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CANADA

Report of the
National Advisory Board
on Science and Technology

STATEMENT ON COMPETTIVENESS

Presented to the
Prime Minister of Canada



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Report of the
National Advisory Board
on Science and Technology

The Right Honourable Brian Mulroney
Prime Minister of Canada
Parliament Hill
Ottawa, Ontario
K1P 8A6

STATEMENT ON COMPETITIVENESS

Presented to the
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March 1991



National Advisory Board on
Science and Technology

Conseil consultatif national
des sciences et de la technologie

March 23, 1991

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Peter J. Richardson



CANADA

National Advisory Board on
Science and Technology

Conseil consultatif national
des sciences et de la technologie

March 25, 1991

The Right Honourable Brian Mulroney
Prime Minister of Canada
House of Commons
Room 309-S
Ottawa, Ontario
K1A 0A6

Dear Prime Minister:

I am pleased to enclose the text of my opening remarks delivered on behalf of the National Advisory Board on Science and Technology when we met with you and your colleagues in Ottawa on November 28, 1990.

This statement represents the culmination of views on the relationship among science and technology, innovation and competitiveness that have been developed by your Advisory Board over the past four years. We believe that the statement provides an accurate diagnosis and a practical plan of action on the basis of which your government could address the crisis of competitiveness now facing Canada.

Sincerely,

Peter J. Nicholson

The views expressed in this paper are those of the authors and do not necessarily correspond to the views or policies of the Government of Canada.

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The following statement was presented to the Prime Minister of Canada, the Right Honourable Brian Mulroney, in Ottawa on November 28, 1990. It was prepared by Peter J. Nicholson on behalf of the National Advisory Board on Science and Technology (NABST).

STATEMENT ON COMPETITIVENESS

Introduction

Our goal is an economy that can compete with the best in the world, producing stimulating new jobs and new opportunities for future generations of Canadians.... Science and technology are the keys to a modern competitive economy.

The Right Honourable Brian Mulroney
Prime Minister of Canada
Ottawa, August 25, 1989

The National Advisory Board on Science and Technology is convinced that Canada is not meeting this competitiveness challenge. Consider these indicators:

- Our productivity is lagging behind that of all the other G-7 nations.
- Manufacturing jobs are disappearing at an alarming rate — estimated to be more than 180 000 in the last year. Many of these jobs are not expected to be recovered, even when the economy improves.
- A number of our most prominent technology-based companies are falling into foreign hands.
- We are running a large and growing trade deficit in highly manufactured products.

The question is “Why?” The members of NABST, after studying the issues for more than a year, have concluded that a fundamental source of Canada’s deepening economic malaise is the failure of our nation as a whole to adequately employ the tools of science and technology to drive innovation through to greater value-added and stronger productivity growth.

When we talk about science and technology, we are not really talking about people in lab coats, engrossed in esoteric pursuits. We are talking about a much broader conception of science and technology (S&T): a concept that defines science and technology as the set of skills and tools that are the cutting edge of continued economic development in modern, high-wage societies.

To be more productive, we need to be more innovative. And to be more innovative requires not only greater investment in R&D and leading-edge technologies, but also a national commitment to develop the right pool of human skills and a supportive public policy environment. Those nations — like Germany, Japan and an increasing number of others — that are able to master this process are gaining a widening advantage in global competition. The overwhelming significance of this development has not been adequately appreciated by governments in this country, nor by industry, nor by Canadians generally. Such complacency is unwarranted and dangerous.

Fortunately, the significance of what we are up against may finally be starting to dawn in the minds of the business community. For example, when the Business Council on National Issues recently announced that Professor Michael Porter was being hired to determine how Canadian competitiveness measures up, their press release acknowledged the scope of what is at stake.

We need a new intellectual foundation for our economic future, fresh ways of thinking, and a solid consensus upon which to build. What really is at stake is whether or not we will remain among the leading economic powers in a fast-changing world.

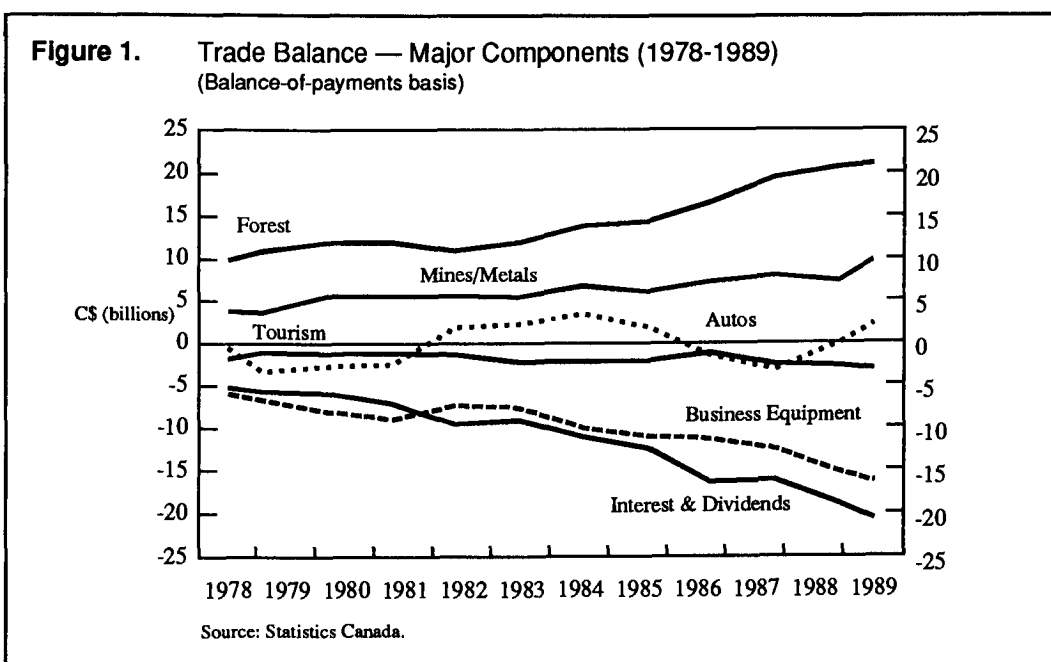
Unfortunately, we still lack in Canada the “solid consensus” on which to build. That is why we believe the Prime Minister must play a pivotal role in helping Canadians to comprehend the dimensions of the challenge we face, and in offering a credible plan for getting Canada back on track.

