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Measuring the Attractiveness of R&D Tax Incentives: Canada and Major Industrial Countries



Measuring the Attractiveness of R&D Tax Incentives: Canada and Major Industrial Countries

**A Report
Prepared for: Foreign Affairs and International Trade Canada,
Ontario Investment Service
and Statistics Canada**

By Jacek Warda

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THE SCIENCE AND INNOVATION INFORMATION PROGRAM

The purpose of this program is to develop **useful indicators of science and technology activity** in Canada based on a framework that ties them together into a coherent picture. To achieve the purpose, statistical indicators are being developed in five key entities:

- **Actors:** are persons and institutions engaged in S&T activities. Measures include distinguishing R&D performers, identifying universities that license their technologies, and determining the field of study of graduates.
- **Activities:** include the creation, transmission or use of S&T knowledge including research and development, innovation, and use of technologies.
- **Linkages:** are the means by which S&T knowledge is transferred among actors. Measures include the flow of graduates to industries, the licensing of a university's technology to a company, co-authorship of scientific papers, the source of ideas for innovation in industry.
- **Outcomes:** are the medium-term consequences of activities. An outcome of an innovation in a firm may be more highly skilled jobs. An outcome of a firm adopting a new technology may be a greater market share for that firm.
- **Impacts:** are the longer-term consequences of activities, linkages and outcomes. Wireless telephony is the result of many activities, linkages and outcomes. It has wide-ranging economic and social impacts such as increased connectedness.

The development of these indicators and their further elaboration is being done at Statistics Canada, in collaboration with other government departments and agencies, and a network of contractors.

Prior to the start of this work, the ongoing measurements of S&T activities were limited to the investment of money and human resources in research and development (R&D). For governments, there were also measures of related scientific activity (RSA) such as surveys and routine testing. These measures presented a limited picture of science and technology in Canada. More measures were needed to improve the picture.

Innovation makes firms competitive and we are continuing with our efforts to understand the characteristics of innovative and non-innovative firms, especially in the service sector that dominates the Canadian Economy. The capacity to innovate resides in people and measures are being developed of the characteristics of people in those industries that lead science and technology activity. In these same industries, measures are being made of the creation and the loss of jobs as part of understanding the impact of technological change.

The federal government is a principal player in science and technology in which it invests over five billion dollars each year. In the past, it has been possible to say only *how much* the federal government spends and *where* it spends it. Our report **Federal Scientific Activities, 1998 (Cat. No. 88-204)** first published socio-economic objectives indicators to show *what* the S&T money is spent on. As well as offering a basis for a public debate on the priorities of government spending, all of this information has been used to provide a context for performance reports of individual departments and agencies.

As of April 1999, the Program has been established as a part of Statistics Canada's Science, Innovation and Electronic Information Division.

The final version of the framework that guides the future elaboration of indicators was published in December, 1998 (**Science and Technology Activities and Impacts: A Framework for a Statistical Information System**, Cat. No. 88-522). The framework has given rise to **A Five-Year Strategic Plan for the Development of an Information System for Science and Technology** (Cat. No. 88-523).

It is now possible to report on the Canadian system on science and technology and show the role of the federal government in that system.

Our working papers and research papers are available at no cost on the Statistics Canada Internet site at <http://www.statcan.ca/english/research/scilist.htm>.

CONTACTS FOR MORE INFORMATION

Science, Innovation and Electronic Information Division

Director Dr. F.D. Gault (613-951-2198)

Assistant Director Brian Nemes (613-951-2530)

Assistant Director Paul McPhie (613-951-9038)

The Science and Innovation Information Program

Chief, Indicators Development

Dr. Frances Anderson (613-951-6307)

Chief, Knowledge Indicators

Michael Bordt (613-951-8585)

Chief, Innovation

Daood Hamdani (613-951-3490)

Life Science Unit

Antoine Rose (613-951-9919)

Science and Innovation Surveys Section

Chief

Bert Plaus 613-951-6347)

Senior Project Officer

Don O'Grady (613-951-9923)

Senior Project Officer

Janet Thompson (613-951-2580)

FAX: (613-951-9920)

Working Papers

The Working Papers publish research related to science and technology issues. All papers are subject to internal review. The views expressed in the articles are those of the authors and do not necessarily reflect the views of Statistics Canada.

PREFACE

This second edition of **R&D Tax Treatment in Canada: A Provincial Comparison**, uses a method developed by the Conference Board of Canada to compare the tax incentives to do R&D in each of the provinces. The results contribute to the analysis of regional differences in science and technology activity in Canada, as part of the work of the Science, Innovation and Electronic Information Division (SIEID) of Statistics Canada.

The objective of the SIEID work on science and technology is to develop useful indicators of activity and to fit them into a framework to tie them together into a coherent picture of science and technology in Canada. The indicators can provide the picture at the national level or at provincial or sub-provincial levels to reflect regional differences. An example of a regional difference is the tax incentive to do R&D in a province. There is the federal Scientific Research and Experimental Development tax programme, which has regional variations. Six out of ten provinces have their own incentive programmes and tax rates which differ from province to province. The 'B-Index' analysis of the Conference Board provides a means of comparing tax incentives and of providing an indicator.

A single indicator does not provide a coherent picture. It must be supplemented by other indicators and information, and some examples of regional indicators are found in other issues of this working paper series and in the catalogue publications of the Division (The papers and publications are listed on the last two pages.). There are estimates of R&D expenditure and personnel for universities, for the federal government, for industry and for provincial research organizations.

To advance the knowledge of regional innovation in Canada, the Project sponsored a workshop at the University of Ottawa in March of 1997 which brought together measurement experts, policy makers, and academics. Some of the papers given at the workshop have been published in a book entitled "Local and Regional Systems of Innovation", edited by John de la Mothe and Gilles Paquet (Kluwer Academic Publishers, 1998).

The objective of all of this work is to highlight regional differences in R&D and innovation and to pose questions about why these differences arise. Tax incentives may make some of the difference.

Highlights

- Canada's combined federal–provincial corporate income tax system remains the most attractive in its treatment of R&D. None of the country or U.S. state tax systems examined are as favourable to R&D as the tax systems of Canada and any of its provinces.

- R&D tax credits are back in favour as a policy tool used at both national and local levels of tax jurisdiction:
 - Eight out of the 11 countries examined provide an R&D tax credit.
 - Eight Canadian provinces offer their own tax incentives.
 - Eight out of 10 U.S. states examined have R&D tax credits in place.

- Selective tax support for R&D performed by small firms is not common among the countries examined. Only four countries—Canada, Italy, Japan and Korea—have programs that provide tax credits for small-company R&D.

Introduction

In many countries, research and development (R&D) tax incentives to stimulate private sector research spending are a significant element of technology and innovation policy. The purpose of this report is to present a measure of the relative attractiveness of these tax incentives in the following jurisdictions: Canada, its 10 provinces, the other G-7 countries—France, Germany, Italy, Japan, the United Kingdom and the United States (including 10 states)—and Australia, Korea, Mexico and Sweden.

A “B-index methodology” is used here to compare the relative importance of R&D tax support across these tax jurisdictions. The value of the B-index depends on the tax treatment of R&D in a country, Canadian province or a U.S. state and is based on the before-tax income required to break even on a \$1 R&D outlay. The more favourable its tax treatment of R&D, the lower is a country’s B-index. Although the B-index is a useful analytical and comparative tool, it is based on a number of methodological assumptions. As well, it does not consider the full range of taxes in a country or the effects of other types of technology policies on research spending. An important issue for consideration is the appropriate role for R&D tax incentives relative to other types of policy instruments.

This study sets out only to measure differences in the tax treatment of R&D, thus it ignores factors such as subsidies, as well as taxes that do not pertain to corporate income. Non-fiscal factors that affect the decision to invest in R&D, such as the availability of competent researchers and a skilled workforce and the presence of a knowledge infrastructure, are beyond the scope of this work. Hence, while the comparison can inform policy discussion, it cannot replace the detailed examination of alternatives for any particular private sector decision.

About the B-Index Model

The R&D tax system of each country, U.S. state or Canadian province was ranked by comparing the minimum benefit–cost ratio—termed the B-index—at which an R&D investment becomes profitable given a jurisdiction’s income tax treatment for firms performing this work. In this way, the B-index reveals the relative support for private sector investment in R&D delivered through a tax system or, stated alternatively, a tax system’s impact on the private sector decision to invest in R&D. Specifically, the B-index is calculated as the present value of before-tax income that a firm needs to generate to cover the cost of an initial R&D investment and to pay the applicable income taxes. The lower the index, the greater the incentive for a firm to invest in R&D.

