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Do Newfoundland and Labrador Royalties Subsidize Offshore Oil and Gas Investments?

An Independent Assessment of the Claims made in Mintz and Chen (2010) and Mintz (2010)

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Executive Summary

> *Economists have had a comparative advantage in developing elegant mathematical models. Economists…have been far less successful in developing general models that make precise quantitative predictions that are approximately empirically accurate.*
>
> *Gabaix and Laibson (2008)*

Validating the accuracy of any analysis that purports to offer insights into the incentive effects of a royalty system on investment is not simply an academic concern. In particular, if the analysis is predicated on an incorrectly specified model, then this reduces the potential contribution of the analysis to real world public policy debates. Unless there is reason to presume that specification errors are minor and the policy implications are unaffected, a misspecification on substantial points is sufficient justification for disregarding the predictions that come out of the analysis. That is, the analysis should be given a reduced or no weight in the debate unless and until a corrected version of the model is able to demonstrate that the policy conclusions remain relevant.

This paper evaluates the relevance of the Mintz and Chen (2010) and Mintz (2010) analyses for Newfoundland and Labrador. These researchers, utilizing the Marginal Effective Tax and Royalty Rate (METRR) approach, have argued that Newfoundland and Labrador's generic offshore oil royalty distorts, that is, subsidizes, marginal investments. The implicit subsidy in their model emanates from the fact that the return allowances permitted for royalty calculations under Newfoundland and Labrador's generic fiscal regime exceed the risk free discount rate needed to preserve the present value of royalty write-offs, — the latter being a prerequisite for maintaining the investment neutrality of the fiscal system.

If the research findings of Mintz and Chen (2010) were correct, then the Government of Newfoundland and Labrador would have to consider raising the effective royalty rates applicable to its offshore projects. These higher effective rates would be needed to capture a fair and enhanced share of economic rents; to remove the suggested distortions; and to reduce the implied excessive investment in that sector. To overcome these deficiencies, Mintz and Chen (2010) recommends that Newfoundland and Labrador adopt a royalty system similar to the 25% flat rate oil sands royalty that was in place in Alberta before 2009.

In assessing the contribution of Mintz and Chen (2010) to enhancing our understanding of the incentive effects contained in Newfoundland and Labrador's offshore oil fiscal regime, it is important to realize that the perceived subsidy effect identified by the authors is contingent upon the profit sensitive royalty rates being non-zero for marginal projects. Yet, for a marginal offshore oil project, earning a 6% after-tax-and-royalty rate of return, the profit-sensitive royalties under the Newfoundland and Labrador system will not come into effect. That is, for these marginal projects, the royalty rates for both Tier 1 and Tier 2 royalties will have values of zero. Since zero multiplied by anything remains zero, the subsidy effect perceived by Mintz and Chen (2010) is non-existent. In other words, since Newfoundland and Labrador's profit-sensitive royalties are not triggered by marginal projects earning a 6% after-tax-and-royalty rate of return, the subsidy through the return allowance claimed by Mintz and Chen (2010) disappears. That being said though, it is important to recognize that the profit-sensitive royalties become effective for infra-marginal projects (that is, those that earn above normal economic profits that have a rate of return of 11%). However, positive economic rents invalidate the use of the METRR, which is the basis for the analysis undertaken in Mintz and Chen (2010). Furthermore, either the project is truly marginal in the Newfoundland and Labrador context, implying that the profit-sensitive royalties are zero and no subsidy would exist or, alternatively, the project is not marginal and it earns positive economic rents, which, in turn, invalidates the METRR approach utilized by Mintz and Chen (2010) for analyzing Newfoundland and Labrador's offshore oil investments. In fact, when one takes into account risk and prospectivity, Newfoundland and Labrador's fiscal regime is neither significantly more onerous nor obviously more generous than comparable fiscal regimes in Canada and around the world.

In the world modeled by Mintz (2010), the investors know with certainty which components of the royalty structure apply at each point in time, even before the first dollar is invested. That is, this model abstracts from uncertainty and risk. The failure to explicitly consider risk has implications for the size of the METRR estimated and may even render the results of the Mintz and Chen (2010) analysis irrelevant. For instance, the investment envisioned in Mintz (2010) is in terms of both "exploration and development" so that there is no exploration that is not ultimately accompanied by development. In this model, investment in exploration and development leads to resources that will be extracted eventually. This means that a large part of risk (i.e., geological risk) is missing or it is assumed not to exist. In other words, Mintz (2010) does not consider the possibility that a firm may explore, not find anything, or find a deposit that is too small to develop.

The presence of risk is the real world for offshore oil and gas investments; especially given the large capital outlays, the long lead times, the irreversibility of investment, and the uncertain outcomes characteristic of investments in Newfoundland and Labrador's offshore. The failure to appropriately account for risk is a serious problem because Newfoundland and Labrador's generic fiscal regime is not characterized by full loss offset and, as such, utilizing the risk free discount rate would not be sufficient to maintain investment neutrality. Given the significant financial outlays and geological risks associated with investing in offshore Newfoundland and Labrador, it would not be out of the realm of possibility that 5% would be a reasonable premium to add to the risk free discount rate to compensate the investor for risk. This is precisely the approach adopted in the Newfoundland and Labrador generic royalty system for Tier 1 royalties. Additionally, if 5% were the appropriate premium, then the implicit subsidy through the Tier 1 return allowance would disappear. In other words, 6% (the assumed risk free rate) plus 5% (the assumed adjustment factor for risk) exactly offsets the Tier 1 return allowance (11%).

While technical in nature, it is important to appreciate that the use of the METRR by Mintz and Chen (2010) and Mintz (2010) is based on several of assumptions that are untenable. Moreover, these assumptions do not hold, then the results derived in Mintz and Chen (2010) are no longer valid. Some of the more significant and questionable assumptions that have direct implications for the estimated METRRs are:

- capital is assumed to be infinitely divisible;
- investments are reversible, in full and without cost;
- international tax competition is absent; and
- perfect certainty is assumed and, as such, risk is ignored.

In addition, there are significant misspecification errors in how Mintz (2010) modeled Newfoundland and Labrador's generic royalty. Correcting these errors would change the cost of capital estimated in Mintz and Chen (2010). Some of the problems with the Mintz (2010) interpretation of Newfoundland and Labrador's generic offshore oil royalty are:

(1) Mintz (2010) does not include any Tier 1 royalties that are payable beyond Tier 2 royalty payout. Yet, Tier 2 royalties supplement, rather than replace, Tier 1 royalties;
(2) Mintz (2010) omits permissible uplifts on capital and operating costs in calculating Tier 1 and Tier 2 royalties and the corresponding royalty payouts. Specifically, there is an uplift of 1% on eligible capital and 10% on eligible operating costs that have been omitted in Mintz (2010);
(3) the Atlantic Investment Tax Credit (AITC) applies only to depreciable capital in Mintz (2010). Yet, the largest benefits from the AITC relate to the eligible non-drilling development expenditures that are grouped in Mintz (2010) under the rubric of exploration and development investment and are not subject to the AITC in his model;
(4) in calculating the return allowance to determine Tier 1 payout, Mintz (2010) omitted the gross royalty which is part of the base for calculating the return allowance payout;
(5) in Mintz (2010), Tier 1 royalties have not been included in the return allowance calculation for determining Tier 2 payout; and
(6) a portion of the exploration and development expenditures should be expensed, but this does not appear to be reflected in the model.

Given the lack of full-loss offset and its 25% royalty rate, the Alberta oil sands flat royalty is neither an ideal rent collection mechanism nor a pure rent tax. Without full-loss offset, the risk-free interest rate falls short of the appropriate threshold rate of return by a risk premium. Moreover, even in those circumstances where a risk free discount rate may be appropriate, a 25% tax rate, assuming that the tax base is defined as true economic rents, would imply that the provincial government, acting on behalf of its constituents – the owners of the resource, would, through the application of the royalty, only collect 25% of the actual rents generated. The residual 75% would accrue to the firms investing their capital in this jurisdiction, only a portion of which would be captured by the provincial government through provincial corporate income taxes. This surplus return is over and above normal economic profits required to compensate the investors for the opportunity cost of their capital, other explicit costs and any risks they incur. Presumably, since rent is over and above the minimum required to exploit the resource, any surplus generated ought to accrue to the resource owners — in this case, the people of the province. In other words, any government employing the 25% tax rate are transferring 75% of the province's rents to the private sector.

While one would ideally like to have recalculated the Mintz and Chen (2010) estimates for the METRR after adjusting for the modeling errors, the parameter values utilized by Mintz and Chen (2010) was neither included in their analysis nor was it made available for this evaluation when requested by telephone. Instead, an alternative test of the claims of Mintz and Chen (2010) was provided through a simulation exercise. There were four separate tests conducted. In none of the simulations did the Newfoundland and Labrador generic royalty subsidize marginal investments. Specifically, the net present values for the incremental, sub-marginal investments were all negative. A positive finding would have been required to corroborate Mintz and Chen (2010). Consequently, not only were there problems with how Mintz and Chen (2010) and Mintz (2010) modeled the investment environment for oil projects in Newfoundland and Labrador's offshore, the robustness of their findings did not hold up in the simulation tests performed.

Finally, the revenue implications of switching from the generic offshore royalty to the 25% flat rate oil sands royalty were simulated for various price assumptions. While the impact of the switch depends on the range of prices considered, neither the impacts on government revenue nor on the after-tax, internal rate of return for this type of project would be significant enough to warrant changing a fiscal system that appears to be working reasonably well.

Without adjustments to their research, this assessment brings into question whether the Mintz (2010) and Mintz and Chen (2010) analyses make significant contributions to the public policy debate in Newfoundland and Labrador with respect to the appropriate structure of the offshore fiscal regime. Their findings that the Newfoundland and Labrador fiscal regime subsidizes offshore oil and gas investment are not supported by their analysis. Therefore, based only on the research presented in Mintz and Chen (2010) and Mintz (2010), there is insufficient evidence to justify changing the royalty system or for adopting the flat rate oil sands royalty in Newfoundland and Labrador. The current fiscal regime in Newfoundland and Labrador is working well for all stakeholders.

1.0 Introduction

Royalties act as an important deterrent to oil and gas investment, except in Newfoundland and Nova Scotia, which have highly distortive systems as a result of cost deductions that are carried forward at unbelievably high discount rates. This could be easily fixed by adopting a royalty similar to Alberta's flat-rate oil sands levy, with a full deduction of both successful and unsuccessful exploration costs, rather than generous discount rates for carrying costs forward…

Dr. Jack Mintz, Financial Post, June 3, 2010[1]

"This is not a system to copy," said Mintz …"In fact, I would not recommend it to any government I work with around the world."

Dr. Mintz on Newfoundland and Labrador's royalty system
Article by Moira Baird, February 25, 2010, The Telegram

Marginal investments in oil and gas in Newfoundland and Labrador and Nova Scotia … obtain a fiscal subsidy…due to both a royalty structure that provides excessive deductibility for investment costs and the federal Atlantic investment tax credit. "In my view, that's just too distortionary; it's not necessary," said Mintz.

University of Calgary News Release, February 24, 2010[2]

These comments, based on Dr. Mintz's research[3] into the incentive effects of taxation and royalties[4] on oil and gas investment, portray Newfoundland and Labrador's offshore generic royalty/fiscal system in an extremely negative light. If these claims are correct and can be substantiated or verified independently, then the Government of Newfoundland and Labrador will have to at least consider

[1] This excerpt is taken from the FPComment in the June 3, 2010 edition of the Financial Post, (http://opinion.financialpost.com/2010/06/03/oil-isnt-subsidized/) and the excerpt from the Moira Baird article is taken from The Telegram, February 25, 2010 (http://www.thetelegram.com/index.cfm?sid=329703&sc=82). A similar story was carried in several other prominent newspapers across the country.

[2] http://www.ucalgary.ca/news/utoday/february24-2010/mintz.

[3] Dr. Mintz and his co-author Duanjie Chen released a briefing paper in February 2010 through the School of Public Policy, University of Calgary entitled: *Taxing Canada's Cash Cow: Tax and Royalty Burdens on Oil and Gas Investments*. http://www.policyschool.ucalgary.ca/files/publicpolicy/cashcow1b.pdf As indicated in Mintz and Chen (2010, fn 9, p. 6), their research drew on the companion paper: *Measuring Effective Tax Rates for Oil and Gas in Canada*, which was authored by Dr. Mintz and also released by the School of Public Policy, University of Calgary as a Technical Paper in March 2010. http://www.policyschool.ucalgary.ca/files/publicpolicy/mintztechtaxoilgas.pdf

[4] In his research, taxation encompasses royalties and other similar rent collection devices applied by host governments to capture rents from their oil and gas resources.

raising the effective tax and royalty rates[5] applicable to its offshore projects in order to both capture a fair share of economic rents[6] and remove the distortions highlighted by Dr. Mintz.

A caveat to following through on the implications of Mintz and Chen (2010) is: if Newfoundland and Labrador increases its effective tax rate when other jurisdictions do not, then the province runs the risk of having potentially serious implications for the level of investment within its offshore oil and gas sector.[7] In particular, if the 6% nominal threshold rate implied by Mintz (2010) and Mintz and Chen (2010) falls below the hurdle rate[8] for offshore investment on the Grand Banks of Newfoundland and Labrador, and available evidence indicates that it does, then adopting this particular fiscal regime could eliminate, or significantly curtail, future investment in offshore Newfoundland and Labrador. More importantly, this, in turn, could substantially alter the province's future prosperity.[9] In other words, Newfoundland and Labrador cannot afford to take lightly either the claims being made in the research of Dr. Mintz and his colleague, Duanjie Chen, nor the policy implications that flow from those claims. A serious consideration and a thoughtful response to this research are essential to provide balance in any public policy discussion surrounding how to optimize offshore oil and gas resources for the benefit of the people of Newfoundland and Labrador.

While it is not defined explicitly within either Mintz and Chen (2010) or Mintz (2010), their research is focused on examining whether petroleum rent collection instruments utilized in Canada and the United States (Texas) are neutral with respect to investment.[10] That is, their analyses are concerned with

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[5] The effective tax and royalty rate can be increased by raising the royalty rate that firms pay, by lowering the return allowance permitted in calculating Tier 1 and Tier 2 royalties, and through the elimination the Atlantic Investment Tax Credit or other tax shields that protect the profit base.

[6] Note that, while not considered in the Dr. Mintz's research, Newfoundland and Labrador has enacted three new royalty agreements since the generic royalty. These new agreements relate to the White Rose Extension, Hibernia South and the Hebron project and each includes an additional profit sensitive royalty that becomes effective if the price of oil exceeds $50 US (WTI) and the project has reached Tier 1 payout. A description of the province's royalties can be found at: http://www.nr.gov.nl.ca/mines&en/exploration/offshore.stm#regime. In addition, NL royalty regulations can be found at http://www.assembly.nl.ca/Legislation/sr/regulations/rc030071.htm#top.

[7] The implication of the Mintz suggestion is that the return allowance under the Newfoundland and Labrador generic offshore regime should be lower, which would make the burden of taxes and royalties higher and reduce the level of investment and economic activity within Newfoundland and Labrador. In fact, Mintz and Chen (2010, p. 14) argues "the tax and royalty systems of Newfoundland and Labrador and Nova Scotia encourage too much investment in offshore investment (sic) with what would occur with a neutral corporate tax system and a true rent tax."

[8] Land (2009, p. 164), while referring to it as the compensatory return on capital, indicates that the hurdle rate consists of a basic return equivalent to the rate of interest on risk-free long-term borrowing plus whatever margin the investor considers necessary to compensate for the technical, commercial and political risks associated with investments. At the very least, the hurdle rate should exceed the risk free rate of return by an appropriate risk premium.

[9] It is worthwhile to note that since 1997, the contribution that offshore oil has made to the Newfoundland and Labrador economy has grown from almost nothing to 40% of the province GDP in 2008 and the province has moved from being a province that received the largest per capita equalization entitlements to being a non-receiving province.

[10] See Mintz and Chen (2010, p. 14-5) for a discussion of neutrality issues in the current Canadian fiscal system and how that has evolved. As well, Mintz (2010, p. 8) refers to neutrality in the context of his model. A tax is neutral if it does not alter the investment decisions of firms so that projects which were profitable to undertake prior to the

technical economic efficiency and whether the fiscal regimes distort or alter investment choices or move the allocation of resources away from an efficient (Pareto Optimal) outcome in the jurisdictions considered in their study.[11]

Despite the attention received when the studies were released and the apparent acceptance of the research results, a careful second look at this analysis is warranted. For instance, it is important to appreciate that Mintz and Chen (2010) consists solely of a series of numerical estimates of marginal effective tax and royalty rates[12] for the various jurisdictions considered and an accompanying discussion of their implications.

Given the potentially serious implications for Newfoundland and Labrador[13] from modifying its offshore oil fiscal regime to reflect the claims in Mintz and Chen (2010), the lack of detail and specificity in their analysis is troubling. As well, this concern is magnified when, as is done in this paper, one scrutinizes carefully the analytics of Mintz (2010). Specifically, as shown in this assessment, Mintz (2010) incorrectly models Newfoundland and Labrador's offshore fiscal regime. The consequence of this misspecification is that the conclusions of Mintz (2010) and Mintz and Chen (2010) with respect to Newfoundland and Labrador's generic offshore royalty are not supported by their analysis. At the very least, these errors would have to be corrected before their research can be given any serious consideration in a public policy debate pertaining to the optimal structure of Newfoundland and Labrador's offshore fiscal regime.

Independent of any technical concerns with their research, a reasonable reality check might be to ask: does it sound right? In particular, would relevant and knowledgeable stakeholders readily agree that Newfoundland and Labrador's fiscal regime subsidizes marginal offshore oil and gas investment? Is there a long line of oil and gas companies chomping at the bit to invest in offshore Newfoundland and

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tax are viable after the tax is implemented. Bond and Devereux (2003, p. 1291-2) consider a tax to be neutral if the post-tax net present value has the same sign as the pre-tax net present value. Alternatively, Lammersen (2002, p. 2) suggests that: "A tax system is neutral with respect to investment decisions if the ranking of net present values of different investment projects is not affected by taxation and the tax system does not alter the ranking with respect to the alternative use of funds." Additionally, the Australian literature, see Hogan (2007, p. 25-6), distinguishes between weak neutrality (the tax does not alter the rankings of alternative risky projects for an investor) and strong neutrality (weak neutrality plus the tax does not change the decisions of investors relating to which projects will proceed).

[11] Pareto optimality, commonly referred to as economic efficiency, occurs within an economy when an allocation of resources is achieved such that the only way to improve the wellbeing of any individual within that economy or society is to reduce the wellbeing of someone else within that economy or society. The idea underlying this concept is that if it is possible to reallocate resources to improve the wellbeing of someone and not reduce the wellbeing of anyone else, then it would be a Pareto Improvement or a good thing to undertake that reallocation and it ought to be undertaken.

[12] As explained in more detail below, this metric measures the tax and royalty wedge between the pre-tax and post-tax rates of return.

[13] Locke (2010) shows that offshore oil projects account for 40% of nominal GDP (25% of real GDP); contribute more than 30% of provincial government revenues; are expected to yield $2.3 billion in government revenue on average for the next ten years (with 2010-11 provincial government expenditures budgeted at less than $7 billion); and have enabled Newfoundland and Labrador to move from being one of the largest equalization recipient provinces per capita to being a non-receiving province in 2008-09 and beyond.

Labrador or in offshore Nova Scotia, for that matter? While there is interest in both areas, albeit more in Newfoundland and Labrador, it would not be correct to characterize this as an excessive demand for the rights to bid on property and undertake exploration in either jurisdiction.

It would also be a surprise to firms investing in Newfoundland and Labrador's offshore oil and gas projects that they are either implicitly or explicitly being subsidized by the province's generic offshore fiscal system.[14] This is especially true given the rates of return earned in the harsh, geologically-risky environment of the storm-swept and iceberg-prone region of the North Atlantic in which they are investing.[15]

Likewise, it would be a surprise to government officials that the Newfoundland and Labrador fiscal system is "highly distortive" and subsidizes the industry as claimed by Mintz and Chen (2010). While a negotiated fiscal arrangement is now in place for the Hebron project,[16] with construction expected to commence in 2012, it is interesting to note that earlier negotiations for the Hebron project were unsuccessful and ceased completely in 2006. At that time, the parties failed to reach an agreement, in part, because the government's negotiating position was to put in place higher royalties for the project if the price of oil exceeded $50 US per barrel (WTI) after the project had reached Tier 1 payout for royalty purposes.[17,18] The fact that the consortium was prepared to walk away when negotiations focused on an enhanced, and, some might argue, a more onerous fiscal regime may not directly refute the subsidy claim of Mintz and Chen (2010). However, it does raise questions about the legitimacy of

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[14] It should be noted that Dr. Mintz's comments are directed specifically at the generic offshore royalty but there are currently six royalty systems in place in Newfoundland and Labrador, applying to the original Hibernia project; the Hibernia South Extension; the Terra Nova project; the original White Rose project, also known as the generic offshore royalty system; the White Rose extension, including the North Amethyst project and the Hebron project, which is currently in its development phase. These royalty regimes all have common features such as ad valorem royalties and profit-sensitive royalties similar in structure to a resource rent tax. The more recent vintages of the royalties have additional profit-sensitive components that come into effect for prices in excess of $50 per barrel when the project has earned a specified rate of return. A description of the province's royalties can be found at: http://www.nr.gov.nl.ca/mines&en/exploration/offshore.stm#regime.

[15] Wood Mackenzie, (2006, p. 4) provides a graph of the investors' rates of return for Grand Bank projects. They suggest that for the next project expected to be developed on the Grand Banks, the Hebron/Ben Nevis project, its "economics are marginal by local comparison." For this project, Wood Mackenzie, at that time, estimated a rate of return for the Hebron project that was between 10 and 15 percent, which they considered to be a marginal project for that area.

[16] A description of the agreement can be found at http://www.releases.gov.nl.ca/releases/2008/exec/0820n04.htm

[17] The Tier 1 payout would only occur after the project earned an 11% nominal rate of return, assuming the long-term government bond rate was 6%. Note, also, that this is well in excess of the 6% threshold rate implied in the Alberta flat-rate oil sands levy suggested by Dr. Mintz to overcome the perceived distortive nature of Newfoundland and Labrador's fiscal regime. While a marginal project in the Newfoundland and Labrador context would be one in which the private sector consortium earned a rate of return between 10 and 15 percent, the regime suggested by Dr. Mintz would become effective once a nominal rate of 6% is earned. The impact of this change would be that marginal projects would not likely proceed if the hurdle rate was in excess of 10%, while the return allowance was only 6%.

[18] In fact, the provincial government had made the achievement of two of three conditions a prerequisite for a successful conclusion to negotiations – a higher royalty if the price were to exceed $50 per barrel, a working interest in the project, or a refinery within the province to process the crude from the Hebron project.

the claim, especially given that two years later a deal on more-or-less the same terms was agreed to by all parties.

Interestingly, a tax that is similar to Newfoundland and Labrador's Tier 1 royalty exists in Australia[19] and despite recently undertaking a major review of resource rent taxation that resulted in a recommendation to implement a super profit taxes on mining, the Australian government decided not to change the way in which they tax petroleum rents.[20] The Australian tax, known as the Petroleum Resource Rent Tax, is levied at a rate of 40 per cent and general project expenditures are accumulated at the long term government bond rate plus 5 per cent.[21] The return allowance of 5% plus the long-term government bond rate is identical to that which exists for Tier 1 royalties under Newfoundland and Labrador's generic offshore royalty. The treatment of exploration is different[22] and the rate of tax is higher in Australia, 40% versus 20% in Newfoundland and Labrador for Tier 1 and an additional 10% if Tier 2 is relevant. Finally, like Newfoundland and Labrador's offshore generic royalty system, Australia's petroleum resource rent tax is both ring-fenced and does not provide full-loss offset.[23] This is an extremely important point in the Newfoundland and Labrador context. Furthermore, it has direct implications for how Mintz and Chen (2010) should have modeled the Newfoundland and Labrador system, especially with respect to risk. This point is evaluated below more fully.

Recognizing that the newspaper articles and the press release are not the evidence upon which Dr. Mintz based his claim, it is important to look more closely at what evidence he did use. In particular, given the potential implications for the province, it is important to critically evaluate the approach proffered by Dr. Mintz as evidence of the distortive nature of the Newfoundland and Labrador generic fiscal regime. This is the primary purpose of writing this paper.

A closer look at the evidence on which Dr. Mintz bases his statement about the distortive nature of the generic offshore royalty does not, in fact, appear to support his conclusion with respect to marginal projects that might be planned for Newfoundland and Labrador's offshore area. When one takes into account risk and prospectivity,[24] Newfoundland and Labrador's fiscal regime is neither significantly more onerous nor obviously more generous than comparable fiscal regimes in Canada and around the world.[25]

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[19] As well, Land (2009, p. 167-8) reports that Timor-Leste has a fiscal regime that allows a 16.5% return allowance.
[20] See Henry et al. (2010a and 2010b) for a discussion of the tax reforms considered in Australia.
[21] Hogan (2007, p. 2-3).
[22] Hogan (2007, p. 14) indicates that exploration expenditure in Australia is transferable between projects within the same company and is immediately deductible.
[23] Hogan (2007, p. 5).
[24] Prospectivity should, in this context, be interpreted as synonymous with potential productivity of the area in terms of its ability to generate commercial quantities of hydrocarbons.
[25] Locke, W., (2006) showed that the Newfoundland and Labrador fiscal system was in the middle of the other regimes considered in terms of its share of revenue that were taken by government. While the government take is not the marginal effective tax and royalty rate utilized by Dr. Mintz, it does make one wonder why two different indicators could be so far apart in terms of their implications. In addition, Watkins (2001, p. 29) evaluates the Newfoundland and Labrador and Nova Scotia royalties and concludes: "… prospective returns to governments and

This study consists of 13 sections, which include the Introduction and five appendices. The next section provides a background on the approach adopted by Mintz and Chen (2010) and Mintz (2010) and is followed, in Section 3, by an illustration of the intuition that underlies the neoclassical theory of investment, the theoretical basis for their analyses and subsequent claims with respect to the Newfoundland and Labrador royalty. To separate the legitimacy of the investment approach from issues associated with its application to rent collection mechanisms employed by governments and, by extension, to Newfoundland and Labrador's generic offshore royalty, this illustration initially considers investment in non-resource firms. Section 4 describes and evaluates the Mintz (2010) model and highlights some concerns and problems with its specification. Issues surrounding the optimal tax rate for an ideal or pure rent tax[26] and its implications for Newfoundland and Labrador adopting the 25% flat rate Alberta oil sands royalty to remove the distortions that Mintz and Chen (2010) perceive for the Newfoundland and Labrador fiscal regime are evaluated in Section 5. In particular, given the lack of full-loss offset[27] associated with the Alberta oil sands flat-rate royalty and its 25% royalty rate, this section also evaluates whether the oil sands flat royalty is either an ideal rent collection mechanism or a pure rent tax. Section 6 provides a simulation exercise as an alternative test of the claims contained in Mintz and Chen (2010) and Mintz (2010). Section 7 provides a separate analysis of the revenue implications of adopting a resource rent tax that has a return allowance of 6% and a 25% royalty rate, the approach advocated by Mintz and Chen (2010). The conclusion is provided in Section 8 and five appendices are attached: three data appendices to allow for independent verification of the simulation results; a derivation of the METR for a non-resource firm is provided in Appendix A and a mathematical evaluation of Mintz (2010) is provided in Appendix B.

2.0 Background

> *In theory, METRs measure the impact of taxation on required rates of return and thus investment incentives at the margin…Results of METR analysis…must be interpreted with due caution, bearing in mind the simplifying assumptions behind the neo-classical theory of investment upon which the methodology is based…METR analysis can be helpful if not pushed beyond its limits. METRs should be seen as rough proxy variables that summarize at a broad level the interaction of various tax rules relating to capital investment.*
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> *OCED (2009)*

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producers are seen by both parties as reasonable, that the schemes are competitive, and that they will not deter continued investment…producers are not enjoying a free ride, and governments are not trying to grab too much."

[26] Mintz and Chen (2010, p. 11) describe the oil sands levy as: "a true rent tax for oil sands projects by which payment is assessed on revenues net of current and capital expenditures (with unused expenditures carried forward at the government bond interest rate)."

[27] Full-loss offset occurs where all losses incurred on a project are offset against future tax liabilities, either on the current project or on some other project. In the context of this study, it also implies that the present value of the tax savings is maintained.

The Mintz and Chen (2010) paper draws upon the analytical model contained in Mintz (2010), which extended the use of the Marginal Effective Tax Rate (METR) approach to oil and gas developments.[28] This metric, referred to by Mintz and Chen (2010) and Mintz (2010) as the Marginal Effective Tax and Royalty Rate (METRR), is calculated in a manner similar to the METR, except that royalties and associated petroleum revenue instruments utilized by governments are incorporated into the METRR indicator.

The METRR represents another metric through which one could theoretically or hypothetically measure the impact of taxes and royalties on investments in marginal oil and gas projects. These tax and royalty impacts, which may either stimulate or inhibit marginal investments, could then be compared across petroleum-producing jurisdictions or to the tax burden imposed on other, non-petroleum industries within the same jurisdiction or within the same jurisdiction, but at different points in time. The rationale for this type of analysis, as pointed out by Chen and Mintz (2008, p. 4), is that "tax burdens that vary across business activities affect the allocation of capital across different assets or industries rather than being invested according to their best use." This implies that resources are allocated inefficiently and general wellbeing could be improved by removing the distortion and restoring efficiency.[29]

Even if one were willing to accept all of the assumptions that underlie the METR, it should be recognized that **the METR, and by extension the METRR, are only valid for considering marginal investment projects**.[30] By extension, as Devereux (2008, p. 21) notes: when faced with discrete, but profitable, investment choices, a company would utilize the average effective tax rate, rather than the marginal effective tax rate. Specifically, the investor would choose the jurisdiction with the higher post-tax net present value. Put differently, if the project under consideration is not a marginal project, but generates above normal returns, then it would not be appropriate to utilize the METRR to analyze the impacts of royalties upon it. This turns out to be an important issue in evaluating how Mintz (2010) analyzes the impact of Newfoundland and Labrador's offshore generic royalties.

By way of further illustration of how the METRR works, consider that analysts who utilize the METR or the METRR would infer that a lower value for this metric would correspond to a higher level of investment and, as such, would be considered a good thing.[31] So, if one were to calculate mechanically a 40% METRR as the difference between the pre- and post-tax rates of return, expressed as a percent of the post-tax rate of return for a project in jurisdiction A and a 10% METRR for a project in jurisdiction B,

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[28] Other studies have looked at the METR in the mining sector. See, for example, Boadway et al. (1987), and Livernois (1989). Boadway and Keen (2009, p. 40-1) discusses how the METR concept can be extended to the petroleum industry. In the context of exploration, the METR would capture the extent to which taxes change the equality of the marginal cost of the exploration and the expected return from the discovery of new resources. The METR for extraction would involve considering the effect of taxes on the equilibrium path of net current benefits from extraction.

[29] It should also be noted that removing one source of distortion when there exists other distortions in the economy, as pointed out by the literature on the theory of the second best, may not be optimal. See, Boadway and Wildasin (1984, p. 176-180) for an explanation of the theory of the second best.

[30] FIAS (2006, p. 12, fn 8) also notes that the METR is "not well suited to analyzing tax effects on investment that generate above-normal returns." The marginal nature of the METR was also highlighted by the OECD (2009).

[31] It would be at least a potential Pareto improvement.

then it might be tempting to conclude that jurisdiction B offers the more attractive investment climate. However, if jurisdiction A has a higher prospectivity and higher economic rents that are captured by the investor — assume, for example, that the investment project under consideration in jurisdiction A has a 20% rate of return to the investor while the project in jurisdiction B has a rate of return of only 8%, then it would be irrational to suggest that the firm should invest in jurisdiction B, even if jurisdiction B has a lower METRR. This illustration is simply to point out that the METRR is an illustrative indicator that is utilized for marginal projects, when everything else is the same.[32]

Utilizing the METRR approach, Mintz and Chen (2010, p.5) calculates "…the marginal effective tax and royalty rate as the amount of taxes and royalties paid as a percentage of the pre-tax-and-royalty return on capital that would be required to cover taxes, royalties, and the financing of capital with debt and equity."[33] Additionally, Mintz and Chen (2010, p. 5) suggest that "…the METRR is a benchmark with which to determine the effects of taxes and royalties on investment decisions."

This strong claim with respect to the impact on investment is not entirely correct. At best, the METRR speaks to the incentive structure faced by marginal projects. That is, even if one were to accept everything that underlies this framework, which reasonable people might not, the METRR speaks to incentives, and not investment levels or rates of investment. In fact, the impact on investment would have to be inferred from the METRR.[34]

On its face, the higher is the value for the METRR, the greater is the tax wedge between the pre-tax and post-tax rates of return on capital invested in the oil and gas sector. That is, at least hypothetically, the METRR is a measure of the distortion that the tax and royalty system imposes on the marginal investment. The higher is the METRR, the greater is the tax and royalty distortion. Correspondingly, in this context, the more significant is the disincentive for investment at the margin. From this, one can infer that the higher is the METRR, the lower will be investment in that fewer projects at the margin will pass the new, higher hurdle rate of return. Alternatively, the METRR can be negative and would imply that the tax and royalty system provides a greater incentive for investment at the margin than would occur in a no-tax, no-royalty world. That is, in this circumstance, the tax and royalty system may be interpreted as providing a fiscal subsidy to marginal projects.

Based on the parameters derived from the analytical model contained in Mintz (2010) and the specific numerical values assumed for these parameters, Mintz and Chen (2010) assigned values to the METRRs

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[32] Ruggeri and McMullin (2004, p. 26) make exactly this point when they suggest that "In interpreting estimated METRs across different countries…those estimates are based on the assumption that all other factors are the same in each country…Locating a given investment in Country A which has a stable political system, low crime rate, highly educated population, and well-developed transportation and communication systems will generate a less risky flow of revenue than in Country B which has lower standards of the above factors…."

[33] To further illustrate the concept that they are utilizing, Mintz and Chen (2010) provide the following numerical example: "if a business invests in capital that yields a pre-tax and royalty rate of return equal to 10% and, after taxes and royalty, a rate of return equals 6%, then the METRR is 10% minus 6% divided by 10%, giving a result of 40%."

[34] OECD (2009), Auerbach (1990, p. 7) and Boadway and Shah (1992, p. 30) make the same point with respect to having to infer the impact on investment.

for various oil and gas jurisdictions, including Newfoundland and Labrador — the METRR is -3.9% for Newfoundland and Labrador projects in pre-royalty-payout status; it is -8.3% for projects for which only Tier 1 royalties are applicable; and it is -11.6% for projects that reach Tier 2 royalties status.[35] The numerical values of the METRRs for each jurisdiction form the basis for their discussion of the relative burdens on oil and gas investment that exist across the various jurisdictions studied.

Given their negatively-valued METRR estimates for Newfoundland and Labrador, Mintz and Chen (2010) conclude that marginal investments in the province's offshore are implicitly subsidized. Based on this logic and their empirical findings, they conclude that this results in distorted and excessive investment in Newfoundland and Labrador's offshore. Specifically, Mintz and Chen (2010, p. 17) highlight that marginal oil and gas investments:

> *…in Newfoundland and Labrador and Nova Scotia bear a negative or very low tax and royalty burden as a result of provincial royalty structures and the federal Atlantic investment tax credit.*

Their concerns are further illustrated by the following statement:[36]

> *With respect to Atlantic offshore oil and gas, the net-profit royalty regimes of Newfoundland and Labrador and Nova Scotia are highly distortionary, resulting in excessive investments and insufficient rents from the projects at a given royalty rate.*

This point is reiterated and reinforced by Mintz and Chen (2010, p. 2), when they summarize their results as follows:

> *Marginal investments in oil and gas in Newfoundland and Labrador and Nova Scotia bear a very low tax and royalty burden– in fact, they obtain a fiscal subsidy with a "negatively" measured burden – due to both a royalty structure that provides excessive deductibility for investment costs and the federal Atlantic investment tax credit.*

Given the potential importance of the Mintz and Chen (2010) estimates for oil and gas investments in Newfoundland and Labrador, it is necessary to look at this research and its conclusions more carefully. The first thing that one needs to know is whether it is correct to conclude, as Mintz and Chen (2010) did, that the Newfoundland and Labrador generic offshore royalty, when combined with the corporate income tax provisions, provides a fiscal subsidy to offshore oil and gas projects. At the very least, an independent verification of this finding is a prerequisite to further policy discussions on whether a change in the Newfoundland and Labrador royalty system is justified.

Before considering precisely how Mintz and Chen (2010) arrived at their conclusions, it is important to provide context to their analysis by considering the limitation of the METR and the METRR metrics that form the analytical basis of their research. As previously noted, the OECD (2009) recently acknowledged

[35] Mintz and Chen (2010, Table 5, p. 14).
[36] Mintz and Chen (2010, p. 16).

that the "METR analysis can be helpful if not pushed beyond its limits," but it also warned that in using the METR,

> *A number of the key assumptions typically invoked are untenable in many instances, thus making comparisons across sectors or countries difficult…Careful consideration of the range of conceptual and data problems … suggests that METR statistics and comparisons across sectors or countries cannot be used confidently as an indicator of the influence of taxation on investment or as a guide to the setting of tax policy.*

Some of the assumptions of concern that have been highlighted in the literature with respect to the use of the METR and apply to Mintz (2010) and, by extension, to Mintz and Chen (2010), are:

- the analysis is undertaken in a first-best world, where government objectives are unidimensional, involving only economic efficiency or ensuring neutral taxation. The possibilities of trade-offs in government policies are not explicitly considered;
- investment plans are motivated by a desire to maximize shareholder equity;
- with free entry, firms will continue to invest until rents at the margin are zero;
- regulations are similar across jurisdictions and do not prohibit or constrain the types of activities considered in their analysis;
- investment takes place in a small open economy, characterized by perfect capital mobility
- firms that are price-takers in both the input and output markets;
- investment capital is infinitely divisible so that it abstracts from lumpy investments;
- investments are reversible, in full and without cost;
- expectations are static;
- international tax competition would be absent in the context of the METRR applied to rent collection mechanisms;
- foreign companies may own the investment projects under consideration, but the host country taxes may be creditable against home (foreign) country taxes. Yet, the role of foreign tax credits is not typically considered explicitly;
- perfect certainty is assumed and, as such, risk is ignored; and
- full loss offset typically is assumed for the fiscal regimes considered.

What are the implications of making these assumptions in the Newfoundland and Labrador context? Each of these concerns is dealt with each briefly below.

2.1 Government objectives unidimensional[37]

It is important to recognize that whichever instrument is chosen by government to capture economic rents associated with its resources, like all other government policies, it is the result of balancing off competing interests or needs. For instance, it is a trade-off whether a government should go with a

[37] Land (2009, p. 160-1) notes that "Government may also use the fiscal system to achieve a host of other objectives besides revenue optimization, relating to value-added processing of minerals and hydrocarbons, environmental protection and broader economic and social development goals."

simpler and automatic, government-revenue generator, such as an ad valorem royalty, versus a true cash flow tax that is efficient, but requires both upfront cash payments from the government to the investor to cover any negative taxes and a sophisticated, well-resourced bureaucracy with specialized skills to administer and monitor.[38] In particular, for the cash flow taxes, negative taxes may occur in the earlier years of development and governments would have to hope that these cash outlays can be recovered in later years, assuming that economic circumstances do not deteriorate to such a level that this recovery is precluded. That is, they would trade-off a higher share of project risk against a higher share of realized economic rent.

While governments are concerned about collecting a fair share of the rents[39] from their natural resources in a non-distortionary or efficient manner, it is also important to realize that all the conditions required for a first best world will not be satisfied in any jurisdiction. As such, the efficient collecting of rents from natural resources will have to be, and are, traded off against some of governments' other objectives.

This trade-off might explain, for example, the preponderance of ad valorem royalties that exist around the world,[40] even though royalties increase the likelihood that some marginal fields may not go into development; there may be premature abandonment of existing fields in the lower tails of production; and the government's average take may be inversely proportional to profitability. If the sophistication of the bureaucracy is not well developed and the bureaucracy is not well resourced, then administering an efficient, but complex, rent collection mechanism may not be feasible and a government might opt for the, simpler to administer, ad valorem royalty. If government cannot borrow freely against the future income expected from the resource developments and it requires monies up front to meet its constituents' immediate needs for services, then it might be reasonable for the government to use ad valorem royalties that, while distortionary when viewed in isolation, generate revenue immediately upon the commencement of production. Or, the government might be more risk averse and not wish to expose itself to the possibility that it would not receive any revenue from the project, if the project's cash flow were not sufficient to meet payout under a true rent tax. Finally, a government may impose a royalty to slow down the rate of extraction because it is concerned that the private sector firms' discount rates are too high and the resource will be exploited faster than the socially optimal rate.[41] In this case, there is a trade-off between current and future wellbeing and the imposition of a royalty is a deliberate attempt to change or distort the behaviour of the investor by slowing down production from

[38] Negative taxes would be equal to the relevant tax rate times the capital expenditures that are claimed for the tax base prior to sufficient revenues being earned to exceed these expenditures.

[39] Land (2009, p. 158-9) indicates that capturing a fair share of economic rents is one of the objectives pursued by governments and the emphasis on this objective has increased in recent times.

[40] Boadway and Keen (2009, p. 19) suggest that "Royalties are not quite ubiquitous in practice…but are very widely applied to resource activities." In fact, they only identify four countries that do not have royalties, two for mining royalties and two for petroleum royalties.

[41] This was noted by Boadway and Keen (2009, p. 20). With a higher discount rate, the higher the weight attached to the present relative to the future. Everything else the same, the higher will be the net present value of the cash flow if production is tilted toward the present.

a rate that would be considered optimal by the firm, but would not be optimal from the perspective of the host country.

A related objective for government is to capture a fair share of the economic rent (surplus) generated by the development of its petroleum resources[42] or to maximize wealth from its petroleum resources. In addition, the government might be motivated to optimize the net financial benefits of petroleum exploitation to the public treasury or to optimize growth and economic development, including regional development.[43] This, of course, could extend to enhancing the benefits of oil and gas projects that accrue to domestic factors of production or to the maximizing the local benefit capture[44] or to the encouragement of technology transfer.[45] Other objectives of government might include contributing to self-sufficiency and security of supply; ensuring that its petroleum resources are developed with minimal environmental impact so as ensure sustainability; enhancing the balance of payments; and avoiding the Dutch Disease or the Resource Curse.[46]

While having different government objectives does not speak to whether the METRR approach ought to be modified, it does indicate whether a government should react to a finding of a negative or, for that matter, a positive METRR. Indeed, the appropriate reactions for governments depend upon their objective(s) and the trade-offs that they are prepared or need to make.

2.2 Company is motivated to maximize shareholder equity

While other motivations could be considered, maximizing shareholder equity[47] seems reasonable for analyzing marginal investments in the Newfoundland and Labrador context. In reality, and to reflect

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[42] Garnaut (2010, p. 6) suggests that governments seek to extract the economic rent because: it has lower economic costs than other forms of taxation; and it represents the value of public property that is being transferred to private ownership. Otto et al. (2006, p. 16) highlights that the owner of minerals has an interest in receiving payment for the transfer of the property rights to mining interests.

[43] This might include trying to grow an infant industry such as the local oil and gas supply industry in Newfoundland and Labrador. As it matures, it can compete domestically and internationally, sustaining local benefits for years to come. Through the development of the local supply industry, unemployed resources and excess capacity get utilized for the benefit of the local people, the owners of the property.

[44] Since higher investment from the offshore will translate into increase demand for labour, through its impact on the marginal product of labour, and other local inputs, the government might wish to facilitate the development of an infant industry to capture local benefits and more fully employ its local resources.

[45] Boadway and Shah (1992, p. 27) pointed out that petroleum development could have positive spillovers in the form of innovation, learning by doing or labor training and can affect both the level and rate of growth of the economy.

[46] The resource curse is an empirically-observed regularity in which countries that have a relatively higher proportion of their exports in terms of natural resources (e.g., petroleum or minerals) experience economic stagnation and political instability. Stevens, (2003) provides an excellent survey of the literature in this area. Another good source of the literature in this area is Overseas Development Institute (2006).

[47] Boadway (1988, p. 77) illustrates that the equity value of the firm is proportional to the present value of the cash flow discounted by the cost of capital. As well, Lund (2002b, p. 24) suggests that "…for most oil companies it may be more reasonable to assume that the management maximizes the market value of the company."

uncertainty, however, this objective should be interpreted as one in which firms maximize the expected value of profits or the expected value of shareholder equity.[48]

Other related objectives that might be relevant for firms investing in offshore jurisdictions are:[49]

(1) firms may follow a loss minimizing strategy in the short term if circumstances do not work out as planned. This might involve making sure things are on time and on budget or only expenditures that are absolutely necessary are undertaken as occurred when Gulf Canada initially pulled out of the original Hibernia project;[50]
(2) firms may pursue a growth maximization strategy which could be in terms of either the company's absolute size – growth of its asset base or sales revenues or its relative size in terms of market share. This would involve exploration, development and mergers and acquisition strategies;
(3) firms may make decisions that protect the company from unjustified risks which could include geological risks (i.e., the chance of a dry hole being drilled), market risks (i.e., a change in price that reduces the financial viability of the company's investment) and political risk (i.e., a change in the fiscal regime or expropriation of the resource with or without compensation); and
(4) firms may wish to maintain a particular corporate image which might include wanting to be perceived as being concerned about safety and the environment or being seen as the most technologically advanced firm when it comes to undertaking well work-overs or as the world leader in subsea technologies.

If the firm's objective differs from maximizing shareholder's equity, then the METRR might not be an appropriate indicator to use in analyzing investment projects. As Lund (2009, p. 303) suggests:

> *What is an optimal tax policy if (a substantial fraction of) companies do not behave according to a neoclassical model? In such cases, the standard theory of optimal taxation no longer works, so many standard results need to be amended.*

2.3 Free-entry and rents at the margin are competed away

The Newfoundland and Labrador offshore oil and gas industry is not characterized by free entry. The Canada Newfoundland and Labrador Offshore Petroleum Board (CNLOPB) periodically releases parcels of land that companies obtain the rights to for exploration purposes through a competitive work-bidding procedure. Successful bidders are granted an Exploration License (EL), which has conditions and timelines attached. To move on to the extraction phase, an operator will first need a Significant Discovery License (SDL) and ultimately, a Production License (PL). Given the lack of free entry, it would

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[48] In a world of perfect certainty, as modeled in Mintz (2010), expected and actual profits are identical.

[49] It should be recognized that if other objective functions are followed, then the optimization problem would also have to be modified.

[50] According to the NOIA website, in February 1992 Gulf Canada Resources announces withdrawal from the Hibernia development. Project activities are retrenched and project schedule delayed by approximately one year. http://www.noianet.com/generalpage.aspx?nid=9%20.

be surprising that any field brought into development would necessarily earn zero economic profits. The least profitable field in this environment may indeed earn positive economic rent and some projects that could potentially earn a positive net present value may be held for later periods, given that a SDL provides rights to the holder of the license that are effectively in perpetuity.[51]

Devereux et al. (2008, p. 4) highlights that firms, within the METR framework, will invest in all projects that earn a rate of return that is at least as large as the required rate of return. If excess returns, or above normal profits, exist within an industry and firms can freely enter, then they will continue to do so until these above-normal or super profits are competed away. For the last entrant or the last project undertaken, the value derived from the investment is just equal to the firm's or consortium's opportunity cost. That is, at the margin, economic rents will be zero. With free entry, it makes sense to talk about zero economic rents being earned on the marginal investment, but with barriers to entry, economic rents are possible on the last investment undertaken.

Osmundsen (2001, p. 4) analyzes the situation where economic rents are not zero for the marginal investment because there are only a few international firms that possess the technology and expertise to extract the rent. Under the scenario considered by Osmundsen (2001), firms will only invest if the returns at the margin are "material". That is, if the returns are large enough to warrant allocating their scarce technology and expertise to the development of the oil and gas fields.[52] Otto et al. (2006, p. 179) highlighted a similar phenomenon in mining when they suggest: "for each company, depending on the approach to economic modeling, a project NPV of zero may not represent its perceived breakeven point." That is, a positive net present value or positive economic rents may be required before investment commences. The significance of this, as noted by Lund (2009, p. 289-90), is that if materiality is an important consideration, an otherwise neutral rent tax will cause some projects to move from being acceptable to unacceptable. Specifically, a tax that applies strictly to rent may cause the share of rent required by the investor to fall short of the materiality constraint. As well, as discussed below, the presence of materiality may violate the value additivity assumption, which is a prerequisite for the use of a risk free discount rate in the presence of uncertainty.

If international firms have this technological expertise that is not easily replicated,[53] then it also opens up the possibility of interjurisdictional competition as countries try to entice the efficient firms to their area to exploit their resources. This, of course, brings into question the definition of a marginal project since the minimum return required to develop the project is in part tied to what the firm can receive in other jurisdictions. Furthermore, this would substantially alter the optimization problem. It would at

[51] In 2006, the CNLOPB put in place, for the first time, increasing rental rates for SDLs that would escalate over time if they were not developed. This will provide an economic incentive for firms to eventually develop or return a SDL issued after 2006. http://www.cnlopb.nl.ca/news/nr20061116eng.shtml.

[52] Boadway and Keen (2009, p. 56) point out that in the medium term, the reward to these scarce resources would increase which should be self-correcting. In other words, other people can be trained and expertise developed through this training so that in the medium to longer term, it would be surprising if a project with a positive net present value was not developed.

[53] This may also extend to their capacity to finance offshore oil and gas projects that require huge amounts of capital. If there are a limited number of firms with this financial capacity, then these firms may also be selective in which jurisdiction they allocate their capital.

least require the inclusion of other constraints that reflect what the firm in question can receive in other jurisdictions. This, in turn, raises issues of prospectivity, the relative onerousness of the fiscal regime, etc. As well, it also raises the need to distinguish between the weighted-average cost of capital and the hurdle rate, where the former is a weighted average cost of the funds utilized by the firm, adjusted for taxes and risk and the latter would also include an adjustment for what the firm would earn on comparable projects in other jurisdictions.

If rents are not competed away at the margin, the METRR would not be an appropriate indicator to utilize in the analysis of royalties.

2.4 Regulations similar across jurisdictions and permits activity

The approach utilized by Mintz and Chen (2010) ignores the impact of regulation on investment decisions. It implicitly assumes that if a project yields a rate of return in excess of the cost of capital, then it will be undertaken as international capital flows to it to take advantage of the opportunity. While this might be a reasonable assumption for non-resource projects, it might be less relevant for offshore oil and gas projects operating in areas that are environmentally difficult.

In fact, regulation and legislation can dramatically affect the profitability of projects and the international competitiveness of a jurisdiction. For example, a drilling moratorium on the Georges Bank[54] may be a more significant factor in explaining the lack of drilling in that area than any influence that the METRR might have. As well, if regulations require a second standby rig to be available adjacent to an exploration project, then the cost of exploration would increase and the unavailability of a second rig to standby could actually prevent exploration from happening, even if the estimated METRR is attractive.

Addressing regulatory issues was one of the objectives of the Atlantic Energy Roundtable. The impact of regulation on the viability of offshore areas has been considered by other jurisdictions. For example, in 2008, Australia established its Productivity Commission to examine the regulatory burden on its upstream petroleum industry. That commission recognized that “regulatory burdens add to exploration, project development and production costs.” The extent to which regulations affect project viability, according to the Productivity Commission, depends on their significance compared with the numerous other determinants of the cost–price relationship.[55]

In other words, regulation can significantly alter the relationship between the marginal product of capital and the user costs of capital and the incentive to invest that is envisioned in the METR and METRR metrics. At a minimum, these regulatory constraints, to the extent that they are significant, should be included in any analysis of the impacts of royalties on offshore oil and gas investments.

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[54] A drilling ban has been in place since 1999 and has recently been extended to 2015. http://www.gov.ns.ca/news/details.asp?id=20100513005.

[55] Australian Government Productivity Commission (2008, p. 21)

2.5 Small open economy with firms with perfect capital mobility

Sorensen (2009, p. 25) suggests that "…although international capital mobility has grown, it is still not perfect." As well, Klemm (2009, p. 7) indicates that there are many reasons for imperfect capital mobility, including home bias, costs of relocation, political interference in major capital movements, or location specific rents, which includes agglomeration rents as a result of industrial concentration. Consistent with these concerns expressed by Sorensen (2009) and Klemm ((2009), Parsons (2008, p.4) notes that because "asymmetric information between a firm's insiders and outside investors may constrain the financing of profitable projects," the assumption of perfect capital markets has been questioned.

The implication of less than perfect capital mobility is that a firm's cash flow may constrain its investment decisions and, as such, the optimization problem would have to be modified appropriately. In fact, Keuschnigg and Ribi (2010, p. 20) shows that in the presence of financial constraints caused by the moral hazard associated with asymmetric information between a firm's insiders and outside investors, "Investment becomes sensitive to net of tax cash-flow…" and "cash-flow…taxes are no longer neutral with respect to investment as they are in the basic neoclassical model with full information." The consequence of the Keuschnigg and Ribi (2010) finding for Mintz (2010), and by extension for Mintz and Chen (2010), is that the flat-rate oil sands royalty, their proxy of the true cash-flow tax, will no longer be neutral. This is a serious problem because the supposed neutrality of the flat-rate oil sands royalty is an important motivation for the suggestion that Newfoundland and Labrador adopt it in the first place.

For any analysis undertaken within the Newfoundland and Labrador context, an assumption of a small open economy is probably fine. The province is a small player in both oil markets, accounting for approximately 0.4 of one percent of daily production in 2008[56] and it is a smaller player in international financial markets. However, the fact that individual firms that might invest in offshore projects may have financial constraints cannot be ruled out. It is a concern that analysts should look at carefully before accepting the METRR analysis.

2.6 Firms are price-takers in both input and output markets

The typical assumption under this type of analysis is that local firms operating in jurisdictions such as Newfoundland and Labrador, for example, do not have sufficient market power in either the input market or the output market to have any noticeable impact on prices. Except for local labour, that is probably a reasonable assumption in the Newfoundland and Labrador context.[57]

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[56] According to the Canada Newfoundland and Labrador Offshore Petroleum Board's website, Newfoundland and Labrador offshore fields produced 125 M barrels in 2008 and from the BP Statistical Review of Energy June 2009, world daily production was 81,820 thousand barrels per day in 2008.

[57] The presence of monopolistic competition (i.e., a downward sloping demand curve) can be easily handled by replacing the value of the marginal product of capital with the value of the marginal revenue product. In other words, instead of using output price P to reflect the marginal revenue from the investment, it would be necessary

2.7 Capital is infinitely divisible

For Newfoundland and Labrador offshore projects, the assumption of infinitely divisible capital is particularly troubling because investments are typically made in discrete allotments, such as a single Gravity-Base Structure or a Floating Production, Storage and Offloading system. While it might be possible to increase the scale of the capital invested, it has its limits. For instance, drilling half a production well may have no value. Likewise, drilling a production well deeper than needed would also have little value for the incremental depth.

When investment is not perfectly divisible, the assumption that investment will proceed up to the marginal or zero rent-generating investment is questionable. It is possible that some investments may not proceed, even though economic rents can be earned at the margin, because they require large discrete investments that involve more costs than the incremental revenue that could be earned on the investment.

The implication of less than perfectly divisible capital is that the METRR approach would not be valid for analyzing projects that earn positive economic profits or when rents are non-zero for the last project undertaken. Moreover, as pointed out by the OECD (2009), "In such cases where economic rents are earned at the margin, (relatively small) variations in METRs…would not be expected to influence the level of investment as conventional METR analysis assumes."

2.8 Investments are reversible in full and without cost[58]

This is certainly a problem assumption for investment in Newfoundland and Labrador's offshore because it is very difficult, and may be even impossible, to reverse the investment or to employ it in another project in some other jurisdiction or to convert it into some other use.[59] While it might be possible, though costly, to move a FSPO to another jurisdiction, the same would not hold true for a Gravity- Base Structure. Moreover, it would be impossible to move the wells that have been drilled to some other location, they are sunk, both literally and figuratively. In particular, as Boadway and Keen (2009, p. 3) point out, "An offshore oil platform may be moved to other fields, for instance, but money spent looking for oil fields (successfully or not) is gone." Finally, for the Norway continental shelf, Mohn and Osmundsen (2008, p. 4) focus on the irreversibility of oil and gas in terms of exploration investment because of the large expenditures required; the lengthy investment lags; and field-specific sequences of

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to use P'=P*(1- 1/), where is the elasticity of demand. That is, this involves substituting P' for P in the METR formula. See Boadway and Shah (1992, p. 41) and Auerbach (1990, p. 14) for an explanation of this type of adjustment. It is unlikely that such an adjustment is needed in the Newfoundland and Labrador context.

[58] An excellent review and assessment of the concept of irreversibility in economics can be found in Perrings and Brock (2009).

[59] A production platform on the Grand Banks cannot easily be converted into a department store in St. John's, for example.

investment decisions involve a series of waiting options. Specifically, they emphasize that the "irrevocable character of investment expenditure is especially salient for exploration activities."[60]

Irreversibility of investment increases the risk of investing because a firm cannot reverse its decision so there is value in waiting and getting additional information.[61] The existence of irreversible investments changes the optimization problem. As tested for empirically and confirmed by Mohn and Osmundsen (2008), irreversibility of investment, raises the risks of investment and reduces the level of investment. McKenzie (1994, p. 617) also calculates the METR in the presence of irreversible investment. He finds that in the presence of irreversible investment, the METR is higher than in the presence of reversible capital and is an increasing function of risk.

Whether a tax will increase the cost of investment in the presence of irreversibility, the presence of irreversibility certainly raises the risk of investment and, everything else the same, the METR will be higher. This leads the analysis in the direction of real option value analysis and away from the approach utilized by Mintz (2010). As well, it does bring into question conclusions about the METRR for investment in offshore areas where irreversibility is an important characteristic. This has been ignored in the Mintz (2010) and Mintz and Chen (2010) analyses.

2.9 Static expectations

Since the METRR is a forward looking indicator, it should use the expected value of the tax parameters and the other factors that feed into it, not the actual value of the parameters at a point in time as is typically done. In particular, fiscal parameters, economic and engineering parameters change all the time and this should be reflected in any model that wishes to examine the incentives created by a fiscal regime.[62]

While Bond and Devereux (1996, p. 59) demonstrated a tax would be neutral in the presence of uncertainty and risk if taxes losses were carried forward at the risk free discount rate, this was subject to certain conditions being satisfied. These included the existence of full loss offset (dealt with below); the asset value satisfying value additivity; and the tax rates being known and constant. In fact, they concluded that "a constant tax rate is a sine qua non for tax neutrality." Hence, without the known and constant tax rate, then neutrality of the tax is not guaranteed when losses are carried forward at the risk free discount rate. Specifically, Bond and Devereux (1995, p. 69) state "…it is not sufficient for the tax rate to be expected to remain constant. To obtain a neutral business tax, the tax rate applying in all future periods of relevance to the firm must be known to be a constant."

In the Mintz (2010) model, there is perfect certainty so these parameters are known and are assumed not to change or to change in a mechanical way as a result of inflation, for example. Since this is

[60] Mohn and Osmundsen (2008, p. 4).
[61] There are also costs in terms of foregone revenues.
[62] Nienmann (2004, p. 265) analyzes the impact of tax rate uncertainty on investment and finds and an ambiguous impact on investment. El-Shazaly (2009, p. 735) also investigates the impact of corporate tax rate and base uncertainty and shows that tax policy uncertainty depresses investment.

obviously not the case in the real world, it does cause real problems for how the model actually gets calibrated. There is probably not much that can be done about the necessity of making an assumption that expectations are static with respect to tax parameters. It is, however, important to understand that the METRR so calculated is defined only for a given set of tax parameters and should they change, the value of the METRR will also change. Moreover, given that tax parameters can and do change, it does raise legitimate questions about whether a fiscal regime that carries losses forward at the risk free discount rate will indeed be neutral, which is the primary rationale for Mintz and Chen (2010) advocating that Newfoundland and Labrador should accept a tax similar to the flat rate oil sands royalty.

2.10 International tax competition on rent absent

Tax competition amongst host governments might make sense when a country is trying to attract mobile investors, but, as Boadway and Keen (2009, p. 12) point out, with immobile resources that generate economic rent only in the host country, tax competition appears more questionable. Yet, as they acknowledge, countries "…care very much how their tax systems compare with others, and are often concerned not to offer regimes that are substantially more onerous." Land (2009, p. 168-9) highlights, as well, "…the intensity of competition among governments to attract investment…" Interjurisdictional competition is also corroborated by Otto et al. (2006, p. 185) where it was suggested that: "Because countries compete with each other for private investment, a country's ultimate success in this endeavor depends less on the absolute attractiveness of its investment climate than on its attractiveness relative to other countries." Finally, Watkins (2001, p. 16) confirms that jurisdictions compete in setting their fiscal regimes. Specifically, he notes that in defining the royalty parameters, each jurisdiction needs "…some degree of sensitivity to regimes in competing jurisdictions… If greener pastures beckon elsewhere, too severe a regime could stultify activity." On the other side of this equation, Sunley, Baunsgaard and Simard (2002 p. 19) reports that multinational oil companies consider how attractive the oil and gas prospects are; how the fiscal terms affect their risk; what is the expected reward if petroleum is found; and how do these factors—for any particular regime—compare to investment opportunities elsewhere. That is, investors expect some degree of interjurisdictional competition in terms of a jurisdiction's fiscal regime. Or, at the very least, the actions of investors will facilitate interjurisdictional competition.

Empirical support for interjurisdictional tax competition at a regional level is found by Blake and Roberts (2006, p. 95-6). While their study recognizes that, in deciding where to invest, companies look at many factors other than taxes,[63] they found that "…the competition among governments for petroleum investment is taking place regionally, not globally." In addition, Lovas and Osmundsen (2009) found that there was a direct relationship between the toughness of the fiscal terms and the attractiveness of the host country's resource base, which they took as evidence of fiscal competition. In particular, Lovas and Osmundsen (2009) suggest that "Even though the petroleum resources are immobile, resource

[63] Other factors identified by Blake and Roberts (2006) as affecting investment were: "the geological potential of the petroleum acreage, political risk and the governments' policies that impact the bottom line, such as local content requirements."

countries compete to attract the most competent companies, personnel and equipment. The competition is either in a free market (bidding or negotiated terms) or in terms of legislative tax design based on comparative analyses."

If countries compete for investors and firms expect this competition, then it brings into question whether the user cost of capital, a key component of the METRR, is, in fact, the most important determinant of investment for marginal projects in any jurisdiction. With interjurisdictional competition, a return equal to the amount of rent captured in other jurisdictions would have to be added to the METRR approach to indicate whether a marginal investment might be undertaken and how taxes affect that decision.

2.11 Host country taxes may be credited against home country taxes

Mooij and Ederveen (2005, p. 3) suggest that the impact of taxes on foreign investment depends on the tax regime in the country where the parent company resides. The OECD (2009) further warns that while the METR literature typically assumes that the host countries tax rate exceeds the home country tax rate for corporations operating in multiple jurisdictions, "foreign tax will matter where foreign…investors are taxed in their home country on their foreign source income at rates in excess of domestic (host country) tax rates." As well, Boadway and Keen (2009, p. 12) notes that the prevalence of foreign ownership may also affect host countries' incentives in tax setting. Ceteris paribus, after-tax profits accruing to foreigners are presumably less valuable socially than are receipts accruing to domestic citizens. They may thus be given relatively little weight in tax design.[64] As such, one might not expect the domestic tax rate, as reflected through the METRR, to have the huge stimulative or distortionary impact on investment in Newfoundland and Labrador's offshore area implied by simply examining the METRR in isolation.

It should be noted that the Mintz and Chen (2010) paper does not explicitly take into account the degree of foreign ownership in offshore oil and gas projects in Newfoundland and Labrador.

2.12 Perfect certainty is assumed and risk is ignored

Offshore oil and gas projects encounter a number of above-ground and below-ground risks during all phases of development. The below-ground risks are uncertainties associated with drilling in deep water, the geological structure of the reservoir, the size of the potential reserves, the decline rates and the ultimate amount of the reserves that are actually recoverable, the reservoir characteristics, the quality of the oil, and the development cost. As well, as demonstrated recently when the Deepwater Horizon rig experienced and an explosion while drilling BP's Macondo well in the Gulf of Mexico, there is also the possibility of well blowouts and other accidents that can have financial, environmental and loss of life costs that can be both significant and substantial.

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[64] That is, foreign investors probably get a zero weight in the host countries social welfare function.

Above-ground risks include political risks, such as possible adverse changes to the fiscal regime and the threat of expropriation without compensation; and economic risks, such as stochastic output prices; and volatility in input costs; and unanticipated construction difficulties.[65]

Sometimes it is convenient to describe these risks using a different conceptual framework. Some economists, Mintz (1996, p. 55) for example, distinguishes between: (1) *Income risk*, which occurs where there is uncertainty with respect to operating income or revenues net of current costs, generated by the stochastic movement of output prices and current input prices or changes in demand faced by the firm;[66] (2) *Capital risk*, which results from the uncertainty associated with economic depreciation costs due to unknown and stochastic rates of wear and tear and to obsolescence of installed capital assets or due to an unknown future purchase price of capital.[67] (3) *Financial risk*, emanates from the variability associated with future interest expenses incurred for borrowed funds; (4) *Inflation risk,* which results from uncertainty with respect to future inflation rates that may affect both future earnings and the cost of replacing assets;[68] (5) *Irreversibility risk*, which occurs if capital cannot be used for another purpose, then uncertainty is increased for investors who have to be concerned about the timing of a project; and (6) *Political (sovereignty) risk*, which comes from the uncertainty associated with public policies, such as tax rate changes or the threat of expropriation without appropriate or adequate compensation. This is the risk associated with changing the rules of the game for established investors since the current host government cannot credibly guarantee that the fiscal terms commitment made at the start of the investment will be maintained throughout the whole life of the project, especially for a period that exceeds the government's electoral mandate.

Other analysts, drawing upon the capital asset pricing models (CAPM), distinguish between systematic and unsystematic (idiosyncratic) risks,[69] where unsystematic or idiosyncratic risks relate to the unique risk characteristics of either the specific project or the specific company that in a perfect capital market can be eliminated through diversification. This would include, for example, geological or operations risks associated with producing and investing in a particular area. It is typically assumed that the unsystematic risks are eliminated through diversification by having multiple projects in different areas so that the negative outcomes of one project will be balanced off by positive results in another project.

Since it is assumed that these risks can be diversified away, analysts ignore them and analyze projects as if they occur in a risk-free environment. It is, however, important to recognize that to the extent to which capital markets are not perfect and/or specific aspects of idiosyncratic risks cannot be diversified

[65] Good descriptions of these risks and their implications can be found in Pongsiri (2005, p. 7), Land (2009, p. 160) and Kaiser and Pulsipher (2006, p. 5).
[66] OECD (2009) added to Mintz definition by adding the explicit stochastic discussion.
[67] OECD (2009) added to Mintz definition by adding the explicit stochastic discussion.
[68] While this is listed as a separate risk, it is really encompassed in income and capital risk.
[69] Mineral Council of Australia (2010, p. 34-5) distinguishes between systematic and unsystematic risk, while Osmundesen (1999, p, 549) distinguishes between idiosyncratic and systematic risk.

away, then some adjustment for this type of risk is needed, either in the discount rate[70] or in calculating the certainty equivalent of the investment.[71]

On the other hand, systematic risk emanates from the uncertainty of the expected returns of an investment relative to the financial market as a whole and cannot be diversified away. Assuming that investors can lend and borrow at the risk-free discount rate,[72] there is an assumed linear relationship between the required return on an investment and the systematic risk. The risk-adjusted rate of return,[73] in this context, is given by the risk-free rate of return and a risk premium that reflects the market risk premium (i.e., the difference from the return on the market and the risk-free return) and the correlation between the asset's cash flow and the volatility of returns on the market, which is normally referred to as the beta coefficient.[74] The rate of return on the asset or project in question, adjusted for systematic risk, is calculated according to the following formula:

$$r_e = r_f + \beta * (r_m - r_f)$$

Equation 1

where:

$$\beta = \frac{Cov\ (r_e, r_m)}{Var\ (r_m)}$$

Equation 2

r_e Ξ risk-adjusted return on the asset or project;

r_f Ξ risk-free return, which is usually proxied by the long term government bond rate; and

r_m Ξ return on the market as a whole.

If idiosyncratic or unsystematic risk cannot be diversified away, then it will require an additional adjustment to the rate of return expected by firms in the presence of risk.

Slade and Thille (2009, p. 254) highlight that it is standard "…for risk-averse investors to trade off risk and return, and mining investment decisions are no exceptions." Likewise, petroleum developments also require a compensation for the risk inherent in exploiting these resources. For risky investments, investors would require a return on capital that consists of a basic return equivalent to the rate of

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[70] Mineral Council of Australia (2010, p. 34-5) suggests that any unsystematic risk that cannot be diversified away needs to be incorporated in the discount rate.
[71] The certainty equivalent is the value of the guaranteed net present value that the investor would find equivalent to the expected net present value of the risky investment.
[72] It should be recognized that it may not be possible for individual investors to borrow at the long-term government bond rate (i.e., the assumed risk-free rate) because of their own individual risk characteristics.
[73] Frederiksen (2003, p. 3,), in discussing a criticism of the Denmark fiscal regime, indicates that an average oil company in Denmark should earn a return on equity of at least 3 per cent above the risk-free real rate.
[74] The β coefficient measures how risky an individual asset is relative to the risk associated with the market as a whole.

interest on risk-free, long-term borrowing and equity costs plus a margin that is necessary to compensate for the technical, commercial and political risks associated with investments. [75]

As emphasized by Baunsgaard (2001, p.5), most investors are risk-averse in the sense that choosing between two projects with the same expected net present value, the less risky project is the preferred one. A typical adjustment for this type of investment is to add a risk premium, reflecting both sovereign (political) and project (commercial) risks, to the discount rate utilized. In so doing, the risky project would need to earn a higher rate of return to be equivalent to the riskless rate of return. Alternatively, as explained in Hogan (2007, p.4) firms might choose to calculate the certainty equivalent value of the investment. In this context, the certainty equivalent is the expected net present value of a resource project less an adjustment for risk that just compensates the investor for incurring risk, implying that a project is viable if the certainty equivalent value is non-negative.

The failure to take account of risk is particularly disturbing since the costs and geological risks are high in Newfoundland and Labrador's offshore area. Consequently, the hurdle rate needs to be adjusted by the appropriate risk premium or the expected net present value needs to be adjusted to its certainty equivalent value.

The fact that project appraisal ought to reflect undiversified risks is not equivalent to saying that the royalty formula needs to incorporate a risk premium in the return allowance to protect the present value of losses that are carried forward until they can be utilized. A separate consideration of how risk might affect the choice of the tax rate and how the tax rate choice itself may affect the risk associated with investing is needed. As explained below, the impact of risk on the optimal rate of taxation depends on whether full loss offset is in effect or not.

2.13 Implication of Assumed Full Loss Offsets for the Royalty Return Allowance

Accepting that risk and uncertainty may affect the investment choices of firms is not equivalent to accepting that this uncertainty ought to be reflected in the tax and royalty fiscal regime imposed by government. For example, under a cash flow or pure rent tax,[76] like the Brown Tax, negative tax liabilities are funded by government when incurred and positive taxes are collected on net revenues at some constant rate that is proportional to economic profits. The Brown Tax is a neutral tax that collects rent generated by the resource project. However, there is no need to carry losses forward at any interest rate, risk free or otherwise. It has full loss offset in that tax losses are written off immediately and refunded to the investor as they accrue. There is no ambiguity about whether the investor receives

[75] See Auerbach (1990, p. 26) Land (2009, p. 164) and Land (2008, p. 5), Baunsgaard (2001, p. 5) Goldsworthy and Zakharova (2010, p. 6), Kaiser and Pulsipher (2006, p.60) for discussions of the need for a risk premium in the discount rate. Mintz (1996, p. 36) suggests that the user cost of capital should also include an adjustment for risk.
[76] See Smith (1999, fn 2, p. 1). A Brown Tax is a proportional tax on cash flow. For example, if the tax rate is 10%, then the government pays 10% of net losses in the year in which they occur and collects 10% of the net revenues when they occur.

at least the present value of the tax times the invested capital. In fact, the Brown Tax is equivalent to the government taking a working interest in the project, with the interest share being equal to the tax rate.[77]

Because of the requirement to pay upfront cash, the Brown Tax has not been implemented anywhere in the world. Instead a number of cash flow taxes, designed to capture the desirable features of the Brown Tax, have been introduced. The most common version is the Resource Rent Tax,[78] proposed by Garnaut and Clunies Ross (1983), which allows the investor to carry losses forward at an appropriate discount rate. The discount rate, under this fiscal regime, would be chosen so as to maintain the present value of the tax deductions and mimic the desirable properties of the Brown Tax. It is noteworthy that the Resource Rent Tax is similar to the Tier 1 and Tier 2 royalties that exist under Newfoundland and Labrador's generic offshore regime, where the return allowances under Tier 1 is the interest rate that has been designed to protect the present value of the deductions for the investors.[79]

While the idea of preserving neutrality of the royalty system through preserving the net present value is not controversial. The problem is in defining the appropriate discount rate or interest rate to apply to losses carried forward. Fane and Smith (1986)[80] and Bond and Devereux (1995, 2003) demonstrate that, in the presence of full loss offset, the return allowance needed to preserve neutrality is the risk free discount rate, typically assumed to be equivalent to the long term government bond rate. The argument is that with full loss offset, the accumulated expenditures represent a guaranteed reduction in future resource rent tax liabilities and, as such, to maintain the equivalence with the cash flow tax and neutrality, the risk free discount rate should be used because there is no risk associated with not getting the present value of these tax deductions at some point in the future.

In other words, whether the fiscal regime ought to be adjusted in the presence of risk and uncertainty is determined in part by whether the tax system is characterized by full loss offset. The importance of full loss offset was emphasized by Mintz (1996, p. 57-9), which suggested that with full loss offset, a risk free discount rate, such as the long-term government bond rate, can be utilized to maintain the present value of the tax write-offs. Moreover, as explained by the OECD (2009), in the presence of full loss offset, the government shares equally in the profits and losses of the company. Or, the cost of bearing income risk is implicitly fully deducted under a full loss offset tax system, with no additional tax distortions being introduced for income-risky investments versus comparable riskless investments.

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[77] Hogan (2007, p. 5).

[78] Henry et al (2010b, p. 244) shows that the resource rent tax is equivalent to a Brown tax when there is full loss offset and the return allowance is the long term government bond rate.

[79] The return allowance applicable to Tier 1 royalties is the long term government bond rate plus 5%. Mintz and Chen (2010) and Mintz (2010) feel that the extra 5% is excessive, unnecessary and distorts investment decisions in Newfoundland and Labrador's offshore.

[80] Hogan (2003, p. 39) references the contribution of Fane and Smith (1986) in this area. Henry et al (2010b, Box C1-3, p. 223-4) characterizes the situation with full loss offset as: "…where the government provides a full loss offset, the riskiness of the project is irrelevant as the delay is equivalent to a loan from a business to the government."

In the absence of full loss offset, a premium could and should be added to the risk free discount rate to compensate for the presence of risk. In particular, Watkins (2001, p 11) and Henry et al (2010b, Box C1-3, p. 223-4) note that one way to compensate investors for less than full loss offset is to set the threshold rate higher than it would be set with guaranteed full loss offset. That is, it is necessary to add a premium to the risk free discount rate in the return allowance. Moreover, Hogan (2003, p. 51) and Hogan (2007, p. 86) indicate that the 5% premium in the Australian Petroleum Rent Tax probably serves the purpose of compensating for the lack of full loss offset in the Australian system. Since the Newfoundland and Labrador generic offshore royalty is similar in important ways to the Australian Petroleum Rent Tax —for example, no full loss offset and a return allowance for Tier 1 royalties of 5% plus the long term government bond rate, the 5% premium in the generic royalty can be thought of as the appropriate adjustment to compensate for risk, given that full loss offset is not guaranteed.

In addition to the full loss offset assumption, there are a number of other conditions that must be met in order for the risk free discount rate to yield a neutral result for the resource rent tax. For instance, Garnaut (2010, p. 10) highlights that the investor will have to finance the delay in the receipt of the negative cash flows. While under ideal conditions, this would involve utilizing the risk free discount rate. However, this would only occur if there were zero transactions costs; competitive finance; perfectly informed financial institutions; and the institutions acted in the interests of maximizing the wealth of their shareholders. Whether these assumptions actually hold in the real world is an empirical question.

As well, Boadway and Keen (2009, p. 28) highlights that sovereign risk also has implications for the conventional wisdom that a risk free discount rate ought to be used for the return allowance. Specifically, Boadway and Keen (2009, p. 28) state:

> *If commitment or other problems mean that the investor is not perfectly sure that cumulated tax credits will be made good, at an unchanging tax rate, they will wish to take account of that in the discount rate applied in valuing future tax reliefs. Applying a risk-free rate to carryforwards will be insufficient to compensate the firm for waiting: from the perspective of the firm, the expected tax base will exceed expected rents, and investment will be discouraged.*

It is generally accepted that in the absence of full loss offset, the resource rent tax will not be neutral and an additional factor may be added to the return allowance to compensate the investor for risks. Hagen and Sannarnes (2007 p. 1516) also show that in the presence of moral hazard created by asymmetric information between outside investors and firm insiders, a proportional profit tax will not satisfy the criteria for a neutral tax. This finding has direct implication for the established literature that indicates with full loss offset, a risk free discount rate is all that is needed to ensure neutrality. As Hagen and Sannarnes (2007 p. 1517) states:

> *These results are in contrast to the results on the neutrality of proportional profit taxes in risk market models without moral hazard. Bond and Devereux (1995) rely on the Value Additivity Principle to ensure the neutrality of a business tax. In our model with moral hazard the celebrated Value Additivity Principle does not apply.*

Finally, Lund (2002, p. 53) notes that value additivity, a required condition for utilizing the risk free discount rate, may not hold if companies demand “volume” or “materiality” conditions to engage in a project. Specifically, Lund (2002) suggests in the presence of materiality, companies:

> *… require some minimum, strictly positive value from a project in order to undertake it….Such behavior would imply that the tax system proposed, as well as a pure cash flow tax, would not be neutral…importantly, the theoretical justification for a neutral tax system breaks down.*

In conclusion, if certain conditions hold, a risk free discount rate can be used to compound the return allowance. Yet, when these conditions do not hold, then a premium will have to be added to the risk free rate to ensure that risk is appropriately accounted for in the return allowance. This has direct implications for the estimated value of the METR and the METRR. Moreover, since neither the Newfoundland and Labrador generic offshore fiscal regime nor the flat rate oil sands royalty are characterized by full loss offset, a risk premium is required for the return allowance. That is, it would not be appropriate to use the risk free rate in the Newfoundland and Labrador context as suggested by Mintz and Chen (2010).

3.0 An Intuitive Perspective on the Theoretical Impact of Non-Resource Taxes on Investment

> *A number of factors can affect the investment decisions…Tax is only one of a long list of potential factors, such as market proximity, quality of infrastructure, location of other like firms in an industry, presence of related industries, labour force skills and productivity, and political and economic stability. For tax to have an impact on the location decision between countries, the choice between possible locations based on all the other non-tax factors would need to be quite a close one.*
>
> *Warburton and Hendy (2006, p. 338)*

> *…the presence or absence of a royalty, though not insignificant, usually is not the overriding determinant of a country’s investment attractiveness. Political stability, geological potential, and the rest of the tax regime are typically more important*[81]
>
> *Otto et al. (2006, p. 186)*

> *If taxation were the only element influencing location decisions…investment should be located in countries where taxation is lower. But taxation is only one of the elements affecting location decisions…The fact that differences in the effective tax burdens between countries persist, shows that the arbitrages are not perfect and that taxation is not the only element affecting location.*

[81] While Otto et al. (2006) made this statement with respect to mining royalties, the point applies equally to petroleum resources.

Commission of European Communities (2001, p. 85)

Recognizing that many factors may influence investment decisions within a jurisdiction or across jurisdictions, it is still legitimate to consider the role taxes and royalties play, everything else the same. To more fully appreciate the intuition and the legitimacy of the Mintz and Chen (2010) approach in a general framework, it is informative to consider their research in two stages. First, an assessment is undertaken of the potential impact of taxes on a typical investment decision for a non-resource firm, which operates within the neoclassical framework assumed by Mintz and Chen (2010).[82] Second, the specifics of non-renewable natural resource investments in Newfoundland and Labrador and its generic offshore royalty will be considered and compared directly with both the Mintz and Chen (2010) claims and the underlying model presented in Mintz (2010). This approach facilitates a separation of the economic rent associated with non-renewable resources and the associated rent collection devices (e.g., royalties) utilized by governments from the impact of taxes per se.

The first stage of this evaluation initially abstracts from natural resource industries where economic rents[83] may be earned and royalties[84] may be paid by the firm to the resource owners (i.e., the host governments representing their constituents) for the right to exploit the resource. The presence of rents and royalties may distort and confuse one's understanding of how taxes, as opposed to royalties, impact the investment decisions of firms.

3.1 Investment in Non-Resource Firms[85]

> *In a small open economy, the post-tax rate of return available to investors is fixed on the world market. Any local tax cannot change the post-tax rate of return to investors, but must raise the required pre-tax rate of return in that country; this would generally be achieved by having lower capital located there.*
>
> *Auerbach, Devereux and Simpson (2007, p. 19)*

If the post-tax rate of return is given to small, open economies, like Newfoundland and Labrador, then the METR should be a good predictor of the impact of taxes on investment. This conclusion is based on the neoclassical theory of investment.

[82] There are many studies that have utilized a similar approach to examine effective tax rates and the excess burden of the corporate income tax. See, for example, Boadway and Bruce (1984a), Boadway and Bruce (1984b), Boadway (1988), Boadway and Shah (1992), McKenzie, K. (1994), McKenzie and Thompson (1997), Chen (2000) and Devereux et al. (2010).

[83] Economic rent, as defined in Hogan (2007, p. 22), is "the excess of revenue over costs, where costs are defined to include a 'normal' rate of return on capital. This normal rate of return…includes an allowance for a risk premium since private investors are usually assumed to be risk averse."

[84] Royalties in this context should be considered as encompassing all rent collection mechanisms that may be utilized by the host government.

[85] In developing this simple illustration, it should be noted that the same notation utilized in Mintz (2010) is employed where possible and convenient.

While the detailed derivation of the METR for a non-resource firm is attached as Appendix A, a graphical illustration of the intuition is provide below. Effectively, firms invest if the present value of the revenue generated from the investment on the margin exceeds the present value of the user cost, which reflects applicable tax rates and tax rules, financing costs, economic depreciation and if relevant, an adjustment for risk.

In keeping with Mintz and Chen (2010, p. 5), assume that in the absence of any taxes, a firm would invest if it could earn at least a 6% rate of return on its investment. That is, its after-tax rate of return would also have to equal 6% or it would move its investment to other jurisdictions or to other sectors in which it could earn 6%, after-taxes. Also, in keeping with the illustration provided in Mintz and Chen (2010), suppose that in the presence of corporation taxation and the associated tax rules, deductions and allowances, the pre-tax rate of return would have to equal 10% in order to be just sufficient to enable the firm to invest and earn 6% after taking into account all of the tax implications of the investment.

For this specific example, as explained in Mintz and Chen (2010, p. 5), the METR, the key parameter in this type of analysis, would be 40%.[86] The fact that the METR is not zero would, within the context of this type of analysis, be interpreted as distortionary relative to the no-tax situation. Moreover, the larger the absolute value of the METR, the bigger would be implied distortion. From a positive METR, it would be inferred that investment in this jurisdiction, or in this sector, will be lower than otherwise. As well, the larger the value of the METR, the bigger would be the perceived distortion on investment and, correspondingly, the lower would be investment at the margin in the jurisdiction or sector under study. Alternatively, if the METR was negative, then the interpretation would be that the fiscal system implicitly subsidizes the investment. Similarly, investment activity in this jurisdiction or in this sector will be inferred to be higher than in the no-tax situation. This metric can then be utilized to consider whether there is a misallocation of capital across industries or between jurisdictions — the implication being that output can be increased by removing this distortion.[87]

If one accepts the neoclassical theory as the appropriate approach to modeling investment decisions of firms, and one might not,[88] then an increase in the user cost of capital will reduce the amount of investment at the margin. The intuition underlying this conclusion is illustrated in Figure 1.

In this diagram, in the absence of taxes, firms will invest in N_A projects,[89] in that the marginal project will yield 6%, which is the assumed user cost of capital in this example. This occurs at point A where the

[86] The METR would be calculated specifically as 10% (the pre-tax rate of return required on the marginal project) minus 6% (the after-tax rate of return earned on the marginal project) divided by 10% (the pre-tax rate of return required on the marginal project).
[87] If capital is misallocated, then it can have implications for productivity, employment, wages, etc. For a discussion of this issue, see Dahlby (2008, p. 3).
[88] Clarke (2009, p. 36-7) indicates that the new geography literature has challenged the neoclassical approach in recent years. This literature emphasizes the role of business concentration or agglomeration economies. Instead of being characterized by diminishing marginal products, investment generates employment, increased demand and market size, encouraging additional investment.

user cost of capital intersects the value of the marginal product curve for capital (i.e., the demand curve for capital). If the tax system causes the user cost of capital to increase, then the required pre-tax return on capital will increase to 10% (for the current numerical example), implying fewer projects will pass this hurdle rate of return or a lower capital stock will be optimal for this jurisdiction. This is shown in Figure 1 by point B, where the demand curve intersects the higher user cost. Specifically, investment falls from N_A to N_B projects or the tax system would discourage marginal investments. On the other hand, if the tax system lowers the user cost of capital, say from 6% to 4% in Figure 1, then investment will be stimulated. This is indicated by point E, which corresponds to an increase from N_A to N_E in viable projects that now surpass or equal the new, lower hurdle rate of 4%.

While it is an empirical issue whether the user cost of capital increases or decreases in the presence of a corporate income tax, the conclusion and intuition does follow from an acceptance of the neoclassical approach to investment. That is, the after-tax rate of return may be equal to, less than or greater than the pre-tax rate of return.

However, as indicated above, when comparing different jurisdictions on the basis of their METRs, one needs to be careful that all other relevant factors are more or less the same. For example, if comparing the level of investment in offshore gas projects in Newfoundland and Labrador and Nova Scotia, the METR in Nova Scotia could exceed the METR in Newfoundland and Labrador by a substantial amount and it would still not increase the amount of investment in offshore gas in Newfoundland and Labrador because Nova Scotia's gas fields are connected to the US market via a pipeline. This infrastructure is not currently available to Newfoundland and Labrador and it would need a substantial investment to put it in place. Differences in infrastructure; the availability of a skilled labour force; differences in the extent and types of regulation; the physical environment; and the prospectivity of an area, for example, have an impact on both the shape and the position of the value of marginal product curve and how a change in the user cost of capital and the METR might affect investment in each jurisdiction.

[89] Instead of "N" representing the number of projects in

Figure 1, it could equally be represented as the size of the capital stock utilized in a particular jurisdiction. Under that interpretation, an increase or a decrease in the number of feasible projects should be considered as an increase or decrease in the optimal capital stock or investment.

Figure 1: Illustration of the Impact of the User Cost of Capital on Investment

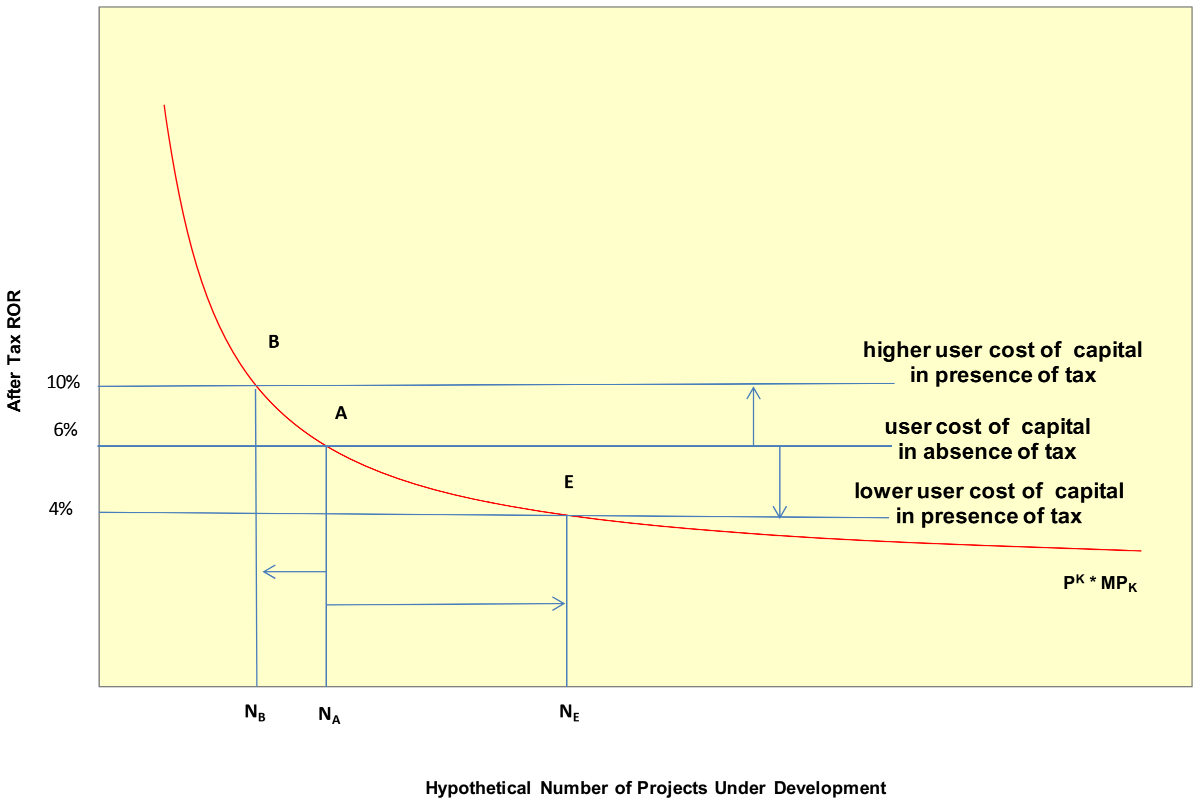

Figure 2: Impact of the METR When Important Factors Differ by Jurisdiction

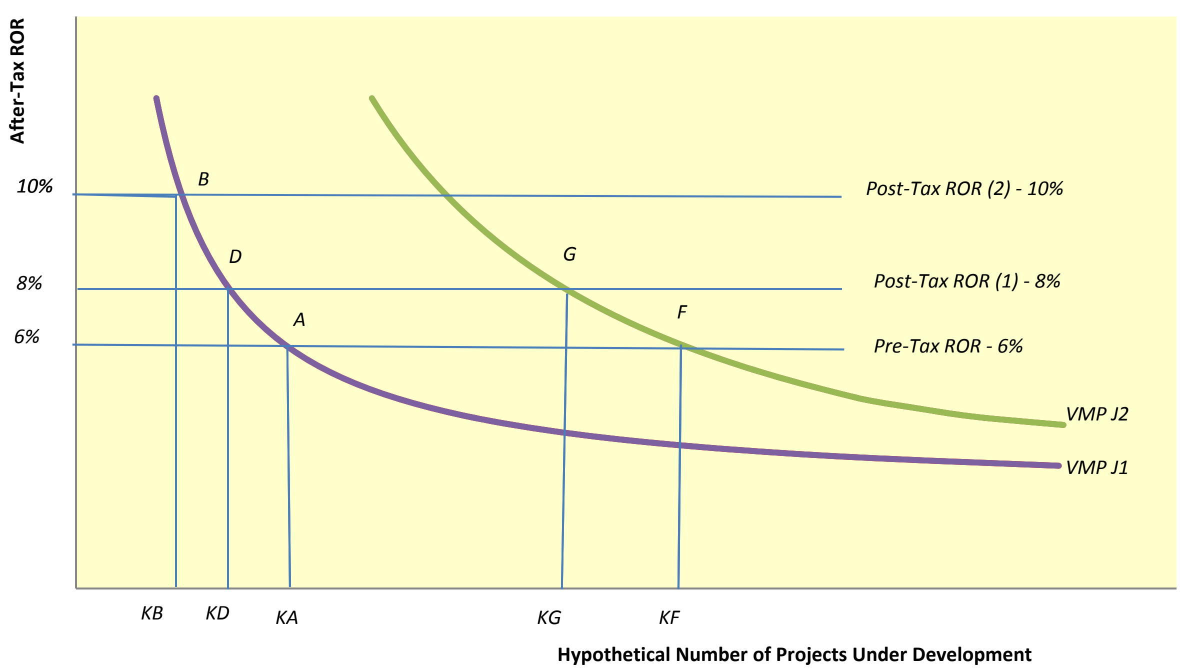

Figure 2 is included to illustrate how significant differences across jurisdictions can impact the reaction of investment to changes in the METR in that jurisdiction. For the purposes of this comparison, continue to assume that the required rate of return in the absence of taxes is 6% in both jurisdictions. For jurisdiction 1, the value of the marginal product curve (VMP J1 – the purple line in Figure 2) intersects the 6% user cost of capital at point A, corresponding to KA investment in that jurisdiction. For the same 6% rate of return, the investment in jurisdiction 2 occurs at point F, where the value of the marginal product curve (VMP J2 – the green line in Figure 2) intersects the user cost of capital and corresponds to an investment of KF in jurisdiction 2.

For the moment assume that the tax system in each jurisdiction is such that it yields a 25% METR ((8% - 6%)/8%) in each jurisdiction. Since the METRs are identical, one would, ceteris paribus, expect the same level of distortion. However, for this illustration, investment in jurisdiction 1 falls from KA to KD and in jurisdiction 2, it falls from KF to KG. As drawn, it is obvious that the size of the distortion, as measure by the reduction in investment, is significantly larger in jurisdiction 2. In fact, the METR in jurisdiction 1 would have to be 40% (10%-6%/10%) to have a similar reduction in investment as occurred in jurisdiction 2.

Therefore, when other factors cannot be assumed to be identical, a comparison across jurisdictions of the impact of the METRs on the implied level of investment may not be precise. Moreover, it also may yield results that are not correct. Hence, unless there are no significant differences in relevant parameters across jurisdictions, then one should be careful in interpreting differences in the METRs as evidence that there is a misallocation of investment resources across jurisdictions.

4.0 A Closer look at Mintz and Chen (2010)

> *In the domestic policy sense, an efficient corporate tax structure is one that does not distort investment decisions …Tax burdens that vary across business activities affect the allocation of capital across different assets or industries rather than being invested according to their best use.*
>
> *Chen and Mintz (2008, p. 4)*

Although being concerned about the potential misallocation of capital across jurisdictions and between sectors that may result from differences in effective tax and royalty rates is legitimate, the legitimacy of this concern does not then automatically extend to support for the claims of Mintz and Chen (2010) and Mintz (2010). That research has to stand the test of scrutiny on its own merits. Whether Mintz and Chen (2010) provides any meaningful guidance as to the neutrality of the Newfoundland and Labrador tax/generic offshore royalty system requires a careful consideration of the methodological approach they utilized and the assumptions they invoked. In addition, whether the Newfoundland and Labrador fiscal regime should be modified to address their concerns requires a careful examination of the appropriateness of the conclusions that they drew from this research. In other words, is the evidence offered strong enough to warrant changing the generic royalty?

An important part of this scrutiny involves a detailed evaluation of the analytical model contained in Mintz (2010). The assessment of the analytical model is especially important in this context because the Mintz and Chen (2010) paper provides only numerical estimates of the METRR, without any demonstration of how they were derived and without sufficient information to allow for independent verification of their results. If there are problems with how Mintz (2010) modeled the Newfoundland and Labrador tax/royalty system and/or if the actual parameters used to calibrate the model do not reflect the reality of the investment environment experienced by firms operating in Newfoundland and Labrador's offshore, then the usefulness and the appropriateness of their analysis as a guide to understanding the incentive effects of the offshore generic fiscal regime is questionable. A detailed evaluation of the Mintz (2010) model is provided below. The mathematical details of this evaluation are provided separately in Appendix B.

4.1 Are Royalties Taxes?

> *Although royalties may be used to support government, that is not their raison d'être. Rather, royalties derive from ownership of resources by the Crown. Thus, a functional distinction can be made between royalties and general tax revenues. In this light, the principles governing taxation do not apply in equal measure to royalty incomes.*
>
> *Watkins (2001, p. 29)*

> *Royalties are payment made by businesses for the right to extract oil and gas from land owned by the property holder. The land is owned by the province so the royalties are a rental payment for the benefit from extracting the product from provincial lands. Thus, provincial royalty payments are a cost to oil and gas companies for using public property…In principle, one should subtract the rental benefit received from oil and gas businesses from taxes and royalty payments to assess the overall fiscal impact.*
>
> *Mintz (2010, p. 2)*

As evidenced by the two positions put forward by Watkins (2001) and Mintz (2010), the conceptual issue about whether royalties can be treated as a tax and, as such, used to calculate a marginal effective tax rate in the same manner as the corporate income tax is at least debatable. Recognizing this potential problem, Mintz (2010, p. 2) employs the METRR in his analysis, without adjusting the results for the "rental benefit received from oil and gas" by the companies. That is, Mintz (2010), and by extension Mintz and Chen (2010), considers royalty payments as a burden on oil and gas investment, but his model and their findings do not incorporate any allowances for the benefits received from having access to the economic rent generated from provincially-owned resources.

Mintz (2010, p. 2) offers two reasons for proceeding in this manner: (1) "since the provincial government is responsible for the royalty regime and could use taxes like the corporate income tax to extract revenue, one might think of royalties as part of the overall fiscal regime to raise revenue" and (2) it is impossible to incorporate the rental benefits unless there is some explicit rental rate for use of provincial property. These rationalizations for incorporating royalties without adjusting for the rental benefits are not particularly convincing. Moreover, if one only examines the costs (the royalty payments) without considering the benefits (access to the rents from provincial resources), the estimated impact coming out of this analytical framework is unlikely to be precise and would probably be more negatively interpreted than would be appropriate or reasonable.

While there is certainly a legitimate debate to be resolved about whether royalties ought to be analyzed as if they were equivalent to taxes, the concerns with Mintz and Chen (2010) and Mintz (2010) expressed in this paper extends beyond how this debate gets reconciled. For the rest of this evaluation, it is assumed that royalties and taxes can be analyzed in a similar fashion, employing techniques such as the METRR.

4.2 Mintz (2010) Perfect Certainty Model

> *… risk can significantly affect the effective tax rate. Without more precise estimates of risk, it is difficult to determine the total impact of the tax system on investment*
>
> *Mintz (1996, p. 60)*

> *Introducing uncertainty into the analysis opens a range of challenges and leads to results that cast doubt on the relevance of studies that neglect uncertainty.*
>
> *Lund (2009, p. 287)*

Mintz (2010, p. 3-5) proposes a model that abstracts from uncertainty and risk. Specifically, oil and gas companies, acting with perfect knowledge, plan extraction and investment so as to maximize the present value of their after-tax cash flows subject to the constraint that the total amount of the resources extracted cannot exceed the amount discovered and developed. The failure to explicitly consider uncertainty, as the quotes above indicate, has implications for the size of the METRR estimated and may even render the results of the analysis irrelevant in a real world context. For instance, this modeling approach does not consider the possibility that a firm may explore, not find anything, or may find a deposit that is too small to develop. The investment envisioned in Mintz (2010) is in terms of both "exploration and development." Surprisingly, there is no exploration that is not accompanied by development. In this model, investment in exploration and development leads to resources that will be extracted at some point so that a large part of the risk (i.e., geological risk) is missing in this framework.[90]

[90] In the Mintz (2010) model, there is no distinction between capital expenditures utilized for exploration versus capital employed for development activities. Specifically, the "e_t" term in Mintz (2010) denotes both exploration and development expenditures. Since there is no distinction between exploration and development, the model does not appear to consider the possibility that a firm might undertake exploration; find a dry hole; and not proceed to development. In this model, without development, there can be no extraction. Since exploration or geological risks are some of the biggest risks faced by offshore oil and gas companies, the omission of these risks from the modeling framework ought to cause one some concern.

In this model, the expenditures associated with exploration and development activities are separated in time from the extraction path, current expenditures and royalty payments. That is, there are two stages of production: exploration for and development of oil and gas resources occur first and then the discovered and developed resources are extracted until exhaustion. This allows Mintz (2010) to introduce the "time to build" assumption, which, in his framework, would enable firms to claim deductions from taxes prior to the occurrence of extraction and prior to the corresponding generation of revenue. In other words, the corporate income tax system is not ring-fenced and Mintz (2010) is implicitly assuming that the companies which invest in Newfoundland and Labrador's offshore can claim tax losses in the pre-production phase of the oil project against other profitable projects in Newfoundland and Labrador or elsewhere in Canada.[91] On the other hand, Newfoundland and Labrador's generic offshore royalty system is project-specific or ring-fenced so that losses (i.e., expenditures) in the early stage of the project can, for royalty purposes, be written off only against the future royalty obligations of the same project (i.e., the Production License) for which the losses were incurred.

The final step in the Mintz (2010) analysis is to specify the royalty system for the jurisdiction being evaluated. The optimization process involves deriving the impacts of the tax/royalty system on the after-tax return on capital and the corresponding tax-adjusted user cost of capital, which, in turn, have implications for business investment decisions as manifested through the following key variables:[92]

1. the profile of the optimal extraction path;
2. the investment in post-production, depreciable capital; and
3. the optimal investment schedule for exploration and development.

The only real differences between how Mintz (2010) models the Newfoundland and Labrador fiscal regime and the more general modeling approach are:

1. how the Newfoundland and Labrador royalties get incorporated;
2. how the royalties affect the firm's cash flow;
3. the number of distinct time periods in which a different cash flow prevails as a result of the changes to the royalty system that become effective at various points in time[93]; and
4. through the addition of the Atlantic Investment Tax Credit (AITC=$\emptyset$).

Mintz (2010, p. 13) adjusts the general model to accommodate for the fact that Newfoundland and Labrador's offshore generic royalty consists of three distinct parts: (1) gross royalties, which are ad

[91] Given the size of companies operating in Newfoundland and Labrador's offshore; their activities elsewhere in Canada; and that corporate income is taxed at the corporation level, not the project level, this particular assumption is consistent with what actually happens with respect to current offshore oil and gas developments within Newfoundland and Labrador.
[92] Mintz (2010) also examines how the incentive effects of holding inventories are affected by the presence of taxes and royalties. This is less of an issue for firms operating offshore Newfoundland and Labrador and is not considered further in this assessment of the Mintz (2010) model.
[93] These changes occur primarily because of changes in profitability—i.e., before and after a project reaches an 11% rate of return or a 21% rate of return and before and after extraction.

valorem royalties that collects a percentage of the value of oil produced, net of transportation costs. The gross royalty rate varies from 1% to 7.5% as various production, reserve and simple payout triggers are met;[94] (2) profit-sensitive royalties, known as Tier 1 royalties, that come into effect at 20% of net revenues when cumulative revenues exceed cumulative cost plus a return allowance[95] on any net cost carrying forward from one year to the next;[96] and (3) additional profit sensitive royalties, referred to as Tier 2 royalties, that are applied at 10% of net revenues when cumulative revenues exceed cumulative cost plus a return allowance[97] on any net cost carrying forward from one year to the next.

In the more detailed analysis, Mintz (2010) does not analyze the gross royalty; rather the analysis focuses on the impacts of Newfoundland and Labrador's Tier 1 and Tier 2 royalties. Instead, as part of the analysis of conventional oil and gas royalties in Alberta, Mintz (2010) does demonstrate how an ad valorem royalty would impact extraction and investment in both depreciable assets and through exploration and development expenditures. The reason for Mintz (2010) not including a separate analysis of the gross royalty is that the results for the user cost of capital in the presence of the gross royalty are "similar to the conventional oil and gas project in Alberta."[98] Therefore, one could presumably infer the effects of the gross royalty on the cost of capital from the results derived for Alberta's conventional oil and gas ad valorem royalty. However, it is important to appreciate that the Alberta ad valorem royalty analyzed by Mintz (2010) has a single rate whereas the royalty rates vary under the generic offshore regime.[99] As well, the gross royalty base in the Mintz (2010) model does not include an explicit deduction for transportation cost to the well head.[100]

While the detailed mathematical demonstration is contained in Appendix B, it is important to note that there are a number of problems with how Mintz (2010) analyzes Newfoundland and Labrador's generic royalty. The first problem relates to the fact that his representation of the present value of Tier 1 royalties is up to and including T_2, the year of Tier 2 payout.[101] It does not include any Tier 1 royalties that are payable beyond T_2. In other words, even though Tier 1 royalties continue to be payable even

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94 While not explicitly considered in the Mintz (2010) analysis, the gross royalty rate will increase to 5% when simple payout is achieved (i.e., the point in time at which cumulative revenues equals cumulative costs), even if the production triggers would imply a lower royalty rate. As well, for small fields, (i.e., fields with less than 250 million barrels of recoverable oil), the gross royalty rate would increase to 2.5% when 20% of the reserves are produced, even though the gross royalty trigger would still imply that 1% should be utilized.

95 The return allowance for Tier 1 royalty calculations is the sum of 5% and the long term government bond rate.

96 Assuming 6% as the long-term government bond rate, Tier 1 royalties become effective after the project earns a nominal rate of return of 11% (i.e., 5% + 6%). As well, this would imply that the Tier 2 royalty would become effective after the project earned a rate of return of 21% (i.e., 6% + 15%).

97 The return allowance for Tier 2 royalty calculations is the sum of 15% and the long term government bond rate.

98 Mintz (2010, p. 13).

99 The gross royalty rate under the Newfoundland and Labrador offshore generic royalty increases from 1% to 7.5% of the value of output less transportation costs as various production, reserve, and/or simple payout triggers are met.

100 While not explicitly acknowledged, it is possible that Mintz (2010) is interpreting the price and current costs to be net of transportation cost. If this is the case, then no other adjustment is required to these equations.

101 The failure to include Tier 1 royalties beyond Tier 2 payout is surprising since Mintz and Chen (2010, p. 4) notes that the "second-tier net royalty rate is 10% (added to the 20% first-tier rate)…resulting in a potential royalty rate of 30% on net revenues…"

when Tier 2 royalties come into effect, Mintz (2010) does not include Tier 1 royalties beyond year T_2. A second problem relates to the fact that in calculating the return allowance to determine Tier 1 payout, Mintz (2010) omitted the gross royalty which is part of the base for the return allowance. Likewise, a third problem with the Mintz (2010) specification is that Tier 1 royalties are included in the return allowance calculation for determining Tier 2 payout. Finally, the fourth problem is that the Mintz (2010) formulation omits permissible uplifts on eligible capital and operating costs. Specifically, in calculating royalties and royalty payouts under Newfoundland and Labrador's generic offshore regime, there is an uplift on eligible capital of 1% and eligible operating costs of 10%.[102]

These omissions will both overestimate the size of Tier 1 and Tier 2 royalties payable in any given period and will tend to overstate the extent to which the Tier 1 and Tier 2 return allowance rates in the Mintz (2010) formulation act0 as "subsidies" on marginal investments.

The basic argument that Dr. Mintz is making is that Newfoundland and Labrador's generic royalty implicitly subsidizes and distorts investment in its offshore because the permissible return allowance rates for Tier 1 royalties (φ_1) and Tier 2 royalties (φ_2) exceed the nominal discount rate (R). Given Tier 1 and Tier 2 royalty rates of $\tau_1$and τ_2, respectively, and royalty payout years of T_1 and T_2 for Tier 1 and Tier 2 royalties, respectively, the subsidy comes through $\tau_1 * (1 + \varphi_1 - R)^{(T_1 - t)}$ and $\tau_2 * (1 + \varphi_2 - R)^{(T_2 - t)}$, which occur throughout the user costs of capital derived in Mintz (2010) and utilized in Mintz and Chen (2010). These occurrences are illustrated in detail in Appendix B.

At this point, it is worth recalling that the Mintz (2010) model involves no risk. It is a perfect certainty world. The investors know with certainty which component of the royalty structure applies at each point in time before they make their first investment. As demonstrated previously, in the presence of risk (i.e., real world investment in the Newfoundland and Labrador context), an adjustment would be required to the discount rate since the fiscal system in Newfoundland and Labrador is not characterized by full loss offset. This implies that the discount rate (R) will normally exceed the risk free interest rate (6% in this illustration). Without looking specifically at the risk characteristics of the project, it is not possible to estimate the specific value for the risk adjustment. However, given the significant financial outlays and geological risks associated with investing in offshore Newfoundland, it would not be out of the realm of possibility that 5% would be reasonable. If this were the case, then the implicit subsidy through the return allowance associated with Tier 1 royalties would disappear.

While there are problems with exactly how the generic royalty has been specified, a more serious problem comes from the fact that for a marginal project in a perfectly certain world (i.e., the Mintz (2010) model), the project would earn the risk free rate of return, which has been approximated by the 6% estimate for the long term government bond rate in Mintz (2010), Mintz and Chen (2010) and in this assessment. If the marginal project earns a 6% rate of return after taxes and royalties, the Newfoundland and Labrador generic royalty is such that Tier 1 and Tier 2 royalties will not be effective. That is, for a marginal project $\tau_1 = 0$ and $\tau_2 = 0$ and the implicit subsidy term identified by Mintz (2010) and utilized by Mintz and Chen (2010) disappears. In order for the Tier 1 royalty rate to have a positive

[102] In calculating royalties, transportation and transshipment costs are not subject to an uplift.

value, then the project would have to be earning more than 6% after taxes and royalties. However, if the project earned more than 6% after taxes and royalties, then it would be earning positive economic rents at the margin. Positive economic rents on marginal projects invalidate the use of the METRR adopted by Mintz and Chen (2010).

5.0 Ideal Tax and the Optimal Tax Rate – A Further Consideration

> *Governments and companies both regard this as very important, whereas economists who focus on tax neutrality have nothing to say about the optimal tax rate*
>
> *Lund (2009, p. 302)*

While it may not be true that economists concerned with the neutrality of petroleum taxes have nothing to say about the optimal tax rate, a review of the literature does support the conclusion that they have very little to say about how large the tax rate ought to be in an optimal framework. Mintz and Chen (2010, p. 16), on the other hand, do recommend Newfoundland and Labrador adopt a tax rate similar to the pre-2009 oil sands type of royalty which has a 25% flat-rate.[103] This recommendation is based on their conclusion that flat-rate oil sands royalty is an ideal rent collection mechanism or a pure rent tax[104] that would remove the distortions that Mintz and Chen (2010) perceives for the Newfoundland and Labrador fiscal regime. However, the pre-2009 royalty does not have full-loss offset and, as such, it would need to have an adjustment on the risk-free interest rate to adequately reflect risks. As demonstrated above, in the absence of full-loss offset, the risk-free interest rate is not the correct threshold rate of return to utilize in the rent tax calculation.

Moreover, to ensure that a 25% flat-rate royalty collects a share of rents without distorting investment behaviour, fundamental changes would be required to how Newfoundland and Labrador currently calculates royalties. These changes would be required to ensure that full loss offset is in place in order to utilize the risk-free rate of return as the threshold rate in its royalty calculations without reducing investment in marginal projects because of an inadequate accounting for risk. Specifically, royalties under the Newfoundland and Labrador fiscal regime are currently calculated on a project-by-project basis so that deductions for royalty purposes are ring-fenced. If the threshold rate were set equal to the risk-free interest rate, losses on any project, including unsuccessful exploration projects, would have to be claimable against royalty obligations of other profitable projects. Alternatively, another way to ensure full-loss offset is to permit losses incurred by one firm that cannot be used by that firm to be sold to other profitable firms for their use in reducing their royalty liabilities to the Newfoundland and

[103] Specifically, Mintz and Chen (2010, p. 16) recommends for Newfoundland and Labrador and Nova Scotia that "…future oil and gas projects should be subject to a single royalty rate on rents, similar to Albert's pre-2009 oil sands royalty structure."

[104] Mintz and Chen (2010, p. 11) describe the oil sands levy as: "a true rent tax for oil sands projects by which payment is assessed on revenues net of current and capital expenditures (with unused expenditures carried forward at the government bond interest rate)." As well, Mintz and Chen (2010, p, 1) describes the oil sands royalty as "…a pure rent tax…"

Labrador government. It is important to realize that these are not small changes and more is involved with the Mintz and Chen recommendation than simply eliminating Tier 2 royalties, increasing the Tier 1 royalty rate to 25% from 20% and substituting the long-term bond rate for the return allowance. The changes to the royalty rates and return allowance will not be sufficient to ensure a neutral rent tax in the Newfoundland and Labrador context.

Furthermore, one could and should take exception to the taxation of rents at a 25% tax rate as is implicit in adopting the flat-rate oil sands royalty being suggested for Newfoundland and Labrador. With a 25% tax rate, assuming that the tax base is defined appropriately as the true economic rents associated with the exploitation of the oil and gas resources in offshore Newfoundland and Labrador, the provincial government, acting on behalf of its constituents – the owners of the resource, would only collect 25% of the actual rents generated. The implication is that the other 75% of the rents would accrue to the firms investing their capital in this area, only a portion of which will be captured by the provincial government through provincial corporate income taxes. At this point, it is important to recognize that this 75% is over and above normal economic profits required to compensate the investors for the opportunity cost of their capital, other explicit costs and any risks they incur.

It is not at all clear the philosophical or economic justifications that one would utilize to make it acceptable for the government to collect one-quarter of the rents on its resources and, after being compensated fully for the opportunity cost of its capital invested, private sector firms would receive over three-quarters of the residual economic rents. Presumably, since rent is over and above the minimum required to exploit the resource, any surplus generated ought to accrue to the resource owners — in this case, the people of Newfoundland and Labrador through the royalties collected by its government.

Interestingly, the economic literature has very little to say about how big the optimal tax rate should be. As Lund (2002, p. 54) notes:

> *…the existing theory of neutral taxation says very little about what the tax rate should be. Based on theory the rate may be set to 99 percent, allowing the companies just a sufficient share of profits so that they are indifferent to the projects.*

Boadway and Keen (2009, p. 4) suggests if all relevant costs are deducted in deriving the estimate of economic rents[105], then true rents "can be taxed at up to (just less than) 100 percent without causing

[105] This would include, according to Boadway and Keen (2009, p. 4), "appropriate allowance for any risk premium in the cost of capital faced by resource companies and for any part of the return to shareholders that may represent incentive payments to managerial skill." It would also include a return earned on specialized expertise and technologies that would be resident with the firm that is not available or is available in limited supply in other firms. The return on these specialized skills would represent quasi economic rent that would be earned by the scarce input until the market reacted to the higher rewards and increased the supply of these inputs. The issue of excluding quasi rents from the rent tax base was also discussed in Daniel (2002, p. 10), where it is suggested that "Competition among investors may be limited to a few companies possessing the expertise and financial resources needed for the project in question; in this case quasi-rents of the type discussed above are likely to exist and to diminish the rent" that the host government can reasonably expect to extract with a pure rent tax. A similar point

any change of behavior." A similar position is advocated by Frederiksen (2003, p. 6) where he indicates that while a 100% tax rate may not be possible because of incentive compatibility issues, " the tax rate should be set to allow private firms a sufficient stake in order to preserve the incentive for efficient decision making. In principle, a 99 per cent tax rate would satisfy this requirement." Finally, Land (2008, p. 12) questions whether resource rent taxes can "… distinguish between true resource rents and efficiency gains that result from the skills and knowhow of the particular investor?" He emphasizes further that "Industry has contended and most governments have recognized that excessive capture of rent could remove any incentives for companies to innovate and become more efficient."

Consistent with the incentive compatibility issue, