



Currency Futures

Performance, hedging, connection to interest rates; hottest game in town

(c) 2006-2011, Gary R. Evans. May be used for educational purposes only with the express consent of the author.

Money itself is completing a developmental arc from matter to bits, stored in computer memory and magnetic strips, world finance coursing through the global nervous system. Even when money seemed to be material treasure, heavy in pockets and ship's holds and bank vaults, it always was information. Coins and notes, shekels and coweries were all just short-lived technologies for tokenizing information about who owns what.

James Gleick, *The Information*

The amount of FX daily global trade: \$4 trillion

Side Show - Real example: A backwardation/contango calendar spread

Our original spread bet (placed hypothetically at market close, placed Tuesday February 24, 2011):

CME Group NYMEX cotton futures, 50,000 lbs.

Long October 2012 at \$0.9395, notional value \$46,975.

Short October 2011 at \$1.4547, notional value \$72,735.

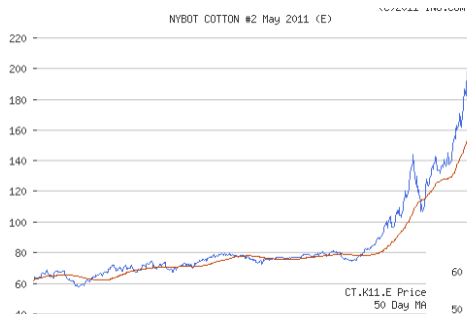
Spread: \$0.5152

Initial margin (believe it or not) is \$165 per contract (\$3.30 for the spread)

Context: Cotton spot and futures were quiet in 2010, at typical prices, around 80 cents per pound, until September 2010, when they started to rise. By February 2011 (a) they were at about \$2.10 per pound (peak) and (b) the futures contracts were in **severe backwardation**. For example on February 22, 2011, the May 2011 contract opened at \$1.85 whereas the October 2013 contract opened at \$96.00.

At this time oil futures were climbing because Egypt had just fallen and Libya was in violent turmoil. As oil futures rose, cotton, sugar, and other agriculture futures fell (for what reason?). Seeing a severe backwardation, we decided to do q-arbitrage

May 2011 NYBOT (ICE) Cotton #2
Feb 23, 2011



Source: ino.com

(Left) Cotton futures go stratospheric from 80 to 200 (cents per lb.), **50,000 lb. contract**. At 200, notional contract value is \$100,000.

Oct11/Oct12 NYBOT (ICE)
Cotton #2 **spread**, Feb 23, 2011



(Right) ICE NYBOT spreads equal the near contract (OCT11) minus the far contract (Oct12) so when it slopes up like this (spread of more than 50 cents, or 20% of value) this represents **severe backwardation**.

Result: Hypothetical offset at 12:24 PST Thursday February 24, 2011 (just as rumors sweep the internet that Omar Ghaddafi has been shot – gold and oil plunge).

Sold Long October 2012 at \$0.9437 (from \$0.9395)

Sold Short October 2011 at \$1.4050 (from \$1.4547)

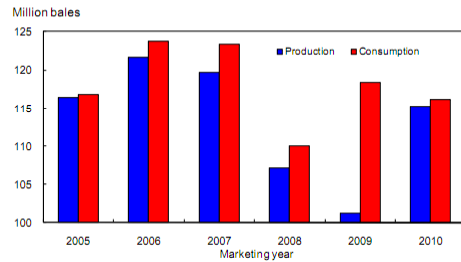
Spread: \$0.4613 (from \$0.5152), a settlement gain of \$0.0539 per pound.

Settlement capital gains: \$2,695 per contract (on a contract pair with IM of \$165)

Note: We had committed \$2,500 to this for safety, so we doubled up.

Economic Background:

Figure 4
World cotton production and consumption



Source: World Agricultural Supply and Demand Estimates reports, USDA.

USDA Research Service, Cotton and Wool Outlook, December 13, 2010

This is subtle, so see the USDA Cotton and Wool Outlook and related documents, but generally this commodity is in backwardation because there is an acute shortage of cotton now (see graph) so spot prices are high now, but production is expected to recover in 2011, so prices then are expected to return to normal.

Today it fell another \$2.69.

A selection of NYBOT (ICE) cotton #2 spread on February 23, 2011, spot 181. Mudd Finance

Jul 2011/Oct 2011 Spread	29.12	30.21	29.12	34.09	0.00	0.00%
Jul 2011/May 2013 Spread	82.68	82.68	82.68	82.68	-5.30	-6.41%
Jul 2011/Jul 2012 Spread	68.30	68.30	68.30	74.66	-2.32	-3.40%
Jul 2011/Dec 2011 Spread	57.11	58.05	52.03	54.69	-5.48	-9.87%
Oct 2011/Dec 2013 Spread	50.84	50.84	50.84	50.84	-5.30	-10.42%
Oct 2011/Dec 2012 Spread	51.91	51.91	50.40	49.21	-4.26	-8.66%
Oct 2011/Dec 2011 Spread	26.45	26.45	21.00	21.61	-4.47	-17.88%
Oct 2011/Jul 2013 Spread	48.84	48.84	48.84	48.84	-5.30	-10.85%
Oct 2011/Mar 2013 Spread	47.45	47.45	47.45	47.45	-4.94	-10.41%
Oct 2011/Jul 2012 Spread	39.00	39.00	39.00	40.57	-2.32	-5.72%
Oct 2011/May 2013 Spread	48.59	48.59	48.59	48.59	-5.30	-10.91%
Oct 2011/May 2012 Spread	37.45	37.45	37.45	37.45	-2.14	-5.71%
Oct 2011/Oct 2012 Spread	51.52	51.52	51.52	51.52	-2.37	-4.60%
Oct 2011/Mar 2012 Spread	7.50	7.50	7.50	33.04	0.00	0.00%
Oct 2011/Oct 2013 Spread	49.84	49.84	49.84	49.84	-5.30	-10.63%
Dec 2011/Mar 2012 Spread	6.90	6.97	5.88	6.21	-0.75	-11.36%
Dec 2011/May 2012 Spread	11.80	11.80	10.50	11.37	-2.14	-18.82%
Dec 2011/May 2013 Spread	22.51	22.51	22.51	22.51	-5.30	-23.55%
Dec 2011/Jul 2012 Spread	13.00	13.00	13.00	13.00	-1.49	-10.28%
Dec 2011/Dec 2013 Spread	34.53	34.53	34.53	24.76	-5.30	-21.41%
Dec 2011/Jul 2013 Spread	22.76	22.76	22.76	22.76	-5.30	-23.29%
Dec 2011/Oct 2012 Spread	25.44	25.44	25.44	25.44	-2.37	-9.32%

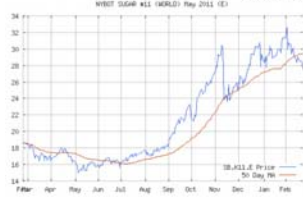
Many issues here: These spreads are huge (as large as the normal price of cotton) and when the futures prices of cotton collapsed yesterday (about \$8 plus \$9 today) in reaction to the Libyan situation (??), the spreads also collapsed. Given that the notional value of this spread is about \$25,500, the settlement gain of playing the spread to narrow (short Oct 11, long Oct 12 – or short this spread) for our contract was 0.0214 (two cents) times 50K, or \$1,070!! IM on this spread is only \$165.!

