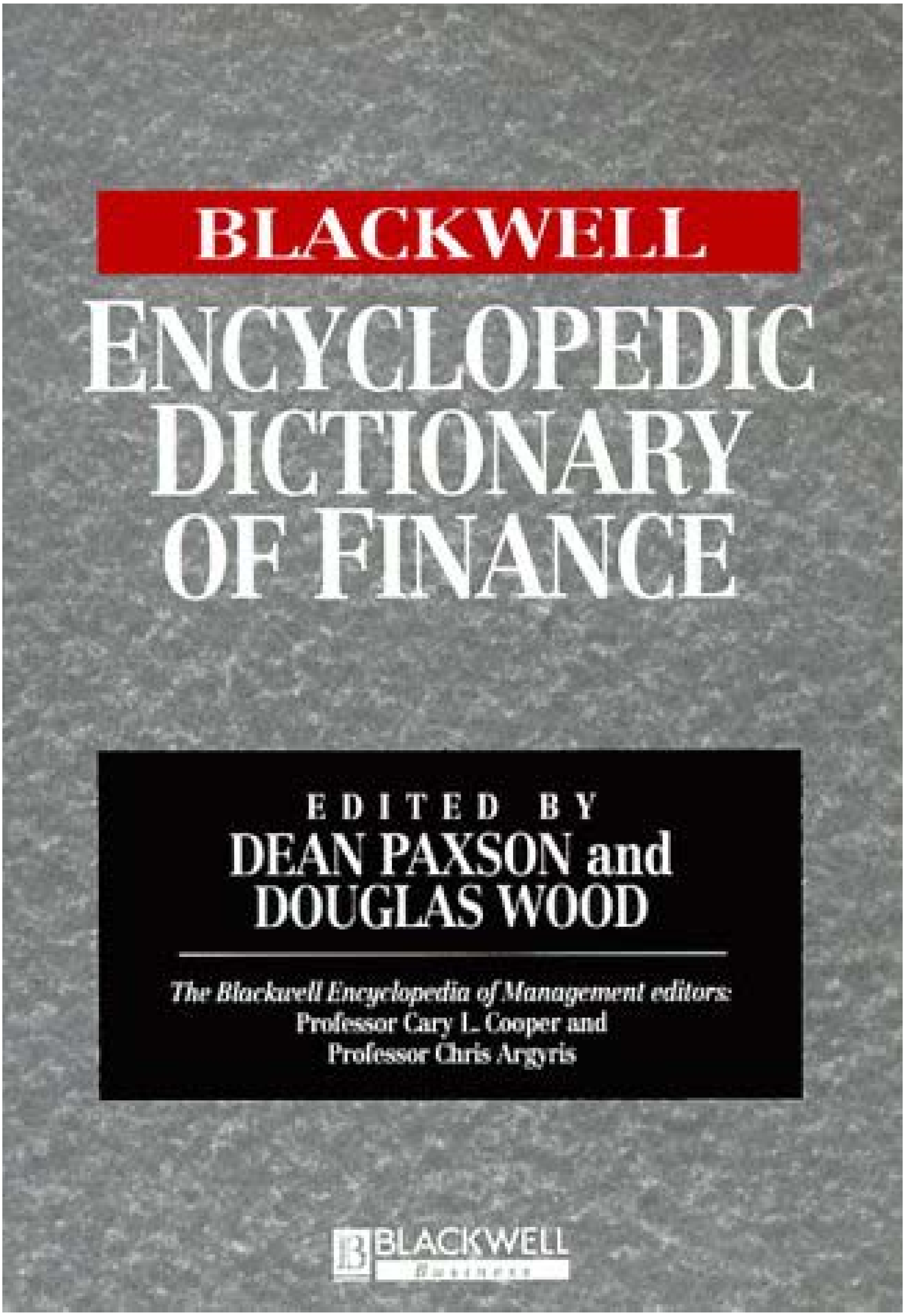

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ENCYCLOPEDIC DICTIONARY OF FINANCE

EDITED BY

DEAN PAXSON and
DOUGLAS WOOD

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Preface

Although the basic purposes of finance, and the nature of the core instruments used in attaining them, are relatively constant, recent years have seen an explosion in complexity of both products and techniques.

A number of forces are driving this explosion. The first is internationalization encompassing a dramatic growth in the number of countries with stock markets, convertible currencies and a positive regime for foreign investors. For a number of years the more adventurous institutional and private investors have been increasing the proportion of their investments in foreign markets in general and emerging markets in particular in search of growth, higher returns and better diversification. Reflecting this, finance has begun the long process of overhauling the traditionally domestic measurement of risk and return. In the new world order in which the next generation is likely to see an unprecedented transfer of economic power and influence from slow growing developed economies to the high growth tigers in Asia and the Pacific Rim, the ability of financial markets to recognize and accommodate the changes will be a priority.

The second change has come from dramatic falls in the costs of both information and transaction processing. More information is available and it is available more quickly in more places. Improved databases allow sophisticated analysis that would have been impossible a few years ago and data intensive artificial intelligence techniques allow a much richer array of market structures to be considered. The switch to electronic systems of transactions and trading has dramatically lowered costs, allowing increased arbitrage and stimulating the widespread use of complex new derivative products and products offering potentially an infinity of combinations of underlying products. It is no exaggeration to claim that these new techniques and instruments can be used to provide a proxy for any underlying traded instrument.

This power is increasingly used in the marketplace to provide the financial community with new choices, including performance guarantees and indexed products. The development of traded instruments provides an ability to pinpoint exposures precisely and this has lead to a new science of risk management, where the net exposures of a portfolio of risky assets such as securities or bank loans can be estimated and, where required, selectively or completely hedged by buying opposite exposures in the marketplace. Not surprisingly, this encyclopedic dictionary reflects these new techniques which are inexorably creating a world in which financial assets are priced in a seamless global marketplace.

New technology has helped in selecting entries for the dictionary. A word count of titles in finance and business journals was used to identify the frequency with which particular terms appeared and this was used as a primary guide to the priority and length of entries. To accommodate new topics such as real options that are only just emerging into the literature, we also included some entries where interest was growing rapidly towards the end of the search period.

In compiling the dictionary we have been privileged in the support we have received from a wide range of distinguished contributors who have taken the time from a busy programme of research and publication to summarize the often voluminous literature in their specialist areas into an accessible form. Inevitably the technical content of some of the entries reflects the rocket science development in the areas covered, but all entries provide an initial definition and bibliographic references for the less expert.

Finally, we would like to thank Joanne Simpson and Catherine Dowie for their support for this project. The demands of monitoring and recording the progress of contributions as they passed from commissioning through each stage of the editing process to final completion provided an essential foundation to the project.

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A

Agency Theory

When human interaction is viewed through the lens of the economist, it is presupposed that all individuals act in accordance with their self-interest. Moreover, individuals are assumed to be cognizant of the self-interest motivations of others and can form unbiased expectations about how these motivations will guide their behavior. Conflicts of interest naturally arise. These conflicts are apparent when two individuals form an agency relationship, i.e. one individual (principal) engages another individual (agent) to perform some service on his/her behalf. A fundamental feature of this contract is the delegation of some decision-making authority to the agent. Agency theory is an economic framework employed to analyze these contracting relationships. Jensen and Meckling (1976) present the first unified treatment of agency theory.

Unless incentives are provided to do otherwise or unless they are constrained in some other manner, agents will take actions that are in their self-interest. These actions are not necessarily consistent with the principal's interests. Accordingly, a principal will expend resources in two ways to limit the agent's diverging behavior: (1) structure the contract so as to give the agent appropriate incentives to take actions that are consistent with the principal's interests and (2) monitor the agent's behavior over the contract's life. Conversely, agents may also find it optimal to expend resources to guarantee they will not take actions detrimental to the principal's interests (i.e. bonding costs). These expenditures by principal and/or agent may be pecuniary/non-pecuniary and are the costs of the agency relationship.

Given costly contracting, it is infeasible to structure a contract so that the interests of both the principal and agent are perfectly aligned. Both parties incur monitoring costs and bonding costs up to the point where the marginal benefits equal the marginal costs. Even so, there will be some divergence between the agent's actions and the principal's interests. The reduction in the principal's welfare arising from this divergence is an additional cost of an agency relationship (i.e. "residual loss"). Therefore, Jensen and Meckling (1976) define agency costs as the sum of: (1) the principal's monitoring expenditures; (2) the agent's bonding expenditures; and (3) the residual loss.

Barnea et al. (1985) divide agency theory into two parts according to the type of contractual relationship examined – the economic theory of agency and the financial theory of agency. The economic theory of agency examines the relationship between a single principal who provides capital and an agent (manager) whose efforts are required to produce some good or service. The principal receives a claim on the firm's end-of-period value. Agents are compensated for their efforts by a dollar wage, a claim on the end-of-period firm value, or some combination of the two.

Two significant agency problems arise from this relationship. First, agents will not put forward their best efforts unless provided the proper incentives to do so (i.e. the incentive problem). Second, both the principal and agent share in the end-of-period firm value and since this value is unknown at the time the contract is negotiated, there is a risk sharing between the two parties (i.e. the risk-sharing problem). For example, a contract that provides a constant dollar compensation for the agent (principal) implies that all the risk is borne by the principal (agent).

Contracts that simultaneously solve the incentive problem and the risk-sharing problem are referred to as "first-best." First-best contracts provide agents with incentives to expend an optimal amount of effort while producing an optimal distribution of risk between principal and agent. A vast literature examines these issues (see e.g. Ross, 1973; Shavell, 1979; Holmstrom, 1979).

The financial theory of agency examines contractual relationships that arise in financial markets. Three classic agency problems are examined in the finance literature: (1) partial ownership of the firm by an owner-manager; (2) debt financing with limited liability; and (3) information asymmetry. A corporation is considered to be a nexus for a set of contracting relationships (Jensen and Meckling, 1976). Not surprisingly, conflicts arise among the various contracting parties (manager, shareholder, bondholders, etc.).

When the firm manager does not own 100 percent of the equity, conflicts may develop between managers and shareholders. Managers make decisions that maximize their own utility. Consequently, a partial owner-manager's decisions may differ from those of a manager who owns 100 percent of the equity. For example, Jensen (1986) argues that there are agency costs associated with free cash flow. Free cash flow is discretionary cash available to managers in excess of funds required to invest in all positive net present value projects. If there are funds remaining after investing in all positive net present value projects, managers have incentives to misuse free cash flow by investing in projects that will increase their own utility at the expense of shareholders (see Mann and Sicherman, 1991).

Conflicts also arise between stockholders and bondholders when debt financing is combined with limited liability. For example, using an analogy between a call option and equity in a levered firm (Black and Scholes, 1973; Galai and Masulis, 1976), one can argue that increasing the variance of the return on the firm's assets will increase equity value (due to the call option feature) and reduce debt value (by increasing the default probability). Simply put, high variance capital investment projects increase shareholder wealth through expropriation from the bondholders. Obviously, bondholders are cognizant of these incentives and place restrictions on shareholder behavior (e.g. debt covenants).

The asymmetric information problem manifests itself when a firm's management seeks to finance an investment project by selling securities (Myers and Majluf, 1984). Managers may possess some private information about the firm's investment project that cannot be credibly conveyed (without cost) to the market due to a moral hazard problem. A firm's securities will command a lower price than if all participants possessed the same information. The information asymmetry can be resolved in principle with various signaling mechanisms. Ross (1977) demonstrates how a manager compensated by a known incentive schedule can use the firm's financial structure to convey private information to the market.

Bibliography

Barnea, A., Haugen, R. & Senbet, L. (1985). *Agency problems and financial contracting.* Englewood Cliffs, NJ: Prentice Hall.

Black, F. & Scholes, M. (1973). The pricing of options and corporate liabilities. *Journal of Political Economy,* **81,** 637–54.

Galai, D. & Masulis, R. (1976). The option pricing model and the risk factor of stock. *Journal of Financial Economics,* 3, 53–82.

Holmstrom, B. (1979). Moral hazard and observability. *Bell Journal of Economics,* **10,** 74–91.

Jensen, M. (1986). Agency costs of free cash flow. *American Economic Review,* **76,** 323–29.

Jensen, M. & Meckling, W. (1976). Theory of the firm: managerial behavior, agency costs, and ownership structure. *Journal of Financial Economics,* **3,** 306–60.

Mann, S. & Sicherman, N. (1991). The agency costs of free cash flow: acquisition activity and equity issues. *Journal of Business,* **64,** 213–27.

Myers, S. & Majluf, M. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics,* **13,** 187–221.

Ross, S. (1973). The economic theory of agency: the principal's problem. *American Economic Review,* **62,** 134–39.

Ross, S. (1977). The determination of financial structure: the incentive signalling approach. *Bell Journal of Economics,* **8,** 23–40.

Shavell, S. (1979). Risk-sharing and incentives in the principal–agent relationship. *Bell Journal of Economics,* **10,** 55–73.

--------------------STEVEN V. MANN

Artificial Neural Networks

Artificial neural networks (ANNs) are learning algorithms in the form of computer programs or hardware. ANNs are characterized by an architecture and a method of training. Network architecture refers to the way processing elements are connected and the direction of the signals exchanged. A processing element or unit is a node where input signals converge and are transformed to outputs via transfer or activation functions. The values of outputs are usually multiplied by weights before they reach another node. The purpose of training is to find optimal values of these weights according to a criterion. In supervised training, inputs are presented to the network and outputs are compared to the desired or target outputs. Weights are then adjusted to minimize an objective function such as the root mean square error for instance. In unsupervised training, the network itself finds its own optimal parameters.

Although there are several types of neural networks, a simple example of ANN is the multilayer perceptron. The middle sets of units are called hidden layers and the other two input and output layers. The transfer functions in the input and output layers can be identities, and those of the hidden layer are usually sigmoid or hyperbolic tangent functions. These functions map the sum of weighted inputs to the range between zero and one or between minus one and plus one. The flow of signals in the example is unidirectional giving the name feedforward to the whole network. One can have also the output from the network and connect it to the inputs thus leading to recurrent networks which are useful for time series modeling. Typically, the hidden layers contain several processing elements. Obviously the outputs are modeled as highly non-linear functions of the original inputs. Thus, it is the architecture of units that allow an ANN to be a universal approximator. In other words an ANN can recover an unknown mapping from the input to the output space as long as it contains enough processing elements (White et al., 1992). The network can be trained with backpropagation (Rumelhart and McClelland, 1986), which seeks a minimum in the error function via the gradient descent method. Weights are adjusted in the direction that reduces the value of the error function after each presentation of the input records.

ANNs sometimes share the problem of local minima and the problem of overtraining. Because of the non-linearity involved, the algorithm may not always reach a global minimum. Overtraining refers to the situation where the network literally memorizes the inputs and cannot generalize (predict well) when it is applied to a new set of data. However, there are ways to overcome these problems and ANNs are very useful. In fact on many occasions they are superior to linear models in terms of prediction accuracy. A correctly trained network should be able to generalize, that is, to recognize patterns in data it has not yet seen. Although statistical measures such as *t*-ratios are not available, one can perform sensitivity analysis. This consists of varying one input within a reasonable range and observing how the estimated output function behaves.

Neural networks have been successfully applied in finance and economics, although research in this area is still new. Examples include forecasting security prices, rating bonds, predicting failure of banks or corporate mergers, and conducting portfolio management (Refenes, 1995). Although statistical models and ANNs overlap considerably, the two sets of models are not identical. White (1989) and Kuan and White (1992) discuss the parallels between statistical or econometric models and feedforward networks. Cheng and Titterington (1994) study ANNs from a statistical perspective, and Ripley (1994) compares standard classification techniques with ANNs. Classification is an area in which neural networks have been useful because they are often capable of sharply discriminating between classes of inputs with different characteristics. The general literature on ANNs is extensive. Hecht-Nielsen (1990) and Wasserman (1993) are two introductory books. The Internet news group comp.ai.neural_nets is an informative forum for exploring this growing field.

Bibliography

Cheng, B. & Titterington, D. (1994). Neural networks: a review from a statistical perspective. *Statistical Science,* **9,** 2–54.

Hecht-Nielsen, R. (1990). *Neurocomputing.* Reading, MA: Addison-Wesley.

Kuan, C. & White, H. (1992). Artificial neural networks: an econometric perspective. *Econometric Reviews,* **13,** 1–91.

Refenes, A. (1995) (Ed.) *Neural networks in the capital markets.* New York: John Wiley.

Ripley, B. (1994). Neural networks and related methods for classification. *Journal of the Royal Statistical Society,* **56,** 409–56.

Rumelhart, E. & McClelland, J. (1986). *Parallel distributed processing: Explorations in the microstructure of cognition.* Cambridge, MA: MIT Press.
Wasserman, P. (1993). *Advanced methods in neural computing.* New York: Van Nostrand Reinhold.

White, A., Gallant, A. R., Hornik, K., Stinchcombe, M. & Wooldridge, J. (1992). *Artificial neural networks: Approximation and learning theory.* Cambridge, MA.: Blackwell.

White, H. (1989). Learning in artificial neural networks: a statistical perspective. *Neural Computation* **1,** 425–64.

-------------------------------ATHANASIOS EPISCOPOS

Asset Allocation

In the analysis of portfolio management, the initial work of Markowitz (1959) was directed towards finding the optimal weights in a portfolio. It was quickly realized that the decisions involved in building up a portfolio were less frequent than the decisions to modify existing portfolios. This is especially important when analyzing how profitable portfolio managers have been over time. If, for example, a portfolio consists of equities and bonds, some investment managers might be particularly skilled in choosing specific companies in which the portfolio should invest, while others might be able to forecast at which times the portfolio should be more heavily invested in shares. The first type of skill would be classified as being more concerned with portfolio selection while the latter would be described as connected with timing or asset allocation.

Asset allocation decisions can be further divided. Investors can decide on an *ad hoc* basis to alter their portfolio by changing the weights of the constituent assets as a result of some specific model. For example, forecasting models are used to predict the performance of equities relative to bonds or real estate relative to equities. Dependent on the outcome of these forecasts, the investor will switch into or out of the asset being forecasted. Models are used to derive frequent forecasts of one asset against another and to move the portfolio day by day depending on the outcome of the forecasting model. This type of model is sometimes referred to as tactical asset allocation (TAA) and in practice is used in conjunction with some sophisticated trading in derivatives such as options or futures. Instead of buying more shares, this system buys options or futures in an index representing equities. If equities rise in value, so will the options and futures position and the portfolio thereby will increase in value to a greater extent than underlying equities. TAA is used to adjust portfolio exposure to various factors such as interest rates and currency movements as well as overseas investments (see Arnott et al., 1989).

An alternative category of asset allocation is the technique of dynamic asset allocation, where there is less emphasis on forecasting which component assets will perform well in the next period and more on setting up a policy by which the portfolio reacts automatically to market movements. This can be organized with the help of options and futures but can also be carried out by adjusting the weights of the component assets in the light of predetermined rules. For example, the policy of buying an asset when that asset has performed well in the current period and selling when it has done badly can be carried out in such a way as to provide portfolio insurance, i.e. it protects the portfolio by reducing the exposure to successive falls in the value of one of its constituent assets. An alternative dynamic asset allocation policy is that carried out by rebalancing so as to maintain a reasonably constant proportion in each asset. This involves selling those assets which have just risen in value and selling those assets which have just fallen in value. The two strategies are profitable in different phases of the market. When the market is moving strongly, the insurance policy is most successful. If, however, the market is tending to oscillate without a strong trend, the rebalancing policy works best. These principles are well illustrated in Perold and Sharpe (1988).

Bibliography

Arnott, R. D., Kelso, C. M., Kiscadden, S. & Macedo, R. (1989). Forecasting factor returns: an intriguing possibility. *Journal of Portfolio Management,* **16,** 28–35.

Markowitz, H. (1959). *Portfolio selection: Efficient diversification of investments.* New York: John Wiley and Sons.

Perold, A. & Sharpe, W. F. (1988). Dynamic strategies for asset allocation. *Financial Analysts Journal,* **44,** 16–27.

Sharpe, W. F. (1992). Asset allocation: management style and performance measurement. *Journal of Portfolio Management,* **18,** 7–19.

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Asset Pricing

The modern theory of asset prices has its foundations in the portfolio selection theory initiated by Markowitz (1952). In a one-period framework Markowitz assumed that agents' utilities, and hence the price they will pay, depend only on the means and variances of returns. This mean-variance model can be justified either on the grounds of quadratic utility (for arbitrary distributions of the asset returns) or on the grounds of multivariate normal (or, more generally, elliptic) distribution of asset returns (for arbitrary preferences). Although quadratic utility has the unappealing properties of satiation and increasing absolute risk aversion in the sense of Arrow–Pratt and multivariate normality violates the limited liability properties of assets, the mean-variance model has had a pervasive influence on financial economics.

The portfolio frontier obtained within the mean-variance framework can be generated by any two frontier portfolios, a property called two-fund separation. Lintner (1965), Sharpe (1964), and Mossin (1966) combined the two-fund separation with the assumptions that agents have homogeneous beliefs, that markets clear in equilibrium, and that there is unlimited lending and borrowing at the riskless rate. The resulting model, the capital asset pricing model (CAPM), has been the major framework of thinking about the trade-off between risk and return. The (unconditional) CAPM states that the excess return on each asset (return less the risk-free rate) is proportional to the asset's market beta:

$$E(R_i - R_f) = \beta_{im} E(R_m - R_f)$$

where R_m is the return on the market portfolio and $\beta_{im} = \mathrm{cov}(R_i, R_m)/\mathrm{var}(R_m)$, the asset's market beta, measures the covariance of the asset's return with the market return. Black (1972) derived the CAPM for an economy without a riskless asset (the zero-beta CAPM).

The CAPM has been extensively tested. Black et al. (1972) and Fama and MacBeth (1973) originated the two frameworks in which most of the tests were done. However, the unsatisfactory empirical performance of the CAPM, as well as the problems identified by Roll (1977) related to the unobserved nature of the market portfolio, are the reasons why the single-period, single-beta relation had to be relaxed. Historically, the first direction was to place the individual decision making in an intertemporal set-up in which agents maximized utility, thus leading to the intertemporal CAPM (ICAPM) of Merton (1973). The other is the arbitrage pricing theory (APT) of Ross (1976).

Merton, working in continuous time under the assumptions of many identical agents with homogeneous expectations and market clearing, derived the ICAPM. The asset prices in Merton's model follow a diffusion process. If the investment opportunity set, namely the drift and diffusion parameters, and the instantaneous correlations between the returns of the different assets, do not change over time, then a continuous time version of the static CAPM holds: one obtains a single-beta security–market-line relationship. If the investment opportunity set is stochastic, however, a multi-beta relationship emerges:

$$\begin{aligned} E(R_i - R_f) = {} & \beta_{im} E(R_m - R_f) \\ & + \sum \beta_{is} E(R_s - R_f) \end{aligned}$$

where β_{is} measures the covariance of the return of the ith asset with the sth state variable. Thus, with a stochastically changing investment opportunities set agents need to hedge the future changes in their consumption for a given level of wealth. Given the interpretation of the S state variables as portfolios, the S portfolios are often referred to as hedge portfolios.

To derive the arbitrage pricing theory (APT) Ross (1976) assumes that asset returns are generated by a linear factor model:

$$R_i = E(R_i) + \sum \beta_{ik} f_k + \varepsilon_i$$

where each factor f_k (without loss of generality) and the error ε_i are zero-mean. In well-diversified portfolios the excess expected return on each asset will be given by a linear combination of the βs above:

$$E(R_i) = R_f + \sum \beta_{ik} \lambda_k$$

where the β's are referred to as factor loadings while the λ's are the risk premiums.

Huberman (1982) offers an alternative derivation of the APT. Connor (1984) was the first to use equilibrium arguments in relation to the APT. Connor and Korajczyk (1986, 1988) extend his arguments. Dybvig and Ross (1983) and Ingersoll (1984) contain useful extensions and refinements of the APT.

There has been substantial empirical work on the APT. Roll and Ross (1980) use factor analysis to test the APT while Connor and Korajczyk (1988) use "asymptotic" principal components analysis to uncover the factors. On the other hand, Chen et al. (1986) explicitly specify five macroeconomic variables (unexpected change in the term structure, unexpected change in the risk premium, change in expected inflation, the unexpected inflation rate, and the unexpected change in industrial production) that proxy for the economy–wide factors. Shanken (1982, 1985) questions the possibility of testing the APT; Dybvig and Ross (1983) present the counter-argument.

The works of Ross (1976), Cox and Ross (1976), Harrison and Kreps (1979), and Ross (1978) contain what has come to be known as the fundamental theorem of asset pricing: the absence of arbitrage is equivalent to the existence of a positive linear pricing rule and still further equivalent to the existence of an optimal demand for some agent with increasing preferences.

From this theorem it follows that the absence of arbitrage implies the existence of a strictly positive stochastic process called a stochastic discount factor μ_t such that:

$$1 = E_t(\mu_{t+1} R_{i,t+1})$$

For the CAPM (an equilibrium model):

$$\mu_t = \frac{1}{R_f} + \frac{E_t(R_m - R_f)}{\operatorname{var}(R_m)} \cdot \frac{E(R_m) - R_m}{R_f}$$

while for the consumption CAPM (CCAPM) $\mu_t = U'(C_{t+1})/U'(C_t)$. The theoretical work on both the ICAPM and APT preceded much of the empirical work which found that price–earnings ratios (Basu, 1977), dividend yields (Fama and French, 1988), and size (Banz, 1981; Reiganum, 1981; Schwert, 1983; Chan et al., 1985) improve the fit of the single-beta CAPM. Some of these papers, together with the weekend effect (French, 1980) and the January effect (Keim, 1983) have been interpreted as evidence of market inefficiency. However, as Fama (1970) has noted, a test of market efficiency, being performed within the framework of a specific model, is a test of that particular model as well. Much research has been done on whether any of these statistics are proxies for others. Reiganum (1981) has shown that the price–earnings effect disappears when controlling for size. Recently, Fama and French (1992, 1993) have shown that size and book-to-market equity (portfolios proxying for factors related to size and book-to-market equity) have high explanatory power for the cross-section (variance) of expected returns.

Considerable work has also been done on testing the conditional CAPM (Sharpe, 1964; Constantinides, 1982). Keim and Stambaugh (1986), among others, have shown that in a CAPM context the risk premium is time varying. Harvey (1989) and Ferson and Harvey (1991) show that the betas are also time varying. These authors have argued that failing to recognize the time variability may lead to a premature rejection of the model.

Historically, the difficulties in identifying the relevant state variables to be used in Merton's ICAPM have led Breeden (1979) to reduce the multi-beta model to a single-beta, CCAPM model:

$$E(R_i - R_f) = \beta_{ic} E(R_c - R_f)$$

where R_c is the return on a security which is perfectly correlated with aggregate consumption and $\beta_{ic} = \operatorname{cov}(R_i, d \ln C)/\operatorname{var}(d \ln C)$.

Lucas (1978) independently derives this asset pricing model in discrete time for a pure exchange economy in which aggregate consumption equals the aggregate dividend in equilibrium. For that model the price of asset *i* is a properly discounted sum of next period's payoff:

$$P_{it} = E_t\left[\frac{U'(C_{t+1})}{U'(C_t)}(P_{i,t+1} + D_{i,t+1})\right]$$

where the representative consumer is assumed to maximize a time- and state-separable utility function with periodic utility $U(C_t)$. Cox et al. (1985a, 1985b) present a full-fledged general equilibrium model (with production) in continuous time along these lines and apply it to a study of the term structure of interest rates. Brock (1982) also derives asset prices in a production economy.

The consumption-based CAPM has not been very successful empirically. The Euler equations have been rejected by Grossman and Shiller (1981), Hansen and Singleton (1982), and Grossman et al. (1987). Moreover, the simple separable utility representative agent model gives rise to various asset pricing puzzles such as the equity premium puzzle of Mehra and Prescott (1985) and the risk-free rate puzzle of Weil (1989).

Recent work on the consumption-based asset pricing model has focused on the calibration of preferences and investment opportunities to include various market frictions (borrowing and short-sales constraints, transactions costs (Bewley, 1992; Heaton and Lucas, 1992)), time non-separable preferences (Constantinides, 1982), recursive preferences allowing for a partial separation between the coefficient of relative risk aversion and the coefficient of intertemporal substitution (Epstein and Zin, 1989, 1991) and various forms of agent heterogeneity (following the work of Constantinides, 1982; Mankiw, 1986; Heaton and Lucas, 1992; Telmer, 1993).

Bibliography

Banz, R. (1981). The relationship between return and market value of common stocks. *Journal of Financial Economics,* **9,** 3–18.
Basu, S. (1977). Investment performance of common stocks in relation to their price–earnings ratios: a test of the efficient market hypothesis. *Journal of Finance,* **3,** 663–82.

Bewley, T. (1992). Some thoughts on the testing of the intertemporal asset pricing model. Manuscript, Cowles Foundation, Yale University.

Black, F. (1972). Capital market equilibrium with restricted borrowing. *Journal of Business,* **45,** 444–55.

Black, F., Jensen, M. & Scholes, M. (1972). The capital asset pricing model: some empirical tests. *Studies in the theory of capital markets.* (Ed.) Jensen, Michael, New York: Praeger, 79–121.

Breeden, D. (1979). An intertemporal asset pricing model with stochastic consumption and investment opportunities. *Journal of Financial Economics,* **7,** 265–96.

Brock, W. (1982). Asset prices in a production economy. *The economics of information and uncertainty.* (Ed.) McCall, J. Chicago, IL: University of Chicago Press.

Chan, K. C., Chen, N. & Hsieh, D. (1985). An exploratory investigation of the firm size effect. *Journal of Financial Economics,* **14,** 451–71.

Chen, N., Roll, R. & Ross, S. (1986). Economic forces and the stock market. *Journal of Business,* **59,** 383–403.

Connor, G. (1984). A unified beta pricing theory. *Journal of Economic Theory,* **34,** 13–31.

Connor, G. & Korajczyk, R. (1986). Performance measurement with the arbitrage pricing theory. *Journal of Financial Economics,* **15,** 373–94.

Connor, G. & Korajczyk, R. (1988). Risk and return in an equilibrium APT. *Journal of Financial Economics,* **21,** 255–89.

Constantinides, G. (1982). Intertemporal asset pricing with heterogeneous agents and without demand aggregation. *Journal of Business,* **55,** 253–67.

Cox, J., Ingersoll, J. & Ross, S. (1985a). An intertemporal general equilibrium model of asset prices. *Econometrica,* **53,** 363–84.

Cox, J., Ingersoll, J. & Ross, S. (1985b). A theory of the term structure of interest rates. *Econometrica,* **53,** 385–407.

Cox, J. & Ross, S. (1976). The valuation of options for alternative stochastic processes. *Journal of Financial Economics,* **3,** 145–66.

Dybvig, P. & Ross, S. (1983). Yes, the APT is testable. *Journal of Financial Economics,* **40,** 1173–88.

Epstein, L. & Zin, S. (1989). Substitution, risk aversion, and the temporal behavior of consumption and asset returns: a theoretical framework. *Econometrica,* **57,** 937–69.

Welch, I. (1989). Seasoned offerings imitation costs and the underpricing of initial public offerings. *Journal of Finance,* **44,** 421–50.

--------------------------------A. TOURANI RAD

Investment Banking

The earliest known banks, temples, operated as repositories of concentrated wealth. They were among the first places where a need for money and money-changers emerged. The word bank traces to the French word *banque* (chest) and the Italian word *banca* (bench). These early meanings capture the two basic functions that banks perform: (1) the safe-keeping or risk-control function (chest); and (2) the transactions function including intermediation and trading (bench). Taking investment to mean the outlay of money for income or profit, an investment bank functions as a safekeeper, risk manager, trader, and intermediary with respect to the outlay of money for income or profit.

Although modern investment banks (also called securities firms) engage in numerous financial activities, especially in a world characterized by globalization, securitization, and financial engineering, two activities represent the heart of investment banking: bringing new securities issues (debt and equity) to market; and making secondary markets for these securities. The first activity captures the underwriting function while the second reflects the broker/dealer function. As brokers, investment banks bring parties together to trade securities while, as dealers, they trade from their own inventory.

To understand the full range of financial services provided by investment banks, consider the six basic functions performed by a financial system: clearing and settling payments, pooling or subdividing resources, transferring wealth, managing risk, providing price information, and dealing with incentive problems. Since investment banks are a major component of financial systems in developed countries, they play a prominent role in performing most of these functions. In the United States because of the separation of commercial and investment banking (Glass–Steagall Act of 1933), investment banks perform all of these functions except clearing and settling payments, a task performed mainly by commercial banks in the USA. In contrast, in Germany and Japan where such artificial barriers between investment and commercial banking do not exist, the activities of commercial and investment banks are commingled, and interwoven with the activities of non-financial firms.

In Japan, banks own shares in businesses, which also own shares in the banks. Although cross-holdings tend to be nominal, the practical effect links dissimilar companies together for mutual support and protection. These cross-shareholding groups, called *keiretsu,* provide a unique approach to corporate control based on continuous surveillance and monitoring by the managers of affiliated firms and banks.

The German model links universal banks and industrial companies through the *Hausbank* approach to providing financial services (i.e. reliance on only one principal bank). In addition, incentive compatibilities and monitoring are accomplished by bank ownership of equity shares, bank voting rights over fiduciary (trust) shareholdings, and bank participation on supervisory boards. The *Hausbank* relationship results in companies accessing both capital-market services (e.g. new issues of stocks and bonds) and bank-credit facilities through their "universal bank." By providing all of the financing needed to start a business (e.g. seed capital, initial public offerings of stock, bond underwritings, and working capital), German banks gain *Hausbank* standing. On balance, in the German model, bank–industry linkages involve strong surveillance and monitoring by banks and the potential for a high degree of control in maximizing shareholder value as banks have an equity stake and fiduciary obligations with respect to depository shares.

The investment banking industry in the USA has three tiers: large, full-line firms that cater to both retail and corporate clients; national and international firms that concentrate mainly on corporate finance and trading activities; and the rest of the industry (e.g. specialized and regional securities firms and discount brokers). Examples of key players in the top two tiers are Merrill Lynch in the top tier and Goldman Sachs, Salomon Brothers, and Morgan Stanley in the second tier. In addition, due to the piecemeal dismantling of Glass–Steagall, major US commercial banks such as BankAmerica, Bankers Trust, Chase Manhattan, Chemical, Citicorp, and J. P. Morgan (listed alphabetically) are important global players as investment banks, especially in derivatives activities.

Although the primary regulator of the securities industry in the USA is the Securities and Exchange Commission (SEC, established in 1934), the New York Stock Exchange (NYSE) and National Association of Securities Dealers (NASD) provide self-regulation and monitoring of day-to-day trading practices and activities. Two important SEC rules governing underwriting activities are Rule 415 and Rule 144A. Rule 415 ("shelf registration") permits large issuers to register new issues with the SEC up to two years in advance, and then "pull them off the shelf" (i.e. issue them) when market conditions are most favorable. Rule 144A establishes boundaries between public offerings and private placements of securities. In a public offering, securities are offered to the public at large; in a private placement, securities are "placed" with one or more institutional investors.

Since investment banking can be defined by what investment banks or securities firms do, let us look at the major functions they perform. Investment banks underwrite and distribute new issues of debt and equity. When firms issue securities for the first time, this is called an initial public offering or IPO. How IPOs are priced is an important research question in empirical finance. Securities may be underwritten either on a best-efforts basis, where the investment banker acts as an agent and receives a fee related to the successful placement of the issue, or on a firm-commitment basis, where the investment bank buys the entire issue and resells it making a profit on the difference between the two prices or the bid–ask spread. A common practice in underwriting public offerings is to form a syndicate to ensure raising enough capital and to share the risk. Trading, market making, funds management (for mutual and pension funds), and providing financial and custodial services, are other functions performed by investment banks.

Financial innovation has been a substantial force in capital markets, and investment banks have played a leading role in this area (e.g. in the development of securitization and in the engineering of risk-management products called "derivatives"). First-mover or innovative investment banks tend to be characterized by lower costs of trading, underwriting, and marketing. Evidence (Tufano, 1989) suggests that compensation for developing new products centers on gaining market share and maintaining reputational capital as opposed to "monopoly pricing" before imitative products appear.

Bibliography

Bloch, E. (1986). *Inside investment banking.* Homewood, IL: Dow Jones-Irwin.

Hayes, S. L., III & Hubbard, Philip M. (1990). *Investment banking: A tale of three cities.* Boston, MA: Harvard Business School Press.

Marshall, J. F. & Ellis, M. E. (1994). *Investment banking and brokerage: The new rules of the game.* Chicago, IL: Probus Publishing Company.

Tufano, P. (1989). Financial innovation and first-mover advantages. *Journal of Financial Economics,* **25,** 213–40.

-----------------------------JOSEPH F. SINKEY, JR.

Iowa Electronic Market

The Iowa Electronic Market (IEM) is a real-money, computerized futures market operated as a not-for-profit teaching and research tool by the University of Iowa College of Business Administration. As a teaching tool, the IEM provides students with hands-on, real-time experience in a fully functional financial market. As a research tool, the IEM serves as a laboratory, providing a unique source of data for studying financial markets.

Market Operation

The IEM operates as a continuous electronic double auction with queues. Trading takes place over the Internet and is open to participants worldwide. Registered traders can issue limit orders to buy or sell, or market orders to trade at the best available prices. Outstanding bids and asks are maintained in price- and time-ordered queues, which function as continuous electronic limit order books. Traders invest their own money in the IEM, bearing the risk of loss and profiting from gains.

The futures contracts traded on the IEM have liquidation values tied to the outcomes of future political and economic events such as elections, legislation, economic indicators, corporate earnings announcements and realized stock price returns. For instance, the 1992 Presidential Election Vote-Share Market traded contracts in "November Clinton" that paid off US$1 times the Clinton share of the two-party vote in the 1992 election. Because these are real futures contracts, the IEM is under the regulatory purview of the Commodity Futures Trading Commission (CFTC). The CFTC has issued a "no-action" letter to the IEM stating that as long as the IEM conforms to certain restrictions (related to limiting risk and conflict of interest), the CFTC will take no action against it. Under this no-action letter, IEM does not file reports that are required by regulation and therefore it is not formally regulated by, nor are its operators registered with, the CFTC.

Contracts are placed in circulation via "unit portfolios." A unit portfolio is a set of contracts with liquidation values that will sum to US$1. The IEM stands ready to buy or sell any unit portfolio at any time for US$1. After purchasing unit portfolios, traders "unbundle" them and trade individual contracts in the market. If held to liquidation, individual contracts receive liquidating payments according to the rules established in the market prospectuses.

The IEM as a Teaching Tool

The IEM serves as a real-time interactive laboratory in which students learn the language of markets and study the events on which the markets are based. It has been integrated into accounting, economics, finance and political science classes at more than thirty colleges and universities. The economic stake that students have in the market provides a powerful incentive for learning how markets work and focusing attention on the economic and political events that drive market prices. In this social science laboratory, students learn first hand about the operation of markets, how public information is assimilated in market prices, market efficiency, arbitrage, and the concepts and problems underlying the measurement of economic events. Because students trade based on their own analysis of market factors, they are better able to understand these factors and how market prices impound information about them.

The IEM as a Research Tool

The IEM combines the features of larger organized futures and securities markets with the experimental control found in laboratory markets. Traders put their own funds at risk and real economic events drive market outcomes. Yet the market structure is simple and controlled, contracts and their payoffs are well specified and actions are time stamped and identified by trader. On-line trader surveys also allow collection of additional individual-trader-level data. Since the markets are relatively short lived, a variety of market structure variables can be controlled and manipulated across markets.

The data from these markets have been used to investigate several research issues. The first, and most obvious, is the ability of the IEM to predict a decidedly non-market event such as an election. Like most futures markets, the ability of the IEM to correctly incorporate information about future events can be tested directly since there is an observable event that ultimately defines the true value of a contract. In contrast to typical futures markets, achieving this informational efficiency is presumably more difficult since there is no underlying, market-traded asset and, hence, there are no arbitrage conditions that drive the futures and spot prices together. Forsythe et al. (1992) undertook the first of several studies to examine this issue using the data from one market on one election. Using the data from a 1988 US presidential election market designed to predict candidates' vote shares, they examined both the ability of a market to predict an election outcome in an absolute sense as well as relative to public opinion polls. They conclude that the market is efficient in both senses; the IEM's error in predicting Bush's actual winning margin was 0.26 percent, while the average poll error was 2.69 percent.

As additional markets have been conducted, studies have begun to examine cross-market comparisons of the IEM's predictive accuracy. Using the data from twelve vote-share markets from seven countries, Forsythe et al. (1993) look at IEM's performance relative to election eve public opinion polls, and find that the IEM's forecast outperformed the polls in nine of the twelve comparisons. Berg et al. (1996) provide a detailed examination of the data from sixteen US vote-share election markets to study factors that influence the IEM's predictive ability.

The average absolute prediction errors for these markets range from 0.06 percent to 8.60 percent. Most of the variance in these errors can be explained by market volume, the number of contract types traded and the level of market imbalance (as measured by absolute differences in election eve weighted bid and ask queues).

A second stream of research examines individual trading behavior. Analyzing the data from the 1988 presidential election market, Forsythe et al. (1992) use trader-level response data to examine how traders' judgments and preferences affect their trading behavior. They find that, on average, traders exhibit systematic trading biases; for instance, at any price the average trader's partisanship leads him to buy more contracts in the candidate he favors than the candidate he does not. Nevertheless, the market predicts quite well due to the presence of bias-free marginal traders (traders who regularly submit orders at or near the market). Thus, while an examination of individual trader behavior would lead one to conclude that, on average, traders are biased, market prices do not necessarily reflect these biases. Market dynamics, along with a core of bias-free marginal traders, still lead to unbiased prices.

Oliven and Rietz (1995) provide additional evidence about the behavior of these "bias-free" marginal traders. They compare the "rationality" of price-taking traders (who accept market prices) to that of market-making traders (who set market prices). Using trader-specific data from the 1992 presidential election market to study no-arbitrage restrictions and individual rationality, they find large differences between these two types of traders. Violations of individual rationality are common among price takers (occurring in 38.3 percent of the orders they submit), while rare among market makers (7.8 percent). Since the 1992 market was one of the most efficient to date, this provides further evidence that market prices can be efficient even though individual traders act suboptimally.

Bibliography

Berg, J., Forsythe, R. & Rietz, T. (1996). What makes markets predict well? Evidence from the Iowa Electronic Markets. *Understanding strategic interaction: Essays in honor of Reinhard Selten.* (Ed.) Guth, W., Berlin: Springer-Verlag.

Forsythe, R., Nelson, F. & Neumann, G. (1993). The Iowa political markets. Mimeo. University of Iowa.

Forsythe, R., Nelson, F., Neumann, G. & Wright, J. (1992). The anatomy of an experimental political stock market. *American Economic Review,* **82,** 1142–61.

Oliven, K. & Rietz, T. (1995). Suckers are born but markets are made: individual rationality, arbitrage, and market efficiency on an electronic futures market. Working Paper. University of Iowa.

