FX: Managing Global Currency Risk

The Definitive Handbook for Corporations and Financial Institutions

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The Use of Analytics

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Introduction and Background

It is fair to state that the use of analytical methods by most corporations is, with some notable exceptions, relatively rudimentary compared to those used by banks and investment managers. While the latter are exploring the applications of chaos theory to markets and developing massive computer systems to analyze markets and instruments, corporations' use of analytical methods is still primarily spreadsheet-based analysis of financial exposures and hedging portfolios. Indeed, the majority of systems development in corporations is still tied to accounting and treasury MIS systems rather than to analytical programs.

The reasons for this are not difficult to find:

1. In contrast to financial institutions, each corporation faces a unique set of factors and forces which work against standardization and analytical techniques.
2. Corporate exposures are caused by assets and liabilities which are not traded and whose value is difficult to measure and analyze.
3. The relationship between gaining a competitive advantage and the use of advanced analytical techniques is less explicit in the corporate arena compared to the financial arena.
4. Until recently, corporations have not felt the pressure of regulation which has spurred on financial institutions in the development of their analytical methods.

The Use of Analytics: The Early Period

The use of analytic tools by corporations had a jump start in the late 1970s and early 1980s when a number of factors made it essential for the treasury area to computerize its information and analysis:

1. Interest rates, commodities, and foreign exchange markets became more volatile at the same time that corporations' exposures to these markets increased dramatically.
2. FAS 8 followed by FAS 52 caused enormous changes in the way companies managed their currency exposures, which increased the need to quantify and analyze these exposures.
3. The development of new instruments (i.e., swaps and currency options) made it necessary for companies to adopt pricing and analytical tools in order to use these new instruments.
4. The rapid development of microcomputer and software programs aided the adoption of new analytic systems.

The result was a proliferation of systems—both in-house and vendor-based—for the (1) measurement of currency and interest rate exposures; (2) pricing and analysis of portfolios of options, forwards, and swaps; (3) simulation programs to measure the impact of market changes on a company's exposures; and (4) portfolio management programs which looked at the overall exposures and hedges of a company. These systems attempted to find correlation between various currency positions and proxy hedges for these positions.

In addition, the quest for economic exposure and capital budgeting led to the development of some interesting quantitative and analytical techniques which included discounted cash flow (reducing anticipated cash flow by a factor that is proportional to risk), Monte Carlo simulation techniques, and quantitative country-risk analysis.

The Present Situation—Regulatory Initiative

While financial institutions have felt the full brunt of the worldwide effort to manage market and derivative risk, the corporate world has not been immune to the headlines, reports, and methods that have revolutionized the banking world. For example, the Securities and Exchange Commission (SEC) has issued a *Derivatives Disclosure Proposal* which is bound to increase the use of analytical techniques among corporations. The SEC has broadened its areas of concern beyond derivatives to include not only futures, forwards, swaps, and options, but also other nonderivative financial instru-

ments such as investments, loans, structured notes, mortgage-backed securities, indexed debt instruments, and depositsin other words, all financial instruments that entail market risk.

Similarly, the Financial Accounting Standards Board has issued an Exposure Draft on accounting for derivative financial instruments and hedging activities, which, if adopted, will call for the recording of all derivatives at fair value (i.e., mark-to-market) and will place a premium on timely analytical systems.

At the same time, a number of government, regulatory, and industry groups have adopted a common analytical method for measuring and reporting financial risk for both corporations and financial institutions: value at risk (VAR). The list of these groups includes the Federal Reserve Bank, the Bank of England, the Group of 30, the Derivatives Policy Group, and the BIS/Basle Committee. The remainder of this chapter looks at the definition of value at risk, the difficulty of applying the approach to corporations, alternative analytical risk measurement methods, and the steps taken by companies to use VAR to measure and report on financial risk.

