

International Finance

Many of the concepts and techniques are the same as the one used in other Finance classes. There are two distinctive features & associated risks:

- Different currencies creating FX rates => Currency Risk
- Different national policies => Country Risk

Chapter 3 - Foreign Exchange (FX) Markets

We'll go over three topics:

- 1) Exchange Rates (definition, overview)
- 2) Currency Markets (organization, characteristics, players)
- 3) Segments of the FX Market

1. Exchange Rates

Definition: An exchange rate is a price: The relative price of two currencies.

Example: The price of a Euro (EUR) in terms of USD is USD 1.115 per EUR
⇒ $S_t = 1.115 \text{ USD/EUR}$. ¶

Exchange Rate: Just a Price

An exchange rate is just like any other price.

- ⇒ Price of a gallon of milk: USD 3.75 (or 3.75 USD/milk).
- ⇒ Price of a British pound (GBP): USD 1.30 (or 1.30 USD/GBP)

Think of the currency in the denominator as the currency you buy.

Both the numerator (USD) and the denominator (GBP) are easily exchanged for each other.

Like any other price, S_t is determined by supply and demand.

- **Supply and Demand: The price of milk (P_t)**

Figure 3.1: Demand and Supply in the Market for Milk

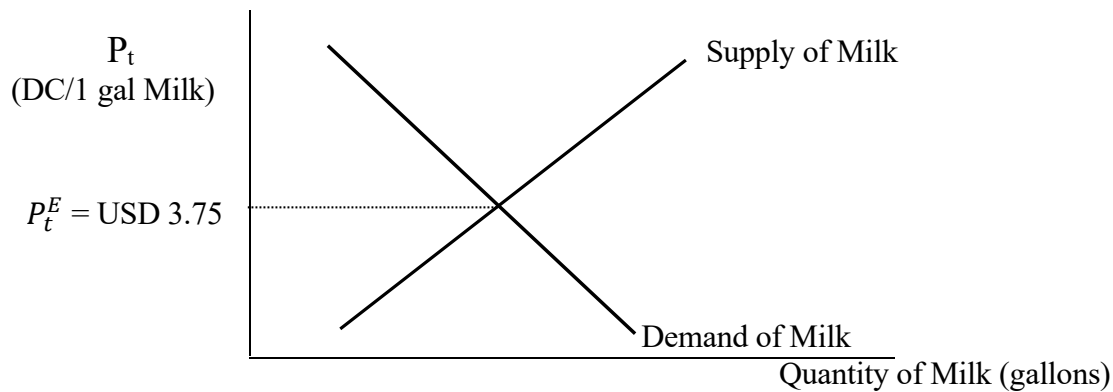


Figure 3.1 shows the determination of the equilibrium price of milk, $P_t^E = \text{USD } 3.75/\text{milk}$, which is determined in the Wholesale market. Interpretation of notation ($P_t = 3.75 \text{ USD/milk}$):

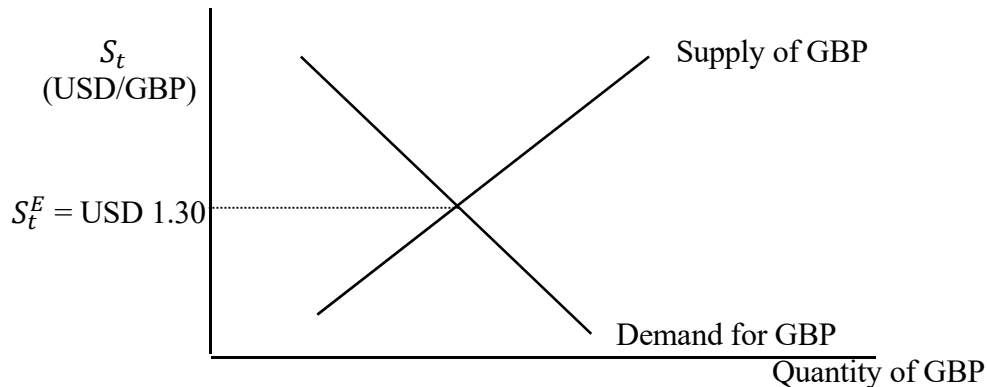
1 gallon of milk = USD 3.75

Note: In the case of the price of milk, only one good (USD) can be used to buy the other. It'll be very difficult to go to Walmart with 10 gallons of milk and get USD 37.50.

What makes an exchange rate tricky is that any of the two goods traded (DC and FC) can be exchanged for the other. You can go to a bank with EUR 1 and get USD or with USD 1 and get EUR.

- **Supply and Demand: Exchange Rates (S_t)**

Figure 3.2: Demand and Supply in the FX Market



The price of one GBP is determined in the FX (wholesale) market, as shown in Figure 3.2:

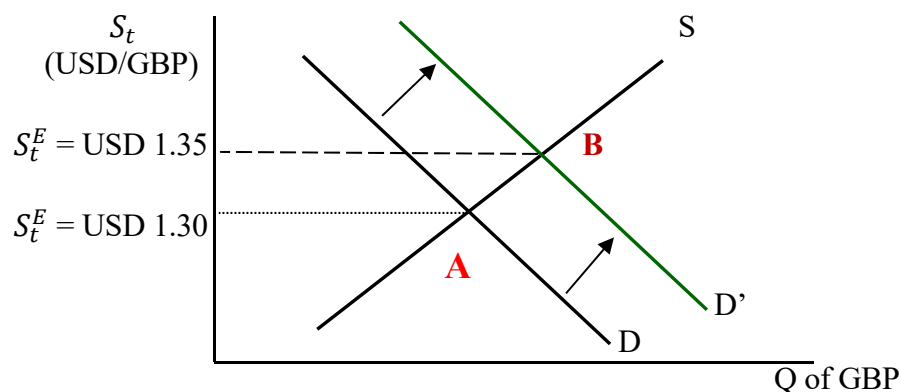
GBP 1 = USD 1.30 ($S_t = 1.30 \text{ USD/GBP}$).

Note: According to this notation, we are in the U.S. The currency in the numerator is the DC. This is the way prices are quoted in the domestic economic. DC units per good we want to buy.

Every time supply and demand move, S_t changes. For example, suppose the FX market is at point **A**,

with an equilibrium exchange rate, S_t^E , equal to 1.30 USD/GBP. All of the sudden, there is a craze for British goods. Then, the demand for GBP increases to pay for the British imports (D moves up to D'). As a result, the value of the GBP increases (more USD are needed to buy GBP 1). The new equilibrium is point **B**, with $S_t^E = 1.35$ USD/GBP.

Figure 3.3: Movements of D & S curves in the FX Market



The GBP becomes more expensive in terms of USD. We say the GBP *appreciates* against the USD (or the USD *depreciates* against the GBP). In general, an appreciation of the foreign currency helps domestic exporters and hurts domestic importers.

Remark: Do not confuse movements of the curve (the demand curve shifts up), with movements along the curve (movement along the supply curve from A to B).

• **Just a Price, but an Important One**

S_t plays a very important role in the economy since it directly influences imports, exports, & cross-border investments. It has an indirect effect on other economic variables, such as the domestic price level, P_d , and real wages. For example:

- When $S_t \uparrow$, foreign imports become more expensive in USD
 $\Rightarrow P_d \uparrow$ & real wages \downarrow (through a reduction in purchasing power).
- When $S_t \uparrow$, USD-denominated goods and assets are more affordable to foreigners. Foreigners buy more goods and assets in the U.S. (exports, real estate, bonds, companies, etc.)
 \Rightarrow Aggregate demand $\uparrow \Rightarrow Y_d \uparrow$ (though, it may take a while for this effect to occur.)

• **The Real Exchange Rate (R_t)**

The nominal exchange rate, S_t , is a *nominal* variable: The price (in DC) of one unit of FC. Economists like to distinguish between *nominal* and *real* values. After all, an increase in S_t does not necessarily mean that domestic goods are cheaper to foreigners: domestic prices can increase so much that domestic goods, once translated to FC, are more expensive. To easily compare where things are more expensive, the real exchange rate, R_t , is used.

The real exchange rate, R_t , measures the cost of foreign goods relative to domestic goods:

$$R_t = S_t P_f / P_d,$$

where P_f is the price of foreign goods (in FC) and P_a is the price of domestic goods (in DC).

If R_t increases, we say the DC *depreciates in real terms* \Rightarrow domestic goods become more competitive (cheaper) relative to foreign goods.

R_t gives a measure of competitiveness. It is a useful variable to explain trade patterns and GDP.

2. Currency Markets

Q: How is the FX market organized?

A: It is organized in two tiers:

- ◊ The *retail tier*
- ◊ The *wholesale tier* (the "FX or Forex market")

Retail Tier: Where small agents buy and sell FX.

Wholesale Tier: Informal network of about 2,000 banks and currency brokerage firms that deal with each other and with large corporations.

• Characteristics of the FX Market

- ◊ Largest of all financial markets in the world.
- ◊ OTC market, with market makers and dealers.
- ◊ Geographically dispersed (NY, LA, NZ, Tokyo, HK, Singapore, Moscow, Zurich, London).
- ◊ **London** is the largest market (**38%** of total turnover), followed by NY (19%) & Singapore (9%).
- ◊ Open 24 hours a day.
- ◊ Typical transaction in USD is about 10 million ("ten dollars").
- ◊ Currencies are noted by a three-letter code, the ISO 4217 (USD, EUR, JPY, GBP, CHF, MXN)
- ◊ Daily volume of trading (turnover) -spot, forward and FX swap-: **USD 7.5 trillion** (2022).
 - Q: What is USD 7.5 trillion?
 - 40 times the daily volume of international trade flows.
 - 85 times the daily total U.S. GDP.
 - 40% of total official FX reserves.
- ◊ USD, EUR, and JPY are the major currencies
- ◊ USD is the dominant currency: involved in 88% of transactions
- ◊ USD/EUR most traded currency pair (23% of turnover), followed by USD/JPY (18%)
- ◊ Emerging market currencies account for **18%** of turnover (CYN, HKD, KRW).
- ◊ 62% of transactions involve a cross-border counterpart.
- ◊ Very small *bid-ask* spreads for actively traded pairs, usually no more than 3 *pips* –i.e., 0.0003.
- ◊ Electronic trading platforms dominate; only **28%** of FX transactions are done via voice.

Example: A bid/ask quote of EUR/USD: 1.2397/1.2398 (spread: one *pip*). See screenshot from electronic trading platform EBS below:

EBS Spot		BBIL EBS		Mar 05 18:05		Page 1		0		
EUR/USD	1.23	97	98	1.23	9	9 - Mar	EUR/USD	1.2397 - 98	USD/JPY	111.50 - 52
97		97	98	11	99		EUR/JPY	138.25 - 26	USD/CHF	1.3345 - 47
		bid	offer				EUR/CHF	1.5802 - 08	GBP/USD	1.8218 - 21
USD/JPY	111.	50	52	111.	9	9 - Mar	EUR/GBP	0.68030 - 090	USD/CAD	1.3317 - 23
49	8	50	52	13	53		CHF/JPY	90.01 - 02	AUD/USD	0.7624 - 26
		bid	offer				Trader Deals			
EUR/JPY	138.	21	25	138.	9	9 - Mar	17:56 BUY 9 1.2390 XPBX EUR/USD			
21		21	26	3	27		17:56 BUY 3 1.2395 XPBX EUR/USD			
		bid	offer				17:57 BUY 1 1.2395 TYBB EUR/USD			
USD/CHF	1.33	45	47	1.33	9	9 - Mar	17:58 SELL 8 1.2397 TWBB EUR/USD			
43	8	45	47	2	50		17:58 SELL 2 111.52 TWBB USD/JPY			
		bid	offer				EBS Deals			
GBP/USD	1.82	18	21	1.82	9	9 - Mar	18:03 111.53 Paid USD/JPY			
15	2	18	21		24		18:03 111.53 Paid USD/JPY			
		bid	offer				18:04 111.50 Given USD/JPY			
18:05 PRESS RELEASE: R/GA Welcomes World Class Creative Steve Olderman, Advertising V										
18:05 DJ Fox-Pitt Starts Accredited Home Lenders At Outperform										
18:05 DJ Atco 2Q Financial Table >ACO.NV.X.T										
18:05 PRESS RELEASE: ISL in Bangladesh Selects Alvarion's Breeze2000 for Large...										
Overview										
18:00 S 1	1.31	56	72	BSK1	USD/CHF					
18:01 B 4	134.			BSK1	EUR/JPY					
18:01 B 10	114.	83		BSK1	USD/JPY					
USD/JPY										
	111.		53		111.					
send	quit	5	5							

Take the EUR/USD quote. The first number in black, 1.23, represents the “big figure” –i.e., the first digits of the quote. The big numbers in yellow, within the green/blue squares, represent the last digits of the quote to form 1.2397-1.2398. The number in black by the ask (“offer”) 98 (11) represents an irregular amount (say USD 11 million); if no number is by the bid/ask quote, then the “usual” amount is in play (say, USD 10 million, usually set by the exchange and may differ by currency). These irregular amounts have a better price quote than the regular amounts. The best regular quotes are on the sides 97 & 99. ¶

• Settlement of FX transactions

At the wholesale tier, no real money changes hands:

⇒ electronic transactions using the international clearing system.

Two banks involved in a FX transaction simply transfer bank deposits.

Example: Transaction: BRL for JPY

Parties: Argentine Bank: Banco de Galicia (BG),
Malayan Bank: Malayan Banking Berhard (MB).

Transaction: BG sells BRL (Brazilian real) to MBB for JPY.

Settlement: a transfer of two bank deposits:

- (1) BG turns over to MB a BRL deposit at a bank in Brazil,
- (2) MB turns over to BG a JPY deposit at a bank in Japan.

If BG doesn't have a branch in Brazil, an associated bank, called a *correspondent bank*, will hold the deposit in BG's name. Same situation applies for MB in Japan. ¶

Financial institutions are involved in the majority of total trading volume (93%).

- ◊ 42% interbank (between dealers).
- ◊ 51% other financial institutions (22% non-reporting dealers, 16% institutional investors, 8% hedge funds).

• Activities

- Speculation (open or "naked" positions)
- Hedging (covered positions)
- Arbitrage (establish positions to take advantage of pricing mistakes in one or more markets)
 - ◊ Types of arbitrage: Local/spatial (one good, one market)
 - Triangular (two related goods, one market)
 - Covered (two related markets, futures and spot transactions)

• Players and Dealers

- Players

- ◊ Big Corporations
- ◊ Mutual funds, Pension funds, Hedge funds, Insurance companies
- ◊ Financial Institutions (Banks, Investment banks)
- ◊ Big Speculators
- ◊ Central Banks (hold, buy and sell FC)

- Dealers:

- ◊ *Market-makers*: provide a two-way quote: bid and ask. Live off the spread.
 - ⇒ Short-term and high volume. Small profits per transactions are expected.
- ◊ *Speculators*: trade with a proprietary system. The dealer's own capital is put at risk.
 - ⇒ Capital can be at risk for extended periods. Large profits are expected.
- ◊ *Brokers*: find the best price for another player. Live off commissions.

• In the U.S., there are over 90 institutions considered active dealers in the FX market (some are market makers, others are brokers, some are all). Almost 90% of them are commercial banks. Ten institutions handled over 50% of the FX turnover in the U.S.

• The majority of the trading is done through electronic platforms. But, dealer institutions still have traditional trading rooms with human ("voice") traders specializing in areas: spot, forwards, options, etc. They have "back offices," where transactions are confirmed and finalized through a clearing system. Increasingly, there is also a "mid-office," where the validity of valuations/strategies is checked.

• Typical "voice-trader" (circa 1995): DEM trader (DEM: German Mark)

- ◊ Executed about 270 transactions a day (one every 67").
- ◊ Average daily volume traded: USD 1.2 billion.
- ◊ For large transactions brokers were used.
- ◊ Median spread: DEM .0003 (.02% of the spot rate).

• Electronic Trading

Today, much of the trading has moved to electronic platforms, like EBS (Electronic Broking System), Reuters Dealing 3000 Matching (D2), and Bloomberg Tradebook. The major trading banks (Barclays, UBS) have their own electronic platforms (*single-bank trading systems*). There are also multi-bank trading platforms (FXall, FXConnect, Hotspot). Trades are increasingly

taking place through multilateral ‘electronic non-bank market makers’ like XTX Markets, Virtu Financial, Citadel Securities, GTS and Jump Trading.

In 2016, electronic trading captured 85% of all FX transactions (up from 20% in 2001). This move towards electronic trading should improve costs and transparency (better price discovery).

For many years, the main electronic trading platforms were EBS and Reuters.

- EBS: main venue for EUR/USD, USD/JPY, EUR/JPY, USD/CHF and EUR/CHF. (the main bulk of the interbank spot market.)
- Reuters D2: primary venue for all other interbank currency pairs.

