Industry Canada
Research Publications

CANADA IN THE 21ST CENTURY

II. RESOURCES AND TECHNOLOGY

LOOKING TO THE 21ST CENTURY — INFRASTRUCTURE INVESTMENTS FOR ECONOMIC GROWTH AND FOR THE WELFARE AND WELL-BEING OF CANADIANS

Paper Number 6
November 1998

Industry Canada Research Publications Program

The Industry Canada Research Publications Program provides a forum for the analysis of key micro-economic challenges in the Canadian economy and contributes to an informed public debate on these issues. Under the direction of the Micro-Economic Policy Analysis Branch, the Program's research paper series features peer-reviewed analytical working papers or policy-related discussion papers written by specialists on micro-economic issues of broad importance.

The views expressed in these papers do not necessarily reflect the views of Industry Canada or of the federal government

Industry Canada
Research Publications Program

CANADA IN THE 21ST CENTURY

II. RESOURCES AND TECHNOLOGY

LOOKING TO THE 21ST CENTURY — INFRASTRUCTURE INVESTMENTS FOR ECONOMIC GROWTH AND FOR THE WELFARE AND WELL-BEING OF CANADIANS

By Christian DeBresson, Université du Québec à Montréal, and Stéphanie Barker, Université de Montréal

Aussi disponible en français

Canadian Cataloguing in Publication Data

DeBresson, Chris.

Looking to the 21st Century – Infrastructure Investments for Economic Growth and for the Welfare and Well-Being of Canadians.

(Canada in the 21st Century. II. Resources and Technology)
Text in English and French on inverted pages.
Title on added t.p.: Visualiser le 21e siècle – Investissements en infrastructure pour la croissance économique, le bien-être et le mieux-être des Canadiens.
ISBN 0-662-63796-8
Cat. no. C21-27/2-1998-2

1. Economic Development – Canada.
2. Infrastructure (Economics) – Canada.
3. Canada – Economic conditions, 1991- .
4. Canada – Social conditions, 1991- .
5. Technological innovations – Canada.
6. Twenty-first century – Forecast.
I. Barker, Stéphanie.
II. Canada. Industry Canada, Micro-Economic Policy Analysis Branch
III. Title.
IV. Series: Canada in the 21st Century (II. Resources and Technology).

HC113.D42 1998 338.971'009051 C98-980329-5E

The list of titles available in the Research Publications Program and details on how to obtain copies can be found at the end of this document. Abstracts of research volumes and papers published in Industry Canada's various series, and the full text of our quarterly newsletter, *MICRO*, are available on *STRATEGIS*, the Department's online business information site, at: http://strategis.ic.gc.ca.

Comments should be addressed to:

Someshwar Rao
Director
Strategic Investment Analysis
Micro-Economic Policy Analysis
Industry Canada
5th Floor, West Tower
235 Queen Street
Ottawa, Ontario
K1A 0H5

Tel.: (613) 941-8187
Fax: (613) 991-1261
E-mail: rao.someshwar@ic.gc.ca

We cannot discuss the future seriously once the situation starts to become difficult, yet that is precisely the moment when we must discuss it. Otherwise we end up mired in propaganda, with an official future that prevents us from addressing the real problems.

Nicole Morgan
Le Sixième continent — L'Utopie de Thomas More
Paris: Vrin, 1996
quoted in *Le Devoir,* August 5, 1996, p. B1

Acknowledgments

We would like to thank Gregory Baum, Pierre Fortin, Johanne Bergeron, Philippe Gabrini, Maurice L'Abbé, François Chesnais, Anne Leluel, Roger Miller, Gilles St-Amant, Raymond Théorêt, Dimitri Roussolpoulos, Robert Dalpé, John Cotsomitis, Phil Hall, Marie-Pierre Ippersiel, Dan Séni, Luc-Normand Tellier and Miville Tremblay for sharing their ideas on this topic with us. While we have benefited from their insightful comments, we remain entirely responsible for the ideas expressed herein. We also thank Marie Rolland for proofreading and Geneviève Gabriel for preparing the figures.

Table of Contents

PREFACE

AS A NEW MILLENNIUM APPROACHES, Canadians are going through a time of dramatic economic change. Markets are becoming global and economic activity across nations is becoming increasingly integrated. Revolutionary developments in computer and communications technology are facilitating globalization, and are also altering a great deal the workplace and the lifestyles of Canadians. At the same time, largely as a consequence of the information revolution, knowledge-based activities are becoming increasingly important within the Canadian economy and the economies of other industrialized nations.

These and related major transformations of the economic environment invite a comparison with the Industrial Revolution of the 1800s. As in the earlier time, major structural changes are giving rise to uncertainties. Firms and workers are struggling to find their place in the new economic order. Canadians collectively face the question of whether their nation's physical, human and institutional resources will provide a firm foundation for continued prosperity. Many see Canada's prospects as being much less secure than in earlier years, when the country's rich natural resources played a major role in shaping the Canadian economy.

To examine fully the medium to longer-term opportunities and challenges of these developments, the Micro-Economic Policy Analysis Branch of Industry Canada asked a group of experts to provide their "vision" for Canada in the 21st Century on a number of important issues. Each author was required to undertake two formidable tasks: first, to identify major historical trends and develop scenarios to illustrate how developments in his/her respective area might unfold over the next ten to fifteen years; and second, to examine the medium-term consequences of these developments for the Canadian economy.

The papers coming out of this exercise are now being published under the general heading of "Canada in the 21st Century". This series consists of eleven papers on different aspects of Canada's medium-term outlook. The papers are divided into three major sections. The first section, *Scene Setting*, focuses on important developments that are going to shape the medium-term economic environment in Canada. The second section, *Resources and Technology*, looks at trends among some important components of Canada's wealth creation and considers the actions needed to ensure that these factors provide a firm foundation for continued prosperity. The last section, *Responding to the Challenges*, explores individual, corporate and government responses to the medium-term challenges and offers some options for appropriate course of action.

As part of the *Resources and Technology* section, this paper by Professor Christian DeBresson of Université du Québec à Montréal and Stéphanie Barker of Université de Montréal, focuses on identifying promising long-term infrastructure investment opportunities. The authors highlight a number of important long-term trends. These include: the increasing importance of

knowledge-based learning activities; the more modest pace of economic growth in Canada and other advanced industrial economies; the emergence of Asia as the new centre of world economic growth; and the worsening of global environmental problems.

On the basis of these trends, the authors develop a list of promising infrastructure projects centred on four objectives. The first is to increase Canada's participation in the global learning economy – for example, through investments in preschool learning, programs to enhance secondary school performance, and the development of Internet tools and applications. The second objective is to build trust between economic actors through local institutions, which would evaluate major proposed projects and make the results available to citizens of affected communities. The third objective is to improve the quality of life and the environment, perhaps by promoting the use of electric vehicles within cities and introducing urban recycling programs. The fourth is to reposition Canada in the world economy by establishing multidisciplinary centres of excellence in research on global economic and social issues.

SUMMARY

THIS PAPER PROPOSES INFRASTRUCTURE INVESTMENTS in the following areas:

- Preschool education.
- Experimental programs of excellence to reduce the high-school drop-out rate.
- Two institutes for teaching modern foreign languages.
- Research into possible Internet applications, particularly the evaluation of possible interactivity.
- Development of technology monitoring networks.
- Development of local forums to evaluate technology.
- Gradual replacement of fossil fuels by electricity in urban and inter-city transportation, recycling and water clean-up.
- Overhaul of infrastructure in city centres and neighbourhoods.
- Relational investment aimed at reducing transaction costs between partners in these infrastructure projects.

Given public sector deficits, these investments must be financed by the private sector. Any additional public borrowing would only serve to increase our vulnerability to financial crises. As in the 19th Century, the three levels of government must promote and support public-private partnerships for such projects, and must first involve potential users. The *subsidiarity* principle must guide the management of these infrastructure initiatives.

Infrastructure choices focus on four goals:

1. Increase our participation in the knowledge-based economy.
2. Establish and maintain a climate of trust.
3. Improve the quality of life and the environment.
4. Reposition Canada within the world economy.

Ten major irreversible trends dictate the choice of those objectives:

- The increasing dominance of the knowledge-based economy.
- The search for well-being as the driving force within our economies.
- Asia as the new centre of the global economy and economic growth.
- The worsening environmental crisis.
- The gradual replacement of competitive zero-sum games with emulative, positive-sum games.
- The increasingly heavy transaction costs imposed by the innovation economy — which can be reduced only through mutual trust between players.
- The downsizing of all forms of organizations, including governments.

- The accelerating pace of technological change.
- Globalization, which proceeds in tandem with the revived role of large urban agglomerations.
- The dominance of the volatile international financial sector.

Canada's position is evaluated in light of each one of these trends. We develop extreme scenarios, analyse their interactions, and project the reactions of the various actors. This makes it possible to define more precisely the critical points as well as the relevant means of action. The paper pays special attention to the revival of various types of communities, particularly those based on mutual trust between their members.

INTRODUCTION[1]

WE ARE HONOURED THAT OUR VISION OF CANADA'S FUTURE is of interest and welcome the opportunity to explain it. It does not often happen that elected representatives, who think and plan within the time frame of an electoral mandate, turn to people who work in a more relevant perspective — the long term.

Infrastructure investment decisions concern the future of our children and our children's children. While assessing the economic benefits of infrastructure investment can be difficult,[2] Robert Heilbroner urges that the issue be considered at a higher level:

> *The collective efficiency … [of] an economy cannot exceed [the limits] of its infrastructure*.[3]

The state of the infrastructure defines what economists call the frontier of possibilities in collective production. Like all capital investment, infrastructure investment logically precedes production activity. Capital investment is needed for private production; infrastructure is required for economic exchanges and transactions between economic agents, and hence for the very functioning of society.

The impact of infrastructure investment may be evident only to the next generation; the effects are often indirect and difficult to predict.[4] It has been recognized since the work of Nicolai Kondratieff (1922, 1984)[5] that infrastructure investment tends to be massive, indivisible and concentrated in time,[6] with the economic impact visible only in the long run (although it is impossible to give a precise number of years).[7] It is often the ancillary, complementary investments following initial large commitments that make infrastructure efficient.[8] In our opinion, despite experiments in cost-earnings analysis, it is impossible to make a priori assessments of the relative value of infrastructure investments, just as it impossible to predict from the first application of an innovation whether or not it will be a radical innovation.[9] It is also impossible to predict a priori whether the initial investment in infrastructure will be followed by the additional investments required to receive all the economic benefits. The economic impact, in terms of infrastructure benefit and other benefits, is felt long after the original investment. We shall see later that this is the current situation with the Internet.

We welcome this opportunity to suggest some directions for future social choices, while adopting a time horizon that allows us to take into account infrastructure investments; these must be considered in a long-term perspective.

We appreciate and accept the challenge, although with some trepidation. Our judgment, informed as it is, is necessarily subjective. Yet any choice regarding infrastructure is partially subjective. One must put forward a *vision* of how our particular part of the world can be made a better place — what the Greeks

called *œtopia* — because infrastructure choices always reflect the desired shape of future society. Thus we acknowledge that our choices are associated with a subjective social and ecological vision. There are two dangers in such an exercise, however: first, the danger of being carried away by optimism to unrealistic conclusions (what Thomas More called *utopia* — the non-place); and then the danger of sinking into excessive pessimism, overwhelmed by the year 2000 apocalypse syndrome that is so prevalent today, seeing nothing but problems and perils.

We shall try to avoid these pitfalls, first by identifying 10 trends that we believe are irreversible, in order to see where Canada stands in relation to them. Second, we shall identify the greatest uncertainties about the future and examine the most extreme scenarios connected with them. Third, we shall suggest the probable reactions of the main actors in the face of these extreme situations. Fourth and last, we shall discuss where, when and how society's choices about long-term investment can improve the opportunities of future generations. Our approach is not purely economic, but also social and cultural. In such a document, however, we can do no more than list a series of infrastructure investments and make some guesses about their effects; to try to estimate precisely the scale of their impact and their costs would be to conjure up fantasies. Our ultimate aim is simply to promote reflection and debate.

Some Irreversible Trends

Certain trends are unlikely to be reversible. Their direction cannot be altered by future economic and political choices, although their extent and speed may be influenced. Canada can only prepare to adjust its choices and its actions in accordance with these trends, in order to derive as much benefit as possible. In our opinion, the following are the most important trends.

Trend 1: The growing dominance of the "knowledge-based economy"[10]

An ever-greater part of human activity is being devoted not to the production of goods using tools and other devices but to the design and preparation of these goods. This trend has accelerated since the Second World War, as evidenced by the growing proportion of highly educated workers in the labour market. At the same time, just as the life cycle of products has shortened, it is not uncommon to see workers benefit during their lifetime from several (often two or three) periods of training.

Services and investment in immaterial and intangible products account for a growing share of economic activity, while the share of material goods has lessened (OECD, 1996).[11] For example, human knowledge and know-how, encoded and transcribed into computer software, have rapidly surpassed computer hardware in importance. The focus of economic activity is shifting from the use of production inputs in as efficient a way as possible to the creation of new inputs, and from the exploitation of comparative advantages to the creation of new advantages.

What does this imply for infrastructure development? There will be a shift away from investment aimed at supporting the exchange of goods (transportation) and information (communications), and toward investment in the exchange and creation of knowledge (education, training, relations and technology). In terms of communications infrastructure, Canada is doing well (see Figures 1-A and 1-B). In a political climate where the actions of nations-states are increasingly perceived as protectionist and anti-competitive, infrastructure investments in public and non-competitive goods have become acceptable political objectives (World Bank 1994, Tassey 1992).[12]

In terms of the knowledge-based economy, Canada's position has improved over the past 10 years, particularly within the NAFTA and in comparison with the United States. However, recessions, debt and budgetary constraints threaten this progress, which is in fact tentative. While the institutional infrastructure for the knowledge-based economy is already in place (although not being used to full capacity), it should be strengthened so that Canadians derive maximum benefit from it.

FIGURE 1A

INFRASTRUCTURE INVESTMENTS BY THE THREE LEVELS OF GOVERNMENT, 1956-93

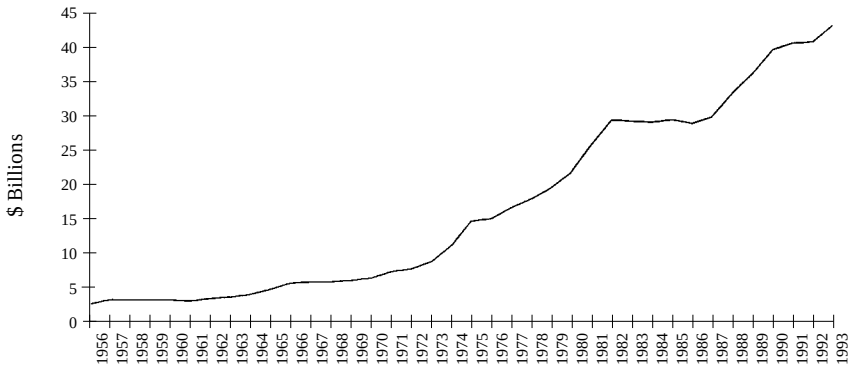
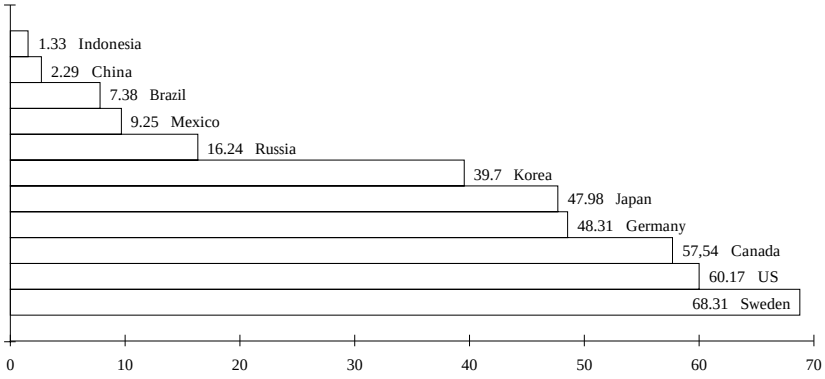


FIGURE 1B

NUMBER OF TELEPHONE LINES PER 100 RESIDENTS, 1994



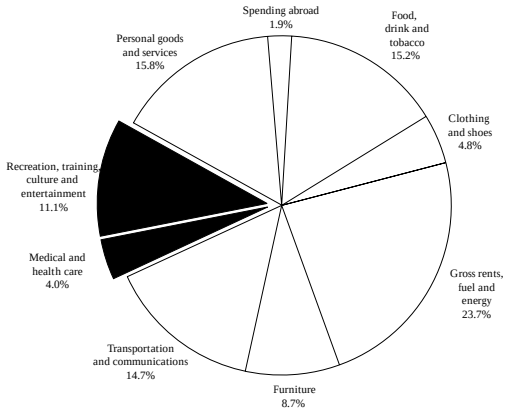
TREND 2: FROM THE ACQUISITION OF CONSUMER GOODS TO THE SEARCH FOR WELL-BEING

CONSUMERS IN THE ADVANCED INDUSTRIALIZED COUNTRIES (AICs) are devoting an increasing share of their incomes to the purchase of intangible goods and services, such as recreation, tourism, education or health care, where quality is more important than quantity (see Figure 2). For a substantial proportion of the population in these rich countries, the underlying reason for this shift in consumer behaviour is the search for a better quality of life, for well-being.[13] The reason rich countries are spending a smaller share of their income on the acquisition of durable consumer goods than they did 50 years ago is simply that they have enough: the marginal satisfaction derived from additional acquisitions is falling. We have moved from an "acquisition" economy to an "abundance" or "saturation" economy.

The shift is partly recorded in the reports of the United Nations Development Programme (UNDP).[14] For rich countries, this means that the thrust of urban and environmental infrastructure investment will have to change.

FIGURE 2

PERCENTAGE DISTRIBUTION OF PERSONAL EXPENDITURES ON CONSUMER GOODS AND SERVICES, PER CAPITA, 1992
1986 DOLLARS



The Scandinavian countries have involved all segments of society in this new type of economic activity driven by a search for well-being. In Canada, as in the United States, we find a bipolar model of consumption. A large part of the population consists of people with stable jobs, who are following or even ahead of the shift in expenditures toward well-being. However, another large segment of the population consists of those with precarious incomes, particularly in Newfoundland, the Maritimes, eastern Quebec, east Montreal and other depressed farming or industrial areas; such people continue to devote most of their meagre income to housing and food, and they continue to struggle with lack of schooling and high social alienation. An endemic high rate of unemployment, long periods of seasonal unemployment, a high proportion of young people outside the labour market, a high crime rate linked to the world's third highest level of drug abuse, and a suicide rate dangerously close to the world average — these indicators show that Canada has allowed the formation of an urban underclass largely excluded from economic activity.[15] Without growth or job creation, economic polarization of this kind seems very difficult to combat except through radical change.

Global economic growth is concentrated in the large newly industrialized countries (NICs) of East and South Asia (China, Indonesia and India). These populations are striving to better their material conditions by purchasing durable consumer goods, which triggers the attendant income multiplier and capital accelerator effects. In these regions, the main focus of infrastructure investment remains transportation, irrigation and energy. Elsewhere, in Africa, part of Asia and Latin America, one third of the world's population is still on the threshold of absolute poverty, struggling for basic subsistence while the minimal economic entitlements needed to benefit from a market economy slip ever further from their grasp.[16] In subsistence economies, basic needs such as housing, water and sewage, schools and hygiene must take precedence in infrastructure development initiatives.

All recent international studies agree that the gaps between these three types of economy are widening. The last two trends point to an important conclusion: it is unrealistic to expect economic growth more than a few percentage points higher than that currently found in advanced industrialized countries such as Canada.[17] We must accept that the 30 years of solid growth following the Second World War are a thing of the past, and we must lower our expectations. The challenge now is to determine the conditions that will best promote the modest growth of our economy, and that will enable all its members to share in the collective well-being.

Two phenomena lie at the root of this situation. First, there is the irreversible drift of the economies of the AICs away from the Keynesian model, which is characterized by a demand for durable consumer goods. These economies can no longer generate growth by manipulating demand, because expenditures on intangibles — which account for a growing share of household spending — do not have the local income multiplier and capital accelerator

effects to support rapid growth. Today, our economy's internal structure does not require and cannot support such growth.[18] The second phenomenon manifests itself as our third irreversible trend.

TREND 3: ASIA, THE NEW CENTRE OF THE WORLD ECONOMY

THE RAPID ECONOMIC GROWTH that will characterize the next historical cycle will centre on the NICs, particularly those in Asia (China, Indonesia, India and a number of smaller countries). With the exception of the Philippines and Burma, over the past 20 years all the countries of Asia have experienced rapid growth — in some cases on the order of over 10 percent annually, often on a continuing basis. Growth of this kind displays the classic signs of a genuine economic takeoff. Just yesterday, these were subsistence economies struggling with famine and epidemics. Today, they enjoy strong income growth, burgeoning consumer spending on locally made durable goods (with the associated income multiplier and capital accelerator effects), strong savings, and high industrial investment rates (particularly in infrastructure).

East Asia benefits from two positive factors. First, its population, educated and efficiently trained, offers a large, relatively cheap pool of human capital. Its education infrastructure is thus a key asset for maintaining industrial growth in the new knowledge-based economy. Second, it is geographically close to the new technological dynamo of the world economy — Japan. This country is not only the second-greatest industrial power in the world but it must invest abroad a good part of its enormous financial reserves to prevent its own economy from overheating. The East Asian countries also share a cultural homogeneity unknown to the countries of South Asia (India, Indonesia and even Pakistan, struggling with bitter ethnic tensions).

The lack of security agreements in Asia, however, could slow the region's rise to economic prominence. Peace and war are maintained in a delicate balance by a number of factors, including ethnic and religious tension, pressures related to natural resources, and U.S. foreign policy on advanced arms sales to rival powers. Nevertheless, assuming no major armed conflicts, the economic domination of Asia appears certain over the next century.

At the same time, it must be acknowledged — not without regret, since we too are North Americans[19] — that the United States and North America as a whole are facing economic decline. While the pace of U.S. decline is a matter of debate, the trend is irreversible in light of the external factors just described and because of internal vicious circles. For instance, the collapse of the public school system and the high drop-out rate have resulted in a significant degree of functional illiteracy. The system for maintaining the level of human capital — which is necessary for maintaining economic prosperity — is in grave trouble. While U.S. universities retain their hegemony,[20] increasing numbers of their professors and researchers are recent immigrants. Yet research and teaching no longer attract the best brains in the United States.[21] The sys-

tem for replenishing human capital, which is vital for economic prosperity, has broken down.