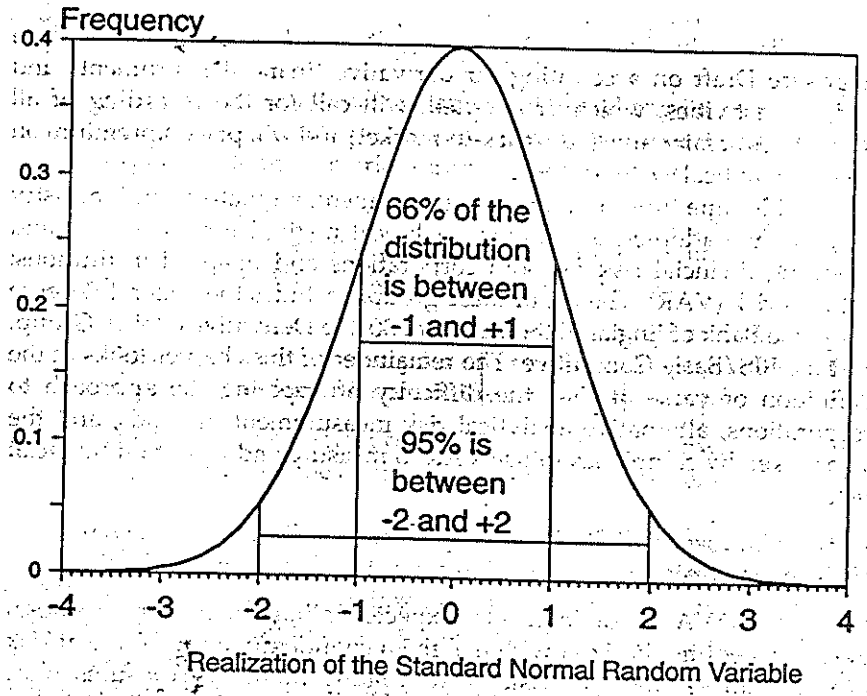
Value at Risk

Value at risk (VAR) is defined as the expected minimum loss (or worst loss) over a target time-horizon within a given confidence level.[1] Value at risk provides an estimate for risk by translating nominal exposures (face amounts) into market risk using volatility and (sometimes) correlation estimates. As in most cases in modern finance, VAR is able to produce results by making several assumptions:

1. VAR models assume linear-instrument payouts which make it difficult to measure the risk of nonlinear instruments or positions (i.e., options risk).
2. VAR assumes normally distributed market movements which are often a poor reflection of reality.
3. VAR assumes that historical volatility and past correlation between instruments and markets will continue into the future.

Value at risk attempts to measure the potential loss of value resulting from market movements over a period of time given a predefined probability. For example, a typical VAR statement for a portfolio of bonds may state that there is a 95 percent chance that the firm will lose no more than one million dollars in the next week, based on market movements. VAR examines potential loss based on statistical probability. Other methods

Figure 1 Normal Distribution



evaluate risk by using discrete future scenarios (i.e., worst-case scenario and stress testing) or by using a large number of alternative future scenarios (i.e., Monte Carlo simulation methods).

Figure 1 shows the VAR of a currency position under the assumption of normal market.[2] It assumes a U.S. investor is long 140 million deutsche marks (DEM). The DEM/USD (U.S. dollar) foreign-exchange volatility is 0.932 percent, and the foreign exchange (FX) rate is 1.40 DEM/USD. Given a probability level of 95 percent (i.e., two standard deviations), the value at risk can be defined as

Value at risk = the forecast amount that may be lost given an adverse market move
= amount of position x volatility of instrument
= DEM 140 million x 0.932%/1.40
= USD 932,000.

Of course, as we reduce the probability level, say to one standard deviation (66 percent), the VAR decreases.

Figure 2 Distribution under Stress Testing

The contrast between using VAR and a stress test or worst-case scenario can be seen by comparing this example with that portrayed in Figure 2. Here, rather than assuming a normal distribution of returns for the dollar, we project several scenarios based on extreme past market movements or on political and economic events such as elections. In this case, the scenarios fall well-outside the confidence limit that we established in the VAR example, which leads to larger potential losses.

Problems in Corporate Applications of VAR

A number of problems make the application of VAR in a corporate setting extremely difficult. These can be broadly placed in the following five categories.[3]

Nature of Corporate Exposures

Unlike financial institutions, whose assets and liabilities—and therefore the institutions' risks—are largely comprised of financial instruments, corporations have a complex and diverse portfolio. This portfolio includes (1) forecast sales and dividends, (2) offshore royalty payments, (3) commodity purchases and sales, (4) short- and long-term borrowings, (5) balance-sheet and economic exposure, (6) speculative trades, and (7) hedges (in order to reduce the volatility of cash flow). This difficulty can be shown by attempting to incorporate a manufacturing plant in Mexico into a VAR analysis.

Interpreting VAR

A second element of difficulty is the interpretation of VAR in a corporate setting where the measure is less intuitive than in a financial institution. For example, a VAR of $50 million is difficult to interpret as a measure of the complex of exposures, assets, liabilities, and income streams that comprise

a multinational corporation. Similarly, explaining the concept of VAR to a board of directors is a daunting task.

