Department of Finance
Ministère des Finances

Working Paper
Document de travail

An International Comparison of Marginal Effective Tax Rates on Investment in R&D by Large Firms

by

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Working Paper 2007-07

September 2007

Abstract

This study compares marginal effective tax rates (METR) on R&D investment undertaken by large profitable firms across the thirty OECD countries and six key emerging and transition economies. The METR framework allows us to combine in a single measure the statutory tax rate that applies to corporate income, other aspects of the corporate income tax system, and profit-insensitive levies that affect the user cost of capital of R&D. Results indicate that nineteen countries offer substantial subsidies for investment in R&D through the tax system. Canada offers the third most generous tax assistance among the countries covered by the analysis. Canada's favourable ranking largely reflects the 20 per cent federal credit for Scientific Research and Experimental Development.

JEL Classification : O31; O39; H25; H87

Résumé

Cette étude compare les taux effectifs marginaux d'imposition (TEMI) sur l'investissement en R&D entrepris par des grandes sociétés profitables pour les trente pays de l'OCDE et six économies clefs en émergence et en transition. Le cadre d'analyse des TEMIs nous permette de regrouper en un seul indicateur le taux d'impôt sur le revenu, les autres éléments du système d'impôt sur le revenu, ainsi que les taxes non-liés aux bénéfices qui affectent le coût d'usage du capital de la R&D. Les résultats indiquent que dix-neuf pays offrent des subventions substantielles pour l'investissement en R&D par l'entremise de leurs systèmes fiscaux. Le système fiscal Canadien est le troisième en termes de générosité parmi les pays couverts par l'étude. La position favorable du Canada est en grande partie le résultat du crédit fédéral de 20 pourcent pour la Recherche scientifique et le développement expérimental.

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1. Introduction

Spending on research and development is widely acknowledged as providing benefits not only to the firm undertaking the activity but also to the economy at large in the form of lower prices, improved products and access to new production technologies.[1] In recognition of these spillover effects, it is common practice for governments to provide assistance to firms undertaking investment in R&D. This study reviews assistance for R&D undertaken by large firms delivered through the tax system in Canada, the US and 34 other countries, using marginal effective tax rates (METRs) as the analytical framework. The estimates apply to investment in R&D by large profitable firms and include all corporate tax changes expected to be in force by 2011 in Canada and other countries. Since the analysis does not include assistance provided by government spending and tax incentives offered to small firms, the results cannot be used to explain variations in R&D intensity across countries.

The main findings of this study are:

- In all but one of the 36 countries included in the comparison the R&D METR is negative, indicating that the tax system subsidizes investment in R&D. Canada has the third most favourable R&D tax regime, largely reflecting a high effective tax credit rate.

- Eighteen other countries covered in the study offer particularly generous tax incentives for investment in R&D. This category comprises: eight emerging economies with Brazil in first position and the Czech Republic in fourth position; six smaller developed economies with Spain ranked second highest overall, Singapore and New Zealand occupying the fifth and sixth positions; along with four other G-7 countries, with the US ranking eighteenth overall, behind France (tenth), Japan (twelfth) and the UK (fourteen).

- In Canada, a small number of industries account for just over half of R&D investment. The METR on overall investment by these industries is negative and fourth lowest of all countries in the comparison group. Within the G-7, only France and the UK have negative METRs on investment by R&D intensive industries.

2. Methodology, Assumptions and Caveats

A marginal effective tax rate is a comprehensive indicator of the tax burden on new investment. It combines in a single measure the statutory tax rate that applies to corporate income, factors that affect the corporate tax base -- capital cost allowances and interest deductibility -- along with investment tax credits and profit-insensitive levies such as capital taxes and sales taxes on investment goods.[2] A METR measures the extra return on an investment required to pay corporate-level taxes, expressed as a percentage of the total return to shareholders. For example,

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[1] For additional detail on spillover effects, see Mobilizing Science and Technology to Canada's Advantage, Government of Canada 2007, available at http://ic.gc.ca/cmb/welcomeic.nsf/vRTF/PublicationST/$file/S&Tstrategy.pdf.

[2] A more complete review of the methodology is presented in the 2005 edition of *Tax Expenditures and Evaluations*, also available at www.fin.gc.ca.

if the gross-of-tax return to shareholders is 6 per cent and if the corporate tax system reduces this return to 4 per cent, the METR would be 33 per cent.[3]

In addition to tax parameters, calculation of METRs requires assumptions about the financial structure of firms, the rate of return on debt and equity and the rate of inflation, all of which are used to calculate the financial cost of capital.[4] The estimates are also sensitive to the capital assets – machinery and equipment, buildings, inventories – used by firms and how quickly they depreciate. In order to focus on differences in tax systems, the same "economic" assumptions are used for all countries included in the international comparison. As a result, the comparisons effectively answer the question: what would the Canadian R&D METR be if we adopted the tax regimes of other jurisdictions?

A central premise underlying the calculation of R&D METRs is that all inputs used to perform R&D are capital expenditures in the sense that they are undertaken to create an asset that is expected to generate a stream of revenue over time. As a result, immediate expensing of current expenditures, such as labour and material costs, puts downward pressure on the METR. Note, however, that firms typically do not capitalize current spending on R&D until the probability of generating revenue from the investment is quite high. This conservative accounting approach is adopted to reduce the scope for overstating profits by capitalizing all R&D expenses.

As with the METRs on tangible assets, a number of working assumptions have been made to keep the methodology tractable:

- The METRs are calculated for large profitable firms such that the credits and deductions can be used as they are earned. Firms that cannot make immediate use of credits and deductions face a higher effective tax rate. This simplification does not significantly affect the international rankings since only France and Austria offer a refundable tax credit to large firms and these countries limit access to the refund. France refunds the credit after three years of carry-forward, while only firms demonstrating that the R&D will benefit the national economy have access to the refund in Austria.

- Investment in R&D is financed at the economy-wide debt-equity ratio. This may overstate the share of debt financing, which would put downward pressure on the METRs. Given our use of common economic assumptions for all countries, this would significantly affect the METR in only one country, India, which allows double deductibility of interest expenses associated with investment in R&D.

- In the absence of evidence to the contrary, investments in R&D are assumed to earn the normal risk-adjusted rate of return on equity. Returns in excess of the normal rate are taxed at the statutory rate, so to the extent that investment in R&D earns rents, the METR methodology will understate the effective tax rate on R&D investment. Further, since statutory rates vary across countries, this assumption could affect the rankings.

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[3] Calculated as (6-4)/6. The return to shareholders is net of all expenses including depreciation.

[4] The financial cost of capital is a weighted average of the return on debt and equity paid by firms. The weights are determined by the economy-wide debt-asset ratio of 40 per cent. The returns on debt and equity are measured in real terms (i.e. observed returns are reduced by the inflation rate, assumed to be 2 percent) and adjusted for risk. See Annex 1 for additional detail on the methodology.