Our job is to provide the Prime Minister with our best advice as to how this might be done. The purpose of this statement is therefore to summarize some dramatic evidence of what we are up against. That should dispel any lingering complacency. Then we will outline measures that we believe will begin to solve the problem.

The Diagnosis

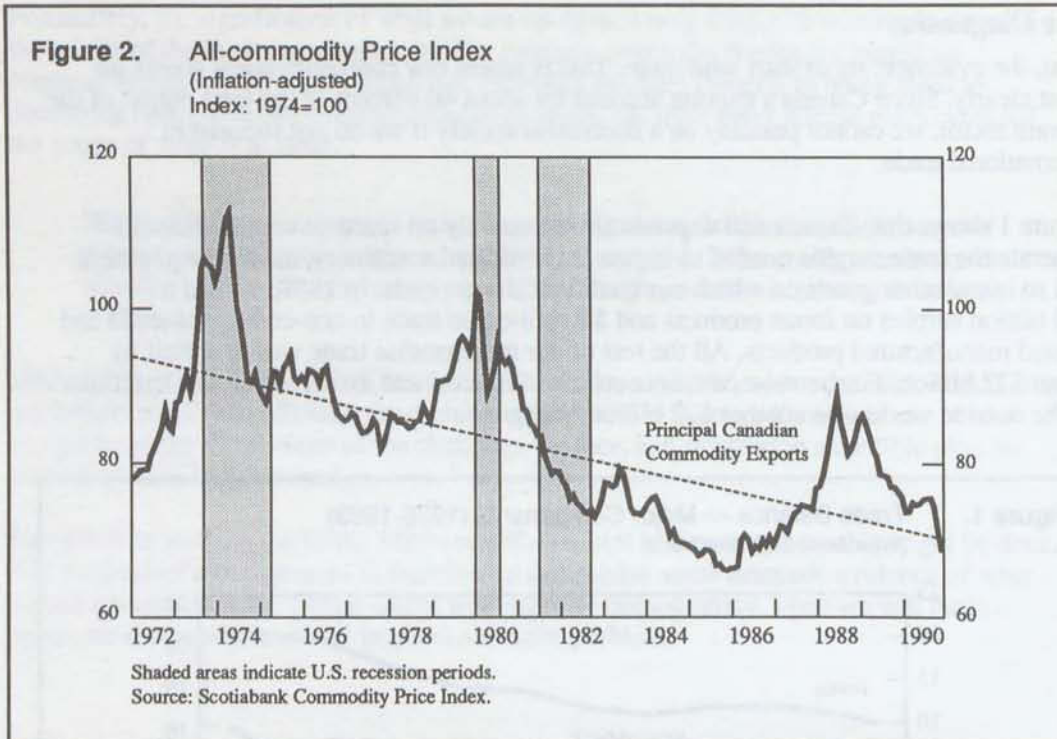
First, the evidence: let us start with trade. This is where raw competitiveness shows up most clearly. Since Canada's exports account for about 40 percent of the total output of the private sector, we cannot possibly be a successful society if we do not succeed in international trade.

Figure 1 shows that Canada still depends almost entirely on resource commodities to generate the trade surplus needed to import sophisticated machinery, medical equipment and so many other goods on which our quality of life depends. In 1989, we had a \$20 billion surplus on forest products and \$10 billion on trade in non-energy minerals and related manufactured products. All the rest of our merchandise trade was in deficit by about \$22 billion. Furthermore, the *net* outflow of interest and dividends on our liabilities to the outside world was another \$22 billion, and growing.



There is nothing really wrong with all this as long as our forest and mining industries are in great shape. But there are some very disturbing trends. For example, figure 2 traces the pattern of world prices for Canada's resource exports over the past 15 years (inflation has been subtracted). Amid the spectacular cycles of boom and bust, it is clear that the long-term trend is down.

