

## Corporate Exposure to Exchange Rates

### Definitions

Broadly speaking, we can classify the exposure of firms to exchange-rate changes on the firm into three types:

*Translation Exposure:* This exposure is the basis of the accounting based exchange rate gains or losses that results from converting foreign currency financial statements of foreign affiliates into parent currency units plus the conversion of FC items into parent currency units on the parent financial statements. It arises from the change in the nominal exchange rate from the previous reporting period. As translation gain or loss is unrealized, translation exposure does not result in a change in current cash flow.

*Transaction Exposure:* This exposure arises from outstanding nominal foreign currency financial receivables or payables incurred prior to an exchange rate change but not due to be settled (for cash) until after the exchange rate change. Gains or losses are the result of the unexpected nominal exchange-rate changes as any expected changes in the exchange rate should be incorporated into the transaction terms. Transaction gains/losses have an impact on current cash flows.

*Operating Exposure:* This exposure arises from the stream of future transactions the firms is expected to enter into whose value will be influenced by a current exchange rate change. Since these transactions are in the future and the price is not set, it is changes in the real exchange rates (relative competitiveness) that generate the gains or losses in future cash flows.

### Examples:

**Translation Exposure** - Most commonly this exposure arises from the need to convert foreign affiliate financial statements into parent currency for consolidation. While the financial statements of the foreign affiliate will balance when measured in FC terms ( $A = L + E$ ), accounting rules do not allow all items to be converted into parent currency at the same exchange rate. Items must be converted at either the current rate or the historic exchange rate associated with the date of its entry on the foreign financial statement. The result of using different rates for different line items is that the financial statements in parent currency will not balance. Depending on the method of foreign currency accounting used by the firm, to make the affiliate financial statements balance in parent currency a translation gain/loss adjustment is added directly to the equity section of the balance sheet or an exchange rate gain/loss is added to the income statement which flows through to retained earnings into the equity section of the balance sheet. In the US, the decision of the choice of foreign currency accounting method is made via the choice of a functional currency for each affiliate. The firm chooses either the USD or the FC as the functional currency for accounting. With the USD, it uses the temporal method of foreign currency accounting and with the FC, it would use the current rate method of foreign currency accounting.

#### Example of translation of foreign affiliate using FC as functional currency:

FC Balance Sheet			PC (USD) Balance Sheet	
Assets	Liab + Equity		Assets	Liab + Equity
CA 100	80 CL	Current XR	CA 50	40 CL
FA 50	60 LT D	HC 0.5/ FC	FA 25	30 LT D
OA 80	90 EQ	Historic XR	OA 40	90 EQ
A 230	230 L+E	HC 1/ FC	A 115	(45) TRANS ADJ
				115 L+E

Under the current rate method, all items except equity (EQ) are converted at the current exchange rate. The result is a (45) translation entry in the USD balance sheet to maintain accounting balance.

**Transaction Exposure** - Transaction exposure arises from unexpected changes in nominal exchange rates when:

1. Purchasing/selling goods or services on credit with foreign currency prices.
2. Borrowing or lending funds when repayment is to be made in a foreign currency.
3. Otherwise acquiring contractual nominal positions denominated in foreign currency.

### Example 1: Sale of Goods on Credit

A U.S. firm sells goods to a foreign buyer with price of \$10,000, with payments due in 90 days. The current spot price is  $S(\text{FC}/\$) = 3.00$ , so the price of the sale in foreign currency is FC 30,000. The transaction exposure arises because in all likelihood the foreign buyer will probably not pay FC 30,000 because the spot rate will differ on the settlement date.

Consider:                   if  $S(\text{FC}/\$)_{t+90} = 4$  the foreign buyer pays FC 40,000  
                                   if  $S(\text{FC}/\$)_{t+90} = 2$  the foreign buyer pays FC 20,000

Thus, the foreign buyer faces an economic gain or loss on the purchase of the goods depending on how the exchange rate changes. Notice that if the contract price had been set in foreign currency, the U.S. producer would face the transaction exposure rather than the foreign buyer.

### Example 2: Borrowing in Foreign Currency:

A UK firm borrows SF100,000 from a bank for 1 year. At the time of the borrowing,  $S(\text{SFr}/\text{£}) = 10$ , so UK firm borrowed £10,000. Ignoring the interest payments at the time of the repayment of principal:

if  $S(\text{SF}/\text{£}) = 12$ , the pound cost of repayment of principal = £8,333 and the firm experiences a gain of £1,666  
 if  $S(\text{SF}/\text{£}) = 8$ , the pound cost of repayment of principal = £12,500 and the firm experiences a loss of £2,500

Thus, the UK firm faces an exchange rate gain or loss (in pounds) depending on the change in the (SF/£) nominal exchange rate.

It must be noted that transaction exposure arises in every international transaction. Either the buyer or the seller will face a transaction exposure. Both will face transaction exposure if they contract in a third currency. Thus, part of the negotiation of international transaction will include the currency of payment and which party will bear the transaction exposure. Ideally, the party best able to bear (manage) the risk will find it in their interest to take on the transaction exposure. In doing so, presumably, they can negotiate a slightly better deal out of the counterparty.