Like education, other types of infrastructure are, in a deplorable state. In 1990 the U.S. Department of Transportation produced cost estimates of urgent infrastructure projects: $50 billion to repair 240 000 bridges; $315 billion to bring road quality up to 1983 levels; $25 billion for air traffic control. Also, the U.S. Department of Housing and Urban Development estimated the cost of rehabilitating existing public housing at $20 billion and the annual cost of repairs and maintenance at between $60 and $118 billion.[22] Several economists had hoped that, with the end of the Cold War and the fall of the Soviet Union, the United States might seize the opportunity to spend its "peace dividend" on infrastructure investment, but there are few concrete signs that it will do so.

Two factors are triggering a phenomenal rise in transaction costs (the magnitude of which will be discussed under Trend 6): the lack of cohesion among the various ethnic and social groups within American society and the predominance of a culture of acquisitive individualism that favours settling every possible conflict through litigation. The "social glue" (to use Douglas North's expression) is starting to deteriorate; as a result, on one side we have the social decline of a very large number of people, while on the other side the well-to-do retreat into fortified encampments, paying growing portions of their income directly or through taxes to maintain an increasingly fragile "public order." The combination of these factors suggests that the economic decline of the United States is irreversible.

How much benefit Canadians can derive from the global economic growth will depend on their ability to capitalize on the possibilities offered by Asian growth and (unfortunately) by the decline of U.S. economic might,[23] while gradually reducing Canada's dependence on the North American market. A major factor will be Canada's exports of knowledge-intensive goods and service to Asian countries.

These trends have some direct implications for infrastructure. Our institutions (trade, transportation and education, particularly language teaching) are all oriented toward relations with the United States, the United Kingdom, France and, to a lesser degree, other European countries. We do not have the infrastructure needed to benefit from the new economic powers emerging in Asia. Substantial infrastructure investment will be necessary in this area.

Continued strong economic growth in the NICs will depend partly on their skill and success in solving the problem that countries now on the decline have left to them: the precarious global environment.[24] This means that sustained economic growth is by no means a certainty, even in new regions of the world.

TREND 4: THE LOOMING ENVIRONMENTAL CRISIS

ONLY IN THE LAST 10 YEARS or so have ecologists started to grasp how human activity affects — and sometimes paralyses or even reverses — the self-regulating feedback loops of natural systems. Think of the following cases: the thinning of the ozone layer as a result of CFC emissions; global warming (the greenhouse effect) as a result of CO2 emissions; acid rain resulting from a wide range of pollutant emissions; soil depletion resulting from agricultural and industrial exploitation and the use of chemicals (particularly pesticides and fertilizers), and so on. Ecology is a relatively young science and researchers will probably find other natural and human-caused vicious cycles as they pursue their investigations. Concern about the sustainability of ecological systems is still a recent phenomenon, and it is a good bet that new problems will be discovered once the issue receives more attention.

Sustainability has been an objective and a priority for at least 10 years in countries whose relative economic comfort allows them to adopt a long-term perspective. Consumers searching for a better quality of life would prefer — and are now demanding — the closure of polluting industrial facilities (such as nuclear plants), the replacement of polluting technologies (such as those that use CFCs and fossil fuels), clean-up programs for rivers and lakes, and so on. Nevertheless, we should not assume that economic activity will evolve in the direction of environmentally sustainable growth simply because of the apparent official consensus on the need for such an approach in the advanced industrialized countries. While the quest for well-being in the AICs promotes this movement, in the Third World the search for economic security and welfare works to opposite effect.

In countries where famine and disease are endemic, the only priority is each family's daily struggle to survive. Any restriction imposed by the industrialized world on the use of natural resources to support this subsistence economy immediately encounters virulent (and quite legitimate) opposition, unless financial compensation is offered in return. In countries where economic growth is just taking off (such as China or Indonesia), the engine of growth is the quest for economic comfort through the acquisition of durable consumer goods; the resulting growth is the primary source, directly and indirectly, of industrial pollution. Unless the countries wishing to promote sustainable development act in partnership with the newly industrialized countries to invest, develop and distribute technologies that are clean, cheap and economically advantageous (in other words, technologies capable of satisfying the NICs' thirst for growth and comfort), global sustainable growth is an unlikely prospect. While the co-operative development of clean technologies (at least in prototype form) would seem a realistic goal in the medium term, there is less likelihood that this will also be true of the development and dissemination of technologies that are *cheap, economically advantageous and sustainable*. Sustainable growth faces a highly uncertain future.

The environmental dangers so far identified already imply considerable outlays for infrastructure in Canada. Despite its relatively small population and industrial base, Canada ranks fifth or sixth in the world in absolute CO2 emissions.[25] In 1990 this country was the world's fourth-largest sulphur dioxide and nitrogen dioxide polluter, again in absolute terms.[26] In terms of per-capita greenhouse gas emissions, Canada stood fourth in the world in 1991.[27] And above all, Canada is one of the world's largest producers by volume of nuclear and other hazardous wastes.[28] Despite considerable efforts since the 1970s to combat industrial pollution, one of North America's assets — the key natural resource of water[29] — remains poorly protected. We have a long way to go in order to ensure that the water in our lakes and rivers can serve multiple uses. Moreover, Canada recycles very little of its reusable resources.[30]

The media and the country's politicians have trumpeted loud and long Canada's top ranking under the UNDP's composite index for life expectancy, educational level and income.[31] This has served to distract attention from the country's generally poor showing on environmental issues and its only fair rating on a range of social problems (unemployment, drug use, school drop-out rate, etc.). All these areas require infrastructure investment, but we must also provide for resources to be used for environmental problems that as yet are unrecognized.

Let us now examine the *qualitative* consequences of the first four trends.

TREND 5: FROM A COMPETITIVE ZERO-SUM GAME TO AN EMULATIVE POSITIVE-SUM GAME

ECONOMIC ACTIVITY IS SHIFTING from the production and exchange of tangible goods to the supply of services, where new knowledge is created by the provider of the service while the customer/user consumes it. In a knowledge-creation economy, we can move from a "zero-sum game" (*If you make it, I won't*) to an emulative, co-operative "positive-sum game" (*If I share my knowledge with you, I still keep it and it will not be lost in the process*). The co-operation of different technical players is becoming increasingly important. More than ever, collaboration is becoming a crucial factor in the creation of value.

In a zero-sum game, there is no real incentive for the actors to co-operate. One actor will make a move (quite aware that the other may retaliate) to derive maximum benefit from a situation in which the interests are inherently antagonistic.[32] This is not the case in a learning-based economy, since knowledge is not an object of competition but rather of emulation. Unlike the situation with a tangible good, *I can share my knowledge with you without losing it along the way*. Knowledge is inexhaustible; using it does not deplete it, but rather refines it. Moreover, the interaction between partners who share their respective knowledge often leads to the creation of new knowledge that would never have been generated in isolation. This kind of synergy is an emergent property of a co-operative system.[33] The mathematical analogy best illustrating this idea

TABLE 1
A GAINS TABLE FOR A ZERO-SUM GAME, SHOWING THE BENEFITS (HERE, PERCENTAGE SHARES) OF COMPETITION OF THE TYPE "I WIN, YOU LOSE; I PRODUCE OR YOU PRODUCE"

First actor	Second actor	
	Cooperates	Doesn't cooperate
Cooperates	50 50	65 35
Doesn't cooperate	30 70	40 60

TABLE 2

A GAINS TABLE FOR A POSITIVE SUM GAME ("STAG GAME"), SHOWING THE BENEFITS (HERE, ACQUIRED KNOWLEDGE) OF COMPETITION OF THE TYPE "WE ALL WIN MORE WHEN WE WORK TOGETHER"

First actor	Second actor	
	Cooperates	Doesn't cooperate
Cooperates	original + joint creation original + joint creation	original + transfer original
Doesn't cooperate	original	original

is perhaps that of the hunting party: it is in the interest of the hunters to co-operate in beating the woods in order to capture a choice deer (the "stag game").

Competition is turning into emulation. The drive to win does not necessarily mean shutting out the other, but creates a model for the loser of the contest to emulate. The creation of new technical knowledge through innovation often requires co-operation among economic actors. Innovation is impossible without co-operation.[35] The learning that results is *interactive*.[36] Innovation and the creation of new technical knowledge are emergent properties of a systematic relationship between companies; if they do not co-operate, no innovation and no new knowledge are produced. The newly created knowledge surpasses the simple transfer of the original knowledge.[37] When they start co-operating, the partners do not, generally speaking, consider that they may end up creating new techniques. While the co-operative aspect of the production and trade of

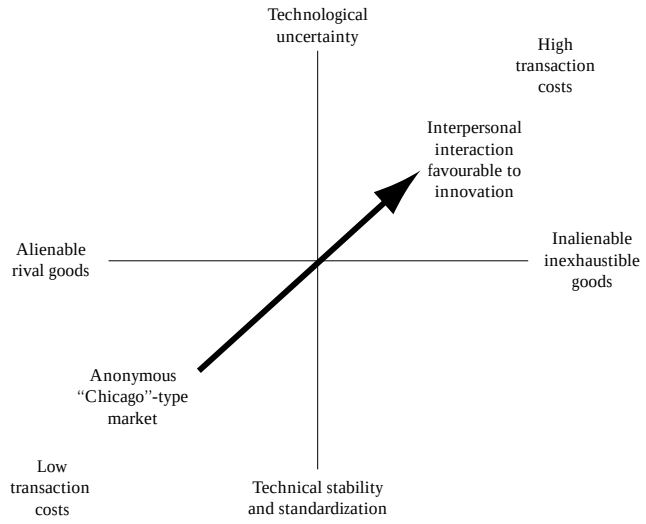
goods in a free-trade system is the *ex post* result of following common trade rules, co-operation becomes the essential *ex ante* prerequisite for the learning process — something without which the process cannot be initiated.

Canada's performance in terms of co-operation, while still uncertain or even weak, is improving. Some metropolitan areas (for example, Montreal, Ottawa, and other cities in southeastern Ontario) and certain industries (for example, forestry, pulp and paper, electronics and telecommunications) have a tradition of co-operation, but in Canada as a whole, the picture is not encouraging. There are few institutions working toward developing this kind of co-operation in Canada compared with Japan, Korea, Italy, Scandinavia and the Netherlands. True, we are doing better than the United States, but this is not saying much.

TREND 6: AN ECONOMY WITH HIGH TRANSACTION COSTS

OVER THE PAST 10 YEARS, it has become increasingly clear that firms no longer compete individually but rather as part of internally co-operative networks of firms. As the pace of introduction of new products has increased, these networks have probably expanded. The network phenomenon leads to greater co-ordination of activities and to more transactions taking place outside the market. Figure 3 shows the transition to an economy with high transaction costs.[38]

FIGURE 3



With the accelerating pace of change in products and technologies, the economy is moving from the zone of low transaction costs to a zone of high transaction costs. While these costs are considered to be quite low in Japan, Douglas North (a recent winner of the Nobel Prize for economics) judges that in the United States transaction costs already account for at least 45 percent of economic costs.

> *One can think of transaction costs as all those costs incurred in operating an economic (market) system.… The more complex an economy, the more individuals will be engaged in co-ordinating and operating that system. So it is not surprising that the transaction sector … in the American economy in 1970 was 45% of GNP.*[39]

The best type of economy — one rich in innovation — necessarily has high transaction costs. We are not referring to the cost of traditional inputs (labour, natural resources and capital), but rather to *relational costs* or the cost of *social interaction* prior to signing a market contract. In the short run, economic organizations try to lower their highest costs. The new focus of competitiveness, however, will be reducing transaction costs, since they have become the primary source of cost. Any factor that can reduce transaction costs becomes that much more important.

What is important is not reducing transaction costs in absolute terms, however. Only an economy with standardized goods and unchanging technology can have low transaction costs. The lower left quadrant of Figure 3 has low transaction costs because the buyer knows exactly what he is getting. Innovation inevitably involves higher transaction costs. Since they cannot be avoided, the key is to ensure that the value created largely offsets the additional costs involved.

Transaction costs can be reduced through factors that facilitate negotiation, that reduce the need to monitor the implementation of agreements, that simplify co-ordination arrangements in organizations, and that promote communication and understanding. The most important factor is undoubtedly mutual trust.[40] This means trust in the rules of the game (or in what Douglas North calls the institutions), trust that other parties will adhere to the implicit and explicit rules, and trust that the other parties are working for the good of the group and will not seize opportunities for immediate personal gain at one's expense.

Trust is a multi-dimensional phenomenon. When focussed on a specific goal, trust can be based on mutual commitment. However, the foundation of trust is often common membership in a community. A community is different from a market in that it forges multi-dimensional links among its members, while a market links two parties by and for a single transaction with an operational goal. In an anonymous market, traders do not necessarily know or even come in contact with each other, whereas the establishment and maintenance

of trust requires interpersonal contact. In light of inevitably rising transaction costs, we believe that communities and long-term co-operative relationships will enjoy a major revival. Their ability to facilitate trust-based commitments offers an efficient way to reduce transaction costs.

Over the past decade, bitter recriminations have been levelled at "Japan Inc." and even at "Quebec Inc." The Japanese retort that their population has proportionately as many engineers as the Americans have lawyers, perhaps reflecting the fact that they have an efficient system of co-operation, while in the United States a culture of litigation inflates transaction costs.[41] Despite some clear cases of collusion and exclusion on the part of "Japan Inc." and "Quebec Inc.," we must accept that it is not only economically logical but also more efficient, faster, less costly and less uncertain to co-ordinate activities with people of the same language and culture who understand the same implicit and explicit rules than with people from other traditions.[42] One of the advantages of Silicon Valley over Route 128 around Boston is the state of development and dynamism of its social network and clubs.[43] Nothing in this behaviour can be construed as fundamentally protectionist, and such a diversity of cultures is in fact a prerequisite to the mutual gains flowing from free trade in goods and services.

In a learning-based, innovative economy, anonymous markets (where buyers and sellers do not know each other and do not negotiate face to face) are losing ground to markets with personal contact; fairs and ongoing trade shows are experiencing a revival. Making a comeback are the old guild neighbourhoods of the medieval towns and the marketplaces of towns in the Industrial Revolution, where people from outside knew they could obtain specific goods and services. These are what Alfred Marshall calls new "industrial districts." Their success is based on strong multi-dimensional links and an abundance of trust. Rising transaction costs also lead to the downsizing of units taking part in trade, in parallel with the new domination of economies of scope versus economies of scale.

Canada does not seem to be particularly competitive in terms of transaction costs. While the centres of innovations around Toronto, Montreal, Ottawa and Vancouver seem to have made effective use of the dense social networks that reduce transaction costs, the level of trust between business communities remains fairly low. While Canada does appear to be in a fairly good position in comparison with the United States, its position is not so good relative to the Scandinavian countries and even to Italy, still less to Japan and Korea. Perhaps a commitment to a common infrastructure project (such as a high-speed rail system linking Quebec, Ontario and the U.S. northeast) would help build the trust needed to compete efficiently in terms of transaction costs.

TREND 7: DOWNSIZING

AS OTHER AUTHORS EXAMINE DOWNSIZING, we shall discuss it only briefly here. The increased costs of internal co-ordination (the internal equivalent of market transaction costs) is leading to downsizing in all organizations. Further, the need for flexibility and economies of scope to ensure the rapid turnover of products leads to a reduction in the size of production units and manufacturing facilities within organizations.

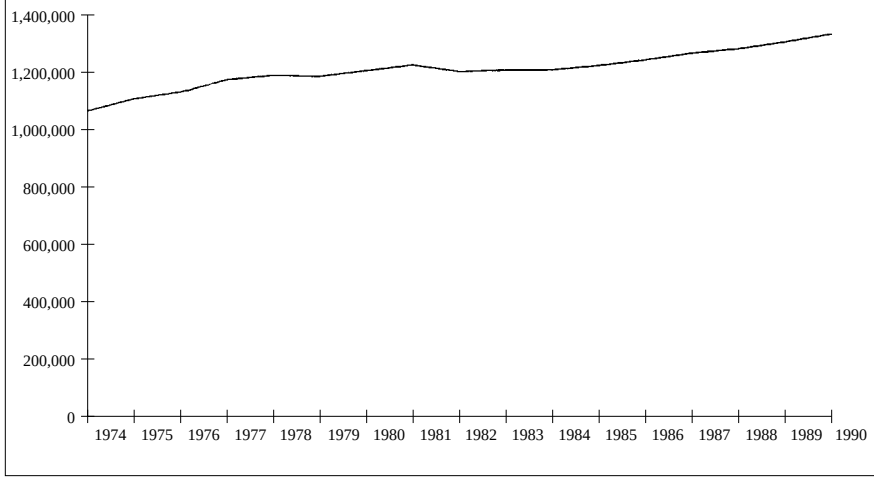
In a "saturation economy" that is increasingly oriented toward well-being and services, a direct and personal relationship between customer and supplier is once again becoming an essential prerequisite to economic activity. After a half-century dominated by the mass production of standardized items considered identical and banal, we are returning to customized or small-run production and to specialized services.

This trend should eventually spread to governments and nation-states. Despite the strong push for downsizing and restructuring in government organizations, Canadian governments still seem to have a long way to go in that regard (see Figure 4).

Downsizing is accompanied by another trend: delegating the same administrative task to several decentralized units of smaller size. The reduction in the average size of nation states is a worldwide phenomenon that cannot be attributed to historical coincidence; it can be interpreted as an attempt to reduce co-ordination costs.

FIGURE 4

TOTAL NUMBER OF FEDERAL, PROVINCIAL AND MUNICIPAL GOVERNMENT EMPLOYEES, 1974-90



In this regard, Canada is faring poorly. Even though production units have been scaled down (on the model of custom or reduced-run producers[44]), Canada's industries are more often vertically integrated than their competitors; the pulp and paper industry is a good example. In addition, its manufacturing and banking firms are heavy and inflexible. Canada must also cope with a population that is geographically dispersed, something that poses considerable administrative challenges. While the downsizing trend does not appear to have reached Canadian institutions yet, they will eventually have to adapt, voluntarily or not. This eventuality will necessarily involve vertical disintegration and the decentralization of operations, as well as a devolution of power and authority to autonomous units in order to ensure that existing infrastructure is used more efficiently.

TREND 8: THE ACCELERATING PACE OF KNOWLEDGE CREATION AND TECHNOLOGICAL CHANGE

AS THE CREATION OF SCIENTIFIC KNOWLEDGE PICKS UP SPEED,[45] the technological opportunities for changing products and production processes increase. As new products are launched more frequently, it becomes more important to find flexibility in basic installations and to reduce total long-term costs than to reduce variable and marginal costs. Investments in new technologies and learning capacity become strategic assets for successful competition. Investments in skills can be targeted so specifically that they might not be recoupable if and when the firm elects to withdraw from a market. However, the specificity of assets may be overstated, since firms opt for new skills with a view to the long-term exploitation of their new assets for a wide range of activities. Yet these kinds of investment decisions, with such important long-term consequences, remain risky, since it is impossible to accurately gauge the risk factors involved. Non-recoverable costs not only pose a market entry barrier for potential competitors, but also present an increased risk of failure for those who have to pay them.

Technological competition increasingly depends on investment in training and learning. In a world where opportunities and economic targets (as well as the identity and behaviour of actors) are constantly changing, scientific, technological and commercial monitoring become critical. In these circumstances, network-based alliances can help firms reduce risk and keep up-to-date with the myriad new developments in order to minimize potentially non-recoupable costs.

Japan, Brazil, the European Union and France have systematically instituted technological monitoring in the public sector. In Canada, similar attempts by public institutions such as the National Research Council have had only a limited impact. More successful has been public support for co-operative initiatives in this line by networks of firms or related industries. All

industries should be consulted to ensure that they have rapid and efficient access to technological monitoring services.

TREND 9: GLOBALIZATION

SPURRED ON BY POSTWAR MULTILATERAL LIBERALIZATION (GATT, Bretton Woods) and by the increasing importance of "knowledge" (which is inherently international) in production, the economic activities of most nations have become more and more international in focus. This is the phenomenon of *globalization*. This trend has been amply documented and we shall discuss it here only briefly.

What we shall do is look at some of the aspects of globalization that are less often mentioned. The increasingly interdependent nature of trade flows among the AICs obscures the emergence of a new and important development in the world economy: international interdependence in terms of direct investment, and interdependence between this investment and international trade. At least half of trade is conducted within transnational organizations or between their subsidiaries. These transnational corporations act, economically, like world oligopolies using all means at their disposal in order to conquer markets, including retaliation.[46] These transnational oligopolies take into consideration the local allocation of resources and their comparative advantages (natural or created), and they exploit them throughout the world. Competition within and between oligopolies uses the search for technological innovation. Innovation strengthens the position of one actor while weakening that of the targeted competitor. Accordingly, a critical consideration for transnational oligopolies is being able to establish themselves in the geographic location best suited to the process of technological innovation.

The current interest in globalization is somewhat faddish, however. Other trends are working in the opposite direction — shifts not from national to international, but from national to regional. Paradoxically, metropolitan areas, which create the most positive externalities, here are playing a dominant role. These local communities provide the needed scientific and technological infrastructure, and benefit from lower transaction costs (see Trend 6).

The two trends discussed above indicate how important it is to "cultivate" innovative metropolitan areas by ensuring that they have solid scientific and technological skills plus reliable social capital. Transnationals already established in Canada (regardless of their country of origin) will then enjoy well-developed bases for their activities, attracting a wide range of investment. Investments by international consortiums yield the benefits of easy access to newer developments and rapid participation in them. Another aspect of globalization is the major structural change that has occurred since the late 1970s, resulting in a much more tightly integrated world financial market.

TREND 10: THE DOMINANCE OF A VOLATILE AND GLOBALLY INTEGRATED FINANCIAL SECTOR

EVER SINCE THE SECOND OIL SHOCK IN 1979, economic recoveries have been fairly weak and limited mainly to financial and speculative growth. While our economy is now better protected from financial crises than it was in the 1920s or 1930s, financial recoveries today have fewer economic effects.

Financial markets now operate 24 hours a day, and brokers can speculate up to 50 times a day. This means that turnover times are shorter and asset values change more quickly. Financial information is exchanged more and more rapidly. Government issues have shorter maturities, are traded more and more on secondary markets, and are held less time in portfolios (on average, 2.5 to 10 days). Leveraging of assets is easier, and speculative price bubbles (inflated share values) have become more likely. These conditions match those identified by Kindleberger as indicative of a possible financial crisis.[47]

The extreme speed of speculative bubbles would be of only marginal importance were it not for their impact on bankruptcies and the money supply, as well as on interest rates, government debt, the role of the dollar as an international currency and, perhaps in the long run, the general level of economic activity.