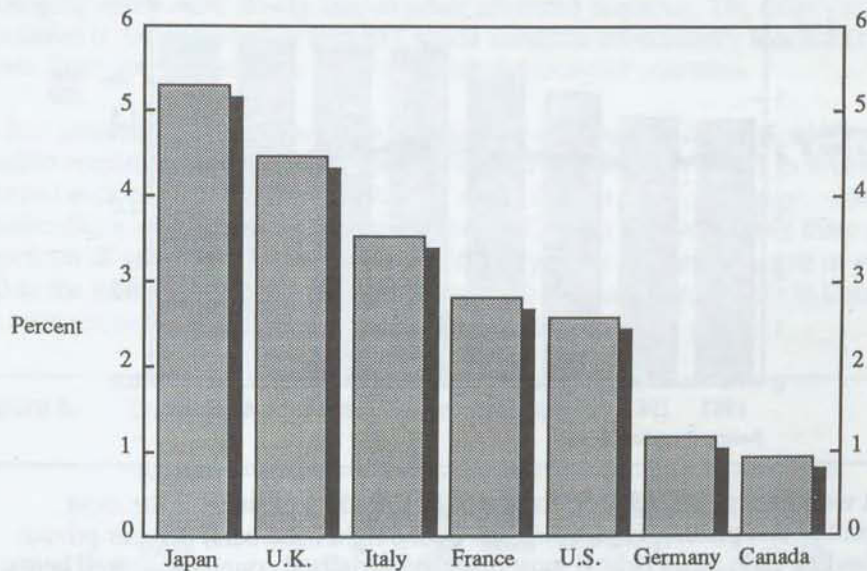
Why is this? First of all, there are many new sources of supply in the developing world. Even more important, materials science is producing a steady stream of innovation that is constantly reducing the resource content of a unit of economic output. For example, 100 kilograms of fibreglass cable can transmit more telephone messages than 2 000 kilograms of copper wire. And producing that 100 kilograms of fibreglass requires 20 times less energy than is needed to produce the 2 000 kilograms of wire.



Obviously, Canada cannot, and should not, abandon its resource industries. But this chart tells us that we have to add much greater value to resources; we must constantly improve our production efficiency; and we must diversify into a broad range of new products. The message is that all three of these necessary responses require a much more intensive application of R&D and innovation skills than most of our resource companies are at present geared to deliver.

Let's look at manufacturing. This sector has been devastated by rising wage rates, compounded by a 20 percent appreciation of the Canadian dollar against its U.S. counterpart since 1986. And while the dollar does have to come down, the way to recover competitiveness, while increasing the standard of living of Canadians, is to boost our productivity growth faster than our competitors boost theirs. But as figure 3 shows, the *opposite* has happened. Canada's manufacturing productivity growth over the past ten years has been "dead-last" among the G-7 countries. While our wage rates and our dollar have been shooting ahead, our productivity has been falling farther behind. Small wonder that manufacturing jobs are haemorrhaging.

Figure 3. Growth of Labour Productivity in Manufacturing (1979-1989)
(average annual rate of change in output per hour)



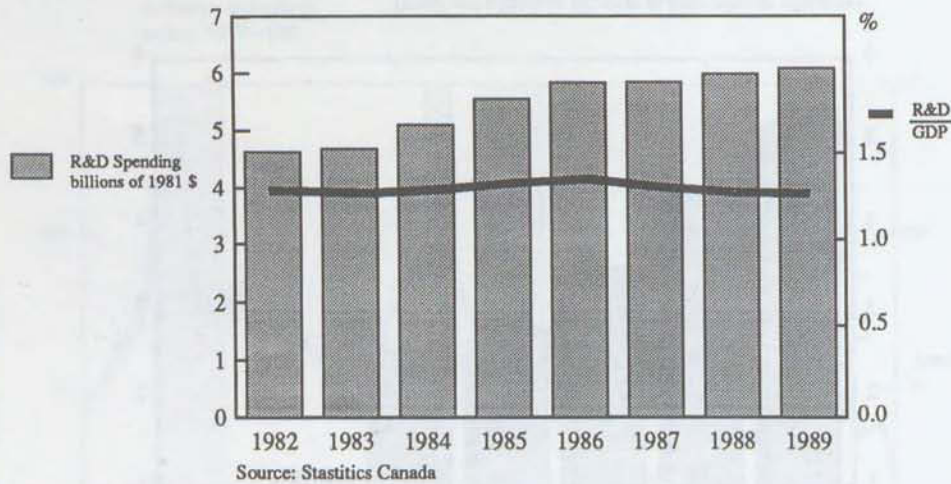
Source: U.S. Bureau of Labour Statistics, *News*, July 27, 1990.

Obviously it is important — as Finance Minister Wilson has rightly emphasized — to bring the macroeconomic situation under control through deficit reduction and wage restraint, which can then justify a more accommodating monetary policy. However, the fundamental issue is *productivity*. Higher productivity is the only way to make Canadians, as a whole, better off. And today, the key to higher productivity is the application of science and technology to product and process innovation. This is why it is so important to dramatically improve the development, acquisition and diffusion of state-of-the-art technology in Canada.

Virtually all studies of the fundamental sources of economic development identify the creation and adaptation of technology as by far the most important growth factor. Fortunately, most sectors of the Canadian economy are already quite sophisticated technologically, but we do very little to embellish our imported know-how. The best indicator of this is to be found in our R&D statistics, which rank Canada far down the industrial-country pecking order.

