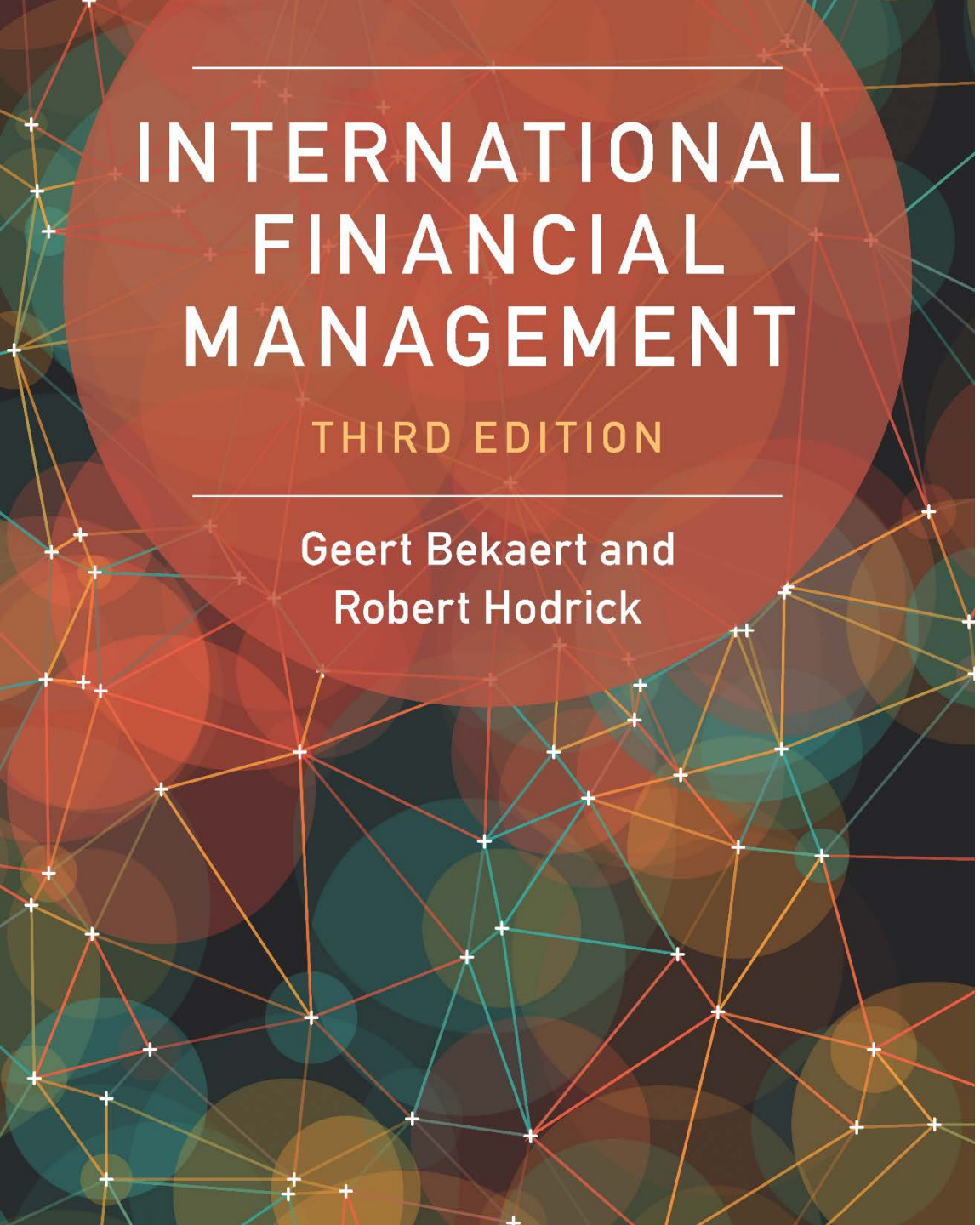
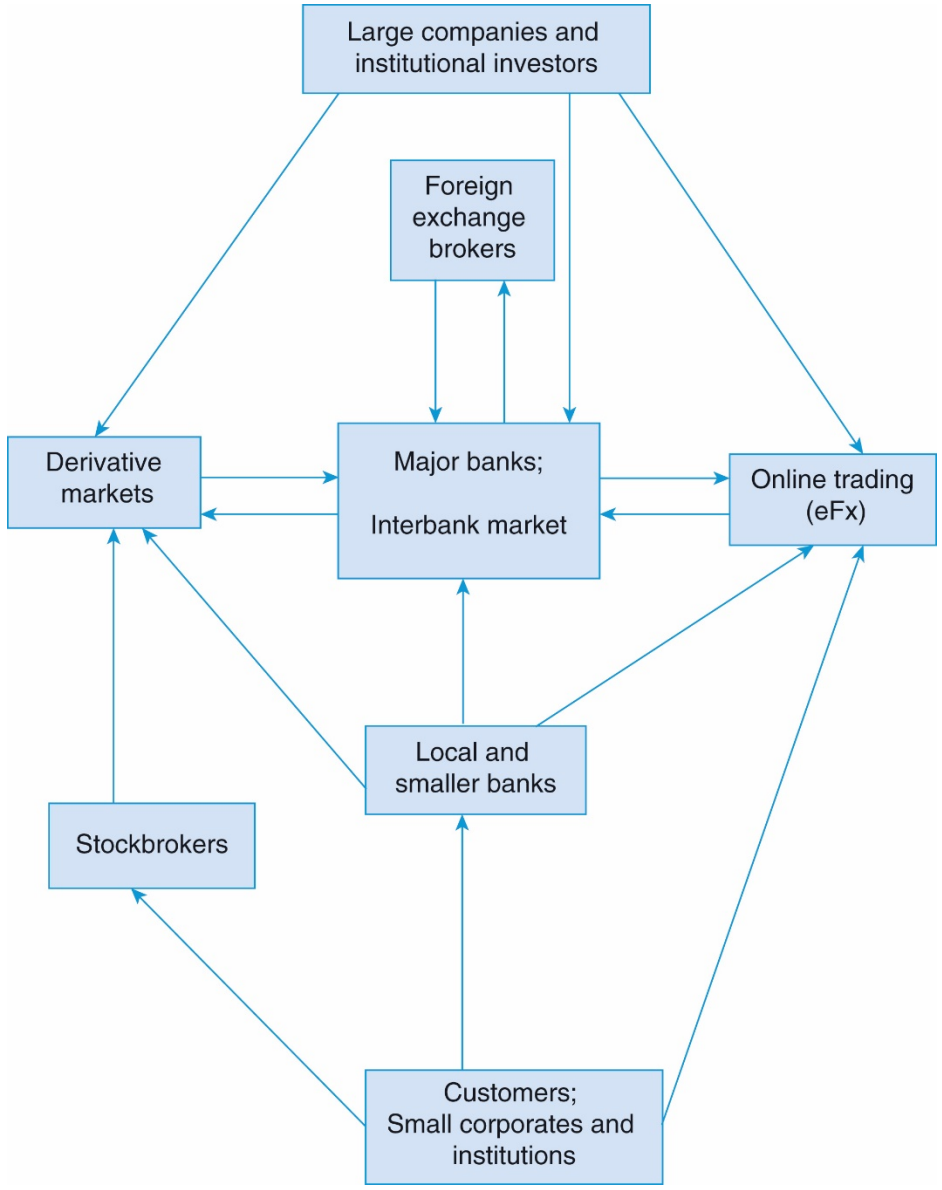