Source: ino.com

NYBOT Sugar #11 spreads same day, same backwardation – spot was \$30

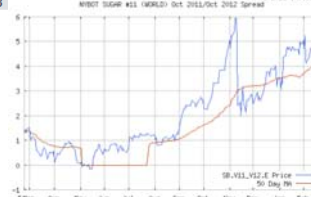
Mudd Finance

SB.V13.E	Oct 2013 (E)	19.33	19.00	19.40	19.32	0.10
SB.H11.V13.E	Mar 2011/Oct 2013 Spread	12.98	12.98	12.98	11.44	-0.22
SB.H11.H13.E	Mar 2011/Mar 2013 Spread	11.44	11.44	10.96	10.68	-0.26
SB.H11.K11.E	Mar 2011/May 2011 Spread	2.60	2.78	2.53	2.63	+0.05
SB.H11.K12.E	Mar 2011/May 2012 Spread	8.31	8.31	8.23	8.23	-0.28
SB.H11.K13.E	Mar 2011/May 2013 Spread	11.30	11.55	11.30	11.01	-0.21
SB.H11.H12.E	Mar 2011/Mar 2012 Spread	7.00	7.09	6.85	6.89	-0.16
SB.H11.N11.E	Mar 2011/Jul 2011 Spread	4.62	4.81	4.54	4.66	+0.07
SB.H11.N12.E	Mar 2011/Jul 2012 Spread	9.60	9.60	9.60	9.49	-0.13
SB.H11.N13.E	Mar 2011/Jul 2013 Spread	14.07	14.07	14.07	11.22	-0.24
SB.H11.V12.E	Mar 2011/Oct 2012 Spread	10.36	10.36	10.36	10.21	-0.19
SB.H11.V11.E	Mar 2011/Oct 2011 Spread	6.24	6.37	6.14	6.16	-0.11
SB.K11.N13.E	May 2011/Jul 2013 Spread	8.70	8.70	8.70	8.64	-0.22
SB.K11.V11.E	May 2011/Oct 2011 Spread	3.69	3.76	3.45	3.56	-0.13
SB.K11.V12.E	May 2011/Oct 2012 Spread	7.76	7.76	7.76	7.63	-0.17
SB.K11.V13.E	May 2011/Oct 2013 Spread	9.70	9.70	9.70	8.86	-0.20
SB.K11.N11.E	May 2011/Jul 2011 Spread	2.04	2.10	1.97	2.03	+0.02
SB.K11.K13.E	May 2011/May 2013 Spread	11.40	11.40	11.40	8.43	-0.19
SB.K11.K12.E	May 2011/May 2012 Spread	5.75	5.77	5.46	5.60	-0.33
SB.K11.N12.E	May 2011/Jul 2012 Spread	7.00	7.01	7.00	6.91	-0.11
SB.K11.H12.E	May 2011/Mar 2012 Spread	4.49	4.49	4.13	4.30	-0.17
SB.K11.H13.E	May 2011/Mar 2013 Spread	7.88	7.89	7.51	7.51	-0.59
		4.48				



May contract

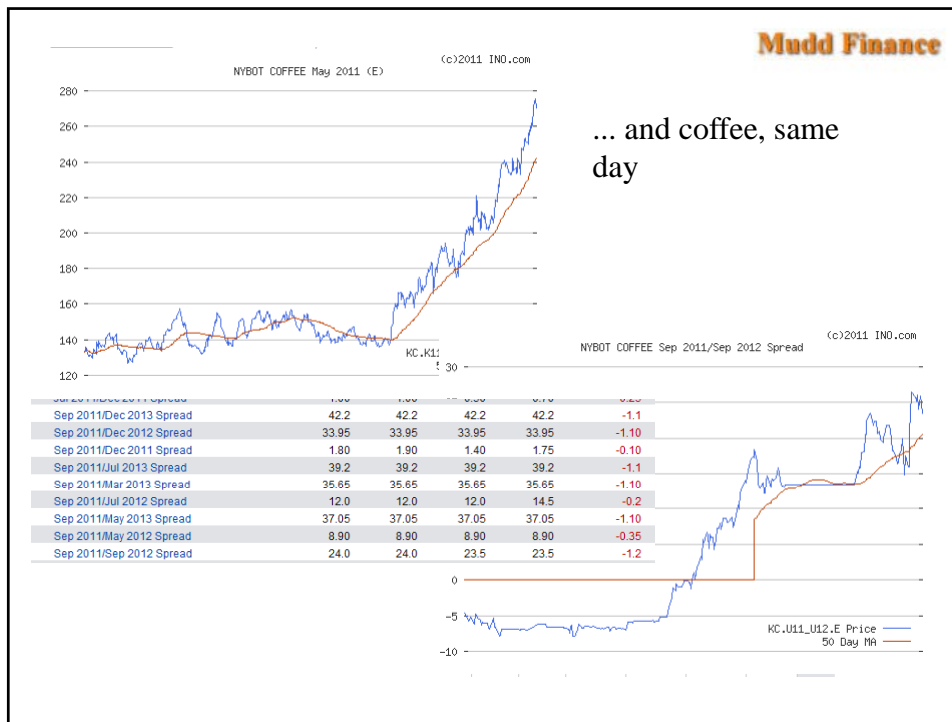
Oct 11/Oct 12 spread



NYMEX Crude Oil spreads on same day are flat (strong negative would imply contango) and spreads are rising slightly, so this market is uncorrelated with ags.

