yield/table/by-year

"No arbitrage" pricing: Market proof

Arbitrage Argument

Cash & Carry Arbitrage

Buyers will not go long in this region

$F = Se^{(r-\delta)t}$

+S implies cost of carry (interest)

Arb profit

Futures price F

Time to maturity t

Sellers will not go short in this region

Short Sale Arbitrage

- If $F > Se^{(r-\delta)T}$
  - Borrow money and buy the asset for S
  - Contract to sell forward at F
  - *** Wait to maturity ***
  - Pay interest, get dividends, return money at a cost of of $Se^{(r-\delta)T}$
  - Net arb profit = $F - Se^{(r-\delta)T} > 0$
    - Note there is no market risk
    - This is arbitrage if default is not possible

- If $F < Se^{(r-\delta)T}$
  - Borrow the asset if possible, and sell it
  - Invest cash but pay dividends to owner
  - Contract to buy it back forward at F
  - *** Wait to maturity ***
  - Buy the stock at F and return to owner
  - Net arb profit = $Se^{(r-\delta)T} - F > 0$

Since the left and right sides of the equation cannot be unequal, they must be equal!

Can we use the GVE to price futures?

- Note that the *value* of a futures contract is not the same as the *price* of a futures contract
  - The price refers to a contracted price some date in the future
  - The value of the contract at inception must be zero
  - The value of the contract at maturity is $S_T - F_{0,T}$
- Recall that if we own the stock, we get the dividend
  - But if we are long the futures, we do not receive any dividend
- Recall that the risk of the futures is the same as the risk of owning the stock
- To simplify the math, let's use a one year time period with no compounding.

Notation:
0,T: Today and maturity date
S_0 = S&P index today
S_T = S&P index at time T (ex-dividend)
F_0 = one year futures today
r = risk-free interest rate
δ = dividend rate
α = expected return on stock
$E[S_T] = S_0(1+\alpha-\delta)$ ex-dividend
$E[S_T] = S_0(1+\alpha)$ cum-dividend

Notes:
1. The stock risk compensation is $S_0(1+\alpha) - S_0(1+r)$ since the stock owner gets dividends.
2. The expected cash flow or terminal value is computed ex-dividend.

Time value + Risk compensation = ECG + ECF

$$0 + [S_0(1+\alpha) - S_0(1+r)] = [S_0(1+\alpha-\delta) - F_0] + 0$$

$$F_0 = S_0(1+r-\delta)$$

1 yr simple interest

or more generally…

$$F_{0,T} = S_0 e^{(r-\delta)T}$$

T yr continuous interest

Why might this formula be considered surprising?

What can we use this formula for, besides pricing?

Questions about futures trading

- Do you know your trading counterparty?

  Clearinghouse; don't know specific
  identity

- What happens when you want to get out of a position?

  Offsetting position

- What if you don't get out of the position before maturity?

  Take delivery (long), Make delivery (short)
  Unless there is cash settlement

- What if you can't make a margin call?

 Terminated!

How do ETFs and futures compare?

Feature\Product	S&P Based ETFs	S&P Futures
Flexibility	none	none
Diversification	high	high
S&P index tracking	good	good
Funding requirement	CASH	MARGIN (deposit)
Dividends	yes	no
Bid-offer spreads	small	small
Commissions	small	small
Ongoing fees	small	none
Transparency	nearly perfect	perfect
P/L realization	on sale or closing short	daily

Commodity markets are different

- In financial futures markets, arbitrage ensures that prices cannot deviate from their theoretical value, i.e. $F = Se^{(r-\delta)t}$

- Arbitrage requires that we can freely buy and short sell the underlying asset, and store it for long periods of time

- This is easy with stocks, but most commodities violate these assumptions

- For example, it is very expensive to hold oil, storage supply is limited, and it is impossible to short-sell