A more detailed review of the methodology used to calculate the R&D METRs is provided in Annex 1.

3. An International Comparison of R&D METRs

The countries included in this comparison can be divided into two broad categories: those offering only basic deductions and those offering these deductions plus substantial tax incentives (Chart 1). All countries except Korea and Russia allow firms to deduct current expenditures related to R&D as they are incurred. By itself, deduction of these current expenses would reduce METRs close to zero, but they would remain positive. The ability to deduct nominal interest payments on the debt associated with current expenditures, however, drives the METRs down to the -10 to -20 per cent range[5] (right panel of Chart 1).

There are sixteen countries providing only these basic deductions.[6] Close to 60 per cent of the smaller developed economies in the comparison group fall into this category, along with a third of the emerging economies and two G-7 countries – Italy and Germany. (See Table A2-1 in Annex 2 for a list of countries arranged by size and stage of development.). At the low end of the spectrum, METRs in Mexico and Germany are affected by restrictions on the deduction of interest expenses, while a provision requiring firms to deduct their R&D expenses over two years affects the ranking for Russia. Profit-insensitive taxes, such as capital duties and capital taxes, affect the METRs in Switzerland and Luxembourg. The Belgian METR is zero because of the allowance for corporate equity (ACE) recently implemented in that country. Tax credits or accelerated deduction/depreciation are completely offset by an adjustment in the equity value used as the base for calculating the ACE, resulting in a METR of zero.[7]

Nineteen countries offer substantial investment tax credits (ITCs) or accelerated deductions for R&D expenditures in addition to the basic deductions.[8] These incentives lower the METRs to the -25 to -120 per cent range (left panel of Chart 1). This category consists of the G-7 countries, excluding Germany and Italy, six smaller developed economies and eight emerging economies.

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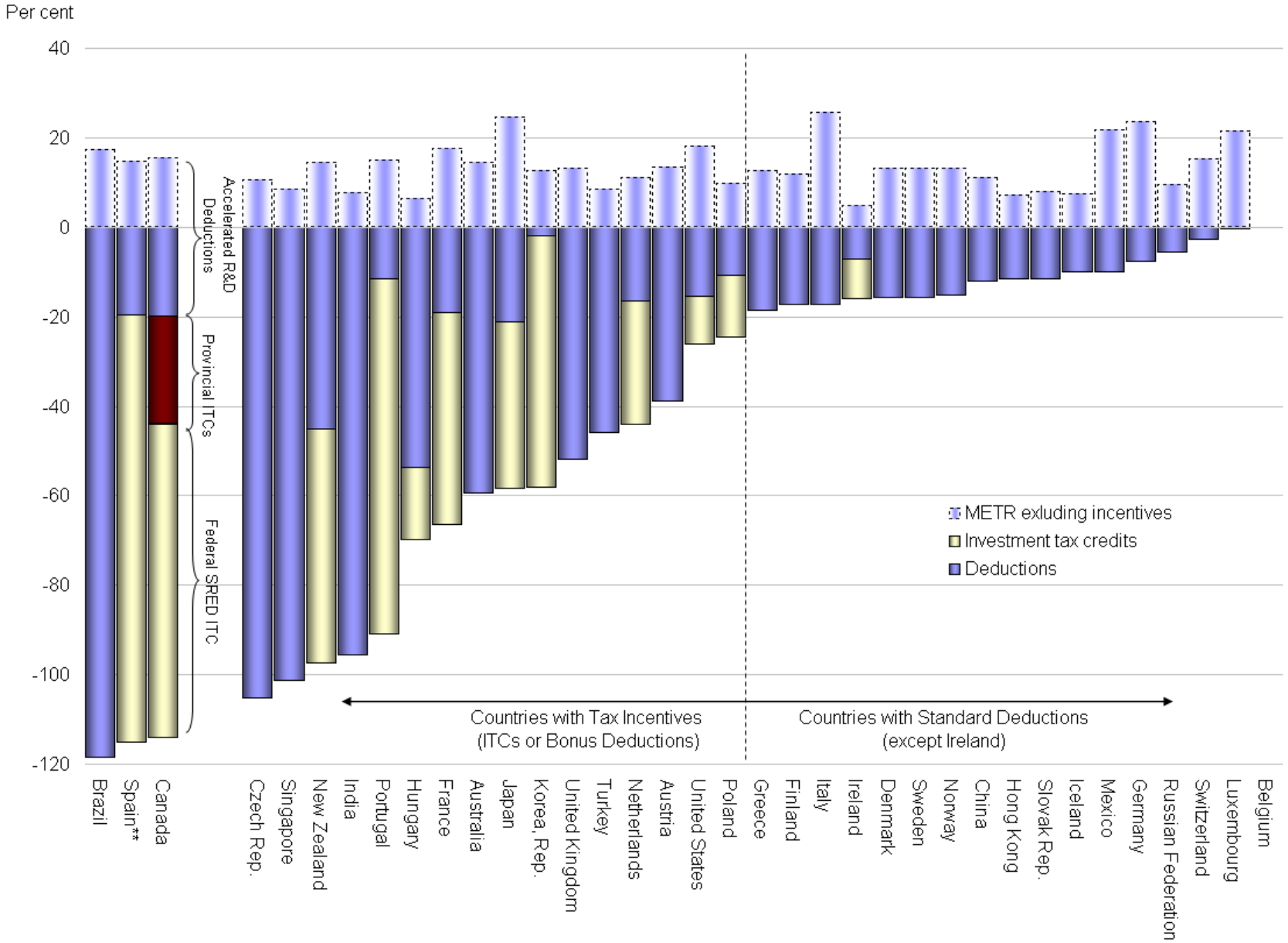
5 A negative METR means that the net-of-tax return exceeds the gross-of-tax return – the tax system is subsidizing investment in R&D.

6 Three of these countries offer small tax incentives, in addition to the basic deductions, that have virtually no impact on the METR. Finland allows capital costs to be deducted as they are incurred; Greece allows both capital costs to be deducted as they are incurred and a bonus deduction on incremental current expenditures; and Ireland offers an incremental tax credit.

7 See Bond, S.R., M. P. Devereux and M. J. Gammie (1996) for more information.

8 Incentives for current expenditures typically covers salaries, contract payments, overheads and materials but a number of countries limit the eligibility of the credit or accelerated deduction to a more narrow expenditure base. Contract payments are not eligible for the incentives in Australia, the Czech Republic, Hungary, Portugal, the United Kingdom and Korea. Overhead expenses are not eligible for the credit in the US while only wages and salaries are eligible in Netherlands.

Chart 1 – International Comparison of Marginal Effective Tax Rates on Investment in R&D for Large Firms in 2011*



* Includes tax incentives offered by sub-national governments in Canada and the US.

** Spain will eliminate the investment tax credit in 2012 causing the METR to increase from second lowest to the nineteenth position.

