Futures, Swaps, and Risk Management

Foreign Exchange Futures

- Exchanges rates between currencies vary
  - Exporters
- The forward market in foreign exchanges
  - Informal
  - Banks and brokers
- Futures markets
  - Chicago Mercantile (International Monetary Market)
  - London International Financial Futures Exchange
  - MidAmerica Commodity Exchange
- Active forward market
- Differences between futures and forward

Source: Reuters

Exchange Rates

March 15, 2006

The foreign exchange mid-range rates below apply to trading among banks in amounts of $1 million and more, as quoted at 4 p.m. Eastern time by Reuters and other sources. Retail transactions provide fewer units of foreign currency per dollar.

	U.S. $ EQUIVALENT		CURRENCY PER U.S. $	
Country	Wed	Tue	Wed	Tue
Argentina (Peso)-y	.3256	.3250	3.0713	3.0769
Australia (Dollar)	.7389	.7370	1.3534	1.3569
Bahrain (Dinar)	2.6534	2.6534	.3769	.3769
Brazil (Real)	.4725	.4714	2.1164	2.1213
Canada (Dollar)	.8663	.8646	1.1543	1.1566
1-month forward	.8670	.8654	1.1534	1.1555
3-months forward	.8685	.8669	1.1514	1.1535
6-months forward	.8709	.8692	1.1482	1.1505
Chile (Peso)	.001898	.001893	526.87	528.26
China (Renminbi)	.1244	.1243	8.0385	8.0478
Colombia (Peso)	.0004423	.0004414	2260.91	2265.52
Czech. Rep. (Koruna)				
Commercial rate	.04195	.04189	23.838	23.872
Denmark (Krone)	.1618	.1610	6.1805	6.2112
Ecuador (US Dollar)	1.0000	1.0000	1.0000	1.0000
Egypt (Pound)-y	.1742	.1742	5.7395	5.7412
Hong Kong (Dollar)	.1289	.1289	7.7588	7.7587
Hungary (Forint)	.004618	.004575	216.54	218.58
India (Rupee)	.02267	.02254	44.111	44.366
Indonesia (Rupiah)	.0001096	.0001091	9124	9166
Israel (Shekel)	.2129	.2122	4.6970	4.7125
Japan (Yen)	.008528	.008508	117.26	117.54
1-month forward	.008562	.008543	116.80	117.05
3-months forward	.008635	.008612	115.81	116.12
6-months forward	.008743	.008724	114.38	114.63
Jordan (Dinar)	1.4104	1.4108	.7090	.7088
Kuwait (Dinar)	3.4239	3.4239	.2921	.2921
Lebanon (Pound)	.0006631	.0006649	1508.07	1503.99
Malaysia (Ringgit)-b	.2699	.2692	3.7051	3.7147
Malta (Lira)	2.8126	2.8001	.3555	.3571
Mexico (Peso)				
Floating rate	.0940	.0938	10.6417	10.6655
New Zealand (Dollar)	.6467	.6425	1.5463	1.5564
Norway (Krone)	.1514	.1508	6.6050	6.6313
Pakistan (Rupee)	.01663	.01668	60.132	59.952
Peru (new Sol)	.3005	.2998	3.3278	3.3356
Philippines (Peso)	.01959	.01956	51.047	51.125
Poland (Zloty)	.3120	.3084	3.2051	3.2425
Russia (Ruble)-a	.03597	0.3577	27.801	27.956
Saudi Arabia (Riyal)	.2667	.2667	3.7495	3.7495
Singapore (Dollar)	.6180	.6164	1.6181	1.6223
Solvak Rep. (Koruna)	.03218	.03201	31.075	31.240
South Africa (Rand)	.1617	.1607	6.1843	6.2228
South Korea (Won)	.0010257	.0010235	974.94	977.04
Sweden (Krona)	.1288	.1281	7.7640	7.8064
Switzerland (Franc)	.7722	.7675	1.2950	1.3029
1-month forward	.7747	.7701	1.2908	1.2985
3-months forward	.7796	.7748	1.2827	1.2907
6-months forward	.7867	.7821	1.2711	1.2786
Taiwan (Dollar)	.03087	.03083	32.394	32.436
Thailand (Baht)	.02553	.02552	39.170	39.185
Turkey (New Lira)-d	.7490	.7478	1.3351	1.3372
U.K. (Pound)	1.7477	1.7460	.5722	.5727
1-month forward	1.7481	1.7464	.5720	.5726
3-months forward	1.7496	1.7477	.5716	.5722
6-months forward	1.7522	1.7505	.5707	.5713
United Arab (Dirham)	.2723	.2723	3.6724	3.6724
Uraguay (Peso)				
Financial	.04120	.04110	24.272	24.331
Venezuela (Bolivar)	.000466	.000466	2145.92	2145.92
SDR	1.4393	1.4341	.6948	.6973
Euro	1.2073	1.2015	.8283	.8323

Special Drawing Rights (SDR) are based on exchange rates for the U.S., British, and Japanese currencies. Source: International Monetary Fund.

a-Russian Central Bank rate. b-Government rate. d-Rebased as of Jan. 1, 2005. y-Floating rate.

Figure 23.2 Foreign Exchange Futures

	OPEN	HIGH	LOW	SETTLE	CHG	LIFETIME HIGH	LIFETIME LOW	OPEN INT
Japanese Yen (CME)-¥12,500,000; $ per 100¥								
June	.8613	.8648	.8599	.8634	.0009	.9949	.8455	170,665
Sept	.8720	.8752	.8708	.8740	.0009	.9435	.8572	18,745
Canadian Dollar (CME)-CAD 100,000; $ per CAD								
June	.8666	.8703	.8662	.8675	.0010	.8879	.7950	84,263
Sept	.8711	.8725	.8693	.8699	.0010	.8912	.7970	2,072
British Pound (CME)-£62,500; $ per £								
June	1.7478	1.7514	1.7440	1.7509	.0026	1.8120	1.7076	69,916
Sept	1.7506	1.7538	1.7468	1.7534	.0026	1.7941	1.7282	98
Swiss Franc (CME)-CHF 125,000; $ per CHF								
June	.7756	.7801	.7746	.7796	.0039	.8635	.7633	93,603

Pricing on Foreign Exchange Futures

SPOT-FUTURE EXCHANEG RATE RELATION

Interest rate parity theorem

Developed using the US Dollar and British Pound

$$F_0 = E_0\left(\frac{1+r_{US}}{1+r_{UK}}\right)^T$$

where

F_0 is the forward price

E_0 is the current exchange rate

Text Pricing Example

$r_{us} = 5\%$ $r_{uk} = 6\%$ $E_0 = \$1.60$ per pound

$T = 1$ yr

$$F_0 = \$1.60\left(\frac{1.05}{1.06}\right)^1 = \$1.585$$

If the futures price varies from \$1.58 per pound arbitrage opportunities will be present.

What if the interest rate parity relationship were violated? For example, suppose the futures price is \$1.97/£ instead of \$1.981/£. You could adopt the following strategy to reap arbitrage profits. In this example let E_1 denote the exchange rate (\$/£) that will prevail in 1 year. E_1 is, of course, a random variable from the perspective of today's investors.

Action	Initial Cash Flow (\$)	CF in 1 Year (\$)
1. Borrow 1 U.K. pound in London. Convert to dollars. Repay £1.05 at year-end.	2.00	$-E_1$(£ 1.05)
2. Lend \$2.00 in the United States.	−2.00	\$2.00(1.04)
3. Enter a contract to purchase £1.05 at a (futures) price of F_0 = \$1.97/£	0	£ 1.05(E_1 − \$1.97/£)
TOTAL	0	\$.0115

In step 1, you exchange the one pound borrowed in the United Kingdom for \$2 at the current exchange rate. After 1 year you must repay the pound borrowed with interest. Because the loan is made in the United Kingdom at the U.K. interest rate, you would repay £1.05, which would be worth $E_1(1.05)$ dollars. The U.S. loan in step 2 is made at the U.S. interest rate of 4%. The futures position in step 3 results in receipt of £1.05, for which you would pay \$1.97 each, and then convert into dollars at exchange rate E_1.

Note that the exchange rate risk here is exactly offset between the pound obligation in step 1 and the futures position in step 3. The profit from the strategy is therefore risk-free and requires no net investment.

Action	Initial CF ($)	CF in 1 Year ($)
1. Borrow 1 U.K. pound in London. Convert to dollars.	$\$E_0$	$-\$E_1(1 + r_{UK})$
2. Use proceeds of borrowing in London to lend in the U.S.	$-\$E_0$	$\$E_0(1 + r_{US})$
3. Enter $(1 + r_{UK})$ futures positions to purchase 1 pound for F_0 dollars.	0	$(1 + r_{UK})(E_1 - F_0)$
TOTAL	0	$E_0(1 + r_{US}) - F_0(1 + r_{UK})$

Direct versus Indirect Quotes

- A dolar per pound
  - Direct exchange rate quote
- A unit of foreign currency per dollar
  - Indirect exchange rate quote

$$F_0(\text{foreign currency} / \$) = \frac{1 + r_{\text{foreign}}}{1 + r_{\text{US}}} \times E_0(\text{foreign currency} / \$)$$

Hedging Foreign Exchange Risk

A US firm wants to protect against a decline in profit that would result from a decline in the pound

- Estimated profit loss of $200,000 if the pound declines by $.10
- Short or sell pounds for future delivery to avoid the exposure

Hedge Ratio for Foreign Exchange Example

Hedge Ratio in pounds

$$\frac{\$200{,}000 \text{ per } \$.10 \text{ change in the pound/dollar exchange rate}}{\$.10 \text{ profit per pound delivered per } \$.10 \text{ in exchange rate}}$$

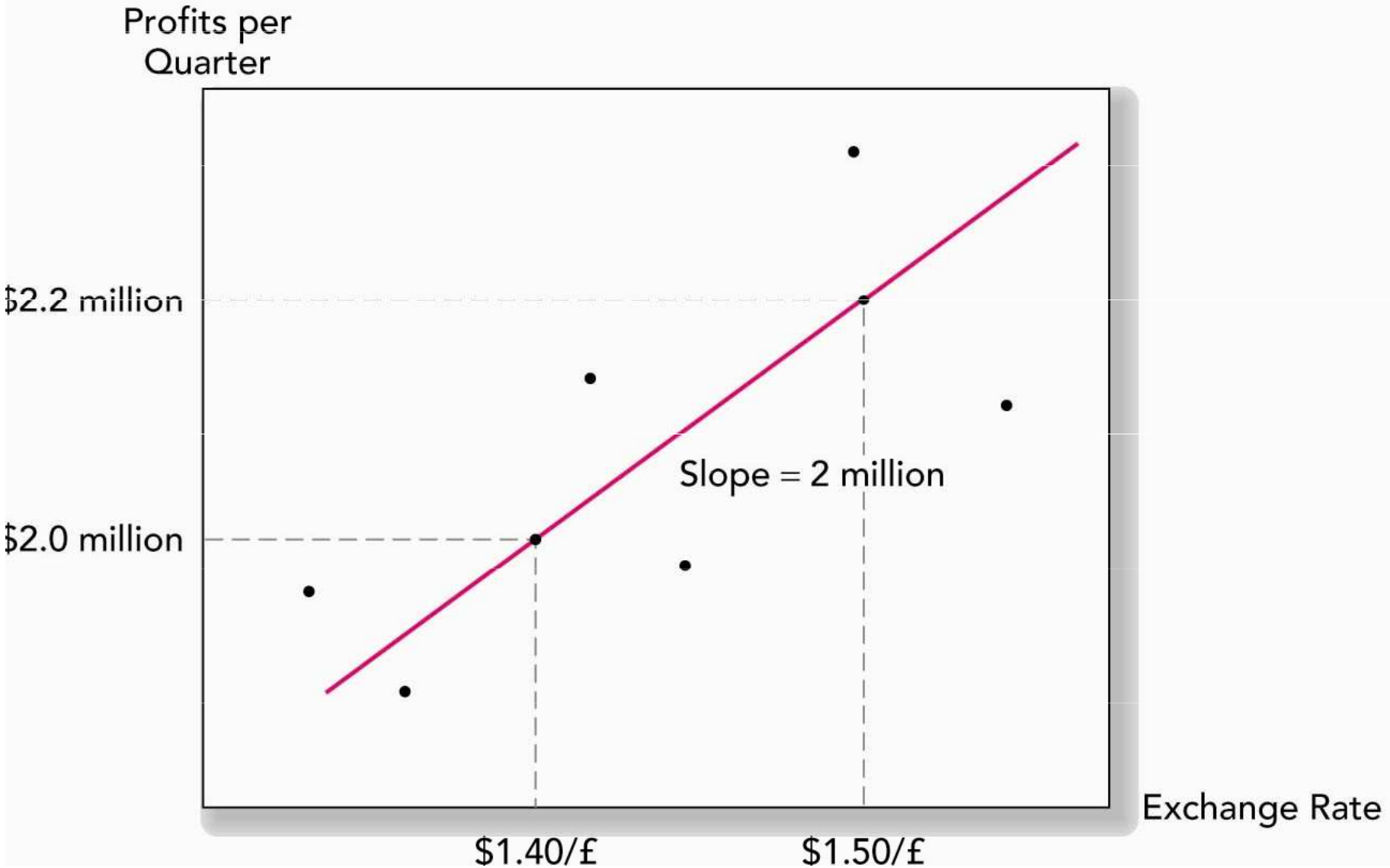
= 2,000,000 pounds to be delivered

Hedge Ratio in contacts

Each contract is for 62,500 pounds or $6,250 per a $.10 change

$200,000 / $6,250 = 32 contracts

Figure 23.3 Profits as a Function of the Exchange Rate



Stock Index Contracts

- Available on both domestic and international stocks
- Advantages over direct stock purchase
  - lower transaction costs
  - better for timing or allocation strategies
  - takes less time to acquire the portfolio

Table 23.1 Major Stock-Index Futures

Contract	Underlying Market Index	Contract Size	Exchange
S&P 500	Standard & Poor's 500 index. A value-weighted arithmetic average of 500 stocks.	$250 times S&P 500 index	Chicago Mercantile Exchange
Dow Jones Industrial Average (DJIA)	Dow Jones Industrial Average. Price-weighted average of 30 firms.	$10 times index	Chicago Board of Trade
Russell 2000	Index of 2,000 smaller firms.	$500 times index	Chicago Mercantile Exchange
S&P Mid-Cap	Index of 400 firms of mid-range market value.	$500 times index	Chicago Mercantile Exchange
Nasdaq 100	Value-weighted arithmetic average of 100 of the largest over-the-counter stocks.	$100 times index	Chicago Mercantile Exchange
Nikkei	Nikkei 225 stock average.	$5 times Nikkei Index	Chicago Mercantile Exchange
FTSE 100	Financial Times Stock Exchange. Index of 100 U.K. firms.	£10 times FTSE Index	London International Financial Futures Exchange
DAX-30	Index of 30 German stocks.	25 euros times index	Eurex
CAC-40	Index of 40 French stocks.	10 euros times index	Euronext Paris
DJ Euro Stoxx-50	Index of blue chip Euro-zone stocks.	10 euros times index	Eurex

TABLE 23.1

Major stock-index futures

Table 23.2 Correlations among Major U.S. Stock Market Indexes

TABLE 23.2

Correlations among major U.S. stock market indexes

	DJIA	NYSE	Nasdaq	S&P 500	Russell 2000
DJIA	1.000				
NYSE	0.931	1.000			
Nasdaq	0.839	0.825	1.000		
S&P 500	0.957	0.973	0.899	1.000	
Russell 2000	0.758	0.837	0.855	0.822	1.000

Note: Correlations computed using monthly returns for 5 years ending in March 2006.

Creating Synthetic Positions with Futures

- Synthetic stock purchase
  - Purchase of the stock index instead of actual shares of stock
- Creation of a synthetic T-bill plus index futures that duplicates the payoff of the stock index contract

Synthetic Position Using Stock-Index Futures

	In General (Per Unit of the Index)	Our Numbers
1. Profits from contract	$S_T - F_0$	$\$100{,}000(S_T - 1{,}414)$
2. Face value of T-bills	F_0	141,400,000
TOTAL	S_T	$100{,}000S_T$

Index Arbitrage

Exploiting mispricing between underlying stocks and the futures index contract

- Futures Price too high - short the future and buy the underlying stocks
- Futures price too low - long the future and short sell the underlying stocks

Index Arbitrage and Program Trading

This is difficult to implement in practice

- Transactions costs are often too large
- Trades cannot be done simultaneously

Development of Program Trading

- Used by arbitrageurs to perform index arbitrage
- Permits acquisition of securities quickly

Hedging Systematic Risk

To protect against a decline in level stock prices, short the appropriate number of futures index contracts

- Less costly and quicker to use the index contracts
- Use the beta for the portfolio to determine the hedge ratio

Hedging Systematic Risk: Text Example

Portfolio Beta = .8 **S&P 500 = 1,000**

Decrease = 2.5% **S&P falls to 975**

Portfolio Value = $30 million

Project loss if market declines by 2.5% = (.8) (2.5) = 2%

2% of $30 million = $600,000

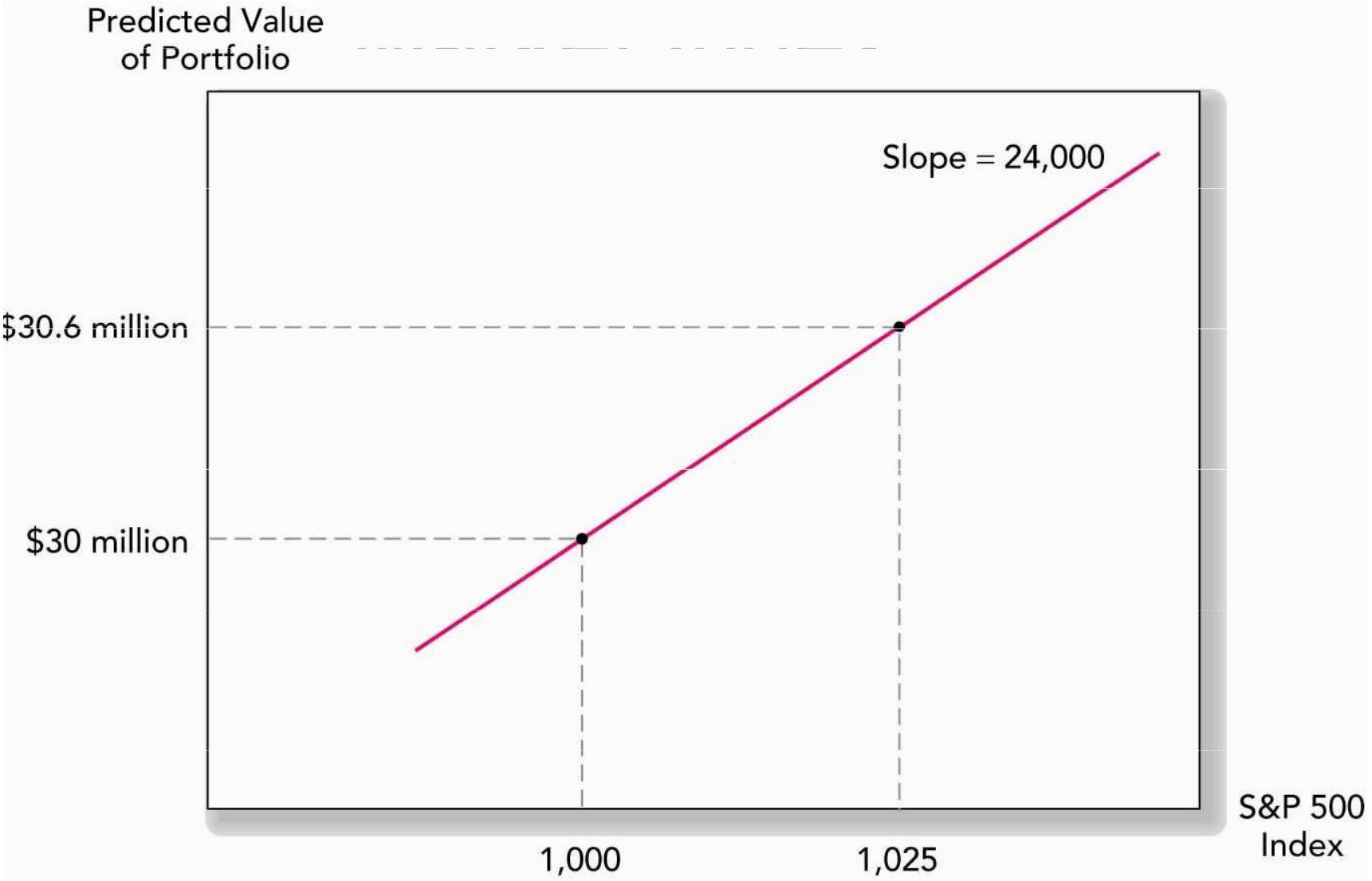
Each S&P500 index contract will change $6,250 for a 2.5% change in the index

Hedge Ratio: Text Example

$$H = \frac{\text{Change in the portfolio value}}{\text{Profit on one futures contract}}$$

$$= \frac{\$600{,}000}{\$6{,}250} = 96 \text{ contracts short}$$

Figure 23.4 Predicted Value of the Portfolio as a Function of the



Uses of Interest Rate Hedges

- Owners of fixed-income portfolios protecting against a rise in rates
- Corporations planning to issue debt securities protecting against a rise in rates
- Investor hedging against a decline in rates for a planned future investment
- Exposure for a fixed-income portfolio is proportional to modified duration

Hedging Interest Rate Risk: Text Example

Portfolio value = $10 million

Modified duration = 9 years

If rates rise by 10 basis points (.1%)

Change in value = (9) (.1%) = .9% or $90,000

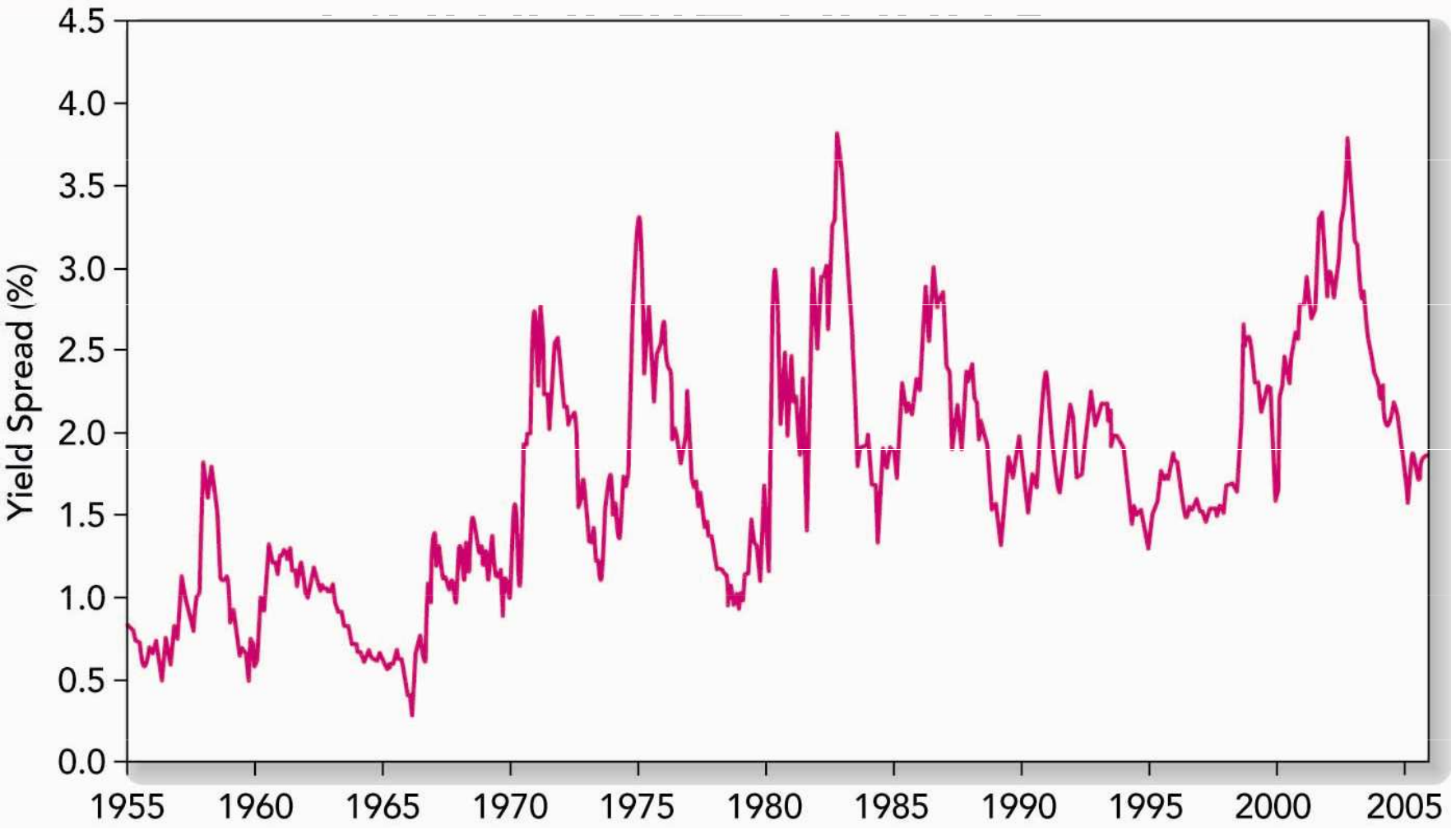
Present value of a basis point (PVBP) = $90,000 / 10 = $9,000

Hedge Ratio: Text Example

$$H = \frac{\text{PVBP for the portfolio}}{\text{PVBP for the hedge vehicle}}$$

$$= \frac{\$9{,}000}{\$90} = 100 \text{ contracts}$$

Figure 23.5 Yield Spread between 10-Year Treasury and Baa-Rated Corporate Bonds



Swaps

- Interest rate swap
- Foreign exchange swap
- Credit risk on swaps

Figure 23.6 Interest Rate Swap

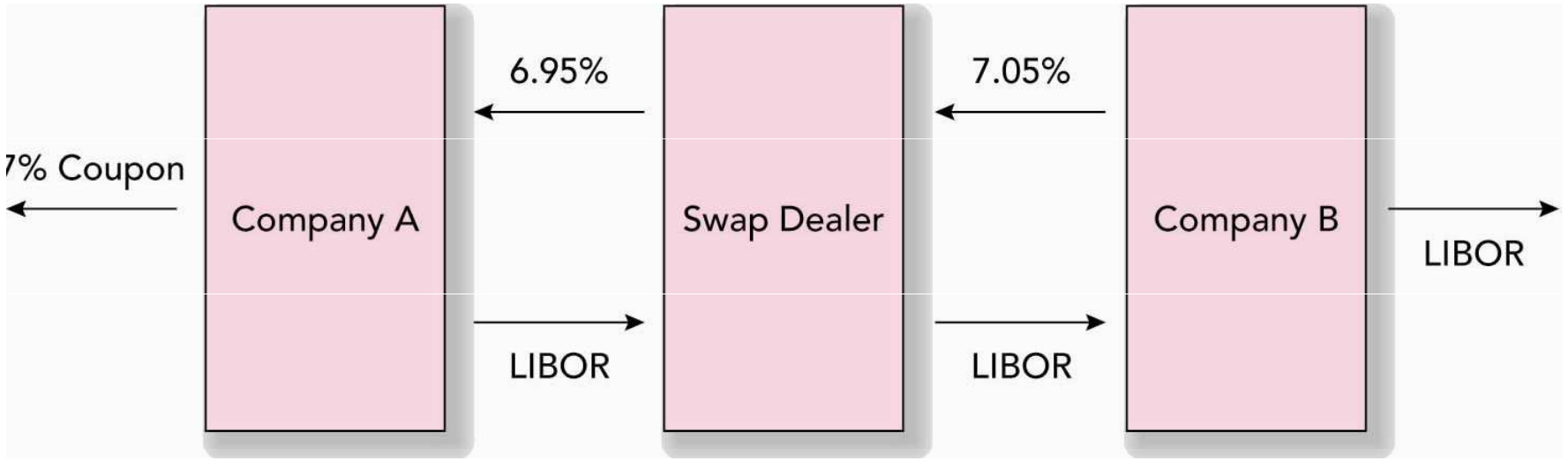


Figure 23.7 Interest Rate Futures

	OPEN	HIGH	LOW	SETTLE	CHG	YIELD	CHG	OPEN INT
1 Month Libor (CME)-$3,000,000; pts of 100%								
Apr	95.1100	95.1100	95.0950	95.1025	−.0050	4.8975	.0050	18,018
May	94.9900	94.9925	94.9800	94.9850	−.0075	5.0150	.0075	34,207
Eurodollar (CME)-$1,000,000; pts of 100%								
Apr	94.9900	94.9900	94.9800	94.9825	−.0075	5.0175	.0075	32,659
June	94.9000	94.9100	94.8650	94.8850	−.0100	5.1150	.0100	1,431,516
Sept	94.8700	94.8850	94.8250	94.8500	−.0150	5.1500	.0150	1,486,577
Dec	94.9100	94.9200	94.8600	94.8850	−.0200	5.1150	.0200	1,321,468

Pricing on Swap Contracts

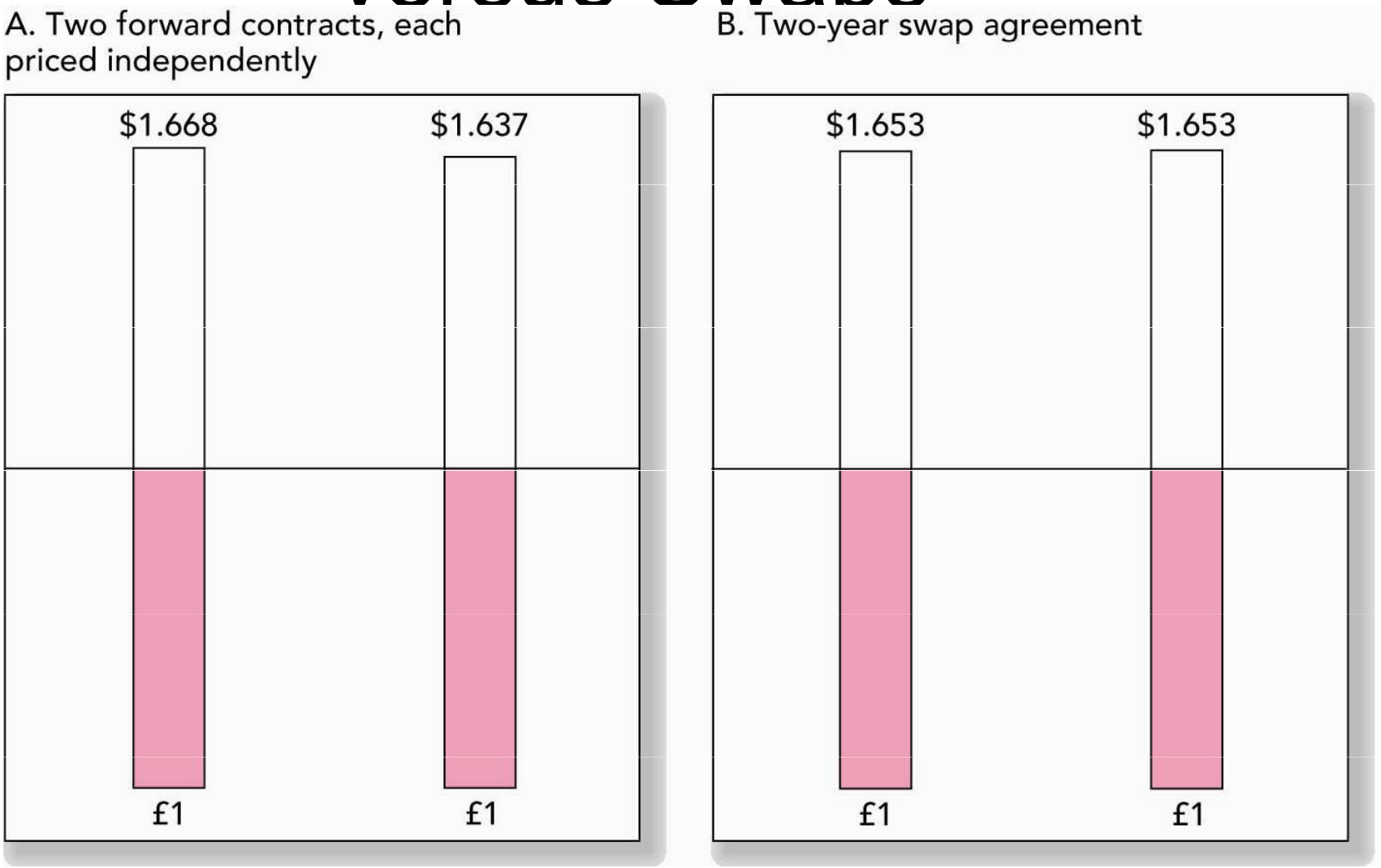
Swaps are essentially a series of forward contracts.

One difference is that the swap is usually structured with the same payment each period while the forward rate would be different each period.

Using a foreign exchange swap as an example, the swap pricing would be described by the following formula.

$$\frac{F_1}{(1+y_1)}+\frac{F_2}{(1+y_2)^2}=\frac{F_*}{(1+y_1)}+\frac{F_*}{(1+y_2)^2}$$

Figure 23.8 Forward Contracts versus Swaps



Commodity Futures Pricing

General principles that apply to stock apply to commodities.

Carrying costs are more for commodities.

