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THE TRICKY ART OF MEASURING FOSSIL FUEL SUBSIDIES: A Critique of Existing Studies

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SUMMARY

Fossil fuel subsidies are of enormous import to policy-makers and public opinion, making it critical to properly define them. However, traditional methodologies tend to place subsidies in the realm of tax expenditure analysis, presenting a flawed picture. A recent report on government subsidies to the Canadian energy sector prepared for the International Institute for Sustainable Development exemplifies this flawed approach along several dimensions: it is not based on a robust underlying economic framework, it fails to account for complex interactions between tax and royalty systems in existing fiscal policy, and it uses a definition of subsidies that was created for a different purpose. The authors of this paper propose an alternative "economic view", based on economic rents, which provides a neutral benchmark against which subsidies, royalties and other energy-focused fiscal measures can be measured. Using marginal effective tax rate (METR) analysis, the authors show that it is possible to obtain a more accurate picture of energy subsidies and their impact on resource allocation and economic activity. This improved schema will ideally allow governments to better understand subsidies and devise sound policies, leading to less waste and distorted investment choices.

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INTRODUCTION

This paper examines methodologies used to analyze the magnitude of "subsidies, which may be in the form of grants or tax relief given to consumers and businesses. In Canada, the focus has been on subsidies provided to the oil, gas and coal industries, of which most have been in the form of tax reductions for specific investment decisions made by the fossil fuel industry.

We believe that the typical approach to measuring fossil fuel subsidies — most of which is essentially rooted in the concept of tax expenditures[1] — is fundamentally flawed and misleading in several ways. The purpose of this paper is to examine these flaws and suggest what we think is a more appropriate methodological approach to evaluating taxes and subsidies in the oil and gas sector.

We present instead what we call the economic view of subsidies. The economic view is based upon an optimizing model of investment in the oil and gas industry. Any definition of subsidy must be based on an underlying benchmark — subsidy relative to what? The economic view suggests a natural benchmark against which subsidies, taxes and royalties can be measured; neutrality with respect to the investment decisions of oil and gas companies and in comparison with other business activities. While the notion of neutrality can itself be defined in numerous ways — we consider some alternatives — it is a concept well grounded in both economic theory and the realities of investing in the fossil fuel sector.

We provide an alternative analysis to the tax expenditure approach, which offers, in our view, a more meaningful understanding of the economic effects of tax subsidies on the allocation of resources. Upon taking into account the impact of taxes and royalties on investment decisions, we find that oil and gas industries are not subsidized in aggregate once negative tax expenditures, not just positive ones, are taken into consideration.

Studies of taxes, royalties and subsidies in the energy sector are very much of interest to policy makers. In the statement issued at the conclusion of their 2009 summit in Pittsburgh, the leaders of the G-20 Group of countries noted that:

> Enhancing our energy efficiency can play an important, positive role in promoting energy security and fighting climate change. Inefficient fossil fuel subsidies encourage wasteful consumption, distort markets, impede investment in clean energy sources and undermine efforts to deal with climate change.[2]

We support this sentiment. Our view is that the appropriate principle for business fiscal policy is to raise revenue in the most efficient manner by setting tax rates as low as possible on neutral bases that do not favour one form of activity over another. Explicit subsidies should generally be avoided. Royalties should be efficiently set to capture rents accruing to the government that owns the resources available for extraction. Only in a limited number of cases is some deviation appropriate from these principles; for example, the imposition of taxes (or regulations) to reduce environmental harms or tax incentives or subsidies to encourage innovative activity that would otherwise not be undertaken due to the inability of firms to appropriate the full social returns to research.

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[1] Stanley Surrey, *Pathway to Tax Reform: The Concept of Tax Expenditures*, Cambridge: Harvard University Press, 1974.

[2] Quoted in OECD Secretariat (2010), *Measuring Support to Energy — Version 1.0*, Background paper to the joint report by IEA, OPEC, OECD and World Bank on "Analysis of the Scope of Energy Subsidies and Suggestions for the G-20 Initiative," on March 23 at http://www.oecd.org/dataoecd/62/63/45339216.pdf, page 5.

A good illustration of the difficulties inherent with measuring tax subsidies is contained in a 2010 report conducted for the Global Subsidies Initiative (GSI) of the International Institute for Sustainable Development (IISD) (hereinafter, the Report). This Report examines government subsidies to the oil and gas sector by the federal government and three Canadian provinces — Alberta, Saskatchewan and Newfoundland & Labrador.[3] The Report identifies a total of 63 subsidy programs for the upstream oil and gas sector totalling over $2.84 billion (2009 dollars). Most of the subsidies included in the study are of the nature of so-called tax breaks and royalty reductions.

We use the IISD Report as a foil to discuss our views on the appropriate way to think about and evaluate subsidies in the oil and gas sector (or any other sector for that matter), and to highlight difficulties with the tax expenditure approach. The Report exemplifies a common approach to measuring subsidies that we think is methodologically flawed. Using the Report as a concrete example is a useful way to present our views, as it provides us with a convenient and concrete context.

In this regard, it is important to emphasize that it is not the intention of this paper to systematically dissect and critique the IISD Report. Rather, we view the Report as representative of a methodological perspective that seems to permeate popular thinking about subsidies in general, and subsidies for fossil fuels in particular. As such, the Report plays the role of a proxy for similar types of analysis.

The proper measurement of subsidies is a matter of no small consequence. The Report seems to have provided the fodder for some recent controversial statements by Canadian politicians. In the most recent federal election campaign the late Jack Layton, at the time leader of the NDP, suggested that if elected he would eliminate $2 billion in subsidies to the oil sands.[4] More recently, Ontario Premier Dalton McGuinty claimed that "hundreds of millions" of dollars in federal oil and gas subsidies provided to Alberta and Saskatchewan were "paid for" by Ontario.[5]

The remainder of the paper is organized as follows. In the next section, we provide a more detailed discussion of the measurement of subsidies, especially with regard to the use of tax expenditure analysis. In the following section we discuss the GSI approach to subsidies used in the Report and present our assessment of it. This is followed by a discussion of the economic view, including a presentation of some illustrative calculations using this approach. This view is motivated by the well-accepted marginal effective tax rate literature. In the following section we discuss other issues, including the incorporation of environmental considerations and the use of appropriate instruments to achieve stated objectives. The last section concludes and summarizes.

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[3] Dave Sawyer and Seton Stiebert (2010), *Fossil Fuels — At What Cost? Government support for upstream oil activities in three Canadian provinces: Alberta, Saskatchewan and Newfoundland and Labrador*. The Global Subsidies Initiative of the International Institute for Sustainable Development, on March 23, 2011 at www.globalsubsidies.org/research/fossil-fuels-what-cost-government-support-upstream-oil-activities-three-canadian-provinces.

[4] *The Globe and Mail*, "Visiting Quebec, Layton rips into oil sands," March 31, 2011. At http://www.theglobeandmail.com/news/politics/visiting-quebec-layton-rips-into-oil-sands/article1964853/

[5] *The Vancouver Sun*, "East-West battle brews over oil, gas subsidies," July 21 2011. At http://www.vancouversun.com/business/East+West+battle+brews+over+subsidies/5136180/story.html

WHAT IS A SUBSIDY?

Typically a subsidy, whether a grant or tax relief, is viewed as a reduction in the cost of buying a good or service. With a reduction in the price of a product, purchasers will be more willing to buy more of it and producer will be more willing to supply it. Grants provided by governments are well-understood subsidies since the expenditure is budgeted. Subsidies provided through the tax system — tax expenditures — need to be understood in terms of the benchmark used for determining the appropriate level of tax to be paid by business. The difficulty is to determine whether the tax relief given to a firm is an explicit subsidy or, instead, an offset to make sure taxpayers pay taxes according to a benchmark system. This point is discussed in more detail below.