The immediate impact of a purely financial crisis can be the utter ruin of retirees who depend on their modest pensions. A crisis can also affect holders of mutual fund and retirement funds (which now hold four to five times more assets than multinational banks). A financial crisis can destroy these assets and trigger serious social problems.

The new degree of interdependence is shown by some of the processes involved in the Wall Street crash of October 1987.[48] On the second day of the market correction, the U.S. Federal Reserve promised not only "easy money" but also selectively offered ridiculous interest rates with the aim of saving brokerage houses in danger of going under; partly it was trying to stave off a payments crisis that might have triggered a wave of bankruptcies. The subsequent loss of confidence in the U.S. dollar as an international currency was a major factor in its devaluation by almost 20 percent. In the years following the crisis, the economies of Europe and Japan had to make major domestic and competitive adjustments, particularly in terms of their foreign direct investment, which in turn led to domestic recession and capital outflows. The U.S. economy then experienced inflationary pressures as the cost of U.S. imports rose.

It should be realized that the fall of the dollar in 1987 was cushioned only by a massive purchase of U.S. government securities by the Japanese. Although these events are not widely recognized, Japan's intervention is estimated to have cost as much as the Marshall Plan.[49] This illustrates the degree of fragility and interdependence in the international financial system.

Financial processes dominate to such an extent that governments are very limited in their ability to influence their national currencies through interest

rates. Higher interest rates can cause an immediate depreciation in previous government issues. When a currency is overvalued, it is vulnerable to speculative fluctuations. A government budget designed to counter speculation will cause a change in credit rating. If, like Canada, the country is carrying a large debt load, the government thereby loses its ability to fashion independent economic policy. According to Lawrence Summers:

> *If … nations dedicate their monetary policy to achieving a foreign exchange target, they lose their ability to conduct monetary policy with a view to domestic objectives*.[50]

These financial processes are not new. What is new is their speed, their impact and the extent of the corrections they engender. These have changed the way business and government affairs are conducted. And there is no indication that this new climate will change; in fact, it will probably intensify.[51]

A trend that may prove particularly dangerous is the growing pressure on the U.S. dollar. The dollar and the Federal Reserve Board are being called on more and more frequently to act as lender of last resort. The Mexican crisis is a good example. Speculation against the overvalued peso touched off a flight of capital and led to the collapse of the secondary government securities markets. In a single day, Mexican banks found themselves with 20 percent of their loans unrecoverable, and they were unable to make any new loans. President Clinton overrode the U.S. Congress to support the peso, citing the importance of Mexico's financial health for NAFTA. He dipped into (in fact, almost exhausted) the United States' reserves for stabilizing the dollar. In 1991, Lawrence Summers (who, before he became a member of the Clinton administration, was free to express himself more openly) summed up the dangers that a financial crisis would present to the dollar from the viewpoint of Federal Reserve policy:

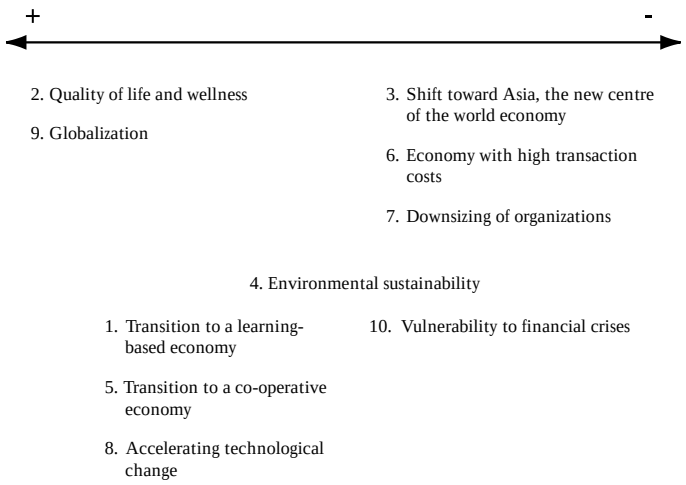
> *The crucial point here is that the international dimension greatly complicates the problem of the lender of last resort. While sufficiently activist lender-of-last-resort policies can always contain a liquidity crisis, there is a risk that they will set off a currency crisis*.[52]

This kind of pressure on the dollar as the main international currency echoes the situation in 1931. Until then, the British pound had been the currency of international commerce. The crisis precipitated by its fall led to the end of multilateralism, the rise of protectionism, a return to currency areas and, with the collapse of world trade, a worldwide recession that affected all countries. A number of parallels and a number of differences can be seen between the current situation and that of the 1930s; in some ways, however, the present situation is worse than the past.

The risks of a financial crisis and the pressures on the U.S. dollar can only increase. Canada will probably be profoundly affected by these developments.

FIGURE 5

CANADA'S POSITION RELATIVE TO THE MAJOR TRENDS DESCRIBED



Multinational banks, pension funds and mutual funds are totally integrated with Wall Street and are heavily involved in short-term loans. This means they are subject to speculative waves and exchange rate fluctuations. The heavy debt load carried by every level of Canadian government (exceeded only by Italy among the industrialized countries) leaves us vulnerable. Policy initiatives aimed at slowing the increase in this burden by reducing current budget deficits are overly timid, and they are based on the premise of renewed growth, which we feel is ill-advised. The high debt-to-assets ratios of Canadian corporations leaves the country extremely vulnerable to a financial crisis. The apparent solidity of financial institutions is partly illusory, given their exposure in the real estate market. Recession persists in Canada, and it may well deepen as the U.S. economy experiences a downturn. New Zealand recently weathered a financial crisis, and it would be naive to believe that Canada is immune or protected. The financial crisis that gripped Mexico from December 1994 to January 1995 occurred when the country was carrying a debt load lower than that of some Canadian provinces. So far, bankruptcies, although they are much more numerous than in the past, have not reached epidemic proportions, and a payments system crisis has been avoided.[53] The Bank of Canada has not yet had to rescue any major financial institutions nor expand liquid assets to support the most heavily indebted provinces.[54] In recent years, economists have been warning about the pressures on our still overvalued dollar. Where does Canada stand relative to these trends?

CANADA'S SITUATION

THE CANADIAN ECONOMY FARES quite well in terms of knowledge, but its competitive position is not so good in terms of transaction costs and flexibility. Also, the country is geographically poorly situated relative to Asia, the emerging centre of the world economy. While it is well positioned to take advantage of globalization, Canada remains extremely vulnerable to financial crises. Most Canadians today enjoy an excellent quality of life but this is threatened by dimming prospects for future economic growth and by pollution. Most of our strengths and limitations today are the outcomes of our past development.

Our development model has gradually changed from an economy based on transportation infrastructure supplying far-flung wealthy cities with goods high in value but low in weight and volume (as described by Harrold Innis) to an economy whose comparative advantages lie in energy-intensive manufacturing and export.[55] More recently, Canada's comparative advantage in North America appears to be shifting toward knowledge-intensive activities.

In the past, Canada's development always depended largely on international financing and government loans. Although the Canadian banking system has gained greater independence and its transnationals have grown in international stature, its tight integration with the world financial system and the country's growing debt level make Canada very vulnerable to any financial or economic upset in the United States. Built on a strong central government and on resource-based industries and financial institutions that are vertically integrated, the Canadian economy has as yet seen little in the way of vertical disintegration, and this structure has bequeathed it a legacy of high transaction costs. Canada's traditional cultural mosaic does help promote relations with certain foreign economies, but it also contributes to higher internal transaction costs.

The 10 trends identified here must be accepted and exploited, and their negative effects must be mitigated. Canadians' prospects can be summarized by drawing an analogy with the situation of Scandinavians in the early part of this century. Industrialization in Scandinavia got under way late, well after Europe had ceased to be the main centre of industrial development. Scandinavia carried on with industrialization while keeping its distance from European conflicts and world wars. Following its own distinct development path, in the 1930s it invented the welfare state. It soon became dependent on world markets, not simply European markets. Similarly, industrialization arrived late in Canada, after the rise to dominance and world hegemony of the United States. In the coming century, when the centre of the world economy has shifted from North America to Asia, Canadians will have the opportunity — and this is their niche — to become world suppliers in technology and services that are environmentally sustainable and knowledge-rich. But a radical change will be required to insulate Canada from the economic difficulties and financial crises of the United States, the collapse of its world hegemony, and the dethroning of

the U.S. dollar as the main currency of international exchange. This vision and this strategic direction are fraught with uncertainties, which we shall discuss in the following section.

THE UNCERTAINTIES MARKING FUTURE SCENARIOS

IN THIS SECTION, we review the main uncertainties about the future. The outcomes of these uncertainties lie outside the control of economic actors — neither governments, industries nor any single country can determine them. We shall construct scenarios around the most extreme outcomes of these uncertainties.[56] Although the actual outcomes will in all probability fall short of the extremes discussed here, exploring the worst-case and best-case scenarios can be helpful in deciding the best courses of action. At the end of our discussion of each uncertainty, we shall suggest the kind of infrastructure investment that could help to improve Canada's situation.

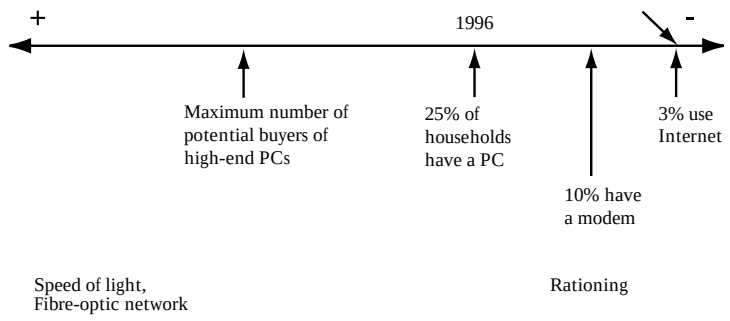
UNCERTAINTY 1: ACCESS TO THE GLOBAL COMMUNICATIONS NETWORK

WE STILL DO NOT KNOW WHAT THE ARCHITECTURE and standards will be of the future global system for communicating knowledge. We also do not know what applications will emerge to bring greater value, better performance and lower costs to the Internet.

Access to the Internet depends, among other things, on the capacity of service providers and the rates they charge. Estimating the total support capacity of service providers would be, to say the least, premature. A number of private corporations, some of them very large, have recently entered the market. This market is obviously lucrative and relatively easy to enter. That is why there are still many providers connecting to the system for free (the "free-rider" phenomenon). If the system were to become a pay service, the number of entries would undoubtedly drop. Yet new entries are needed to increase capacity. What will be the elasticity of capacity supply of service providers relative to

FIGURE 6

INTERNET ACCESS



profits and rates? What will be the elasticity of demand relative to providers' rates? How will access to the Internet be affected by the economics of Internet supply and use, of access to service providers and services? These questions are impossible to answer. Rates and standards are not yet regulated. The shares of public and private service providers and the use of the network are also not yet regulated. Regulation may not even be necessary, or it may become essential. These considerations will depend on the main uses that potential users make of the Internet.

In 1996, virtually the only activities that clearly put to use the Internet's speed and low cost are the location and downloading of bibliographic information, as well as international scientific collaboration (through Internet forums). Most other uses remain experimental, are forms of technological snobbism or fetishism,[57] or reflect the fact that some economic actors are able to "free-ride" the system. Most of the applications available on the Internet remain more practical with other technology (for example, it is cheaper to buy a television to watch movies than to equip a home computer with the necessary equipment to watch movies over the Internet). The usefulness of other Internet applications will depend on the development of ancillary support technologies, particularly software ("intelligent" search engines, for example). This uncertainty has led to a significant rivalry between competing Internet systems and standards.

The consequences of this uncertainty have direct implications for participation in the learning-based economy. The Internet can potentially not only provide access to new international libraries, but also promote the exchange and transfer of knowledge among research groups. The crucial question here is who will have access to these facilities. Figure 6 presents our view of the state of the Internet today. Because this technology is relatively new, it seems to hold limitless promise. Yet so far, only a small number of people are able to use the Internet: well-educated, often professional, computer-literate, generally young, owners of relatively sophisticated home computers (and modems), with access to a service provider and to the necessary software. And of these people, only a handful know how to use the Internet effectively.[58] Useful applications remain quite limited.

Beyond search functions, the Internet can become useful to the learning-based economy if — and only if — the user is *actively* involved in an *interactive* manner with other *people*. It has been conclusively shown that learning cannot be passive. Yet the system as it stands today is entirely passive; the user is simply a *spectator*, with his or her interaction limited to an algorithmic dialogue with the machine.

The average citizen in 1996 finds little utility in the Internet — even less than the French find in their Minitel. Even the efforts of media-oriented companies to develop spectator-oriented Internet uses have yet to produce any applications that could not be provided more cost-efficiently by other delivery systems.

This type of access is limited physically — at a very basic level — by the potential market for high-end personal computers, by computer training, and by the capacity and rates of service providers. Other potential Internet access providers, such as the cable TV companies, still have little in the way of content, applications and technical know-how to offer a clientele that is still not very computer-literate.

Nonetheless, the Internet as a technological platform is generating its own investigative research synergy. With no demand to meet and with no guarantee that there will ever be such a demand, software engineers and electronic equipment manufacturers are developing anciliary technologies as options without expecting any immediate economic return. This means that the Internet may become an important tool of the learning-based economy, particularly for access to knowledge from abroad.

If this comes to pass, a larger share of the population may gain access to the learning-based economy. In a recent report on employment strategies,[59] however, the OECD argued that new electronic, computer and telecommunications technologies could lead to enhanced productivity or to social exclusion.

Imagine the following scenario: over the next few decades, the Internet continues to be accessible only to well-educated and computer-literate professionals using high-end personal computers. This would lead to the creation of a large underclass of people — the majority of the population, in fact — with no possibility of using the Internet as a learning tool. The result: the larger part of human capital would rapidly become out of date. If we assume that communications firms manage to develop economically viable Internet-based applications, then for one part of the population it is likely that vicarious experiences via computer (as is already the case for television) will simply become an alternative to the mediocre programming of television networks. And if the ranks of the underemployed continue to swell, we shall see a population that spends most of its time living vicariously as mere spectators.[60] Little has changed since the advent of television. We shall discuss the reactions of the various actors in the following section.

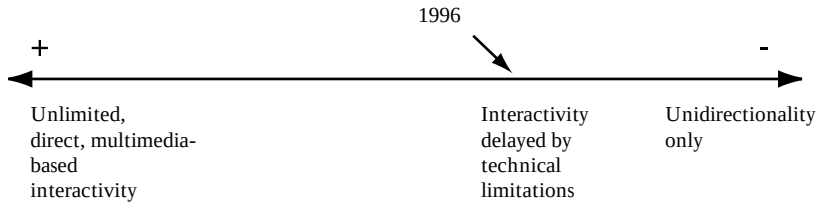
UNCERTAINTY 2: INTERACTIVITY?

HERE IS A KEY QUESTION: How much activity on the Internet will be interactive, and how much will be one-way? When television was being developed, the original designs called for interactivity; however, TV has become the epitome of unidirectional transmission. The Internet, on the other hand, has already proven its potential for interactivity (something that only the telephone has had up to now); an example is IRC (Internet Relay Chat) which, as long as the network is not congested, makes direct conversations possible over the Internet.[61]

This feature of the Internet brings to mind the metaphor of the global village. A number of international communities have formed or established

FIGURE 7

INTERACTIVITY



themselves on the Internet.[62] However, most Internet use at present remains one-way. "Surfing" and electronic mail (e-mail) are nothing more than one-way reading or sending of information. Libraries, research resources and global directories can be created in this fashion, but this is simply an extrapolation and quantitative development of research and access to electronic data bases. Given the cuts being made in all areas, including education (and library services), these developments are welcome. But they can make only a modest contribution to the learning-based economy by facilitating the international dissemination of information.

What role will interactivity eventually play on the Internet? Depending on the final outcome of the interactivity question, the effects of and on the Internet (and on all global communications systems) will vary considerably. Yet we have no idea what this outcome will be.

A host of people are now working to develop the architecture of the Internet, and they will be joined by many more. It is tempting for economists to apply Adam Smith's "invisible hand" metaphor to this example of a technological system, but it must be admitted that the Internet will be fashioned by many, quite visible hands, some of them more powerful than others.

What will be the relative roles of the telephone, cable and media companies? When will the narrow window of opportunity offer the propitious moment to introduce a regulatory body? How will this regulatory body perceive the needs of Internet users, and what can and should be considered a "reasonable" set of criteria for public regulation?[63] As in all struggles between rival systems, a number of visible hands are involved, and a few consortiums may well end up setting the standards, intentionally or otherwise. This is a volatile, competitive process, and there is no way of telling what the outcome will be and no guarantee that the best solution will win.[64] Still-evolving technological systems thus remain a major source of uncertainty for the future.

The two uncertainties associated with the worldwide communications system — interactivity and access to service providers — are related to each other. People's ability to interact in real time is directly proportional to the

total capacity of service providers but inversely proportional to the number of people using system resources. The parameters of communications systems affect economic agents, their welfare and their well-being in a variety of ways.

Would investment in Internet infrastructure be useful and desirable at this time? If so, should public funds be used? If private interests (groups, clubs, etc.) find economically useful applications for the Internet, they should also have the needed incentive to invest in larger server capacity and in the development of ancillary software and technologies. Accordingly, private interests that benefit from this infrastructure without investing in it (the "free-rider" problem) should pay for the use they make of the system: their use contributes to system overload, thereby blocking other users and hampering direct real-time interactivity, even slowing the growth of interactivity. In our opinion, public investment in Internet infrastructure should not be considered except in the case of public goods, in which the private sector is slow to invest in any case. The question of public goods on the Internet raises a host of issues, including security, privacy and the whole question of individual freedom versus collective rights. Ethics is another area of public interest that governments prefer to forget. Public investment should also be aimed at supporting direct interaction on the Internet, since it is this mode of use that promotes genuine democratic public debate and encourages us to learn and to participate in the creation of new knowledge.

In concrete terms, the Internet's function as an international research network should receive support. While it is already clear that some public money will go to support libraries, a part of these funds should be directed to facilities to link the libraries of the world together, even with one-way surfing and information retrieval.

In general, it is still too early to foresee the ways in which Internet applications might serve the public interest. Activities that should be considered for public funding include research, the experimental development of content and software, and the evaluation of the system as a whole. Expanding the knowledge horizons of public agents may thus encourage them to develop useful applications. In particular, it would useful to investigate (and to experiment with) ways for communities to profit from the public forum capabilities of the Internet. Research programs of this kind should be experimental.[65]

A word of warning is in order here. The federal and provincial governments are just now reacting (in a rather knee-jerk fashion) to the prospect of Canada's becoming a nation of computer illiterates. They are looking for a fast technological fix — hooking up all the schools to the Internet — to solve a very complex problem. The approach may even backfire. The overhasty introduction of computers into schools has sometimes simply turned teachers and students off computers. Installing hardware to allow Internet access could have a similar effect, discouraging people from using the network. Any experimental introduction of the Internet into schools should be prepared in three stages. First, educational activities and content need to be developed, for which the

Internet is, pedagogically speaking, the ideal medium. Second, teachers need special training. Third, a voluntary pilot project should be carried out, with a control group using a different technology for comparison purposes. As with any innovative approach, the applications, users and problems encountered must be identified before the technology is adopted.

These initiatives, which require modest investment and cannot do harm, will help ensure a positive outcome to Internet development. They constitute one viable investment option among the many potentially necessary measures.

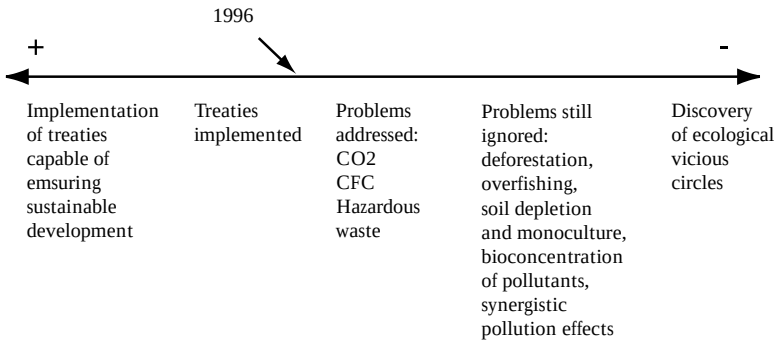
UNCERTAINTY 3: THE SPATIAL-TEMPORAL DIMENSION OF THE ENVIRONMENTAL CRISIS

THE ENVIRONMENTAL CRISIS IS A MAJOR SOURCE OF UNCERTAINTY. Not only is there no consensus on the causes of ozone layer depletion and global warming, but environmental science is only starting to enable us to understand the interdependencies among ecological systems. The long-term effects of the different products we currently use — including fluorocarbon substitutes — remain unknown.

We do not know whether international agreements will actually make sustainable development possible. Some recent estimates predict that the 1996 scenario proposed in the Brundtland Report (*Our Common Future*, World Commission on Environment and Development) cannot be achieved without foreign aid on an unprecedented scale, and there is no guarantee that even such a massive influx of aid would actually result in sustainable development.[66] In addition, environmental priorities change, imposing unpredictable pressures on transportation systems, several industries (energy production, distribution and use), and urban infrastructure (sewers, wastewater treatment, waste manage-

FIGURE 8

THE SCOPE OF THE ENVIRONMENTAL CRISIS



ment and landfill). Environmental uncertainties appear to be those most difficult to adequately assess.

In terms of investment, six classes of requirements emerge from the foregoing scenario:

1. As a major world polluter (see part one), we must accept our responsibility to clean up the environment.

2. Where possible, all production processes must be made environmentally sound.

3. Facilities that cannot be made safe must be replaced or mothballed.

4. We must address a major challenge: developing clean and economical substitutes. This may help us establish links with the NICs by exporting or collaborating on the development of these substitutes; CIDA and IDRC could play a role here. These projects would likely require investment in new lines of research. For example, the economic revitalization project for east Montreal — particularly the Rosemont area, where Canadian Pacific's old Angus switching yard is being converted — presents a challenge as well as an opportunity.

5. After we have made some progress in this area, our international voice on behalf of regulation and development will enjoy new credibility, and we shall be able to play a bigger role in the search for sustainable development. Such initiatives will likely lead to the creation of new international institutions. Since Montreal is the headquarters of international agencies associated with NAFTA and the United Nations, this represents not only a challenge but an unparallelled opportunity.

