

Lecture 4: Foreign Currency Derivatives

Reading: Eun & Resnick Ch. 7 & 14 (10th ed.)

Derivatives

- *These are financial instruments whose value **depends** on an observable value*
 - A financial asset, such as a stock price (or commodity or exchange rate), is used as an observable value. In such case, that asset is referred to as the underlying asset.
- *Derivatives include:*
 - **Options:** A contract that grants the holder the right, but not the obligation, to transact in an asset.
 - **Futures:** A contract to buy or sell a commodity at a point in the future. Changes in prices in the commodity are settled daily.
 - **Swaps:** A contract in which two parties exchange cashflows from different financial instruments.

Futures and Forwards

Currency forward and futures contracts both represent an obligation to buy or sell a certain amount of a specified currency some time in the future at an exchange rate determined now.

Futures vs Forwards

	Futures Contracts	Forwards Contracts
Markets:	Prices determined in centralized exchanges	Decentralized inter-bank market
Trading Hours:	Most trading during exchange hours	Open somewhere around the world
Contract Size:	Standardized sizes depending on currency	Standard size of \$1m etc. & can be tailored
Contract Maturity:	Fixed delivery dates: 3 rd Wed. of March, June, Sept. or Dec.	Fixed maturities (1, 3, 6 or 12 months) or can be tailored to specification
Quotation:	American terms (USD/FC)	American (USD/FC) or European (FC/USD)

Contract Specification - An Example

Specification of the **Australian Dollar futures** contract (Chicago Mercantile Exchange)

Contract Size	AUD 100,000
Quotation	USD per AUD
Delivery Month	March, June, September, December
Min. Price Move	\$0.0001 (\$10.00)
Settlement Date	Third Wednesday of delivery month
Stop of Trading	Two business days prior to settlement date

Futures vs Forwards (2)

Contd.	Futures Contracts	Forwards Contracts
Settlement:	Delivery of underlying fx is feasible, but almost never occurs. Position closed out by taking an offsetting position	Delivery of foreign exchange normally takes place.
Security against default:	Clearing houses stand behind traders	Assets of bank
Required collateral:	Margin requirements (“Performance Bond”)	Deposit required if no standing relations with bank
Cash flows	Occur daily because of “marking-to-market” feature	No cash flows until forward contract matures

Mechanics of Marking to Market

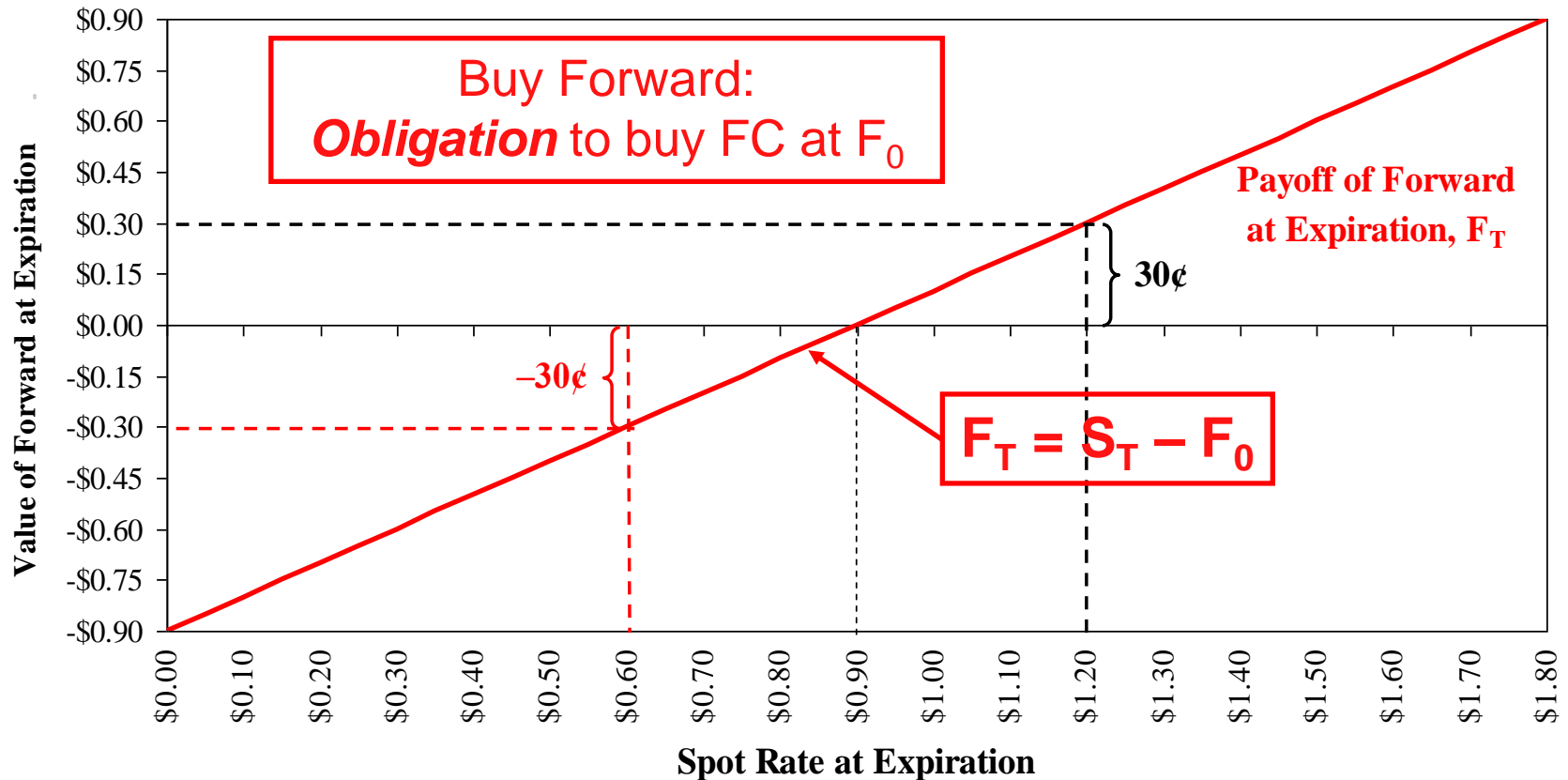
Day	Futures Price (USD/FC)	Change in Futures price (USD/FC)	Gain/Loss	Cumulative Gain/Loss	Margin Account
t	1.3321	0	0	$0.0006 \times \text{Eur}125,000$	\$2000.00
t+1	1.3315	-\$0.0006	-\$75	-\$75	\$1925.00
t+2	1.3304	-\$0.0011	-\$137.50	-\$212.50	\$1787.50
t+3	1.3288	-\$0.0016	-\$200.00	-\$412.50	\$1587.50
t+4	1.3264	-\$0.0024	-\$300.00	-\$712.50	\$2000.00
t+5	1.3296	+\$0.0032	+\$400.00	-\$312.50	\$2400.00
t+6	1.3301	+\$0.0005	+\$62.50	-\$240.00	\$2,462.50