Chapter 2

The Foreign Exchange Market

Exhibit 2.1 The Structure of the Foreign Exchange Market

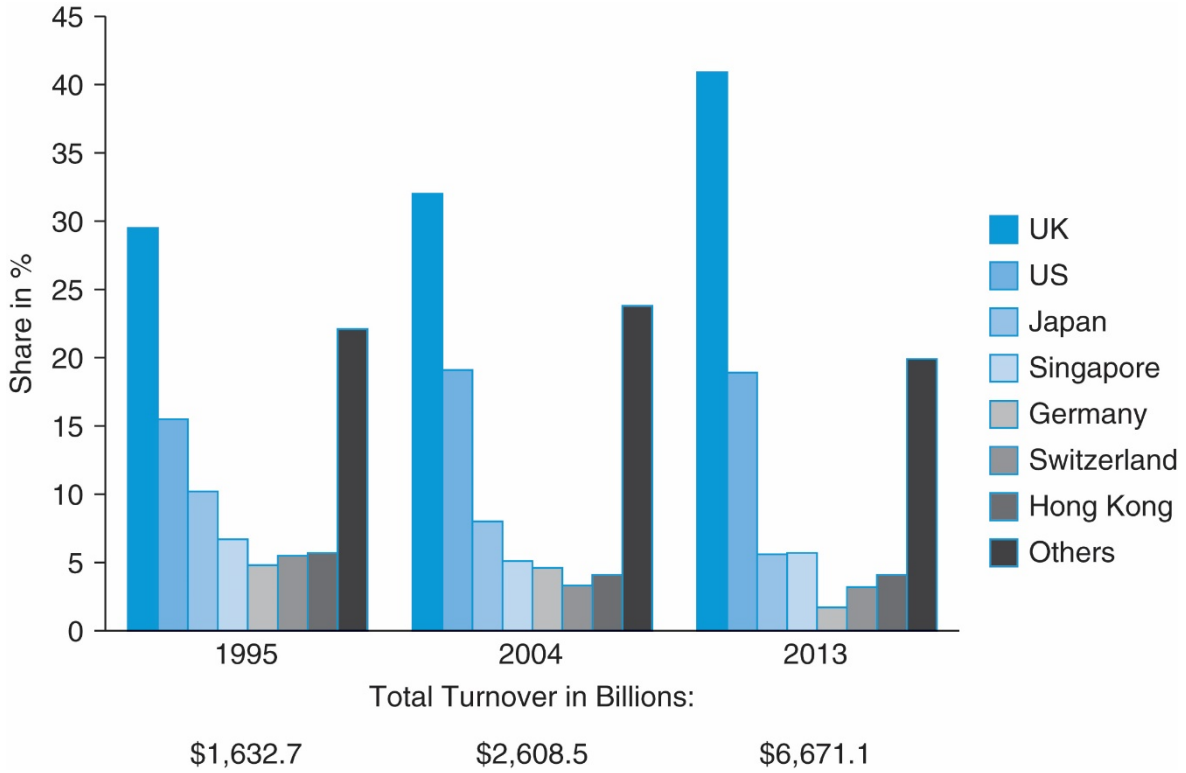
- Most important cities:
  - London, New York, Tokyo
- ForEx (or FX) operates 24 hrs/day
  - Interbank market (39%)
  - Corporations (9%)
  - Other financial institutions (53%)
  - Most trades are $1M or more!



2.1 The Organization of the Foreign Exchange Market

- Size of the market
  - Largest financial market in the world
    - $5.3 trillion a day (as of April 2013)
    - Compared to only $36 billion on NYSE (in 2013)

Exhibit 2.2 Foreign Exchange Trading Activity Across the World



2.1 The Organization of the Foreign Exchange Market

- Types of contracts traded
  - Spot
  - Future transactions: swaps, forward contracts (Ch. 3)
  - Derivatives: futures and options (Ch. 20)
  - Conventions
    - Transactions completed within 2 business days
      - Exception 1: Exchanges between US Dollar, Mexican Peso, and Canadian Dollar
      - Exception 2: Holidays don’t count in U.S. dollar transactions
      - Exception 3: Fridays are not business days in Middle East but Saturdays/Sundays are so – non-Middle Eastern currencies settle on Fridays and Middle Eastern currencies settle on Saturdays

2.1 The Organization of the Foreign Exchange Market

- Foreign exchange dealers
  - Who?
    - Commercial banks
    - Investment banks
    - Brokerage firms (Intermediary – does not put own money at risk)
  - Market makers
    - They make it easier for buyers and sellers to come together
  - Liquidity
    - Ease with which one can sell an asset at its fair value
    - Low transaction costs
  - Other participants in the forex market
    - Central banks
    - Multinational corporations

2.1 The Organization of the Foreign Exchange Market

- Electronic foreign exchange trading (eFX)
  - > 30% of all trading volume and > 50% in spot markets
  - Straight Through Processing (STP)
    - Forex trade takes place from placement of order to settlement in automated fashion
  - Three categories
    - Single bank sponsored platforms (“portals”)
      - Best known and most active platform is FXConnect (State Street)
    - Multi-bank portals
      - Another leader is FXall (consortium of banks)
    - Independent companies
      - HotSpot and Currenex
  - Originally designed for corporate clients or institutional investors but got a boost from hedge funds and retail aggregators

2.1 The Organization of the Foreign Exchange Market

- The competitive marketplace
  - No product differentiation – money is money
  - Has been a lot of players (past)
    - Top 4 account for less than 30%
    - Top 20 less than 75%
  - Recently, there has been consolidation (2014)
    - Top 4 account for over 40%
    - Top 20 over 90%
  - Still exceedingly competitive with no signs of any dominant leader in this market

Exhibit 2.3 The Top 20 Dealers in the Foreign Exchange Market

Exhibit 2.3 The top 20 dealers in the foreign exchange market

Rank 2015	Company	Market share	Rank 2014	Market share 2000[1]
1	Citigroup	16.11%	1	8.07%
2	Deutsche Bank	14.54%	2	12.53%
3	Barclays	8.11%	3	2.07%
4	JPMorgan Chase[2]	7.65%	6	12.10%
5	UBS[3]	7.30%	4	5.02%
6	Bank of America Merrill Lynch	6.22%	7	1.86%
7	HSBC	5.40%	5	4.55%
8	BNP Paribas	3.65%	9	–
9	Goldman Sachs	3.40%	10	4.38%
10	Royal Bank of Scotland[4]	3.38%	8	2.71%
11	Société Générale	2.43%	13	0.60%
12	Standard Chartered	2.40%	14	0.62%
13	Morgan Stanley	1.97%	11	2.87%
14	Credit Suisse	1.66%	12	2.89%
15	State Street	1.55%	16	1.95%
16	Nomura	1.17%	15	–
17	Crédit Agricole	0.99%	22	–
18	Commerzbank	0.94%	18	–
19	RBC Capital Markets	0.74%	19	–
20	Westpac Banking Corporation	0.73%	17	–
	Total	91.26%		

"When did your dad first explain foreign-currency exchange rates to you?"