But, competition from single-bank trading systems (*internalization of flows*) is big and driving significantly down volume at both venues (traded volume at EBS went from 60% in 2011 to 19% in 2014). A big percentage of the FX trading is done through algorithmic trading. In the EBS platform, algorithm trading represents 75% of the volume.

3. Segments of the FX Market

All transactions in the FX Market are classified into different segments, see Exhibit 3.1 below. The daily turnover (USD 7.5 trillion) is divided into:

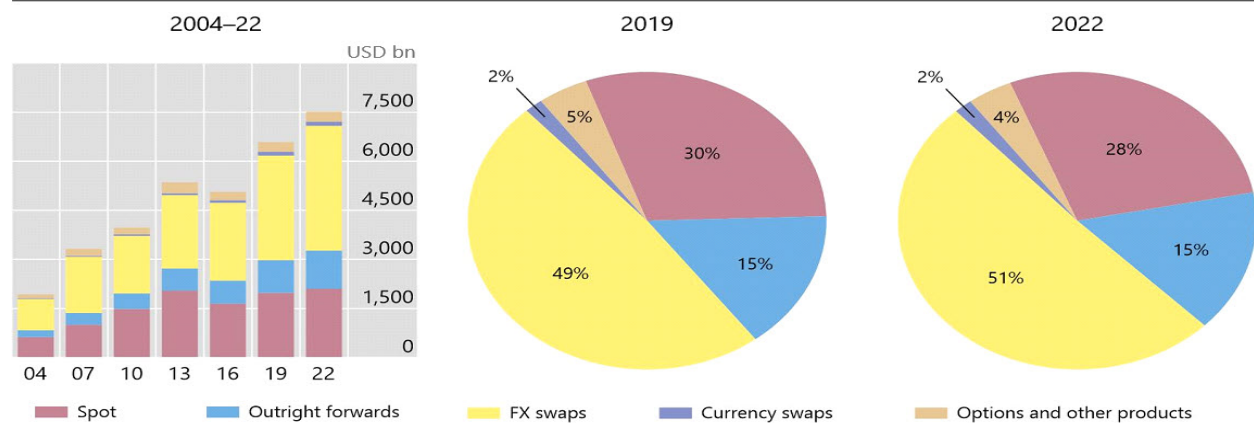
- USD 2.10 trillion in spot transactions (**28%**)
- USD 1.16 trillion in outright forwards (**15%**)
- USD 3.81 trillion in FX swaps (**51%**)
- USD 428 billion estimated gaps in options, currency swaps, etc.

Exhibit 3.1: Size of FX Market by Segments

Foreign exchange market turnover by instrument¹

Net-net basis, daily averages in April

Graph 1



¹ Adjusted for local and cross-border inter-dealer double-counting, ie “net-net” basis.

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

• **Segment 1: The Spot Market**

The spot market is the exchange market for payment and delivery today. In practice, "today" means today only in the retailer tier. Usually, it means 2 business days.

The Spot Market represents **28%** of total daily turnover (USD 2.1 trillion in 2022).

Example: Bank of America (BOFA) buys GBP 1M in the spot market at $S_t = 1.30$ USD/GBP. In 2 business days, BOFA will receive a GBP 1M deposit and will transfer to the counterparty USD 1.3M. ¶

Two quote systems:

- ◊ *Indirect quote* or "European" quote
S(indirect) = units of foreign currency that one domestic unit will buy.
- ◊ *Direct quote* or "American" quote.
S(direct) = units of domestic currency that one foreign unit will buy.

Remark: Indirect quotation = Reciprocal of the direct quotation.

Example: A U.S. tourist wishes to buy JPY at LAX.

(A) Indirect quotation (JPY/USD).

A quote of JPY 110.34-111.09 means the dealer is willing to buy one USD for JPY 110.34 (*bid*) and sell one USD for JPY 111.09 (*ask*).

For each round-trip USD transaction, she makes a profit of JPY .75.

(B) Direct quotation (USD/JPY).

If the dealer at LAX uses direct quotations, the bid-ask quote will be .009002-.009063 USD/JPY. ¶

Note: $S(\text{direct})_{\text{bid}} = 1/S(\text{indirect})_{\text{ask}}$,
 $S(\text{direct})_{\text{ask}} = 1/S(\text{indirect})_{\text{bid}}$.

Remark: In class, we will use **direct** quotations.

Most currencies are quotes against the USD, so that *cross-rates* must be calculated from USD quotations. (Think of liquidity!)

Rule for cross-rates (based on triangular arbitrage. We will see this topic again in Chapter 7):

$$\Rightarrow (\text{Quote } X/Z)/(\text{Quote } Y/Z) = \text{Quote } X/Y \quad (\Rightarrow \text{currency } Z \text{ has to cancel out!})$$

Example: Calculate the CHF/EUR cross rate:

$S_t = 1.00$ CHF/USD

$S_t = 0.97$ EUR/USD

$S_{\text{CHF/EUR},t} = 1.00 \text{ CHF/USD} / 0.97 \text{ EUR/USD} = 1.03093 \text{ CHF/EUR}$. ¶

Example: JPY/GBP cross rate.

$S_t = 0.00833 \text{ USD/JPY} = 120 \text{ JPY/USD}$.

$S_t = 1.30 \text{ USD/GBP}$

$S_{\text{JPY/GBP},t} = 120 \text{ JPY/USD} \times 1.30 \text{ USD/GBP} = 92.3077 \text{ JPY/GBP}$. ¶

• **Segment 2: The Forward Market**

A forward transaction is generally the same as a spot transaction:

⇒ but settlement is deferred much further into the future, at a later time T .

- T (=Maturity): 7-day, 1-, 2-, 3- and 12-month settlements. (Up to 10-year contracts.)

- Forward transactions are tailor-made.

- Forward contracts allow firms and investors to transfer risk.

- Notation. $F_{t,T}$: Forward price at time t , with a T day maturity.

- Forward transactions are classified into two classes: *outright* and *swap*.

⇒ Outright forward transaction: an uncovered speculative position in a currency (though it might be part of a currency hedge to the other side).

- The (outright) Forward Market represents **15%** of total daily turnover (USD 1.2 trillion in 2022).

- 40% of outright forwards have duration of less than 7 days.

Example: BOFA holds British bonds worth GBP 1,000,000. BOFA fears the GBP will lose value against the USD in 7 days. BOFA sells a 7-day GBP forward contract at $F_{t,7\text{-day}} = 1.305 \text{ USD/GBP}$ to transfer the currency risk of her position.

In 7 days, BOFA will receive USD 1,305,000 and will transfer to the counterparty GBP 1M. ¶

Forward transactions are classified into two classes: *outright* and *swap*.

⇒ Outright forward transaction: an uncovered speculative position in a currency (though it might be part of a currency hedge to the other side).

• **Segment 3: The FX Swap**

FX swap transaction (a “package trade”): The simultaneous sale (or purchase) of spot foreign exchange against a forward purchase (or sale) of approximately an equal amount of the foreign currency.

Motivation for a FX swap transaction: A position taken to reduce the exposure in a forward trade.

The FX Swap Market represents **51%** of total daily turnover (USD 3.81 trillion). The majority of FX Swaps (70%) are short-term (7 days or less).

Example: A U.S. trader wants to invest in a GBP bond position for a 7-day period. (Assume the U.S. trader thinks interest rates in the U.K. will go down and is worried about the GBP/USD exchange rate.)

Simultaneously, the U.S. trader

(1) Buys GBP 1M spot at $S_t = 1.30 \text{ USD/GBP}$,

(2) Buys the short-term GBP 1M bond position, and

(3) Sells GBP 1M forward at $F_{t,7\text{-day}}=1.305$ USD/GBP.

The sale of GBP 1M forward protects against an appreciation of the USD.

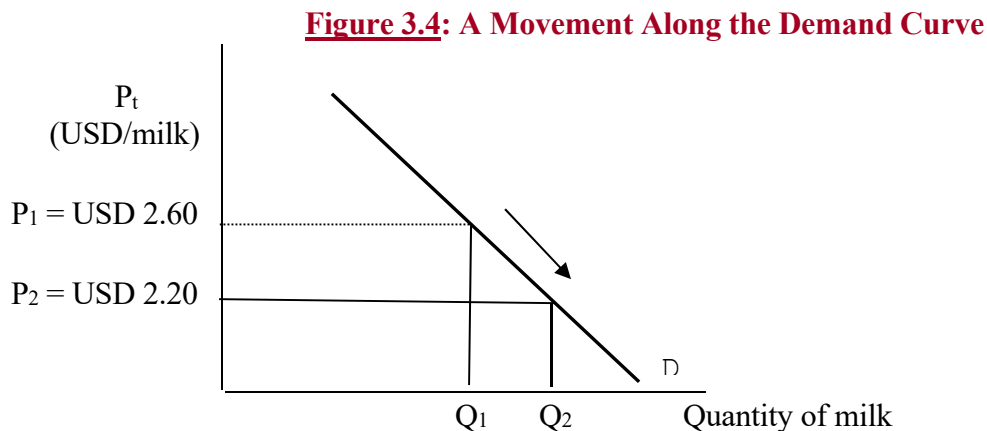
Transactions (1) and (3) are classified as an FX Swap transaction. ¶

CHAPTER 3 - BONUS COVERAGE: A Shift vs. A Movement

In economics, a *movement* and a *shift* in relation to the supply and demand curves represent very different market events.

1. A Movement

A movement refers to a change along a curve. On the demand curve, a movement denotes a change in both price and quantity demanded from one point to another on the curve. The movement implies that the demand relationship remains unchanged. Therefore, a movement along the demand curve will occur when the price of the good changes and the quantity demanded changes in accordance to the original demand relationship. In other words, a movement occurs when a change in the quantity demanded is caused only by a change in price, and vice versa.



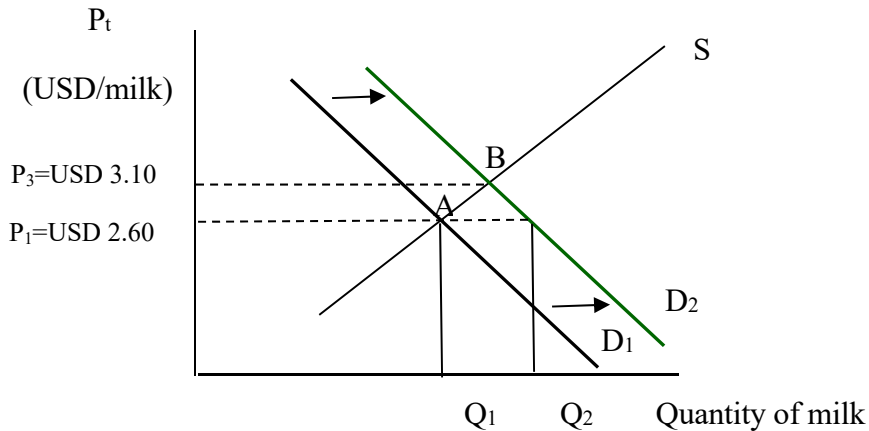
Similarly, a movement along the demand curve, a movement along the supply curve means that the supply relationship remains unchanged. Therefore, a movement along the supply curve will occur when the price of the good changes and the quantity supplied changes in accordance to the original supply relationship. In other words, a movement occurs when a change in quantity supplied is caused only by a change in price, and vice versa.

2. A Shift

A shift in a demand or supply curve occurs when a good's quantity demanded or supplied changes even though price remains the same. For instance, if the price for a gallon of milk was USD 2.60 and the quantity of milk demanded increased from Q_1 to Q_2 , then there would be a shift in the demand for milk. Shifts in the demand curve imply that the original demand relationship has changed, meaning that quantity

demand is affected by a factor other than price. A shift in the demand relationship would occur if, for instance, cereal for breakfast –a complimentary good- suddenly became very inexpensive. As a result of the shift in demand, the final price is USD 3.10 (new equilibrium is Point B).

Figure 3.5: A Shift in the Demand Curve



Conversely, if the price for a gallon of milk was USD 2.60 and the quantity supplied decreased from Q_1 to Q_2 , then there would be a shift in the supply of milk. Like a shift in the demand curve, a shift in the supply curve implies that the original supply curve has changed, that is, the quantity supplied is affected by a factor other than price. A shift in the supply curve would occur if, for instance, a virus caused a significant reduction in the stock of cows; milk producers would be forced to supply less milk for the same price.

CHAPTER 3 – BRIEF ASSESMENT

1) In the USD/GBP market, draw the effect on the equilibrium S_t of the following movements of the curves:

- a) The supply of GBP increases.
- b) The demand for GBP decreases.

2) Calculate the CHF/JPY cross rate, using the following exchange rates:

$$S_t = 1.00 \text{ CHF/USD}$$

$$S_t = 112 \text{ JPY/USD}$$

3) Structure an FX swap for a U.K. trader wants to invest in a US T- bond for a 15-day period.