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Foreign Exchange Exposure

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The Executive's Guide to Foreign Exchange Exposure Management

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INTRODUCTION AND SUMMARY

This report is a guide for financial professionals who analyze and evaluate their companies' foreign exchange exposures. The concepts used in this report form the building blocks of foreign exchange exposure measurement and management. The conceptual discussion, the related practical issues and the empirical evidence that we present suggest several guidelines that will aid the executive in formulating foreign exchange exposure management policies.

To form a foreign exchange exposure management strategy, an executive must have a basic understanding of four distinct topics:

- What is foreign exchange risk?
- What are foreign exchange market dynamics?
- What are the available tools?
- What are the proper strategies?

In answering these questions, we recommend that an executive rely on, among others, the following concepts and tools:

- Visible versus invisible risks;
- Purchasing power parity (PPP);
- Interest rate parity (IRP);
- Shortfall risk;
- Analysts' forecasts (economic versus technical);
- Market forecasts (forwards and implied-option volatilities);
- Derivative instruments (forwards, swaps, conventional and exotic options); and
- Quantitative risk analysis.

WHAT IS FOREIGN EXCHANGE RISK?

Since the 1970s, exchange rate volatility has increased markedly, and with it, the levels of foreign exchange risk have risen. In fact, fluctuations in the currency and related fixed-income markets have sometimes produced gains and losses so large as to swamp many companies' operating results. In response, numerous financial managers have turned to hedging and active risk management strategies. To manage foreign exchange exposures, we first have to define them and then quantify them as best as possible.

Identifying Foreign Exchange Exposures

Typically, a company may have two types of foreign currency exposures:

- Visible (transaction or cash flow) exposures; and
- Invisible (economic) exposures.

As the terms imply, visible exposures or risks are easier to identify and quantify than invisible exposures or risks. If a company expects to receive or disburse future cash flows in various foreign currencies, then it is subject to visible transaction or cash flow risks. Moving away from the concrete, exchange rates also may influence a company's overall economic strength, future balance sheets, future income statements, future stock prices, and relative positioning. Furthermore, such dependence on exchange rates may not be immediately obvious in the company's current cash flows. If so, a company is subject to invisible or economic currency exposure.

Visible Risks

An executive identifies his company's foreign currency transaction exposures by preparing a schedule of projected foreign currency cash flows including the following factors associated with these cash flows:

- Currency of denomination;
- Magnitude;
- Timing;
- Direction (long or short); and
- Uncertainties.

For example, a U.S. company importing from Japan and exporting to Mexico and Germany would be exposed to fluctuations in the Japanese yen, the Mexican peso and the Deutschemark relative to the U.S. dollar. Specifically, this company effectively is long the Mexican peso and the Deutschemark (the company owns or expects to own these currencies) and short the yen (the company owes or expects to owe yen). Long positions experience gains (losses) if the associated currencies appreciate (depreciate); the reverse is true for short positions.

Certain foreign currency transactions, such as bond coupon payments or receipts, are timed precisely. Other foreign currency transactions, such as foreign mergers and acquisitions, are timed less precisely and may occur over an extended time period.

In addition to timing uncertainties, foreign currency cash flows may be subject to realization uncertainties. For example, a U.S. construction company bidding for projects in Korea would receive Korean won only if it emerges as the winner.

Certain foreign currency transaction risks are indirect but still visible. For example, a French power plant subsidiary's profitability may depend on the price of coal bought from Germany; thus, the U.S. parent would be directly exposed to the French franc/U.S. dollar rate and indirectly exposed to the French franc/Deutschemark rate.

An executive preparing a schedule of foreign currency cash flows carefully should consider the various complications that we discuss above. Such considerations may affect the nature of hedging transactions that an executive may have to implement, as discussed later in this report.

Invisible Risks

Foreign exchange risk is multifaceted, and typically, there is more than meets the eye when analyzing it. Management needs to distinguish between perceived versus real risks: Invisible risks are significantly more difficult to identify, measure and manage than visible risks. Despite such difficulties, we introduce two concepts that can help executives to manage invisible risks: **purchasing power parity** (PPP) and **interest rate parity** (IRP).

A physical plant located in a country whose currency is depreciating rapidly may not be exposed to foreign exchange risk.

Exchange rate fluctuations that are not matched by offsetting changes in price levels in the respective countries are **real** exchange rate changes or, alternatively, deviations from **purchasing power parity** (PPP). Typically, only changes in real exchange rates affect a country's international competitiveness: A company's international competitiveness will deteriorate in a country where the rate of inflation exceeds that of currency depreciation — and vice versa. For example, in the mid-1980s, when the dollar was exceptionally strong in real terms, U.S. manufacturers such as Schwinn Bicycle and International Harvester lost market share to their

Japanese competitors and eventually either ceased to exist or had to restructure their corporate form. Furthermore, the economic exposure of owning a factory in another country depends on how the local currency market price of the factory moves relative to the exchange rate. Even if the foreign currency is depreciating rapidly, perhaps because of high local inflation, the physical plant would not be exposed to currency risk if the local currency price of the physical plant also increased by at least as much as the currency depreciation.

Borrowing in a high-interest currency may turn out to be cheaper than borrowing in a low-interest currency.

Just as deviations from PPP have implications for the foreign exchange exposures of real goods and assets, deviations from **interest rate parity (IRP)** have implications for the foreign exchange exposure of financial assets and liabilities: Financial assets and liabilities are considered exposed only if interest rate differentials on similar assets denominated in different currencies are not matched by subsequent changes in exchange rates. For example, assume that the Italian lira five-year swap rate is 9.40% versus the U.S. dollar five-year swap rate of 5.47%. This difference does not necessarily imply that Italian lira funding is more expensive than U.S. dollar funding. Such a conclusion would be warranted only if the Italian lira depreciates by less than approximately 3.93% (9.40%-5.47%) per year over the next five years.

The long-term investor focuses on deviations from PPP and IRP. The short-term trader worries about the daily profit or loss of his portfolio!

Like beauty, risk is in the eye of the beholder. The long-term investor likely will define risk as deviations (shortfalls) from PPP and IRP. Conversely, the short-term trader will care less about deviations from PPP and IRP and more about the immediate stock price impact of currency fluctuations and the daily profit or loss of his portfolio.

Management likely will emphasize accounting measures.

Although most managers try to make decisions based on investors' long-term goals, short-term considerations may also influence the kinds of foreign exchange exposures taken on. Perceived market responses to short-term accounting results and incentive plans that reward managers based on these results can cause managers to worry more about occasional losses than on occasional gains. Consequently, most managers like to limit or eliminate foreign exchanges exposures, especially if accounting exposures hurt their reported performance.

Quantifying Foreign Exchange Risk

After an executive specifies his company's schedule of expected future foreign exchange transactions, he can then measure the company's foreign currency risk. Such risk measures can be **deterministic** (scenario-dependent) or **probabilistic**. Probabilistic approaches use measures such as **standard deviation** and **shortfall risk**.

- **Scenario-Dependent Measures of Risk.** A company can estimate its foreign currency risk by analyzing the present value or the internal rate of return of its cash flows associated with planned foreign currency transactions under different exchange rate scenarios. For example, a company may study the return on a yen-denominated asset over ten years while assuming that the yen/U.S. dollar exchange rate moves linearly from its value today to an assumed terminal value in year ten. The *range* of net present values or internal rates of return as a function of this assumed terminal value will indicate the risk inherent in the company's yen/U.S. dollar exposure.

- **Probabilistic Estimates of Risk**. A company also can estimate the risk inherent in its foreign currency operations by using probabilistic analysis. In this approach, the company studies the statistical results derived from numerous computer-generated scenarios of future exchange rates. In a typical study, an analyst uses various statistical techniques and random number generators to simulate 1,000 or more future foreign exchange rate scenarios. In these scenarios, the exchange rate moves randomly, yet consistently, with its historical volatility and maintains a specified average value. The net present value or internal rate of return of the cash flows associated with the currency transactions is calculated for each scenario. The company can then study the resulting **probability profile** of returns.

Depending on his objectives, an executive may choose standard deviation or shortfall risk, among others, as measures of risk.

Two useful measures of risk that can be derived from this probability profile are **standard deviation** — the best known — and **shortfall risk**. Standard deviation measures the uncertainty, dispersion or spread in expected results of an investment. With standard deviation as a risk measure, outcomes well above the average contribute as much to the riskiness of the profile as do outcomes below the average.

In popular usage, however, risk captures the possibility of an outcome that is less favorable than expected; that is, most people would not consider unusually favorable outcomes as risky. Only outcomes falling short of some acceptable level are considered risky. We take a generalized approach to risk, incorporating both standard deviation and shortfall risk. We define foreign exchange risk as the chance that fluctuations in the exchange rate will cause the profitability or cost of a transaction to vary from a specified benchmark. As such, risk could be defined as standard deviation, as in the typical academic literature, or as a measure of performance below a specified benchmark, as would be implied by popular usage.

Executives' dislike of unfavorable outcomes outweighs their like of favorable outcomes. They would prefer a measure of shortfall risk rather than a measure of standard deviation.

To formalize the notion of risk implied by popular usage, we introduce three measures[1]:

- Shortfall probability;
- Average shortfall; and
- Shortfall risk.

Shortfall probability measures the proportion of all outcomes that fall below a specified performance threshold. Average shortfall measures the average amount by which poor outcomes miss the threshold. When measuring investment performance, poor outcomes are defined as those that fall below the specified benchmark. When measuring funding performance, poor outcomes are defined as those that fall above a specified benchmark. Shortfall risk is defined as shortfall probability multiplied by average shortfall.

To illustrate, suppose that a company has a multicurrency funding portfolio and a pain threshold of 8% interest expense (that is, interest expense exceeding 8% contributes to risk, while interest expense below 8% does not). Shortfall probability would be defined as the probability that the interest expense would be above 8% (assume 20% probability). The average shortfall would be defined as the average excess of all possible outcomes above 8%. Assuming that the average of all outcomes above 8%

[1] There are many one-sided measures of risk, but here we focus on shortfall risk, which is similiar to an asset manager's notion of shortfall risk. See for example, *Portfolio Optimization under Shortfall Constraints: A Confidence Limit Approach to Managing Downside Risk*. Martin L. Leibowitz. Salomon Brothers Inc. August. 1987.

is 11%, the average shortfall would be 3%. And shortfall risk would be defined as shortfall probability times average shortfall. Thus, shortfall risk would be:

$$0.20 \times 3\% = 60\text{bp}$$

Stated differently, if the company pursues the multicurrency funding strategy described above, on average, it would be penalized by paying 60 basis points of interest expense above its pain threshold (benchmark). A risk averse manager would seek to minimize shortfall risk while keeping favorable outcomes as large and as frequent as possible.

WHAT ARE FOREIGN EXCHANGE MARKET DYNAMICS?

A broad array of factors — ranging from parliamentary votes, to money supply increases, to trade imbalances, to GNP growth rates, to speculative attacks — might affect exchange rates. Similarly, a broad array of analysts — ranging from fundamental economic forecasters, to statistical (or econometric) model builders, to technical analysts — comment on such developments, opining where, when and at what pace exchange rates will move. To add to the confusion, the modern foreign exchange manager feels compelled to read and analyze a plethora of market data delivered through the print media or through a clutter of video terminals. The obvious questions are what do I do? and where do I start?