2.2 Currency Quotes and Prices

- Exchange rate – price of one currency in terms of another
  - JPY100 = USD1
  - ¥100 = $1
  - ¥100/$1 or ¥100/$ (the number one is implied)
- Exchange rate quotes
  - Direct – quoting FX rate with domestic currency first, i.e., numerator of fraction
    - For American, the “interesting” part is in $’s:
      - $1.60 = £1 (This is called the American quote)
  - Indirect – quoting foreign currency first
    - For American, the “interesting” part is in £’s:
      - $1 = £0.625 (Often called the European quote)

2.2 Currency Quotes and Prices

- Direct and indirect: inverse of each other
  - $Direct = \frac{1}{Indirect}$

	In the US	In Britain
$ per £	Direct	Indirect
$ per £	American	American
£ per $	Indirect	Direct
£ per $	European	European
	In Thailand	In the European Union
Thai baht per €	Direct	Indirect

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Exhibit 2.4 Currencies and Currency Symbols

Exhibit 2.4 Currencies and currency symbols

Country	Currency	ISO currency code
Argentina	Peso	ARS
Australia	Dollar	AUD
Bahrain	Dinar	BHD
Brazil	Real	BRL
Canada	Dollar	CAD
Chile	Peso	CLP
China	Yuan	CNY
Colombia	Peso	COP
Czech Republic	Koruna	CZK
Denmark	Krone	DKK
Ecuador	US dollar	USD
Egypt	Pound	EGP

Exhibit 2.4 Currencies and Currency Symbols

Country	Currency	ISO currency code
European Union	Euro (€)	EUR
Hong Kong	Dollar	HKD
Hungary	Forint	HUF
India	Rupee	INR
Indonesia	Rupiah	IDR
Israel	Shekel	ILS
Japan	Yen (¥)	JPY
Jordan	Dinar	JOD
Kuwait	Dinar	KWD
Lebanon	Pound	LBP
Malaysia	Ringgit	MYR
Mexico	Nuevo Peso	MXN
New Zealand	Dollar	NZD
Norway	Krone	NOK
Pakistan	Rupee	PKR
Peru	New Sol	PEN
Philippines	Peso	PHP
Poland	Zloty	PLZ
Russia	Ruble	RUR
Saudi Arabia	Riyal	SAR
Singapore	Dollar	SGD
South Korea	Won	KRW
South Africa	Rand	ZAR
Sweden	Krona	SEK
Switzerland	Franc	CHF
Taiwan	Dollar	TWD
Thailand	Baht	THB
Turkey	Lira	TRY
United Arab Emirates	Dirham	AED
United Kingdom	Pound (£)	GBP
United States	Dollar ($)	USD
Uruguay	Peso	UYU
Venezuela	Bolivar	VEB
Vietnam	Dong	VND

Exhibit 2.5 U.S. Dollar Currency Quotes from Tuesday, July 21, 2015

G-10 Currencies	Code	Per USD	In USD
Australian dollar	AUD	1.3513	0.7400
Canadian dollar	CAD	1.2985	0.7701
Swiss franc	CHF	0.9592	1.0425
Euro	EUR	0.9153	1.0925
UK pound	GBP	0.6412	1.5593
Japanese yen	JPY	123.84	0.008075
Norwegian krone	NOK	8.1352	0.1229
New Zealand dollar	NZD	1.5138	0.6606
Swedish krona	SEK	8.5726	0.1167

Other OECD	Code	Per USD	In USD
Chilean peso	CLP	653.886	0.001529
Czech koruna	CZK	24.7753	0.0404
Danish krone	DKK	6.88365	0.1453
Estonian kroon	EEK	14.3212	0.0698
Hungarian forint	HUF	281.89	0.003547
Icelandic krona	ISK	134.45	0.007438
Israeli shekel	ILS	3.8048	0.2628
South Korean won	KRW	1152.07	0.0008680
Mexican peso	MXN	16.0426	0.0623
Polish zloty	PLN	3.7734	0.2650
Turkish lira	TRY	2.6985	0.3706

Emerging Markets	Code	Per USD	In USD
Argentine peso	ARS	9.1685	0.1091
Azerbijan manat	AZN	1.049	0.9533
Bahraini dinar	BHD	0.3744	2.6709
Bangladeshi taka	BDT	75.8144	0.01319
Belarusian ruble	BYR	15084.8	0.0000663
Belize dollar	BZD	1.9568	0.5110
Bhutan ngultrum	BTN	63.5799	0.01573
Botswana pula	BWP	9.8347	0.1017

Emerging Markets	Code	Per USD	In USD
Brazilian real	BRL	3.1877	0.3137
Brunei dollar	BWP	9.83468	0.1017
Bulgarian lev	BGN	1.79002	0.5587
Cambodian riel	KHR	3987.03	0.0002508
Chinese yuan	CNY	6.0847	0.1643
Columbian peso	COP	2728.64	0.0003665
Egyptian pound	EGP	7.8068	0.1281
Hong Kong dollar	HKD	7.7505	0.1290
Indian rupee	INR	63.4336	0.01576
Indonesian rupiah	IDR	13369	0.0000748
Iranian rial	IRR	29,535	0.0000339
Jamaican dolllar	JMD	84.052	0.0119
Jordanian dinar	JOD	0.7061	1.4162
Kazakhstan tenge	KZT	183.681	0.005444
Kuwaiti dinar	KWD	0.3027	3.3036
Lebanese pound	LBP	1477.49	0.0006768
Malayasian ringgit	MYR	3.7942	0.2636
Nigerian naira	NGN	196.412	0.005091
Pakistani rupee	PKR	100.515	0.00995
Peruvian new sol	PEN	3.1187	0.3206
Philippines peso	PHP	45.1415	0.0222
Russian ruble	RUB	57.0418	0.0175
Saudi Arabian riyal	SAR	3.7489	0.2667
Singapore dollar	SGD	1.3645	0.7329
South African rand	ZAR	12.359	0.0809
Taiwan dollar	TWD	31.1201	0.03213
Tajikistani somoni	TJS	6.2597	0.1598
Thai baht	THB	34.5612	0.02893
UAE dirham	AED	3.6723	0.2723
Uruguayan peso	UYU	26.9294	0.03713
Venezuelan bolivar	VEF	6.29582	0.1588
Vietnamese dong	VND	21443.7	0.00004663