■ Some assumptions:

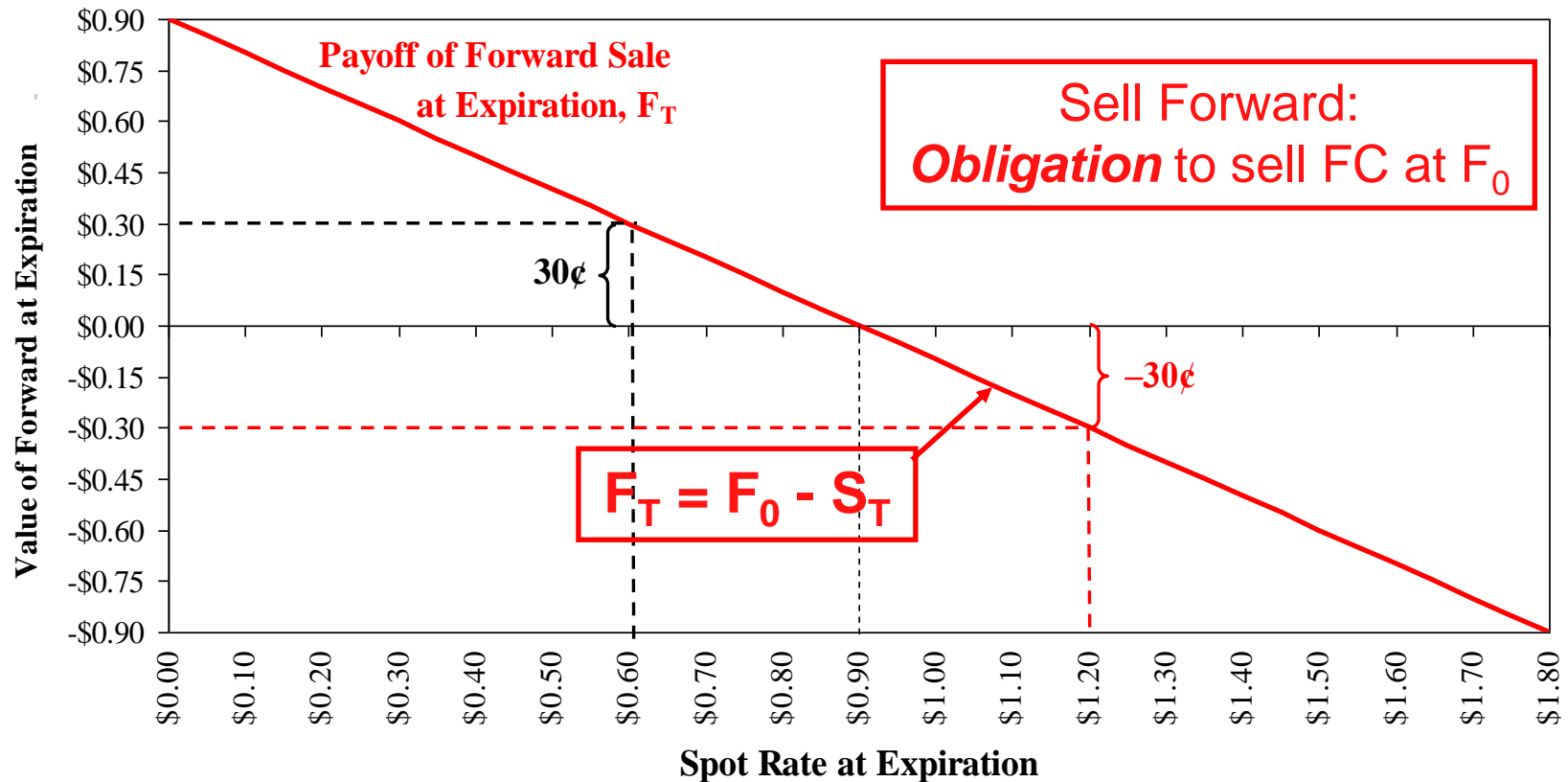
- Initial margin: \$2000
- Maintenance margin: \$1500
- Contract Size: EUR 125,000

Note: This is a made-up example of marking to market.