Subsidies can be measured in different ways depending on the focus of a study. For governments, the total cost of subsidies is important to determining their impact on public budgets. For economic and environmental objectives, subsidies should be measured in terms of their impact on the allocation of resources in the economy. This latter approach critically depends on how subsidies affect consumer or business decisions, which is a focus of many recent analytical reports.

Two concerns are particularly important with respect to business subsidies: waste and impact on the allocation of resources.

Waste arises when subsidies have a large revenue cost without impacting behaviour, either because the recipients would have undertaken the activity anyway, or the subsidy does not influence their economic decisions. In this case, taxes must be increased in order to fund ineffective subsidies and these taxes in turn impose economic costs by discouraging economic activity or distort business decisions. While we are particularly critical of subsidies that are wasteful in this manner, they are not in fact the focus of many fossil fuel subsidy studies, such as the Report, which view subsidies as having economic and environmental impacts due to fossil fuel investments encouraged by the subsidies.

The misallocation of resources results when businesses are directed to activities because the subsidy is available rather than investing solely on the basis of economic criteria. Businesses invest in capital until the risk-adjusted return is equal to the financial cost of capital. If a subsidy lowers the cost of capital or augments revenue, more investment would take place than otherwise, at least in principle. Thus, if the main concern over subsidies is their impact on economic behaviour, the appropriate measure is to look at how subsidies influence marginal decisions. In recent years, economists have developed methodologies that are used to assess how fiscal policies influence economic decisions. These methodologies are based upon the notion of the marginal effective tax rate on investment, which will be further discussed later.[6]

In the following section, we examine in detail the GSI Report that illustrates well the difficulties involved with measuring fossil fuel subsidies under the tax expenditure approach.[7]

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[6] For the initial methodologies that were developed, see M. King, and D. Fullerton, *The Taxation of Income from Capital*, Chicago: University of Chicago Press, 1984 and R. Boadway, R., N. Bruce and J. Mintz (1984), "Taxation, Inflation and the Effective Marginal Tax Rate on Capital in Canada," *Canadian Journal of Economics*, 17 (1), 62-79.

[7] Sawyer and Stiebert (2010), *Fossil Fuels — At What Cost*, International Institute of Sustainable Development, Winnipeg, Manitoba, 2010, p. 11.

THE GSI APPROACH TO MEASURING SUBSIDIES

The GSI approach to subsidies is based upon the notion of preferential treatment.[8] This begs the obvious question: preferential relative to what? While this question will be returned to throughout this paper — and can indeed be viewed as the primary unifying theme — the approach is to label a program as a subsidy if preferential treatment is provided:

- To selected companies;
- To one sector or product when compared to other sectors;
- To sectors or products in one country when compared internationally.

The definition of subsidy employed by the GSI is based on the WTO's *Agreement on Subsidies and Countervailing Measure*s (ASCM). Article 1 of the ASCM identifies four types of high-level subsidy categories whereby:

- Government provides a direct transfer of funds or potential direct transfer of funds or liabilities;
- Revenue is foregone or not collected;
- Government provides goods or services or purchases goods;
- Government provides income or price support.

Article 2 of the ASCM requires that a subsidy be specific to an enterprise, industry or group of enterprises or industries.

The Report takes a four-step approach to assessing subsidies for fossil fuels in Canada:

1. Identify programs in the oil sector that are not available to other sectors;
2. Sort the programs (by jurisdiction) into the four high-level subsidy categories identified above;
3. Quantify the number of the subsidies and their value;
4. Estimate the environmental and economic impacts of the subsidies.

The Report identifies 63 subsidies in the upstream oil sector using this approach, attributing 17 to the federal government, 18 to Alberta, 19 to Saskatchewan and nine to Newfoundland & Labrador. Of these 63 subsidies, they are able to quantify 46 of them. Summing over these 46 programs, they determine that in total about $2.84 billion in subsidies are offered to the upstream oil sector by the four governments — $1.382 billion by the federal government, $1.049 billion by Alberta, $327 million by Saskatchewan and $83 million by Newfoundland & Labrador.

[8] For a discussion of the GSI approach to defining fossil-fuel subsidies, see Global Subsidies Initiative (2010), *Defining fossil-fuel subsidies for the G-20: Which approach is best?*, Policy Brief. Geneva: GSI, June 2010.

The vast bulk of the subsidies are of the nature of tax expenditures, arising from so-called tax breaks, such as the accelerated write-off of capital expenditures and royalty relief. Of the $2.84 billion in subsidies estimated in the Report, $1.536 billion are due to tax expenditures and $840 million due to royalty relief, comprising 83.7 percent of the total estimated subsidies. Moreover, the bulk of the subsidies are associated with lowering the costs of development designed to bring new oil resources into production ($1.681 billion), followed by operational subsidies directed at reducing long-term operational costs ($424 million), exploration subsidies directed at lowering the costs of searching for and identifying new sources of oil ($359 million) and subsidies to research and technology activities which involve the development of new oil recovery technologies with the objective of increasing productivity and/or reducing emissions ($377 million).

The Report indicates that the $2.84 billion in subsidies represents about 31 percent of the total revenue raised from upstream oil. It estimates that the subsidies will increase oil production by about 5 percent nationally by 2020, will lead to a concomitant 5 percent increase in emissions and will have a slight positive impact on economic activity and a modest erosion of government balances over this period.

EVALUATION

Our problems with the approach to measuring subsidies to the oil sector used in the Report — which, as we have mentioned, are common to other studies of a similar ilk — are essentially fourfold:

1. It employs a definition of a subsidy that was designed for a different purpose;
2. It inappropriately adds together individual tax expenditure and royalty relief items without appropriately accounting for important interactions;
3. It is not based upon an underlying optimizing economic model which emphasizes the impact of taxes, royalties and subsidies on investment at the margin;
4. It is not based upon an economically meaningful benchmark.

Each is discussed in turn.

The Subsidy Definition

The authors of the Report were prescient in anticipating some "pushback" to their study:

> Of course many will not be happy with our results. And indeed we expect some pushback from industry, governments and the environmental community. This will likely stem from differences in the definition of subsidy.[9]

[9] Sawyer and Stiebert (2010), note 1, page 11.

They go on to identify what they call "two competing extremes" regarding the definition of a subsidy. The so-called environmental view, not surprisingly associated with the environmental community, is that "any benefit to the oil and gas sector is a subsidy regardless of whether or not they are available to other sectors." The development view — which they ascribe to industry and to some extent governments — "is one where competitiveness is maintained through keeping taxes and royalty payments low to keep investment activity levels high."

The authors of the Report claim to adopt a definition of subsidy that balances these two extremes. Their self-proclaimed balanced view uses a definition of subsidy developed by the World Trade Organization (WTO). We will discuss the WTO definition and the way that it is employed in the Report in more detail in what follows. At this point we merely indicate that while the use of the WTO definition may be balanced in the sense that neither of the groups claimed to support the "two competing extremes" are likely to be happy with it, the WTO definition of a subsidy is designed for a substantially different purpose and the manner in which it is employed in the Report is not, in our view, appropriate. Moreover, and importantly, the definition is *ad hoc* and is not informed by any sort of underlying economic model of the process governing investment and production in the oil and gas sector.

It is important to point out that the GSI approach to defining subsidies is agnostic in the identification, sorting and quantification stages on the issue of whether a subsidy is good or bad, justified or unjustified. For example, a subsidy with the objective of encouraging oil production is treated in the same way as a subsidy designed to lower greenhouse gas emissions. As discussed above, this is one of the reasons that the authors' claim that their approach to defining subsidies is balanced — both sides of the issue will object to some programs being called a subsidy.