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L

Leasing

An agreement between two parties to rent an asset is a leasing arrangement. The owner of the leased asset, the lessor, receives a set of fixed payments for the term of the contract from the lessee. If the lease contains a provision that allows the lessee to cancel at any time or if the lessor is responsible for insurance and maintenance, then it is called an operating lease. Financial leases are long term, carry no cancelation options, and the lessee is responsible for all insurance and maintenance.

It has been pointed out in a number of studies (see Smith and Wakeman, 1985) that leasing would not exist in the absence of capital market imperfections like taxes, transaction costs, and agency costs. The demand for short-term leasing arrangements stems from the need to eliminate the transactions costs of buying and selling an asset (Flath, 1980). In the absence of transaction costs, Myers et al. (1976) show that lessee and lessor tax rates must differ for a leasing arrangement to be advantageous. A number of other firm and asset characteristics that increase the likelihood of leasing have also been identified (Smith and Wakeman, 1985). Empirical evidence suggests that the market value of both lessee and lessor stock rises upon announcements of new leasing arrangements (Slovin et al., 1990; Vora and Ezzell, 1991).

Sale and Leaseback

In a sale and leaseback, an asset is sold and simultaneously leased back by the seller. The rights to ownership are transferred to the buyer/lessor while the seller/lessee enjoys the rights to services provided by the asset. The financial effects of a sale and leaseback are: (1) the lessee gets an immediate inflow of cash equal to the selling price of the asset, while the lessor receives (2) a promise of a stream of fixed lease payments in the future; (3) the salvage value of the asset; and (4) the depreciation tax shields.

Although the sale and leaseback offers the same advantages to the lessee that an ordinary lease arrangement would, it has been suggested that the sale-and-leaseback can also be used as a device to expropriate wealth from the senior claimholders to the common stockholders of the lessee since it rearranges the priority of the claims against the lessee in favour of the lessor (Kim et al., 1978). The empirical evidence suggests that the market value of lessee common stockholders rises when a sale and leaseback is announced (Slovin et al., 1990 and 1991; Vora and Ezzell, 1991), the source of the gain does not seem to be wealth expropriation since the value of lessee preferred stock remains unchanged (Vora and Ezzell, 1991). In fact, as suggested in a number of studies (e.g. see Myers et al., 1976) savings in taxes seems to be the motivating factor behind such sale and lease-backs (Vora and Ezzell, 1991).

Net Advantage to Leasing (NAL)

This is the present value of the benefits that are provided by leasing an asset instead of purchasing it via other financing alternatives. If the NAL of a lease is positive, leasing is preferred over the purchase. In the absence of transaction costs, savings in taxes is considered to be the paramount benefit of leasing. It has been shown that a necessary condition for the NAL to be positive for both lessee and lessor, is that their tax brackets must differ (Myers et al., 1976; Miller and Upton, 1976; Lewellen et al., 1976). The intuition is that an organization that is non-tax-paying or even in a low tax bracket would be better off by transferring its depreciation and interest tax shields to a company that pays taxes at a higher tax rate. This can be easily accomplished by entering into a leasing arrangement (either for assets that are newly put into use or for existing assets – by entering into a sale and leaseback). In return for the tax shields, the lessee receives consideration in the form of lower lease payments relative to its outflows under other financing alternatives.

Bibliography

Flath, D. (1980). The economics of short-term leasing. *Economic Inquiry,* **18,** 247–59.

Kim, E. H., Lewellen, W. G. & McConnell, J. J. (1978). Sale-and-leaseback agreements and enterprise valuation. *Journal of Financial and Quantitative Analysis,* **13,** 871–83.

Lewellen, W. G., Long, M. S. & McConnell, J. J. (1976). Asset leasing in competitive capital markets. *Journal of Finance,* **31,** 787–98.

Miller, M. H. & Upton, C. W. (1976). Leasing, buying and the cost of capital services. *Journal of Finance,* **31,** 761–86.

Myers, S. C., Dill, D. A. & Bautista, A. J. (1976). Valuation of financial lease contracts. *Journal of Finance,* **31,** 799–819.

Slovin, M. B., Sushka, M. E. & Poloncheck, J. A. (1990). Corporate sale-and-leasebacks and shareholder wealth. *Journal of Finance,* **45,** 289–99.

Slovin, M. B., Sushka, M. E. & Poloncheck, J. A. (1991). Restructuring transactions by bank holding companies: the valuation effects of sale-and-lease-backs and divestitures. *Journal of Banking and Finance,* **15,** 237–55.

Smith, C. W. Jr. & Wakeman, L. M. (1985). Determinants of corporate leasing policy. *Journal of Finance,* **40,** 895–908.

Vora, P. P. & Ezzell, J. R. (1991). Leasing vs. purchasing: direct evidence on a corporation's motivations for leasing and consequences of leasing. Working paper, Penn State University.

------------------------------------PREMAL VORA

Log Exponential Option Models

Since Black and Scholes (1973) derived the first closed form equilibrium solution for European call options in a continuous time framework, the ability of the Black–Scholes option pricing model to estimate the market price of publicly traded options has been the topic of a number of studies. Based on the fact that the market value of a call option is a function of five variables – the price of the underlying asset, exercise price of the option, interest rate, time to expiration, and the volatility of the stock return – their model has been examined from different angles.

The Black–Scholes model has two properties that make it useful both theoretically and empirically. First, the popularity of the model is due to the fact that the option price does not explicitly depend on investors' preferences. This is the well-known risk-neutral valuation relationship (RNVR). Under a unique risk-neutral probability density, the value of an option at maturity depends on the value of the underlying asset. Thus, it is possible to calculate the expected value of the option before maturity based on the probability distribution of the terminal value of the underlying asset, i.e. the current value of the call is the discounted value of its expected value at expiration date.

Second, the Black–Scholes model has a form-invariance property. In the Black–Scholes case both the original and risk-neutral distributions are lognormal. Since the risk-neutral probability density function has the same functional form as the original density, this form-invariance property makes it possible to reduce one of the parameters of the underlying distribution which need to be estimated. In the Black–Scholes model this parameter is the mean associated with a normal probability density function.

When investors' preferences are assumed to be risk neutral such that all securities have the same expected rate of return, we say that the valuation relationship is risk neutral. This implies that while securities with different probability density functions may have different expected rates of returns, when the state-contingent pricing structure is substituted for a security's probability density function, all securities have the same expected rate of return if the valuation relationship is risk neutral. RNVR is used to describe the state-contingent valuation structure from which option pricing formulas are derived. Deriving a RNVR with restrictions on investor preferences in a discrete time framework is similar in spirit to showing that a riskless hedge can be constructed and maintained in a continuous time framework.

Rubinstein (1976) first develops a discrete-time option-pricing formula with bivariate lognormality of terminal-date wealth and asset price and a constant relative risk-averse (CRRA) preference. Surprisingly, the resulting option-pricing formula is identical to the Black–Scholes formula even though only costless discrete-time trading opportunities are available, so that a perfect hedge cannot be constructed. Brennan (1979) shows that the bivariate lognormality with a CRRA utility function and the bivariate normality with a constant absolute risk averse (CARA) utility function are necessary and sufficient to generate a RNVR. Stapleton and Subrahmanyam (1984) obtain similar results for the joint multiplicative binomial process and a CRRA class utility function, and the joint additive binomial process and a CARA class utility function.

Vankudre (1985) shows that Brennan's definition of a RNVR can be relaxed to allow a larger set of RNVRs. He derives simple option-pricing formulas for probability distributions of terminal-date wealth and asset price other than the lognormal or the normal under a relatively weaker condition than the conditions required in earlier papers. Madrigal and Smith (1995) provide necessary and sufficient conditions for the existence and uniqueness of a form invariant RNVR when markets are incomplete. They show that combinations of a CRRA utility function and log exponential distributions or a CARA utility function and linear exponential distributions will generate form-invariant, risk-neutral densities. In these cases option prices will depend on fewer parameters than those which determine the original probability density since the resulting form-invariant risk-neutral densities do not explicitly contain the parameters of the investors' utility function. This is very important because the utility parameters are not observable. Heston (1993) calls these parameters "invisible parameters" and provides an example with a combination of a CRRA class utility function and log-gamma distribution.

While the issue of which alternative assumptions fit the market data best is largely unresolved, Kim (1995) empirically tests the impact of underlying distribution assumptions on the option price using three forms of distributions which belong to the log exponential family: inverted gamma, gamma, and lognormal distributions. Interestingly, his findings indicate that the gamma distribution performs better than the other two distributions using standard statistical criteria.

Bibliography

Black, F. & Scholes, M. (1973). The pricing of options and corporate liabilities. *Journal of Political Economy,* **81,** 637–54.

Brennan, M. J. (1979). The pricing of contingent claims in discrete time models. *Journal of Finance,* **34,** 53–68.

Heston, S. L. (1993). Invisible parameters in option prices. *Journal of Finance,* **48,** 933–47.

Kim, J. (1995). The pricing of options for a class of distributions. Georgia State University. Working paper.

Madrigal, V. & Smith, S. D. (1995). Risk-neutral valuation without spanning: the discrete time case. Georgia State University. New York University. Working paper.

Rubinstein, M. (1976). The valuation of uncertain income streams and the pricing of options. *Bell Journal of Economics,* **7,** 407–25.

Stapleton, R. C. & Subrahmanyam, M. G. (1984). The valuation of options when asset returns are generated by a binomial process. *Journal of Finance,* **39,** 1525–39.

Vankudre, P. P. (1985). The pricing of options in discrete time. The Wharton School, University of Pennsylvania. PhD dissertation.

----------------------------------JONGCHAI KIM

M

Market Efficiency

The term market efficiency is used to explain the relationship between information and share prices in the capital market literature. Although the tests of market efficiency were reported as early as 1900, it was not until 1953 that the idea of market efficiency was put forward by Maurice Kendall. The concept was a byproduct of a chance discovery through his paper on behavior of prices of stocks and commodities. He discovered that security prices follow a random walk that implied that price changes were independent of one another. The formal definition of "market efficiency" was given by Fama (1970). Fama classified market efficiency into three categories namely, weak form, semi-strong form, and strong form. According to Fama a market is efficient in weak form if stock price changes cannot be predicted based on past returns, and semi-strong efficient if stock prices instantaneously reflect any new publicly available information. The strong form of the market efficiency hypothesis states that prices reflect all types of information whether available publicly or privately.

The weak form of the market efficiency hypothesis is that stock returns are serially uncorrelated and have a constant mean. The market is considered weak-form efficient if current prices fully reflect all information contained in historical prices, which implies that no investor can devise a trading rule based on past price patterns to earn abnormal return. A weaker and economically more sensible version of the hypothesis says that prices reflect information to the point where the marginal benefits of acting on the information (profits to be made) do not exceed the marginal costs (Jensen, 1978). This view led to many early tests of weak-form efficiency and has influenced the interpretations of the various anomalies in stock returns that have been documented so far.

Based on mixed results for and against the efficient market hypothesis Fama (1991) made changes in all the three categories. In order to cover a more general area of testing weak form of market efficiency, tests for return predictability and forecasting of returns with variables like dividend yields, interest rates, etc. have been included. Also issues such as cross-sectional predictability for testing asset-pricing models and anomalies like size effect (Banz, 1981), seasonality of returns like the January effect (Keim, 1983; Roll, 1983) and day of the week effect (Cross, 1973; French, 1980) have been included under the theme of return predictability. In the semi-strong form of market efficiency it is assumed that the prices of securities will change immediately and rationally in response to new information and the market neither delays nor overreacts or underreacts in response to the new information. This means that investors cannot earn excess returns by developing trading rules based on publicly available information. When announcement of an event can be dated to the day, daily data allow precise measurement of the speed of the stock price response which is the central issue for market efficiency. Event studies have become an important part of research in capital markets since they come closest to allowing a break between market efficiency and equilibrium pricing issues and give direct and mostly supportive evidence on efficiency. Event studies such as those of Ahrony and Swary (1980), Mandelker (1974), and Kaplan (1989) document interesting regularities in response of stock prices to dividend decisions, changes in corporate control, etc.

Strong-form efficiency assumes that prices fully reflect all new information, public or private. The tests of private information help to ascertain whether such information is fully reflected in market prices. Fama (1991) reviews tests for private information and concludes that the profitability of insider trading is now established. Insider trading refers to the use of private information to earn abnormal profits. The evidence that some investment analysts have insider information (Jaffe, 1974; Ippolito, 1989) is balanced by evidence that they do not (Brinson et al., 1986; Elton et al., 1991). The concept of an efficient stock market has stimulated both insight and controversy since its introduction to the economics and financial literature. The efficient market hypothesis addresses the consequences of competition in financial markets in determining the equilibrium values of financial assets. Perhaps the most important implication of the hypothesis is that the market price of any security reflects the true, or rational, value of security; thus in an efficient market, investors are assured that the securities they purchase are fairly priced. A precondition for this strong version of the hypothesis is that information and trading costs, the costs of getting prices to reflect information, are zero.

The fact that in practice the investors have to incur trading costs and that not all behave homogeneously in response to the information has led to a huge amount of research producing evidence for and against the proposition that financial markets are efficient. However, in spite of these controversies the efficient market hypothesis has contributed to our understanding of how and when economic and industry information is encoded in the prices of securities. The hypothesis has also provided very useful insights on the role of information in determining stock prices.

The early evidence seemed unexpectedly consistent with the theory. The large amount of research in the area of market efficiency tests with the help of common models of market equilibrium like the one factor Sharpe–Lintner–Black (SLB) model, multifactor asset pricing models of Merton (1973) and Ross (1976), and consumption-based intertemporal asset pricing model of Rubinstein (1976), Lucas (1978), and Breeden (1979), provide evidence that the market efficiency is a maintained hypothesis.

However, several recent papers have uncovered empirical evidence which suggests that stock returns contain predictable components. Keim and Stambaugh (1986) find statistically significant predictability in stock prices using forecasts based on certain predetermined variables. Fama and French (1988) show that long-holding-period returns are significantly negatively serially correlated, implying that 25 to 40 percent of the variation of longer-horizon returns is predictable from the past returns. Lo and MacKinlay (1988) reject the random walk hypothesis and show that it is inconsistent with the stochastic behavior of weekly returns, especially for smaller capitalization stocks. Empirical evidence of anomalous return behavior in the form of variables like P/E ratio, market/book value ratio (Fama and French, 1992) has defied rational economic explanation and appears to have caused many researchers to strongly qualify their views on market efficiency.

The efficient market hypothesis is frequently misinterpreted to imply perfect forecasting abilities. In fact, it implies only that prices reflect all available information. When we talk of efficient markets, we mean that the market is functioning well and prices are fair. Thus in assessing the efficiency of the market on the basis of observed behavior of stock returns, and observed predictability of returns in particular, one must judge whether the observed behavior is rational. Given the subjectivity of judgment of rational behavior, it is not surprising that the question of whether markets are efficient is hotly debated.

Bibliography

Ahrony, J. & Swary, I. (1980). Quarterly dividend and earning announcements and stock holders returns: an empirical analysis. *Journal of Finance,* **35,** 1–12.

Bachelier, L. (1900). *Théorie de la spéculation.* Paris: Gauthiers-Villars.

Banz, R. W. (1981). The relationship between return and market value of common stocks. *Journal of Financial Economics,* **9,** 3–18.

Black, F. (1972). Capital market equilibrium with restricted borrowings. *Journal of Business,* **45,** 444–65.

Breeden, D. T. (1979). An intertemporal asset pricing model with stochastic consumption and investment opportunities. *Journal of Financial Economics,* **7,** 265–96.

Brinson, G. P., Hood, L. R. & Beebower, G. L. (1986). Determinants of portfolio performance. *Financial Analysts Journal,* **42,** 39–44.

Cross, F. (1973). Price movements on Fridays and Mondays. *Financial Analysts Journal,* **29,** 67–79.

Elton, E. J., Gruber, M. J., Das, S. & Hlavka, M. (1993). Efficiency with costly information: a reinterpretation of evidence from managed portfolios. *Review of Financial Studies,* **6,** 1–22.

Fama, E. (1970). Efficient capital markets: a review of theory and empirical work. *Journal of Finance,* **25,** 383–417.

Fama, E. F. (1991). Efficient capital markets II. *Journal of Finance,* **46,** 1575–618.

Fama, E. F. & French, K. R. (1988). Permanent and temporary components of stock returns. *Journal of Political Economy,* **96,** 246–73.

Fama, E. F. & French, K. R. (1992). The cross-section of expected stock returns. *Journal of Finance,* **47,** 427–66.

French, K. R. (1980). Stock returns and the weekend effect. *Journal of Financial Economics,* **8,** 55–69.

Ippolito, R. A. (1989). Efficiency with costly information: a study of mutual fund performance 1965–84. *Quarterly Journal of Economics,* **104,** 1–23.

Jaffe, J. (1974). Special information and insider trading. *Journal of Business,* **47,** 410–28.

Jensen, M. C. (1978). Some anomalous evidence regarding market efficiency. *Journal of Financial Economics,* **6,** 95–101.

Kaplan, S. (1989). The effect of management buyouts on operating performance and value. *Journal of Financial Economics,* **24,** 217–54.

Keim, D. B. (1983). Size-related anomalies and stock return seasonality. *Journal of Financial Economics,* **12,** 13–32.

Keim, D. B. & Stambaugh, R. F. (1986). Predicting returns in stock and bond markets. *Journal of Financial Economics,* **17,** 357–90.

Kendall, M. G. (1953). The analysis of economic time series. Part I: prices. *Journal of the Royal Statistical Society,* **96,** 11–25.

Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. *Review of Economics and Statistics,* **47,** 13–37.

Lo, A. W. & MacKinlay, A. C. (1988). Stock market prices do not follow random walks: evidence from a simple specification test. *Review of Financial Studies,* **1,** 41–66.

Lucas, R. E. (1978). Asset prices in an exchange economy. *Econometrica,* **46,** 1429–45.

Mandelker, G. (1974). Risk and return: the case of merging firms. *Journal of Financial Economics,* **1,** 303–36.

Merton, R. C. (1973). An intertemporal capital asset pricing model. *Econometrica,* **41,** 867–87.

Roll, R. (1983). Vas ist das? "The turn of the year effect and the return premia of small firms." *Journal of Portfolio Management,* **9,** 18–28.

Ross, S. A. (1976). The arbitrage theory of capital pricing. *Journal of Economic Theory,* **13,** 341–60.

Rubinstein, M. (1976). The valuation of uncertain income streams and the pricing options. *Bell Journal of Economics,* **7,** 407–25.

Sharpe, W. F. (1964). Capital asset prices: a theory of market equilibrium under conditions of risk. *Journal of Finance,* **19,** 425–42.

-----------------------------------SUNIL POSHAKWALE

Mergers and Acquisitions

Definitions and Nature of Activity

Mergers or acquisitions occur when the assets and activities of two independently controlled corporations are combined under the control of a single corporation. A merger is negotiated directly between the management of an acquiring company and the management of a target company, and the proposals are approved by the separate boards of directors before shareholders vote on them. If recommendation for a merger is not forthcoming from target company directors, an acquirer can then make a public tender offer to target company shareholders (for all or part of the equity), and a hostile takeover bid is launched, which if accepted by the target company shareholders, results in an acquisition. However, acquisition is commonly used even where no hostile bid occurs – for example where a company acquires an unquoted company or a subsidiary with the agreement of the previous owners.

Demergers are also possible. A demerger takes place when part of a company's assets or operations are divested in a flotation, management buyout (MBO), or leveraged buyout (LBO). The ICI pharmaceuticals subsidiary is a recent example of a large demerger, involving the flotation of Zeneca as a separate company.

Merger activity, in terms of both number and value, is closely connected with stock market buoyancy in both the USA (Nelson, 1966) and the UK (Golbe and White, 1988). Peak volumes of activity occurred in the 1920s, 1960s, and 1980s during long bull markets. Bishop and Kay (1993) suggest that this interrelationship is counter-intuitive since one would expect companies to buy physical assets when the price of companies is high, and to prefer companies to new investment when the price of companies is low. One theory which explains this relationship is that the incidence of corporate mis-valuation is greater in bull markets than in bear markets, and thus highly valued companies are able to issue shares at prices that allow them to acquire enterprises whose valuations have not increased so dramatically. Another explanation suggests that mergers occur during periods of strong economic performance because confidence is high and the inevitable risk of major expansion is acceptable during bull markets. Behind both these theories lies the role of corporate management who need to consider not only extending their control to other companies, but also safeguarding their control of existing assets by performing well enough to deter takeover. Mergers are seen as a major element in the market for corporate control and a major avenue through which shareholders can deal with the agency problems presented by the shareholder–manager relationship (Jensen and Ruback, 1983).

Mergers and Theoretical Views on the Market for Corporate Control

Many economists have seen takeovers as the mechanism by which shareholders (principals) can exercise control over managers (agents) and that only firms which maximize stock market value will survive (Friedman, 1953). With separation of the ownership and control of production, shareholders can still exercise control through their ability to sanction a takeover. Early neoclassical economists saw the threat of takeover as enough to ensure the efficient use of resources by managers. Jensen and Meckling (1976) linked takeovers to the whole range of principal–agent issues in corporate governance. These include the costs of structuring a set of contracts with managers, the costs of monitoring and controlling managerial behavior, and the costs of shareholders acting against any breach of contract by managers. Takeovers as a market selection device can then be seen as a means of insuring that firms with incentive contracts which optimize shareholder interests will survive, while those that do not are taken over. Alternatively, because optimal incentive contracts are infeasible, the takeover mechanism in practice helps to reduce agency costs by targeting those firms with the highest agency costs for takeover Jensen, 1988).

The above theories rest on an efficient and effective markets view of mergers. Many economists have challenged this. Shleifer and Vishny (1988) pointed out that acquirers may themselves be dominated by empire-building, rather than value-maximizing, managers. This is consistent with the theory of the firm articulated by Marris (1964), which proposed that managers were motivated by superior compensation in large firms and that growth by acquisition fulfills this desire as effectively as economic growth (Mueller, 1969). Peacock and Bannock (1991) identified the high transaction costs involved in takeovers as a major weakness of the effective market view, with managers as insiders having better information than potential acquirers. Stein (1988, 1989) shows that asymmetric information allows managers to defend a takeover threat by inflating current earnings. This gives shareholders inaccurate information, and undermines takeovers as a function of control over managers. Thus, information asymmetry penalizes acquirers at the expense of acquirees (Helm, 1989), and Singh (1971) pointed out that it was much easier for large firms to take over small firms than vice versa, suggesting that takeovers are a less than perfect managerial control device. Grossman and Hart (1980) argue that shareholders in practice may be an obstacle to the optimum level of takeovers because the "free-rider" problem reduces the chances of takeover bids succeeding. The optimal strategy for shareholders (in particular small shareholders) is always to refuse any offer, in the hope of an improved offer. If all shareholders adopt this strategy then no disciplinary bids would occur. Others have gone further by suggesting that the market for corporate control may actually be perverse, rather than just inefficient.

Shleifer and Summers (1988) suggest that efficiency gains measured by stockholder gains are outweighed by losses incurred by managers and workers. Under this hypothesis, they suggest takeovers are on balance harmful to economic efficiency.

Empirical Evidence on the Market for Corporate Control

There is an enormous empirical literature on mergers profiling acquirers and targets, and measuring the economic consequences of mergers in terms of profits and shareholder returns. The theoretical contributions on principal–agency issues, and perverse selection, have, however, received less attention. In this section we look at the kind of firms which are taken over, or remain independent, in the market for corporate control.

Early studies in the USA looked at profitability, size, growth, and earnings multiples of acquired companies (Hayes and Taussig, 1967). The assumption behind these studies is that companies which underperform their peers do so because of poor management, and that in an efficient market for corporate control, those companies will fall prey to takeover. The studies showed that in the 1950s and 1960s acquired firms tended to be relatively unprofitable, had low growth, and were cash rich. Schwartz (1982) and Harris et al. (1982) were able to forecast underperforming companies which were likely to be taken over, using probit analysis. However, Palepu (1986), who conducted the most exhaustive of all US studies, found that the financial variables were not useful in predicting targets, a finding that challenges the corporate control explanation for mergers.

Singh (1971, 1975), looked at the size, profitability, short-term change in profitability and growth characteristics of acquiring and acquired firms in the UK between 1955–60 and 1967–70. In the first period significantly more than 50 percent of acquired firms were below the median for size, profitability, and growth. Between 1967 and 1970 targets were again below the median for profitability and profit growth, but size and growth were not significant. Kumar (1984) confirms both the size and growth for 1967–74, and Cosh et al. (1989) confirm the result for size and growth for 1981–83 and 1986; however, they find that the profitability of acquired firms is indistinguishable from industry averages during the 1980s, suggesting that the 1980s' merger wave was different from early periods.

Acquiring companies in the UK are generally larger than non-acquirers, and grow faster (organically), but are not (with the exception of those merging most intensively or involved in diversifying mergers) unduly profitable (Cosh et al., 1980).

Compared with acquired companies, acquirers present a picture of superior profits, growth, and size for the acquiring companies during the period 1955–60. In the 1967–70 period they again dominate on size and growth, but not on profitability. In the 1980s acquiring company profitability is greater than that of acquired companies, but the result is statistically insignificant.

The implication of these findings for both the USA and the UK is that the market for corporate control does not conform neatly to the profit maximization assumption of neoclassical theory, since efficiency (profit or market value) has not been demonstrated as the only (indeed perhaps not the pre-eminent) criterion determining acquisition activity. Indeed, size matters as much if not more because evidence suggests that a relatively inefficient large company has a better chance of survival than a relatively much more efficient smaller company. The threat of takeover is more likely to encourage firms to increase their size rather than their profitability. It is hard to see takeovers as a mechanism for principals to exercise control over managers, when unsuccessful managers can defend themselves by enlarging their company through acquisition.

Measuring the Economic Benefits of Mergers

Despite recent signs of European activity, mergers remain largely an Anglo-Saxon phenomenon. The unexciting economic performance of the UK and USA raises the inevitable question of whether takeovers are economically beneficial. Furthermore, the takeover battles of the 1980s have shown that financial advisors play a leading part in precipitating mergers and benefiting from them, and shareholders are naturally concerned to see whether on aggregate an undue proportion of any benefit is realized by advisors and managers.

Assessing the economic consequences of merger activity leads to difficult methodological problems. One approach has been to contrast the combined pre-merger profits of the two companies with the post-merger performance. The comparison typically adjusts for economic changes across time by using a sector relative measure so that positive benefits from merger are only deduced if the merged entity improves its position in the sector. Bias is still evident in most of the studies since no account is taken of the dispersion of profits across firms.

In the USA studies have found that mergers do not generally increase profits. Markham (1955) and Reid (1968) looked at mergers over long periods that straddled World War II, and concluded that profits of the business combination did not exceed the profits of the premerged companies. Mueller (1980) found that after-tax profits increased, but before-tax profits showed a relative decline, suggesting a decline in efficiency, partly paid for by the taxpayer. Piper and Weiss (1974) and Ravenscraft and Scherer (1987), using different control procedures and time periods, both found declines in profitability.

For the UK Singh (1971) and Kumar (1977) both reported small declines in post-tax return on net assets after merger, after allowing for accounting adjustments. Cosh et al. (1980), who did not allow for the downward accounting bias, found that more than half their sample of merged firms improved their profitability relative to the control groups, and that the improvement is particularly pronounced for non-horizontal mergers. If the downward accounting bias is adjusted upwards then the result is even more favorable to mergers. The major study to cover the 1980s merger boom (Cosh et al., 1989) shows that profitability was if anything lower after merger than before, and that the mergers which were successful in terms of post-merger profit enhancement were cases where both parties had been relative under-performers before merger.

Because of the likelihood of mean reversion (outperforming companies are likely to become average performers even without any merger activity), problems with accounting differences, and with matched samples, many studies look at shareholder returns as well as, or instead of, profits (see, for example, Cosh et al., 1980; Cosh et al., 1989; Franks and Harris, 1989).

A recent survey of nineteen US merger studies shows consistent positive returns for acquired company shareholders with a median gain of 19.7 percent (Mueller, 1992). Acquiring company shareholders, on the other hand, have cumulative returns substantially below the market portfolio in the six months post merger in twelve out of fifteen studies, with a median return of –7.2 percent. These losses continue for several years after the mergers (Agrawal et al., 1992; Mueller, 1992). Prior to merger announcements, acquiring firms registered positive cumulative returns in all ten studies which looked at stock performance for at least twelve months before announcement. The median cumulative abnormal gain over this period was +13.2 percent. So, in the USA the evidence tends to support the view that firms generally undertake acquisitions when they have outperformed the market (Halpern, 1983; Mueller, 1992). The large gain to acquired company shareholders overshadows the negative returns to acquirer shareholders and this is normally construed as a net social benefit (Council of Economic Advisors, 1985).

In the UK Cosh et al. (1980) find that acquiring firms had better shareholder returns in the first year after merger but after that the acquirers deteriorated relative to the control group. Cosh et al. (1989) found that for 1981–83 acquiring firms performed worse in the three years post-merger than the three years premerger. Using event study methodology, Franks and Harris (1989) found that acquirers gain slightly in the post-merger period, but when the measurement period is extended to twenty-four or thiry-six months, negative residuals occur. Overall, therefore, these studies suggest an opportunistic motive with acquirers launching their bids when their prices are relatively high, and that either acquisitions do not provide medium term benefits or that the acquirer return performance then falls towards the market return.

The overall shareholder returns are positive, however, because of the significant premiums which target companies command. Franks and Harris (1989) report premiums between 25 and 30 percent in the period of four months before and one month after the first bid date. The premiums are substantially above this average when the bid is in cash, suggesting that companies need to offer a higher premium when they are taking all the benefits of acquisition for their own shareholders.

Types of Merger

Most mergers do not fit neatly into one category, and definitions are not uniformly applied, with an obvious difference between the economics and strategy literature. In the economics literature it is common to see mergers defined as horizontal mergers, between competitors; vertical mergers, involving acquisitions of suppliers or customers; and conglomerate mergers, of companies with no complementary markets or production processes.

One motive for horizontal mergers is to achieve market share even if the firm is not dominant enough to exert monopoly or oligopoly power. Merging firms might be expected to increase prices to achieve higher profits but Salant et al. (1983) found that horizontal mergers were unprofitable. However, the disappearance of a firm may lead remaining competitors to expand production and depress prices. Deneckere and Davidson (1985) show that only if rival firms respond to the takeover by raising prices does the merging firm benefit. Further evidence of this can be found in specific industries such as the airline industry (Kim and Singal, 1993).

The other important horizontal motive is cost reduction. Scale economies may result at the plant level (Pratten, 1971) or from operating several plants within one firm (Scherer et al., 1975). Most studies have failed to find significant cost improvements (Mueller, 1980).

Thus, it is difficult to substantiate the argument that market power justifies merger activity, not least because a dominant position would generally conflict with competition policy and invite regulatory intervention (Weir, 1993).

Motives for vertical integration include eliminating price distortions in factor inputs when suppliers have market power, reducing bargaining costs between vertically linked firms in the presence of asymmetric information, and reducing contracting cost between vertically linked companies (Williamson, 1989). Lubatkin (1987) investigated the post-merger performance of vertical acquisitions over various periods up to five years. He found a positive abnormal return over the short term, but a negative abnormal return over the three- to five-year period. Seth (1990), however, confirmed the earlier result of Rumelt (1974) that companies making vertical acquisitions do not perform as well as those making horizontal, or unrelated acquisitions.

With conglomerate mergers the motives are: diversification to reduce a company's dependence on existing activities, and perhaps achieve uncorrelated, or negatively correlated profitability, which would lower the holding company's cost of capital; and the transference of managerial competence across dissimilar business activities. In a well functioning capital market, diversification should not provide a worthwhile motive, since shareholders can achieve required allocations in their own portfolios (Porter, 1987). The managerial competence motive is often allied to the free cash flow hypothesis for mergers (Jensen, 1986), which sees leveraged deals as an effective way of shareholders replacing poor management with good management and keeping management effective because of the high debt burden.

International Comparisons of Merger Activity

Domestic mergers in the USA still account for a large proportion of worldwide acquisition activity. In 1985, 85 percent of all deals were in the USA. By 1989 this had fallen to 50 percent. Europe and, in particular, the UK account for most of the other transactions. After the recessionary years of 1990–92 in which the number of European mergers fell considerably, recent evidence suggests that activity is rising again, and that both continental European firms and American cross-border deals are growing in importance.

Historically and through the 1980s, most European mergers were ones in which British firms took over other British firms (Bishop and Kay, 1993). The explanations for this lie in the relatively undeveloped capital markets in continental countries, and the different attitudes to corporate governance, particularly in Germany. There are three reasons to believe that this may change during the next few years. First, many European companies feel they are uncompetitive against their American counterparts and may use mergers as a means of rationalizing. Second, privatization programmes and EU competition policy may lead to merger induced restructuring, particularly in sectors such as airlines and telecommunications. Last, larger international shareholdings in European firms are starting to foster takeovers, and the German banks are already selling stakes in German corporations for their own reasons and as a result of political pressure.

Thus, there is good evidence to support a prediction that European corporate activity will embrace mergers at a time when Anglo-Saxon academics are sceptical about the overall economic benefits, and the question of whether mergers primarily serve shareholder, manager, or advisor interests is unresolved.

Bibliography

Agrawal, A., Jaffe, J. F. & Mandelker, G. N. (1992). The post-merger performance of acquiring firms: a re-examination of an anomaly. *Journal of Finance,* **47,** 1605–21.

Auerbach, A. J. (ed.), (1988). *Corporate takeovers: Causes and consequences.* Chicago: National Bureau of Economic Research, University of Chicago Press.

Bishop, M. & Kay, J. (1993). *European mergers and merger policy.* Oxford: Oxford University Press.

Cosh, A. D., Hughes A. & Singh, A. (1980). The causes and effects of takeovers in the UK: an empirical investigation for the late 1960s at the micro-economic level. *The determinants and effects of mergers.* (Ed.) Mueller, D. C. Cambridge, MA: Oelgeschlager, Gunn and Hain.

Cosh, A. D., Hughes, A., Lee, K. & Singh, A. (1989). Institutional investment: mergers and the market for corporate control. *International Journal of Industrial Organisation,* 73–100.

Council of Economic Advisors (1985). *Annual report.* Washington, DC: US Government Printing Office.

Deneckere, R. & Davidson, C. (1985). Incentives to form coalitions with Bertrand competition. *Rand Journal of Economics,* **16,** 473–86.

Franks, J. R. & Harris, R. S. (1989). Shareholder wealth effects of corporate takeovers: the UK experience 1955–85. *Journal of Financial Economics,* **23,** 225–50.

Friedman, M. (1953). *Essays in positive economics.* Chicago, IL: University of Chicago Press.

Golbe, D. L. & White, L. J. (1988). A time series analysis of merger acquisitions in the UK economy. (Ed.) Auerbach, A. J. *Corporate takeovers: Causes and consequences.* Chicago, IL: University of Chicago Press.

Grossman, S. J. & Hart, O. D. (1980). Takeover bids: the free-rider problem and the theory of the corporation. *Bell Journal of Economics,* **11,** 42–64.

Halpern, P. (1983). Corporate acquisitions: a theory of special cases? A review of event studies applied to acquisitions. *Journal of Finance,* **38,** 297–317.

Harris, R. S., Stewart, J. F., Guilkey, D. K. & Carleton, W. T. (1982). Characteristics of acquired firms: fixed and random coefficients probit analysis. *Southern Economic Journal,* **49,** 164–84.

Hayes, S. & Taussig, R. (1967). Tactics of cash takeover bids. *Harvard Business Review,* **45,** 135–48.

Helm, D. (1989). Mergers, takeovers, and the enforcement of profit maximization. *Merger and merger policy.* (Ed.) Fairburn, J. & Kay, J. A. Oxford: Oxford University Press.

Hindley, B. (1970). Separation of ownership and control in the modern corporation. *Journal of Law and Economics,* **13.**

Hogarty, T. F. (1970). Profits from mergers: the evidence of fifty years. *St John's Law Review,* **44,** 378–91.

Jensen, M. C. (1986). Agency costs of free cash flow, corporate finance and takeovers. *American Economic Review,* **76,** 323–29.

Jensen, M. C. (1988). Takeovers: their causes and consequences. *Journal of Economic Perspectives,* **2,** 21–48.

Jensen, M. C. & Meckling, W. H. (1976). Theory of the firm: managerial behavior, agency costs and ownership structure. *Journal of Financial Economics,* **3,** 305–60.

Jensen, M. C. & Ruback, R. (1983). The market for corporate control: the scientific evidence. *Journal of Financial Economics,* **11,** 5–50.

Kim, E. H. & Singal, V. (1993). Mergers and market power: evidence from the airline industry. *American Economic Review,* **83,** 549–69.

Kumar, M. S. (1984). *Growth, acquisition and investment.* Cambridge: Cambridge University Press.

Lubatkin, M. (1987). Merger strategies and stakeholder value. *Strategic Management Journal,* **8,** 39–53.

Markham, J. W. (1955). Survey of the evidence and findings on mergers. *Business concentration and price policy.* New York: National Bureau of Economic Research.

Marris, R. L. (1964). *The economic theory of "managerial" capitalism.* London: Macmillan.

Mueller, D. C. (1969). A theory of conglomerate mergers. *Quarterly Journal of Economics,* **83,** 643–59.

Mueller, D. C. (Ed.) (1980). *The determinants and effects of mergers: An international comparison.* Cambridge, MA: Oelgeschlager, Gunn and Hain.

Mueller, D. C. (1992). Mergers. *The new Palgrave dictionary of money and finance.* London: Macmillan. 700–7.

Nelson, R. L. (1966). Business cycle factors in the choice between internal and external growth. *The corporate merger.* (Ed.) Alberts, W. & Segall, J. Chicago, IL: University of Chicago Press.

NIESR (1994). *National Institute of Economic and Social Research study into executive pay.* London.

Palepu, K. G. (1986). Predicting takeover targets: a methodological and empirical analysis. *Journal of Accounting and Econ1omics,* **8,** 3–36.

Peacock, A. & Bannock, G. (1991). *Corporate takeovers and the public interest.* Aberdeen: Aberdeen University Press for the David Hume Institute.

Piper, T. F. & Weiss, S. J. (1974). The profitability of multibank holding company acquisitions. *Journal of Finance,* **29,** 163–74.

Porter, M. E. (1987). From competitive advantage to corporate strategy. *Harvard Business Review,* **45,** 43–59.

Pratten, C. F. (1971). *Economies of scale in manufacturing industry.* Cambridge: Cambridge University Press.

Ravenscraft, D. J. & Scherer, F. M. (1987). *Mergers, sell-offs and economic efficiency.* Washington, DC: Brookings Institution.

Reid, S. R. (1968). *Mergers, managers and the economy.* New York: McGraw-Hill.

Rumelt, R. P. (1974). *Strategy, structure and economic performance.* Cambridge, MA: Harvard University Press.

Salant, S. W., Switzer, S. & Reynolds, R. J. (1983). Losses from horizontal merger: the effects of an exogenous change in industry structure in Cournot-Nash equilibrium. *Quarterly Journal of Economics,* **98,** 185–99.

Scherer, F. M., Beckensten, A., Kaufer, E. & Murphy, R. D. (1975). *The economics of multiplant opeation: An international comparisons study.* Cambridge, MA: Harvard University Press.

Schwartz, S. (1982). Factors affecting the probability of being acquired: evidence for the United States. *Economic Journal,* **92,** 391–98.

Seth, A. (1990). Value creation in acquisitions: a reexamination of performance issues. *Strategic Management Journal,* **11,** 99–115.

Shleifer, A. & Summers, L. H. (1988). Breach of trust in hostile takeovers. *Corporate takeovers: cause and consequences.* (Ed.) Auerbach, A. J., Chicago, IL: University of Chicago Press.

Shleifer, A. & Vishny, R. W. (1988). Value maximization and the acquisition process. *Journal of Economic Perspectives,* **2,** 7–20.

Singh, A. (1971). *Takeovers: Their relevance to the stock market and the theory of the firm.* Cambridge: Cambridge University Press.

Singh, A. (1975). Takeovers, economic "natural selection," and the theory of the firm: evidence from the post-war UK experience. *Economic Journal,* **85,** 497–515.

Stein, J. C. (1988). Takeover threats and managerial myopia. *Journal of Political Economy,* **96,** 61–80.

Stein, J. C. (1989). Efficient stock markets, inefficient firms: a model of myopic corporate behaviour. *Quarterly Journal of Economics,* **104,** 655–69.

Utton, M. A. (1974). On measuring the effects of industrial mergers. *Scottish Journal of Political Economy,* **21,** 13–28.

Weir, C. (1993). Merger policy and competition: an analysis of the monopolies and mergers commissions decisions. *Applied Economics,* **25,** 57–66.

Williamson, O. E. (1989). Transaction cost economics. *Handbook of industrial organization.* (Ed.) Schmalensee, R. & Willig, R., Amsterdam: North-Holland.

------------------------------------NICK COLLETT

Mutual Funds

Mutual funds are equity claims against prespecified assets held by investment companies (firms that professionally manage pools of assets). Thus, a share of a mutual fund is an equity claim, typically held by an individual, against a professionally managed pool of assets.

Mutual funds provide four benefits to individual investors. First, since most mutual funds are well diversified, these funds allow individuals with limited capital to hold diversified portfolios. Second, since mutual funds are professionally managed, an individual investor can obtain the benefits of professional asset management at a fraction of the cost of privately retaining a professional manager. Third, mutual funds can provide superior liquidity both during the holding period of the fund and at liquidation. Since transaction costs are not typically proportional to order dollar values, mutual funds can rebalance portfolios at a lower proportional cost than an individual investment can. Furthermore, to liquidate a portfolio, mutual funds require the sale of only a single security (the fund). Finally, mutual funds reduce book-keeping and clerical costs by automatically reinvesting dividends or coupons and by providing quarterly performance reports and annual consolidated statements for investors' tax purposes.

Mutual funds carry several costs for investors. Management fees, charged daily against the net asset value of the fund, are summarized, aggregated and reported quarterly. Load funds charge a one-time fee to the investor whenever shares are purchased (a "front-end" load) and/or sold (a "back-end load"). Some back-end load fees are contingent on the holding period. For example, a back-end load fee of (5 percent – 1 percent × years held) means that an investor can escape the back-end load fee if the shares are held for five years or more. Such contingent back-end fees are often called "contingent deferred sales loads." Finally, investment companies may charge mutual fund holders "12b-1 fees" to reimburse the investment company for marketing, advertising, reporting, and maintaining investor relations.

The most important dichotomy in the analysis of mutual funds is the distinction between open-end and closed-end funds. In an "open end fund," purchases and sales of shares in the fund can be made through the investment company at any time. Thus, the number of shares outstanding and the amount of capital under management vary constantly. Further, such transactions occur at the stated net asset value (NAV). The NAV, which is calculated at least daily, is the current market value of the fund's assets divided by shares outstanding.

