

# Research Program

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**2001-2002**

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Adopted by CIRANO's Board of Directors May 24th 2001.

## Introduction

### Human Resources Group

Goals for the year 2001–2002

Research Funding

Research Team of the Finance Group Human Resources Group

Research Projects of 2001–2002

- Human capital
  - Choice of Academic Discipline
    - Choice of Academic Discipline
    - Return to a Canadian High-School Diploma
    - Evolution of Returns to Human Capital
    - Educational and Occupational Segregation
  - Performance of Educational Systems
    - Comparison of Educational Systems
    - The Impact of School Quality
    - Too Many or Too Few Diplomas?
    - Adult Education
    - In-House Training
- Health
  - Evaluation of Public Healthcare Policy
  - Evaluation of the Performance of Healthcare Institutions
- Labour-Force Participation, Employability, and Pay Equity
  - Labour-Force Participation and Fiscal Structures
  - Pay Equity
- The Work Environment
  - Stress and Absenteeism
  - Compensation Modes and Structures
  - Outsourcing Human Resources and Retaining Skilled Workers
  - Labour Codes

## Finance Group

Goals for the year 2001–2002

Research Funding

Research Team of the Finance Group

Research Projects of 2001–2002

- [Risk](#)
  - [Credit Risk](#)
  - [Model Risk](#)
  - [Modelling Contagion Effects](#)
- [Derivatives](#)
  - [Valuation Models](#)
  - [Empirical Evaluation of the Models](#)
  - [Creation of derivatives](#)
  - [Software Package for Derivatives Research](#)
- [Statistical and Numerical Methods](#)
  - [Statistical Models](#)
  - [Numerical Models](#)
  - [Learning models](#)
  - [Statistical Models for prevision](#)

## **Electronic Commerce Group**

[Goals for the year 2001–2002](#)

[Research Funding](#)

[Research Team of the E-Commerce Group](#)

[Research Projects for 2001–2002](#)

- [Generic E-Commerce Technology](#)
- [Calls for Tenders](#)
- [Markets for Initial Public Offerings](#)
- [Financial Markets and Securities](#)
- [Freight Exchanges](#)
- [Interfirm Negotiations](#)
- [Interfirm Flows and Corporate Management](#)
- [Management of Distribution Channels and Online Brokerages](#)
- [B2C: Personalization of E-Commerce](#)
- [Going virtual](#)

## **Corporate Governance Group**

[Goals for the year 2001–2002](#)

[Research Funding](#)

[Research Team of the Corporate Governance Group](#)

[Research Projects for 2001–2002](#)

- [The ESI axis: Enhancement of Shared Infrastructure](#)
  - [Apportionment of Shared Costs](#)
  - [Performance Measures in the New Economy](#)
  - [Delegated Infrastructure Management and Public-Private Partnerships](#)
  - [Management of Natural Resources and the Environment](#)
  - [Real Options and Corporate Strategy](#)
  - [Sales-Force Management](#)

- [The IRM axis: Integrated Risk Management](#)
  - [Methodological Developments in IRM](#)
  - [Use of Derivatives and Financial Contracts](#)
  - [Management of Major Technological Risks](#)
  - [Organizational Management of Hospital Risk](#)

### [Experimental Analysis](#)

[The Savings Environment and the Working Poor](#)

[In-House Training](#)

[Experiments in Multiple Task Performance](#)

[Mergers and the Structure of Remuneration](#)

[Workplace Practices and Physio-Psychological Measures](#)

[Experimental Analysis and Underground Work](#)

[Other Development Protocols](#)

## INTRODUCTION

This document presents the research programming adopted by CIRANO's Board of Directors for the year 2001–2002, following the recommendation of the programs committee and consultations with the four thematic committees. The projects are presented by research group: "Human Resources," "Finance," "E-Commerce," "Corporate Governance" and "Experimental Analysis".

The programs committee is presided over by the Chairman of the Board of Directors and consists of the Presidents of the thematic committees (whose function is to ensure the monitoring of projects and to liaise with the partners) as well as of the President and Chief Executive Officer, and the Vice-President, of CIRANO. Thus, its makeup is as follows: Jacques Gilbert (Raymond Chabot Grant Thornton), Chairman of the Board of Directors; Guy Delisle (Alcan Inc., for the Human Resources Group); Louis Vachon (National Bank of Canada, for the Finance Group); André Lalonde (AXA Canada, for the E-Commerce Group); Jean Levert (Bombardier, for the Corporate Governance Group); Marcel Boyer (Université de Montréal and President and Chief Executive Officer of CIRANO); and Michel Patry (École des Hautes Études Commerciales and Vice-President of CIRANO).

The research programming of CIRANO is focussed on the concrete and operational implementation of the most recent theoretical developments and the newest innovations in CIRANO's areas of research and liaison activities. Indeed, the principal mission of CIRANO is to establish links between leading researchers and organizations that will enrich our research, on one hand, and will also translate the research results into a form useful to the organizations, on the other hand.

Consequently, it is no surprise that the concerns of many private and public organizations have had a significant impact on our research programming. To see this, one need only examine the projects involving e-commerce, mobilizing and motivating employees, integrated risk management, valuing derivatives, corporate governance, the enhancement of shared infrastructure, the development of knowledge-based economies, etc. Moreover, an inspection of our research programming also reveals that the most recent developments in the scientific analysis of organizations drive the work performed at CIRANO and underlie liaison activities and high-level transfers.

## HUMAN RESOURCES GROUP

### GOALS FOR THE YEAR 2001–2002

If it can be considered established that the education and training of human capital are primary determinants of the growth of the Canadian economy in light of its knowledge-based character, it remains difficult to determine what adequate training is. This is why CIRANO fellows are attempting to identify the educational institutions and incentive structures that will satisfy our society's current and future needs—needs that are reflected in the coexistence of a shortfall in skilled labour with a high unemployment rate, especially among youths and the poorly educated. The need for a policy to improve training and integration into the labour force has never been as acutely felt as today, and this is one of the focuses of the Human Resources Group.

The agenda of the Human Resources Group is very full. Two principal themes dominate our programming: the training of human capital and health. Other major projects that do not directly fall into either of these categories are also dealt with, such as the work environment, factors determining performance and human resources management in firms, employment and employability, and the comparative and historical study of labour law. Finally, research into experimental economics, which

began in 2000 with the founding of the BUL-C3E† is now coming into full bloom. Our research programming in experimental economics, which touches on several subjects, is described at the end of this document.

## RESEARCH FUNDING

Most of the research projects of the Human Resources Group receive financing from multiple sources, and some partners are associated with several projects. Partners associated with the Human Resources Group's projects are CETECH (Emploi-Québec), the HRDC (Socio-Economic Analysis Group), the National Bank, the HRDC (Applied Research Branch). Some partners are currently discussing collaborating in ongoing CIRANO projects, or becoming involved in new ones, such as the HRDC (Applied Research Division), the Ville de Montréal, and the Ministère de l'Éducation du Québec (Direction de la Recherche et Évaluation). The team is also examining the possibility of requesting substantial funding from subsidizing bodies (SSHRC, VRQ, CFI).

## RESEARCH TEAM OF THE HUMAN RESOURCES GROUP

\* *Associate fellow*

[Claude Montmarquette](#) is the Director of the Human Resources Group. A professor in the economics department of the Université de Montréal, he is renowned as a specialist in the economics and econometrics of education and labour, as well as in the economics of public choice. He was a pioneer of the establishment of experimental economics in Quebec.

[Paul Beaudry](#) \* holds a Chair in Canadian Studies and is a professor at the University of British Columbia. His research bears on the issues of the knowledge economy, unemployment (especially of youths and women), and the plateauing of Canadian women's labour-force participation rates.

[Christian Belzil](#) is a professor in the economics department at Concordia University. His specializations are the economics of labour, the economics of education, and econometrics. Specifically, his research bears on the choice of academic concentration, job search, employment insurance, as well as on the determinants of behaviour related to fertility and birth spacing.

[Marc Blais](#) is a professor in the department of psychology at UQAM. His research projects primarily focus on motivation and social psychology as they relate to issues of physical and mental health in the workplace (e.g. stress, exhaustion, and quality of life at work), as well as on health related issues (e.g. motivating change, maintaining and integrating change).

[Marcel Boyer](#) is a professor in the economics department of the Université de Montréal. His research activities centre around technology and international competition, the economics of information and uncertainty, and organizations and strategic competition. His work in the Human Resources Group bears on the shortage of skilled labour and on the determinants of an efficient educational system.

[Bernard Fortin](#), is a professor in the economics department at Université Laval and holds a Chair in Canadian Studies. He specializes in labour economics and public economics. More specifically, his research is focussed on the impact of the fiscal and regulatory environment on the behaviour of workers and firms.

[Nicole Fortin](#) \* is a professor in the economics department of the University of British Columbia. Her work was critical to the success of the wage-equity project. Specializing in labour economics, she is particularly active in the analysis of public policies, the influence of gender on working conditions, and the economics of the family.

[Michael Huberman](#) is a professor in the history department of the Université de Montréal. Specializing in economic history, Michael Huberman has pursued research in the development of the labour market during the 19th and 20th centuries. With CIRANO he has analysed the impact of globalization on working conditions and the impact of remuneration methods on productivity.

[Claudia Keser](#) \*, an expert in experimental economics, is a professor at the Institute for Statistics and Mathematical Economics at the Universität Karlsruhe in Germany. She spent a year with CIRANO helping set up the laboratory for experimental economics (BUL-C3E) and is currently a researcher at IBM's Yorktown Heights Research Center in New York.

[Guy Lacroix](#) is a professor in the economics department at Université Laval. His specialties are labour economics, applied economics and health economics. His research bears on the interaction of income security policies and individuals' behaviour on the labour market, as well as on the measurement of the effectiveness of policies aimed at reintegrating poorly-educated individuals into the labour market.

[Paul Lanoie](#) is a professor at the HEC's Institute of Applied Economics, of which he is also the Director. He is specialized in public economics and has authored works examining government intervention in the fields of labour health and safety and the environment. Paul Lanoie is interested in all aspects of job sharing.

[Thomas Lemieux](#) \* is a professor in the economics department of the University of British Columbia. Specializing in labour economics and applied economics, Thomas Lemieux is particularly involved with issues related to wage disparities, employment growth and the impact of education on remuneration.

[Louis Lévy-Garboua](#) \* is a professor at the Université de Paris I. Specializing in the economics of education, his research interests are specifically focussed on the economics of uncertainty, individual rationality, and the economics of education.

[W. Bentley MacLeod](#) \* is a professor of economics and law at the University of Southern California. He collaborates with Daniel Parent (McGill) in studies on the determinants of training acquired and supplied in firms.

[Daniel Parent](#) is a professor in the economics department of McGill University. His specialization is labour economics and applied econometrics. His current research bears on the industry-specific acquisition of knowledge, the impact of private-sector training, the school-work transition, the impact of bonuses on the wage structure, and the determinants of methods of compensation.

[Michel Patry](#) is a professor at the HEC's Institute of Applied Economics and Associate Director of Academic Affairs and Strategic Planning. He is specialized in the economic analysis of organizations and his work deals with the issues of outsourcing, contract management and corporate strategy. He has published many studies on the links between technology and the economy and, in collaboration with his colleague Michel Tremblay (HEC), has examined issues associated with the outsourcing of human resources.

[Bruce Shearer](#) is a professor in the economics department at Université Laval. Specialized in labour economics and applied econometrics, he is interested in incentive labour contracts in firms and their impact on worker productivity. His research focusses on the analysis of incentive contracts and the effects of different compensation schemes, especially the use of bonuses.

[Michel Tremblay](#) is a professor with the Groupe de Recherche en Gestion des Ressources Humaines (GR<sup>2</sup>H) at the HEC. His research examines the careers of professionals and managers, career plateauing, the mobilization of human resources, international compensation strategies and policies, outsourcing human resources activities, and atypical workers.

## **RESEARCH PROJECTS FOR 2001–2002**

### **HUMAN CAPITAL**

If it can be considered established that the education and training of human capital are primary determinants of the growth of the Canadian economy in light of its knowledge-based character, it remains difficult to determine what adequate training is. This is why CIRANO fellows are attempting to identify the educational institutions and incentive structures that will satisfy our society's current and future needs—needs that are reflected in the coexistence of a shortfall in skilled labour with a high unemployment rate, especially among youths and the poorly educated. The need for a policy to improve training and integration into the labour force has never been as acutely felt as today, and this is one of the focuses of the Human Resources Group.

A fundamental preoccupation expressed by our partners is the training of a skilled labour force. They are particularly concerned about a shortfall of qualified workers in the near future. This problem, combined with the clear recognition of the role played by human capital in economic development, has motivated CIRANO fellows to pursue this field of research. Various themes will be broached, including several that were already the subject of preliminary examinations last year.

### **Choice of Academic Discipline**

#### ***The issue***

The question of how students choose their academic concentration has become a preoccupation to everyone studying the economics of education. Several factors come into play in this decision: uncertainty regarding successful completion of the studies, remuneration prospects, the cost of schooling, the availability of information, personal motivation, etc. Our researchers wish to evaluate the determinants of these choices for men and women (educational and occupational segregation) by establishing whether the decision to continue studying and the choice of field of study are affected by the

business cycle or by cohort effects.

While an individual's decision to pursue advanced studies and the selection of a discipline are partly attributable to personal choice reflecting individual preferences, it is equally likely that employment prospects have an impact. This important decision is certainly not easy, especially given the limited amount of information available on future employment prospects. Nonetheless, it is clear that the labour market situation influences students in their career choices. How do they establish these expectations?

