CHAPTER VIII

CURRENCY RISK MANAGEMENT AT THE FIRM LEVEL

At the firm level, currency risk is called *exposure*. The globalization of the business environment has turned exposure into a general management responsibility. Exposure is traditionally divided in three areas: *transaction exposure*, *economic exposure*, and *translation exposure* (balance sheet exposure). Transaction exposure refers to the currency risk of transactions denominated in foreign currency, for example, exports or imports. Economic exposure measures the degree to which a firm's expected cash flows are affected by unexpected changes in exchange rates. Translation exposure measures potential accounting-based changes in a firm's consolidated statements that result from a change in a change in exchange rates.

Example VIII.1: The different exposures.
A. Transaction exposure.
Swiss Cruises, a firm with headquarters in Switzerland, sells cruise packages to U.S. customers priced in USD. Swiss Cruises has several U.S. suppliers that bill their services and goods in USD. Swiss Cruises only cares about CHF returns, therefore, they are exposed to exchange rate fluctuations.

B. Economic exposure.
Swiss Cruises has the majority of its costs denominated in CHF. Almost 50% of its revenue is denominated in USD. Suppose the CHF significantly appreciates against the USD. The cruise business is a very competitive business and it is extremely unlikely that Swiss Cruises can increase the USD prices of its cruise packages. Thus, Swiss Cruises net cash flows, denominated in CHF, will be affected.

C. Translation exposure.
Swiss Cruises has assets and liabilities denominated in USD. Once a quarter, Swiss Cruises has to consolidate the financial statements of its subsidiaries into one statement. The assets and liabilities denominated in USD must be translated into their CHF equivalent. Since different accounting rules applies to different book items an accounting gain or loss may appear due to the translation. ¶

♦ **Kellogg's Exposure**
The Kellogg Company is the world's largest cereal company; second largest producer of cookies and crackers; and a major producer of snacks and frozen foods. The principal markets for these products include the U.S. and Europe. Kellogg's operations are managed in two major divisions –U.S. and International- with International further delineated into Europe, Latin America, Canada, Australia, and Asia.

Looking at the results for Q3 2015 EPS declined by 10% on a year-to-year basis to USD 0.85 on sales of USD 3.3 billion. On currency-neutral basis, EPS would actually have increased by 2% to USD 0.96. That is, the strong USD in 2015 affected Kellogg's financial performance. This is not surprising. According to Kellogg's financial statements:

"Our operations face significant foreign currency exchange rate exposure and currency restrictions which could negatively impact our operating results.

We hold assets and incur liabilities, earn revenue and pay expenses in a variety of currencies other than the U.S. dollar, including the euro, British pound, Australian dollar, Canadian dollar, Mexican peso, Venezuelan bolivar fuerte and Russian ruble. Because our consolidated financial statements are presented in U.S. dollars, we must translate our assets, liabilities, revenue and expenses into U.S. dollars at then-applicable exchange rates. Consequently, changes in the value of the U.S. dollar may unpredictably and negatively affect the value of these items in our consolidated financial statements, even if their value has not changed in their original currency"
Source: Kellogg Annual Report 2014. ♦

This chapter studies the different techniques used by firms to manage their currency exposures. We will study how firms measure and manage transaction exposure, economic exposure and translation exposure. Throughout this chapter, the techniques used to measure and manage exposure will be illustrated with real world situations. Finally, we will address a fundamental question for a firm: should a firm hedge?

I. Transaction Exposure

Multinational firms routinely transact in different currencies. The value of a multinational firm's cash flows, denominated in the home currency, will depend on the value of the corresponding exchange rates. Transaction exposure refers to gains or losses that arise from the future settlement of transactions denominated in foreign currency. These transactions include purchasing or selling on credit goods or services whose prices are stated in foreign currency, borrowing or lending funds denominated in foreign currency, acquiring assets denominated in foreign currency, and being a party to an unexpired futures currency contract.

Exchange rates are very volatile. Moreover, exchange rates are not only volatile, but they are also difficult to forecast. The uncertainty about the future value of exchange rates makes uncertain the home currency value of a multinational firm's cash flows. Take, again, the case of Swiss Cruises, with headquarters in Switzerland. The owners of Swiss Cruises only care about CHF cash flows. Almost half of Swiss Cruises' business is done in the U.S., through a subsidiary based in Miami. The usual practice is to quote U.S. packages in USD. For example, a standard 7-day Caribbean cruise package is sold for USD 649. In general, it takes an average of 20 days to settle these transactions. If, during the 20-day settlement period, the USD appreciates (depreciates) against the CHF, Swiss Cruises' CHF cash flows will increase (decrease). Thus, every cruise package sold in the U.S. involves an uncertain CHF denominated cash flow. This uncertainty about the future value of a foreign exchange denominated transaction is referred as transaction exposure.

1.A Measuring Transaction Exposure

Transaction exposure is very easy to identify and measure, especially in the short-run, when firms can forecast future cash flows with high accuracy. For a multinational firm, measurement of transaction exposure requires a consolidation of the contractually fixed future currency inflows and outflows for all subsidiaries, categorized by currency. Take the case of a U.S. multinational firm. If a subsidiary has positive cash flows in EUR and another subsidiary has negative cash flows in EUR, the net transaction exposure might be very low. Thus, firms evaluate transaction exposure on net basis. The net transaction exposure, NTE, in each currency is converted to the domestic currency so the firm has a standardized measure for each currency.

Example VIII.2: Swiss Cruises, a Swiss firm, has sold cruise packages to a U.S. wholesaler for USD 2.5 million. Swiss Cruises has bought fuel oil for USD 1.5 million. Both cash flows are going to occur in 30 days. Assume S_t = **1.45 CHF/USD**. Thus, the net transaction exposure in USD is:

NTE = (USD 2,500,000 - USD 1,500,000) * **1.45 CHF/USD** = CHF 1,450,000

Swiss Cruises also estimates the sensitivity of this net transaction exposure to changes in the CHF/USD exchange rate. For example, if the exchange rate changes by -/+10%, then transaction exposure changes by **-/+CHF 145,000**. ¶

Now, suppose that a U.S. multinational has a subsidiary with positive cash flows in EUR and another subsidiary has negative cash flows in GBP. The U.S. multinational knows that there is very high and positive correlation between these two currencies. The U.S. multinational will take this correlation into account when measuring the overall net transaction exposure. This measurement technique is called *netting*.

Netting involves offsetting exposures in one currency with exposures in the same or another currency, where exchange rates are expected to move in opposite directions. Therefore, gains (losses) in the first exposure compensate for the losses (gains) in the second exposure. Netting involves looking at transactions with a portfolio approach. The assumption behind exposure netting is that the net gain or loss is what really matters to a company or an international investor. Under this view, hedging decisions are not made transaction by transaction. Rather, hedging decisions are made based on the exposure of the portfolio.

Example VIII.3: Swiss Cruises has a USD net transaction exposure of USD 1 million. Swiss Cruises also expects to repay a loan from a Canadian bank for an amount of CAD 1.50 million. Both cash flows are going to occur in 30 days. Assume S_t = 1.47 CAD/USD.

Since CHF/CAD monthly changes and CHF/USD monthly changes are highly correlated (ρ = .86, from 1988 to 2017), Swiss Cruises management considers the net transaction exposure from both transactions to be close to zero.

Swiss Cruises is in a very good situation. If the CHF appreciates against the USD, the USD inflows will be reduced, once expressed in CHF. However, given the high correlation between the USD and the CAD, the CAD outflows, once expressed in CHF, will be reduced by a similar amount, leaving the net transaction exposure virtually unchanged. ¶

1.A.1 Range Estimates of Transaction Exposure

Given that exchange rates are very difficult to forecast, firms regularly report the sensitivity of transaction exposure to exchange rates changes. A range estimate of the net transaction exposure, rather than estimating a single number, will provide an estimate of the sensitivity of net transaction exposure to future exchange rates scenarios. The smaller the estimated range is, the lower the sensitivity of the net transaction exposure is. It is common to see reported, in the annual reports, the impact of a 10 percent depreciation or appreciation on the fair value of foreign currency denominated assets and liabilities. In addition, from an operational point of view, it is very important for firms to have funds available to cover net outflow positions. Thus, firms should measure the sensitivity to changes in exchange rates of its net transaction exposure. There are different methods for estimating ranges. One, we have already discussed above, in Example VIII.2, where we assume s_t changed by an arbitrary ("*ad hoc*") amount, ± 0.10 The other wo popular methods for estimating a range for transaction exposure are (1) sensitivity analysis (or simulating exchange rates), and (2) assuming a statistical distribution for exchange rates changes, s_t.

1.A.1.a Range Estimates: Sensitivity analysis

The goal of a sensitivity analysis is to measure the sensitivity of transaction exposure to different exchange rates. Recall that we are interested in forecasting a transaction exposure range. One simple way to create a range using sensitivity analysis is to measure the sensitivity of transaction exposure to extreme forecasts of exchange rates. Another alternative is to randomly simulate thousands of exchange rates –according to some rule- and evaluate the transaction exposure for each simulated exchange rate. Then, we can draw a histogram to analyze the empirical distribution of transaction exposure that we generated. Now, we can select as boundaries for our desired range the two more extreme cases or, more general, the cases that lie on the boundaries of a $(1-\alpha)$% confidence interval, where α is usually 5%.

Example VIII.4: Sensitivity analysis – Extreme values.
It is December 2014. Based on the empirical distribution of CHF/USD monthly changes over the past 20 years (1994-2014), with descriptive stats in Table VIII.1, Swiss Cruises has developed extreme exchange rate scenarios for the next 30 days.

TABLE VIII.1
Descriptive Statistics for CHF/USD 1-mo changes

Mean (μ)	**-0.00152**
Standard Error	0.00202
Median	-0.00363
Mode	#N/A
Stand Deviation (σ)	**0.03184**
Sample Variance (σ^2)	**0.00101**
Kurtosis	0.46327
Skewness	0.42987
Range	0.27710
Minimum	**-0.11618**
Maximum	**0.15092**
Sum	0.05768
Count	248

Since 1994, the extremes were **15.09%** (on October 2011) and **–11.62%** (on January 2009). According to the empirical distribution, the best case scenario would be a **15.09%** appreciation of the USD against the CHF, while the worst case scenario would be a **11.62%** depreciation of the USD against the CHF. Based on these scenarios, Swiss Cruises calculates a range for the USD net transaction exposure. (Recall that the net USD cash flows are **USD 1 million**.)

(A) Best case scenario: largest appreciation of USD: 0.1509
NTE: **USD 1M** * 1.45 CHF/USD * (1 + **0.1509**) = **CHF 1,668,805**.

(B) Worst case scenario: largest depreciation of USD: -0.1162
NTE: **USD 1M** * 1.45 CHF/USD * (1 – **0.1162**) = **CHF 1,281,510**.

Based on the recent history of the CHF/USD exchange rate, in the next 30 days the USD net transaction exposure should be between CHF 1,320,370 and CHF 1,620,665. That is,

$$NTE \in \textbf{[CHF 1,281,510, CHF 1,668,805]}$$

Note: A risk manager will only care about the lower bound. That is, if Swiss Cruises is counting on the **USD 1 million** to cover CHF expenses, from a risk management perspective, the expenses to cover should not exceed CHF 1,281,510. ¶

This range based on observed extremes may be considered too conservative -i.e., too wide-, after all these extreme observations are rare. For instance, in Example VIII.4, the probability of the extremes is very low, only once in 240 months. As mentioned above, a good alternative is to randomly simulate thousands of exchange rates –according to some rule- and evaluate the transaction exposure for each simulated exchange rate. Then, we can draw a histogram to analyze the empirical distribution of transaction exposure that we generated. Typical simulation:

(i) Randomly draw one scenarios from the ED -say, $s_{t=Jun\ 1999}$.
(ii) Calculate quantity of interest using simulated scenario -say, **TE** = USD 1M * S_t (1+ $s_{t=Jun\ 1999}$).

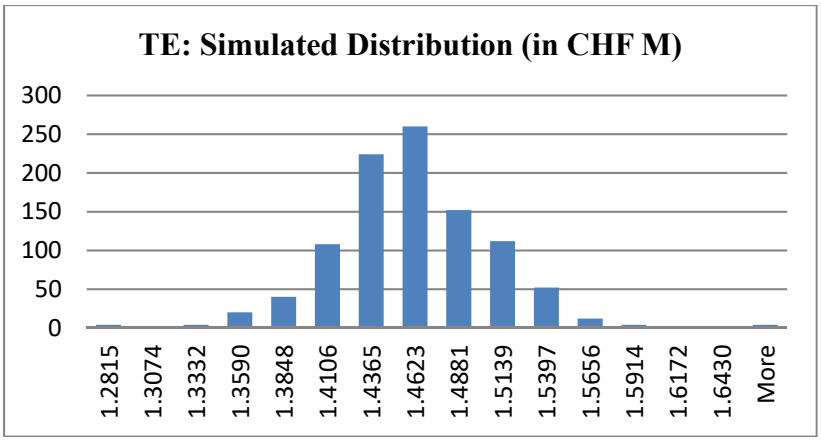
(iii) Repeat (i)-(ii) *R* times. This is your *simulated distribution*. Analyze it as usual (calculate mean, SD, (1-α)% C.I., etc.)

Example VIII.5: Simulation for SC's Net TE (CHF/USD) over one month.
Based on the ED, we will draw R = 1,000 s_t realizations (past monthly s_t.). Then, we calculate 1,000 TE for each scenario drawn. Steps:
(i) Randomly draw $s_t = s_{sim,1}$ from ED: Observation 19: s_t = **0.0034**.
(ii) Calculate $S_{sim,1}$: S_{t+30} = **1.45 CHF/USD** * (1 + **.0034**) = **1.4549**
(iii) Calculate $TE_{sim,1}$: **TE** = USD 1M * S_{t+30} = **1,454,937.57**
(iv) Repeat (i)-(iii) 1,000 times. Plot the 1,000 TEs in a histogram. (This is your simulated TE distribution.)