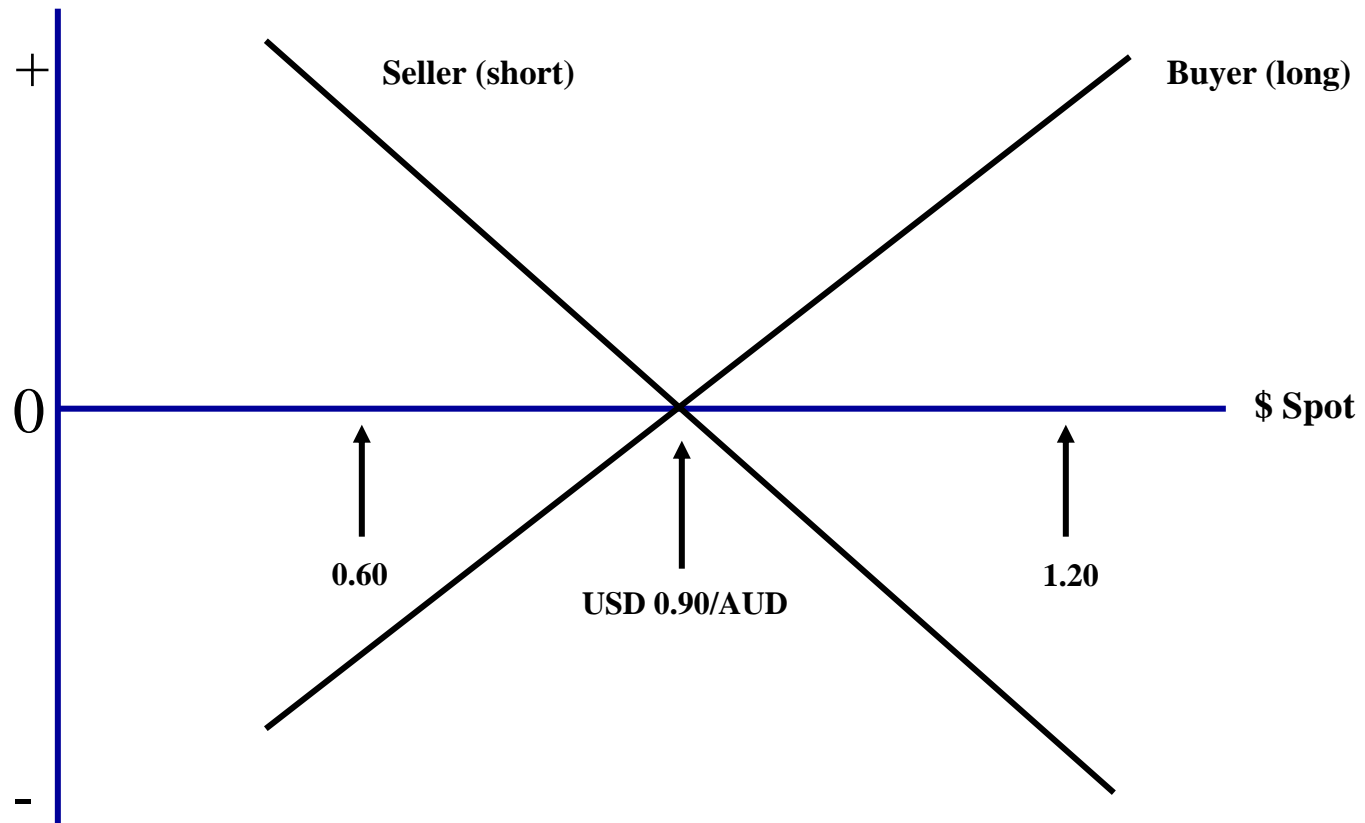
Value of Forward Purchase at Expiration



Value of Forward Sale at Expiration



The Trouble with Forwards



Options Contracts

Options contracts give the option holder the **right, but not the obligation** to buy or sell a specified amount of the underlying asset (currency; stock) at a pre-determined price (*exercise* or *strike price*).

Call Options

Strike price

The price at which the holder of the option may transact in the stock.

Underlying security

The security to which this option applies.

June 2024 109 call option on the Euro

Expiration

The point **after** which the option may no longer be used or **exercised**. Monthly options on a stock typically expire the third Friday of the month.

Call option

Grants the holder the right, but not the obligation to **buy** the security at the strike price.

Put Options

Strike price

The price at which the holder of the option may transact in the stock.

Underlying security

The security to which this option applies.

June 2024 109 put option on Euros

Expiration

The point **after** which the option may no longer be used or **exercised**. Monthly options on a stock typically expire the third Friday of the month.

Put option

Grants the holder the right, but not the obligation to **sell** the security at the strike price.