6. To meet the environmental crisis, new institutions must be established. Our democracies, the heirs of the Age of Enlightenment, are built on the principle of individual rights and, occasionally, collective rights. But there is no provision in democracies for technological choices.[67] Such choices are made on behalf of the authority and rights of either owner-investors or citizen-users. When it comes to the environmental impact of these technologies, however, the two visions are at odds. It is thus necessary to set up public forums to debate these issues, and the obvious setting is the place where these technologies are used and where the environmental problems are rooted.[68] Public hearings have been tried on an experimental basis in certain communities and cities. While broad consensus has not always emerged from such exercises, there has usually been agreement by large majorities. To ensure that decisions follow a democratic process, the final step in these public

debates should be a referendum on the resulting government choices. This measure would *institutionalize democracy* and empower citizens to shape their immediate environment. Otherwise, all the decisions will be made by technocratic institutions, which are myopic (if not blind) giants. Their choices will arouse opposition among citizens of the various communities affected and will lead to technological inefficiency and wasted investment.

The six points presented here are potential avenues for examining the current environmental crisis. This issue will only gain in importance as the crisis starts to affect the existing system of international trade, perhaps triggering a return to trade-bloc-style protectionism.

UNCERTAINTY 4: INTERNATIONAL GOVERNANCE AND REGULATION

A MAJOR SOURCE OF UNCERTAINTY is represented by the international arrangements and treaties governing the rules of international behaviour, international institutions, and what Kindleberger calls "international public goods." This applies to issues such as pollution, intellectual property, privacy and international trade. Some of these issues are new (pollution and privacy, for example) and bases for agreement have yet to be established. But that is not really our concern here. Other issues have deep historical roots, marked sometimes by controversy (e.g., intellectual property) and sometimes by consensus (e.g., commercial rights). It is this latter group we are concerned with here, particularly international regulations on world trade, since the outcome of these issues will affect the scope and impact of market globalization.

The terms of references of the postwar treaties are almost completely out of date. The 1949 General Agreement on Tariffs and Trade (GATT), for example, refers exclusively to trade in commodities, whereas the majority of trade these days (excepting farm goods and textiles) involves foreign investment, services, knowledge, migration, and so on. The Bretton Woods accords and the gold-convertibility of the international currency (the dollar) virtually all ended in 1972 with the unilateral measures adopted by the Nixon administration (see Trend 10, above, and Uncertainty 5, below). Since then, financial speculation (with its tax-free profits) has escalated and financial markets have become much more volatile. Moreover, there is no generally accepted theory on what conditions favour mutual and dynamic gains from trade liberalization (other than static gains from freer commodity trade). Thus there is no real benchmark for international relations.[69]

New international regulations must be drafted for the learning-based economy. New multilateral accords on issues relevant to the knowledge-based economy are needed. The Uruguay Round and the World Trade Organization have made some attempt to address these issues, but the results are confused and inconsistent. For example, the Uruguay Round Subsidies Agreement

appears to conform to the general approach of mutual gain through trade liberalization. It stipulates clearly that R&D subsidies are still allowed. This agreement abrogated the 1986 Tokyo Round's Aircraft Manufacturing agreement, which had been passed in response to lobbying by Boeing, McDonnell-Douglas and Airbus with the support of the Department of Commerce in Washington and the European Commission in Brussels. On another front, the Agreement on Trade-Related Intellectual Property Rights (TRIPs) is, in the view of several experts on trade policy and law, a dangerous protectionist precedent. The legal foundation of this agreement is very weak, luckily, making it virtually impossible to implement. Instead of following the tradition of *reciprocity*, well established in international law (according to which countries make mutual concessions on their commonalities and eventually converge toward one another), the TRIPs agreement derives from the *internationalist* tradition (abandoned ages ago in international law) in that it overtly requires[70] signatory countries to establish patent laws according to common general principles. The legal foundations of intellectual property are themselves fairly shaky.

Lastly, the restrictions placed on the use of technical knowledge in multilateral trade agreements can in no way be justified in terms of mutual welfare.[71] On the contrary, the experience of the past 40 years indicates that a large part of world economic growth is due to first Europe's and then Asia's efforts catch up to foreign technology. Given that, in a positive-sum game (see Trend 5, above), the firm that shares its knowledge is the firm that learns the most in a process of exchange,[72] knowledge sharing should be liberalized and encouraged. Even though the patent system contributes to the dissemination of technological information among all countries, unless mandatory licensing clauses are instituted, the rights of large firms (particularly the multinationals) and the restrictive power granted them can slow the adoption of foreign technologies at the local level.

The relative failure of the Uruguay Round to establish the international playing rules for the learning-based economy indicates that the entire multilateral system currently in place needs to be overhauled.

Uncertainty regarding international rules stems from the fact that the world economy is no longer dominated by a hegemonic power, but has evolved into a multipolar structure. The United States is now backing away from its leadership role, and the new economic leaders — Japan and Germany (or Europe) — are reluctant to assume the mantle. In addition, the United States has embarked on a protectionist tack — in opposition to the system it itself helped to build.

The main danger faced by the multilateral liberalism ushered in by the GATT in 1969 comes not from the NICs[73] but from the government of the United States itself. The 1988 act of Congress known as "Super 301" stipulates a punitive tariff of 100 percent. This is a short-sighted attempt by the United States to use its market size to encourage its domestic business lobbies to "extract unilateral, unrequited trade concessions from others" in an illegal and

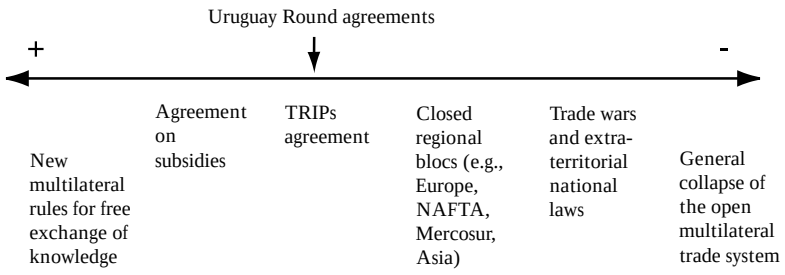
discriminatory manner that contravenes the Most Favoured Nation clause (Articles I and II of the GATT fundamental principles). Clara Hills, the U.S. Commissioner of Commerce, had made assurances that this act, at the discretion of the United States, would never be invoked against GATT regulations.[74] Nonetheless, this aggressive unilateral approach by the Americans was recently revived, resurfacing in extra-territorial legislation (introduced by Senators Helms and d'Amato) aimed at countries and firms trading with Cuba, Libya and Iran.[75] This policy direction threatens the stability of the international rules of the game, particularly since it is advanced by the party that remains, after all, the leading global economic power and the largest market in the world. The United States is also the architect, promoter and enforcer of the open multilateral trade system.

The enforcer not only is failing to apply the law, but is also undermining the very laws it helped to create. The result may be the collapse of the rules of international trade.[76] Were a trade war to start today, it would rage virtually unimpeded. Regional trading blocs dominated by different currencies (the dollar, the yen, the ECU or the German mark) could form if the advantages enjoyed by members of these blocs are not extended to outside parties. In fact, some aspects of the NAFTA are protectionist with respect to Asian competitors. Figure 9 sums up the extreme scenarios.

It is obviously in the best interests of Canada, a small country dependent on imports and exports, for multilateral free trade to be maintained and extended. Yet Canada's manoeuvring room to support this development is limited because of the small size of its domestic market. That is precisely why Canada must collaborate with partners. For example, it should actively work toward constructing and developing a broad-based coalition to defend and extend the open multilateral trade system.

FIGURE 9

UNCERTAINTIES LINKED TO INTERNATIONAL TRADE RULES



This idea worked for the Cairns group in the area of agriculture, but Canada should consider allying itself with other groups on other issues. For example, the European Union has adopted a more liberal position than the United States on TRIPs and compulsory licences. In the civil aircraft manufacturing industry, for instance, Canada has more in common with Indonesia, Brazil and China than with the United States and Europe. Alliances with rising world economic powers would prove to be one of the best possible long-term relational investments once these countries are ready to promote an open system of multilateral trade. In any event, it would be prudent to diversify our alliances in order to reduce our dependence on our immediate neighbour to the south, in light of its susceptibility to protectionist pressures. Given Canada's featherweight importance and its proximity to the United States, it only makes sense to avoid a confrontation we are bound to lose so that we can stand firm on key issues that are essential to our distinct existence.

From this standpoint, strategic relationships should be developed with east and south Asia (Japan, China, Indonesia and India) and with Mexico and Brazil. Of course, efforts currently under way will not bear fruit immediately, and may never do so. Another investment question has to do with our ability to play a more active role in international organizations concerned with trade, other forms of exchange, property rights, standards of environmental sustainability and privacy laws — areas that are evolving rapidly at the international level.

The uncertainty discussed here has some risky ramifications for exchange markets, a subject examined next.

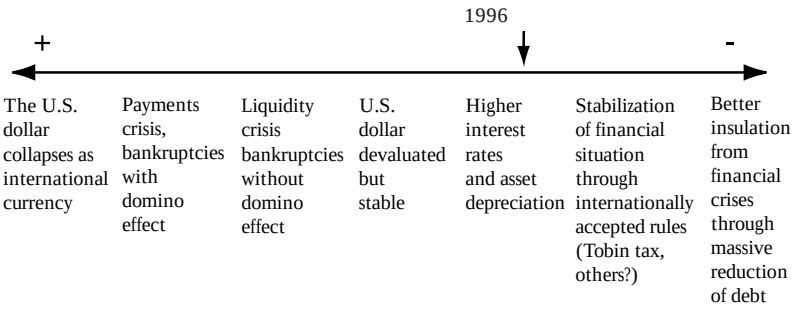
UNCERTAINTY 5: FINANCIAL UNCERTAINTIES

THE 10TH TREND DESCRIBED IN THE FIRST PART of this study was the increasing volatility of asset markets, interest rates and exchange rates. The extreme scenarios are depicted below.

At one extreme is a scenario strikingly similar to the situation in the 1930s, when a financial crisis deepened into economic depression with the rise of regional currency areas that were protectionist in nature. The scenario at the other extreme is a reduction in our vulnerability through a massive reduction in national debt. In the middle, the various types of change (interest rates, value of assets, liquidity crises, etc.) are arranged in more or less arbitrary rank and order. If even a handful of large organizations in the United States and Canada were to go bankrupt, the central banks would have to expand the cash supply, leading to a revival of inflationary pressures (which are almost nonexistent in Canada). This would in all likelihood provoke a devaluation of the dollar. Given the very active role played by central banks since the 1930s as lenders of last resort, devaluation would become all the more probable if a payments crisis were to erupt following some major bankruptcies, creating a domino effect.

FIGURE 10

SCENARIOS RANGING FROM FINANCIAL CRISIS TO STABILITY



In the beginning of part four, we discuss the need to ease budgetary constraints through debt reduction in order to allow infrastructure development. This would not only make such investment possible but also — and this is the main message of this section — reduced public debt would certainly help insulate Canada from most of the negative scenarios. It is instructive in this regard to look at the worst-case scenarios and imagine the unimaginable. In the first part, we noted the growing tendency toward financial instability. This is not only the view of financial experts; it is also the considered opinion of an internationally famed economist and one of the architects of postwar institutions, Charles Kindleberger. Similar warnings have been sounded by the neo-Keynesian Hyman Minsky[77] and by a prominent member of the current Clinton administration, Lawrence Summers, who has already been cited here. Awareness of the various aspects of financial instability highlights the importance of reducing our vulnerability. Yet since the 1987 financial crisis on Wall Street and the 1995–96 Mexican crisis, very few steps have been taken to ensure that these events do not repeat themselves.

Merely a rapid rise in interest rates would threaten pension funds, leading to an immediate depreciation in the value of their shares. At the same time, social stress would intensify, the financial system would lose credibility and social cohesion would be eroded. A steep depreciation of the U.S. dollar, even in a controlled manner, would inflict a substantial shock on our domestic markets and our exports to the United States (which remains by far our most important export market), unless the Canadian dollar is devalued in step.

None of these scenarios is desirable, but they may be inevitable. Even so, their effects can be mitigated if we reduce our vulnerability by decreasing our heavy debt load.

We do not know of any infrastructure development that would further this goal, but we are not financial experts. Most of the measures we are contemplating are associated with other policy areas. For instance, equity in the rules of the game should be re-established by taxing financial transactions (on the capital or volumes involved) at the same level as industrial activities.[78] Unless such measures are undertaken, an increasing part of our capital and talent will continue to be siphoned away from activities and investments that create jobs in industry and the services sector. In fact, infrastructure investment may be needed specifically to monitor electronic financial markets. However, we can only hope that the Bank of Canada is sufficiently motivated and equipped, and able to finance these investments itself.

Which scenarios are the most probable is a matter of opinion; optimism and pessimism do not enter into it. In any event, there are so many visible and invisible hands, both human and institutional, and so many natural factors involved in shaping the ultimate outcome that it is futile to try to predict what will happen in each of the scenarios we have identified. There are some obvious feedback loops that can be identified by looking at systemic interdependencies between the uncertainties. For example, trade wars and protectionism could make it difficult to implement environmental agreements, since some of the key natural factors would become next to impossible to control. A currency crisis accompanied by the collapse of the U.S. dollar could lead to regional protectionism. Vicious circles such as these are not easily stopped. On the other hand, the power of the emerging communications system could be harnessed to counter the environmental crisis. Further, changes can be made to the nature and direction of the impact of certain subsystems on others: while the speed of the global communications system promotes financial instability, this could be changed by putting appropriate control and taxation mechanisms in place. The existence of positive feedback loops, such as self-regulating and self-reinforcing processes, could be enough to increase or diminish the probability that some negative scenarios will come true.

THE PROBABLE REACTIONS OF ECONOMIC AND SOCIAL AGENTS TO THE VARIOUS SCENARIOS

HAVING EXAMINED THE MAJOR TRENDS AND UNCERTAINTIES, we now turn to the reactions of actors. Here we enter increasingly into the realm of speculation, based on our judgment and impressions. We shall explore what we think are the most probable reactions of the various actors to the extreme scenarios presented in the second part of the paper. We begin by identifying the groups of actors selected and then examine their reactions.

- The reactions of *consumers, families and individuals* should vary according to their education, occupation, and access to the Internet. They will be directly affected by all the uncertainties.

Various industrial activities will be affected in different ways by the uncertainties, in turn affecting different levels of infrastructure. We shall distinguish the following activities:

- The *communications sector* is a particular case, since it provides the infrastructure for the global communications system, which lies at the heart of the new emerging technological system. This sector will be affected by environmental uncertainties, by uncertainties concerning international regulation, and by financial uncertainties.
- The service industries furnish the applications and content needed to exploit the technological opportunities offered by the system. They will also be affected by financial uncertainties.
- The emerging *environmental industry* is growing rapidly. It will be affected by the extent of the environmental crisis, obviously, but also by other uncertainties.
- The *knowledge-based industries* exhibit a very wide range of needs and reactions. They will all be affected in varying degree by the regulatory and financial situation. Some of these industries will be hurt by the environmental crisis, and others will be more sensitive to problems connected with the global communications system.
- Because of their high transaction costs, the *short-life-cycle products industries* will require much more infrastructure investment in communications and training than will the *standardized-technology industries*, and will benefit much more from this investment. While both these industries will be affected by the financial and regulatory situation, the short-life-cycle products industries will be more sensitive to developments in communications and the environment.

- *The resource, energy and transportation industries* will feel the full impact of environmental uncertainties and, to a lesser degree, the uncertainties related to competing communications systems. Naturally, they will also be affected by international financial turmoil and by international trade regulation.
- The *education sector* will see its way of operating strongly affected by the outcome of rivalry between communications systems. Its objectives and priorities will be influenced by the environmental crisis. The financial situation is already having a significant impact.
- *Health care services* may be affected by distance-spanning technologies (the Internet, videophone, voice recognition systems, etc.). They have been ravaged by the financial crisis, and the environmental crisis is already making itself felt through an increasing incidence of pollution-related diseases. The other uncertainties will likely not affect health care services.
- In the first section, we noted that we awaited the emergence of *new actors and sectors* in response to environmental necessities and competition centred on transaction costs. We expect to see new kinds of organizations that are more successful at reducing transaction costs. We anticipate a resurgence of *communities*. By "community," we mean any group formed on the basis of similarity and close interaction. Similarity may be rooted in mutual trust, culture, language, interests, values and beliefs, activities, objectives — anything that reduces transaction costs within the community relative to transaction costs outside. Communities may be international or local (like Silicon Valley, Emilia Romagna and other industrial districts). The new community players are rewriting the rules of the game: they organize and regulate themselves, and they do not need or want any outside involvement. Some communities are closed, exclusive, even discriminatory, and others are open and interact with other communities; sometimes their members can even belong to more than one community at a time. Communities will likely be affected by all five uncertainties.
- The various l*evels of government* (municipal, provincial, federal, international) will be deeply affected by the financial and regulatory situations. They will also have to deal with environmental issues, but they will be relatively insulated from — or at least not much affected by — the outcome of the rivalry between communications systems, which they have no real control over, practically speaking.

Table 3 summarizes how the various actors will be affected or not affected by the outcomes of the five scenarios stemming from the uncertainties described in the second part of the paper.

TABLE 3
POSSIBLE IMPACTS OF THE OUTCOMES OF THE VARIOUS UNCERTAINTIES

Uncertainties Actors	Access to Internet	Internet interactivity	Ecological crisis	International regulations	Finances
Consumers	Little	Little	Yes	Indirect	Yes
Communications	Yes	Yes	Indirect	Yes	Yes
Services	Yes	Yes	Indirect	Yes	Yes
Knowledge-based	Little	Yes	For some	Yes	Yes
Standardized production	No	No	Yes	Yes	Yes
Short-life-cycle products	Little	No	For some	Yes	Yes
Energy-based	No	No	Yes	Yes	Yes
Education	Yes	Yes	Yes	Little	Yes
Health	Little	Yes	Little	Little	Yes
New agents	Yes	Yes	Yes	Little	Yes
Governments	Little	Little	Yes	Yes	Yes

For the actors selected, let us now consider various possible impacts and reactions associated with the most extreme scenarios, compared with the five uncertainties described in the second part of the paper. Since financial instability and crisis affect all actors, we shall begin there and follow the table in reverse order. Thus we begin by thinking about the unthinkable.

A FINANCIAL CRISIS OUT OF CONTROL

MORE THAN HALF A CENTURY OF RELATIVE ECONOMIC tranquillity (since the 1930s) has banished the spectre of recession that has haunted the generation that grew up in the affluence of the postwar years. It is useful to contemplate the consequences of the collapse of the U.S. dollar and the return of currency areas, and even the less extreme scenario of cascading bankruptcies accompanied by a payments crisis. In such a situation, the open multilateral trading system would not survive. We would be forced to return to trade zones. Since a large part of trade today (much more than in the 1930s) takes place *between* trade zones, recessions would evolve into depressions. Economic rules of conduct could be applied only in these restricted areas. In the end, only the zones most affected by global ecological damage (plus AICs) would be likely to address environmental problems, but their response would be limited by recessionary budgets. Irrespective of the outcome of the current rivalry among communications systems, there would be a drop in usage and traffic volume on the global communications system, although key international contacts would probably be maintained despite the prevailing isolationist mood.

Some provincial governments would probably go bankrupt, and the Bank of Canada would have to step in as lender of last resort. If the Bank should decline to fulfil this role for one province, the Canadian federation would probably be irreparably damaged (and would no longer have the luxury of wallowing in constitutional debate). The debt would have to be monetized, leading to a devaluation of the Canadian dollar. While this situation would provide some boost to international exports, it would generate significant inflationary pressures, since Canada would remain dependent on its imports despite international protectionist sentiment. With the lower fiscal base, education, health care, social services and pension payments would be dramatically reduced. The number of business failures, which have multiplied since the early 1990s, would increase and culminate in the collapse of several large corporations, burdening several sectors with high debt-to-equity ratios, including real estate, education, and transportation equipment.[79] All industries and services would suffer from protectionism and recession, although the traditional resource-based industries, which have the advantages of a monopoly, would be less affected. In fact, they might even be in a position to handle orders previously satisfied by imported products.[80]

There would be two groups of consumers: those who had been able to retain some viable assets and a basic income, and those who had been left des-

titute (the majority, including retired persons with no pensions). A social crisis would be inevitable, and the political system could be at risk. In such circumstances, some people would turn to the parallel black-market economy, using community-based arrangements. As contacts with the outside world diminished, communities would tend to turn inwards and become hostile to outsiders.

In this situation, investment for the future would be limited to community support for subsistence income programs — recalling the Depression or even the Soviet gulags. Governments would be asked to intervene more often but their means to do so would be more limited; there would be a real risk of authoritarianism.

That is, of course, the pessimistic scenario. Let us now examine some more optimistic prospects.

ACHIEVING RELATIVE STABILITY BY REDUCING OUR DEBT AND OUR EXPOSURE TO FINANCIAL CRISES

LET US ASSUME THAT WE FIND THE POLITICAL WILL TO ELIMINATE, or at least dramatically reduce, our debt (a number of ways to do so have been suggested; see part four of the paper). This would insulate us from a potential financial crisis. Assume also that mechanisms to ensure financial stability are found and put in place at the international level, eliminating the chance of uncontrolled financial crises such as that of October 1987 or the 1994–95 Mexican crisis. A significant reduction in our debt load, if accompanied by a reduction in the individual tax burden proportional to the decline in the cost of servicing the debt, would stimulate economic recovery, foster growth, provide employment for most of the labour force, and free up funds for infrastructure investment. It would then be possible to address ecological problems and to equip ourselves for the learning-based economy.

Even though governments would have restored order to their finances and gained credibility, they would still be monitored to head off any return to the days of profligate borrowing. This would be necessary because governments would have increased capacity to intervene, even though there would be less need to do so. Commitments to pensions, health care and social services would be met in a lower-pressure atmosphere. There would be a higher level of trust in society and institutions, which would facilitate collaboration and problem resolution. The knowledge-based industries, particularly services, communications and the environmental protection industry, would experience strong growth. Since innovative areas of strong growth have high transaction costs, communities would flourish. Given the high level of trust, communities would be stimulated by outside contacts without incurring any risk, as long as these communities remained open and receptive to interaction with other groups. In these circumstances, it would be possible and logical to make infrastructure investments, even on a unilateral basis, to clean up and restore the environment.