The B-index model used in this paper makes it possible to measure and rank the relative attractiveness of R&D tax systems among jurisdictions. Within any single region, a firm’s R&D opportunities can be regarded as a series of projects, each of which will have a benefit–cost ratio. The firm will find it profitable to undertake all projects with benefit–cost ratios in excess of B. Generally, the lower B is, the greater the amount of R&D that a firm will undertake.

Across jurisdictions, interest focuses on the effect of differences in a country or region’s tax systems on identical projects. The value of the B-index depends on the income tax treatment of R&D. The more favourable its tax treatment of R&D, the lower is a jurisdiction’s B-index and,

other things being equal, the greater the amount of R&D that will be conducted by its corporate residents.

Technically speaking, the B-index formula is simple; it represents a ratio of the after-tax cost (ATC) of a \$1 expenditure on R&D divided by 1 less the corporate income tax rate. The generic formula for the B-index is as follows:

$$B = \text{ATC}/(1-t) \quad \text{where:} \quad t = \text{corporate income tax rate}$$

The ATC enters the numerator of the B-index equation. It is defined as the net cost to the company of investing in R&D, taking account of all available tax incentives for R&D.¹ Tax incentives lower the ATC of an R&D project. Corporate income tax rates influence the level of ATC, as well. The higher the tax rate, the lower is the ATC of R&D and vice versa. As can be seen, using ATC as a measure of the relative attractiveness of R&D tax incentives can yield a distorted result, complicated by the size of the corporate income tax rate that enters the ATC equation. To isolate the impact of tax incentives from the impact of the corporate income tax rate, the study applies the measure of the B-index. Since the B-index is expressed as a before-tax ratio, it reduces the impact of tax rates and makes interprovincial or international comparison possible.

Assumptions

At times, the model can be complicated by the fact that the labour, current, capital and building components of R&D expenditures are taxed differently. To ensure comparability in this case, all R&D is assumed, based on OECD averages for those expenditures from an earlier study,² to follow these proportions: labour, 60 per cent; other current expenses, 30 per cent; machinery and equipment, 5 per cent; and buildings, 5 per cent.

Elements Included in the B-index

This study examines the following features of corporate income tax systems as they relate to R&D:

- the time period over which both current and capital expenditures on scientific research may be written off against taxable income;
- the existence of any deductions, including accelerated and bonus deductions, from taxable income that are based on the level or the change in the level of R&D spending;
- the availability of any tax credits (reductions in taxes payable) that are based on the level or the change in the level of R&D spending; and

¹ For more information on the model, see Donald G. McFetridge and Jacek P. Warda, *Canadian R&D Tax Incentives: Their Adequacy and Impact* (Toronto: Canadian Tax Foundation, 1983); and Jacek P. Warda, *International Tax Competitiveness of Canadian R&D Tax Incentives: An Update* (Ottawa: The Conference Board of Canada, 1990).

² See, McFetridge and Warda, *Canadian R&D Tax Incentives*, p. 27. This distribution does not differ substantially from that in Canada today, with the exception of labour component, which in Canada is about 50 per cent. Assuming 50 per cent for wages would lower the attractiveness of R&D tax incentives in Quebec because this province's tax credit is based on wages.

- the rate at which corporate income is taxed, including the impact of major provincial or state tax systems.

Elements Not Included

A number of features of tax systems that relate to R&D decisions as well as to other investment decisions are outside the scope of the research. Important tax factors involved in corporate decisions to invest in R&D, such as personal income taxes, commodity taxes, property taxes, payroll taxes and taxes on capital, and grants and subsidies for R&D are also excluded. This is particularly relevant to tax jurisdictions that rely on capital, property and commodity taxes as main sources of their revenues rather than on corporate income tax.

Other Assumptions

The analysis focuses on the tax treatment of R&D expenditures of both small³ and large manufacturing companies. The study assumes that firms have sufficient taxable income to claim the full amount of R&D tax incentives in the current year, and, therefore, certain dynamic aspects of R&D tax incentives, particularly the use of carry forward/carry back provisions, do not alter B-index values. To incorporate them would require restrictive assumptions regarding the distribution of income over time.

In the case of graduated income tax rates or graduated tax incentives, the analysis assumes a tax rate or tax incentive available on top eligible income. Because of the assumption that firms are able to claim the full value of tax incentives, this rules out certain limits on income and caps on claimability of tax incentives, often based on size, that may exist in the jurisdictions examined. In this respect, the index makes no difference between non-refundability and refundability provisions of tax incentives.

Canada in the International Context

By international standards, Canada provides the most attractive treatment for R&D among the 11 countries examined. Significant provincial sharing in the package of R&D tax incentives has contributed to Canada's standing at the top in the B-index ranking in both large and small firm categories. Tables 1 and 2 give the current B-indices for the 11 countries. Table 1 shows the indices for a large manufacturing company, while Table 2 shows the indices for a small manufacturing company. The initial comparison of R&D tax provisions according to the B-index methodology indicates that Canada has the lowest B-index. In the large firm category, Canada outpaces the runner-up comparator countries—the United States and Australia—by a fair distance. At the opposite end of the spectrum, Germany, Italy and Sweden were found to have the highest B-indexes, which would offer the least incentives to business research spending (see, Table 1). In the small firm category, Canada and Quebec top the standings, while Canada and any of its provinces are far ahead of all countries except for Italy. At the opposite end of the spectrum are again Germany and Sweden, which have the highest B-indexes.

³ Equivalent to Canadian Controlled Private Corporation (CCPC).

The Canadian provinces' corporate income tax systems continue to offer an attractive incentive for companies to engage in R&D. The conclusions apply equally to R&D tax treatment for large and small corporations. In 1990, there were only three provinces operating their own R&D incentives: Ontario, Quebec and Nova Scotia. In 1992, Manitoba joined the group of provinces that provide tax incentives for R&D. It was followed by New Brunswick in 1994, Newfoundland in 1996 and Saskatchewan in 1998. And most recently, in September 1999, British Columbia followed the suit. These eight provinces constitute the "G-8" provinces. Large companies conducting R&D in these provinces need to make less than 80 cents and small firms less than 60 cents before tax in order to break even on their \$1 investment in R&D (see Tables 3 and 4). In 1999, Quebec improved its already leading position in R&D tax treatment with the introduction of a system of super-deductions from taxable income. These super-deductions are in lieu of the R&D tax credits offered and benefit profitable corporations based in Quebec.

The remaining two provinces do not provide their own R&D tax incentives. These provinces—Alberta and Prince Edward Island—fare less well in the interprovincial comparison. Their B-indexes, influenced only by federal R&D tax support, are some 100 basis points higher (or less attractive) than the B-indexes of the G-8 provinces, meaning that companies in these jurisdictions must derive a higher before-tax income (on average by 10 cents) in order to break even. All things being equal, the theoretical implication of this result is that companies located in G-8 provinces would spend more on R&D because they require (thanks to increased government assistance) a lower rate of return to make a profit.

Still, the two provinces that rely only on the federal R&D tax incentives are very competitive internationally. They surpass each tax system examined (except for Italy in the small firm category), including the national tax systems and the 10 U.S. state tax systems chosen for the study (see Table 5). Their B-indexes show Alberta and Prince Edward Island would place at the top of the international ranking, if they were used for international comparisons. The use of any province in this group would still permit Canada to place first among the countries examined. In other words, it would not affect the international ranking of the attractiveness of Canada's R&D tax system. This result points out the high overall level of the Canadian federal R&D tax support. Indeed, this study supports further the findings of the earlier Conference Board studies in this area that Canada's federal tax support for R&D has not diminished over time and continues to be one of the most generous and stable offerings in the industrialized world.

The top ranking of Canada's R&D tax treatment internationally results from the combination of a "palatable pie"(the federal tax incentive package) and the "topping"(the tax treatment of R&D in the provinces that offer it), which makes the "pie" even more attractive. By and large, no country or state tax system of those examined in the study can measure up to the attractiveness of the R&D tax treatment in Canada and any of its provinces.

International Comparative Analysis

Based on the results, the 11 countries studied have been classified into four groups depending on the degree to which they promote R&D through tax incentives. We have distinguished the following groups:

1. Leading promoters: Canada
2. Medium promoters: Australia, Korea, France and the United States
3. Small promoters: Italy, Japan, Mexico and the United Kingdom
4. Non-promoters: Sweden and Germany

Leading Promoters

Of the countries examined, Canada is the only one that can be considered for this category. Canada has relied extensively on tax incentives in its innovation policy for many years. Its federal tax system has evolved over a 30-year period through a range of tax incentives from incremental allowances, through level-based tax credits and incremental tax credits, usually reflecting regional disparities, to the package available today. Canada's federal R&D tax treatment now includes an immediate write-off of both current costs and R&D machinery and equipment costs, as well as a 20 per cent, level-based and taxable, tax credit. The rate of R&D tax credit increases to 35 per cent for small companies. Regional preferences in the federal system were abolished at the end of 1994. However, the federal R&D tax provisions have been generously strengthened by provincial R&D tax incentives. Today, 8 of the 10 Canadian provinces offer their own incentive packages relying mainly on tax credits. This makes Canadian R&D tax treatment by far one of the most attractive tax incentive packages in the world.