### Differences between Economic and Accounting Transaction Exposure

Transaction gains or losses result in changes in *actual cash flows*. In this sense, transaction exposures are cash flow exposures that have a direct impact on firm value. However, the economic measure of transaction exposure differs in two important ways from the accountants' measure of transaction exposure that we discussed previously and demonstrated above.

The first difference between the economic transaction exposure and the accounting transaction exposure is the timing of the exposure. Economically the transaction exposure arises the moment the firm enters a **FIXED NOMINAL FOREIGN CURRENCY CONTRACT**. That is, whenever it commits to pay or receive a specific amount of foreign currency as part of a transaction at some date in the future. Thus, the economic exposure begins not when the transaction is entered into the books (typically when the good is shipped to or received by the buyer) but when the agreement is reached and the terms set for the transaction to occur. This date is typically called the commitment date. The economic definition of transaction exposure differs from the accounting definition in that the actual cash flow impact of exchange rate changes on the value of the transaction begin from the commitment date rather than the transaction date (which is when the accountants enter the transaction into the books).

A second difference is the definition of exchange rate change that generates the gain/loss on an economist's measurement of transaction exposure compared to the exchange rate change that generates the gain/loss on the accountants' measurement of transaction exposure. Under the accountant's definition, the transaction is originally recorded the spot exchange rate on the transaction date and closed using the exchange rate on the settlement date. Thus, the exchange rate gain/loss is a function of the total nominal exchange rate change between these two dates. However,

from an economic standpoint, this makes no sense. If I am setting a price today in foreign currency, knowing that I will not receive/pay foreign currency for say, ninety days in the future, why would I worry about the current exchange rate? I should be making my pricing decision based upon the expected value/cost of the transaction in 90 days. Thus, my decision regarding this transaction should be based upon my expectation of the exchange rate in 90 days—not upon the current exchange rate. Put another way, I should be taking into account all the exchange rate change expected to occur between now and the settlement date when deciding on the price with which I will enter into the transaction. Ultimately I am concerned about the amount I am expecting to receive/pay on settlement, not how much the transaction is worth today. It is the present value of the expected cash flow that matters for firm value, not the value of that foreign currency cash flow at today's spot rate. The spot rate is irrelevant as the cash flow is not occurring today. Thus, the second important difference is that economic transaction exposure is based upon UNEXPECTED nominal exchange rate changes not the actual nominal exchange rate changes as the accountants measure it.

### Example:

On September 1, a U.S. firm agrees to a contract to provide a specialized computer chip to an Italian firm. The agreement specifies that the U.S. firms must design, build and ship 1000 of these made-to-order chips within 180 days and that the Italian firm will make payment to the U.S. firm in the amount of EUR 2.5m within 180 days of receiving the chips.

The current and expected XRs are  $S(\text{USD}/\text{EUR})_t = 1.20$ ;  $E_t(S(\text{USD}/\text{EUR})_{t+180}) = 1.21$ ;  $E_t(S(\text{USD}/\text{EUR})_{t+360}) = 1.220$

What is the value of this transaction to the U.S. firm?

The U.S. firm will receive EUR2.5m in 360 days. The current value of this inflow is the present value of \$3.05m ( $\text{EUR}2.5\text{m} \times S(\$1.22/\text{EUR})$ ). Note that this expected value has nothing to do with the current spot rate or the exchange rate on the transaction date ( $t + 180$ ). The transaction exposure the US firm faces is the difference between the this amount, \$3.05m, and the amount of dollars they actually receive which will be EUR2.5m times the actual spot rate on the settlement date. Thus, the economic transaction exposure arises from the date that the EUR price is set (September 1) and the size of the transaction gain or loss will be the product of EUR 2.5m and the deviation of the actual  $S(\text{USD}/\text{EUR})$  rate in 360 days from the expected  $S(\text{USD}/\text{EUR})$  rate in 360 days from September 1.

The important managerial implication of this point is that when setting the foreign currency contract price, the firm should not be concerned about the current spot price, but rather the expected future spot price when it receives/makes payment in foreign currency. The firm should take into account any expected change in the nominal exchange rate in determining the expected revenue/cost associated with the contract. Given the expectational equilibrium in the market the expected future spot price is approximated by the forward rate. Thus, the firm should be making international pricing decisions using the forward rate curve rather than the spot rate.

### Summary for Transaction Exposure

- If you are holding a foreign denominated net asset position, you gain from an unexpected depreciation of the home currency
- If you are holding a foreign denominated net liability position, you gain from an unexpected appreciation of the home currency.