In this section, we introduce several approaches to understanding exchange rate variation:

- **Fundamental (economic)** analysis;
- The **purchasing power parity** approach (do currencies move in step with inflation differentials?);
- The **interest rate parity** approach (do currencies move in step with interest differentials?, or are forward rates good predictors of future spot rates?);
- **Technical** analysis; and
- **Implied volatilities** and **modern finance** theory (the **random-walk** approach).

We emphasize that while these approaches are all useful for understanding foreign exchange market movements, none of these can be relied on as definitive predictors of short- or long-term market movements. Rather, each technique offers insights that will help an executive to form his own opinions about the direction and magnitude of future foreign exchange movements and to understand how his company's activities relate to these movements.

Do Currencies Move in Step With Market Fundamentals?

The financial services industry employs many analysts in its efforts to predict such future events as changes in foreign exchange and interest rates or other economic developments. Despite a distinctly mixed forecasting record, the predictions of such analysts still are eagerly awaited by market participants. It may be that the accuracy of their forecasts is considered secondary to their help in sorting through issues, and providing interesting trading ideas.

Economists have varying schools of thought, such as Keynesian or monetarist. And depending on those ideologies, an economist may think that a certain development will affect an exchange rate in one way or another, or not at all. However, most economists will agree only on the following:

- That **relative** macroeconomic changes in two countries affect exchange rates between those countries. For example, if both the German and U.S. economies are growing at a real 3% annual rate, then economists would not expect the Deutschemark/U.S. dollar exchange rate to be affected. However if the German real growth rate jumps to 4%, then an economist would expect the Deutschemark to appreciate versus the dollar.
- That unexpected **(news)** developments affect exchange rates.

In Figure 1, we present a list of the most commonly tracked economic factors and a typical economist's predictions on how news about relative movements in these factors might affect exchange rates.

Figure 1. Factors Affecting Exchange Rates

Macroeconomic Factors (Increases In)	Effects on Home Currency
Home Money Supply Growth	Depreciation
Home Real Income Growth	Appreciation
Home Inflation	Depreciation
Home Real Interest Rate	Appreciation
Home Nominal Interest Rate	Appreciation if because of real increase, Depreciation if because of inflation
Home Trade Balance	Appreciation

Source: Salomon Brothers Inc.

Similar changes in macroeconomic factors in a foreign country would produce the opposite effects on home currency valuations relative to that foreign currency.

An executive might use Figure 1 as an approximate guide regarding how the foreign exchange market would react to various economic reports and statistics issued by the U.S. and other governments. Such statistics include GNP growth rates, unemployment, consumer and producers price increases, durable goods orders, inventories, and money supply growth rates, among others.

However, in applying Figure 1, an executive should not forget that economic relationships, unlike physics theorems, are unstable over time. Markets have limited attention spans — traders tend to concentrate on one or, at most, two macroeconomic variables at a time. And just like Madison Avenue fashion fads, a trader's love affair with a specific macroeconomic variable is fickle. Episodically, traders will focus, for example, on money supply announcements, trade imbalances and/or, unemployment statistics. Yet, what is important today may become irrelevant tomorrow. In the United States, for example, during the high-inflation 1970s, traders followed U.S. money supply announcements religiously; however, in the low-inflation 1980s, traders showed virtually no interest in U.S. money supply announcements.

Furthermore, relationships shown in Figure 1 may totally reverse their direction at certain times. For example, a large trade deficit caused by overconsumption might result in a depreciating currency, while a large trade deficit caused by infrastructure investments might result in an appreciating currency. Specifically, in the early 1970s, the dollar was

depreciating as the United States was running then-unprecedented large trade deficits associated with the Vietnam War. In the mid-1980s, however, the dollar was appreciating sharply as the United States still was running unprecedented trade deficits associated with the Reagan military buildup.

In sum, even though economic analysis provides the executive with various rules of thumb, these rules might be misleading and ought to be used with caution.

For low-inflation countries, inflation rates are not good predictors of exchange rate changes in the short run.

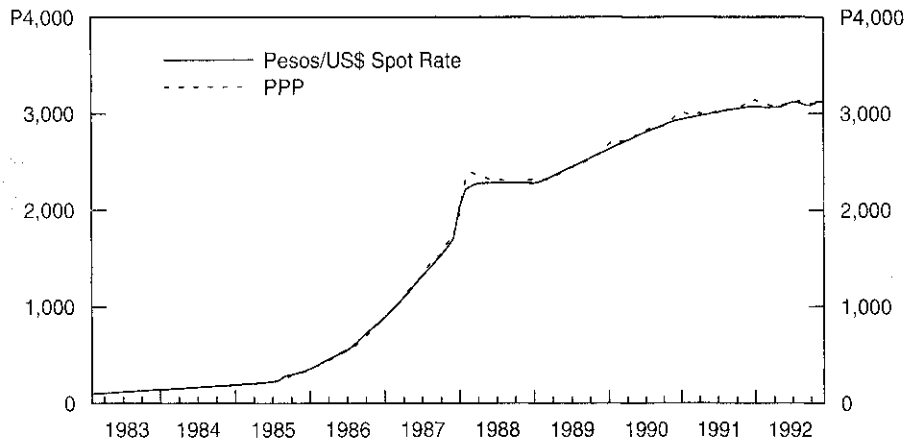
Do Currencies Move in Step With Inflation Differentials?

Since 1973, there have been persistent deviations from PPP in developed countries that have lasted, on average, about five years. These deviations possibly were caused by exchange rates reacting to news more quickly than price levels do. In the long run, however, both exchange rates and price levels will tend to adjust fully to news. The best available estimate of this rate of adjustment is 2%-4% per month.[2]

For high-inflation countries, and for countries in close monetary union, PPP does seem to hold even in the short run.

Conversely, PPP holds for most hyperinflationary economies. For example, in Mexico which was hyperinflationary until recently, PPP has held very well (see Figure 2). In addition, PPP holds for countries that are in close economic cooperation and near monetary union (see Figure 3).

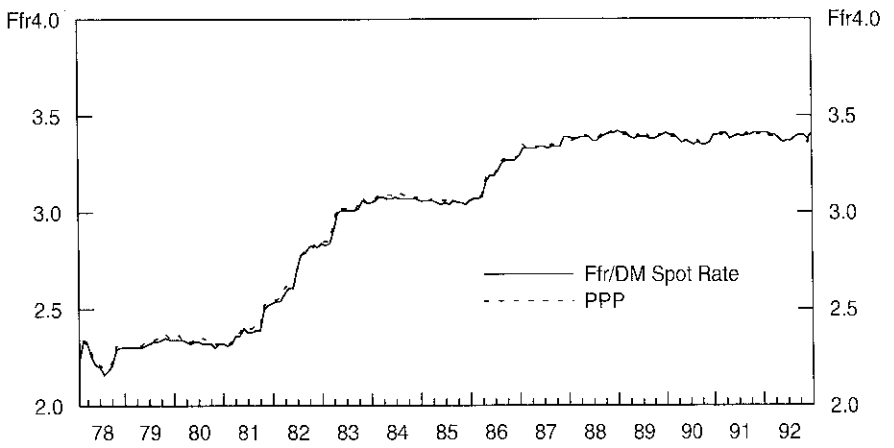
Figure 2. Purchasing Power Parity in High-Inflation Periods — Mexico versus the United States, 1983-92 (Base Year=1983)



PPP Purchasing power parity.
Sources: Salomon Brothers Inc and *International Financial Statistics*, International Monetary Fund.

[2] See "Purchasing Power Parity in the Long Run", Niso Abuaf and Philippe Jorron, *Journal of Finance*, March 1990; and *Purchasing Power Parity — Relevant for the 1990s?*, Anita Lauria and Niso Abuaf, Salomon Brothers Inc, March 1991.

Figure 3. Purchasing Power Parity within the European Monetary System — France versus Germany, 1979-92 (Base Period=1979-90)



PPP Purchasing power parity.
Sources: Salomon Brothers Inc and *International Financial Statistics*, International Monetary Fund.

The Economist annually applies the PPP theory by comparing the relative prices of a McDonald's Big Mac around the world. For example, recently, it found that a Big Mac cost DM4.30 in Germany and $2.20 in the United States. This PPP application implies that the Deutschemark/U.S. dollar exchange rate should be DM1.95/US$. At the time of the comparison, however, the rate was DM1.49/US$, suggesting a 30% overvaluation of the Deutschemark. Indeed, since then, the rate has moved to approximately DM1.65/US$.

Do Currencies Move in Step With Interest Differentials?

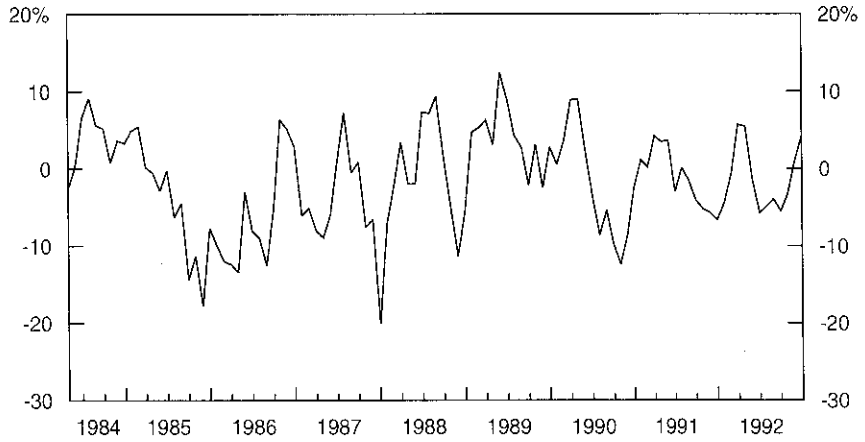
An investor either can invest a dollar at home or, alternatively, convert it to foreign currency, invest it abroad and repatriate it at the end of the investment period. The functioning of arbitrageurs who are indifferent between holding domestic and foreign assets ensures that the above two investment strategies produce the same rate of return. That is, we would expect the home currency to depreciate (appreciate) by an amount approximately equal to the excess (shortfall) between domestic and foreign interest rates. For example, if home interest rates are 2% below (above) foreign rates, then one expects the home currency to appreciate (depreciate) by approximately 2%. This relationship is known as the **uncovered interest rate parity** theorem.

• **Forward Rates and Future Spot Rates.** The existence of foreign exchange forward or futures markets is tied closely to the uncovered interest rate parity concept. In the absence of capital controls, arbitrage dictates that the home currency must be at a forward discount or premium that is approximately equal to the difference between home and foreign interest rates.[3] For instance, if foreign annual interest rates are 3% above (below) home rates, then the foreign currency must be at a roughly 3% annual forward discount (premium). Otherwise, arbitrage opportunities would exist through the forward market. And, this is known as the covered interest rate parity theorem

[3] In equation form, $({}_tf_{t+1} - s_t)/s_t = (1+i)/(1+i^*)$, where ${}_tf_{t+1}$ is the forward rate set at time t for delivery at time t+1, s_t is the exchange rate at time t in home currency units per foreign currency unit, and i and i^* are the home and foreign interest rates, respectively. Naturally, this equation has be be adjusted for compounding.