Investment in education would also be practical, perhaps promoting interactivity not only among researchers, but also between students and teachers.

The preceding outcomes condition the options available under subsequent scenarios. Let us consider the example of the open multilateral trade system; if an out-of-control exchange rate crisis were to occur, that system would be impossible to maintain. On the other hand, the multilateral trade system might collapse even without an out-of-control financial crisis, although protectionism would be more easily reversed. In this case, the depression should be less severe, unemployment lower, cuts to social programs less drastic, etc. Another extreme case would be a return to worldwide protectionism, but with Canada and its provinces protected from the effects by having eliminated their debt. In this case, infrastructure investments would be possible, but would lose effectiveness by focusing on traditional, non-competitive, energy-intensive or resource-based activities. As we saw, an uncontrolled financial and monetary crisis is very likely to trigger the collapse of the open multilateral trade system (without the reverse necessarily being true). But let us not dwell on such a pessimistic scenario. Instead, we shall examine the more positive prospects for the regulation of international trade (obviously, a positive outcome is in no way guaranteed, even in a stable international financial climate).

EXTENDING THE OPEN MULTILATERAL TRADE SYSTEM TO THE LEARNING-BASED ECONOMY

IMAGINE THAT TRADE LIBERALIZATION can be broadened to include services (particularly knowledge-based services) as well as more generally to include knowledge exchange. This would encourage international co-operation to solve environmental problems. In particular, freer sharing of AICs' knowledge with developing countries should allow them to reduce their investments by directing them toward environmentally sustainable technologies. In addition, this co-operation could be extended to development of new technologies and experimentation with them, and could reduce the fixed and operating costs associated with these alternative technologies. International co-operation would create a demand for a more interactive, efficient and inexpensive international communications system. The capacity, user-friendliness, applications and content of this communications system would be improved, allowing the system to reach and serve more users.[81]

Even if both an uncontrolled financial and monetary crisis and the collapse of the open multilateral trade system are avoided, there is no guarantee that international environmental agreements will be implemented. The world ecological system (biosphere, hydrosphere, lithosphere and atmosphere) evolves largely independently of human action, even though it can be strongly affected by it. Even if the outcomes of financial and trading uncertainties are positive, there is still a risk of a grave environmental crisis.

EMERGENCE OF A NEW ENVIRONMENTAL CRISIS

ECOLOGICAL VICIOUS CIRCLES APPEAR UNPREDICTABLY. They may well heighten tensions between the advanced industrialized countries and the newly industrialized and developing countries. The latter group will increase the pressure on the developed world for international aid, and the industrialized countries will put pressure on the poorer nations to use clean technologies (almost always new technologies). These pressures would have repercussions (that can be overcome) on the international trade system and on the financial system. International research and co-operation would immediately be called for, which would heighten awareness that "we are all in the same leaky boat." The pressure for co-operative research at the international level would make it essential to have a more efficient, totally interactive system for international communications with greater support capacity.

Consumers in certain regions would be more affected than others. For example, global warming would probably hit coastal cities more severely than inland tropical cities, while acid rain would most strongly affect northern regions. As occurred with the Love Canal, environmental disasters must be expected, wiping out the assets of an affected region and triggering mass outmigration; entire communities may be affected. Unable to meet their own needs, they would be dependent on outside assistance. Public resources would necessarily be involved. As with natural disasters — the recent Saguenay flood comes to mind — human solidarity will not allow financial constraints to get in the way. When money is necessary and must be found, other expenses must be put off or funds for assistance monetized. Similar to epidemics, such events put stress on the health care system and on the industrial sectors that must respond to the problem.

In the event that new ecological vicious circles emerge that threaten human survival, the extent and timing of the problem are crucial. What is the time frame for action to control or reverse the problem, if this is indeed possible? What impact will initiatives to reverse the situation have? Each problem has to be responded to differently. That is why basic investment in multidisciplinary infrastructure for ecological research, environmental monitoring, education and regulation is so important.

ENVIRONMENTAL SUSTAINABILITY THROUGH IMPLEMENTATION OF INTERNATIONAL AGREEMENTS

IN THE PRECEDING SECTION, we mentioned the results of simulations showing that the objectives of the Brundtland Report on sustainable development are unlikely to be achievable, given the current pace of change and efforts already undertaken to this end. As an act of faith, let us assume that these objectives are met. This would leave the same level of pressure on the trading system as now, so that the demands made on research, health care, public funds, and the

various industries and services involved would remain modest. Consumers would be reassured. Overall, this scenario does not teach us much; even though it is rather unlikely, it merely leaves us with the status quo.

Let us examine the most probable (and most instructive) of the favourable outcomes. Imagine that currently endorsed environmental reforms prove inadequate to ensure sustainable economic growth. This would lead to extensive industrial change, particularly in energy-intensive industries involving natural-resource exploitation, processing and transportation. The replacement of fossil and nuclear fuels by renewable energy sources would in all likelihood accelerate. In particular, short inter-city air travel, which causes noise and air pollution and is also overcrowded, would be replaced by electric light-rail systems. Pollution levels in urban areas would probably necessitate that some percentage of vehicles become electric-powered (as is already the case in California with the Clean Air Act). There are at least three reasons to believe that the time has come for this conversion. First, the almost byzantine complexity of internal combustion engines means that each R&D dollar invested to improve their fuel efficiency has less marginal value. Second, the main impediment to the electric car is the battery, and some practical new solutions are now available. Last, as a result of rapid urbanization (and the phenomenon of the suburbs), 90 percent of trips last under an hour, so that the independent range of electric vehicles is no longer a competitive barrier.

The above developments will necessitate extensive infrastructure investment. High-speed trains would require new rails. Electric vehicles would require a new maintenance and service system. Most of these costs would be borne by industry and consumers. Canada has the technical know-how to make this transition right now, but it is questionable whether the political will yet exists to push North America to make this technological transformation.

We shall now look at the uncertainties associated with the global communications system in general and the Internet in particular (which is still really at the prototype stage). While we consider access and capacity separately from interactivity, remember that smooth and efficient interactivity is impossible with an inadequate support capacity. We examine here one negative and one positive scenario.

LIMITED ACCESS TIME AND HIGH ACCESS COST: TOWARD A PASSIVE-SPECTATOR SYSTEM

THE INTERNET IS ALREADY EXPERIENCING CONGESTION. Surfing and interactivity are subject to a response lag, which increases the pressure on server capacity. With public funds becoming scarcer, private industry should become involved in the development of server capacity. But currently the industry concentrates on providing unidirectional services, where the user is a passive spectator. We cannot predict today what applications will be economically viable (after

eliminating the "free-rider" effect). With the number of users doubling each year, it is conceivable that users' on-line time may be rationed or that high rates will be imposed to discourage heavy use and limit access for some users.

Should this occur, the usefulness of the system for research would be limited, affecting research in ecology and other areas concerned with international governance. The growth in the speed of international financial transactions would also be affected, even though transactions were virtually instantaneous even before the introduction of the Internet and before service firms started investing in communications systems. The saturation of the Internet would slow the creation and transfer of knowledge, hamper the dynamics of a positive-sum game, and increase transaction costs in the learning-based economy.

Moreover, the "telespectator" role of the consumer would become more firmly entrenched. Given a high unemployment rate (as under the negative scenario discussed earlier), the time spent living passively and vicariously in an on-screen virtual-reality world would increase. Knowledge-based industries, services, education and training would expand less quickly. On the other hand, the media would enjoy a lucrative market with the freedom to set rates. Communities would have little chance to create public forums to foster interaction. Governments would play the role of regulators in a monopolistic context. The new system could be used as a means to exert social control over a fragmented populace of passive spectators shut in their homes. Governments and corporations alike might be tempted to flirt with authoritarianism.

Greater opportunity for direct human interaction at the international level: toward the global village

This utopian dream has fascinated many people. However, these visions have always relied on non-existent technologies to shape the layout and design of the new technical and organizational systems. Unfortunately, these visions, particularly those put forward by engineers and technocrats, are often fixated on the distant future without precisely envisaging the stages and paths by which to arrive there. Such visionary proposals do counterbalance the short-sighted perspectives of financial players, who focus on current technology and ignore the possible effects of investment in technical knowledge that cannot immediately turn a profit in the marketplace. An understanding of the preconditions for possible changes can be gained by combining these two visions.

Any expansion of international human interaction from a voice-based medium (the telephone) to a medium that carries text, images and eventually multimedia content would promote democracy and the learning-based economy, which are inherently interactive. Interactivity would require a substantial increase in server capacity; with the number of users doubling annually, simply preserving the current level of interactivity will require an increase in system capacity. To allow more space for human interactivity, the medium must not be overwhelmed by advertising in all its forms.

Imagine that at least a few global villages manage to grow and prosper. With direct, real-time interactivity, the speed of interaction on research projects would increase, aiding in particular multidisciplinary research oriented toward problem solving. Health care and ecology, among other fields, would benefit from these advances. In terms of disseminating research results, the impact would be restricted to unidirectional access to scientific journals over the Internet. The impact is minimal because research results are disseminated through a closed, controlled system.[82]

The impact would be much greater if the interactive communications system eventually includes a visual dimension (as in videophone, video-conferencing and multimedia). Adding a visual dimension to long-distance human interactivity would facilitate active learning at all levels of the education system, and would open up new horizons in the health care system.

Students in one area, aided by an instructor, facilitator or tutor, would be able to attend lectures and participate in question periods with eminent foreign professors.[83] The primary and secondary education systems would be required to instil better computer-literacy skills. In the medical field, doctors would be able to observe patients' symptoms as they experienced them. The time lapse between the appearance of the symptoms and the prescribing of treatment would diminish significantly. Health care costs, particularly hospital costs, could thus be reduced. The supplier-customer relationship in short-life-cycle product industries would be supported and facilitated in the areas of planning, design and testing of products, as well as for customized production to suit the special needs of clients.[84] Most of the knowledge-based industries would ultimately benefit from this technology.

Communities would benefit enormously from such a system, particularly if their members are geographically scattered. If the members of a community preferred to meet in the same physical location, the interactive medium could provide a public forum for those unable to be present because of distance. The system would create a kind of "virtual meeting place." Interaction among communities would also be enhanced. On the other hand, interaction of this kind would only be possible by keeping the number of forum participants relatively small through some kind of representation (internal to the community to guard against unwanted intrusion).[85] This suggests that these new forms of governance would rely more on smaller units. Top-heavy, hierarchically structured bureaucratic organizations (governments in particular) would play a less important role. If the principle of subsidiarity holds, a number of organizational and regulatory functions would devolve upon the groups concerned. Several levels of government may find their role reduced to simply co-ordinating relations among the various communities in order to foster consensus or clear majorities on matters pertaining to general welfare.

Obviously, the positive scenarios outlined above all depict the best possible outcomes, while the negative scenarios describe the absolute worst. The reality will fall somewhere between these two extremes. But where exactly?

Will it be closer to the best of worlds ... or to a modest utopia? Will we avoid the worst-case scenarios? These are the questions everyone would like to see answered. To a certain, limited degree we can influence the shape of the future, particularly through infrastructure development. That is the topic of the next section.

Controllable Variables That Should Be Subject To Public Policy

Here we shall discuss only those variables over which the various levels of government in Canada can exercise control. Infrastructure development cannot be considered separately from other policy instruments. For example, regulation and tax incentives can often substitute for costly infrastructure investments, making it possible to achieve the same outcome at lower cost. A policy framework will be proposed (see Figure 11) in which infrastructure becomes an instrument of both demand and supply policy, affecting economic activity, growth, welfare and well-being.

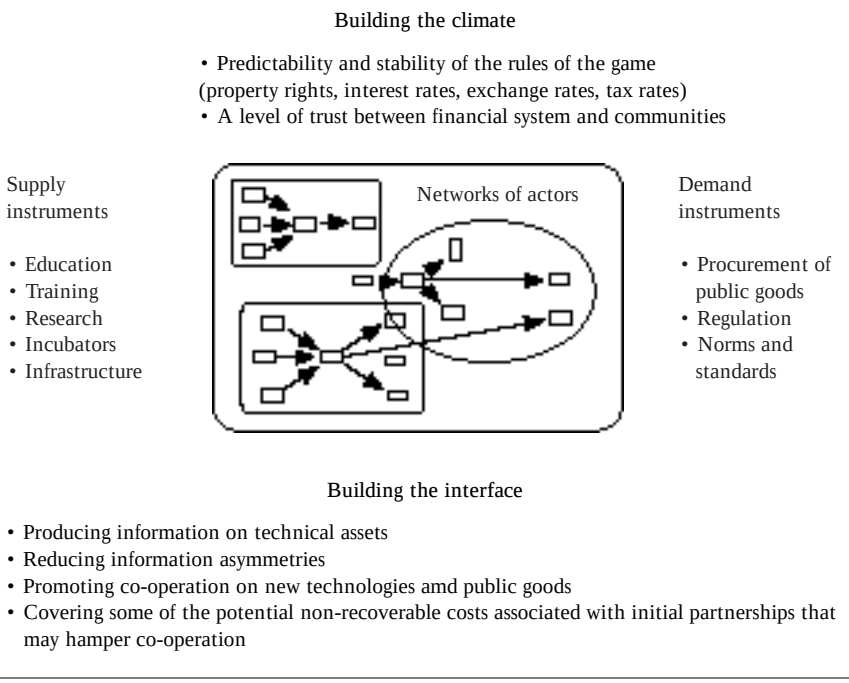
This policy framework is based on the following premise: the creation of new wealth and new knowledge occurs through networks of agents working together toward a common objective on a concrete project. In an economy with high transaction costs, depending on the project, agents working co-operatively utilize the trust and communications facilities that already exist among communities (metropolitan areas, industrial complexes), or else they construct new networks on the basis of existing ones. There are a number of things governments can do to foster this process: they can guarantee a stable financial climate — assuming their debt load is not too onerous — or they can finance the supply of public goods (including infrastructure), stimulate demand (particularly through infrastructure projects), and develop the interface between agents when markets are not equal to the task (including organizing joint infrastructure projects). Just as economic choices must be evaluated in terms of their opportunity cost, all policy instruments must be assessed against their alternatives.[86]

What is the place of infrastructure in this policy approach? The state of infrastructure affects the conditions or climate in which economic transactions are carried out. Infrastructure projects influence demand. They may also enhance the supply of inputs. But, as we shall argue later, the main means available to public authorities to encourage infrastructure development is establishing policies to develop the relational interface among agents and to build bridges between new collaborators. Public services should aim to promote co-operation.

A word of warning to the reader, who may support one or another of our suggestions regarding infrastructure development without necessarily agreeing with our reasons. We shall make recommendations for infrastructure development, which will be highlighted in boxes. These recommendations will be grouped according to the extent that they meet four objectives for the 21st century: fostering participation in the learning-based economy in order to guarantee continued wealth creation; building trust in order to reduce transaction costs; maintaining and improving Canadians' quality of life; and repositioning Canada internationally in response to the shift in economic power and global priorities.[87] We shall end by proposing some general principles for deciding who

FIGURE 11

POLICY FRAMEWORK FOR A TRANSACTION-INTENSIVE ECONOMY THAT RESULTS IN A POSITIVE-SUM GAME



should finance these infrastructure investments, how governments should be involved (if they should be at all), and how fast and how far these investments should be pursued.

We begin by establishing a precondition. Up to now, infrastructure investment has been growing in this country, at least in absolute terms (see Figure 1-A). This does not necessarily mean that infrastructure itself has expanded, because the effectiveness of investment can vary. Are we collectively rich enough to undertake such collective investment? If the answer is no,

FIGURE 12

RATIO OF NET DEBT TO GDP AT FACTOR COST OF FEDERAL, PROVINCIAL AND MUNICIPAL GOVERNMENTS, 1977-95

then the entire question is moot, and we must find alternative sources of investment funds and other ways to make infrastructure more efficient. Looking at the ratio of net debt to gross domestic product over time (see Figure 12), it is clear that we cannot continue to live beyond our means; if we do, financing new infrastructure development will make the threat of financial disaster more likely to come true.

THE PRECONDITION: REDUCING OUR BUDGETARY CONSTRAINT

IN ANY DECISION, the economic calculations begin with this accounting question. At the present time, our lack of funds represents a major constraint.

Lenders are generally favourable to infrastructure investment, because it serves to increase the value of assets. There is no shortage of funds on financial markets. As a borrower, Canada is less risky in terms of its debt load than Rwanda or Bosnia, perhaps even than Italy (although Italy has recently managed to gain control democratically of its political crisis and has started constitutional reform, something that Canada has not managed to do). Assuming constitutional debate finds a peaceful solution and does not dissolve into confrontation, Canada should continue to be a good prospect as a borrower.

Financing infrastructure development through new borrowing, however, is dangerously short-sighted. Incurring higher debt to finance infrastructure would increase our vulnerability to financial crises, make the economic climate even more uncertain and jeopardize past commitments to citizens and immigrants regarding health care universality, minimum income (through pensions,

unemployment insurance and social assistance), education and culture. If these commitments are called into question, all levels of government agree that there is a real risk of "the meltdown of the social glue"[88] (and so of an increase in transaction costs). The idea of more borrowing to finance infrastructure development ignores current problems; it is like sticking one's head in the sand, and it would push the country toward an impasse.

While we need infrastructure investment to prepare for future generations, we should not borrow to do so. We must find the bulk of the funds internally, by getting our financial house in order. This is one of those rare points on which Canadians agree: the debt problem is a top priority. But the solutions so far offered are too timid and only address current deficits, that is, what is being added to the debt. The only concrete success so far is a slowdown in the rate of increase of the current budget deficits. The accumulated debt load continues to rise. We estimate that the total public debt in Canada is already a multiple of the country's total assets.

The boldest strategies so far offered are *to maintain constant the nominal debt* and *to gradually reduce the deficit*. Both these scenarios assume that Canada will emerge from the difficulties via significant and sustained growth — something that is far from certain. Neither of these strategies directly targets the accumulated debt. All these strategies assume that the days of job-creating economic growth (in other words, growth that is more than simply financial) will return and will outweigh any recessions. Yet Canada has been unable to achieve sustained growth even as the U.S. economy continues to post strong growth. Thus these assumptions seem unrealistic. Given that Canada's external debt is growing more rapidly than its GDP, these solutions assume that the country can generate much higher trade surpluses in the future than it does presently.[89]

Since the 1970s, the world (except for Asia) has been mired in a long-lasting recession, although there have been brief periods of growth in some of the AICs and some more sustained periods of growth in the NICs. The countries at the centre of the last long period of economic growth no longer have the internal structural dynamics needed to generate strong and sustained growth. While politicians and economists are loath to accept this diagnosis, even though it at least explains the behaviour of our economies over the past 20 years, they agree that it is dangerous "to put all our eggs into one basket" by betting exclusively on rapid and sustained economic growth to create future jobs. A better guarantee for the future would be a much more substantial reduction in our accumulated debt.

Even if the current deficit were to be eliminated and the accumulated debt were to be stabilized at its current level, growth-based strategies would leave retired people vulnerable to a sizeable devaluation in their assets in the event of a financial crisis. The health care system — a cornerstone of the Canadian identity and something that Canadians wish to preserve at all cost —

as well as other social services would be drastically reduced and no new investment in infrastructure would be possible.

Accordingly, we must investigate more radical solutions to reduce or eliminate the accumulated debt of Canada's federal, provincial and municipal governments in order to free up money to invest in infrastructure development. Let us look at what funds would be forthcoming under various proposals.

1. In a working paper,[90] Raymond Théorêt and Gilles St-Amant propose transferring the federal debt to ordinary Canadians, who would assume the full cost of the public debt and would show more responsibility. This method also has the merit of freeing the provinces from the shackles of the federal debt. The current creditors of the federal government would have to finance the increased borrowing needs of individuals. Were this solution implemented, the anticipated worsening in government finances over the next few years would be headed off, perhaps even reversed. What's more, Canada's public accounts would start to show budget surpluses. Income taxes could then be lowered, providing a boost for economic activity. Each person would contribute according to his or her means. This contribution would take the form of a monthly payment similar to an insurance premium for the preservation of public services (such as universal health care). The federal government's capacity to borrow to finance infrastructure development would gradually grow.

2. At the Quebec economic summit in March 1996, Norbert Rodrigue, chair of the Conseil de la santé et du bien-être, along with Jean-Pierre Bélanger and Paul Fecteau, presented a proposal to reduce Quebec's debt.[91] Inspired by a Manitoba initiative, it called for the creation of a "Quebec Heritage Fund" to pay off the debt of the government of Quebec. The objective would be to collect some $60 billion over the course of 30 years, after which time the debt could be paid off in its entirety. This fund would be created by legislation and built up through special tax contributions graduated according to taxpayers' ability to pay. The fund would be managed by the Caisse de dépôt et placement du Québec. The end result would be an upgrading in Quebec's credit rating, according to the Minister of Finance. The borrowing capacity of the government for infrastructure development would probably increase after the 30 years had passed, and Quebec's capacity to self-finance these investments would also increase, while taxpayers' disposable incomes would decline.[92]

3. In an article entitled "Privatisation rétroactive des RÉER : une solution aux problèmes de nos gouvernements," published in the December 1995 issue of *Revue Gestion*,[93] Luc Vallée suggested repaying one seventh of the federal debt out of income tax deductions granted under

TABLE 4

	Federal or provincial debt?	Who will pay?	How?	Basis of method	Main advantages	Main disadvantages	Ability to fund infrastructure development
Théorêt St-Amant	Federal.	All Canadians.	Monthly payment similar to an insurance premium to preserve public services.	Various scenarios for percentage of debt reimbursement and interest rates are used to obtain a monthly payment over 25 years.	• Public debt better managed; • Monthly payment similar to an insurance premium; • Eventual reduction of individual income taxes; • Canadians made more accountable; • Should promote economic growth; • Commitment of government not to increase debt and to reduce spending.	• Substantially more debt for households; • Social consensus difficult to obtain.	Gradual for the public sector and eventually for households as well.