Using data from the RELANCE survey, the researchers wish to analyse the following issues:

- How are the decision to continue education and the choice of field of study affected by the business cycle?
- Do economic conditions impact on the decision to pursue education and the choice of academic concentration? Since surveys of Quebec graduates cover several periods and all of Quebec, we have data from a natural experiment on the effect of the business cycle on education-related decisions.
- What are the main trends observed in these choices?
- How have women's choices evolved relative to men's?
- Do we observe a convergence toward male/female parity in certain disciplines and in the length of studies?

#### ***Research Program 2001–2002***

- Model the issue
- Perform empirical analysis using data from the RELANCE survey
- Supplement the information from the RELANCE survey with macroeconomic data
- Perform econometric analysis using the new database

#### **Return to a Canadian High-School Diploma**

##### ***The issue***

The wage premium paid to high school graduates is considerably smaller in Canada than in the United States. This large gap has persisted for many years and is observed in all age groups. For example, the wage premium earned by graduates under 25 years old is effectively nil in Canada, while it amounts to approximately 12–15 per cent in the United States.

Why is the rate of return to a high school diploma, measured as the wage premium paid to graduates relative to dropouts, so low in Canada? The goal of this research is to attempt to identify the reasons underlying this differential. Three factors may play a role, and the researchers intend to determine which one could be responsible for this systematic divergence between the Canadian and U.S. data:

- A simple supply and demand differential by education group, as in Katz and Murphy
- Selection effects on poorly-educated individuals that work in opposite directions in the two countries (In other words, it could be that Canadian dropouts are of a higher quality than U.S. dropouts. Consequently, they would “compare favourably” to graduates.)
- The interaction of various institutions—such as the minimum wage, the level of unionization of dropouts relative to graduates, and transfer payments that are generally higher in Canada—with the functioning of the labour market. For example, the minimum wage may well have a greater impact in Canada than in the United States in terms of the boost it gives to poorly-educated workers. In the same vein, preliminary research reveals that, relative to high school graduates, dropouts are more likely to be unionized in Canada than in the United States.

#### ***Research Program 2001–2002***

- Assemble the various databases
- Perform empirical modelling
- Write the report

#### **Evolution of Returns to Human Capital**

### ***The Issue***

This phase is complementary to the former, but rather than addressing the determinants of the difference observed in the education premium between Canada and the United States, this phase seeks to establish, from a more global perspective, the history of the cost effectiveness of obtaining various diplomas in order to determine the evolution of their relative value, not only over time but also by gender. This project intends to draw on dynamic programming techniques to estimate a model for choice of discipline that yields the attitude toward risk, the preference for education, and the return to education simultaneously.

This project complements the previous ones in the sense that dropping out is sometimes followed by a return to school and that adult education is particularly sensitive to issues of risk aversion and time preference.

Even though the role structural dynamic-programming models play in economic research has been growing, few authors have estimated applied stochastic dynamic-programming models to agents' decisions in the area of human capital—especially education.

This project will analyse several current issues:

- How has the cost effectiveness of investment in human capital evolved over the last twenty years?
- Has the profitability of certain diplomas increased or diminished over time?
- Do we observe a convergence in returns to different types of diplomas according to specialization?
- According to gender?
- For the United States and Canada, Card and Lemieux (2000) demonstrate the considerable impact of the supply of skilled labour by age cohort on the return to education. The importance of this phenomenon should also be observed in Quebec, but there has been no rigorous study on cohort effects. We hope to fill that gap.

### ***Research Program 2001–2002***

- Replicate the Card and Lemieux study with data from Quebec
- Develop models of stochastic dynamic programming
- Analyse the evolution of the return to diplomas

### **Educational and Occupational Segregation**

#### ***The Issue***

We know that in the overall university student population of Quebec there were 37 per cent more women than men in 1998. Indeed, only in pure and applied sciences do we find more men than women. A disturbing fact is the relative scarcity of women in graduate studies. Notice, in this context, that the female-male ratio in the fields of pure science and administrative science is greater than one at the level of undergraduate studies but not at the master's level, where men are in the majority. This female-male gap continues to expand at the level of doctoral studies, where all fields of study, bar none, see their share of women decline substantially. It is noteworthy that, of all disciplines, pure and applied sciences show the lowest female-male ratio at the doctoral level. If the trend observed since 1990 continues, serious doubts arise as to the future availability of skilled workers in the sectors of pure and applied sciences. We have good reason to ask (1) why are men turning away from university studies? and (2) what explains women's lack of interest in pure sciences?

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### ***Research Program 2001–2002***

- Perform econometric analysis on data from the RELANCE survey and the census.

### **PERFORMANCE OF THE EDUCATIONAL SYSTEMS**

This project, dealing with the performance of Quebec's schools and educational system, is in two phases. The first proposes

a comparison of the Quebec and Canadian educational systems, while the second analyses the impact of school quality on the performance of youths and on the rate of return to education.

## **Comparison of Educational Systems**

### ***The Issue***

To evaluate education policies it is important to understand school systems in their relationship with the labour market and the training offered by firms. But it is also important to see the big picture, since observations on the parts sometimes only reveal their full meaning in the context of the whole. Finally, a synthetic comparison between several educational systems may shed some light and provide a perspective for the problems perceived in the case of a single one, such as Canada's or Quebec's.

We propose building a simple model of educational systems to explain their general features in terms of differences in curricula and pupil selection. This model could be calibrated with a stylized description of several national educational systems based on the responses of a sample of experts to a questionnaire.

### ***Research Program 2001–2002***

- Survey experts in education
- Compare of the different educational systems

## **The Impact of School Quality**

### ***The Issue***

The literature on the impact of school quality on the performance of, and rate of return to, education remains controversial. On one hand, authors like Betts and Hanushek find that reducing the teacher/student ratio has little impact on students' later functioning on the labour market or on their performance in skill tests. On the other hand, Card and Drueger find that youths having attended schools with a lower teacher/student ratio perform better for each additional year of schooling acquired. One issue that is not broached in a convincing fashion in either of these studies is the fact that the composition of the student population has changed substantially over the decades. Given the increase in school attendance rates over the past century, we may reasonably speculate that the average quality of students has undergone a marked decline. The data used by Betts are relatively recent compared to those of Card and Krueger. In other words, this debate could prove moot, at least in part, simply because we are comparing apples and oranges.

Our goal in this project will be to follow Rosenbaum's work on the impact of these changes in composition on the measurement of returns to education while expanding the analysis to look at the role played by educational resources. This issue is clearly of crucial importance to public and fiscal policy: Are citizens' taxes being used wisely when invested in the school system?

### ***Research Program 2001–2002***

- Assemble data on different measures of the quality of the educational system
- Perform empirical modelling that accounts for the composition of cohorts
- Replicate the studies by Card and Krueger and by Betts

## **Too Many or Too Few Diplomas?**

### ***The Issue***

The issue of occupational skill may be defined in theory as expertise acquired through formal or workplace training, and a worker without either is characterized as unskilled. This type of definition is so broad, however, that depending on the precise designations used, the proportion of the labour force deemed skilled can vary between 1 and 30 per cent.

In reality, skill is a function of the task to be accomplished. For any job with specific performance requirements, a skilled worker is simply one able to execute the assigned duty. In practice, of course, it is impracticable to obtain an index of the effective skill level of the workers in an economy by measuring the ability of each worker to accomplish his/her tasks

proficiently. Thus, we are compelled to resort to definitions such as the aforementioned one. There is, however, another source of information that may help us better appreciate whether the labour force measures up to the required tasks. This source is the Dictionary of occupations. This dictionary attempts to define the level of expertise required for every job type. Consequently, matching jobs' skill requirements with the average level of training of individuals occupying them yields a measure of whether the workforce is over- or under-qualified.

What is the use of this exercise? First, it will allow us to identify who is affected. For example, are youths and women overqualified for their jobs? Furthermore, what sectors of the economy are most impacted by skill shortages? Answers to these questions will provide a measure of the quality of the matching between academic training and the needs of the market, and to appreciate the capacity of market adjustments to coordinate qualifications with requirements. Comparisons between provinces and countries and over time will contribute greatly to our understanding of the ability of our educational system and labour market to adjust, as well as providing a measure of our level of competitiveness in response to the challenges posed by the new economy. The CIRANO team (in collaboration with CETECH) will examine this issue. Reviewing the literature and identifying the available databases will be the first order of business. Subsequently, a more precise research proposal will be elaborated.

### ***Research Program 2001–2002***

- Review the literature
- Perform econometric modelling
- Analyse census data for Ontario and Quebec

### **Adult Education**

#### ***The Issue***

In a knowledge-based society human capital is recognized as the key factor for stable economic growth. Given the speed at which knowledge is expanding, we must now take steps to encourage continuing education in order to preserve our human capital. It is time to deal with the issue of the demand for, and supply of, adult education. We need to determine the factors that motivate individuals and firms to acquire and supply training.

Researchers involved in this project propose the use of experimental economics to supplement studies based on surveys and case studies. On the demand side, they wish to identify and analyse the factors that govern the decision to pursue training. Since the cost of training is known, attitudes towards risk and the intertemporal discount rate of employees are critical factors that remain to be determined. On the supply side, the debate deals with the link between different forms of worker compensation and the formal training offered by companies.

While market experiments are useful, it is clear that a study of the mode of certification of in-house training by an outside body would yield great insight for future public policy. Such a system for validating learning acquired within the firm could allow our society to achieve equilibrium between demand and supply for a certain category of highly-sought workers, and do so at a low cost to society at both the public and the private level.

Finally, in a more traditional vein, researchers at CIRANO hope to use Statistics Canada's Workplace and Employee Survey. The WES is unique in that it collects detailed and linked data on employers and employees from the same workplaces, allowing an analysis of the determinants and the intensity of training from the perspectives of both employers and employees. Note that two of CIRANO's researchers belong to the Review Committee for survey.

### ***Research Program 2001–2002***

- Study a mode of certification of in-house training
- Establish an experimental design
- Develop the experiments and analyses

### **In-House Training**

#### ***The Issue***

One of the serious problems arising from firms' perceptions of the shortage of skilled labour is their resulting reluctance to invest in training their own personnel for fear that their investment will be quickly snatched up by competitors. This problem of

“raiding” appears to generate perverse results. How much of this is unfounded? how much realistic? This project will attempt to find out.

In this project we propose a new method that will allow wages and seniority within a firm to be linked to specific jobs’ potential for training and to the firm’s knowledge intensity. We can thus characterize jobs and firms by the extent of the potential for training they offer employees, and re-evaluate the theory of dual markets. This methodology will also allow us to estimate the amount of informal training dispensed over the course of a year by firms to their employees, and to compare this amount with formal training given elsewhere. The measurement of informal training supplied by firms, which is not accounted for in current statistics, could lead to a substantial upward revision of the total training provided by companies. Moreover, we want to evaluate under what circumstances a firm operating under (imperfect) competition will be interested in paying for the general training of its employees, especially to retain them. An experimental study is envisaged to examine the behaviour of firms and their employees when there is imperfect competition between firms attempting to attract skilled workers.

### **Research Program 2001–2002**

- Develop the model
- Perform econometric estimation of the model
- Elaborate the protocols

## **HEALTH**

This project, dealing with health, comprises two principal themes: “the evaluation of public policy in matters of health,” and “the evaluation of the performance of healthcare institutions.”

### **Evaluation of Public Healthcare Policy**

#### ***The Issue***

This project will examine three distinct themes: the evaluation of anti-smoking campaigns; the impact of taxes on the demand for black-market cigarettes; and an evaluation of the prescription drug insurance plan.

The projects amalgamated under this theme are devoted to measuring the impact of public policy on prevention, education, and access to care. Evaluative research will allow the true reach of the various programs to be quantified and reveal their return to society. The three themes we wish to examine are:

*Evaluation of anti-smoking campaigns:* This project constitutes an extension to the work of Lanoie and Leclair (1998). Three avenues of research shall be pursued in this framework: (1) updating the data; (2) distinguishing between different types of regulation to determine which are most effective; and (3) accounting for major federal and provincial awareness campaigns.

*The impact of taxes on the demand for black-market cigarettes:* The CIRANO team has survey data directly covering individuals’ consumption of black-market cigarettes during the periods preceding and following the dramatic reduction in taxes on cigarettes in 1994. This unpublished data makes possible a rigorous measurement of the relative price-elasticities of demand for legal and black-market cigarettes. We will be able to precisely determine the impact of taxes on total cigarette consumption.

*An evaluation of the prescription drug insurance plan:* The act of June 1996 creating the prescription drug insurance plan had the goal of ensuring that the entire population of Quebec had reasonable and equitable access to medication and pharmaceutical services as required by their health. The prescription drug insurance plan was recently subjected to a first appraisal. This project aims to shed further light on the evaluation of this program using state-of-the-art statistical and econometric methods. These methods have successfully been applied to evaluate similar programs in the United States.

### **Research Program 2001–2002**

- Develop an econometric methodology drawing on models previously developed in the framework of projects on education
- Evaluate and classify anti-smoking programs
- Perform econometric estimation of the impacts of the prescription drug insurance plan

## **Evaluation of the Performance of Healthcare Institutions**

### ***The Issue***

Another health-related project, under the direction of Robert Gagné (HEC and CIRANO), is titled **evaluation of the performance of healthcare institutions**. This theme comprises two phases: an evaluation of the relative performance of national healthcare systems and a comparison of the efficiency of different healthcare establishments within the same system.