Using the excel functions Randbetween and Vlookup, below we have the first 9 draws:

Lookup cell	s_t	Random Draw with Randbetween	Draw s_sim with Vlookup	S_sim	TE(sim)
1					
2	0.0025	19	**0.0034**	1.4549	**1,454,937.57**
3	-0.0027	147	-0.0104	1.4349	1,434,895.83
4	**0.0001**	99	0.0125	1.4682	1,468,189.96
5	-0.0443	203	-0.0584	1.3653	1,365,272.92
6	-0.0017	82	-0.0727	1.3446	1,344,597.25
7	-0.0031	**4**	**0.0001**	1.4502	1,450,168.79
8	-0.0227	67	-0.0226	1.4172	1,417,218.22
9	-0.0099	136	0.0095	1.4638	1,463,838.02
10	0.0098	232	0.0191	1.4777	1,477,749.46

The generated histogram is shown below:



Now, based on the simulated distribution of the CHF/USD exchange rate, we can construct a 95% confidence interval for the next 30 days for the USD net transaction exposure. To construct the 95% confidence interval, we leave 2.5% of the observations to the left and 2.5% of the observations to the right.

That is, based on the 95% confidence interval, the USD net transaction exposure should be between CHF 1.3661 M and CHF 1.5443 M. That is,

NTE $\in$ [**CHF 1.3661 M**, **CHF 1.5443 M**]

Note: If SC expects to cover expenses with this USD inflow, the maximum amount in CHF to cover, using this 95% CI, should be CHF 1,366,100. ¶

1.A.1.b Range Estimates: Assuming a Distribution

We can also create ranges using standard statistical theory. Confidence intervals based on an assumed distribution will provide a range for transaction exposure. For example, a firm can assume that exchange rates follow a normal distribution and based on this distribution construct a $(1 - \alpha)$% confidence interval.

Example VIII.6: A firm assumes that S_t changes (s_t) follow a normal distribution with mean μ and variance σ^2. That is, $s_t \sim N(\mu, \sigma^2)$. Based on this assumption, a firm can construct a $(1 - \alpha)$% CI:

$$[\mu - z_{\alpha/2} * \sigma,\ \mu + z_{(1-\alpha/2)} * \sigma] = [\mu \pm |z_{\alpha/2}|\ \sigma].$$

Then, a 95% ($\alpha = .05$, $z_{.025} = -1.96$) CI is given by

$[\mu \pm 1.96\ \sigma]$. (Instead of 1.96, it is common to use 2.) ¶

Example VIII.7: Confidence Interval based on a Normal distribution.
Go back to Examples VIII.4 and VIII.5. Now, assume Swiss Cruises believes that CHF/USD monthly changes follow a normal distribution, with monthly mean, μ, **-0.00152** and monthly variance, σ^2, **0.001014**, where the mean and the variance are estimated using the past 12 years of monthly percentage changes (see Table VIII.1). That is,

$s_t \sim N(-0.00152, 0.001014)$.

Based on this distribution, we construct a 95% confidence interval for CHF/USD monthly changes. That is, we expect that s_t in the next 30 days will be between:

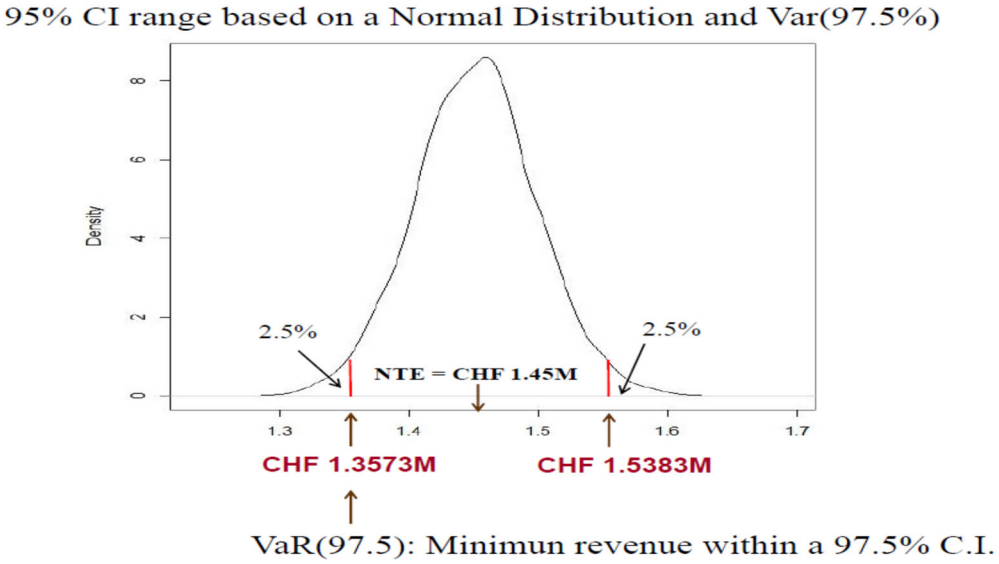
[**-0.00152** ± 1.96 * **0.03184**] = [-0.06393; 0.06089].

Based on this range for s_t, we can derive bounds for the net transaction exposure:
(A) Upper bound
NTE: **USD 1M** * 1.45 CHF/USD * (1 + 0.06089) = **CHF 1,538,291**.

(B) Lower bound
NTE: **USD 1M** * 1.45 CHF/USD * (1 - 0.06393) = **CHF 1,357,302**.
⇒ NTE ∈ [**CHF 1.357 M**, **CHF 1.538 M**]

That is, in the next 30 days the USD net transaction exposure will be between CHF 1.357 M and CHF 1.538 M with 95% confidence.

Note: Recall the VaR concept discussed in Chapter V. The lower bound has a straightforward VaR interpretation: CHF 1,357,302 is the minimum revenue to be received by Swiss Cruises in 30 days, within a 97.5% confidence interval.



Again, if Swiss Cruises expects to cover expenses with this USD inflow, the maximum amount in CHF to cover, within a 97.5% confidence interval, should be **CHF 1,357,302**.

We can also calculate the maximum expected loss relative to today's valuation of the cash flow, or VaR-mean, within a 97.5% confidence interval. That is,
VaR-mean (.975%) = **CHF 1.357302 M** – CHF 1.45 M = **CHF -0.092698 M**. ¶

In Table VIII.1, we notice that s_t displays a positive kurtosis and also an excess kurtosis different from zero. Under normality, both statistics should be 0. A departure from normality is very common in financial time series. We can introduce departures from normality in different ways; usually, by assuming a fat-tail distribution, like the *t-distribution*, or using the Cornish-Fisher (CF) approximation. The CF approximation uses a Taylor expansion of the normal density, which makes the approximate density a function of skewness (SK) and excess kurtosis (EK). Under the CF approximation, we have new z_α values, z_α^{CF}:

$$z_\alpha^{CF} = z_\alpha + \frac{SK}{6}\{(z_\alpha)^2 - 1\} + \frac{EK}{24}\{(z_\alpha)^3 - 3z_\alpha\} + \frac{SK^2}{36}\{2(z_\alpha)^5 - 5z_\alpha\}$$

Notice that if SK = EK = 0, then, $z_\alpha^{CF} = z_\alpha$.

For $\alpha = .025$, $z_{.975} = 1.96 \Rightarrow z^{CF}_{\alpha=.975} = 1.96 + 0.474 * SK + 0.069 * EK + 1.335 * (SK)^2$.
$z_{.025} = -1.96 \Rightarrow z^{CF}_{\alpha=.025} = -1.96 + 0.474 * SK - 0.069 * EK - 1.335 * (SK)^2$.

Example: For the CHF/USD used above we have SK = **0.214** & EK = **1.357** (& $\mu = 0$). Then,
$z^{CF}_{\alpha=.975} = 1.96 + 0.474 * (\mathbf{0.463}) + 0.069 * (\mathbf{0.430}) + 1.335 * (\mathbf{0.463})^2 = 2.495$
$z^{CF}_{\alpha=.025} = -1.96 + 0.474 * (\mathbf{0.463}) - 0.069 * (\mathbf{0.430}) - 1.335 * (\mathbf{0.463})^2 = -2.056$.
Then,
CHF VaR(mean, $(1 - \alpha)$) ≈ CHF 1.45M * (-2.005) * **0.03184** = **CHF -0.092567.** ¶

♦ **Approximating returns at different frequencies**

If we use logarithmic returns –i.e., $s_t = \log(S_t) - \log(S_{t-1})$-, changing the frequency of the mean return (μ) and return variance (σ^2) is very simple. Let μ and σ^2 be measured in a given base frequency. Then,

$\mu_f = \mu\ T$,
$\sigma^2_f = \sigma^2\ T$,

where f is the frequency selected (days, months, years) and T represents the frequency selected relative to the base frequency. The standard deviation is calculated by taking the square root of σ^2_f:

$\sigma_f = \sigma\ T^{1/2}$.

We can use these logarithmic rules to approximate arithmetic returns for different frequencies than the original frequency.

Example: Consider the monthly percentage changes in the CHF/USD exchange rate presented in Table VII.1: μ_m= **-0.00152** and σ_m= **0.03184**. These are arithmetic returns. We want to calculate the daily and annual percentage mean change and standard deviation for the CHF/USD exchange rate. We will approximate them using the logarithmic rule.

(1) Daily (i.e., f=d=daily and T=1/5)
μ_d = (**-0.00152**) * (1/30) = -.0000507 (-0.006%)
σ_d = (**0.03184**) * $(1/30)^{1/2}$ = .00602 (0.60%)

(2) Annual (i.e., f=a=annual and T =52)
μ_a = (**-0.00152**) * (12) = -.01824 (-1.82%)
σ_a = (**0.03184**) * $(12)^{1/2}$ = .110297 (11.03%)

The annual compounded arithmetic return is -.01809 = $(1\text{-}.00152)^{12}$-1. When the arithmetic returns are low, these approximations work well. ¶

Note: Using logarithmic returns rules, we can approximate USD/CHF monthly changes by by changing the sign of the CHF/USD. The variance remains the same. For example, the annual USD/CHF mean percentage change is approximately 1.82%, with an 11.03% annualized volatility.

For the SC example, using these annualized numbers, we can approximate an annualized VaR(.975), if needed:
VaR(.975) = USD 1M * 1.45 CHF/USD * [1 + (-.0182 -1.96 0.1103)] = CHF 1,101,374. ♦

1.A.2 Netting: The Role of Correlations

Multinational companies with a lot of foreign currency transactions tend to base their hedging decisions on the overall portfolio of exposures, not on transaction by transaction. In the netting approach, correlations play a very important role. A practical approach to derive a range for the net transaction exposure (NTE) of a firm is to do a simulation, drawing, for example, from the empirical distribution. That is, we calculate the NTE under different scenarios and then we have an empirical distribution for the NTE.

Example VIII.8: Sensitivity Analysis for portfolio approach
Suppose HAL has the following CFs in the next 90 days

	Outflows	Inflows	S_t	Net Inflows
GBP	100,000	25,000	**1.60 USD/GBP**	(75,000)
EUR	80,000	200,000	1.05 USD/EUR	120,000

NTE (in USD) = EUR 120,000 * 1.05 USD/EUR + (GBP 75,000) * 1.60 USD/GBP =
= **USD 6,000** (this is our baseline case)

Situation 1: Assume $\rho_{GBP,EUR} = 1$. (The correlation between the EUR and the GBP is high.)
Scenario (i): EUR appreciates by **10%** against the USD

Since $\rho_{GBP,EUR} = 1$, S_t = 1.05 USD/EUR * (1 + **.10**) = 1.155 USD/EUR
S_t = **1.60 USD/GBP** * (1 + **.10**) = **1.76 USD/GBP**

NTE (in USD) = EUR 120,000 * 1.155 USD/EUR + (GBP 75,000) * **1.76 USD/GBP** =
= USD 6,600. (10% change)

Scenario (ii): EUR depreciates by **10%** against the USD

Since $\rho_{GBP,EUR} = 1$, S_t = 1.05 USD/EUR * (1 – **.10**) = 0.945 USD/EUR
S_t = **1.60 USD/GBP** * (1 – **.10**) = **1.44 USD/GBP**

NTE (in USD) = EUR 120,000 * 0.945 USD/EUR + (GBP 75,000) * **1.44 USD/GBP** =
= USD 5,400. (**-10%** change)

Now, we can specify a range for NTE ⇒ **NTE ∈ [USD 5,400, USD 6,600]**

Note: The NTE change is exactly the same as the change in S_t. If a firm has matching inflows and outflows in different currencies –i.e., the NTE is equal to zero-, then changes in S_t do not affect NTE. That's very good.

Situation 2: Suppose the $\rho_{GBP,EUR} = -1$ (NOT a realistic assumption!)
Scenario (i): EUR appreciates by **10%** against the USD

Since $\rho_{GBP,EUR} = -1$, $S_t = 1.05$ USD/EUR * (1 + **.10**) = 1.155 USD/EUR
$S_t =$ **1.60 USD/GBP** * (1 – **.10**) = **1.44 USD/GBP**

NTE (in USD) = EUR 120,000 * 1.155 USD/EUR + (GBP 75,000) * **1.44 USD/GBP** =
= USD 30,600. (410% change)

Scenario (ii): EUR depreciates by **10%** against the USD

Since $\rho_{GBP,EUR} = -1$, $S_t = 1.05$ USD/EUR * (1 – **.10**) = 0.945 USD/EUR
$S_t =$ **1.60 USD/GBP** * (1 + **.10**) = **1.76 USD/GBP**

NTE (in USD) = EUR 120,000 * 0.945 USD/EUR + (GBP 75,000) * **1.76 USD/GBP** =
= (USD 18,600). (-410% change)

Now, we can specify a range for NTE ⇒ **NTE ∈ [(USD 18,600), USD 30,600]**

Note: The NTE has ballooned. A 10% change in exchange rates produces a dramatic increase in the NTE range. Having non-matching exposures in different currencies with negative correlation is very dangerous. ¶

The method described in Example VIII.8 looks like the ad-hoc method, the ±10% rule. In practice, given that exchange rates are correlated, a company like HAL will randomly draw s_t pairs from the empirical distribution to construct a histogram for NTE. From this simulated NTE data, a range and a VaR for the NTE can easily be derived.