Observers of forward markets frequently ponder whether forward rates are unbiased predictors of future spot rates. Because speculators take forward positions that reflect their views, forward rates should be unbiased predictors of future spot rates.[4] In fact, some authors have coined the term **forecasting efficiency** to indicate that forward exchange rates are the best available forecasters of the future spot rate. Conversely, for forecasting efficiency to hold, speculators must be risk neutral and dominate the markets.

Figure 4. Forward Rates as Predictors of Future Spot Rates — The Yen/U.S. Dollar Exchange Rate, Apr 84-Apr 92



Source: Salomon Brothers Inc, and *International Financial Statistics*, International Monetary Fund

As shown in Figure 4, forward rates may continuously under- or overpredict future spot rates. These biases may be due to the risk characteristics of the underlying economies. For instance, U.S. monetary policy is considered more unstable than that of Germany. Hence, the dollar is viewed as a riskier asset than the Deutschemark. This suggests that the Deutschemark forward rate would overvalue the German currency, compared with the expected future spot rate. In fact, econometric evidence suggests that forward rates actually are biased predictors of future spot rates. If the riskiness of the underlying economies fluctuates, so would the bias in the forward rate.[5]

Regardless of whether forwards are good predictors of future spot rates, they constitute benchmarks with which a manager can judge his expectations against market-set prices.

Technical analysis may work in the very short run and signal market sentiment.

What Can Technical Analysis Predict?

Technical analysts typically attempt to forecast the price of a financial asset based solely on that asset's own price or volume history.[6] Most of these models attempt to forecast only the direction of price movements.

[4] This assumes no risk premium exists in international capital markets —either because of risk neutrality or because assets can be readily substituted.

[5] In addition, if the market expects a currency to be sharply devalued at an unknown future date, forward rates will tend to continously undervalue the currency up to the sharp devaluation date. On the devaluation and subsequent dates, however, the currency will tend to have been sharply overvalued by the forward market. This is known as the peso problem, after the Mexican peso, which exhibited such a pattern in the mid-1980s.

[6] Common forms of technical analysis include models with names such as momentum, slope, moving average, and head and shoulders.

For example, a typical **momentum** model predicts that an exchange rate will continue to move up if it has been rising in the past, and vice versa. Another theory defines a **peak** as a **resistance** area. If the market again approaches a peak, after having moved down from it, the market is said to be **testing** the resistance area. If it **pierces** the resistance area, the market likely will move up for a while. If it backs away, it likely will drop some more. Resistance areas also are formed on the downside.

Mass psychology in the form of price changes feeding upon themselves, the slow spread of new information and the existence of central banks that **lean against the wind** cause successive price changes to be correlated. In turn, these correlations may be picked up by the technical analysts.

For example, if there is market pressure for the exchange rate to move by 10% and the central bank instead allows only a series of 2% changes in stages, these small changes would be positively autocorrelated, whereas a one-shot 10% jump does not have to be correlated with subsequent changes.

Because many traders use technical analysis, regardless of its predictive power, technical analysis may be a useful indicator of market psychology. For instance, with respect to current prices, an apparent ceiling (resistance area) may indicate a level at which there are many sell orders. Similarly, an apparent floor (support area) may indicate a level at which there are many buy orders. Once a ceiling (resistance) is pierced from below, market participants may rush to buy, signaling an upward trend. Similarly, once a floor (support) is pierced from above, market participants may rush to sell, signaling a downward trend. As such, some analysts use technical analysis to gauge market sentiment.

If a technical model signals that a market will rise — and if enough people act on this signal — the market will go up by an amount corresponding to the information embodied in the technical signal. However, because financial markets react quickly to news, it is unlikely that any pertinent news will take a month or longer to be disseminated. Thus, the very use of technical models in the short term may invalidate their use in the long term.

What Can Modern Finance and Options Markets Add?

Econometric studies indicate that, over the long term, spot rates are better predictors of future exchange rates than are forward rates and economic and technical forecasts. This observation, however, does not imply that spot rates are good predictors of future exchange rates — they are merely slightly better than the alternatives. For example, forecast errors, as measured by mean absolute errors, are smaller when spot as opposed to forward rates are used for prediction.

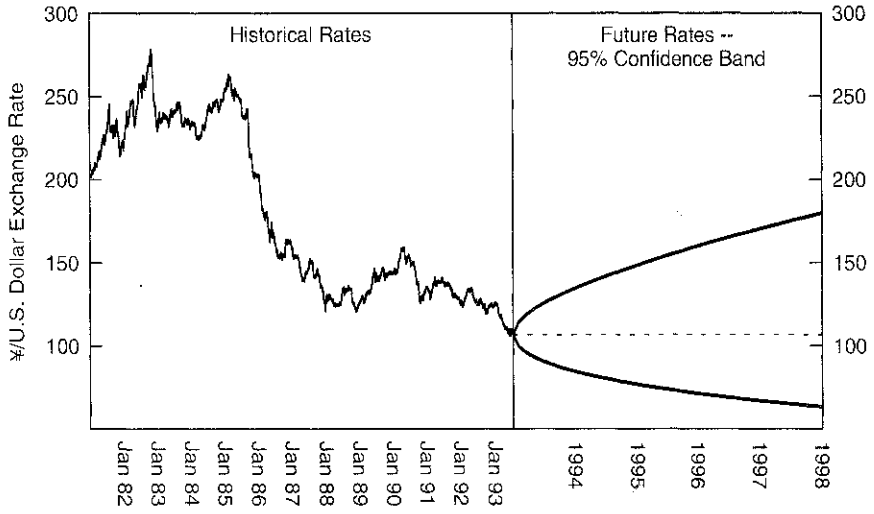
This fact implies that the foreign exchange manager would benefit by statistically estimating the range of future foreign exchange rate movements by using a random-walk model. According to this model, the best forecast of all future spot rates is the current spot rate. One's confidence in the accuracy of such a forecast, however, diminishes with time.

The random-walk model can be used to build statistical confidence bands around the current rate. These bands increase with time but at a less-than-proportional rate, as shown in Figure 5.[7] For example, a DM1.70/US$ current spot rate and a 10% historical or implied-option

[7] Mathematically, the 95% confidence band is given by S x 1.96 x sigma x t 0.5 where S is the current rate, sigma is the volatility in percentage per year, and t is the forecast horizon in years.

volatility imply that 95% of possible Deutschemark/U.S. dollar rates one year from now will fall within 1.70 ± 1.96 x 0.10 x 1.70 = 1.36 - 2.05. Similarly, a 66% confidence band is given by plus or minus one standard deviation around the current spot rate (that is, 1.70 ± 0.10 x 1.70 = 1.53 - 1.67).

Figure 5. The Yen/U.S. Dollar Exchange Rate — The Past and the Random-Walk Future, 1980-98F



F Forecast.
Source: Salomon Brothers Inc.

Putting It All Together: Forming a View on the Foreign Exchange Market

Because foreign exchange market developments cannot be forecast with consistency and accuracy, foreign exchange managers should go through five steps before embarking on a hedging strategy:

(1) Critically evaluate fundamental economic forecasts;

(2) Evaluate deviations from PPP;

(3) Evaluate market data as embodied in forward rates and implied-option volatilities;

(4) Critically evaluate technical (chartist) forecasts; and

(5) Accept ignorance and rely on implied-option or historical volatilities in developing a sense of possible statistical outcomes as generated by the random-walk model.

After executing these five steps, a manager should rely on his and his company's intuition and business expertise and, accordingly, formulate foreign exchange policy guidelines. Naturally, these guidelines also will depend on the company's risk/reward appetite and could benefit from various analysis discussed later in this report.

WHAT ARE THE AVAILABLE TOOLS?

A company can use a wide variety of financial tools and techniques to manage its foreign currency exposures. These tools include currency swaps, options, forwards, futures, options on swaps, options on futures, and other derivatives. The techniques include borrowing and lending, commodity hedging, leading and lagging, and matching. (The techniques and the tools

are summarized in Appendix A, and we discuss the tools in detail in this section.) The tools offer a manager the power to control his company's foreign exchange exposures. However, the variety, flexibility and sometimes the apparent similarity of these tools make it a daunting task for a manager to decide which tools will best handle his company's foreign exchange exposure most effectively.

To shed light on these complexities, we first discuss the economics of each of these instruments. Subsequently, we explore how the accounting and tax treatment of using them differ.[8] In some cases, an economically effective hedging tool may have unfavorable tax or accounting treatment. On the other hand, certain instruments may have favorable tax and accounting treatment.

Conventional Derivatives

• **Currency Forwards.** Currency forward contracts are customized contracts, offered primarily by commercial banks, to buy or sell foreign exchange in the future at a specified price. The maturity and size of these contracts can be tailored individually to exactly hedge a company's position if it is so known.

A company may need to deliver ¥100 million in six months as payment for goods to be imported from Japan. The company can enter into a forward contract today to lock in the dollar cost of that transaction and eliminate the risk that it will suffer a loss if the yen appreciates more than indicated by the forward curve. However, the company also gives up any possible benefit from a yen depreciation. Thus, a currency forward contract is a **symmetrical** hedge management tool: The hedger eliminates downside risk by forgoing upside potential, because the return is locked in at a preset rate.

The market for forward contracts of up to five years in maturity is well established for most major currencies and many minor currencies. Forwards tie up a fraction of a company's credit line with the counterparty bank. This situation can cause a problem if a company has two separate but economically offsetting forward positions with two different banks, which effectively use up a company's credit line with both banks.

• **Currency Futures.** Currency futures can be purchased on several exchanges around the world. Currency futures are ready-made contracts to buy or sell foreign exchange in the future at a specified price on exchange-specified dates. Several dates per year are available for maturity of currency futures, typically in March, June, September, and December. The contract sizes are fixed. A futures contract's credit is guaranteed by the clearinghouse associated with the exchange on which it is traded. Futures markets have low margin requirements, approximately 2%-3% of contract value, and no credit lines are necessary to open positions. On the negative side, a futures contract's margin requirements lead to uncertainty in cash flows, and managing this cash flow uncertainty can exhaust valuable managerial resources.

A company may use a currency futures contract as it uses a currency forward contract: to lock in the dollar value of an anticipated foreign currency purchase in the future. A company expecting to deliver ¥100 million on June 28 of a given year may enter into eight futures contracts (each yen futures contract consists of ¥12,500,000) to buy ¥100 million

[8] See "Foreign Exchange: Transactions in Spot, Forwards, Swaps, Futures, and Options" and "Foreign Currency Options," N. Abuaf and S. Schoess, *The Handbook of International Financial Management*, Robert Z. Aliber (editor), Dow Jones-Irwin, 1989.

on the June 23 expiration date (contracts expire on the second business day immediately preceding the third Wednesday of the contract month) of the yen future on the International Money Market of the Chicago Mercantile Exchange. The company locks in the dollar price of the yen commitment five days before delivery date. Thus, the company will earn yen interest on its yen asset for five days, even though the company does not need this extra interest income to cover its commitment. That is, the company's flows are not exactly matched, an outcome that is not a major shortcoming but, nonetheless, is a nuisance otherwise known as **basis risk**.

