



FALL 2005: **RISK MANAGEMENT**

Findings from Faculty Research at Columbia Business School

Risk Management

Many of the tools and concepts that shape business practice began as ideas in the classroom. This is particularly true in the field of risk management: the principles of diversification, hedging and risk measurement all originated in universities. Banks, insurers, fund managers and corporate treasurers rely on these ideas for their core businesses.

Columbia Business School continues to play a leading role in the development of modern risk management. Our faculty members are devising better ways to measure and manage market risk and credit risk—comparing international regulatory and legal perspectives on risk, testing innovative risk management techniques for hedge funds and studying cultural attitudes toward risk.

This newsletter describes some of our faculty's recent research on risk management. The work described here draws on several fields that have helped break new ground on the topic, including finance, accounting, economics, statistics and psychology. If you are intrigued by the work described in this newsletter, we invite you to read more by visiting the Columbia Ideas at Work Web site: www.gsb.columbia.edu/ideas.



Disclosing Risk

When is it in a firm's best interest to voluntarily disclose information

about risk? Two decades ago, the number of product-liability lawsuits rose dramatically as U.S. juries made bigger and bigger awards to successful plaintiffs. The cost of product-liability insurance went through the roof: in just three months of 1985, the price quadrupled. As a result, by the end of 1986 half of the firms who had purchased product-liability insurance ended their coverage. Why did the other half choose to continue their coverage?

Professor **Bjorn Jorgensen** explored this question with Anne Beatty from Ohio State and Anne Gron from Northwestern. The results of their research showed a correlation between

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a firm's response to the premium hike and the firm's compensation structure: firms that paid senior executives in stock options were less likely to continue their coverage than those that paid in stock. In other words, you care less about risk management instruments like insurance if you benefit when the stock price goes up but bear no risk when the stock goes down.

In addition to making internal risk management decisions, executives also decide whether or not to disclose risk to shareholders and the public. Investors worry when firms provide too much or too little information about firm-specific risks, so disclosure has a direct effect on a firm's stock price and its ability to borrow money. How a firm measures and discloses risk ultimately reflects back on the firm's operating decisions, and risk disclosure is an important way of communicating the firm's strategy to investors.

Accountants traditionally limit their analysis to past transactions, and so pay little attention to future risk. Jorgensen's research helps fill that gap. New regulations help, too, by forcing companies to include in their financial statements items that accountants can use to assess risk. Since 1998, the SEC has required large public firms, especially those in the financial sector, to reveal much more risk-related information. In other industries, companies still have greater leeway about the confidence level, time horizon and method of estimating risk. The 2002 Sarbanes-Oxley Act extends similar rules of risk disclosure to smaller public firms.

Yet managers still decide how much risk information to disclose beyond the legal requirements. Using an economic model of voluntary risk disclosure, Jorgensen and Michael Kirschenheiter of Purdue showed that firms maximize value by disclosing additional risk information only if it is favorable. The key factor is investor uncertainty about whether managers

possess additional information about firm-specific risk. Managers disclose when the risk information is not very damaging, so investors are more willing to buy the firm's shares at a lower price.

The researchers found that a firm's risk disclosure also affects its beta—the relation between firm-specific risk and market risk—as well as the beta of other firms. If other firms in a sector voluntarily disclose information about their risks, a firm that fails to disclose must pay investors a higher risk premium to compensate for the uncertainty.

Effective risk measurement requires a big investment in information technology to calculate the potential benefits of disclosure, and the result is often that voluntary risk disclosure outweighs the cost. Still, when firms provide adequate risk disclosure it helps investors make better portfolio decisions in the future. Once investors become better at diversifying risk across different shares, they invest more effectively. In turn, firms become more willing to invest in good risk controls. In the end, better informa-

tion is better for firms, investors and the economy as a whole.

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Bjorn Jorgensen is the Gary Winnick & Martin Granoff Associate Professor of Business at Columbia Business School. His working paper with Michael Kirschenheiter won the KPMG UIUC Competitive Manuscript Award on Risk Measurement and Disclosure in 2003. During the 2005–06 academic year, Jorgensen is an academic fellow at the U.S. Securities and Exchange Commission.

Bankruptcy Codes and Default Risk

Do different national codes turn bankruptcy into a strategic tool for companies?