The use of the WTO definition of a subsidy as per the ASCM seems to be motivated by a desire to adopt a definition that has been accepted by an international organization subject to an extensive (if not exhaustive) vetting process. And indeed 153 countries, including Canada, have agreed to the ASCM definition. As indicated in GSI (2010, page 2), the ASCM definition has "been tried and tested through a rigorous negotiating process and is supported by extensive legal analysis and jurisprudence from the Dispute Settlement Body and the Appellate Body" of the WTO.

We do not question the fact that the ASCM definition of a subsidy has been thoroughly vetted and extensively analyzed. Nor do we question the legitimacy of the definition for the purpose for which it is intended. We do question the way that it is employed in the Report.

A key question is: to what purpose is the definition of the subsidy being used? The ASCM definition of a subsidy was designed (and agreed to) with a specific purpose in mind. From the WTO web site:

> The WTO Agreement on Subsidies and Countervailing Measures disciplines the use of subsidies, and it regulates the actions countries can take to counter the effects of subsidies. Under the agreement, a country can use the WTO's dispute-settlement procedure to seek the withdrawal of the subsidy or the removal of its adverse effects. Or the country can launch its own investigation and ultimately charge extra duty ("countervailing duty") on subsidized imports that are found to be hurting domestic producers.[10]

[10] See also Global Subsidies Initiative, March 28, 2011 at http://www.wto.org/english/tratop_e/scm_e/scm_e.htm .

Thus, the ASCM definition of a subsidy is designed specifically to identify and remediate trade distortions. Importantly, it was not the purpose of the ASCM to add together a plethora of identified subsidies for the purposes of determining their impact on investment, output and emissions.

The Tax Expenditure Approach

Yet this is precisely what the Report does. As indicated above, almost 84 percent of the subsidies identified in the Report are of the nature of tax expenditures associated with fast write-offs and other tax breaks in the income tax system, as well as royalty reductions associated with various royalty programs. There are several problems with the tax expenditure approach as it is employed in the Report.

An obvious issue concerns the benchmark used to identify a tax. We discuss this separately and in some detail below. Another issue, independent of the benchmark, involves the legitimacy of adding together a number of individual tax expenditure items to arrive at a total tax expenditure (total subsidy) number, which is what the Report does in order to arrive at its total subsidy figure of $2.84 billion. This adding up is widely and generally accepted as being completely illegitimate and misleading by those familiar with tax expenditure accounting.

The reasons for this are threefold.

First, tax and royalty systems are characterized by several complicated interactions whereby a change to one aspect of the system interacts with other aspects of the system. These interactions can result in a net impact of a change in a tax or royalty provision that is very different from what a naive analysis of the initial change may suggest. In its most recent tax expenditure report, Canada's federal Department of Finance provides an explicit caveat cautioning against this:

> The cost of each tax measure is determined separately, assuming that all other tax provisions remain unchanged. Many of the tax expenditures do, however, interact with each other such that the impact of several tax provisions at once cannot generally be calculated by adding up the estimates and projections of each provision.[11]

A second, and related, issue concerns interactions between federal and provincial income tax and royalty systems. Again from the federal government's tax expenditure report:

> The federal and provincial income tax systems interact with each other to varying degrees. As a result, changes to tax expenditures in the federal system may have consequences for provincial tax revenues.[12]

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[11] Department of Finance (2010), *Tax Expenditures and Evaluations 2010*. At http://www.fin.gc.ca/taxexp-depfisc/2009/taxexp0901-eng.asp#caveats. See also, Department of Finance (2004), T*ax Expenditures: Notes to the Estimates/Projections 2004* and N. Bruce, *Tax Expenditures and Government Policy: Proceedings of a Conference held at Queen's University November 17-18*, Kingston, Ontario: John Deutsch Institute for the Study of Economic Policy, 1990.

[12] Ibid.

As one important example, provincial royalties are deductible for both federal and provincial corporate income tax purposes. Any subsidy that lowers royalty payments will therefore be expected to give rise to higher income tax revenues — some of the royalty relief will effectively be taxed back, leading to a significantly lower net effect; but the net effect is what matters. There are several other important interactions in the tax and royalty systems that need to be carefully modeled and taken into account in order to determine the true impact of a particular tax or royalty provision that is labelled as a subsidy. As far as we can tell, none of these interactions are properly taken into account in the Report.

Third, subsidy and tax provisions also interact with each other. Capital subsidies provided by governments increase corporate tax liabilities since the tax cost of assets is reduced when calculating things like tax depreciation allowances. This is entirely appropriate as it reflects the fact that the firm's expenditures (or capital costs) have been reduced by the amount of the subsidy, and lower depreciation deductions are a natural result of this. But it is important to recognize that this interaction exists, and that the net value of the subsidy may be reduced by lower depreciation allowances. Similarly, income-based subsidies are often subject to corporate taxation, and as such are partly taxed back. Again, none of this seems to have been accounted for in the Report.

The Margin is the Key

Another problem with the approach to measuring subsidies used in the Report is the lack of an underlying economic model applied to the determination of the subsidies. While the Report does employ an optimizing economic approach in a computable general equilibrium (CGE) model to analyze the *implications* of the identified subsidies in terms of output, growth, emissions, etc., it does not employ a similar approach to the actual *measurement* of the subsidies.

As discussed above, subsidies can be measured in terms of their overall cost to the budget or in terms of their impact on behaviour. Which approach is appropriate depends on the purpose of the analysis. If the concern is over the loss in government revenues, a measure of the total subsidy cost (properly measured) is appropriate. On the other hand, if the concern is with the impact of subsidies on economic behaviour, a much different measurement of subsidy is needed.

This perhaps subtle distinction is important. Some of the subsidy programs included in the Report, particularly those related to royalty relief, have either explicit or implicit maximums, or caps, on the amount of the relief. Some of these caps are expressed in terms of dollars — the firm is granted royalty relief up to $X per well;[13] others are expressed in terms of production — royalties are reduced for the first Y units of production.[14] Regardless, the presence of these caps is important for how we evaluate the economic effects of the subsidies.

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[13] For example, the Alberta CO2 Projects Royalty Credit program allows a maximum of $5 million in royalty credits for a single project; the Alberta Low Productivity Well Royalty Reduction program allows for a maximum $50,000 royalty value reduction.

[14] For example, the Saskatchewan Horizontal Well Drilling Incentive grants a reduced royalty rate on a fixed volume of oil produced from the well, where the fixed volume is dependent on the depth of the well.

In terms of the impact of a subsidy on firm behaviour — production, investment, etc. — what matters is the impact at the margin. How does the subsidy program affect the decision to produce *one more* unit of oil, or invest in *one more* unit of capital? Subsidy programs subject to a cap may not, and indeed one might argue typically do not, affect marginal decisions. As a result, a subsidy program may well result in a giveaway to the sector in terms of reduced taxes or royalties, without actually incentivizing behaviour. While one may well be justified in being critical of this, and we are, for our purposes the key insight is that some of the subsidies measured in the Report will not actually feed through to affect output, investment and emissions in a significant way. There is no indication in the Report that this is taken into account in the measurement of the subsidies nor in the evaluation of their economic effects. Rather, the Report appears to treat all of the subsidies as if they apply at the margin when in fact they do not.

The Benchmark

Finally, we address the critical question of the appropriate benchmark to use when assessing the presence of subsidies. The Report is particularly flawed in its approach to measuring the size of subsidies since it fails to outline properly the benchmark tax and royalty systems against which the subsidies are measured. A tax subsidy can only be meaningfully measured as the difference between the benchmark tax system and the treatment provided to the business activity.

We discuss several issues in this regard, first with reference to corporate taxes and then with regard to royalties.