The "evaluation of the relative performance of national healthcare systems" starts from the premise that these systems are principally defined by two characteristics: the mode of financing and the mode of production of healthcare services. In both cases, these modes differ between countries in the level of involvement of the public sector (centralized organization) versus the private sector (decentralized organization). To illustrate, we note that the U.S. healthcare system is characterized by little public funding or government involvement in its administration. At the opposite extreme, we can think of the former Soviet Union, in which the system was entirely financed by the government and where the administration was extremely centralized. The goal of this phase of the research is to identify the ideal private/public combination of healthcare services, in terms of both funding and production. The methodology shall draw on national data for 29 countries published by the OECD.

The second phase will examine the relative efficiency of different healthcare establishments within the same system. Beginning with the assumption that each institution is an identity seeking to satisfy the demand for healthcare services at the lowest cost, but that these establishments are not equally successful in their pursuit of this goal, we can rank them. It is further possible to measure the cost differentials attributable to variations in efficiency between institutions and, especially, to identify the factors responsible for these differentials. This phase of the research thus attempts to ameliorate the entire healthcare system through improvements at the level of individual establishments. The methodology should draw on exact data at the level of individual healthcare institution.

### ***Research Program 2001–2002***

- Identify the ideal private/public combination both in terms of financing and in terms of the production of healthcare services
- Rank healthcare institutions by efficiency
- Develop an analytical grid of governance practices

## **LABOUR-FORCE PARTICIPATION, EMPLOYABILITY, AND PAY EQUITY**

This project comprises three parts that deal with: (1) labour-force participation, (2) the impact of marginal tax rates on the participation decision and on the number of hours worked, and (3) pay equity. The labour-force participation decision does not depend exclusively on individuals' training, but on a series of factors, especially the fundamental issue of the marginal profitability of working in the case of certain socio-economic groups. For example, recipients of an income supplement from governments often face steep effective marginal tax rates when they abandon their status as beneficiaries to accept jobs that are frequently precarious and poorly paid. The researchers wish to identify the most efficient way to solve this problem. This research will involve several CIRANO fellows over the coming years.

## **LABOUR-FORCE PARTICIPATION AND FISCAL STRUCTURES**

### ***The Issue***

The economic literature contains a number of studies analysing the impact of personal income taxes on the supply of labour. While these studies use a variety of research methodologies and draw on widely divergent sample populations, we can classify them into two groups. The first group consists of studies based on questionnaires or long surveys. The second group encompasses econometric studies measuring the impact of several factors, including taxes, on the supply of labour.

A survey of recent economic literature will attempt to synthesize existing research results around several issues that should underlie the design of any fiscal policy or other relevant program, such as family allowances and other social programs:

- Can we find evidence that impacts resulting from changes to direct income taxation (for example, federal income tax, payroll tax) differ from those resulting from income-contingent benefits (e.g. the National Child Benefit)?
- How do the impacts differ between the decision of whether or not to work (incentive to integrate into the active labour force) and the decision to increase the work effort for those already employed (incentive to work an

- additional hour)?
- How do the effects differ by socio-economic group (especially from one income level to another)? by gender? by age? by marital status?
  - Does the impact change when the person has dependants?
  - To what extent is the effect influenced by uncertainty concerning workers' real wages?
  - To what extent do EMTRs (effective marginal tax rates) affect individuals' labour supply?

The synthesis should conclude with a discussion of the implications of the different policy measures and an enumeration of Canada-specific aspects that would benefit from further study.

#### ***Research Program 2001–2002***

- Synthesize studies examining the impact of social programs on the decision to join the labour market in light of individuals' characteristics
- Analyse the available data

#### **Pay Equity**

##### ***The Issue***

At the national and international levels, the question of whether differences in men's and women's professional outcomes are attributable to characteristics of the labour market or to discriminatory policies and practices is still relevant and remains unresolved. Some maintain that occupational segregation is at the root of discrimination between the sexes, given that this segregation causes women to receive different wages and benefits and opportunities for promotion. To counter this type of discrimination, governments at the provincial and federal level have recently passed legislation to close these wage gaps.

Research into links between policies aimed at improving gender equality in the labour market and the impacts these policies have on occupational segregation has been rather limited, in part because it is difficult to capture the full scope of the issue. This project aims to study the extent of occupational segregation and analyse the impact of government policies to correct wage differentials.

#### ***Research Program 2001–2002***

- Participation in the joint CIRANO/ HRDC "Conference on occupational gender segregation," June 4 and 5, 2001
- Publication of a special issue of Canadian Public Policy, spring 2002

#### **THE WORK ENVIRONMENT**

The research team intends to expand and build on models of the work environment, worker performance, and human-resources management that have been developed in recent years, and to integrate them as development tools for firms.

##### **Stress and Absenteeism**

##### ***The Issue***

With their work on job sharing, but even more with their studies on stress and job satisfaction in the workplace, several of CIRANO's researchers have had the occasion to become involved with issues affecting our partners in a very concrete manner and to provide essential data for their analysis. We intend to pursue this type of work further with this project, examining stress and absenteeism and their impact on worker performance. This is an important challenge, given that this type of analysis remains largely undeveloped.

The team will focus its research efforts on the issue of retaining highly sought-after staff and human resources management strategies that will motivate public-sector employees and those whose jobs are precarious. The issues we hope to analyse with our partners include stress and absenteeism and their impact on workers' performance, compensation methods and structures, and problems arising from mergers.

### ***Research Program 2001–2002***

- Survey the partners
- Analyse the compiled data
- Report to the partners

### **Compensation Modes and Structures**

#### ***The Issue***

With this project we wish to examine incentive mechanisms within firms, particularly compensation methods, and how they relate to economic efficiency. We have found, for example, that in the United States the use of bonuses has increased over the past 20 years concurrently with a substantial decline in unemployment.

Using the Workplace and Employee Survey (WES), our researchers intend to take a deeper look at the relationship between the local unemployment rate (at the county level) and the use of bonuses. They wish to see to what extent bonus payments by firms function as one-shot, transitory substitutes for standard (and permanent) wage raises. To the extent that this holds true, firms should be less inclined to resort to layoffs in response to downwardly-rigid nominal wages. This method of remuneration should thus have an impact from the perspective of economic efficiency. The researchers feel that the WES data provides an exceptional opportunity to better understand this dynamic.

### ***Research Program 2001–2002***

- Pursue research into firms' incentive mechanisms
- Develop a methodology to empirically analyse the relationships between compensation, productivity and employment

### **Outsourcing Human Resources and Retaining Skilled Workers**

#### ***The Issue***

This team is involved in research into the determinants and the organizational consequences of outsourcing human resources. The issues this project will deal with are retaining information-services staff, motivating employees, compensation policies in high-tech at the international level, problems of cooperation between employees, and communication between managers and workers.

The team will focus its research efforts on the issue of retaining highly sought-after staff and human resources management strategies that will motivate public-sector employees and those whose jobs are precarious. It also intends to continue studying remuneration policies at the international level (comparisons between France, England, and Canada) and in the high-tech sector. Finally, several human resources management issues arising from the Montréal municipal mergers shall be examined. Use of experimental economics with participants in firms is considered.

### ***Research Program 2001–2002***

- Analyse compensation policies at the international level
- Study human resources management in the context of municipal mergers
- Apply the techniques of experimental analysis to firms

### **Labour Codes**

#### ***The Issue***

In March 2000 the Ministre du Travail, Diane Lemieux, proposed a series of amendments to the Labour Code, which had previously only been subject to major revisions in 1969 and 1997. On May 15, 2001, the Ministre d'État au Travail, à l'Emploi et à la Solidarité Sociale, Jean Rochon, tabled Bill 31, an Act to Amend the Labour Code, in the National Assembly, establishing a labour relations commission and amending articles 45 and 46 of the Labour Code.

The demographic changes that the working world is experiencing, the decline in wage workers, the increase in the numbers of the self-employed, and the growing use of contracting out, all raise questions about traditional methods of organizing work and union accreditation.

This research project will use a comparative approach to study recent changes to provincial labour laws, as well as to the federal law governing self-employed workers. Michael Huberman is preparing a comparative and historical study of planned changes to labour laws in Quebec and elsewhere, particularly Ontario.

### **Research Program 2001–2002**

- Perform a comparative and historical study of planned changes to labour laws in Quebec and elsewhere, particularly Ontario
- Write a monograph on the subject

### **FINANCE GROUP**

Risk analysis, efficient market theory, portfolio selection theory, evaluation of derivatives and forecast analysis are all leading-edge research fields whose work is today finding concrete applications in the different forms of financial activities. Also, utilization of mathematical models in the management of financial assets offers the advantage of rigorously evaluating the performance and risk associated with decision-making systems or buying and selling rules. The advent of NASDAQ in Montreal, the specialization of Canadian stock exchanges, the regulatory standards established by the Basel Committee, and in particular close links with the Institut de finance mathématique de Montréal have led to significant developments both in CIRANO's research projects and in its team of fellows.

CIRANO's Finance research group is looking at the theoretical, statistical and numerical aspects of mathematical modelling in the following financial fields: risk and risk management, derivatives, dynamic portfolio management, intertemporal evaluation of financial assets, and term structure of interest rates. The fields of study, themes and methods developed in the context of our work are many and varied: dynamic portfolio management, utilization of non-parametric methods in asset evaluation, modelling of the volatility of financial series, dynamic factor-based models for evaluating financial assets and forecasting, simulation-based estimation and statistical test methods, high-frequency data analysis, financial market microstructure, etc. Several of these research projects lead to design and application of software for the financial sector. CIRANO's finance research program is divided into three components: RISK, DERIVATIVES and STATISTICAL AND NUMERICAL METHODS.

### **GOALS OF THE FINANCE GROUP FOR THE YEAR 2001–2002**

Research in the Finance Group is organized according to three main themes: risk, valuation of derivative products, and statistical and numerical methods.

The principal theme unifying research in the Finance Group relates to risk in all its dimensions: market risk, credit risk and operational risk. For each of these types of risk, particular attention is paid to its measurement and management with particular emphasis on the appropriate statistical and numerical methods. The integrated management of these various types of risk is the object of a three-year project with Valorisation-Recherche Québec. In the context of this theme, we will examine as well the more macroeconomic issue of financial market stability and contagion effects.

Another unifying theme of finance research at CIRANO is the valuation of derivatives, the basic tools of risk management. This theme, also a primary field of study for the Institut de Finance Mathématique de Montréal (IFM2), brings together a large share of our current research. As is was the case with the previous theme involving risk, a central concern over the coming years will be the preparation of materials describing the principal models and tools that incorporate research undertaken at CIRANO. These documents will include computer programs for the ready implementation of the various methods investigated.

A large part of the ongoing scientific research at CIRANO that deals with risk and pricing of derivatives involves advanced statistical and numerical techniques. For example, statistical research into extreme values or into statistical methods based on simulations often underlies the computations of risk measures. In coming years, we propose to make these links among these various methods more transparent through the publication of more general documents.

### **RESEARCH FUNDING**

Since the creation of the Institut de Finance Mathématique de Montréal, the Minister of Finance has assigned the Finance

Group at CIRANO a special role in that organization's research program. Within this framework the Group has grown substantially in two specific areas. On one hand, the scope of research has expanded considerably with the addition of many new researchers from various universities that are partners of CIRANO. This trend continues. On the other hand, in keeping with CIRANO's fundamental mission of facilitating the transfer of knowledge between the research sector and industry, we have substantially increased the number of partners with an active interest in the program of research into finance at CIRANO. Our current partners are: the National Bank of Canada, Hydro-Québec, the Montréal Exchange, the Royal Bank of Canada and, more recently, the Bank of Canada and the Laurentian Bank of Canada.

The subjects close to these institutions are the measurement and management of risk. In fact, they are obligated to demonstrate to regulatory bodies that they have implemented adequate risk management systems, specifically based on controlling the value-at-risk. In response to the needs expressed by banking institutions we have assembled a team of researchers with an interest in this area. Furthermore, to ensure the overall training of these partners' personnel, we have collaborated with the IFM to elaborate training workshops aimed at transferring state-of-the-art expertise in the area of risk management.

#### RESEARCH TEAM OF THE FINANCE GROUP

- *Associate fellow*
- (©) *CIRANO's Researcher.*

[René Garcia](#) is the Director of the Finance Group. A professor in the economics department of the Université de Montréal, his work in the field of finance involves developing dynamic models for valuing financial assets, especially options. He is also interested in portfolio management, risk management, and forecasting, and is further involved with the econometric analysis of time series and nonlinear models. His recent work has focussed on the issue of the structure of the implicit volatility of stock options and on the use of simulation methods for calculating optimal portfolio composition in a dynamic context.

[Marie-Claude Beaulieu](#) © is an associate professor in the Département de Finance et Assurance of Université Laval. Her fields of interest deal with futures and forward contracts, applied econometrics (GARCH), and the microstructure of financial markets.

[Yoshua Bengio](#) holds a Canada research chair in artificial intelligence and is a professor in the Département d'Informatique et de Recherche Opérationnelle (IRO) at the Université de Montréal. He is particularly specialized in improving the generalization of learning algorithms and their various applications. He has contributed to analysing contextual learning in repetitive networks and Markov models and has implemented large commercial systems involving convolutional neural networks and probabilistic models for document analysis and handwriting recognition systems and for portfolio management.

[Martin Boyer](#) is a professor in the Service de l'Enseignement de la Finance at the HEC. His primary research interests are insurance, risk management, consumers' behaviour when faced with uncertainty, information management, and corporate finance. la gestion de l'information et la finance corporative.