### Operating Exposure

The effects of operating exposure are more important for the financial position of the firm than the effects of transaction exposure. However, unlike transaction exposure, which is easily identified (directly from looking at the transaction contracts), operating exposure is somewhat subjective: it depends on assessing the impact of exchange-rate changes on transactions into which the firm has not yet entered. To determine operating exposure it is necessary to measure the change in the *expected future cash flows* of the firm in response to changes in the exchange rate. Since prices have not been set for future transactions, operating exposure depends not on changes in nominal exchange rates, but on changes in *real* exchange rates. As with transaction exposure, operating exposure should

only be a function of *unexpected* changes in the real exchange rate as expected changes should be incorporated into current expectations about future firm performance (i.e. current market valuation). However, under relative PPP the expected change in the real exchange rate is zero. Under absolute PPP, the change in the exchange rate is determined by its movement back toward the assumed equilibrium. Unless there is large sudden devaluation, this typically happens slowly. However, to the extent that deviations from PPP are expected to cause real exchange rate changes over the medium term, the firm should incorporate these expectations into its pricing, production, and location decisions and should be prepared for such movements.

It is important to be aware that just about every firm conceivably has some operating exposure to exchange rates. The size and sign of a firm's operating exposure will be a function of several factors: the activities in which it participates (such as exporting, importing, foreign investments etc.), the nature of the competition it faces (such as a perfectly competitive output market or an oligopolistic output market where firms have some market power), and the structure of the markets for its factors of production. However, it is impossible to generalize about how all these factors interact to determine exposure.

Lets look at some examples of operating exposure in a plausible real world setting.

## Operating Exposure with Imperfect Competition and Strategic Behavior

Despite what economists would like to think, the world is generally not characterized by perfect competition. Most firms that participate in international activities are large, and tend to have some market power. They also have the ability to partially segment the markets they serve. However, they do face competition from other international firms that limits their market power. In a world with imperfect competition, the possibilities for strategic behavior also arise, in the sense that a firm attempts to gain advantages over its competitors even at some short run cost to itself. This is presumably because of expected gains from increasing market share (economies of scale) or market power (driving competitors out of business).

Before we begin, we need to discuss the metric for the strategic pricing behavior. The important question is how the firm alters the foreign currency price of its good in response to an exchange-rate change. This is known as the pass-through effect. Pass-through is the ratio of the percentage change in the foreign currency price of your

$$\text{Pass-through} = \frac{\% \Delta \text{ FC price of export}}{\% \Delta S \left( \frac{\text{FC}}{\text{HC}} \right)}$$

exports to the percentage change in the foreign currency price of domestic currency.

While pass-through can theoretically take on any value, it is usually in the range between zero and one. These two points represent specific behaviors with respect to FC price changes and exchange-rate changes. When pass-through is zero, this means that the firm keeps the FC price of the good fixed and therefore, absorbs the gain or loss (resulting from an exchange rate change) on the HC value of the sale. In cases where pass-through is zero, when the HC appreciates, the firm sees a decrease in the proceeds of a foreign sale. Similarly, when the HC depreciates and pass-through is zero, the firm receives the larger HC proceeds of each foreign sale. With pass-through equal to zero, the firm's FC price (and therefore quantity sold) remains fixed and the HC revenue *per foreign sale* fluctuates.

When pass-through is one, the firm has "passed through" the entire impact of the exchange-rate change into the FC price of the good to the foreign consumers. Thus, when the HC appreciates, the firm raises the FC price of the good by the same proportion as the exchange-rate change, leaving the HC proceeds of a foreign sale the same as before the exchange rate change. Similarly, when the HC depreciates, the firm lowers the FC price of the good and receives the same HC proceeds of each foreign sale as before the exchange-rate change. Thus, with pass-through equal to one, the firm's FC price (and therefore quantity sold) fluctuates and the HC revenue *per foreign sale* remains fixed. Notice that in either case total HC proceeds from the foreign market fluctuate with the exchange rate.

Be aware that price fluctuations in the foreign market will result in quantity fluctuations (as long as demand is not perfectly inelastic). Another way to think about pass-through is that choosing pass-through of zero attempts to maintain *quantity* stability at the expense of *HC profit margin* stability. Alternatively, choosing pass-through of one attempts to maintain *HC profit margin* stability at the expense of *quantity* stability. In strategic terms, setting pass-through at zero when the HC appreciates and at one when the HC depreciates is an aggressive pricing behavior (one that seeks to maintain or maximize market share). This is also known as pricing to market. A policy of maintaining pass-through at one all the time (making the foreign-currency price reflect all the variability in exchange rates) corresponds to the maintenance of a fixed HC margin on each good. This was a common policy of U.S. firms before the mid 1980s.

In reality, pass-through can vary anywhere between zero and one, depending on market structure, elasticity of demand, the behavior of competitors and strategic considerations. In a world where firms have some market power, the determination of pass-through is a corporate decision that must be made in response to market conditions. As we shall see below, pass-through decisions do not affect the *relative* performance of the firms in strategic interaction as a result of exchange rate changes but they will have an influence on the reported impact of exchange-rate changes on the reported operating performance.

Let us consider strategic behavior in terms of pricing policy: a firm has market power to choose between the market-determined trade-off of price and quantity. As such, behavior is more descriptive of the real world, we consider several examples to demonstrate how operating exposure can vary depending on the activities and strategic behavior of firms. First, we will examine firms with domestic operations only.