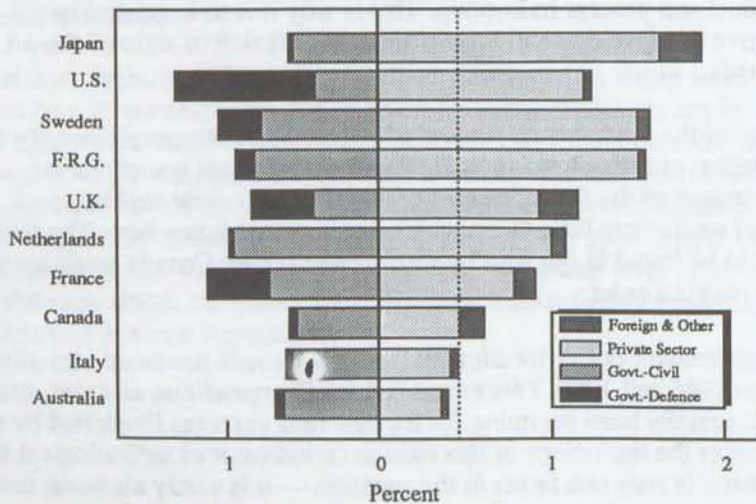
Figure 4 shows that constant-dollar spending on R&D in Canada remained virtually unchanged between 1986 and 1989. This meant that R&D expenditure as a percentage of national output has actually been declining for the past four years (as illustrated by the line in the chart). Whatever the limitations of this ratio as an indicator of technological fitness — and we know that it is only one factor in the equation — it is surely alarming that this factor has been *decreasing* in Canada.

Figure 4. R&D Spending in Canada (1982-1989)



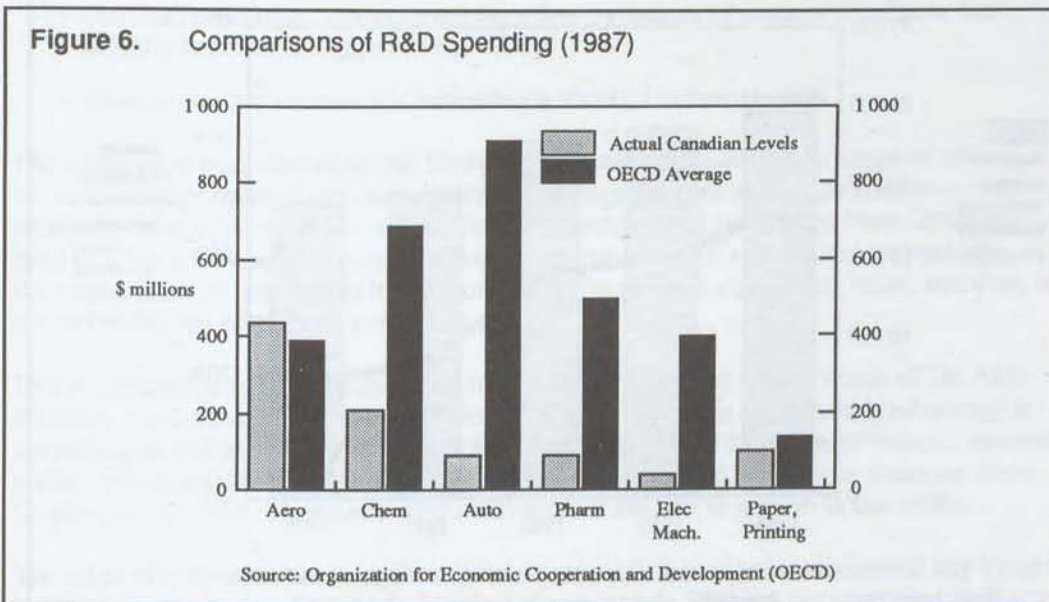
The persistent weakness of the R&D performance of Canadian business is the most disturbing aspect of this picture. Figure 5 shows (in the right hand bars) that our private sector R&D funding ratio ranks behind most other industrialized countries — well below not only the U.S., Japan and Germany, but also below Holland and Sweden. (The left side of the chart shows that Canada's public sector R&D, excluding defense, is about average within its peer group.) Again, the disturbing fact is that the trend of relative business spending on R&D over the past several years has not been improving at all.

Figure 5. *GERD/GDP by Source of Funds, 1987



Why is R&D spending by Canadian business so feeble? Partly, it is because we are specialized in industries that do not conduct a great deal of R&D, regardless of their country of location. More disturbing, this characteristic of our industrial structure seems to be changing much more slowly than in other advanced countries. The other part of the explanation is that the average firm in Canada conducts substantially less R&D, in relation to sales, than firms in the same industry in other developed countries.

This low propensity to perform R&D is illustrated strikingly in figure 6, which compares Canadian research and development spending with international norms in several important sectors. For example, in 1987 the entire Canadian auto industry — parts makers and assemblers — spent about \$95 million on R&D. This was only about three-tenths of one percent of sales. But had the Canadian industry spent the same fraction of sales on R&D as the industrial-country average for the auto industry, expenditure in Canada would have been ten times as great, or roughly \$900 million.