Thanks to a U.S. bankruptcy code that favors borrowers, United Airlines has gone nearly three years under Chapter 11 protection without a change of management. That situation is unthinkable in Germany or the United Kingdom, where bankruptcy laws are tougher. But a new U.S. law that went into effect in October 2005 will make some important changes to the bankruptcy code, such as limiting restructuring to 18 months with no extensions. How will this new law affect the U.S. market for corporate debt?

Professor **Suresh Sundaresan** has studied how the institutional features of markets, particularly bankruptcy codes, influence the behavior of borrowers and

lenders. He expects that the new law will change how U.S. companies borrow: for example, less debt overall or loans in other currencies that convert to dollars through interest rate swaps. But other factors, such as the Fed increasing short-term interest rates to slow the economy, further complicate the situation.

Sundaresan and fellow researchers Ron Anderson of Université Catholique de Louvain, Hua Fan of Credit Suisse First Boston and **Mark Broadie** and **Mikhail Chernov** of Columbia have developed models that predict both the probability that a company will default on its debt and the payouts creditors can expect in the event of a default. This research method is of direct interest to credit rating firms such as Moody's, Standard & Poor's and

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Risk-Averse vs. Risk-Aware

If you know more about a risk, do you fear it less? Your new MBA hire does something strangely conservative in her first week on the job: you worry that she is too risk-averse to succeed. Then your entrepreneurial father-in-law opens a fourth restaurant after three failures: you worry that he is too risk-seeking, especially with your wife's inheritance. What explains the difference between them?

People differ in their risk attitude—some are excited and attracted by the upside potential of risky situations, while others find the uncertainty and possible downside scary and distasteful. Even so, don't be too quick to ascribe observed behavior to an individual's risk attitude. Chances are that your new hire or your father-in-law simply has miscalculated the risks involved.

Professor **Elke Weber** has worked on the issue of risk perception for a number of years, first with students and colleagues at the University of Chicago and more recently at Columbia's Center for the Decision Sciences. In a typical experiment, the researchers observe choices made by study participants in a set of investment tasks that contrast safer options with predictable returns and riskier options with a wide distribution of possible returns. In addition, participants rate their perception of each option's risk and likely return.

The results show that different investors agree about likely returns—judging

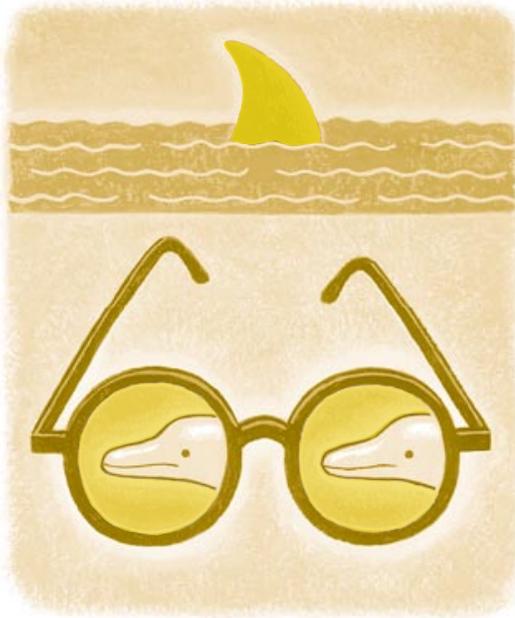
them close to the expected value based on past returns—but often widely disagree about the risk of different investment options. Investors choosing safer options do so not because they are more risk-averse (most people make moderately risk-averse choices) but because they perceive the risks of the

more variable options to be greater than other investors do.

Why do perceptions of risk vary? Sometimes the cultural context changes a person's perception of an action's consequences. In a study with Christopher Hsee comparing the investment

decisions of MBA students based in Chicago and Shanghai, Weber found that investors with larger networks that they could rely on for financial support appeared to be more risk-seeking. Thus the Chinese students, who were more likely to have networks that cushioned their risk, made riskier investment decisions and rated the more variable options as less risky than their American counterparts.

In other situations, perceptions of risk may not be accurate. Women tend to see greater risk in risky alternatives in all domains, except social situations, where men perceive the risks to be greater. Differences in risk perception seem to be driven by such variables as familiarity with the situation and perceptions of control; people are less worried about things they are familiar with and think they can control.



