International Financial Markets (Emphasis on the FOREX market)

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Abstract

The foreign exchange market is the largest market in the world and the only market currently open 24 hours a day. These lecture notes analyzes foreign exchange quotations as they are presented in the Financial Times and Oanda. A brief look at the current structure of the foreign exchange markets will 'kick-off' our discussion of the Foreign Exchange Market. This will be followed with a description of the type of FOREX transactions. Following this discussion we will discuss major macroeconomic factors that impact exchange rates and arbitrage in financial markets.

Outline:

I. Current structure of the FOREX Market

II. A look inside a trading day

III. Understanding Quotations

IV. Arbitrage in FOREX

V. Macro-economic factors impacting FOREX

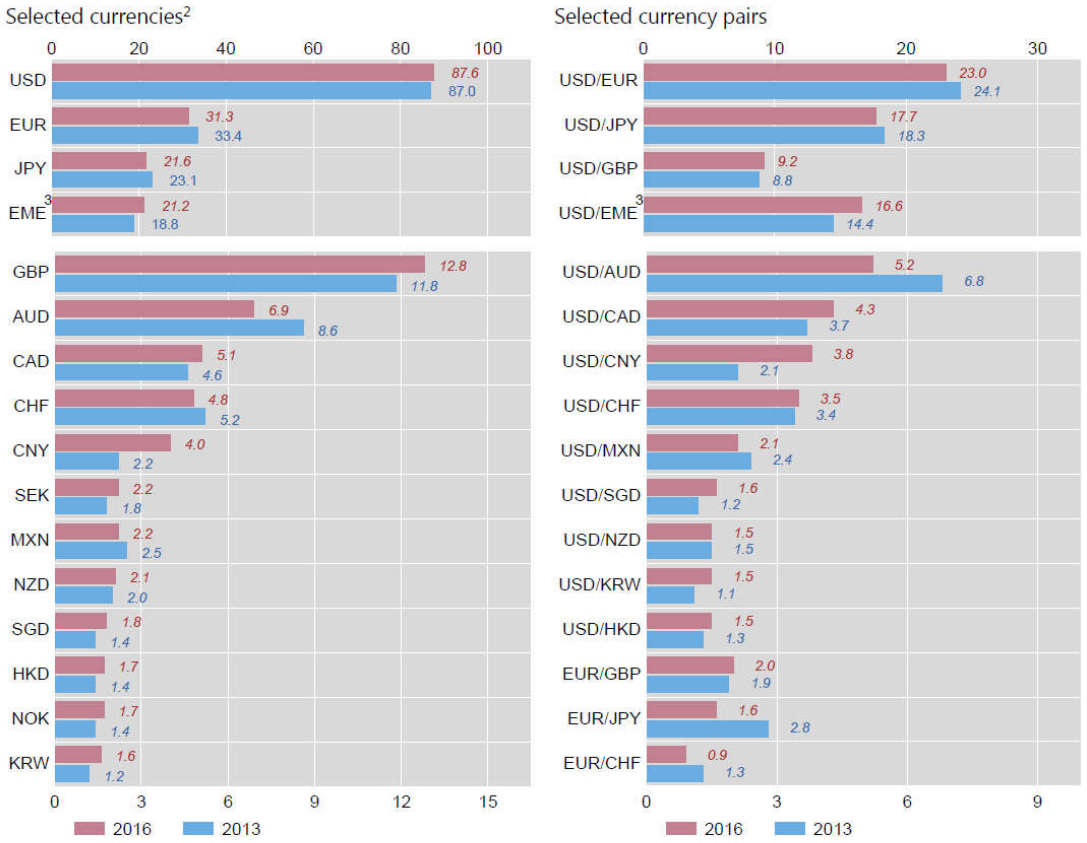
VI. PPP and IFE

I. Current Structure of FOREX Market

When we speak of the foreign exchange market, we are usually referring to the trading of foreign exchange by large commercial banks located in a few financial centers especially London, New York, Tokyo, and Singapore. Foreign exchange transactions topped $250B/day by 1986. By 1995 the foreign exchange market had a daily transactions volume of over a trillion dollars in the major Financial centers (BIS, 2002, Table B.1). By 1998 volume had risen to more than USD **1.5 trillion per** day (after making corrections to avoid double counting). This is about **60 times** the global volume of exports of goods and services. However 1998 marked a temporary peak of trading volume in the traditional foreign exchange markets: although the forward market continued to grow, trading volume fell sharply in the spot foreign exchange markets. By 2001 volume had fallen to about $1.2 trillion per day. However, as seen in Figure below, by 2007 volume reached USD 3.2T per day. In April of 2010 turnover reached over 4 trillion per day. Figures below show the details for the most recent BIS survey. The turnover has continued to grow up to over 5.3 trillion per day in 2013 and fell a little to 5.1 trillion per day in 2016.