CORPORATE TAXES

To define the benchmark corporate tax, it is critical to understand the role of the corporate income tax. As outlined in several past studies, Canadian corporate tax policy has been based on three particular roles: (i) a withholding role on income as a backstop to the personal income tax, (ii) a withholding role on income accruing to foreign owners and (iii) a payment to capture the benefit of public services that add to the profitability of businesses operating in Canada.[15] The underlying intent of the corporate tax is to withhold income payable to shareholders in accordance with the principles articulated by the Haig-Simons approach to comprehensive income taxation.[16]

To properly measure shareholder profits, revenues from the sale of goods and services must be included on an accrual basis in the tax base. From this are subtracted the production cost of goods and services including wages and salaries, rents, capital depreciation and interest expenses. The Haig-Simons approach requires the appropriate measurement of the *economic* values of revenues and costs. The most difficult issues arise with respect to depreciation or depletion and borrowed financing costs.

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[15] See the Technical Committee on Business Taxation, *Report*, Ottawa: Finance Canada, 1997.

[16] See Finance Canada, *Tax Expenditures and Evaluations*, Notes to Estimates/Projections, 2010, http://www.fin.gc.ca/taxexp-depfisc/2010/taxexp1004-eng.asp#tocnotes-03.

Under the Haig-Simons approach, unsuccessful exploration costs should be expensed while successful costs should be written off as income is earned from projects. Development expenditures should be deducted overtime as the reserves are depleted and sold to the market. Depreciation and depletion costs should in principle be equal to the economic loss in the value of an asset over a time period.[17] This loss can be due to inflation (a reduction in the purchasing power of assets) and real capital losses arising from selling capital in secondary markets. The latter is particularly important since technological change and other uncertainties might increase depreciation costs if assets have lower resale values. Inflation also impacts on borrowing costs. As interest, unadjusted for inflation, is deductible from profit, the corporation is able to deduct some of the real debt's principal from the tax base even though asset prices are rising. This is an economic gain to the company.

Current tax policy is to set capital cost allowances to reflect estimated economic depreciation rates as the difference between current and following-year prices.[18] However, there is no adjustment for inflation since nominal income is typically taken to be the benchmark even though this is not consistent with the Haig-Simons approach. As for exploration expenses, oil and gas companies may fully expense them, whether successful or not, similar to the tax treatment of expenditures on research. Development expenditures for oil and gas are written off at a declining balance rate of 30 percent, unlike research development expenditures, which are fully expensed.

The Report, however, presumes that the *accounting* measure of profit is an appropriate basis for measuring the economic cost of depreciation or depletion and compares that with capital costs used for tax purposes. However, as is well known, a large number of distortions arise from using these comparisons such as these, resulting in biased conclusions. As Finance Canada states:

> Not withstanding the different methodologies available, annual tax expenditure estimates are not provided for accelerated deductions because adequate data are not generally available to calculate them with a reasonable degree of accuracy. In many cases, this is due to differences in categorization of assets and recording of related expenses between the tax system and possible benchmarks such as financial statements and studies of economic depreciation. In some cases, the accelerated category encompasses a range of assets or expenses, but tax filings do not provide any detail on the particular type of assets in which companies invest.[19]

The complexities involved include:

- Capital cost allowances and other capital deductions are typically discretionary under the tax system. This could result in negative tax expenditures when claims are less than the economic cost of assets.

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[17] P. A. Samuelson, "Tax Deductiblity of Economic Depreciation to Insure Invariant Values," *Journal of Political Economy*, 72, 1964, 604-6.

[18] See Finance Canada on tax expenditure methodology in various reports over the years.

[19] See Finance Canada Tax Expenditures and Evaluations 2010, at http://www.fin.gc.ca/taxexp-depfisc/2010/taxexp1004-eng.asp#tocnotes-05.

- For accounting purposes, there may be different approaches for depreciating or depleting assets. For example, no standard accounting practice exists to capitalize interest in assets, therefore leading to differences in asset values. For tax purposes, interest is expensed and not capitalized in asset values. The accounting treatment of exploration and development can vary. Further, constant revisions to accounting principles (the most recent with the adoption of International Financial Reporting Standards) play havoc with accounting measures.
- Accounting practices estimate depreciation on an asset-by-asset basis (often with straight-line depreciation methods based on economic asset lives) while, for tax purposes, assets are grouped in classes to calculate depreciation (typically based on declining balance methods) with disposal gains and losses resulting in an adjustment for asset values.

The Report brushes aside these difficulties in measuring the benchmark corporate tax base and the value of tax expenditures.

Four other issues related to the corporate tax are worthy of emphasis.

First, the tax value of items such as accelerated depreciation or exempt income depends on the corporate tax rate. The Report is clear in basing its estimates of tax subsidies on 2008 corporate tax rates, which were 19.5 percent at the federal level and about 12 percent at the provincial level, for a total of 31.5 percent. However, scheduled reductions in the corporate tax rate were already announced by legislation in 2008. By 2012 the rate will be 15 percent at the federal level and 11 percent on average at the provincial level, for a total of 26 percent. Any subsidy associated with accelerated depreciation should be based on the present value of the tax value of the depreciation deductions in the year 2008, which in turn depends on both the current and future tax rates. As the tax rate declines, the tax value of tax depreciation and other capital cost deductions taken over time decline in present value terms. None of this is taken into account in the Report. Given that 2012 corporate income tax rates are about 18 percent less than those in 2008, the Report overestimates corporate tax subsidies significantly, never mind other adjustments that would be necessary.

Second, some capital cost deductions permitted to oil and gas companies are being phased out, which is especially the case of one of the largest items in the Report: accelerated capital cost allowance for oil sand investments (estimated by the Report to cost $300 million per year), which is being phased out by 2015. Given the length of time for regulatory approvals and project development, it is not unusual for governments worldwide to provide transition measures in order not to discourage long-term capital decisions that are encouraged by stable tax regimes. Otherwise, a jurisdiction can gain a reputation for changing the rules of the game after investment decisions have been committed. For example, the end of deferral-of-cash accounting for small businesses provided for a 10-year transition. The Report notes that a significant share of oil sand projects will qualify for accelerated capital cost allowances before being phased out entirely and therefore should be viewed as a subsidy in 2008. While this point is correct, the question is whether accelerated depreciation should be marked down in value for prospective analysis since the transition period is finished by 2015.

Third, the report includes the Atlantic Investment Tax Credit (AITC) as an explicit tax subsidy to the oil and gas sector. While oil and gas companies are significant beneficiaries of the credit, the intent of the AITC is to support a broad range of sectors in the Atlantic region, including agriculture, forestry, mining, mineral and manufacturing industries. While we do not support the continuation of the AITC, on the grounds that it distorts the allocation of capital in the Atlantic Region, it is not clear why it is identified as a subsidy specific to the oil and gas sector, as opposed to a tax expenditure that is provided to a wide range of business activities. Other broadly applicable tax expenditures are not included; for example, the full expensing of research and development expenditures, industrial property tax exemptions and accelerated deductions for other capital expenditures besides those specific to oil and gas. This apparently arbitrary classification of policies as a subsidy specific to the oil and gas sector is inevitable when an appropriate benchmark is not clearly stated.

Fourth, it must be remembered that corporate tax in Canada (as well as in most countries) is fully levied on profits but provides limited relief for losses. Under the Haig-Simons definition of profits, full loss deductions should be provided by either carrying forward loss pools at an interest rate, carrying back losses without limitation to claim refunds of past taxes or exchanging the losses for tax refunds or reductions in other taxes. The current approach is to permit losses to be carried forward for 20 years but not indexed for the time value of money. Thus, governments do not fully share risks under the corporate tax and therefore penalize risky investments. This is a general issue that affects all corporations, not just oil and gas. However, it must be remembered that some aspects of the tax system are negative tax expenditures that discourage capital investment. Others will be discussed below in the final section.