## Examples of Operating Exposure with Imperfect Competition

### *Domestic Production Only*

Let us consider a situation where there are two representative firms, one in the U.S. and the other in Germany. These firms operate in an oligopolistic industry and each possesses some degree of market power. Each firm produces similar goods that are close substitutes with the others and sells in both countries. There are no transport costs and the products initially have the same price. Initially, all inputs to production are available in segmented domestic markets. Assume that under original market conditions the products had the same price and unit profitability. Also, assume the two firms split each market.

Initially the exchange rate is  $S(\$/\text{€}) = 1.00$ . The condition of each firm is:

	<u>U.S.</u>	<u>Germany</u>
Cost of production	\$5	€5
Price in home market	\$10	€10
Price of exports	\$10 = €10	€10 = \$10

Initially the profit margin is \$5 in the U.S. and €5 in Germany. If we assume that each firm sells the same quantity initially, then the expected value of each firm's cash flows are the same at the current spot exchange rate.

Suppose the nominal exchange-rate changes unexpectedly resulting in a real exchange-rate change. The new spot rate is  $S(\$/\text{€}) = 2.00$  (\$ depreciation of 50%). There has been no change in input prices. The real dollar depreciation provides a competitive advantage to the slack to the U.S. exporter. The new situation in the market depends on the pricing behavior of the firms. The U.S. producer may set pass-through to one by lowering her export price to €5, squeezing her German competitor, and forcing him to lower his price to €5 or lose market share. Alternatively, assuming that she has the ability to segment her markets, the U.S. exporter can be passive and keep her export price at €10 (now \$20) and enjoy larger profit margins on the same export quantities as before. In a similar fashion, the price in the U.S. market will depend on the reaction of the German firm to the exchange rate change. If the German producer follows pass-through = 1, then the price of German imports in the US rises to \$20 (€10 @ \$2/€), leaving the US producer room either to raise her domestic price and/or increase her share of sales in the US market.

The possible polar cases resulting from the 50% dollar depreciation ( $S(\$/\text{€}) = 2$ ), look like:

U.S. Firm		German firm		PT = 1		PT = 0	
<b>PT = 0</b>	COSTS	<u>U.S.</u>	<u>Germany</u>	<u>U.S.</u>	<u>Germany</u>	<u>U.S.</u>	<u>Germany</u>
	$P_{HOME}$	\$5	€	\$5	€	\$5	€
	$P_{EXPORT}$	\$20	€10	\$10	€10	\$10	€10
	PROFIT	\$20 = €10	€10 = \$20	\$20 = €10	€ = \$10	\$20 = €10	€ = \$10
		HOME = \$15	HOME = €	HOME = \$5	HOME = €	HOME = \$5	HOME = €
	EXPORT = \$15	EXPORT = € 1	EXPORT = \$15	EXPORT = € 2	EXPORT = \$15	EXPORT = € 2	
<b>PT = 1</b>	COSTS	<u>U.S.</u>	<u>Germany</u>	<u>U.S.</u>	<u>Germany</u>	<u>U.S.</u>	<u>Germany</u>
	$P_{HOME}$	\$5	€	\$5	€	\$5	€
	$P_{EXPORT}$	\$20	€	\$10	€	\$10	€
	PROFIT	\$10 = €	€10 = \$20	\$10 = €	€ = \$10	\$10 = €	€ = \$10
		HOME = \$15	HOME = €	HOME = \$5	HOME = €	HOME = \$5	HOME = €
	EXPORT = \$5	EXPORT = € 3	EXPORT = \$5	EXPORT = € 4	EXPORT = \$5	EXPORT = € 4	

In addition to these four polar cases, there is an infinite set of possible results in between.

In all four cases, the U.S. producer has gained relative to the German producer. In square 1, both the U.S. and German producers react passively to the exchange rate change. The result is a price increase in the U.S. by both producers. However, this price increase only leads to higher profit margins for the U.S. firm [note that there will be a decrease in the quantity demanded as a result of the price increase, but this will be shared by both firms]. Unless the decrease in quantity demanded is substantial, the U.S. firm should benefit because it has tripled its profit margin on domestic sales while the German firm's profit margin on exports remains unchanged (because of the change in the exchange rate). In the German market, since the U.S. firm reacted passively, the price remains at €10. Thus the German firm sees no change in its cash flows from the domestic market; however, the U.S. firm, by selling at €10 now receives \$20 for each sale, resulting in much higher dollar cash flows from the German market. The German firm experiences only a partial decrease in total cash flows (due to the decreased sales in the U.S.) resulting from the price rise, while the U.S. firm experiences an increase in cash flows, from exports, and perhaps, also from domestic sales (depending on demand elasticity). Thus, the U.S. firm has improved its competitive position vis-a-vis its German competitor.