Futs price

maturity

ex. storage oil 25¢/bbl-m
not fixed
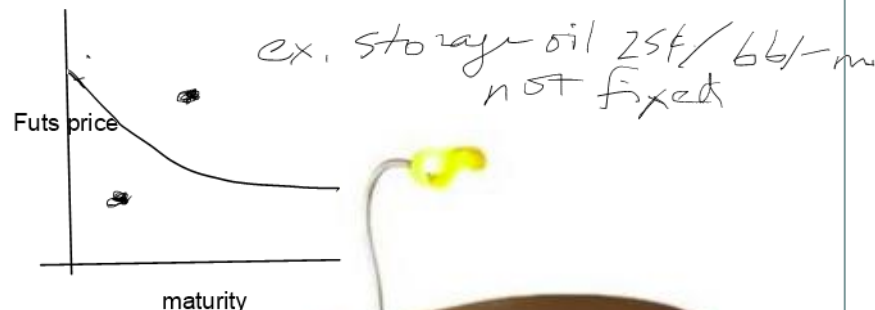
Desk made from two recycled barrels.

The futures curve for crude oil, 5/13/19

- What determines the upper pricing bound?

  Carry costs, except when cost of carry rises as the futures price rises (super contango)

- What determines the lower bound?

  Ability to short-sell underlying asset - does not exist in commodities

Crude Oil Futures - WTI

Contango = "carry market"

"*Backwardation*"

J.M. Keynes - Caused by producers' desire to hedge

USD Price per barrel

Years in the future

from www.cmegroup.com

- Can oil futures prices be negative?

  yes

- What is the futures price in this (nonfinancial) case?
  - Futures price equals expected future spot price ± risk premium
  - Backwardation could reflect either
    - Market's expectation of falling oil prices
    - Price concession short hedgers are willing to take to reduce risk
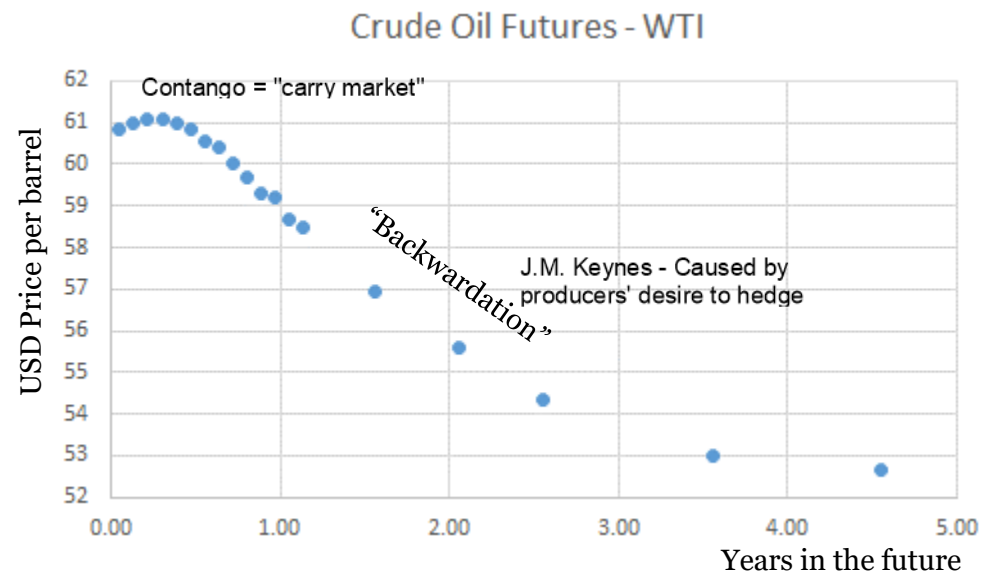
Super contango

- With no arbitrage bounds active, there is no upper limit on oil futures prices
- High futures prices cause storage costs to rise
  - Note direction of causation!
- Pipelines, trucks and ships are used as storage

Oil prices have moved into 'super contango'

COMMENTARY

John Kilduff | @KilduffReport

Published 10:22 AM ET Wed, 25 Nov 2015 | Updated 1:39 PM ET Wed, 25 Nov 2015

CNBC

It looks to be a volatile final few weeks for crude oil prices. So far, the low for WTI oil prices in 2015 of $37.75 a barrel set in August stands as the low price point -- but not for long.