In contrast, shares of a "closed-end fund" are issued by the investment company only once and are fixed thereafter. As a result, individuals wishing to buy or sell shares of an established closed-end fund must identify a counterparty willing to take the other side of the transaction. This is why closed-end funds, but not open end funds, are listed on stock exchanges. Often, secondary market transactions of a closed-end fund occur at prices that differ from the fund's NAV. Funds with market prices above their NAV trade at a premium; funds with market prices below their NAV trade at a discount. Closed-end funds do not charge an explicit front-end load fee. Instead, this fee is charged implicitly, through the difference between the higher purchase price and the NAV of the fund.

A second important distinction between mutual funds is their investment "style." Some funds are "passively" managed; that is, holdings of the mutual fund are rarely altered and the fund mimics a benchmark index such as the Standard and Poor's 500 Index. However, the vast majority of mutual funds are "actively" managed, with portfolio holdings frequently altered according to management discretion. One example of an actively managed style is "market timing," where a manager dynamically alters a fund's weights in stocks, bonds, and short-term debt in anticipation of future moves.

Actively managed funds are classified by the type of assets they hold. For example, some funds invest only in tax-exempt municipal bonds, while others invest only in mortgage-backed debt obligations. Equity funds are normally classified as growth funds (containing speculative stocks with low dividend yields), income funds (containing less volatile, higher yield stocks, and sometimes bonds), or balanced funds (containing elements of both growth and income funds).

Furthermore, some equity funds consider only foreign issues, while others, called "country funds," invest only in equities in one particular foreign country. Since many countries restrict foreign investment, a closed-end fund may be the only viable avenue for investing in a particular country. Thus, a foreign country closed-end fund is likely to trade at a premium.

In the USA, mutual funds, and the investment companies that manage them, are regulated under the Investment Company Act of 1940. Under this Act, the Securities and Exchange Commission is granted authority to regulate mutual funds. Investment companies, like the equity market, are regulated by disclosure, rather than merit, regulation. Consequently, mutual fund regulation focuses on mandatory disclosure of information, including the filing of a prospectus at the time of issue as well as quarterly and annual reports. To prevent potential conflicts of interest, regulation limits the holdings of brokers and underwriters in a mutual fund.

--PAUL SEGUIN

N

Noise Trader

Black (1986) defines noise trading as trading on noise as if it were information. In addition, he notes the importance of noise trading in capital markets: "Noise makes financial markets possible but also makes them imperfect." That is, in a world without noise traders, all trading is motivated by informational advantages. Recognizing they will be trading against another informed investor, traders will be reluctant to transact. Noise traders provide the necessary liquidity to financial markets. In providing liquidity, however, they also provide noise.

Why Do Noise Traders Trade?

Noise trading may arise for various reasons. Some investors may simply enjoy trading or erroneously believe they have unique information or insights. In addition, some traders may trade on "sentiment." Shiller (1984), for example, argues that evidence from social psychology, sociology, and marketing suggests that individual investor's decisions are likely to be influenced by "fads" or "fashion." Alternatively, Friedman (1984) suggests that institutional investors may be more inclined to trade on sentiment, due to the close-knit nature of the investment community, the importance of performance relative to other institutional investors, and the asymmetry of incentives. Similarly, Froot et al. (1992) develop a model in which rational short-horizon investors may trade on the same signal, but the signal need not be related to fundamental value (e.g. technical analysis). Trueman (1988) suggests that institutional investors may engage in noise trading because it provides an imperfect signal to clients that the manager is informed. In sum, noise trading may result from perceived information advantages, sentiment, trading appearing in the utility function, or agency problems.

The Impact of Noise Trading on Prices

Noise trading can explain excess volatility in security prices (i.e. price will be more volatile than value), temporal patterns in stock prices (e.g. momentum and/or mean-reversion) and the use of technical analysis and positive feedback trading (see Shleifer and Summers, 1990). The magnitude of noise traders' impact on security prices will depend on both the degree of noise trading in the market and the systematic nature of noise trading. The greater the degree of noise trading, the greater the deviation between price and value. As the deviation between price and value increases, rational arbitrageurs should work to push prices toward fundamental value. In real markets, however, arbitrage is costly (e.g. short sale proceeds are not available for investment). Moreover, in a world with noise traders and finite horizons, arbitrage can be risky. For example, rational arbitrageurs with limited horizons may be forced to unwind their positions in a period when noise traders have pushed prices even further away from fundamental values (see DeLong et al., 1990).

If noise trading is cross-sectionally independent, then the impact of noise traders on a security's price is likely to be small relative to a world in which noise trading is cross-sectionally correlated. That is, if orders from noise traders are equally likely to be buy or sell initiated at a point in time, then many noise traders' orders will cancel out and the impact on price should be relatively small. Alternatively, if the noise traders' orders generally come from the same direction (i.e. primarily buy initiated or primarily sell initiated), their impact on a security's price is likely to be large. A similar argument holds for the expected impact of noise traders on the market. If noise traders' orders are cross-sectionally correlated across securities, then they are likely to impact market averages. That is, if noise traders systematically enter (or exit) financial markets, market averages may be affected.

Empirical evidence regarding the impact of noise traders on security prices is mixed. Lee et al. (1991) argue that the systematic noise trading of individual investors influences both closed-end fund share discounts (since individual investors play a more important role in closed-end fund shares than in the market for the underlying assets of the funds) and the prices of small capitalization securities (that are also dominated by individual investors). Although there is evidence that there is some correlation between closed-end discounts and the returns of small capitalization securities, there is considerable debate regarding the statistical and economic significance of the correlation (see Chen et al., 1993).

Alternatively, recent investigations into the behavior of institutional investors suggests that noise trading by institutional investors may impact security prices. Wermers (1994) documents results consistent with the hypothesis that some mutual funds engage in positive feedback trading and that such trading moves prices. Assuming that previous returns do not indicate future fundamental values, this suggests that some institutional investors engage in systematic noise trading.

Can Noise Traders Survive?

Historically, the impact of noise trades has been assumed to be minimal since noise traders should lose wealth (and therefore eventually become unimportant) when trading against rational "smart-money" arbitrageurs. Shiller (1984), however, argues that there is little reason to suspect that rational smart money speculators dominate financial markets. DeLong et al. (1990, 1991) develop formal models that allow for the survival of noise traders. In DeLong et al. (1991), noise traders systematically underestimate variances of risky assets and therefore invest a greater fraction of their wealth in the risky asset than would an otherwise equally risk-averse rational investor. Their excessive risk-taking may not only allow noise traders to survive, but they may come to dominate the market. Alternatively, in DeLong et al. (1990), the actions of noise traders are cross-sectionally correlated (systematic) and influence asset prices. Like any other systematic risk, the risk impounded by the random sentiments of noise traders should be priced. Thus, noise traders may be compensated for a risk that they create. Moreover, even though the model predicts that noise traders will lose (on average) when trading against rational arbitrageurs, noise traders may garner higher rates of returns than sophisticated investors if they concentrate their holdings in assets that have a greater sensitivity to innovations in noise trader sentiment.

Sias et al. (1995) examine the issue of whether investors are compensated for bearing noise trader risk. Specifically, DeLong et al. (1990) suggest that assets with greater sensitivity to noise-trader risk will tend to sell below fundamental values (reflecting the pricing of noise trader risk). They suggest that such a scenario can explain the fact that most closed-end funds sell at a discount to their underlying assets (assuming individual investors are noise traders). Specifically, the discount from fundamental values reflects the additional risk from the ownership structure: closed-end fund shares are held primarily by noise traders (individual investors), but noise traders play a less important role in the underlying assets of the funds. Thus, under these conditions, passive closedend fund shareholders should garner larger returns than passive investors of the underlying assets as compensation for bearing noise trader risk. Sias et al. (1995) demonstrate that, despite selling at discounts, (passive) closed-end fund shareholders do not garner larger returns than the holders of the underlying assets. In fact, discounts are just large enough to cover the expenses incurred by the funds. In addition, Sias et al. (1995) demonstrate that, holding capitalization constant, NYSE stocks with greater exposure to individual investors (and presumably greater exposure to noise trader risk) earn lower returns than stocks with greater exposure to institutional investors.

Unresolved Issues

Our understanding of noise traders is small relative to their likely importance in the market. Thus, noise traders represent a substantial and promising area for future research. Some of the key questions to be answered include: Who are the noise traders? Why do they trade? Is their trading independent or systematic? What is their impact on security prices? What is the relationship between informed traders and noise traders? Finally, how can noise traders survive?

Bibliography

Black, F. (1986). Noise. *Journal of Finance,* **41,** 529–43.

Chen, N., Kan, R. & Miller, M. (1993). Are the discounts on closed-end funds a sentiment index? *Journal of Finance,* **48,** 795–800.

DeLong, B., Shleifer, A., Summers, L. & Waldmann, R. (1990). Noise trader risk in financial markets. *Journal of Political Economy,* **98,** 703–38.

DeLong, B., Shleifer, A., Summers, L. & Waldmann, R. (1991). The survival of noise traders in financial markets. *Journal of Business,* **64,** 1–19.

Friedman, B. (1984). Comment on Shiller's stock prices and social dynamics. *Brookings Papers on Economic Activity,* **2,** 504–8.

Froot, K., Scharfstein, D. & Stein, J. C. (1992). Herd on the street: informational inefficiencies in a market with short-term speculation. *Journal of Finance,* **47,** 1461–84.

Lee, C., Shleifer, A. & Thaler, R. (1991). Investor sentiment and the closed-end fund puzzle. *Journal of Finance,* **46,** 75–109.

Shiller, R. (1984). Stock prices and social dynamics. *Brookings Papers on Economic Activity,* **2,** 457–98.

Shleifer, A. & Summers, L. (1990). The noise trader approach to finance. *Journal of Economic Perspectives,* **4,** 19–33.

Sias, R., Starks, L. & Tinic, S. (1995). Is noise trader risk priced? Washington State University. University of Texas. Koc University. Working paper.

Trueman, B. (1988). A theory of noise trading in securities markets. *Journal of Finance,* **43,** 83–95.

Wermers, R. (1994). Herding, trade reversals, and cascading by institutional investors. University of Colorado, Boulder. Working paper.

--RICHARD W. SIAS

Note Issuance Facilities

A note issuance facility (NIF) is a medium-term commitment under which a borrower can issue short-term paper in its own name. The NIF commitment is typically made for a few years, while the paper is issued on a revolving basis, most frequently for maturities of three or six months. A broader range of maturities, however, is available, ranging from seven days up to one year. Most euronotes are denominated in US dollars and are issued in large denominations. They may or may not involve underwriting services. When they do, they are sometimes referred to as RUFs (revolving underwriting facilities). When they do not, they are often called euro-commercial paper programs (ECPs). When underwriting services are included in the contract, the underwriting banks are committed either to purchase any notes the borrower is unable to sell, or to provide standby credit.

NIFs have some features of the US commercial paper market and some features of commercial lines of credit or loan commitments by banks. Like commercial paper, notes issued under NIFs are short-term, non-secured, debt of large corporations with high credit ratings. Like loan commitment contracts, NIFs generally include multiple pricing components for various contract features, including a marketbased interest rate and fees known as participation, facility, and underwriting fees. The interest on notes issued is generally a floating rate based on LIBOR, the London Interbank Offered Rate, but occasionally other bases are used. The contract often includes a series of clauses or covenants that allow the NIF provider to revoke the arrangements under certain circumstances. These may have to do with deteriorations in the borrower's creditworthiness or external changes that affect the costs to the NIF providers.

The provider of NIFs agrees to accept notes issued by the borrower throughout the term of the contract and to distribute them either at a fixed margin or on a "best efforts" basis to investors. The notes are distributed under pre-arranged terms. Underwriting services in the NIF means that the borrower is assured a given interest rate and rapid access to funds. Like underwriting arrangements in other markets (Baron, 1982; Bloch, 1989; Courtadon, 1985; Freeman and Jachym, 1988), NIFs are provided by a lead manager who puts together a tender panel of banks. These then purchase the notes for distribution and occasionally for themselves. The shares of each panel member are determined in the underwriting agreement. The panel members usually agree to take up notes that cannot be placed or to extend automatically short-term loans to the issuer in place of such notes.

There are several variations on the basic product. A decade ago banks introduced NIFs with an issuer-set margin, where the issuer determines the margin (spread over LIBOR) at which notes will be offered. Notes not taken up (at the issuer set margin) are allocated to the underwriters at a pre-set cap rate. During the same period the multiple component facility (MCF) was introduced as another major development in the market for euronotes. This type of facility allows the borrower to draw funds in several currencies or in several forms, including short-term advances, swingline credits, etc. The borrower gains greater flexibility, choosing the maturity, loan form and interest rate base of his credit utilization.

A growing proportion of new facilities have included extra borrowing options. The most popular option has been short-term advances, enabling borrowers to draw in any of several forms of instruments. Options for such alternatives were included in around 50 percent (by value) of the underwritten facilities arranged since 1986. One of the most popular has been swinglines, which enable borrowers to draw at short notice (generally same-day funds) to cover any delay in issuing notes.

While in the early 1980s most NIFs did include some form of underwriting service, more recently a growing number of NIFs have been arranged partly or entirely without underwriting commitments. Non-underwritten NIFs expanded from about 33 percent in 1985 to 70 percent in 1992. Most of these facilities, known today as euro-commercial paper (ECP), are similar to underwritten NIFs except that they do not include underwriting guarantees or standby credit in case notes cannot be sold. The borrowers under such facilities have been of the highest credit rating. They are presumably confident in their ability to sell notes without underwriting services. As a result they are able to save the cost of underwriting.

As noted by Melnik and Plaut (1991), the main borrowers in the euronote market were banks and OECD governments. After 1983, note-issuing techniques rapidly gained popularity, mainly as a low-cost substitute for syndicated credits. High quality corporate borrowers entered the market and became the largest borrowers. Corporate borrowers rose from an average of 40 percent of the market in 1983 to over 70 percent in 1990. On the lending side, the underwriting function of NIFs has been largely performed by international commercial banks, but these banks hold only limited amounts of the paper. According to various estimates non-bank investors purchased about 30 percent of notes issued in 1985. By 1992 non-bank firms held 60 to 75 percent. The principal non-bank investors are money-market funds, corporations, insurance companies, and wealthy individuals. For these investors euronotes offer an alternative to bank certificates of deposit.

Three fees are payable on NIFs: participation or front-end management fees (a single payment whose frequent value is 10 basis points). Underwriting fees between 5 and 15 basis points are paid annually. Finally facility fees are also paid annually. Facility fees range from 5 to 10 basis points, and sometimes rise over the life of the facility. Comparisons of the cost of note issuance facilities and syndicated credits have shown that NIFs are on average between 10 and 40 basis points cheaper than syndicated credits (see Bankson and Lee, 1985; Goodman, 1980; Howcroft and Solomon, 1985). The savings are positive because the lower interest spread usually more than offsets the other fees.

Bibliography

Bankson, L. & Lee, M. (Ed.) (1985). *Euronotes.* London: Euromoney Publications.

Baron, D. P. (1982). A model of the demand for investment banking advising and distribution services for new issues. *Journal of Finance,* **37,** 955–76.

Bloch, E. (1989). *Inside investment banking.* 2nd edn, Homewood, IL: Dow-Jones Irwin.

Courtadon, C. L. (1985). *The competitive structure of the eurobond underwriting industry.* Salomon Center Monograph, New York University.

Freeman, J. L. & Jachym, P. C. (1988). Syndication. (Ed.) Williamson, J. P. *The investment banking handbook.* New York: John Wiley.

Goodman, L. S. (1980). The pricing of syndicated eurocurrency credits. *Federal Reserve Bank of New York Quarterly Review,* **5,** 1020–8.

Howcroft, J. B. & Solomon, C. (1985). *Syndicated lending by banks.* Bangor: University of Wales Press.

Melnik, A. L. & Plaut, S. E. (1991). *The short-term eurocredit market.* Salomon Center Monograph Series in Finance and Economics, New York University.

-------------------------------ARIE L. MELNIK and STEVEN E. PLAUT

P

Persistence of Performance

Performance persistence refers to a portfolio manager's ability to consistently deliver investment returns above (or below) a benchmark return. Persistence means that a manager with a good performance in the past is likely to have superior performance in the future, or that a manager who performs poorly is likely to continue to perform poorly.

The question of whether there is persistence in the performance of professional portfolio managers has long been important, both for academic research and for practical decision making. Investors put a lot of time and money into the process of evaluating managers. Pension fund sponsors pay consultants to identify superior managers, and individual investors seek out funds that are ranked highly by the various fund evaluation services. The empirical evidence of persistence remains controversial. Academics view evidence of persistent abnormal profits as inconsistent with the efficient markets hypothesis. Furthermore, biases present in standard data on manager returns can make it appear that good performance persists, even when it does not.

Methodology for Empirical Testing of Performance Persistence

Empirical tests for the persistence of performance involve two steps. The first is the calculation of a performance measure, usually denoted alpha. The second step is the assessment of how well alpha predicts future performance.

Models for Performance Evaluation

Traditionally, performance is measured by the average portfolio returns, net of a fixed benchmark return, over some historical period. Such an approach uses unconditional expected returns as the performance baseline. It assumes that no information about the state of the economy is used to form expectations.

The unconditional alpha can be calculated in a number of ways. A widely used unconditional alpha is the intercept from a regression of the manager's portfolio return on a benchmark return. A simplified version of this alpha is the average value of portfolio returns in excess of the benchmark. Unconditional alphas have been estimated using various benchmark returns. The capital asset pricing model implies that the market portfolio should proxy for the benchmark. The existence of differences in manager investment styles suggests the use of a benchmark specific to each manager's style (e.g. a small capitalization stock index for "small cap" managers). Unconditional alphas can also be estimated using multiple-benchmark models.

Unconditional measures of performance are known to be biased when managers adjust their risk exposures in response to market conditions. If biases in alpha persist over time, they can distort inferences about the persistence of performance.

Models of "conditional performance evaluation" make expected returns and risks a function of a set of predetermined, publicly available information variables, such as dividend yields and interest rates. Such models can be estimated by regressing portfolio returns on benchmark returns and on the cross-products between benchmark returns and the information variables (see Ferson and Schadt, 1996). The intercept in such a regression is a conditional alpha. Variants of the conditional model include multiple-benchmark models and models in which alpha varies over time as a function of the information variables.

Methodology for Assessing Persistence

One way to assess persistence is to rank managers by their performance and to compare the rankings across time periods. Performance persistence can also be examined by testing for serial correlation in the residuals from a market model regression. Another approach is to estimate a set of cross-sectional regressions in which future performance for a manager is regressed on a measure of past performance.

The choice of the variable representing future performance raises important issues. Some researchers compare future alpha to past alpha. The advantage of this is that alpha is a risk-adjusted measure. The disadvantage is that likely sources of bias in alphas may be correlated over time, creating spurious evidence of persistence in performance. An alternative approach is to relate future returns to past alpha. Future returns are the variable of most practical interest, but they are not risk adjusted.

When cross-sectional regressions are used, regression errors may be correlated, since the returns of the managers are likely to be correlated at a given date. The estimator must take account of this cross-sectional correlation. When the future return horizon is longer than the sampling interval, the time series of slope estimates will be autocorrelated due to overlapping data. The estimates of standard errors must be adjusted for this autocorrelation.

Evidence

The literature on the persistence of mutual fund performance is large and dates back to work by Jensen (1969) and Carlson (1970). The evidence has been mixed from the start: Jensen finds significant correlation between alphas in successive decades, while Carlson reports insignificant rank correlations across decades. More recently, Hendricks et al. (1993) find persistence only up to one year, but Goetzmann and Ibbotson (1994) find persistence at one-month, one-year, and two-year horizons, and Grinblatt and Titman (1994) report persistence over five years. Brown and Goetzmann (1994) report persistence of both superior and inferior performance. However, Shukla and Trzcinka (1994) and Carhart (1995) find that persistence is concentrated in the poorly performing funds, a result also suggested by Jensen (1969).

Only a few studies have examined the persistence of performance for pension fund managers. Christopherson and Turner (1991) find no evidence of persistence in alpha for horizons of one year and five years. Lakonishok et al. (1992) find some persistence in rankings for two- to three-year investment horizons, but no evidence of persistence at shorter horizons. Using conditional performance evaluation models, Christopherson et al. (1996) find evidence of persistence at longer (two- to three-year) horizons, and it is concentrated among poorly performing managers. They report that conditional models provide more power to detect persistence than unconditional measures.

Issues Outstanding

Overall, the evidence on mutual funds and pension funds suggests that there is more persistence at longer horizons than shorter ones and that persistence is concentrated among inferior managers. However, the evidence is not yet conclusive, and a number of issues remain to be resolved.

A key issue is the degree of survivorship bias in manager return data. If investors seek out superior managers and drop inferior ones, then databases of managers are biased towards including the surviving superior managers. This tends to create a bias towards finding persistence of superior performance. In fact, the process by which managers enter and leave databases (and, more generally, the process by which managers are hired and fired) is complicated and merits further investigation.

Another issue is whether managers deliver returns that are larger than portfolio management fees. The determination of fees is particularly difficult when examining the management of pension fund monies, since posted fees are likely to exceed actual fees, at least for some pension fund sponsors.

The finding of persistence among poorly performing managers raises the question of why inferior managers are retained. Is this irrationality on the part of investors? Lakonishok et al.

(1992) suggest that poor managers may provide services, such as research, that investors value and that compensate for poor returns.

The differences in performance persistence between mutual funds and pension funds provide another area for future research. For example, Christopherson et al. (1996) observe that conditional measures can detect persistence in pension fund performance, whereas unconditional measures are sufficient to detect persistence for mutual fund returns. This could indicate that pension fund managers are evaluated in a more sophisticated manner, with the implication that the market for pension fund monies is more informationally efficient.

Bibliography

Brown, S. J. & Goetzmann, W. N. (1994). Attrition and mutual fund performance. New York University. Working paper.

Carhart, M. (1995). On persistence in mutual fund performance. University of Southern California. Working paper.

Carlson, R. S. (1970). Aggregate performance of mutual funds, 1948–1967. *Journal of Financial and Quantitative Analysis,* **5,** 1–32.

Christopherson, J. A., Ferson, W. E. & Glassman, D. A. (1996). Conditioning manager alphas on economic information: another look at the persistence of performance. University of Washington. Working paper.

Christopherson, J. A. & Turner, A. L. (1991). Volatility and predictability of manager alpha: learning the lessons of history. *Journal of Portfolio Management,* **18,** 5–12.

Ferson, W. A. & Schadt, R. (1996). Measuring fund strategy and performance in changing economic conditions. *Journal of Finance,* **51,** 425–62.

Goetzmann, W. N. & Ibbotson, R. G. (1994). Do winners repeat? *Journal of Portfolio Management,* **20,** 9–18.

Grinblatt, M. & Titman, S. (1994). The persistence of mutual fund performance. *Journal of Finance,* **47,** 1977–84.

Hendricks, D., Patel, J. & Zeckhauser, R. (1993). Hot hands in mutual funds: short-run persistence of relative performance, 1974–1988. *Journal of Finance,* **48,** 93–130.

Jensen, M. (1969). Risk, the pricing of capital assets, and the evaluation of investment portfolios. *Journal of Business,* **42,** 167–247.

Lakonishok, J., Shleifer, A. & Vishny, R. (1992). The structure and performance of the money management industry. *Brookings Papers on Economic Activity,* 339–91.

Shukla, R. & Trzcinka, C. (1994). Persistent performance in the mutual fund market: tests with funds and investment advisors. *Review of Quantitative Finance and Accounting,* **4,** 115–36.

------------------------------------DEBRA A. GLASSMAN

Portfolio Management

Portfolio management (Strong, 1993) is concerned with distributing investible liquidity across a range of available assets and liabilities with the objective of providing risks and returns that achieve performance objectives. Portfolio management therefore comprises objective setting (establishing the relative importance of delivering capital and income growth and providing stability of principal and income to actual or prospective investors), asset allocation (where the available funds are distributed across geographic markets and security categories to exploit broad market and currency movements) and security selection (the choice of particular securities in each category that offer the best value in terms of portfolio objectives).

So far as objective setting is concerned this is conducted in either a direct or indirect mode. Direct objectives emerge from detailed customer financial reviews conducted in approved form by financial intermediaries licensed by a regulatory authority. Alternatively pension or insurance fund trustees might set portfolio managers income and growth objectives relative to a specific benchmark such as the *Financial Times*/Actuaries All Share Index. Indirect objective setting arises where portfolios in the form of mutual funds (unit trusts and investment trusts in the UK) are offered to the public in which case the basic strategy in terms of exposure to equities or bonds or to UK, European, or Far Eastern markets will be outlined in a prospectus. Arising from this strategy a benchmark in terms of the growth, income, and capital stability characteristics of a particular index (e.g. European equity, North American bond) will be defined and the security reported in that category by the financial press.

Historically the distinction between portfolio management and investment management arises from new ideas about risk diversification introduced in the 1950s by Harry Markowitz (1952) with the observation that the variability of returns for a collection of assets depended on the correlation of asset returns with each other and not just on the weighted average of the individual assets. Diversifying investments across a range of substantially uncorrelated securities, whether within one country or increasingly internationally (Levy and Sarnat, 1970) provides portfolio managers with lower

Table 1 Sample Portfolio Recommendations (%)

	Equities	Bonds	Cash
MerrillLynch	50	40	15
LehmanBrothers	65	40	10
NikkoSecurities	45	30	5
DaiwaEurope	55	40	5
CreditAgricole	65	35	0
CreditSuisse	30	48	22

Source: *Economist* 7 January 1995, p. 72.

variability for the same return or a higher return for the same variability than any single one of the underlying national or internat1ional securities.

The theory of diversification was developed by Sharpe (1963) and Lintner (1965) to show that where large numbers of securities are used to create a fully diversified portfolio the effect is to eliminate the specific risks relating to each particular asset, leaving only the systematic risk, the common risks to which all securities are exposed. This systematic risk or market risk is effectively equivalent to the riskiness of the market portfolio and provides the reference benchmark for risk pricing used in the capital asset pricing model or CAPM.

Depending on diversification strategy, portfolio management may be active or passive. Passive portfolio management aims to replicate the performance, say, of a particular stock index by neutral weighting whereby asset distribution in the portfolio matches the proportions of each asset or asset class in the index to be proxied. In contrast under active portfolio management elements in the portfolio are either overweight (overrepresented) or underweight (underrepresented) relative to the target index. The intention is to produce outperformance relative to the target index by overrepresentation of assets or asset classes expected to outperform the relevant index. Active management therefore involves frequent rebalancing of both the asset allocation and the individual underlying security holdings to reflect changes in the expected risks and returns.

This rebalancing will aim to exploit timing effects. The relative returns for different countries and for the different types of security such as equities bonds and money market balances within a country vary with economic conditions of growth, inflation, etc. By overweighting the portfolio with the asset most likely to outperform under the anticipated economic climate the portfolio manager aims to outperform a portfolio that maintains unchanged weightings throughout the economic cycle.

If the choice of assets is simplified to comprise simply high risk (equity) investments that generally outperform under economic recovery and low risk (bonds and cash) that outperform in conditions of economic slowdown and recession, timing effectiveness can be measured relative to a benchmark portfolio with fixed equity and bond/cash proportions. In principle the benchmark portfolio could be fully invested in equities with the bond/cash proportion zero, but a fund manager wishing to increase equity exposure relative to the benchmark could borrow cash to invest more than 100 percent of portfolio value in equities. Significant leverage (using debt to purchase equities in excess of the total value of the fund) is encountered both in closed end funds and in the speculative hedge funds, but open-ended mutual funds are prohibited from borrowing and in practice most portfolios contain liquidity either to meet imminent liabilities (pension payouts, insurance claims, fund withdrawals) or from uninvested new contributions. To reflect this, the benchmark portfolio might have 20 percent cash/bonds and 80 percent equity. If the equity index yields 7 percent and money market rates are 5 percent an active fund with a 30 percent/70 percent allocation will earn 0.3

× 5 percent + 0.7 × 7 percent or 6.4 percent, an underperformance relative to the benchmark return (0.2 × 5 percent + 0.8 × 7 percent or 6.6 percent) of 0.2 percent.

The timing stances of a variety of funds in respect of cash, bonds and equities are illustrated in a sample of portfolio recommendations published regularly by *The Economist* (Table 1).

Strictly performance comparison between portfolios should specifically adjust for the *ex ante* risks taken by the portfolios, otherwise portfolio managers would simply increase risk levels to improve returns. The CAPM model provides a framework for risk adjustment by using beta or the correlation of returns of a security or portfolio with the returns of the market portfolio as a proxy for riskiness with the market portfolio definitionally having a beta of one. The beta is then multiplied by the risk premium or historical outperformance of equities relative to government bonds to provide a risk adjusted benchmark return. Thus if the risk premium is 7 percent then a portfolio with a beta of 1.5 has to achieve returns 7 percent higher than a portfolio with a beta of 0.5 before outperformance is demonstrated. Unfortunately in recent years the risk premium has been rather volatile: see Table 2.

Table 2 Real Returns on Investment in US dollar terms, 1984–93 annual average.

	Equities	*Bonds*	*Cash*
France	18	14.5	9.5
Holland	17.5	11.5	8
Britain	15	8.5	7.5
Germany	14	9	7.5
Switzerland	13.5	8	6.5
Italy	13	14	9.5
Japan	13	13.5	10
USA	12	11	3
Australia	10.5	11	6
Canada	3.5	11	5.5

Source: *Economist* 14 May 1994.

As an alternative Merton (1981) argued that as returns of an all-equity portfolio are more variable (risky) than an all-bond portfolio, risk differences due to composition should be proxied by using option performance. Perfect timing is equivalent to holding cash plus call options on the entire equity portfolio with benchmark adjustments using reduced options to reflect any equity proportion.

The two best known portfolio performance yardsticks are the Sharpe measure and the Treynor measure. Sharpe (1966) measures return differences from average relative to the standard deviation of returns, while Treynor measures return differences from average relative to beta, or systematic risk.

Within the overall asset allocation, active portfolio management involves security analysis aimed at picking the best value way of investing allocated funds in asset categories such as bonds, deposits, real estate, equities, and commodities. Portfolios, though, mainly emphasize bonds and equities for the simple reason that they have high liquidity (reasonable quantities can be bought or sold at market price) and low transaction costs. In analyzing securities, portfolio managers utilize either fundamental analysis or technical analysis. Fundamental analysis utilizes financial and non-financial data to locate undervalued securities which relative to the market offer growth at a discount, assets at a discount or yield at a discount. Although brokerage houses, among others, invest heavily in such analysis if successful it would contradict the efficient market hypothesis (EMH) which argues that the market prices of securities already incorporate all information in the market and that therefore it is impossible in the long term to outperform the market. Nevertheless, relatively simple transformations such as Gordon's growth model (Gordon, 1963) relating share prices shares to dividends and dividend growth are widely used in security selection. There is an extensive literature, including Fama (1969), on signaling where factors such as dividend changes or investment announcements are used to explain security price changes.

The arbitrage pricing theory APT developed by Ross (1976) provides a more general formal framework for analyzing return differences based on the basis of multiple factors such as industry, size, market to book ratio, and other economic and financial variables.

Not surprisingly, the possibility of beating the passive or buy and hold strategies indicated by the EMH has attracted considerable attention, with Banz (1981) among the first to detect an anomaly in the risk-adjusted outperformance of small firms followed by Keim's (1983) analysis of a January effect. End of month, holiday, and weekend effects together with price/book anomalies have also been reported, but with an overall effect small relative to transaction costs. Despite this limited success market practitioners continue to offer simple guidelines that they have used to produce exceptional returns. Jim Slater (Slater, 1994) reports favorable results for a stock picking exercise that uses principles developed by the legendary Warren Buffett and more recently by O'Higgins and Downes (1992) who report in *Beating the Dow* that picking the ten highest yielding shares from the 30 Dow Jones Industrial Index and then investing in the five cheapest (in dollar price) of these shares produced a gain of 2,800 percent against a 560 percent gain on the Dow over eighteen years. It is unclear, though, what these authors have to gain by disclosing such valuable procedures.

Technical analysis or chartism is an alternative and widely used technique in portfolio management. In direct contradiction to the weak-form version of the EMH, which states that all information contained in past securities prices is incorporated in the present market price, technical analysts use past patterns to project trends. These patterns may be simply shapes described for example as "head and shoulders," "double tops," "flags," and so on or more elaborate short- or long-term trend lines, all of which are used to generate buy or sell signals. Evaluations of technical analysis have generally run into problems because of subjectivity in classifying signals, but recent work in neural networks (Baestans et al., 1994) has provided objective evidence of information in the trend lines used by technical analysts, much of it in non-linear components neglected in some econometric analysis.

The relatively recent development of large, liquid derivative markets – security and index options and futures – has revolutionized the asset allocation process because it allows portfolio managers to proxy the exposure of one asset allocation despite holding a portfolio consisting of a completely different set of assets. A bond or money market portfolio together with equity index futures contracts effectively proxies an equity portfolio. An equity portfolio together with the purchase of put options and sale of call options is similarly equivalent to a fixed interest portfolio. Portfolio managers are able to use derivatives to segment risks asymmetrically. An equity portfolio or index future hedged by put options gives the downside stability of a bond portfolio and the upward opportunities of an equity portfolio. This allows the portfolio manager to create funds with partial or full performance guarantees where investors are offered half any upward movement in the equity market plus the return of their original investment.

Index-based derivatives are particularly popular with portfolio managers because they provide market diversification with very low transaction costs and none of the trading and monitoring activity involved in maintaining a portfolio of securities that mimicked the index. A portfolio manager wishing to hold a long-term position in equities but at the same time wanting a flexible asset allocation will typically use an index transaction to adjust exposure. A sale of an index future on 20 percent of the portfolio is equivalent to a 20/80 bond equity portfolio.

The possibility of altering positions in this way without transactions on the spot market has generated a number of new techniques. Program trading, for example, involves buying or selling bundles of shares. A portfolio manager with a bundle of shares that provide an adequate proxy for the market index may use programme trading to arbitrage between the spot market and index futures, with the transaction itself being computer initiated. In other words if index futures rise in value it may be profitable to buy a bundle of shares that proxy the index in the spot market. Alternatively the index future price may fall and a portfolio manager who has bought in the forward market may then program sell in the spot market, depressing the spot market which then transmits a further downward signal to the futures market, arguably increasing the risk of a major price melt down (Roll, 1988).

The second major development is dynamic hedging. Because of the low cost and flexibility of futures markets a portfolio manager can optimize the portfolio on a continuous rather than one off basis. Dynamic hedging incorporates the possibility of new information and the dynamic hedge ratio for a portfolio reflects the quantity of an option that must be traded to eliminate a unit of risk exposure in a portfolio position. This depends on the delta, which measures the sensitivity of the value of an option to a unit change in the price of the underlying asset, and/or the ratio of the dollar value of the portfolio to the dollar value of the futures index contract multiplied by the beta or systematic risk of the portfolio.

Bibliography

Baestans, D., Van den Berg, W. M. & Wood, D. (1994). *Neural solutions for trading in financial markets.* London: F. T. Pitman.

Banz, R. (1981). The relationship between return and market value of common stocks. *Journal of Financial Economics,* **9,** 3–18.

Fama, E. (1969). The adjustment of stock prices to new information. *International Economic Review,* **9,** 7–21.

Gordon, M. J. (1963). Optimal investment and financing policy. *Journal of Finance,* **18,** 264–72.

Keim, D. (1983). Size related anomalies and stock return seasonality: further empirical evidence. *Journal of Financial Economics,* **12,** 12–32.

Levy, H. & Sarnat, M. (1970). International diversification of investment portfolios. *American Economic Review,* **60,** 668–75.

Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital bu1dgets. *Review of Economics and Statistics,* **47,** 13–37.

Markowitz, H. (1952). Portfolio selection. *Journal of Finance,* **7,** 77–91.

Merton, R. C. (1981). On market timing and investment performance. I. An equilibrium theory of value for market forecasts. *Journal of Business,* **54,** 363–406.

O'Higgins, M. & Downes, J. (1992). *Beating the Dow; high return, low risk method for investing in the Dow-Jones Industrial Stocks with as little as $5000.* New York: Harper Collins.

Roll, R. (1988). The international crash of October 1987. *Financial Analysts Journal,* **45,** 20–9.

Ross, S. (1976). The arbitrage theory of capital asset pricing. *Journal of Economic Theory,* **13,** 341–60.

Sharpe, W. F. (1963). A simplified model for portfolio analysis. *Management Science,* **9,** 227–93.

Sharpe, W. F. (1966). Mutual fund performance. *Journal of Business,* **39,** 119–38.

Slater, J. (1994). *The Zulu principle revisited.* London: Orion.

Strong, R. A. (1993). *Portfolio construction, management and protection.* St Paul, MN: West Publishing.

Treynor, J. (1965). How to rate management of investment funds. *Harvard Business Review,* **43,** 63–75.

---DOUGLAS WOOD

Portfolio Performance Measurement

The principal activities of a portfolio (or fund) manager are portfolio structuring and adjustment on behalf of a client. The manager uses the client's funds to purchase a portfolio of (generally) risky assets, based on the client's specified objectives and the fund manager's assessment of asset risks and returns, with the aim of beating an agreed target or benchmark of performance. At the end of an agreed period (usually a year), the fund manager's performance will be measured.

The Components of Portfolio Performance Measurement

The questions that are important for assessing how well a fund manager performs are how to measure the *ex post* returns on the portfolio, how to measure the risk-adjusted returns on the portfolio, and how to assess these risk-adjusted returns. To answer these questions, we need to examine returns, risks, and benchmarks of comparison.

Ex Post Returns

There are two ways in which *ex post* returns on the fund can be measured: time-weighted rates of return (or geometric mean), and money-weighted (or value-weighted) rates of return (or internal rate of return). The simplest method is the money-weighted rate of return, but the preferred method is the time-weighted rate of return, since this method controls for cash inflows and outflows that are beyond the control of the fund manager. However, the time-weighted rate of return has the disadvantage of requiring that the fund be valued every time there is a cash flow.

Consider the following table on the value (V) of and cash flow (CF) from a fund over the course of a year:

Table 1 Fund Value and Cash Flow

	0	*6 months*	*1 year*
value of fund	V_0	V_1	V_2
Cash flow		CF	

The money-weighted rate of return is the solution to (assuming compound interest)

$$V_2 = V_0(1+r) + CF(1+r)^{1/2} \qquad (1)$$

or to (assuming simple interest)

$$V_2 = V_0(1+r) + CF(1+\tfrac{1}{2}r) \qquad (2)$$

In the latter case, this implies that

$$\text{Money-weighted rate of return} = \frac{V_2 - (V_0 + CF)}{V_0 + \frac{1}{2}CF} \qquad (3)$$

The time-weighted rate of return is defined as

$$\text{Time-weighted rate of return} = \frac{V_1}{V_0}\frac{V_2}{V_1 + CF} - 1 \qquad (4)$$

If the semi-annual rate of return on the portfolio equals r_1 for the first six months and r_2 for the second six months, then we have

$$V_1 = V_0(1+r_1) \qquad (5)$$

and

$$\begin{aligned} V_2 &= (V_1 + CF)(1+r_2) \\ &= [V_0(1+r_1) + CF](1+r_2) \end{aligned} \qquad (6)$$

Substituting (5) and (6) into (4) gives

$$\begin{aligned} \text{Time-weighted rate of return} \\ &= \frac{V_0(1+r_1)}{V_0}\left[\frac{[V_0(1+r_1) + CF](1+r_2)}{V_0(1+r_1) + CF}\right] - 1 \\ &= (1+r_1)(1+r_2) - 1 \end{aligned} \qquad (7)$$

which is a chain-linking of returns between cash flows.

It is clear that the time-weighted rate of return reflects accurately the rate of return realized on the portfolio. This is because both cash inflows and outflows are beyond the control of the fund manager, and their effects should be excluded from influencing the performance of the fund. This is the case for the time-weighted rate of return, but not the money-weighted rate of return.

Adjusting for Risk

The *ex post* return has to be adjusted for the fund's exposure to risk. The appropriate measure of risk depends on whether the beneficiary of the fund's investments has other well-diversified investments or whether this is his only set of investments. In the first case, the market risk (beta) of the fund is the best measure of risk. In the second case, the total risk or volatility (standard deviation) of the fund is best.

Benchmarks of Comparison

In order to assess how well a fund manager is performing, we need a benchmark of comparison. Once we have determined an appropriate benchmark, we can then compare whether the fund manager outperformed, matched, or underperformed the benchmark on a risk-adjusted basis.

The appropriate benchmark is one that is consistent with the preferences of the client and the fund's tax status. For example, a different benchmark is appropriate if the fund is a gross fund (and does not pay income or capital gains tax, such as a pension fund) than if it is a net fund (and so does pay income or capital gains tax, such as the fund of a general insurance company). Similarly, the general market index will not be appropriate as a benchmark if the client has a preference for high-income securities and an aversion to shares in rival companies or, for moral reasons, the shares in tobacco companies, say. Yet again, a domestic stock index would not be an appropriate benchmark if half the securities were held abroad. There will therefore be different benchmarks for different funds and different fund managers. For example, consistent with the asset allocation decision, there will be a share benchmark for the share portfolio manager and a bond benchmark for the bond portfolio manager.

Measures of Portfolio Performance

There are two performance measures based on risk-adjusted excess returns, each distinguished by the risk measure used. The first is the excess return to volatility measure, also known as the Sharpe measure (Sharpe, 1966). This uses the total risk measure or standard deviation:

$$\text{Excess return to volatility (Sharpe)} = \frac{r_p - r_f}{\sigma_p} \quad (8)$$

where r_p is the average return on the portfolio (usually geometric mean) over an interval, σ_p is the standard deviation of the return on the portfolio, and r_f is the average risk-free return (usually geometric mean) over the same interval.

The second performance measure is the excess return to beta measure, also known as the Treynor measure (Treynor, 1965). This uses the systematic risk measure or beta,

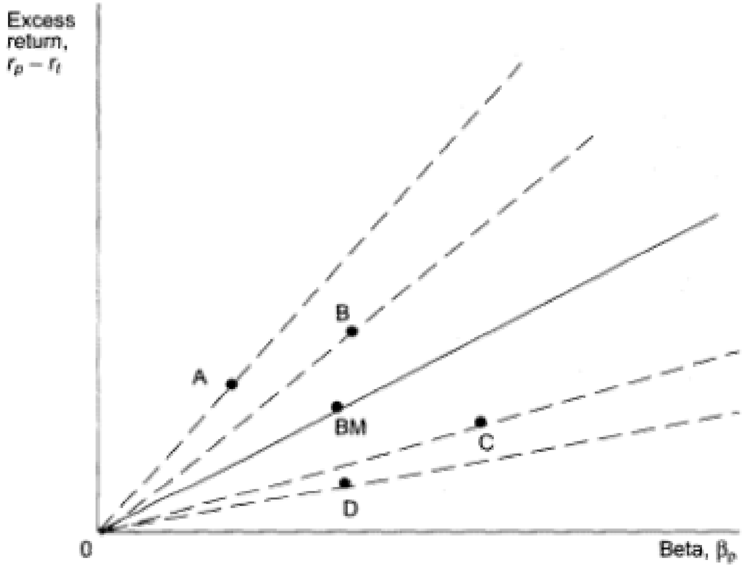

Figure 1Excess return to beta

$$\text{Excess return to beta (Treynor)} = \frac{r_p - r_f}{\beta_p} \quad (9)$$

where β_p is the beta of the portfolio.