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These results have important implications for understanding how to interpret people's behavior in risky situations. Take, for example, the decisions of female investors. It is fortunate that their behavior, which looks like excessive risk-aversion, results not from a more negative or fearful attitude toward risk but from insufficient familiarity with the task and its options. Risk attitudes result from years of past experience and have a biological basis, so changing them is difficult. It is far easier to correct misperceptions of the risk of various options through better information and more exposure to their consequences.

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Elke Weber is the Jerome A. Chazen Professor of International Business at Columbia Business School. She is also codirector of the Center for Decision Sciences and director of the Center for Environmental Decisions at Columbia University.

Portfolio Credit Risk for Financial Institutions

You've measured your risk. Now, where did it come from? To meet regulatory requirements, banks and other financial institutions regularly measure the total credit risk in their debt portfolios. For internal risk management, however, measuring overall risk is just a first step in understanding how a portfolio's elements contribute to its risk. By decomposing total risk into risk contributions for each sector, region, line of business or creditor, banks can better manage their risk and make more informed risk-return tradeoffs. But what is the best way to break down overall portfolio risk?

Professor **Paul Glasserman** studied this problem in a project funded by the Federal Deposit Insurance

Corporation and the National Science Foundation. His work has led to better methods for measuring marginal risk contributions—the part of a portfolio's overall credit risk that can be attributed to each component.

A portfolio view of credit risk is essential in comparing the risk and return of individual transactions. Consider a bank's decision to extend credit to an airline. A naïve analysis would view the transaction in isolation and simply balance the airline's creditworthiness against the interest and fees the bank could charge. A portfolio view asks how the transaction contributes to the risk and return of the bank's overall portfolio. The transaction may contribute more risk—and thus appear less attractive—if the bank has already made loans to several other airlines.

Banks gauge portfolio credit risk through the concept of economic capital, a measure of the buffer of capital required to cover losses resulting from defaults. In order to calculate economic capital for a large portfolio of corporate debt, a bank must capture correlations in the creditworthiness of the many creditors to which it is exposed. The process is further complicated by the fact that defaults of highly rated firms are rare events and are thus difficult to predict.

Working with a former doctoral student, Jingyi Li, now at Credit Suisse First Boston, Glasserman developed an efficient Monte Carlo technique that addresses these chal-

lenges. Monte Carlo techniques use computer simulation to generate scenarios, and statistical tools to analyze the results. The Glasserman-Li method identifies scenarios that are most likely to lead to large losses from defaults and then systematically

explores those scenarios.

In work he presented at a Moody's credit risk conference in London in May 2005, Glasserman showed that related ideas could be used to dramatically improve precision in measuring the marginal risk contributions of portfolio components. His approach separates factors that influence credit risk across broad sectors or regions from idiosyncratic sources. He shows that the key determinants of marginal risk contributions are the individual default probabilities in those scenarios in which the common factors produce higher overall default rates.

Glasserman showed that related ideas could be used to dramatically improve precision in measuring the marginal risk contributions of portfolio components.



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Paul Glasserman is the Jack R. Anderson Professor of Business and senior vice dean of Columbia Business School. In 2004, he received the Wilmott Award for Cutting-Edge Research in Quantitative Finance.

Portfolio Risk for Institutional Investors

How can endowments and pension funds create investment strategies that best match their liability streams?

Seeking to compensate for the stock market's lackluster returns over the past five years, institutional investors have increasingly turned to alternative investments. Endowments and pension funds, while maintaining core portfolio allocations in bonds and stock index funds, have largely shifted their active portfolio allocations from equities to hedge funds. As a result, hedge funds are now the fastest-growing sector of the asset management industry. As endowment and pension fund managers explore this largely uncharted territory, how can they best understand and manage the risk associated with hedge funds?

Building on a decade of academic research in the area of dynamic portfolio theory, Professor **Sid Browne** developed a model that helps endowments and pension funds use hedge fund investments to securely meet their long-term financial obligations. His earlier research was based on the idea that endowments and pension funds are less interested in maximizing utility—the classic framework for economic analysis—than in maximizing survival; that is, given a fixed spending rule, what investment strategy will keep the organization alive for the next 100 years? In his work at Columbia Business School, Browne developed a variety of goal-based portfolio models that enable institutional investors to create such a strategy.