In square 4, the same relative result holds, except it takes a dramatically different form. As both firms have priced aggressively, the consumer is the big winner. The price in the U.S. market remains at \$10 and the price in the German market is driven to € by the aggressive U.S. pricing. As a result, the German firm is severely squeezed. It earns no profits on its export sales in the U.S. as the \$10 just covers the € costs. It also makes no profits in the German market with the price driven down to €. On the other hand, the U.S. firm's cash flows increase but only slightly. In the U.S. market, nothing has changed for the U.S. firm: it still sells the same quantity at \$10 per sale. In the German market, by pricing at € the U.S. firm will experience an increase in export sales [just as the German firm will experience an increase in domestic sales due to the price reduction], and the dollar profit margin on each export sale is the same as it was prior to the exchange rate change. Thus in square 4, the U.S. firm experiences a small increase in cash flows—from the export market—while the German firm is severely squeezed, experiencing a dramatic decrease in cash flows and perhaps facing financial distress.

It is important to note that the off-diagonal entries (squares 2 and 3) require the ability to segment markets as the price of the good is significantly different in one country than the other. Unless market segmentation exists, arbitrageurs will purchase the item in the low cost area and ship them to the high cost location arbitraging away the price difference. In the absence of this ability, the results will lie somewhere in between with the prices possibly converging around some level like \$15 and €7.5. In any case, it can be seen by examining these situations that the U.S. firm experiences a relative increase in its cash flows compared to the German firm.

The bottom line is that a depreciation of the domestic currency benefits the competitive position (cash flows and thus value) of domestic firms involved in exporting or import competing activity. This benefit continues until the real exchange rate returns to its original level.

*U.S. Firm with Imported Inputs to Production:*

Suppose that the U.S. firm changed the sourcing of its inputs to make use of some inputs that are sold in Canada. In addition, let us assume that the U.S. firm does not export, but does face competition from the German exports. The imported inputs used by the U.S. firm come from Canada and their price is determined in the Canadian market in Canadian dollars. Let us assume that initially  $S(C\$/\$) = 1.00$ . Together with all of the original assumptions from above, we have the following situation with the German competitor (assume it does not use imported inputs):

	<u>U.S.</u>	<u>Germany</u>
Cost of local input	\$2	€
Cost of imported input	C\$3 = \$3	-
Total Cost	\$5	€
Price in U.S. market	\$10	€10 = \$10

The initial profit margins are \$5 per unit for the U.S. local market sales and € per unit on each German export to the U.S.

Now suppose that there is a real change in the value of the Canadian dollar, so that  $S(C\$/\$) = 1.5$  (dollar appreciation against the Canadian dollar), while prices in Canada remain the same [the price of the input the U.S. firm imports from Canada remains at C\$3]. If the exchange-rate change is due to Canadian factors so that  $S(\$/€)$  remains unchanged at  $\$1/€$  the following are the polar cases assuming fixed Canadian prices:

U.S. firm	Aggressive Pricing Behavior		Passive Pricing Behavior	
	<u>U.S.</u>	<u>Germany</u>	<u>U.S.</u>	<u>Germany</u>
local input costs	\$2	€	\$2	€
imp input costs	C\$3=\$2	-	C\$3=\$2	-
Total costs	\$4	€	\$4	€
$P_{US}$	\$9	€=\$9	\$10	€10=\$10
PROFIT IN US	\$5	€ 1	\$6	€ 2

Although these represent just two of many possible market outcomes because of these events, it draws out two important points. First, as an importer of inputs to goods that are sold in a competitive foreign market, the U.S. firm gains a competitive advantage as a result of the appreciation of its home currency against that foreign currency (the Canadian dollar) vis-a-vis the German competitor. The C\$/ \$ exchange-rate change reduces the dollar costs of its imported inputs and thereby reduces its costs of production.

In square 1, we assume the U.S. firm takes an aggressive pricing behavior and lowers its final output price by the full amount of the imported input price reduction. [Note: while this is analogous to  $PT = 1$ , it is not exactly the same as our definition because the firm is changing a domestic currency price]. The result of the domestic price reduction is that it forces the German firm to react, either by lowering its export price or surrendering market share. The net result of the lower price is more domestic sales with the same profit margin per sale, leading to greater cash flows for the U.S. firm, and a decrease in export cash flows for the German firm.

In square 2, a similar result will hold, but as with the previous table, it will take a slightly different form. In this situation, we assume that the U.S. firm takes a passive pricing stance (the analogous position to  $PT = 0$ ) and keeps the benefits of the reduced input costs in the form of a higher profit margin. Thus, the price in the U.S. market does

not change, so quantity demanded does not change, but the U.S. firm now has a profit margin of \$6 on each sale whereas it had only \$5 before. This leads to greater cash flows for the U.S. firm. The German firm on the other hand, sees no change in the market. The price is still \$10, which converts into receipts of €10 on each export sale. Also, as quantity demanded does not change its cash flows from exporting do not change. However, the German firm is now facing a stronger competitor in the U.S. market. This may lead to some second-order valuation effects that could slightly reduce the value of the German firm. However, the relative result is the same, a relative increase in cash flows and value for the U.S. firm.

This example demonstrates the simple intuition regarding the operating exposure of importing firms: firms that import goods with fixed foreign currency prices gain from a real appreciation of their home currency. Note that this is different from the exposure of an importing firm in a perfectly competitive environment.