Eleven countries offer ITCs, eight of which are applied to both current and capital R&D expenditures. Largely reflecting the federal ITC for Scientific Research and Experimental Development (SR&ED)[9], Canada has the third lowest METR, behind Spain and Brazil. Despite the phase-out of the credit implemented in 2006, Spain is projected to have the highest effective ITC (28%) in the comparison group in 2011. The METR in Spain will increase from second lowest overall to ninetieth when the credit is eliminated in 2012. The introduction of an investment tax credit in New Zealand's 2007 budget lowered that country's R&D METR by fourteen positions to sixth lowest overall. Four of the countries providing ITCs, including the US, offer a credit for incremental investment exceeding a base amount generally defined as a two- or three-year average of spending.

Incremental credits have a substantially smaller impact on the marginal investment decision than a level credit since the current year investment increases the base in future years. For example, the 20 per cent US federal credit on incremental expenditures exceeding a four-year moving average of the expenditure base falls to an effective rate of 2.3 per cent when the loss of credits in the following four years is factored into the calculation. With this relatively low ITC, the US treatment of R&D is one of the least generous of the nineteen countries[10] offering additional incentives.

Nine countries in the left panel of Chart 1 offer a bonus deduction for current expenditures. Since 2006, Brazil has offered the most generous bonus deduction by allowing firms to increase all current expenditure related to R&D by a factor of 1.6, giving Brazil the lowest overall METR.[11] The Czech Republic, Singapore and Hungary also offer generous bonus deductions, allowing firms to deduct two times most current expenditures. The double deductions in the Czech Republic and Singapore push their R&D METR to fourth and fifth lowest, respectively. Among the G-7 countries, only the UK has a bonus deduction for current expenditures, allowing them to be increased by 30 per cent.

Preferential deductions are also given to capital expenditures in ten countries, with most countries, including Canada and the US, allowing firms to fully expense capital expenditure in the year incurred instead of depreciating the assets according to the tax depreciation rules. Australia is the only country allowing a bonus depreciation allowance for capital expenses. Preferential treatment of capital spending does not impact significantly the R&D METRs since such spending accounts for only 5 per cent of total R&D expenditures.

The key features of R&D tax provisions in Canada and 35 other countries are shown in Table A1-2 of Annex 1. Tables A1-3 present the R&D tax incentives offered by the sub-national jurisdictions in Canada and the US.

International comparisons of R&D tax regimes are often made using the "B-Index" methodology, which, after adjustment, measures the percentage change in the cost of undertaking R&D arising from the statutory rate of income tax and special tax provisions (e.g.

[9] The average Canadian ITC for R&D expenditures is 23.6 per cent. The 20 per cent federal ITC for large firms becomes an effective rate of 19.1 per cent when provincial assistance is netted out of the base for the credit. The provincial weighted average ITC is 4.5 per cent.

[10] Ireland, which offers a very small effective tax credit, is excluded from this group.

[11] A relatively high income tax rate in Brazil also contributes to its top position since bonus deductions and deduction for nominal interest expenses are worth more under higher income tax rates.

ITCs and capital cost deductions) for investment in R&D[12]. In contrast, the R&D METR measures the percentage change in the required rate of return on an investment due to all elements of the tax system (e.g. capital taxes, RSTs on capital inputs), not just those directly related to investment in R&D. Finally, the B-Index is calculated assuming that investment in R&D is 100 per cent equity financed, compared to 60 per cent in the METR methodology. As a result of the narrower coverage and the different financing assumptions, the international rankings vary substantially using the two methodologies. Annex Table A2-3 shows that when the B-Index is calculated using the tax parameters presented in this study, rankings change for 26 countries, with an average change of 4 positions and a maximum change of 13 positions.

4. METRs for R&D Intensive Industries

In Canada, most of the R&D incentives are received by firms operating in a narrow range of industries. Ten industries, listed in Annex Table A2-4, account for just over half (53 per cent) of R&D spending in Canada, but only 3 per cent of overall capital investment. In these industries, R&D represents at least 25 per cent of total investment. The Canadian METR on overall investment by these R&D intensive industries is deeply negative (-41.5 per cent) and is the fourth lowest among all countries[13], behind Singapore, Spain and the Czech Republic, and slightly ahead of New Zealand (Chart 2). The METR in these R&D intensive industries is negative for nineteen of the 36 nations in the comparison group. Within the G-7, France and the UK are the only other countries having negative METRs on investment by R&D intensive industries.

The METRs for non-R&D intensive industries are also shown on Chart 2. The gap between the estimates for the two types of industries is largest for Canada: 65.3 percentage points compared to an average of 26.9 percentage points for the other countries. The negative METR for non-R&D intensive industries in Singapore reflects an extremely generous capital cost allowance regime.[14]

[12] More formally, the B-Index is defined as the gross-of-tax return required to recover, on a present value basis, the initial cost of the investment in R&D and to pay corporate income taxes. The impact of the tax system is isolated by deducting the initial cost of the investment, which is assumed to be one dollar. See "OECD Science, Technology and Industry Scoreboard 2005" for a more detailed description of the methodology and a comparison of OECD countries based on the B-Index as calculated by the OECD. These results differ from the ones presented in this study because of changes in tax provisions since the OECD publication and differences in assumptions. The main differences in the assumptions are a finer detail for current expenditures (wages & salaries, contracts, overhead and materials) in this study, which allow us to assess differences in the types of expenditures eligible for the R&D incentives, and the fact that we are assuming the Canadian economic parameters for the international comparison.

[13] Note that although the list of R&D intensive industries will in practice vary by country, the Canadian list is assumed to apply in all countries in the comparison. The chart effectively compares the METR in Canada using the tax parameters from other countries.

[14] See "Taxes on Business Investment: an International Comparison of Marginal Effective Tax Rates in the Manufacturing Sector" *Tax Expenditures and Evaluations* Department of Finance 2006.

Chart 2 –International Comparison of Marginal Effective Tax Rates for Large Firms in R&D Intensive Industries and Other Industries in 2011 – All Assets (including R&D)