Mudd Finance

Sep 2011/Feb 2012 Spread	-0.54	0.19	-0.54	0.14	+1.14	0.00%
Sep 2011/Mar 2012 Spread	-0.44	0.40	-0.44	0.40	+1.48	0.00%
Sep 2011/Oct 2011 Spread	-0.29	-0.01	-0.30	-0.08	+0.21	0.00%
Sep 2011/Nov 2011 Spread	-0.52	-0.03	-0.58	-0.15	+0.40	0.00%
Oct 2011/Feb 2012 Spread	-0.16	0.22	-0.16	0.22	+0.95	0.00%
Oct 2011/Jan 2012 Spread	-0.62	0.07	-0.64	0.02	+0.66	0.00%
Oct 2011/Mar 2012 Spread	-0.24	0.48	-0.24	0.48	+1.28	0.00%
Oct 2011/Apr 2012 Spread	-0.84			0.70	+1.61	0.00%
Oct 2011/Nov 2011 Spread	-0.26	-0.03	-0.29	-0.08	+0.19	0.00%
Oct 2011/Dec 2011 Spread	-0.49	-0.02	-0.51	-0.12	+0.35	0.00%
Nov 2011/Feb 2012 Spread	-0.28	0.27	-0.28	0.27	+0.74	0.00%
Nov 2011/Dec 2012 Spread	-0.60			-0.60	+0.43	0.00%
Nov 2011/Dec 2011 Spread	-0.24	0.02	-0.24	-0.04	+0.18	0.00%
Nov 2011/Apr 2012 Spread	0.06	0.76	0.05	0.76	+1.37	0.00%
Nov 2011/Mar 2012 Spread	0.20	0.53	0.09	0.45	+0.98	0.00%
Nov 2011/Jan 2012 Spread	-0.28	0.11	-0.28	0.05	+0.43	0.00%
Dec 2011/Dec 2012 Spread	-0.35	3.18	-0.35	2.70	+2.98	0.00%
Dec 2011/Jan 2012 Spread	-0.22	0.11	-0.23	0.07	+0.24	0.00%
Dec 2011/Dec 2014 Spread	-3.00	-3.00	-3.00	-3.00	-0.15	0.00%



Mudd Finance

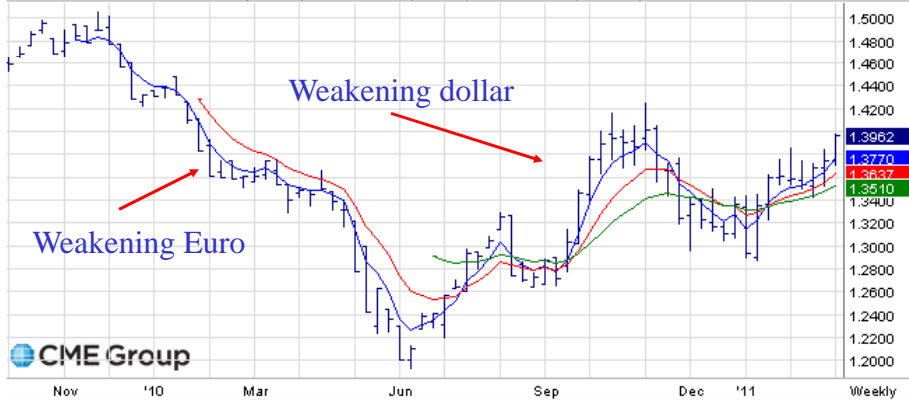
The CME Globex Euro FX and e-Micro

- 125,000 Euros (Euro FX)
- 1 tick equal \$.0001 equals \$12.50
- Mar, Jun, Sep, Dec ... pure electronic
- Margin: \$4,320i \$3,200m spec
 - e-Micro
- 12,500 Euros
- 1 tick equals \$1.25
- Margin: **\$432i** **\$329m**

See CME Group website for list of all currencies.