A similar situation would hold in our example above if the Canadian firm exporting the good to the U.S. producer increased his C\$ price (kept the \$ cost the same) in response to the exchange rate change (i.e. set his pass-through = 0). However, everything else held constant, importing creates a positive relation between the change in expected cash flows and the change in the real value of the home currency.

The second point to note from this example is that the result of the Canadian dollar's real depreciation against the U.S. dollar also implies a real depreciation of the Canadian dollar against the Euro.

From triangular arbitrage,  $S(C\$/\text{€})$  was originally 1.00 and has now become  $S(C\$/\text{€}) = 1.50$ .

Although the German firm does not interact in the Canadian market, its cash flows can be affected by the real depreciation of the Canadian dollar. In square 1, due to the decrease in the U.S. market price, the German firm must lower its export price or lose sales. Thus, the current and expected future cash flows of the German firm from exporting to the U.S. market will have fallen, and with it, firm value. This demonstrates the point that you need not transact in a currency in order to have an operating exposure to it. *If your competitors' costs are exposed to a particular foreign currency, then you also will have some exposure to that foreign currency.*

## Real Exchange Rate Exposures Even with No Exchange-Rate Change

While changes in nominal exchange rates are the most common source of real exchange rate fluctuations—resulting in a high correlation between nominal and real exchange-rate changes—real exchange rates may also change due to relative price changes even when nominal exchange rates are constant. This is especially true in developing countries and Europe where there are attempts to maintain fixed nominal exchange rates. Real exchange rate changes of this sort also give rise to operating exposures that can affect firm cash flows and thus current market value. Although they occur due to price changes (rather than FX changes), they usually occur more slowly. As a demonstration of this phenomenon, let us take the U.S. firm from the previous example and consider the effect of a generalized price increase in Canada relative to the U.S. with no offsetting change in the value of the Canadian dollar.

Originally the cost of the imported Canadian input was  $C\$3 = US\$3$  resulting in a total cost per good for the U.S. firm of \$5. Now assume prices in Canada rise by 33% relative to the U.S. (Canada has 33% higher inflation than the U.S.) while the exchange rate remains fixed at  $S(C\$/\$) = 1.0$ . The result of this event is a real appreciation of the Canadian dollar and the price of the Canadian input rising from C\$3 to C\$4 leading to production costs of the U.S. firm rising from \$3 to \$4. Now the total cost per good for the U.S. firm rises to \$6. This squeezes the cash flows of the U.S. firm competing with the German firm in the U.S. market. (it either squeezes its profit margin to \$4 or loses market share by raising price to \$11). The result is exactly analogous to a real appreciation of the Canadian dollar due to a nominal exchange rate movement with fixed input prices; however, this time the exchange rate stayed fixed and prices moved. This is also different from domestic inflation under which both input and output prices would have risen. This distinction is important to keep in mind when we discuss hedging operating exposure because this type of operating exposure to real exchange-rate changes cannot be hedged via nominal foreign currency contracts.

## Summary of Impact of Exchange-Rate Changes on Firm's Local Production Cash Flows

Real Depreciation of the Home Currency :

- increases profitability of exporters through higher margins and/or increased sales
- decreases profitability of importers through lower margins and/or decreases sales
- increases profitability of import competitors through higher margins and/or sales

Real Appreciation of the Home Currency:

- decreases profitability of exporters through lower margins and/or decreased sales
- increases profitability of importers through higher margins and/or increase sales
- decreases profitability of import competitors through lower margins and/or sales

## Operating Exposure and Foreign Operations

We have considered the operating exposures to different activities when production was carried out in the local market. For multinational firms, on the other hand, a substantial amount of production occurs in foreign markets, generally with foreign currency costs. This production may be sold in the local market, exported to some other foreign market where it is sold for another foreign currency, or it may be sold back to the parent's domestic market. Under these scenarios, exposures can differ substantially in terms of the value of the operating flows back to the parent operating flow. Generally speaking, there are two things going on when determining the exchange rate exposure of foreign operation cash flows from the parent's point of view. First, there is the exposure of the operating cash flows denominated in the foreign currency (analogous to what we examined above). Second, there is a valuation (or conversion) effect resulting from measuring the net foreign currency cash flows in the parent's currency. The size and sign of these two effects determine the operating exposure to the parent foreign operations.

Below we consider several examples to demonstrate the possible outcomes. These examples are simple, ignoring the impacts of transaction exposures to focus completely on the operating exposure of foreign subsidiaries.

### No Operating Exposure in Foreign Currency

Consider the case of a stand-alone German subsidiary of a U.S. parent. Let us assume that this firm produces in Germany with €costs and sells its goods in the German market. The current exchange rate is  $S(\$/\text{€}) = 1.00$  and the future expected exchange rates are the same as the spot rate so a provisional estimate of expected cash flows generated by the subsidiary for the coming period looks as follows:

*German Subsidiary of U.S. Parent*

Revenues	€100
Cost of goods	<del>€90</del>
Profit	€10

At the current exchange rate, the contribution of the foreign subsidiary to the parent's consolidated financial performance is \$10 ( $\text{€}10 \times \$1/\text{€}$ ).