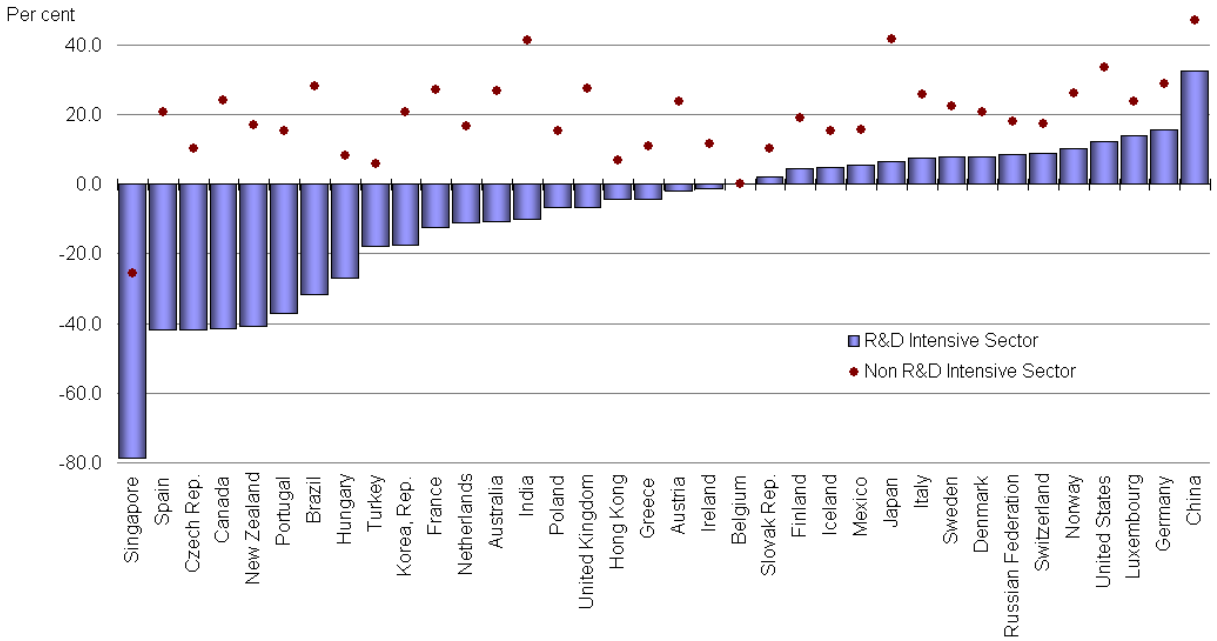
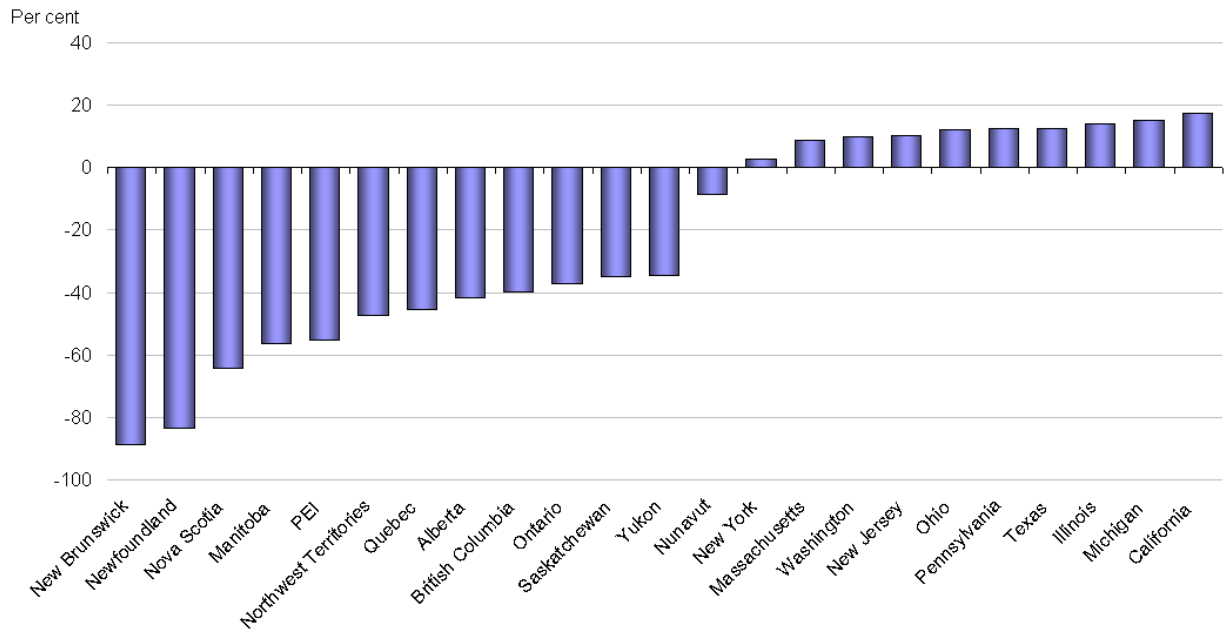


Chart 3 compares METRs for the R&D intensive sector for the Canadian provinces and ten US states accounting for about two-thirds of all R&D investment in the US - California accounts for a quarter of national investment in R&D. US states generally match the federal incentives by allowing firms to expense all R&D-related expenditures and by offering an additional ITC on incremental investment ranging from 5 to 26 per cent. The METRs in the US states are all positive with New York registering the lowest of the ten states with a METR close to zero. The low METR in New York is not due to the presence of significant R&D tax incentives but to a generous ITC on M&E and buildings offered to all manufacturing industries. California has the highest METR in the comparison group despite offering a 15% incremental tax credit on R&D. A retail sales tax (RST) on capital inputs is responsible for its poor ranking, increasing the METR by 9 percentage points.

The METRs for the Canadian jurisdictions are all negative due to generous ITCs, with the lowest METRs in the Atlantic Provinces as a result of the Atlantic Investment Tax Credit. The METRs in British Columbia, Ontario and Saskatchewan are among the highest due to the presence of RST on capital inputs.[15] The harmful impact of the RST in Ontario almost completely offsets the benefit from the provincial ITC for R&D investment while it offsets by half the ITCs offered by British Columbia and Saskatchewan. The absence of RST allows Alberta to be more competitive than these provinces without offering a tax credit.

[15] The impact of the RST in Prince Edward Island and Manitoba is offset by the presence of generous investment tax credits.

Chart 3–Province/State Comparison of Marginal Effective Tax Rates for R&D Intensive Industries in 2011 - All Assets



Ontario recently replaced its bonus deduction with a 4.5% ITC in the 2007 Budget in order to comply with the Tax Collection Agreement. This change was, however, neutral with respect to the METR. Tables A1-3 and A2-2 in the Annex present the R&D tax incentives offered by the sub-national jurisdictions in Canada and the US, as well as the sub-national METR results.

5. Conclusion

The marginal effective tax rates calculated in this study show the percentage change in the return to an investment in R&D arising from the tax system. The estimates are developed for large, profitable firms that finance the investment at the economy wide debt-asset ratio of roughly 40 per cent and that expect to earn the same risk-adjusted rate of return on R&D as on investments in other assets. The METRs for foreign countries reflect the application of their R&D tax regimes to Canadian data. The rankings obtained using the METR methodology vary substantially from those obtained using the more common B-Index. The differences reflect alternative financing assumptions and more complete coverage of tax parameters in the METR framework.

Many countries support R&D via tax incentives and grants, likely reflecting a view that R&D provides benefits not only to the firm undertaking the investment but also to society at large. The review of tax incentives in the 36 countries included in this analysis indicates that all but one country subsidizes R&D through the tax system. That is, in almost all countries the after-tax cost of investing in R&D is lower than the pre-tax cost. The subsidy is generous enough to reduce the overall METR for R&D intensive industries below zero in 20 of the 36 countries in the comparison group.

