

Canada Research Chair in Risk Management

Description of the research

Over recent years, we have observed a significant increase in collective and social risks: The risk of natural disasters has greatly increased; the economic and social costs of ecological risks are reaching record levels; and risks linked to food consumption are a concern for several populations. Nor must we forget the September 11 events which take us into new territory, as they were premeditated. Private risks have also largely increased. The stock market has been very volatile, particularly for stocks related to the new economy. These trends may be associated with new non-human, exogenous natural phenomena or they may be considered endogenous—the results of poor private and social management of risks. These trends may, moreover, be linked to private and social choices that put the concern for prevention far too low on the policy agenda.

I have been involved in risk analysis for more than two decades. My current research activities are primarily related to information problems, road safety, decision-making under uncertainty, portfolio choice, integrated risk management, environmental risk, credit risk, insurance fraud, and risk-management regulation. Most of my work is empirical, but some of models developed are primarily or solely theoretical. In the following pages I shall address the most significant projects related to my future research on risk management. Work on these issues will be stimulated and broadened in the academic environment of a Canada Research Chair in Risk Management.

School's strategic plan

The proposed research program is integrated in HEC Montréal's strategic research plan. It will help HEC Montréal to improve its position in risk management by proposing projects in two major areas: 1) the production of wealth and the optimal use of resources, and 2) the market and the consumers. Risk management is a field of finance of crucial importance for HEC Montréal since it is now at the forefront of teaching, research and practice in this field. Since 1996, HEC Montréal has invested significant resources in the development of risk management. The School wants to be very well positioned on the international scene and to have nothing to envy any other Canadian university in this field.

Theory of risk and risk perception

Ever since the seminal works on risk aversion and risk measurement, we have known that the specific risk measurement selected for use will depend on what and how decision-makers want to evaluate. It is also important to know that the volatility of markets is not an exact measure of risk that can suitably be applied in all situations. These often repeated facts are of particular importance for credit and operational risks and for most insurable risks, especially those involving natural disasters and environmental accidents. They also matter for the analysis of financial portfolios containing derivative products such as options. These risks are distributed very asymmetrically and they have heavy tails.

It is possible that evaluation or utility functions should themselves be radically challenged. Over recent years, several researchers have used different tests to gain a better understanding of how individuals make choices when in a state of uncertainty. Indeed, economists would perhaps gain from consulting psychologists on the way individuals perceive risk. It is now well documented that the perceptions of individuals are a function of the events or circumstances surrounding gains or losses. It is also well

documented that these perceptions affect the behavior of individuals. We have published an article on these issues in the *Journal of Risk and Uncertainty* in 2000 (with Yves Alarie, a postdoctoral fellow) and we are working on extensions. Our model takes into account the possibility that decision-makers may be bounded rational. By taking account of this restriction, we propose a model that minimizes the complexity of the decision process. Many authors, such as Conlisk (*Journal of Economic Literature*, 1996), have recently given reasons and empirical evidence for incorporating bounded rationality in economics and decision-making models. By doing so we are able to explain the major violations of the expected (and non-expected) utility theory for two-points lotteries. We also show the necessity of explicitly considering the qualities of the lotteries and not only their probability and monetary amounts. By qualities we mean, for example, that the probability of gain is winning or losing (non-linear transformation of probabilities). During the next years, we plan to extend the analysis to n points lotteries. Another more fundamental extension involves explaining the nature of a buying and a selling price and the difference between the two. This is closely related to the concept of ambiguity in lottery choices. This distinction has already been discussed in an important article by LaVallée (*Management Science*, 1968) but researchers have used only the selling price to define risk aversion. This may explain why the expected utility model is not able to explain many behavioral results. We plan to write a comprehensive survey on all the significant tests published over the last twenty years, showing how the dispersed results on specific aspects of risk misperception may be integrated to build up a sound empirical support for new theories of risk behavior. We shall also conduct an empirical study on the links between alcohol consumption, risk perception, and road accidents. Our objective is to test how risk perception affects individual safety behavior in different circumstances. This study will be conducted with the collaboration of the Société de l'Assurance Automobile du Québec. It will imply the administration of a detailed questionnaire to a random sample of drivers and will link the subjective information obtained to facts measured by traffic violations and accidents.