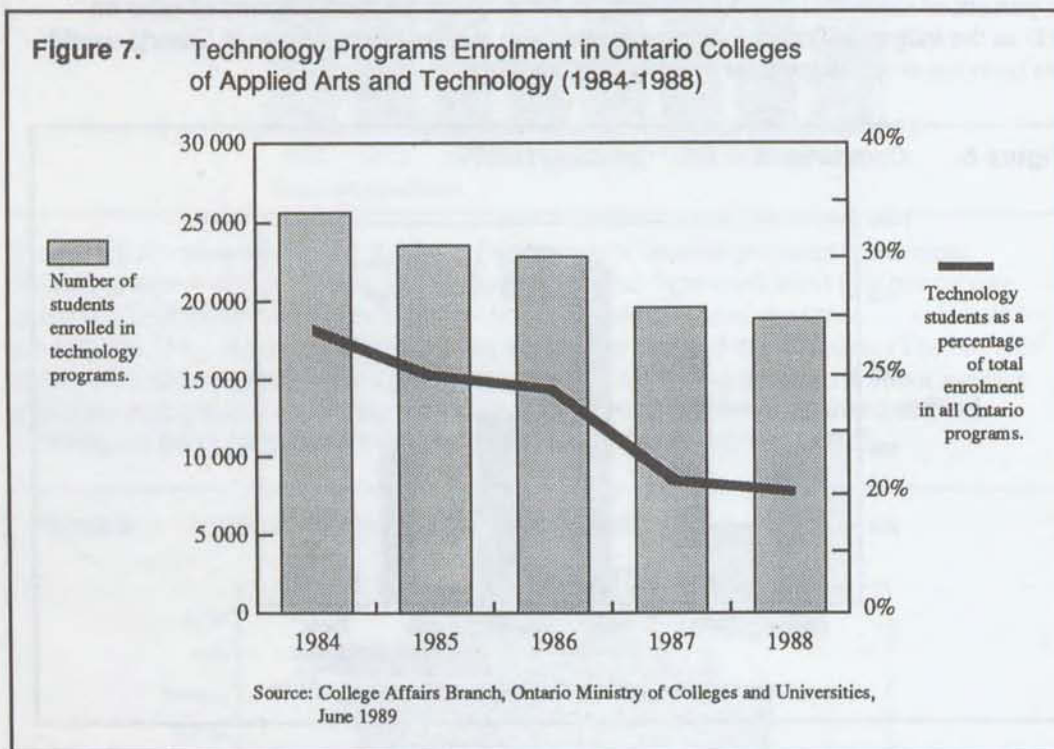


Clearly, foreign ownership and branch-plant status largely explain the pattern in this picture. However, our aerospace industry — one of Canada's most successful sectors over the past decade — has an R&D spending ratio comparable with that of the leaders. The Defense Industry Productivity Program (DIPP) has given a big assist, demonstrating one way in which government can play a very constructive role.

Beyond the issue of R&D, there is also the need to adopt and adapt best-practice technologies that are applicable to manufacturing processes and to new products, especially in relation to Canada's resource industries. One indicator of the gap that must be overcome is that, of 22 key manufacturing process technologies, fully half of our manufacturing companies do not use a single one.

Another major issue focuses on human resources. Human resources are undoubtedly Canada's greatest potential asset: *potential* because it is increasingly evident that our educational facilities are not emphasizing the skills needed to create and sustain a technologically sophisticated economy.

We know that Canadian high school students are not doing well in international tests in math and science. We also know that university enrolment in these subjects has dropped approximately 20 percent during the past five years. Figure 7 shows that enrolment in the *technology* programs at Ontario colleges of applied arts and technology has been falling between 1984 and 1988 — down 26 percent in absolute numbers and from 27 percent to 20 percent of total enrolment (the line). This trend, which is mirrored across Canada, is particularly alarming because it implies a lack of interest in acquiring the basic, practical technical skills needed to run a modern economy. Obviously, something has gone very wrong, since we are also being told that Canada will be short at least 10 000 engineers by the end of the decade — yet the educational pipeline is drying up.



What careers are Canadians choosing and how do they stack up with the choices in other countries? The following figures from the Ontario Premier's Council are quite astounding. Comparing Japan with Ontario on a per-worker basis: Japan has over 3.5 times as many engineers, but Ontario has more than 14 times as many accountants and 39 times as many lawyers. This tells a lot about relative priorities. And if productivity and competitiveness are the objectives, the message is alarming.

Some say there is nothing to worry about, since we can count on immigrants (who seem to be more attracted to scientific and technical careers than native-born Canadians) to fill any skills gap that may be developing. Although this can help, we cannot afford to count on it because the skills-transfer appears to be drying up. Forty percent of the immigrant PhDs currently resident in Canada arrived in the decade between 1967 and 1976. Fewer than 20 percent arrived during the following ten-year period. Three-quarters of the foreign students enrolled in doctoral programs in Canada profess an intention to leave the country. Internationally, the competition for technical skills is already fierce and will become more so.

Most of the underlying indicators of Canada's relative technological weakness still lie beneath the threshold of broad public awareness. But they are beginning to have consequences that are very visible, and are bound to become more so. For example, the foreign takeovers of companies like Lumonics, Connaught, Leigh Instruments and de Havilland are increasingly recognized as symptomatic of a fundamental problem. Before long, people will begin to realize that the dramatic loss of manufacturing jobs has deeper roots than high interest rates and an 86-cent-dollar.

To recap Canada's circumstances:

- Resource products are the key to Canada's trading success but the trend of prices is down and the trend of costs is up.
- Inflation and the high dollar have left our manufacturing sector in very bad shape, but the really fundamental problem is dismal productivity growth.
- Our R&D spending, already extremely low by industrial country standards, has actually been declining relative to GDP.
- Meanwhile, our economy is increasingly short of technical skills.

The evidence is overwhelming that Canada must make a fundamental change of course. We must change course from our traditional path in which resource exploitation — with relatively little value-added — was sufficient to ensure great prosperity. Now Canadians need to forge a new path in which the intensive application of science and technology drives a process of continuous innovation leading to productivity, added value, and thus, to a new foundation of national prosperity.

The Americans have been quicker to recognize what is needed. In the words of Dr. Alan Bromley, the Science Advisor to President Bush: "Investing in science and technology is something an industrial country cannot afford not to do." The Japanese, of course, go even further. For example, in a poll of Japanese executives reported recently in *Business Week* (September 3, 1990), 91 percent cited innovation as the key to growth in the 1990s.