ROYALTIES

The Report classifies various programs that lead to royalty relief relative to the base system as subsidies. By royalties we mean any levy based upon gross output or revenue. In its typology the Report classifies royalty relief as a subsidy arising from the "provision of goods or services below market value." This classification is revealing, and reflects a view that royalties are a cost, or price, that firms pay to produce oil and gas. This interpretation has legalistic roots arising from the fact that provincial governments constitutionally own the rights to the oil and gas and that royalties are the price that firms pay to extract it; we address this in more detail below. The important thing to emphasize here is that the Report treats the *base royalty system* (that is the system without special programs that lower royalties), and its accompanying price and production-sensitive royalty schedules, as the market value of access to the oil and gas, and any royalty program that reduces the amount that companies pay relative to the base system as the "provision of goods or services below market value" and therefore a subsidy. We think that this approach is fundamentally flawed, for several reasons.

In general, any government program that results in the provision of a good or service below its market value or price should indeed be viewed as a subsidy. However, this presumes that the price is in fact set by the market. This is emphatically not the case for oil and gas royalties. Royalty rates are set by government fiat — there is no market-determined royalty rate that is the analog of a market price. Indeed, there is no necessity that governments use royalties at all to collect payment for the resource from firms. Governments can and do use other mechanisms. In the oil and gas sector the obvious example is the net cash flow tax applied to oil sands after payout (which the Report does not treat as a subsidy). Provinces also use bonus bids for land tracts to raise revenue. In the mining sector most provinces do not levy royalties

based on gross output or revenue at all, but rather impose profit-sensitive mining taxes. Rather than a market price charged by governments to firms — any deviation from which is labelled a subsidy — royalties are in fact simply a fiscal instrument used to collect revenue from the oil and gas sector. The ownership of the provinces of the resource simply gives them the constitutional right to collect these revenues. There is nothing sacrosanct in the base royalty system that suggests it should be viewed as a benchmark, and that deviations from it should be thought of as subsidies.

To see the problem with this, consider a simple royalty system that levied a flat one percent royalty on gross production rather than the typical royalty rates which are much higher than this, with no programs that provided royalty relief at all. One might imagine that this approach would lead to a significant reduction in royalties relative to the current system, and indeed many may well consider this to be a substantial subsidy according to the popular use of the word. Yet under the methodology used in the Report, this system would involve no subsidies whatsoever, as there would not be a provision of goods or services below market value as determined relative to the base system.

We think that a more appropriate benchmark to assess the presence of subsidies is one based on the concept of economic rent. Economic rent — also referred to as pure economic profits or economic income — arises from non-reproducible (or fixed) factors of production such as entrepreneurship, land and natural resources. It can also arise due to the presence of natural or artificial barriers to entry that generate market power and special advantages that firms may possess (such as location, patents, etc.). More generally, rent is the surplus value of a resource after all costs, including opportunity costs, have been accounted for. Rent is thus measured as the difference between the price at which a resource can be sold and the costs associated with its discovery, extraction and production, including a normal return. Any tax or levy applied to pure economic rent will be non-distortionary, and will neither discourage nor encourage (subsidize) the investment or production decision; such a levy is said to be *neutral*.[20]

The economic view of evaluating taxes and subsidies that we propose here, and which we expand upon in the next section, is to use economic rent and the notion of neutrality as a benchmark. Under this view, taxes, royalties, royalty programs, etc., are assessed in terms of the extent to which they deviate (in either direction) from a non-distortionary levy imposed on pure economic rent. We argue that taxes, gross royalties and the accompanying royalty programs are fiscal instruments that are used to extract economic rent and should be evaluated against a neutral benchmark.

Before turning to a more detailed discussion of the economic view, it is useful to briefly discuss the nature of Alberta's royalty system to make another point about the inconsistency of the approach to measuring subsidies used in the Report. The base royalty system in Alberta as it applies to conventional oil and gas consists of both price and production-sensitive royalty rates applied to gross production. Without going into details, within a minimum and a maximum range royalty rates increase with both price and production. Price sensitivity is motivated by a desire to collect more rent as prices increase and is not our focus here. What is the justification for production-sensitive royalty rates?

[20] As will be discussed in the next section, neutrality can be defined in either absolute or relative terms.

The rationale for production-sensitive royalties lies in the notion of economic rent. By their nature, royalties do not constitute a tax on economic rent because they are levied on gross production or revenue, with no deduction for costs. As such, royalties are distortionary and discourage investment and production in the oil and gas industry. One of the reasons often given for using gross royalties instead of an alternative approach that allows for the deduction of costs lies in administrative difficulties with measuring these costs, and in informational asymmetries between companies and the government. The idea is that production, which is easy to measure, can act as a proxy for costs. This is because conventional oil and gas wells involve large fixed costs and relatively low operating costs. Thus, on a per-unit-of-production basis a high-production well will have lower costs than a low-production well. Higher royalty rates on high-production wells (or rather the converse of lower royalty rates on low production wells) are therefore an imperfect attempt to incorporate costs into a gross royalty system and approximate a levy on rent.

Presumably for this reason, the Report does not consider lower royalty rates levied on low-production, high-cost wells under the base royalty tables as a subsidy. Nor does it consider the lower royalty rates imposed on the production of pre-payout oil sands as a subsidy. Yet it does consider royalty relief programs for non-conventional or low-productivity wells that face higher costs as subsidies, despite the fact that these programs are specifically in place in recognition of the higher costs associated with these wells.[21] Thus, many of the programs labelled as subsidies in the Report are in fact designed (albeit imperfectly) to account for the fact that a gross royalty-based system is an imperfect instrument to collect economic rents. Again, despite the claim that it takes a balanced view on what is or is not a subsidy, the lack of underlying economic principles to evaluate taxes and subsidies makes this type of inconsistent, *ad hoc* treatment as to what is and is not a subsidy inevitable.

Finally, we note that the Report fails to recognize the interaction of royalty and corporate tax systems, a point discussed in more detail in the next section. Even though royalties are deductible from the corporate income tax, royalty regimes do not share the cost of corporate taxes faced by resource industries. For example, the Alberta oil sands royalty that is intended to be structured as a rent payment, as discussed above, results in the industry sharing the investment costs, risks and returns with the Alberta government. However, the royalty does not share the corporate tax that is levied on the shareowners. This results in higher taxes imposed on the industry, a point that will be made more obvious in the next section.[22]

AN ECONOMIC APPROACH TO MEASURING SUBSIDIES

If the intent of subsidy analysis is to understand how subsidies impact the allocation of resources in the economy, then the appropriate methodology is to measure the effect of subsidies at the margin. A well-known concept for examining the impact of taxes and other fiscal policies on investment decisions is the marginal effective tax rate (METR).

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[21] For example, in Alberta the CO_2 Enhanced Oil Recovery program, the Enhanced Recovery of Oil Royalty Reduction program, etc.

[22] This same point is made by J. Mintz, "An Evaluation of the Business Tax Recommendations of the Henry Report and the Australian Government Response," in C. Evans, R. Krever and P. Mellor (eds), *Australia's Future Tax System: Prospects after Henry,* Thomson Reuters, Sydney, Australia, 2010, Chapter 8.