Canada has the third most generous level of tax assistance for R&D undertaken by large firms in the group of countries compared, behind Brazil and Spain. Canada's favourable ranking largely reflects the 20 per cent federal credit for Scientific Research and Experimental Development. Eighteen other countries offer substantial subsidies for investment in R&D through the tax system. This category consists of the other G-7 countries excluding Germany and Italy, six smaller developed economies and eight emerging economies. These results can not be used to explain variations in R&D intensity across countries since grants and tax incentives offered to small firms are not covered in the analysis.

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Annex 1 – Notes on the Methodology

The calculation of marginal effective tax rates (METRs) in this report follows the neoclassical capital accumulation theory set out in the seminal study by Jorgenson (1963), and later extended by a number of authors[16] to incorporate taxes in the investment decision framework. The basic framework has been applied to R&D by interpreting expenditures on current inputs used as different types of R&D capital.[17] The overall user cost of capital for investment in R&D is calculated by aggregating the user cost of the various capital inputs.

The required gross-of-tax return on R&D capital to suppliers of financial capital (*Rg*) is determined by the general equation for the user cost of capital net of depreciation expense. This is the same formula used in our recent reports on METRs[18]:

$$Rg_i = (1+rst_i)(1-\phi_i)\frac{(Rf+\delta_i-\pi)}{1-u}\left[1-uZ_i+\frac{CT(1-u)}{Rf+\delta_i}\right]-\delta_i,$$

where *rst* is the retail sales tax on capital inputs, ϕ is the investment tax credit rate, *Rf* is the cost of finance, which combines equity and debt financing, δ is the depreciation rate, π is the inflation rate, *u* is the corporate income tax rate, *Z* is the present value of tax depreciation[19], and *CT* represents capital taxes or duties. The subscript *i* represents the different types of R&D capital, which are shown in Annex Table A1-1 along with their importance in total R&D expenditures. METRs are calculated by expressing taxes payable (the tax "wedge") as a percentage of the gross-of-tax return to suppliers of financial capital, or, when the tax wedge becomes a subsidy, as the percentage of the net of tax return.

A forthcoming paper by Mackenzie (2007) proposes an alternate approach to measuring the user cost by explicitly modeling the production of an R&D asset, where current and capital inputs are used to create the R&D capital. The approach proposed by Mackenzie (2007) is, however, virtually equivalent to the standard approach when current expenditures, such as salaries and overhead costs, represent a considerable share in the creation of R&D. Given that these expenditures represent close to 95% of R&D expenditures, we opted for the standard approach in order to minimize differences with prior studies calculating R&D METRs.

16 See, for example, Hall, R. E. and D. W. Jorgenson (1967), King, M. A. and D. Fullerton (1983), and Boadway R., N. Bruce and J. Mintz (1984).

17 See Hall, B. and J. Van Reenen (2000) and Bloom et al. (1997, 2002) for further reading on the methodology.

18 Tax Expenditure Report (2006), "Marginal Effective Tax Rates on Business Investment: Methodology and Estimates for Canadian and US Jurisdictions", Department of Finance; and Tax Expenditure Report (2005), "Taxes on Business Investment: An International Comparison of Marginal Effective Tax Rates in the Manufacturing Sector", Department of Finance.

19 *Z* equals one when R&D expenditures are allowed to be expensed when incurred.

Economic Parameters

As noted in the text, the same economic assumptions are used for all countries included in the international comparison. As a result, the comparisons examine the impact of applying different tax regimes to a given investment in Canada.

The financial cost of capital is a weighted average of the return on debt and equity paid by firms, measured in real terms and adjusted for risk. The weights are determined by the economy-wide debt-asset ratio of approximately 40 per cent.[20] The adjustment for risk recognizes that suppliers of capital require a premium for investing in riskier assets, but in the long run expect to obtain the same real, risk-adjusted rate of return on all investments. The risk-free nominal rate of return on debt is assumed to be 6.0%, representing the average return on government of Canada 10-year bonds over the 15-year period ending in 2006. The risk-free return on equity is estimated by imposing the long run equilibrium condition requiring that the returns on debt and equity, net of personal taxes, are equal. Assuming that the saver is a representative G7 taxable individual facing top marginal tax rates on interest and equity income, the gross-of-tax risk-adjusted return on equity is 4.8%. The weighted average nominal return to suppliers of financial capital is 5.3% and the real return is 3.3%, assuming a 2.0% inflation rate.

How quickly an investment in R&D depreciates is an important determinant of the user cost of capital for R&D. The depreciation of R&D is linked to three main factors: the probability of failure; creative destruction[21] - newer innovations are continually rendering older technologies obsolete; and the probability of diffusion of the technology, which increases over time (e.g. the likelihood of corporate secret leaks or the development of generic replicas may increase with the age of the technology and patents eventually expires). Researchers have had difficulty measuring the rate of depreciation for R&D given its intangible nature, but have generally accepted a depreciation rate of 10% for R&D capital.[22] We follow the literature by assuming a 10% depreciation rate for R&D capital created from current expenditures and use the official depreciation rate from Statistics Canada for scientific equipment, 19.0%, for physical R&D capital inputs. The higher rate on physical R&D accounts for the higher likelihood of obsolescence and wear and tear.

The economic parameters are presented in Table A1-1.

Tax Parameters

The corporate tax parameters were collected from two sources - the tax databases published by the International Bureau of Fiscal Documentation (IBFD) and country-specific tax legislation. The model uses the statutory tax parameters announced as of May 31st, 2007 and expected to be

[20] We use data from the Quarterly Financial Statistics survey conducted by Statistics Canada to measure the importance of debt and equity in the overall financing strategy. The economy-wide average for the debt-asset ratio is 40% for 2001 to 2005 period

[21] Schumpeter, J. A. (1942), *Capitalism, Socialism and Democracy*. London.

[22] This rate is employed in several key studies. It is also close to the estimate from a careful study conducted by Nadiri, M. I. and I. R. Ingmar (1996), who estimated depreciation rates for R&D performed by the US manufacturing industries over the 1960 to 1988 period. Their average estimate for the depreciation rate of R&D is 12%.

in effect in 2011. Payroll taxes, as well as credits and deductions related to these taxes, are not included in the analysis. To correctly model personal taxes, one would need an accurate measure of the incidence of the payroll taxes on businesses - elasticities of the labour demand and supply curves, which vary by sector of activity and by country. Ignoring these taxes assumes that the burden of taxes on wages is borne completely by workers.

Table A1-2 presents the tax parameters used in the model. Tax parameters for Canadian and US subnational governments are shown in Table A1-3. The tables are not meant to replace a detailed analysis of tax legislation when assessing the tax benefits available on a specific investment in R&D in a particular country. For example, carry-forward provisions, refundability and tax holidays could affect the effective tax rates for specific firms or investments. In addition, incentives for contracts to non-profit research organizations, such as universities, are not covered by the study; these expenses, however, represent a very small portion of the overall R&D expenditures.