- **Currency Swaps.** A currency swap is an exchange of cash flows, in different currencies and over time, between two parties. In a typical currency swap, parties exchange principal in one currency for principal in another currency at the outset and reexchange these principals at maturity.[9] Usually, the initial and final rates of exchange are identical. In addition, interim interest payments, which reflect market rates in the respective currencies, are made to service the principal amounts. These payments are set according to a predetermined rule.

To illustrate, assume two parties enter into a generic fixed-for-fixed five-year U.S. dollar/Deutschemark currency swap. Under the terms of this contract, DM171 million is exchanged for $100 million at the onset and reexchanged at the maturity of the swap. Furthermore, the U.S. dollar payor makes semiannual coupon payments of $2.795 million (5.59% of the U.S. dollar principal amount) to the counterparty and receives semiannual payments of DM5.455 million (6.38% of the Deutschemark principal amount). The coupon rates are the five-year swap rates in the U.S. dollar and Deutschemark interest rate swap markets, respectively.

Typically, a currency swap is used to hedge the return of a foreign currency-denominated investment. A U.S.-based company purchasing an existing factory in Germany may expect the factory to generate a certain amount of Deutschemark profits to be repatriated to the United States each year. The company may also plan to sell the factory in five years for a known amount of Deutschemarks. The currency swap example given above will provide a perfect economic hedge for this company, because all of the future Deutschemark-denominated cash flows are locked in at a dollar value determined today. Therefore, like currency forward and future contracts, swap agreements are essentially **symmetrical** hedging tools.

The major advantage of using currency swaps is their flexibility. Currency swaps can be structured so that coupon set dates, amount and timing match a company's needs. A company with a five-year German investment yielding a Deutschemark-denominated annuity, rather than a payment stream and a balloon payment at the end, can enter in to an annuity swap that matches this cash flow. The notional amount of the currency swap can be structured to meet the company's need. For example, the notional amount on which the coupons are paid may be amortized over the life of the contract to coincide with the structure of the company's foreign currency-denominated assets.

Currency swaps are traded actively by commercial and investment banks worldwide. Unlike with currency futures, a typical company with investment-grade debt can enter into currency swaps without needing to post margin or collateral. This freedom allows the manager more control in managing corporate cash. On the other hand, currency swaps are subject to

[9] For further information, see *Currency Swaps: Corporate Applications and Pricing Methodology*, C. Johnson and J. Showers, Salomon Brothers Inc, September 1990.

counterparty credit risk. That is, a counterparty to a currency swap may fail to live up to its contractual commitments. Consequently, the credit rating of a counterparty to a currency swaps plays an important role in deciding whether to enter into a currency swap with that counterparty.

- **Currency Options and Swap Options.** A company can purchase currency options in the over-the-counter market and as options on futures at various exchanges. A company also can purchase options to purchase swaps in the future. For example, a company can purchase the option to receive dollars and pay Deutschemarks in a five-year currency swap beginning one year from today.

A major distinguishing feature of options versus forwards, futures and swaps is that as hedge tools, an options payoff to the purchaser is **asymmetrical**. Options buyers have the **right but not the obligation** to enter the contract and, thus, only will enter into the contract if it is in their favor upon expiration. For this right, the option purchaser pays an **option premium**. The option buyer obtains insurance protecting him against any adverse move in a currency but can participate fully if any move in the market is in his favor.

A **call** option is the right to purchase a currency at a set price (the **strike price**) at some time or for some period in the future. A **put** option is the right to sell a currency at a given strike price at some time or for some period in the future. An **American-style** option can be exercised at any time up to the expiration date of the option, and a **European-style** option can only be exercised at the expiration date.

To hedge an anticipated payment of yen for goods to be received from a Japanese supplier, a company may buy yen call options. The company may want to hedge because past yen appreciation causes it concern that further appreciation by the purchase date may cause losses. The company can hedge itself by purchasing a European call option to purchase yen at a strike price fixed on the initiation date and expiring on the date of the expected payment. The company is protected in its future transaction against yen appreciation up to the strike price, but it need not exercise the option if the yen depreciates, in which case it reaps the dollar savings.

A swap option involves the purchase of the right but not the obligation to enter into a currency swap. These options can be European or American style as in regular currency options. A company holding a foreign asset may expect to receive a foreign currency-denominated return starting one year from now, subject to the completion of certain negotiations. This company may want to hedge the return today without incurring the potential liability of a currency swap. The company can then buy an option to enter a swap one year from now with the conditions of the swap specified today.

- **Combination Tools.** A company also can choose from a number of tools that simultaneously combine elements of forwards, options, or swaps. The most common foreign currency combination tool is a range forward contract also known as a collar. For example, a company may decide to purchase Deutschemarks through a range forward contract struck at 1.60DM/US$ and 1.80DM/US$ (assume the current spot rate is 1.70DM/US$). This contract means that at the maturity of the range forward, if the spot exchange rate ranges from 1.60DM/US$ to 1.80DM/US$, then the company has to buy Deutschemarks at the prevailing rate. If, however, the Deutschemark appreciates beyond the 1.60DM/US$ level, the company has assured itself a maximum cost of 1.60DM/US$. Analogously, if the Deutschemark depreciates beyond the

1.80DM/US$ level, the company has to buy Deutschemarks at the 1.80DM/US$ rate — and not benefit from the further depreciation. Range forwards are explained in more detail in Example 1, later in this report.

Exotic Options

Exotic Derivatives

Exotic options, also called path-dependent options, resemble conventional options in that they give their buyer the right (but not the obligation) to buy or sell a specific amount of an underlying asset (for example, foreign exchange) at a specified price during a specific time period. However, unlike conventional options, exotic options exhibit unusual features such that their ultimate payoff depends on the **path** of the price of the underlying asset. These options, first introduced in a 1979 academic paper, are now actively used and traded.[10] Below, we present various exotic option examples.

- **Average-Rate Options (Asian Options).** Unlike a conventional option, which is settled by comparing the strike with the spot rate at expiration, an average-rate option is settled by comparing the strike with the average of the spot rates over the option period. The average can be geometric or arithmetic and can begin at any point during the option period. The sampling process (frequency and interval of underlying price observations) also can vary to suit the buyer's need.

Average-rate options are particularly suitable for a multinational corporation that wants to hedge estimated foreign exchange income. The stream of foreign exchange income throughout the year can be better hedged by buying a put option on the average exchange rate of a foreign currency (protecting against weakening of the foreign currency, on average) rather than a conventional put (protecting against weakening of the foreign currency at expiration).

U.S. domestic manufacturers facing foreign import competition also may find average-rate options attractive. For instance, weakening of the foreign currency against the U.S. dollar would allow the foreign competitor to cut the dollar price of the U.S. import while preserving the profit margin in the foreign local currency, thereby increasing its market share in the United States. In this case, the average foreign exchange rate better typifies the currency exposure than the spot exchange rate at any given moment. Hence, the appropriate hedging strategy is to buy an average-rate put option on the foreign currency.

Average-rate options also are cheaper than conventional options because the averaging process smoothes out the underlying price movements, thereby reducing the volatility and, hence, the premium of the option. After modifying the underlying exchange rate and volatility, one can use conventional options pricing models, such as **Black-Scholes** or **Binomial**, to price average-rate options. Typically, the volatility of an average-rate option is about 57% of the volatility of a conventional option.[11] One variant of the average rate option settles the option at expiration by comparing the spot price at expiration with a strike computed by averaging the spot rates during the specified period.

- **Contingent-Premium Options.** In a contingent-premium option, there is no up-front premium. The premium is paid at expiration and only if the option expires in the money. The premium payment is such that if the

[10] See "Path-Dependent Options: Buy at the Low, Sell at the High," B. Goldman, H. Sosin and M.A. Gatto, *Journal of Finance*, December 1979.

[11] See "Options on Average Exchange Rates," N. Abuaf, Working Paper, Chase Manhattan Bank, June 1985.

option is in the money but not deeply enough to recoup the premium, the option still has to be exercised and the premium paid. If the option expires at the money or out of the money, no premium is paid. For the option holder to benefit, the option either has to expire at or out of the money, or it has to expire sufficiently deep in the money to recoup the contingent premium.

Such a premium is more expensive than conventional option premiums because the premium is paid only if the option expires in the money, and expiring in the money is not guaranteed. The premium can be approximated by dividing a conventional option premium by the probability of the option expiring in the money, adjusted by the time value of money.[12] For example, assume that a six-month conventional call on the Deutschemark (against the U.S. dollar) struck at-the-money forward costs $0.04. Because the option is struck at the money forward, its probability of expiring in the money is 50%. Assuming that the six-month dollar interest rate is 5%, the contingent premium call would cost:

Premium:	If in the money:	($0.04/0.5) x (1.025) = $0.082
	If out of the money:	$0.00

The contingent-premium option is an attractive risk management tool if the buyer has a strong bullish or bearish market view. Assume that a U.S.-based company owns a Japanese subsidiary. The company can protect the dollar value of the yen-denominated income by purchasing a put on the yen against the dollar. However, if the company's management believes strongly that the yen will strengthen against the U.S. dollar for at least two to three years, it would be reluctant to pay the premium of the yen put. If, also, the company cannot afford to be wrong, or if its board may require its management to hedge, then buying a contingent-premium put on the yen would be a better hedging alternative than an outright put purchase. If the company's market view is correct, it does not owe any premium for the put. Even if the yen depreciates against the dollar, the company is hedged by the put, although at a higher premium cost.

This option can be structured to suit the client's needs. For example, if the company expects that the dollar will strengthen against the yen, the company can purchase a reverse contingent-premium yen put, under which the premium is due only if the option expires at or out of the money. If the dollar strengthens versus the yen, the company achieves the hedge at no premium cost.

Conventional and contingent-premium options can be combined: A portion of the premium can be paid up front, with the rest contingent on the option expiring in the money.

- **Barrier Options (Trigger Options).** Barrier options have all the features of conventional options plus a **trigger** (or barrier) point. These options get activated or deactivated only if the spot exchange rate reaches a trigger point during its life. There are two types of such options: a **knock-out** option and a **knock-in** option. In a knock-out option, if the exchange rate reaches a trigger point, called the **outstrike**, before expiration, the option is extinguished. In a knock-in option, if the exchange rate reaches a trigger point, called the **instrike**, before expiration, the option turns into a conventional option for its remaining life.

[12] In the Black-Scholes formulation, this is given by the quantity $N(d_2)$, the cumulative normal distribution of the option expiring in the money.

Like a contingent-premium option, a barrier option is highly leveraged, compared with a conventional option; that is, the buyer benefits significantly more compared with a conventional option if his view turns out to be correct. Assume again that a U.S.-based company owns a Japanese subsidiary. The company can protect the dollar value of its yen-denominated income by purchasing a put on the yen against the dollar. However, if management has a strong view that the yen will keep strengthening versus the U.S. dollar for at least one to two years, it would be reluctant to pay the put's premium. If, also, the company cannot afford to be wrong, or if its board may require its management to hedge, the premium can be reduced by buying a knock-out put option on the yen.