TABLE 4 (CONT'D)

	Federal or provincial debt?	Who will pay?	How?	Basis of method	Main advantages	Main disadvantages	Ability to fund infrastructure development
Rodrigue Bélanger Fecteau	Provincial.	All Quebec residents.	Annual tax contribution.	Three scenarios for annual contribution and contribution growth are used to obtain various debt-to-GDP ratios over 30 years.	• Compared with direct reduction of borrowings and debt (as in Alberta and B.C.), this proposal allows investment in high-yield securities. • A fund managed by the CDPQ would be high profile and its performance easy to monitor. • Since the fund would be managed by an agency distinct from government, citizens would have more confidence in it. • It would be easier for them to control debt reduction. • This approach could lead to an improvement of perhaps four levels in the Quebec government's credit rating, with a drop in financing costs of up to 35 basis points.	• The direct reduction of spending and debt, in contrast to the fund method, produces an immediate and rapid fall in current debt, which translates into lower borrowing needs. • This method offers savings in management and operational costs, whereas the fund method carries extra costs and requires a greater tax effort. • Another significant disadvantage of the funds approach is that it could lead to uncertainty about yields on predominantly international securities, not to mention the incompatibility between the role of governments and this essentially speculative measure.	• Immediate improvement in capacity to self-finance public investment. • After 30 years, an improvement in borrowing capacity. • Reduced investment capabilities for individuals.

TABLE 4 (CONT'D)

	Federal or provincial debt?	Who will pay?	How?	Basis of method	Main advantages	Main disadvantages	Ability to fund infrastructure development
Luc Vallée	Federal.	RRSP holders.	Tax deductions on income generated from non-deductible payments.	A reduction in the federal debt of $100 billion and an annual decrease in budget deficit of $7.5 billion.	According to Luc Vallée: • Would reduce taxpayers' deductions. • An equitable measure, in contrast to abolishing RRSPs or capital gains exemptions, which are unfair to those who have not taken advantage of them. • Would reduce debt and eliminate provincial deficits. • Would improve the credit ratings of Canada and the provinces. • Would reduce investors' fears of a resurgence of inflation. • Would allow long-term interest rates to fall further. • Would reduce the current-account deficit, reducing our dependence on foreign capital and reassuring investors.	According to Jean Lanctôt: • Lack of synchronization with registered employer pension plans. • Lower tax rate at retirement than at the time the deduction is claimed. • Does not take into account people's retirement planning. • Runs counter to the goal of encouraging people to take responsibility for retirement planning. • Privatization could have unforeseen negative consequences on retirement incomes. • Making the measure retroactive is unfair. • Financial markets would be destabilized. •Risk that governments would use "fresh" money instead of reducing spending.	• Immediate increase in the federal government's borrowing capacity. • Then, gradual improvement through reduction in borrowing requirements.

the RRSP program. He proposed making the measure retroactive in order to utilize all deductions plus accumulated interest held in RRSPs since their creation. (A number of objections to this proposal were raised by Jean Lanctôt[94] in the March 1996 issue of *Revue Gestion*.) Yet even reducing the debt outright by $100 billion would leave the federal government with a far higher debt-to-GDP ratio than that imposed by the European Community on its members,[95] although it would improve the government's ability to borrow to finance infrastructure development.

There is no point in discussing future public investment in infrastructure unless funds for such investments are freed up one way or another. The three solutions mentioned here — the only ones, to our knowledge, that directly address the accumulated debt — may not even be enough. It may be that the only course is shock therapy, an expression currently in vogue at the International Monetary Fund and the World Bank.[96]

In addition to our inherited debt problem, we also need to take a long, hard look at the institutional framework or the rules of the game that have permitted, even encouraged, the development of this heavy mortgage on our collective future. A number of possibilities should be examined, including financial reform and modifications to the Bank Act. In particular, the legislation does not favour the creation and development of business banks — investment-oriented banks that are able to undertake long-term infrastructure investment projects. Having examined our precondition, we shall now make some concrete infrastructure investment proposals based on four selected objectives.

OBJECTIVE 1: TO INCREASE OUR PARTICIPATION IN THE LEARNING-BASED ECONOMY

OUR CAPACITY TO ABSORB AND ASSIMILATE NEW KNOWLEDGE basically depends on our educational attainment and training. Economists call the accumulated stock of knowledge human capital, and they have found that sustained growth and development depend to a large extent on a high and rising level of human capital.

According to developmental psychologists, a large part of human knowledge is acquired in the first five years of life. Yet we still have no education system in place for preschoolers. Day care centres employ underpaid staff who, although they may be qualified as day care technicians (when they're qualified at all), are rarely trained as educators. All too often, children are left to their own devices to develop their abilities. The experience of at least two countries is pertinent in this regard. In France and China, children learn to read, count and develop a broad range of skills (gross and fine motor, musical, spatial, social and reflective) before they reach school age.

- A preschool education system for young children (aged 2 or 3 to nursery school).
- Provincial institutions for training preschool educators.

These two initiatives are complementary. The success and relative usefulness of the first depends on the second. The impact would be far-reaching: children who learned to read in preschool and Grade 1 could learn faster; the primary school system and its teachers would be able to raise the level of their programs; new jobs for specialized educators would be created; at least one new institution would be created in every province[97]; all children aged two to three would benefit from the same education, regardless of their family's income, educational attainment and culture. (We shall see later that an educational infrastructure initiative such as this should be co-ordinated with an urban renewal program. Preschool institutions must be located in residential areas close to both single- and two-parent families, so that both home and school settings reinforce the incentive to learn.)

The second weak link in our education and training system is at the secondary level. This is not a matter of infrastructure; there are already enough buildings (which are often underused), and enough teachers. However, secondary schools do not offer complete environments for life and learning, with integrated activities aimed at the multidimensional development of adolescents. The problem clearly lies in the curriculum, pedagogy and design of secondary programs, and in teachers' low social status and lack of power within the community. To address these problems, excellence programs need to be developed, tested in pilot projects, and then implemented following evaluation, adjustment and social choice.

- Evaluate and implement programs to raise the quality and performance of secondary education in order to reduce drop-out rates and eliminate functional illiteracy.
- Evaluate and implement programs of excellence in order to increase the skills and basic knowledge of secondary teachers and to enhance their social standing.

Again, the two investment objectives noted above are complementary. One of the benefits would be to create several successful examples showing how the secondary education system can be improved, and the development of both adolescents and teachers enhanced.

The third weak link in our education system — and the authors as, respectively, teacher and student would like to stress this point — is the lack of pedagogical training and, more important, professional development for college and university professors. Right now, there is nothing. University professors are automatically assumed to be experts in pedagogy; it is as if a music lover who had listened to opera all his life were suddenly sent on stage to sing a complete

opera! We shall not go here into the self-defeating nature of the university incentive system, nor the possible improvements in teaching quality.[98] Provincial governments could offer grants conditional on the reform of these incentives and recruitment practices. Universities are being increasingly called upon to broaden their functions (training, instilling knowledge, advanced research, resolution of social problems).[99] But it is not obvious that a single institution can fulfil all these functions simultaneously. Perhaps the time has come to redesign our institutions. Infrastructure investment is clearly not the best tool for the purpose — at least not until a comprehensive review has been undertaken.

To gain access to knowledge and to reposition ourselves internationally (specifically, to penetrate the new Asian markets) we must train the next generation to be multilingual, particularly in Asian languages (first Mandarin, the most important language of Asia, but also Japanese, Korean, and Malay) as well as Spanish and Portuguese.

- Establish training institutions for modern languages.
- Establish two institutions for training language teachers.

Private language schools only meet part of the need for multilingual training, and only in a superficial way. Their rates are so high and their courses so short that for many young people learning a foreign language remains an impossible dream. All universities should have their own language schools to facilitate contact with other cultures, make it possible to carry out research and pursue studies in other countries, and in short to develop the skills needed to interact with these countries. Universities should not relinquish this area to the private sector (after all, it is quite lucrative). We believe that the reason they are doing so today is the university incentive system (we offer this hypothesis as language students). For example, if publishing an article on China garners more academic recognition than teaching Mandarin, then everything associated with this foreign culture will have greater priority than training in its difficult language. The wisest course would probably be to set up independent language training institutes, like professional schools. At the same time, at least two institutions for language teacher training should be founded, with an emphasis on language pedagogy. One would be for Anglophone students, the other for Francophones. Both the language teaching and language teacher training institutes could be set up in collaboration with similar organizations in other countries. This would facilitate immersion programs, teacher exchanges, and so on. The Canadian International Development Agency (CIDA) could assume some of the responsibility and costs associated with such a project.

As we noted earlier, at present the three levels of education do not inculcate basic computer skills. We feel that simply installing large numbers of computers in schools is not productive. It would be better to develop ways to use computers and the Internet in classrooms, and to integrate these technologies

into pedagogical and professional development programs. Infrastructure investment in research, development, testing and evaluation to demonstrate to students the unique possibilities offered by computer technology would probably achieve the desired aims at essentially the same cost.

- Invest in research, experimental development and evaluation of software and Internet technologies for pedagogical and professional development programs, with the aim of developing useful applications.

In our opinion, what is limiting the use of the Internet is, first, a lack of content and applications and, second, a lack of functional computer skills. At this stage, we do not need more experiments, because the necessary skills undoubtedly already exist in Canada. But the fact that the various levels of government are spending large sums of money on computers indicates that infrastructure investment priorities need to be reviewed.

Knowledge grows with greater openness to the world, and scientific research requires international interaction. The Natural Sciences and Engineering Research Council (NSERC) has now discontinued its special financing for international programs involving international consortiums. Other programs allow researchers to pursue similar activities should they wish to do so. In other words, no special incentive was judged necessary to promote the international character of research. However, we must ensure that part of the Internet can support international networks by providing real-time human interaction; this is more a question of regulation[100] than of infrastructure development, in our opinion. Public investment should not be used to promote interactivity until the possibilities of using regulatory instruments to this end have been exhausted. Software performance must be improved, however. Compatibility of computers and software is in the public interest, since this facilitates communication among people. And the development of better hardware and software must be parallelled by the development of gateways to link new and existing facilities so as not to squander the benefits of past investment.

- Experimental development of “intelligent” tools facilitating searches, the dissemination of information and human interaction on the Internet in order to promote the participation of students, teachers and researchers in international research networks.

The most appropriate policy instrument here is regulation. A substantial part of the costs could be assumed by the software industry, with public agencies, scientific establishments and universities as their clients. Perhaps in this particular case, public funds could be used to help develop and launch the process, leaving the marketing to the private sector.

Similarly, in the area of technology, there is no shortage of data bases for keeping abreast of technological progress (on the Internet and elsewhere). What is lacking is the software to consult these data bases. They are still hard to use, user-unfriendly and rather inefficient. While large corporations may have the funds to acquire effective tools, small business and aspiring entrepreneurs are generally left out. Much of this information is already available through expert networks. These communities of experts could organize themselves into self-supporting technical consultation groups, offering small firms preferential rates partly financed by governments. Here again, the initial investment would be on an experimental basis with a limited number of client-users, in order to develop the necessary tools and to reduce the non-recoverable costs of organizations responsible for delivering these services. Canada, it must be noted, fulfils this role less well than Japan, Brazil or France ... which may lead to an eventual technological gap.

- In co-operation with industrial associations, establish user-friendly and "intelligent" technology monitoring systems in order to allow small and medium-sized businesses and individuals (who are potential entrepreneurs) to keep abreast with the latest technological developments and to disseminate information on their own projects.

We have seen that it is the lack of useful applications that is limiting the use of the Internet. Even after adequate application technologies are developed for this purpose, an access problem may develop. By that time, however, guaranteed access to the system may be a thing of the past. When applications are available for all segments of the population, access may make the difference between participation in or exclusion from the learning-based economy. Potential access may be improved by establishing standards for computer performance and, especially, for systems compatibility. Suppliers of new systems (including software) must try to preserve the value of legacy systems by providing gateways to link the data bases of yesterday to the systems of tomorrow.

Regulation may help bring this about. New-system suppliers, too, will benefit from most of the externalities offered by such gateways. The CRTC has a central role to play in this regard; it needs to take these considerations into account as well as those related to infrastructure development to guarantee physical access, functional computer access, linguistic access and interactivity. The establishment of regulatory compatibility standards is thus a way to maintain flexibility and preserve future options. Compatibility standards between systems also aim to support and preserve network externalities as well as earlier investment by the agents so as to reap the full benefit of these externalities. These considerations become particularly important given current uncertainty about the global communications system. Two oligopolistic groups (the telephone companies and the cable companies) are vying for the privilege of setting the standards. Governments are not in a position to assess which system

would be better. The public interest (and the network externalities) would be better served by inter-system compatibility and gateways. Public infrastructure investment has no role to play in this regard, in our opinion, and it cannot support the existence of competing systems. Arrayed against consortiums such as British Telecom–MCA–Nippon Electric, any Canadian initiative is doomed to failure.

Yet infrastructure investment in the Internet, even on a modest scale, will be crucial. During the period of system rivalry, public institutions will have only a narrow window of opportunity to act and acquire information. Moreover, opportunities for acting and for acquiring information may not coincide. This means that system rivalry must be closely monitored.

- Finance research on the development of system architecture; manage issues of access, performance, applications, privacy, rights and ethics raised by the Internet and the global communications system, with the aim of opening up more channels for information and more opportunities for public institutions to act effectively.

Investment of this kind can be considered a kind of technology monitoring, but it also seeks to protect the public interest. While a broad spectrum of users will play an important part in the technology monitoring, at least one thrust of the initiative must focus exclusively on public policies and regulation.

Such infrastructure development links participation in the learning-based economy with building the trust needed to bring down transaction costs. Interactivity is a particularly promising avenue for reducing transaction costs, not only for international networks but also for communities whose members are physically distant from one another. Some of these communities (industrial, professional, for-profit organizations, etc.) have the means to finance their own tools, while others (non-profit organizations, etc.) do not. Some may be in a position to assume the costs of operating and upgrading existing systems, but most do not have the resources for developing and testing such tools. Providing these communities with the necessary means will serve the public interest by helping to speed up the learning process and to build a climate of trust.

- Develop experimental “intelligent” software designed to facilitate interactive exchange, with the aim of creating public forums, guiding communities and fostering dialogue between community members.

OBJECTIVE 2: TO ESTABLISH AND MAINTAIN A CLIMATE OF TRUST

A CLIMATE OF TRUST COULD HELP REDUCE TRANSACTION COSTS, maintain a stable institutional framework, and increase the possibilities of interactive learning and co-operation, to facilitate joint creation of new products, new processes and new technological knowledge.

We have already discussed the importance of maintaining a climate of trust in our existing institutions in order to guarantee the respect of past commitments. Universal access to health care provides a good illustration of the difference between Canadian and U.S. values. Recent surveys reveal how important these values are to Canadians: they are considered a priority that outweighs even deficit reduction. And these values are shared by all Canadians, including Quebec sovereignists, Aboriginal people and advocates of centralized federalism — as well as those who favour less extreme constitutional reform options, of course. If this historic commitment is reneged upon, Canadians may lose confidence in their political institutions. A part of the country's social glue will deteriorate — as will Canada's cultural distinctiveness within North America. The resulting climate of mistrust will drastically elevate transaction costs. In our view, governments are "playing with fire" by tampering, consciously or unconsciously, with universality. All efforts to instil a climate of trust will come to naught if we remove the guarantee of universal health care or established rights to retirement pensions, unemployment insurance and education.

In our discussion of the previous objective, we noted the importance of promoting and strengthening democratic governance within communities while fostering interaction among communities. Constructing gateways and making modest investments to promote the use of the Internet furthers these objectives. These are relational investments. In our policy framework, the expanding role of *infrastructure* is accompanied by the development of *interfaces*. In addition to investment aimed at renewing and reorienting education and training, a significant share of investment is i*nstitutional and relational*, because there is a risk that communities, despite their advantages in terms of transaction-cost competitiveness, could slide into an unhealthy inwardness. It is thus important to put mechanisms in place to allow actors from different communities to interact; this is what we mean by interfaces. Relational investments of this kind are likely to be non-recoverable costs. Public financing may thus be called for to ensure that this factor does not prevent these projects from proceeding, and to reduce potential friction between existing communities, and between such communities and new groups of actors. Once these relationships are established, co-operation is possible with little or no non-recoverable costs.

This approach relies not only on the vertical disintegration of government functions (those vestiges of "Big Brother" that are increasingly criticized by citizens) but also on acceptance of the *principle of subsidiarity*, according to which governing should be performed at the lowest level, by the unit closest to

the base, following its own processes of self-management.[101] The current pre-election rhetoric makes passing reference to *subsidiarity*, albeit in a somewhat diluted version. According to Gordon Gibson:

> *It is thus not correct to see subsidiarity as being a principle applicable only to governments. In fact, the first test for any proposed government activity is whether government should be in the particular business at all.*[102]

In the original meaning of the term, governance includes business and public affairs. Many communities are capable of self-governance and are eager for it. In order to downsize administrations in Canada, therefore, a general devolution of functions must take place wherever possible. Without such an undertaking, all efforts by the various levels of government to encourage joint ventures between communities or governments in order to build a climate of trust will simply not be credible.

If the conditions laid out here are met, there are a number of joint projects that can help to build (or rebuild) a climate of trust. Before discussing these projects, we shall look at another important institutional and relational investment that is needed in a world of technological change where the impacts of artifacts can sometimes turn out to be negative.

- In urban neighbourhoods and towns, set up special forums where the various technical alternatives can be weighed by the citizens who will be affected by these choices.

Much of the mistrust and apathy that citizens feel toward today's political processes stems from the fact that they have no part in most of the decisions that affect their day-to-day material lives. For them, the democratic process is not real. For example, the decision to build an incinerator, nuclear station, landfill site and so on is generally not debated during political campaigns. By the time citizens learn about these projects in the press, they sense that the decisions are already made. And these are decisions that directly affect their lives. To help them transcend the instinctive "not in my backyard" reaction, citizens should be encouraged to examine all sides of the alternatives and to participate in the decision-making process.

A clarification is in order. This is not simply a matter of giving communities the right to block projects but of inviting them to participate in the start-up and design phases of the projects, to help identify the needs and define the priorities. In this way the project benefits from the backing of the entire community. The traditional approach of regulation, with mandatory public hearings based on the adversarial principle, should be replaced by institutions that allow *ex ante* consultation and co-operation.

Our governments' failures reflect the fact that in our democracies, the descendants of the Age of Enlightenment, rights related to technical choices

are not clearly defined. These are residual rights. At the same time, we face a legal battle over rights and privileges, one that pits users, clients, local actors (including citizens), promoters and the various levels of government against each other. All our institutions and levels of government set up ad hoc commissions (with their very high transactions costs) to seek out compromise. We suggest that the current institutional crisis provides an opportunity to make democracy more concrete and to integrate citizens into the evaluation and decision-making process for technological infrastructure projects, particularly projects that concern the general quality of life and the environment.

As Mark Roseland suggests, these issues should be dealt with at the local level.[103] Federal and provincial commissions of inquiry — such as the Berger Commission — are too slow to react and too far removed from the concerns of citizens. A number of recent experiments are instructive in this regard. For example, Montreal's Bureau des audiences publiques en environnement (BAPE) co-ordinated a weekend evening television program and public forum on waste recycling. This type of public forum should be made a permanent institution at the municipal level. It should be supplemented by a petition mechanism to allow a certain percentage of citizens to force social assessment of the technical options before a decision is taken. Ultimately, citizens could have the power to require that a particular decision be put to a referendum.

An institution of this kind would serve to integrate citizens into the conception and design, the choice and the implementation of majority decisions. Building bridges between the various communities will involve some high transaction costs, because transaction costs among communities are always high. No technological infrastructure today involves a single community. As an institution for interface, the public forum will help build an atmosphere of understanding and trust among communities. These institutions could look into local issues or examine larger projects.

We shall now examine some collective initiatives that can help build a climate of trust. We shall restrict our attention to projects that are already under way, involving various municipalities or levels of government.

Objective 3: To improve our quality of life and our environment

Among major infrastructure projects, the most important are clearly those that make it possible to maintain and improve our quality of life while tackling some of Canada's environmental problems.

- Establish the infrastructure needed to gradually replace fossil fuel–powered urban transit with electric transportation.
- Put in place an interurban electric-rail system to replace the noisy and polluting aircraft-based system for short-distance travel.
- Extend urban recycling and reuse programs.
- Restore the multiple uses of water resources (lakes and rivers).

TABLE 5

Activities	Problems	Functions
Research	Water pollution	Clean-up
Monitoring and follow-up	CO_2	Recycling
Development	Dioxides (nitrogen, etc.)	Reuse
Experimentation	Hazardous waste	Repair
Testing	Deforestation	Recovery
Demonstration	Desertification	Conversion
Evaluation	Soil depletion	Replacement
Discussion	etc.	etc.
Choice		
Investment		
Operation		
Training		
Education		

The above-noted infrastructure projects are only examples; many other projects would also be worthwhile. They should all be evaluated according to their costs. Their relative priority will vary from one community to another. Each project combines an activity, a function and a specific sustainable development problem.

Each of these projects is necessarily joint. The number of shareholders, levels of government, industrial firms, financial institutions and community groups involved will vary. The experience of meeting goals and fulfilling mutual commitments (even if only partially) will help build capital and develop trust between persons in different organizations or communities, which then can be utilized for future projects. Some of these projects will bring new participants into the labour market.[104] The management of new projects could be gradually ceded to a new institution (unless a suitable one already exists), which would eventually assume complete responsibility for operating the infrastructure, once it is in place and self-sufficient.

Note that the rationale behind these projects was laid out in the previous two parts of this paper. All of these projects are aimed at cleaning up the environment, converting older polluting technologies into ecologically sustainable ones, and improving our quality of life (Objective 3). Bringing them to fruition would benefit all parties concerned.

Projects to improve environmental infrastructure have multiple benefits. The environmental industry is one of the few (along with telecommunications) that can boast consistent growth. It is a new, high-growth industry where Canada is rapidly establishing its reputation. It also has an important advantage over other high-growth industries: it includes not only several knowledge-intensive sectors (control technology, nuclear waste disposal, research into fluorocar-

bon substitutes, etc.) but also labour-intensive activities. It is a sector of job creation. Its growth transcends the dichotomy between an R&D-intensive sector with high growth and a stagnant, marginalized sector that perpetuates poverty.

Improving our quality of life is not limited to eliminating pollution. Most Canadians live in cities or large urbanized areas. These locations are experiencing the dangerous "doughnut hole" syndrome: the city core deteriorates and slides into poverty and criminal activity, and once these forces have seized the centre, they expand outward, eventually reaching the suburbs. This syndrome is not as common in Canada as it is in the United States, where some city centres resemble bombed-out European cities after the Second World War.

It has been suggested that the disintegration of the family lies behind this social deterioration. But that phenomenon is as much a symptom as a cause. The modern nuclear family no longer enjoys a safety net in the form of an extended family or a local community. It is these local communities and urban neighbourhoods that must be rebuilt, by systematically equipping them with facilities for preschool education, social assistance and retirement. Examples like the city of Verdun show how community initiatives can reverse the effects of poverty. And the municipal, provincial and federal governments must allow, if not encourage, the development of neighbourhood facilities to support communities' economic growth.