The crisis of competitiveness in Canada is so pervasive that, if left unaddressed any longer, it risks permanently eroding the foundation of our society. Without the continued ability to sustain a world-competitive economy, we Canadians will not be able to solve our fiscal and monetary problems. We will not be able to clean up our environment. We will not be able to maintain, let alone improve, the quality of our social programs. We will not be able to help either the disadvantaged regions or the disadvantaged groups in our society. The list goes on.

An Action Plan

So what is to be done? In the remainder of this document we will outline very briefly the key elements of a strategy that we recommend for the Government's consideration.

Let us acknowledge at the outset that competitiveness is primarily the responsibility of the private sector. We must also recognize that there are no quick fixes — no magic bullets. Having said that, there is an essential and constructive role for government. In the words of Michael Porter of Harvard University: "National prosperity is created, not inherited."

The Government has already taken a number of fundamental steps to encourage a more innovative and productive economy. It has dismantled trade barriers. It has encouraged privatization and deregulation. It has begun a fundamental reform of the tax system, which should foster greater savings and investment. It has responded to our recommendations by funding a Centres of Excellence program and Canada Scholarships.

In fairness, the Government has already done a lot, but has received precious little credit for it. We of the Advisory Board are appreciative of what has already been accomplished. Nevertheless, our advice is that the Government must do even more, a great deal more — because the challenge we have described is so pervasive, so stubborn and yet so critical.

We are of course aware of the daunting array of challenges that the country is now facing — national unity, the fiscal crisis, the environment, the unique problems of native people. We understand the temptation to let an issue like competitiveness, with all its connotations of a business agenda and “bad” news, slip to the back of the queue. But we are saying that if that is allowed to happen, and if the fundamental issues of innovation and productivity are not tackled aggressively, all of the other problems that try our nation’s spirit can only become more intractable.

We have some specific suggestions as to how the Government can address the issue in both the short and the long term. First, there is a need to demonstrate, up-front, the Government’s commitment, and to put in place a process to ensure continuation of that commitment. We recommend four immediate steps:

Step I – Send a clear signal that the Government takes *seriously* the situation we have described. Make competitiveness a major theme in the next Speech from the Throne, placing it at least on a par with the other pressing issues on the national agenda.

Step II – Ensure that all major initiatives of the Government are evaluated in light of their implications for competitiveness. To put in place the machinery for this to happen, we believe that the Government should either establish a permanent Cabinet Committee charged with ensuring that the issues we have raised remain front-and-centre in the mind of the Government, or at least make these issues central to the mandate of the existing Cabinet Committee on Economic Policy.

Step III – We ask the Prime Minister and his Ministers to carry the competitiveness message from coast to coast. There is still a tremendous amount of educating that needs to be done. And the Prime Minister should consider convening, perhaps in 1992, a second national conference on innovation and competitiveness to take stock of progress and to establish fresh priorities.

Step IV – Raise the issues we have been describing to the top of the federal-provincial agenda. If ever there was a challenge that requires cooperation and mutually supporting strategies, this is it.

These four steps begin to deal with the important matter of process. But what about the substance of our recommended strategy? What concrete steps might we take to close the widening gap that exists between the technological fitness of Canadian industry and that of our competitors?

We need to move forward on several fronts simultaneously. Let us mention three:

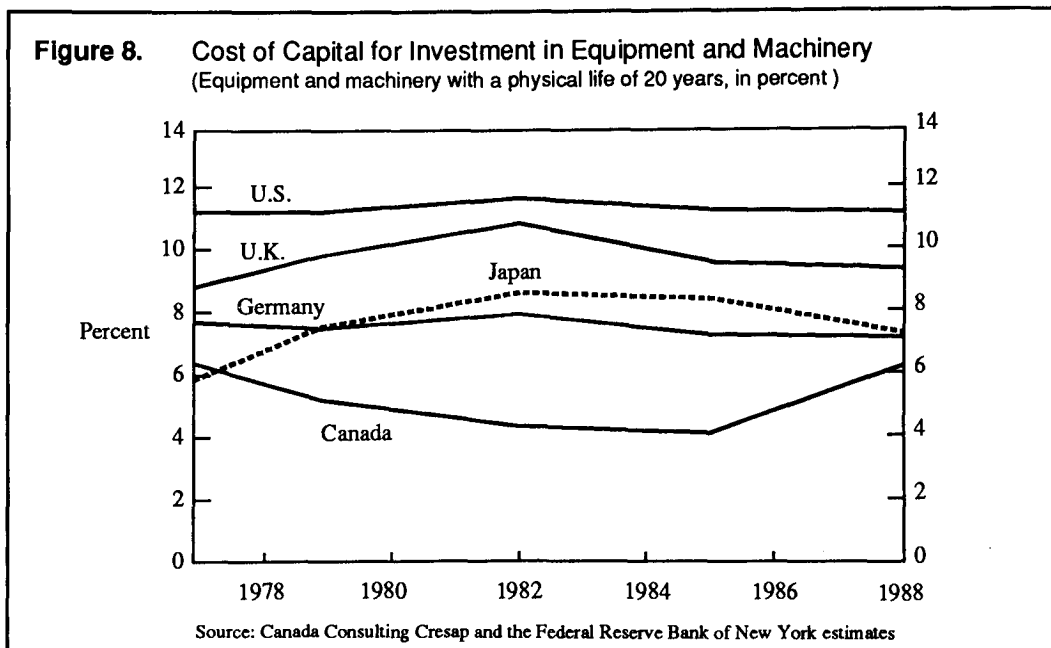
- We need broad *framework policies* that are favourable to innovation. These include the regulatory environment; creating conditions favourable to financing young, innovative firms; policies that would make Canada a more attractive location for R&D; and so forth.
- We need a battery of *human resources policies* that will inspire more young people to pursue technical careers and that will provide much more extensive employee training.
- And at the level of the individual firm, we need policies to promote the *development, acquisition and diffusion of technology* and the most up-to-date industrial practices.