METR analysis takes into account corporate income taxes, sales and excise taxes on capital purchases and capital-related taxes (such as asset-based taxes). It can also extended to include other fiscal policies that impinge on investment, including royalties and capital subsidies.[23] For example, suppose the pre-tax risk-adjusted rate of return on capital is equal to 10 percent, and after payment of taxes at a 50 percent rate, the after-tax rate of return on capital earned by the project is five percent. A business will undertake the investment if the return on the project is just sufficient to cover its minimum required rate of return on capital. If five percent is the minimum rate of return that is needed to attract capital from financial markets, then a business will undertake any marginal project that just earns this minimum rate of return on capital. The METR on capital has been widely used in policy analysis to provide an understanding of how investment decisions are affected by taxation. Conceptually, investments in various assets (machines, structures, inventory, land, and intangibles such as exploration and development and research and development) made by businesses will be made so long as the net-of-risk return on each asset is at least as high as the cost of capital. To maximize a company's value, businesses will invest in capital until the rate of return on capital is just equal to the cost of capital at the margin. The METR measures distortions at the margin, and therefore provides an indication of how capital investment is affected by taxes on capital investments.

Appendix A of this report provides a detailed theoretical description of how the cost of capital, including taxes, and the METR is derived for oil and gas investments. The model is based on a multinational company seeking to maximize its value for projects around the world, raising equity and debt financing from international markets. The multinational minimizes its cost of finance by choosing its optimal debt and dividend policy, taking into account tax and non-tax factors that influence financial decisions (independent of the investment decision). The cost of equity and debt is determined by international markets independent of the availability of domestic savings in a small open economy. Therefore, personal income taxes on dividends, interest and capital gains do not affect the multinational's cost of financing even though these personal taxes do impact personal savings decisions.

In Table 1, we provide estimates of the METRs on investments in the oil and gas sector in Alberta, Saskatchewan and Newfoundland & Labrador in comparison to aggregated METRs for all other non-financial companies (forestry, manufacturing, construction, utilities, transport, communications, trade and other services) in the same provinces. Government grants are not included in the analysis, but the Report clearly shows the most important subsidies are primarily related to tax expenditures that are incorporated in this analysis. The key aspect of this analysis is that all the interactions of different types of levies are included. As seen in the Table, certain types of business activities have positive (negative) METRs implying that, at the margin, taxes on returns are more (less) than the tax value of deductions.

We have argued for the use of neutrality as the appropriate benchmark against which to assess the presence of subsidies. Neutrality may be defined in either relative or absolute terms.

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[23] R. Boadway, N. Bruce, K. McKenzie and J. Mintz (1987), "The Effective Tax Rates on Mining Industries," *Canadian Journal of Economics*, February, 1-17 and recently, J. Mintz, "Measuring Effective Tax Rates for Oil and Gas in Canada," SPP Technical Papers, March, 2009 using a time-to-build model.

TABLE 1: MARGINAL EFFECTIVE TAX (AND ROYALTY) RATES, 2011

	INCLUDING ROYALTIES		EXCLUDING ROYALTIES	
Oil and Gas Sector*	**Aggregate**	**E&D only**	**Aggregate**	**E&D only**
Alberta – conventional**	29.9%	33.4%	6.8%	-2.6%
Alberta – oil sands	23.4%	-1.9%	23.2%	-1.9%
Saskatchewan**	35.6%	33.2%	13.8%	-0.7%
Newfoundland & Labrador***	-7.4%	-23.8%	-21.6%	-11.5%
Non-Resource Sector****	**Aggregate**	**E&D only**		
Alberta	16.0%	-34.6%		
Saskatchewan	21.8%	-58.7%		
Newfoundland & Labrador	8.8%	-58.8%		

Note: The overall R&D share in the non-resource sector is less than five percent while the E&D share in the oil and gas sector is 64 percent for conventional oil and gas, 18 percent for oil sands and 79 percent for offshore drilling in Newfoundland & Labrador.

* The daily production is assumed to be 80 barrels for oil and 600Mcf for natural gas and the price as $95/barrel and $4.22/Mcf, which are rough averages of the past year up to July. Price variation will affect METRR differently in these three jurisdictions: (1) Alberta's conventional and oil sands royalties is set to be price sensitive and hence the higher the price, the higher the METRR, (2) Saskatchewan's royalty is based on production (albeit also price sensitive) and hence the higher the price, the slightly lower the METRR, and (3) the royalty regime in Newfoundland & Labrador is ultimately proportional to net profit and hence its METRR is insensitive to price changes.

** Numbers shown in the Table are the average between oil and gas; for Saskatchewan, the calculations are for fourth-tier oil and gas. Saskatchewan also collects a resource surcharge from oil and gas companies.

*** Assuming investment project has reached Tier 2 payout threshold. The provincial resource and manufacturing industries also benefit from the 10 percent Atlantic investment tax credit.

**** Including agriculture, forestry, public utility, construction, manufacturing, wholesale and retail, communication, transportation and other services.

In relative terms, one interpretation of a subsidy is that the METR is less than some sort of general average. Here we use an aggregation of the METRs for non-resources sectors as a comparator.[24]

When royalties are excluded from the analysis, in which case the METRs reflect taxes only, we see that the METRs on the conventional oil and gas sector are indeed lower than the METRs in the non-resource sector (an exception being the oil sands). However, the oil and gas sector faces additional levies in the form of royalties. When royalties are accounted for, oil and gas tends to be more heavily taxed than the non-resource sector, except in Newfoundland & Labrador. Thus, under the relative notion of neutrality, the METR on oil and gas investment (except in Newfoundland & Labrador) is higher than other industries suggesting, on the whole, that the oil and gas sector is not in fact subsidized at all; this is especially true of conventional oil and gas.

In absolute terms, another definition of a subsidy may be a METR that is negative in value — the reference point in this case being a completely neutral system with a METR of zero — in which case the tax value of deductions is greater than the taxes and royalties on investment returns. Any losses generated by the system would be used against infra-marginal returns on investment or other income earned. As seen in the Table, only oil and gas investments in Newfoundland & Labrador qualify as being subsidized by this definition. The negative METR

for oil and gas in Newfoundland & Labrador is due to very favourable corporate income tax and royalty provisions, particularly relating to development expenditures and the generally available Atlantic Investment Tax Credit.[25]

It is also seen in the Table, exploration and development expenditures in the oil and gas sector have a negative METR, suggesting the presence of a subsidy by this definition. However, we see that research and development in the non-financial sector is even more heavily subsidized. Both exploration and development and research and development are essentially about information and knowledge acquisition. There are typically thought to be spillovers associated with the generation of information and knowledge. These spillovers mean that the information discovered or acquired by one firm generates information, and therefore uncompensated benefits, to others.

Without government grants or tax preferences, information and knowledge acquisition would be too low since businesses do not fully appropriate the social returns on their investments. This provides a policy rationale for subsidizing knowledge acquisition. This is the typical justification provided for the R&D tax credit that is available to all corporations. A similar point may be made with regard to exploration (but perhaps not development) in the resource sector. For example, the discovery (or not) of oil or gas in a particular region most certainly conveys information to other companies that is not properly internalized. While one can debate the size of these informational spillovers, on their own and in comparison to spillovers from R&D more generally, it seems indisputable that they exist. Ideally, any subsidy to account for informational spillovers due to either R&D or exploration should be based upon the size of those spillovers. This is currently not the case in Canada, where the same R&D tax credit is given for all eligible expenditures, regardless of the size of the spillovers. For example, some discoveries are protected by patents, which suggests that at least some of the potential spillovers have been internalized and a lower credit should be applied. Further to this point, higher R&D credits are given to small businesses, despite the complete lack of evidence that the spillovers are higher for these firms. Our point is simply that both research and exploration involve knowledge spillovers and generate unappropriated returns that should, in principle, be subsidized even if the subsidy rates should differ in principle.

An issue that merits some discussion is the legitimacy of including royalties in the METR calculations. One point of view is that royalties are a payment for the use of the resource, a cost of doing business, and therefore should not be included in the METR calculation.