Canada enjoys a relative advantage over the rest of North America in the quality of its urban life. We must redouble our efforts to maintain and improve the viability of our city centres — the hearts of our cities. Some of the relevant policies here do not require new infrastructure. For instance, suburbanites who use city-centre facilities should contribute to their maintenance and renewal. Automobiles that travel daily from suburb to city centre could be systematically recorded and taxed, without tolls, like the system used for rolling stock for over 10 years.

The changing population structure generates new housing needs. Given the rising proportion of retired persons and the possibility of delivering health care and social services at a distance, it is only logical to leave retirees in their communities and to decentralize health-care delivery mechanisms. The growing proportion of single-parent families is transforming housing needs. Lastly, an increasing number of independent working couples are seeking the integration of their home and working environments. One of the best ways to counter the spread of gangrene in large urban centres and to build or restore a climate of trust is the renewal of small neighbourhoods with their own public areas.

Urban infrastructure in city centres:
Experiment with:

- new forms of housing;
- environmentally sound reconstruction;

- decentralized siting of retirement homes, health care facilities and social services within users' own neighbourhoods;
- neighbourhood public areas.

These initiatives would help attract external investment from knowledge-intensive firms. Such investment capital is now less attracted by the availability of production inputs than by the quality of urban life and amenities for employees, as well as the suitability of transportation, science, technology and education infrastructure. Several Canadian cities present distinctive advantages in this regard within North America.

Another cautionary note must be sounded here. The key to improving the quality of life is reducing social alienation, which is manifested in our society by the high incidence of suicide, unemployment and long-term social assistance, television addiction, drug abuse and crime, particularly family violence. Chronic unemployment leads to intellectual, emotional and physical stagnation, creating an underclass of marginalized and excluded people. Accordingly, we must turn our attention to the problems associated with creating stimulating jobs, with education and with the financing of public institutions.

Objective 4: To reposition Canada

We have stressed the importance of creating modern foreign language institutes in order to benefit from the burgeoning economic growth of the Asian and Latin American NICs. Canada must reposition itself in our evolving world, not simply in geographical terms, but in a much more fundamental way.

When the United States was the main promoter of the open multilateral trade system, Canada profited handsomely from its efforts. This is less and less true now. Even from a strictly intellectual point of view, most U.S. thinkers (with the possible exception of Paul Krugman) who deplore the new protectionism championed by the U.S. Department of Commerce are foreigners residing in the United States (for example, J. Bhagwati and A. Dixit). If Canada is to play a more independent role by defending and extending the open multilateral trade system, it must make its own investments and it must encourage capable intellectuals to articulate the underlying rationale for this international policy thrust. At the same time, new avenues are emerging for international relations, having to do with the exchange of knowledge, ecology, the private sector, cultural rights and the politics of identity, as well as military balance in the absence of hegemony, the continental shift in the focus of the world economy, etc. These avenues must be explored in order to find firm foundations for the existence (or lack) of mutual gains and global welfare — foundations on which to build international policies. To play an independent role in the world, Canada needs interdisciplinary centres of excellence that can attract the world's best researchers as well as the most brilliant young minds, in order to

generate the critical intellectual mass needed to explore the future of international relations.

- Establish interdisciplinary centres of excellence associated with universities, with a mandate to study international relations issues.

The Centre for Human Rights in Montreal, set up by the previous federal government with Ed Broadbent as founding director, demonstrates the usefulness of an independent, multidisciplinary research group exploring policy solutions to problems in order to provide support for foreign policy.

The foregoing points target what we feel are the key areas for infrastructure development. It is not meant to be a comprehensive or prioritized list. In addition, the cost implications of these proposals have not been assessed. Our aim, as requested, is to stimulate debate and discussion about long-term perspectives. We would like to conclude by addressing the following points: Who should assume the costs of infrastructure development? What form should governments' commitments to public infrastructure investment take? And how urgent are these investments?

WHO SHOULD BEAR THE COSTS?

WHO SHOULD FINANCE AND ADMINISTER which new infrastructure projects? In our opinion, infrastructure development should be the responsibility of those groups, either public or private, that benefit from the results. In accordance with the principle of subsidiarity, management should be provided by the authority closest to the user. If a group of potential users (an industrial association, a group of municipalities, etc.) has specific infrastructure needs, it should raise the funds and make the investment itself without straining the public purse. Only when absolutely every facet of society will have unfettered access to the infrastructure should public funding be considered. When infrastructure development by a particular group of actors benefits society as a whole but the sponsoring group cannot profit monetarily from the wider benefit, the group does not take this aspect into account in its investment decisions and will underinvest; in that case, government involvement may be warranted. Responsibility for the project should devolve on the level of government closest to the citizens concerned. This means that the lowest level of government would have the social taxation powers needed to carry out projects requiring public funds, just as it would be responsible for ensuring that projects receive public approval through public hearings, and for social evaluation of the technologies involved.

In the event that the government cannot or will not invest in infrastructure development, the private sector must take over. In the 19th and early 20th centuries, most infrastructure development was made by public-private part-

nerships. It was only in the last 50 years or so that government took over most of the responsibility for infrastructure development and investment.

There are exceptions, however. In southeast Nigeria, for example, there is a flourishing industrial district called Nnewy. Because the generals in power divert virtually all public funds, industries are left to themselves to build the roads and sewer systems they need. If private infrastructure investment can work in a developing nation, then it should work in industrially advanced countries as well.

As vertical disintegration proceeds in current government functions, some responsibilities could be assumed by private interests (as suggested by Gordon Gibson). For example, professional training (accounting, specialized management, engineering, etc.) that serves only one occupation or group of industries should be financed by professional or industrial associations. Only that share of education that has an impact on society as a whole should be publicly funded, such as general education, research, basic science and general engineering. For example, it is clear that introductory training in chemical engineering and all basic research in this field should be financed from the public purse, but the chemical industry is quite capable (and in a better position) to finance specific training in applied research, both in universities and within companies.[105] Even if by some miracle our governments eliminate all their debt and so are in a position to finance these activities, it would be neither logical nor efficient for public funds to be used for this purpose. Use of public money should be limited to helping launch specialized training programs (like Montreal's Centre de calcul appliqué).

The public arena is not limited to public administration and government. Coalitions, associations and alliances, with the support of the public authorities, can do much of what governments used to do but can no longer. Does this mean that the public sector no longer has a role to play? On the contrary, it should foster co-operation on infrastructure projects, provide the catalyst for the formation of coalitions, alliances and consortiums, work to reduce transaction costs between new partners, etc.; it should assign public employees to these tasks, and should establish the relational capital of trust among agents. Without this kind of relational investment in human capital and trust capital, infrastructure projects will never get off the ground.

- Support and encourage relational investment in order to lower the initial transaction costs of possible collaboration.
- Build relational capital in order to establish a climate of trust conducive to co-operative ventures.

Institutional investment of this kind should rely on existing public resources. It should involve no additional spending, but should be based on using resources more efficiently. Such interfaces or bridges can be constructed

by governments at the request of private firms or on the model of a policy to protect public goods.

This approach calls into question the current policies of Canadian governments, which deliberately stand back from the process of wealth creation to act instead as the final arbiter of the public good. Public services should have a pivotal role to play as catalysts or convenors, skilled in creating new solutions to common problems.

If we cannot evolve beyond the current institutional paradigm — confrontation followed by government intervention — we shall inevitably suffer the effects of underinvestment and wasted energy. It is curious, for example, that while Canada is the North American leader in high-speed rail technology, we have not managed — largely because of intergovernment rivalry — to construct a rapid-rail service linking our two main cities.

WHAT SHOULD BE THE CONTRIBUTION OF PUBLIC FINANCES?

IN THE PAST, virtually all infrastructure development was indivisible and massive, involving projects such as railways, airports, dams, etc. But in the age of miniaturization and knowledge-based products, this is no longer true. Economically efficient infrastructure investment takes place in cycles. Public funding may only be necessary to prime the pump, with further investment coming from private interests. The role of public money is thus twofold: initiating and nurturing the process.

Investments should be short-term; in both planning and execution, they should be mainly experimental. After a few years, the results should be evaluated jointly by the primary users and potential beneficiaries. If the parties involved decide not to financially commit to see the project through to completion, the project should be abandoned. Because infrastructure projects represent long-term options for future profit-making activities, the probability of users' abandoning their initial investment is very low.[106] Periodic evaluation of costs over the entire life cycle of the infrastructure, including its eventual disposal, can lead to the abandonment of a project that involves negative externalities. In a world undergoing rapid technological change, where adaptability has become the crux of the process, public funds can no longer be committed decades in advance. The public sector must be able to re-assess its choices ... and change its mind.

HOW QUICKLY SHOULD THESE INVESTMENTS BE MADE?

WE HAVE STRESSED THAT THE MOST URGENT NEED is not infrastructure development but bringing order to our public finances. Given this priority, obviously some projects are more important than others. Some are in fact urgent because a system is degrading rapidly, and the longer it is postponed, the more difficult and costly will be the solution. In our view, there are three areas of urgency:

1. The most pressing area for infrastructure development is the preschool system and the need to improve secondary-school education and training.
2. Given their rapid deterioration, it is urgent to address the problems of city centres and their environmental problems (such as water pollution).
3. One area of infrastructure development that must be addressed immediately (even if it must be abandoned should international standards be developed) is research into architectures and standards for the Internet and the global communications system as a whole. Once the standards are determined, there will be no further point for investment in this area.

There are a number of investment areas that are important today and will remain so in the future, such as the establishment of foreign language teaching institutions. Other types of investment that are impossible today because of budgetary constraints will still be worth pursuing tomorrow, even though it would be better to begin immediately.

We hope that this text will serve as a catalyst for reaction and discussion.

NOTES

1 This paper was originally written in the summer of 1996.

2 For a summary of recent debate on this issue, see John F. Helliwell, "Infrastructure and the Economy: Evidence and Implications," *in Infrastructure and Competitiveness*, Kingston: John Deutsch Institute for the Study of Economic Policy, 1993, pp. 451-83.

3 Robert Heilbroner. "Seize the Day." *The New York Review of Books*, Vol. XXXVIII, No. 2, February 15, 1990, pp. 30-31.

4 Politicians responsible for infrastructure development are often no longer active in politics when the impact of the investment becomes visible. Politicians wishing to make their mark on history find it easier to erect a monument in their own names.

5 Nikolai Kondratieff, "The World Economy and Its Cycles During and After the War" (Russian), *The Long Wave Cycle*, New York: Richard and Snyder, 1984 (1922c); see also Christopher Freeman, *Long Wave Theory*, Edward Elgar, 1996.

6 Given that the focus of our infrastructure development favours education and institutions over transportation and communications, this is not necessarily true. The effects persist in the long term.

7 Chris DeBresson, "Technological Innovation and Long Wave Theory: Two Pieces of the Puzzle." *Journal of Evolutionary Economics*, Vol. 1, pp. 241-72. Reprinted in Christopher Freeman, *Long Wave Theory*, Edward Elgar, 1996.

8 Peter Wylie, "Infrastructure and Economic Performance: Comment," in I*nfrastructure and Competitiveness*. Kingston: John Deutsch Institute for the Study of Economic Policy, 1993, pp. 205-10.

9 Christian DeBresson, *Economic Interdependence and Innovative Activity*. Edward Elgar, July 1996, Ch. 1, pp. 3-15.

10 The term "learning-based economy," in our view, reflects better than "knowledge-based economy" the intrinsic cumulative dynamics of the phenomenon.

11 *Science, Technology, Industry: The Knowledge-Based Economy*, Paris: OECD, 1996.

12 World Bank, *World Development Report, Infrastructure for Development*, New York: Oxford University Press, 1994; Gregory Tassey, *Technology Infrastructure and Competitive Position*, Dordrecht: Kluwer Academic Publishers, 1992.

13 We distinguish between welfare and "well-being" following the example of Armatya Sen, an economist specializing in social choices and development. In his book *The Standard of Living* (Cambridge: Cambridge University Press, 1987), Sen argues, for example, that a Latin American peasant with no land and no income has less welfare than a young black living in a U.S. inner-city ghetto; however, the same peasant has better well-being than the young black in terms of life expectancy, suicide rate, probability of violent death, exposure to crime and drug addiction, risk of imprisonment and rate of unemployment.

14 United Nations Development Programme (UNDP), *Human Development Report 1995*, Paris: Economica, 1996.

15 UNDP. *Human Development Report 1995*. Paris: Economica, 1996.

16 A.K. Sen. *Poverty and Famines: an Essay on Entitlement and Deprivation*. New York: Oxford University Press, 1981.

17 We are aware that this perspective is completely at odds with current political rhetoric. What we must demand — and promise — is not new jobs, but better jobs for a better quality of life, and for all citizens.

18 There is another factor that could provide the necessary support for strong growth: a massive wave of immigration into Canada. However, this would require a fundamental change in Canadians' policies and attitudes.

19 It took more than a century for glorious Albion to accept the end of its economic hegemony, and British politicians wasted enormous effort and resources in refusing to recognize the inevitable.

20 British universities retained their international reputation long after the economic decline of the United Kingdom.

21 Because of the structure of economic advantage and status symbols, professions such as law and finance have become more attractive than engineering, which is no longer the ticket up the social ladder that it once was.

22 Robert Heilbroner. "Seize the Day." *The New York Review of Books*. Vol. XXXVIII, No. 2, February 15, 1990, pp. 30-31.

23 Within NAFTA, Canada has an advantage because large areas of the United States have become nothing more than reservoirs of cheap, unschooled labour, while Canada still ranks relatively higher in terms of wages, with higher educational attainment levels.

24 On the terms *sustainable development and sustainability*, see Jean-Guy Vaillancourt, "Penser et concrétiser le développement durable," *Ecodecision*, Vol. 15, winter 1995, pp. 24-29.

25 In 1991, Canada emitted 118.1 million tonnes of CO2 from mobile sources, 148.6 from energy production and 97.3 from industrial activity, making the country the sixth, fifth and fifth largest emitter in the world in these categories, respectively (UNDP, *Human Development Report 1995*, Paris: Economica, 1996, p. 231).

26 Canada emitted 5 billion tonnes of NO2 and SO2 (UNDP, *Human Development Report 1995*, Paris: Economica, 1996, p. 231).

27 UNDP, *Human Development Report 1995*, Paris: Economica, 1996, p. 231.

28 In 1991, Canada produced 1.3 million tonnes of nuclear waste and 6.08 million tonnes of other hazardous waste (UNDP, *Human Development Report 1995*, Paris: Economica, 1996, p. 231).

29 Canada is fortunate enough to rank third in the world (behind Iceland and New Zealand) in terms of renewable water resources per capita: 106 000 cubic metres per year (UNDP, *Human Development Report 1995*, Paris: Economica, 1996, p. 231).

30 Canada recycles only 20 percent of the paper and cardboard it consumes, and 12 percent of the glass: this is one of the worst performances among the 20 industrialized countries supplying this information (UNDP, *Human Development Report 1995*, Paris: Economica, 1996, p. 231).

31 UNDP, *Human Development Report 1995*, Paris: Economica, 1996, p. 21.

32 Jaddish Baghwati in *The World Trading Systems at Risk* and Paul Krugman in *Pop Internationalism* have recently argued that treating competition strictly as a zero-sum game is superficial and mercantilist. Through mutual co-operation to liberalize goods trade, countries increase their mutual welfare. The liberal economic system is essentially co-operative, based on a recognition of the relative differences and advantages of each party. In this way, a larger quantity of goods can be produced and consumed. This is a positive result of co-operation governed by trade regulations.

33 Human interaction is the cornerstone of a learning-based economy. This has important implications for public policy regarding the Internet. Note, however, that

"human interaction" should not be confused with "interaction with a computer program."

34 The best known zero-sum game, because of its mathematical interest, is the prisoner's dilemma. In the case of two accomplices who are imprisoned and isolated from each other, should they co-operate with the police and denounce each other? When discussing learning and knowledge creation, however, the stag game model shown in Table 2 is a better analogy. The only difference in these two zero-sum games is the order in which the disadvantaged actor's benefits are classified. In the latter case, by repeating this game, the actors learn to maximize their benefits and rapidly move toward a co-operative model (more often than in the prisoner's dilemma model).

35 DeBresson, C. "Les entrepreneurs n'innovent pas (seuls); seuls des réseaux d'entrepreneurs peuvent innover." Montreal: McGill University, Association canadienne-française pour l'avancement des sciences, May 1996.

36 Lundvall, B-Å. *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. London: Pinter, 1992.

37 Tassey, Gregory. *Technology Infrastructure and Competitive Position*. Dordrecht: Kluwer Academic Publishers, 1992.

38 Adapted from DeBresson and Amesse, "Networks of Innovators: An Introduction to the Issue," *Research Policy*, 1991.

39 Douglas C. North, "Transaction Costs, Institutions and Economic Performance." San Francisco: International Center for Economic Growth, May 1992. J. Wallis and D. North, "Measuring the Transaction Sector in the American Economy, 1870-1970," in *Long Term Factors in American Economic Growth*, ed. S. Engerman and R. Gallman, Chicago: University of Chicago Press, 1986.

40 Francis Fukuyama. *Trust: The Social Virtues and the Creation of Prosperity*. Penguin Books, 1995.

41 In this regard, the recent tendency (following the patriation of the Constitution in 1981) to give more influence to the judiciary and hence to lawyers favours legal action over compromise. This increases transaction costs in Canada.

42 It should be noted that the economic objective of reducing transaction costs poses the danger of making a community narrow-minded or turned in on itself. We shall discuss this possibility as a potential difficulty later.

43 Anna-Lee Saxenian. *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*. Cambridge: Harvard University Press, 1994.

44 C. DeBresson and J. Lampel. "Bombardier's Mass Production of the Snowmobile: The Canadian Exception?" *Scientia Canadensis*, Vol. 29, 1985, pp. 133-49.

45 Derek J. de Solla Price. *Little Science, Big Science*. New York: Columbia University Press, 1963. Although this trend has not been systematically monitored since this work was published, there is no doubt that it is proceeding as described.

46 François Chesnais. *La mondialisation du capital*. Paris: Syros, 1994.

47 C. P. Kindleberger. *Manias, Panics and Crashes: A History of Financial Crisis*. New York, Basic Books, 1978, revised edition, 1989. A financial crisis may be defined as follows: "A sharp, brief, ultra-cyclical deterioration of all or most of a group of financial indicators — short term interest rates, asset prices (stock, real estate, land) prices, commercial insolvencies and failures of financial institutions." R. Goldsmith, "Comment on Minsky," in *Financial Crisis: Theory, History and Policy*. Edited by C.P. Kindleberger and J.-P. Laffargue. New York: Cambridge University Press, 1982. See also François Chesnais (ed.), *La mondialisation financière: genèse, coûts et enjeux*. Paris: Syros, 1996.

48 This paper was written during the summer of 1996, more than one year before the financial crisis of late October 1997.

49 R. Koo. *Testimony before the Joint Economic Committee*. Cited by Lawrence Summers, "Planning for the Next Financial Crisis," in *The Risk of Economic Crisis*. Edited by M. Feldstein following NBER Conference. Chicago: University of Chicago Press, 1991, p. 159.

50 L. H. Summers. "Planning for the Next Financial Crisis," in *The Risk of Economic Crisis*. Edited by M. Feldstein following NBER Conference. Chicago: University of Chicago Press, 1991.

51 In 1991, Lawrence Summers felt (op. cit., p. 157), "The payments system has probably become more fragile than before" (i.e., than in October 1987).

52 Summers, op. cit., p. 155.

53 John Chant and Stephen Easton. "Corporate Debt and its Macroeconomic Consequences," in *Deficits and Debts in the Canadian Economy*. Edited by Richard Harris. Kingston: John Deutsch Institute for the Study of Economic Policy, 1993, pp. 145-76.

54 Robin Richardson, speaking on behalf of the Canadian Taxpayers Federation, noted that each of the 10 Canadian provinces qualifies as a severely indebted country under the World Bank's definition. Richard Harris (ed.), *Deficits and Debts in the Canadian Economy*. Kingston: John Deutsch Institute for the Study of Economic Policy, 1993, p. 95.

55 H.V. Nelles, *The Politics of Development: Forest, Mines and Hydro-Electric Power in Ontario*, 1849-1941, Macmillan Canada, 1974; K. Hamilton, "Canadian Industrial Energy Consumption and External Trade," in *Technology and National Competitiveness: Oligopoly, Technological Innovation, and International Competition*, edited by Jorge Niosi, Montreal and Kingston: McGill-Queen's University Press, 1991.

56 Given that these uncertainties are all related to situations with no existing precedent, it would be inappropriate and entirely subjective to assign risk factors and probabilities to them.

57 On the subject of technological snobbism and fetishism, see Christian DeBresson, *Comprendre le changement technique*, Presses des universités d'Ottawa et de Bruxelles, 1993, Ch. 5, pp. 95-108, as well as *Understanding Technological Change*, Montreal: Black Rose Books, 1987, Ch. 11, pp. 133-39.

58 A recent Statistics Canada publication indicates that only one family in four has a home computer. Only a third of these have a modem, and only one in five of this limited group uses the Internet. See Jeffrey Frank, "Preparing for the Information Highway: Information Technology in Canadian Households." *Canadian Social Trends*. Statistics Canada, 1994-95, http://www.statcan.ca/Documents/english/SocTrends/infotech.htm.
A survey by Andersen Consulting reports more optimistic results: one consumer in three uses the Internet at home or at work, and the number of users is doubling each year. On the other hand, two thirds of users spend only a few hours a month on the Internet (study reported in MatInternet, July 1996, http://www.matin.qc.ca).

59 OECD. *The OECD Jobs Strategy: Technology, Productivity and Job Creation, Volume 1: Highlights; Volume 2: Analytical Report*. Paris: July 1996.

60 Such a vicarious existence as a pure spectator recalls how Lewis Mumford, the historian of technology and urban development, described the lifestyles of decadent Romans: 100 days of annual leave spent at the Coliseum soaking up stimulation, rev-

elling in violence and losing all sense of social cohesion. See *The City in History*. New York: Harcourt Brace, 1961, pp. 222-35.

61 If the network is congested, interaction is only possible with a time delay; it becomes essentially a form of electronic mail. Obviously, this diminishes the usefulness and value of Internet service.

62 In order to preserve their efficiency and avoid information overload, these communities must rely on mediation. Global villages can create public forums and forge their own forms of governance. But not all subjects and activities are well suited to interactive forums.