[Bryan Campbell](#) is a professor in the economics department at Concordia University. His research work focusses specifically on financial econometrics and the application of nonparametric tests to the evaluation of macroeconomic forecasts.

[Peter Christoffersen](#) is a professor in the Faculty of Management at McGill University. His research interests are risk management and financial econometrics, and more specifically predicting monetary crises, the nonparametric valuation of assets, and statistical tests of measures of market risk.

[Jérôme Detemple](#) \* is a professor at Boston University School of Management. His research activities deal with the following subjects: valuing assets in the presence of friction, portfolio composition, valuing and calculating American options, and the theory of intertemporal contracts.

[Jean-Marie Dufour](#) holds a Canada research chair and is a professor in the economics department of the Université de Montréal. His primary fields of interest are econometrics and statistics, macroeconomics, and public finance.

[Robert Gagné](#) is a professor in the Institut d'Économie Appliqué at the HEC. His fields of interest encompass applied microeconomics, econometrics, transportation, and industrial organization.

[John W. Galbraith](#) is a professor of economics at McGill University. His interests include the econometrics of time series, macroeconomics, and empirical finance. His recent work deals with the content horizons for statistical forecasts applied to

macroeconomics and financial volatility and with estimating long memory models and GARCH models.

[Geneviève Gauthier](#) © is a professor in the Service de l'Enseignement des Méthodes Quantitatives de Gestion at the HEC. Her principal areas of research are differential stochastic calculations, stochastic processes, derivatives (finance), financial modelling and financial engineering.

[Eric Ghysels](#) \* is Edward M. Bernstein Distinguished Professor of Economics at the University of North Carolina, Chapel Hill, as well as Professor of Finance at the Kenan-Flagler School of Business. His principal research interests are finance and the econometrics of time series.

[Sílvia Gonçalves](#) © is a professor in the economics department of the Université de Montréal. Her areas of specialization are financial econometrics, the analysis of time series, and econometric theory. Sílvia Gonçalves is an expert in the "bootstrap" technique.

[Kris Jacobs](#) is a professor of finance in the Faculty of Management at McGill University. His research focusses on the valuation of assets, econometrics, and the relationship between asset yields and macroeconomic variables.

[Éric Jacquier](#) \* is a professor in the finance department of Boston College. He is specialized in the valuation of assets, financial econometrics, and the analysis of the properties of time series. He taught at the University of Chicago, Cornell University, and Wharton School before joining Boston College.

[Lawrence Kryzanowski](#) is a professor of finance at Concordia University. His research and teaching interests deal with models for valuing assets, efficiency and the regulation of financial markets, portfolio theory, international trade, and financing in the real estate sector.

[Tom McCurdy](#) \* is a professor of finance at the Joseph L. Rotman School of Management and at the Institute for Policy Analysis at the University of Toronto. His recent research has examined the dynamics of asset yields. In particular, he seeks to identify the sources of volatility in asset yields in order to improve forecasts of these yields.

[Nour Meddahi](#) is a professor in the economics department of the Université de Montréal. He is specialized in econometrics, the microstructure of financial markets, and finance. His research bears on modelling and statistical inference in time series, especially of financial data. He is currently working on high-frequency data as well as factor models.

[Andrey Pavlov](#) © teaches in the finance department of Simon Fraser University in Vancouver. He is specialized in financial risks and real options.

[Éric Renault](#) is a professor in the economics department of the Université de Montréal. His research deals with finance and time series. His fields of interest include models of stochastic volatility, options valuation models, long memory models, causality and models with dynamic factors.

[Marcel Rindisbacher](#) © is a professor of finance at the Joseph L. Rotman School of Management at the University of Toronto. His areas of specialization include financial economics, mathematical finance, and econometrics.

[Nizar Touzi](#) \* is a professor of finance at Université Paris I. Specialized in mathematical finance, his fields of interest are specifically focussed on the following subjects: issues of deterministic and stochastic control in finance, economics and insurance, the statistics of continuous-time processes, and Monte Carlo simulations.

[Simon van Norden](#) is a professor in the Service de l'Enseignement de la Finance at the HEC. His primary areas of interest are international finance, time series, and monetary economics.

## RESEARCH PROJECTS FOR 2001–2002

Research in the Finance Group is organized according to three main themes: risk, valuation of derivative products, and statistical and numerical methods. Following is a summary of the different research projects.

### Risk

#### RISK: MEASUREMENT AND MANAGEMENT

## **Market Risk**

### ***The Issue***

Value-at-risk has become a key concept in risk management for most institutions and financial institutions. Our projects will examine: (1) application of this concept to decentralized management decision making, and (2) calculation of the value-at-risk in the long term. These issues are of interest to most of our partners, as many of them use the VaR, particularly the National Bank, the Laurentian Bank, the Royal Bank, Hydro-Québec, and the Bank of Canada.

### ***Research Program 2001–2002***

- Establish the conceptual validity of the value-at-risk and other prudential criteria applied to risk management. Evaluate them using different methods. Perform portfolio management and evaluate it ex post using these criteria.
- Study the aggregation properties of the distribution of yields in order to better model market risk over a long time horizon.

## **Credit risk**

### ***The Issue***

Credit risk appears on top of market risk when financial institutions confront the risk of default by their clients (firms or individuals) or their financial partners. Our research program will apply various methods to generate better measures.

### ***Research Program 2001–2002***

- Evaluate bonds with credit risk and market risk.
- Model the intensity function, the sensitivity of bonds to the interest-rate model, and calibrate the model with market data. Build econometric models of banks' "scoring" with an application to commercial and personal loans. This project will use data supplied by financial institutions.

## **Operational risk**

### ***The Issue***

Operational risk is due to be subjected to regulatory standards covering capital reserves. As in the case of market risk and credit risk, the regulatory framework is expected to establish incentive mechanisms to encourage institutions to apply increasingly advanced methods to the measurement and management of operational risk. CIRANO researchers can help our partners establish such methods.

### ***Research Program 2001–2002***

- Establish new regulatory standards (Basle 2) for measuring and managing operational risk.
- Examine model risk for financial transactions. Evaluate the impact of using a potentially misspecified model in pricing decisions—apply to volatility models.

## **Integrated Risk Management**

### ***The Issue***

A key aspect of risk management is the integration of these various risks and their integrated management. Several members of the Finance Group are participating in Valorisation-Recherche Québec's integrated risk management project. They will collaborate with researchers from other CIRANO Groups to develop a generalized methodology for managing integrated risk. These guidelines are the result of research efforts involving CIRANO fellows with various areas of expertise, ranging from specialists in contract theory to statisticians and including experts in insurance.

### ***Research Program 2001–2002***

- Assemble the various approaches and models in a general document to demonstrate their interdependence and create software for the implementation of these methods.

### **The Stability of Financial Markets and Contagion Effects**

#### ***The Issue***

The Bank of Canada, which is collaborating with other central banks to establish prudential criteria for financial institutions, is interested in their ultimate impact on the stability of the financial system. A first project aims to better understand the types of credit contracts signed between financial institutions and their impact in the presence of default and systemic shocks.

### ***Research Program 2001-2002***

- Apply the perspective and tools of contract theory to analysis of the phenomenon of financial contagion. The researchers will accomplish this by developing a model of self-executing contracts for the market for credit between financial institutions. Since contracts are incomplete, they are vulnerable to default, and to losses caused by systemic shocks. To highlight the contagion problem, which is a multilateral rather than a bilateral phenomenon, the model will include multiple agents.
- A mini-conference is planned at the Bank of Canada with Jean-Charles Rochet in June 2001.

### **DERIVATIVES**

The derivatives market has experienced exceptional growth during the last twenty years. An agreement between Canadian stock exchanges has made Montreal the only Canadian exchange for options and futures. A large variety of derivatives are examined in this project: including European options as well as American, Asian and barrier options. Each options model requires a different algorithm for valuation. The research program on options and futures comprises a theoretical and an empirical part. In addition, a software package containing all theoretical, statistical and numerical methods for valuing options is also planned.

Within the framework of this second major research phase we are undertaking several research projects:

1. Valuation models
2. Empirical evaluation of the models
3. The creation of derivatives
4. A software package for valuing derivatives.

### **Valuation Models**

#### ***The Issue***

This project focusses on derivatives, including European options as well as American, Asian and barrier options. Each option model requires a different algorithm for valuation. While European options yield analytical valuation formulas under certain conditions, the other option types must be valued by approximation.

### ***Research Program 2001–2002***

- Develop series-expansion methods for formulas for the valuation of stochastic volatility models. Elaborate estimation methods based on the generalized method of moments applied to integrated volatility.
- Find methods for valuing interest-rate derivatives from a structural model of rates' term structures incorporating long- and short-term memories.
- Analyse volatility models based on eigenfunctions and use to value derivatives—apply to interest-rate term structure models.

## **Empirical Evaluation of the Models**

### ***The Issue***

This part groups the research work of CIRANO fellows on new valuation models. Some seek to explain the “smile” effect using latent variables, others are interested in comparing various models on an empirical level, while yet another group is working on models for valuing options that are based on the GARCH process. The principal studies to be conducted are:

### ***Research Program 2001–2002***

- Compare the empirical performance of models for valuing options in discrete and continuous time.
- Empirically estimate an intertemporal model for valuing options that incorporates latent variables, using S&P 500 options prices in terms of pricing and hedging errors.
- Work with time series models of the structure of implicit volatility—the volatility surface. Build a model for the volatility surface or implicit “smile” using S&P 500 options indices and including all cross-section data available on options each day.
- Perform a detailed empirical study of several models for valuing options in discrete and continuous time.

## **The Creation of Derivatives**

### ***The Issue***

The Bourse de Montréal Inc. currently offers several derivatives on the market, such as futures on fixed-income securities with maturities ranging from three months to ten years, futures on indices, and stock options. These derivatives represent the core of the strategic portfolio of most of the world’s exchanges, but some derivatives are not featured in the Bourse de Montréal’s portfolio. Should the Bourse diversify its portfolio of derivatives and, if so, in what directions? Furthermore, it should also be borne in mind that the level of activity of a given derivative may increase while that of another decreases, since derivative products have varying sensitivities to the business cycle and other relevant macroeconomic factors.

### ***Research Program 2001–2002***

- Develop a complete model of an exchange offering a portfolio of derivatives. This portfolio will reflect an optimal mix of derivatives in the context of the Canadian market, ensuring that the Bourse has a constant level of activity and protecting it against a cyclical falloff of interest in its products. An important element of this model is evaluating the demand for derivatives and the potential market for new derivative products.

## **Software Package for Valuing Derivatives**

### ***The Issue***

Given the interest many researchers and partners have expressed in models for establishing the value of derivatives, we have begun to build a computer library containing various methods for valuing derivatives. Naturally, we began with the most common formulas and models, but our goal is to develop a tool integrating new valuation models and formulas much more rapidly than commercially available programs. Since we have researchers who are simultaneously contributing to theoretical, statistical and numerical developments in this field, the value added of such a program appears considerable to us. It would also be useful for training researchers.

### ***Research Program 2001–2002***

- Create a software library permitting the valuation of an option using various available models. It will include analytical evaluations along with numerical simulations and discrete approximations. These programs will be accompanied by a document summarizing both the theoretical underpinnings of each model and the parameters necessary for valuing the derivative. There will also be a short note on the method by which the various models are implemented numerically. We have decided to write the library in S+ for Windows and to integrate recent work of researchers in the field. This document should finally be completed with the addition of less technical subsections in order to expand the range of potential users of the library.

## **NUMERICAL AND STATISTICAL METHODS**

This phase of the research program develops numerical and statistical tools, in particular to support estimations and inference in diffusion models currently used in finance. It will also invoke numerical techniques associated with valuing options. Each project described hereafter must meet the same challenge: generate a better understanding of statistical and numerical procedures to improve the precision and expand the applicability of the models used in empirical finance.

This third phase includes several research projects:

1. Statistical models
2. Numerical Models
3. Learning Models
4. Statistical Models for Forecasting

### **Statistical Models**

#### ***The Issue***

This project deals with the following issues of general interest: inference with Monte Carlo tests, inference in financial time series, statistical models for financial time series, and “bootstrap” methods.

#### ***Research Program 2001–2002***

- Construct inference procedures that account for the characteristics of the data and the estimators.
- Study the impact of the Box and Jenkins method when applied to the case of mixing conditions.
- Model high-frequency financial data.
- Fine-tune statistical models to capture nonlinearities and thick tails in financial series.
- Study a consistent estimator of the covariance matrix of the quasi-maximum likelihood estimator.

### **Numerical Models**

#### ***The Issue***

This project deals with dynamic portfolio management. In a dynamic framework portfolios include hedge balances that, over long periods, are very large.

#### ***Research Program 2001–2002***

- Compute portfolio shares with several assets and several state variables. We propose an improved Monte Carlo method using transformed state variables. The results we have obtained to date are very reasonable compared to the traditional mean-variance approach.
- Apply strategic sampling, control variables, and stratified sampling to portfolios of options. The problem with portfolios of options is that the choice of an optimal drift coefficient is difficult: one which is suitable for certain options fails in the case of others. How can we apply this method to these portfolios? Our approach is to adapt the variance reduction method to portfolios.

### **Learning Models**

#### ***The Issue***

The valuation of options and calculation of the various derivatives of the price function (the Greeks) most often rely on parametric models. These models inevitably contain specification errors. The activities in this project will primarily focus on estimating functions of the options prices, hedge ratios, and risk neutral distributions with nonparametric methods based on learning algorithms. The application of learning algorithms to the elaboration of trading strategies and to hydrological runoff options are also part of this phase.