Medium Promoters

Until recently, Australia was a leading promoter of R&D tax incentives based on its 150 per cent R&D tax concession. In the 1996–97 budget, the concession was significantly reduced, dropping Australia's position to the medium promoter category. Today, Australia offers a special 125 per cent allowance for current R&D expenditures and R&D expenditures made on machinery and equipment.

Since 1981, the United States has provided a tax credit at the federal level for increases in R&D tax expenditures. The credit is less generous than the Canadian federal R&D tax credit, but it is, like Canada's, matched by tax credits offered by many states. California is the leading state in this area.

Of the two remaining countries in the group, Korea continues to rank relatively high with two investment tax credits, one on the level of capital investment in R&D facilities and another on incremental R&D expenditures. In France, an incremental tax credit remains a strong element of the tax environment for R&D. Still, in recent years, the generosity of the French tax package has been slightly diminished because the extension of the average base period in the calculation of the tax credit has been cut from one preceding year to two years.

Small Promoters

Japan, Italy, Mexico and the United Kingdom fall into the group of small promoters. Japan is considered to be a small promoter not because it does not provide tax credits—on the contrary, it offers quite a few of these incentives—but because all of them are modest compared with tax credits offered by other countries. However, Japan is the first country to promote basic or

enabling technology through a specifically designed tax credit. Japan is also the first country to promote collaborative research through tax credits at the national level. Because these “innovative” credits are levied on only a fraction of R&D costs, their value is small.

In Italy, the R&D tax credit applies only to small companies, hence it is considered a relatively small promoter of R&D.

Mexico recently joined the ranks of small promoters by introducing an incremental tax credit for R&D in 1997. It had not provided any R&D tax credit before then.

Although it does not provide any R&D tax credits, the United Kingdom has always had a generous allowance system that permits a full write-off of all R&D expenditures incurred in the year. In fact, this makes the U.K. tax system neutral with respect to R&D.

Non-promoters

The last group of countries consists of Sweden, Italy and Germany. These countries generally do not use R&D tax incentives, though some may have used them before. By and large, Sweden has made the most far-reaching changes. Until 1982, companies in Sweden enjoyed a relatively generous R&D tax treatment based on special allowances designed to foster R&D. Currently, there is no explicit R&D tax incentive in Sweden, which is reflected by Sweden’s low B-index. However, Sweden’s corporate income tax rate is low—28 per cent—making up in some way for the lack of tax incentives.

Until the end of December 1989, Germany granted a tax credit on fixed R&D assets. Since the expiry of the Investment Premium Law, Germany has not had a general tax credit aimed at R&D. Italy also does not grant an R&D tax credit to large firms. However, Italy enjoys a lower corporate income tax rate —37 per cent—than Germany with its combined federal and municipal rate of 56.6 per cent.

Overall, as Tables 1 and 2 show, the B-indexes tend to be greater than 1 for the non-promoter countries, indicating the significantly less generous R&D tax treatment compared with the leading promoter and medium promoter countries that offer specific tax incentives for R&D. The B-indexes of the small promoter countries hover around 1, meaning that their R&D tax incentives exist but have relatively little effect on corporate returns.

Trends in R&D Tax Support

Overall, it can be said that, after the period of adjustment and cuts in their generosity in the early 1990s, tax credits for R&D are back in favour among governments. This can be seen at both national and local levels of tax jurisdiction.

A significant number of countries—8 of the 11 examined—provide an R&D tax credit or a related tax incentive. Generally, tax credits are applied to the increment (increase) in R&D expenditure or to the level of R&D spending. Canada and Italy offer an R&D tax credit that applies to the level of R&D expenditure. Australia and two Canadian provinces, Ontario and Quebec, also offer a level-based but somewhat different mechanism—an increased deduction of

R&D expenditure from the taxable income of a corporation. The remaining countries—France, Japan, Korea, Mexico and the United States—provide a tax credit based on increases in R&D expenditure or a mix of level-based or increase-based (incremental) tax credits.

In contrast to R&D allowances, which are deducted from taxable income, tax credits are always deducted from income tax. Tax credits can be taxable or non-taxable. Those offered by France, Italy, Japan, Korea and Mexico are non-taxable. Both Canada and the United States have taxable tax credits in place.

Selective tax support for R&D performed by small firms is not very common among the countries examined. Only three countries, Canada, Japan and Korea, have programs that provide selective tax credits for small company R&D. These credits are usually offered in addition to the general R&D tax treatment of all companies in those countries. They take the form of an increased rate of a generally available tax credit (e.g., in Canada) or a completely new credit, specifically designed for small innovative firms (e.g., in Italy and Japan). They are usually complemented by reduced rates of corporate income tax.

On top of federal tax incentives, Canada and the United States provide R&D tax incentives at the provincial/state level. This is marked by a growing number of provinces and states introducing their own R&D tax incentives. This study has noted that, since 1990, the number of Canadian provinces applying tax credit or special allowances has grown from three to seven. Both Quebec and Ontario offer generous R&D tax incentives on top of the federal ones. Likewise, out of the 10 U.S. states examined, 8 offer a specific tax credit toward R&D expenditure.

It is expected that in these and other countries, particularly those with federal systems, the sharing of R&D tax incentives among the various tiers of government may increase in the future. This is a reflection of increasing competition among regions to attract knowledge-based investment.

Table 1
International Comparison of B-indexes and After-Tax Costs, 1998
(for a large manufacturing company)

Country	ATC	B-index	Tax Credits	Expense Deduction	CIT
Canada—PQ	0.482	0.699	yes*	CUR, ME	31.00
Canada—ON	0.507	0.787	yes	CUR, ME	35.60
United States—CA	0.521	0.879	yes	CUR	40.75
Australia	0.570	0.890	yes*	CUR, ME	36.00
France	0.533	0.914	yes	CUR	41.67
Korea	0.635	0.918	yes	CUR	30.80
Mexico	0.640	0.969	yes	CUR	34.00
United Kingdom	0.690	1.000	no	CUR, ME, B	31.00
Japan	0.525	1.010	yes	CUR	48.00
Sweden	0.731	1.015	no	CUR	28.00
Italy	0.647	1.027	no	CUR	37.00
Germany	0.456	1.051	no	CUR	56.60

* Allowances from taxable income

CUR = immediate current expense deduction

ME = immediate machinery and equipment cost deduction

B = immediate buildings cost deduction

NO = no immediate current expense or capital cost deduction

CIT = statutory corporate income tax rate (per cent)

Notes: This comparison assumes California's tax system for the United States (an 11 per cent tax credit).

The proportion of R&D expenditure is assumed to be 90 per cent (0.90) for current expenses (including 60 per cent [0.60] for wages and salaries), 5 per cent (0.05) for machinery and equipment, and 5 per cent (0.05) for buildings and structures.

A nominal discount rate of 10 per cent was used in calculating present values of depreciation allowances and incremental tax incentives. The present value of depreciation allowances was calculated using the end-of-period rule.

Source: The Conference Board of Canada.

Table 2
International Comparison of B-Indexes and After-Tax Costs, 1998
(for a small manufacturing company)

Country	ATC	B-index	Tax Credits	Expense Deduction	CIT
Canada—PQ	0.288	0.369	yes	CUR, ME	22.00
Italy	0.367	0.552	yes	CUR	37.00
Canada—ON	0.464	0.591	yes	CUR, ME	21.60
Korea	0.689	0.837	yes	CUR	17.60
United States	0.521	0.879	yes	CUR	40.75
Australia	0.570	0.890	yes	CUR, ME	36.00
France	0.533	0.914	yes	CUR	41.70
Japan	0.609	0.937	yes	CUR	35.00
Mexico	0.640	0.969	yes	CUR	34.00
United Kingdom	0.690	1.000	no	CUR, ME, B	31.00
Sweden	0.731	1.015	no	CUR	28.00
Germany	0.456	1.051	no	CUR	56.60

Countries in bold have special R&D tax treatment for small companies. Other explanations are the same as in Table 1.

Source: The Conference Board of Canada.