For example, assume the current spot is ¥110/US$. If the premium of a one-year conventional put on yen with strike at ¥115/US$ is $0.07, a knock-out put with the same strike but with an outstrike of ¥105/US$ may cost only $0.05. The buyer's view is that if the yen strengthens to the point where the spot becomes ¥105/US$, it will not turn around within a year to finish weaker than ¥115/US$. For taking this risk, the buyer could reduce the put premium by almost 30%.

- **Lookback Options.** A lookback option does not have a specified strike price. Instead, it allows the buyer to look back over the life of the option and choose as the strike price the most favorable price that has occurred during that time. For example, a lookback call option allows the buyer to choose the lowest underlying price for a period as the strike of the call. A lookback put allows the buyer to choose the highest underlying price for a period as the strike of the put. These strikes are then compared with the spot price at the expiration to determine the payoffs.

For example, in November 1992, if an investor had purchased a six-month lookback call on DM1 million, expiring in May 1993, at expiration, the buyer pays for DM1 million the lowest dollar-denominated price during the option period. In March 1993, the Deutschemark was as weak as DM1.6680/US$ (DM1 million was worth only $599,520). At expiration in May 1993, the exchange rate was DM1.6255/US$ (DM1 million was worth $615,195). The buyer of the lookback call, therefore, buys DM1 million worth $615,195 but pays only $599,520.

Because lookback options allow the buyer to choose the best strike with perfect hindsight, premiums are much higher than conventional options. A lookback option returns a significant profit to the buyer if the realized volatility of the underlying price is higher than the implied volatility. If the buyer envisions a sharp move in the price but is not sure when and for how long the price will move, a lookback option may be especially attractive.

Accounting and Tax Treatment for Foreign Currency Hedging Tools[13]

The tax and accounting treatment of foreign currency hedging tools is an essential part of formulating a hedging program. A hedging program may work perfectly from an economic standpoint while causing unacceptable fluctuations in a company's income statement. Awareness of such implications will help a company to avoid future management headaches and provide opportunities for the astute manager.

[13] The information contained in this section is for general discussion purposes only. This discussion is not intended to represent the rendering of accounting , tax and regulatory advice. A change in the facts of circumstances of any transaction could materially affect the accounting, tax or legal treatment for that transaction. The ultimate responsibility for the decision on the appropriate application of generally accepted accounting principles, and proper tax and regulatory treatment rests with the preparers of financial statements and in-house tax and regulatory counsel, who should consult with outside advisors.

Accounting for Foreign Exchange Hedgers

An executive embarking on a foreign exchange hedging program focuses on managing not only his company's economic exposure, but also its accounting exposure as reflected in the balance sheet and income statement. Ideally, accountants should recognize the gain or loss on a hedged item at the same time that they recognize a mirror image gain or loss on the hedging transaction (the hedger). Such coincident recognition allows the company's balance sheet and income statement to accurately reflect the economics of the hedge.

For example, if a corporation fully hedges the foreign currency risk inherent in a foreign currency bond issuance, exchange rate changes should not affect the company's economic position and accounting statements. Thus, a gain (loss) on the bond issue should be fully offset by a loss (gain) on the foreign exchange hedger. Consequently, both the company's balance sheet and its income statement should be fully shielded from gains or losses caused by exchange rate effects on fully hedged items. Unfortunately, executives may have to jump several hurdles to receive such ideal accounting treatment, if at all.

The Financial Accounting Standards Board's (FASB) Statement 52, issued in 1981, largely governs the accounting treatment of foreign exchange hedgers. Specifically, FASB 52 covers the accounting of foreign exchange forwards, futures and currency swaps.[14] Unfortunately for most practitioners, FASB 52 leaves certain areas gray. For example, it offers no guidance on currency options.

A foreign exchange hedging transaction covered by FASB 52 may be considered a hedge if it meets all of the following criteria:

- The transaction is designated as a hedge;
- The transaction is effective as a hedge;[15] and
- The transaction relates to a firm commitment and not an anticipated transaction.

According to FASB 52, the gain or loss on a hedging instrument can be marked to market quarterly, recognized or deferred until maturity.[16,17]

FASB 52's main objective is to record gains or losses on the hedging instrument at the same time and in the same manner as the losses or gains on the hedged item. For example, if the economic gain or loss on the hedged item is deferred, then the gain or loss on the hedging instrument also should be deferred. Similarly, if the gain or loss on the hedged item is recognized, then the gain or loss on the hedging instrument also should be recognized. If the hedging instrument does not meet the hedging criteria specified above, it is then marked to market separately, reflecting the associated income or loss in the income statement.[18]

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[14] FASB 80 covers accounting for all futures contracts except foreign currency.

[15] A hedging transaction must be executed in the same currency of the hedged item. Tandem currency hedging is allowed only if it is not practical to hedge in the currency of the hedged item. That is, there is not an active forward market in that currency.

[16] That is, according to FASB52, and depending upon the nature of the hedged item, the gain or loss on a hedging instrument can be recognized in income, deferred and included in the recognition of a firm commitment, or recognized in the cumulative translation adjustment.

[17] Foreign currency gains and losses on hedges of net investments in foreign subsidiaries are offset with the cumulative translation adjustment.

[18] For more details see "The Challenges of Hedge Accounting", John E. Stewart, *Journal of Accounting*, November 1989.

In practice, FASB 52 allows a company to apply hedge accounting to foreign currency-denominated equity investments, debt issuance, leases, and other such firm commitments. Conversely, FASB 52 does not allow a company to apply hedge accounting when hedging nonfirm cash commitments, such as expected foreign revenues.[19]

Companies may be able to circumvent this restriction by using options, particularly because options specifically are not covered by FASB 52. Fortunately, the American Institute of Certified Public Accountants (AICPA) allows companies to apply hedge accounting rules for foreign currency options that hedge anticipated transactions. Naturally, these options need to meet the hedge criteria specified above. Although the accounting treatment of all options — including foreign currency options — is a gray area, the AICPA recommends market value accounting for options that do not qualify for hedge accounting.

Although the AICPA does not address foreign currency option per se, the emerging issues task force (EITF), a higher body than the AICPA, does. The EITF may allow hedge accounting for anticipated transactions by using foreign currency options. To qualify, in addition to meeting the first two of the above three hedge criteria, the following conditions must also be met:

- The transaction must be probable, and
- The terms of the transaction must be known.[20]

In addition to the accounting treatment of hedging transactions, FASB 52 covers broader issues, such as the accounting treatment of foreign subsidiaries. Thus, a foreign subsidiary should first specify its functional currency. Functional currency is the currency of the primary economic environment in which an entity operates. Generally, this is the currency in which cash is generated and expended. There are special situations where the functional currency is not the currency of the local economy, such as when an entity generates revenues outside of that local economy. For example, the French subsidiary of a U.S. parent company may designate the Deutschemark as its functional currency if it operates in the German market primarily. This French subsidiary's unhedged local French franc-denominated transactions (for example, salary payments) would be subject to movements in the franc/Deutschemark exchange rate.

These gains and losses first would be measured in the French subsidiary's functional currency, the Deutschemark, and reported as gains and losses in the subsidiary's income statement. Subsequently, the subsidiary's balance sheet would be translated into the parent's reporting currency, the U.S. dollar, such that currency fluctuations would be reflected in adjustments to stockholders' equity. Thus, the foreign subsidiary's functional currency-denominated transactions are not subject to transaction exposure but only to translation exposure to the parent.

Tax Treatment of Foreign Exchange Hedgers

Principally, Internal Revenue Service (IRS) regulations under Section 988 govern the tax treatment of foreign exchange hedgers and other foreign

[19] In practice, FASB52 allows a company to apply hedge accounting to firm commitments such as leases and the purchase of a foreign investment where both parties have executed a purchase agreement. On the other hand, FASB52 does not allow a company to apply hedge accounting when hedging forecasted transactions such as an anticipated debt issuance or expected foreign revenues.

[20] The EITF disallows hedge accounting for certain transactions when using foreign currency options. For example, hedging anticipated foreign currency net income is prohibited under any circumstances. Also, the Securities Exchange Commission disallows hedge accounting for anticipated transactions using complex foreign currency option such as synthetic forwards, range forwards and participating forwards.

currency transactions.[21] Although significant differences remain, on balance these new regulations, issued in March 1992, have moved toward creating conformity between the accounting and the tax treatment of foreign currency hedging transactions.

Integrated treatment requires companies to treat both the hedged item and the hedging instrument as one entity. The combined entity is then treated like other comparable items on the company's books.

As a result, transactions that qualify for hedge accounting under generally accepted accounting principles (GAAP) may also qualify for **integrated treatment** for tax purposes. Integrated treatment requires companies to treat both the hedged item and the hedging instrument as one entity. Once the hedged item and the hedging instrument get coupled into one combination under integrated treatment, they become inseparable thereafter and are treated as one instrument. Special considerations, as described below, apply if the company unwinds either the hedged item or the hedger. While many complex tax rules govern these transactions (their domain is beyond the scope of this report). It appears that under these rules, most transactions that qualify for hedge treatment under GAAP also would qualify for similar treatment for tax purposes. As in GAAP, tax treatment would entail either deferred or mark-to-market treatment for the combined entity.[22]

For example, if a U.S. company issues a Deutschemark-denominated, semiannual coupon-paying bond and swaps its liability into U.S. dollars through a dollar/Deutschemark currency swap, the bond and the swap would receive integrated treatment. That is, the perfect hedging of the Deutschemark bond through a currency swap results in a synthetic U.S. dollar bond, which is taxed exactly like an identical U.S. dollar bond. Thus, the combination receives tax treatment identical to a U.S. dollar bond. For most companies this means that the combination is not marked to market. (If the company marks-to-market all exposures, then the combination would also be marked to market). If, however, the company decided to unwind the swap before maturity, then the gain or loss on the swap is marked to market. Symmetrically, the opposite in sign but equal in magnitude gain or loss (foreign exchange) on the remaining Deutschemark bond also is marked to market at the same time that the swap is unwound.

Following the above logic, the foreign exchange gain or loss on a stand-alone foreign currency receivable typically would be recognized when the receivable matures. If this receivable were hedged with a foreign currency forward or futures contract, then the gain or loss on the foreign exchange forward or future also would be deferred until maturity. That is, the gain or loss on both the hedged item and the hedger would be deferred until maturity. This practice typifies the accounting and tax treatment used by most corporations.

Foreign currency options designated as hedges of items whose tax recognition will be deferred are taxed at maturity or exercise. That is, the premium paid or received for such options is held in suspense until exercise or maturity. Under such circumstances, if a call option finishes in the money, the seller records the option premium plus the strike price as ordinary taxable receipts at exercise or maturity. Symmetrically, the buyer records the same amount as ordinary taxable payables at the same time. If the option expires worthless, then the seller (buyer) registers an ordinary gain (loss).

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[21] For details see "Final and Proposed Regulations Expand Available Foreign Currency Hedging Opportunities," *The Journal of Taxation*, August 1992.

[22] Nevertheless, significant exceptions persist. For example, foreign currency options used to hedge anticipated foreign exchange transactions would not qualify for integrated tax treatment — unless an IRS advance ruling permits it.