Statistical measurement of information problems

Wherever risks arise—whether in the environment, transportation, health care, the workplace or financial markets—problems of asymmetric information abound. Over recent years, my principal contributions have focused on the empirical study of such problems in various markets. The methodologies I have developed enable us to identify, isolate, and estimate the effects of moral hazard and adverse selection on the allocation of resources (*Review of Economics and Statistics*, 1991, 2000; *Journal of Political Economy*, 1994, 2001; *Journal of Risk and Uncertainty*, 2002).

There are two well-known information problems that feature prominently in the economic literature: moral hazard and adverse selection. These two problems occur in most markets but, over the past twenty years, they have drawn particularly sharp attention in insurance and financial markets. One important bifocal question is the following: Are these problems truly significant and do they really affect the performance of markets? Before answering this question, let us go back over the classical definitions of these two information problems. Adverse selection exists because one party to the insurance or financial contract cannot observe the other party's risk. To remedy this, the insurer or the banker fall back on risk classifications and whatever can be surmised about risks from the choices of contracts or riders. The presence of adverse selection can thus be observed to affect the forms of contracts.

Moral hazard for its part is associated with the non-observable behaviors of policyholders. There are two forms of moral hazard, depending on whether the non-observable actions affecting contracts outputs occur before or after the random event. Ex-ante moral hazard is more closely linked to

activities aimed at preventing accidents, whereas ex-post moral hazard involves the statements of individuals on accidents. This second form of moral hazard is now associated with insurance fraud. Under both forms of moral hazard, it is the form of the contract that may affect risk behavior and incentives.

For a researcher, it is difficult to know which of the three problems weighs most heavily in the portfolio of an insurer or banker, because he has no information at his disposal other than that available to the financial institution being studied. Usually open to his observation are the contracts chosen, the claims or financial distresses in play, and the risk classification variables used. Over the past five years, much progress has been made with regard to the measurement of the residual information problems present in different markets (see Chiappori and Salanie, 2000 for a survey). For example, it has been ascertained that risk classification variables are efficient in controlling adverse selection: The results are less spectacular as concerns moral hazard—a more difficult problem to isolate, as it arises from endogenous behaviors which are in constant evolution, unlike adverse selection where the characteristics of individuals are assumed exogenous and stable.

In the coming years, I plan to apply the models developed to financial contracts and more particularly to venture capital contracts. It is now documented that standard debt is not optimal when the projects are very risky and when their results depend on the non-observable behavior of many decision-makers. Convertible debt, warrants, and even stocks are used to finance projects, depending on their level of risk. But the true risk is not perfectly observable ex-ante and this raises an interesting question: Can these different forms of contract somehow be used as lenses to reveal risk ex-ante. We are building a data set in collaboration with a large venture capitalist in order to be able to analyze this question.

We also plan to extend the current statistical tests to fleets of drivers or vehicles. Here the information problems are at three levels and the accidents observed may be affected by drivers of vehicles as well as by owners of fleets. We are interested in constructing a statistical model that, by separating the different responsibilities, will allow us to develop an optimal pricing scheme for hierarchical information problems between the insurer, the owner of the fleet, and the driver. This project will be run in collaboration with an insurer. We shall have access to a panel of more than one million observations. We shall face a huge estimation problem in dealing with two forms of “panel effects,” the traditional time effect, and the fleet effect. And this will require expanded computational capacity, a need which, in part, motivates our application for FCI funding in relation to this project.

Risk management in financial and non-financial firms

Over recent years, I have also been involved in many activities concerned with firms risk management. In some joint work with graduate students, we have extended Tufano’s data base (*Journal of Finance*, 1996) to analyze more carefully the determinants related to the maximization of a firm’s value. We have obtained very good preliminary results that were recently published in *Economics Letters* (2003). All the theoretical determinants except one prove to be significant. I am currently working on this research with two Ph.D. students. Another Ph.D. student recently extended the results to take into account merger and acquisition activities.