The Sharpe measure is suitable for an individual with a portfolio that is not well diversified. The Treynor measure is suitable for an individual with a well-diversified portfolio.

The Treynor measure, for example, is shown in Figure 1: funds A and B beat the selected benchmark (BM) on a risk-adjusted basis, whereas funds C and D did not.

Performance Measures Based on Alpha Values

As an alternative to ranking portfolios according to their risk-adjusted returns in excess of the riskless rate, it is possible to rank them according to their alpha values. Again, two different performance measures are available depending on the risk measure used.

If the risk measure is total risk, the appropriate alpha value is defined with respect to the capital market line:

$$\bar{r}_p = r_f + \left(\frac{\bar{r}_m - r_f}{\sigma_m}\right)\sigma_p \qquad (10)$$

where $\bar{r}_p$ is the expected return on the portfolio, $\bar{r}_m$ is the expected return on the market, and σ_m is the standard deviation of the return on the market.

The corresponding alpha value is

$$\alpha_\sigma = r_p - \bar{r}_p \qquad (11)$$

If the risk measure is systematic risk, the relevant alpha value is defined with respect to the security ma1rket line:

$$\bar{r}_p = r_f + (\bar{r}_m - r_f)\beta_p \qquad (12)$$

The corresponding alpha value is

$$\alpha_\beta = r_p - \bar{r}_p \qquad (13)$$

This is also known as the Jensen differential performance index (Jensen, 1969). Funds with superior investment performance will be those with large positive alpha values.

The Decomposition of Total Return

Having discussed various measures of the performance of a fund, the next task is to identify the sources of that performance. This involves breaking down the total return into various components. One way of doing this is known as the Fama decomposition of total return (after Fama, 1972): see Figure 2. Suppose that fund *P*

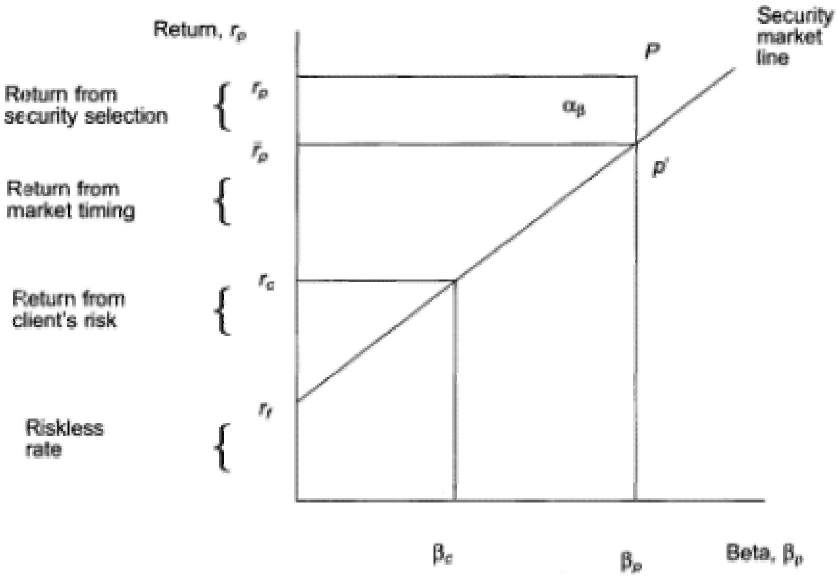

Figure 2 Fama decomposition of total return

generates a return r_p and has a beta of β_p. The fund has performed well over the period being considered. Using the Jensen performance measure, it has a positive alpha value, equal to $(r_p - \bar{r}_p)$. The total return r_p can be broken down into four components:

return on the portfolio = riskless rate + return from client's risk + return from market timing + return from security selection (14)

The first component of the return on the portfolio is the riskless rate, r_f; all fund managers expect to earn the riskless rate. The second component of portfolio return is the return from the client's risk. The fund manager will have assessed the client's degree of risk tolerance to be consistent with a beta measure of β_c, say. The client is therefore expecting a return on the portfolio of at least r_c. The return from the client's risk is therefore $(r_c - r_f)$.

The third component is the return from market timing. This is also known as the return from the fund manager's risk. This is because the manager has chosen (or at least ended up with) a portfolio with a beta of β_p which differs from that expected by the client. Suppose the fund manager has implicitly taken a more bullish view of the market than the client by selecting a portfolio with a larger proportion invested in the market portfolio and a smaller proportion invested in the riskless asset than the client would have selected. In other words, the fund manager has engaged in market timing. With a portfolio beta of β_p, the expected return is r_p, so that the return to market timing is $(\bar{r}_p - r_c)$.

An alternative test for successful market timing is due to Treynor and Mazuy (1966). A successful market timer increases the beta of his portfolio prior to market rises and lowers the beta of his portfolio prior to market falls. Over time, a successful market timer will therefore have portfolio excess returns that plot along a curved line. To test this, a quadratic curve is fitted using historical data on excess returns on the portfolio and on the market:

$$(r_{pt} - r_{ft}) = a + b(r_{mt} - r_{ft}) + c(r_{mt} - r_{ft})^2 \tag{15}$$

where both *b* and *c* are positive for a successful market timer: see Figure 3.

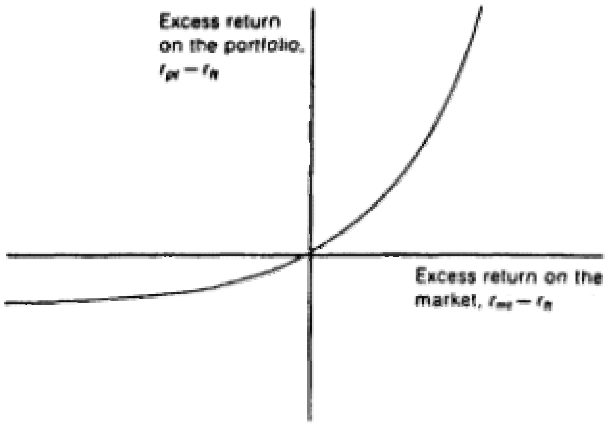

Figure 3 Successful market timing

The fourth component is the return to selectivity (i.e. the return to security selection), which is equal to $(r_p - \bar{r}_p)$.

The decomposition of total return can be used to identify the different skills involved in active fund management. For example, one fund manager might be good at market timing but poor at stock selection. The evidence for this would be that his ($r_p - r_c$) was positive but his $(r_p - \bar{r}_p)$ was negative; he should therefore be recommended to invest in an index fund but be allowed to select his own combination of the index fund and the riskless asset. Another manager might be good at stock selection but poor at market timing; he should be allowed to choose his own securities, but someone else should choose the combination of the resulting portfolio of risky securities and the riskless asset.

The Evidence on Portfolio Performance

A number of studies have tried to measure the performance of fund managers; most of them have involved an examination of the performance of US institutional fund managers. They have examined the managers' abilities in security selection, market timing, and persistence of performance over time.

Studies to determine the ability of fund managers to pick stocks calculate the Jensen alpha values of the funds. Shukla and Trzcinka (1992), using data from 1979 to 1989 on 257 mutual funds, found that the average *ex post* alpha value was negative (–0.74 percent per annum) and that only 115 funds (45 percent) had positive alphas. Similar results were found for US pension funds by Lakonishok et al. (1992). These results suggest that a typical fund manager has not been able to select shares that on average subsequently outperform the market.

However, these results have to be modified when shares are separated into two types: value shares (which have low market-to-book ratios) and growth shares (which have high market-to-book ratios). Fama and French (1992) found a strong negative relationship between performance and market-to-book ratios. Firms with the 1/12th lowest ratios had higher average returns than firms with the 1/12th highest ratios (1.83 percent per month compared with 0.30 percent per month over the period 1963–90), suggesting that value strategies outperform growth strategies.

The market timing skills of fund managers have been examined in papers by Treynor and Mazuy (1966) and Shukla and Trzcinka (1992). Treynor and Mazuy examined 57 mutual funds between 1953 and 1962 and found that only one had any significant timing ability. The later study of 257 funds by Shukla and Trzcinka found that the average fund had negative timing ability, indicating that the average fund manager would have done better by executing the opposite set of trades.

Hendricks et al. (1993) examined 165 mutual funds between 1974 and 1988 for persistence of performance over time, i.e. whether good (or bad) performance in one period was associated with good (or bad) performance in subsequent periods. They found that the 1/8th of funds with the best performance over a two-year period subsequently had an average 8.8 percent per annum superior return over the subsequent two-year period compared with the 1/8th of funds with the worst performance over the same two-year period. But this was the average superior performance, and the performance of individual funds can differ significantly from the average. This is shown clearly in a study by Bogle (1992), who examined the subsequent performance of the top twenty funds every year between 1982 and 1992. He found that the average position of the top twenty funds in the following year was only 284th out of 681, just above the median fund.

All these results indicate that fund managers (at least in the USA) are, on average, not especially successful at active portfolio management, either in the form of security selection or in market timing. However, there does appear to be some evidence of consistency of performance, at least over short periods. But as the saying goes: past performance is not necessarily a good indicator of future performance.

Bibliography

Bogle, J. (1992). Selecting equity mutual funds. *Journal of Portfolio Management,* **18,** 94–100.

Fama, E. (1972). Components of investment performance. *Journal of Finance,* **27,** 551–67.

Fama, E. & French, K. (1992). The cross-section of expected returns. *Journal of Finance,* **47,** 427–65.

Hendricks, D., Patel, J. & Zeckhauser, R. (1993). Hot hands in mutual funds: short-run persistence of relative performance, 1974–1988. *Journal of Finance,* **48,** 93–130.

Jensen, M. (1969). Risk, the pricing of capital assets and the evaluation of investment portfolios. *Journal of Business,* **42,** 167–247.

Lakonishok, J., Schleifer, A. & Vishny, R. (1992). The structure and performance of the money management industry. *Brookings Papers on Economic Activity: Microeconomics,* 339–79.

Sharpe, W. F. (1966). Mutual fund performance. *Journal of Business,* **39,** 119–38.

Shukla, R. & Trzcinka, C. (1992). Performance measurement of managed portfolios. *Financial Markets, Institutions and Instruments,* 1.

Treynor, J. (1965). How to rate management of investment funds. *Harvard Business Review,* **43,** 63–75.

Treynor, J. & Mazuy, K. (1966). Can mutual funds outguess the market? *Harvard Business Review,* **44,** 131–6.

--------------------------------DAVID BLAKE

Price/Earnings Ratio

The price/earnings (P/E) ratio is a valuation tool calculated as current stock price divided by annual earnings per share. The earnings statements from the previous twelve months are typically used, although P/E forecasts are calculated with twelve-month earnings estimates. P/E can be used to value individual stocks or the market as a whole.

Corporate P/E

The P/E ratio is used as a fundamental benchmark to relate a stock's price to corporate performance. The company's management may influence the ratio through accounting practices, the management of growth and market expansion and the capital structure. The price, however, is driven by the investment community's confidence in the predictability of stable or optimistic earnings. This sentiment reflects projections about earnings, profitability, and cost of capital, as well as intangible factors such as confidence in the quality of management and the prospects of the industry.

Graham and Dodd (1934) cite the multiplier of ten as the historically accepted valuation standard before the 1927–29 bull market. Given the volatility of the elements affecting P/E, it is impossible to adhere to firm parameters of "acceptable" rates of valuation. High P/E ratios, which may be 25/1 or more are to be expected for growth stocks with a promising outlook. P/E ratios in the range of 20/1 may be expected for moderate-growth companies with stable earnings.

It is difficult to compare P/E values for companies from one country to another. Differing accounting conventions and methods to state earnings and value assets contribute to distortions which may be hard to control for. Cultural biases towards understating or inflating earnings also affect the validity of comparison.

In the research of stock performance, the P/E ratio has been examined theoretically as it is correlated to other factors such as risk, firm size, and industry effects. The efficient market hypothesis states that security prices reflect all current and unbiased information and that securities with higher risk should bring higher rates of return. Basu (1977) examined the investment performance of stocks and determined that low P/E portfolios earned higher risk-adjusted rates of return than high P/E securities, thus indicating market inefficiency. Banz (1981) examined the "size effect" and determined that small firms have higher risk-adjusted returns than large firms, and that P/E may be a proxy for the size effect. Peavy and Goodman (1983) showed that stocks with low P/E multiples outperform high P/E stocks after controlling for the "industry effect" which occurs when characteristically low or high P/E industries skew the results in an analysis of an undifferentiated group.

Market P/E

The P/E ratio of the S&P 500, FT-A 500 or other market indices may be examined as a predictor of future market profitability as a whole. Bleiberg (1989), however, could conclude only generally that based on historic P/E ratios of the S&P 500 and the distribution of subsequent returns, stock returns will be higher (lower) in the periods following low (high) P/E multiples, and that the market will do better as the P/E ratio falls. He illustrated that from 1959 to 1965 the S&P produced an annualized rate of return of 11.1 percent, despite the fact that the P/E ratio never fell below 16 and quite often hovered at highs between 18 and 22.

The P/E ratio serves best as an indicator of the present sentiments of the investment community, either with respect to one stock or the market as a whole. It can swing with volatility up or down based on the intangible values and estimates used to judge the premium of an issue or the health of the general investing climate. Although general inferences can be made about the patterns which emerge from the trends of the P/E ratio movement, there is no clear evidence that it can be reliably used to profitably time the market.

Bibliography

Banz, R. W. (1981). The relationship between return and market value of common stocks. *Journal of Financial Economics,* **9,** 3–18.

Basu, S. (1977). Investment performance of common stocks in relation to their price-earnings ratios: a test of the efficient market hypothesis. *Journal of Finance,* **32,** 663–81.

Bleiberg, S. (1989). How little we know . . . about P/Es, but perhaps more than we think. *Journal of Portfolio Management,* **15,** 26–31.

Graham, B. & Dodd, D. L. (1934). *Security analysis.* New York: Whittlesey House, McGraw-Hill.

Peavy, J. W., III & Goodman, D. A. (1983). The significance of P/Es for portfolio returns. *Journal of Portfolio Management,* **9,** (2), 43–7.

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Privatization Options

Over the last decade, the sales of state-owned enterprises (SOEs) have reached dramatic levels on a worldwide scale. For instance, in Europe, they are expected to grow at the rate of US$30 to US$40 billion annually till the turn of the century and in Russia alone, 25,000 firms need to be privatized (see Boycko et al., 1994).

In spite of these impressive figures, there is no consensus over the optimal means and financial strategies that are necessary for a successful privatization. Moreover, the empirical evidence regarding the "success" of privatizations in achieving their stated objectives has been mixed. Studies such as those conducted by Kay and Thompson (1986) argue that privatizations did not promote economic efficiency. However, more recent empirical analyses such as Megginson et al. (1994) suggest otherwise.

Alternative Methods of Privatization

At the theoretical level, there is no model that explains the diversity of the methods of sale. It is generally accepted that there is no single "best" method and that each case should be examined on its own merit (see Baldwin and Bhattacharyya, 1991).

Public Offerings of Shares

This option involves the partial or complete sale to the public of an SOE's shares. It frequently dominates alternate modes of privatization and has often been of record-breaking proportions. The offer can be on a fixed price basis, in which case the issuer determines the offer price before the sale. Perotti and Serhat (1993) find evidence from twelve countries that such sales tend to be made at highly discounted fixed price offerings. Alternatively, the offer can be made on a tender basis where the investors indicate the price they are willing to pay.

Private Sales of Shares

In a private sale of shares, the government sells the shares to a single entity or a group. The sale can be a direct acquisition by another corporate entity or a private placement targeting institutional investors. Megginson et al. (1994) point out that France and Mexico systematically used this method to transfer ownership to a few large "core" shareholders.

Pricing strategies involve a negotiation or a competitive bidding process. The disclosure policy can be an auction.

Cornelli and Li (1995) warn that the investor with the highest bid may not necessarily be the one who will run the privatized firm in the most efficient way. They give examples of Fiat, Mercedes-Benz, and Volkswagen which recently acquired majority stakes of several Eastern European car makers. These companies may not necessarily believe that the acquired factories *per se* have great potential value. They may have been motivated to acquire them mainly to gain a foothold in the local markets.

Private Sale of SOEs' Assets

The transaction basically consists of the sale of specific assets rather than the sale of the company's shares.

Fragmentation

This method consists of the reorganization of the SOE into several entities that will be subsequently privatized separately, e.g. the break up of a monopoly.

New Private Investment in an SOE

This operation takes place when the government adds more capital by selling shares to private investors, usually for rehabilitation and expansion purposes. This method dilutes the government's equity position.

Management and Employee Buyout

This transaction refers to the new acquisition of a controlling interest in a company by a small group of managers. Employees can also acquire a controlling equity stake with or without management. The assets of the acquired company are usually used as collateral to obtain the financing necessary for the buyout.

Leases and Management Contracts

These options involve a transfer of control, rather than ownership, to the private sector. In a lease, the lessee operates the SOE's assets and facilities and bears some burden of maintenance and repair in exchange for a predetermined compensation. The lessee has to make the payment regardless of the profitability of the firm.

The management contractor, on the contrary, assumes no financial responsibility for the running of the enterprise. A World Bank report (1995) found that although management contracts have not been widely used, they were generally successful when attempted. Using a worldwide search, they found only 150 management contracts, mainly in areas where output is easily measurable and improvements tangible.

For a review of the techniques discussed above, see also Vuylsteke (1988).

Mass Privatization

Mass privatization is very popular in Eastern Europe and other former centrally planned economies in Central Asia. It involves a rapid give away of a large fraction of previously state-owned assets to the general public. Boycko et al. (1994) cite numerous examples of mass privatization such as free grants of shares to workers and managers in the enterprises employing them; distribution of vouchers to the whole population, with the subsequent exchange of these vouchers for shares in SOEs; and free grants of shares of mutual funds, specially created to manage a portfolio of shares of SOEs, to the whole population.

Pre- and Post-Privatization Options

If the chosen method is through a public equity offering, the government and the new management have several pre- and post-privatization options concerning the strategy to maximize the revenues from such a privatization. Errunza and Mazumdar (1995) assume that a SOE's debt may be perceived as a junior secured debt contract. Thus the risk premium on a SOE's debt is less than that of a comparable private firm. This difference in risk premium is the value of the government's loan guarantee. When a SOE is privatized, this guarantee may be potentially removed leading to a wealth transfer from debt holders to equity holders. Other factors such as production efficiencies, monopoly power, government debt guarantees, tax shields, and bankruptcy costs affect the value of this loan guarantee and hence the potential gains from privatization. Errunza and Mazumdar (1995) believe there are various optimal government financial strategies that would maximize the gains from privatization:

1. The value gains from privatization are likely to be relatively smaller when implemented by governments with overall riskier public sector operations. Further, the government should prioritize its privatization program by selling off its most heavily subsidized firms.

2. The government should prioritize its privatization program by selling off firms from minor sectors first, and under certain conditions, the government could improve the valuation gains to equity holders by undertaking riskier investment strategies prior to privatization. Similarly, value gains from a privatization are higher for firms with the highest levels of debt.

3. A more active role by the government in the management of the company even after privatization may not necessarily be detrimental to the firm's shareholders since it may enhance tax shields and wealth transfers from debtholders. Moreover, to maintain SOE ownership in domestic private hands, appropriate tax subsidies and restrictions should be considered.

4. SOEs that were well managed prior to privatization, or have fully exploited any monopoly power in the product market, or may be handicapped with bureaucratic malaise or trade union pressures after privatization, would be less attractive to investors, *ceteris paribus.* Indeed, the prospects for the new management, of capitalizing on unrealized gains would be smaller under these scenarios.

5. Finally, if post-privatization bankruptcy costs are significant, then the firm may be forced to reduce its debt level as well as opt for safer investments. The first hypothesis is empirically validated by Megginson et al. (1994).

Bibliography

Baldwin, C. & Bhattacharyya, S. (1991). Choosing the method of sale: a clinical study of Conrail. *Journal of Financial Economics,* **30,** 69–98.

Boycko, M., Shleifer, A. & Vishny, R. W. (1994). Voucher privatization. *Journal of Financial Economics,* **35,** 249–66.

Cornelli, F. & Li, D. D. (1995). Large shareholders, private benefits of control, and optimal schemes of privatization. London Business School. Working paper.

Errunza, V. R. & Mazumdar, S. C. (1995). Privatization: a theoretical framework. McGill University. Working paper.

Kay, J. & Thompson, D. (1986). Privatization: a policy in search of a rationale. *Economic Journal,* **96,** 18–38.

Megginson, W., Nash, R. & Van Randenborgh, M. (1994). The financial and operating performance of newly privatized firms: an international empirical analysis. *Journal of Finance,* **49,** 1231–52.

Perotti, E. & Serhat, G. (1993). Successful privatization plans. *Financial Management,* **22,** 84–98.

Vuylsteke, C. (1988). *Techniques of privatization of state-owned-enterprises. Vol. I. Methods and implementation.* Washington, DC: World Bank. Technical paper 88.

World Bank (1995). *Bureaucrats in business: The economics and politics of government ownership.* New York: Oxford University Press. Policy research report.

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Program Trading

The New York Stock Exchange defines a program trade as the simultaneous trading of at least fifteen stocks with a total value of over US$1 million and, since May 1988, has required the reporting of program trades, classified under seventeen categories. These categories include index arbitrage, which accounted for half of NYSE program trading in 1989 (Quinn et al., 1990), index substitution, portfolio insurance, tactical asset allocation, and portfolio realignment. During June 1989, the average program trade on the NYSE was valued at US$9 million and involved shares in 177 different companies (Harris et al., 1990). Program trading is neither defined nor recorded by the London Stock Exchange.

The 1987 stock market crash was initially blamed on program trading in general, and portfolio insurance in particular (Brady, 1988). This blame was based on the possible market impact of these very large trades, and on the feature of some portfolio strategies which require selling (buying) a basket of shares in an already falling (rising) market, so amplifying the initial price movement. However, the general conclusion from a large number of subsequent studies (see Miller, 1988; Furbush, 1989) is that there is little theoretical or empirical evidence to support this view. Subsequent NYSE regulations limit the scope and nature of program trading (e.g. by limiting the use of the Super DOT system) during unusual market conditions.

Program trading involves the simultaneous trading of a basket of shares, and this may or may not involve computers. Although index arbitrageurs use computers both to monitor the relationship between actual and no-arbitrage prices in real time, and to deliver the program trading instructions to the floor of the NYSE (via Super DOT), many non-program traders also rely on computers to provide information on trading opportunities and to submit orders to trade.

One effect of program trading may be to increase the measured volatility of a market index based on trade prices. Usually, roughly equal numbers of shares in the index will have been bought and sold so that the bid–ask spread tends to cancel out. However, just after a program trade to buy (sell) many shares, most of the prices used in the index calculation will be ask (bid) prices and movements in the index will be exaggerated by about half the bid–ask spread. A different effect is that a program trade temporarily ensures that most of the last trade prices are recent, so removing the "stale" price effect (which biases measured volatility downwards). While both of these effects will increase measured volatility, neither of them implies any economically adverse consequences of program trading.

Modest increases in measured US stock market volatility associated with program trading have been found by Duffee et al. (1992) and Thosar and Trigeorgis (1990), while Grossman (1988) found no such increase. A modest increase is consistent with the bid–ask and stale price effects (Harris et al., 1990).

Bibliography

Brady, N. F. (Chairman) (1988). *Report on the Presidential Task Force on Market Mechanisms.* Washington, DC: US Government Printing Office.

Duffee, G., Dupiec, P. & White, A. P. (1992). A primer on program trading and stock price volatility: a survey of the issues and the evidence. *Research in financial services. Private and public policy.* Vol. 4, (Ed.) Kaufman, G. G. Greenwich, CT: Jai Press Inc., 21–49.

Furbush, D. (1989). Program trading and price movement: evidence from the October market crash. *Financial Management,* **18,** 68–83.

Grossman, S. J. (1988). Program trading and market volatility: a report on interday relationships. *Financial Analysts Journal,* **44,** 18–28.

Harris, L., Sofianos, G. & Shapiro, J. E. (1990). Program trading and intraday volatility. NYSE Working Paper No. 90–03.

Miller, M. H. (Chairman) (1988). *Final Report of the Committee of Enquiry Appointed by the CME to Examine the Events Surrounding 19 October 1987.* Chicago Mercantile Exchange.

Quinn, J., Sofianos, G. & Tschirhart, W. E. (1990). Program trading and index arbitrage. *Market volatility and investor confidence.* Report to the Board of Directors of the NYSE New York: Appendix F.

Thosar, S. & Trigeorgis, L. (1990). Stock volatility and program trading: theory and evidence. *Journal of Applied Corporate Finance,* **2,** 91–6.

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Project Financing

During the next decade it is estimated that much more than US$1 trillion will be needed to finance power projects, transport facilities, and other infrastructure around the world. Privatization continues to create a large demand for capital. International consortiums are being formed to finance these large projects. The project finance industry, while it has matured considerably, still faces tremendous risk. Commercial banks were the traditional source of funding for project finance until 1990, when investment bankers started taking large deals to capital markets. Besides traditional project financiers, companies and developers are also turning to pension funds and limited partnerships for capital.

In a general loan, the issuance of securities or simply borrowing the money and the payment of the loan are not specifically associated with the cash flows generated by a given project or economic unit. Generally loan collateral does not have to be generating income to pay for the loan. In contrast, cash flow from the operation of the project is the sole source of return to lenders and equity investors in project financing. The project may be supported through guarantees, output contracts, raw material supply contracts, and other contractual arrangements.

In project financing, securities are issued or loans are contracted that are directly linked to the assets and the income generating ability of these assets in the future. In other words, project financing means that securities are issued or loans are contracted that are based on the expected income generation of a given project or economic unit. By the same token, the collateral, if any, are the assets related to the project or belonging to the economic unit. A project is financed on its own merits and not on the general borrowing ability of the economic unit that is sponsoring it.

Project financing may be called off-balance sheet financing because it may not affect the sponsor's income or balance sheet. It has no effect on the sponsor's credit rating as well because the financing is not provided based on the income generation ability of the sponsor and does not use the sponsor's assets as collateral.

The sponsor of the project to be financed has to show its commitment and possibly give guarantees to the lenders on the repayment of the loans. It is obvious that the lenders will agree to project financing only if they have some sort of commitment from the sponsor, which is the economic unit with assets in place and borrowing power, to back up the project financing and to carry out the projects execution properly. So project financing does not mean that the project is totally independent from the sponsors, who have to show commitment to the project to satisfy the lender's assessment of the project's credit risk.

Sometimes a project cannot be financed off the balance sheet, if it has not commenced yet. Lenders use standard credit analysis tools to verify the project's attractiveness. They do not see the project as equity or as venture capital. Therefore, the sponsor may have to commit resources at the initial stages of the project to get it off the ground and later seek off-balance sheet financing.

There are many reasons for the sponsor to look for project financing. In general, a sponsor would prefer not to have the project reported on its balance sheet, so that it does not affect its financial ratios or credit standing. The sponsor desires that its credit risk and that of the project be judged independently. There could be many reasons why the sponsor would seek project financing, including advantages available only to the project. Some sources of subsidized or favorable financing may only be available for the project itself. The project may be able to meet legal and other restrictions while the sponsor may not. This type of situation often arises when the project is being carried out in a foreign country or in areas of business with special needs.

Project financing is made up of the securities or loans that are contracted by the project, the sponsors and other institutions that may be involved. The securities can be any type of debt securities, from the usual short- and long-term securities such as commercial paper or bonds to other securities particularly designed to tap a specific source or to capture a specific advantage provided by the project. The entities involved may also make a difference. Sometimes it may be better that one of the sponsor's subsidiaries or associated joint ventures will carry out or provide guarantees to the project.

Designing project financing involves executing the appropriate credit analysis of the project with conservative estimates, assessing all the legal, tax, and any other relevant restrictions and advantages stemming from the nature of the project, selecting institutions or entities that should participate in the project in its different stages and determining the securities and types of loans that will be issued. Project financing is a type of financial engineering and participants must carefully analyze several issues including the economics of the transaction, sponsorship, construction, technology, and environmental needs.

Several changes have occurred related to the sources and access to economic development project financing. Capital constraints are increasing the cost of doing business, lenders are requiring additional recourse and guarantees. Equity capital is tight and bank credit criteria have been tightened. Many commercial lending institutions are constrained by regulatory or reserve requirements or internal policies in lending to projects in developing nations as a result of country, political, currency and other risks associated with such lending. Successful financing of projects in developing nations will often require support from the host nation.

Bibliography

Bemis, J. R. (1992). Access to and availability of project financing. *Economic Development Review,* **10,** 17–19.

Forsyth, G. J. & Rod, J. R. (1994). Project finance and public debt markets. *International Financial Law Review, Capital Markets Yearbook,* 5–10.

Nevitt, P. K. (1988). *Project financing.* 2nd edn, London: Euromoney Publications.

Siddique, S. (1995). Financing private power in Latin America and the Caribbean. *Finance and Development,* **32,** 18–21.

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R

Real Options

"Real options" are opportunities (or commitments) to acquire or develop or dispose of real assets at a price determined (or estimated) in the present but settled, or delivered, in the future. Like financial options, there is conceptually an underlying asset, or liability, that determines the option value at termination, but unlike financial options, real options are not commonly traded, are often difficult to identify, and may involve more complex methods for valuation.

Real option theory has been applied to a wide variety of characteristic aspects of projects, including deferring investment commitments, choices in selection, sequential alternative actions, follow-on investment opportunities, and flexibility in projects (including maintenance and/or abandonment).

There are several extensive surveys of real option valuation and applications including Sick (1989), Trigeorgis (1993), and Dixit and Pindyck (1994). This introduction will only cover some critical articles in the development of real option theory, showing some generic analytical solutions and some common applications.

Jevons (1871) was arguably the first to identify real (environmental) options in the prospective utility of a commons which "might be allowed to perish at any moment, without harm, if we could have it re-created with equal ease at a future moment, when need of it arises." Although Merton (1973) believed options are "relatively unimportant financial securities," he believed that a theory of contingent-claims pricing could lead to a unified theory of (speculative) markets and the term and risk structure of interest rates. Myers (1977) showed that option analysis is an appropriate valuation technique for a firm's growth opportunities; Banz and Miller (1978) applied the theory for state-contingent claims to practical capital budgeting; Mason and Merton (1985) argued that the flexibility of a project is "nothing more (or less) than a description of the options made available to management." McDonald and Siegel (1986) studied the optimal timing of investment in an irreversible project; Majd and Pindyck (1987) modeled sequential investment decisions and outlays; and Ingersoll and Ross (1992) argued that almost every project competes with itself postponed, with uncertainty in interest rates.

The valuation of real options is dependent on assumptions regarding the life, variable stability, and payouts on the underlying inputs. This is a short menu of some analytical solutions for real options of increasing complexity.

Almost all contingent-claim pricing models commence with some basic assumptions regarding the diffusion process for the underlying asset of the contingent claim. In line with the conventional approaches, assume that the present value (P) of future cash flows for a project follows a diffusion process such that:

$$dP = \mu(P)dt + \sigma(P)dz_p \qquad (1)$$

where μ = the drift rate of the underlying asset, σ = the annualized standard deviation of P and dz_p = a Wiener process with zero drift and unit variance.

Many authors have provided solutions for the value of any contingent $W(P)$ claim on such a (more valuable) asset as:

$$0.5\sigma^2 W_{pp} + (rP - D)W_p - rW + W_t + \hat{D} = 0 \qquad (2)$$

where the subscripts denote partial derivatives, r is the riskless rate, D is the net payout to the holder of the underlying asset and $\hat{D}$ is any payout on any asset converted into the more valuable asset.

If the real option is a finite-life European option, and the underlying asset value is lognormally distributed with a geometric diffusion process (that is $\mu(P) = \mu$ and $\sigma = \sigma * (P)$ and D is proportional to the price, Merton (1973) showed an analytical solution as:

$$W(P) = e^{-\delta T} P N(d_1) - e^{-rT} K N(d_2) + \frac{\hat{D}}{r}(1 - e^{-rT}) \qquad (3)$$

where N ( ) is the cumulative density formula for a normally distributed variable with zero mean and unit variance, and

$$d_1 = \frac{\ln(e^{-\delta T} P/K) + (r + 0.5\sigma^2)T}{\sigma\sqrt{T}} \qquad (4)$$

and

$$d_2 = d_1 - \sigma\sqrt{T} \qquad (5)$$

where K = the "exercise" price of the option, T = the time to expiration, and δ = the dividend expressed as a continuous return.

If the real option is a perpetual American option, which might be exercised at any time and the project value follows a log-normal process, a solution provided by various authors, including Sick (1989) is:

$$W(P) = \frac{\hat{D}}{r} + \frac{P^*}{\gamma}\left(\frac{P}{P^*}\right)^{\gamma} \qquad (6)$$

where

$$P^* = \frac{\gamma}{\gamma - 1}\left(K + \frac{\hat{D}}{r}\right) \qquad (7)$$

and

$$\gamma = 0.5 + \frac{\delta - r}{\sigma^2} + \sqrt{\left(0.5 + \frac{\delta - r}{\sigma^2}\right)^2 + \frac{2r}{\sigma^2}} \qquad (8)$$

For a similar perpetual real option, with normally distributed prices, Sick (1989) provides an easy solution as:

$$W(P) = \frac{\hat{D}}{r} + \frac{1}{\gamma}e^{\gamma(P - P^*)} \qquad (9)$$

where

$$P^* = \frac{\hat{D}}{r} + K + \frac{1}{\gamma} \qquad (10)$$

and

$$\gamma = \frac{\lambda B - \mu + \sqrt{(\lambda B - \mu)^2 + 2r\sigma^2}}{\sigma^2} \qquad (11)$$

B is the value beta of the underlying asset, $B = \sigma(P)\rho\,(dz_P$ and $dz_{\text{market}})$, and λ is the risk aversion coefficient.

The case where there is a required investment, rather than an exercise price for the real option, and both the investment cost and the present value of the project are risky are described by various authors, including Quigg (1993). Suppose the investment cost (*X*) follows a stochastic process:

$$\frac{\mathrm{d}X}{X} = \alpha_x \mathrm{d}t + \sigma_x \mathrm{d}z_x \qquad (12)$$

and the value of the project *P* follows a similar process:

$$\frac{\mathrm{d}P}{P} = (\alpha_P - x_2)\mathrm{d}t + \sigma_P \mathrm{d}z_P \qquad (13)$$

where x_2 are the payouts on the project, and $\rho \mathrm{d}t$ is the constant correlation between $\mathrm{d}z_X$ and $\mathrm{d}z_P$. Also assume that the drift rates of *X* and *P* can be represented as v_X and v_P, that is expected future cash flows under risk-adjusted probabilities, discounted at the risk-free rate, and the risk aversion coefficients for *X* and *P* are constant parameters, λ_X and λ_P.

The value of such a real option $V(P, X)$ is

$$\begin{aligned} &\tfrac{1}{2}\sigma_X^2 X^2 V_{XX} + \sigma_{XP} XPV_{XP} + \tfrac{1}{2}\sigma_P^2 P^2 V_{PP} \\ &\quad + \nu_X XV_X + \nu_P PV_P - rV + \beta P = 0 \end{aligned} \qquad (14)$$

where β is any annual investment expense (such as alternative or opportunity costs).

For simplification, let $z = P/X$ and $W(z) = V(X, P)/X$, the relative value of the project option to the investment costs, and

$$\omega^2 = \sigma_X^2 - 2\rho\sigma_X\sigma_P + \sigma_P^2 \qquad (15)$$

Then equation (15) is simplified as:

$$\begin{aligned} &\frac{1}{2}\omega^2 z^2 W'' + (\nu_p - \nu_x)zW' \\ &\quad + (\nu_x - r)W + \beta_z = 0 \end{aligned} \qquad (16)$$

In solving this differential equation, assume there is a ratio of project value to the investment costs z^*, at which it is optimal to commence production, and that there are certain other boundary conditions. The solution is:

$$V(P, X) = X(Az^{\epsilon} + k) \qquad (17)$$

where

$$A = (z^* - 1 - k)(z^*)^{-j} \tag{18}$$

$$z^* = \frac{j(1 + k)}{(j - 1)} \tag{19}$$

$$k = \frac{\beta z}{(r - \nu_x)} \tag{20}$$

$$\begin{aligned} j = \omega^{-2}(0.5\omega^2 + \nu_x - \nu_p \\ + [\omega^2(0.25\omega^2 - \nu_p - \nu_x + 2r) \\ + (\nu_x - \nu_p)^2]^{0.5}) \end{aligned} \tag{21}$$

Quigg (1993) applied this model to value development land; Capozza and Sick (1991) used a real option approach to explain part of the discount between leased and "fee-simple" (freehold) land; and Williams (1995) extended real option theory to price real assets with costly search.

Several authors have built on Jevons's real option valuation of natural resources. Brennan and Schwartz (1985) determined not only the value but also the optimal development, management and abandonment decisions regarding mining projects; Paddock et al. (1988) valued offshore petroleum leases; and Bjerksund and Ekern (1990) valued several sequences of petroleum development projects.

Finally, research and development, where there is substantial uncertainty regarding both the research budget and the discovery value, is modeled in Newton et al. (1996). Other areas of production and equipment flexibility are modeled by many authors, such as Triantis and Hodder (1990). Real options are explicit or implicit in many areas of finance, as well as ordinary life, so future research will no doubt cover complex and exotic applications.

Bibliography

Banz, R. W. & Miller, M. H. (1978). Prices for state contingent claims: some estimates and application. *Journal of Business,* **51,** 653–72.

Bjerksund, P. & Ekern, S. (1990). Managing investment opportunities under price uncertainty: from "last chance" to "wait and see" strategies. *Financial Management,* **19,** 65–83.

Brennan, M. J. & Schwartz, E. S. (1985). Evaluating natural resource investments. *Journal of Business,* **58,** 135–57.

Capozza, D. R. & Sick, G. A. (1991). Valuing long-term leases: the option to redevelop. *Journal of Real Estate Finance and Economics,* **4,** 209–24.

Dixit, A. & Pindyck, R. (1994). *Investments under uncertainty.* Princeton, NJ: Princeton University Press.

Ingersoll, J. E. Jr. & Ross, S. A. (1992). Waiting to invest: investment and uncertainty. *Journal of Business,* **65,** 1–29.

Jevons, W. S. (1871, reprinted 1965). *The theory of political economy.* New York: Augustus M. Kelley.

McDonald, R. & Siegel, D. R. (1986). The value of waiting to invest. *Quarterly Journal of Economics,* **101,** 707–27.

Majd, S. & Pindyck, R. S. (1987). Time to build, option value and investment decisions. *Journal of Financial Economics,* **18,** 7–28.

Mason, S. P. & Merton, R. C. (1985). The role of contingent claims analysis in corporate finance. *Recent advances in corporate finance.* (Ed.) Altman, E. & Subrahmanyam, M. Homewood, IL: Irwin. 7–54.

Merton, R. C. (1973). The theory of rational option pricing. *Bell Journal of Economics and Management Science,* **4,** 141–83.

Myers, S. C. (1977). Determinants of corporate borrowing. *Journal of Financial Economics,* **5,** 147–75.

Newton, D. P., Paxson, D. A. & Pearson, A. W. (1996). Real R&D options. *R&D decisions.* (Ed.) Belcher, A., Hassard, J. & Proctor, S., London: Routledge, 273–82.

Paddock, J. L., Siegel, D. R. & Smith, J. S. (1988). Option valuation of claims on real assets: the case of offshore petroleum leases. *Quarterly Journal of Economics,* **103,** 479–508.

Quigg, L. (1993). Empirical testing of real option-pricing models. *Journal of Finance,* **48,** 621–40.

Sick, G. (1989). *Capital budgeting with real options.* Salomon Brothers Center for the Study of Financial Institutions. Monograph Series in Finance and Economics, New York University.

Triantis, A. J. & Hodder, J. E. (1990). Valuing flexibility is a complex option. *Journal of Finance,* **45,** 549–66.

Trigeorgis, L. (1993). Real options and interactions with financial flexibility. *Financial Management,* **22,** 202–24.

Williams, J. T. (1995). Pricing real assets with costly search. *Review of Financial Studies,* **8,** 55–90.

--------------------------------------DEAN A. PAXSON

Regulation of US Equity Markets

The basic concept underpinning much of US federal securities regulation is disclosure regulation. An alternative form of regulation, ignored by Congress but used by some states, is based on the concept of "merit regulation," where government judges the quality of an investment. Thus, federal securities laws are unlike, say, drug regulation by the FDA, where a government agency approves new drugs.

Equity market disclosure is regulated mainly through the Securities Act of 1933 (1933 Act) and the Securities Exchange Act of 1934 (1934 Act). The 1933 Act concentrates on the regulation of distribution of securities in the primary market, while the 1934 Act concentrates on security distribution in the secondary market.

The 1933 Act requires significant disclosures at the time a firm plans to issue new publicly traded securities in an effort to prevent fraud in the sale of new securities. Under the 1933 Act, a firm issuing securities to the public must follow a prescribed registration process. The issuing firm (aided by investment banks) prepares registration documents that require approval by the Securities and Exchange Commission (SEC) before the securities can be sold. A prospectus, the major component of this set of registration documents, must be disseminated to all potential investors. The prospectus details the issuer's businesses and properties, significant provisions of the securities offered, and the management of the issuer, as well as providing financial statements that have been certified by independent public auditors. In addition, due diligence requires anyone who signs a registration statement to investigate the accuracy of the information within the document. The SEC examines completed registration documents for compliance with disclosure requirements. Once the documents are approved by the SEC, the offering can be made to the investing public.

Federal securities laws also regulate underwriter behavior during the selling period, specifically the act of price stabilization. "Stabilization" covers numerous practices, but the commonly accepted definition, outlined in a 1940 SEC release, is "the buying of a security for the limited purpose of preventing or retarding a decline in its open market price in order to facilitate its distribution to the public." Although the SEC recognized that stabilization was a form of manipulation, under Section 9(a)(6) of the Securities Exchange Act of 1934, the SEC deemed stabilization activities as necessary to offset a temporary market glut of securities. Rule 10b-7 of the 1934 Act regulates the stabilization activities of participants in an offering at the time of distribution. First, the intent to stabilize must be disclosed in the prospectus. Second, a valid stabilizing bid must not exceed either the bid of the highest independent bidder or the offer price. Finally, stabilization must cease once the offer is "distributed," that is, when all offered securities are in the hands of the investing public.

The 1933 Act applies to all securities offered to the public in the USA and outlines penalties for deficient registration statements. However, there are exemptions to the provisions of the 1933 Act including offerings to limited numbers of sophisticated investors ("private placements"), intrastate offerings which are instead regulated by the individual states, certain government issued securities, and certain small offerings. Securities offered under one of these exemptions are unregistered and so, cannot generally be resold. This inherent lack of secondary market liquidity adversely affects the primary market value of these securities. To mitigate this problem, the SEC adopted Rule 144A which allows for some secondary trading of securities issued under an exemption, but only among qualified institutional buyers. Rule 144A offers are subjected to significant disclosure and SEC scrutiny.