There are three responses to this. First, corporate income taxes are also a cost of doing business, yet we are interested in their incentive effects. What makes royalties, which are also set by governments, any different? This leads to the second point, which is the distinction between a cost of doing business that is determined by the market versus by the government. As discussed previously, there is absolutely no sense in which royalty rates set in Canada are a proxy for market-determined rates which might be set in a pure freehold system. Finally, and more fundamentally, we are of the strong view that the basis upon which to apply any payment for the use of the resource should be economic rent. As the owners of the resource, governments are entitled to a share of the rent, not a share of the output. At the margin, where no rents are earned, royalties should be zero. On the other hand, if a project earns infra-marginal returns positive royalties should be paid. Our METRs, which take account of both taxes and royalties, explicitly account for this.

With this in mind, why is oil and gas more heavily taxed despite the more preferential treatment given to exploration and development? A key reason is that the royalties imposed on oil and gas companies are not in fact levied on rent, which, as discussed above, requires the deduction of the economic costs of exploiting the resource. Rather, in the case of production-related royalties, no deduction is provided for costs. Therefore, even though there are no rents generated at the margin (when the return on capital is equal to the cost of capital), royalty payments on gross revenues reduce the return earned on marginal investments, thereby reducing their scale. These royalties increase the cost of investing in the oil and gas sector.

Even in the case of the oil sands levy, much of which is imposed on rents in principle, oil sand companies bear more tax and royalty levies compared to other industries.[26] In part, this arises from the nature of the oil sand royalty, whereby the Alberta government shares the investment costs, returns and risk with the producer but not corporate income taxes, which is a burden on shareholders. This results in a negative tax expenditure whereby the royalty is collected on marginal investments even though no rent is earned.

CONCLUSIONS

This paper evaluates common methodologies used to assess fossil fuel subsidies and concludes that they can be methodologically problematic. We are especially critical of the tax expenditure approach used in many studies, as exemplified by a recent report by the International Institute for Sustainable Development (IISD).

In our view subsidies require careful interpretation in order for good public policy to be developed. Our preference is that federal and provincial governments should assess levies on broad bases at low rates in order to achieve an efficient allocation of resources according to their best economic use. Corporate income taxes that operate as a tax on shareholder profits should be assessed on neutral tax bases at low corporate rates. Royalties should be levied on economic rents in order to maximize the benefits that governments receive from their ownership of the resource. Environmental concerns are important, and are best addressed by regulations or specific taxes that price the environmental harm. These principles provide a much better guidance for public policy than erroneously calculating subsidies without a clear, consistent underlying framework for good public policy.

TECHNICAL APPENDIX[a]:

CORPORATE TAX AND ROYALTY ON NON-RENEWABLE RESOURCE INVESTMENTS

A non-renewable resource firm maximizes the present value of risk-adjusted cash flows (CF) from its project subject to the constraint that the extracted resources are equal to the amounts discovered over time. Let T be the period in which reserves are discovered and prepared for extraction that begins at that time.

(1) $\text{Max } V = \sum_0^{\infty} (1 + R)^{-t} CF_t$

(2) subject to $\sum_T^{\infty} Q_t \, dt = X = \sum_0^{T} f[e_t]$ (accumulated reserves equal total extraction)

with $CF_t = P_t Q_t - C(Q_t, K_t)(1 + \pi)^t - (\delta K_t + k_t)(1+\pi)^t - T_{c[t]} - T_{R[t]}$ for $t \geq T$

$CF_t = -e_t (1 + \pi)^t - T_{c[t]}$ for $t \leq T$

where,

R is the discount rate

Q_t is production at time t

X is total reserves

$C(Q_t, K_t)$ are current costs that are strictly concave in output (denoted as $C'>0$ and $C''>0$) and capital that reduces costs (denoted as $C<0$ and $C_{KK}<0$).

K_t = depreciable capital stock

k_t = new investment = $K_{t+1} - K_t$

π is inflation

δ = economic depreciation

$f[e_t]$ = incremental reserves found through spending on exploration in period t (e_t) with the function being strictly concave ($f'>0$ and $f''<0$).

$T_{c[t]}$ = corporate tax payments (paid in each period and can be negative)

$T_{R[t]}$ = royalty payments in each period t (only paid after extraction begins)

P_t = nominal price of output normalized to one and equal to all other prices ($P_t = P(1 + \pi)^t$).

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[a] Readers may wish to happily avoid this technical appendix. It is meant to provide an analysis of effective tax rates for non-renewable resource industries based on J. Mintz, *op cit supra note* 14 and R. Boadway, N. Bruce, K. McKenzie and J. Mintz, "The Effective Tax Rates on Mining Industries," *Canadian Journal of Economics*, February 1987, 1-17.

The analysis below incorporates corporate income taxes and royalty payments based on revenues and cash flows (for application we also include sales taxes on capital inputs). Corporate tax is imposed on the revenues earned from the sale of mining ore net of the costs of production, which include current extraction costs, capital costs allowances and exploration and development costs (exploration is expensed but development is capitalized and written off at the declining balance rate σ). This implies the following:

(3) $T_{c[t]} = u \{P_tQ_t - C(Q_t, K_t) (1 + \pi)^t - \alpha D_t - \sigma E_t(1 + \pi)^t - T_{R[t]}\}$

(4) $D_t = (\delta K_s + k_s) (1 + \pi)^t - \alpha D_s$

(5) $Et = e_t (1 + \pi)^t - \sigma E_s$

(6) with α = capital cost allowance rate, D_s = the undepreciated capital cost base and E_s = the undepreciated stock of exploration and development spending at time s.

Manipulating the terms associated with capital cost allowances and investment, $(\delta K_t + k_t) (1 + \pi)^t$, in equation (1) with the insertion of terms in (3), (4) and (5), one can show that the investment costs are reduced by the present value of capital allowances so that:

(2') $CF_t = \{ P_0Q_t - C (Q_t, K_t)\} (1 - u) (1 + \pi)^t - (\delta K_t + k_t)(1 - uZ)(1 + \pi)^t - T_{R[t]} (1 - u)$

for $t \geq T$

(2') $CF_t = - e_t (1 - uZ) (1 + \pi)^t - T_{R[t]} (1 - u)$ for $t < T$

with $Z = \alpha / (\alpha + R)$.

Note that royalty payments in the exploration and development phase are negative if such costs are deductible from the royalty base, which will be the case for the rent tax.

OUTPUT-RELATED ROYALTY

Royalties are a percentage of the value of extracted output. The corporate income tax system allows companies to deduct exploration and development expenses against other income earned. Let τ be the ad valorem payment on sales, PQ, so that $T_R = \tau PQ$ (suppressing time scripts here on in unless needed). Maximizing equation (1), subject to (2) and (2'), choosing Q, K, k, and E, yields the following:

Output Decision

The choice of Q yields the following result (λ is the Lagrange multiplier for the constraint in (2)):

(7) $(1 + r)^{-t} (P (1 - \tau) - C') (1 - u) = \lambda$

with $r = R - \pi = Bi (1 - u) + (1 - B)\varrho - \pi$.

The shadow price of extracted output is equal to the marginal value of extracting a marginal unit of output.

Differentiating (7) for time (let p denote the time change in the price) yields the familiar Hotelling condition that the increase in the quasi-rents from rent extraction is equal to the discount rate:

(8) $(p(1 - \tau) - C') / (P(1 - \tau) - C'') = r$

The royalty rate on ad valorem sales generally reduces quasi-rents and the incentive to extract since the royalty reduces revenues relative to costs of extraction. On the other hand, the deductibility of interest expense from taxable income lowers the cost of finance and, therefore, increases extraction to early periods.