The Basics of Options

❖ Types of Options

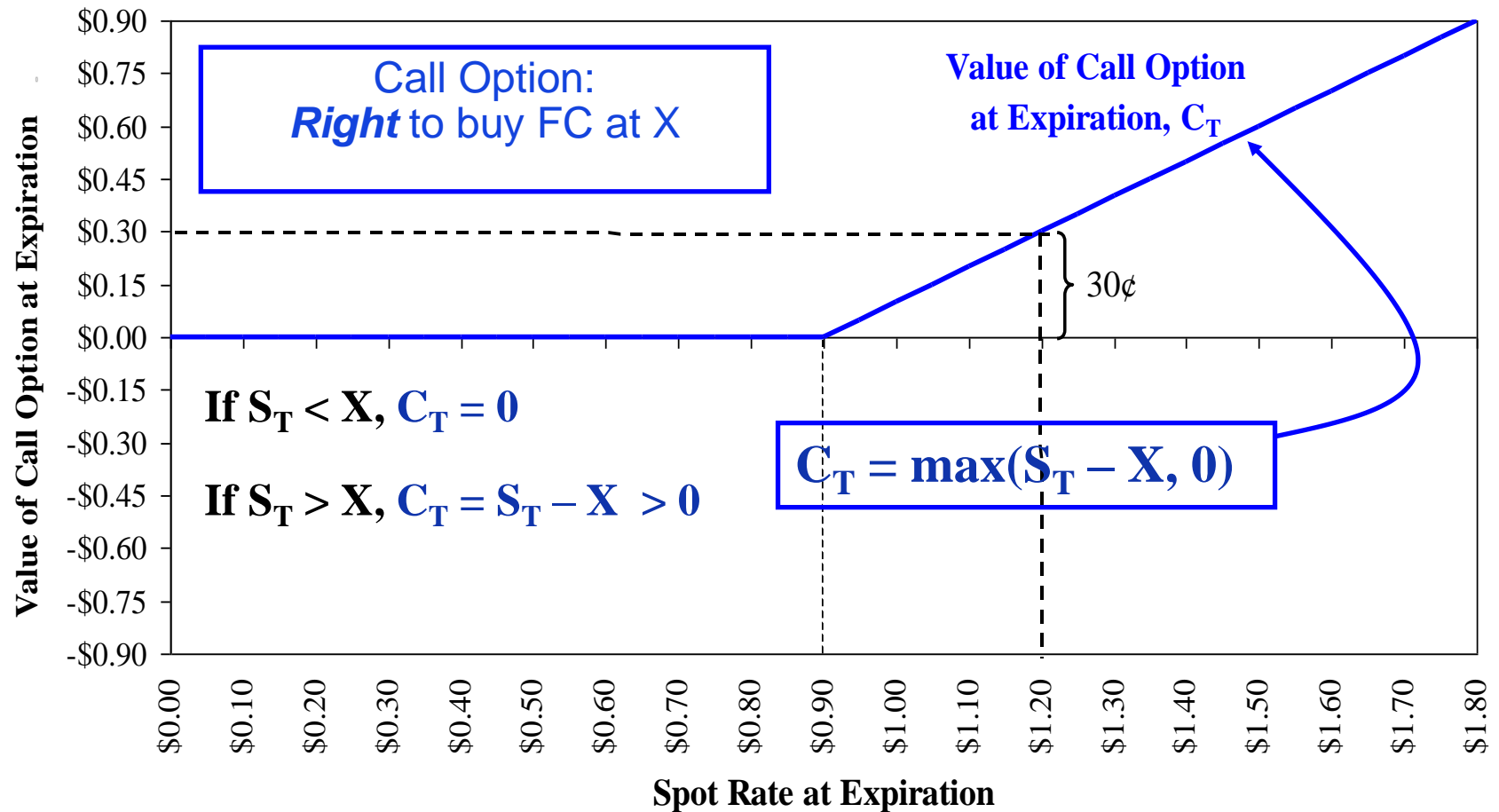
- **Call:** gives the holder the right to buy
 - **Put:** gives the holder the right to sell
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- An **American option** gives the buyer the right to exercise the option at *any time* between the date of writing and the expiration or maturity date.
 - A **European option** can be exercised *only* on the expiration date, not before.
 - The **exercise or strike price (X)**, which is the exchange rate at which foreign currency can be purchased (call) or sold (put).
 - The **premium, cost, price, or value of the option itself** (paid in advance by the buyer to the seller).
 - The **underlying or actual spot exchange rate** in the market.

PRODUCT SPECIFICATIONS: AUSTRALIAN DOLLAR (XDA)

Symbol	XDA
Contract Size:	10,000 Australian dollars
Trading Symbol:	XDA
Settlement Value Symbol:	AJW
CUSIP® Number:	69391M 11 1
Exercise Style:	European
Expiration Date:	The third Friday of the expiration month.
Expiration Cycle:	Quarterly on the March cycle plus two additional near-term months (six months at all times).
Settlement:	U.S. dollars
Settlement Value for Expiring Contracts:	The spot price at 12:00:00 Eastern Time (noon) on the expiration date. The settlement value is disseminated under the symbol AJW. Consult PHLX Options 4C, Section 6 for further information.
Last Trading Day for Expiring Contracts:	The third Friday of the expiration month.
Contract Point Value:	\$100 (i.e., .01 x 10,000)
Exercise (Strike) Price Intervals:	The Exchange shall determine fixed-point intervals of exercise prices. Generally, the exercise (strike) price interval shall be set at fifty-cent intervals. Consult PHLX Options 4C, Section 5 for further information.
Premium Quotation:	One point = \$100. Thus a premium quote of 2.13 is \$213. The minimum change in a premium is .01= \$1.00.
Position Limits:	600,000 contracts on the same side of the market. Hedge exemptions are available. For more information consult PHLX Options 9, Section 13(j) and Section 15 .
Trading Hours:	9:30 a.m. to 4:00 p.m. Eastern Time
Issuer and Guarantor:	The Options Clearing Corporation (OCC)