Table 3
Ranking of Canada's Provinces According to the Value of the B-index:
Manufacturing Firms, 1999

Province/Territory	Large Company		Small Company	
	B-index	Rank	B-index	Rank
*Quebec	0.699	1	0.369	1
*Newfoundland	0.709	2	0.582	2-3
*Saskatchewan	0.713	3	0.585	5
*Nova Scotia	0.717	4	0.582	2-3
*Manitoba	0.719	5	0.584	4
*British Columbia	0.730	6	0.604	7
*New Brunswick	0.757	7	0.614	8
*Ontario	0.787	8	0.591	6
Prince Edward Island	0.825	9	0.676	9-10
Alberta	0.831	10	0.676	9-10

* Provinces offering R&D tax credit

Source: The Conference Board of Canada.

Table 4
Inter-provincial Comparison of ATC and B-Indexes:
Manufacturing Firms, 1999

Province/Territory	After-tax Cost of \$1 R&D Expenditure		B-index ATC/(1-tax rate)	
	Large firm	Small firm	Large firm	Small firm
*British Columbia 0.448	0.473	0.730	0.604	
Alberta	0.527	0.547	0.831	0.676
*Saskatchewan	0.484	0.462	0.713	0.585
*Manitoba	0.438	0.461	0.719	0.584
*Ontario	0.507	0.464	0.787	0.591
*Quebec	0.482	0.288	0.699	0.369
*Newfoundland	0.517	0.477	0.709	0.582
Prince Edward Island	0.581	0.537	0.825	0.676
*New Brunswick	0.461	0.497	0.757	0.614
*Nova Scotia	0.444	0.477	0.717	0.582
* Provinces offering R&D tax credit				
Source: The Conference Board of Canada.				

Table 5
Interstate Comparison of ATC and B-Indexes, 1999

U.S. State		After-tax Cost of \$1 R&D Expenditure	B-index ATC/(1-tax rate)
*California		0.521	0.879
*Colorado	0.574	0.929	
*Illinois		0.549	0.912
*Massachusetts		0.521	0.886
Michigan		0.593	0.933
*Minnesota		0.533	0.909
*New York		0.545	0.921
*North Carolina		0.541	0.909
Ohio		0.554	0.932
*Oregon		0.552	0.910
* States offering R&D tax credit			
Source: The Conference Board of Canada.			

APPENDIX: A REVIEW OF R&D TAX SYSTEMS

This appendix details the elements of the corporate income tax system that directly affect R&D expenditure in the tax jurisdictions selected. These items include the statutory corporate income tax rate, treatment of current and capital R&D expenditures, depreciation allowance on R&D capital assets (machinery, equipment and buildings), and availability of tax credits and other allowances for R&D.

The elements of the R&D corporate income tax environment enter the calculation of the B-index in the manner described in the previous section on methodology. As a general rule, the description of the pertinent tax incentives is based upon most recent (1998 for the countries, 1998–99 for the U.S. states, and 1999 for the Canadian provinces) information available in the printed tax sources.⁴

Canada: Key Elements of R&D Tax Treatment

Federal Level

The federal corporate income tax system in Canada provides a number of significant tax incentives for companies conducting R&D in Canada. Its Scientific Research and Experimental Development (SR&ED) program allows a 100 per cent deduction for qualifying current R&D expenditures, as well as for qualifying capital expenditures made on R&D machinery and equipment. Buildings, whether for R&D purposes or not, are depreciated on an ordinary basis, typically at a 4 per cent declining balance per annum.

The program also allows an investment tax credit on qualifying SR&ED expenses incurred in Canada. The qualifying expenses are generally the same as for the current deduction. For large companies, the rate of the credit is 20 per cent of R&D expenditures. The rate of SR&ED tax credit for companies eligible for the small business deduction - the Canadian Controlled Private Corporations (CCPCs) - is 35 per cent. Both current expenses and expenditures on machinery and equipment qualify for the credit. The SR&ED tax credit is taxable, however, in the sense that it must be deducted in calculating the base for current and capital expenses eligible for the 100 per cent deduction from business income. The federal SR&ED tax credits and deduction are based on qualifying expenditures net of government assistance. For small companies in a non-tax-paying position, the credit is refundable.

Canada's corporate income tax system is a combination of federal and provincial income taxes. All provinces generally follow federal rules with respect to the deductibility of current and capital expenditures on R&D. Under federal income tax rules, provincial investment tax credits are considered to be government assistance and reduce the amount of expenditures available for the federal SR&ED tax incentives in the year in which the provincial credits are earned.

Currently, British Columbia, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia and Newfoundland provide additional R&D tax treatment at the corporate income tax level. The remaining two provinces—Alberta and Prince Edward Island—do not offer any

⁴ International Bureau of Fiscal Documentation, *Taxes and Investment in Asia and the Pacific*, (Amsterdam); and International Bureau of Fiscal Documentation, *Taxation of Companies in Europe*, (Amsterdam).

R&D tax incentives at the provincial level, but rely solely on the federal R&D tax treatment. Nevertheless, they are included in the study, providing a full comparison of Canadian provinces (see Tables 3 and 4). However, only the provincial R&D tax systems of Ontario and Quebec, Canada's two major R&D spenders, have been included in international comparisons.

Ontario

In 1988, the Ontario budget introduced a new R&D super-allowance. Expenditures eligible for the federal R&D investment tax credit can qualify for the super-allowance. The incentive is based on the amount of qualifying expenditures incurred less the federal investment tax credit claimable. The R&D super-allowance has two components: base level and incremental. All corporations performing R&D in Ontario are eligible for a base level R&D super-allowance deductible from taxable income. The base amount of allowance is equal to 25 per cent of qualifying expenditures for large corporations and 35 per cent for small companies. The incremental component is 37.5 per cent for large firms and 52.5 per cent for small firms of qualifying incremental expenditures incurred in the year. The average of R&D expenditures incurred in the three immediately preceding taxation periods constitutes the basis for determining incremental expenditures. Current and capital expenditures in excess of the base average are considered incremental.

The federal R&D tax credit reduces the 100 per cent deduction for Ontario tax purposes; the purpose of the super-allowance is to nullify the Ontario tax impact of this reduction, while the incremental allowance rewards growth in R&D. The value of the benefit from this incentive is not taxable federally.

Since January 1, 1995, Ontario has offered a 10 per cent refundable Ontario innovation tax credit (OITC) to Ontario-based small companies for R&D carried on in the province. The OITC reduces the amount of R&D expenditures eligible for the federal tax credit and the 100 per cent R&D deduction for both federal and provincial income tax purposes, including the allowable deduction for the super-allowance.

Quebec

Since 1988, Quebec has offered a host of tax relief measures for R&D conducted in the province, and has gradually expanded their attractiveness to the private sector. One of the tax incentives that is applicable to this study is Quebec's fully refundable tax credit of 20 per cent of wages paid in Quebec for carrying out R&D. The credit is increased to 40 per cent for small firms. The Quebec investment tax credit does not reduce the base for the R&D deduction for Quebec income tax purposes, but it does reduce the amount of R&D expenditures eligible for the federal R&D tax credit and the 100 per cent R&D deduction for federal income tax purposes. With the 1996 provincial budget, the federal R&D tax credit became taxable for Quebec income tax purposes.

The range of available measures has culminated in the implementation of an integrated fiscal strategy for the knowledge-based economy, announced in the 1999 Quebec budget. The following measures are applicable to this study:

- Super-deductions—To optimize the tax benefits relating to R&D activities, Quebec tax legislation enables corporations otherwise eligible for refundable tax credits to *forgo* such credits and instead claim super-deductions when calculating taxable income for Quebec tax purposes. Corporations with enough income to make use of these super-deductions will find that, on the whole, these super-deductions will be more attractive than tax credits in the Canadian tax environment. This is because, in the federal tax system, provincial tax credits reduce the amount of R&D expenditures eligible for the federal R&D tax credit and the 100 per cent R&D deduction. The super-deduction does not reduce federal tax assistance. The applicable rates of super-deduction are 230 per cent of eligible wages for large companies and 460 per cent for small companies.
- Tax credit or super-deduction based on the increase in R&D expenditures of small firms— This is a temporary measure in effect until July 1, 2004. It is based on the increase in all R&D expenditures (in this study, it will apply to wages) incurred by a corporation in a taxation year that are used to calculate Quebec refundable tax credits compared with the average of all such expenditures incurred during the three preceding taxation periods. The rate of the refundable tax credit is 15 per cent and of the super-deduction 190 per cent.

In addition to tax credits to facilitate the technological adaptation of businesses, Quebec provides the private sector with an accelerated depreciation deduction of 125 per cent of the acquisition costs of machinery and equipment incorporating new technologies. In the calculations of the B-index, the study uses the super-deduction since it is more beneficial to a corporation.