Alternatively, a company can assume a correlation (estimated from the data) and, then, create many scenarios for s_t assuming a statistical distribution, say a normal distribution. Then, it is possible to randomly draw joint s_t 's. As usual, a company will build a histogram for NTE and, then, compute a range –and a Value-at-Risk– for the NTE.

1.B Managing Transaction Exposure: A Comparison of Hedging Techniques

A firm can hedge its transaction exposure using both external and internal methods. An external hedge involves a financial instrument, such as a forward contract or a currency option. An internal hedge involves organizing the firm in such a way that transaction exposure is minimized. For example, a firm can use pricing policies to transfer currency risk to a customer or a supplier.

1.B.1 External Methods: Futures/Forwards, Options, and Money Market Hedges

To deal with transaction exposure, firms routinely use hedges using the two contracts studied in Chapters VI and VII: a *forward/futures hedge* and an *options hedge*. Hedging with currency futures/forward contracts and currency option contracts is very simple. To hedge payables denominated in foreign currency; a domestic company buys a forward/futures contract or buys a call option. To hedge receivables denominated in foreign currency; a domestic company sells forward/futures contracts or buys a put option. This section compares these two hedges. In addition to these two hedges, firms also use another hedge: a *money market hedge*.

To hedge payables denominated in foreign currency, the money market hedge is constructed by borrowing in the domestic market, converting these borrowed funds into the foreign currency needed and investing these funds in a foreign currency instrument until we need to pay the foreign. When the payables are due, we liquidate (or just transfer to the foreign creditor) our foreign currency instruments. Similarly, to hedge receivables denominated in foreign currency, the money market hedge is constructed by borrowing in the foreign market, converting these borrowed foreign funds into the domestic currency and investing these funds in a local bank. When the receivables are due, we repay the bank loan with the foreign denominated receivables.

The money market hedge is simple. You might have noticed that it is just a replication of the IRP arbitrage condition. Under perfect market conditions, a money market hedge is equivalent to a forward hedge. That is, a money market hedge synthesizes a forward hedge (see Chapter VI). Due to transaction costs, different credit ratings and market imperfections, however, one might be superior to the other. For example, firms with high credit ratings might find it cheaper to synthesize a forward hedge, while low-rated firms will find it cheaper to use a forward hedge.

TABLE VIII.2
Review of Hedging Techniques

Hedging Technique	To Hedge Payables	To Hedge Receivables
Forward/Futures hedge	Buy a currency futures/forward contract representing the currency and amount related to the payables.	Sell a currency futures/forward contract representing the currency and amount related to the receivables.
Money market hedge	Borrow home currency and convert to currency denominating payables. Invest these funds until they are needed to cover the payables.	Borrow currency denominating receivables and convert to home currency. Invest these funds. The foreign loan is paid with the receivables.
Currency option hedge	Purchase a currency call option representing the currency and amount related to the payables.	Purchase a currency put option representing the currency and amount related to the receivables.

Example VIII.9: Comparison of Hedging Techniques for Transaction Exposure.
Iris Oil Inc., a Houston-based energy company, has a large foreign currency exposure in the form of a 300 million CAD cash flow from its Canadian operations. The exchange rate risk to Iris Oil is that the CAD may depreciate against the USD in the next 90 days. In this case, Iris' CAD revenues, transferred to its USD account will diminish and its total USD revenues will fall. Iris Oil is considering different alternatives: (1) do nothing; (2) using a forward hedge, (3) using a money market hedge and (4) using an option hedge. Its analysts develop the following information, which can be used to assess the alternative solutions:

Situation: Iris will have to transfer **CAD 300M** into its USD account in 90 days.

Data:
S_t = 0.8451 USD/CAD
$F_{t,90}$ = 0.8493 USD/CAD
i_{USD} =3.92%; i_{CAD} =2.03%

Date	**Spot market**	**Forward market**	**Money market**
t	**S_t = .8451 USD/CAD**	**$F_{t,90}$ = .8493 USD/CAD**	i_{USD} =3.92%; i_{CAD} =2.03%
t+90	Receive **CAD 300M** and transfer into USD.		

Hedging Strategies:
1. Do Nothing:
Do not hedge and exchange the **CAD 300M** at the market exchange rate in 90 days, S_{t+90}.

2. Forward Hedge (FH):
At t, sell the **CAD 300M** forward and in 90 days Iris Oil gets:

(CAD 300M) * (.8493 USD/CAD) = USD 254,790,000

3. Money Market Hedge (MMH):
At t, Iris Oil takes the following three steps, simultaneously:
1) Borrow from Canadian bank at 2.03% for 90 days :
CAD 300M / [1 + .0203 * (90/360)] = CAD 298,485,188.
2) Convert to USD at S_t:
CAD 298,485,188 * **0.8451 USD/CAD** = USD 252,249,832
3) Deposit in US bank at 3.92% for 90 days. Thus, Iris Oil gets a sure cash flow in 90 days:
CAD 252,249,832 * [1 + .0392 * (90/360)] = **USD 254,721,880**.

Note: Both the FH and the MMH guarantee certainty in 90 days
FH delivers to Iris Oil: USD 254.79M
MMH delivers to Iris Oil: USD 254.72M
=> Iris Oil will prefer the forward hedge.

4. Option Hedge:
At t, buy a put. Use the options market. Available 90-day options are (premium in USD cents):

X	Calls	Puts
.82 USD/CAD	----	0.21
.84 USD/CAD	1.58	**0.68**
.88 USD/CAD	0.23	----

Iris Oil decides to buy the .84 USD/CAD put .

The total premium paid is **USD .0068 * 300M = USD 2.04M**
Since options involve an upfront payment, Iris Oil includes a carrying cost (CC) in the total cost of the option hedge. That is,
CC = **USD 2.04M** * .0392 * (90/360) = USD 19,992.

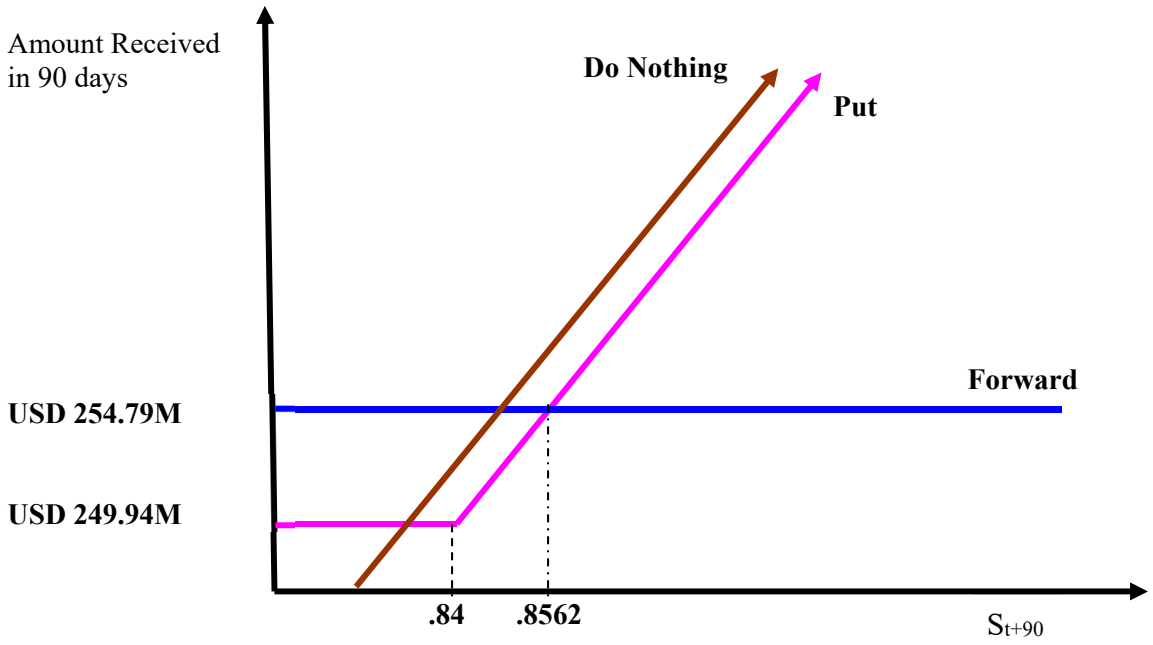
Then, the total cost for the option hedge is:
USD 2.04M + 0.019992M = USD 2.059992 (≈ USD 2.06M)

The option hedge has the following cash flows (CF) in 90 days:

Position	**Initial CF**	**Cash flows at t+90**	
		S_{t+90} < .84 USD/CAD	**S_{t+90} > .84 USD/CAD**
Option (HP)	**USD 2.04M**	(**.84** – S_{t+90}) * **CAD 300M**	0
Underlying (UP)	0	S_{t+90} * **CAD 300M**	S_{t+90} * **CAD 300M**
Total CF	**USD 2.04M**	USD 252M	S_{t+90} * CAD 300M

Net Cash Flow in90 days: **USD 249,940,000** for all S_{t+90} < **.84 USD/CAD**
or **S_{t+90} * CAD 300M – USD 2.06M** for all S_{t+90} > **.84 USD/CAD**

The cash flows in 90 days can be summarized by the following graph:



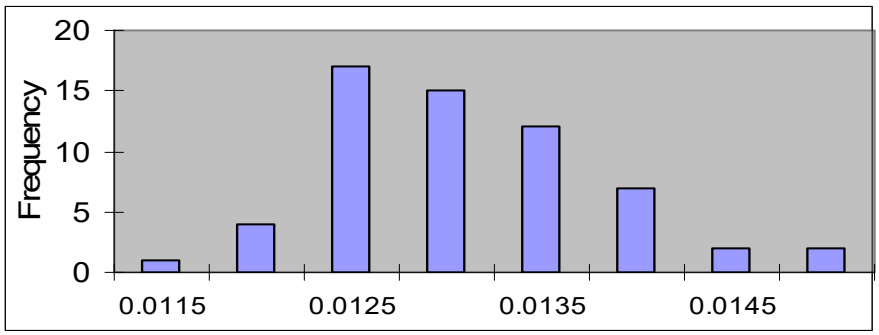
Remark: Iris Oil's decision will depend on the probability distribution of S_{t+90}. Suppose we compare the forward hedge and the option hedge. The forward and the option alternatives have the same cash flows when S_{t+90}=.8562 USD/CAD. Then, if the probability of S_{t+90} <.8562 USD/CAD is high, the forward option will be the likely hedging choice. But, preferences will matter. A risk taker manager may love the low probability upside of the option hedge. ¶

Firms will use probability distributions to make hedging decisions. These probability distributions can be obtained using the empirical distribution, a simulation, or by assuming a given distribution. For example, a firm can assume that changes in exchange rates follow a normal distribution.

Example VIII.10: Comparison of Hedging Techniques with a given probability distribution.
Cudillero Corp. has bought Japanese auto-parts two months ago. Cudillero Corp. will need **JPY 100 million** in 120 days. Cudillero Corp. wants to hedge its currency risk. Cudillero considers using (1) a forward hedge, (2) a money market hedge, (3) an option hedge, or (4) no hedge. Its analysts develop the following information, which can be used to assess the alternative solutions:

- Spot rate (USD/JPY) .012470 - **.012502**
- 4-mo forward rate .012478 - **.012499**
- 4-mo interest rates
  - USD (%) 0.6840 - 0.6970
  - JPY (%) 0.4120 - 0.4304
- A call option on JPY that expires in 120 days has an exercise price of .012 USD/JPY with a premium of USD .000781
- A put option on CHF that expires in 120 days has an exercise price of .012 USD/JPY with a premium of USD .0003921.

• Using the past 5 years (60 observations), Cudillero Corp. draws a historgram of 4-mo changes in the USD/JPY exchange rate:



Then, Cudillero Corp. decides to use the following distribution of exchange rates, in 120 days, to evaluate the hedging techniques:

S_{t+120}	Probability
USD .0115	13%
USD .0125	50%
USD .0135	30%
USD .0145	7%

Each alternative solution is assessed below:

1. *Forward Hedge*: Purchase JPY 120 days forward. at .012499 USD/JPY

USD needed in 120 days = Payables in JPY * Forward rate of USD/JPY
= **JPY 100M** * **.012499 USD/JPY** = **USD 1.2499M**.

2. *Money Market Hedge*: Borrow USD for 120 days, Convert to CHF, Invest CHF, Repay USD loan in 180 days.

Amount in JPY to be invested = JPY 100M /(1 + .00412 * 120/360) = JPY 99.862855M

Amount in USD needed to convert into JPY for deposit = JPY 99.862855M * **.012502 USD/JPY**
= USD 1.2484854M

Interest and principal owed on USD loan after 120 days = USD 1.2484854M * (1 + .00697*120/360)
= **USD 1.251386M**

3. *Call Option*: Purchase call options. Exercise price = .012 USD/JPY; premium = **USD .000781**
(Recall that the option is to be exercised on the day the JPY are needed or not at all.)