One intention of the provisions in Rule 144A is to aid foreign issuers of securities. These firms face severe restrictions when issuing securities in the USA, most notably in complying with US registration requirements and accounting standards. Although US exchanges such as the NYSE and Nasdaq would prefer exemptions from some restrictions for foreign issuers, the SEC has resisted most exemptions.

The second major security Act is the 1934 Act which is primarily concerned with the secondary market. Though the 1934 Act has been amended often in response to changing conditions, the theme behind the 1934 Act is, as with the 1933 Act, disclosure. The 1934 Act requires periodic reporting, including 10K filings, by firms with publicly traded securities. Though most regulation of corporate governance is at the state level, the 1934 Act provides for some federal regulation of corporate governance with regulations on proxy solicitations and tender offers. Proxy rules govern: (1) what must be contained in a proxy solicitation; and (2) what contact between a firm and shareholders or between shareholders is considered a proxy solicitation (and is thus subject to regulation). Tender offer regulations, formulated in 1968 with the Williams Act, extend disclosure requirements to anyone making a tender offer for a firm and to investors who hold over 5 percent of the shares of a firm.

Furthermore, the 1934 Act regulates insider trading, short selling, fraudulent, or manipulative acts, and margin requirements. The 1934 Act, as amended by several SEC rules, defines both financial fraud and insider trading. Under the 1934 Act, margin accounts and margin eligibility are regulated by both the SEC and the Federal Reserve Board. The current initial and maintenance margin rates are 50 percent and 67 percent respectively. That is, a qualified investor may borrow up to 50 percent of the value of a portfolio of margin-eligible securities, but is subject to a margin call if the value of this portfolio falls to or below 67 percent of its original value. Margin-eligible securities are securities listed on the NYSE, Amex, or Nasdaq's National Market, as well as other securities deemed eligible by the Federal Reserve Board. In addition, the 1934 Act regulates exchanges and broker-dealers. Under this act, exchanges and broker-dealers must register with the SEC, which also monitors exchange rules.

Finally, the 1934 Act provided for the establishment of the SEC with powers to monitor disclosure and enforce the securities acts and other security laws. Securities regulations can be enforced through three channels. First, the SEC can seek injunctions and monetary penalties for violations of the securities acts. Second, in many cases, violations of the securities acts can lead to civil suits by private party plaintiffs. The Justice Department can pursue criminal penalties for certain violations of the securities acts.

--PAUL SEGUIN

Restructuring and Turnaround

Corporate restructuring and turnaround occurs where there is a major rearrangement of stakeholder claims, possibly including a change of control. The reason for restructuring is underperformance, either relative to industry norms, leading to acquisition, or threatened survival, in which case debtholders gain control and force changes to protect their interests.

In the USA and UK the 1960s saw a merger wave in which conglomerate mergers were a prominent feature. By 1980 industrialists and academics were questioning the performance of large diversified groups, and the decade saw considerable restructuring through divestments and sell-offs, leveraged buyouts, management buyouts, and takeovers. The restructuring is typically asset restructuring or financial (liability) restructuring, although a common theme of all restructuring places greater onus on management to improve the company's performance to avoid takeover and the consequent loss of their own control over assets.

Asset restructuring may involve the sale of property or operating assets, and can be accompanied by leaseback or simple outsourcing of work which was formerly done using the assets which have been sold. For example, the car industry has outsourced increasing numbers of components and design work, so that some manufacturers are now primarily coordinators of design, assembly and marketing, relying on suppliers for the majority of inputs. Asset restructuring also occurs when companies demerge their activities, and distribute free shares in subsidiaries to original shareholders to eliminate a conglomerate discount. This is a common way of disposing of non-core activities, In the UK, ICI did this with Zeneca, and both Williams Holdings and Albert Fisher demerged car dealerships, one by distributing free shares to existing shareholders, and the other by selling 100 percent of the shares in the dealership to institutions.

Financial restructuring changes the liability side of the balance sheet and can generally take two forms. First, debt can be swapped for equity so that a company with a negative net worth balance sheet is recapitalized. This reduces the interest burden of the company and restores the company to solvency, with the expectation that at some point in the future dividends will be paid again; but debt equity swaps dilute the interests of original shareholders, possibly to the point where control is lost. Alternatively, and typically in management buyouts (MBOs) and leveraged buyouts (LBOs), new capital structures are created with a small proportion of equity and substantial debt, some with security over designated assets and some unsecured. These restructurings are often "going private" transactions in which the company (or part of it) is bought out by management or by new owners. The company continues in private ownership until performance and general stock market conditions allow a flotation at a price which gives investors (and managers in MBOs) a suitably high return (often 40 percent + per annum in the first half of the 1980s). Celebrated examples of new ownership restructurings which fall into the LBO category because of the very high gearing associated with the buyout are the Kohlberg, Kravis, Roberts and Co. buyout of R. J. R. Nabisco and the Isosceles buyout of Gateway. Many MBOs are also LBOs because of the level of gearing (50 percent or more of total capital).

Almost all studies show that financial restructuring proposals benefit shareholders. DeAngelo et al. (1984) find that reprivatizing quoted companies gives shareholders gains averaging more than 40 percent. Kaplan (1989a) and Lehn and Poulsen (1989) report similar results. Research into announcements of divestitures, spin-offs or liquidations by Hite et al. (1987), and Bagwell and Shoven (1989) also show large premiums for shareholders.

A number of explanations have been advanced (and tested) for this market reaction. Tax savings might occur if the restructured entity uses large amounts of debt and achieves large tax deductions on interest payments, at the same time as lenders are not generating taxable profits (Gilson et al., 1987). Overpayment by investors may explain part of the premium in post 1985 buyouts (Kaplan and Stein, 1991), but does not provide an explanation for buyouts analysed before then. Transfers of wealth from bondholders may occur, especially in refinancings involving increased leverage. Asquith and Wizman (1990) report that bonds in such events lose an average of 2.8 percent of their value, but that this accounts for at most 6.8 percent of the increase in equity value. The employee–wealth transfer hypothesis (Shleifer and Summers, 1988) argues that the market anticipates enhanced profits and cash flows as employment levels are reduced and/or employee remuneration is cut. Kaplan (1989b), Smith (1990), and Lichtenberg and Siegel (1990) fail to find any significant reduction in employment levels, and Lichtenberg and Siegel do not find any wage reductions. Lowenstein (1985) proposes that manager external investor information asymmetries are important because managers have information about the company and knowledge of potential operating improvements that other investors would not have. Kaplan (1989a), Smith (1990), and Muscarella and Vetsuypens (1990) all present results which fail to support this explanation. Jensen (1986, 1989) argues that leveraged refinancings reduce agency costs and provide new incentives by persuading managers to increase operating cash flows to pay down loans and benefit shareholders, and also by giving the manager a larger stake in the residual profit of the company. Baker and Wruck (1989) and Palepu (1990) offer support to these explanations.

The employee–wealth transfer hypothesis, manager–external investor information asymmetries, and reduced agency costs and new incentive explanations all require operational changes post restructuring, and in many cases this means corporate turnaround and revitalization. Kaplan (1989b) found that companies involved in large MBOs between 1979 and 1985 increased their operating income (before depreciation), reduced their capital expenditures, and increased their net cash flow, relative to industry control samples. The operating income improvements expressed as a percentage of both sales and assets were approximately 20 percent, and the net cash flow to sales and assets approximately 50 percent better than the control groups. The big difference in the levels of improvement from operating income to net cash flow suggest that managers in restructured companies are able to make big savings in working capital and capital expenditure and that this is beneficial at least in the short term to shareholders. These results are corroborated by Smith (1990), and Lichtenberg and Siegel (1990).

So, in conclusion, the corporate restructuring of the 1980s produced gains to shareholders and owner/managers. These were marginally at the expense of bondholders, but not at the expense of employees. Inevitably, these results to a large extent reflect the buoyant economic conditions of most of the decade. The generally depressed state of both the buyout and mergers and acquisitions market suggests that these results may not be generalizable to the more depressed economic conditions experienced on either side of the Atlantic in the first half of the 1990s.

Bibliography

Asquith, P. & Wizman, T. (1990). Event risk, covenants and bondholders returns in leveraged buyouts. *Journal of Financial Economics,* **27,** 195–214.

Bagwell, L. S. & Shoven, J. B. (1989). Cash distributions to shareholders. *Journal of Economic Perspectives,* **3,** 129–40.

Baker, G. & Wruck, K. (1989). Organizational changes and value creation in leveraged buyouts: the case of O. M. Scott and Sons Company. *Journal of Financial Economics,* **25,** 163–90.

DeAngelo, H., DeAngelo, L. & Rice, E. (1984). Going private: minority freezeouts and stockholder wealth. *Journal of Law and Economics,* **27,** 367–401.

Gilson, R. M., Scholes, M. & Wolfson, M. (1987). Taxation and the dynamics of corporate control: the uncertain case for tax motivated acquisitions. *Takeovers and contests for corporate control.* (Ed.) Coffee, J., Lowenstein, L. & Rose-Ackerman, S. New York: Oxford University Press.

Hite, G., Owers, J. & Rogers, R. C. (1987). The market for interfirm asset sales: partial sell-offs and total liquidations. *Journal of Financial Economics,* **18,** 229–52.

Jensen, M. (1986). Agency costs of free cash flow, corporate finance and takeovers. *American Economic Review,* **76,** 323–9.

Jensen, M. (1989). The eclipse of the public corporation. *Harvard Business Review,* **67,** 61–74.

Kaplan, S. (1989a). Manag1ement buyouts: evidence on taxes as a source of value. *Journal of Finance,* **44,** 611–32.

Kaplan, S. (1989b). The effects of management buyouts on operations and value. *Journal of Financial Economics,* **24,** 217–54.

Kaplan, S. & Stein, J. (1991). The evolution of buyout pricing and financial structure in the 1980s. Working paper, University of Chicago.

Lehn, K. & Poulsen, A. (1989). Free cash flow and stockholder gains in going private transactions. *Journal of Finance,* **44,** 771–88.

Lichtenberg, F. & Siegel, D. (1990). The effects of leveraged buyouts on productivity and related aspects of firm behaviour. *Journal of Financial Economics,* **27,** 165–94.

Lowenstein, L. (1985). Management buyouts. *Columbia Law Review,* **85,** 730–84.

Muscarella, C. & Vetsuypens, M. (1990). Efficiency and organizational structure: a study of reverse LBOs. *Journal of Finance,* **45,** 1389–414.

Palepu, K. (1990). Consequences of leveraged buyouts. *Journal of Financial Economics,* **27,** 247–62.

Shleifer, A. & Summers, L. (1988). Breach of trust in hostile takeovers. *Corporate takeovers: causes and consequences.* (Ed.) Auerbach, A. C. Chicago, IL: University of Chicago Press.

Smith, A. (1990). Corporate ownership structure and performance: the case of management buyouts. *Journal of Financial Economics,* **27,** 143–64.

---NICK COLLETT

Retail Banking

Historically retail banking was a relatively simple business. Commercial banks, operating essentially via a branch network, took in consumer deposits which were then usually used to provide loans, in most countries on overdraft, to the corporate sector. In return for deposits held in current accounts the banks provided free transaction services largely by the use of cheques in most developed economies. Personal loans to consumers were also available but did not constitute a significant proportion of a bank's loan portfolio. There was little or no segmentation of the consumer market.

As late as the end of the 1960s electronic personal products were in their infancy, automated teller machine (ATM) networks undeveloped, and credit finance, while accepted as a necessity by commercial banks, was treated as a peripheral and somewhat unsavoury product.

The role of the branch was to provide a complete service range to all forms of clients. The branch manager was expected to both operate as administrator, credit assessor (within narrow limits) and to have knowledge of the domestic services provided by the bank. International services were usually provided by specialist international branches. The system tended to be paper based, negative in customer attitude and focus, slow, expensive, and seriously lacking in marketing and selling efforts (see Channon, 1988).

The structure of the industry in the UK had been stable for over fifty years until 1968 when the first major merger occurred between banks with the creation of the National Westminster. In West Germany the major banks were not really interested in retail banking leaving this to the Landesbank, while in France retail custom was approached in a similar manner to the UK. In the USA retail banking was largely provided by small local institutions due to legal constraints at state level on geographic coverage. An exception to this was the state of California where state-wide branching was permitted. This led to the development of large multi-branch institutions such as the Bank of America, while elsewhere retail banking tended to be the province of local community banks. In Japan, the leading city banks were also much more concerned with corporate clients than with personal customers.

By the mid-1970s around the world retail banking could be considered to be a Cinderella business with personal customers tolerated rather than sought after and many poorer customers predominantly serviced by savings banks, mortgage institutions, and the like which tended to be denied access to the bank-dominated clearing systems, usually with the tacit support of central banks. Interest rates were usually fixed in conjunction with the central banks and competition was minimal.

The Impact of Deregulation

In the mid-1970s Citibank, operators of a branch network in New York, questioned the viability of its retail banking operation. At this time it operated some 260 branches and employed 7,000 people. The bank concluded that retail banking could be viable but only if costs were strictly controlled. Customers were carefully segmented to only service profitable accounts and technology was used to substitute for premises and people.

In addition, led by savings and loans banks, it became normal to offer interest on current accounts and to unbundle interest and transaction costs. Moreover, US regulations provided opportunities to non-banks to offer some retail financial services to selected customer groups which were superior to those offered by the banks themselves and at the same time cost less. The most notable of these was the development of the cash management account (CMA), a product developed by Merrill Lynch for retail customers with over US$20,000 in cash or securities. This new account was to revolutionize retail banking (Kolari and Zardkoohi, 1987).

In 1978, US regulations restricted interest rates paid to 5.25 percent while domestic inflation was high and money market rates were running at some 18 percent. In return for a small annual fee the CMA allowed investors to withdraw bank deposits and place them into the account which aggregated the funds into a mutual fund. Money was invested in the capital markets at the going market rate. At the same time investors were provided with a cheque book and a Visa card. To avoid being classified as a bank and thus being subject to the banking regulations, the two services were operated by Bank One of Columbus, Ohio, one of a new breed of emerging, high technology banks.

Investors also received a comprehensive monthly statement of all transactions conducted using the CMA. The statement showed to investors assets held in money market funds, stocks and bonds, dividends and interest received, securities trading, check and credit card transactions, margin loans taken and paid off and interest charged.

Funds placed in the CMA could be in the form of cash, stocks, and bonds. All cash was placed in one of a series of money market funds which paid interest at market rates. All dividends and interest received were automatically swept into the money market funds unless required to cover transactions incurred. If transactions exceeded available cash then this would automatically trigger sales of assets held in money market funds and if these, too, were inadequate an automatic margin loan could be generated against an account holder's stocks or bonds.

By the mid-1990s the repercussion of the CMA and its derivatives had had a major impact on retail banking around the world. Despite its dramatic success, however, even today few banks have sufficiently developed their information technology capabilities to be able to provide a similar product on a fully integrated basis (Snirreff, 1994).

The success of the money market funds forced regulators to relax control on interest rate ceilings. In addition the use of technology allowed banks, and in particular Citibank, to transform the cost structure of the industry and turn retail banking into an increasingly attractive proposition. By the mid-1980s Citibank had reduced its branch network in New York to 220 branches and its staff to 5,000, yet service quality was improved by the introduction of over 500 ATMs. Market share of assets doubled and profitability increased dramatically. This success was soon mirrored elsewhere, as commercial banks began to rediscover the potential of retail banking and turned away from the blind pursuit of the large corporate market.

Retail Market Diversification

By the mid-1990s commercial banks had rapidly increased the range of retail banking products on offer. This had been stimulated by new moves into the market by other non-banks such as retailers, insurance companies, consumer appliance manufacturers, and the like. Uninhibited by regulatory constraint which applied to banks, these institutions often enjoyed a significant cost advantage over the banks as well as in many cases being more innovative and marketing oriented.

Up until the early 1970s most institutions could be classified as operating in distinct sectors with readily definable boundaries. By the mid-1990s there had been a dramatic convergence of all these specialist institutions such that each tended to operate in the others' traditional marketplace.

Thus banks have become heavily involved in mortgage finance while housing specialists have transformed themselves into full retail banks. Retailers offered credit cards, loans, investment products, insurance, and the like. Capital goods manufacturers and automobile producers provided house finance, leasing, trade finance, credit cards, with a company such as General Electric Capital Services being a market leader in some twenty-six financial service industry segments, including being the largest operator of store credit cards in the world. Increasingly it had become more difficult to precisely define a bank except that such institutions were classified by being subject to bank regulatory authorities, while most non-bank retail financial service providers took great pains to avoid being formally classified as banks.

By 1994, British banks were all involved in investment management products, both debit and credit cards, were introducing telephone banking, personal financial advice, consumer loans, a wide variety of deposit products, interest-bearing transaction accounts, an increasingly diverse range of mortgage products and retail share shops. Overall in Europe, where deregulation had proceeded further, banks had strongly entered the market for insurance products notably for life products. Mortgage protection and household insurance were significant areas in non-life. Keen to increase the throughput of their expensive branch networks, the banks had been relatively successful in developing their insurance business.

Bancassurance or *Allfinanz* was a key element in the developing strategies of many major European banking and insurance groups.

Delivery System Transformation

The traditional vehicle for the delivery of retail banking, the branch network has come under increasing pressure in recent times. This can be attributed to a number of causes. First, the increased diversification of banks has led to specialization, and in particular the separation of corporate and retail banking. As a result, corporate accounts tended to be serviced via specialist corporate branches, and serviced by relationship officers, who are trained to perform a very different task to that of the traditional branch manager. Second, it had become recognized that retail customers did not require a full service range from every branch but rather within a location area simple transaction branches or ATMs could fulfil customer requirements at sharply reduced levels of costs (Prendergast and Marr, 1994). The micromarket concept substitutes low cost, limited service delivery systems within a defined geographic area for full service branches, except where considered essential (Aractingi, 1994).

Third, the role of the branch manager needed to be modified or eliminated by the use of centralized technology. Fourth, further labor savings could be achieved by the use of smart ATMs or in branch machinery and electronic data capture so sharply reducing the number of in branch personnel needed. Fifth, branches had come under serious pressure from alternative delivery systems with dramatically lower costs while also offering customers the opportunity to determine the time and place when they conducted their banking transactions.

These pressures in the mid-1990s were leading an increasing number of banks to rationalize their networks and their employees with little or no loss in customer service or satisfaction. New branch configurations and delivery system combinations are therefore developing rapidly such as the hub and spoke concept (see Channon, 1988). At the same time there had been a rapid move to open plan branch configurations, specialist branches such as mortgage shops, fully automated branches and limited service operations. Despite these efforts, however, the cost of operating branch networks remained high. In the UK the average cost–income ratio for operating a retail branch network was around 55 percent. This compared very unfavorably with a telephone banking operation where nearly all banking services, except cash dispensing, twenty-four hours per day and year round could be provided with a cost–income ratio of as low as 20 percent.

Other Delivery System Alternatives

In addition to telephone banking which by 1995 in the USA already accounted for some 25 percent of transactions, other new delivery systems included smartcards (which can be used as a substitute for cash), smart ATMs, home banking, and virtual reality systems either in branches or via home computer systems. Substantial experimentation was underway around the world in each of these alternative service delivery mechanisms and by the millennium it is expected that the further cost pressure would result in additional sharp rationalization and re-engineering of traditional branch-based banking.

Future Prospects

Retail banking has evolved rapidly since its Cinderella position at the beginning of the 1970s. Technology has resulted in many new non-traditional entrants able to gain competitive advantage, a massive increase in consumer product choice and mode of service delivery, strategic convergence between historically separated financial service providers, separation of corporate from retail banking, a move to electronic versus paper based systems and the adoption of a marketing orientation.

For the future, traditional branch-based retail banking can expect to continue to decline, integrated data bases will permit even more refined customer segmentation and product design, staff numbers will continue to fall as paper-based systems are converted to electronic systems and the customer determines the time, the place, the institution, and the product to be used in retail banking operations.

Bibliography

Aractingi, E. (1994). The next great downsizing initiative. *Journal of Retail Banking,* **16,** 19–22.

Channon, D. F. (1988). *Global banking strategy.* New York: John Wiley.

Kolari, A. & Zardkoohi, A. (1987). *Bank costs, structure and performance.* Lexington, MA: D. C. Heath.

Prendergast, G. & Marr, N. (1994). Towards a branchless banking society. *International Journal of Retail and Distribution Management,* **22,** 18–26.

Snirreff, D. (1994). The metamorphosis of finance. *Euromoney,* **25,** 36–42.

--DEREK CHANNON

Risk Analysis

Risk can be simply defined as exposure to change. It is the probability that some future event, or set of events, will occur. Hence, risk analysis involves the identification of potential adverse changes and the expected impact on the organization or portfolio as a result. There are many types of risk to which organizations can be exposed, some that are more easily identified and quantified and others that seem beyond control. A few of the more common risks that require analyses and management include price (or market) risks, credit (or default) risks, legal and regulatory risks, and operational risks.

When evaluating risks, a deviation in an outcome from that which is expected is not necessarily for the worse. In fact, with unbiased expectations, propitious deviations are just as likely as unfavorable ones. Nevertheless, downside risks, or the possibilities of unwanted outcomes, are typically of greatest interest to analysts. For example, in the first half of 1986, world oil prices plummeted, falling by more than 50 percent. While this was a boon to the economy as a whole, it was disastrous to oil producers and companies that supply machinery and equipment to energy industry producers. How could companies that are sensitive to changes in oil prices manage the risks associated with a downward plunge in the price of oil?

Generally speaking, there are three different ways to manage financial risks: purchase insurance, proactively manage the firm's assets and liabilities, and hedging. These approaches are not mutually exclusive; they can be used alone or in conjunction with one or both of the other two approaches.

The first approach, buying insurance, is only viable for certain types of financial risk: predictable risks whose probabilities can be assessed with a fairly high degree of certainty. Insurable risks typically include the risk of loss from fire, theft, or other disaster. Insured organizations pay an insurance premium for the removal of the risk. In effect, the insured risks of many individual firms are transferred to the insurer, but, because the individual risks are not highly correlated (that is, they are unsystematic) the insurer's per firm risk is quite small. In other words, since the risks are independent of one another, the premiums received from all the firms tend to offset the payments to the firms that suffer a loss. This is a simple application of portfolio theory.

The second approach to managing financial risks involves the careful balancing of a firm's assets and liabilities so as to meet the firm's objectives and minimize its risk exposure. The key to using this approach is holding the right combination of on-balance sheet assets and liabilities. Ideally, asset/liability management should strive to match the timing and the amount of cash inflows from assets with the timing and the amount of cash outflows from liabilities. However, precisely matching cash flows can be extremely difficult and expensive. Therefore, firms should concentrate instead on making the value difference between assets and liabilities as insensitive to exogenous shocks as possible. This is commonly referred to as portfolio immunization.

The final approach, hedging, involves the taking of offsetting risk positions. This is similar to asset/liability management except that hedging usually involves off-balance sheet positions. A hedge is a position that is taken as a temporary substitute for a later position in another asset (liability) or to protect the value of an existing position in an asset (liability) until the position can be liquidated. The financial tools most often used for hedging are forwards, futures, options, and swaps. Collectively, these tools are commonly referred to as derivative instruments, or derivative contracts.

The appropriate approach to managing financial risks depends on the complexity of the risks and the sophistication of the risk manager. Risks that are insurable and more easily priced can be managed by purchasing insurance. However, most financial risks are not insurable. Thus, risk managers often employ either asset/liability management techniques or hedging strategies. While these two approaches to risk management are similar, the former usually involves on-balance sheet positions and the latter off-balance sheet activities. However, hedging strategies are often superior to asset/ liability management activities because they can be implemented quicker and often do not require the sacrifice of better, more profitable, opportunities.

Bibliography

Fabozzi, F. J. & Zarb, F. G. (Ed.) (1986). *Handbook of financial markets: Securities, options and futures.* Homewood, IL: Dow Jones-Irwin.

Knight, F. H. (1921). *Risk, uncertainty and profit.* New York: Houghton Mifflin.

Smith, C. W., Jr. (1995). Corporate risk management: theory and practice. *Journal of Derivatives,* **3,** 21–30.

-----------------------------------THOMAS F. SIEMS

Rollover Risk

Traders will often maintain a long-term position in a futures market by holding a contract until near to its maturity, closing out the position and establishing a new position of similar size in a contract with a longer maturity. This is known as rolling a position forward. In following such a strategy the trader faces certain risks which would not arise if he had maintained a position in a single long-dated futures contract.

In particular the strategy is affected by the difference between the price at which the old contract is terminated and the new contract is entered into. The price difference between futures contracts on the same underlying asset but with different maturities is known as a calendar spread. The spread is predictable if the futures contracts are trading at their theoretical fair value. However, futures contracts often trade at a premium or discount to fair value, and this gives rise to rollover risk.

Suppose, for example, that the trader wants to be long on a futures contract. If the futures contract which he holds is trading at a discount to fair value and the contract which he wants to roll into is trading at a premium, then the trader will make a loss on rolling over. He is selling cheap and buying dear. Clearly, the position could well be the other way round, in which case the trader would make a rollover gain.

In principle, the trader could avoid rollover risk by entering into a futures contract whose maturity extends at least as far as the horizon over which the trader wants to maintain the position. In practice, there are a number of reasons why the trader may not wish to do this. First, there may not exist any traded futures contracts with a sufficiently long maturity. Second, the longer-dated contracts which are traded may be illiquid. In most futures markets much of the liquidity is in the contracts closest to maturity. The bid–ask spread tends to be narrower, and it is generally possible to deal in larger size in short-dated contracts. Third, rollover risk represents an opportunity as well as a danger. If the trader can forecast the behavior of the calendar spread, the strategy of rolling from contract to contract may have a lower expected cost than a strategy of maintaining a position in a single long-dated contract.

Rollover Risk in the Commodities Market

The issue of rollover risk has come into particular prominence since the substantial losses incurred by the German company Metallgesellschaft and its US oil refining and marketing subsidiary MGRM. In brief, MGRM sold oil forward on long-term fixed price contracts and hedged itself by buying short-dated oil futures, and similar over the counter products, which it rolled forward. As the oil price fell it was required to fund its futures position; eventually the position was closed out in 1994 with MGRM incurring substantial losses (see Culp and Miller, 1995).

The nature of the risks taken by MGRM can be understood by considering a very simple world with zero interest rates where an agent at time 0 writes a forward contract to deliver one barrel of oil in T months time at a price of US\$$K$/barrel. The agent hedges himself by buying one-month futures and holding them to maturity, rolling forward monthly. At time T he buys the oil on the spot market and delivers it to the client. Assume that each month the futures contract final settlement price is equal to the spot price, the agent's profit on the whole strategy is:

$$K - S(0) + \sum_{t=0}^{T-1}[S(t) - F(t)]$$

where $S(t)$ is the spot price of oil at time t and $F(t)$ is the futures price at time t for a futures contract with one month to maturity.

This equation shows that the profit can be decomposed into two parts. The first is the difference between the contract price and the spot price, both of which are fixed at the outset. The second is related to the difference between the spot price and the contemporaneous futures price over the life of the contract.

Historically the oil market has tended to be in backwardation. The near-term future has tended to trade above the longer maturity future for much of the last decade. So the second term in the equation has generally been positive. There has been much discussion about why this has occurred and whether it can be expected to persist (see Litzenberger and Rabinowitz, 1995).

Spot and futures prices are tied together by arbitrage trades. The cash and carry relation means that the future price should equal the spot price less the yield from holding the asset (the convenience yield less any storage costs) plus the cost of financing. If the spot is high relative to the futures, agents who have surplus oil will earn high returns by selling the oil spot and buying it forward. Conversely if the spot is low the arbitrage trade involves buying the spot, storing it and selling it forward.

The relationship is not very tight. The costs of performing the transaction may be quite substantial. Furthermore, neither the convenience yield nor the cost of storage is constant; they will tend to vary substantially with the level of inventory. If there are large inventories the marginal storage cost will be high, the marginal convenience yield will be low and the future may trade at a premium (contango) without permitting arbitrage. When inventories are low, the converse may hold, and the future will trade at a discount (backwardation).

The significance of rollover risk in a long-term hedging strategy depends on the stability of the term structure of oil futures prices. Culp and Miller (1995) and Mello and Parsons (1995) offer conflicting views of this in the specific context of the Metallgesellschaft case.

Rollover Risk in the Financial Markets

Rollover risk tends to be smaller with financial futures than with commodity futures. Storage costs for the underlying asset (a bond, or a portfolio of shares) are much lower and more predictable than for commodities. The yield from owning the underlying asset is the coupon or dividend on the financial asset which can normally be predicted rather precisely, at least in the short term.

Nevertheless the arbitrage between the future and the spot asset is neither costless nor riskless. This means that financial futures do not trade exactly at their theoretical value. To the extent that the difference between the two is hard to predict, rollover risk is a problem for the trader who is rolling over financial futures contracts just as it is for commodity futures.

Bibliography

Culp, M. & Miller, M. (1995). Metallgesellschaft and the economics of synthetic storage. *Journal of Applied Corporate Finance,* **7,** 62–76.

Hotelling, H. (1931). The economics of exhaustible resources. *Journal of Political Economy,* **39,** 137–75.

Litzenberger, R. H. & Rabinowitz, N. (1995). Backwardation in oil futures markets: theory and empirical evidence. *Journal of Finance,* **50,** 1517–45.

Mello, A. & Parsons, J. E. (1995). Maturity structure of a hedge matters: lessons from the Metallgesellschaft debacle. *Journal of Applied Corporate Finance,* **8,** 106–18.

-----------------------------------ANTHONY NEUBERGER

S

Scrip Dividend

Scrip dividend is the practice of offering shareholders the option to receive shares in lieu of cash when companies make a distribution. In the UK, the popularity of this option has grown significantly in recent years. The total number of companies that offered the scrip dividend option rose from 67 in 1987 to 202 in 1992, an average increase of more than 20 percent a year. While other forms of dividend distributions, such as cash dividends and share repurchases, are mandatory and involve cash outflows, scrip dividend payment does not affect the firm's cash position and it is offered as an option whereby shareholders are able to choose between receiving dividends in cash or their equivalent in the form of shares.

The method of paying scrip dividends in the United Kingdom is different from the way stock dividends and/or dividend reinvestment plans are offered in other countries. For example, unlike stock dividends offered in the USA, where the recipient shareholder is not taxed and does not generally have an opportunity to opt for cash (e.g. McNichols and Dravid, 1990), scrip dividends entitle the shareholder to choose between the offered share (the scrip) and the cash and both these alternatives are taxed at the personal income tax rate. Moreover, the scrip dividend option is different from dividend reinvestment plans adopted by many companies in Australia where the newly issues shares are normally at a discount of 5–10 percent (e.g. Chan et al., 1993). With scrip dividends companies are capitalizing part of their distributable profits in order to issue new shares without any discount offered.

Scrip dividends are a cheaper means of acquiring shares because shareholders are not charged brokerage fees, commission or any other costs for the allotment of shares. They also provide issuing firms with an ideal opportunity to retain cash without altering their dividend payout policies to meet fixed charges in particular in the period of severe recession. Moreover, given that scrip dividends allow a firm to retain cash, they reduce the cash shortage problem (e.g. Eisemann and Moses, 1978).

Under the classical system of corporation tax where the taxation of dividends at the firm level and in the hands of shareholders is not linked, scrip dividends, like stock dividends in the USA, are a cosmetic financial manipulation with no effect on the firm and its shareholders (e.g. Lakonishok and Lev, 1987). On the other hand, in an imputation system such as the one in operation in the UK, scrip dividends allow firms to save in taxes because, unlike cash dividends, scrip dividends are not subject to the advanced corporation tax. Firms can thus retain cash and avoid potential tax loss. However, the firms' tax savings are not likely to be shared by all shareholders because the tax credit on scrip dividends can only be claimed by tax-paying investors. Tax-exempt investors forgo the tax credit when they opt for scrip dividends and, as a result, their after-tax return from scrip dividends is likely to be lower than that on cash dividends. Therefore, tax-exempt investors will prefer cash rather than scrip dividends and shareholders whose cash dividend income is taxed at a higher rate than capital gains will prefer scrip dividends for which the firm will issue additional shares. Given that tax-exempt investors are the largest group in the London Stock Exchange the take-up rate of the scrip in the UK amounts to an average of 4 percent. To increase the take-up rate, a number of companies have offered recently an enhanced scrip dividends where the notional dividend used to compute the number of shares offered is higher than cash dividend by up to 50 percent.

Empirically, Lasfer (1995) showed that firm's decision to issue scrip dividend is not motivated by taxes, cash shortage, or signaling. Instead, managers appear to retain cash through scrip dividends to maximize their own utility.

Bibliography

Chan, K. K. W., McColough, D. M. & Skully, M. T. (1993). Australian tax changes and dividend reinvestment announcement effects: a pre- and post-imputation study. *Australian Journal of Management,* **18,** 41–62.

Eisemann, P. C. & Moses, E. A. (1978). Stock dividends: management's view. *Financial Analysts Journal,* **34,** 77–80.

Lakonishok, J. & Lev, B. (1987). Stock splits and stock dividends: why, who and when. *Journal of Finance,* **42,** 913–32.

Lasfer, M. A. (1995). Firms' characteristics and the payment of scrip dividends. *Working paper 95/3,* Centre for Empirical Research in Finance and Accounting, City University Business School.

McNichols, M. & Dravid, A. (1990). Stock dividends, stock splits and signalling. *Journal of Finance,* **45,** 857–79.

----------------------------------M. AMEZIANE LASFER

Securitization

Securitization is a process through which illiquid claims such as loans can be converted into liquid claims that can be sold and traded among third parties. The term is associated with two different but related phenomena: (1) disintermediation processes that allow for direct access to the security markets by companies that traditionally relied on bank funding (reflected, for instance, in the growth of the junk bond and commercial paper markets during the 1980s); and (2) the processes of off-balance sheet securitization (OBS), that enable banks to transfer part of their assets to third parties, retaining their monitoring and management functions and some exposure to credit risk, but avoiding their traditional role as direct providers of the funds. The process of OBS is simplified where the assets to be securitized are standardized (or standardizable) and can be bundled into well-diversified portfolios. Many of the traditional assets held by banks (home mortgage loans, credit card receivables, lease contract receivables) meet these requirements and are routinely transferred to non-bank institutions or into securities markets in the form of tradable securities.

Securitized assets of this kind have been common, especially in the USA, since the mid-1960s. However, a major surge in securitization deals occurred in the 1980s, influenced by the results of and the experience acquired with the US government mortgage-backed securities program. Home mortgages are still by far the biggest asset type in securitization deals, but a whole range of different assets – automobile receivables, commercial loans, commercial mortgages, consumer loans, lease receivables, interbank loans, and local authority loans, etc. – are suitable for securitization. The success experienced in the US market has stimulated comparable activity in most leading international financial centers. Despite the difficulties created by the idiosyncrasies of different regulatory and legal systems, the beginning of the 1990s saw the securitization procedures widely used in Canada and Australia as well as in several European financial markets.

Disintermediation-type securitization bypasses financial intermediaries with direct access to the financial markets changing the nature of the initial asset originated by the credit process but not involving any innovation by intermediaries or any real novelty in the nature of the securities available. OBS in contrast, tends to split up the customary intermediation components of the bank lending function. Traditionally, banks were largely self-funding and dealt simultaneously with the origination, funding, monitoring, and service of their loans. This demanded substantial resources to acquire the necessary expertise and scale in each area. With the development of securitization, banks no longer need to balance deposits with loans and can concentrate resources on only part of the process.

The literature on securitization has focused on two main topics: the reasons for the development of the process, and the expected consequences for the banking industry. The success of the securitization, as with all financial innovation, depends on creating more value for the economic agents involved, than the available alternatives. Securitization must provide securities whose after tax cash-flow structure could not be replicated by any of the securities (or combinations of securities) previously available.

The literature suggests several reasons why securitization processes add value in relation to the classic intermediation processes. OBS was stimulated by changes in regulatory requirements and tax laws during the 1980s, which effectively increased the cost of the reserves absorbed by assets on banks' balance-sheet (Benston, 1992; Kim and Santomero, 1988). Securitization allowed intermediaries to obtain origination fees but to remove assets from their balance sheets. Another advantage arises from improved risk management, because securitization allows intermediaries to buy or sell assets to create an efficient portfolio irrespective of any industry or sector bias in their loan origination, giving banks the freedom to specialize and exploit available scale economies. The transaction costs of securitization have also fallen sharply as technology has improved. Finally, securitization creates assets which have substantial liquidity advantages over the traditional lending instruments and this is reflected in more competitive funding costs.

But intermediaries are not the only beneficiaries from securitization. Non-financial companies are attracted by the low funding costs and high liquidity of securities markets and so have a strong incentive to approach the market directly. They may also perceive the agency relationship inherent in the classic bank lending process as more difficult to manage than the more transparent procedures involved in traded securities. The availability of external ratings from specialists such as Dun and Bradstreet enables industrial companies to bypass the monitoring function in the traditional bank lending system and to access markets on the basis of their own reputation. This option is generally attractive where a company has a lower risk rating than its potential financial intermediaries.

There are two competing views on the future impact of securitization in banking industry. Some authors argue that securitization will continue to generate new products capable of transferring an increasing portion of the banks' assets to the financial markets (Ocampo and Rosenthal, 1988; Bryan, 1988). Others argue that it will be very difficult for this growth to be sustainable in the long term (Benston, 1992; Sinkey, 1992), with securitization likely only for assets amenable to formal actuarial analysis. Variable rate securities or securities with early retirement, call, conversion, or other contingent features are much harder to value. As a result, banks still have a comparative advantage in the evaluation and control of credit risk which offers flexibility to borrowers that is difficult to obtain in the securities market.

Although some effort has gone into empirical analysis of the securitization process, a number of key issues are still a matter of debate:

1. How significant are standard regulations and fiscal rules in the success of securitization?

2. In what circumstances is securitization able to create value? Are the gains obtained by more creditworthy borrowers at the expense of weaker borrowers?

3. Will banks increase the use of securitization to achieve a fundamental change in their funding structure?

4. What impact will the trend to securitization have on the stability and soundness of the banking system? What plausible implications will the securitization have for the development of monetary and financial policies?

5. Will securitization lead to a major reversal in the trend towards universal banking?

Bibliography

Benston, G. J. (1992). The future of asset securitization: the benefits and costs of breaking up the bank. *Journal of Applied Corporate Finance,* **5,** 71–82.

Benveniste, L. M. & Berger, A. N. (1987). Securitization with recourse: an instrument that offers uninsured bank depositors sequential claims. *Journal of Banking and Finance,* **11,** 403–24.

Berger, A. N. & Udell, G. F. (1992). Securitization, risk, and the liquidity problem in banking. *Structural change in banking.* (Ed.) Klausner, M. & White, L. J. Homewood, IL: Irwin Publishing.

Bryan, L. L. (1988). Structured securitized credit: a superior technology for lending. *Journal of Applied Corporate Finance,* **1,** 6–19.

Greenbaum, S. I. & Thakor, A. V. (1987). Bank funding modes: securitization versus deposits. *Journal of Banking and Finance,* **11,** 379–401.

Kareken, J. H. (1987). The emergence and regulation of contingent commitment banking. *Journal of Banking and Finance,* **11,** 359–77.

Kim, D. & Santomero, A. M. (1988). Risk in banking and capital regulation. *Journal of Finance,* **43,** 1219–33.

Ocampo, J. M. & Rosenthal, J. A. (1988). The future of credit securitization and the financial services industry. *Journal of Applied Corporate Finance,* **1,** 90–100.

Pavel, C. A. (1989). *Securitization: The analysis and development of loan based asset-backed securities markets.* Chicago, IL: Probus.

Sinkey, J., Jr. (1992). *Commercial bank financial management in the financial services industry.* 4th edn, New York: Macmillan.

Stone, C., Zissu, A. & Lederman, J. (Ed.) (1993). *The global asset backed securities market: Structuring, managing and allocating risk.* Chicago, IL: Probus.

---------------------------------J. AZEVEDO PEREIRA

Share Repurchases

The purchase by a company of its own shares is an alternative to cash dividend distribution. This practice involves using surplus cash and/or debt to buy back in the marketplace a proportion of the issued share capital. In the UK the ability of a company to repurchase its own shares was introduced in the Companies Act 1981. Share repurchases are now an accepted tool of corporate financial management in most major developed markets (Barclay and Smith, 1988; Bagwell and Shoven, 1989; Rees and Walmsley, 1994).

The accounting treatment of share repurchases differs across countries. In the United Sates, shares acquired by the issuing company can either be retired or continue to be held as treasury stock in the published balance sheet for future resale. These shares are issued but not outstanding; they cannot be voted, they pay or accrue no dividends, and they are not included in any of the ratios measuring value per common share. In contrast, in the UK, shares repurchased by a company must be cancelled so that they cease to exist.

Firms can either use the open market or the tender offer method to repurchase their own shares. Under the open market repurchase method, a firm can simply enter the market and repurchase shares without revealing its identity unless the disclosure is required by law. The tender-offer method involves the declaration of intention and the purchase of substantial proportions of equity at a significant premium.

There are a number of motives for share repurchases. Given that they are a substitute for cash dividends, share repurchases can be used by firms to reduce their shareholders tax liability. They are also used to provide for the exercise of stock options and warrants and the conversion of convertible securities. A company subject to a takeover bid can use share repurchases to counter the tender offer (Bagnoli et al., 1989; Sinha, 1991). Share repurchases allow firms to alter their debt to equity ratio in particular when debt is issued to finance the acquisition of shares.

In the academic literature, the signaling motive has emerged as one of the most important explanations for share repurchases (Dann, 1981; Vermaelen, 1986; Ikenberry et al., 1995). The signaling approach is motivated by asymmetric information between the market and a firm's managers. When the firm is undervalued, mangers can chose to buy back, in the expectation that share prices will adjust immediately after this signal to the less informed market participants. Ikenberry et al. (1995) show that the first signal through the announcement of a repurchase program is ignored by the market, but that after the repurchase, the share price continues to rise significantly, implying that the managers buy shares at a bargain price.

Bibliography

Bagnoli, M., Gordon, R. & Lipman, B. L. (1989). Stock repurchases as a takeover defense. *Review of Financial Studies,* **2,** 423–43.

Bagwell, L. S. & Shoven, J. B. (1989). Cash distribution to shareholders. *Journal of Economic Perspectives,* **3,** 129–40.

Barclay, M. J. & Smith, C. W. (1988). Corporate payout policy: cash dividend versus open-market repurchases. *Journal of Financial Economics,* **22,** 61–82.

Dann, L. (1981). Common stock repurchases: an analysis of bondholders and stockholders. *Journal of Financial Economics,* **9,** 115–38.

Ikenberry, D., Lakonishok, J. & Vermaelen, T. (1995). Market under-reaction to open market share repurchases. *Journal of Financial Economics,* **39,** 181–208.

Rees, B. & Walmsley, T. (1994). The impact of open market equity repurchases on UK equity prices. Working paper, The University of Strathclyde.

Sinha, S. (1991). Share repurchase as a takeover defense. *Journal of Financial and Quantitative Analysis,* **26,** 233–44.

Vermaelen, T. (1986). Common stock repurchase and market signalling: an empirical study. *Journal of Financial Economics,* **13,** 137–51.

------------------------------M. AMEZIANE LASFER

Short-Termism

In principle any investment decision requires a willingness to sacrifice present cash flows in return for improved cash flows in future. The time horizons of the decision taker may therefore affect willingness to invest. An economically rational organization applies an infinite time horizon to all its investment decisions, simply discounting future revenues according to its cost of capital. Short term pressures (S-TP), then, could be defined as factors acting upon (or within) an organization which cause decision makers (explicitly or implicitly) either to use a discount rate higher than its cost of capital, and/or to choose some time horizon beyond which future revenues are ignored altogether. Companies subject to such pressures will tend to behave in a short-termist way; that is, they will reduce the rate of investment below the "economically rational" level, and/or bias it towards "short-term" projects. In other words they will act as economically irrational.

However, this does not mean that where there are no S-TP, we would find economic rationality. Therefore a more robust definition would be "factors tending to raise the discount rate applied (explicitly or implicitly) and/or to foreshorten the time horizon." Again the effect would be to reduce the rate of investment and increase the bias towards projects with short pay back periods. This latter definition (but not the former) allows S-TP to include factors like high interest rates and low profitability which increase the opportunity cost of capital.

There is evidence that British industry has experienced during the 1980s a definite intensification of short-term pressures which has continued throughout the early 1990s. High real interest rates throughout the decade, and severe recession and overvaluation at the beginning, were external factors obviously making for short-term pressures; there also appears to have been an increase in the takeover threat and other manifestations of shareholder impatience with poor financial performance. Privatization, deregulation, and the liberalization of procurement in the defense and telecommunications industry have presumably pushed in the same direction.

Muellbauer (1986) and others show the remarkably rapid growth of productivity on British manufacturing since 1980. The rate of product innovation, on the other hand, is not at all impressive: this can be inferred, for example, from Pavitt and Patel's (1988) Anglo-German comparisons of patenting rates for the late 1960s and the early 1980s, and from the alarming deterioration in the UK balance of trade on manufacturing.

It is widely argued that the extent of short-termism differs considerably among countries, and is particularly prevalent in Britain and the United States, with damaging effects on the technological progress and long-term economic prospects of those countries (see Pavitt and Patel, 1988). Equally, however, there are clearly pronounced differences in "technological progressiveness" between industries in Britain and the United States which may well be linked to differences in short-term pressures (see Patel and Pavitt, 1987a and b, and 1988).

Several financial, managerial, organizational, and behavioral sources of short-termism have been suggested and in examining these perhaps it is useful to distinguish between external and internal sources of short-term pressures (see Demirag, 1996).

Determinants of External Pressures

The Cost of Capital

The opportunity cost of capital is determined by the availability, acceptability, cost, and period of external funds and also by the extent to which external funds are required. The higher the (opportunity) cost of capital, the more pressures will be put on firms for short-termist behavior.

The Quality of Information Available to Shareholders (and Lenders) and the Pressures upon them

Given perfect information, and a willingness to take account of it, shareholder pressure would be for economic rationality, which is the maximization of the present value of the firm's profits to eternity. To the extent that shareholders lack information relevant to the medium- and long-term outlook, such as on technological progress "in the pipeline," they will tend to respond excessively to current profit, cash flow and dividend figures, and similar data easily available.

The Sensitivity of the Firm to the Views of Shareholders and Lenders

Shareholders' views of the firm's performance and prospects are reflected by the share price. Management will be sensitive to the share price to the extent that it fears a hostile takeover and/or it wishes to issue new equity in order to raise funds for new investments or to pay for a possible takeover. Under a hostile takeover threat it will be more sensitive to S-TP, if it expects possible "predators" to be better informed than the market.

The Accounting Standards for Intangible Assets

To the extent that it is possible to capitalize "intangible" assets in published accounts, the firm will be able to reduce the impact of research and development spending on current declared profits. (But note that this will only be relevant if very strong and adverse assumptions are made about market efficiency. Firms can always publish R&D expenditures and leave the more competent readers of their accounts to make their own allowances.)

The "Tangibility" of Desired Investment

To the extent that the firm's desired investment (i.e. any deterioration in current cash flow intended to lead to an improvement in future cash flow) is in assets which can be capitalized, such as "hardware" (plant and machinery), there is again no need for current profits to be reduced.

It must be noted, however, that the capitalization of expenditures is not a long-term solution. First, the capital base is immediately increased, which tends to reduce the measured return on capital next year. Second, increased depreciation will reduce profits.

The Predictability of the Return on Assets

If at some point in the future it becomes clear that the money spent has been wasted, it will be necessary, or at least proper, to write it off at once. Thus if R&D on such a project has been capitalized, as with the Rolls Royce RB211, profits over a period will have been maintained, only to lurch suddenly downwards. This will make the firm more vulnerable to a takeover bid than if the annual expenditure on R&D had been written off contemporaneously.

Determinants of Internal Pressures

The Level of Technology of the Firm and Industry

The importance of intangible investment will be greater, and the predictability of return (on all investment) lower, in a high technology industry, that is one in which technology is sophisticated and quickly changing. This will tend to increase short-term pressures. The quality of information available to shareholders and lenders will also tend to be lower, relative to what is required for an accurate assessment of the firm's prospects. (On the other hand any shareholder in, or lender to, a high technology industry, may recognize that the prospects of firms in it depend heavily on their technological performance and that (s)he should not invest in it unless (s)he is willing and able to assess this.)

Management Perceptions of External Financial Markets

It is conceivable that managers may perceive short-term pressures from capital markets even where they do not exist. Where this is the case these perceptions will contribute to short-term behavior in their organizations. However, if company managers perceive short-termism and act accordingly, but the market is interested in long-term prospects, in a negative feedback system, share prices will fall until managers learn that their perceptions were wrong.

Nevertheless, this argument has certain limitations. Changes in share price are not unambiguous: prices reflect many issues and management's commitment to long-term perspectives is just one of the many factors which influence share prices. Investors may well have long-term financial objectives but these objectives can only be realized to the extent that they can obtain the information relevant to the long-term prospects of firms from the managers themselves (see Pike et al., 1993). But if managers think investors are short-termist, then it is unlikely that they will disclose this information to the investors: thus management's view of the markets will be self-fulfilling (see Demirag, 1996).

Management Remuneration

If top management's main stakes in the firm are salaries (and they expect to retire before long), profit-related bonuses, and stock options which they will soon be able to exercise, then personal self-interest may be little affected by the long-term performance of the firm. This distortion of goals may well induce a distortion of perceptions: managers may not wish to know that their actions are not for the best in the longer term. On the other hand, managers may well be responsible for deciding on their own system of remuneration, and we may then treat their culture as the prime mover (it may of course have been overt or tacit shareholder pressure which determined the remuneration system). Until recently, the pay of top managers in Britain was much less tied to firms' financial results or share price than in the United States (see Vancil, 1979; Cosh and Hughes, 1987). However, the trend has been to copy the USA in this respect.

Organizational Structure and Management Control Style

In large and diversified firms, how far middle managers share top management's goals and objectives for the firm will depend, again, on culture and structure. In multidivisional firms, financial control seems to be the dominant style of control. Goold and Campbell (1987) describe financially controlled firms where the head-quarters is slim, supported only by a strong finance function, but prime profit responsibility is pushed right down to the lowest level.

Goal Congruence

It is important to note that the "financial control style" does not only generate or transmit short-term pressures, that is pressures which foreshorten the time horizons of decision takers. It also generates pressures which narrow the spatial field of vision of decision takers. That is, those managing a given profit center tend to concern themselves with whatever will improve their results: cooperation with other parts of the firm will be given a low priority. Any form of technological progress which requires, or is facilitated by, such cooperation will therefore be inhibited.

In summary, short-termism is probably the single most important concept in the management of technology and in other investment decisions. In practice it is often not easy to identify its impact on investment decisions as there is more than one source which give rise to short-term pressures. The possible sources of short-termism include financial, managerial, organizational, and behavioral factors which often interact. How these pressures may result in short-termism in some companies and industries and how they may be resisted in other cases will continue to be debated. More case-study based research is needed to better understand the sources of short-term pressures and their impact on the management of technology and in other investment decisions.

Bibliography

Cosh, A. D. & Hughes, A. (1987). The anatomy of corporate control: directors, shareholders and executive remuneration in giant US and UK corporations. *Cambridge Journal of Economics,* **11,** 401–22.

Demirag, I. S. (1995). Short-term performance pressures: is there a consensus view? *European Journal of Finance,* **1,** 41–56.

Demirag, I. S. (1996). The impact of manager's short-term perceptions on technology management and R & D in UK companies. *Technology Analysis and Strategic Management,* **8,** 21–32.

Goold, M. & Campbell, A. (1987). Managing diversity: strategy and control in diversified British companies. *Long Range Planning,* **20,** 42–52.

Muellbauer, J. (1986). The assessment: productivity and competitiveness in British manufacturing. *Oxford Review of Economic Policy,* **2,** 1–25.

Patel, P. & Pavitt, K. (1987a). The elements of British technological competitiveness. *National Institute Economic Review,* **122,** 72–83.

Patel, P. & Pavitt, K. (1987b). Is Western Europe losing the technological race? *Research Policy,* **16,** 59–85.

Patel, P. & Pavitt, K. (1988). Technological activities in FR Germany and the UK: differences and determinants. SPRU.Working Paper.

Pavitt, K. & Patel, P. (1988). The international distribution and determinants of technological activities. *Oxford Review of Economic Policy,* **4,** 35–55.

Pike, R., Meerjanssen, J. & Chadwick, L. (1993). The appraisal of ordinary shares by investment analysts in the UK and Germany. *Accounting and Business Research,* **23,** 489–99.

Vancil, R. F. (1979). *Decentralisation: managerial ambiguity by design.* Homeward, IL.: Dow Jones-Irwin.

--ISTEMI S. DEMIRAG

Sovereign Risk

Strictly speaking, sovereign risk arises when a sovereign government fails to honor its foreign debt obligations. Sovereign risk is unique because, unlike a private loan where there are well established legal proceedings to handle default and bankruptcy, there is no international court with the jurisdiction to deal with the defaults of sovereign governments.

However, when a government cannot or will not service its foreign debt for financial reasons, e.g. it does not possess sufficient foreign exchange reserves, it will in all likelihood forbid its private sector borrowers to remit foreign exchange to their international lenders as well. Therefore, both sectors will fail to honor the debt, even if the private borrower is creditworthy in terms of its current assets in domestic currency. In practice, therefore, the term sovereign risk has a broader meaning and is not limited to a sovereign loan. It is the risk that the actions of a government may affect the ability of that government, or government-affiliated corporations, or private borrowers residing in the country, to honor foreign debt obligations.

It is for this reason that the terms "sovereign risk" and "country risk" are often used interchangeably. It is this broader definition of sovereign risk which is implied in the following discussion.

Before the World War II, most foreign debts were in the form of bonds held by numerous bondholders all over the world. When a country encountered difficulties in servicing foreign debts, a common practice was repudiation, i.e. a simple cancelation of all its debt obligations. In the post-war period, most of the international loans are from a smaller number of banks, and the most common form of sovereign risk is rescheduling, i.e. announcing a delay in payment and renegotiating the terms of the loan (Saunders, 1994). The most notable event that taught the international banking community an unforgettable lesson about the importance of sovereign risk is the debt moratorium declared by the Mexican government in 1982, and which triggered the subsequent international debt crisis.

Analysis of Sovereign Risk

When making an international loan, a lender must assess two types of risk. The first is the creditworthiness of the borrower itself. This analysis is the same as a credit analysis of any domestic borrower. The second risk to assess is the sovereign risk of the country. In principle, a lender should not extend credit to a foreign borrower if the sovereign risk is unacceptable, notwithstanding that the borrower may have good credit quality. This second type of risk, or sovereign risk, should be the predominant consideration in international lending decisions.

The analysis of sovereign risk involves both economic and political analysis. Economic analysis should be primarily concerned with the capability of an economy to generate foreign exchange reserves. The foreign exchange reserves are the common pool of resources that both the private sector and the government rely upon when servicing foreign debt. These reserves are the cumulative international balance of payments of a country which, in turn, depends upon its current account balance, or its foreign trade performance measured by exports minus imports. Macroeconomic theory reveals that a trade deficit (surplus) is the result of aggregate demand (aggregate consumption plus investments plus government spending), being greater (smaller) than aggregate production of a country. Therefore, all factors that influence the aggregate demand and aggregate production of an economy should be analyzed in order to understand the economics of sovereign risk.

In terms of political analysis, the focus is on the political decision-making process through which debt repudiation and rescheduling decisions are made. Also of importance is the capability of the political system to support the economic system and to maintain the credit quality of the country. By undertaking a dual analysis of both the economic and political systems of a country, an analyst can come to a comprehensive understanding of the sovereign risk.

Comparable international financial data can be found in the publications of supranational organizations such as the World Bank and the International Monetary Fund. It might also be helpful for analysts to take advantage of the cross-country credit ranking provided by such credit rating agencies as Moody's and Standard and Poor's, and financial publishers such as *Euromoney* and *Institutional Investor.*

Forecasting Sovereign Risk

In addition to a complete macroeconomic analysis, analysts can also study a number of financial ratios indicative of the financial soundness of a country. Examples of these ratios and their relationship with sovereign risk exposure include: debt ratio (foreign currency debt/GDP; foreign currency debt/exports), positive; import ratio (imports/foreign exchange reserves), positive; trade surplus ratio (trade surplus/GDP), negative; budget balance ratio (government budget deficit/ GDP), positive; investment ratio (aggregate investment/GDP), negative; and inflation rate, positive. Based on selected ratios and the history of sovereign risk events across countries, a discriminant analysis model can be built to predict sovereign risks.

An alternative way to forecast sovereign risk is to utilize information in the secondary market for developing country debt, a market developed by major banks in the mid 1980s. The prices of these loans reflect the market's collective assessment about the sovereign risk of the indebted countries. Regression analysis can be performed to determine what variables (similar to those discussed above) are significantly associated with the prices of these loans and to estimate the extent of the association. Based on the projected values of the variables, this model can then be used to predict loan prices. Changes in loan prices are indicative of possible changes of sovereign risk (see Boehmer and Megginson, 1990).

Political Risk

Political risk arises when actions of a government or other groups in the political process adversely interfere with the operation of business. These actions may include expropriation, confiscation, foreign exchange control, kidnapping, civil unrest, *coup d'état,* and war. While both economics and politics should be considered in the analysis of sovereign as well as political risks, the emphasis of sovereign risk is on economics and the focus of political risk is on the political process. Since sovereign risk events are the result of governmental actions, it can be viewed as part of political risk. Organizations such as Economist Intelligence Unit and Business International conduct extensive political risk analysis. Their publications are useful resources for international business executives.

Bibliography

Boehmer, E. & Megginson, W. L. (1990). Determinants of secondary market prices for developing country syndicated loans. *Journal of Finance,* **45,** 1517–40.

Saunders, A. (1986). *The international debt problem: Studies in banking and finance.* Amsterdam: North Holland.

Saunders, A. (1994). Sovereign risk. *Financial institutions management: A modern perspective.* (Ed.) Saunders, A., Boston, MA: Irwin. 261–92.

Shapiro, H. D. (1994). Country credit: accentuate the positive. *Institutional Investor,* **94,** 93–9.

van Duyn, A. (1994). Country risk: where in the world is Japan? *Euromoney,* 177–80.

--PHILIP CHANG

Speculation

Speculation is often seen in pejorative terms, although it is widely recognized in trading and academic circles as providing a useful economic function. In the commodity markets, for example, which are often characterized by output uncertainty and (hence) price volatility, an optimal market equilibrium is achieved when participants can exchange risk through the process of speculation (Courchane and Nickerson, 1986). In this sense, speculators are often seen as the counter-parties to hedge traders who wish to offload an exposure to risk. Marshall's view was that speculation was only marginally distinguishable from gambling. However, in a more refined distinction, Floersch (Vice Chairman, Chicago Board Options Exchange, in Strong, 1994) sees gamblers as creating risk where none exists, and speculators as accepting an existing risk. In this sense, hedgers offer a market for risk which speculators accept at a price. The speculators' unique skill is in their ability to judge whether the risk is worth taking at a particular price and, in so doing, they will try to ascertain and learn from information that others do not have (Froot et al., 1992).

Speculation is not restricted to financial markets. Agricultural products, gold, and other precious metals are the subject of speculative trading. In this sphere, gold is often seen as fundamentally a speculative venture since traders mostly do not take delivery but can trade in gold certificates, gold futures, and futures options. However, the important risk hedging function is still evident since gold is often a safe refuge in times of political or economic uncertainty.

Many of the controversies surrounding speculation relate to the association of speculators with destabilized markets and huge financial losses, particularly in recent times with respect to currency markets and also in the use of derivative securities. While financial losses can be a natural consequence of taking a position in a security, the question of a destabilized market is a subject of debate. Traditionally, speculation is seen as an activity that assists in moving prices to equilibrium (Friedman, 1953) and, as such, cannot be the cause of market destabilization. Critics of speculation would argue that the use of derivative securities, for which there might be a huge open interest relative to the supply of the deliverable commodity, is indicative of how such assets might be destabilizing by giving rise to price runs unrelated to the scarcity of the underlying commodity. Moreover, the ease at which a substantial position can be created through the use of leverage can give rise to a resulting price dynamic against which the market, itself, cannot fight. While the desired role of speculation is not disputed, the pertinent question – which will help determine its impact – is whether speculation results from a rational/fundamentals-based realignment or is a response to noise trading whereby apparently random events can give rise to destabilizing trading responses. The often observed coexistence of speculation and instability has led to considerable theoretical work in an attempt to identify and quantify possible linkages between the two and a number of different markets have been investigated.

Speculative activity in foreign exchange is often a two-edged sword. On the one hand, speculation within the context of an underlying stable economic policy can create a framework within which long-term fundamentals prevail as the principal driving forces in currency movements. Speculators then look to longer-term horizons and this has been seen as a mechanism by which currency volatility can be reduced. On the other hand, Krugman and Miller (1992), argue that stop–loss orders made by speculators can undermine the stability of a currency if a currency target zone, such as the ERM, is not seen as effective. Badly misjudged target zones can create speculative runs on the expectation that a currency will be forced to leave a target zone (as in the departure of sterling from the ERM in 1992).

In principle, trading in derivatives markets (on currencies, bonds, stocks, and stock indices) cannot be destabilizing because – if the pricing of these securities is correct – options and futures of all types only serve to make easier the taking of positions which enable the exchange of risk. In general, derivative assets can only present a picture of a situation that already exists, but in an easier-to-trade manner. In particular, futures trading, for example, is largely perceived to perform the role of price discovery and thereby enable the process of risk transfer. However, speculators in futures are often criticized for not trading on the basis of fundamentals (Maddala and Yoo, 1991), thereby creating excessive volatility and raising the risk premiums faced by hedgers when it is their economic role to reduce premiums thereby allowing the easier transacting of risk. The issue is an empirical one. In measuring average levels of speculation with average volatility, Edwards and Ma (1992), report no correlation, whereas some degree of association should be present for there to be a relationship.

On a global scale, the crash of 1987 revealed a situation in which an extremely destabilized market was associated with hedging/speculation and derivatives trading. Program trading and portfolio insurance have been accused of destabilizing the market and these subjects are covered elsewhere.

Bibliography

Courchane, M. & Nickerson, D. (1986). Optimal buffer stock and futures market policies for commodity price stabilisation. Duke Working Paper in Economics. No. 43, 12.

Edwards, F. R. & Ma, C. (1992). *Futures and options.* New York: McGraw-Hill.

Froot, K. A., Scharftstein, D. S. & Stein, J. C. (1992). Herd on the street: informational inefficiencies in a market with short-term speculation. *Journal of Finance,* **47,** 1461–84.

Friedman, M. (1953). *Essays in positive economics.* Chicago, IL: University of Chicago Press.

Krugman, P. R. & Miller, M. (1992). Why have a target zone? *Carnegie Rochester Conference Series on Public Policy,* **38,** 279–314.

Maddala, G. S. & Yoo, J. (1991). Risk premia and price volatility in futures markets. *Journal of Futures Markets,* **11,** 165–78.

Strong, R. A. (1994). *Speculative markets.* New York: Harper Collins.

---DAVID BROOKFIELD

Stability of Returns

Over the last two decades a large number of researchers have investigated the temporal stability of various dimensions of equity returns. The extensive academic interest in this area is hardly surprising given the importance of stability (or at least predictability) in returns to professional investors attempting to construct optimal portfolios on the basis of historic information; if returns are not stable, or if the instability is unpredictable, then such attempts are futile. Early investigations in this area concentrated on developed stock markets such as the UK and the USA while more recent studies have typically focused on both emerging and developed stock markets. In addition, the majority of the research has examined the stability of relationships between the returns earned by equity indices of different national markets by analyzing correlation or covariance matrices rather than focusing on the stability of other aspects of the return distribution for individual equities. However, since the mid-1980s, a growing number of investigations have begun to examine whether the mean return and the variance of returns are also stable over time.

The time periods covered, the countries examined, the statistical tests employed, and the interpretation of the results have all varied across the different studies undertaken in the substantive literature. For example, Makridakis and Wheelwright (1974) used principal component analysis to investigate the intertemporal stability of the correlation matrix of daily returns (in US dollars) of fourteen developed stock markets over the period 1968–70. They found that the correlation coefficients were both unstable and unpredictable. Their early finding was confirmed in two later investigations: a study by Hilliard (1979) that analyzed daily returns for ten developed stock market indices over the period July 1973 to April 1974 (a period which included the OPEC oil embargo) using spectral analysis which suggested that no stable relationship existed between intercontinental returns; and a study by Maldonado and Saunders (1981) which reported that correlations of monthly index returns for five countries followed a random walk. However, Phillipatos et al. (1983) employed principal component analysis and found that the correlation matrix for returns of fourteen developed stock markets was stable over two ten-year periods (1959–68 and 1969–78), but not over shorter horizons. This finding of stability over long horizons contradicted the earlier study of Panton et al. (1976). They analyzed their data using cluster analysis a technique which aggregates indices together into groups, or clusters, according to their degree of similarity – and found considerable stability in the relationship between the returns of their sample for one-year and three-year periods, but weaker stability in the correlations of returns for five-year periods.

A special virtue of more recent investigations has been the multiplicity of advanced statistical techniques employed and the greater range of markets investigated. For example, Cheung and Ho (1991) use five different tests to examine the intertemporal stability of the relationships between the weekly domestic-currency returns of seven emerging stock markets and four developed stock markets in the Asian-Pacific region over the period 1977–88. In general, their findings suggested that relationships between returns were unstable although evidence of instability decreased for longer-horizon returns according to their principal component analysis. Sinclair et al. (1996) use four tests to investigate the intertemporal stability of returns for a larger, more diverse group of emerging markets drawn from Europe, Latin America, and Africa as well as the Asian-Pacific region over a longer time period 1977–92. Although they report that these relationships are unstable, they find that this instability may be sufficiently predictable to permit a portfolio strategy based on historic variance/covariance matrices to outperform the UK market by a substantial margin in the following period.

Sinclair et al. (1997) investigate the intertemporal stability of the mean and the variance of quarterly returns as well as the correlations among returns for a sample of sixteen Western European markets over the period 1989–94. They find a great deal of variability in the mean returns and in the volatility of returns over the time period covered by their analysis and suggest that the international fund manager not blessed with perfect foresight would have had great difficulty in achieving the theoretical gains available from international diversification on an *ex ante* basis. This finding that the volatility of returns varies over time is not new. Ever since the pioneering work of Engle (1982), a class of models which are termed "autoregressive conditionally heteroscedastic" (ARCH) has been developed which allows the variance of the series analyzed to alter through time. The results from fitting these models to return data for both developed and emerging stock markets suggest that volatility does vary over time, although not in a totally random fashion. For example, Fraser and Power (1995) report that in eight of the nine emerging markets analyzed there was a tendency for volatility shocks to persist over several months. They attribute this time-varying volatility to the non-linear flow of information to the stock market. Lamoureaux and Lastrapes (1990) provide empirical evidence to support this contention that a clustering in the share volatility data is associated with "the process generating information flow to the market." Specifically, for their sample of the twenty most actively traded shares in the S&P 500 index the proportion with significant ARCH effects declined from 75 to 20 percent when an information variable was included in the analysis.

The question of whether returns are stable or not has moved on from the narrow focus on the relationships between equity returns for developed markets to consider different dimensions of returns for shares traded across a broader range of markets. The evidence seems to suggest that returns may not be stable although this instability may not be random.

Bibliography

Cheung, Y. L. & Ho, Y. K. (1991). The intertemporal stability of the relationships between the Asian emerging equity markets and the developed equity markets. *Journal of Business Finance and Accounting,* **18,** 235–54.

Engle, R. F. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of UK inflation. *Econometrica,* **50,** 987–1008.

Fraser, P. & Power, D. M. (1995). Conditional heteroscedasticity in the equity returns from emerging markets. *Advances in Pacific Basin Financial Markets,* **2,** 331–347.

Hilliard, J. (1979). The relationship between equity indices on world exchanges. *Journal of Finance,* **34,** 103–14.

Lamoureaux, C. G. & Lastrapes, W. D. (1990). Heteroscedasticity in stock return data: volume versus GARCH effects. *Journal of Finance,* **45,** 221–30.

Makridakis, S. & Wheelwright, S. (1974). An analysis of the inter-relationships among the major world stock exchanges. *Journal of Business Finance and Accounting,* **1,** 195–215.

Maldonado, R. & Saunders, A. (1981). International portfolio diversification and the intertemporal stability of international stock market relationships. *Financial Management,* **10,** 54–63.

Panton, D., Lessig, P. & Joy, M. (1976). Comovement of international equity markets: a taxonomic approach. *Journal of Financial and Quantitative Analysis,* **11,** 415–31.

Phillipatos, G. C., Christofi, A. & Christofi, P. (1983). The intertemporal stability of international stock market relationships: another view. *Financial Management,* **12,** 63–9.

Sinclair, C. D., Power, D. M. & Lonie, A. A. (1996). An investigation of the stability of relationships between returns from emerging stock markets. *Applied Financial Economics,* forthcoming.

Sinclair, C. D., Power, D. M., Lonie A. A. & Helliar, C. V. (1997). An investigation of the stability of returns in Western European markets, 1989–1994. *European Journal of Finance,* forthcoming.

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State-Contingent Bank Regulation

It is well known that government-sponsored deposit insurance creates incentives for bank shareholders to shift risk to the insurer (moral hazard), and/or may attract only high-risk banks to the system (adverse selection). Current legislation in many countries attempts to solve the incentive problems encountered in bank regulation by mandating policies such as risk-adjusted deposit insurance premiums, strict capital requirements, prompt closure policies, etc. Results from recent literature, however, suggest that such regulatory policies are neither necessary nor sufficient, *per se,* to solve the incentive problems: for instance, risk-adjusted deposit insurance premiums do not mitigate risk shifting by banks (John et al., 1991). Prompt (or even early) closure of insolvent banks is also unlikely to solve the moral hazard problem and, moreover, even fixed-rate deposit insurance, if accompanied by a rational policy of forbearance, can be incentive compatible (Nagarajan and Sealey, 1995). In fact, fairly priced deposit insurance premiums may actually be inconsistent with incentive compatibility in the absence of *ex post* deposit insurance subsidies (Chan et al., 1992).

A common theme in the above works is that they all involve some type of *ex post* contracting in order to achieve incentive compatibility. In particular, if the regulator sets up appropriate *ex post* rewards and/or punishments that are triggered by *ex post* outcomes, then bank shareholders are induced to weigh the potential returns from *ex ante* risk shifting against any *ex post* cost associated with such behavior. Under certain conditions, banks choose higher asset quality *ex ante* than would otherwise be the case, although they may not necessarily choose first best.

State-contingent bank regulation, first proposed by Nagarajan and Sealey (1996), extends existing notions of *ex post* pricing to a new concept of bank regulation. Its key distinguishing feature is the design of policy mechanisms that are contingent on the performance of banks, not in absolute terms, but relative to that of the market. State-contingent regulation works as follows. First, a bank's total risk is decomposed into its market (systematic) and idiosyncratic components, and the regulator prices the deposit insurance based on the bank's performance relative to the market. Such a mechanism is more informationally refined than a corresponding mechanism based on absolute performance. The reason is that the regulator can filter out that part of performance that is attributable to factors beyond the bank's control, and thus make a more informed (although still imperfect) evaluation of the bank's choice of unobservable asset quality and/or risk class.

Nagarajan and Sealey (1996) have shown that moral hazard and adverse selection problems in bank regulation can be completely alleviated by a wide range of simple relative-performance mechanisms that involve (1) *ex post* rewards to banks in some states of nature and penalties in others, and (2) a minimum capital requirement. Specifically, banks may be rewarded if a modest performance in a particular period was achieved despite poor market conditions, and penalized if it was helped by good market performance. Two families of optimal regulatory mechanisms, one for moral hazard and another for adverse selection, are derived, which have the following properties distinguishing them from much of the literature on incentive compatible bank regulation:

1. First-best outcomes are achieved under both moral hazard and adverse selection.

2. No deposit insurance subsidy is required to achieve incentive compatibility, even when loan markets are competitive.

3. Since deposit insurance is priced fairly, these mechanisms do not create economywide distortions in resource allocation.

There are two issues of concern to the regulator: the informational task of identifying and filtering out systematic risks; and implementing the state-contingent mechanism itself. Regarding the first issue, banks' systematic risk exposures can be estimated using current examination procedures, and hence the mechanisms are not very informationally demanding. In fact, the assessment of systematic or factor risks in regulating banks is also shared by the current Bank for International Settlements' guidelines on risk-adjusted capital requirements, which weight various categories of bank loans differently, thus implicitly assigning higher weights to higher systematic risks. Note that this weighting scheme reflects the systematic risks of a loan portfolio, and has nothing to do with unique risks, as the latter get diversified away in any sizeable loan portfolio.

With regard to implementation, the optimal capital requirement might be coordinated with the state-contingent, *ex post* premiums, in order to insure that the bank has enough capital to pay the penalty in the relevant states. Penalty collection is also made easier by the fact that the bank's payoff in penalty states need not be low, and can even be higher than in reward states. Finally, *ex post* refunds of deposit insurance premiums are quite feasible, and have in fact occurred in some countries (e.g. the USA), although they have not been based on relative performance in the past.

Bibliography

Chan, Y., Greenbaum, S. I. & Thakor, A. V. (1992). Is fairly priced deposit insurance possible? *Journal of Finance,* **47,** 227–45.

John, K., John, T. A. & Senbet, L. (1991). Risk-shifting incentives of depository institutions: a new perspective on federal deposit insurance reform. *Journal of Banking and Finance,* **15,** 895–915.

Nagarajan, S. & Sealey, C. W. (1995). Forbearance, deposit insurance pricing, and incentive compatible bank regulation. *Journal of Banking and Finance,* **19,** 1109–30.

Nagarajan, S. & Sealey, C. W. (1996). State-contingent bank regulation. McGill University. Working paper.

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Stochastic Processes

A stochastic process is a collection of random variables $X(t)$ indexed by a parameter t, which usually represents discrete or continuous time. If we fix a time t, $X(t)$ is a random variable; if we fix a point in the joint probability space describing the process for all values of t, $X(t)$ is a path of the process through time.

Stochastic processes are said to be stationary if the joint distribution of $X(t_1 + h)$, $X(t_2 + h)$..... does not depend on h. This property states that the law of the process is invariant with respect to time. Stochastic processes are said to be Markovian if their history provides no information about their future evolution beyond the information provided by the knowledge of their current state. The evolution of a stochastic process for $t \to \infty$ may approach a steady point or a stationary distribution or grow without bounds. A mixture of these outcomes is possible. The conditional distribution of $X(t + h)$ given $X(t)$ is known as the "transition probability." If transition probabilities do not depend on t and the increments of the process through time are independent of each other the process is called a random walk.

Important examples of random walk processes in management applications are the Poisson process and the standard Brownian motion. The Poisson process is often used to represent the random independent arrivals of customers to a service centre. Its value at time t, given $X(0) = 0$, is described by the Poisson distribution:

$$P\{X(t) = i | X(0) = 0\} = \frac{(\lambda t)^i \exp(-\lambda t)}{i!}$$

where $i = 0, 1, 2, ...$ The interval before the arrival time of next customer is distributed according to a negative exponential function and it is often used to model equipment malfunction rates.

The Brownian motion process is used to represent the evolution of stock prices and other quantities subject to frequent, small shocks. The increments of the Brownian motion over time are described by the equation:

$$\mathrm{d}X(t) = \mu \mathrm{d}t + \sigma \mathrm{d}z(t) \qquad (2)$$

where μ and σ can be functions of $X(t)$ and t and $\mathrm{d}z(t)$ represents the random shock to the process, the limit of the product

$$\Delta z(t) = \sqrt{\Delta t}.x \qquad (3)$$

for $\Delta t \to 0$, where x is drawn from a standard normal distribution. The process $z(t)$ is known as a Wiener process. Often the logarithm of the stock price is assumed to follow a Brownian motion in order to maintain constant returns to scale. The Brownian motion travels an infinite distance in any discrete time interval, but it has zero velocity because it changes its course infinitely many times. Brownian motions with independent increments are unsuitable for many applications to interest rates and bond prices, for which the Ornstein–Uhlenbeck mean reverting model is preferred. The increments of this process are described by the equation

$$dX(t) = K(c - X(t))dt + \sigma dz(t) \qquad (4)$$

where c is a centrality parameter towards which the process is attracted at a speed proportional through a factor K to its current distance from c. The above processes are Markovian, but the Ornstein–Uhlenbeck process is not a random walk because its increments are not independent through time.

The Brownian motion process is continuous but almost surely not differentiable with respect to time. Increments of functions of Brownian motions, and time $y(t)$, can be related to increments in the underlying Brownian motion, $X(t)$, by Ito's lemma:

$$\begin{aligned} dy(t) = {} & \frac{\partial y(t)}{\partial X(t)} dX(t) + \frac{\partial y(t)}{\partial t} dt \\ & + \frac{1}{2} \frac{\partial^2 y(t)}{\partial X(t)^2} \sigma^2 dt \end{aligned} \qquad (5)$$

Ito's lemma takes the place of the chain rule of ordinary calculus in the study of stochastic processes. Ito's stochastic integrals represent functions $f(X(t),t)$ in terms of the underlying Wiener processes.

Functions $F_n(X_1, X_2 \ldots. X_n)$ of a stochastic process $(X_1, X_2 \ldots. X_n)$ are said to be martingales if the expected value of F_{n+1} equals F_n, supermartingales if the value of the function at time $n + 1$ is expected to be lower than its value at time n, submartingales if it is expected to be greater The concept of martingale reflects the notion of fair game and it has many useful applications in financial markets. Future security prices discounted at the risk-free rate follow a martingale under the assumption of investors being indifferent to risk. More general functions of stochastic processes may be reduced to martingales by changing the probability measures associated with the random variables $X(t)$. This result is known as Girsanov's theorem and it is widely used in the valuation of derivative securities. It allows for the valuation of securities to be independent of their expected rate of return, which can be taken to be the risk-free rate for ease of computation.

A stopping time τ is a rule to stop sampling a stochastic process. If a reward function is associated with the outcomes of the stochastic process up to time τ, the optimal stopping time, τ^*, maximizes the expected value of the reward function. More general interventions on stochastic processes are objects of stochastic control theory, where a variable influencing the process is modulated in order to maximize a given function of the process.

-----------------------------------GIOVANNI BARONE-ADESI

Stock Market Indices

Stock market indices measure the value of a portfolio of stocks relative to the value of a base portfolio as a weighted average of stock prices. Stock market indices as aggregate measures are an instrument to meet the information requirements of investors by characterizing the development of global markets and specific market segments (descriptive function). In their function as a basis of derivative instruments, stock market indices facilitate the application of certain portfolio strategies such as hedging and arbitrage (operative function).

In order to perform these functions, a stock market index should fulfill statistical as well as economic requirements. The statistical requirements for indices in general were summarized by Fisher (1922), Eichhorn (1976), and Diewert (1986). Crucial for stock market indices are: (1) invariance to changes in scale; (2) symmetric treatment of components; (3) time reversal, that is, the index between any two dates will not be changed if the base period of the index is changed from one date to another; and (4) indifference to the incorporation of new stocks, that is, *ceteris paribus,* the inclusion or removal of a stock will not change the index compared to its previous value. As a representative stock market index only contains a selection of stocks, index construction involves a sampling problem.

The commonly used stock indices belong to one of the following three categories: averages, capitalization-weighted indices, and performance indices. The most prominent representative of the class of averages is the Dow Jones Industrial Average (DJIA). The DJIA is a price-weighted average of thirty blue chip stocks traded at the New York Stock Exchange (NYSE). The DJIA, comprising twelve stocks, first appeared in 1896 with a value of 40.94. In its present form with thirty common stocks the DJIA was first published in 1928. For the purpose of futures trading the Chicago Board of Trade formed the Major Market Index which comprises twenty shares of which sixteen are also included in the DJIA. Since 1975 the Nikkei 225 Stock Average has been calculated on the basis of stocks traded in the first section of the Tokyo Stock Exchange. In the case of all of these indices, reductions of stock prices due to stock splits, as opposed to dividend payments, are accounted for in order to leave the average unaffected. The main disadvantage associated with the calculation method of these averages is the fact that a given percentage price change of a high-priced stock induces a larger change of the average than an identical percentage change of a low-priced stock.

The majority of stock indices belong to the category of capitalization-weighted indices using the Laspeyres, Paasche, or Fisher formula. The most prominent indices are the Standard and Poor's 500 (NYSE/AMEX/OTC market), the TOPIX (Tokyo Stock Exchange, first section), the FT-SE 100 (London Stock Exchange), the CAC 40 (Paris Stock Exchange), the SMI (twenty-four Swiss stocks), and the FAZ-Index (100 German stocks). Due to its breadth, the S&P 500 is widely used by portfolio managers as a benchmark for the performance of their portfolios (Berlin, 1990). Empirical studies show that the average pre-tax return of the S&P 500 portfolio between 1925 and 1986 reached 12.1 percent per annum, while a portfolio of government bonds yielded 4.7 percent per annum on average. Since 1982 the S&P 500 has served as the basis for cash-settled stock index futures contracts. Some of the above indices contain an additional adjustment factor to allow for the case when the outstanding capital significantly exceeds the free floating capital.

The increasing use of stock market indices as a basis for derivative products called for provisions to allow a balanced reflection of the descriptive and the operative function. In response to this requirement the DAX (thirty shares listed at the Frankfurt Stock Exchange), introduced in 1988, was constructed as a performance index (Janssen and Rudolph, 1992). The Swiss Performance Index and the FAZ Performance Index followed afterwards. These indices measure the total return of a portfolio under the following assumption: dividend payments and the hypothetical money value of share warrants from rights offers are immediately reinvested in the respective stock to obtain the change of the overall value of a particular portfolio compared to the value at a given base period.

For specific purposes, a variety of other indices has been developed. In order to provide a benchmark needed for international asset allocation, Morgan Stanley Capital International developed the MSCI World Index which is based on 1609 securities listed on the stock exchanges of twenty-two countries (as of January 1995). In contrast to all indices mentioned above, the value line arithmetic index assigns the same weight to each stock. It represents approximately 95 percent of the market values of all US securities. On the basis of portfolios which comprise stocks from a specific industry, a large variety of branch indices such as the Dow Jones Transportation Average, the AMEX Oil Index, or the NYSE Utility Index have been constructed. In order to study the performance of initial public offerings, for each major European stock exchange the Institute for Advanced Studies established an initial public offerings index (IPOX) which is isomorphic to the respective stock market index (Haefke and Helmenstein, 1995). When IPOX futures become available, investors will have an instrument at hand to fully participate in promising initial public offerings without being rationed. Due to the increasing interest in derivatives, Trinkaus and Burkhardt designed the TUBOS as real-time index to measure the performance of German warrants *vis-à-vis* the DAX.

Bibliography

Berlin, H. M. (1990). *The handbook of financial market indexes, averages, and indicators.* Homewood, IL: Dow Jones-Irwin.

Diewert, W. E. (1986). Microeconomic approaches to the theory of international comparisons. Technical Working Paper No 53 Cambridge, MA: NBER.

Eichhorn, W. (1976). Fisher's tests revisited. *Econometrica,* **44,** 247–56.

Fisher, I. (1922). *The making of index numbers: A study of their varieties, tests, and reliability.* Publications of the Pollak Foundation for Economic Research, No. 1, Boston/New York: Houghton Mifflin.

Haefke, C. & Helmenstein, C. (1995). Neural networks in the capital markets: an application to index forecasting. *Computational methods in economics and finance.* (Ed.) Gilli, M. Dordrecht/Boston/London: Kluwer Academic Publishers.

Janssen, B. & Rudolph, B. (1992). *Der Deutsche Aktienindex DAX.* Frankfurt: Knapp.

-------------------CHRISTIAN HELMENSTEIN and CHRISTIAN HAEFKE

Syndicated Euroloans

Syndicated euroloans consist primarily of medium-term, unsecured, and secured credits provided by syndicates of international banks. Maturities range from one to twelve years, with average maturity of about five years. Technically euroloans are usually renewable six-month loans, rolled over or extended through the designated maturity. The interest rate floats, usually with relation to LIBOR. As such, euroloans in many ways resemble medium-term note issuance facilities.

The euroloans are granted by syndicates of banks formed for that purpose on a loan-by-loan basis. The managing bank, or a few banks jointly, assemble the syndicate and draw up loan agreements, receiving management fees. These are then shared with lead banks in the form of participation fees. The lead banks provide funding for the loan according to a formula agreed upon in the syndicate agreement.

There are several forms of syndicated eurolending:

1. Traditional syndicated bank loans: this type usually has a floating interest rate and fixed maturity, drawn once and repaid according to an agreed schedule. Normally one, two, or even three banks negotiate the loan, and they, in turn, draw other banks into the syndicate. A single bank acting as agent (one of the lead banks) administers the loan after execution, gathering the funds from the lenders for the borrower to withdraw during a fixed time (the commitment period), distributing repayments from the borrower to the lenders, and representing the lenders if any problems arise with the borrower.

2. Revolving credit: has the same attributes as a syndicated bank loan but allows the borrower repeatedly to draw the loan, or a portion thereof, and to repay what it has drawn at its discretion or according to a set formula during the life of the loan. This resembles revolving credit arrangements such as overdraft accounts or credit lines in the domestic market.

3. Standby facility: the borrower is not restricted to a commitment period during which he must draw down the funds. He may, instead, pay a contingency fee until he chooses to draw the loan, at which time the contractual interest rate begins to run.