There is a global supply glut, not just of crude oil, but, increasingly, refined products that will likely break the back of price support in the market, sending oil prices into a holiday plunge. So much so, land based storage tanks are filling up and increasing numbers of volumes are being stored on tankers.

'Scary,' 'visceral,' 'unprecedented': Traders describe oil's wild week and fall to negative prices

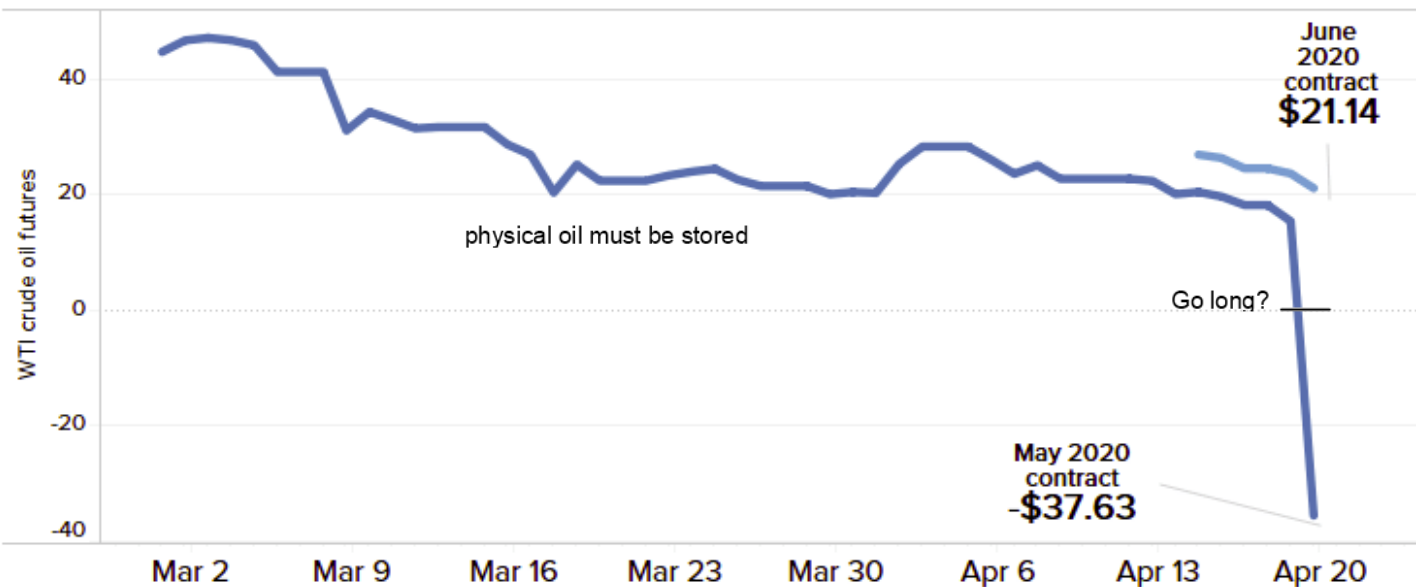PUBLISHED SAT, APR 25 2020·10:11 AM EDT | UPDATED MON, APR 27 2020·9:17 AM EDT

Pippa Stevens
@PIPPASTEVENS13

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Oil futures crash
Crude oil WTI futures, dollars per barrel

June 2020 contract $21.14

physical oil must be stored

Go long?

May 2020 contract -$37.63

WTI crude oil futures

40, 20, 0, -20, -40

Mar 2, Mar 9, Mar 16, Mar 23, Mar 30, Apr 6, Apr 13, Apr 20

SOURCE: FactSet, CNBC data

CNBC

Who trades commodity futures?

- ## Speculators
  - Think commodity prices are going to rise or fall
  - Use their deep knowledge of the physical markets to exploit pricing anomalies

- ## Hedgers
  - Producers short futures on their production to lock in future prices (increasing stability) of revenues
  - Consumers long futures on their planned purchases to lock in future prices (increasing stability) of costs
  - *Example:* The corn farmer hedges corn prices before the harvest to lock in a profit margin.