Possible Spot Rate in 120 days	Premium per Unit for Option	Exercise Option? (X= .012)	Total Price Paid per Unit	Total Price Paid for **JPY 100M**	Prob
USD .0115	USD .000781	No	USD .0122821	USD 1.22821M	**13%**
USD .0125	USD .000781	Yes	USD .0127821	USD 1.27821M	50%
USD .0135	USD .000781	Yes	USD .0127821	USD 1.27821M	30%
USD .0145	USD .000781	Yes	USD .0127821	USD 1.27821M	7%

Note: The total price paid per unit includes the carrying cost of the option. That is,

Opportunity Cost per unit = **USD 0.000781** * .00412 * 120/360 = **USD .00000107**.
Total Cost per unit = **USD 0.000781** + **USD .00000107** = USD 0.0007821

Then, if $S_{t+120} > X = 0.012$ USD/JPY $\Rightarrow$ Total Price per JPY = X + 0.0007820726
= USD 0.0127821

We can calculate an expected value for the distribution of the call option's cash flows:

E[Net Amount to pay in 120 days] = USD 1.22821M * **.13** + USD 1.27821M * .87 = **USD 1.27171M**

4. *Remain Unhedged*: Purchase **JPY 100 M** in the spot market 120 days from now.

Possible Spot Rate in 120 Days	USD Needed to Purchase JPY 100 M	Probability
USD .0115	USD 1.15M	13%
USD .0125	USD 1.25M	50%
USD .0135	USD 1.35M	30%
USD .0145	USD 1.45M	7%

We can calculate an expected value for the distribution of the call option's cash flows:

E[Amount to pay in 120 days] = **USD 1.281M**

Conclusion: Cudillero Corp. is expected to perform best if the forward hedge is used. However, risk preferences can play a role in the final decision. For example, a risk-taking manager may like the 13% chance of doing better with the no hedge alternative (and, also, an attractive 50% of paying almost the same amount as with the forward hedge!). ¶

Many firms find options to be very attractive hedging tools. Hedging with options is more flexible than hedging with futures or with a money market hedge, since an option is only exercised if it is convenient to the buyer. In addition, options present an interesting choice to companies. Firms can choose options with different costs. Firms can hedge with out-of-the-

money, at-the-money, or in-the-money options. These different options have different prices and they also provide different coverage for the exposed cash flows of a given firm. Firms hedging with option face the same trade-off that owners of cars face when they select car insurance. Car insurance with a high deductible is cheap, but the coverage starts at a high floor, say USD 500. On the other hand, car insurance with a low deductible is more expensive, but the coverage starts at a low floor, say USD 100. This trade-off is also seen when companies use options to hedge. For example, out-of-the-money options are cheaper than at-the-money options, but they provide a lower degree of insurance protection to the company's cash flows.

Many firms like the flexibility and different cost profiles of options. For example, Microsoft mainly uses options to hedge a portion of forecasted international revenue for up to three years in the future. On the other hand, there are firms that mainly use forward contracts. For instance, Kellogg only use short-term forward contracts of up to one year of maturity to hedge foreign currency revenue. The following case study illustrates the advantages of hedging transaction exposure with options.

1.B.1.i Using Options with Different Strike Prices: Case Study: Ruggeri SA

Ruggeri SA, a U.S. firm, agrees to buy Wallabies Inc., an Australian manufacturer for **AUD 100 million**. The deal is set to close in late June (in five months) if it passes the vote of the Board of Directors of Wallabies Inc. The deal is priced in AUD, but Ruggeri's books and financing are in USD. The company is prepared for some variability in the USD cost of the deal, but has an internal break-even point beyond which the acquisition becomes unattractive. Therefore, Ruggeri SA faces a currency risk.

Ruggeri can easily hedge the currency risk by buying AUD forward. Today is February 1, 1999. The spot rate is .6721 USD/AUD; the June futures rate is .6772 USD/AUD. It would cost Ruggeri USD 67.72 million to buy AUD 100 million forward at the June futures rate. This would be a perfect hedge if the future were certain.

But what if the deal fails because of opposition of the Wallabies's Board of Directors and falls through? Ruggeri would have to buy AUD anyway and then convert them back to USD. If the USD strengthened in the interim to below .6772 USD/AUD, Ruggeri would lose money in the conversion: The stronger the USD, the greater the loss. If the USD/AUD were at .6050 USD/AUD, for instance, Ruggeri would spend USD 67.72 million buying AUD at USD .6772, but receive only USD 60.50 million reconverting the AUD to USD.

There are two risks: changes in exchange rates and the uncertainty of the deal's closure. Clearly, buying dollars forward covers one, but exacerbates the other. In this real-world case, a development team at Casullo Financial Services (CFS) gave Ruggeri a choice of strategies.

- **Solution 1**: At-the-money Option

Buy: June .6700 USD/AUD American Call for **AUD 100 million** (2,000 contracts).

Cost:

a. premium USD .0217 per AUD	USD 2,170,000
b. broker fee USD 25 + USD 1.00 per contract	USD 2,025

Ruggeri buys an AUD call option, giving it the right, but not the obligation to buy AUD at .6700 USD/AUD in late June. The option is American: it may be exercised anytime before expiration. It is effectively at-the-money, since the strike rate .6700 USD/AUD is close to the spot rate of .6721 USD/AUD.

Note: A June .6700 USD/AUD European Call has a premium of USD .0164 per AUD.

The strategy is simple and effective. If the deal goes through, Ruggeri buys AUD at USD .6700. If it fails and the AUD has appreciated to, say, USD .6900, it may still exercise the option and make a profit of USD 2 million. If the deal fails and the AUD has depreciated, the call option is not exercised. The strategy's major drawback is its cost.

• **Solution 2**: Out-of-the-money Option

Buy: June .7000 USD/AUD American Call for AUD 100 million (2,000 contracts).

Cost:

a. premium USD .009 per AUD:	USD 900,000
b. broker fee USD 25 + USD 1.00 per contract	USD 2,025

Ruggeri buys an AUD call option, giving it the right, but not the obligation to buy AUD at .7000 USD/AUD in late June. The option is out-of-the-money, since the strike rate .7000 USD/AUD is well above the spot rate of .6721 USD/AUD. There is a considerable cost reduction, from USD 2,172,025 to USD 902,025.

This strategy is a form of disaster insurance. If the deal goes through, Ruggeri knows it will pay no more than .7000 USD/AUD --it is capping its payment to USD 70 million. If the deal fails, it is unlikely to profit from the option, since the odds against the spot rate going up to .7000 USD/AUD in five months are low. The major drawback is that Ruggeri is uncovered for currency movements between the spot (.6721 USD/AUD) and the option price of .7000 USD/AUD.

• **Solution 3**: Collar (one put and one call with different strike prices)

Buy: June .7000 USD/AUD American Call for AUD 100 million (2,000 contracts).

Sell: June .6500 USD/AUD American Put for AUD 100 million (2,000 contracts).

Cost:

a.	premium paid: USD .009 per AUD call	USD 900,000
	premium received: USD .008 per AUD put	USD 800,000
	net premium:	USD 100,000
b. broker fee USD 25 + USD 1.00 per contract		USD 4,050

Ruggeri buys the same out-of-the-money AUD call, giving it the right, but not the obligation to buy AUD at .7000 USD/AUD in late June. It simultaneously sells a June AUD put option, incurring the obligation to buy AUD at .6500 USD/AUD in June, if the buyer chooses to exercise the option. The put option is also out-of-the-money since the put strike rate (.6500 USD/AUD) is well below the spot rate (.6721 USD/AUD).

The cost of buying the AUD call is almost canceled out by the proceeds from selling the AUD put, for an USD 104,050 net cost.

This strategy offers the same form of disaster insurance as Solution 2. If the deal goes through, Ruggeri knows it will pay no more than USD 70 million for Wallabies Inc. The strategy is relatively inexpensive, but its potential cost is that Ruggeri may have to cover its short position in USD if the USD appreciates against the AUD below .6500 USD/AUD. However, it is better to be short at USD .6500 than at USD .6772, the forward rate.

♦ **Zero Cost Insurance**
It is possible to set strike prices for the calls and puts in such a way that the net premium is zero. That is, it is possible to obtain "zero-cost insurance." ♦

• **Solution 4**: Zero-premium Collar

Buy: June .7000 USD/AUD American Call for AUD 100 million (2,000 contracts).

Sell: June .6600 USD/AUD American Put for AUD 100 million (2,000 contracts) with a Put Knock-in .6450 USD/AUD.

Cost:

a.	premium paid: USD .009 per AUD call	USD 900,000
	premium received: USD .009 per AUD put	USD 900,000
	net premium:	USD 0
b. broker fee USD 25 + USD 1.00 per contract		USD 4,050

Ruggeri buys the same out-of-the-money AUD call, giving it the right, but not the obligation to buy AUD at .7000 USD/AUD in late June. It simultaneously sells an AUD put option, incurring the obligation to buy AUD at .6600 USD/AUD in June, if the buyer chooses to exercise the option. Both options are out-for the money. The put option is less out-of-the-money (with its .6600 USD/AUD strike price) and could be sold for more as a simple option. However, the knock-in feature reduces its premium to about the same level as the AUD call option.

This strategy offers the same form of disaster insurance as Solution 3. If the deal goes through, Ruggeri knows it will pay no more than USD 70 million for Wallabies Inc. The strategy is relatively inexpensive, but its potential cost is that Ruggeri may have to cover its short position in USD if the USD appreciates against the mark below .6600 USD/AUD. The wrinkle here is that the AUD put is triggered only if the AUD depreciates below USD .6450, a large decrease that would be unlikely to occur in the next five months.

♦ **Case Remarks**
Given the amount involved in the operation, Ruggeri SA would normally buy a package offered by CFS. For example, on February 1, 1999, the total number of currency options at the Philadelphia Stock Exchange was 7,370 (2,035 calls). Therefore, it would be very difficult to carry the operation (buying 1,600 AUD call contracts) through the exchange.

Another possibility is to use options on futures in the proposed solutions. Options on futures are more liquid markets. For example, on February 1, 1999, the total number of AUD options on futures at the Chicago Mercantile Exchange was 1,690.

In the above-proposed solutions, for learning purposes, Ruggeri buys the contracts involved in each solution through the Philadelphia Stock Exchange. The cost of the package offered by CFS, however, would be a bit more expensive than the cost we got in each solution. ♦

1.B.2 Internal Methods

Internal methods involve several steps a firm can internally take to minimize transaction exposure. These methods include using pricing policies (risk shifting or risk sharing) to pass all or part of the currency risk to a counter-party, leading and lagging, and matching.

1.B.2.i Risk Shifting

Many firms can completely avoid transaction exposure. They can do so by pricing all foreign transactions in the domestic currency. In this way, firms shift the currency risk of foreign currency transactions to the foreign party.

Example VIII.11: Bossio Co., a small U.S. firm, sells natural colored cotton. Asuni, a Japanese textile company, buys Bossio's colored cotton. Bossio Co. prices all exports in USD. ¶

Due to the high U.S. inflation of the 1970's many Japanese exporters priced their goods in JPY. In particular, OPEC members talked about pricing oil using a gold standard. On the other hand, during the early 1980's, when the U.S. dollar sharply increased against all major currencies, many U.S. exporters demanded payment in USD. Valuable sales, however, maybe lost by limiting contract terms to the domestic currency. Flexibility in the choice of currencies for exports and imports provides firms with additional bargaining power to extract price concessions or enables them to maintain or expand its sales.

♦ **Risk Shifting does not Eliminate Currency Risk**
In Example VIII.11, USD invoicing does not eliminate currency risk; it only shifts that risk to Asuni, the foreign buyers of Bossio's products. Therefore, in order to export, Bossio Co. needs to find a foreign company, like Asuni, willing to bear currency risk. ♦

1.B.2.ii Currency Risk Sharing

An alternative to risk shifting is for the two parties to share the currency risk involved in the transaction. For instance, in Example VIII.11, Bossio Co. and Asuni can develop a customized hedge contract embedded in the underlying trade transaction.

Example VIII.12: Suppose Asuni buys colored cotton for **USD 1 million** from Bossio Co. The exchange rate at the time they sealed the transaction is 100 JPY/USD. If the exchange rate moves between a range of 98 JPY/USD and 140 JPY/USD, the transaction is unchanged. That is, Asuni pays USD 1 million to Bossio Co.

The exchange range where the transaction is unchanged is called *neutral zone*. If exchange rates move beyond the neutral zone, both companies share the risk equally.

Suppose that at the time Asuni has to pay Bossio Co., the JPY depreciates to **180 JPY/USD**. The exchange rate actually used in settling the transaction is:

160 JPY/USD = (**180** - 40/2).

Asuni's final cost is JPY 160 million, which is less than **USD 1 million** (JPY 180 million). ¶

♦ **Chrysler-Mitsubishi Motors Corporation Risk Sharing Agreement**
In the early 1980's, Chrysler management decided to outsource to Mitsubishi Motors Corporation the production of V6 engines. The contract, negotiated in 1983 and 1984, became the major element of Chrysler's foreign currency exposure. This contract included a risk-sharing agreement.

The contract stipulated that for exchange rates from 240 JPY/USD to 220 JPY/USD Mitsubishi would absorb the entire cost of an exchange rate change. Within the range 220 JPY/USD to 190 JPY/USD, Chrysler and Mitsubishi split the cost of exchange rate shifts evenly. In the range 190 JPY/USD to 130 JPY/USD Chrysler bore 75% of the costs of exchange rate shifts and below 130 JPY/USD Chrysler had to absorb the entire cost. ♦

1.B.2.iii Leading and Lagging

Firms can reduce transaction exposure by accelerating or decelerating the timing of payments that must be made in different currencies, that is, by *leading* or *lagging* the movement of funds. In leading and lagging, a decision is taken to make early payments in currencies that are expected to appreciate and to delay those payments that are expected to depreciate. Given that counter-parties would like to do the opposite, leading and lagging is usually done between the parent company and its subsidiaries or between two subsidiaries. Leading or lagging is also used to change the assets or liabilities in one firm, with the reverse effect on

the other firm. Therefore, it changes balance sheet positions and so can be considered as a technique for achieving a hedged balance sheet position.