Now suppose that the  $S(\$/\text{€})$  exchange rate and its future expectations changes to  $S(\$/\text{€}) = 0.50$  (50% euro depreciation) with no immediate change in prices in either country. Since the disturbance causing the exchange-rate change was common to all exchange rates with the dollar, cross rates of other currencies against the € that may influence the firm remain the same. To a first approximation, the exchange-rate change has no impact on the €cash flows generated by the German subsidiary: they remain at €10. Although it has no impact on the €cash flows of the German subsidiary, the exchange-rate change has a one-for-one change on the dollar value of these cash flows: they

fall to \$5 (€10 / \$0.5/€). Thus the dollar appreciation reduces the dollar value of the expected future cash flows of the foreign subsidiary to the U.S. parent, via the conversion effect—by the amount the dollar changed in value against the €. Note that this exchange rate impact on subsidiary value is the same as the effect on a fixed €payoff instrument such as a bank deposit or a government bond.

This demonstrates that when the *foreign currency cash flows* are independent of the exchange-rate change, either because of a lack of exposure to that particular exchange-rate change or a complete lack of exposure to exchange-rate changes (i.e., barbershops), there is a negative relation between a change in the real value of the parent currency vis-a vis the subsidiary currency and the parent-currency value of the foreign subsidiary. Note, for simplicity we are ignoring an accounting adjustment that may occur because of translation or transaction hedging.

However, it is difficult to conceive of a firm that does not have some exposure to exchange rates. Under more realistic assumptions, the impact of exchange rate changes on the parent's currency value of foreign operations requires a more careful look. As we shall see, it depends on identifying the size and the sign of the foreign subsidiary's operating exposure.

### Subsidiary with Operating Exposure on the Cost Side

Consider a German subsidiary of a U.S. parent with cost exposure. For example, let us assume that the German firm is a manufacturer that imports certain inputs to the production process from abroad (a foreign country that uses the foreign currency FC). Since the German subsidiary is an importer, we know it has an operating exposure on the cost side. To keep the analysis simple, we shall continue to assume that this subsidiary only sells its good in the German market and has no operating exposure in its revenues.

The initial exchange rates and future expectations are  $S(\$/\text{€}) = 1.00$  and  $S(\text{FC}/\text{€}) = 2.00$ . A provisional estimate of expected cash flows generated by the subsidiary in the near future looks as follows:

#### *German Subsidiary of U.S. Parent*

Revenues		€100
Local input costs:	€45	
Imports FF90@2FC/€	€45	
Total Costs		<del>€90</del>
Profit		€10 = \$10 from parent perspective

At the current \$/€ exchange rate, this subsidiary is expected to contribute \$10 per period to the parents overall expected cash flows.

Consider the exposure to the parent from this subsidiary enterprise of a 50% generalized real appreciation of the €. This appreciation of the € raises the exchange rates to  $S(\$/\text{€}) = 1.50$ , and  $S(\text{FC}/\text{€}) = 3.00$ . Given the assumed market conditions, revenue exposure is second order and is ignored; however, there is a cost exposure due to the importation of some inputs to production that are priced in foreign currency. As a result of the exchange-rate change, the expectation of Euro cash flows for the subsidiary become:

#### *German Subsidiary of U.S. Parent*

Revenues		€100
Local input costs:	€45	
Imports FF90 @ 3FC/€	€30	
Total Costs		€75
Profit		€25 = \$37.50

Now the German subsidiary's expected €cash flows rise to €25 which convert into \$37.50 from the parent's perspective. With the subsidiary's cost exposure, the exposure of the parent arising from the foreign subsidiary was negatively related to the change in the real value of the parent currency and larger than in the case when the subsidiary had no operating exposure. Here the operating exposure of the subsidiary and the valuation effect are both working in the same direction. The operating exposure is the change in expected €cash flows from €10 to €25. The valuation effect is the result of every €now being worth \$1.50 instead of \$1.00.

### Operating Exposure on the Revenue Side

The opposite situation emerges when the foreign subsidiary has an operating exposure on the revenue side. Consider a German subsidiary with a revenue exposure. For example, assume that the German subsidiary is a manufacturing plant that competes with non-EU firms in selling its good in Germany as well as the other non-EU countries (that use the foreign currency FC). As this subsidiary is an exporter, we know it has a revenue exposure. For simplicity, we shall assume that there is no cost exposure: all production costs are denominated and determined in €. Let us consider the same original exchange rates as the previous example,  $S(\$/\text{€}) = 1.00$  and  $S(\text{FC}/\text{€}) = 2.00$ . A provisional expectation of the €cash flows to the German subsidiary are:

#### *German Subsidiary of U.S. Parent*

Local €revenues:	€80	
Export rev FF 40 @ 2FC/€	€20	
Total revenues		€100
Total Costs		<u>€0</u>
Profit		€10 = \$10

At the current \$/€exchange rate, this subsidiary is expected to contribute \$10 per period to the parents overall expected cash flows.