These are the major rubrics under which a great many mutually reinforcing policies and programs need to be developed. Two Committees of the Advisory Board (chaired by Hugh Wynne-Edwards and Beverley Brennan) have examined the issues of education and training, and of better ways to finance industrial innovation. To set the stage for further discussion, the following highlights from their reports provide a flavour of their analysis and recommendations.

Financing Innovation

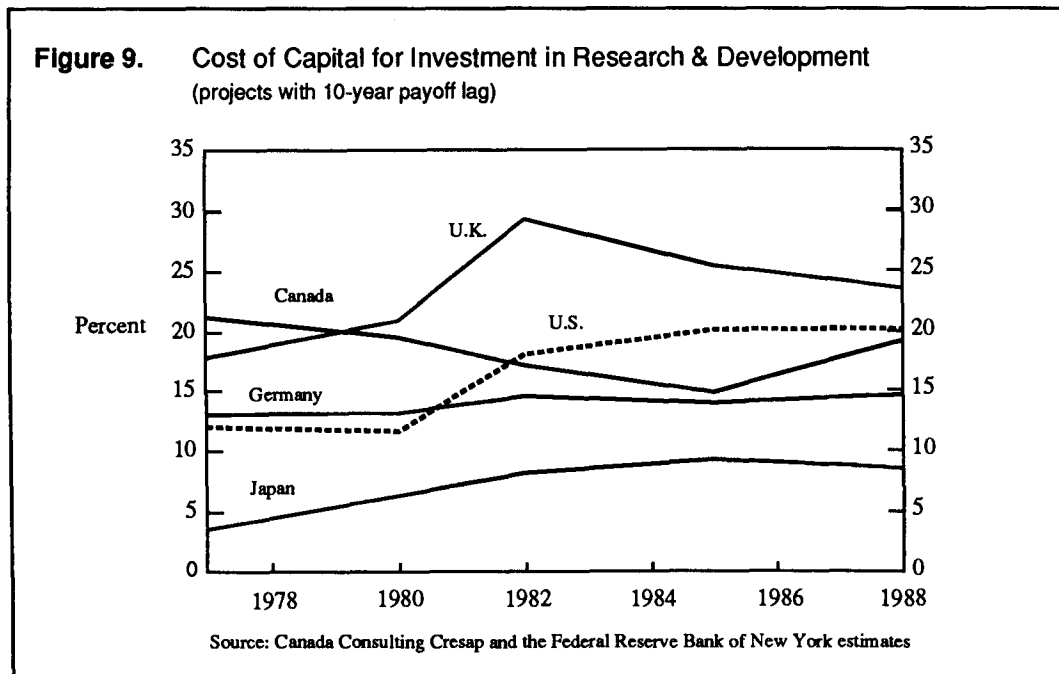
The report on Financing of Industrial Innovation addresses one of the most pervasive framework factors — the cost of capital. The recommendations aim to benefit innovative companies of all sizes, from small start-ups (where simply the *availability* of funds is often a major constraint) to large R&D performers (where the relatively high cost of capital in Canada can deter investment in risky projects that offer only long-term payoff).

To provide a taste of the analysis, figure 8 traces the comparative cost of capital in several countries for an investment in equipment and machinery, taking into account the various tax-based incentives, differing interest rates, inflation and so forth. This chart shows that Canada compares very favourably, at least through 1988. In 1980, we had one of the most



encouraging tax treatments in the world for this type of investment. Subsequent budgets, however, have steadily removed the incentives. The ultimate effect of this on investment in our manufacturing and processing industries remains to be seen.

Consider next the cost of capital in the context of a typical R&D project with a ten-year payoff lag. Figure 9 shows that Canada's cost is significantly higher than Japan's and Germany's, although it is comparable to the situation in the U.S. and more favourable than the U.K. Despite a reasonably supportive R&D tax treatment (at least for smaller Canadian-controlled firms), our relative position is nevertheless not nearly as favourable as it was in figure 8. One of the main reasons is that our competitors also maintain R&D incentives of comparable attractiveness.



These two examples demonstrate that *targeted* policy measures can have a significant effect on the cost of capital for types of investment that one might wish to encourage. Obviously, there are technical issues regarding the relative cost-effectiveness of different policy choices. Those can be debated in the appropriate forum. But the bottom-line message is that deliberate policy *can* have a major impact. The only questions are "How much?" and "At what cost?" And that's where we come down to competing priorities and political choices.

The following three recommendations from the report aim to create a structure that would lead to more effective financing of innovation.

I. Capital Gains: The report recommends that the capital gains tax rules be modified so that gains from eligible equities that are held longer than three years would not be taxed. The objective of this proposal is to increase the supply of investment funds available to finance innovation by increasing the after-tax reward for investors. We believe that the proposal is operationally feasible and note that our current tax system already allows for different classes of capital gain. So the issue really boils down to an assessment of cost-benefit versus competing initiatives.