Example VIII.13: HAL, a U.S. firm, operates in a worldwide basis. HAL Mexico and HAL Brazil, two HAL subsidiaries, regularly buy parts from HAL Hong Kong, another subsidiary. If HAL Hong Kong's exposure is deemed too large by the parent company, HAL Mexico and HAL Brazil may lead its payments to HAL Hong Kong. ¶

In addition to foreign exchange motivations, leading and lagging is also used for liquidity reasons. For example, if a subsidiary is temporary illiquid, the parent house may decide to lead payments to that subsidiary and lag payments from the subsidiary.

Because the use of leads and lags is an obvious method for shifting the burden of financing, many governments impose some limits on the allowed range. For example, the U.K. government does not allow import leads and the maximum export lag allowed is 180 days.

1.B.2.iv Matching

The key to hedging is to create a match between inflows and outflows denominated in foreign currency. Matching involves changing the amounts or the currencies (or both) of the planned cash flows of a multinational firm or its subsidiaries to reduce the firm's net transaction exposure. For example, if a subsidiary has positive net inflows denominated in the subsidiary's local currency, the parent company can reduce the net transaction exposure in that currency by increasing expenses denominated in the subsidiary's local currency. Table VIII.3 summarizes several matching strategies for a subsidiary of a multinational firm, depending on its cash flows.

TABLE VIII.3

Subsidiary has positive cash flows denominated in subsidiary's currency	Subsidiary has negative cash flows denominated in subsidiary's currency
Increase local purchases	Decrease local purchases
Decrease foreign purchases	Increase foreign purchases
Decrease local sales	Increase local sales
Increase foreign sales	Decrease foreign sales
Increase local borrowing	Reduce local borrowing
Reduce foreign borrowing	Increase foreign borrowing

The decision of several Japanese and German automobile manufacturers to build plants in the U.S., where a big part of their revenue is generated, can be seen as a matching hedge.

♦ **Transaction Exposure: The Case of Ericsson**

Ericsson, the Swedish telecommunications giant, has the largest total customer base in the telecommunications industry in the world. Ericsson has been working in international markets since 1880s. Worldwide, four out of ten mobile calls are handled by Ericsson equipment. Ericsson reported total income from sales in 2000 as SEK 273 billion (USD 29 billion). Ericsson reports in Swedish Krona (SEK), but operates in more than 140 countries. Foreign currency denominated assets, liabilities, sales and purchases, together with a large cost base in Sweden, result in substantial foreign exchange exposures.

An analysis of net transaction exposures for the whole company, including revenues and costs by currency, shows a major net revenue exposure in EUR, but a more balanced position for USD. A +/-10% change in the SEK/EUR or SEK/USD exchange rate would have an approximate impact of +/-SEK 3.0 billion, while a +/-SEK 0.3 billion respectively, before any hedging effects are considered.

Ericsson would from this perspective benefit from Swedish participation in the European Monetary Union with a currency conversion to EUR. The unfavorable effects of the weaker EUR during 2000 were more than offset by hedging activities, and by positive developments in a number of to the currencies in which Ericsson also has a net revenue exposure (such as JPY, GBP, THB, and others).

Ericsson hedges transaction exposure using forward contracts and options. Ericsson reported a loss of SEK 508 million (USD 53.8 million) associated with its hedging activities during year 2000. **Source**: Ericsson Annual Report 2000. ♦

II. Translation Exposure

Multinational firms operate in different countries through subsidiaries, which tend to operate in the local currency. Therefore, the subsidiaries have assets, liabilities, revenues, and expenses measured in different units than the unit used by the parent company. Translation exposure arises from the consolidation of assets and liabilities measured in foreign currencies into one reporting currency. If the same exchange rate is used to restate each asset and liability on income statements and balance sheets, there will be no imbalances resulting from the restatement. If different exchange rates are used for different items on the financial statements, an imbalance will happen. This restatement, called *translation*, follows rules set up by a parent firm's government, an accounting association, or by the firm itself.

The translation process involves complex rules that sometimes reflect a compromise between historical and current exchange rates. Historical rates may be used for some equity accounts, fixed assets, inventories, while current exchange rates are used for current assets, liabilities, expenses and income. Thus, since the translation process uses different exchange rates for different items on financial statements, imbalances will occur. The key issue in the translation process is what to do with the resulting imbalances. It is taken to either current income or equity reserves.

2.A Measuring Translation Exposure

The local currency is usually the unit of account for accounting, performance measure and taxation at the local level. Therefore, the operating financial statements of subsidiaries are usually denominated in the local currency. Periodically, these subsidiary statements must be consolidated into one general statement for the entire multinational firm and denominated in the home currency. Even though there is a restatement of values into a different currency, there is no actual conversion of one currency into another. The question faced by accountants is which exchange rate should be use to perform this translation. There are several methods to translate foreign currency accounts into the reporting currency. There are three methods that predominate: the *current/noncurrent method*, the *monetary/nonmonetary method*, also called the *temporal method* in the U.S., and the *current rate method*.

2.A.1 Current/Noncurrent method

The *current/noncurrent method* was widely used prior to 1976 in the U.S. The accounting principle behind this method is that assets and liabilities should be translated based on their maturity. All current assets and liabilities, which by definition have a maturity of one year or less, are translated into the domestic currency at the current exchange rate, that is, at the exchange rate in effect on the date of the statement. Noncurrent assets and liabilities are translated at historic exchange rates, that is, at the exchange rates that were in effect on the date the assets were acquired or the liabilities incurred.

According to Kasibhatla, Rivera-Solis and Malindretos (2001), in the U.S., many companies were able to establish reserves and could defer unrealized translation gains and losses by adding to or charging against reserves. Then, the influence of any major changes in currency values on earnings could be smoothed.

2.A.2 Temporal method (Monetary/Nonmonetary method)

The *temporal method*, also called *monetary/nonmonetary method*, was used in the U.S. from October 1975 until December 1981. This method was defined in the U.S. by the issuance of Statement of Financial Accounting Standards Number 8 (FASB #8) by the Financial Accounting Standards Board, the authority in the U.S. that determines accounting policy in the U.S. With FASB #8, uniform standards for the translation into USD of foreign-currency denominated financial statements and transactions of U.S.-based multinational companies were established. An important feature of this statement was that translation gains and losses could not be deferred and multinational corporations (MNCs) had to include them in current income -see, Norton and Malindretos (1991).

The accounting principle behind this method is that monetary accounts have a similarity because their value represents a sum of money whose currency equivalent after translation changes every time the exchange rate changes. Under the temporal method, all monetary

assets and monetary liabilities -for example, cash, marketable securities, account receivables and account payables- are translated at current exchange rates. All nonmonetary balance sheet accounts are translated at the historical exchange rate in effect when the account was first recorded. Income statements items are translated at the average exchange rate for the period, except for those items, such as depreciation and cost of goods sold, that are directly associated with nonmonetary assets or liabilities. These items are translated at their historic rate. Note that assets translated at historical rates are not exposed to the appreciation or depreciation of the foreign currency against the domestic currency.

The advantage of this method is that foreign nonmonetary assets are carried at their original cost in the parent's consolidated statements. In general, this practice is consistent with the domestic cost treatment of those assets. However, this differential treatment of monetary and nonmonetary accounts forces the translated balance sheets not to balance. This situation creates a gain or loss, which has been labeled "dangling debit or credit." In the U.S., FASB #8 was not very popular with big companies, changes in exchange rates would tend to influence the profit and loss statements in a greater manner than it would the product lines themselves. In order to address the influence of translation gains (losses), firms would often utilize different financial instruments like forward exchange contracts to hedge against translation exposure.

2.A.3 Current Rate method

The *current rate method* became official U.S. practice with the December 1981 issuance of Statement of Financial Accounting Standards Number 52 (FASB #52). For foreign currency revenues, expenses, and gains and losses, "the exchange rate at the dates used on which those elements are recognized shall be used" (FASB, 1989, p. 505). Dividends paid are translated at the exchange rate in effect on the date of payment. Existing equity accounts, such as common stock and paid-in capital, are translated at historical rates. Year-end retained earnings consist of the original year-beginning retained earnings plus or minus any income or loss of the year.

An important feature of this new standard is that translation gains and losses are deferred and accumulated on the balance of the parent corporation, bypassing the income statement, which is in contrast to FASB #8 (FASB, 1989). Translation gains or losses are reported separately and accumulated in a separate equity account named *cumulative translation adjustment* (CTA), and thus, are reported directly to stockholders' equity. When the gain or loss of a given investment is realized, it is reported as net income or loss for the period. Then, the *translation* gains or losses due to that investment are removed from the CTA.

The current rate method is popular among big companies because the changes caused by translation adjustments do not pass through the income statement. That is, reported earnings are not sensitive to translation effects.

2.A.4 Functional and Reporting Currency

It has been argued that FASB #52 represents a current rate method of translation. This is not entirely correct, however. FASB #52 uses the current rate method in some cases and the monetary/nonmonetary method in others. The method prescribed by FASB #52 depends on the *functional currency* used by the foreign subsidiary, whose accounts have to be translated.

FASB #52 defines two currencies: a foreign subsidiary's *functional currency* and the parent company's *reporting currency*. Functional currency is defined as the currency of the primary economic environment in which the subsidiary operates and in which it generates cash flows. The reporting currency is the currency at which the parent firm prepares its own financial statements, usually the domestic currency.

In general, if the foreign subsidiary's operations are relatively self-contained and integrated within a given country, its functional currency will be the local currency of the country. This foreign subsidiaries are called *self-sustaining foreign entities*.

If the foreign subsidiary's functional currency is the same as the parent company's currency, translation of the subsidiary's statements employs the temporal method of FASB #8. These foreign subsidiaries are called *integrated foreign entities*. Therefore, some U.S. multinationals use the temporal method for those subsidiaries that are integrated, while using the current rate method for their other self-sustaining subsidiaries. International accounting rules also follow this pattern. Two exemptions are Japan and Germany that use the temporal method for all foreign subsidiaries.

Example VIII.14: For most of the subsidiaries of the Swedish telecommunications giant Ericsson, the local currency is the currency in which the companies primarily generate and expend cash, and is thus considered their functional (business) currency. Their financial statements are translated to SEK using the current rate method. On the other hand, the financial statements of companies with finance activities or other companies, having such close relations with the Swedish operations that their functional currency is considered to be the SEK, are labeled "integrated companies," and their statements are translated using the monetary/nonmonetary method. ¶

2.B Managing Translation Exposure

Translation exposure appears because there is a mismatch between assets and liabilities denominated in the same currency. The most popular method to manage translation exposure is called *balance sheet hedge*. A balance sheet hedge can be achieved by having an equal amount of exposed foreign currency assets and liabilities on a firm's consolidated balance sheet. For example, suppose that a U.S. firm has a Japanese subsidiary with exposed assets equal to JPY 100 million and exposed liabilities equal to JPY 50 million. That is, the U.S. firm has a net translation exposure of JPY 50 million. To create a balance sheet hedge, the U.S. firm can borrow JPY 50 million. Thus, net translation exposure will be zero and the accounting books will not be affected by changes in the USD/JPY exchange rate.

Since translation exposure is measured by currency, not by country, equality of exposed balance sheet items can be achieved on a worldwide basis and not necessarily on the individual balance sheet of each foreign subsidiary.

The cost of a balance sheet hedge depends on relative borrowing costs. If foreign currency borrowing costs, after adjusting for foreign exchange risk, are higher than parent currency borrowing costs, then, the balance sheet hedge has a positive cost, and vice versa.

Example VIII.15: HAL Hong Kong, a subsidiary of HAL, has the balance sheet shown in Table VIII.4. All items are in HKD. We report exposure measured by two methods: the current rate method and the monetary/nonmonetary method.

TABLE VIII.4
HAL Hong Kong Balance Sheet in millions of HKD

	Balance sheet accounts	Current rate exposure	Temporal exposure
Assets			
Cash	300	300	300
Accounts receivable	850	850	850
Inventory	400	400	Not exposed
Net fixed plant and equipment	1,000	1,000	Not exposed
Total assets	2,550		
Total exposed assets		2,550	1,150
Liabilities and Capital			
Accounts payable	200	200	200
Notes payable	300	300	300
Long-term debt	900	900	900
Shareholder's equity	1,150	____	____
Total liabilities and capital	2,550		
Total exposed liabilities		1,400	1,400
Net exposed assets		**1,150**	**-250**

At the current exchange rate of S_t = .128 USD/HKD, the parent's exposure in USD is:

Current rate method: HKD 1,150,000,000 x .128 USD/HKD = USD 147,200,000
Temporal method: HKD -250,000,000 x .128 USD/HKD = USD -32,000,000

Management believes that the HKD will depreciate 20% against the USD within one year. Should the depreciation occur, HAL would have a translation loss equal to USD 29.44 million under the current rate method and a translation gain equal to USD 6.4 million under the temporal (monetary/nonmonetary) method.

Under the current rate method the translation loss will be reflected directly in the CTA, while under the temporal method the gain will flow through the income statement and increase current earnings.

Since HAL Hong Kong's functional currency is the HKD, HAL uses the current rate method. If HAL wants to avoid translation exposure in HKD, then HAL should increase its HKD borrowings and, then, exchange those HKD for non-exposed assets. HAL should borrow HKD 1,150,000,000, and then the second step has two possibilities: HAL Hong Kong could exchange the HKD for USD, which

HAL Hong Kong could continue to hold; or HAL Hong Kong could transfer the borrowed HKD to HAL, perhaps as a dividend. Then HAL would exchange the HKD for USD in the U.S.