The lead manager that serves as the agent bank is usually responsible for negotiating the conditions of the loan with the borrower, circulating an information memorandum, marketing the loan to other banks, and preparing the loan documentation. As noted by Melnik and Plaut (1991), if the loan is particularly large or complicated, a number of managers may share these duties. Potential lenders who have indicated an interest in the loan get the information memorandum, which covers the following main points: (1) outlines of the terms of the loan agreement (maturity, repayment fees, and interest rates, etc); (2) summary of the agreements signed or to be signed; (3) details of the project or purpose of the loans; (4) financial analysis of the proposal/project; and (5) where relevant, a consultant's report.

The lead manager offers prospective syndicate members a chance to participate in the loan. The choice depends on several factors (Berlin and Loeys, 1986; Melnik and Plaut, 1995). The size of the loan is important; more banks will be invited to join in a very large loan. The riskiness of the loan is also a factor that is positively correlated with the number of participants. The borrower may have preferences regarding inclusion (or exclusion) of certain banks. This could be based on its relationship with a bank or group of banks or because it operates in (or hopes to expand into) a certain part of the world.

Of those banks approached, there will inevitably be some that are unable or unwilling to join in for a number of reasons. They may already have reached their lending ceiling for the borrower's country. There may be legal restrictions on lending to the borrower's country or to companies engaged in certain types of businesses. Finally, they may find the terms of the loan insufficiently attractive or the underlying project too risky to justify the advance.

The interest rate on euroloans is expressed directly as a spread over the banks' marginal cost of funds, usually LIBOR. The participating banks normally raise funds on the short-term eurocurrency markets for successive three-, six-, or twelve-month periods throughout the life of the loan. A formula in the loan agreement fixes these periods, known as the loan rollover dates. These are the same as repricing dates. It is therefore the bank's funding of the loan, rather than the loan itself, that is rolled over. The banks merely pass on the prevailing interest rate at each rollover period, adding to it an agreed percentage margin, or spread, that represents their profit, based on their assessment of risks and their overhead costs.

Management fees are paid to the lead managers for negotiating the loan agreement and marketing the loan. They are generally expressed as a percentage of the total amount of the loan and negotiated with the borrower, bearing in mind various factors, such as size and complexity of the loan, market competition, the borrower's relationship with the manager, etc. These fees are paid at the time the loan agreement is signed. The fees usually contain three components: (1) agent's fees to cover administrative expenses; (2) underwriting fees paid to the banks underwriting the loan; and (3) participation fees to the participant banks in proportion to the amount of their participation.

The level of spreads and the size of fees are determined by the creditworthiness of the borrower, the size and terms of the loan, the state of the market, and the degree of competition for the loan. Just as in the domestic market, the cost of loans varies across borrowers in the euromarkets, but there are even more factors to consider. Besides the questions regarding the borrower and his business there are considerations of politics, economics, and geography.

Bibliography

Berlin, M. & Loeys, J. (1986). Bond covenants and delegated monitoring. *Journal of Finance,* **43,** 397–412.

Melnik, A. & Plaut, S. E. (1991). *The short-term eurocredit market.* Salomon Center Monograph Series, New York University.

Melnik, A. & Plaut, S. E. (1995). Industrial structure in the eurocredit underwriting market. Presented at the European Financial Management Association, London.

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T

Tactical Asset Allocation

Sharpe (1992) defines asset allocation as "the allocation of an investor's portfolio across a number of 'major' asset classes. " Asset allocation generally refers to the division of investment capital among the various available investment categories such as stocks, bonds, money market instruments, derivative funds, real estate, and other asset classes. Usually both domestic and international markets are considered in the allocation process.

Performance measurement of mutual fund managers by researchers such as Sharpe (1966) and Jensen (1968) compared the returns of a fund to those of an index after adjusting for systematic risk as measured by beta. These studies found that mutual funds underperformed risk adjusted index portfolios. In the 1980s several studies found that systematic risk adjusted mutual fund performance was not significantly different from the index. Grinblatt and Titman (1989) found that the results of such studies was highly dependent upon the index used for benchmarking mutual fund performance. They showed that by changing benchmarks, it is possible to show that some classes of mutual funds provided superior performance

Debates on the appropriateness of the index used for benchmarking, on the suitability of the capital asset pricing model derived beta as a risk measurement:, and on the dual hypothesis problem between the efficient market hypothesis and any asset pricing model, all contributed to a need for a more acceptable way to judge the performance of mutual fund managers.

Brinson et al. (1986) took a different approach by measuring the contribution that "active" management had over a passive benchmark. They defined the investment process in four steps. First, decide on which asset classes to include and which to exclude from the portfolio. Second, decide on the normal or long-term policy weights for each of the asset classes allowed in the portfolio. Third, alter the investment mix weights away from the policy weights in an attempt to capture excess returns from short-term fluctuations in asset prices. Finally, select individual securities within an asset class to achieve superior returns relative to that asset class. The first two steps have become known as strategic asset allocation (SAA) while the third step is known as tactical asset allocation (TAA).

By breaking returns down into the active (tactical) and passive (strategic) portions, it becomes possible to make judgments on performance without arguments on indices, betas, and dual hypothesis problems. Subsequently, the use of TAA has grown from an estimate of US$10 billion under TAA management in 1986 to more than US$75 billion in 1994.

It is important to distinguish between TAA and more active forms of investment such as dynamic asset allocation or market timing. Unlike the latter two, TAA is a disciplined approach to shifting away from SAA benchmarks and sticking to those weightings. Dynamic asset allocation and market timing, on the other hand, are attempts to pick market peaks and troughs. Because SAA and TAA are more disciplined approaches, they are seen as contrarian by nature. This is because in order to rebalance a portfolio back to benchmarks, it is necessary to sell assets in the asset class which has performed well in order to buy assets in the class which has performed badly.

The value of TAA, however, seems minimal when compared to SAA. Many studies (Brinson et al., 1986; Droms, 1989; Brinson et al., 1991) show that SAA contributes more than 80 percent of the returns and most often between 92 percent and 98.6 percent of the returns. TAA, therefore, is an attempt to add additional returns to the SAA benchmark. Some studies claim that TAA actually reduces returns. In order to obtain positive TAA performance, fund managers are increasingly turning to sophisticated computer models to help predict future returns. There are claims that, in good years, some TAA computer programs have delivered up to 15 percent above the SAA benchmark. Others claim that since TAA adds so little to the returns, that serious questions must be asked about the costs of TAA in terms of increased (or decreased) risk and increased (or decreased) costs of management.

Bibliography

Brinson, G. P., Hood, R. & Beebower, G. L. (1986). Determinants of portfolio performance. *Financial Analysts Journal,* **42,** 39–44.

Brinson, G. P., Singer, B. D. & Beebower, G. L. (1991). Determinants of portfolio performance II: an update. *Financial Analysts Journal,* **47,** 40–8.

Droms, W. G. (1989). Market timing as an investment policy. *Financial Analysts Journal,* **45,** 73–7.

Grinblatt, M. & Titman, S. (1989). Portfolio performance evaluation: old issues and new insights. *Review of Financial Studies,* **2,** 393–422.

Jensen, M. C. (1968). The performance of mutual funds in the period 1945–1964. *Journal of Finance,* **23,** 389–416.

Sharpe, W. F. (1966). Mutual fund performance. *Journal of Business,* **39,** 119–38.

Sharpe, W. F. (1992). Asset allocation: management style and performance. *Journal of Portfolio Management,* **18,** 7–19.

--ED VOS

Term Structure Models

Measured by the number of discussion papers and published articles the theory of the term structure of interest rates is one of the most active fields of research in the literature on finance. This is partly due to the theoretically demanding questions these models create and partly to the direct practical significance of these models for the financial management of interest rate risks. The first step in modeling the term structure is the dynamic specification of bond prices for different maturities as well as the forward rate processes relative to each other under the requirement of no arbitrage. All models of the term structure of interest rates are relative pricing models in the sense that the dynamics of the bond price process are derived relative to the initially observed prices at time $t = 0$. Given a term structure model the second step is the pricing of interest rate dependent contingent claims relative to the assumed model of the term structure. The different modeling approaches are characterized by the time framework, which may be discrete or continuous. Depending on which of the stochastic processes are exogenous to the model we furthermore distinguish between the direct, i.e. the bond price based approach and the indirect, i.e. the forward rate based approach. Mainly due to the work of El Karoui et al. (1991) these two approaches are now understood within a unified framework.

The first term structure model in a narrow sense was proposed by Ho and Lee (1986). It was developed within a finite discrete time binomial lattice framework as a model for the entire term structure. Denote by $B_{j,i}$ $(1 + l)$ in the lattice vertex j the price of a zero coupon bond with face value 1 at time t_i ε$\{0 = t_0 < . . . < t_n = T\}$ and time to maturity of $1 + l$ periods. Assume an exogenous transition probability p as given, constant in time and state. For all $j = 0, . . . , N - 1; i = 0, . . . , j; l = 0, . . . , N - j$ the entire term structure is described by

$$B_{j,i}(1+l) \begin{cases} B_{j+1,i+1}(l) & = \frac{B_{j,i}(1+l)}{B_{j,i}(1)} \cdot h(l) \\ & \text{with probability } p \\ B_{j+1,i}(l) & = \frac{B_{j,i}(1+l)}{B_{j,i}(1)} \cdot h^*(l) \\ & \text{with probability } 1-p \end{cases}$$

where the perturbation functions h (.) and h^* (.) are independent of time and state, depending only on the remaining time to maturity l. The path independence and the no arbitrage condition yield

$$h(l) = \frac{1}{p + (1-p)\delta^l} \quad \text{and } h^*(l) = h(l) \cdot \delta^l$$

where δ is an additional parameter of the model. By induction the price process of a zero coupon bond with one period to maturity is determined by

$$
\begin{aligned}
&B_{j,i}(1) = \frac{B_0(j+1)}{B_0(j)} \cdot h^*(j) \cdot \delta^{-i} \\
&\forall j = 0, \ldots, n-1; \quad \forall i = 0, \ldots, j
\end{aligned}
$$

This implies that the logarithmic return per period $r_{i,j}$ takes the form

$$
\begin{aligned}
r_{j,i} &:= -\frac{1}{\Delta t} \ln B_{j,i}(1) \\
&= \frac{1}{\Delta t} \left(\ln \frac{B_0(j)}{B_0(j+1)} \right. \\
&\qquad \left. + \ln\left(\delta^{-j} \cdot p + (1+p)\right) + i \cdot \ln(\delta) \right)
\end{aligned}
$$

The continuous time limit of the Ho–Lee model is a special case of the Heath et al. (1992) term structure approach. Instead of zero coupon bond prices continuously compounded, forward rate processes are modeled as stochastic processes. Let (Ω, *F, P*) be a probability space and denote for all $t < u$ by

$$
f(t, u) = -\frac{\partial \ln B(t, u)}{\partial u}
$$

the continuously compounded forward rate on a riskless bond $B(t, u)$ at time t with maturity u. For fixed T these forward rate processes are assumed to satisfy the following stochastic differential equation

$$
\begin{aligned}
\mathrm{d}f(t, u) &= \mu(t, u, \omega)\mathrm{d}t \\
&\quad + \sigma(t, u, \omega)\mathrm{d}W(t) \quad \forall 0 \le u \le T
\end{aligned}
$$

where $f\,(0,.)$ is the given, non-random initial forward rate curve, $W(t)$ an n-dimensional standard Brownian motion. The instantaneous drift $\mu(.,.,.)$ and the n-dimensional instantaneous volatility vector $\sigma(.,.,.)$ are assumed to be adapted to the filtration induced by $W(t)$. Starting from the initial curve $\{f\,(0, u)\text{: } u\ \varepsilon[0, T]\}$ the Brownian motion $W(t)$ determines the fluctuation of the entire forward rate curve. The Heath–Jarrow–Morton model is the general framework for forward rate based term structure models assuming necessary regularity conditions on the functions $\mu(.,.,.)$ and $\sigma(.,.,.)$.

For one-factor models the dynamics of the term structure are completely determined by the continuously compounded short rate process $\{r(t) := f^{(t,\,t)}\}t_{\varepsilon[0,\,T]}$. In specifying the volatility functions $\sigma(.,.,.)$ such that the continuously compounded short rate is Markov these models are special cases of the Heath–Jarrow–Morton model. The majority of these models are of the form

$$
\mathrm{d}r(t) = (\theta(t) - a \cdot r(t))\mathrm{d}t + \sigma(t) \cdot r(t)^{\beta}\mathrm{d}W(t)
$$

For $a = 0$ and $\beta = 0$ one obtains the continuous time Ho–Lee model, for $\beta = 0$ the generalized Vasicek (1977) model, for $\beta = 1$ the class of lognormal models and for $\beta = 0.5$ the generalized Cox–Ingersoll–Ross (1985) model. In the case of $\beta = 0$ the short and forward rate becomes negative with positive probability. Models with $\beta = 1$, e.g. Brennan–Schwartz (1977), Dothan (1978), Black–Karasinski (1991) and Hull–White (1990a) guarantee positive rates. However, lognormal models have another serious drawback: expected rollover returns are infinite, even if the rollover period is arbitrarily short (Hogan–Weintraub, 1993). The choice of $\beta = 0.5$ can be viewed as a plausible compromise between the two extremes. However, for American interest rate data from June 1964 to December 1989, Chan et al. (1992) show that short rate movements are best explained by choosing $\beta = 1.5$. Sandmann–Sondermann (1994) point out that the problem with $\beta = 1$ disappears if one follows the way interest rates are quoted in practice and models the effective annual or nominal rate instead of the continuous rate. The assumption that the nominal short rate follows a lognormal model implies that the dynamics of the continuously compounded short rate are:

$$\mathrm{d}r(t) = (1 - \mathrm{e}^{-r(t)}) \left[\left(\theta(t) - \frac{1}{2}(1 - \mathrm{e}^{-r(t)})\sigma^2 \right) \mathrm{d}t + \sigma \mathrm{d}W(t) \right]$$

Along this line Sandmann–Sondermann–Miltersen (1995), Brace–Musiela (1995), Goldys–Musiela–Sondermann (1994) consider models where the stochastic process of nominal rates for finite compounding periods are lognormally distributed.

Instead of the forward rate processes the direct approach to term structure modeling starts with the dynamics of zero coupon bond prices. This approach is originally concentrated on two specific zero coupon bond price processes, ignoring the rest of the initial term structure (e.g. Ball–Torous, 1983; Schaefer–Schwartz, 1987; Bühler, 1988; Kemna-de Munnik-Vorst, 1989; Jamshidian, 1989; Briys–Crouchy–Schöbel, 1991; Käsler, 1991). In our exposition we follow El Karoui et al. (1991), who provided a unified framework and extended this approach to fit the entire term structure.

Let (Ω, F, P) be a probability space. For all maturities $u \leq T$ the dynamics of the stochastic processes for default free zero coupon bonds with face value 1 are assumed to fulfil the stochastic differential equation

$$\mathrm{d}B(t,u) = \alpha(t,u)B(t,u)\mathrm{d}t + B(t,u)\tau(t,u)\mathrm{d}W(t) \quad \forall t \leq u$$

where $B(0, u)_{u \leq T}$ is the non-random initial curve of the zero coupon bonds and $B(u, u) = 1$ with probability one. The instantaneous drift $\alpha(.,.)$ and the volatility function $\tau(.,.)$ with $\tau(t, t) = 0$ have to satisfy some regularity conditions and $W(t)$ is an n-dimensional Brownian motion under the probability measure P. If $\tau(.,.)$ is non-stochastic the above specification is known as the Gaussian term structure model, because it implies normally distributed continuously compounded rates.

Let $\{F_t\}_{t\leq T}$ be the natural filtration given by $W(t)$. For simplicity assume that $W(t)$ is a one-dimensional Brownian motion. Consider a predictable portfolio strategy $\{\Phi_1(t), \Phi_2(t)\}_t$ consisting of two zero coupon bonds with different maturities $u_1 < u_2$ such that the portfolio yields a riskless return. Under the assumption of no arbitrage the riskless return must be equal to the instantaneous spot rate, i.e.

$$\Phi_1(t)\mathrm{d}B(t,u_1) + \Phi_2(t)\mathrm{d}B(t,u_2) = r(t)\mathrm{d}t$$

This classical duplication argument implies by no arbitrage that the excess return per unit risk of a zero coupon bond under the probability measure P is independent of the maturity, i.e. there exists a function $\lambda(t, r)$ such that

$$\begin{aligned}\forall u \leq T : \lambda(t,r)\\ &= \frac{E_p[\mathrm{d}B(t,u)|B(t,u)] - B(t,u)r(t)\mathrm{d}t}{\sqrt{V_p[\mathrm{d}B(t,u)]}}\end{aligned}$$

Given sufficient regularity conditions on the function λ (.,.) the economy with risk premium can be transformed into an economy without risk premium. Define

$$\begin{aligned}&\frac{\mathrm{d}P^*(t)}{\mathrm{d}P(t)} :=\\ &\exp\left\{-\int_0^t \lambda(s,r(s))\mathrm{d}W - \frac{1}{2}\int_0^t \lambda^2(s,r(s))\mathrm{d}t\right\}\end{aligned}$$

where by $P(t)$ resp. $P^*(t)$ the restriction on the σ-algebra J_t is denoted and using Girsanov's Theorem, the process

$$\mathrm{d}W^*(t) := \lambda(t,r(t))\mathrm{d}t + \mathrm{d}W(t)$$

is a standard Brownian motion under the probability measure P^*. The change of probability measure has no influence on the volatility coefficients in the differential equations, whereas the instantaneous drifts are replaced by $r(t)$. In this artificial economy, the expected rate of return over the next time interval of length dt will for any asset be equal to $r(t)$:

$$\begin{aligned}\mathrm{d}B(t,u) = r(t)B(t,u)\mathrm{d}t + B(t,u)\tau(t,u)\mathrm{d}W(t)\\ \forall t \leq u\end{aligned}$$

*P** is called the equivalent martingale measure since the discounted price processes of any security in this market is a martingale under *P**. The solution of the risk neutral differential equation for a zero coupon1 bond is given by

$$\begin{aligned} B(t,u) &= B(0,u).\exp\{\textstyle\int_0^t (r(s) - \frac{1}{2}\tau^2(s,u))\mathrm{d}s \\ &\quad + \textstyle\int_0^t \tau(s,u)\mathrm{d}W(s)\} \\ &= \tfrac{B(0,u)}{B(0,s)} \cdot \exp\{-\tfrac{1}{2}\textstyle\int_0^t (\tau^2(s,u) - \tau^2(s,t))\mathrm{d}s\} \\ &\quad \cdot \exp\{\textstyle\int_0^t (\tau(s,u) - \tau(s,t))\mathrm{d}W(s)\} \end{aligned}$$

The relationship between the direct approach and the indirect approach is determined by the volatility function $\tau(.,.)$. For $\tau(t, u) = \sigma(u - t)$ we obtain the continuous time Ho–Lee model; for the specification

$$\tau(t,u) = \frac{\sigma}{a}(1 - \exp\{-a \cdot (u - t)\})$$

corresponds to the generalized Vasicek model and the Cox et al. (1985) square root model can be obtained by

$$\tau(t,u) = \frac{-2(1 - \exp\{-\gamma \cdot (u - t)\})}{2\gamma + (a - \gamma)(1 - \exp\{-\gamma(u - t)\})}$$

with

$$\gamma = \sqrt{a^2 + 2\sigma^2}$$

Using the bank account as a numeraire discounted asset prices are martingales under *P**, thus the price of an interest rate contingent claim is determined by the expected discounted value of the payoff stream. In many cases the payoff of the contingent claim depends only on the value of the underlying security (bond) at the exercise date. In such a situation El Karoui and Rochet (1989) and Jamshidian (1991) introduced a second measure transformation known as the time T_0 forward risk adjusted measure. This basically corresponds to a change of numeraire from the bank account to the zero coupon bond with maturity T_0. This can be interpreted as a transformation from the spot market to the forward market with delivery at time T_0. The time T_0 forward risk adjusted measure is defined by

$$\frac{\mathrm{d}P^{T_0}}{\mathrm{d}P^*} := \frac{\exp\left\{-\int_0^{T_0} r(s)\mathrm{d}s\right\}}{B(0,T_0)}$$

which in the framework of Gaussian term structure models is equal to

$$\frac{dP^{T_0}}{dP^*} := \exp\left\{-\frac{1}{2}\int_0^{T_0}\tau^2(s,T_0)ds + \int_0^{T_0}\tau(s,T_0)dW(s)\right\}$$

By Girsanov's Theorem, the process

$$dW^{T_0}(t) := dW^*(t) - \tau(t,T_0)dt$$

is a standard Brownian motion under P^* and the time T_0 forward price process of the zero coupon bond is equal to:

$$d\frac{B(t,u)}{B(t,T_0)} = \frac{B(t,u)}{B(t,T_0)}\cdot(\tau(t,u)-\tau(t,T_0))dW^{T_0}$$

The time T_0 forward risk adjusted measure is of practical importance for the pricing of those interest rate contingent claims with a final payoff only depending on the realization of the underlying security at time T_0. Within the Gaussian term structure framework the $t_0 = 0$ arbitrage price of a European call option on a zero coupon bond with maturity $T > T_0$, exercise price K and exercise date T_0 is determined by:

$$\begin{aligned}\text{Call}[B(t,T),K,T_0] &= B(0,T_0)E_{P_{T_0}}[\max\{B(T_0,T)-K,0\}]\\ &= B(0,T)N(d)\\ &\quad - K\cdot B(0,T_0)N(d-v(T_0))\end{aligned}$$

where N(.) denotes the standard normal distribution, and

$$d := \frac{\frac{B(0,T)}{K\cdot B(0,T_0)}+\frac{1}{2}v^2(T_0)}{v(T_0)}$$

$$v^2(T_0) := \int_0^{T_0}(\tau(s,T)-\tau(s,T_0))^2ds$$

The advantage of the Gaussian term structure model is that for a large class of interest rate contingent claims the arbitrage price is determined by analytical closed form solutions similar to the one given above. However, in order to overcome the drawback of negative spot and forward rates, one has to assume state dependent volatilities for forward rate and/or bond price processes, leading to a loss of analytical tractability. As a consequence, numerical methods such as those presented by Hull–White (1990b) and Schmidt (1994) become more and more important. Theoretical elegance aside, practical applicability requires derivative prices to be available within seconds to keep up with the volatile market.

Bibliography

Ball, C. A. & Torous, W. N. (1983). Bond price dynamics and options. *Journal of Financial and Quantitative Analysis,* **18,** 517–31.

Black, F., Derman, E. & Toy, W. N. (1990). A one-factor model of interest rates and its application to treasury bond options. *Financial Analysts Journal,* **46,** 33–9.

Black, F. & Karasinski, P. (1991). Bond and options pricing when short rates are lognormal. *Financial Analysts Journal,* **47,** 52–9.

Brace, A. & Musiela, M. (1994). A multifactor Gauss–Markov implementation of Heath, Jarrow and Morton. *Mathematical Finance,* **2,** 259–83.

Brace, A. & Musiela, M. (1995). The market model of interest rate dynamics. Working paper, New South Wales, Australia: University of New South Wales.

Brennan, M. J. & Schwartz, E. S. (1977). Savings bonds, retractable bonds and callable bonds. *Journal of Financial Economics,* **5,** 67–88.

Briys, E., Crouhy, M. & Schöbel, R. (1991). The pricing of default-free interest rate cap, floor and collar agreements. *Journal of Finance,* **46,** 1879–92.

Bühler, W. (1988). Rationale bewertung von options-rechten auf anleihen. *Zeitschrift für betriebswirtschaftliche Forschung,* **10,** 851–83.

Chan, K. C., Karolyi, G. A., Longstaff, F. A. & Sanders, A. B. (1992). An empirical comparison of alternative models of the short-term interest rate. *Journal of Finance,* **47,** 1209–27.

Courtadon, G. R. & Weintraub, K. (1989). *An arbitrage free debt option model based on lognormally distributed forward rates.* New York: Citicorp. North American Investment Bank.

Cox, J. C., Ingersoll, J. E., Jr. & Ross, S. A. (1985). A theory of the term structure of interest rates. *Econometrica,* **53,** 385–407.

Dothan, L. U. (1978). On the term structure of interest rates. *Journal of Financial Economics,* **6,** 59–69.

El Karoui, N. & Rochet, J.-C. (1989). A Pricing formula for options on coupon bonds. SEEDS Working paper 72.

El Karoui, N., Lepage, C., Myneme, R., Roseau, N. & Viswanathan, R. (1991). The valuation and hedging of contingent claims with Markovian interest rates. Working paper, Université de Paris 6.

Goldys, J.D., Musiela, M. & Sondermann, D. (1994). Log-normality of rates and term structure models. Working paper, University of New South Wales.

Heath, D., Jarrow, R. & Morton, A. (1992). Bond pricing and the term structure of interest rates: a new methodology for contingent claims valuation. *Econometrica,* **60,** 77–105.

Ho, T. & Lee, S.-B. (1986). Term structure movements and the pricing of interest rate contingent claims. *Journal of Finance,* **41,** 1011–30.

Hogan, M. & Weintraub, K. (1993). The lognormal interest rate model and eurodollar futures. Discussion paper, Citibank, New York.

Hull, J. & White, A. (1990a). Pricing interest rate derivative securities. *Review of Financial Studies,* **3,** 573–92.

Hull, J. & White, A. (1990b). Valuing derivative securities using the explicit finite difference method. *Journal of Financial and Quantitative Analysis,* **25,** 87–100.

Hull, J. & White, A. (1993). One factor interest rate models and the valuation of interest rate derivative securities. *Journal of Financial and Quantitative Analysis,* **28,** 235–54.

Jamshidian, F. (1989). An exact bond option formula. *Journal of Finance,* **44,** 205–9.

Jamshidian, F. (1990). The preference-free determination of bond and option prices from the spot interest rate. *Advances in Futures and Options Research,* **4,** 51–67.

Jamshidian, F. (1991). Forward induction and construction of yield curve diffusion models. *The Journal of Fixed Income,* **1,** 62–74.

Käsler, J. (1991). *Optionen auf anleihen.* PhD thesis Germany: Universität Dortmund.

Kemna, A. G. Z., de Munnik, J. F. J. & Vorst, A. C. F. (1989). On bond price models with a time-varying drift term. Discussion paper, Erasmus Universiteit, Rotterdam, Netherlands.

Longstaff, F. A. & Schwartz. E. S. (1992). Interest rate volatility and the term structure: a two-factor general equilibrium model. *Journal of Finance,* **47,** 1259–82.

Miltersen, K. R. (1994). An arbitrage theory of the term structure of interest rates. *The Annals of Applied Probability,* **4,** 953–67.

Rady, S. & Sandmann, K. (1994). The direct approach to debt option pricing. *Review of Futures Markets,* **13,** 461–514.

Sandmann, K. & Sondermann, D. (1994). On the stability of log-normal interest rate models and the pricing of Eurodollar futures. Discussion Paper No. B-263, Department of Statistics, University of Bonn.

Sandmann, K., Sondermann, D. & Miltersen, K. R. (1995). Closed form term structure derivatives in a Heath–Jarrow–Morton model with log-normal annually compounded interest rates. *Research Symposium Proceedings (CBOT),* 145–64.

Schaefer, S. M. & Schwartz, E. S. (1987). Time-dependent variance and the pricing of bond options. *Journal of Finance,* **42,** 1113–28.

Schmidt, W. M. (1994). *On a general class of one-factor models for the term structure of interest rates.* Frankfurt: Deutsche Bank Research.

Vasicek, O. A. (1977). An equilibrium characterization of the term structure. *Journal of Financial Economics,* **5,** 177–88.

--KLAUS SANDMANN

Time Series Analysis

A series of measurements made in chronological order is a time series. Finance research has concentrated on series of prices and returns to investors, although there has also been interest in series of earnings and dividends. Time-series analysis is a collection of statistical methods that is used to understand the dynamic behavior of the measured quantity, and to make forecasts about future values.

The earliest important insights into financial time series may be attributed to Holbrook Working and Maurice Kendall. The first detailed analysis of investment returns using markets to develop electronic or screen based trading. In these systems, the centralized floor is replaced by a centralized computer system. Market participants do not meet each other, but enter orders directly into the system. These orders will be automatically matched according to explicit priority rules (e.g. time and price priority). Limit orders that cannot be matched will be entered into the central limit order book, to be executed, if possible, against future incoming orders. Examples of electronic markets include the Toronto CATS, the Paris Bourse, and futures markets in Frankfurt and Osaka.

The relative merits of the two systems is being debated by academics and practitioners alike (see Kofman and Moser, 1995; Fremault Vila and Sandman, 1995). Proponents of the traditional floor mechanisms argue that market makers on the floor are critical in providing liquidity, especially when large order imbalances develop and prices move very fast. Furthermore, they suggest that the open environment of the floor is an important source of information for all participants in the trading process. By contrast, screen based systems offer potentially faster execution and reporting, thereby reducing so called immediacy risk (the possibility that the executed price differs from the price at which an order was entered). But theoretical and empirical studies fail to determine whether the absence of market makers in the screen based system hampers liquidity. Likewise, it is unclear whether the computerized system is more transparent (the central limit order book is usually visible to all market participants) or less transparent (traders don't face each other).

A very different trading environment is the over-the-counter market. This trading system ceases to be centralized. Instead, it is a dispersed network of dealers, linked by telephones and computers. At any point in time, multiple dealers provide quotes at which they are willing to trade with the public. Most of the world's bond markets, currency markets, as well as some stock markets (e.g. Nasdaq and LSE) are organized this way. It is usually argued, yet not proven, witness the recent controversy around Nasdaq quotes (see Christie and Huang, 1994), that the competition between dealers results in lower transaction costs (i.e. bid–ask spreads) than in the centralized trading systems. It is further suggested that the over the counter trading system can play a useful role in markets with relatively low liquidity (see Chan and Lakonishok, 1995) and/or very heterogeneous products (e.g. complex derivatives).

Finally, in recent years, several alternative trading systems have seen the light. Electronic clearing systems such as INSTINET and Tradepoint challenge the role of the traditional market systems, by offering longer trading hours, and by promising improved execution and reduced transaction costs.

Bibliography

Chan, L. & Lakonishok, J. (1995). A cross market comparison of institutional equity trading costs. Working paper, University of Illinois at Urbana Champaign.

Christie, W. & Huang, R. (1994). Why do Nasdaq market makers avoid odd-eight quotes? *Journal of Finance,* **49,** 1813–40.

Fremault Vila, A. & Sandman, G. (1995). Floor trading versus electronic screen trading: an empirical analysis of market liquidity and information transmission in the Nikkei Stock Index futures markets. Working paper, London School of Economics.

Kofman, P. & Moser, J. (1995). Spreads, information and transparency across trading systems. *Federal Reserve Bank of Chicago.*

O'Hara, M. (1995). *Market microstructure theory.* Cambridge, MA: Blackwell.

Stoll, H. (1992). Principles of trading market structure. *Journal of Financial Services Research,* **6,** 75–107.

--ANNE FREMAULT VILA

Transaction Costs

The buyers and sellers of virtually any asset incur costs in attempting to trade the asset in a public domain. Transaction costs are directly or indirectly associated with efforts to assess the fair value of the asset and to search for a trading counterparty. The size and nature of transaction costs ultimately depend on various characteristics of the asset. In particular, assets whose values can be readily ascertained in relation to other similar assets can be traded with lower costs than assets that have unique characteristics. The size of the trade, as well as the total size of the market (and thus the potential trading volume), also affect transaction costs, due to often tremendous economies of scale in search costs. These characteristics will also determine the type of market structure that will exist to facilitate trading in the asset, or indeed whether a formal market structure for the asset will exist.

Most assets trade in one of four market structures – direct search, broker, dealer or auction markets. In a direct search market, buyers and sellers conduct their own search effort to find a trading counterparty. Cost and effort incurred by the seller may include placing advertisements in newspapers, placing the asset in a conspicuous public place with a "for sale" sign attached, or other means of drawing the attention of the public. For buyers, efforts may center on locating such advertisements or placing ads indicating an interest in purchasing the asset. Examples of assets commonly traded in direct search markets are real estate, collectables and used automobiles, though in none of these cases is direct search the predominant market structure.

In brokered markets, either the buyer or seller, or both, hire a broker to conduct a search for a counterparty. For this service, the trader pays the brokers a fee, or commission. The amount of the fee in relation to the value of the asset depends largely on the costs normally incurred by the broker. The broker incurs fixed costs for equipment and training (used to monitor the status of potential counterparties and the overall state of the market) that must be allocated to each trade, as well as variable costs specifically associated with a given trade. Examples of assets traded in brokered markets are real estate and fine art, as well as some financial assets such as municipal bonds and large blocks of common stocks.

In a dealer market, the dealer holds an inventory of the asset and stands ready to buy or sell directly against this inventory. Thus the dealer effectively eliminates search costs and trading delays for both buyers and sellers. In exchange for providing this immediacy of trade, the dealer receives compensation in the form of a spread between the price at which the dealer will purchase the asset, called the bid price, and a higher price at which the dealer will sell the asset, called the ask (or offer) price. Examples of assets that trade in dealer markets are new and used automobiles and financial assets such as secondary markets for US Treasury securities, corporate bonds, foreign exchange, and common stocks traded on the Nasdaq Stock Market and the London Stock Exchange. The difference between the ask and bid prices, expressed as a percentage of the average of these prices, is commonly used as a measure of transaction costs in a dealer market.

Auction markets are characterized by the simultaneous presence of many buyers and sellers in a given location, each monitoring counterparty bids and offers in an active attempt to trade at the best possible price. The auction market structure is best suited for assets with large trading volume. Examples of assets traded in auction markets include fine art and, among financial assets, new-issue US Treasury securities and common stocks traded on the New York Stock Exchange, the Paris Bourse and the Tokyo Stock Exchange. Trading on the NYSE actually reflects aspects of the broker, dealer and auction structures. Buyers and sellers submit their trade requests to a broker that is a member of the NYSE and is therefore allowed to trade on the floor of the exchange. On the floor, the broker engages in the auction process known as open-outcry, attempting to obtain the best price for the customer. Occasionally, however, there is an imbalance of purchase or sale orders for a given stock, and orders may languish. To avoid this problem, the NYSE assigns to each stock a specialist, a member firm who acts as an exclusive dealer in the stock. The specialist posts bid and ask prices and has a general fiduciary responsibility to facilitate trading in the stock. Brokerage fees paid by customers to the member firms reflect the high fixed cost, and relatively low variable cost, associated with the auction market structure. In addition, when trades are consummated between the customer and the specialist, rather than between two customers, the customer also implicitly pays the specialist for their service as a dealer. For this reason, researchers often estimate transaction costs on the NYSE as the sum of a representative brokerage commission plus the specialists' proportional bid–ask spread.

Bibliography

Garbade, K. (1982). *Securities markets.* New York: McGraw-Hill.

-----------------------------------JOSEPH OGDEN

Transition Economies

The economies referred to in this section are those which were previously members of the COMECON trading bloc. As this bloc collapsed, the previously centrally planned economies entered a period of transition to a market style of economic organizations. The issues involved in re-engineering the financial and economic systems of these countries together with the complexities of restructuring the existing social and cultural framework constitute the economics of transition. Because of the extensive nature of the issues involved in transition, this section will attempt only to deal with the financial sector, and the commercial sectors which are intrinsically related.

The collapse of the centrally planned system created some new, indeed unprecedented, problems. In a command system markets, and of course market-based prices, are non-existent, with internal allocation achieved through state quotas and external transactions through barter arrangements with the state obtaining its resources by direct ownership of the means of production. The collapse of the communist system left the transitory economies with no fiscal system, no pricing system, no mechanism to provide internal or external liquidity, and no meaningful company, contract, or property law. Transition economies therefore needed to downsize commitments (privatize), create markets, create and capitalize financial intermediaries, and create the infrastructure that Western economies take for granted. As a first step, prompted by the massive overhang of inflation from money supply growth and unspent claims in the banking system, governments introduced harsh fiscal policies, combined with contradictory monetary policies. These policies are typical of those imposed in countries with a high level of foreign debt, the need for financial support, and declining productivity. The "shock therapy" has had high social costs, but is now beginning to show itself as successful in controlling inflation and stabilizing exchange rates. The countries which began to move away from the centrally planned approach prior to the complete collapse of the system are showing the strongest signs of recovery (Hungary and Poland).

The legacies of the centrally planned period are similar in most of these countries, the degree to which they are exhibited is somewhat dependent on the degree to which central planning policies were enforced.

Banks Which Have Poor Liquidity

The banks are generally poorly capitalized and have portfolios made up of a large number of non-performing loans, partially as a result of enforced lending to state-owned companies and partially due to poor lending decisions post 1989 (Szego, 1993). Private banks have emerged since 1989: however, much of the lending to private companies has not been repaid. As a result, few state-owned or private banks are in a position to lend to the new private manufacturing sector for periods of more than one year, and then only on the basis of highly liquid collateral which covers the initial loan plus expected accumulated interest.

Individual banks face problems in three major areas:

1. They are still developing the internal skill base needed to run a bank.

2. There are no performance norms or benchmarks for private companies thus making pricing risk highly uncertain.

3. The legal system lacks a framework of corporate contract or property law making it difficult to impose the bank's rights through bankruptcy or seizure of collateral.

In addition to the issues listed above, management in the formerly state-owned banks is problematic (Thorne, 1993). The lack of knowledge in the area of bank financial management combined with the retention of managers in place prior to 1989, has resulted in little change in the structure of the banks. The banks were founded in order to respond to instructions from the centre to dispense credits to the state-owned companies. Therefore, they have a structure which is highly bureaucratic, heavily overmanned and largely unequipped to operate in a market economy. State-owned company debt which is continually rolled over at high interest rates further hinders the banks' ability to develop its loan portfolio as much of the capital available is consumed by the interest on these loans (Saunders and Sommariva, 1993). Given that successful private companies tend to lodge their profit in Western European banks and in hard currency, it is unlikely that the real deposits required for on-lending will increase in the near future.

An Economic Structure with Few Companies of Medium Size

The economies were industrialized through the development of large, vertically integrated firms which had monopolies in their markets (Gibb, 1992). As they were designed to produce in line with a command from the center rather than for profit reasons, they are neither efficient nor market driven, nor did they have much flexibility to exploit opportunities at any intermediate stage. Retention of capital for reinvestment was not a priority for these companies and this has resulted in serious quality problems.

Some of these companies have been broken up and parts sold, with the easiest disposals being companies based in commodity trading with hard currency export potential. However, for those which have not yet been privatized, the structure remains intact and inefficient. As with the banks, the top management of most of these companies has not changed yet.

The status of the large firms is:

- recently privatized;
- being prepared for privatization;
- partners in joint ventures with foreign investors;
- to be privatized in the future.

Privatization

The most attractive firms were the first to be privatized. The privatization method which is often used is the voucher method with the population (as listed on the voting register) being offered a quantity of vouchers at a nominal price which could then be exchanged for shares of privatized companies through an auction process. While this method may be equitable, it does not relieve the problems associated with the pricing of these firms or with their capitalization. Delays in bringing companies forward to auction and speculative trading in vouchers are major political problems.

Mass privatization has worked well in some of the countries (e.g. Poland); however, it only achieves a change in ownership without restructuring or reform. The companies then need to change the management and financial structures and this may be regarded as the second phase of the process. In many cases, this second phase must be completed in plants which have suffered an output collapse since 1989 (Calvo and Corricelli, 1993). It is remarkable that, almost without exception, the management of the companies has not changed on privatization. This may be attributed in part to the vote of the workers who retain a percentage of the company and tend to vote for their managers to stay on in an attempt to protect their jobs. The maintenance of key management personnel is useful in terms of their knowledge of the other firms operating in the marketplace. However, the lack of turnover of top management in both the state-owned (or previously state-owned) companies and banks has sometimes been blamed for the slow restructuring of the companies. It may be regarded as in the personal interest of neither the top management of banks nor enterprises to restructure (Frydman and Rapaczynski, 1994).

It is expected that the break up of the state-owned enterprises will create a market for supplies and that some of the private companies will be able to compete for this business. However, there is little evidence of this to date.

The private start up and SME sectors are small and relatively new, with mangers inexperienced in operating in a market environment. They have little access to finance as financiers such as venture capitalists are still relatively inactive and banks unable or unwilling to take on new, risky loans (Szego, 1993). In a market economy, it would be normal to see high levels of growth in these companies. However, their inability to access affordable funds for long enough periods means that they cannot accumulate capital easily. While they are relatively successful in finding markets in their immediate geographical area, the level of investment needed to succeed on a larger scale is prohibitive. Many managers of small firms have difficulty in pricing their goods, resulting in poor realized value added as compared to the potential. The above factors combined with high corporate taxation levels means that many of the small companies operate in the informal economy.

The most successful small firms are those which also have an import/export trading branch. The profits from the trading activity feed the relatively newly established manufacturing plant with working capital and investment funding. In addition to the provision of capital, many of the owners of these companies have experience of living and working in market economies prior to 1989. This factor meant that they could successfully enter the market soon after the changes and therefore gain and maintain market share quickly.

While the capital markets are not very active in most of the economies, legislation has been put in place allowing such markets to emerge as the speed of privatization increases. In the economies with capital markets (e.g. Hungary, Poland, and the Czech Republic), there is relatively low turnover. The prices in these markets have fluctuated greatly since their establishment and they remain susceptible to political uncertainty, exchange rate devaluations, poor liquidity, and unpredictability resulting from the inexperience of fund managers. Much of the uncertainty associated with trading has been absorbed by the citizens of the countries as they participated through investment funds using vouchers.

As more companies are privatized, the pricing mechanisms are improving. Liquidity is also improving as regulations are loosened with regard to foreign investors and the experience of the indigenous population increases.

Governments are attempting to put in place legislative measures suitable to a market environment. There has been some loosening of legislation with regard to ownership and investment rights for non-nationals. Foreign investment is protected in most countries.

Legislation is still changing rapidly and some problems remain with regard to its implementation:

- There are long lead times with regard to taking a case to court in most of these countries.

- Corruption in the courts remains a problem, and this is unlikely to change quickly given present institutional structures.

- There are some cultural barriers with regard to collateral redemption.

Under the central planning system, most of the trading between COMECON countries, and with client states such as India and Cuba, was on a barter basis (Grint and Choi, 1993). In many cases the balance of trade was uneven, and the collapse of the communist regime resulted in high levels of debt both between ex-COMECON countries and outside of the bloc. The debt was mostly intergovernment, and the failure to pay, combined with the currency devaluations in exchange rates, has had serious balance of payments repercussions. Similarly the reliance on barter means that the mechanisms for the movement of money are weak, and there is no history of private companies raising money in syndicate. This is a continuing problem for the banks given the poor capitalization levels and the fact that many do not have access to international money markets.

Bibliography

Calvo, G. A. & Corricelli, F. (1993). Output collapse in Eastern Europe: the role of credit. *IMF Staff Papers,* **40,** 32–52.

Frydman, R. & Rapaczynski, A. (1994). *Privatisation in Eastern Europe: Is the state withering away?* London: Central European University Press.