Up to the early 90s, risk management in non-financial firms was limited to the demand for insurance. The globalization of markets and the increased volatility of interest rates, exchange rates, commodity prices, and the prices of several resources such as petroleum, natural gas, and gold have pushed non-financial firms to develop risk-management activities. Besides taking into account managers' risk

aversion, several determining factors associated with the maximization of the firm's value have been considered to explain the varying intensity of risk-management activities. For example, Dionne and Garand (2003) have shown that gold producers who hedge against fluctuations in the price of gold are those who experience the greatest financial difficulties, who pay the highest taxes, and who are the largest producers. Managers with more shares or actual funds in firms are more active, but those with options are less so; for, it is a well-known fact that the values of such options will increase along with the volatility of the underlying asset or the price of gold (Tufano, 1996). This result follows directly from application of the Black-and-Scholes formula and is due to the fact that higher volatility increases the probability that the option will be in the money. One particular difficulty on which we plan to work next years is finding ways to separate hedging from speculation. But more fundamentally, it seems that the different results are sensitive to the methodology used (Dionne and Triki, 2003). Indeed, the significant determinants vary depending on the econometric specification used and on the way endogeneity problems are controlled. For example, it has often been proposed in the literature that expected financial distress costs may affect hedging decisions because they reduce the firm's value. Many researchers use debt to approximate these costs as a determinant of risk management. But risk management may affect the firms' capital structure by gaining access to more debt for firms that manage their risks. Moreover, the manager's decision to hedge his firm's risk may be driven by his own portfolio of stocks and more particularly of stock options in this firm. But the decision to hold options may, in turn, be affected by the firm's risk-management policy. It seems that these interactions must be analyzed jointly, and we are planning to model risk-management decision, debt policy, and the number of options held by managers in a system of three simultaneous equations with panel data.

Bancassurance

Risk management has enjoyed a phenomenal expansion over the past 10 years and this growth is not without its link to the presence of electronic methods of information retrieval and rapid calculation. To be specific, computer technologies have changed the way credit and insurance risks are managed by banks and other financial institutions. Bancassurance is a strategic subject at the core of future concerns in the banking and insurance milieus in general. It removes the traditional barrier separating activities providing insurance products and those offering financial services. The new common target becomes the financial portfolios of individuals or households, and the integrated management of the assets they generate. Bancassurance is highly developed in several countries. According to Mr. Gilles Benoist, chairman of CNP Assurances, 61% of life insurance collected in France now takes place via bank windows. In non-life insurance, the penetration of bancassurance is more modest, representing only 8% of turnover (Assurances, July 2002).

The development of bancassurance in different countries depends on several factors such as regulation, tax breaks, and the role accorded to banks in the financial system. In Canada, bancassurance is not yet allowed and will probably not be before 2006. In Quebec, it has been allowed since 1999 in institutions with provincial charters. These businesses thus enjoy a unique opportunity to develop this form of portfolio management for individuals or households, using the latest procedures of information acquisition and all forms of e-finance. Quebec thus offers an ideal laboratory to test the effectiveness of bancassurance, since its financial and life insurance markets are composed of some businesses which, since 1999, have been in a position to launch bancassurance activities and of others, operating under federal charter, which have not.

The main advantages of bancassurance are linked to the profitability of distribution networks, the possibility of obtaining greater customer loyalty, and a more accurate estimation of the value and risks

associated with each client. The impact of distribution channels can be of particular importance, as can the growing use of Web solutions. But, in order to be effective, it requires the free flow of information concerning the elements in client portfolios which are kept in different management units. Consequently, it will need very large computational facilities and motivates FCI funding.

Our first objective is to build up, with a Ph.D. student, an integrated risk-management model of consumers over their life cycle that integrates all significant risk-management decisions. Our research will be done in collaboration with a large financial institution that offers all kinds of products, including banking and insurance. In order to achieve this objective, we shall build up a large data set of more than one million clients. Some of the most recent techniques of data mining will be used to find the correlations between the different individuals' risks.