Note: HAL can also reduce its balance sheet exposure, by exchanging the HKD 300 million cash for USD. ¶

♦ **Translation Exposure: The Case of Ericsson**
Ericsson has many subsidiaries operating outside Sweden. The value in SEK of Ericsson's foreign investments is exposed to exchange rate fluctuations. Translation exposure in foreign subsidiaries is hedged within a policy established by the Board:

- Monetary net in companies translated using the temporal method (translation effects in investment affecting the income statement) is hedged to 100%.
- Equity in companies translated using the current method (translation effects reported directly in stockholders' equity in the balance sheet) is hedged selectively up to 20% of the total equity.

The translation differences reported in equity, during the year 2000, were SEK 2.0 billion, mainly due to a weaker SEK. **Source**: Ericsson Annual Report 2000. ♦

III. Economic Exposure

Economic exposure (EE) arises when the net present value of a firm's expected cash flows changes due to an *unexpected* change in foreign exchange rates. An *expected* change in exchange rates is not included in the definition of economic exposure. Expected changes are already incorporated into the decision making of a firm and investor -besides, according to the efficient hypothesis, expected changes have been already incorporated into prices! Since economic exposure emphasizes the impact of exchange rates on operating cash flows, economic exposure is also called *operating* exposure. Economic exposure is the most relevant exposure from the long-run perspective of a firm.

Example VIII.16: On February 2, 2015, Owens-Illionis (OI), the giant U.S. manufacturer of glass containers, reported its fourth-quarter results. OI reported that sales declined 9% year over year to USD 1.6 billion due to a stronger USD that adversely impacted sales by 6%. OI forecasted that, in 2015, earnings will be negatively impacted by the strong USD. The strong USD is expected to reduce translated sales by nearly 10%. This is *economic exposure.* ¶

EE measures how changes in FX rates affect cash flows. It is easy to see that importers benefit from a strong domestic currency (the cost of buying foreign goods decreases as S_t decreases); while exporters benefit from a weak domestic currency (domestic exports become to foreign buyers as S_t increases). But, not only importers and exporters face economic exposure, many purely domestic firms are exposed too.

Example VIII.17: As the USD becomes stronger, more U.S. tourism goes to visit the active volcano Arenal, in Costa Rica. Restaurants in Costa Rica buy and sell everything in CRC (CRC = Costa Rican Colón), thus having no direct EE. But, as U.S. tourism increases (decreases) in Arenal, the cash flows of restaurants in Arenal will also increase (decrease). Thus, even smaller Costa Rican restaurants (called *sodas*) face EE. In this case, they behave like an exporter. ¶

3.A Classic Example

After a six-year battle won in the courts, Freddie Laker obtained a permit for his Laker Airways to operate the Skytrain service on both sides of the Atlantic, using two DC-10 planes. The Skytrain was a no-reservation, low cost air service, which revolutionized the air transport industry. On September 26, 1977, the first Skytrain flight departed London for New York, and subsequently went on to carry over 50,000 passengers before the end of the year with each flight over 80% full. The success was such that the Skytrain service was expanded to include a London to Los Angeles service in 1978, London to Miami in 1980 and London to Tampa in 1981.

During this time of expansion, the USD was weak against the GBP, moving from 1.71 USD/GBP to 2.12 USD/GBP. U.S. trips were relatively cheap for U.K. residents. Freddie Laker was able to expand the Skytrain concept by buying more DC-10s, which were financed by the manufacturer in USD. Thus, Laker's debt payments were in USD. This USD debt and the fact that jet fuel is priced in USD made the cost structure tilted towards the USD. On the other hand, Laker's revenues were both in USD and GBP, with a larger share denominated in GBP. Therefore, Laker Airways did not have a good balance of inflows and revenues denominated in the same currency. As the USD depreciated, the imbalance favored Laker Airlines.

But, in 1981, the USD started to quickly gain against all European currencies, reaching 1.60 USD/GBP by 1982. Then, Laker's expenses increased, while Laker's revenues decreased. In February 1982, Laker Airways was forced to file for bankruptcy. Skytrain's foreign exchange losses were one of the main factors behind Laker Airways' bankruptcy.

3.B Understanding Economic Exposure

Economic exposure is a function of how changes in exchange rates, s_t, affect the revenues and costs of a firm. If s_t affects a firm's revenues and costs in different ways, a change in S_t will affect the firm's net cash flows.

To illustrate economic exposure, let's look at the simplified cash flow of an MNC's subsidiary, which exports its production, Q, at the international price, P, denominated in foreign currency:

Revenue: Price in FC x Quantity = PQ

Cost: Variable (VC) + Fixed (FixC) = α PQ + FixC (α: proportion of PQ as VC, 0<α< 1)
Gross profits: (1- α) PQ - FC
EBT = [(1- α) PQ – FixC] – IE (IE: Interest Expense)
EAT = [(1- α) PQ – FixC – IE] (1-t) (t: tax rate)

Costs and IE have, potentially, two components: a foreign currency (FC) and a domestic currency (DC). For example, suppose Fixed Costs are not affected by S_t, but VC is affected by S_t, in the proportion α_{FC} (α_{DC} is the part not affected by S_t). Suppose that IE also has two components a local component, IE_{DC}, and an S_t affected component, IE_{FC}.

In the definition of EE, we say that EE measures how changes in S_t affect CFs of the firm. Suppose we use EAT to measure cash flows, then taking the first derivative of EAT with respect to S_t sheds light on the determinants of EE:

$$\frac{\partial EAT}{\partial S_t} = \left[(1-\alpha_{FC}) \frac{\partial PQ}{\partial S_t} - \frac{\partial IE_{FC}}{\partial S_t} \right] (1-t)$$

Note that if the first derivative is equal to 0, then EAT is independent of S_t. That is, there is no EE. The match between revenue and costs denominated in foreign currency impacts EE: the higher α_{FC}, the lower EE. Borrowing abroad also impacts EE, potentially borrowing enough abroad may create a very low EE.

In the illustration above, the subsidiary sells its production, Q, at the international price, P, which the firm takes as given. In general, how P and Q affect economic exposure depends on many factors. The degree to which a P and Q affect economic exposure depends on the type and structure of the firm and the industry structure in which the firm operates. In general, importing and exporting firms face a higher degree of economic exposure than purely domestic firms do. As mentioned above, note that many purely domestic firms –i.e., firms that purchase all their supplies and sell all of their products, domestically- also face economic exposure. For example, consider the case of a plastic surgeon in Mexico. She purchases all of her supplies in Mexico and all of her clients are Mexicans. Suppose the Mexican peso greatly appreciates against the USD. All of the sudden, many of the plastic surgeon's clients will find that similar plastic surgeries in the U.S. are priced at very attractive prices. Thus, the Mexican plastic surgeon faces economic exposure.

Industry structure is also very important. In general, monopolistic firms will face lower economic exposure than firms that operate in competitive markets will. For example, suppose a U.S. firm face almost no competition in the domestic market. Thus, this U.S. firm can probably transfer to its prices any increase of its costs due to changes in exchange rates. Therefore, this firm faces no economic exposure, since its net cash flows are unaffected by changes in exchange rates. On the other hand, a U.S. firm that operates in a competitive market will not be able to transfer to its prices any increase of its costs due to changes in exchange rates. Thus, in this case, the net cash flows are affected by changes in exchange rates.

Example VIII.18: How market structure and matching –i.e., α_{FC} & α_{DC}- affects H&M vs. Zara

In late June 2015, Sweden's Hennes & Mauritz, the world's second-biggest fashion retailer, warned it expects the strong USD to translate into rising sourcing costs throughout the year after it hurt second-quarter profits.

H&M, which buys the bulk of its clothes in Asia on USD contracts while selling most of them in Europe, is more exposed to the strong USD than bigger rival Inditex, the Zara owner which produces more garments in house and sources the majority of them in or near Europe.

And it is harder for the budget brand to pass on costs by raising prices as it faces growing competition from discounters like Primark and Forever 21, which pose less of a threat to mid-market brand Zara.
Source: Reuters. ¶

In Chapter III we pointed out that if absolute PPP holds, then real cash flows are unaffected by changes in exchange rates and/or relative prices. Under absolute PPP, the real exchange rate is equal to one. That is, changes in exchange rates are exactly compensated by changes in relative prices, leaving operating cash flows in the home currency unaffected. If a change in the nominal exchange rate, however, is not offset by inflation, then the real exchange rate changes -PPP does not hold- and home currency denominated operating cash flows also change.

Transaction and translation exposures appear in financial statements, while economic exposures are impossible to observe in the usual accounting statements. Thus, economic exposure is often subjective and, then, difficult to measure.

3.C Measuring Economic Exposure

3.C.1 Accounting Data

Economic exposure can be easily measured by analyzing the sensitivity of income statements to different exchange rate scenarios. Simple measures can be calculated with only two scenarios.

Example VIII.19: C&S, a U.S. firm, produces and sells in the U.S. and in Australia. C&S generates two different scenarios to have a sense of its economic exposure. It uses Operating Income (OI) to measure cash flows:
Base case: S_t=0.72 USD/AUD, OI: **USD 4.3M**
Simulated case (**+10%**): S_t=0.792 USD/AUD, OI: **USD 5.2675M**

That is, under the simulated scenario, OI increases **22.50%** (= **USD 5.2675M/USD 4.3M** – 1).

Assuming that the only change is in the exchange rate, C&S can calculate the elasticity of EAT to changes in OI:
CF elasticity = % change in earnings / % change in S_t = **.225/.10** = **2.25**

Interpretation of CF elasticity: a 1% depreciation of the USD increases OI by **2.25%**.

Note: C&S behaves like an exporter. That is, a depreciation of the domestic currency increases income. ¶

In general, a firm will generate more than two scenarios. A firm can simulate thousands of exchange rate scenarios and, through those scenarios, analyze the empirical distribution of net cash flows generated by them. For example, using a simulation, a Swedish firm calculates that a 10% appreciation of the USD against the SEK increases earnings after taxes by 16%.

Instead of simulating scenarios, companies can use the actual accounting data on cash flows collected over time. With only two observations, a company can calculate the cash flow elasticity. Or with many observations, a company can calculate a simple correlation. But, when using data collected over time, we need to be careful, since companies and the overall business environment change and it may be unrealistic to assume that only one variable – say, exchange rates- is the only factor affecting cash flow.

Example VIII.20: Disney's EE using EAT elasticity from 2006 to 2013.

	2006 (in USD)		2013 (in USD)	
	Revenue	**Operating Income**	**Revenue**	**Operating Income**
Media	14.75B	3.61B	20.35B	6.82B
Parks & Resorts	9.95B	1.53B	14.09B	2.22B
Studios	7.2B	0.73B	5.98B	0.66B
Consumer Products	2.4B	0.62B	3.56B	1.11B
Interactive Media			1.06B	-0.09B
Total	**34.3B**	**6.49B**	**45.04B**	**10.72B**

We use Operating income (OI) as proxy for cash flows.
Calculations:
06-13 Change in OI = **USD 10.72B** – **USD 6.49B** = USD 4.23B (**65.18%)**
06-13 change in S_t = 0.05725 (or **5.725%** depreciation of the USD against a basket of currencies)
CF elasticity = **.6518**/**.05725** = **11.39**

According to the elasticity, DIS behaves like a *net exporter*, a depreciation of the USD increases cash flows. The elasticity is huge: a 1% depreciation increases operating income by **11.39%**.

Note: Likely, we calculated an uninformative quantity. The problem? DIS added assets since 2006: Marvel, Lucasfilm, two cruises, a new media division, etc. Also the economy and the stock market grew during these dates. We need to be careful with these numbers. ¶

As pointed out by **Example VIII.20**, elasticities or correlations may not be very informative, since there are other variables that also affect cash flows. These simple measures are not able to isolate the effect of exchange rates on cash flows.

Elasticities and correlations are more informative in the short-run, where the structure of the firm is not very different.

Example VIII.21: Kellogg's cash flow elasticity in 2020-2019.

From 2019 to 2020 (end-of-year to end-of-year), K's operating income increased **2.6%**. The USD depreciated against basket of major currencies by **3.58%**. Then,

CF elasticity = **.026**/**0.0358** = **0.73**

Interpretation: We say, a 1% depreciation of the USD produces a positive change of **0.73%** in operating income. K's behaves like a **net exporter**. ¶

If a firm is interested in evaluating its long-run economic exposure, the firm needs to "control" for the changes in other variables that affect cash flows is to use a regression. Data on cash flows are easily available from the firm's recent past. Data on exchange rates changes are also easily available. Moreover, if we assume that the efficiency hypothesis holds, all changes in exchange rates are unexpected.

Now, we want to run the following regression:

$$cf_t = \alpha + \beta\, s_t + \delta_1 X_{1,t} + \delta_2 X_{2,t} + ... + \delta_k X_{k,t} + \varepsilon_t, \qquad \text{(VIII.1)}$$

where cf_t represents % changes in cash flows denominated in the reporting currency at time t, s_t represents % changes in exchange rates at time t, $X_{i,t}$ represent one of the k*th* variable that affects cash flows, and ε_t represents the regression error term. The beta coefficient, **ß**, measures the sensitivity of cash flows to changes in exchange rates. The higher the beta coefficient, the greater the impact of changes in exchange rates on the cash flows of a given company. An additional advantage of a regression that it also provides a test for EE: If ß is not significant, there a company faces no EE.