Source: PHLX World Currency Options

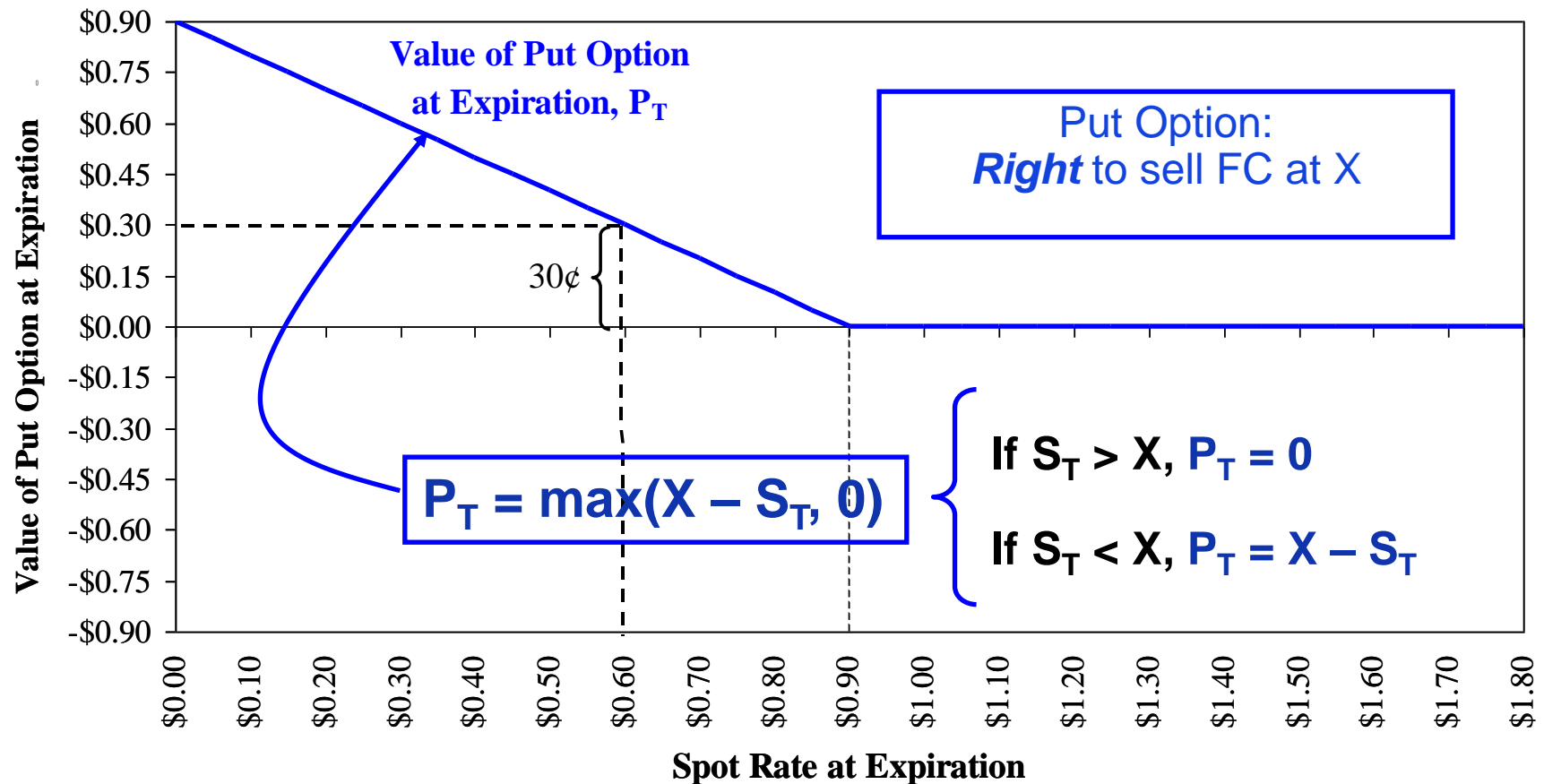
Value of Call Option at Expiration



Value of Put Option at Expiration

- ❖ You might be interested in contracts that give you just the nice part of a forward sale
 - That is, the right to sell at a pre-specified price when the currency trades below that price, without the obligation to sell at X when the currency is worth more.
 - With such an option, you obtain no less than X per unit of foreign currency, and possibly more than X .
 - In contrast, with a forward sale you always get X .
 - A right to sell at X , without any obligation to do so, is called a put option, or put.

Value of Put Option at Expiration



An Example

- ❖ You buy a call on AUD at USD/AUD 0.5000 expiring on June 30th.
- You are “*long* the call.”
- Counter party is the *writer* of the call – Has to deliver AUD at 50¢ should you *exercise* the call
- If $S_T = \text{USD/AUD } 0.60$ – Will exercise your right to buy AUD at 50¢ and save 0.10
- If $S_T < \text{USD/AUD } 0.50$ – Will *not* exercise, since it can be purchased in the spot market at a cheaper price

Intrinsic and Time Value

	Call	Put
<i>Intrinsic value</i>	$\max(S_T - X, 0)$	$\max(X - S_T, 0)$
<i>in the money</i>	$S_T - X > 0$	$X - S_T > 0$
<i>at the money</i>	$S_T - X = 0$	$X - S_T = 0$
<i>out of the money</i>	$S_T - X < 0$	$X - S_T < 0$
<i>Time Value</i>	$C_T - \text{Int. value}$	$P_T - \text{Int. value}$

Factors that Affect Options Prices

- ❖ current exchange rate (S) – as $S \uparrow$, Call price \uparrow and Put price \downarrow
- ❖ strike price (X) – as $X \uparrow$, Call price \downarrow and Put price \uparrow
- ❖ time to expiration (T) – as $T \uparrow$, the value \uparrow
- ❖ volatility of the exchange rate (σ) – the higher the σ of the exchange rate, the greater the value
- ❖ interest rates (i_A and i_B).

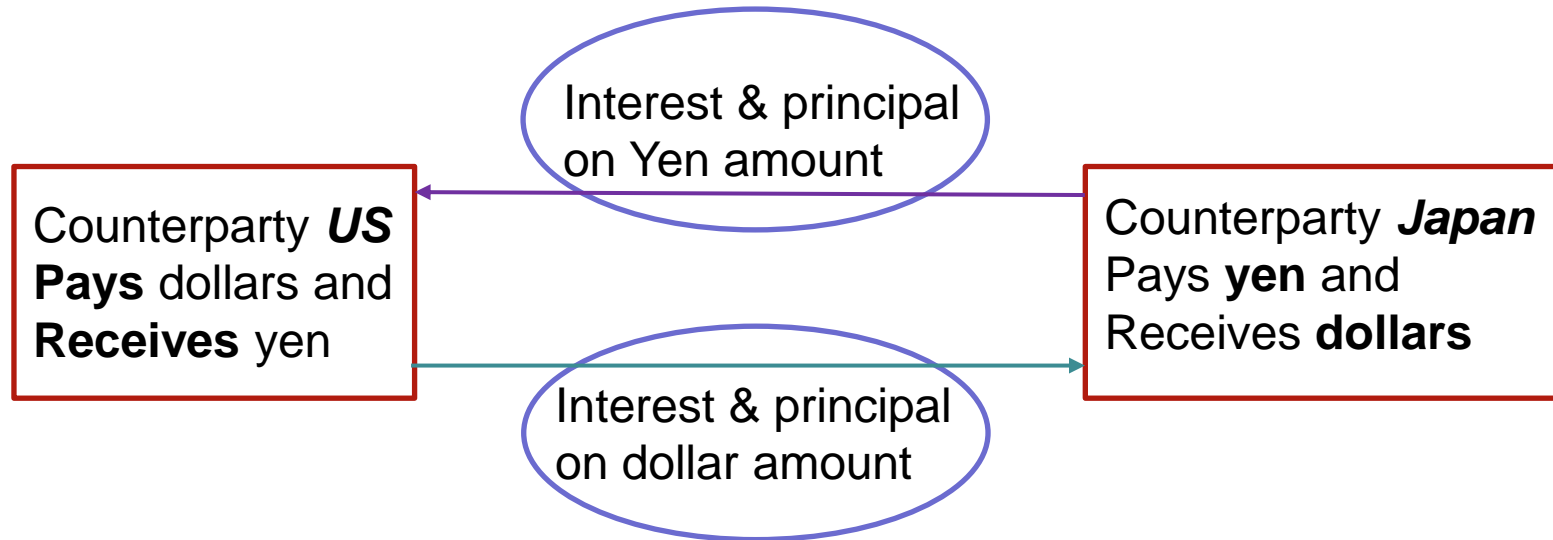
Swaps

- ❖ A swap is a contractual agreement to exchange periodic cash flows between two parties.
- ❖ Single currency interest rate swap
 - One counterparty exchanges the interest payments of a floating-rate debt obligation for the fixed-rate interest payments of the other counterparty. Both debt obligations are denominated in the **same currency**.
- ❖ Cross-currency interest rate swap
 - One counterparty exchanges the debt service obligations of a bond denominated in one currency for the debt service obligations of the other counterparty denominated in **another currency**.

How do currency swaps work?

- ❖ Here, the MNC would enter into an agreement with a counter party to exchange fixed rate debt service in one currency for fixed rate debt service in another currency.
- **Example:** Suppose a U.S. MNC, **Gaggle Co.**, wants to finance a ¥10 billion expansion of a Japanese plant.
 - They could borrow dollars in the U.S. where they are well known and exchange dollars for yen. This results in exchange rate risk. OR
 - They could borrow yen in the international bond market but pay a lot since they are not well known abroad. OR
 - If **Gaggle** can find a Japanese MNC with a mirror-image financing need, both companies may benefit from a swap.

How do currency swaps work?



Swap Bank

- ❖ A **swap bank** is a generic term used to describe a financial institution that facilitates swaps between counterparties.
- ❖ The swap bank serves as either a broker or a dealer.
 - A broker matches counterparties but does not assume any of the risk of the swap. The swap broker receives a commission for this service.
 - Today most swap banks serve as dealers or market makers. As a market maker, the swap bank stands willing to accept either side of a currency swap.

Currency swaps: Example

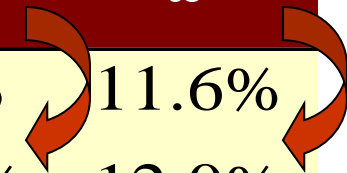
- ❖ Consider two firms: Firm A is a U.S.-based MNC and Firm B is a U.K.-based MNC.
- ❖ Both firms wish to finance a project of the same size in each other's country (worth £10,000,000 or \$16,000,000 as $S = 1.60$ \$/£). Their borrowing opportunities are given below.