The May 2011 Euro FX contract

6E H1 [10] - EURO-GLOBEX LAST: 1.3962 CHANGE: ▲ 0.0102 HIGH: 1.3975 LOW: 1.3831 3/4/2011
 EMA (6E H1,4) = 1.3770 EMA (6E H1,9) = 1.3637 EMA (6E H1,18) = 1.3510



Source: cmegroup.com

CME Globex Japanese Yen Contract

Contract specs: 12,500K Japanese Yen, quoted in \$ per Yen X 100 (inverse is what is quoted on FOREX), 1 point = \$.000001 per yen = \$12.50, \$6,075 im \$4,500 mm

6J H1 [10] - JAPANESE YEN-GLOBEX LAST: 1.2128 CHANGE: ▼ 0.0086 HIGH: 1.2237 LOW: 1.2118 3/4/2011
 HLMA (6J H1,10,8) Ma,High = 1.2241 Ma,Low = 1.2016

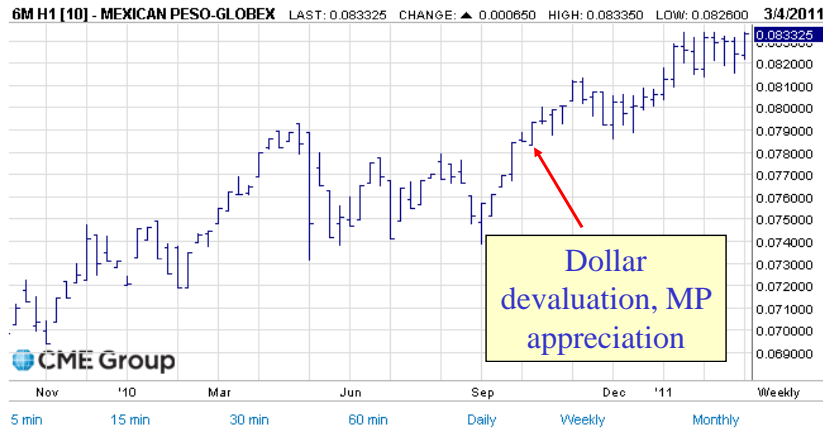


Note: CME quotes on **Yen** are Yen value in \$ times 100. Therefore the Yen price of the \$ is the inverse of 1.2128 / 100, or 82.45.

Source: cmegroup.com

CME Globex Mexican Peso Contract

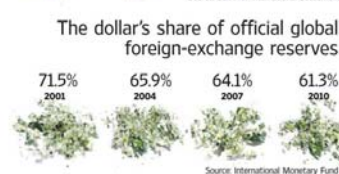
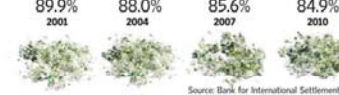
Contract specs: 500K Mexican Pesos, quoted in cents per MP, 1 point = \$.00001 per MP = \$5.00, (\$1,875 im \$1,400mm old = couldn't access CME)



Source: cmegroup.com

Why the Dollar's Reign is Near an End: The Wall Street Journal, March 2, 2011

1. The Euro now and the Yuan later are emerging as alternative currencies.
2. The European "house" is in better shape than the US house – we ignore budget deficits, they eliminate them.
3. China is tired of bailing out our deficits and holding the bulk of their reserves in only one asset, they are seeking alternatives.
4. Smaller, nimble currencies (Swiss Franc, Australian and Canadian Dollar) allow market baskets of multiple currencies, and some now are used for flight to quality, as seen in recent days.

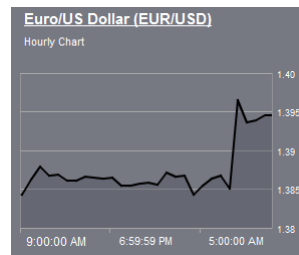


Important question ...