During a three-year stint at Goldman Sachs Asset Management from 1998 to 2001, Browne shifted his attention from investment risk to trading risk, developing a factor model that decomposes the risk of option volatilities. Just as the Fama-French model allows stock traders to analyze equity risk, Browne's model helps options traders to understand volatility risk. In 2004, he took another leave of absence from the classroom and returned to Goldman, where his responsibilities include helping endowment

and pension fund managers understand how to use hedge fund investments within a long-term asset-allocation framework.

Applying insights from his goal-based portfolio models and volatilities factor model, Browne developed a factor model that decomposes the risk of hedge funds' dynamic trading strategies. It focuses on the wings—for example, the top and bottom quartiles—of the distribution of hedge fund returns, because when you invest over a long time horizon, you can't trade around volatility, so you are more interested in the wings of the distribution. Since hedge funds use sophisticated strategies to control risk, their returns have interesting statistical behavior that pension funds can use to match the pension funds' liability streams.

In the wake of the mutual fund scandals of 2001–02, the opacity of hedge funds has raised concerns among some investors and regulators, prompting the SEC last fall to step up hedge fund regulation. But Browne thinks much of the doomsday fear about the systemic risk associated with hedge funds is somewhat overblown, noting that General Motors's credit downgrade in May caused only a minor ripple in the hedge fund world.

While portfolio management and risk management are based on seemingly opposed philosophies—portfolio theory tells you to buy on the losses and take profits on the gains, while risk management tells you when to sell your losses—Browne's research combines the two approaches. His models both enable endowment and pension fund managers to dynamically reallocate their portfolios within risk parameters that ensure the health and longevity of the organization and allow them to recalibrate when they have lost confidence in a particular model.

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Sid Browne is professor of decision, risk and operations at Columbia Business School. He is currently head of quantitative analysis, risk and research for alternative investments at Goldman Sachs Asset Management.

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Fitch, and it can also help buy-side asset management firms assess the pricing of particular loans and bonds.

The bankruptcy code's impact on debt pricing is very difficult to measure. On the one hand, lenders should charge U.S. companies higher interest rates because the U.S. code grants less protection to creditors than its German or British counterparts. On the other hand, interest payments depend on a complex combination of factors, including market liquidity, tax codes and the contractual features of specific debt instruments. And in a country like the United States, where a company can drag creditors into a long and costly restructuring process, some borrowers are likely to engage in strategic default behavior. By threatening to declare bankruptcy, a company can essentially blackmail creditors into renegotiating debt contracts with terms that are more favorable to the borrower.

Sundaresan and Anderson found that this type of strategic debt service costs lenders from 25 to 100 basis points. The interest rate a bank charges for a corporate loan should account for the risk that the company might ask to renegotiate the loan several times. This "blackmail effect" is strongest with sovereign debt, as illustrated by Argentina's December 2001 decision to halt payments on more than \$100 billion in debt—the largest sovereign

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Downside Risk

Should you measure risk the same way in down and up markets?

A fundamental tenet of finance is that there is a relationship between reward and risk. The most famous model of reward and risk, the capital asset pricing model (CAPM), measures risk by beta, or covariance with the market. The higher a stock's beta, or the more a stock covaries with the market portfolio, the higher the stock's return. The CAPM, as well as more recent multifactor models of asset returns, treats risk the same way in down and up markets. But does investor behavior conform to this assumption?

Professor **Andrew Ang** worked on this problem with Joseph Chen from USC and Yuhang Xing from Rice. They found that investors treat risk differently in down and up markets and that this difference affects a firm's cost of capital. An asset that loses more value in a declining market than it gains in a rising market is unattractive to hold because its payoffs are low precisely when investors' wealth is low and market returns are poor. Investors who are more sensitive to downside losses versus upside gains require a premium for holding assets that covary strongly with the market when the market declines. In an economy where investors care more about downside

risk than upside gains, assets with large sensitivities to downward market movements must have high average returns.

As Ang and his colleagues demonstrate, you can see this premium for bearing downside risk by analyzing a cross section of U.S. stock returns with a CAPM that allows betas to differ across upward and downward movements. A downside beta, which measures covariance with the market conditional on movements of the market below the market's mean return, emphasizes only the down movements that investors most dislike.