As before, consider the exposure to the parent from this enterprise of a 50% generalized real appreciation of the €. This appreciation of the €changes the exchange rates to  $S(\$/\text{€}) = 1.50$ , and  $S(\text{FC}/\text{€}) = 3.00$ . Given our assumptions, cost exposure should be considered second order and is ignored; however, there is a revenue exposure due to the export of some outputs priced in francs. As a result of the exchange-rate change, the expectation of €cash flows for the subsidiary become:

#### *German Subsidiary of U.S. Parent*

Local €revenues:	€80	
Export rev FF40@3FC/€	€13.33	
Total revenues		€93.33
Total Costs		<u>€0</u>
Profit		€3.33 = \$5

In this case, the parent sees a drop in the expected dollar cash flows from the German subsidiary resulting from the real appreciation of the €(depreciation of the dollar). This is despite the fact that now each €is converted into \$1.50 at the current exchange rate. This negative exposure arises because the decrease in net €cash flows (profits) because of the currency movement [from €10 to €3.33, (-67%)] is more dominant than the change in the \$ value of the euro [from \$1.0 to \$1.50 (+50%)]. Put another way, these two effects, the operating exposure of the subsidiary and the valuation effect to the parent were working in opposite directions. In this example, it happened that underlying cash flows fell by more than the valuation effect could counteract, causing the net dollar cash flows to fall.

In certain cases, it is possible to have a foreign subsidiary that is “operationally” hedged. This occurs when the size of these two impacts of exchange rate changes on the parent’s valuation of a foreign subsidiary exactly offset. Such would be the situation in the following example:

*German Subsidiary of U.S. Parent*

Local €revenues:	€0	
Export rev FF 20 @ 2FC/€	€10	
Total revenues		€100
Total Costs		€0
Profit (exchange rate at 2€/\$)		€10 = \$10

At the current \$/€exchange rate of 1.00, this subsidiary is expected to contribute \$10 per period to the parents overall expected cash flows.

Once again, assume a generalized real appreciation of the €. This appreciation of the € changes the exchange rates to  $S(\$/€) = 1.50$ , and  $S(FC/€) = 3.00$ . As a result of the exchange-rate change, the expectation of €cash flows for the subsidiary become:

*German Subsidiary of U.S. Parent*

Local €revenues:	€0	
Export rev FF20 @ 6FF/€	€6.67	
Total revenues		€6.67
Total Costs		€0
Profit		€6.67 = \$10

In this situation, the exposure to the parent firm is zero. The change in the exchange rate has had no impact on the expected cash flows from foreign operations. The operating exposure and the conversion effect exactly offset. Note that this is a rare situation, but does drive home why some multinational firms operations may have relatively low exposures.

A third possibility with the revenue exposure is that if the revenue exposure is small enough (goes to zero) we move toward the initial case of a firm without operating exposure (examined above). In this case, the parent benefited from the dollar depreciation against the €. Thus, for foreign operations with revenue exposures, the exposure to the parent depends on the size of the revenue exposure. If the revenue exposure is small with respect to the cost exposure, the parent benefits from a home currency depreciation. As the revenue exposure gets large, the parent gain from a depreciation of its home currency gets smaller and at some point, the firm is naturally hedged. As the net revenue exposure continues to increase, we move to a situation where the parent actually is financially harmed by a home currency depreciation against the subsidiary currency. Thus, the operating exposure of a parent with a foreign subsidiary with a net revenue exposure is ambiguous. It depends on the relative sizes of the operating and conversion exposures.

A final word of warning, in these examples regarding foreign operations we have considered price effects as the source of operating exposure. While this may be valid for cost exposures, it is clearly not valid for revenue exposures as the change in competitiveness may change the quantity of items sold as well as the subsidiary’s currency price of the items.

### Important Extensions on Operating Exposure

While we have gone through several examples of operating exposure, it is important to note a few extensions to the analysis that were not always explicitly mentioned or were ignored in the cases above. The primary caveat is to keep in mind that the impact of large changes in the exchange rate is not necessarily just a linear multiple of a small exchange rate change. While people sometimes respond only passively to small changes, they may react quite dramatically to large changes in their environment. Examples of different groups’ possible reactions to large exchange rate changes include:

*Consumers:* As we have shown, large changes in the real exchange rate result in substantial changes in relative prices and as such, they influence the relative purchasing power of a consumer's currency. When the dollar appreciates substantially, as it did in the early 1980s, this leads to an increase in the purchasing power of the U.S. dollar. Not only will this lead to a relative increase in the purchase of foreign goods, but through an income effect of the increased purchasing power of U.S. residents, it may also lead to an increase in both foreign and domestic purchases. Such an effect may mitigate the negative influence of a large appreciation on a U.S. exporter that also has sales in the U.S. This potential impact of large exchange rate changes was not considered in the examples above.

*Public Sector:* It should be no surprise that politicians and governments may also react to large real exchange rate changes. Large changes in real exchange rates cause governments to consider protectionist policies, offer tax breaks for new (possible foreign ) investment, or place controls on capital and exchange flows. These policies can have impacts on the value of either the domestic or the foreign firm that were not considered above.