Other Provinces

British Columbia (as of September 1, 1999), Saskatchewan, Manitoba, New Brunswick, Nova Scotia and Newfoundland each provide investment tax credits for R&D. Provincial and territorial governments provide full deductibility for eligible current and capital expenditures on qualifying R&D. Provincial rules generally follow federal rules relating to the definitions of qualifying work and expenditures, and the treatment of government assistance, non-government assistance and the federal SR&ED tax credits. The definitions of eligible work and expenditures for purposes of these provinces' R&D tax credits are generally the same as for the federal SR&ED tax credits.

Eligible expenditures are also generally reduced by the amount of any government or non-government assistance except for purposes of the tax credits offered in British Columbia, Nova Scotia and Newfoundland. Under federal rules, provincial investment tax credits are considered to be government assistance and reduce the amount of expenditures eligible for the federal SR&ED tax credits and deduction in the year in which the provincial credits are receivable.⁵

British Columbia: Qualifying corporations carrying out R&D in British Columbia will be able to claim a credit equal to 10 per cent of the corporation's R&D expenditures incurred in the province starting September 1, 1999, for the five-year period until August 31, 2004. The credit is refundable for small companies but non-refundable for large companies. Qualifying work and

⁵ This provincial analysis draws on Gordon J. Lenjosek, *Income tax Incentives for Research and Development in Canada*, Unpublished paper, Department of Finance Canada, October 1997.

expenditures are those eligible for the federal SR&ED tax credit except that federal and provincial R&D tax credits are not considered as government assistance, and thus are not deducted from the amount of expenditures qualifying for the provincial tax credit. The federal tax credit does not reduce the amount of qualifying expenditures for purposes of the BC tax credit. However, the provincial tax credit reduces the amount of qualifying expenditures for the federal SR&ED tax credit and the 100 per cent deduction for both federal and provincial income tax purposes. The B.C. tax credit may be used to reduce provincial corporate income tax otherwise payable.

Saskatchewan: As of the April 1998 Saskatchewan budget, the province offers a 15 per cent non-refundable tax credit to encourage investment in R&D and the expansion of knowledge-based industries in the province. The credit fully conforms to the federal Income Tax Act. Qualifying expenditures are reduced by the amount of any government or non-government assistance. The federal tax credit does not reduce the amount of qualifying expenditures for purposes of the Saskatchewan tax credit. However, the provincial tax credit reduces the amount of qualifying expenditures for the federal SR&ED tax credit and the 100 per cent deduction for both federal and provincial income tax purposes. The Saskatchewan tax credit may be used to reduce provincial corporate income tax otherwise payable.

Manitoba: Manitoba introduced a 15 per cent non-refundable Research and Development Tax Credit in its 1992 budget. Qualifying work and expenditures are those eligible for the federal SR&ED tax credit and incurred in Manitoba after March 11, 1992. Qualifying expenditures are reduced by the amount of any government or non-government assistance. The federal tax credit does not reduce the amount of qualifying expenditures for purposes of the Manitoba tax credit. However, the provincial tax credit reduces the amount of qualifying expenditures for the federal SR&ED tax credit and the 100 per cent deduction for both federal and provincial income tax purposes. The Manitoba tax credit may be used to reduce provincial corporate income tax otherwise payable.

New Brunswick: New Brunswick introduced a 10 per cent non-refundable Research and Development Tax Credit in its 1994 budget. Qualifying work and expenditures are those eligible for the federal SR&ED tax credit and incurred in New Brunswick after February 25, 1994. Qualifying expenditures are reduced by the amount of any government or non-government assistance. The federal tax credit does not reduce the amount of qualifying expenditures for purposes of the New Brunswick tax credit. However, the provincial tax credit reduces the amount of qualifying expenditures for the federal SR&ED tax credit and the 100 per cent deduction for both federal and provincial income tax purposes. The New Brunswick tax credit may be used to reduce provincial corporate income tax otherwise payable.

Nova Scotia: In its 1994 budget, Nova Scotia increased the rate of its Research and Development Tax Credit to 15 per cent from 10 per cent and made the credit fully refundable. Qualifying work and expenditures are those eligible for the federal SR&ED tax credit except that government and non-government assistance are not deducted from the amount of expenditures qualifying for the provincial tax credit. The federal tax credit does not reduce the amount of qualifying expenditures for purposes of the Nova Scotia tax credit. However, the

provincial tax credit reduces the amount of qualifying expenditures for the federal SR&ED tax credit and the 100 per cent deduction for both federal and provincial income tax purposes.

The Nova Scotia tax credit may be used to reduce provincial corporate income tax otherwise payable or may be refunded in cash to companies that are not in a taxpaying position. Corporations can renounce the provincial tax credit for a specified taxation year to maximize the benefit from the federal SR&ED tax credit.

Newfoundland: In its 1995 budget, Newfoundland announced that it would implement a Scientific Research and Experimental Development Tax Credit in 1996, following consultations with the business community. Effective for expenditures incurred after 1995, a fully refundable tax credit was introduced at a rate of 15 per cent for qualifying expenditures made on qualifying R&D work in the province.

Qualifying work and expenditures are those eligible for the federal SR&ED tax credit except that government and non-government assistance are not deducted from the amount of expenditures qualifying for the provincial tax credit. The federal tax credit does not reduce the amount of qualifying expenditures for purposes of the Newfoundland tax credit. However, the provincial tax credit reduces the amount of qualifying expenditures for the federal SR&ED tax credit and the 100 per cent deduction for both federal and provincial income tax purposes.

The Newfoundland tax credit may be used to reduce provincial income taxes otherwise payable or may be refunded in cash to companies that are not in a taxpaying position.

Other Canadian Provinces and Territories: There are no specific provisions for R&D in other Canadian provinces and territories. As a result, the corporate income tax provisions for R&D in the remaining provinces employ the federal R&D tax system.

Canadian Corporate Income Tax Rates

Canada offers different tax rates for small business in all sectors and for large companies. Within the latter category, the manufacturing sector receives a rebate of 7 percentage points while non-manufacturing sectors have to pay at the full rate of corporate income tax. These differences are included in the model. Corporate taxpayers must also pay the 4 per cent surtax applicable to all businesses on the top of federal rates. The surtax is included in the rates presented below. These combined provincial/federal tax rates are incorporated in the B-index calculation.

Small company: The applicable top combined tax rates are: British Columbia, 18.6 per cent; Alberta, 19.1 per cent; Saskatchewan, 21.1 per cent; Manitoba, 21.1 per cent; Ontario, 21.6 per cent; Quebec, 22.0 per cent; New Brunswick, 19.1 per cent; Prince Edward Island, 20.6 per cent; Nova Scotia, 18.1 per cent; and Newfoundland, 18.1 per cent.

Large company: The applicable top combined tax rates for manufacturing companies are: British Columbia, 38.6 per cent; Alberta, 36.6 per cent; Saskatchewan, 32.1 per cent;

Manitoba, 39.1 per cent; Ontario, 35.6 per cent; Quebec, 31.0 per cent; New Brunswick, 39.1 per cent; Prince Edward Island, 29.6 per cent; Nova Scotia, 38.1 per cent; and Newfoundland, 27.1 per cent.

Ontario B-index Formula

Large companies:

$$B_{\text{Ont}} = (1 - .90z_1t - .05t(z_2 + z_3) - .95c_f(1-t) - ((1-.171)(.95)(1-c_f)c_p t_p + .95(1-c_f) t_p c_{pi}(1 - (1/3) \sum (1+i)^{-3}))) / (1-t)$$

Small companies:

$$B_{\text{Ont}} = (1 - .90z_1t - .05t(z_2 + z_3) - .95c_f(1-c_{po})(1-t) - ((1-.171)(.95)(1-c_{po})(1-c_f)c_p t_p + .95(1-c_{po})(1-c_f)t_p c_{pi}(1 - (1/3) \sum (1+i)^{-3}))) - .95c_{po}(1-t) / (1-t)$$

where: t = combined federal and provincial corporate income tax rate (= 0.356 or 0.446 or 0.216)

t_p = provincial corporate income tax rate (= 0. or 0.085)

$z_1 = 1$; $z_2 = 1$; $z_3 = 0.300$

c_f = federal R&D tax credit rate (= 0.20 or 0.35)

c_p = provincial R&D superallowance rate—level component (= 0.25 or 0.35)

c_{pi} = provincial R&D superallowance rate—incremental component (= 0.375 or 0.525)

c_{po} = Ontario innovation tax credit rate (= 0.10)

0.90 = proportion of current R&D expenditure

0.05 = proportion of R&D expenditure incurred on M&E and buildings, respectively

0.171 = proportion of incremental R&D expense on which an incremental tax credit is assessed

i = discount rate (= 0.10)

Quebec B-index Formula

Large companies:

$$B_{\text{que}} = (1 - .90z_1t_f - .05t_f(z_2 + z_3) - .05t_p(1.25z_2 + z_3) - .3t_p - .6st_p - .95c_f(1 - t_f))/(1-t)$$