Spoilage is a concern.

$$F_0 = P_0(1+r_f)+C$$

Where; F_0 = futures price P_0 = cash price of the asset

C = Carrying cost c = C/P_0

$$F_0 = P_0(1+r_f+c)$$

Figure 23.9 Typical Agricultural Price Pattern over the Season

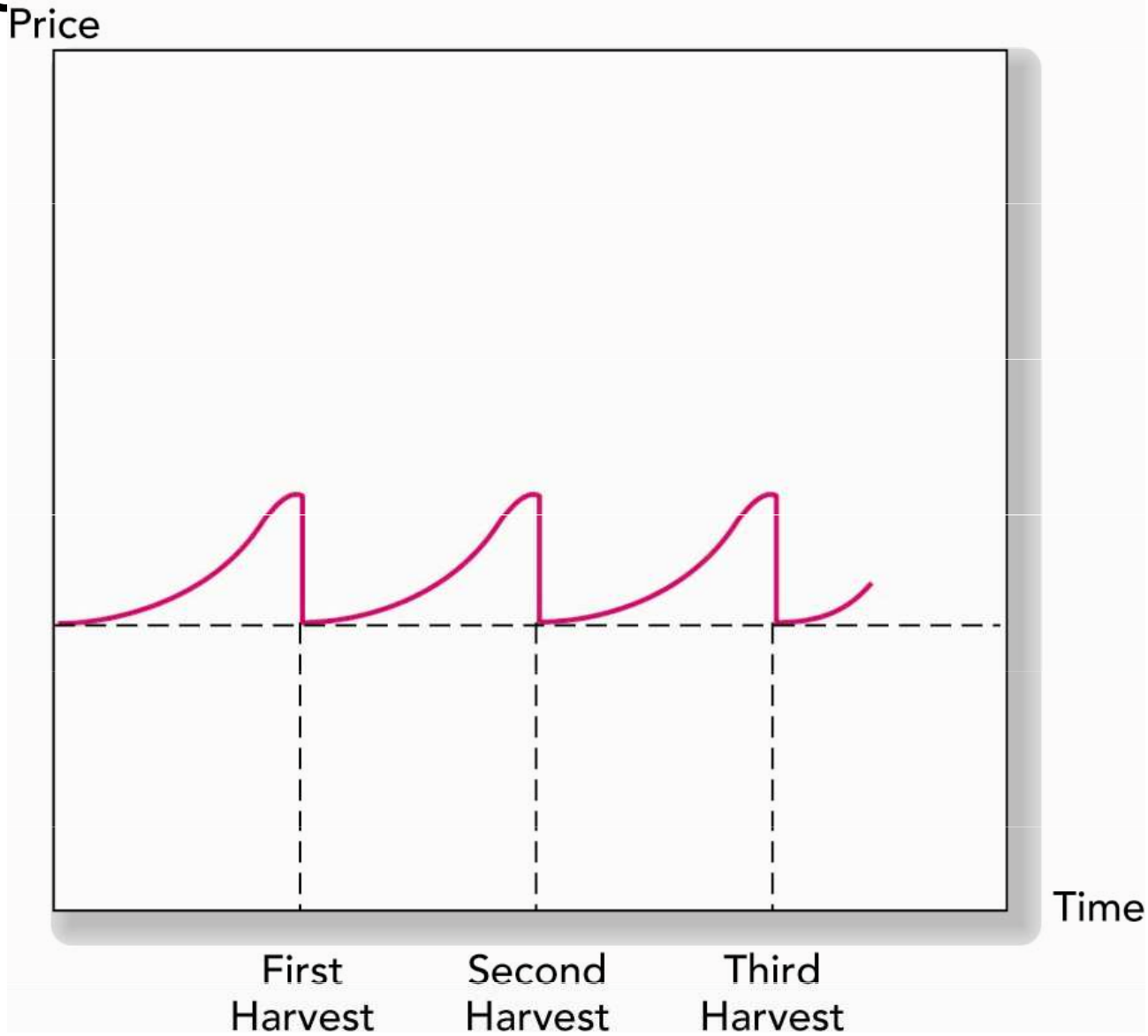


Table 23.3 Commodity Betas

TABLE 23.3

Commodity betas

Commodity	Beta	Commodity	Beta
Wheat	−0.370	Orange juice	0.117
Corn	−0.429	Propane	−3.851
Oats	0.000	Cocoa	−0.291
Soybeans	−0.266	Silver	−0.272
Soybean oil	−0.650	Copper	0.005
Soybean meal	0.239	Cattle	0.365
Broilers	−1.692	Hogs	−0.148
Plywood	0.660	Pork bellies	−0.062
Potatoes	−0.610	Egg	−0.293
Platinum	0.221	Lumber	−0.131
Wool	0.307	Sugar	−2.403
Cotton	−0.015		

Source: Zvi Bodie and Victor Rosansky, "Risk and Return in Commodity Futures," *Financial Analysts Journal* 36 (May–June 1980). Copyright 1980, CFA Institute. Reproduced from the *Financial Analysts Journal* with permission from the CFA Institute. All rights reserved.