II. Pension Funds: The Committee recommends that a tax penalty be applied against pension funds that fail to invest at least one percent of their assets in eligible small enterprises. (The penalty would be 10 percent of the amount not invested.) "Eligible enterprises" would include companies performing substantial amounts of R&D or venture capital groups that specialize in funding technology-intensive firms.

This is an innovative, and probably controversial proposal that is designed to spur pension funds to supply more capital to innovative enterprises. Obviously, it would be irresponsible to deliberately place the retirement funds of Canadians at risk. But we believe that a greater risk for the long term would arise from a failure to address the issues of innovation and competitiveness that we have identified.

III. Industrial Innovation Merchant Bank: The report proposes the establishment of a new type of financial institution that would specialize in providing equity and debt investment for technology-intensive firms. Governments would contribute some part of the initial capitalization. The objective is to increase the supply of what might be called "intelligent capital," i.e., capital provided by a specialized institution possessing a keen understanding of the particular circumstances and needs of technology-intensive industries. We are pleased to see that the Government's new financial sector policy makes reference to a "specialized financing corporation" that would be a new type of bank subsidiary. The objectives appear to be consistent with our recommendation.

Human Resources

Another major theme in our proposed policy framework is the development of skilled human resources. No issue is more important and none has been more studied and recommended upon. And while annual education and training expenditures in Canada are enormous — about \$45 billion on formal education and \$5 billion on adult training — the outcomes alluded to earlier still leave a lot to be desired.

The report of the Human Resource Development Committee, *Learning to Win*, offers insightful analysis and recommendations as to how we should respond. The following points summarize a few of the report's highlights.

- Adult training is our greatest area of untapped potential. The average Canadian worker is now receiving approximately seven hours of formal training per year, compared with approximately 200 hours for the average Japanese and 170 hours for Swedish workers. To focus attention on both the need and the opportunity for much greater adult training, the Committee is recommending, as a national target for the year 2000, that five percent of adult working time should be spent on teaching and learning.
- Investment in training should be initiated by employers, but supported by government. It should be up to firms to set their own individual targets. And if we are to implant a training culture in Canadian society, the first priority should be to train our managers, since without their commitment, it will be impossible to instill the required new attitudes.

- We need to improve the quality of science teaching in our school system at all levels. Too many curious young minds are being turned off before they leave the early grades. The report recommends the establishment of a program of "Awards for Excellence" in science teaching. The program would recognize 50 outstanding science teachers across the country each year. This could be a very effective, yet inexpensive, initiative and could begin to pay dividends immediately.
- There must be a much greater effort in Canada to promote excellence at the apex of the educational system. Accordingly, the report repeats the long-standing recommendation of the Advisory Board to double the funding of the three granting councils*. This would enable Canadian universities to develop sufficient "critical mass" to achieve world-class research capability in key subject areas.
- This focus on excellence at the top should be complemented by promoting excellence throughout the education system. Probably one of the most effective ways to address this is to try, once again, to agree on national, or at least regional, standards of performance that would be measured and made public.
- Finally, the ideas we have discussed cross a great many jurisdictions and poach on much well-defended turf. If we are to move forward, it is essential, therefore, to think hard about questions of effective process and about new institutional machinery. Accordingly, the Committee is recommending the creation of a "Continuous Learning Board", which would focus on developing excellence at all levels in the workforce through continuous learning programs. Reporting annually to all First Ministers, the Board would primarily fulfill an analytical and advisory role, much like that played by the Economic Council of Canada.

The importance of highly qualified people for the future of this country cannot be overstated. We simply must bring new focus and urgency to the issue. There are other proposals currently on the table that aim at many of the same objectives as the Continuous Learning Board. The Minister for Employment and Immigration, Barbara McDougall, is now considering a proposal to set up a National Training Board. The Ontario Premier's Council has just proposed a Training and Adjustment Board for that province. Obviously, there is a particular timeliness in concepts of this sort and it would be tragic to miss this unusual opportunity to achieve some degree of national consensus.

Acquisition and Diffusion

Another critically important policy theme is the need to promote more effective development, acquisition and diffusion of technology and best-practice techniques. This has not been the subject of a special committee of the Advisory Board, but it probably should be. The federal government already operates a number of very effective programs to promote technology acquisition and diffusion, such as the Industrial Research Assistance Program (IRAP) of the National Research Council and the Technology Inflow Program (TIP) of External Affairs and International Trade Canada.

* The Natural Sciences and Engineering Research Council (NSERC); the Medical Research Council (MRC); and the Social Sciences and Humanities Research Council (SSHRC).

Evidently, these could be strengthened as part of an aggressive strategy to really come to grips with the matters we are discussing here. But no strategy to enhance the rate of acquisition and diffusion of best-practice technology can work without addressing the low level of capability of managers in many sectors to introduce advanced technologies, and the inadequate skill levels of many workers to use them. In other words, as with so many other issues, people are at the heart of the problem, and also at the heart of its solution. We understand that the Honourable Benoît Bouchard, Minister for Industry, Science and Technology, has been addressing many of these issues in the context of a comprehensive strategy on competitiveness. Obviously, we urge sympathetic consideration.

Conclusion

The objective of this report has been, first, to define and to document the competitiveness problem Canada is facing; second, to convey the critical need for Canada to respond by changing course now; and finally, to propose a strategy for the role the federal government can play in initiating this change of course.

In conclusion, the National Advisory Board on Science and Technology wants to re-emphasize the seriousness with which it regards the circumstances facing our nation. We are convinced that the future well-being of Canadians is at stake.