What impact does a change in real interest rates have upon the exchange rate of a currency (and, hence, upon the futures rate)?

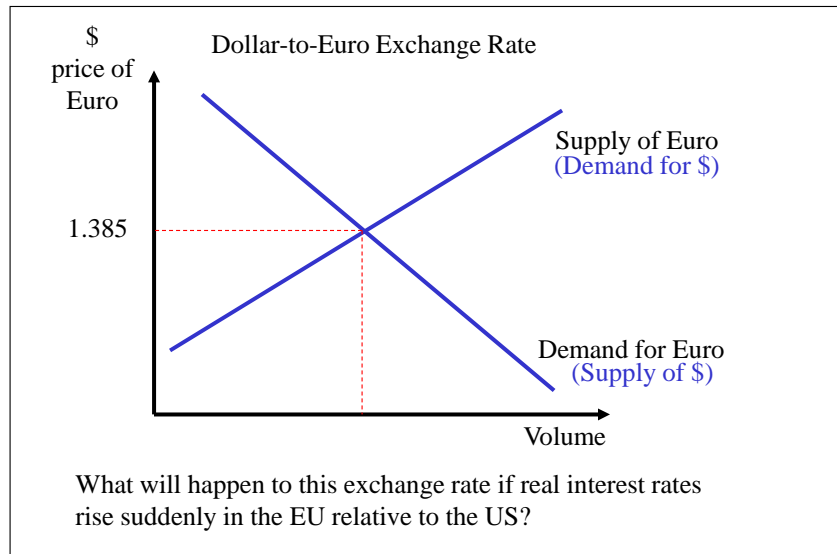
For example, what should happen to the dollar price of the Euro if *real* interest rates rose suddenly in the European Union relative to those in the United States?

Relevance: This happened yesterday (March 2, 2011)
 – ECB President Trichet said EU rates will likely rise next month to combat emerging inflation.

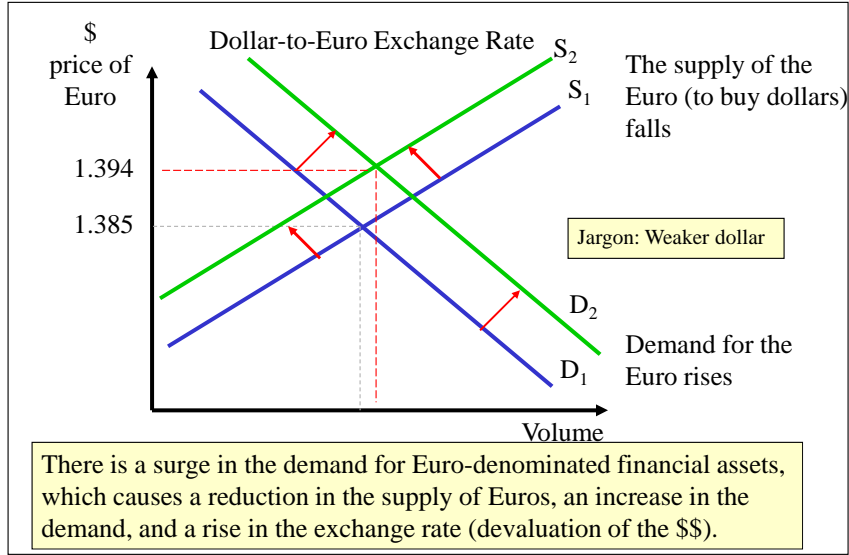


Source: forex.com

The Exchange Rate Model (applied to March 2, 2011)



The Exchange Rate Model



The Reaction of the Euro/Dollar Exchange Rate to the Trichet Announcement – March 2, 2011



Two years

March 3 – the Pound also slides against the Euro because interest rate increase not matched in Britain.

A snapshot of the Euro futures contract: (market close on March 2, 2011)

Euro (CME)-€125,000; \$ per €									
	Open	High	Low	Settle	Chg	LIFETIME			Open Int
						High	(▲▼)	Low	
Mar 11	1.3774	1.3890	1.3742	1.3860	+0090	1.4970		1.1930	208,799
Jun 11	1.3756	1.3872	1.3726	1.3843	+0090	1.4330		1.2220	7,823
Sep 11	1.3775	1.3820	1.3775	1.3814	+0090	1.4162		1.2391	85
Dec 11	1.3805	1.3805	1.3805	1.3781	+0090	1.3901		1.2801	77

Est vol 341,018; vol Tue 279,455; open int, 217,066, -172.
Sources: Thomson Reuters; WSJ Market Data Group

No backwardation, not as responsive to Trichet until March 3

Market Reactions

Both the FOREX (spot) and foreign exchange futures markets are "rational expectations" markets extremely sensitive to news events, especially economic data releases in the early morning hours that are broadcast, for example, on CNBC. *Anything at all* that is relevant to interest rates, inflation rates, economic growth rates, direct or indirect, can move the FOREX 50 pips or more. This is especially true for U.S. economic data.

FOREX trading starts each "day" in Sydney at 9:00 (Sydney time) then the Tokyo, Singapore, Hong Kong, Frankfurt, London and New York markets open at their respective times, so a news event can shock the market at any time ... the market need not wait for an "open."

Generally, a relative rise in one countries interest rates will make that currency stronger, or a rise in the inflation rate will make that currency weaker, but this is priced in quickly on interpretations of economic data, and is also influenced by trade statistics, stock market performance, you name it. *Very, very sensitive markets*. These markets are also sensitive to short-term "technical" speculators.

Arbitrage and the relationship between interest rates and currency futures rates

Because of arbitrage possibilities, generally speaking, the relationship between the futures price and spot price is roughly determined by the following formula (using the \$/MP as an example):

$$\frac{F}{S} = \frac{(1 + ru)^t}{(1 + rm)^t}$$

F = future price \$/MP
 S = spot price of \$/MP
 ru = interest rate in U.S.
 rm = interest rate in Mexico

which implies $F = \frac{(1 + ru)^t}{(1 + rm)^t} S$

Example

Suppose the \$/MP exchange rate is .1050 (which implies 9.52 pesos to the dollar). Assume that interest rates in Mexico are 9% and interest rates in the U.S. are 6%. Then the one year forward futures rate will be approximately

$$F = \frac{(1 + ru)^t}{(1 + rm)^t} S = \frac{(1 + .06)}{(1 + .09)} \times .1050 = .10211$$

The six month forward futures rate will be approximately

$$F = \frac{(1 + ru)^t}{(1 + rm)^t} S = \frac{(1 + .06)^{.5}}{(1 + .09)^{.5}} \times .1050 = .10354$$

The book's continuous approach

The book uses this formula, which is identical:

$$F = Se^{(ru-rm)t}$$

To use it, though, we have to convert our discrete annual rates to continuous rates using our conversion formula:

$$ruc = \ln(1.06) = 0.058269$$

$$rum = \ln(1.09) = 0.086178$$

$$0.10211 = 0.1050e^{(0.058269-0.086178)t}$$

Arbitrage profits

$$F > \frac{(1+ru)^t}{(1+rm)^t} S$$

If this condition to the left holds, the arbitrage profits are guaranteed. Suppose in our previous example that the one-year future price is .10350 instead of .10211.

1. Buy 458,715 MP (500,000/1.09) using \$48,165 (at the current spot rate of .1050), borrowed money.
2. Pay interest on the loan of \$2,889.91 (\$48,165 X .06).
3. Deposit the 458,715 MP in a Mexican deposit for one year, at which time it will be worth 500,000 MP (458,715 X 1.09)
4. Short (sell) a single futures contract in Pesos (500,000 MP).
5. At the end of the year, close your futures contract, convert your cash back to dollars.