Gibb, A. A. (1992). Small business development in Central and Eastern Europe: opportunity for a rethink? DUBS Occasional Paper, No. 9241.

Grint, K. & Choi, C. J. (1993). *Whither the embrangled East? Trust and information in Eastern Europe.* MRP.

Saunders, A. & Sommariva, A. (1993). Banking sector and restructuring in Eastern Europe. *Journal of Banking and Finance,* **17,** 931–57.

Schiffman, H. N. (1993). The role of banks in financial restructuring in countries of the former Soviet Union. *Journal of Banking and Finance,* **17,** 1059–72.

Szego, G. (1993). Introduction. *Journal of Banking and Finance,* **17,** 773–83.

Thorne, A. (1993). Eastern Europe's experience with banking reform: is there a role for banks in the transition? *Journal of Banking and Finance,* **17,** 959–1000.

------------------------------------KATHERINE O'SULLIVAN

V

Valuing Flexibility

Flexibility in production allows a firm to switch between alternative "states" of operation in order to respond to uncertainty in input and output product markets. These states may be discrete (e.g. an open or closed plant) or continuous (e.g. operating at different levels of capacity, or selecting different product mixes). The degree of flexibility is inversely related to the size of the switching costs. Recently, sophisticated financial techniques have been developed to quantify the value of flexibility. These techniques are based on contingent claims analysis which involves replicating the cash flows from the flexible asset with a continuously rebalanced portfolio of underlying traded securities. A martingale, or risk–neutral, pricing operator is then employed. Hodder and Triantis (1993) provide a detailed description of this approach for valuing flexibility. They also discuss computational approximation techniques that can be used to value complex compound switching options that arise due to flexibility.

Various types of flexibility have been analyzed using the contingent claims approach. Brennan and Schwartz (1985) and McDonald and Siegel (1985) value the option to shut down and resume production. Trigeorgis and Mason (1987) and Pindyck (1988) examine the options to expand or contract production or plant capacity. Triantis and Hodder (1990) and He and Pindyck (1992) show how to value a production system that has the flexibility to switch its output mix over time. Kulatilaka (1993) shows how to value a dual-fuel industrial steam boiler which allows switching between two inputs in response to input cost changes. Kogut and Kulatilaka (1994) and Mello et al. (1995) value global production flexibility which allows a firm to change its production location configuration to take advantage of exchange rate fluctuations. Finally, Cortazar and Schwartz (1993) analyze flexibility inherent in a multistage production process, and Baldwin and Clark (1993) examine the benefits of modularity in manufacturing.

This literature on flexibility is significant for two major reasons. First, it provides rigorous valuation techniques for evaluating flexibility, thus allowing firms to appropriately weigh the benefits of production flexibility against the significant costs associated with purchasing or developing such flexibility. This is particularly important in light of recent criticisms that the use of unsophisticated valuation techniques may be leading firms to underinvest in flexible capital. Second, a by-product of the valuation procedure is the determination of the optimal "switching" policy, i.e. how a firm should optimally use its flexibility. This formal link between production strategy and valuation is important to establish.

Among the specific results that have emerged from the flexibility valuation literature, flexibility has been shown to be particularly valuable under the following conditions: (1) when the underlying uncertainties (e.g. product prices or demands) are very volatile; (2)

when the life of the flexible capital is long; (3) when switching costs are low; (4) when more frequent switches are allowed; and (5) when the correlations between the alternative production inputs (or outputs) are low (or negative). The last result concerning correlation indicates that there is an advantage to pursuing strategic diversification in a firm that has flexible capital. The phenomenon of hysteresis is also highlighted in many of the papers in the literature. Hysteresis results when the output price at which one would switch from state 1 (e.g. an open plant) to state 2 (a closed plant) is different than the price at which one would switch from state 2 to state 1. The hysteresis band widens as switching costs and volatilities increase.

Most models in the existing literature on valuing flexibility adopt two key assumptions that are standard in the financial option pricing literature. First, the underlying variables are assumed to be observable and their uncertainty resolution is assumed to follow a diffusion process with constant volatility. Second, the optimal switching (exercise) policy is derived assuming that the objective is to maximize the market value of the flexible asset. These assumptions may be inappropriate for many of the situations in which the theory of valuing flexibility is meant to be applied. These shortcomings of the existing literature on flexibility valuation are discussed further below (along with citations of recent papers that attempt to address some of these problems).

The processes for uncertainty resolution are likely to be quite complicated in practice. Competition in product markets, for example, may result in the product price processes involving stochastic volatility, mean reversion, and/or jumps. These complexities will typically eliminate the possibility of obtaining closed-form valuation formulas. However, the literature on financial options has dealt with fairly general specifications of the uncertainty resolution processes in numerical approximation frameworks (such as lattice approaches). Since most practical applications involving flexibility require the use of numerical techniques anyway due to their complexity (stemming from the American and/or compound option features), future research should attempt to incorporate more general processes to avoid errors from misspecification of the underlying processes.

In some cases, uncertainty resolution may not occur exogenously (simply from the passage of time), but rather may be endogenous, depending on the firm's production strategy. For example, uncertainty about the demand or price of some output may only (or partially) be resolved by producing that output or related outputs. These learning by doing and collateral learning features are incorporated into the investment model of Childs et al. (1995).

A further complication in valuing flexibility may arise if the values of the underlying variables are not observable. In such cases, costs may be associated with acquiring information in order to decide whether to switch states of production. Alternatively, noisy estimates of the values of the underlying variables may be used. In either case, the resulting effect will be a reduction in the value of flexibility. Determining the magnitude of this reduction in flexibility value is an interesting topic for future research.

The switching strategy for a flexible asset depends on the decision maker's objective function. This can create problems if the objective of the agent that selects the optimal strategy is not consistent with that of one or more of the principals who hold the switching option. For example, it is well known that agency costs may arise in a levered firm given that management selects an operating policy that maximizes only shareholder wealth. Mello et al. (1995) compare first-best and second-best switching policies and measure the resulting agency costs in a levered firm that has global production flexibility. Agency costs may also arise if management tries to maximize its own wealth rather than that of the shareholders (e.g. by continuing to operate when it would be optimal from the shareholders' perspective to shut down operations).

Other factors may cause switching strategies and flexibility values to differ from those identified in the papers cited earlier. The illiquidity of a firm's assets may result in switching strategies that appear suboptimal when compared to those obtained from maximizing value under the assumption of perfect marketability. The structure of the industry in which a firm operates may also significantly affect flexibility value. Kulatilaka and Marks (1988) show that the nature of a firm's contracts with its suppliers can have a significant impact on the value of flexibility. Finally, other "real options" that a firm holds could also affect the value of its production flexibility (see Trigeorgis (1993) on option interactions).

While there has been significant progress in developing techniques to accurately value flexibility, there remain several important avenues for future research in this area. First, more realistic assumptions need to be introduced into the valuation models, as suggested above. Second, implications of the valuation theory should be tested against empirical data from different industries. Third, since many applications are bound to involve several underlying uncertainties, the search for more efficient computational approximation techniques must continue.

Bibliography

Baldwin, C. Y. & Clark, K. B. (1993). Modularity and real options. Harvard Business School. Working paper 93-026.

Brennan, M. J. & Schwartz, E. S. (1985). Evaluating natural resource investments. *Journal of Business,* **58,** 135–57.

Childs, P. D., Ott, S. H. & Triantis, A. J. (1995). Investment decisions for mutually exclusive projects: an options framework. University of Maryland. Working paper.

Cortazar, G. & Schwartz, E. S. (1993). A compound option model of production and intermediate inventories. *Journal of Business,* **66,** 517–40.

He, H. & Pindyck, R. S. (1992). Investments in flexible production capacity. *Journal of Economic Dynamics and Control,* **16,** 575–99.

Hodder, J. E. & Triantis, A. J. (1993). Valuing flexibility: an impulse control framework. *Annals of Operations Research,* **45,** 109–30.1

Kogut, B. & Kulatilaka, N. (1994). Operating flexibility, global manufacturing, and the option value of a multinational network. *Management Science,* **40,** 123–39.

Kulatilaka, N. (1993). The value of flexibility: the case of a dual-fuel industrial steam boiler. *Financial Management,* **22,** 271–80.

Kulatilaka, N. & Marks, S. G. (1988). The strategic value of flexibility: reducing the ability to compromise. *American Economic Review,* **78,** 574–80.

McDonald, R. & Siegel, D. (1985). Investment and the valuation of firms when there is an option to shut down. *International Economic Review,* **26,** 331–49.

Mello, A. S., Parsons, J. E. & Triantis, A. J. (1995). An integrated model of multinational flexibility and financial hedging. *Journal of International Economics,* **39,** 27–51.

Pindyck, R. S. (1988). Irreversible investment, capacity choice, and the value of the firm. *American Economic Review,* **78,** 969–85.

Triantis, A. J. & Hodder, J. E. (1990). Valuing flexibility as a complex option. *Journal of Finance,* **45,** 549–65.

Trigeorgis, L. (1993). The nature of option interactions and the valuation of investments with multiple real options. *Journal of Financial and Quantitative Analysis,* **28,** 1–20.

Trigeorgis, L. & Mason, S. P. (1987). Valuing managerial flexibility. *Midland Corporate Finance Journal,* **5,** 14–21.

--------------------------------------ALEXANDER TRIANTIS

Venture Capital

Venture capital involves medium-term equity participation in an unquoted enterprise where returns are mainly generated in the form of capital gains realized at the end of the venture.

It variously refers to the application of capital to new or developing unquoted enterprises; the financial support industry which has been built around supplying the capital; or the techniques and procedures involved in the process of screening, evaluating, and investing in enterprises. The term is applied in a variety of business contexts and may refer to a very small investment in a new enterprise start up or a much larger and much more complex structured financing, such as a management buyout (MBO). Depending on who is describing venture capital, the connotation may be positive, with terms like business angels used to describe investors, or derisive, with "vulture capital" substituted for venture capital. Even firms which are closely associated with the industry often prefer to describe themselves as development capital or investment capital providers rather than venture capitalists.

So what is venture capital? At its simplest venture capital is equity investment in new and growing enterprises, but even this definition would not be strictly true. Many investments are a combination of debt and equity investment, and venture capital providers often take a holistic approach to the company's financial structure by carefully balancing the increased risk which additional debt brings with the investor's need for short-term returns. The venture capitalist may not even provide all of the funds, but may itself only invest a part of the total requirement, and seek other investors on the company's behalf to make up the remainder of the required funds. Banks, pension funds, insurance companies, other institutional investors, suppliers, customers, and private investors may make up the remainder. Even the involvement in new and growing business included in the definition is not always true. Venture capital may be used to restructure failing firms, transfer ownership in a mature firm, or finance a demerger.

Every new venture capital financing seems to expand our definition of what we understand to be venture capital. To understand venture capital we need to look at the types of venture capital applications, the providers and advisors who make up the industry and the process of placing venture capital.

Types of Venture Capital

Since the size of venture capital investment varies from the tens of thousands to the hundreds of millions, business stage from start up to mature and the industry from high-technology to fast food, it is not surprising that the venture capital industry is fragmented into several distinct types.

For the smallest business, and those which are at the earliest stages of development, there is very little recourse to venture capital funding from commercial venture capital providers, although specialist financial sources, often government supported, may provide some assistance. "Seed capital" funds provide support to enterprises which are still developing a product and may not be able to offer a commercially viable product for at least a year. Likely customers for seed capital are biotechnology and other higher-technology companies which may require regular injections of capital over a period of years before a product is clearly defined and its likely market identifiable. While the returns to this type of investment may be very high, most commercial venture capital operations steer clear because of the high risk, the uncertain capital commitments, and the expertise required to assess the proposal.

Once an enterprise has identified a product and market, produced a business plan and is looking for its first external capital, "start-up funds" may be approached. Unless the business will require at least £100,000 in capital, promises rapid, sustained growth, and stock market flotation within a few years, many of the major venture capital providers will again be less than enthusiastic. This is at least partly because smaller deals may cost nearly as much and take as much effort to put together as bigger deals. Legal and accounting costs for the smallest of equity investments may cost over £50,000, but will rise much less than proportionately with the size of the proposition. Furthermore, a smaller business, even after years of remarkable growth, may still not be large enough to take to the stock exchange. This means that the venture capitalist will face a long-term commitment to a risky and illiquid asset.

Together, seed and start-up funds invest about 6 percent of total venture capital funds in the UK (BVCA, 1992) although this figure may be slightly higher in the USA and the rest of Europe. Far more important in terms of volume are the funds used in business expansion, also referred to as "development capital." Investment in unquoted, but established companies may not be considered to be venture capital in the United States, but it appears to be the direction in which the European venture capital industry is headed. Development capital, which accounts for around 30 percent of venture capital financing in the UK, helps family-controlled businesses expand beyond the limits set by gearing ratios and reinvested profits, enabling them to prove their ability to establish market leadership and create a reputation which will make them attractive to equity markets. For venture capital providers, this type of investment is attractive because it offers the prospect of a relatively quick and predictable way of cashing in their investment, and the security which the management and firm's well-established track record offer.

While development capital investments rely on growth to build value, "management buyouts" (MBOs), and buyins (MBIs) establish value through the demerger and eventual flotation of a subsidiary operation. MBO and MBI activity accounts for about two-thirds of venture capital funds invested, but a much smaller proportion of deals, because MBO/MBI deals are typically much larger than other types of venture capital investments. MBOs are usually initiated by existing management of the subsidiary; MBIs involve recruitment of a substantial part of the new management from outside the company. As mentioned above, a management buyout may not rely on growth to create the scale needed for an eventual flotation, and in some cases may involve reducing the size of the spun-off subsidiary's operation, rather seeking to demonstrate previously unrecognized value to potential investors.

Venture capital firms also invest in shares in unquoted companies held by other venture capital providers, a transaction referred to as "secondary purchase." Many venture capitalists' portfolios, and a substantial part of certain specialist funds' portfolios may be made up of turnaround or restructuring investments. These investments may involve buying out existing management and investors and implementing often extreme remedial actions. This type of venture capital investment is very "hands on" or active and is of particular interest to funds which are willing to commit the management resources to the company, as well as the capital.

The Venture Capital Process

Venture capital deals do come in a wide variety of shapes and sizes, but there are certain elements in common. They require a high return to compensate for the risk; they generally have less available collateral than the typical bank loan and hence are more complex and expensive to set up; and they require an exit route in order to recover the fund's capital.

Matching venture capital providers and users is the first stage in the process. Each venture capital fund sets its own criteria for investments, and most have a fairly well defined idea about the minimum and maximum size of investment they are willing to undertake, the length of time they expect to hold the investment, the geographical and industry parameters, the stage of investment, the amount of management involvement they are willing to contribute, and of course, the rate of return they potentially offer. For most venture capital firms the latter may be as high as 40 percent per annum (realized within five years), an amount they consider fair since as few as one in five investments is expected to achieve this target, while twice as many will fail, and the remainder will struggle along without ever providing the target rate of return. Since a 40 percent return on successful investments offers the prospect of a fivefold gain (given compounding) the portfolio offers some prospect of eventually showing a fair return overall, even after the failures. Companies looking for equity funding need to be able to demonstrate the potential for growth that can support the fund's expected rate of return, and perhaps even more importantly, explain how the return will be realized. Most venture capital funds look for an exit route even before the investment is made – in fact most will require at least two potential exits. Floating the company on a public stock exchange, selling the company to an industry competitor (a trade sale), selling the fund's shares to another venture capital fund (secondary purchase) and selling the shares back to management (an MBO) are all potential exit routes.

Once a match has been found, the venture capital fund will begin its evaluation of the company, usually starting with an assessment of the company's business plan. One venture capital firm reports that it looks at over a thousand plans a year in order to make fifteen investments (Rowan, 1994) and many of the business plans are reviewed by professionals. For the few companies that pass this first screen, more thorough interviews and investigations will follow, and additional market research and product testing may be required.

After this the company will enter into negotiations with the venture capitalist to determine the amount of equity which the founders or current owners will surrender to the venture capitalist in order to obtain the investment. At the same time, a firm of accountants will usually be engaged to investigate and verify the company's financial projections, particularly the assumptions used to reach the projections, and to look for any other irregularities. This investigation is referred to as "due diligence" and if satisfactory, agreements are concluded between the venture capitalist, management, and other parties such as banks.

Following the investment the venture capitalist will take a more or less active role in monitoring the investment. Certain firms prefer to maintain a close hands on relationship while others allow management a free hand (hands off) as long as certain conditions are met. These conditions are usually specified in the agreements, and may provide for the venture capital fund to take control if certain conditions occur. The venture capitalist will often appoint a non-executive director to the board of the enterprise.

Ultimately, the venture capital fund is looking for an exit route and will push for a flotation when the company's growth and market conditions appear suitable. In certain countries a smaller-companies stock exchange such as Nasdaq in the USA or the AIM in the UK, may allow an easier route to flotation than a full listing, but these markets are less liquid when market conditions are flat. If a full listing is the only option, management may be reluctant to meet the requirements of disclosure, increased public scrutiny, and the high listing costs. Under certain conditions refinancing, secondary purchase, or even a trade sale may seem a better option.

The Industry

The venture capital industry was originally established to fill a gap which existed for growing firms which were too small to raise equity from public markets, yet too successful to constrain growth to the boundaries set by bank debt-equity guidelines. Venture capital providers are as diverse in shape as the clients they serve, and range in size from the largest, firms like 3i with £2.5 billion in investments, to the smallest three-person office with a handful of small investments.

The industry includes venture capital firms closely associated with or owned by major banks. Insurance and pension funds may also provide funds directly to companies, although they are more likely to invest through specialist venture capital firms.

Companies may also invest in new ventures, and certain larger corporates have specialized units which invest in related new ventures, often with the intention of later acquiring the venture or its new technology, or providing a market for the new firm's product. This type of venture capital is called corporate venturing.

Part of the seed capital and start-up funding not provided by the mainstream venture capital industry is being provided by a new class of venture capitalist, the "informal investor" or "business angel." These investors are often business people who have already sold a business and retired or may be high net worth individuals seeking higher returns than offered by portfolio investment. While the number of business angels is small, it has been suggested that they may be the largest single source of new investment over the next few years (Harrison and Mason, 1996).

The Future of Venture Capital

The venture capital industry continues to evolve, and it would be difficult to say what form it will eventually reach or even what name we will be using to describe it. After a decade of returns which are probably below the expectations of the institutions which originally provide the funds which the venture capitalists invest, it is certain that there will be changes, and it is just as certain that any retrenchment will create opportunities which others will possibly fill. There is also an increasingly important international dimension to the industry, and the next decade may see venture capital applied in areas currently served by conventional lending products in countries where the banking systems are as yet underdeveloped.

Bibliography

Bhide, A. (1992). Bootstrap finance: the art of startups. *Harvard Business Review,* **70,** 109–17.

Bovaird, C. (1990). *Introduction to venture capital finance.* London: Pitman Publishing.

BVCA (1992). *A guide to venture capital.* London: British Venture Capital Association.

Gregory, A. (1992). *Valuing companies: Analysing business worth.* Hemel Hempstead: Woodhead Faulkner.

Harrison, R. & Mason, C. (1996). *Informal venture capital: Evaluating the impact of business introduction services.* London: Prentice Hall.

Lorenz, T. (1989). *Venture capital today.* 2nd edn, Cambridge: Woodhead Faulkner.

Mason, C. & Harrison, R. (1993). Strategies for expanding the informal venture capital market. *International Small Business Journal,* **11,** 23–38.

Moore, P. (1993). Vultures or venturers? *Director,* **46,** 59–65.

Murray, G. C. (1992). A challenging market for venture capital. *Long Range Planning,* **25,** 79–86.

Ooghe, H., Manigart, S. & Fassin, Y. (1991). Growth patterns of the European venture capital industry. *Journal of Business Ventures,* **6,** 381–404.

Pratt's Guide to Venture Capital Sources (1989). 13th edn, *Venture economics.* Needham, MA.

Robbie, K. & Murray, G. (1992). Ven1ture capital in the UK. *International Journal of Bank Marketing,* **10,** 32–40.

Rowan, M. (1994). Are the backers backing Britain? *Finance Director,* June.

Sahlman, W. A. & Stevenson, H. H. (1991). *The entrepreneurial venture.* Boston, MA: Harvard Business School Publications.

Sharp, G. (1991). *The insider's guide to raising venture capital.* London: Kogan Page.

------------------------------------CHARLES SCHELL

Volatility

Volatility is the term used in finance to denote the standard deviation of returns on an asset. It is therefore the square root of the variance of asset returns. Given a sequence of n weekly returns, an equally weighted estimate of the weekly variance (volatility squared) would be $\sigma_w^2 = [1/(n-1)]\Sigma_i\,(r_i - R)^2$, where σ_w denotes weekly volatility, σ_w^2 is the weekly variance, r_i is an individual return and R is the mean of all returns.

It is customary to express volatility on an annual basis. If an asset price follows a random walk, then its variance grows linearly with time. Hence the annual volatility is 52 times the weekly variance and the annual volatility may be expressed as $\sigma = \sqrt{52} \times \sigma_w$. σ will be used henceforth to denote the annual volatility.

A rather simple example of estimating a volatility is given in Table 1. Note that more than the ten prices given here would be required to obtain a reliable estimate and the table gives calculations which have been rounded to two decimal places.

Table 1. Estimating Volatility

Week	*Price*	r_i *(%)*	$(r_i - R)^2$
1	100		
2	110		56.33
		9.53	
3	115		19.76
		4.45	
4	110		19.76
		–4.45	
5	115		19.76
		4.45	

6	105	–9.10	82.76
7	110	4.65	21.64
8	120	8.70	75.71
9	125	4.08	16.66
10	120	–4.08	16.66
Sum =		18.23	329.05
Average (R) =		2.03	

Using the table, the weekly variance is then, $\sigma_w^2 = (1/8) \times 329.05 = 41.13$ and the weekly volatility is $\sqrt{41.13} = 6.41$ percent. The annual volatility is then, $\sigma = 6.41 \times \sqrt{52} = 46.25$ percent.

In the example, percentage returns were calculated as $r_t = \log(P_t/P_{t-1}) \times 100$. The reason for using (natural) logs in this calculation is that it is consistent with an asset which has a lognormally distributed price and this leads to returns which are normally distributed. Using such geometric returns has the commonsense feature that an increase in price followed by an equal fall in price gives returns which are equal and opposite, as in the sequence over weeks 2 to 3 (+4.45 percent) and 3 to 4 (–4.45 percent) in the example. Had arithmetic returns been used, the sequence would have given +4.54 percent and –4.35 percent, resulting in a positive average return when the price had not risen.

This simple example of estimating volatility assumed that all observations on returns were equally important. However, it is possible to weight recent returns more heavily than earlier ones, a typical arrangement being an exponential weighting scheme. Yet another approach is to take account of intra-day price movements, by using the day's high and low prices as well as the closing price (see Garman and Klass, 1980).

It is useful to know what levels of volatility typically arise in financial markets. Customary levels would be: shares 25 percent, commodities 25 percent, share indices 17 percent, bonds 14 percent and exchange rates 12 percent. From a few weeks of observations, it would not be unusual to find a share with a volatility as high as 70 percent or as low as 10 percent. After the stockmarket crash of 1987, estimated volatilities for shares exceeded 100 percent in some cases. Volatility for London's FTSE100 Index (estimated from 30-day data), was in the range 8 percent to 70 percent over the 1984–94 period. Extreme values do not persist, there being a tendency for volatility to revert towards its long-term mean.

Forecasting Volatility

Forecasting volatility is extremely important for calculating the fair value of an option. The only unknown in the Black–Scholes options-pricing model is the volatility, so that trading in options is effectively trading in volatility. It is possible to solve the model iteratively in order to find that volatility which equates model and market prices, the so-called "implied volatility." This reveals the market consensus for the period to maturity of the chosen option. An interesting feature of implied volatilities is that they tend to be larger for options which are at very low or very high exercise prices, leading to "volatility with a smile." Observed smiles also tend to be skewed to the left, which is consistent with the evidence for some financial assets that volatility rises as the price falls. In principle the implied volatility might be expected to provide a better forecast than an estimate of volatility based upon past returns. Most empirical studies confirm this hypothesis, but not all (see Canina and Figlewski, 1993).

Although an asset may be weak-form efficient in terms of prices, with the direction of the next move not predictable from past moves, it is possible to predict whether the next move is likely to be larger or smaller than previous moves. In other words, there are systematic changes in volatility. Time-series models for the variance have been developed, known as ARCH models, which exploit this dependence (see Engle and Rothschild, 1992). There is a whole family of such models, some of which allow the distribution of returns to have fat tails and others which incorporate skewness of the distribution. Despite a large volume of research, the ability of these models to forecast volatility is only marginally better than that of a simple, equally weighted, model as given in the example above. Nevertheless, they do confirm that good forecasts require skewness, fat tails, and mean reversion to be taken into account.

Volatility Spillovers

After the stockmarket crash of 1987, it became apparent that a large price movement in one time zone could spill over into another time zone. Not surprisingly, there is also evidence that an increase in volatility of the US stockmarket spills over into the European and Japanese markets (Hamao et al., 1990). A slightly different kind of volatility spillover is sometimes claimed to occur from futures and options markets to the stockmarket, to which the response in the United States has been to introduce "circuit breakers": these prohibit further arbitrage between the stock and derivative markets until conditions are quieter.

Excess Volatility

A contentious aspect of volatility in finance is whether it can be "excessive." A share's price is fundamentally the present value of the stream of future dividends. Shiller (1981) argued that changes in share prices were larger than could be justified by subsequent changes in dividend payments and he called this "excess volatility." Later papers showed that Shiller's argument was not statistically significant and pointed to the potential error which can be made in forecasting dividends. There is also the question of whether investors require a larger risk premium in periods when the volatility is higher, thus affecting share prices.

Volatility of a Bond

In the analysis of bonds, volatility is defined in a rather different way: it is the percentage change in the price of a bond for a 1 percent change in its yield. For example, if the yield rose from 8 percent to 9 percent and the price of a bond fell from 100 to 95, then the bond's volatility would be equal to 5 percent/1 percent = 5. This measure of volatility is related to a bond's duration, as volatility = duration/(1 + yield).

Bibliog1raphy

Canina, L. & Figlewski, S. (1993). The informational content of implied volatility. *Review of Financial Studies,* **6,** 659–82.

Engle, R. & Rothschild, M. (Eds) (1992). ARCH models in Finance. *Journal of Econometrics,* **52,** (supplement), 1–311.

Garman, M. & Klass, M. (1980). On the estimation of security price volatilities from historical data. *Journal of Business,* **53,** 67–78.

Hamao, Y., Masulis, R. & Ng, V. (1990). Correlations in price changes and volatility across international stock markets. *Review of Financial Studies,* **3,** 280–307.

Shiller, R. (1981). Do stock prices move too much to be justified by subsequent changes in dividends? *American Economic Review,* **71,** 421–36.

---GORDON GEMMILL

Volatility Risk Pricing

In both the academic and popular press, the subject of volatility risk has been an issue of debate. Evidence that stock volatility is both time varying and stochastic has led researchers to ask whether volatility risk is priced in equity stock and option markets. Volatility risk may be said to be priced if the risk premium determining the expected return on the security is a function of volatility.

In the equity stock market, the notion that the expected return is a positive monotonic function of risk suggests that the expected return on the market portfolio should be positively correlated with the market volatility. Although the detailed description of this relationship is not important for pricing individual stocks relative to each other (where one only needs to know the covariance of the stock's return with the market or another posited factor), it is required for understanding the intertemporal changes in prices. There are two questions that have been asked in the literature. First, is there a significant relationship between the expected return and volatility for the market portfolio? Merton (1980) offers some preliminary evidence, noting that the empirical research in examining the relationship between the expected return and volatility is confounded by the fact that the volatility in actual returns is likely to be larger than the volatility in the expected returns. However, the tests of French et al. (1987) indicate that a positive relationship does exist between expected return and volatility. They decompose the volatility time series into its predictable and unexpected components. Although they do not find a direct relationship between the market return and the predictable component of volatility, they show that the market return is negatively correlated with the unpredictable shocks to volatility. They suggest that this provides indirect evidence of the *ex ante* positive relationship between expected returns and volatility, as a positive shock to volatility would cause an increase in the expected return in the next period, thus decreasing the stock price (and leading to a negative return) in the current period. They confirm this relationship by fitting an ARCH-M model (Engle et al., 1987) and showing that the conditional variance is a determinant of the market risk premium.

The second question that has been asked in the literature is whether the changes in the risk premium can explain the time variation in stock prices. Poterba and Summers (1986) examine this question and conclude that the shocks to volatility are not persistent enough to create the magnitude of volatility-induced fluctuations in risk premiums required to explain the observed intertemporal variation in stock prices. This conclusion is in line with the general observation in the literature that the volatility of the stock market is difficult to understand in terms of changes in fundamentals. In this regard, it appears that the more interesting and tractable problems lie in other markets, especially derivative markets.

The importance of volatility in determining the price of an option (and thus its expected return) has been well-known since the derivation of the celebrated Black–Scholes equation (Black and Scholes, 1973). However, as the option in the Black–Scholes world can be replicated by dynamically trading the underlying stock and bond, there is no additional volatility-based risk premium. For option prices to incorporate a risk premium based on volatility, the option-pricing formula has to be generalized to allow for stochastic volatility. Stochastic volatility induces two effects on the option price. First, the underlying stock return distribution is no longer normal; it has fatter tails (kurtosis) and it may also be skewed. The net effect of this on the option price is well understood (Hull and White, 1987; Heston, 1993); the kurtosis reduces (increases) the at-the-money (away-from-the-money) option price relative to the Black–Scholes and positive (negative) skewness increases the price of the out-of-the-money (in-the-money) option price relative to the Black–Scholes.

Second, the incompleteness of markets resulting from stochastic volatility may imply that the equity option price incorporate a volatility based risk premium. The early literature on stochastic volatility (Hull and White, 1987) made the assumption that volatility risk was diversifiable and thus not priced. However, this assumption is not tenable for the option on a market index (Amin and Ng, 1993). The notion that equity options may incorporate risk premiums is a movement away from the no-arbitrage Black–Scholes world; however, observed anomalies in the option equity markets have attracted attention recently to such alternative hypotheses. For example, Lamoureux and Lastrapes (1993) provide evidence of the informational inefficiency of implied volatility, which they suggest could be consistent with a volatility risk premium. Unlike the case for stocks, where one might expect a positive risk premium, this may not be the case for stock options. Therefore, researchers have to ascertain both the magnitude and sign of the risk premium. Kapadia (1995) suggests that the index option should incorporate a negative risk premium for the following reason. From the evidence of French et al. (1987) already cited, stock returns react negatively to positive volatility shocks, while option prices react positively. Therefore, the option acts as a natural hedge to a long stock position. This would indicate that stock options should be priced higher than in the absence of a risk premium. Evidence from Kapadia (1995) suggests that stock options are higher priced than they should be in a Black–Scholes world or in a world of stochastic volatility with a zero risk premium. The difficulty of distinguishing between alternative hypotheses, especially those dealing with the effects of market frictions and alternative distributions for the underlying stock return, still leaves this an open question. Most empirical research has concentrated on the index option markets and it would be useful to test implications in the individual stock option market. If the market volatility risk were priced, it would imply a cross-sectional relationship between individual stock options through the relationship between the individual stock volatility and the market volatility; this could provide empirically testable implications which could supplement the existing results from the index option market. Although empirical research may resolve the direction of the effect of a volatility risk premium (whether the risk premium is positive or negative), the inherent non-observability of the volatility process is likely to make the ascertaining of the magnitude of the risk premium a far more challenging problem.

Bibliography

Amin, K. I. & Ng, V. K. (1993). Option valuation with systematic stochastic volatility. *Journal of Finance,* **48,** 881–910.

Black, F. & Scholes, M. (1973). The valuation of options and corporate liabilities. *Journal of Political Economy,* **81,** 637–54.

Engle, R. F., Lillien, D. A. & Robins, R. P. (1987). Estimating time varying risk premia in the term structure: the ARCH-M model. *Econometrica,* **55,** 391–407.

French, K. R., Schwert, G. W. & Stambaugh, R. F. (1987). Expected stock returns and volatility. *Journal of Financial Economics,* **19,** 3–30.

Heston, S. L. (1993). A closed-form solution for options with stochastic volatility with applications to bond and currency options. *Review of Financial Studies,* **6,** 327–43.

Hull, J. & White, A. (1987). The pricing of options with stochastic volatilities. *Journal of Finance,* **42,** 281–300.

Kapadia, N. (1995). The price of volatility risk. New York University. Working paper.

Lamoureux, C. G. & Lastrapes, W. D. (1993). Forecasting stock return volatility: toward an understanding of stochastic implied volatilities. *Review of Financial Studies,* **6,** 293–326.

Merton, R. (1980). On estimating the expected return on the market. *Journal of Financial Economics,* **8,** 323–61.

Poterba, J. P. & Summers, L. H. (1986). The persistence of volatility and stock market fluctuations. *American Economic Review,* **76,** 1142–51.

---------------------------------------NIKUNJ KAPADIA

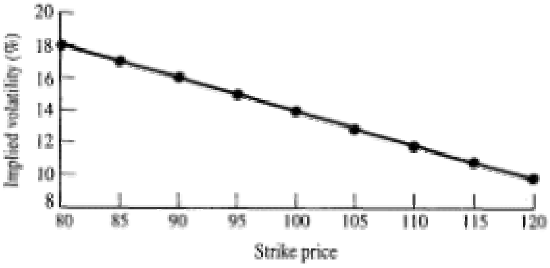
Volatility Smile

In recent years, especially after the 1987 market crash, it became clear that the prices of derivative securities do not exactly follow the model of Black and Scholes (1973). For instance, the Black–Scholes implied volatility is supposed to be constant, but in practice it strongly depends on option strike price and maturity. That effect, commonly known as volatility smile, is in contrast to the basic assumption of the model. Instead of trying to find a more general model based on a specific mechanism, one can simply construct a numerical procedure consistent with the volatility smile. Probably the simplest and most intuitive tools for valuation of derivative securities are recombining binomial (and multinomial) trees. A tree which is consistent with or implied by the volatility smile can be constructed from the known prices of European options. Once the appropriate prices and transition probabilities corresponding to the nodes and links of the tree are calculated, any American or path-dependent option can be priced consistently with the market.

An implied tree should satisfy the following criteria:

- It must correctly reproduce the volatility smile.

- Negative node transition probabilities are not allowed.



- The branching process must be 1risk-neutral at each step.

The last two conditions also eliminate arbitrage opportunities.

Note that the Black–Scholes formula is used only as a translator between prices and implied volatilities, providing a simpler description of the data.

We are aware of four different approaches to the problem of construction of implied trees. They all deal with computationally simple, i.e. recombining, trees.

Dupire (1994) demonstrates the similarity between the usual problem of finding option prices given the diffusion (in the form of a known volatility and the inverted problem of finding the diffusion process from the given option prices). He sketches a procedure for building a trinomial risk-neutral implied tree which is able to capture both the maturity and strike dependence of the smile. Due to the large number of degrees of freedom of a trinomial tree, Dupire can assign the node prices in advance. The construction of the tree is reduced to the calculation of transition probabilities. Efficiency and stability of the method depend on the details of the algorithm for extracting the Arrow–Debreu profiles from the given option prices.

Rubinstein (1994, 1995) starts building a binomial tree backwards from the expiration date using a set of probabilities assigned to the logarithmically equidistantly spaced final nodes. Following the known European option prices, final probabilities are assigned by a non-linear minimization routine. After that, the method is very simple and easy to program. To obtain a unique (i.e. well-defined) algorithm, Rubinstein assumes that the diffusion along any path connecting two given nodes bears the same probability. That assumption guarantees non-negative node transition probabilities, but neglects the actual time dependence of the volatility smile known from the existing options of earlier maturities.

Derman and Kani (1994) proposed an algorithm for a risk-neutral implied binomial tree able to incorporate both the strike price and term structure of volatility. Given the smaller number of degrees of freedom in a binomial tree, the node positions are not known in advance. The algorithm of Derman and Kani reproduces the volatility smile accurately in certain circumstances, but fails if the interest rates are high.

Barle and Cakici (1995) introduce important modifications to the method proposed by Derman and Kani (1994). They start from the root at present time and current stock price, so the recombining binomial tree is constructed recursively forward, one level at a time. A new algorithm provides correct treatment of interest rate and dividends, as well as some additional practical improvements. For the purpose of testing, they reconstruct the volatility smile using the new implied tree and obtain excellent results. Their modifications become especially important if the interest rate is high.

The methods of Derman and Kani and the method of Dupire are similar in spirit. They are both able to capture not only the smile, but also its term structure, which is crucial for accurate pricing of American and path-dependent derivatives.

The main purpose of implied binomial trees is to price derivatives consistently with quoted market prices. But they are also useful for analyzing hedging and calculating implied probability distributions.

Bibliography

Barle, S. & Cakici, N. (1995). Growing a smiling tree. *RISK,* October, 8, 76–80.

Black, F. & Scholes, M. (1973). The pricing of options and corporate liabilities. *Journal of Political Economy,* **81,** 637–59.

Derman, E. & Kani, I. (1994). Riding on a smile. *RISK,* February, 7, 32–9.

Dupire, B. (1994). Pricing with a smile. *RISK,* January, 7, 18–20.

Rubinstein, M. (11994). Implied binomial trees. *Journal of Finance,* **69,** 771–818.

Rubinstein, M. (1995). As simple as one, two, three. *RISK,* January, **8,** 44–7.

------------------------------NUSRET CAKICI

W

Warrants

Traditionally warrants are defined as rights issued by a company to buy a certain number of "new" shares in this company (during the exercise period against the exercise price). These warrants are nowadays referred to as equity warrants. Around 1980, also bond warrants, giving the right to buy "new" bonds, were introduced. In fact, equity warrants and bond warrants both give the right to buy the (eventual) liabilities of the issuer. In the 1980s also other securities were introduced under the name warrant, which give the right to buy gold, oil, foreign currencies, existing shares, and existing bonds. These securities are generally referred to as covered warrants. During the last five years also index warrants have also become popular. Because covered warrants and index warrants give the right to buy underlying values, which are existing assets to the issuer, they resemble traded options rather than warrants. This topic will be limited to equity warrants, from now on to be referred to as warrants. Warrants differ from the conversion rights attached to convertibles, in the sense that the warrant exercise price is paid in cash, while the exercise price of a conversion right is paid by redeeming the accompanying bond.

If warrants are exercised, new shares are created. This dilution effect creates a valuation problem. Galai and Schneller (1978) presented the first solution for this problem, by showing that the value of a warrant is a fraction ($1/(1 + q)$) of the value of a call option on the stock of an otherwise identical firm without warrants. The factor q represents the ratio of the number of new shares to be issued upon warrant exercise and the number of existing shares. However, this solution cannot be used in practice, because such an identical firm does not exist. Building on the Galai and Schneller (1978) result, Crouhy and Galai (1991) and Schulz and Trautmann (1994) derive a dilution corrected version of the Black–Scholes option pricing model. Schulz and Trautmann (1994) also prove that the outcomes of this dilution corrected option pricing model only marginally differ from the outcomes of the original no dilution corrected Black–Scholes option pricing model. An important difference that remains between warrants and call options is that warrants generally have a longer maturity. Therefore a correction for dividend payments on the underlying stock is necessary. One of the few markets in which both warrants and long-term call options are available is the Dutch market. In an empirical study, Veld and Verboven (1995) have shown that, despite the large similarities between these instruments, warrants are valued more highly than long-term call options.

Because of the similarities between convertibles and warrants issued with bonds (warrant bonds), the discussion on traditional and modern motives for the issuance of convertibles is also applicable to warrant bonds. Theoretically the modern motives are more convincing than the traditional motives. However, from a survey of Dutch companies that issued warrant bonds from 1976 to 1989, Veld (1994) concludes that these companies have mainly been driven by the traditional motives.

With regard to the choice between convertibles and warrant bonds, Veld (1994) concludes that the main motives for the issuance of warrant bonds are (1) the possibility to attract equity while the accompanying bonds remain outstanding; and (2) the possibility to acquire a higher premium for the warrants in relation to the conversion rights, because of the separate tradeability of the warrants and the bonds. In an empirical study, Long and Sefcik (1990) find that convertibles have an advantage over warrant bonds, because the flotation costs for issuing convertibles are significantly lower.

Covered and Index Warrants

According to Veld (1992) covered warrants are rights to buy existing assets from the issuer. In past issues these assets have included gold, foreign currencies, oil, existing shares and existing bonds (see Duffhues (1993) for an extensive list of examples). Because they entitle the holder to buy existing assets, they are traded more like call options, than warrants. The main differences between covered warrants and traded call options are: (1) covered warrants are traded on the stock exchange instead of the options exchange; thus, the credit risk is not taken over by a clearing organization; and (2) the issuer of covered warrants issues a fixed amount of contracts, whereas the number of traded options is flexible. One of the latest innovations are basket warrants. These are rights to buy a basket of existing shares of companies in the same branch of industry or from the same country.

Index warrants are options on a stock index. They differ from traded options in the same way as covered warrants differ from traded options. On the American and the Canadian markets, Nikkei put warrants have become popular (Wei, 1992). On the European markets a number of index warrants are traded. De Roon and Veld (1996) mention that in the Netherlands index warrants are traded on German, English, French, American, Japanese and Hong Kong indexes. Wei (1992) has developed a number of valuation models for index warrants.

Bibliography

Crouhy, M. & Galai, D. (1991). Warrant valuation and equity volatility. *Advances in futures and options research.* (Ed.) Fabozzi, F. J. Greenwich, CT: JAI Press. 203–15.

De Roon, F. & Veld, C. (1996). An empirical investigation of the factors that determine the pricing of Dutch index warrants. *European Financial Management,* **2,** 97–112.

Duffhues, P. J. W. (1993). Developments in the use of warrants on the national and international capital markets (in Dutch). *Financiele Instrumenten.* (Ed.) Duffhues, P. J. W. et al. Deventer, Netherlands: Kluwer Bedrijfswetenschappen. 171–93.

Galai, D. & Schneller, M. I. (1978). Pricing of warrants and the value of the firm. *The Journal of Finance,* **33,** 1333–42.

Long, M. S. & Sefcik, S. E. (1990). Participation financing: a comparison of the characteristics of convertible debt and straight bonds issued in conjunction with warrants. *Financial Management,* **19,** 23–34.

Schulz, G. U. & Trautmann, S. (1994). Robustness of option-like warrant valuation. *Journal of Banking and Finance,* **18,** 841–59.

Veld, C. (1992). *Analysis of equity warrants as investment and finance instruments.* Tilburg, Netherlands: Tilburg University Press.

Veld, C. (1994). Motives for the issuance of warrant-bond loans by Dutch companies. *Journal of Multinational Financial Management,* **4,** 1–24.

Veld, C. & Verboven, A. (1995). An empirical analysis of warrant prices versus long term call option prices. *Journal of Business Finance and Accounting,* **22,** 1125–46.

Wei, J. Z. (1992). Pricing Nikkei put warrants. *Journal of Multinational Financial Management,* **2,** 45–75.

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