### **Research Program 2001–2002**

- Use learning algorithms with the fewest possible economic and distributional assumptions for the valuation of options and for computing the Greeks. In particular, we incorporate weak constraints on the properties of the functions (monotonicity and convexity) that determine the price function for a large number of processes.
- Evaluate trading strategies with statistical methods—in particular, develop a project on portfolio management that predicts yields for a very large base of securities.
- Study the valuation of runoff options, i.e. a coverage that Hydro-Québec could buy to hedge against years of low precipitation in hydrological basins.

### **Statistical Models for Forecasting**

#### ***The Issue***

The diffusion index model reduces a great deal of information to a limited number of elements called factors. It thus offers the possibility of reducing unexplained elements attributable to the business cycle and other changes. These factors can then be used in a standard forecasting model.

### **Research Program 2001–2002**

- Expand and evaluate the predictions of the diffusion index model to longer forecast horizons than those studied to date. Two criteria will be evaluated. First, the information content of the predictions shall be considered. Second, the predictive performance of the diffusion model over longer time horizons will be compared to predictions generated by other models.
- Analyse the handling of missing data in the factor extraction process.

## **ELECTRONIC COMMERCE GROUP**

### **GOALS FOR THE YEAR 2001–2002**

The principal goal of the “E-Commerce” Group is to accelerate the transferral of the results of fundamental and applied research in the field of electronic commerce to implementation and development. We envision the following procedure: evaluate existing e-commerce tools, research and conceive of new ways of doing things, implement prototypes and models, experiment and simulate, technologically integrate the prototypes on a test platform, train future participants, and implement pilot projects. This will require building on past accomplishments, drawing on our research infrastructure (physical and computer software), and capitalizing on the variety of disciplines represented on our team: economics, information technologies, distributed computer systems, operational research, marketing, and finance.

One important aspect of our research and transferral strategy revolves around advanced prototypes (i.e. computer programs that will allow us to perform tests, simulations, and experiments in the laboratory) that we intend to build with the help of our partners. Thus, our efforts will be directed at creating prototypes and then testing and verifying them with our partners, whose ultimate aim will be to commercialize the concepts they incorporate. Our research work will concentrate on implementing advanced prototypes in the following fields: firm-client relationships, interfirm workflows, competitive bidding systems, transportation and logistics, and the financing of corporations. We will also be looking at the impact of technology on organizations and how to integrate new technologies into firms. It is not necessarily the case that a new technology is adopted just because it is available. It is important to develop a thorough understanding of why companies are reluctant to accept new technologies, and under what conditions they will be adopted.

The exponential growth of e-commerce—between firms and in retailing—has prompted the governments of Quebec and Canada to undertake major initiatives in this area. Comments made by our partners reflect this same sense of urgency. Companies understand the importance of e-commerce and are aware that they cannot remain indifferent to it. This opens the door to us for many collaboration and partnership opportunities. Finally, the popularity of e-business has also had an impact on the academic and university research milieu. Several of the associate researchers in our Group participated in the establishment of new graduate studies programs in e-commerce at the HEC and the Université de Montréal. Similar initiatives have been undertaken in other universities in Canada (Laval, Dalhousie, and Ottawa, in particular) and in the United States. The creation of these programs underlines the popularity and importance of this interdisciplinary field of study.

CIRANO wishes to apply its general research infrastructure to support the development of research tools and enhancements in the field of e-commerce. More precisely, over the coming years we hope to be able to contribute to:

17. implementing prototyping tools to create different e-business environments meeting the needs of our researchers and industrial partners. In particular, we intend to build models of virtual interfirm marketplaces in our laboratory.
18. developing expertise on technology's impact on intra-firm and interfirm organization and on firm-client relationships.
19. creating the biggest laboratory for experimental economics and analysis of strategic behaviour in Canada, and making it a global leader.
20. contribute to generating and disseminating greater understanding of the human and social impact of new technologies, especially within firms.
21. finally, preparing students for integration into the labour market by involving them in applied projects using the most advanced technologies; developing training tools and teaching e-business solutions to users.

## RESEARCH FUNDING

Most of the phases of our scientific programming receive funding from two sources. One part is provided by the TEM (Towards Electronic Marketplaces) project, which is co-funded by Bell University Laboratories and by the NSERC. The goal of the TEM project is to develop prototypes of electronic markets. This project involves six researchers from CIRANO and the Centre for Research on Transportation (J. Robert, M. Gendreau, G. Babin, T. Crainic, R. Keller, and P. Kropf). The budget for the TEM project is \$1,775K for four years (June 1999–March 2003). The second source of funding is Valorisation-Recherche Québec (VRQ). The “Advanced Prototypes for E-Commerce” project aims to structure e-business research and ensure its development. This project involves four universities (Université de Montréal, Université Laval, Université du Québec à Montréal, and the HEC) and 13 of CIRANO's researchers (J. Robert, B. Aubert, G. Babin, M. Boyer, B. Chaib-Draa, T. Crainic, M. Gendreau, R. Keller, P. Kropf, C. Montmarquette, J. Natel, S. Rivard, and J.-M. Suret). The budget provided by the VRQ is \$1,600K for three years (May 2001–April 2004).

The last element of our research program, titled “Going Virtual,” deals with the impact of new technologies on organizations. Four CIRANO researchers (B. Aubert, G. Paré, M. Patry, and S. Rivard) have already made significant contributions in this field, which will culminate in the publication of a book in early 2002. We hope to find supplementary financing to continue our research in this area.

Funding provided by the TEM and VRQ projects are complementary. The TEM project is a significant NSERC-partnered research undertaking that supports research professionals as well as graduate students working in applied research, while financing from the VRQ is primarily directed at promoting activities to enhance the value of research. To a considerable extent our scientific programming integrates the research and enhancement activities funded by BUL and the VRQ. CIRANO also devotes part of its infrastructure to this programming.

Finally, we expect to receive additional funding from our partners for work specifically targeted to their needs. In particular, last year we obtained financing from the Treasury Board (\$115K) to examine the use of reverse auctions for government procurement (APÉERO project). Also, we have held discussions on these matters, which we intend to continue, with our CIRANO partners, particularly AXA Insurance, Bell Canada, Bombardier, Pratt & Whitney, the Bank of Canada, the Mouvement Desjardins, and the Montréal Exchange.

**RESEARCH                      TEAM                      OF                      THE                      E-COMMERCE                      GROUP**  
*\* associate fellow*

E-commerce is not a discipline in and of itself, but rather an applied field with many elements requiring the contribution of diverse and complementary disciplines. Thus, we have made a particular effort to gather researchers with a variety of specializations and an interest in the different facets of e-business. For each discipline identified, we have sought to recruit Quebec's best academics, especially those known for their dynamism and exceptional expertise. We believe that the interdisciplinary quality of our team constitutes one of its principal strengths. CIRANO's E-Commerce Group unites Quebec's best and brightest in the fields of software engineering, operational research, economics, information technologies, management, and finance. The members of this team are known for dynamism in their respective fields of expertise.

**Jacques Robert** is a professor in the department of economics at the Université de Montréal. His specialization is the design of marketplace rules and the theory of auctions. He is Director of the E-Commerce Group as well as of CIRANO's electronic auctions research team. Over the last five years this team has been involved in many applied

projects and has several impressive accomplishments to its credit.

[Benoit Aubert](#) is a professor in the Service d'Enseignement des Technologies de l'Information at the HEC. He has long worked on virtual and networked firms, and on the links connecting the participants and the systems supporting their exchanges. Modelling the flow of information is at the heart of information technologies. Benoit Aubert is also responsible for SAP projects at the HEC. The SAP software supports all the business processes of an organization.

[Gibert Babin](#) is a professor in the Service d'Enseignement des Technologies de l'Information at the HEC. It is worth noting that Gilbert Babin, along with Peter Kropf, co-founded the PARADIS laboratory for distributed systems at Université Laval. They are eminent members of the international WOS (Web Operating System) consortium, which is working on developing a communications infrastructure to support distributed virtual communities.

[Martin Boyer](#) is a professor in the Service d'Enseignement de la Finance at the HEC and a specialist in insurance issues. He also works on projects related to the design of financial certificates and the microstructure of financial centres, and actively collaborates with other Quebec researchers on topics of current interest, such as online financial markets.

[Michel Gendreau](#) is a professor in the Département de Recherche Opérationnelle of the Université de Montréal and Director of the Centre for Research on Transportation (CRT). He contributes extensive experience in operations research, especially the optimization of networks and combinatorics, and in distributed and parallel computing and the development of decision support systems. He also has an international reputation for his expertise in applying these methodologies to transportation issues.

[Rudolf Keller](#) is an associate professor at GELO (Laboratoire de Génie Logiciel), the Université de Montréal's software engineering lab. His research interests bear on modelling business processes and technologies for electronic markets.

[Claudia Keser](#) \*, an expert in experimental economics, is a professor in the Institute for Statistics and Mathematical Economics at the Universität Karlsruhe in Germany. She spent a year with CIRANO helping set up the laboratory for experimental economics (BUL-C3E) and is currently a researcher at IBM's Yorktown Heights Research Center in New York.

[Peter Kropf](#) is a professor in the Département de Recherche Opérationnelle at the Université de Montréal. He is responsible for setting up the master's program in e-commerce, an interdisciplinary initiative of the Université de Montréal and the HEC. He also shares responsibility with Gilbert Babin for the graduate studies program in electronic commerce at the Université de Montréal.

[Guy Paré](#) is a professor of information technologies at the HEC. His research principally relates to change resulting from the introduction of new technologies, managing this change efficiently, and the use of information technologies to support emerging organizational forms.

[Michel Patry](#) is a professor in the HEC's Institute of Applied Economics and Associate Director of Academic Affairs and Strategic Planning at the HEC. His research work focusses on issues of outsourcing, contract management and corporate strategy.

[Suzanne Rivard](#) is a professor in the Service d'Enseignement de la Finance at the HEC. She has researched the management of information technologies for several years. In recent work she has examined the issue of coordinating corporate strategy, organizational structure, and information technology strategies. She is particularly interested in the coordination of these variables in an e-business framework.

[Jean-Marc Suret](#) is a full professor and Director of Université Laval's École de Comptabilité, which is affiliated with the Faculté des Sciences de l'Administration. He is an expert in the structure of financial centres and the financing of start-ups. His recent submission to the Quebec Securities Commission and brokerage firms on the reform of Canadian financial centres and especially on the rise of online brokers was well received.

## **RESEARCH PROJECTS FOR 2001–2002**

The E-Commerce Group's extensive research programming is defined around applied sub-projects. We chose to

separate the project into a number of precise applications designed to respond to our partners' specific needs.

Phase one of our scientific programming deals with generic tasks, while phases two through nine consider eight applied sub-projects we have identified. Phase ten is the continuation of the project "Going Virtual." Our goal is to enrol corporate partners in each sub-project. Over the next year we will develop some prototypes and generate a few basic results, which we hope will elicit our partners' interest in what we are doing and can do. During the following years we will focus our resources on the themes that are of particular interest to them.

Phases two through five relate to the mechanisms of cybermarkets. In terms of the technology, we will make use of the GNP (Generic Negotiation Platform) software—developed in the framework of the TEM research project—which we will continue to improve. In these phases we will pursue the examination of different applications of auctioning and cybermarketing mechanisms with our partners. Phases six and seven will integrate distributed agent technologies and ERP systems. Phases eight and nine will be focussed on the impacts of e-business on distribution channels. Finally, phase ten will examine the impact of new technologies on organizations.

## **GENERIC E-COMMERCE TECHNOLOGY**

### ***The Issue***

In this phase our interest will be focussed on negotiation mechanisms in electronic markets. On the internet, negotiation engines have assumed an important function, and the design of marketplace rules has become an important topic of research. In particular, we believe that optimization tools may play a key role.

Our work in the area of e-commerce technologies centres around two overlapping activities. First is the completion of the second version of the generic negotiation software package (GNP 2.0). This package will allow the creation of complex markets on which orders are combined according to various criteria.

Among other activities planned for the completion of GNP 2.0, the multi-object combinatoric auction (buy and sell) software, we find: defining the semantics of combinatoric bids and programming them, creating a library of economic objects and presentations for simple and combinatoric auctioneers, and a console and experimental robots.

In addition, the various phases require advanced e-commerce services, created with XML, Java 2 (Enterprise Edition), and especially programmed web-service environments. The major challenge confronting these services is to build an electronic community of flexible business systems that is open and comprises elements easily adaptable to a great variety of partners and distributed computer systems.

Furthermore, organizing these projects requires the implementation of pooled development tools, such as a shared library, a source code archive, and a virtual collaboration site. All of these tools will be used by every sub-project, as much for development as for the creation of prototypes.

### ***Research Programming for 2001–2002***

- Complete the second version of the generic negotiation program (GNP 2.0)
- Implement the pooled development tools as a shared library, a source code archive, and a virtual collaboration site

## **CALLS FOR TENDERS**

### ***The issue***

The use of electronic auctions to solicit calls for tenders is one of the areas in which B2B (Business to Business) e-commerce has experienced its greatest growth. E-commerce tools are indeed transforming the bidding process by allowing the use of open mechanisms for competitive bidding. Many American firms are now relying on reverse auctions for their calls for tenders.