Stocks with high downside betas have high average returns. But such stocks tend to have high regular betas, so to find the downside premium, the researchers had to disentangle it from the reward to regular beta. To do this, they created portfolios of stocks with different exposures to downside beta loadings but high average returns to high downside beta, and held regular beta constant. Controlling for other cross-sectional effects—such as size, value-growth, momentum, volatility, skewness, kurtosis and liquidity risk—they found a downside risk premium of around 6 percent per year. This method works for several different methods of computing the downside betas and for different portfolios of stocks.

Stocks with high downside risk

exposure hold their value during market downturns. Such companies include utilities, small caps and value stocks and past winners. Stocks with high past accounting return on equity are also more likely to have high downside risk, but firms paying dividends don't necessarily have less downside risk than firms that don't pay dividends.

Forecasting downside risk exposure lets traders create portfolios with high future downside beta today to earn high future expected returns. This research shows that the tail behavior of asset returns affects prices, especially as asset returns covary with bad market outcomes. Assets with high sensitivity to downside risk must have high average returns to induce investors to hold these stocks.

Read More

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Andrew Ang is the Roger F. Murray Associate Professor of Finance at Columbia Business School.

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default in history. The settlement agreement took three years, and most of the country's creditors settled for 30 cents on the dollar. So in the case of a sovereign debt, lenders should charge a higher spread.

Sundaresan and his colleagues have developed other tools for assessing default risk, including models for debt renegotiation, such as debt-equity swaps and strategic debt service, as well as more detail on the bankruptcy

codes themselves. For example, they found that features such as automatic stay provisions, absolute priority rules and potential debt forgiveness increase the likelihood of default but reduce the likelihood of wasteful liquidation.

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Suresh Sundaresan is the Chase Manhattan Bank Professor of Financial Institutions at Columbia Business School.

Foreign Exchange Risk

Your global firm uses a dozen currencies. How do you manage exchange rate fluctuations?

A firm's profits change—for better or worse—when changes in the exchange rate between two countries fail to offset movements in the prices of inputs and outputs in those same countries. A common way of handling this situation is to match currency “footprints,” a practice that offsets any change in your home currency relative to a foreign currency with corresponding changes in the home currency value of revenues and costs. The result is less variation in home currency profits, but is it good for the firm overall?

Professor **Nahum Melumad** studied this issue with Trevor Harris of Morgan Stanley and Toshi Shibano of Thunderbird. They explored how matching currency footprints affects a firm's overall profits and whether it does in fact reduce home currency variation. They found that matching footprints could actually result in lower profit.

In some cases the preference not to match is based on competitive cost efficiency. Not matching creates strategic flexibility: a firm with fluctuating costs can better adjust its quantities and prices. When costs are high, the firm can produce and sell less—or vice versa—and so lower its average unit cost and raise

profits. The expected profit effects of matching depend on the tradeoff between the possible cost savings of sourcing abroad versus the strategic flexibility to make adjustments in prices and quantities that exploit competitive cost differentials created by exchange rate shifts.

These counterintuitive results suggest that the substantial cost advantages of sourcing abroad may be insufficient to offset the loss of strategic flexibility. And even the basic intuition that matching currency footprints reduces profit variance does not always hold true.

In many situations, matching currency footprints does reduce profit variance,

but in many other cases it has the opposite effect. To assess actual variability, a firm must consider how a competitor will react to the firm's currency-matching decision.

But can you achieve variance reduction through other means, such as a financial instrument independent of source loca-

tion? For example, as an alternative to sourcing in the foreign market, a U.S. firm might lock in a foreign currency price for the inputs for any exchange rate. Yet this kind of financial instrument would cancel out the potential expected profit benefits of U.S. sourcing associated with the strategic flexibility. The research shows that a U.S. firm may actually have a higher expected profit if

In many situations, matching currency footprints does reduce profit variance, but in many other cases it has the opposite effect.

it does not convert its cost structure to match its revenue base.

Of course, matching currency footprints makes sense in some cases: for example, when it is significantly cheaper to produce in the country where sales are generated, a scenario that elevates the cost advantage as the key determinant of the manufacturing location. In other situations, strategic considerations may dominate: a firm may match currency footprints to reduce political sensitivity, to circumvent trade barriers or for other specific reasons that vary by country and time. Absent such strategic objectives, however, firms should think twice about using currency matching to manage foreign exchange risk, since the practice may both lower expected profits and fail to reduce profit variance.

Read More

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Nahum Melumad is the James L. Dohr Professor of Accounting and chair of the Accounting Division at Columbia Business School.





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