	\$	£
<i>Company A</i>	8.0%	11.6%
<i>Company B</i>	10.0%	12.0%

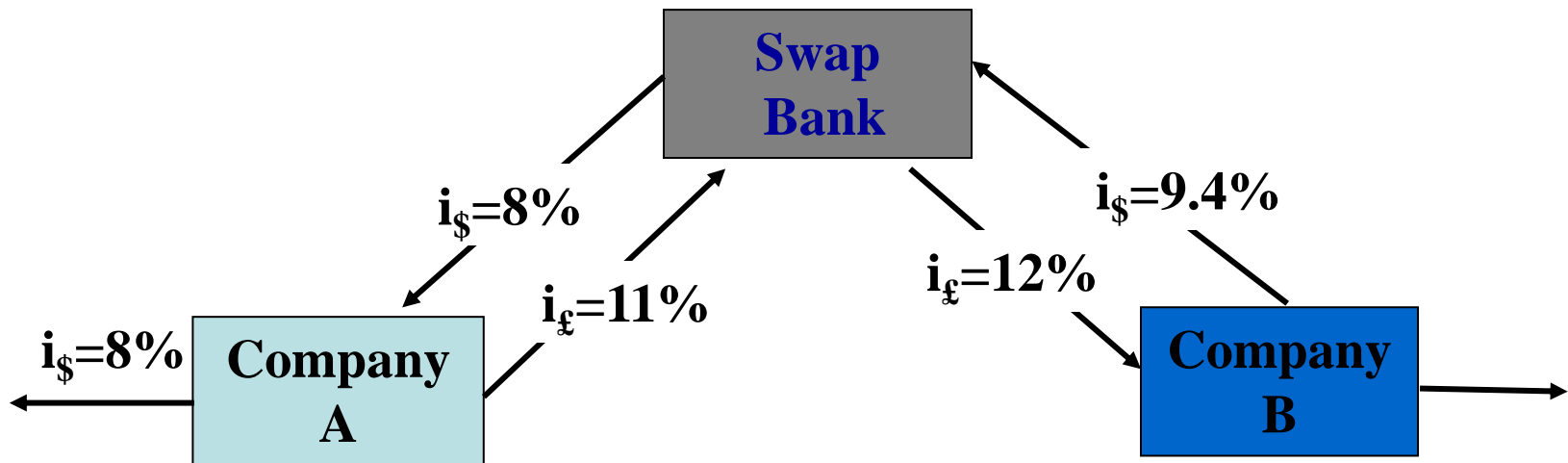
Comparative Advantage as the basis of Swaps

- ❖ A has a comparative advantage in borrowing in \$.
- ❖ B has a comparative advantage in borrowing in £.
- ❖ B pays 2% more to **borrow in dollars** than A.
- ❖ B pays *only* 0.4% more to **borrow in pounds** than A:

	\$	£
<i>Company A</i>	8.0%	11.6%
<i>Company B</i>	10.0%	12.0%

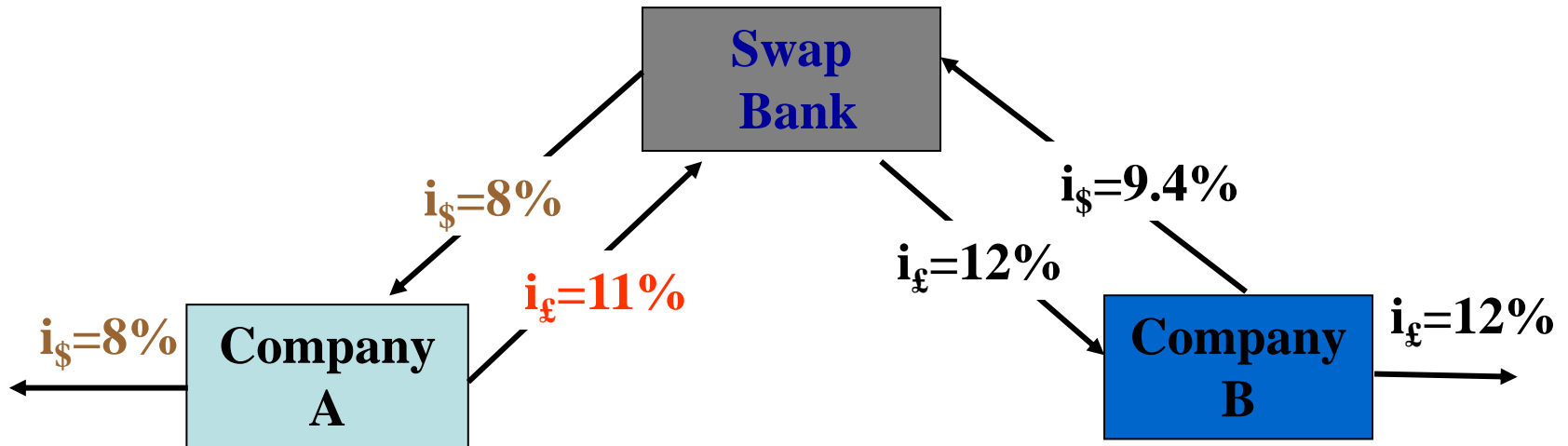
The diagram consists of two curved arrows. The first arrow starts at the 8.0% rate for Company A in dollars and points to the 10.0% rate for Company B in dollars, indicating a 2% differential. The second arrow starts at the 11.6% rate for Company A in pounds and points to the 12.0% rate for Company B in pounds, indicating a 0.4% differential.

Transaction with a swap bank



	\$	£
<i>Company A</i>	8.0%	11.6%
<i>Company B</i>	10.0%	12.0%
<i>Differential (B-A)</i>	2.0%	0.4%