Time Frame for Analysis

Corporations are typically interested in a period of months and years when they evaluate their exposures, which is a major reason that scenario analysis rather than statistical probability is still the preferred method of analysis in corporate treasuries. Evaluating longer-term time horizons (say, 6 to 24 months) brings up three serious problems in VAR analysis:

1. Longer-term estimates of volatility tend to be unstable over time and to be difficult to estimate. J. P. Morgan, for example, only provides estimates of volatility for a one-day and a 28-day time horizon in its RiskMetrics program. Recently, a number of vendors (notably Bankers Trust and its RAROC program) have started providing standard deviations for up to one year.
2. Correlation between various markets and instruments, which is based on historical data, becomes less reliable the farther out that one goes in time.
3. Operating assumptions and forecasts regarding the relationship between operating variables (i.e., sales and imports) and financial flows become less reliable the farther out one goes, and this weakens the VAR approach.

Treatment of Hedges

Since a significant part of a corporation's financial instruments will consist of hedges (partial or complete) of underlying cash flows, it is important to capture both the hedge and the underlying exposure in the VAR analysis. A VAR which is performed only on the hedge instruments will tend to show a speculative or open position and will show a risk which does not exist.

Consolidation of Exposures

The VAR methodology is based on the assumption that vastly different exposures and risks can be made comparable by reducing them to three factors: nominal size, volatility, and correlation. Thus, a factory and an export can, in theory, be defined by their dollar amount, the volatility of their value, and the correlation between their volatility and those of other exposures.

This approach is antithetical to many corporations' risk management methodologies which focus on the *differences* between cash flows and exposures. This is shown in the treatment of currencies. While VAR reduces currencies to a common denominator, which can be aggregated and compared, many corporations tend to view currencies individually or in currency blocks.

New Approaches to Corporate Risk Management

The basic idea which allows VAR and similar approaches to be used to measure firmwide risk in corporations can be found in the area of finance known as valuation or shareholder value.[4] In this field, theorists and practitioners long ago gave up the notion of decomposing companies to all their component parts in order to place a value on a firm. Rather, theorists and practitioners now start with the assumption that the overwhelming proportion of a firm's value rests with its cash flows projected into the future, plus a residual (much smaller) value from the sale of the firm's assets in the far future.

This simplifying assumption, for example, makes possible the famous *dividend discount model* which reduces a firm's value to the following formula:

$$\text{Value per share of stock} = \sum_{t=1}^{t=\infty} \frac{DPS}{(1+r)^t}$$

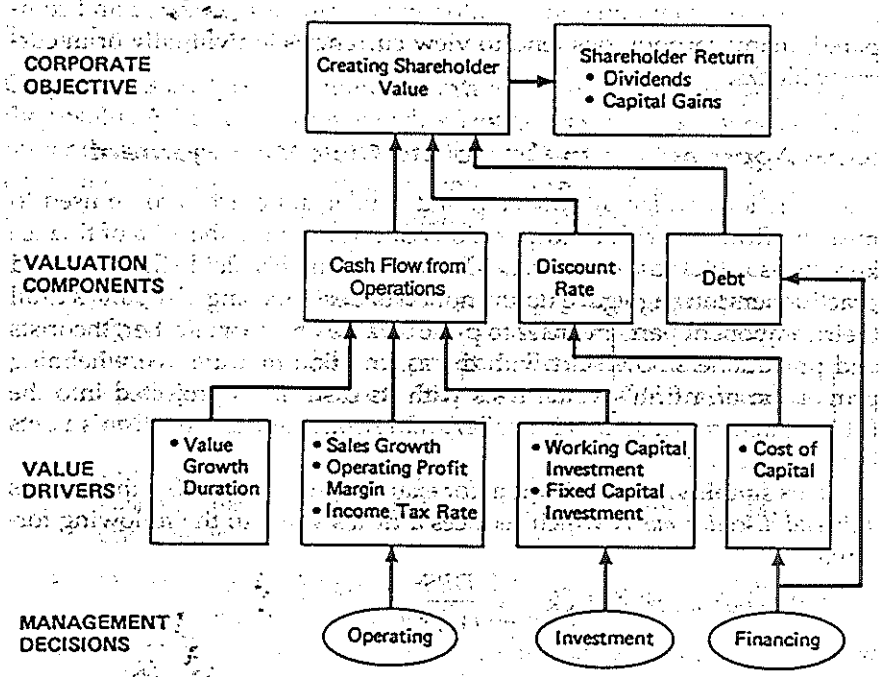
where

DPS = expected dividend per share
r = required rate of return on stock.

If we follow the same logic in measuring risk that the valuation model uses to measure value, our task is to distill the complexity of a corporation to its essential cash flows, and then to measure the risk to those cash flows using VAR and related approaches. In turn, the value of the firm is driven by such "value drivers" as revenue, cost of goods sold, current assets and liabilities, and capital expenditures. Other relevant flows include changes in the value of interest expense, foreign-exchange-denominated cash flows, and commodity prices for buyers and sellers of commodities. See Figure 3.

A number of banks, software companies, and consulting firms have been using this cash-flow approach in order to allow corporations to use VAR. Chase Bank's Cash Flow at Risk (CFAR)[5] is one example of this approach to risk analysis. According to Chase, "[CFAR] may be thought of as a family of tools whose applications are differentiated by three factors: the composition of exposure; the definition of risk; and the cycle of measurement. By varying these factors, VAR can be applied to a wide variety of problems . . . CFAR's measure of financial price risk is complete because it

Figure 3 Corporate Value Drivers for Shareholders Value



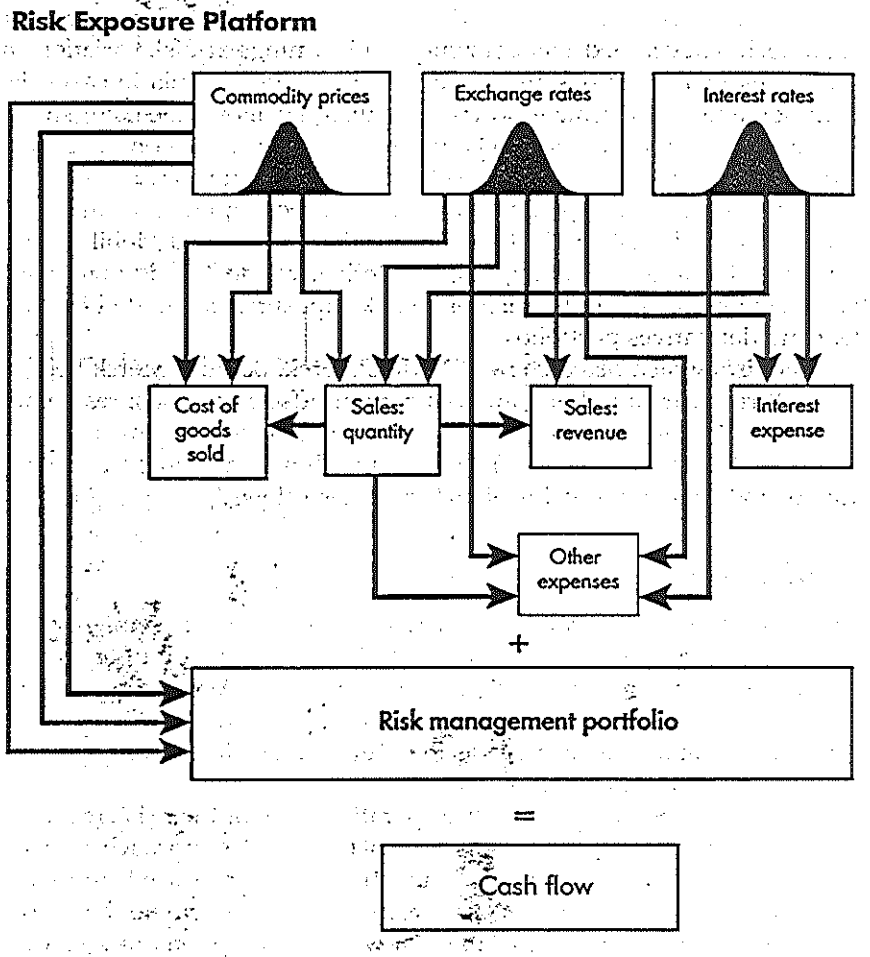
Source: Alfred Rappaport, "Creating Shareholder Value," *Free Press*, 1986, p. 76.

accounts fully for interactions among the firm's risksit treats the firm as a portfolio of exposures. Some firms might have additional exposures but all are likely to be exposed to financial price risk through the following items: *Sales revenues, Cost of goods sold and Interest expense."* See Figure 4.

In the case of valuing corporate risk, CFAR's dimensions are as broad as possible:

1. The definition of exposure encompasses all (or most) of the firm.
2. Risk is defined in terms of earnings, or some other measure of operating performance, rather than asset value.
3. CFAR employs the same measurement cycle as the definition of risk.

Figure 4 Risk Management Cash Flows



Source: Chris Turner, "VAR as an Industrial Tool," *Risk*, March 1996.

A number of related approaches to CFAR have been used by companies including stock price at risk (SPAR), of MEK Associates, which uses the ultimate value measure of a company, its stock price, as the measure at risk. Similarly, Genentech has developed a variant called earnings at risk (EAR), while Emcor has come out with a variant called corporate-value-at-risk.

Examples from the Corporate World

Some corporations are putting their own spin on these techniques,[6] which reflects their specific industry and company differences. Genentech, for example, has developed a model which is an Earnings-at-Risk variation on VAR. This model reflects the impact of accounting regulations on the definition and measurement of risk. Essentially, it allows the company to generate probability distributions of future interest rates along the yield curve and to then test the risks to the company's interest-rate-sensitive assets and liabilities. PepsiCo has used VAR techniques to evaluate its exposure to credit risk, while Dow Chemical Company and Mobil Corporation use the same type of approach as derivatives dealers do to monitor the foreign-exchange and interest-rate-risk exposures embedded in their debt and derivatives portfolios.

One firm which has eschewed VAR is Merck. Because Merck hedges over a three-year time horizon, uses natural offsets in exposures before using hedging instruments, and self-insures a portion of its risk (i.e., only does partial hedges of exposure), Merck finds Monte Carlo analysis a better way to model the dollar value of its foreign cash-flows.[7]

Conclusion

Given the focus on derivatives and risk management, it seems hard to believe that corporations will not greatly increase their use of analytical systems in order to manage currency and other risks. Already, companies and vendors are tackling the shortcomings of VAR and are refining some of the other risk management tools in order to take into account corporations' unique requirements.[8]

Ultimately, the method which corporations use for their risk management will be a hybrid which adopts parts of (1) the VAR approach, with its normal-distribution assumptions, and (2) the scenario-based approach (such as worst-case scenario or stress test) in order to combine the strong analytical powers of VAR and the real-world assumptions of scenario-based approaches.

Endnotes

1 Those who wishing to read an excellent treatment of the value-at-risk subject are referred to Philippe Jorion, *Value at Risk*, Chicago, IL: Irwin, 1996

2 This example is based on J. P. Morgan's, *Introduction to Riskmetrics_* , 4th ed., November 21, 1995.

3 Jacob Boudouch, Mathew Richardson, and Robert Whitelaw, "Expect the Worst," *Risk*, September 1995; and Jeffrey Wallace, "The Long-Term & Corporate VAR," *International Treasurer*, May 27, 1996.

4 See Alfred Rappaport, "Creating Shareholder Value," New York: Free Press, 1986.

5 Chris Turner, "VAR as an Industrial Tool," *Risk*, March 1966; and James MeVay and Christopher Turner, "Could Companies Use Value-at-Risk?" London: *Euromoney*, October 1955.

6 Karen Spinner, "Companies Put Their Own Spin on VAR," *Global Finance*, August 1996.

7 Karen Spinner, "Companies Put Their Own Spin on VAR," *Global Finance*, August 1996.

8 See Appendix for a partial listing of vendors.

Appendix: VAR Consultants and Software Vendors

Consultants
Advanced Risk Management Solutions
American Management Systems
Andersen Consulting
Coopers & Lybrand Consulting, L.L.P.
Deloitte Touche Tohmatsu International
Emcor Risk Management Consulting
Ernst and Young
KPMG
Logica
Price Waterhouse
Ezra Zask Associates, Inc.

Software Developers
Algorithmics Incorporated
BARRA International, Ltd.
Brady, Plc.
C*A*T*S Software, Inc.
Centre Financial Products Limited
Derivatives Strategy/Computer Masters
Dow Jones/Telerate
EDS Systems and Management SpA
Financial Engineering Associates, Inc.
Infinity Financial Technology, Inc.
INSSINC
Leading Market Technologies
Lombard Risk Systems Limited
Microcomp GmbH
Midas-Kapiti

Objective Edge, Inc.
Oy Trema Ab
Quantec, Ltd.
Renaissance Software, Inc.
PappersData
Sailfish Systems, Ltd.
Summit System, Inc.
TrueRisk, Inc.
Value & Risk GmbH
Wall Street Systems