Small companies:

$$B_{\text{que}} = (1 - .90z_1t_f - .05t_f(z_2 + z_3) - .05t_p(1.25z_2 + z_3) - .3t_p - .6st_p - .6s_i(1 - (1/3)\Sigma(1+.10)^{-n}) - .95c_f(1 - t_f))/(1-t)$$

where: t = combined federal and provincial corporate income tax rate (= 0.31 or 0.38 or 0.22)

t_f = federal corporate income tax rate (= 0.221 or 0.291 or 0.131)

t_p = provincial corporate tax rate (= 0.089)

$z_1 = 1$; $z_2 = 1$; $z_3 = 0.300$

c_f = federal R&D tax credit rate (= 0.20 or 0.35)

s = Quebec's super-deduction (= 2.3 or 4.6)

s_i = Quebec's super-deduction for small company incremental R&D (= 1.9)

c_p = provincial R&D tax credit rate (= 0.20 or 0.40)

0.90 = proportion of current R&D expenditure

0.05 = proportion of R&D expenditure incurred on M&E and buildings, respectively

0.60 = proportion of wages and salaries on which Quebec R&D tax credit is assessed

Saskatchewan B-index Formula

$$B_{\text{sk}} = (1 - .90z_1t - .05t(z_2 + z_3) - .95 \cdot c_f(1 - c_p)(1-t) - .95 \cdot c_p(1-t))/(1-t)$$

where: t = combined federal and provincial corporate income tax rate (= 0.321 or 0.211)

$z_1 = 1$; $z_2 = 1$; $z_3 = 0.300$

c_f = federal R&D tax credit rate (= 0.20 or 0.35)

c_p = provincial R&D tax credit rate (= 0.15)

0.90 = proportion of current R&D expenditure

0.05 = proportion of R&D expenditure incurred on M&E and buildings, respectively

Important: Other states discussed in this study follow the above formulas. Where a given incentive is not available at the provincial level, its value in the formula is set to zero.

Australia

Although there is no tax credit available for R&D expenditures, under the R&D Tax Concession Law companies incorporated in Australia can write off up to 125 per cent of current expenditure for R&D incurred in the year. Prior to the 1996–97 budget presented on August 20, 1996, firms were eligible for a 150 per cent R&D tax concession.

Capital R&D expenditures for machinery and equipment are written off to the extent of 125 per cent over three years on a straight-line basis. Capital expenditures on buildings face normal

are written off on a straight-line basis over 40 years. A corporate income tax rate of 36 per cent is in effect in Australia.

B-index Formula

$$B_{\text{aus}} = (1 - .9z_1t - .05t(z_2 + z_3))/(1 - t)$$

where: t = corporate income tax rate (= 0.36)

z_1 = present value of current R&D expenditure (= 1.25)

z_2 = present value of depreciation of R&D machinery and equipment (= 1.1139)

z_3 = present value of depreciation of R&D buildings (= 0.269)

0.90 = proportion of R&D expenditure deducted immediately

0.05 = proportion of R&D expenditure incurred respectively on machinery and equipment and on buildings

France

Current R&D expenditures are fully deductible in France in the year they are incurred. The capital assets for R&D have to be depreciated. Capital R&D expenditures for machinery and equipment would generally be depreciated over five years on a straight-line basis, or on a declining-balance basis at 40 per cent per annum. The 40 per cent rate is a product of multiplying a straight-line rate by a statutory conversion factor applicable for assets with an estimated useful life of five to six years ($20.0 * 2.0 = 40$ per cent). Buildings are normally depreciated over 20 years on a straight-line basis, or at a rate of 5 per cent per annum.

France offers an incremental (marginal) tax credit for company research expenditures. The marginal tax credit is equal to 50 per cent of the difference between current year R&D expenditures and average R&D expenditures during the preceding two years. This non-taxable credit is applied on current R&D expenditures and amortization of fixed assets, including amortization of buildings used for R&D purposes. It is interesting to note the flexibility of the French tax credit, in particular the refundability provision that favours small firms. The credit can be positive or negative. If it is positive, it is subtracted from corporate income tax, and where it is negative (i.e., it exceeds the income tax), the surplus can be spread over the next three years; any surplus at the end of this period is refundable. In the case of start-up firms, any surplus is immediately refunded. If the tax credit is negative, it can be carried over from one year to another indefinitely until it can be deducted from the positive tax allowance. The applicable corporate income tax rate in France is $33 \frac{1}{3}$ per cent. However, a temporary surcharge of 25 per cent was levied on the corporate income tax in 1998 bringing its total to 41.67 per cent.

B-index Formula

$$B_{fra} = (1 - .9z_1t - .05t(z_2 + z_3) - (.9 + .05(z_2 + z_3))c(1 - (1/2) \sum (1+i)^{-2})) / (1 - t)$$

where: t = corporate income tax rate (= 0.4167)

$z_1 = 1$; $z_2 = 0.88$; $z_3 = 0.367$

c = R&D tax credit rate (= 0.5)

0.90 = proportion of current R&D expenditure

0.05 = proportion of R&D expenditure incurred on M&E and buildings, respectively

Germany

In Germany, current R&D expenditures are fully deductible from taxable income in the year incurred. Capital expenditures are awarded the same treatment as other depreciable assets. Machinery and equipment can be depreciated using either the straight-line method or the declining-balance method. The study uses the declining-balance method at a rate of 30 per cent per annum for machinery and equipment. Buildings are generally depreciated on a straight-line basis at a 4 per cent annual rate. The German tax law also allows accelerated depreciation on fixed assets (equipment and buildings) used for R&D purposes. Since the fixed assets must have been acquired between May 18, 1983, and January 1, 1990, this provision is not applicable to the study.

Since the expiry of the Investment Premium Law, Germany has not had any general tax credit aimed at R&D. There are tax incentives for investment in certain regions, particularly in Berlin (e.g., special depreciation allowance, tax premium for new fixed assets), that may be applicable to R&D activities. Incentives for regional development, however, are not the subject of this research.

The corporate income tax rate is a product of the national corporate tax rate and the trade income tax rate. The national income (undistributed profits) tax rate is 45 per cent, while the trade tax rate ranges from about 12 per cent to 20 per cent of taxable corporate income, depending on the municipality in which a company is located. The trade tax is deductible for national income. The study applies the average trade tax rate of 16 per cent. Accordingly, the combined corporate income tax rate in Germany is 53.8 per cent, or $(45.0 \cdot (1 - .16) + 16.0)$. In addition, a 7.5 per cent solidarity surcharge on the corporate income tax has applied since 1995, bringing the total tax rate to 56.6 per cent, or $(45.0 \cdot (1 - .16) + .075 \cdot 45.0 \cdot (1 - .16) + 16.0)$.

B-index Formula

$$B_{ger} = (1 - .9z_1t - .05t(z_2 + z_3)) / (1 - t)$$

where: t = corporate income tax rate (= 0.566)

$z_1 = 1$; $z_2 = 0.825$; $z_3 = 0.399$

0.90 = proportion of current R&D expenditure

0.05 = proportion of R&D expenditure incurred on M&E and buildings, respectively

Italy

Current R&D expenditures in Italy may be either fully deducted in the year incurred or amortized on a straight-line basis over a maximum of five years. Depreciation rates for capital R&D expenditures vary between 3 per cent and 31 per cent depending on asset categories. Machinery and equipment are normally depreciated over 10 years and industrial buildings over 33 years (at 3 per cent a year). Companies may also claim accelerated depreciation in respect of their R&D capital expenditures for their second and third taxation years. Specifically, under the accelerated depreciation rules, capital expenditures are depreciable at the statutory rate for the first taxation year and at a rate that is up to double the statutory rate for the second and third taxation years. (The total maximum depreciation would then amount to 20 per cent for machinery, and 6 per cent for buildings in the second and third year.) The remainder of the depreciable base of an asset is then depreciated straight-line over the remainder of its useful life. The half-year rule is applicable to Italian depreciation.

There are no R&D tax credits for large companies in Italy. However, small companies are eligible for a 30 per cent R&D tax credit. The credit is not taxable and applies to all expenditures incurred, including construction outlays.

The corporate income tax rate in Italy is 37 per cent. This is the only applicable income tax rate because the local income tax has been repealed. The local income tax is not deductible in computing national corporate income tax.