Case Study – Hedging with Corn Futures

- In February, Farmer Brown plans to sow 1,000,000 bu of corn in April, and harvest in July

- Each corn contract is for 5000 bushels

- What position should Farmer Brown take in corn futures to hedge himself _{her} against the price risk?

- Notes:

  CME   KCBOT

  o Farmer Brown is located in Illinois, and corn markets trade in Illinois and Missouri
  o Current futures price is $4 per bushel
  o Farmer Brown's costs are $2,000,000 including everything, and are prepaid.

- Position   long/short

- Contract month   JULY

- Number of contracts (Volume):   1mm/5000 = 200 contracts

- Location: CME

Case Study (2): *To hedge or not to hedge?*

- Suppose the actual harvested price is $3, $4 or $5.
- Show Farmer Brown's profit in each case, hedged and unhedged

F = $4
Cost = $2mm prepaid
Qty = 1mm bu

FUTS P/L

Price of Corn at harvest	Unhedged revenue (MM)	Unhedged profit	Hedged revenue (MM)	Contract lifetime Mark-to-market	Hedged profit
		−2			*4 − 2*
$3	3	1	4	+1	2
$4	4	2	4	0	2
$5	5	3	4	−1	2

NO HEDGE =

HEDGE =

TONGHUA : FAIRY TALE

Case Study (3): *My kingdom for rainfall!*

- What if there is a drought, eliminating the crop? (lack of water)
- Because of the drought, corn prices _____ ⬆ $1 to _____ $5 _____ per bu.

Price of Corn at harvest	Unhedged revenue (MM) *NO BUSHELS!*	Unhedged profit	Hedged revenue (MM)	Contract lifetime Mark-to-market *BECAUSE SHE HEDGED*	Hedged profit
~~$3~~					
~~$4~~					
$5	0	-2	-1	(-1)	-3

- Farmer Brown can buy $3 mm in crop insurance for $0.5 mm. → NET -0.5
- Does this help?

DROUGHT W/O HEDGE WITH INS +0.5

Case study (4): *The best day of my life!*

- The day after Farmer Brown put on the trading position, Donald Trump sent out a tweet

- **Corn is the COVID-19 cure!** Prices went to $100 per bushel!!

- What was Farmer Brown's margin requirement that day? Assume Farmer Brown has access to $5 million in cash and loans.

- After a week, Trump was fact-checked, and prices returned to normal

- What was the outcome for Farmer Brown?

MARGIN CALL = $96 MM
TERMINATED!

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Risks of hedging with futures

- Futures are a popular choice for hedgers
  - Believed to be highly competitive markets with low transaction costs
  - Little to no credit risk due to central counterparty
  - Liquid markets mean easy modifications and strategy reversals
- However, there are three major recurring risks for hedgers

Margining risk *COVID*

- Risk that you may have to put up cash margin on a losing position, even if it is offset with a noncash gain on your asset

Basis risk *CME vs KCBOT*

also see B from earlier

- Hedging something with futures on an asset different than the one in which you have a position

Volumetric risk *DROUGHT*

- Risk that the volume of your asset being hedged may change for some reason unexpectedly

> In general, it is a good idea to simulate future margin requirements when you first enter a futures position.

Takeaways

- A futures contract allows you to buy or sell something in the future at terms specified today.

- In a futures transaction, the market risk of an asset is transferred from the asset owner to the long position.

- People use futures to take leveraged market positions (speculators) or to change their risk profile (hedgers).

- For financial assets, forward price $F_{0,T} = S_0e^{(r-\delta)T}$

  ○ For commodities, there is no general formula

- Risks in practice

  ○ Futures contracts were designed to mitigate credit risk and liquidity risk, but they also create incremental risks.

  ○ For those who hedge or speculate with futures, the biggest risks are margining, basis risk and volumetric risk.

- Ultimately, futures are called derivatives in the press, but they really approximate an extreme form of leverage. High borrowing can be very dangerous when the value of the invested asset is volatile.