63 See Paul David's discussion in "Blind Giants, Narrow Windows and Angry Orphans" on the dilemma facing public institutions that have to deal with competing systems. We suggest that publicly funded research on the possible use of the Internet and on related ethical and political issues be carried out to widen the window of opportunity where public authorities can exercise a useful influence.

64 Paul David. "The Economics of QWERTY." *American Economic Review I*, 75:2 (1985):332-37.

65 Some of the most useful contributions to technology policy come from the Experimental Technology Incentives Programme (ETIP) of the Department of Commerce at the National Institute of Standards and Technology (NITS). See G. Bell, J.-E. Aubert, C. DeBresson, and P. Dubarle. *Policies to Stimulate Industrial Innovation*. Paris: OECD, 1978. Some of this experience is reflected in a book by the former head of its Policy Research Division — Gregory Tassey, *Technology Infrastructure and Competitive Position*. Boston: Kluwer Academic Publishers, 1992. The Canada Standards Association, a self-financing body that enjoys an excellent international reputation, may be called on to play a role in these experiments and pilot projects.

66 Faye Duchin and Glen-Marie Lange. *The Future of the Environment*. *Ecological Economics and Technological Change*. New York: Oxford University Press, 1994.

67 See Thornstein Veblen, *The Vested Interests and the Common Man*, New York: Capricorn Books, 1969; also DeBresson 1987, Ch. 15, and 1993, Ch. 20.

68 Mark Roseland, Research Director at the School of Resource and Environmental Management, Simon Fraser University, argues, "[Trans.] To a very large extent, the environmental crisis is a crisis of creativity. The only way to successfully meet the countless challenges posed by sustainable development in the communities is to encourage social innovation and local initiative.... Downstream initiatives require upstream leadership." *La Revue de la Table ronde nationale sur l'environnement et l'économie*, spring 1994, pp. 3 and 10.

69 For example, the Uruguay Round's Trade-Related Intellectual Property Rights Agreement is biased; instead of being based on the mutual and dynamic gains of knowledge sharing (see Trend 5 in the first part of the paper), it is based on the static gains from price reductions, which are known to account for no more than 1 percent of the gains.

70 The implementation of the TRIPs agreement and patent law is somewhat problematic on this point, since it appears unlikely to have any real consequences (fortunately).

71 If foreign patent rights had been compensated at least by a mandatory licensing clause after a certain number of years, as originally proposed by the European Commission, the restrictive influence of TRIPs on the flow of technical knowledge would have been mitigated. See J. Baghwati. *Protectionism*. Cambridge: MIT Press, 1989.

72 W.J. Baumol. *Entrepreneurship, Management and the Structure of Payoffs*. Cambridge: MIT Press, 1993.

73 The GATT allowed for generous provisions for the temporary protection of fledgling industries and for the social adjustment of NICs undergoing trade liberalization.

74 Jagdish Bhagwati. *The World Trading System at Risk*. Princeton: Princeton University Press, 1991, particularly Ch. 4.

75 The legal commission of the Organization of American States recently condemned this legislation as contrary to international law. This declaration was unanimous (including the U.S. representative).

76 The previous enforcer, the United Kingdom, had the advantage that its domestic market was not large enough to be a tool for potential reprisals. Despite this weakness, the unilateral end to the pound's convertibility in 1931 was enough to revive rampant protectionism and to plunge the world into recession (Hilgert; Svennilson).

77 Hyman Minsky. *Can "It" Happen Again: Essays on Instability and Finance*. New York: M.E. Sharpe, 1982.

78 The financial establishment can certainly live and prosper under a Tobin tax; it would face only a minimal level of taxation. On the other hand, this tax will not reduce the sector's lead in profits over industry and services.

79 For a discussion on the financial vulnerability of the corporate world, see John F. Chant and Stephen T. Easton, "Corporate Debt and its Macroeconomic Consequences," in *Deficits and Debt in the Canadian Economy*. Edited by Richard G. Harris. Kingston: John Deutsch Institute for the Study of Economic Policy, 1993, pp. 145-76.

80 The demand for newly protected resources would certainly increase if the demand for these products in the zone remained higher than pre-depression domestic production. This would mean that demand was almost completely satisfied by imports from outside the trade bloc prior to the depression. This happened with rubber after the Japanese invasion of Indochina and Malaysia, with the result that an innovative substitute — synthetic rubber — appeared and created a flourishing new industry in Canada.

81 How to achieve these objectives (through economic incentives, regulation, strategic policies, etc.) will be discussed in the next section.

82 William D. Garvey. *Communication: The Essence of Science*. New York: Pergamon Press, 1979.

83 Subjects do not lend themselves equally well to distance learning. The subject must be sufficiently open-ended to benefit from interaction over long distances. It would be difficult to teach the solution of complex technical or mathematical problems with this medium, for example, except perhaps to gifted students.

84 The aeronautic equipment industry benefits from this type of interaction in its international collaborations, but it does not yet enjoy direct visual links.

85 In the case of the Internet chat feature, mediation is provided by senior users known as "operators," who are nominated by at least two incumbent operators. Operators have the technical means to bar from the discussion group any party whom they judge to be abusing the privilege.

86 DeBresson developed this framework for policy analysis and this approach while working at the science department of the OECD in the mid-1970s. See G. Bell, J.-E. Aubert, C. DeBresson, and P. Dubarle. *Policies to Stimulate Industrial Innovation*.

Paris: OECD, 1978 (three volumes). This model is consistent with the "diamond" model offered by Michael Porter in *The Competitive Advantages of Nations* (1991).

87 Entrepreneurs invest in innovations when they perceive an opportunity, but which innovation projects they choose depends on what they judge possible and advantageous for the future. The choice of a collective investment in public infrastructure depends on the vision of the body making the decision for the community. Objective factors may impose constraints on our freedom, but the choice among the remaining options depends on subjective preferences linked to citizens' personal values. Our aim is to explicitly lay out our vision, the strategic choices involved, and possible long-term investment projects in order to encourage debate on the future.

88 An evocative expression coined by Douglas North.

89 Michael B. Devereux. "Provincial Budget Deficits and the Debt Crisis of Canada," in Richard G. Harris, *Deficits and Debts in the Canadian Economy*. Kingston: John Deutsch Institute for the Study of Economic Policy, 1993, p. 82.

90 Raymond Théorêt and Gilles St-Amant. "Une solution radicale pour régler le problème de la dette publique au Canada: la transférer aux Canadiens!" March 1994. Théorêt, St-Amant and Jean Canonne. "La meilleure méthode pour libérer les provinces de la dette fédérale: la transférer de façon équitable à l'ensemble des Canadiens." Centre de recherche en gestion, Université du Québec à Montréal, February 1995.

91 Quebec Ministry of Finance. "Le Fonds de remboursement de la dette." Document 22, Series: Tax and Financing of Public Services. Québec: Les publications du Québec, 1996.

92 The three proposals are compared in Table 4. Infrastructure development is primarily a provincial responsibility. Only the Rodrigue, Bélanger, and Fecteau proposal takes account of this fact, but it takes 30 years to increase borrowing capacity to finance new infrastructure. All proposals assume additional taxation but all upgrade the capacities that reduce to some extent taxpayers' own ability to invest.

93 Luc Vallée. "Privatisation rétroactive des REER : une solution aux problèmes de nos gouvernements." *Revue Gestion*, Vol. 20, No. 4, pp. 10-11, December 1995. See also *Revue Gestion*, Vol. 21, No. 1, pp. 12-13, March 1996 and 2, pp. 12-13, June 1996.

94 Jean Lanctôt is chair of the adult education centre of the École des Hautes Études Commerciales.

95 According to an article by Rodrigue Tremblay published in *Le Devoir* (August 27, 1996, p. A7), "[Trans.] In order to join the future European Monetary Union, a country's total public debt must not exceed 60 percent of its gross domestic product, and its budget deficit must not exceed 3 percent of GDP."

96 The approach proposed by Joseph Schumpeter to eliminate Austria's debt after the First World War entailed a one-time tax on assets; this is not applicable to the Canadian case because governments have accumulated a public debt that represents a multiple of all public and private assets in Canada.

97 We believe it would be better to innovate outside of existing structures — in this case, outside the current education programs (teacher training) offered in colleges and universities. The idea is to avoid imposing on the new institutions the bureaucratic lethargy and regulations common to existing large and complex organizations.

98 College and university professors are recruited for a specific purpose — to instil knowledge and teach the latest techniques — but are evaluated on the basis of its necessary complement (advanced research). They are then rewarded for their perfor-

mance in research by lighter teaching duties — for which they were hired in the first place.

99 Michael Gibbons, Camille Limoges, Helga Nowotny, Simon Schwartzman, Peter Scott and Martin Trow. *The New Production of Knowledge — The Dynamics of Science and Research in Contemporary Societies*. London: Sage Publications, 1994.

100 At the present time, human interaction in real time is taking a back seat to deferred interaction because of server congestion. The public interest would be served by reserving part of network capacity for real-time interaction, which would make the Internet the text equivalent — and soon the visual equivalent — of the telephone. Deferred interaction, however, is little better than fax technology (which can be operated over the Internet, by the way). How can we reduce the congestion and guarantee that researchers and communities as a whole have ready access to this tool? There are a number of policy instruments at our disposal: make it a pay service (to end the "free-rider" phenomenon), make for-profit industries pay, invite the private sector to cover all their server-related financial needs, reserve part of server capacity (if possible) exclusively for real-time interaction, etc.

101 In any confederation based on subsidiarity, when a community is not self-sufficient, external assistance must be forthcoming in order to encourage the community to regain self-sufficiency.

102 Gordon Gibson. "A Sensible Solution for Saving Canada." *Fraser Forum*, June 1996, p. 12.

103 Mark Roseland. "Initiative en amont, leadership en aval." *La Revue de la Table ronde nationale sur l'environnement et l'économie*, spring 1994, pp. 3 and 10.

104 The recent aid project for the residents of the flood-stricken Saguenay that involved unemployed persons is interesting. Given recent reforms to unemployment insurance and welfare, it is essential for the unemployed to be able to choose from among a variety of solutions: community service, infrastructure projects and training.

105 The traditional economic approach, which assumes that firms are in competition as isolated entities with no interest in the group, leads to the (we think overhasty) conclusion that firms will not invest sufficiently in specialized training because they fear that their competitors might benefit. For this reason, public funds are required for specialized training. In our opinion, this theory underestimates the intelligence of company managers, who know well that their own firms' health depends in part on the health of the industry. In our approach, we consider that firms, rather than being isolated, belong to networks that compete with each other, and that the benefits of innovation and of creation of new technical knowledge are shared — or will never see the light of day (see note 35).

106 In finance, an interesting and originally unexpected phenomenon has been observed re non-recoverable costs. Investors are reluctant or even completely unwilling to abandon initial investment decisions, even if it means "throwing good money after bad" (at least from their perspective).

Industry Canada Research Publications

INDUSTRY CANADA WORKING PAPER SERIES

No. 1 Economic Integration in North America: Trends in Foreign Direct Investment and the Top 1,000 Firms, Industry Canada, Micro-Economic Policy Analysis Staff including John Knubley, Marc Legault and P. Someshwar Rao, 1994.

No. 2 Canadian-Based Multinationals: An Analysis of Activities and Performance, Industry Canada, Micro-Economic Policy Analysis Staff including P. Someshwar Rao, Marc Legault and Ashfaq Ahmad, 1994.

No. 3 International R&D Spillovers Between Industries in Canada and the United States, Jeffrey I. Bernstein, Carleton University and National Bureau of Economic Research, under contract with Industry Canada, 1994.

No. 4 The Economic Impact of Mergers and Acquisitions on Corporations, Gilles Mcdougall, Micro-Economic Policy Analysis, Industry Canada, 1995.

No. 5 Steppin' Out: An Analysis of Recent Graduates Into the Labour Market, Ross Finnie, School of Public Administration, Carleton University and Statistics Canada, 1995.

No. 6 Measuring the Compliance Cost of Tax Expenditures: The Case of Research and Development Incentives, Sally Gunz, University of Waterloo, Alan Macnaughton, University of Waterloo, and Karen Wensley, Ernst & Young, Toronto, under contract with Industry Canada, 1996.

No. 7 Governance Structure, Corporate Decision-Making and Firm Performance in North America, P. Someshwar Rao and Clifton R. Lee-Sing, Micro-Economic Policy Analysis, Industry Canada, 1996.

No. 8 Foreign Direct Investment and APEC Economic Integration, Ashfaq Ahmad, P. Someshwar Rao and Colleen Barnes, Micro-Economic Policy Analysis, Industry Canada, 1996.

No. 9 World Mandate Strategies for Canadian Subsidiaries, Julian Birkinshaw, Institute of International Business, Stockholm School of Economics, under contract with Industry Canada, 1996.

No. 10 R&D Productivity Growth in Canadian Communications Equipment and Manufacturing, Jeffrey I. Bernstein, Carleton University and National Bureau of Economic Research, under contract with Industry Canada, 1996.

No. 11 Long-Run Perspective on Canadian Regional Convergence, Serge Coulombe, Department of Economics, University of Ottawa, and Frank C. Lee, Industry Canada, 1996.

No. 12 Implications of Technology and Imports on Employment and Wages in Canada, Frank C. Lee, Industry Canada, 1996.

No. 13 The Development of Strategic Alliances in Canadian Industries: A Micro Analysis, Sunder Magun, Applied International Economics, 1996.

No. 14 Employment Performance in the Knowledge-Based Economy, Surendra Gera, Industry Canada, and Philippe Massé, Human Resources Development Canada, 1996.

No. 15 The Knowledge-Based Economy: Shifts in Industrial Output, Surendra Gera, Industry Canada, and Kurt Mang, Department of Finance, 1997.

No. 16 Business Strategies of SMEs and Large Firms in Canada, Gilles Mcdougall and David Swimmer, Micro-Economic Policy Analysis, Industry Canada, 1997.

No. 17 Impact of China's Trade and Foreign Investment Reforms on the World Economy, Winnie Lam, Micro-Economic Policy Analysis, Industry Canada, 1997.

No. 18 Regional Disparities in Canada: Characterization, Trends and Lessons for Economic Policy, Serge Coulombe, Department of Economics, University of Ottawa, 1997.

No. 19 Inter-Industry and U.S. R&D Spillovers, Canadian Industrial Production and Productivity Growth, Jeffrey I. Bernstein, Carleton University and National Bureau of Economic Research, under contract with Industry Canada, 1998.

No. 20 Information Technology and Labour Productivity Growth: An Empirical Analysis for Canada and the United States, Surendra Gera, Wulong Gu and Frank C. Lee, Micro-Economic Policy Analysis, Industry Canada, 1998.

No. 21 Capital-Embodied Technical Change and the Productivity Growth Slowdown in Canada, Surendra Gera, Wulong Gu and Frank C. Lee, Micro-Economic Policy Analysis, Industry Canada, 1998.

No. 22 The Corporate Tax Structure and the Effects on Production, Cost and Efficiency, Jeffrey I. Bernstein, Carleton University and National Bureau of Economic Research, under contract with Industry Canada, 1998.

No. 23 Restructuring in Canadian Industries: A Micro Analysis, Sunder Magun, Applied International Economics, under contract with Industry Canada, 1998.

No. 24 Canadian Government Policies Toward Inward Foreign Direct Investment, Steven Globerman and Daniel Shapiro, Simon Fraser University, under contract with Industry Canada, 1998.

INDUSTRY CANADA DISCUSSION PAPER SERIES

No. 1 Multinationals as Agents of Change: Setting a New Canadian Policy on Foreign Direct Investment, Lorraine Eden, Carleton University, 1994.

No. 2 Technological Change and International Economic Institutions, Sylvia Ostry, Centre for International Studies, University of Toronto, under contract with Industry Canada, 1995.

No. 3 Canadian Corporate Governance: Policy Options, Ronald. J. Daniels, Faculty of Law, University of Toronto, and Randall Morck, Faculty of Business, University of Alberta, 1996.

No. 4 Foreign Direct Investment and Market Framework Policies: Reducing Frictions in APEC Policies on Competition and Intellectual Property, Ronald Hirshhorn, 1996.

No. 5 Industry Canada's Foreign Investment Research: Messages and Policy Implications, Ronald Hirshhorn, 1997.

No. 6 International Market Contestability and the New Issues at the World Trade Organization, Edward M. Graham, Institute for International Economics, Washington (DC), under contract with Industry Canada, 1998.

INDUSTRY CANADA OCCASIONAL PAPER SERIES

No. 1 Formal and Informal Investment Barriers in the G-7 Countries: The Country Chapters, Industry Canada, Micro-Economic Policy Analysis Staff including Ashfaq Ahmad, Colleen Barnes, John Knubley, Rosemary D. MacDonald and Christopher Wilkie, 1994.

Formal and Informal Investment Barriers in the G-7 Countries: Summary and Conclusions, Industry Canada, Micro-Economic Policy Analysis Staff including Ashfaq Ahmad, Colleen Barnes and John Knubley, 1994.

No. 2 Business Development Initiatives of Multinational Subsidiaries in Canada, Julian Birkinshaw, University of Western Ontario, under contract with Industry Canada, 1995.

No. 3 The Role of R&D Consortia in Technology Development, Vinod Kumar, Research Centre for Technology Management, Carleton University, and Sunder Magun, Centre for Trade Policy and Law, University of Ottawa and Carleton University, under contract with Industry Canada, 1995.

No. 4 Gender Tracking in University Programs, Sid Gilbert, University of Guelph, and Alan Pomfret, King's College, University of Western Ontario, 1995.

No. 5 Competitiveness: Concepts and Measures, Donald G. McFetridge, Department of Economics, Carleton University, 1995.

No. 6 Institutional Aspects of R&D Tax Incentives: The SR&ED Tax Credit, G. Bruce Doern, School of Public Administration, Carleton University, 1995.

No. 7 Competition Policy as a Dimension of Economic Policy: A Comparative Perspective, Robert D. Anderson and S. Dev Khosla, Economics and International Affairs Branch, Bureau of Competition Policy, Industry Canada, 1995.

No. 8 Mechanisms and Practices for the Assessment of The Social and Cultural Implications of Science and Technology, Liora Salter, Osgoode Hall Law School, University of Toronto, under contract with Industry Canada, 1995.

No. 9 Science and Technology: Perspectives for Public Policy, Donald G. McFetridge, Department of Economics, Carleton University, under contract with Industry Canada, 1995.

No. 10 Endogenous Innovation and Growth: Implications for Canada, Pierre Fortin, Université du Québec à Montréal and the Canadian Institute for Advanced Research, and Elhanan Helpman, Tel Aviv University and the Canadian Institute for Advanced Research, under contract with Industry Canada, 1995.

No. 11 The University-Industry Relationship in Science and Technology, Jérôme Doutriaux, University of Ottawa, and Margaret Barker, Meg Barker Consulting, under contract with Industry Canada, 1995.

No. 12 Technology and the Economy: A Review of Some Critical Relationships, Michael Gibbons, University of Sussex, under contract with Industry Canada, 1995.

No. 13 Management Skills Development in Canada, Keith Newton, Industry Canada, 1995.

No. 14 The Human Factor in Firm's Performance: Management Strategies for Productivity and Competitiveness in the Knowledge-Based Economy, Keith Newton, Industry Canada, 1996.

No. 15 Payroll Taxation and Employment: A Literature Survey, Joni Baran, Industry Canada, 1996.

No. 16 Sustainable Development: Concepts, Measures, Market and Policy Failures at the Open Economy, Industry and Firm Levels, Philippe Crabbé, Institute for Research on the Environment and Economy, University of Ottawa, 1997.

No. 17 Measuring Sustainable Development: A Review of Current Practice, Peter Hardi and Stephan Barg, with Tony Hodge and Laszlo Pinter, International Institute for Sustainable Development, 1997.

No. 18 Reducing Regulatory Barriers to Trade: Lessons for Canada from the European Experience, Ramesh Chaitoo and Michael Hart, Center for Trade Policy and Law, Carleton University, 1997.

No. 19 Analysis of International Trade Dispute Settlement Mechanisms and Implications for Canada's Agreement on Internal Trade, E. Wayne Clendenning and Robert J. Clendenning, E. Wayne Clendenning & Associates Inc., under contract with Industry Canada, 1997.

No. 20 Aboriginal Businesses: Characteristics and Strategies for Growth, David Caldwell and Pamela Hunt, Management Consulting Centre, under contract with Aboriginal Business Canada, Industry Canada, 1998.

CANADA IN THE 21ST CENTURY SERIES

No. 1 Global Trends: 1980-2015 and Beyond, J. Bradford De Long, University of California, Berkeley, under contract with Industry Canada, 1998.

No. 2 Broad Liberalization Based on Fundamentals: A Framework for Canadian Commercial Policy, Randy Wigle, Wilfrid Laurier University, under contract with Industry Canada, 1998.

No. 3 North American Economic Integration: 25 Years Backward and Forward, Gary C. Hufbauer and Jeffrey J. Schott, Institute for International Economics, Washington (DC), under contract with Industry Canada, 1998.

No. 4 Demographic Trends in Canada, 1996-2006 : Implications for the Public and Private Sectors, David K. Foot, Richard A. Loreto and Thomas W. McCormack, Madison Avenue Demographics Group, under contract with Industry Canada, 1998.

No. 5 Capital Investment Challenges in Canada, Ronald P. M. Giammarino, University of British Columbia, under contract with Industry Canada, 1998.

No. 6 Looking to the 21st Century – Infrastructure Investments for Economic Growth and for the Welfare and Well-Being of Canadians, Christian DeBresson, Université du Québec à Montréal, and Stéphanie Barker, Université de Montréal, under contract with Industry Canada, 1998.

JOINT PUBLICATIONS

Capital Budgeting in the Public Sector, in collaboration with the John Deutsch Institute, Jack Mintz and Ross S. Preston eds., 1994.

Infrastructure and Competitiveness, in collaboration with the John Deutsch Institute, Jack Mintz and Ross S. Preston eds., 1994.

Getting the Green Light: Environmental Regulation and Investment in Canada, in collaboration with the C.D. Howe Institute, Jamie Benidickson, G. Bruce Doern and Nancy Olewiler, 1994.

To obtain copies of documents published under the Research Publications Program, please contact:

Publications Officer
Micro-Economic Policy Analysis
Industry Canada
5th Floor, West Tower
235 Queen Street
Ottawa, Ontario, K1A 0H5

Tel.: (613) 952-5704
Fax: (613) 991-1261
E-mail: fumerton.cheryl@ic.gc.ca