B-index Formula

$$B_{ita} = (1 - .9z_1t - .05t(z_2 + z_3) - c)/(1 - t)$$

where: t = corporate income tax rate (= 0.37)

$$z_1 = 1; z_2 = 0.713; z_3 = 0.344$$

c = small firm R&D tax credit rate (= 0.30)

0.90 = proportion of current R&D expenditure

0.05 = proportion of R&D expenditure incurred on M&E and buildings, respectively

Japan

In Japan, current R&D expenses are fully deductible in the year incurred. Alternatively, capital expenditures may be amortized over a period of not less than five years. Capital R&D expenditures must be depreciated. Japanese tax law provides special depreciation measures in order to promote selected industries or to attain certain national policy goals. Because these rules are very complex and include, depending on the circumstances, a mix of ordinary depreciation, increased initial depreciation and accelerated depreciation measures, it is difficult to assign a typical depreciation rate to capital R&D assets.

This study assumes that R&D expenditures on machinery and equipment are depreciated according to the duration period shown in the law. Some R&D performers can use the special depreciation rate of 30 per cent of the assets' acquisition price intended for high-technology companies located in technopolis or small firms, but, generally, there is no special depreciation

for R&D performers. The typical rates are 18 per cent declining-balance for machinery and 2 per cent straight-line for buildings, and these rates are used in the study.

A 20 per cent tax credit for R&D expenditure is available in Japan. The credit is allowed against the corporate tax on increases in R&D expenses. A base for calculating an increase in a current year is defined as the largest amount of R&D expenditure incurred in any of the previous accounting years since 1966. The eligible expenditures include current R&D expenses (salaries, wages, cost of materials, etc.) and depreciation allowance for R&D machinery and equipment. Eligible R&D expenditures do include a depreciation allowance for buildings. Hence, the proportion of R&D expenditures on which the credit is allowed is estimated at 93.5 per cent. The R&D tax credit is not taxable, and therefore it does not reduce the deductible base for R&D expenditures.

Japan's companies may also be granted two other tax credits: a credit to promote the R&D of basic technologies, and a credit for R&D carried out by small and medium-sized enterprises. A 5 per cent basic technologies tax credit is provided in addition to the incremental 20 per cent R&D tax credit. This credit is allowed for depreciable assets (machinery and equipment) used in connection with the R&D of advanced technologies. These technologies include advanced robotics and machinery, advanced processes, advanced artificial conditions, advanced electronics, biotechnology and new material technology. A 6 per cent small business R&D tax credit may be claimed only in place of the incremental tax credit. (The study uses a 6 per cent tax credit because it is more beneficial to small companies than the incremental R&D tax credit.) Neither tax credit is taxable.

To encourage R&D, Japan has recently introduced a new tax credit for special R&D expenditure. The 6 per cent tax credit is allowed on total expenditure incurred in collaborative research undertaken in co-operation with a national research institution, foreign research institution or with a university. Since in Japan the share of private sector R&D expenditure devoted to research performed by the higher education sector is less than 1 per cent (1995), the average value of this incentive will likely be negligible. Nevertheless, we have incorporated this incentive in the model, assuming that up to 2 per cent of business R&D expenditures are devoted to collaboration (1 per cent with universities and an additional 1 per cent with other institutions). This special credit (with the effective value of 0.12 per cent) is non-taxable and in addition to other credits available to companies.

The corporate income tax rate applied in this study is a blend of income taxes levied by three levels of Japanese government: national, prefectural (inhabitants' tax) and municipal (enterprise tax). For large companies, the top rate of the national corporate income tax is 34.5 per cent. For small firms the rate of 25 per cent is applicable under 8 million yen of profit. The total corporate income tax figure will vary since the inhabitant and enterprise tax rates can vary depending upon the location of the corporation. In general, it can be said that the effective tax rate of a domestic corporation ranges between 46.36 per cent and 49.98 per cent and averages 48 per cent. Small companies will pay the corporate income tax at an average rate of 35 per cent. These two figures are used in the study.

The applicable R&D tax credits to this study are:

- For small companies: 6 per cent (general), 5 per cent (fundamental technology instrument) and 0.12 per cent (special credit for collaborative activities);
- For large companies: 20 per cent (incremental, general), 5 per cent (fundamental technology instrument) and 0.12 per cent (special credit for collaborative activities).

B-index Formula

Large company

$$B_{\text{jap}} = (1 - .9z_1t - .05t(z_2 + z_3) - .935c_1(1 - (1/(1+i)))) - .05c_2 - .12c_4 / (1 - t)$$

Small company

$$B_{\text{jap}} = (1 - .9z_1t - .05t(z_2 + z_3) - .95c_3 - .05c_2 - .12c_4) / (1 - t)$$

where: t = corporate income tax rate (= 0.48 or 0.35)

$$z_1 = 1; z_2 = 0.707; z_3 = 0.218$$

$$c_1 = \text{R\&D tax credit rate (= 0.20)}$$

$$c_2 = \text{fundamental research tax credit rate (= 0.05)}$$

$$c_3 = \text{small firm R\&D tax credit rate (= 0.06)}$$

$$c_4 = \text{special credit for collaborative activities (= 0.12)}$$

$$0.90 = \text{proportion of current R\&D expenditure}$$

$$0.05 = \text{proportion of R\&D expenditure incurred on M\&E and buildings, respectively}$$

$$i = \text{discount rate (= 0.10)}$$

Korea

In Korea, current expenditures for research into developing and manufacturing new products can be deducted in the year they are incurred. Alternatively they can be amortized over a period not exceeding five years from the year they are incurred.

Capital R&D expenditures must be depreciated. Both R&D machinery and equipment and R&D buildings are depreciated at a rate of 20 per cent straight-line.

Korea grants domestic corporations a major incentive—a tax credit for the development of technology and human resources. The credit is 5 per cent of current expenditures for large firms, and 15 per cent for small firms. There is also a 50 per cent incremental tax credit available for companies whose current-year R&D expenditures exceed the average of the two preceding years. Neither credit reduces the deductible base for R&D expenditures. However, under the current law only one of the tax credits can be claimed. The more beneficial credit is the incremental tax credit, and it is included in the study. In addition to the two credits applicable to current expenses, there is a tax credit for capital investment in R&D facilities. Its general rate of 5 per cent of the expenditure on machinery and equipment is applied in the study. (A 10 per cent rate applies for investment in domestic machinery and equipment.)

The current national corporate income tax rate is 30.8 per cent for large companies and 17.6 per cent for small firms having taxable income of not more than KRW 100,000,000 (approximately Can. \$130,000). Both rates include the inhabitants' tax surcharge of 10 per cent.

B-index Formula

$$B_{kor} = (1 - .9z_1t - .05t(z_2 + z_3) - 0.9c_1 - 0.9c_2(1 - (1/2)\Sigma(1+i)^{-2}) - 0.05c_3)/(1 - t)$$

where: t = corporate income tax rate (= 0.308 or 0.176)

z₁ = 1; z₂ = 0.834; z₃ = 0.834

c₁ = development of technology and human resources tax credit rate (= 0.05 or 0.15)

c₂ = incremental R&D tax credit rate (= 0.5)

c₃ = tax credit for investment in R&D facilities (= 0.05)

0.90 = proportion of current R&D expenditure

0.05 = proportion of R&D expenditure incurred on M&E and buildings, respectively

i = discount rate (= 0.10)

Mexico

In Mexico, current R&D costs may be deducted in a year as incurred. The machinery and equipment used for research on new products or on technological development in Mexico may be written off at a maximum rate of 35 per cent per year. Buildings are typically depreciated at 5 per cent per year. These depreciation percentages apply to the original acquisition costs of the assets using a straight-line method.

Mexico has recently introduced a 20 per cent incremental tax credit. The base for the tax credit calculation is the difference between the current year R&D expenditures and the average of R&D expenditures from the three previous years. The credit is applicable to current R&D expenditures and is non-taxable.

The rate of corporate income tax in Mexico is 34 per cent.

B-index Formula

$$B_{mex} = (1 - .9z_1t - .05t(z_2 + z_3) - 0.9c_1(1 - (1/3)\Sigma(1+i)^{-3}))/ (1 - t)$$

where: t = corporate income tax rate (= 0.34)

z₁ = 1; z₂ = 0.916; z₃ = 0.468

c₁ = tax credit for current R&D expenditures (=0.20)

0.90 = proportion of current R&D expenditure

0.05 = proportion of R&D expenditure incurred on M&E and buildings, respectively

Sweden

In Sweden, current R&D expenditures are fully deductible from taxable income in the year they are incurred. However, capital R&D expenditures must be depreciated.

For machinery and equipment the maximum rate of depreciation is generally 30 per cent (declining balance). Research buildings are treated as industrial buildings, and are usually depreciated at 4 per cent (straight line). There is no accelerated depreciation provision in the Swedish law. Likewise, there is no provision for tax credits intended as a measure to stimulate R&D. The corporate income tax rate in Sweden is 28 per cent.

B-index Formula

$$B_{\text{swe}} = (1 - .9z_1t - .05t(z_2 + z_3))/(1 - t)$$

where: t = corporate income tax rate (= 0.28)

$z_1 = 1$; $z_2 = 0.825$; $z_3 = 0.399$

0.90 = proportion of current R&D expenditure

0.05 = proportion of R&D expenditure incurred on M&E and buildings, respectively

United Kingdom

In the United Kingdom, both current and capital R&D expenditures are fully deductible from taxable income in the year they are incurred. Aside from this provision, there are no other tax incentives directed at R&D activity. The top corporate income tax rate is 31 per cent.

B-index Formula

$$B_{\text{ukg}} = (1 - .9z_1t - .05t(z_2 + z_3))/(1 - t)$$

where: t = corporate income tax rate (= 0.31)

$z_1 = 1$; $z_2 = 1$; $z_3 = 1$

0.90 = proportion of current R&D expenditure

0.05 = proportion of R&D expenditure incurred on M&E and buildings, respectively

United States

Like Canada's, the U.S. corporate income tax system represents a blend of federal and state taxes. Although many states have quite elaborate income tax regimes, their treatment of R&D conforms largely to federal law.

For federal purposes, current R&D expenditures are 100 per cent deductible in the year incurred. A U.S. corporation may also elect to amortize current expenditures over a minimum period of 60 months. Capital expenditures on R&D must be depreciated as ordinary capital assets over a prescribed time period. Expenditures on machinery and equipment for R&D

purposes will generally fall in a five-year double declining-balance depreciation category, while buildings will be depreciated over 39 years on a straight-line basis. The half-year convention is assumed.

Currently, U.S. taxpayers are entitled to a federal income tax credit for certain research expenditures. The credit is 20 per cent of the amount by which the qualified research expenditures for the taxable year exceed a base amount. The base amount is the product of the taxpayer's "fixed-base percentage" and the average of the taxpayer's gross receipts for the four preceding years. The fixed base percentage is the ratio of the taxpayer's qualified research expenditures in its gross receipts during the 1984–88 period (not to exceed 16 per cent). The base amount, however, cannot be less than 50 per cent of the taxpayer's current-year qualified research expenditures. Unused tax credits can be carried back 3 years and forward 15 years. The 20 per cent R&D tax credit is taxable, reducing the deductible base for R&D current expenditures.

Because of differences in tax systems among the 50 states, including local tax incentives and tax rates, it is difficult to determine a representative estimate of an average state corporate income tax system. Rather than looking at some generic number, this study has chosen the corporate income tax systems of two states—California and North Carolina—for international analysis. These states have a competitive manufacturing and technological base, rendering them appropriate for the analysis.

Generally, U.S. federal and state tax credits and deductions operate independently of each other. However, the federal and state income tax systems are connected through the deductibility of state income taxes for federal income tax purposes. Since state tax credits reduce the amount of state income tax payable, the taxable income for federal tax purposes will increase, triggering an increase in the federal income tax payable. This aspect has been captured by the B-index.

U.S. Corporate Income Tax Rates

The top federal corporate income tax rate is 35 per cent of taxable income. All state income taxes are deductible from taxable income for federal income tax purposes, reducing the effective rate of state income tax by 35 per cent.

California: An incremental R&D tax credit of 11 per cent for qualified research expenses and a credit for 24 per cent of basic research payments are available. California conforms to the federal definition for qualified research expenses under Internal Revenue Code (IRC) Section 41(b). Hence, the California credit is also based on the excess of qualified research expenses over base-period expenses, and is fully taxable for state tax purposes. In addition to the R&D credit that is based on current expenses, California allows taxpayers a credit of 6 per cent for certain tangible personal property used in manufacturing and research. This level-based and taxable credit is applicable to depreciable R&D machinery and equipment.

North Carolina: Effective for taxation years beginning January 1, 1996, North Carolina offers a tax credit of 5 per cent for R&D. Like California, North Carolina conforms to the federal

definition for qualified research expenses under Internal Revenue Code (IRC) Section 41(b). Therefore, the rules for its tax credit are the same as those for the federal incremental R&D tax credit, including its full taxability and applicability to current expenses only. North Carolina's combined federal and state corporate income tax rate used in this study is 40.55 per cent ($35.0+(7.0(1-35.0))$).

Illinois: An R&D tax credit of 6.5 per cent for increases in R&D expenditure is offered. It conforms to the rules governing the federal incremental R&D tax credit (Internal Revenue Code [IRC] Section 41[b]). Illinois' combined federal–state corporate income tax rate is 39.75 per cent ($35.0+(7.0(1-35.0))$).

Michigan: There are no R&D tax incentives available in Michigan. However, the state provides qualified taxpayers with a tax credit for high-technology activity. The credit is equal to the tax liability attributable to high-technology activity. It is effectively equivalent to a tax holiday (for a 10-year period) for taxpayers who are involved in high technology activity. Because this activity is not directly related to the performance of R&D and is limited to qualified taxpayers and activities as defined by local development financing acts, this incentive is not included in the study. Michigan imposes a 2.3 per cent single business tax, a value-added-based tax for the privilege of doing business in Michigan. Because income is a large component of the single business tax formula, this study treats it as an income tax, thus Michigan's combined federal–state corporate income tax rate is 36.5 per cent ($35.0+(2.3(1-35.0))$).

New York: A tax credit for tangible property used in R&D is available. The rate is 10 per cent of the acquisition cost of R&D machinery and equipment and associated buildings. New York's combined federal–state corporate income tax rate is 40.85 per cent ($35.0+(9.0(1-35.0))$).

Massachusetts: The state has two credits related to R&D. First is a 10 per cent tax credit for increases in R&D expenditures. The credit conforms to the rules governing the federal incremental R&D tax credit (Internal Revenue Code [IRC] Section 41[b]). The second is a tax credit on tangible property engaged in R&D. As of July 1, 1999, the rate of this non-taxable credit is 1 per cent. Massachusetts' combined federal–state corporate income tax rate is 41.175 per cent ($35.0+9.0(1-35.0)$).

Ohio: There are no specific R&D tax incentives. A sort of related incentive is the Second Credit (a 20 per cent First Credit has expired) for Purchases of New Manufacturing Machinery and Equipment. The credit ranges between 7.5 per cent and 13.5 per cent. However, only one-seventh of this non-taxable credit can be claimed each year. The study uses a general rate of 7.5 per cent, thus the annual value of the credit is 1.07 per cent. The second credit is in effect until December 31, 2000. Ohio's combined federal–state corporate income tax rate is 40.525 per cent ($35.0+(8.5(1-35.0))$).

Minnesota: A 5 per cent incremental R&D tax credit is available. The credit conforms to the rules governing the federal incremental R&D tax credit (Internal Revenue Code [IRC] Section 41[b]). Minnesota's combined federal–state corporate income tax rate is 41.37 per cent ($35.0+(9.8(1-35.0))$).

Oregon: As in North Carolina and Minnesota, a 5 per cent incremental R&D tax credit is available. The credit conforms to the rules governing the federal incremental R&D tax credit

(Internal Revenue Code [IRC] Section 41[b]). Oregon's combined federal–state corporate income tax rate is 39.29 per cent (35.0 +(6.6(1-35.0))).

Colorado: Taxpayers who have incurred R&D expenditures in an enterprise zone are entitled to a credit in the amount of 3 per cent of such current year expenditures in excess of the average of such expenditures for the two preceding tax years. The tax credit applies to all current R&D expenses and R&D machinery and equipment. The credit is non-taxable by the state and does not conform to the federal Internal Revenue Code (IRC) Section 41(b). Colorado's combined federal–state corporate income tax rate is 38.25 per cent (35.0 +(5.0(1-35.0))).

B-index Formula

$$B_{cal} = (1 - .9z_1t - .05t(z_2 + z_3) - .9c_f(1-5)(1-t_f) - .9c_1(1-.5)(1-t) - .05c_2(1-t_f))/(1 - t)$$

$$B_{nca} = (1 - .9z_1t - .05t(z_2 + z_3) - .9c_f(1-5)(1-t_f) - .9c_1(1-.5)(1-t))/(1 - t)$$

where: t = combined federal–state corporate income tax rate (California = 0.4075;

North Carolina = 0.4055)

t_f = federal corporate income tax rate (= 0.35)

z₁ = 1; z₂ = 0.85; z₃ = 0.263

c_f = federal R&D tax credit rate (= 0.20)

c₁ = state R&D tax credit rate (California = 0.11; North Carolina = 0.05)

c₂ = California machinery and equipment tax credit rate (= 0.06)

0.90 = proportion of current R&D expenditure

0.05 = proportion of R&D expenditure incurred on M&E and buildings, respectively

Important: Other states discussed in this study follow the above formulas. Where a given incentive is not available at the state level, its value in the formula is set to zero.

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