Sometimes the impact of changes in exchange rates is not felt immediately by a firm. This situation might be due to the existence of contracts and other fixed short-run costs that make short-term adjustment very difficult. Therefore, it might be the case for an exporting U.S. company that an appreciation of the USD increases cash flows in the short term, but in the long-term the effect is negligible. To deal with this situation, the regression in (VIII.1) can be modified as follows:

$$cf_t = \alpha + \beta_0 \Delta s_t + \beta_1 s_{t-1} + \beta_2 s_{t-2} + \beta_3 s_{t-3} + ... + \varepsilon_t.$$

Now, the sum of the beta coefficients will measure the sensitivity of cash flows to changes in exchange rates. That is, the total effect is

$$\beta = \beta_0 + \beta_1 + \beta_2 + \beta_3 + ...$$

An important issue in this dynamic specification is the number of lagged regressors included in the regression. Depending on the characteristics of each firm, firms should use different lags. For instance, firms with longer-term contracts should use more lags than firms with shorter-term contracts. The usual practice is to include at most two years of information in the regression.

Example VIII.22: HAL has run the following regression to measure its economic exposure to changes in the HKD. They use 48 monthly observations from the most recent past. (T-statistics in parenthesis.)

$$cf_t = \underset{(.89)}{.456} + \underset{(2.79)}{.421\, s_t} + \underset{(2.01)}{.251\, s_{t-1}} + \underset{(0.77)}{.052\, s_{t-2}} + \underset{(0.17)}{.33\, X_{1,t}} + \underset{(0.03)}{.05\, X_{2,t}} \qquad R^2 = .068.$$

Only the two first s_t regressors are important (significantly different than zero). That is, HAL faces EE. The sensitivity of HAL's HKD cash flow (translated into USD) to changes in exchange rates is estimated to be

$$ß = ß_0 + ß_1 = 0.672.$$

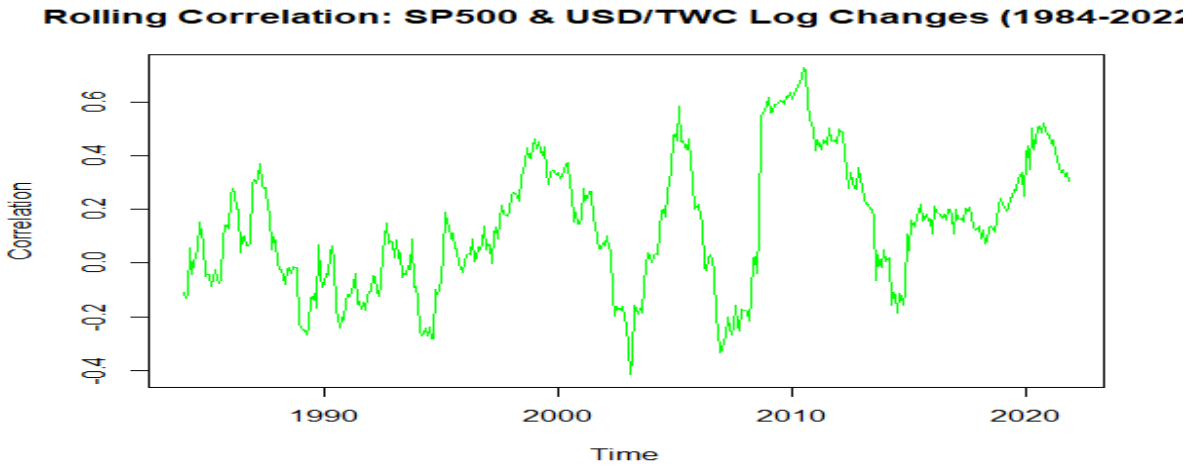
That is, a 1% appreciation of the HKD will increase HKD cash flows (translated into USD) by 0.672%
The R^2 tells us that the independent variables explain 6.8% of the variability of HKD cash flows. ¶

3.C.2 Economic Data

For publicly traded companies, there is a better way to measure economic exposure. Recall that stock prices reflect the discounted value of all future cash flows of a firm. Changes in stock prices reflect changes in future cash flows. Thus, changes in stock prices can be used instead of cf_t. Using time series data, we can calculate correlations and estimate regressions.

Example VIII.23: We use the returns of the S&P 500 to gauge the economic exposure of the average large U.S. firm. A simple visual tool is the 24-month rolling correlation between the S&P returns and percentage changes in the USD/TWC, $s_{USD/TWC,t}$; where TWC represents a Trade Weighted Basket of Major Currencies. Exhibit VIII.1 shows the rolling correlations from 1982:Jan to 2022:Jan.

Exhibit VIII.1
Rolling Correlations (24-mo): S&P & USD/TWC



The relation between stock returns and changes in exchange rates is time-varying. Recessions and crises affect the relation. After the financial crisis of 2007-2008, there is a higher correlation between stock returns and changes in exchanges rates. The average correlation is **0.15**, which does not seem to be representative.

As discussed with accounting data, a more formal test can be done with a regression. For example, a univariate regression can be used to test the EE of the average large U.S. firm, using the S&P returns as representative, as shown in Table VIII.5:

TABLE VIII.5

Regression of S&P returns on changes in the USD/TWC exchange rate (1982:Jan-2022:Jan)

R Square	0.024874
Standard Error	4.320756
Observations	481

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	0.737501	0.197041	3.742879	0.000204
USD/TWC	**0.408969**	0.116998	**3.495515**	0.000517

At the 5% standard significance level, changes in the value of the USD have a significant impact on the returns of the average big U.S. firm. According to the estimation, returns are quite sensitive to changes in the value of the USD: a 1% depreciation of the USD against the TWC increases returns by **0.41%**. The R^2 tells us that exchange rates changes explain 4.4% of the variability of S&P returns. A significant number. ¶

In Example VIII.23, we run a univariate regression, where we implicitly assumed that s_t – i.e., changes in S_t- is the only variable affecting a company's stock returns. We know that other variables also affect a company's stock price. We need to be careful and "control" for these other variables, to isolate the effect of s_t. A multivariate regression will do that and we can include other independent ("control") variables like income growth, inflation, sales growth, assets growth, etc., not just s_t as determinants of the change in CFs (or stock returns).

We can also borrow from the investments literature and use the three popular Fama-French factors (Market, Size (SMB), Book-to-Market (HML)) as controls. In this case, we can run a regression to check if a company faces economic exposure:

$$\text{Stock Return}_t = \alpha + \boldsymbol{\beta}\, s_t + \delta_1 \text{ Market Return}_t + \delta_2 \text{ SMB}_t + \delta_3 \text{ HML}_t + \varepsilon_t$$

A momentum can be added to accommodate the extension of Carhart (1997) of the Fama-French model.

Example VIII.24: Measuring Kellogg's Economic Exposure

We want to know if Kellogg (K) has faced economic exposure in the last 15 years. We use monthly data from January 1988 to January 2022, for a total of 409 observations. We estimate a regression using Kellogg's stock returns against a constant and changes in the USD/TWC, $s_{USD/TWC,t}$; where TWC represents a Trade Weighted Basket of Major Currencies. We obtain the following results (absolute value of t-statistics in parenthesis):

$R^2 = 0.01596$
Observations = 409

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept (α)	0.38592	0.27515	1.4026	0.1615
s_t (**β**)	**0.43775**	**0.17041**	**2.5688**	0.0106

The R^2 of the regression is .016, that is, changes in the USD/TWC explain 1.60% of the variability of Kellogg's returns. At the standard 5% significance level, changes in the value of the USD have a significant impact on Kellogg's returns ($|t_\beta = \mathbf{2.57}| > \mathbf{1.96}$). Moreover, a depreciation of the USD has a positive impact on returns, that is, Kellogg's behaves like an exporter.

But, as mentioned above, Kellogg's returns are not only influenced by changes in exchange rates. of the changes in exchange rates is significant. We estimate a multivariate regression, including not only $s_{USD/TWC,t}$, but also the Fama-French factors: excess market returns over T-bill rates, $(R_m\text{-}R_f)_t$, Size $(SMB)_t$ and Book-to-Market $(HML)_t$:

$$Kret_t = \alpha + \mathbf{\beta}\ s_t + \delta_1\ \text{Market Return}_t + \delta_2\ SMB_t + \delta_3\ HML_t + \varepsilon_t$$

$R^2 = 0.0995$
Observations = 409

	Coefficients	*Standard Error*	*t Stat*
Intercept	0.0798	0.2691	0.2967
Market $(R_m\text{-}R_f)$	0.3893	0.0647	6.0204
Size (SMB)	-0.1144	0.0898	-1.2738
B-M (HML)	0.1546	0.0851	1.8157
s_t (**β**)	**0.2601**	0.1664	**1.5633**

The R^2 of the regression is .0742, a higher value driven mainly by the market factor. But, looking at measuring economic exposure, we observe that the t-stat is now **1.56**, that is, the significance of changes in the value of the USD drops to 12%. Thus, at the 5% significance level, we cannot reject the null hypothesis of no economic exposure. Note, also, the big drop in **β**.¶

The above regressions have been done repeatedly for firms around the world. (We have already done it for Kellogg.) Ivanova (2014) reports a mean β equal to 0.57 (a 1% USD depreciation increases returns by 0.57%). However, only 40% of the EE are statistically significant at the 5% level. But, for large firms (MNCs), EE is small –an average β=0.063– and not significant at the 5% level. Interestingly, 52% of the EEs come from U.S. firms that have no international transactions (a higher S_t can "protect" some domestic firms from foreign competition).

3.D Managing Economic Exposure

Managing economic exposure is about matching revenue in foreign currency and costs in foreign currency. This matching is very important for a firm. In section 3.A, we mentioned the case of Laker Airlines. Recall that Laker Airlines had unbalanced inflows and outflows denominated in USD. The majority of Laker's revenue was in GBP, but a huge part of its outflows, loan repayments, were in USD. Thus Laker Airlines was facing economic exposure. Laker Airlines' economic exposure was a big reason behind its 1982 bankruptcy.

The objective of economic exposure management is to minimize the effect of changes in exchange rates on a firm's future cash flows. As we stressed in Chapter V, it is very difficult to predict exchange rate changes. Thus, a firm should be prepared in advance to face the effects of changes in exchange rates. Managing economic exposure is more difficult than managing transaction exposure. Transaction exposure involves short-term and medium-term cash flows. Economic exposure involves long-term cash flows.

In general, managing economic exposure involves a restructure of a firm's operations. Usually, by restructuring a firm's operations, management attempts to achieve a better balance between inflows and outflows denominated in foreign currencies. This restructuring process might involve several areas of the firm. For example, in the case of Laker Airlines, management could have avoided bankruptcy by having a more balanced mixture of inflows and outflows denominated in USD. They could have achieved this by borrowing less in USD and/or generating more revenue in the U.S.

Example VIII.25: The case of Toyota.
By the late 1970s, Toyota, the Japanese automobile manufacturer, had established itself in the U.S. market, with a market share close to 10%. But, during those years, the JPY began to appreciate against the USD. Since the majority of Toyota's production was done in Japan, the costs were mainly denominated in JPY and profits were seriously hurt by the JPY appreciation. Because of competition, Toyota was unable to increase the USD price of their cars in the U.S. market. Toyota's EE was very significant. Toyota decided to restructure to reduce EE: they moved part of the production to the U.S. ¶

Another tool to reduce economic exposure is international diversification. True international diversification is probably the best way for a firm to manage economic exposure. Again, using international diversification as a risk management tool involves restructuring a firm's organization. True international diversification means that a firm should diversify internationally the location of production, sales, input sources, and the borrowing of funds.

If a firm is internationally diversified, management can respond quickly to economic shocks or disequilibrium situations. For example, management might notice a change in comparative labor costs due to changes in exchange rates. Then, management can readjust production patterns in response to this change.

Even if management does not actively alter normal operations when exchange rates change, the firm should experience some beneficial portfolio effects. In general, the variability of its cash flows is reduced by international diversification, because exchange rate changes are likely to increase the firm's competitiveness in some markets while reducing it in others. In that case economic exposure would be very low.

♦ **Economic Exposure: The Case of Ericsson**
Ericsson is very dependent on the behavior of the SEK and on economic conditions in Sweden. Around 40% of all employees and 25% of total production is located in Sweden, but Sweden accounts for just 3% of all sales. With this substantial cost base in SEK, for example, an appreciation of the SEK against the major currencies will have a negative impact

on Ericsson's cash flows. As a matter of fact, during the year 2000, the depreciation of the EUR against the SEK had a negative impact on Ericsson compared to Ericsson's competitors with costs denominated in EUR Usually, Ericsson does not hedge economic exposure. **Source**: Ericsson Annual Report 2000. ♦

IV. Should a Firm Hedge?

So far we have analyzed different hedging tools and techniques. We have analyzed examples where firms hedge their exchange exposure. But we have not addressed a basic point: should a firm hedge? Or, in other words, does hedging add value to a firm?

There are two views with respect to hedging at the firm level. The first one is based on the pioneering theoretical work of Franco Modigliani and Merton Miller, both Nobel Laureates. It states that hedging adds nothing to the value of a firm. The second view exploits some of the basic assumptions underlying the work of Modigliani and Miller. This second view analyzes specific situations where hedging might add value to a firm.

4.A Hedging is Irrelevant: The Modigliani-Miller Theorem

Modigliani and Miller, in a path-breaking paper published in the Journal of Political Economy in 1958, showed that firms make money if they make good investments (investments that increase their operating cash flows). When we value a firm, the financing source of those good investments is irrelevant. Different mechanisms of financing will determine how the cash flows are divided among the different classes of investors, that is, shareholders or bondholders. This surprising and insightful result is called the Modigliani-Miller Theorem (MMT). The MMT depends on a set of assumptions about financial markets. These assumptions basically require that a firm operates in perfect markets (i.e., no transaction costs, no distortions, etc.).

The MMT has implications for hedging. Clearly, if the methods of financing and the character of financial risks do not matter, managing them is not important, and therefore, should not add any value to a firm. On the contrary, since hedging is not free, hedging might reduce the value of a firm.