Several countries offer investment tax credits on incremental R&D expenditures. An adjustment is needed to the incremental credit rate to account for the fact that the current year spending increases the base expenditure in future years and therefore reduces the effectiveness of the credit. The effective tax credit is calculated as the credit on the current year increment less the present value of the foregone credits as a result of the increase in the base in future years[23]:

$$\phi' = \phi\left[1 - \frac{1}{k}\sum_{i=1}^{k}(1+Rf)^{-i}\right] \quad ,$$

where ϕ' is the before-tax effective credit rate and ϕ the statutory credit rate, k is the number of years used to calculate the moving average of past expenditures, i is time, and Rf is the discount rate.

Table A1-1: Economic Parameters (in per cent)

	Capital Weights	Depreciation Rate
R&D Expenditures by Type:		
Physical Capital	7.5	19.0
Salaries	54.9	10.0
Contracts	12.5	10.0
Overheads	18.1	10.0
Intermediate Inputs	7.0	10.0
R&D expenditures as a share of economy-wide investments	8.1	
Financing Parameters	**Rate**	
Average real return to savers	3.3	
nominal interest rate	6.0	
nominal equity return	4.8	
inflation rate	2.0	
Debt –asset ratio	40.0	

[23] Eisner, R., Albert, S. and Sullivan, M. (1984)

Table A1-2: Research and Development Tax Provisions and METRs by Country (2011) (in per cent)

	Statutory Income Tax Rate	Investment Tax Credit*	Tax Deductibility	Profit-insensitive Taxes (Capital Tax / Duties & Stamp Taxes / Retail Sales Tax)
		Current** / Capital	Current** / Capital	
Group of Seven				
Canada	30.9	23.8 / 21.2	100 / 100	0.06 / - / 1.5
Federal Only	18.5	20.0 / 20.0	100 / 100	- / - / -
France	34.4	10.0 + 40.0 on increment [3.0] / 10.0 + 40.0 on increment [3.0]	100 / CCA	- / - / -
Germany	29.4	-	100 / CCA	- / - / -
Italy	37.3	-	100 / CCA	- / 1.0a / -
Japan	42.2	10.0 / 10.0	100 / CCA	- / - / -
United Kingdom	28.0	-	130 / 100	- / - / -
United States	37.9	25.0 on increment [3.0] / 25.0 on increment [3.0]	100 / 100	0.04 / - / 5.4
Federal Only	33.5	20.0 on increment [2.0] / 20.0 on increment [2.0]	100 / 100	- / - / -
Smaller Developed Economies				
Australia	30.0	- / -	125 + 175 on increments / 125 + 175 on increments	- / - / -
Austria	25.0	- / -	125 / CCA[1]	- / 1.0a / -
Belgium	34.0	Allowance for corporate equity[2]		- / - / -
Denmark	28.0	- / -	100 / CCA	- / - / -
Finland	26.0	- / -	100 / 100	- / - / -
Greece	24.6	- / -	100 + 150 on increments / 100	- / 1.0b / -
Hong Kong	17.5	- / -	100 / CCA	- / - / -
Iceland	18.0	- / -	100 / CCA	- / - / -
Ireland	12.5	20.0 on increment [2.0] / 20.0 on increment [2.0]	100 / CCA	- / - / -
Luxembourg	22.9	- / -	100 / CCA	0.5 / - / -
Netherlands[3]	25.0	14.0 / -	100 / Firm choice[4]	- / - / -
New Zealand[5]	30.0	15.0 / 15.0	100 / CCA	- / - / -
Norway[6]	28.0	- / -	100 / CCA	- / - / -
Singapore	20.0	- / -	200 / CCA	- / - / -
Spain[7]	30.0	25.0 + 42.0 on increment [2.9]| / 8.0	100 / Firm choice[4]	- / 1.0a / -
Sweden	28.0	- / -	100 / CCA	- / - / -
Switzerland	16.7	- / -	100 / CCA	0.2 / 1.0b, 0.9c / -

Table A1-2 (Continued): Research and Development Tax Provisions and METRs by Country (2011) (in per cent)

	Statutory Income Tax Rate	Investment Tax Credit* Current** / Capital	Tax Deductibility Current** / Capital	Profit-insensitive Taxes (Capital Tax / Duties & Stamp Taxes / Retail Sales Tax)
Emerging Economies				
Brazil	34.0	- / -	160 / CCA	- / - / -
China[8]	25.9	- / -	100 / CCA	- / - / 17.0
Czech Rep.	24.0	- / -	200 / CCA	- / - / -
Hungary	16.0	10.0 over 4 years / -	200 / CCA	- / - / -
India[9]	33.0	- / -	150 / 100	1.0 / - / -
Korea, Rep.	27.5	15.0 / 10.0	100 over 5 years / CCA	- / - / -
Mexico	28.0	- / -	100 / CCA	- / - / -
Poland	19.0	- / 30.0	100 / 100	0.5 / - / -
Portugal	25.0	20.0 + 50 on increment [4.0] / 20.0 + 50 on increment [4.0]	100 / CCA	- / 0.4a, 2.5c / -
Russian Federation	22.0	- / -	100 over 2 years / CCA	- / - / -
Slovak Rep.	19.0	- / -	100 / CCA	- / - / -
Turkey	20.0	- / -	140 / CCA	- / - / -

* The effective tax credit rates for credits on incremental expenditures are presented in brackets.
** Incentives for current expenditures generally cover payments for wages and salaries, contracts with other businesses, overhead expenses and the cost of materials and supplies. Contracts with other businesses are not eligible for the tax incentives in Australia, the Czech Republic, Hungary, Portugal, the United Kingdom and Korea. Only payments for wages and salaries are eligible in Netherlands. Overhead expenses are not eligible for the credit in the US. Note that in countries where the legislation does not explicitly exclude overhead costs from eligible current expenditures, the model assumes they are covered.