2.2 Currency Quotes and Prices

- Vehicle currencies and currency cross-rates
  - Vehicle currency
    - a currency that is actively used in many international financial transactions around the world
    - Used due to transaction costs of making markets in many currencies being too high
    - U.S. Dollar primary vehicle currency (85% of all transactions)
  - Cross-rates
    - Trading currency in the New York market where both currencies are not expressed in U.S. dollars
    - Trend toward cross-rate transactions

Exhibit 2.6 Representative Cross-Rate Quotes from July 21, 2015

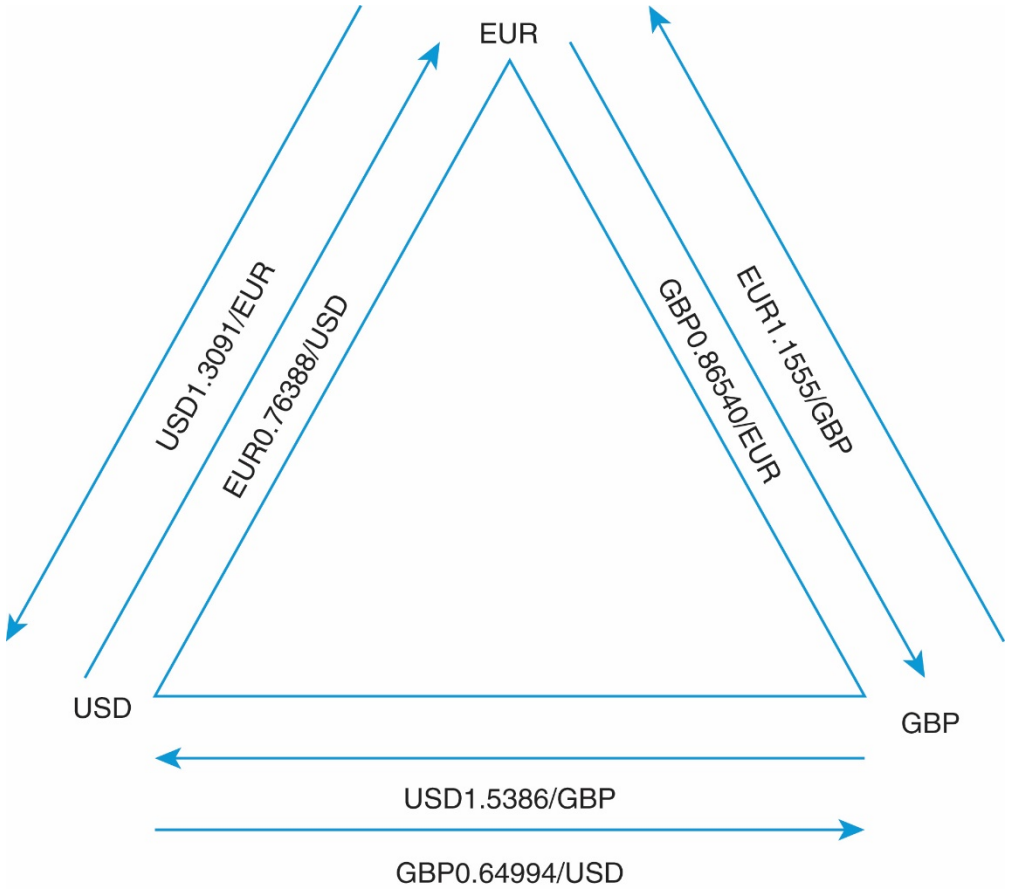
Exhibit 2.6 Representative cross-rates from July 21, 2015

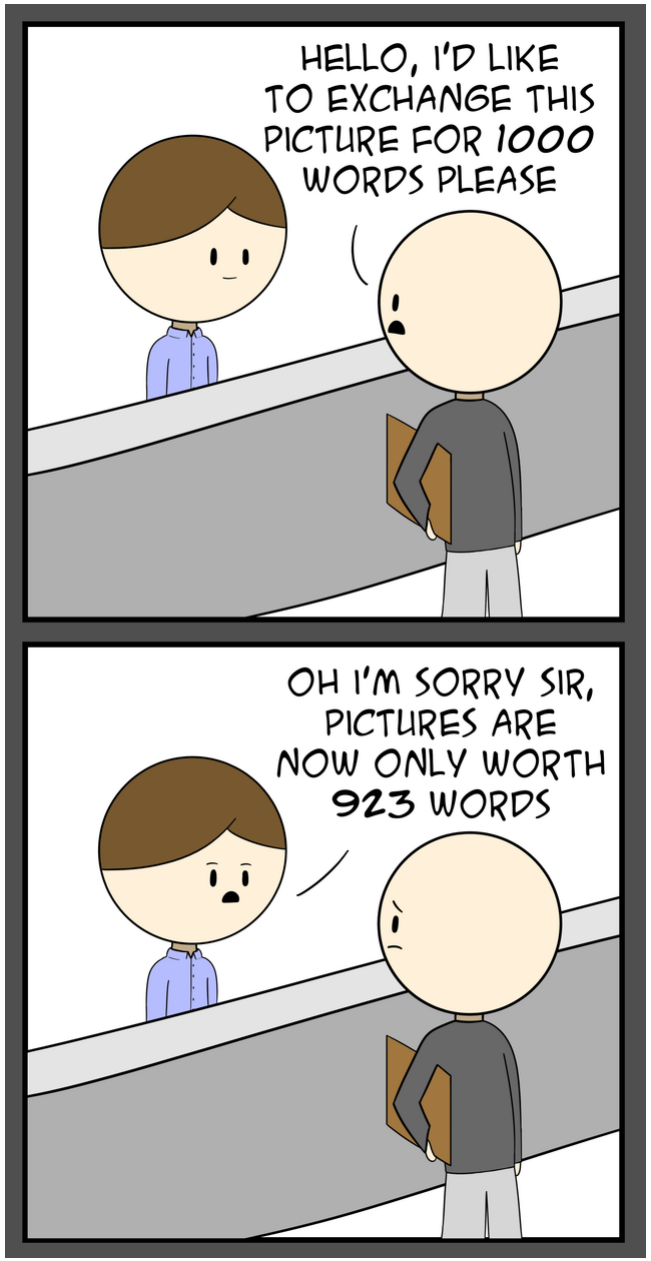
	USD	EUR	GBP	CHF	MXN	JPY	CAD
Canada CAD	1.2985	1.4185	2.0248	1.3533	0.08094	0.01049	...
Japan JPY	16.043	17.525	193.12	129.08	7.7200	...	95.360
Mexico MXN	16.043	17.525	25.015	16.719	...	0.12954	12.352
Switzerland CHF	0.95923	1.0479	1.4958	...	0.05979	0.00774	0.73857
UK GBP	0.64122	0.70047	...	0.66831	0.03995	0.00518	0.49371
Euro	0.91529	...	1.4272	0.95398	0.05702	0.00739	0.70474
US USD	...	1.0924	1.5593	1.04219	0.06230	0.00807	0.76997