♦ **The Value of a Used Car**
When you sell your car, the price you get is independent of how you financed the purchase of it. All the financial risks you took when buying the car will not affect its value (as long as the financial risks did not affect your driving!). The MMT has similar implications for the value of a firm. ♦

In another insight, Modigliani and Miller show that if investors want to reduce the financial risks associated to holding shares in a firm, they can diversify their portfolio of holding.

Managers, therefore, do not need to manage financial risks of firms, since investors can do it for themselves.

Example VIII.26: Suppose Ms. Sternin, a U.S. investor, holds shares of a U.S. exporting company and shares of a U.S. importing company. A depreciation (appreciation) of the USD will negatively (positively) affect the importing company and will positively (negatively) affect the exporting company. Ms. Sternin's portfolio is hedged against exchange rate movements. Hedging at the firm level -since it is expensive- will negatively affect the value of Ms. Sternin's portfolio. ¶

4.B Hedging Adds Value

The MMT is very powerful. Many economists, however, point out that the assumptions behind the MMT are routinely violated. And, when the assumptions are violated, the MMT does not hold. Under these circumstances, at least theoretically speaking, hedging adds value to a firm. The added value of hedging to the value of the firm, however, is still open to discussion.

4.B.1 Investors might not be able to replicate an optimal hedge

Several economists argue that even though investors could potentially hedge by themselves all risks, sometimes they might not be able to exactly replicate the optimal hedge structure of a firm. There are situations where firms can do a better job at hedging than individual investors. For example, investors might not be big enough to have access to optimal hedges. Or investors might not have enough information about the outflows and inflows, denominated in different currencies, of the firm.

4.B.2 Hedging as a tool to reduce the risk of bankruptcy

If cash flows are very volatile, a firm might be faced with the problem of needing cash to meet its debt obligations. Therefore, a firm with little debt or with very good access to credit markets (a highly rated company) has no need to hedge, as the risk of getting into financial trouble is very small. Under this view, some of the U.S. largest corporations --which are the biggest hedgers-- may be wasting their capital.

Myron Scholes, from Stanford University, disagrees with the previous argument. As a matter of fact, he proposes the opposite. Under his view, firms with little debt could reduce their riskiness by hedging, and, then, they are able to borrow more at better rates and to rely less on equity financing. Equity financing could be expensive compared to debt. Recall that equity offers no guaranteed payoff, so investors will require a higher rate of return.

4.B.3 Hedging as a tool to reduce investment uncertainty

Kenneth Froot, David Sharfstein and Jeremy Stein, in a paper published in Harvard Business Review in 1994, argue that firms should hedge to ensure they always have sufficient cash flows to fund their planned investment plan. For example, an exporting company might have cash flow problems in a period when the USD appreciates.

Example VIII.27: Merk, a U.S. pharmaceutical firm, has used derivatives to ensure that investment, especially R&D, plans can always be financed and are not subject to USD fluctuations. ¶

One problem associated with this strategy can be illustrated with an example. Suppose the USD has a long-term trend of appreciation against major currency. An exporting company will face fewer opportunities to expand and invest, and, therefore, will have a lesser need to hedge.

4.B.4 Hedging as a tool to reduce taxes

For most firms, income taxes are a convex function of income. Thus, a well-known implication, using Jensen's inequality, is that firms can reduce tax exposure from reduced income volatility. Since hedging reduces cash flow volatility, hedging can lower a firm's tax liability. In addition, given that firms that have lower cash flow volatility can borrow more, hedging can help firms take advantage of the tax deductibility of interest.

4.C Do companies hedge?

In this section, we present the results of three surveys of domestic companies about their FX hedging policies. Overall, the surveys found that companies understand FX risk. However, not all companies hedge their FX exposure. A significant proportion of companies that do hedge only hedge part of their exposure. This popular hedging practice is called *selective hedging*. Selective hedging carries risks, since the no-hedged part of the FX position will be subject to FX risk. It is common for companies based their FX hedging decisions on their expectations for the exchange rate. That is, speculation is not rare.

Since 2004, the Bank of Canada has carried out a qualitative annual survey to assess the degree of activity in Canadian foreign exchange (FX) hedging. The survey participants comprise banks that are active in Canadian FX markets, including the eleven members of the Canadian Foreign Exchange Committee (CFEC). The 2011 survey was divided into two parts, each separately covering the FX hedging activity of the banks' corporate and institutional accounts that have CAD hedging requirements. In 2011, the CAD continued to appreciate against the USD. The main findings in the 2011 survey were:

(1) Institutional customer volume continues to account for the majority of client hedging activity, but remains largely mechanical in nature and is driven by routine hedging and rebalancing activity. Exporter FX hedging activity continues to be the largest contributor to corporate customer volume and is driven primarily by the actual level of the currency.

(2) Across both corporate and institutional accounts, approximately half of the currency exposures are hedged. The majority of institutional accounts have a formal FX hedging policy, while fewer than half of the corporate accounts have any formal policy.

(3) The majority of institutional hedges are extended (rolled) to maintain the hedge on an underlying longer-term investment, whereas most corporate hedges are used to hedge specific cash flows and are therefore not rolled forward. For both client groups, the majority of hedges are conducted for terms of less than six months.

(4) Selective hedging is popular. Banks estimated that Canadian importers were affected positively by the strong CAD, increasing both their hedging volumes and the duration of the FX hedges. On the other hand, Canadian exporters have moderately reduced or delayed hedging their exposures as the CAD appreciated. If they did hedge, only shorter durations were targeted, since exporters expected some future weakness in the CAD..

(5) Domestic institutional investors increased their foreign currency investments, taking advantage of the higher CAD, but there has been no change in their overall hedging ratio for their foreign assets.

♦ **Do U.S. Firms Hedge?**

A survey of the largest 250 U.S. MNCs, by Kasibhatla, Rivera-Solis and Malindretos (2001), studies the behavior of those firms with respect to translation, transactions, and economic exposures. They find the following results:

(1) Most of the MNCs in the survey understood translation, transactions, and economic exposure completely or substantially.

(2) A large percentage (32%-44%) hedged themselves substantially or partially. However, a larger percentage did not cover themselves at all against transactions and economic exposure.

(3) A significant percentage of the firms' hedging decisions depended on future exchange rate fluctuations. A significant percentage of them did not cover themselves against translation and transaction exposures, transactions and economic exposures, and translation and economic exposures.

(4) With respect to hedging, a majority of the firms indicated not applicable or they did not hedge. However, over a quarter of the firms surveyed indicated that they utilized the forward hedge.

(5) The majority of the firms surveyed do have a better understanding of transactions and translation exposure than of economic exposure. ♦

The National Bank of Australia also conducts an annual survey, since 2000, of superannuation (retirement program) funds. In the past years, the AUD has also seen a steady appreciation. The 2009 survey found the following results:

(1) The average hedge benchmark for international equities has remained stable at around 45%. But there was a big dispersion in hedge ratios for participants.

(2) Government funds have decreased their average hedging from 61% to 57% but this was offset by industry funds that have increased their hedge ratio from 40% to 43%.

(3) When tracking the 18 participants who have participated in every survey since 2000, there was a significant decline in the weighted average hedge benchmark, resulting primarily because government and industry funds have reduced their hedging.

(4) Some 22 % of funds now have a 'portfolio approach' compared to only 5% in 2007.

(5) Illiquid assets continue to have a very high hedge ratio of around 70% to 80%, depending on the asset class.

(6) 85% of super funds believe currency issues are important or very important. This compares to 74% in 2007.

(7) Use of specialist for either passive or active currency management stands at 76%. Some super funds have moved currency management in-house and smaller funds increasingly use their custodian for this service.

(8) Active currency management remains low at 24%, and reaching an all-time low of 18% when we look at the same sample set since 2000.

Interesting readings

Parts of Chapter VIII were based on the following books:

International Financial Markets, by J. Orlin Grabbe, published by McGraw-Hill.

International Financial Management, by Jeff Madura, published by West.

International Financial Markets and The Firm, by Piet Sercu and Raman Uppal, published by South Western.

International Investments, by Bruno Solnik, published by Addison Wesley.

Financial Accounting Standards Board, Original Pronouncements, 1999/90 edition, Homewood Illinois: Irwin, 1989.

Kasibhatla, K. M., Rivera-Solis, L. E. and Malindretos, J. (2001), "MNC foreign exchange exposure under FASB no.8 and FASB no.52: A survey," American Business Review.

Norton and J. Malindretos, "FAS 52 and Exchange Rate Exposure: Hedging Strategies", American Business Review, June 1991, pp. 31-34.

Pringle, J. J. (1990), “Managing Foreign Exchange Exposure,” Journal of Applied Corporate Finance, pp. 73-82.

Exercises:

1. Reconsider Example VIII.10. Suppose Burgos Corporation anticipates no payables in CHF, but will receive CHF 200,000 in 180 days. The same information on the spot, forward, and options prices are used to compare techniques and an unhedged strategy. Which strategy would you recommend to Burgos Corporation?

2. GZK wants to measure its economic exposure to changes in the USD/ZAR. They have available 80 quarterly observations from the past 20 years. They run the following regression (standard errors in parenthesis):

$$\Delta CF_t = \underset{(.14)}{.207} + \underset{(.191)}{.552}\,\Delta S_t + \underset{(.12)}{.354}\,\Delta S_{t\text{-}I} + \underset{(0.09)}{.199}\,\Delta S_{t\text{-}II} + \underset{(0.09)}{.103}\,\Delta S_{t\text{-}III}. \qquad R^2 = .248.$$

Determine GZK's ZAR cash flow sensitivity to changes in exchange rates. Interpret your sensitivity estimate. Based on your estimate and the R^2, do you think that GZK should manage its currency exposure?

3. Mr. Poppie is the owner of a big and trendy New York French restaurant. He obviously sells all its production in the U.S. His monthly revenue is USD 750,000. More than 60% of his purchases are imports from France. The monthly total cost of the French imports is Europe EUR 250,000. Mr. Poppie wants to set up a USD/EUR hedge that would ensure his ability to make affordable purchases should the USD collapse. In particular, he is very worried about a potential appreciation of the EUR against the dollar in December. Mr. Poppie broker charges a flat fee of USD 20 and the exchange charges USD 1.50 per contract. Using the information given in Example VII.2, construct:

i) at the money Dec hedge.
ii) out-of-the money Dec hedge.
iii) a collar.

(Specify type and number of contracts, strike prices, and costs.) Briefly discuss the advantages and disadvantages of each strategy. Which one would you recommend to Mr. Poppie? (Why?)

4. Swiss Cruises believes that changes in the CHF/USD exchange rate follow a normal distribution with mean 0% and standard deviation of 4%. That is, $s_t \sim N(0,.0.0016)$. Assume that S_t=1.45 CHF/USD. The USD net transaction exposure is USD 1 million. Calculate a 95% range for the USD net transaction exposure.

5. You work for a Vandelay Industries, U.S. MNC. Vandelay gives you the following projections for next year:

Currency	Total inflows	Total outflows	Exchange rate
GBP	GBP 65,000	GBP 50,000	1.60 USD/GBP
EUR	EUR 80,000	EUR 95,000	0.95 USD/EUR

a.- What is Vandelay's net transaction exposure (NTE)?

b.- Suppose the GBP and the EUR are perfectly and positively correlated. The USD/GBP exchange rate increases to 1.76. What is the **change** in net transaction exposure for Vandelay Industries?
c.- Go back to part (a). The GBP's standard deviation is .10, while the EUR's standard deviation is .05. Construct a range -i.e., a 95% confidence interval- for the transaction exposure of each currency.

6. Cami SDP, a Mexican subsidiary of the California based Cami MVP, has the following balance sheet. All items are in MXP. The current exchange rate of S_t=.14 USD/MXP.

Cami SDP Balance Sheet in millions of MXP

Balance Sheet Accounts	
Assets	
Cash	200
Accounts receivable	860
Inventory	120
Net fixed plant and equip.	900
Total assets	2,080
Liabilities and Capital	
Accounts payable	150
Notes payable	400
Long-term debt	510
Shareholder's equity	1,020
Total liabilities and capital	2,080

i. Calculate the exposure in USD of Cami SDP under the current method and the monetary/nonmonetary method.
ii. Management believes that the MXP will depreciate against the USD within one year. Cami MVP wants to avoid translation exposure in MXP. Suggest a translation hedge.
iii. Suppose in a year the company has the same balance sheet but S_t=.1900 USD/MXP. Calculate the translation gain under FASB #52. Is this translation loss/gain increase, decrease or leave unchanged earnings?

7. From 1999 to 2001, the euro showed a depreciating trend against the dollar and the yen. Did the increase in the USD affect the net transaction exposure of a European exporting firm? And what about economic exposure?

8. Kramerica Company does business in the U.S. and Canada. In attempting to assess its economic exposure, it compiled the following information:
• Its U.S. sales are somewhat affect by the Canadian dollar's value because it faces competition from Canadian exporters. It forecasts the U.S. sales based on the following exchange rate scenarios:

S_t (USD/CAD)	Revenue from U.S. (in million)
.70	USD 90
.80	USD 110

• Its CAD revenues on sales to Canadians invoiced in CAD are expected to be CAD 200,000,000.
• Its anticipated cost of goods sold is estimated at USD 50 million from the purchase of U.S. material and CAD 80 million from the purchase of Canadian materials.
• Fixed operating expenses are USD 30 million.
• Variable operating expenses are estimated at 20 percent of total sales (including Canadian sales, translated to a USD amount).
• Interest expense is estimated at USD 10 million on existing U.S. loans, and the company has no CAD loans.
• Income tax is paid at the U.S. tax rate of 30%.

A. Create a forecasted income statement for Kramerica under each of the two exchange rate scenarios.
B. Does Kramerica face economic exposure? Explain how Kramerica's projected earnings before taxes are affected by possible exchange rate movements.
C. Explain how Kramerica can restructure its operations to reduce the sensitivity of its earnings to exchange rate movements, without reducing its volume of business in Canada.