1. Invention Allowance I (Sec. 4(4) EStG) is modelled. The Invention Allowance II (Sec. 4(4)4a EStG) is not modelled given its restrictions related to the benefits to the Austrian economy.
2. Belgium recently introduced an allowance for corporate equity (ACE). Tax credits or accelerated deduction/depreciation are completely offset by an adjustment in the equity value used as the base for calculating the ACE – resulting in a METR of zero.
3. Netherlands offers a refund R&D wage tax credit, where 14% of the cost for salaries reduces the withholding tax on wages. Wage taxes are not included in our comparison.
4. Firms may choose any depreciation rate. Firms are assumed to fully expense capital investment in the year incurred.
5. New Zealand reduced its corporate income tax rate to 30% and implemented a 15% investment tax credit on R&D expenditures in the 2007 Budget. In addition, the investment tax credit does not reduce the base for the deductions.
6. Norway offers an 18% ITC on current expenditures below USD 650,000. We assume that the marginal investment is above the threshold.
7. The investment tax credits are being phased-out in Spain and will be eliminated by 2012.
8. Tax provisions to domestic firms are modelled.
9. India allows a double-deductibility of interest expenses when financing R&D activities by debt instruments.

a. Cash contribution

b. Cash contribution and issuance of debt

c. Issuance of debt

Table A1-3: Research and Development Tax Provisions and METRs for the Canadian Provinces and the US States (2011) (in per cent)

	Combined Statutory Income Tax Rate	Investment Tax Credit* Current / Capital	Profit-insensitive Taxes (Capital Tax / Retail Sales Tax)
Canada			
British Columbia	30.5	10.0 / 10.0	- / 7.0
Alberta	28.5	- / -	- / -
Saskatchewan	30.0	15.0 / 15.0	- / 5.0
Manitoba	31.5	20.0 / 20.0	0.4 / 7.0
Ontario	31.7	4.5 / 4.5	- / 8.0
Quebec	30.4	17.5 / -	0.29 / -
New Brunswick	31.5	15.0 / 15.0	- / -
Nova Scotia	34.5	15.0 / 15.0	0.05/ -
PEI	34.5	- / -	- / 10.6
Newfoundland	30.3	15.0 / 15.0	- / -
Yukon	30.4	15.0 / 15.0	- / -
Northwest Territories	30.0	- / -	- / -
Nunavut	30.5	- / -	- / -
United States			
East North Central Region			
Illinois[1]	38.0	6.5 [0.57] / -	0.15** / 6.25
Indiana	39.1	10.0 [1.07] / -	- / 6.0
Michigan	33.4a	- / -	- / 6.0
Ohio	33.4b	7.0 [0.61] / -	- / 5.0
Wisconsin	38.3	5.0 [0.54] / -	- / 5.0
Alabama	35.4	- / -	- / 4.0
Kentucky	37.8	- / 5	0.21 / 6.0
Mississippi	36.8	- / -	0.25 / 7.0
Tennessee	37.8	- / -	0.25 / 7.0
Middle Atlantic Region			
New Jersey	39.1	10.0 [1.07] / -	- / 6.0
New York	38.1	- / -	0.178** / 4.25
Pennsylvania	39.6	10.0 [1.07] / -	- / 6.0
Mountain Region			
Arizona	37.8	- / -	- / 5.6
Colorado	36.3	- / -	- / 2.9
Idaho	38.1	5.0 [0.54] / -	- / 5.0
Montana	37.6	5.0 [0.54] / -	- / -
New Mexico	38.1	- / -	- / 5.0
Nevada	33.4	- / -	- / 6.5
Utah	36.5	6.0 [0.65] / 6	- / 4.75
Wyoming	33.4	- / -	0.02 / 4.0
New England Region			
Connecticut[2]	38.1	26.0 [6.63] / -	- / 6.0
Massachusetts	39.8	10.0 [1.07] / -	0.26 / 5.0
Maine	39.4	5.0 [0.43] / -	- / 5.0

Table A1-3 (continued): Research and Development Tax Provisions and METRs for the Canadian Provinces and the US States (2011) (in per cent)

	Combined Statutory Income Tax Rate	Investment Tax Credit* Current / Capital	Profit-insensitive Taxes (Capital Tax / Retail Sales Tax)
New Hampshire	39.1	- / -	- / -
Rhode Island	39.0	16.9 [1.81] / -	- / 7.0
Vermont	40.4	10.0 / -	- / 6.0
Pacific Region			
Alaska	39.3	- / 5	- / -
California	39.3	15.0 [1.61] / -	- / 6.5
Hawaii	37.7	- / -	- / 4.0
Oregon	37.8	- / -	- / -
Washington	33.4c	1.5 [1.5] / -	- / 6.5
South Atlantic Region			
District of Columbia	39.6	- / -	- / 5.75
Delaware	38.8	10.0 [1.07] / -	0.025** / 0
Florida	36.8	- / -	- / 6.0
Georgia	37.4	10.0 / -	- / 4.0
Maryland	38.1	10.0 [1.08] / -	- / 5.0
North Carolina	38.0	5.0 [0.54] / -	0.15 / 4.5
South Carolina[3]	36.8	5 / -	0.1 / 5.0
Virginia	37.2	- / -	- / 3.5
West Virginia	39.4	10.0 [3] / 5	0.7** / 6.0
West North Central Region			
Iowa	39.0	6.5 [0.7] / -	- / 5.0
Kansas[4]	36.0	6.5 [0.7] / -	- / 5.3
Minnesota	40.0	2.5 [0.27] / -	- / 6.5
Missouri	36.3	- / -	0.0333 / 4.225
North Dakota	35.7	4.0 [0.44] / -	- / 5.0
Nebraska	38.3	- / -	- / 5.5
South Dakota	33.4	- / -	- / 4.0
West South Central Region			
Arkansas	37.9	- / -	0.3 / 5.125
Louisiana	35.8	8.0 [0.87] / -	0.3 / 4.0
Oklahoma	37.2	- / -	0.125 / 4.5
Texas	33.4d	5.0 [0.54] / -	- / 6.25

* The effective tax credit rates for credits on incremental expenditures are presented in brackets.
** Net worth tax.

1. Incremental expenditures in Illinois are calculated using a three-year moving average.

2. Connecticut offers a 6% ITC on current expenditures plus a 20% ITC on incremental expenditures.

3. All R&D current expenditures are eligible for the ITC in South Carolina.

4. Incremental expenditures in Kansas are calculated using a two-year moving average.

a. Federal rate, Michigan State levies a gross receipt tax of 1.2%.

b. Federal rate, Ohio State levies a gross receipt tax of 0.104%.

c. Federal rate, Washington State levies a gross receipt tax ranging from 0.471 to 1.5% according to sector.

d. Federal rate, Texas State levies a gross receipt tax ranging of 0.7% with retail and wholesale trade at 0.35%.
Note: Current and capital expenditures are deductible in the year incurred in all Canadian and US jurisdictions. Overhead expenses are not eligible for the credit in the US.

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Annex 2– Supplementary Tables

Table A2-1: Research and Development METRs by Country (in per cent, 2011)

	METR	
	RD Asset	**R&D Intensive Industries**
Group of Seven		
Canada	-114.3	-41.5
France	-66.7	-12.3
Germany	-7.5	15.6
Italy	-17.1	7.6
Japan	-58.5	6.4
United Kingdom	-51.9	-6.6
United States	-26.4	12.3
Simple Average =	*-48.9*	*-1.8*
Average Absolute Deviation =	*27.4*	*15.0*
Simple Average Excluding Canada =	*-38.0*	*4.8*
Average Absolute Deviation Excluding Canada =	21.0	8.9
Emerging Economies		
Brazil	-118.4	-31.6
China	-12.1	32.4
Czech Rep.	-105.2	-41.9
Hungary	-69.9	-27.1
India	-95.6	-10.0
Korea, Rep.	-58.4	-17.5
Mexico	-9.9	5.6
Poland	-24.6	-6.8
Portugal	-91.1	-37.2
Russian Federation	-5.4	8.3
Slovak Rep.	-11.4	2.2
Turkey	-45.7	-17.9
Simple Average =	*-54.0*	*-8.7*
Average Absolute Deviation =	*35.8*	*17.1*

	METR	
	RD Asset	**R&D Intensive Industries**
Smaller Developed Economies		
Australia	-59.4	-10.9
Austria	-38.8	-2.0
Belgium	0.0	0.0
Denmark	-15.6	7.8
Finland	-17.2	4.5
Greece	-18.4	-4.3
Hong Kong	-11.6	-4.3
Iceland	-9.9	4.8
Ireland	-16.3	-1.3
Luxembourg	-0.3	13.9
Netherlands	-44.2	-11.0
New Zealand	-97.5	-40.7
Norway	-15.0	10.0
Singapore	-101.2	-78.7
Spain	-115.3	-42.0
Sweden	-15.5	7.6
Switzerland	-2.6	8.7
Simple Average =	*-34.0*	*-6.4*
Average Absolute Deviation =	*29.7*	*16.8*
	-59.4	-10.9

Table A2-2: Research and Development METRs for the Canadian Provinces and US States (in per cent, 2011)

	METR			METR	
	R&D Asset	R&D Intensive Industries		R&D Asset	R&D Intensive Industries
Canada - Federal/Provinces	**-114.3**	**-41.5**	***New England Region***		
British Columbia	-122.3	-39.8	Connecticut	-54.9	-9.6
Alberta	-94.3	-41.5	Massachusetts	-28.3	8.8
Saskatchewan	-137.9	-35.0	Maine	-25.4	12.6
Manitoba	-147.3	-56.3	New Hampshire	-25.4	6.9
Ontario	-109.5	-37.1	Rhode Island	-31.1	-6.9
Quebec	-121.6	-45.6	Vermont	-28.6	2.3
New Brunswick	-138.6	-88.6	***Pacific Region***		
Nova Scotia	-139.2	-64.2	Alaska	-25.4	6.7
PEI	-93.4	-55.2	California	-30.4	17.5
Newfoundland	-137.0	-83.5	Hawaii	-22.7	14.1
Yukon	-139.8	-34.4	Oregon	-24.7	6.2
Northwest Territories	-94.5	-47.2	Washington	-26.9	9.8
Nunavut	-93.1	-8.4	***South Atlantic Region***		
			District of Columbia	-22.9	17.8
United States - Federal/States	**-26.4**	**12.3**	Delaware	-30.6	4.4
East North Central Region			Florida	-21.3	16.2
Illinois	-24.5	14.0	Georgia	-27.1	3.4
Indiana	-28.0	12.5	Maryland	-28.0	10.7
Michigan	-18.2	15.2	North Carolina	-25.1	5.8
Ohio	-25.8	12.3	South Carolina	-46.7	3.2
Wisconsin	-27.8	10.4	Virginia	-22.6	10.9
Alabama	-28.2	7.4	West Virginia	-37.0	6.0
Kentucky	-23.9	14.6	***West North Central Region***		
Mississippi	-20.3	18.0	Iowa	-29.4	-12.8
Tennessee	-20.8	16.1	Kansas	-21.5	12.0
Middle Atlantic Region			Minnesota	-24.1	14.7
New Jersey	-27.9	10.3	Missouri	-26.0	9.7
New York	-22.5	2.8	North Dakota	-26.9	9.7
Pennsylvania	-28.2	12.6	Nebraska	-22.3	13.3
Mountain Region			South Dakota	-20.4	12.4
Arizona	-21.9	13.2	***West South Central Region***		
Colorado	-22.5	9.3	Arkansas	-21.7	16.7
Idaho	-25.2	6.8	Louisiana	-28.2	10.7
Montana	-27.3	4.8	Oklahoma	-21.9	12.5
New Mexico	-22.4	15.9	Texas	-23.7	12.6
Nevada	-19.2	16.8		-54.9	-9.6
Utah	-27.9	8.9			
Wyoming	-20.3	9.8			

Table A2-3: METR and B-Index Comparison

			International Ranking		
	METR	**B-Index**	**METR**	**B-index**	**Change in rank**
Brazil	-118.4	72.2	1	1	0
Spain	-115.3	73.6	2	2	0
Canada	-114.3	74.7	3	3	0
Czech Rep.	-105.2	75.0	4	4	0
Singapore	-101.2	76.2	5	5	0
New Zealand	-97.5	85.4	6	9	-3
India	-95.6	77.2	7	6	1
Portugal	-91.1	79.6	8	7	1
Hungary	-69.9	83.8	9	8	1
France	-66.7	87.8	10	10	0
Australia	-59.4	89.3	11	12	-1
Japan	-58.5	91.0	12	15	-3
Korea, Rep.	-58.4	89.1	13	11	2
United Kingdom	-51.9	90.7	14	13	1
Turkey	-45.7	90.9	15	14	1
Netherlands	-44.2	92.3	16	16	0
Austria	-38.8	92.8	17	17	0
United States	-26.4	100.1	18	24	-6
Poland	-24.6	97.8	19	18	1
Greece	-18.4	98.9	20	20	0
Finland	-17.2	100.0	21	21	0
Italy	-17.1	100.6	22	33	-11
Ireland	-16.3	97.8	23	19	4
Denmark	-15.6	100.5	24	30	-6
Sweden	-15.5	100.5	25	31	-6
Norway	-15.0	100.6	26	32	-6
China	-12.1	100.7	27	34	-7
Hong Kong	-11.6	100.0	28	22	6
Slovak Rep.	-11.4	100.2	29	26	3
Iceland	-9.9	100.3	30	27	3
Mexico	-9.9	100.4	31	29	2
Germany	-7.5	100.8	32	35	-3
Russian Federation	-5.4	102.3	33	36	-3
Switzerland	-2.6	100.2	34	25	9
Luxembourg	-0.3	100.4	35	28	7
Belgium	0.0	100.0	36	23	13

Table A2-4: Canadian R&D Intensive Industries[1]

1. Pesticide, Fertilizer and Other Agricultural Chemical
2. Pharmaceutical and Medicine Manufacturing
3. Computer and Peripheral Equipment Manufacturing
4. Communications Equipment Manufacturing
5. Audio and Video Equipment Manufacturing
6. Semiconductor and Other Electronic Component Manufacturing
7. Navigational, Measuring, Medical and Control Instruments
8. Aerospace Product and Parts Manufacturing
9. Railroad Rolling Stock Manufacturing
10. Scientific Research and Development Services

1. Investments in R&D represent at least 25 per cent of overall investment.