We shall also study the efficiency of such management over time. The research methodology will consist of comparing the main financial ratios and cost structures of firms dealing with the two different regulations from the early 90s to 2004, taking 1999 as the year of structural transition for those firms in the sample operating under the provincial charter. It will, of course, be necessary to see whether these firms effectively used the regulatory advantage to which they are entitled and, if so, starting at which date. The financial ratios will be obtained from financial statements and we shall collaborate with Statistics Canada to obtain data on cost structures. The network aspect of the technology used by the financial institutions will be measured by the number of their banking branches or insurance brokers and agents. As to the volume of financial intermediation activities, this can be measured by the return on investments. The estimation method chosen will have to take into account the fact that financial institutions are not equally effective and that the industry and, consequently, our samples are shaped by the entry and exit of numerous firms. The procedure proposed by Dionne, Gagné, and Vanasse (*Journal of Econometrics*, 1998) lends itself well to an extension like the one proposed in this research program.

Operational risk

Over the past few years, the operational risk of financial institutions has become an important concern. Financial institutions and regulatory agents worry about what potential effects breakdowns in the likes of electronic computer and information exchange systems will have on the financial health of businesses and even markets. But there does not yet exist any statistical measurement of these operational risks which can reliably predict the scope of this form of financial distress. With a Ph.D. student, we plan to address this difficult question in collaboration with a private bank.

At the end of the last decade, special attention was paid to the regulation of capital as associated with operational risk. In effect, the large losses incurred by investment banks such as Barings and Daiwa Securities in 1995 alerted the Basel Committee to impose directives for the measurement and management of operational risk. Our research project examines the problem of quantifying this risk and developing a VaR (Value at Risk) for it. This will require rather advanced operational tools such as the theory of extreme values.

The leading difficulty comes from the fact that some occurrences of operational risk are rare and that the losses to be expected from an operational event are difficult to quantify. Besides, the stochastic process of operational losses can in no way be explained by a normal distribution, as in the case for market risk. Data for the former are generally composed of a large number of small events and a small number of major events. For good risk management, we thus need to know the behavior of the tail

(events incurring enormous losses) of such a distribution. Therefore, the mathematical techniques to be used are those such as the theory of extreme values which treat thick-tailed distributions for a limited number of data.

Conclusion and impact in the field

In this short statement, I have presented my future research projects linked to private and social risk management. I have highlighted the fact that issues in risk theory are associated with four important considerations that I plan to study in detail:

- Models for evaluating risks generated by individuals and firms are not yet satisfactory, more importance should perhaps be given to cognitive processes.
- It is important to analyze all risks with a portfolio approach so as to better diversify them.
- The deregulation of markets must be accompanied by mechanisms motivating commitment to the social objectives of prevention.
- It is important to develop statistical tools and data sets to measure the different effects and the real issues.

I believe that these considerations will be significant to risk-management research for the next years. I hope the results will enable managers to better understand and qualify new issues emerging in the field of risk management. In particular I hope they will be able to see which contract forms and market structures will best maximize the outcomes of risk management. Some regulatory aspects of risk management under asymmetrical information problems will be re-examined. Finally, new risk-management tools will be developed, in particular new data sets and statistical methodologies designed to measure the real issues more accurately.

Graduate students and post doctoral fellows

Over the past seven years at HEC, I have been very involved in training students. Seven of them have completed their Ph.D. thesis (two in Paris), 19 have completed their masters thesis, and I have supervised five postdoctoral fellows, three from Europe. I am currently supervising seven Ph.D. students at HEC Montréal and two in Paris. Four masters students are also working under my supervision. I enjoy working with graduate students, particularly when they are motivated by their research projects. In the previous paragraphs, I mentioned that four Ph.D. students will be involved in the different projects. Over the next seven years, I plan to recruit about one Ph.D. and two masters students each year. Moreover, in collaboration with the new Centre for research in e-finance at HEC Montréal, I plan to invite a postdoctoral fellow each two years.