In addition, corporations need to consider other tax ramifications, such as foreign tax credits and the avoidance of straddle rules.[23] As stated before, these issues are beyond the scope of this report, and corporations need to consult with their tax advisors. In summary, although, corporations can assume that tax and GAAP treatment are mostly similar — especially under the new tax rules. They must, however, consider all the differences and various tax ramifications of hedging transactions.

WHAT ARE THE PROPER STRATEGIES?

When managing foreign exchange exposures, executives have to develop a view on whether or not to hedge visible transaction or translation exposures. In addition, they need to address whether invisible economic exposures can or should be hedged. After answering the ***to hedge or not to hedge*** question, executives need to decide whether they should introduce another layer of complexity to their operations by pursuing active position-taking strategies. To address these issues, executives would benefit by using various quantitative tools. Although such tools may not provide the perfect answers, they would clarify the risk-reward profiles of various policy decisions. We present this section in three parts:

- Hedging policy;
- Active management policy; and
- Evaluating policies using quantitative tools.

Hedging Policy

One of the crucial steps in foreign exchange exposure management is assessing and, if necessary, hedging foreign exchange risk. The selection of an appropriate risk management strategy depends on management's view of what constitutes risk. Managers can decide to hedge balance sheet exposures, income statement exposures, or even economic exposures. Most practitioners, however, view the primary purpose of exchange rate risk management as reducing the variability of the firm's profits — whether measured by cash flows or conventionally reported dollar earnings. Indeed, most corporations attempt to manage earnings per share or cash flow. Academics, on the other hand, argue that reducing the variability of a company's returns, while keeping the expected level of those returns constant, should have little effect on the value of the firm. This view of risk management considers a firm risky only to the extent that the firm's activities move systematically (in tandem) with the market, as a whole. Accordingly, well-diversified international investors should not be willing to pay a premium for corporate hedging activities that investors easily can duplicate. Consequently, although hedging to reduce overall variability of profits may be important to executives compensated on the basis of reported results, the matter largely is irrelevant to shareholders.

This argument underestimates the importance of information, transaction costs and other sources of friction in the operation of markets. These factors may make it more costly for market participants to hedge certain risks than for the firm to do so. Hence, hedging does have value for shareholders (in part because it is so widely observed). Reducing the firm's overall risk profile — stemming from fluctuations in interest rates, commodity prices, high fixed costs, high financial leverage, as well as

[23] According to straddle rules, the owner of a long and short position in the same instrument or currency cannot recognize losses on one side until gains are recognized on the other. A gain, however, can be recognized while the loss is deferred. This rule was adopted to prevent trades designed solely to defer tax payments. Transactions receiving integrated tax treatment are exempt from straddle rules.

exchange rate swings — is relevant to shareholders primarily because risk affects the perceptions and behavior of other corporate stakeholders such as employees, managers, lenders, and suppliers.[24] By reducing the total risk or variability of the firm, hedging transactions reduce the exposure of a range of corporate constituencies, and this reduction in turn, may increase the value of shareholders' claims.

Theoretically, it is almost impossible to resolve the debate over whether corporations should hedge their invisible exposures. This dilemma results in confusion or inaction if a manager believes that PPP and IRP hold in the long run but not in the short run. To make matters worse, most analysts will not define clearly how many years it takes to move from the short run to the long run.

In practice, some corporations fully hedge their visible exposures and some do not hedge at all. Some corporations may even hedge their balance sheet or invisible economic exposures. Still other corporations may only hedge against disaster scenarios. Naturally, the cost of the hedging instrument plays an important role in the hedging decision. To use a medical insurance analogy, some corporations buy outside medical insurance for their employees, some corporations self-insure and still others may buy residual insurance or disaster insurance to ensure their survivability in case of a major medical catastrophe.

The cost of forwards, futures and swaps is represented as the difference between the bid-ask spread in these markets.[25] The cost of an option is its premium, which represents a larger cost than most bid-ask spreads. Consequently, we recommend that companies seriously consider hedging with forwards, futures or swaps — particularly when cost is an issue. The problem with these instruments is that their payoffs are symmetrical. When in doubt about market direction, purchasing options to hedge against catastrophe scenarios or when hedging bids on foreign contracts may make sense.

Try to Forecast Real Exchange Rates in the Long Term

Real or **economic** exchange risk, arises from permanent changes in real exchange rates and from permanent differences in real returns across countries. Such changes influence the profitability of various production locations around the globe and are critical to decisions about foreign production, investment and multicurrency liability management.

Hedging real exchange risk in the marketplace with any precision and completeness is very difficult. Explicit instruments for such operations are either nonexistent or thinly traded. Nevertheless, some, admittedly crude, approaches to hedging economic exchange risk do exist. For example, a U.S. multinational that is sourcing some of its components in Brazil will face reduced profitability if the real exchange value of the cruzeiro appreciates — that is, if Brazilian prices (wages and other costs) rise faster than the rate of cruzeiro depreciation. To protect itself, the company can construct a hedge by selling the Brazilian cruzeiro forward, together with buying forward contracts on Brazilian commodities. Or, it can sell forward cruzeiros and buy Brazilian real assets.

[24] For an extensive discussion of this point see "An Integrated Approach to Corporate Risk Management," Alan Shapiro and Sheridan Titman, *Midland Corporate Finance Journal*, Vol.3 No.2 (1985).

[25] This however, is a controversial matter. Some authors argue for the difference between the current spot and the forward rate. Others believe that cost should be viewed as the difference between the forward contract and the spot rate at maturity. Still others vote for the difference between the forward rate and the expected future spot rate. Ultimately, however, the cost of the forward cover is the income of traders that provide this cover. This income is the bid-ask spread, and it is this cost that has to be compared with the alternative of transacting in the spot market.

The problem with these strategies, however, is that long-dated forward markets for the cruzeiro and for Brazilian commodities are extremely thin. One alternative is to borrow in the United States and lend in Brazil. However, such transactions may be too cumbersome or risky. Yet another alternative is to attempt to forecast real exchange rates, particularly because long-term real exchange rates for emerging markets probably are easier to forecast than short-term ones.

Under certain assumptions, an improvement in overall home country productivity points to a real appreciation of the home country currency. This correlation suggests that when multinationals produce abroad, they should invest in industries with higher-than-average expected productivity growth. Such a strategy helps to ensure that the cost of the components sourced in these countries remains competitive.

Active Management Policies

At times, certain calculated risks might be worth taking. For example, in the early 1980's when 15-year interest rates were approximately 8% for the Swiss franc and approximately 17% for the U.S. dollar, the World Bank was funding some of its operations in Swiss francs. The bank calculated that the break-even point would occur at approximately 9% annual rate of appreciation for the Swiss franc vis-a-vis the dollar. Over 15 years, this trend would compound to a 364% appreciation, or a change to US$1.75/Sfr from the US$0.48/Sfr prevailing at the time. Because the World Bank reasoned that this outcome was unlikely, it accepted the risk and funded in Swiss francs. This will probably be a profitable strategy given that more than a decade after that decision, the exchange rate is US$0.68/Sfr (Sfr1.47/US$).

Similarly, in today's U.S. dollar steep yield curve environment, many companies are betting that interest rates will not rise by as much as indicated by forward rates. Consequently, these companies are funding themselves with short-term, fixed-rate liabilities and swapping them into floating rates. Although this example is in a different domain than foreign exchange, it illustrates how certain bets might be worth taking.

As in the World Bank example given above, borrowing in low-interest rate currencies and lending in high-interest rate currencies and not covering the foreign exchange rate position may be taken as a calculated bet at certain times — as in the yield curve bet explained above. For example, in today's market, some investors borrow in U.S. dollars and invest in Mexican Government bills (cetes), at around 14.5% per year, or Turkish Government bonds at around 80% per year, and not hedge their currency position. Clearly, such investors are betting that the Mexican peso and the Turkish lira will depreciate by less than their interest differential relative to the U.S. dollar.

When making such bets, executives also need to consider the correlations — or lack thereof — among various exchange rate changes. We call this the portfolio approach. For example, we know that movements in the Dutch guilder and the Deutschemark are highly correlated versus the dollar. If Dutch interest rates suddenly go up, the portfolio approach suggests that an investor or manager should borrow Deutschemarks and lend guilders. This strategy is less risky than borrowing dollars and lending guilders because it involves uncertainty in only one exchange rate, that is the Deutschemark versus the guilder. By contrast, borrowing dollars and lending guilders entails uncertainty in two exchange rates: the dollar versus the Deutschemark and the Deutschemark versus the guilder. Here, it is useful to think of the Deutschemark as a price leader and the guilder as a price follower.

While it is advantageous to exploit high degrees of co-movements, managers can reduce overall variability when low degrees of co-movement exist between returns on different assets or markets. This diversification can be achieved by moving away from a single market or asset toward several markets or assets. For example, if returns on French securities, after accounting for exchange rate changes, have almost no correlation with returns on Australian securities, a U.S. investor or liability manager could reduce the overall variability of his portfolio by holding both French and Australian securities or liabilities. This approach is similar to selling life insurance to a diverse group of people.

International portfolio diversification pays off if national financial markets are sufficiently segregated. If they are, arbitrage relationships such as PPP may not hold while returns or costs, measured in the investor's or liability manager's home currency, may be uncorrelated. The risk of this approach is that correlations among the returns of various assets may be unstable over time. Nonetheless, the evidence suggests that international portfolio diversification pays off by reducing risk when an expected return is the main goal or by increasing expected return when a specific level of risk is kept under control.

After all, active management policies boil down to the question of whether management has the courage to take certain calculated bets. Such bets can be discussed qualitatively. And, such a discussion is absolutely necessary — particularly given the prevailing macroeconomic conditions. Nevertheless, a quantitative, statistical analysis of such strategies adds to management's insights.

Evaluating Policies Using Quantitative Tools

Salomon Brothers has developed a simulation methodology to help executives clarify the rewards that they can expect for certain risks that they might undertake.[26] Using this methodology, we simulate exchange rates and interest rates based on historical behavior, volatilities and correlations. The results of the analysis show the probability distribution of costs or benefits associated with various strategies. Executives can then choose their preferred strategy.[27]

To illustrate this methodology, we present below two examples.

Example 1: Issuing a DM100-Million Five-Year Zero-Coupon Bond

Assume that a U.S.-based multinational corporation issues a DM100-million five-year maturity zero-coupon bond at a 6.38% DM (annual compounding) internal rate of return. Under these assumptions, the company can raise DM73.40 million or $42.71 million when converted at the current DM1.7185/US$ exchange rate. Furthermore, assume that the corporation is considering the following alternatives:

- Not hedging the foreign exchange exposure;
- Hedging the foreign exchange exposure through a forward contract by buying Deutschemarks forward;

[26] See *Empirical Global Optimization: Toward the Efficient Frontier*. Marwan A. Marshi, Salomon Brothers Inc. October 1989; and *Empirical Global Optimization: Liability Management in an Uncertain World*. Marwan A. Marshi. Salomon Brothers Inc. September 1988.

[27] In particular, our model generates a large number of random-walk exchange rate and interest rate scenarios based on historical volatilities and cross correlations. The model then computes the portfolio performance of each scenario and any associated overlay hedge strategy. By repeating this process numerous times, the probability distribution of the performance measure is constructed. This probability distribution is then used to identify and measure the risk associated with any particular portfolio. Subsequently, the risk-reward profile of various strategies would be quantified.

• Hedging the issue with a range forward contract (for example, buying a call on DM100 million and selling a put on DM100 million such that the premium on the call exactly offsets the premium on the put); or

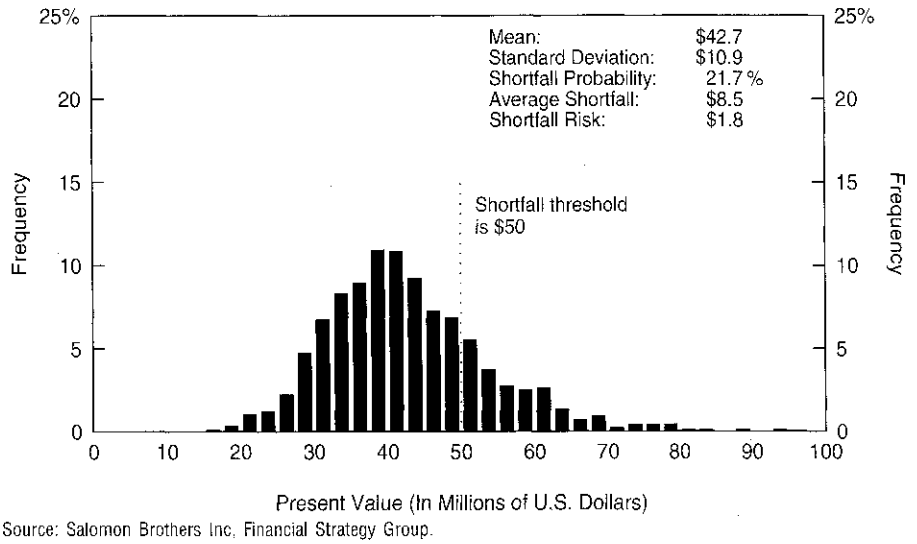
• Hedging by buying a call option on DM100 million.

Through this simple example, we would like to illustrate how the concepts of shortfall probability, average shortfall and shortfall risk can help the executive make informed decisions.

Figure 6 represents the probability distribution of the net present value (NPV) of this Deutschemark offering, assuming that the issue is not hedged at all and that the Deutschemark/dollar exchange rate five years from now will be symmetrically distributed around the five-year forward rate observed today. This probability distribution looks approximately normal with a mean NPV of $42.7 million and a standard deviation of $10.9 million. Assume that the issuer likes to match assets and liabilities and, as a result, wants to assure itself that the NPV of the liability does not exceed the NPV of the matching asset — namely $50 million. Consequently, if the issuer's shortfall threshold is a current NPV of $50 million, then there is a 21.7% chance that the NPV of the issue will be costlier than the $50 million due to Deutschemark's appreciation. On average, this excess cost would have a current NPV of $8.5 million, resulting in a shortfall risk of $1.8 million.

If the company hedged the issue at a DM1.7835/US$ forward rate (compared with a DM1.7185/US$ spot rate), then the issue would have a current NPV of $42.7 million with zero standard deviation, zero shortfall probability, zero average shortfall, and zero shortfall risk. This NPV would correspond to a five-year future value of $56.07 million and a 5.59% (annual compounding) US$ internal rate of return. Naturally, a full forward hedge implies no probability distribution, per se, other than a deterministic outcome (100% probability) that corresponds to the NPV of the hedged issue.

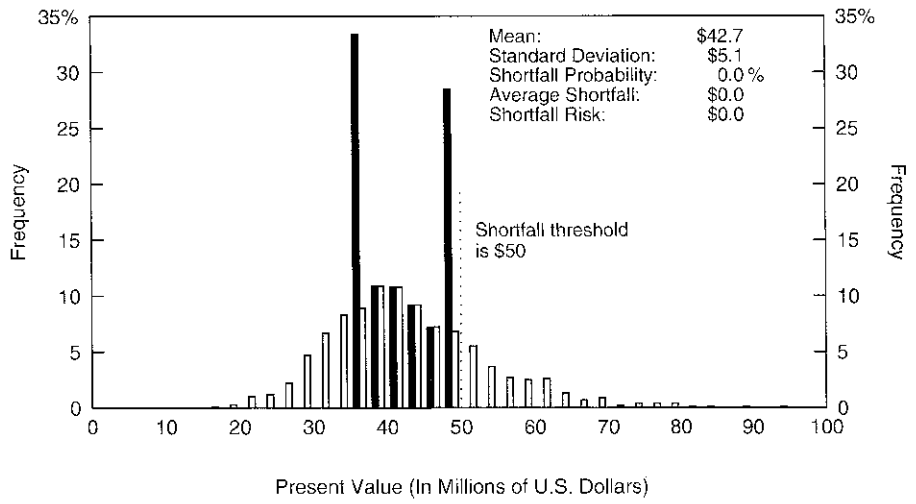
Figure 6. Present Value of DM100-Million Five-Year Zero-Coupon Liability in U.S. Dollars (U.S. Dollars in Millions)



Source: Salomon Brothers Inc, Financial Strategy Group.

Figure 7 illustrates the probability distribution of the NPV of hedging the issue with a range forward contract such that the company buys a five-year call on DM100 million struck at DM1.55/US$ and sells a five-year put struck at DM2.079/US$. To allow the company not to pay any up-front premium, both of the options are out of the money (compared with the forward rate) by approximately equal magnitudes. A range forward keeps the NPV profile to a minimum of $36.6 million and a maximum of $49.1 million. Hedging with a range forward results in the same mean as hedging with a forward. Compared with the deterministic outcome of hedging with a forward (no standard deviation), a range forward results in more uncertainty, but if the call option is properly selected, a range forward will yield no shortfall risk.

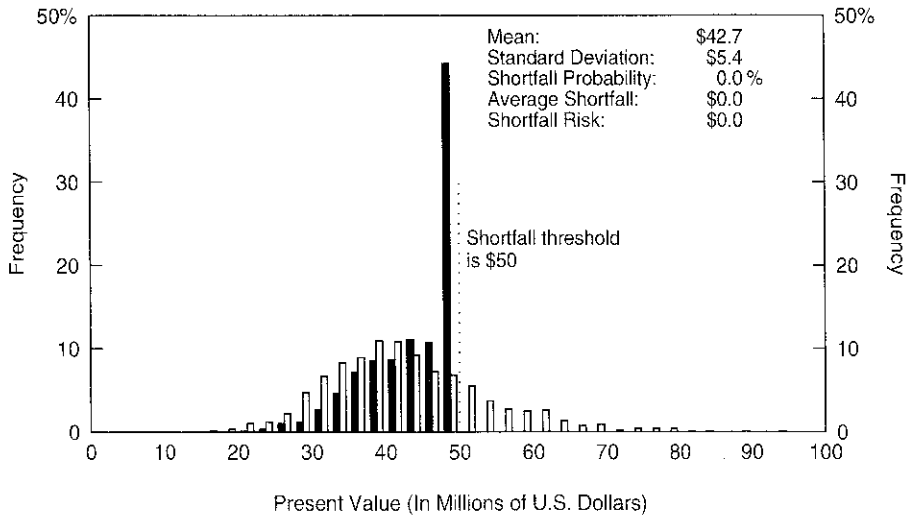
Figure 7. Present Value of DM100-Million Five-Year Zero-Coupon Liability in U.S. Dollars (Hedged with a Range Forward Contract; U.S. Dollars in Millions)



Source: Salomon Brothers Inc, Financial Strategy Group.

Figure 8 illustrates the probability distribution of hedging with call options. This alternative has the same mean as a forward contract, no shortfall risk and upside potential. It seems that hedging with options may have superior cost-risk characteristics. Unfortunately, options usually are fairly priced, indicating no free lunches. The catch is that for scenarios in which the Deutschemark depreciates beyond the strike price of the call option, the average value of these costs will be higher than the average value of such scenarios under the no hedge alternative. This difference will equal the option premium. Specifically, for the unhedged alternative, the average of the outcomes below the $50-million threshold is $38.3 million, $4.4 million below the $42.7-million average of the hedged alternative. This $4.4 million reflects the cost of the call option.

Figure 8. Present Value of DM100-Million 5-Year Zero-Coupon Liability in U.S. Dollars (Hedged with Call Options; U.S. Dollars in Millions)



Source: Salomon Brothers Inc. Financial Strategy Group.

Example 2: Multicurrency Liability Management

Typically, a corporation funds in different currencies for several reasons:

- As a natural hedge to offset revenue streams;
- To exploit currency and interest rates views;
- To move away from illiquid and into liquid markets; and
- To diversity funding sources.

Such a corporation's multicurrency funding policy can be analyzed as an active interest rate and foreign exchange rate management strategy. Specifically a corporation has to answer the following questions:

- Under what conditions (for example, exchange rate expectations and risk appetite) should a corporation borrow in low-interest rate currencies?
- How should a corporation exploit interest rate and currency correlations as, for example, applied to the Deutschemark, Swiss franc and Dutch guilder trio?

Our proprietary simulation methodology helps executives answer such questions in a world with uncertain (probabilistic) outcomes.

To illustrate, we analyze a U.S. dollar-based company whose assets are denominated in U.S.-dollars. The goal of our analysis is to quantify the foreign exchange risk inherent in the company's liability portfolio and to suggest ways to manage this risk.

Figure 9. Analytical Process — Monte Carlo Simulation of Multicurrency Funding

Inputs	Analytical Framework	Output
• Portfolio size and maturity	• Simulate exchange rates based on volatility, correlation, and view assumptions	• Optimal Funding Portfolio — best risk-return trade-off
• Universe of currencies	• Compute probability distribution and related statistics for performance measures, such as internal rates of return	
• Historical volatilities and correlations of interest rates and spot exchange rates	• Select an optimal funding portfolio by finding the portfolio that minimizes risk for a given expected cost	
• Yields in each of the selected currencies		
• Exchange rate views		
• Management's objectives		

Source: Salomon Brothers Inc, Financial Strategy Group.

• **Portfolio size and maturity.** In this example we assume that the company, Rainbow Inc., needs the equivalent of $100 million with maturity in ten years.

• **Universe of currencies.** Rainbow Inc. management is familiar with debt markets denominated in U.S. dollars, British pounds, Canadian dollars, Deutschemarks, French francs, Japanese yen, and Swiss francs. These are the only currencies they will consider.

Figure 10. Historical Volatilities and Correlations, Jan 87-Jul 93 (U.S. Dollar Base Currency: Weekly Data

		Correlations				
Currency	Volatility	¥	Ffr	DM	C$	£	Sfr
Japanese Yen	10.3%	1.00					
French Franc	10.8	0.59	1.00				
Deutschemark	11.1	0.60	0.97	1.00			
Canadian Dollar	4.6	0.03	0.01	0.01	1.00		
British Pound	11.6	0.53	0.81	0.80	0.06	1.00	
Swiss Franc	12.2	0.60	0.89	0.92	0.02	0.75	1.00

Note: There is a strong correlation among the fluctuations in European currencies. However, the Japanese yen exhibits a lower correlation with European currencies.
Source: Salomon Brothers Inc, Financial Strategy Group.

• **Coupon rates and spot exchange rates.** We assume that the coupon rates and spot rates for the various currencies are as shown in Figure 11.

Figure 11. Ten-Year Coupon Rates and Spot Exchange Rates, Jul 93

Currency	Coupon	Spot Exchange Rate (versus US$)
U.S. Dollar	6.26%	—
Japanese Yen	4.86	¥106.55
French Franc	7.70	Ffr1.280
Deutschemark	6.98	DM5.884
Canadian Dollar	6.76	C$1.724
British Pound	7.67	£0.666
Swiss Franc	4.80	Sfr1.521

Source: Salomon Brothers Inc, Financial Strategy Group.

- **Exchange rate views.** Company management can specify a multitude of exchange rate scenarios. Typically, a company will indicate one of the following:

- Spot exchange rate expectations;
- Forward exchange rate expectations; or
- An imposed view of expected appreciation or depreciation.

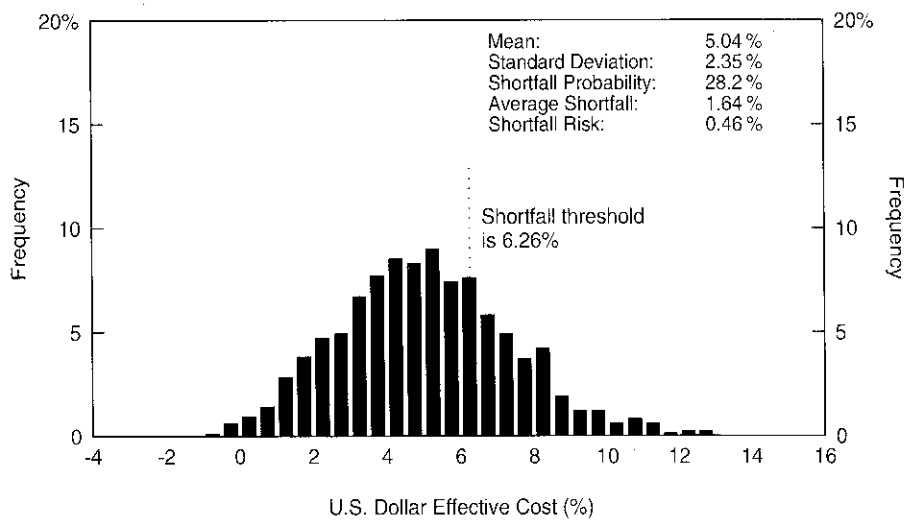
Under spot expectations, the model will generate random-walk exchange rates centered around the mean (spot exchange rate) and with the specified volatility (standard deviation) and correlations. Under forward expectations, the model will repeat the above process, except that the exchange rates will be centered around the implied forward rates rather than the spot rates. Under an imposed view, the model again will repeat the above process with the condition that the exchange rates will be centered around the specified views. In this example, we perform the analysis assuming the following:

- Imposed expectations by which the U.S. dollar appreciates against the French franc, British pound (3% per year), Deutschemark (2% per year), and Swiss franc (1% per year), stays flat versus the Canadian dollar and depreciates against the Japanese yen (0.5% per year).

- **Exchange rate simulation.** For each view, we generate 1,000 random-walk exchange rate scenarios using the specified volatility and correlation estimates.

- **Probability distributions.** Figure 12 exhibits the probability distribution of the effective cost (internal rates of return) of our sample portfolio under imposed expectations. The shortfall threshold, 6.26%, represents the cost of 100% U.S. dollar financing.

Figure 12. Probability Distribution of Funding Costs — Imposed Foreign Exchange Expectations



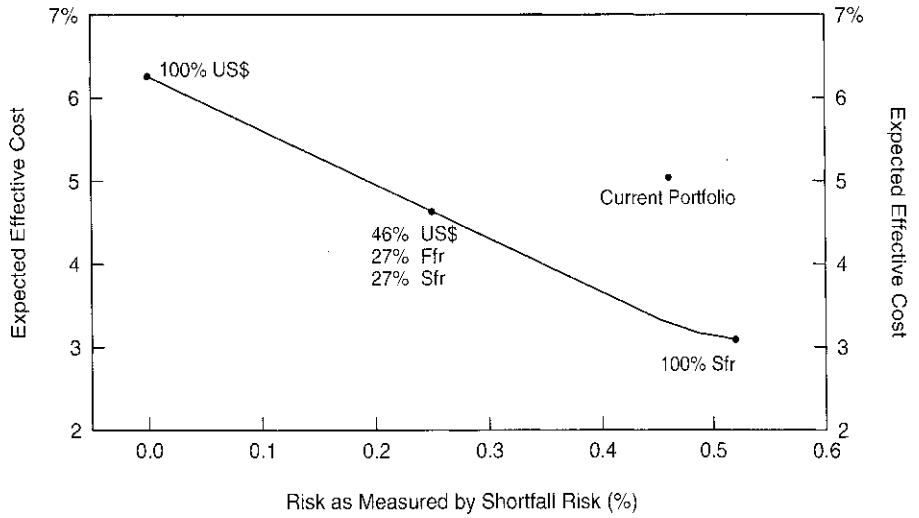
Source: Salomon Brothers Inc, Financial Strategy

- **Optimal funding portfolio.** Figure 13 illustrates the risk-return trade off of a combination of portfolios. The solid line in the Figure, called the efficient frontier, represents the minimum amount of risk achievable given

a specified cost or, alternatively, the minimum of cost achievable given a specified risk. Because the liability manager always is interested in reducing expected cost and reducing risk, he will be interested only in those portfolios that lie along the efficient frontier.

Figure 13 indicates that the equally weighted portfolio is not efficient in the sense that it is possible either to reduce the risk and maintain the cost by moving to its left or to lower its cost by keeping the same amount of risk by moving down from it. Indeed, it seems that under the imposed expectations, an almost 100% Swiss franc financing would have the same amount of risk as the equally weighted portfolio but significantly lower expected cost. Intuitively, the Swiss franc has the lowest coupon (4.8%) and a 1% annual expected depreciation. In U.S. dollar terms, the 100% Swiss franc-financed portfolio would have an approximate annual cost of 3.8%. With the exception of the Canadian dollar, currency volatilities are approximately equal, ranging from 10.3% to 12.2%. Therefore, a 100% Swiss franc-financed portfolio would have the lowest expected cost, given similar amounts of risk for other possible portfolio combinations. This explains why the 100% Swiss franc-financed portfolio lies on the efficient frontier. Similarly, a 100% U.S. dollar-financed portfolio also lies on the efficient frontier: Although it is the highest cost portfolio, it has zero risk by definition, and no other portfolio would lower this risk, given the expected 100% U.S. dollar-financed cost.

Figure 13. Optimal Funding Portfolio — The Efficient Frontier



Source: Salomon Brothers Inc, Financial Strategy

This report recommends that executives charged with managing foreign exchange exposures first define risks — preferably as quantitatively as possible. Once they have defined their risk parameter such as (shortfall risk) and tolerance, or their risk-return trade-off, executives should attempt to understand foreign exchange market dynamics.

Unfortunately for most executives, such dynamics are quite complex, and no single method provides all the answers. It is virtually impossible to predict foreign exchange market developments accurately. Despite this complexity, an executive should check out five distinct analyses before finalizing his views on future foreign exchange developments.

- Fundamental economic analysis;
- Purchasing power parity analysis:
- Forward rates;
- Technical analysis; and
- Implied-option volatilities and the random-walk approach.

Subsequently, an executive needs to grasp the pros and cons associated with various foreign exchange hedging transactions, such as forwards, futures, swaps, conventional options, and exotic options. Naturally, an executive also needs to grasp the various accounting and tax treatment of these instruments.

Finally, the report details how an executive should decide the degree to which he will hedge his company's exposures or even take active positions in the foreign exchange markets. To quantify such decisions, the report discusses a Salomon Brothers methodology using Monte Carlo Simulation.

Taken together, the concepts and methodologies described in this paper will help executives ask the right questions and quantify answers to those questions. Such a process will improve executives' abilities to manage the complexities of foreign exchange exposure management.

APPENDIX A. FOREIGN EXCHANGE HEDGERS

Figure A1. Pros and Cons of Various Foreign Exchange Hedgers

Instruments	Description	Pros	Cons
Forwards	An almost custom-made contract to buy or sell foreign exchange in the future, at a specified price.	Maturity and size of contract can be determined individually to almost exactly hedge the desired position.	Ties up bank credit lines even when two forward contracts exactly offset each other.
Futures	A ready-made contract to buy or sell foreign exchange in the future, at a specified price. Unlike forwards, futures have a few maturity dates per year. The most common contracts have maturity dates in March, June, September, or December. However, these contracts are almost continuously traded on organized exchanges. Contract sizes are fixed.	No credit lines required. Easy access for small accounts. Fairly low margin requirements. Contract's liquidity guaranteed by the exchange on which it is traded.	Margin requirements cause cash flow uncertainty and use managerial resources.
Options	A contract that offers the right but not the obligation to buy or sell foreign exchange in the future, at a specified price. Unlike forwards and futures, options do not have to be exercised. Available on an almost custom-made basis from banks or in ready-made form on exchanges.	Allow hedging of contingent exposures and taking positions while limiting downside risk and retaining upside potential for profit. Also permit trade-offs other than risk versus expected return.	Because an option is like insurance, coupled with an investment opportunity, its benefits are not readily observable, leading some to conclude that it is "too expensive."
Swaps	An agreement to exchange one currency for another at specified dates and prices. Essentially, a swap is a series of forward contracts.	Versatile; allows easy hedging of complex exposures.	Credit-sensitive; uses credit lines.
Swap Option	A right but not the obligation to enter into a swap at a specific date or within a specific time frame.	Versatile like swaps; flexible like options.	Up-front premium, seller's credit is a factor. May be expensive.
Exotic Options	Like options, but payoff depends on path of the currency rather than terminal value.	More versatile than conventional options — ability to better suit buyer's or seller's needs.	New and unfamiliar to many executives.
Borrowing and Lending	Creates a synthetic forward by borrowing and lending at home and abroad. For example, a long forward foreign exchange position is equivalent to borrowing at home, converting the proceeds to foreign exchange and investing them abroad. The converse holds for a short forward foreign exchange position.	Useful when forwards, futures or swaps markets are thin — particularly for long-dated maturities.	Uses costly managerial resources. May be prohibited by legal restrictions.
Commodity Hedging	Going short (long) a commodity contract denominated in a foreign currency a to hedge a foreign exchange asset (liability).	Commodity markets are usually deep, particularly for maturities up to a year.	Price changes of commodities, in terms of home currency, may not exactly offset price changes in the asset (liability) to be hedged. Commodity hedging may not be possible for maturities of more than one year.
Leading and Lagging	Equating foreign exchange assets and liabilities by speeding up or slowing down receivables or payables.	Avoids unnecessary hedging costs.	Appropriate matches may not be available; uses costly managerial resources.
Matching	Equating assets and liabilities denominated in each currency.	Avoids unnecessary hedging costs	Appropriate matches may not be available.

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