... when the futures price is too high at 0.1035

Mexican rate:	0.09			
U.S. rate:	0.06			
Spot price:	0.105			
Futures price:	0.1035			
Spot price in 1 year	Gain/loss on cash	Gain/loss on margin	Interest paid	Profit
0.1050	4,335	-750	-2890	695
0.1040	3,835	-250	-2890	695
0.1030	3,335	250	-2890	695
0.1021	2,885	700	-2890	695
0.1010	2,335	1250	-2890	695
0.1000	1,835	1750	-2890	695

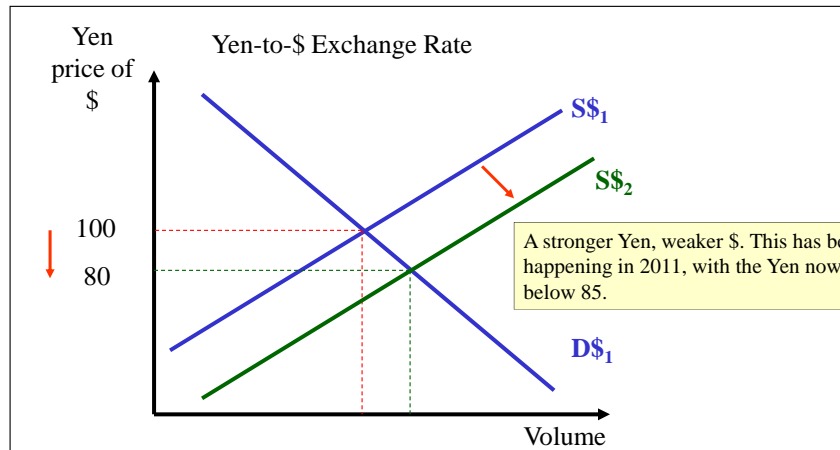
The effect of exchange rates on investment rates of return

Given the rising popularity of global investing in multiple areas, which implies U.S. investors buying Euro-denominated bonds and Japanese investors buying U.S. stocks, how does *exchange rate risk* factor into yields on overseas investments? After all, if you invest overseas, normally you start with your own currency, then convert it to the foreign currency, make your investment, and then later convert back to your domestic currency.

One popular financial venue impacted by this was the carry-trade, when U.S. investors borrow Yen at low interest rates, convert to the dollar, then invest in the U.S. What exchange rate risk is being experienced?

Answer the question on the next slide:

The Yen-to-\$ exchange rate: mirror image of the Euro



Consider the case of the Japanese investor who has invested in the U.S. after converting Yen to \$ at 100. Will the exchange rate change shown above *reduce* or *increase* the yield on this investment upon conversion back to Yen?

reduce by about 2% absolutely

Answer: exchange rate complications for global investing

The answer to the previous problem is that increase in the value of the Yen will reduce the yield of an overseas investment by a Japanese investor. She will receive fewer Yen when she converts back to her own currency.

We can generalize that into the following:

If you are investing overseas in financial assets that are denominated in another currency, then a general *weakness* in your own currency will *add* to your yield and a general *strength* in your own currency will *reduce* or even eliminate your yield.

Therefore, if you invest in Japanese stocks (or an ETF that does), you want the Yen price of the dollar to fall (say from 100 to 80). In fact, even if the investor realized a 10% gain on investment, net return would be -12%.

This feature has a tendency to *leverage* one-way investment flows.

The Math of the previous example:

$$r_a = (1 + r_i) \left(\frac{P_n}{P_f} \right) - 1$$

r_a : adjusted rate of return

r_i : return on investment

P_f : future (offset) cost of a foreign currency in your currency

P_n : present (now) cost of a foreign currency in your currency

$$1/100 = 0.01 \text{ (Yen cost of a \$)} \quad 1/80 = 0.0125$$

$$-0.12 = (1 + 0.10) \left(\frac{0.01}{0.0125} \right) - 1$$

Exchange Rates and Staple Commodity Prices

For global commodities like staples (wheat), metals (gold), and fuels (nat gas), the ratio of prices in any two countries will exactly reflect the exchange rate between those two countries:

$$\frac{\text{Canadian Price of Gold}}{\text{U.S. Price of Gold}} = \text{Exchange Rate} = 1.24 = \frac{\text{CD\$1,146}}{\text{US\$925}}$$



This Canadian Dollar move in November caused a 28% gain in Gold for Canadians, but not in the U.S.

If the above exchange rate goes *down*, it will raise the price of wheat and natural gas imported from Canada, but not for them.

Inflation need not be global.