Foreign exchange market turnover by currency and currency pairs

Net-net basis,[1] daily averages in April, in per cent — Graph 1

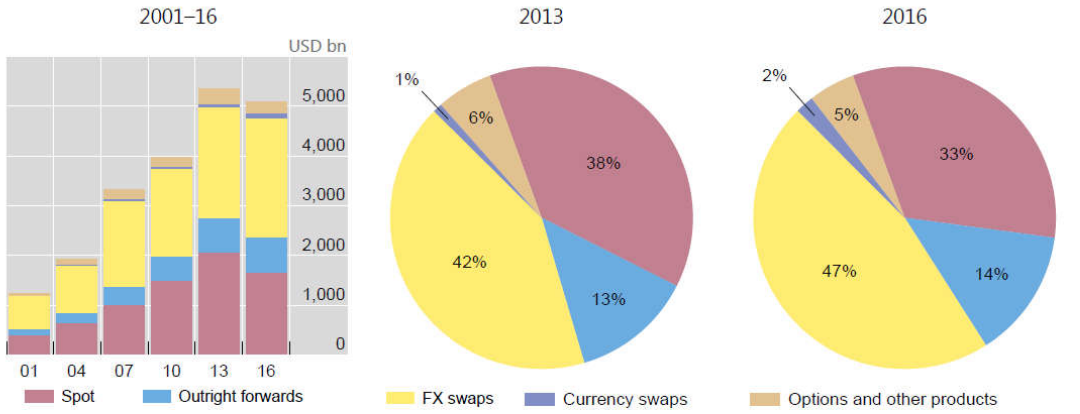


[1] Adjusted for local and cross-border inter-dealer double-counting. [2] As two currencies are involved in each transaction, the sum of shares in individual currencies will total 200%. [3] Emerging market currencies.

Source: BIS Triennial Central Bank Survey. For additional data by currency and currency pairs, see Tables 2 and 3 on pages 10 and 11.

Foreign exchange market turnover by instrument

Net-net basis,[1] daily averages in April — Graph 2



[1] Adjusted for local and cross-border inter-dealer double-counting.

Source: BIS Triennial Central Bank Survey. For additional data by instrument, see Table 1 on page 9.

OTC foreign exchange turnover

Net-net basis,[1] daily averages in April, in billions of US dollars — Table 1

Instrument	2001	2004	2007	2010	2013	**2016**
Foreign exchange instruments	1,239	1,934	3,324	3,973	5,357	**5,067**
Spot transactions	386	631	1,005	1,489	2,047	**1,652**
Outright forwards	130	209	362	475	679	**700**
Foreign exchange swaps	656	954	1,714	1,759	2,240	**2,378**
Currency swaps	7	21	31	43	54	**82**
Options and other products[2]	60	119	212	207	337	**254**
Memo:						
Turnover at April 2016 exchange rates[3]	*1,381*	*1,884*	*3,123*	*3,667*	*4,917*	***5,067***
Exchange-traded derivatives[4]	*12*	*25*	*77*	*145*	*145*	***115***

[1] Adjusted for local and cross-border inter-dealer double-counting (ie "net-net" basis). [2] The category "other FX products" covers highly leveraged transactions and/or trades whose notional amount is variable and where a decomposition into individual plain vanilla components was impractical or impossible. [3] Non-US dollar legs of foreign currency transactions were converted into original currency amounts at average exchange rates for April of each survey year and then reconverted into US dollar amounts at average April 2016 exchange rates. [4] Sources: Euromoney Tradedata; Futures Industry Association; The Options Clearing Corporation; BIS derivatives statistics. Foreign exchange futures and options traded worldwide.

Currency distribution of OTC foreign exchange turnover

Net-net basis,[1] percentage shares of average daily turnover in April[2] Table 2