2.2 Currency Quotes and Prices

- Triangular arbitrage
  - An arbitrage process involving three currencies
  - Keeps cross-rates in line with exchange rates quoted relative to the U.S. dollar
  - Occurs when one can trade three currencies and make a profit (versus two)
    - $€/£ < €/\$ \times \$/£$
    - Notice that the $ signs on the RHS cancel out

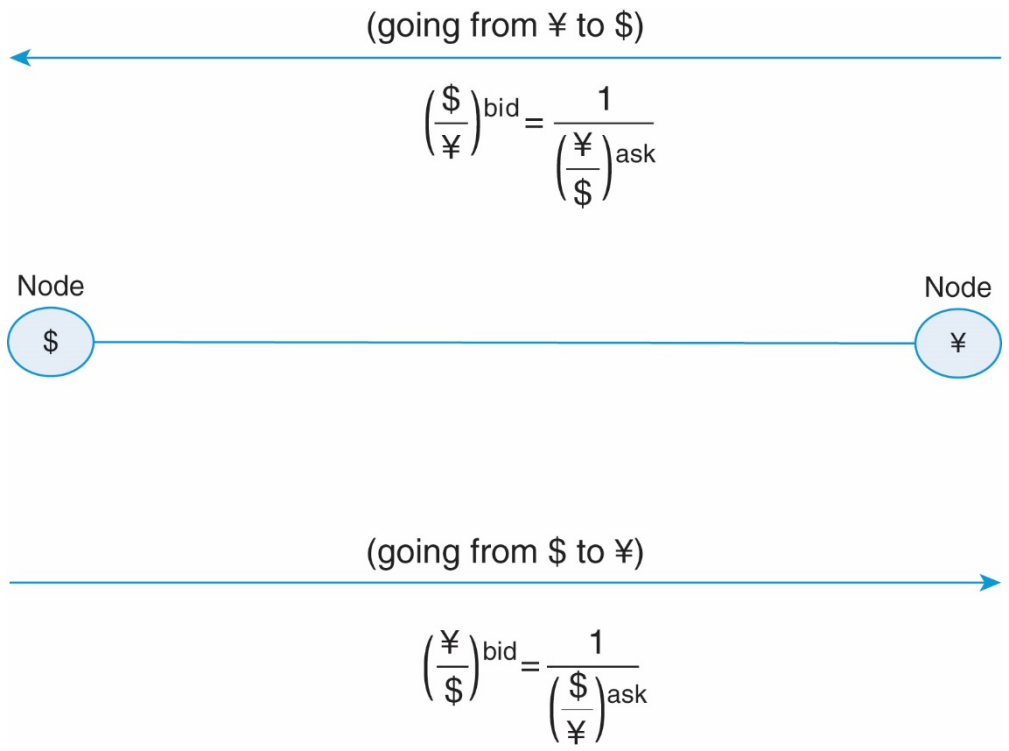
Exhibit 2.7 Triangular Arbitrage Diagram





2.3 Inside the Interbank Market I: Bid-Ask Spreads and Bank Profits

- Bid-ask spreads
  - Bid: Rate at which banks will buy the base currency
  - Ask: Rate at which banks will sell base currency
  - Always keep in mind that you transact with the bank to your disadvantage

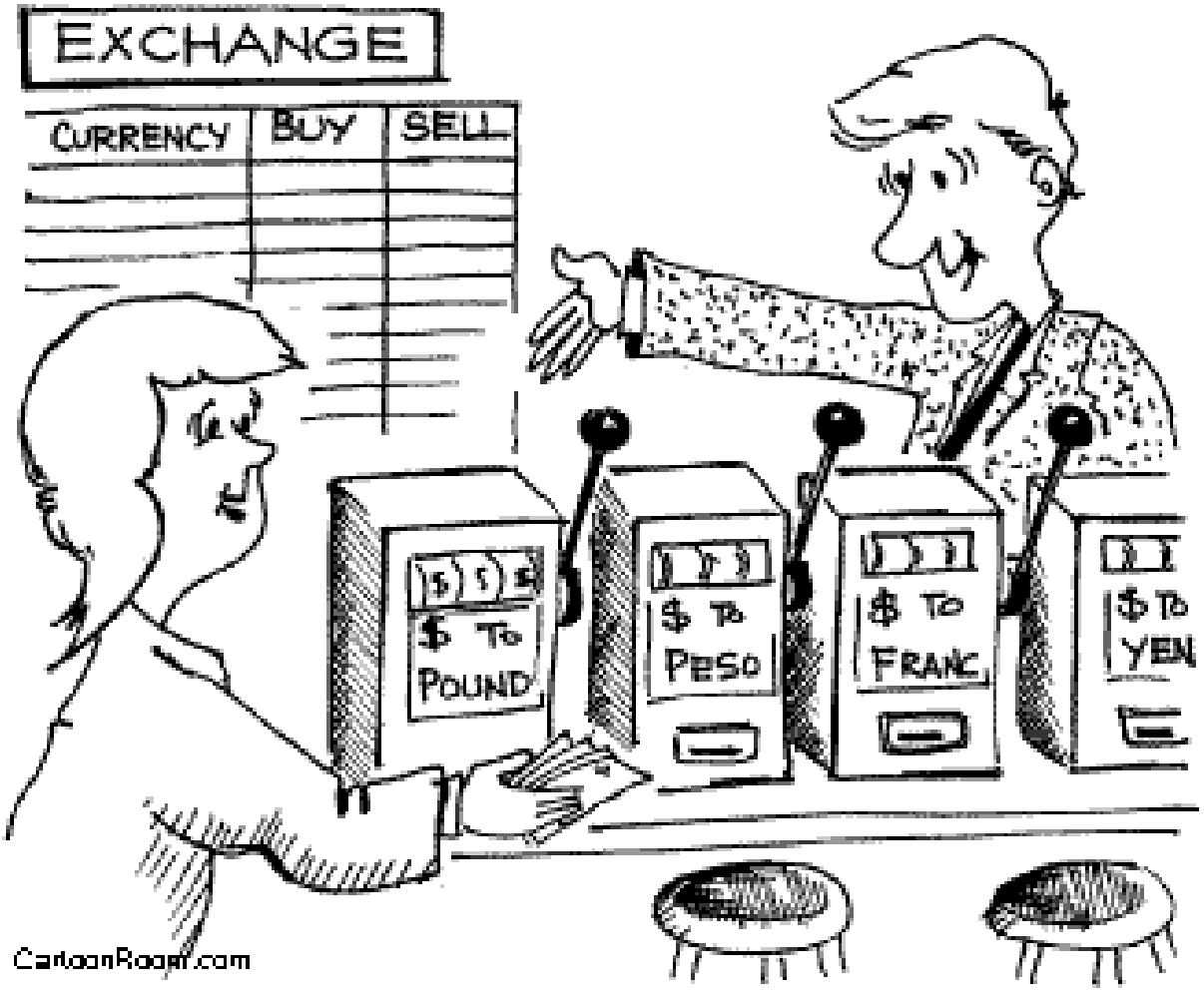


2.3 Inside the Interbank Market I: Bid-Ask Spreads and Bank Profits

- Magnitude of bid-ask spreads
  - Interbank market
    - Within 5 pips
      - Fourth decimal point in a currency quote, or 0.0001
    - The most liquid currencies trade at less than 10 pips
    - Higher spreads for less liquid currencies
  - Physical exchange
    - 5% or more
      - Banks have to have inventory, which means it is not interest bearing
      - Banks must transact with brokers
    - Use credit cards to exchange when in another country – this is the best possible rate for you
  - Differs across the day

2.3 Inside the Interbank Market I: Bid-Ask Spreads and Bank Profits

- Treasurer of a U.S. company purchases pounds with dollars to hedge a British goods purchase.
  - Directly after, he is told that they no longer need to purchase the goods, so he sells the £ back for $
    - Assume that the % bid-ask spread is 4 pips.
    - If the ask rate is $1.50/£, the bid rate is $1.4996/£ and the percentage spread is:
      - $[(\$1.50/£) - (\$1.4996/£)] \div (\$1.4998/£) = 0.03\%$
    - If the treasurer bought £1M at $1.50/£, the cost would be:
      - $£1M \times (\$1.50/£) = \$1{,}500{,}000$
    - Selling back:
      - $£1M \times (\$1.4996/£) = \$1{,}499{,}600$
      - A loss of $400 on the two transactions, or 0.03% of $1.5M

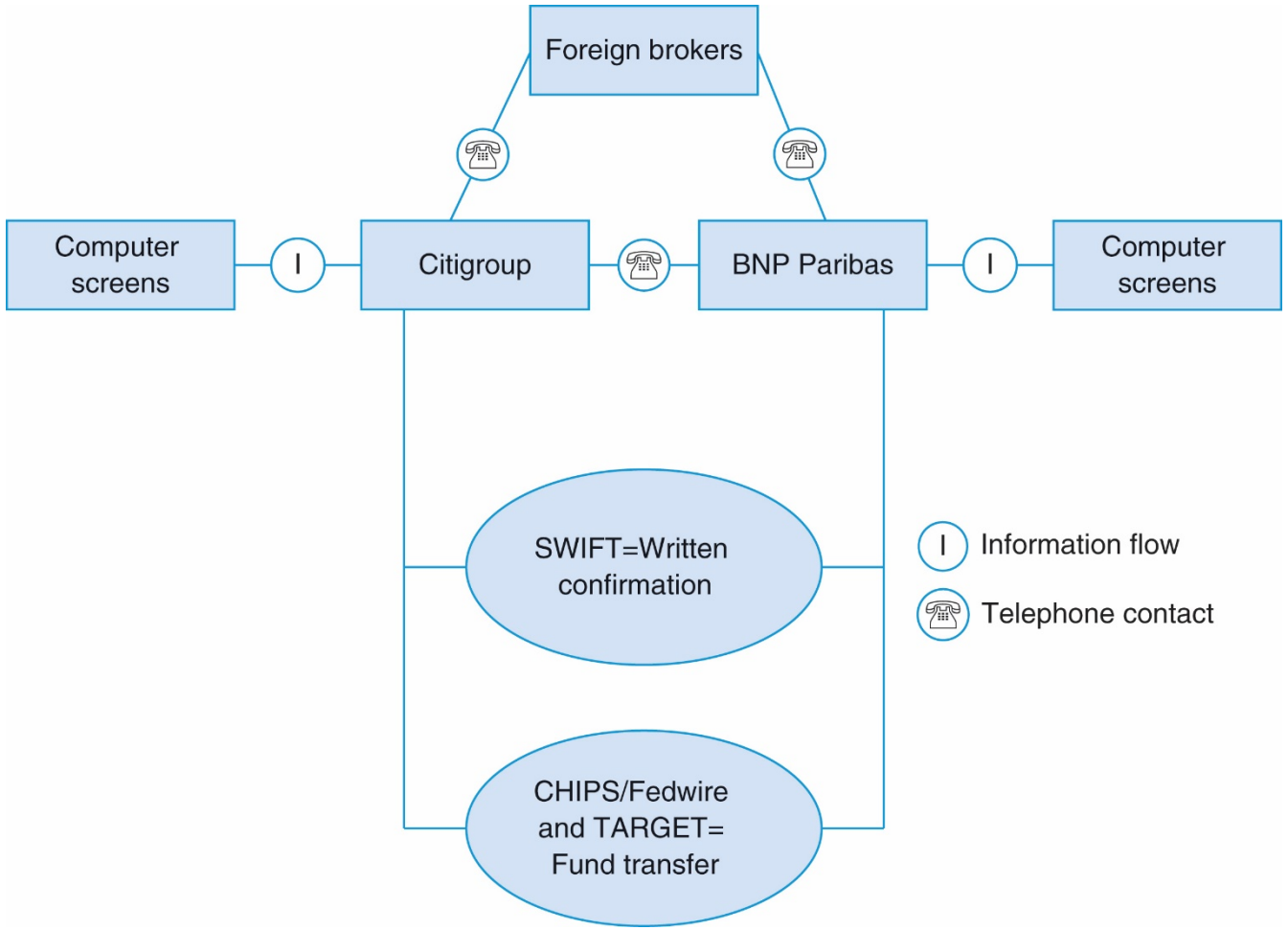


OR, WOULD YOU RATHER TRY YOUR LUCK ON OUR "EXCHANGE RATE" MACHINES

2.4 Inside the Interbank Market II: Communications and Fund Transfers

- Communication systems
  - Society of Worldwide Interbank Financial Telecommunications (SWIFT)
    - Links more than 7500 banks in 200 countries
  - Clearing House Interbank Payments System (CHIPS)
    - Clearing house in U.S. for dollars
  - Fedwire
    - Links computers of more than 7500 institutions that have deposits with the U.S. Federal Reserve
  - Trans-European Automated Real-time Gross Settlement Express Transfer (TARGET2)
    - Euro counterpart to Fedwire

Exhibit 2.9
Communication Systems in the Forex Market



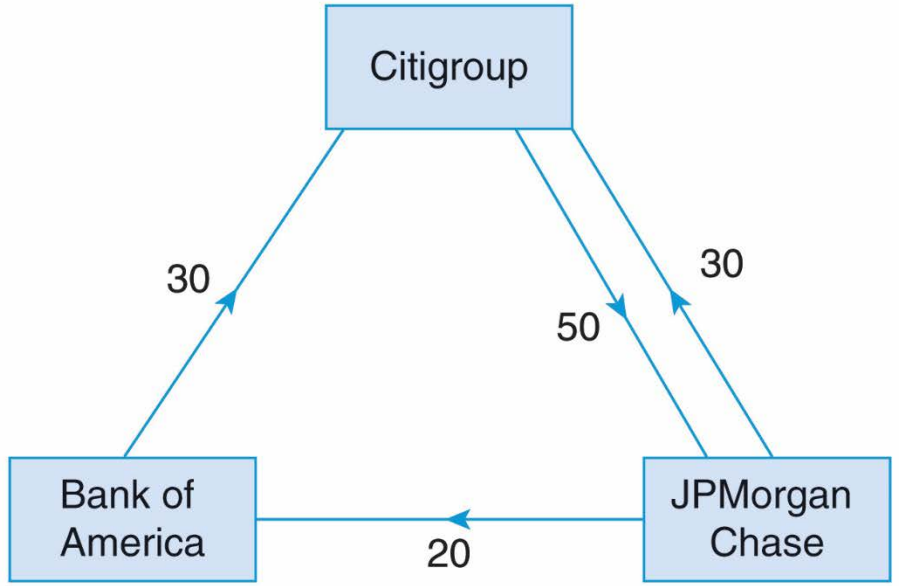
2.4 Inside the Interbank Market II: Communications and Fund Transfers

- Cross-currency settlement (or Herstatt) risk
  - The risk that a financial institution may not deliver the currency on one side of a completed transaction
  - How this risk is addressed:
    - Bank of International Settlements (BIS) has studied this and encouraged the restriction of transaction amounts to limit this form of risk
    - Simultaneity of both transactions – to this end, Continuous Linked Settlement, owned by 71 of the world's largest financial groups, acts as a global clearing house
    - Netting arrangements

Exhibit 2.10 Netting Arrangements

- Situation
  - Citigroup owes JPMorgan Chase $50M from a foreign exchange deal
  - JPMorgan Chase owes Citigroup $30M from another foreign exchange deal
  - Bank of America Owes Citigroup $30M from a foreign exchange deal
  - JPMorgan Chase owes Bank of America $20M from another foreign exchange transaction

Cash flows under no-netting

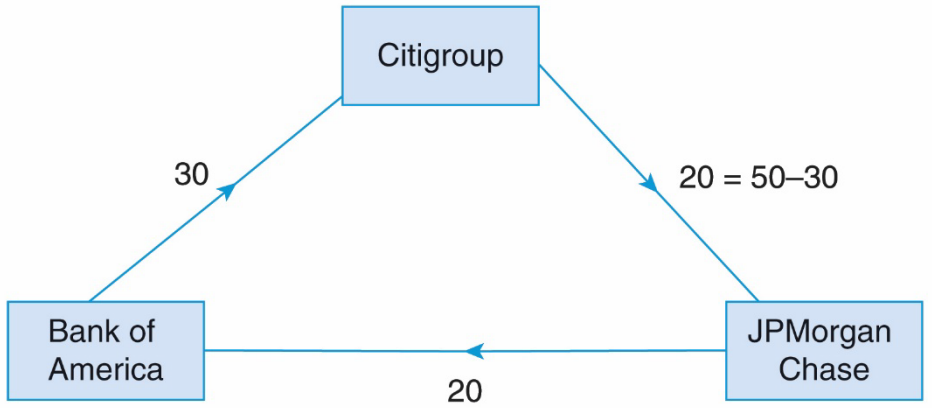


Total flows: 30 + 20 + 50 + 30 = 130 million

Exhibit 2.10 Netting Arrangements

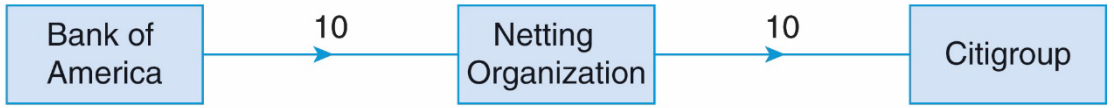
- Situation
  - Citigroup owes JPMorgan Chase $50M from a foreign exchange deal
  - JPMorgan Chase owes Citigroup $30M from another foreign exchange deal
  - Bank of America Owes Citigroup $30M from a foreign exchange deal
  - JPMorgan Chase owes Bank of America $20M from another foreign exchange transaction

Cash flows under bilateral netting



Total flows: 30 + 20 + 20 = 70 million

Cash flows under multi-lateral netting



Total flows: 10 + 10 = 20 million

2.5 Describing Changes in Exchange Rates

- Appreciate / depreciate
  - The value of a currency increases/decreases in terms of another
- Devalue / Revalue
  - The value of a currency is changed by the domestic government

2.5 Describing Changes in Exchange Rates

- Rate of change:
  - $\frac{(new-old)}{old}$
    - Refers to the currency in the denominator of the exchange rate (for $/£, we're talking about £)
  - Rate will not necessarily be the same if you calculate the rate for the £ and the rate for the $ due to perspective
    - The denominators are different
    - Sometimes used to cause alarm/concern over currency movements for political purposes
  - Continuously compounded rates of appreciation reconcile the difference in the two rates:
    - $Old \times e^{a} = New$

For example, suppose the price of British pounds rises from \$1.31 to \$1.33. The percentage depreciation of the dollar is given by:

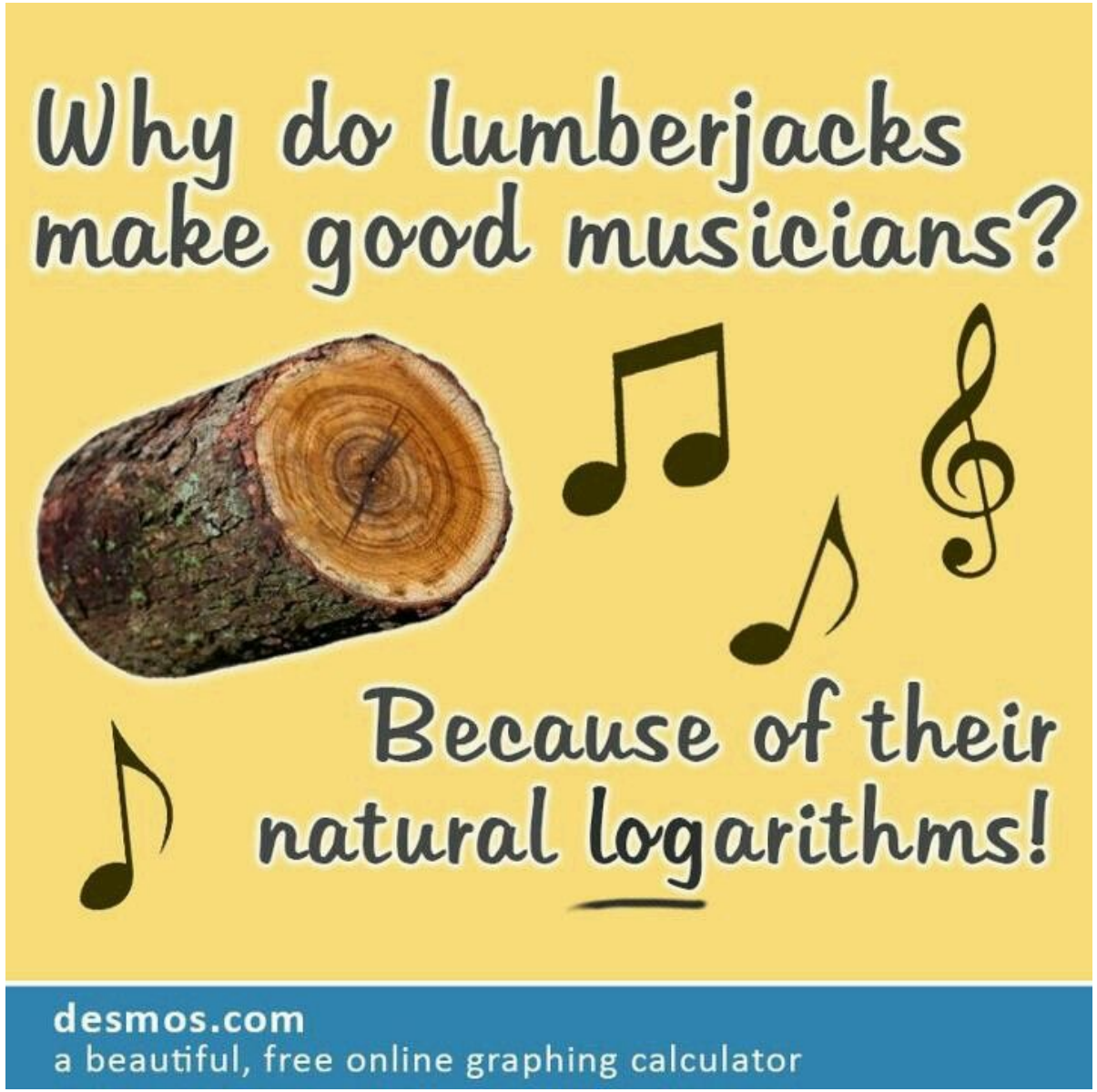
$$100 \times \frac{1.33 - 1.31}{1.31} = 1.53\%$$

The pound per dollar fell from 1/1.31 to 1/1.33. The percentage appreciation of the pound is given by:

$$100 \times \frac{(1/1.31) - (1/1.33)}{1/1.31} = 100 \times \frac{1.33 - 1.31}{1.33} = 1.50\%$$

If we used log changes, the rate of appreciation and depreciation would be the same:

$$\begin{aligned} & 100 \times \left[\ln(1.33) - \ln(1.31) \right] \\ & = 100 \times \left[\ln(1/1.31) - \ln(1/1.33) \right] \\ & = 1.515\% \end{aligned}$$



Properties of natural logs:

$$\ln(e)=1 \qquad \ln(1)=0$$

$$\ln(xy)=\ln(x)+\ln(y) \qquad \ln(x^y)=y\cdot\ln(x) \qquad \ln(e^y)=y\cdot\ln(e)=y$$

$$\ln(x^a y^c)=a\cdot\ln(x)+c\cdot\ln(y) \qquad \ln(x/y)=\ln(xy^{-1})=\ln(x)-\ln(y)$$

If $y=\ln(x)$, then $\dfrac{dy}{dx}=\dfrac{1}{x}$

Taylor series approximation: $\ln(x)\approx\ln(x_0)+\dfrac{1}{x_0}(x-x_0)$, or $\ln(x)-\ln(x_0)\approx\dfrac{x-x_0}{x_0}$

Turnover of OTC foreign exchange instruments, by currency

"Net-net" basis, April 1998–2016 daily averages, in billions of US dollars and percentage share — Table D11.3

	1998		2001		2004		2007		2010		2013		2016	
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
USD	1,325	87	1,114	90	1,702	88	2,845	86	3,371	85	4,662	87	4,438	88
EUR	...	...	470	38	724	37	1,231	37	1,551	39	1,790	33	1,591	31
JPY	332	22	292	24	403	21	573	17	754	19	1,235	23	1,096	22
GBP	168	11	162	13	319	16	494	15	512	13	633	12	649	13
AUD	46	3	54	4	116	6	220	7	301	8	463	9	348	7
CAD	54	4	56	4	81	4	143	4	210	5	244	5	260	5
CHF	108	7	74	6	117	6	227	7	250	6	276	5	243	5
CNY	0	0	0	0	2	0	15	0	34	1	120	2	202	4
SEK	5	0	31	2	42	2	90	3	87	2	94	2	112	2
NZD	3	0	7	1	21	1	63	2	63	2	105	2	104	2
MXN	7	0	10	1	21	1	44	1	50	1	135	3	97	2
SGD	17	1	13	1	18	1	39	1	56	1	75	1	91	2
HKD	15	1	28	2	34	2	90	3	94	2	77	1	88	2
NOK	4	0	18	1	27	1	70	2	52	1	77	1	85	2
KRW	2	0	10	1	22	1	38	1	60	2	64	1	84	2
TRY	...	...	0	0	2	0	6	0	29	1	71	1	73	1
RUB	5	0	4	0	12	1	25	1	36	1	86	2	58	1

Turnover of OTC foreign exchange instruments, April 2016

Daily averages, in billions of US dollars

Table D11.1

Instrument, currency, counterparty and country	Total	Spot transactions	Outright forwards	Foreign exchange swaps	Currency swaps	FX options
	2016	2016	2016	2016	2016	2016
Total, "net-net" basis	**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

Turnover of OTC foreign exchange instruments, April 2016

Daily averages, in billions of US dollars

Table D11.1

Instrument, currency, counterparty and country	Total	Spot transactions	Outright forwards	Foreign exchange swaps	Currency swaps	FX options
	2016	2016	2016	2016	2016	2016
By counterparty						
With reporting dealers	2,121	605	189	1,205	38	84
Local	673	204	59	374	14	23
Cross-border	1,447	402	130	831	24	61
With other financial institutions	2,564	930	431	1,026	37	141
Local	901	334	158	344	13	52
Cross-border	1,664	596	273	682	24	89
Non-reporting banks	1,113	354	136	564	18	42
Institutional investors	798	290	171	278	6	52
Hedge funds and PTFs	389	200	82	66	9	32
Official sector	74	14	14	43	2	1
Other	182	68	26	72	3	13
Undistributed	8	3	1	4	0	0
With non-financial customers	382	117	80	147	7	30
Local	224	82	55	66	3	17
Cross-border	158	35	25	81	4	13
Of which: prime-brokered	887	564	119	143	3	58
Of which: retail-driven	283	60	22	178	3	19