The Swap Positions: A

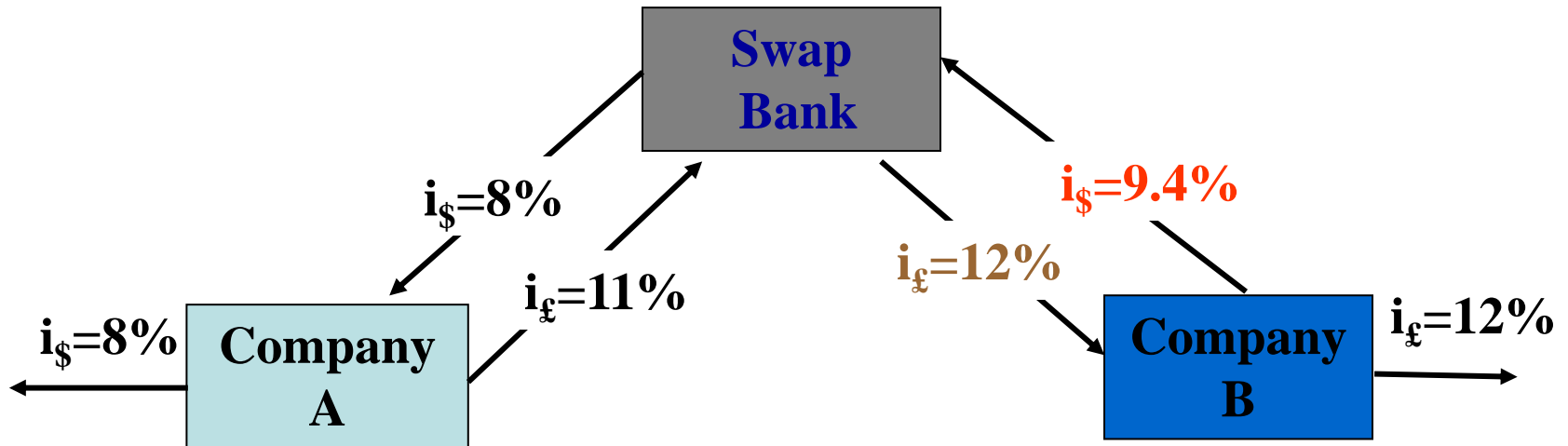


A's net position is to borrow at $i_{\pounds}=11\%$

A saves
 $i_{\pounds}=0.6\%$

	\$	£
Company A	8.0%	11.6%
Company B	10.0%	12.0%
Differential (B-A)	2.0%	0.4%

The Swap Positions: B



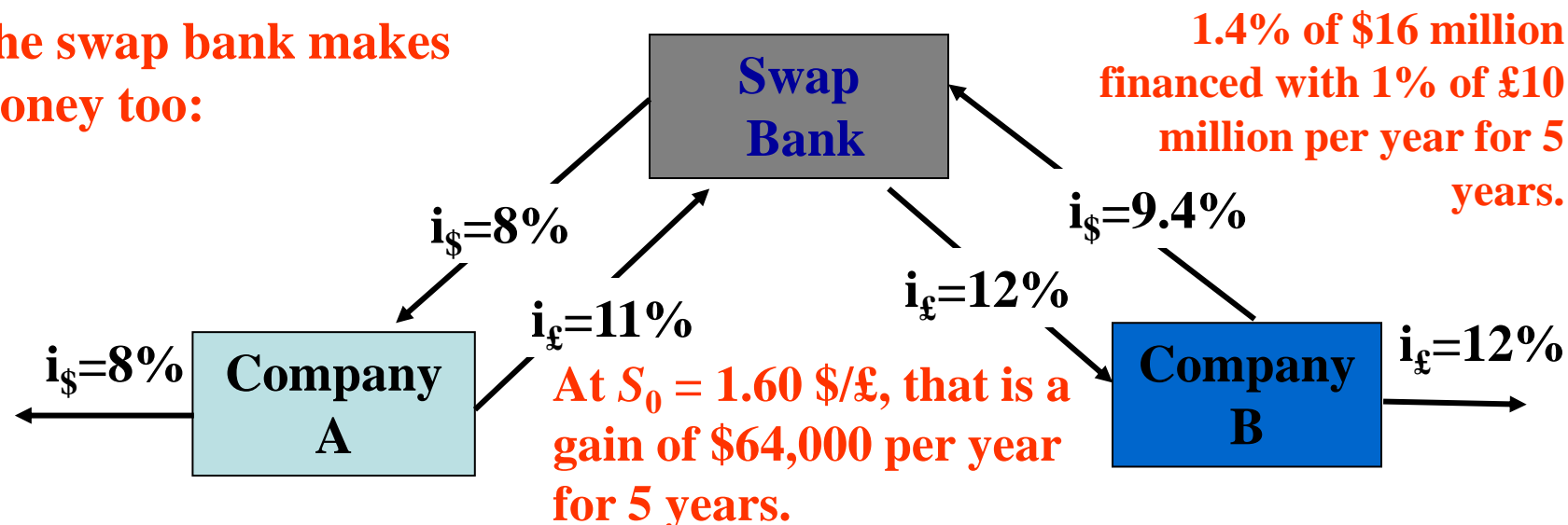
	\$	£
Company A	8.0%	11.6%
Company B	10.0%	12.0%

B's net position is to borrow at $i_{\$}=9.4\%$

**B saves
 $i_{\$}=0.6\%$**

How much does the swap bank make?

The swap bank makes money too:



	\$	£
<i>Company A</i>	8.0%	11.6%
<i>Company B</i>	10.0%	12.0%

The swap bank faces exchange rate risk, but maybe they can lay it off in another swap.

Why do a swap?

- ❖ The Quality Spread Differential (QSD) represents the **potential gains** from the swap that can be shared between the counterparties and the swap bank.
- ❖ There is no reason to presume that these gains will be shared equally.
- ❖ In the example, Company B is less credit-worthy than Bank A, so it probably will get less of the QSD, to compensate the swap bank for the default risk.

Unwinding a swap

- ❖ Discount the remaining cash flows under the swap agreement at current interest rates, and then (in the case of a currency swap) convert the target currency back to the home currency of the firm.
- ❖ Payment of the net settlement of the swap terminates the swap.