We have already worked with the Treasury Board to examine the suitability of these procedures for the government's calls for tenders. We intend to continue these studies while expanding our group of partners. Our scientific programming will examine simple calls for tenders (one unit of a single good). We will then examine

competitive bids on several units and several goods. Experimental economics techniques will allow us to propose the most efficient bidding mechanisms.

#### ***Research Programming for 2001–2002***

- Verify the impact of bidding rules on participation
- Implement prototypes and experimental frameworks to test multi-unit and multi-object auctions

### **MARKETS FOR INITIAL PUBLIC OFFERINGS**

#### ***The issue***

The structures of financial markets are evolving rapidly and electronic exchange networks (ECNs) are multiplying, forcing the evolution of traditional stock exchanges. Thus, e-commerce is transforming the means by which new companies can be listed. For example, virtual stock offerings allow them to raise funds rapidly and at a lower cost than traditional methods. These new financing methods will reduce the cost of capital and improve the competitiveness of new firms while reducing the hurdles high-tech companies face when attempting to raise funds. Nonetheless, getting listed presents significant challenges to entrepreneurs, one of which is setting the price of the initial stock offering.

The use of electronic auctions has been considered as a means for setting the initial stock price, and some experiments in that vein have already been conducted. We wish to examine these experiments in greater detail, to see what provisions Canadian regulation makes for this type of procedure and develop auctioning prototypes to determine which regulations are most appropriate. We have already initiated discussions with the Mouvement Desjardins.

#### ***Research Programming for 2001–2002***

- Evaluate the international experience with IPO auctions
- Identify the relevant aspects of regulation
- Implement prototypes and an experimental framework to test IPO auctions

### **FINANCIAL MARKETS AND SECURITIES**

#### ***The issue***

This sub-project will primarily focus on the microstructure of markets for fixed-income securities in order to identify protocols to promote greater liquidity of bonds: government or corporate. In particular, one of the greatest foreseeable advantages of electronic transaction systems is the potential for grouped transactions: portfolio transactions, transactions with weighted-basket trade orders, contingent transactions, etc.

In the short term, a good deal of the researchers' time will be spent studying markets on which fixed-income securities are currently traded. This examination of the current situation will allow us to delineate how we will later model the interactions between participants. When this modelling is complete, all that will remain is to establish the protocols and examine what type of microstructure is most suitable. Prototypes of exchange mechanisms will be built to test the different structures.

We have already held discussions with the Montréal Exchange to study the issue of bundle trading derivatives. We are also aware of a research group at the Bank of Canada examining fixed-income securities.

#### ***Research Programming for 2001–2002***

- Study the markets on which fixed-income securities are traded
- Elaborate prototypes of exchange mechanisms
- Evaluate different types of microstructures

### **FREIGHT EXCHANGES**

### ***The issue***

E-commerce tools permit the creation of freight exchanges. In this type of exchange, shippers submit a request for a carrier while the latter solicit the business of the former using a dynamic auction engine.

This year we shall invest little in this research phase beyond our existing commitments under the TEM project. We will primarily examine the role of decision-support tools in this type of market. Next year the auction tools developed in the “multi-object call for tenders” and “intelligent transportation” projects will be applied to build a more elaborate prototype of freight exchanges.

- Determine the role of decision-support tools in freight exchanges.

## **INTERFIRM NEGOTIATIONS**

### ***The issue***

The common denominator of the applications considered in the framework of this research phase will be the use of software agents to engage in distributed negotiations involving decentralized locations, portals and auctioneers.

In terms of the technology, this phase partly derives from the CONSENSUS prototype developed under the TEM project. Most of the applications relate to logistics and intelligent transportation:

33. Bargaining agents in transportation (sale of transportation): The key concept is that requests for transportation services will be concentrated around a point of origin—on “regional” servers—and that a carrier travelling across America will wish to assemble a package of orders for one trip. Competition between these trips, and the selection of the best trip from among the packages assembled by the agents, may be very simple or may require an optimization algorithm, requiring expertise in operational research.
34. Purchasing agents for travellers: A traveller buying road transportation services obtains several types of goods and services (fuel, lodging, repairs, etc.) and it is not feasible for a single supplier to provide each and every one of these services for all of America. The traveller’s “agent” objects must thus “dynamically” assemble the trip’s components from several “seller” systems. The choice of best combination may be very simple or very complex.
35. Intermodal (train, truck): It is frequently necessary to complement demand for transportation of a container by train with a further demand for trucking services at both ends of the trip. In this case the participants post their requirements on three different exchanges: one for the train and two for trucking. The agent systems serve as bridges and coordinators between the different exchanges.

During the first year our efforts will be directed at defining the basic architecture and developing simple prototypes. We shall write one report per application, describing the issues, the solution paths, and an initial analysis of the use of agents and workflows. Clearly, more advanced prototypes will be developed later in response to our partners’ needs.

### ***Research Programming for 2001–2002***

- Define the basic architecture of the prototypes
- Develop simple prototypes
- Write a report for each application

## **INTERFIRM FLOWS AND CORPORATE MANAGEMENT**

### ***The issue***

Our work in this phase of the research is an extension of an ongoing project on modelling and automating a system for managing the workflows of certain inter-organizational quality control processes in the aeronautical industry in Quebec. Since the model-building stage is nearing completion and the creation of the prototype is underway, this is an opportune time to specify the upcoming steps.

Our contribution will be at the level of ERP systems, which are at the core of the internal management of firms.

Initiatives using workflow technologies must account for ERP systems and integrate into them. It appears that, in the aeronautical industry, the SAP R/3 computer program is the most widespread (notably at Pratt & Whitney, Bombardier Aerospace, and Rolls-Royce). During the first years we intend to (i) create and configure a stylized firm using SAP's R/3 program; (ii) create workflow prototypes and the links required for them to interact with SAP R/3; (iii) evaluate each prototype for functionality, relative performance, and the capacity to integrate with SAP R/3. Implementing these prototypes in a firm will occur sometime after the first year.

#### **Research Programming for 2001–2002**

- Create and configure a stylized firm using SAP R/3
- Create prototypes capable of interacting with SAP R/3
- Evaluate the prototypes for their functionality, relative performance, and capacity to integrate with SAP R/3

### **MANAGEMENT OF DISTRIBUTION CHANNELS AND ONLINE BROKERAGE**

#### ***The issue***

By dispensing with the middleman, e-commerce tools provide significant benefits to firms wishing to practise virtual management of their value chain and directly communicate with clients. However, many companies from all industrial sectors, automotive, petrochemical, and general insurance, hesitate to adopt practices that may damage long-established relationships with their network of distributors. We refer to "channel conflict" when the creation of direct distribution channels between firms and their clients competes with traditional distribution channels, such as car dealerships, distributorships, wholesalers, and insurance brokers. Since some of the tools that will be developed in the framework of the VRQ e-commerce project have the potential to create channel conflict, the feasibility of their being adopted by firms will depend on conflict-resolution type models. Our goal is to elaborate a model for the conception and implementation of an e-commerce strategy that will minimize the intensity of channel conflict.

In the first year we will define the issues: What are the important variables to account for in this context? We will document best practices in terms of channel conflict and examine what has been done in different industries to manage this problem (documentation is available for a variety of firms, such as 3M, Levi Strauss, General Motors, etc.). We will then elaborate a preliminary conflict resolution model working in partnership with AXA insurance.

#### **Research Programming for 2001–2002**

- Analyse case studies
- Elaborate a conflict-resolution model

### **B2C: PERSONALIZATION FOR E-COMMERCE**

#### ***The issue***

During the first year we will examine how the internet, as a means of communication and a distribution channel for products and services, allows consumers and firms to trade significant quantities of information on various products and services offered. We will seek to understand and measure the impact of the use of these different types of online interpersonal exchanges on consumers' purchase decisions. We emphasize that there are no research results on the variables influencing the effectiveness of the different types of interpersonal communications occurring online.

In order to achieve these goals we will use an experimental device. A 3 (web sites: retailer, third party linked to the retailer, third party not linked to the retailer) × 3 (additional sources of information: other consumers, experts, professional review) × 2 (nature of the product: search, experience) factorial design will be used. Since the experiments will be conducted autonomously online, the factorial design should be managed by a program that can randomly assign any of the three web sites to any remote participant. Finally, the subjects' responses to questionnaires and their choice of products should automatically be entered into a database compatible with the statistical analysis package SPSS.

The results generated by this experiment, and the outcome of the research, will contribute to our understanding of the role played by different types of online interpersonal relationships in the consumer's purchase-decision process.

This research will eventually enable firms wanting to use this type of persuasive communication to understand the differences between the various types of online interpersonal relationships, and especially their impact on the consumer's purchase decisions.

#### ***Research Programming for 2001–2002***

- Develop the online experiments
- Analyse the results of the experiments

### **GOING VIRTUAL**

#### ***The issue***

Firms' competitiveness depends increasingly on their flexibility and ability to innovate, as much in their organizational structure and their mode of production as in how they interact with their clients and suppliers. The role of information technologies has become pervasive in this knowledge-based economy. Of course, IT has an important role to play in traditional organizations: Without the support of IT for business processes, control and planning, and even the implementation of corporate strategies, modern companies would not be able to function. However, in the new, knowledge-based economy, information technologies play an even greater role since they are the catalysts of transformation.

Our work shall specifically bear on this new role of technologies. The new forms share several characteristics: organization around processes rather than tasks, flat structure, emphasis on the team rather than the individual, preference for multiple skills, tailored training and information, maximization of contacts with suppliers and clients, focus on the customer. While promising, this new type of organizational structure is only part of a very complex puzzle. To have a real impact on organizations' performance it must be combined with other elements that are equally important. These are: organizational strategy, deployment of information technologies, leadership, and management techniques.

Since these new organizational forms are emergent and few companies have adopted them, we still know little about the interaction of the various pieces of the puzzle. The principal goal of our research will be to understand these interactions. To illustrate, some of the themes we will focus on are listed below:

- IT and the virtual office: telecommuting, virtual teams
- IT and mass customization
- IT and the "smart" business
- IT and the virtual organization

Owing to the specific characteristics of this research, we will invite the collaboration of academics from related branches of management, such as industrial organization, marketing, and corporate strategy. Our research methods shall sometimes be qualitative, taking the form of in-depth case studies that will allow for a detailed analysis of the interactions between the variables of interest, and sometimes quantitative, in the form of surveys that will allow us to test our research models.

#### ***Research Programming for 2001–2002***

- Complete the monograph for phase one of the research project

### **CORPORATE GOVERNANCE GROUP**

#### **GOALS FOR THE YEAR 2001–2002**

The Corporate Governance Group has evolved considerably over the course of the past year. In the spring of 2001, 23 fellows were involved in this Group's projects. The 2001–2002 year promises many new projects, each as ambitious as it is pertinent. Consequently, this Group is ushering in the new year with a drive to consolidate its efforts—a process that carries with it at least three corollaries: first, a scientific refocussing to increase the synergy among researchers; second, coordinating the liaison and transferral activities and; third, articulating new activities

and opportunities that cut across CIRANO's facilities, such as the experimental economics laboratory.

The focal point of the Corporate Governance Group has been and remains the allocation of resources by methods that are not strictly market-based. This encompasses a vast field of study, extending from the internal organization of small and medium-sized firms to that of the civil service, and embracing the structure of multinational firms and of regulation. In light of the disparateness of our research agenda, it is useful at this point to realign our activities along two axes that will simultaneously reflect the specific interests of our researchers and the preoccupations of our partners. These axes are the "Enhancement of Shared Infrastructure" and "Integrated Risk Management."

## RESEARCH FUNDING

Most of the research projects described here receive funding from several sources, and some of our partners are also associated with more than one project, such as the Ville de Montréal, Industry Canada, the OECD, and the Bank of Canada. Substantial funding has recently been granted to CIRANO researchers in the framework of the Valorisation-Recherche Québec program on projects dealing with integrated risk management. Finally, several partners have expressed an interest in this Group's projects, though they are not yet involved in the research planning. These potential partners are Bombardier, Hydro-Québec, AXA Insurance, Pratt & Whitney, Statistics Canada, Alcan, Bell, and the Ministère de la Santé est des Affaires Sociales.

## RESEARCH TEAM OF THE CORPORATE GOVERNANCE GROUP

(\*) associate fellow

(©) CIRANO researcher

[Bernard Sinclair-Desgagné](#) is the Director of the Corporate Governance Group. He is a professor at the École Polytechnique de Montréal, where he is also associated with the Jarislowsky Chair in Technology and International Competition and the NSERC Industrial Chair in Site Remediation and Management. His areas of interest are the economic analysis of organizations, industrial policy, regulations and the management of environmental resources, and management of major industrial hazards.

[Benoit Aubert](#) is a professor in the Service d'Enseignement des Technologies de l'Information at the HEC. His research focusses on the management of IT activities and on outsourcing as a way of managing them, management of corporate risk, and new forms of organization (network, virtual). He studies different types of contractual relationships between clients and service providers in order to identify optimal modes of organization.

[Marcel Boyer](#) is a professor in the department of economics at the Université de Montréal. His research activities centre around the following subjects: technology and international competition, the economics of information and uncertainty, and organizations and strategic competition.

[Martin Boyer](#) is a professor in the Service d'Enseignement de la Finance at the École des Hautes Études Commerciales de Montréal (HEC). His main research interests are insurance, risk management, consumer behaviour in the face of uncertainty, information management and corporate finance.

[Peter Christoffersen](#) is a professor in the Faculty of Management at McGill University. His research interests include risk management and financial econometrics, and more specifically currency crises forecasting, non-parametric options pricing and the statistical testing of market-risk measurements.

[Claude Denys Fluet](#) is a professor in the economics department of the Université du Québec à Montréal (UQAM). His research areas are risk management, contract theory, financial microeconomics, regulation and the economic analysis of law.

[Robert Gagné](#) is a professor at the Institute of Applied Economics at the HEC. His fields of interest include applied macroeconomics, econometrics, transportation and industrial organization.

[Karine Gobert](#) © is a professor of finance at Concordia University. Her fields of specialization include finance and industrial organization. More specifically, her interests bear on the application of contract theory to corporate finance and insurance economics, as well as the integration of long-term decisions in finance and insurance.

[Patrick González](#) is a professor in the department of economics at Université Laval. His fields of interest include microeconomics, game theory and information economics.

[Jozée Lapierre](#) is a professor in the Département de Mathématiques et de Génie Industriel of the École Polytechnique. Her work on perceived value has highlighted the challenges facing Quebec firms working in the high-tech sector, particularly in communication and information technologies (CIT). She is currently studying the impact of CIT on sales forces and their management.

[Pierre Lasserre](#) is a professor at the Université du Québec à Montréal (UQAM). He specializes in the economics of natural resources and the environment, and has authored theoretical and applied studies in taxation, measures of resource rents and of technological progress. His research is specifically focussed on investment and real options, and on the role of institutions in economic life.

[Élisabeth Lefebvre](#) is a professor of technology management at the École Polytechnique. Her current research is focussed on determinants of new technology adoption, innovation management (especially in small and medium-sized manufacturing firms), the dynamics of industrial subcontracting, and firms' competitiveness.

[Louis-A. Lefebvre](#) is a professor in the Département de Mathématiques et de Génie Industriel of the École Polytechnique. He specializes in technology and innovation management. His research deals with the dynamics of Quebec's industrial sectors, industrial subcontracting in the aeronautics and aerospace industries around the world, and innovation and competitiveness of small and medium-sized firms.

[Pierre Thomas Léger](#) © is a professor at the Institute of Applied Economics at the HEC. His fields of specialization are health economics, applied economics and industrial organization.

[Ngo Van Long](#) is a professor in the department of economics at McGill University. He works on the following subjects: mergers, vertical integration, joint ventures, the environment and natural resources.

[Pierre Mohnen](#) is a professor in the department of economics at the Université du Québec à Montréal (UQAM). His research areas are production theory, applied econometrics, and R&D and technological change. At CIRANO he works with the team researching technological change.

[Michel Moreaux](#) \* is a professor of economics at the Université de Toulouse I, and has been a senior member of the University Institute of France's Chaire d'économie de l'environnement et des ressources naturelles since 1997. His research focusses on the economics of the environment and natural resources, and industrial economics.

[Jorge Niosi](#) is associated with the Département de Management et Technologie of the Université du Québec à Montréal (UQAM). His research interests are innovation systems, management of R&D and technology, and industrial structures. His current research focusses on Canadian technology transfers in China, Canadian R&D abroad, and Canada's R&D system.

[Guy Paré](#) is an associate professor in the Service d'Enseignement des Technologies de l'Information at the HEC. His main areas of interest are clinical information systems, implementation of information technologies, management of technological change, and the impact of information technologies on organizations.

[Michel Patry](#) is a professor in the HEC's Institute of Applied Economics and Associate Director of Academic Affairs and Strategic Planning at the HEC. He is specialized in the economic analysis of organizations and his recent research bears on issues of outsourcing, contract management and corporate strategy.

[Michel Poitevin](#) is a professor in the economics department of the Université de Montréal. Specialized in financial economics and the economics of information within firms, he has produced research work on the interaction between production and financial decisions, information, financial markets and oligopolies, as well as on the economic implications of asymmetric information, particularly as they relate to contractual agreements and investment decisions. He is also interested in the dynamics of financial savings, investment, and consumption in the case of households and firms.

[Suzanne Rivard](#) is a professor in the Service d'Enseignement des Technologies de l'Information at the HEC. She is interested in information technologies and the management of uncertainty created by the introduction of new IT systems into firms.

[Jean-Marc Suret](#) is a full professor and Directeur de l'École de Comptabilité associated with Université Laval's Faculty of Administrative Sciences. His work is dedicated to the study of corporate finance, performance measurement, the analysis of technological risk and innovation.

[Michel Truchon](#) is a professor in the economics department at Université Laval. His main areas of interest are public economics, social choice and cost sharing.

## **RESEARCH PROJECTS FOR 2001–2002**

### **THE ESI AXIS: ENHANCING SHARED INFRASTRUCTURE**

With “shared infrastructure” we mean not only those infrastructures commonly referred to as public (such as transportation, energy, communication and water supply systems), but more generally any support system essential for the efficient operation of a firm or a group.

Those countries, regions and firms that have experienced the strongest growth and shown the greatest efficiency gains in recent years owe it largely to the efficiency of their shared infrastructures. In the current economic environment—characterized by heightened competitiveness—the availability, quality and efficient management of shared infrastructures are proving key elements of competitiveness.

Moreover, in the opinion of many public and private actors, the relative deterioration of several of our shared infrastructures justifies not only massive new investments, but also renewed efforts to expand on them. Enhancing their value in this way is conditional on the development of management techniques and tools that will increase their efficiency and spin-offs while minimizing costs. It also requires the establishment of user fees and cost-sharing arrangements to encourage the emergence of private-private, public-private, or public-public partnerships. This is the focus of our current research.

The ESI axis comprises four interrelated modules.

#### **Apportionment of Shared Costs**

##### ***The Issue***

The apportionment of shared costs is a solution to the growth of networked industries and the need to allocate cumbersome infrastructure systems. For large corporations and public institutions that are examining the opportunities for greater decentralization, sharing common costs constitutes a strategic choice. Indeed, the profitability of the firm, the performance of the public institution, and the success of the desired partnership often depend on the quality of the cost-sharing rules they adopt.

This project will allow us to propose formulas that are appropriate for sharing the costs associated with building and maintaining complex infrastructures, and that will also improve the management of shared infrastructure and promote efficient partnerships. In addition, this project will contribute to developments in the scientific analysis of organizations and strategic behaviour, as well as of user fees and cost sharing. By translating these results into the specific context of shared infrastructure, we expect to contribute to increasing its value added and, by extension, fostering economic growth in Quebec, allowing our companies to acquire a competitive edge on international markets for shared infrastructure—markets that are expanding rapidly.

#### **Research Programming for 2001–2002**

- Write a series of technical and transfer reports on cost sharing methods
- Examine real options and cost sharing: Montréal's underground city

#### **Performance Measures in the New Economy**

##### ***The Issue***

Enhancing the value of shared infrastructures requires a precise and convincing estimate of their contribution to social well-being and business competitiveness. In this project we shall be particularly interested in the exact contribution of certain corporate infrastructures, such as human resources and information systems, and of certain

key operations, such as R&D and marketing, to growth.

The goal of this project is to provide appropriate performance indicators for the new economy, especially reflecting the propensity of technology firms to innovate. These could then serve as benchmarks for comparing different infrastructures. The researchers will establish yardsticks of performance covering various aspects of knowledge-based economies: indicators of innovation, international comparisons of obstacles to innovation, measures of e-commerce, the growth of emergent firms, and the governance of multinational firms.

E-commerce is experiencing phenomenal growth, and yet measures of its expansion remain very rudimentary. It is necessary to move far beyond simply counting the number of internet connections to measure the use of the information superhighway by individuals—but even more by firms for purchases, sales, real-time production, calls for tenders, inventory management, and for numerous other activities all along the value chain.

From another perspective, biotechnology and software firms are relatively new in Canada, and yet the growth of some companies in these sectors has already proven phenomenal. We notice, however, that this growth remains very uneven. On the basis of surveys of these companies it should be possible to examine the factors contributing to their success. Is it necessary, for example, to conduct R&D, to belong to strategic networks, to specialize in certain niches, or to make decisions in a certain order?

Finally, multinationals control 70 per cent of international trade, 60 per cent of direct foreign investment, and 30 per cent of global production. Our focus here will be to construct indices of business globalization allowing us to evaluate multinationals' corporate-governance practices and, by extension, the feasibility of regulating their location or employment and investment policies.

#### ***Research Programming for 2001–2002***

- Using data from the European Community Innovation Surveys for 1996 (CIS2), the researchers intend to study the link between R&D, innovation and productivity, and to re-estimate the returns to R&D in light of the information these surveys contain regarding yields to research, i.e. the sale of innovations
- Develop tools to measure e-commerce
- Construct indices of globalization
- Analyse factors contributing to the success of emergent firms

#### **Delegated Infrastructure Management and Public-Private Partnerships**

##### ***The Issue***

Until very recently, elected officials and managers had to measure the performance of public institutions using the same approaches as the private sector, despite the fact that municipalities, as well as higher orders of government, have unique features (monopoly, social activities, non-profit status, mission of improving residents' quality of life, etc.). In a project aimed at developing a system for measuring the performance of public institutions, CIRANO wishes to establish a new approach to this issue that will meet the requirements of elected representatives and managers in terms of reducing costs and increasing services to the population.

On one hand, this project deals with mechanisms and tools for managing infrastructures. The researchers intend to identify efficient incentive mechanisms for investment, development, maintenance, and renewal of infrastructures, as well as analysis grids for optimal regulation and governance. These tools will be based on an explicit model of stakeholders' imperfect and incomplete information structures, their ability to make credible commitments, uncertainties and risks inherent in technologies, and human behaviour and complex strategic interaction processes.

On the other hand, the system proposed by CIRANO is divided into four different measurement models to respond to the different information requirements of the stakeholders in public life. Thus, "Measures of Service" aims to determine the level of activity of civil servants in terms of both their financial aspects and the inputs and outputs produced. "Measures for Citizens" are designed to inform the population about the activities of public institutions. This information is handled at three levels: (1) how much do the services cost the population? (2) what is the level of satisfaction of the clientele? and (3) what impact do these services have on the population? Measuring the contribution these programs make to citizens' quality of life requires special approaches and indicators to ensure maximization of their satisfaction and responsiveness to their demands.

### ***Research Programming for 2001–2002***

- Elaborate tools for the management of infrastructures
- Pursue work on performance measures for the public sector
- Develop a framework for analysing public-private partnerships

### **Management of Natural Resources and the Environment**

#### ***The Issue***

Ecosystems are our most basic shared infrastructure. There can be no sustainable development without preservation, which can only be done efficiently, however, if each element of the ecosystem is “valued” accurately by economic agents. Economists frequently propose fiscal measures, rationing, and regulation as instruments for assigning a value to the environment. Several members of the Corporate Governance Group shall pursue work on this issue.

We will elaborate socially efficient mechanisms for public or private management of natural resources and the environment, with special emphasis on firms’ competitiveness.

### ***Research Programming for 2001–2002***

- Environmental regulation
- Organization of water management
- Real options and the environment
- Evaluation of biodiversity
- Decision support for decontaminating sites
- Establish tools for managing reservoirs in the presence of climactic and market uncertainty
- Institutional solutions for the valuation of brown fields

### **Real Options and Corporate Strategy**

#### ***The Issue***

Real options represent a true revolution in the strategic management of firms and organizations. Like financial options, real options capture the various choices decision makers have, under the right conditions, to modify their business and investment plans. These real options, again like financial options, provide an opportunity for managers to intervene without obligating them to do so. The value of these real options is attributable to the volatility of the real environment. In general, the worth of real options implicit in business plans, investment programs, and strategic plans is not known by managers when these plans are drawn up and implemented. Thus, an important contribution to the comparative evaluation of these plans is overlooked, which may lead to suboptimal choices. Explicitly accounting for and shaping real options constitutes a very important source of value added, since the flexibility they create allows for the “downside risk” inherent in plans to be controlled. To make informed choices that maximize the value of the firm, managers must explicitly consider their real options and evaluate them properly. This approach, which some consider a revolution in corporate management, is still essentially ignored by most firms, despite the fact that it has been adopted by several leading giants.

By definition, a business decision is considered strategic, precisely if there is no “going back” after its implementation. Thus, around the world many researchers are now rethinking corporate strategy in terms of the new theory of real options, which systematically broaches the issue of irreversible decisions in a context of uncertainty and learning.

### ***Research Programming for 2001–2002***

- Analyse corporations’ strategic decision-making using the theory of real options
- Develop models of real options for successive investments in alternative technologies
- Apply the theory of real options to the evaluation of factory portfolio decisions
- Elaborate models of real options for successive investments in alternative technologies. The treatment will be theoretical. However, since analytical solutions cannot be found, numerical solutions will be developed. Extensions to this project will include developing evaluation procedures applicable to factory

portfolios and projects within existing portfolios

## **LA GESTION DE LA FORCE DE VENTE**

### ***Problématique***

La force de vente est actuellement un ingrédient-clé de la compétitivité de l'entreprise, particulièrement dans les secteurs de la haute technologie. L'accélération de l'innovation, la versatilité des consommateurs et la concurrence internationale font toutefois de la vente une tâche de plus en plus complexe. Ce projet à la fois théorique et empirique a pour but d'identifier les éléments des systèmes de contrôle et de rémunération qui sont appropriés dans ce contexte. On évaluera aussi l'impact des nouvelles technologies de l'information sur le travail du gestionnaire de force de vente.

### **Le pôle GIR - gestion intégrée des risques**

La mesure et la prise en compte des risques associés à toute décision d'envergure sont devenues une étape incontournable du processus de décision des grandes organisations, publiques ou privées. L'imputabilité des décideurs exige de ceux-ci qu'ils procèdent désormais à un examen rigoureux de l'impact éventuel des décisions qu'ils sont appelés à prendre tant aux plans financier, environnemental, technologique et juridique qu'au plan de la santé de la population. Les avancées récentes en finance mathématique, en économie et en gestion ouvrent la voie au développement d'outils de mesure et de gestion de plus en plus sophistiqués. Mentionnons, à titre d'exemple, les développements spectaculaires dans le domaine de la valorisation des options et des contrats financiers, ceux dans le domaine des options réelles pour le développement et l'évaluation des stratégies d'entreprise et, enfin, dans les outils d'aide à la décision et les logiciels permettant d'intégrer des renseignements tant qualitatifs que quantitatifs dans l'analyse et la gestion des risques.

La gestion intégrée des risques vise donc le développement d'une approche globale de la gestion des risques d'affaires qui incorpore à la fois les aspects financiers, contractuels, technologiques, politiques, etc. Ce pôle comporte donc une importante interface avec le groupe «Finance». Ce dernier considère toutefois les risques comme exogènes, alors que nous nous concentrons sur les aspects endogènes (et souvent non assurables, non diversifiables) des risques d'affaires.

Dès son lancement, le projet portant sur la «Gestion intégrée des risques» s'est avéré être un pôle fédérateur, capable de mobiliser simultanément l'expertise de nombreux chercheurs du groupe «Design organisationnel et incitations», voire de chercheurs des quatre groupes représentés au CIRANO. En effet, la mise en branle d'une gestion proprement *intégrée* des risques dans l'entreprise requiert à la fois l'examen des stratégies de partage du risque, i.e. des choix de portefeuille et d'assurances, l'étude des risques contractuels, le repérage des facteurs de flexibilité et d'ajustement organisationnel, de même que l'inventaire des instruments de contrôle et de réduction des risques d'affaires. La gestion intégrée des risques suscite par ailleurs l'intérêt croissant de nombreux partenaires et du milieu universitaire en général.

### **Methodological Developments in IRM (Software and Analytical Grids)**

#### ***The Issue***

Tools permitting the quantification of different types of risk have evolved in various respects, building on methods developed in finance, insurance, engineering, computer science, medicine, economics, and project management. However, integrating these tools is much more difficult, and needs to be developed. Significant theoretical progress has already been made by researchers working on this need. These efforts have allowed us to identify the tools available for integration and to evaluate their limitations.

The proposed project will facilitate (1) further development of risk measurement and management tools, (2) exploration of the theoretical aspects of their integration, and (3) construction of a framework to render these theoretical elements operational. New methods, built into computer programs, will allow organizations to better evaluate and manage risks, and to do so in a more integrated fashion. In addition, since our work also examines risk-management processes, these methods and programs will also play an advisory role, suggesting risk management modes appropriate to each situation.

Creating this general decision-making aid requires a flexible architecture, allowing the integration of tools with very different structures. These tools can be viewed as a series of modules—each appropriate for a different type of risk. Some will be computerized, allowing for a more automated operation, while others will assume the form of grids or

protocols. Whatever their form, they will be linked to an integrating tool that will oversee the allocation of the information to these tools. This architecture has several advantages. First, it will permit each tool to conform to the unique features of its domain and to assume the most appropriate shape (computer program, procedure, method, etc.). It will, however, allow the sharing of information and integration across domains. Second, this open architecture will permit the addition of further modules in response to organizations' particular needs, so that modules can be selected that are relevant to the context of each organization. The modular structure also ensures the evolution of the tools. These tools will be able to support managers in their choice of risk management strategies. The proposed project aims to (1) build a shared structure allowing for the integration of risks, and (2) supply a series of concrete applications (the tools) using this structure.

#### ***Research Programming for 2001–2002***

- Write the computer programs
- Elaborate the analysis grids
- Implement integration platforms

#### **Use of Derivatives and Financial Contracts**

See the [Program of the Finance Group](#)

#### **Management of Major Technological Risks**

##### ***The Issue***

Major technological risks refer to potential damages associated with existing or new technological procedures, for example, the failure of complex engineering systems or the mismanagement of dangerous substances. The consequences of these occurrences are characterized by the following three fundamental elements: they are collective, they are difficult to measure, and they can last a long time. One phase will examine regulating risks with information.

Over the course of the coming year the researchers hope to analyse new types of major technological risks, particularly those associated with the expansion of networking of large sections of economic activity (especially computers), and with new biotechnologies (genetically modified organisms, cloning, etc.). The former raise unprecedented questions about correlations, domino effects, and cascading individual risks that even insurance companies are reluctant to manage. The latter introduce issues relating to (1) decision-making under extreme uncertainty, i.e. when it is impossible to even list the possible outcomes a priori (a necessary condition for standard probability calculations), and (2) maintaining the credibility of institutions responsible for managing this type of risk (as is illustrated by the "mad cow" problem in Europe).

The phase on regulating risks with information starts from the principle that public regulation of health and environmental risks increasingly involves keeping the public informed about possible dangers. In Quebec, specifically, a regulatory plan along these lines has been tabled, similar to a number of regulations enacted in the United States, such as the "Toxic Release Inventory," and the "Risk Management Program." Research beginning at CIRANO will attempt to understand the impact this type of regulation has on the organization and operation of the affected firms.

#### ***Research Programming for 2001–2002***

- Elaborate organizational and institutional methods to prevent, attenuate, and control traditional industrial risks (spills, explosions, fires) and new ones (computer system failures, biotechnological pollution).
- Organize a joint conference of CIRANO and the École Polytechnique de Paris on the theme "Organizing Appeals to Scientific Expertise in Situations of Uncertainty," to be held in Paris on January 10 and 11, 2002.

#### **Organizational Management of Hospital Risk**

##### ***The Issue***

Because of growing costs associated with mortality and the lengthening of hospital stays, the management of hospital-related risks has attracted increasing attention. The report "To Err is Human" by the Institute of Medicine,

published in November 1999, reveals that every year between 44,000 and 98,000 deaths may be caused by iatrogenic errors in short-term healthcare facilities in the United States. This report raises many questions concerning the sources of these accidents, organizational causes, preventive measures, etc.

We shall elaborate efficient organizational solutions to prevent and control the risks confronting hospital patients.

#### **Research Programming for 2001–2002**

- Measure hospital performance
- Examine incentives in the organization of hospital care
- Evaluate new medications
- Analyse new medical treatment techniques

#### **EXPERIMENTAL ANALYSIS**

Last year CIRANO established an experimental economics laboratory with financial assistance from Bell University Labs (BUL). In recent years experimental economics has become an important branch of economic research. Experimental economists have developed protocols to enable them to study how individuals make decisions of an economic nature in a laboratory-type environment.

Experimental economics permits the comparison of environments and institutions to evaluate their relative efficiency. This approach also provides a flexible platform on which new policies or new institutional or organizational “designs” can be tested without the need to incur the social and private costs that could arise in the absence of preliminary testing. It thus becomes possible to verify the implications of social policies or private management decisions without having to conduct costly “natural” experiments, which more often than not are put in place with parameters that are later recognized as poorly chosen or specified. This new tool of economists allows them to join the ranks of other research oriented disciplines, such as psychology, sociology, human resources management, etc., in a wide variety of applications touching decision-making by individuals, firms, institutions and governments. CIRANO’s experimental economics research laboratory aims to function as a meeting place for the different research Groups. It will seek financing both from these Groups and externally.

Several of CIRANO’s researchers are already involved with the laboratory and have expressed an interest in this approach.

#### **SAVINGS CONDITIONS AND THE WORKING POOR**

##### ***The Issue***

The Government of Canada is considering conducting a natural experiment along the following lines: Since the acquisition of assets, even more than income, alters mentalities, would motivating the working poor to save (by topping up the return to their savings, for example) increase their desire to invest in obtaining human capital that could eventually lead them and their families out of the cycle of generations of poverty? We have proposed studying this issue with experimental economics, rather than as an expensive natural experiment with an uncertain outcome.

#### **Research Programming for 2001–2002**

- Elaborate the experimental design
- Conduct experiments with the working poor
- Analyse the data
- Write a report

#### **IN-HOUSE TRAINING**

##### ***The Issue***

Econometric studies attempt to explain the supply of, and the demand for, training with variables reflecting characteristics of the workplace (size, number of competitors, turnover rate, etc.) and employees (age, profession, the level of education, etc.). These studies are essential for our understanding of the issue of in-house training.

However, despite the considerable effort represented by the momentous Workplace and Employee Survey, the scope of these studies remains limited. We shall always have difficulty obtaining information on certain relevant variables, such as those associated with firms' strategies or employees' characteristics, including their competence, motivation, and attitude towards risk. The interaction between the supply of, and the demand for, training is difficult to model. In addition, it is not obvious what economic policies can be based on these studies—especially in the case of new concepts in intervention or the implementation of new institutions. The natural experiment does not exist for these cases, and thus cannot be the object of an econometric evaluation: Experimental economics provides an interesting alternative approach. The main question we are interested in here is the study of barriers to the supply of, and demand for, in-house training, and the role that certification of the training can play.

#### ***Research Programming for 2001–2002***

- Analyse the barriers to in-house training
- Study the impact a certification system has on training

### **EXPERIMENTS IN MULTIPLE TASK PERFORMANCE**

#### ***The Issue***

Employers are often confronted with the challenge of ensuring that their employees perform duties that are specific to their jobs as well as those that benefit the entire staff. How can workers be motivated to perform both of these types of tasks when their compensation is generally only based on one of them? CIRANO researchers will develop an experimental protocol to test the hypothesis that a particular type of job audit would be effective for motivating workers to attend to company or team tasks.

#### ***Research Programming for 2001–2002***

- Develop an experimental protocol
- Conduct the experiments
- Analyse the results

### **MERGERS AND THE STRUCTURE OF COMPENSATION**

#### ***The Issue***

An increasing number of firms are merging in response to the globalization of the economy. Frequently it is the case that these companies' employees work under different compensation structures. How is the merger, which will impose a unified remuneration structure on the employees, lived by them? Is the new structure efficient? How can cooperation between the two groups of employees be ensured? An experimental design is currently in the works that will be used with the employees of two French pharmaceutical firms having recently merged. Student participants will also be used to explore other applications of the protocol.

#### ***Research Programming for 2001–2002***

- Pursue development of the experimental design
- Conduct experiments with the employees of the pharmaceutical firms
- Apply other variations of the protocol to students

### **WORKPLACE PRACTICES AND PHYSIO-PSYCHOLOGICAL MEASURES**

#### ***The Issue***

A letter of intent on workplace practices has been submitted to Valorisation-Recherche Québec by a team from CIRANO. The researchers in this team are not only from economics and psychology, but also from several related disciplines (political science and information technologies, among others) and can bring a considerable amount of additional clarity to implicit or explicit processes of conflict resolution and organizational restructuring, and to the impact of introducing new information and communications technologies into the workplace.

The goal of this team is to find effective strategies, i.e. practices that will be accepted by workers and will positively

impact on their productivity and job satisfaction. We know with certainty that private and public organizations are always on the lookout for these types of strategies. It is very plausible that we will eventually proceed to field studies, i.e. experiments conducted outside of the lab (and whose participants are not students) involving workers in their workplaces. Since the goal of effective workplace practices is to improve the productivity and the working conditions of the workforce, it seems reasonable to expect that firms will allow us to conduct this type of experiment to validate our laboratory results.

A substantial infrastructure request will be submitted to the Canadian Foundation for Innovation under the aegis of professor Ursula Hess of the Université du Québec à Montréal. One of the goals of this project will be to link studies of workplace practices using experimental economics with physio-psychological measurements. Four CIRANO researchers will be directly involved with this project.

## **EXPERIMENTAL ANALYSIS AND UNDERGROUND WORK**

### ***The Issue***

Underground work is of particular concern to governments because it represents a significant amount of foregone tax revenue. It is, however, difficult to conduct surveys on this issue: The truthfulness of the answers provided is not always obvious. Experimental economics opens an alternative path to researching this issue by, for example, confronting participants with fines and probabilities of getting caught if they chose to participate in work that allows them to evade taxes. Comparing behaviour observed in the experiments with answers to traditional questionnaires, we can also verify the validity of the latter. Finally, we may use experiments to study how the concept of a network affects the development of underground work in an economy. Meetings with the Ministère du Revenu du Québec are planned to discuss this approach.

## **OTHER DEVELOPMENT PROTOCOLS**

### ***The Issue***

- Auction game with entry fee: This game involves requiring an entry fee to participate in an English (ascending-price) auction. The game tests players' ability to analyse a sequential game, and in particular their ability to anticipate the perfect equilibrium that should be the final outcome. Repeating the game also allows us to evaluate their ability to learn. Subsequently, we can waive the entry fee as a control to compare the evolution of the price under a different mechanism. Contrasting this game with the classic auction will allow us to determine whether sunk costs have a psychological impact, ex post, on the players' behaviour.
- *Bargaining under asymmetric information: We propose a variation on the ultimatum game incorporating two essential modifications: (1) the first players' advantage is compromised by asymmetric information benefiting the responder, and (2) the game is repeated. We wish to measure how information is transmitted by this mechanism. We also wish to understand the "support" for negotiations when the rules are not specified a priori, and when negotiation is free.*
- *Voting on a tax to finance a public good: This game studies the tax system. We collect some money from each player and use it to finance a public good. Using the initial game without voting as a control, we can determine whether the players give as much proportionally for the collectivity as in the control game. If not, this would tend to indicate that taxes undermine the sense of responsibility—in fact, making players less cooperative.*