Depreciable Capital

The choice of capital stock and new investment, post-exploration and development, as well as the undepreciated capital cost base and changes to it, yields the following cost of capital for depreciable capital:

(9) $-C_K = (\delta + R - \pi) (1 - uZ) / (1 - u).$

This is the familiar cost of capital expression noting that R is the weighted average of the cost of debt and equity finance and Z is the present value of depreciation.

Exploration and Development

The choice of exploration and development, E, yields the following for the cost of capital:

(10) $(P_T - C_T')f_t' = (1 - uZ) (1 + r)^{(T-t)} / [(1 - u) \{1 - \tau P / (P - C')\}]$

The quasi-rent earned by investing in exploration $(P_T - C_T')ft'$ is equal to the interest-adjusted cost of exploration (the price of exploration and development is set equal to unity) divided by the one minus the royalty imposed on the cost of capital. The term in the denominator $\tau P/(P - C')$ is the ad valorem tax paid as a share of the quasi-rents on incremental sales (this is expected to be less than one so long as the ad valorem tax rate is less than the margin $(P - C') / P$). The cost of exploration is reduced by interest deductions taken early at time t relative to the earning of income at time T. Given the deductibility of interest expense from income, the effect of corporate taxation is to reduce the real cost of finance (r) and the discount factor $(1+r)^{(T-t)}$ resulting in a lower cost of capital (and lower effective tax rate on capital).

RENT-BASED ROYALTY ON CASH FLOWS

Cash flow is equal to the revenues net of both current and capital costs incurred in undertaking the project. Interest expense is not deductible and unused deductions, fully written off in later years are carried forward at the riskless bond rate (the uplift factor).

The royalty payment after payout is the following:

$$T_R = \tau[P_t Q_t - C(Q_t, K_t)\,(1 + \pi)^t - (\delta K_t + k_t)\,(1 + \pi)^t - e_t\,(1 + \pi)^t],$$

This is substituted into equation (3). The determination of output, Q, accords with the following Euler equation:

$$(11) \qquad (1 + r)^{-t}\,(1 - \tau)\,(P - C')\,(1 - u) = \lambda.$$

The extraction decision is determined by selling output until the increase in the quasi-rent from higher prices net of marginal cost (p - C") per dollar of quasi-rent is equal to the cost of finance.

$$(12) \qquad (p - C'') / (P - C') = R - \pi$$

Depreciable Capital

The user cost for depreciable capital for the oil sands case is similar to equation (9), but royalties directly affect the cost of capital because current costs are deductible from the royalty base. That is, changes in the stock of capital reduce current costs, which are netted from royalty payments.

$$(13) \qquad -C_K = (\delta + R - \pi)\,\{1 - \tau(1 - u) - uZ)\} / [(1 - u)\,(1 - \tau)]$$

$$\text{with } Z = \alpha / (\alpha + R)$$

Exploration and Development

The user cost for exploration and development for the cash flow tax is the following:

$$(14) \qquad (P - C')f_t' = (1 - uZ - \tau(1-u))\,(1 + r)^{(T-t)} / [(1 - u)\,(1 - \tau)].$$

The term of Z is the typical CCA allowance by which the deduction could be used against other income.

If the corporate tax terms are zero (u = 0 and Z = 1), the royalty terms appearing in equations (12) to (14) disappear. Otherwise, the rent-based royalty is not neutral as it increases the corporate tax burden on capital.

The marginal effective tax rate estimated in the Table is the difference between the pre-tax return and post-tax return on capital as a proportion of the pre-tax rate of return on capital. The pre-tax rate is calculated on the right-hand side of equations (9), (10), (13) and (14)) net of depreciation. The post-tax rates of return of capital are equal to the same except all tax and royalty terms are set to zero.

About the Authors

Kenneth J. McKenzie is a Professor in the Department of Economics and The School of Public Policy at the University of Calgary, where he has been since 1992. He received his B.Comm. from the University of Saskatchewan in 1982, his M.A. from the University of Calgary in 1985 and his Ph.D. from Queen's University in 1990. From 1984 to 1986 he was an economist in the Tax Policy Branch of the federal Department of Finance. His first academic appointment was at the University of Toronto in 1990. His principle area of research is public economics, with an emphasis on taxation and political economy. Professor McKenzie has received the Harry Johnson Prize for the best article in the Canadian Journal of Economics (1996, with Herb Emery). He is a two time winner of the Douglas Purvis Memorial Prize for a published work of excellence relating to Canadian public policy (1999, with Ron Kneebone; 2010, with Natalia Sershun). In 2000 he was the recipient of the Faculty of Social Sciences Distinguished Research Award at the University of Calgary. He was the EnCana Scholar at the C.D. Howe Institute, where he delivered the 2001 Benefactors Lecture, and has been a visiting fellow at research institutes in both Germany and Australia. He was the inaugural director in 2004 of the University of Calgary's Institute for Advanced Policy Research. Professor McKenzie has acted as an advisor to governments and institutions at the international, federal and provincial levels. He has been on the Panel of Experts for the International Monetary Fund and the World Bank and has provided analysis and advice on tax policy to several developing countries. He has sat on the Taxation and Finance Committee of the Alberta Economic Development Authority, was a member of the Alberta Business Tax Review Committee in 2000, an expert advisor to the Financial Review Commission in Alberta in 2002, and involved in research for the federal government's Technical Committee on Business Taxation in 1997. In 2007 he was a member of the Alberta Royalty Review Panel. Professor McKenzie has served on the Executive Council of the Canadian Economics Association, and on the editorial boards of the Canadian Journal of Economics and the Canadian Tax Journal and is past editor and associate editor of Canadian Public Policy. He served as Department Head in Economics from 2007-2010, and is currently Director of the Tax and Economic Growth Program in The School of Public Policy.

Dr. Jack Mintz
The James S. & Barbara A. Palmer Chair in Public Policy

Jack M. Mintz was appointed the Palmer Chair in Public Policy at the University of Calgary in January 2008.

Widely published in the field of public economics, he was touted in a 2004 UK magazine publication as one of the world's most influential tax experts. He serves as an Associate Editor of *International Tax and Public Finance* and the *Canadian Tax Journal*, and is a research fellow of CESifo, Munich, Germany, and the Centre for Business Taxation Institute, Oxford University. He is a regular contributor to Canadian Business and the National Post, and has frequently published articles in other print media.

Dr. Mintz presently serves on several boards including Brookfield Asset Management, Imperial Oil Limited, Morneau Shepell, and Royal Ontario Museum. He was also appointed by the Federal Minister of Finance to the Economic Advisory Council to advise on economic planning and served as research director for the Federal-Provincial Minister's Working Group on Retirement Income Research.

Dr. Mintz held the position of Professor of Business Economics at the Rotman School of Business from 1989-2007 and Department of Economics at Queen's University, Kingston, 1978-1989. He was a Visiting Professor, New York University Law School, 2007; President and CEO of the C.D. Howe Institute from 1999-2006; Clifford Clark Visiting Economist at the Department of Finance, Ottawa; Chair of the federal government's Technical Committee on Business Taxation in 1996 and 1997; and Associate Dean (Academic) of the Faculty of Management, University of Toronto, 1993-1995. He was founding Editor-in-Chief of *International Tax and Public Finance*, published by Kluwer Academic Publishers from 1994-2001, and recently chaired the Alberta Financial and Investment Policy Advisory Commission reporting to the Alberta Minister of Finance.

In 2002, Dr. Mintz's book, *Most Favored Nation: A Framework for Smart Economic Policy*, was winner of the Purvis Prize for best book in economic policy and runner-up for Donner Prize for best book in public policy.

Dr. Mintz has consulted widely with the World Bank, the International Monetary Fund, the Organization for Economic Co-operation and Development, the governments of Canada, Alberta, New Brunswick, Ontario, and Saskatchewan, and various businesses and nonprofit organizations.

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