Currency	2001		2004		2007		2010		2013		**2016**	
	Share	Rank	Share	Rank	Share	Rank	Share	Rank	Share	Rank	**Share**	**Rank**
USD	89.9	1	88.0	1	85.6	1	84.9	1	87.0	1	**87.6**	**1**
EUR	37.9	2	37.4	2	37.0	2	39.0	2	33.4	2	**31.4**	**2**
JPY	23.5	3	20.8	3	17.2	3	19.0	3	23.0	3	**21.6**	**3**
GBP	13.0	4	16.5	4	14.9	4	12.9	4	11.8	4	**12.8**	**4**
AUD	4.3	7	6.0	6	6.6	6	7.6	5	8.6	5	**6.9**	**5**
CAD	4.5	6	4.2	7	4.3	7	5.3	7	4.6	7	**5.1**	**6**
CHF	6.0	5	6.0	5	6.8	5	6.3	6	5.2	6	**4.8**	**7**
CNY[3]	0.0	35	0.1	29	0.5	20	0.9	17	2.2	9	**4.0**	**8**
SEK	2.5	8	2.2	8	2.7	9	2.2	9	1.8	11	**2.2**	**9**
NZD[3]	0.6	16	1.1	13	1.9	11	1.6	10	2.0	10	**2.1**	**10**
MXN[3]	0.8	14	1.1	12	1.3	12	1.3	14	2.5	8	**1.9**	**11**
SGD[3]	1.1	12	0.9	14	1.2	13	1.4	12	1.4	15	**1.8**	**12**
HKD[3]	2.2	9	1.8	9	2.7	8	2.4	8	1.4	13	**1.7**	**13**
NOK[3]	1.5	10	1.4	10	2.1	10	1.3	13	1.4	14	**1.7**	**14**
KRW[3]	0.8	15	1.1	11	1.2	14	1.5	11	1.2	17	**1.7**	**15**
TRY[3]	0.0	30	0.1	28	0.2	26	0.7	19	1.3	16	**1.4**	**16**
RUB[3]	0.3	19	0.6	17	0.7	18	0.9	16	1.6	12	**1.1**	**17**
INR[3]	0.2	21	0.3	20	0.7	19	0.9	15	1.0	20	**1.1**	**18**
BRL[3]	0.5	17	0.3	21	0.4	21	0.7	21	1.1	19	**1.0**	**19**
ZAR[3]	0.9	13	0.7	16	0.9	15	0.7	20	1.1	18	**1.0**	**20**
DKK[3]	1.2	11	0.9	15	0.8	16	0.6	22	0.8	21	**0.8**	**21**
PLN[3]	0.5	18	0.4	19	0.8	17	0.8	18	0.7	22	**0.7**	**22**
TWD[3]	0.3	20	0.4	18	0.4	22	0.5	23	0.5	23	**0.6**	**23**
THB[4]	0.2	24	0.2	22	0.2	25	0.2	26	0.3	27	**0.4**	**24**
MYR[4]	0.1	26	0.1	30	0.1	28	0.3	25	0.4	25	**0.4**	**25**
HUF[3]	0.0	33	0.2	23	0.3	23	0.4	24	0.4	24	**0.3**	**26**
SAR[4]	0.1	27	0.0	32	0.1	32	0.1	34	0.1	34	**0.3**	**27**
CZK[4]	0.2	22	0.2	24	0.2	24	0.2	27	0.4	26	**0.3**	**28**
ILS[4]	0.1	25	0.1	26	0.2	27	0.2	31	0.2	29	**0.3**	**29**
CLP[4]	0.2	23	0.1	25	0.1	30	0.2	29	0.3	28	**0.2**	**30**
IDR[4]	0.0	28	0.1	27	0.1	29	0.2	30	0.2	30	**0.2**	**31**
COP[4]	0.0	31	0.0	33	0.1	33	0.1	32	0.1	33	**0.2**	**32**
PHP[4]	0.0	29	0.0	31	0.1	31	0.2	28	0.1	31	**0.1**	**33**
RON[4]	...	37	...	40	0.0	34	0.1	33	0.1	32	**0.1**	**34**
PEN[4]	0.0	32	0.0	35	0.0	36	0.0	36	0.1	35	**0.1**	**35**
OTH	6.6		6.6		7.7		4.7		1.6		**2.1**	
Total	**200.0**		**200.0**		**200.0**		**200.0**		**200.0**		**200.0**	

[1] Adjusted for local and cross-border inter-dealer double-counting (ie "net-net" basis). [2] Because two currencies are involved in each transaction, the sum of the percentage shares of individual currencies totals 200% instead of 100%. [3] Turnover for years prior to 2013 may be underestimated owing to incomplete reporting of offshore trading in previous surveys. Methodological changes in the 2013 survey ensured more complete coverage of activity in emerging market and other currencies. [4] Turnover may be underestimated owing to incomplete reporting of offshore trading.

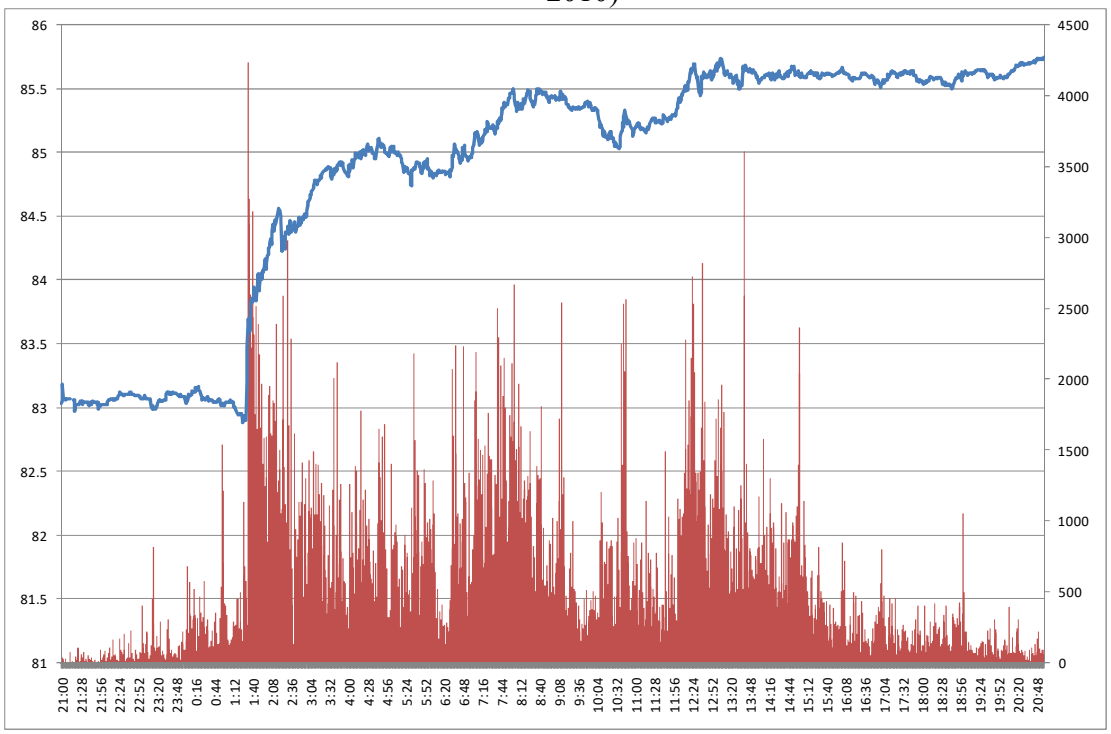
OTC foreign exchange turnover by instrument, currency and counterparty

Net-net basis,[1] daily averages in April 2016, in billions of US dollars — Table 5

Instrument/currency/counterparty	Total	Spot transactions	Outright forwards	Foreign exchange swaps	Currency swaps	FX options
Total	5,067	1,652	700	2,378	82	254
By currency						
USD	4,438	1,385	600	2,160	74	218
EUR	1,591	519	178	807	22	64
JPY	1,096	395	151	458	18	74
GBP	649	211	92	305	10	30
AUD	348	143	41	138	7	20
CAD	260	105	34	103	4	14
CHF	243	57	30	150	2	5
CNY	202	68	28	86	3	18
SEK	112	34	13	59	1	5
NZD	104	40	11	43	1	8
MXN	97	43	12	36	0	6
SGD	91	28	8	51	2	3
HKD	88	22	6	57	1	1
NOK	85	29	8	44	1	3
KRW	84	29	35	14	1	5
TRY	73	20	6	40	4	4
RUB	58	24	6	27	1	1
INR	58	19	23	13	0	3
BRL	51	13	27	1	2	8
ZAR	49	16	4	24	4	2
DKK	42	7	5	30	0	0
PLN	35	12	4	18	0	1
TWD	32	9	13	8	0	1
HUF	15	4	2	8	0	1
OTH	232	72	61	78	6	15

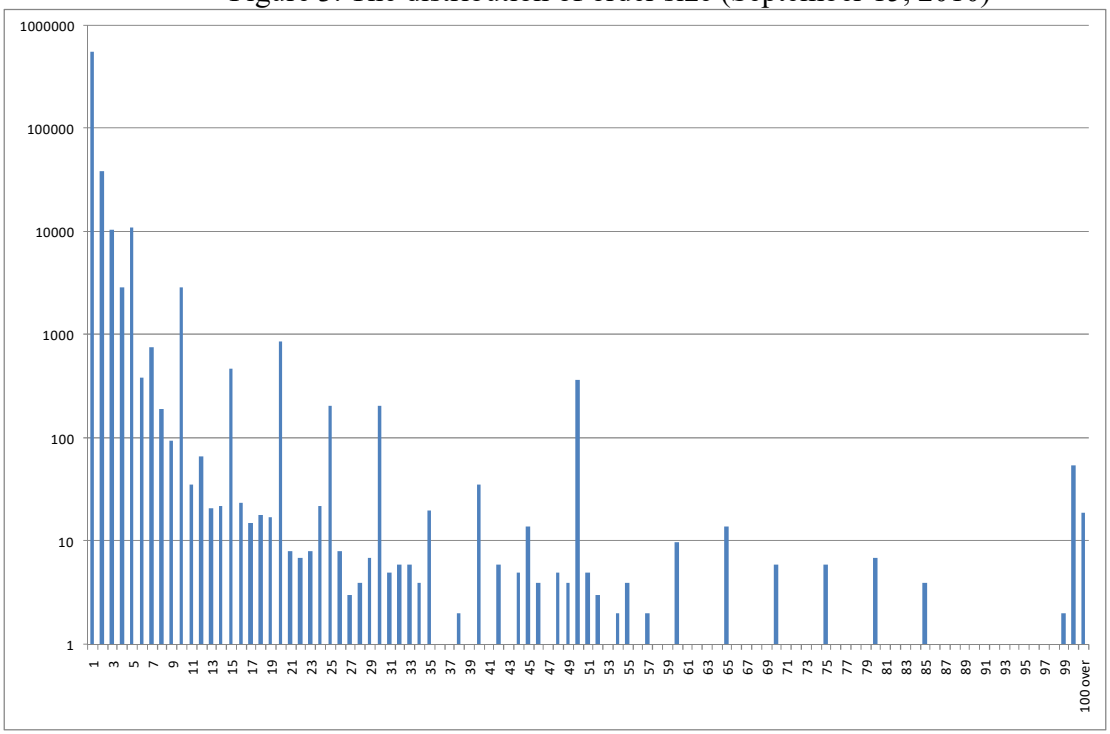
II. A look inside a trading day

Figure 2. Exchange rate and **limit-order** volume plotted against minute interval (September 15, 2010)



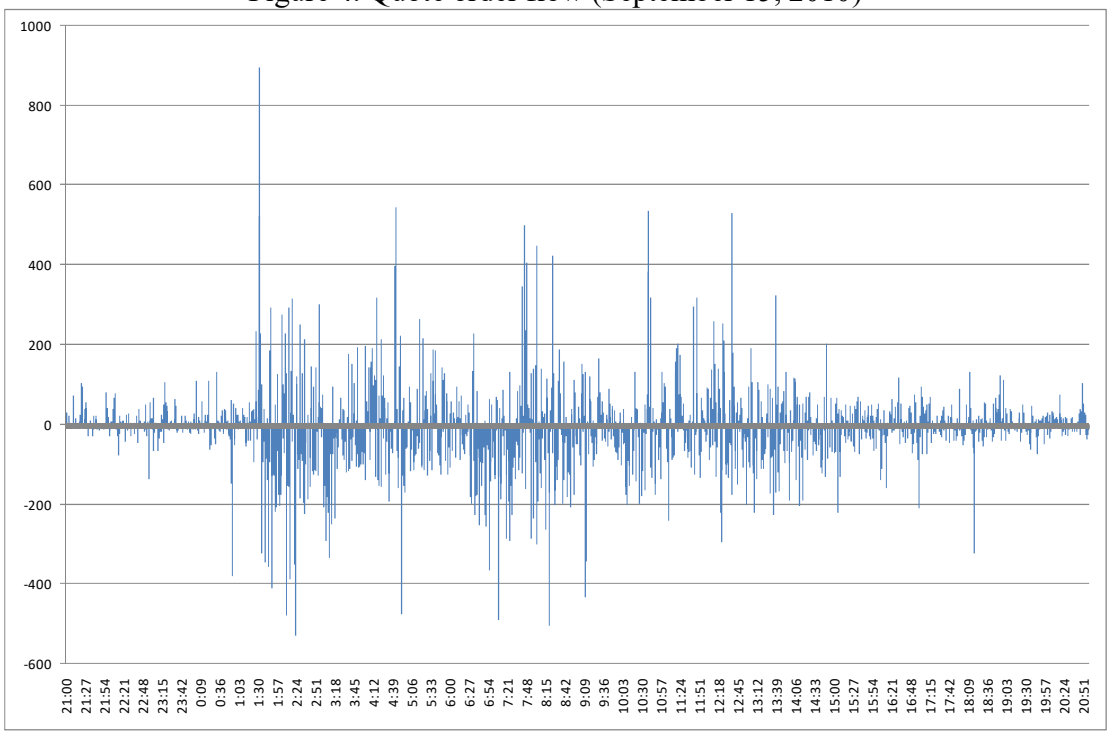
Note: The minute interval sums all limit order volumes in a one minute period. For example, the volume at 23:02 covers all transactions that occur between 23:02:00 and 23:02:59. The minute interval exchange rate is the mid-rate of the latest best bid-ask rates during the current minute. The exchange rate is scaled on the left vertical axis and the limit-order volume (bar) is scaled on the right vertical axis.

Figure 3. The distribution of order size (September 15, 2010)



Note: All limit orders on the JPN/USD spot market from 21:00:00 (GMT) on September 14 to 20:59:59 (GMT) on September 15, 2010. The number of data points is 625,725. The vertical axis is the number of orders, shown on a log scale. The size of orders on the horizontal axis is marked in US million dollars. Over 85 percent of all orders have a minimum value of 1 million US dollars.

Figure 4. Quote order flow (September 15, 2010)



Note: The net quote order flow is defined as the bid (dollar purchase) minus offer (dollar sales). The minute interval sums all quote volumes for the one minute.

III. Understanding the Modern Foreign exchange market

a. Spot quote vs. forward quotes
b. Bid vs. Ask/offer
c. www.oanda.com
d. Direct vs. Indirect quotations

e. Financial times, slightly dated materials

	Closing mid-point	Change on Day	Bid/offer spread	Three rate	%PA
Japan (y)	122.505	0.22	480-530	122.02	-1.6
Singapore (S$)	1.7627	-0.0016	623-630	1.7597	-0.7

f. Note that one simply replaces the last three digits of the Bid/offer

Indirect for USD

	Bid	offer	mid-point
Japan	122.480/USD	122.530/USD	122.505/USD
Singapore	1.7623/USD	1.7630/USD	1.7627/USD

F. Bid/ask or offer spread

- Pay 122.530 when buying one USD (What the bank sells USD for)
- Receive 122.480 (What the bank Pays for USD)
- Remember buy high receive low
- Bid/ask spread=(ask rate-bid rate)/ask rate
- What is the bid/ask spread for the USD vs. Singapore dollar?

G. Direct vs. Indirect quotes, forward rates

- Direct quotations state the number of dollars per foreign currency
- Indirect quotations state the foreign currency per dollar
- What is the direct for USD mid-point quote for the Japanese Yen?

H. Appreciation and Deprecation

Appreciation/Depr

	Closing mid-point	Change on Day
Japan (Y)	122.505	0.22
Singapore (S$)	1.7627	-0.0016
UK (0.6435)	1.5539	-0.0105

	Closing mid-point	Change on Day	Prior day closing
Japan (Y)	122.505	0.22	122.285
Singapore (S$)	1.7627	-0.0016	1.7643
UK (0.6435)	1.5539	-0.0105	1.5644

- Calculation of Appreciation and Deprecation simply equals [(ending rate-beginning rate)/beginning rate]
- More precisely, compounding an interest rate, r, over n periods produces for a $1 investment a future value equal to [1+(r/n)]^n. If we take the limit of this expression as n approaches infinity it equals e^r. Where *e* is roughly 2.71828 or the base of the natural logarithm. Hence (ending rate/beginning rate) equals e^r continuously, so that ln(ending rate/beginning rate) or simply the log difference will precisely measure the continuous rate of appreciation or deprecation.
- Calculate the discrete rate of appreciation for each currency. Are there some potential problems with this method of calculating appreciation or deprecation?

I. Forward Premium/Discount
   a. (forward rate-Spot)/spot*animalization factor (AF) or (ln forward rate-ln spot rate)*AF

b. Calculate for Japanese Yen and SGD

J. Cross exchange rates

- www.oanda.com
- Cross rate is the exchange rate between two countries inferred from each country's exchange rate with a third country.
- **Example:**
- On 29/10/2004 the spot exchange rates between GBR (£) and the Euro (€) and GBR (£) and the Japanese Yen (¥) were: **1.4353 €/£** and **194.46 ¥/£** respectively.

Practice:

1. **The quotations from the *Financial Times* are shown below for these currencies**

	Closing Mid-point	Change on day	Bid/Offer spread	Three months Rate
Brazil (R$)	6.5115	0.0795	080-150	6.435
Mexico (Peso)	12.1800	-0.0120	750-850	12.3675

(a) What is the cross exchange rate for this transaction (you can use mid-point for calculation) directly quoted for the BRL?

(b) What was the prior trading day direct quote for the USD for the Mexican peso?

(c) What was the rate of appreciation or depreciation for the BRL (Discrete or continuous calculations are both acceptable)?

(d) Is the BRL in forward premium? What is the percentage discount or premium annualized?

VI: Arbitrage in Foreign Exchange Markets

Arbitrage
Definition: It involves *no risk* and *no capital of your own*. It is an activity that takes advantages of pricing mistakes in financial instruments in one or more markets.

There are 3 kinds of arbitrage
(1) Local (sets uniform rates across banks)
(2) Triangular (sets cross rates)
(3) Covered (sets forward rates)

Note: The definition we used presents the ideal view of (riskless) arbitrage. "Arbitrage," in the real world, involves risk. We'll call this arbitrage *pseudo arbitrage*.

• **Local Arbitrage** (One good, one market)
Example: Suppose two banks have the following bid-ask FX quotes:

	Bank A		Bank B	
USD/GBP	1.50	1.51	1.53	1.55

Sketch of Local Arbitrage strategy:
(1) Borrow USD 1.51
(2) Buy a GBP from Bank A
(3) Sell GBP to Bank B
(4) Return USD 1.51 and make a USD .02 profit (1.31% per USD 1.51 borrowed)

Note I: All steps should be done simultaneously. Otherwise, there is risk! (Prices might change).
Note II: Bank A and Bank B will notice a book imbalance. Bank A will see all activity at the ask side (buy GBP orders) and Bank B will see all the activity at the bid side (sell GBP orders). They will notice the imbalance and they'll adjust the quotes. For example, Bank A can increase the ask quote to 1.54 USD/GBP. ¶

• **Triangular Arbitrage** (Two related goods, one market)
Triangular arbitrage is a process where two related goods set a third price. In the FX Mkt, triangular arbitrage sets FX cross rates. Cross rates are exchange rates that do not involve the USD. Most currencies are quoted against the USD. Thus, cross-rates are calculated from USD quotations.

The cross-rates are calculated in such a way that arbitrageurs cannot take advantage of the quoted prices. Otherwise, triangular arbitrage strategies would be possible.

Example: Suppose Bank One gives the following quotes:
S_t = 100 JPY/USD
S_t = 1.60 USD/GBP
S_t = 140 JPY/GBP
Take the first two quotes. Then, the implied (no-arbitrage) JPY/GBP quote should be S^I_t = 160 JPY/GBP
At S_t = 140 JPY/GBP, **Bank One undervalues the GPB against the JPY** (with respect to the first two

quotes).

Sketch of Triangular Arbitrage (Key: Buy undervalued GPB with the overvalued JPY):

(1) Borrow USD 1
(2) Sell the USD for JPY 100 (at S_t = 100 JPY/USD)
(3) Sell the JPY for GBP (at S_t = 140 JPY/GBP). Get GBP 0.7143
(4) Sell the GPB for USD (at S_t = 1.60 USD/GBP). Get USD 1.1429
=> Profit: USD 0.1429 (14.29% per USD borrowed).

Note: Bank One will notice a book imbalance (all the activity involves selling USD for JPY, selling JPY for GBP, etc.) and will adjust the quotes. For example, will set S_t = 160 JPY/GBP. ¶

Again, all the steps in the triangular arbitrage strategy should be done at the same time. Otherwise, we'll be facing risk and what we are doing should be considered pseudo-arbitrage.

Examples and Practice:

1. **CFA exam problem**: Assume you are a trader with Deutsche Bank. From the quote screen on your computer terminal, you notice that Dresdner Bank is quoting €0.7627/$1.00 and Credit Suisse is offering SF1.1806/$1.00. You learn that UBS is making a direct market between the Swiss franc and the euro, with a current €/SF quote of .6395. Show how you can make a triangular arbitrage profit by trading at these prices. (Ignore bid-ask spreads for this problem.) Assume you have $5,000,000 with which to conduct the arbitrage. What happens if you initially sell dollars for Swiss francs? What €/SF price will eliminate triangular arbitrage?

2. **Triangular Arbitrage: Real example developed on February 16th, 2018**

Table 1: Bitcoin Prices in Thailand

Buy Orders

Volume (THB)	Rate	Volume (BTC)
2,375.12 THB	319,800.00	0.00742690 BTC
107.73 THB	319,678.00	0.00033700 BTC

Sell Orders

Volume (THB)	Rate	Volume (BTC)
4,157.34 THB	320,033.00	0.01299035 BTC

Volume (THB)	Rate	Volume (BTC)
641,758.66 THB	320,828.00	2.00032000 BTC

Table 2: Bitcoin prices in USA

GLOBAL BITCOIN PRICE INDEX (GBX) - Bitcoin (BTC) to United States Dollar (USD) 11.16.39

$ 9948 USD Bid Price

$9978 Ask Price

Table 3: Exchange rates between USD/THB

	Bid Sell 1 USD	Ask Buy 1 USD
MIN	31.1170	31.2920
AVG	31.2431	31.3367
MAX	31.2910	31.4810

• **Covered Interest Arbitrage** (Four instruments -two goods per market-, two markets)
Brazilian bonds yield 10% and Japanese bonds 1%.

Q: Why wouldn't capital flow to Brazil from Japan?
A: FX risk: Once JPY are exchanged for BRL (Brazilian reals), there is no guarantee that the BRL will not depreciate against the JPY. The only way to avoid this FX risk is to be covered with a forward FX contract.

Intuition: Let's suppose we have the following data:
i_{JPY} = 1% for 1 year (T=1 year)
i_{BRL} = 10% for 1 year (T=1 year)
S_t = .025 JPY/BRL

You can construct the following strategy to take "advantage" of the interest rate differential:
Today, at time t=0, we do the following:
(1) Borrow JPY 1000 at 1% for 1 year. (At T=1 year, we will need to repay JPY 1010.)
(2) Convert to BRL at .025BRL/JPY. Get BRL 25.
(3) Deposit BRL 25 at 10% for 1 year. (At T=1 year, we will receive BRL 27.50.)
At time T=1 year, we do the final step:
(4) Exchange BRL 27.50 for JPY at S_T.

Problem with this strategy: Today, we do not know $S_{T=1\text{-year}}$. Note:
If S_T= .022 BRL/JPY, we will receive JPY 1250, for a profit of JPY 240.
If S_T= .025 BRL/JPY, we will receive JPY 1100, for a profit of JPY 90.
If S_T= .027 BRL/JPY, we will receive JPY 1019, for a profit of JPY 9.
If S_T= .030 BRL/JPY, we will receive JPY 916, for a profit of JPY -74.
=> We are facing FX risk. That is, (1)-(4) is not an arbitrage strategy.

Now, at time t=0, we can use the forward market to insure a certain exchange rate for the JPY/BRL.
Suppose we get a quote of $F_{t,1\text{-yr}}$=.026 BRL/JPY. We could re-do step (4):
(4') Sell BRL forward at .026 BRL/JPY. (We will receive JPY 1058, for a profit of JPY 48.)
=> We are facing no FX risk. That is, (1)-(4') is an arbitrage strategy (covered arbitrage!).

Now, instead of borrowing JPY 1000, we will try to borrow JPY 1 billion (and make a JPY 48M profit) or more. Obviously, no bank will offer a .026 BRL/JPY forward contract!

• **Interest Rate Parity Theorem**
Q: How do banks price FX forward contracts?
A: In such a way that arbitrageurs cannot take advantage of their quotes.

- Take notes of deviation

1. The following bid and offer spot and 3-month forward exchange rates are shown for the Euro against the U.S. dollar (USD).

	Bid	Offer	Mid
Euro spot	1.01/Euro	1.03/Euro	1.02/Euro
3-mo forward	0.99/Euro	1.00/Euro	0.995/Euro

Also, the following offer and bid bank annualized interest rate, based on 3-month maturities, are shown for the Euro and USD.

	Annualized (in fractions) Three months Offer (%) bid (%)	or	Annualized (in decimals) Three months Offer	Bid	Mid
Euro	3 1/4 - 3 5/32		0.0325	0.0315	0.032
U.S. Dollar	1 5/8 - 1 1/2		0.015	0.013	0.014

(a) Show the self-financing riskless covered interest arbitrage that s possible in this market, starting the analysis by borrowing 1 million units of the currency to be borrowed. (Determine which currency to borrow by examining the relationship between the mid spot and forward exchange rates and the interest rates.)

2. **The following bid and offer spot and 3-month forward exchange rates are shown for the Switzerland franc (CHF) against the U.S. dollar (USD).**

	Bid	Offer	Mid
Switzerland spot	CHF 1.4695/USD	CHF 1.4707/USD	CHF 1.4701/USD
3-mo forward	CHF 1.4530/USD	CHF 1.4550/USD	CHF 1.4540/USD

Also, the following offer and bid bank annualized interest rate, based on 3-month maturities, are shown for the CHF and USD.

	Annualized (in fractions) Three months Offer (%) bid (%)	or	Annualized (in decimals) Three months Offer	Bid	Mid
Swiss Franc	25/32 - 11/16		0.0078125	0.006875	0.00734375
U.S. Dollar	1 5/8 - 1 1/2		0.01625	0.015	0.015625

(a) Show the self-financing riskless covered interest arbitrage that s possible in this market, starting the analysis by borrowing 1 million units of the currency to be borrowed. (Determine which currency to borrow by examining the relationship between the mid spot and forward exchange rates and the interest rates.)

V.Macro-economic factors impacting Exchange rates

a. Understanding marcoeconomic factors with Demand and Supply analysis

b. Law of one price in a one currency world

    i. Holiday Inn room in Colorado vs. Florida
        1. Goods are non-tradable not much one can do other than move
    ii. French wine in Germany vs. Holland
        1. If price gets to large goods arbitrage is possible assuming free flows of goods

c. Law of One price in a Multi Currency world
    i. Equilibrium exchange rate itself can play a part in causing price differentials, an equilibrium exchange rate can be identified as an exchange rate that eliminates arbitrage
    ii. **The theory of exchange rate determination starts with the assertion that the exchange rate in equilibrium is the one that satisfies price equalization for products among countries when markets are well developed and free, and transportation and transaction costs are zero.**
        1. This implies it is possible to determine a rate of exchange between currencies such that their prices are the same after adjusting for the exchange rate regardless of which currency one uses for denomination purposes. Indeed, under these conditions, one can determine the path that the value of currencies will take when predictable prices changes—inflation rates—exist.
        2. Such equilibrium conditions are generically referred to as purchase power parity (PPP), with the two major classifications, the classical (Cassel, 1921) and the efficient market (Roll, 1979) version.

B. Classical Purchase Power Parity

a. Classical PPP itself can be classified into absolute and relative versions, and the absolute into a special case of commodity price parity. The latter applies to a single commodity, whereas the general case of absolute PPP applies to a basket of commodities represented by price indices.

i. Example of Absolute PPP—Chilean Wine ins Uruguay and Bolivia
    1. http://english.vietnamnet.vn/fms/society/105316/smuggling-continues-unabated-across-vietnamese-cambodian-border.html

ii. Example 3: Big Mac Index: http://www.economist.com/content/big-mac-index

A. Relative PPP

- **a.** Relative PPP takes absolute one step further, by assuming that prices represent price indexes.
- **b.** Deviation of Relative PPP—Take good notes
- **c.** Forecasting with PPP—Take good notes
- **d.** Some issues with Relative PPP: http://www.time.com/time/photogallery/0,29307,1626519,00.html

B. The Real Exchange Rate

- **a.** We have shown in part III a method to forecast the spot exchange rate based on PPP. The actual future spot exchange rate may either be the forecast or not—likely not. What happens to the real exchange rate if the actual future spot exchange rate is equal to the forecast based on PPP?
  - **A.** Analogy
- **b.** The same idea applies to the nominal versus the real exchange rate. If the future nominal exchange rate changes exactly to what is required owing to inflation, then the real exchange rate is unchanged. In this case, the competitive international position of a firm or investor is unchanged vis-à-vis the other country. Of course, if the nominal value of a currency rises by more than is required owing to inflation, then that currency has gained value on a real basis and vice versa.
- **c.** Generally, currencies that gain value on a real basis are less competitive internationally, and those that lose value on a real basis are more competitive

C. International Fisher Effect or Uncovered Interest Parity

- **a.** The Fisher effect states the nominal rates of interest are composed of a real rate and an inflation premium. The idea is that the nominal rate of interest is derived from compounding the real rate at the rate of inflation, given that the nominal rate reflects an adjustment of the real rate for inflation.
- **b.** Deviation of IFE—Take notes

D. Foreign Exchange Forecasts and Interest Rate Parity

Notice that the exchange rate forecasts are the same with the International Fisher Effect and the relative PPP. This is the case because for our examples (and the ones in the book) the Fisher effect and the law of one price are assumed to hold. It must finally be pointed out that the forecasts made with relative PPP and IFE are not guaranteed to come out to be true. Certainly these ideas suggest countries with higher inflation rates and higher nominal rates of interest owing to higher inflation should experience depreciation in the international value of their currencies. But there are other factors that influence the exchange rate, including money supply, growth, the velocity of money, and real economic activity. In these latter cases, however, the postulated effects depend on the interpretation, which may be influenced by whether one has a monetarist or Keynesian view of the world. Even political considerations need to be taken into account in exchange rate forecasts. Will the central bank support a currency or not? The

numerous variables that can impact exchange rate forecasts make it necessary that econometric multivariate techniques be used in these, as in practiced by major forecasting services.

Regardless, the astute student should observe that there is a substantive difference between the International Fisher Effect and the Interest Rate Parity. The forecast for former may or may not hold. Interest rate parity holds in free markets, and provides in itself no forecast. It simply specifies the equilibrium relation between a forward and spot exchange rate, given interest rates for currencies involved.

Practice Problems

1. Imagine a bye-gone era, when the Portuguese currency was the escudo and the Spanish currency the peseta. Now, assume a Portuguese tourist plans to vacation in Spain in one year. The tour package is currently priced at Spanish peseta 307,760, and the current exchange rate is Portuguese escudo (Esc) 1.20 per Spanish peseta (Pta). The annual inflation rate in Spain is expected to equal 10 percent and in Portugal 8 percent during the coming year. What will the Portuguese escudo cost of the vacation equal in one year, assuming that all parity conditions and the law of one price are satisfied between Portugal and Spain (using discrete calculations)?

2a. The US nominal annual rate of interest is 6% and annual rate of inflation is 2%. What is the precise U.S. real annual rate of interest, assuming the Fisher effect holds?

b. The German nominal annual rate of interest is 5%. Assuming the Fisher effect holds domestically and internationally, and give the information in (a) above, what is the expected inflation rate in Germany?

3. The U.S nominal annual rate of interest is 5% and the European annual nominal rate of interest on the Euro is 3%. At the same time, the spot exchange rate is $1.40 per Euro and the real rate is 2% in both the US and Europe.

a. What is the one year forecast of the U.S. dollar (USD) per Euro spot exchange rate, assuming the International Fisher effect holds?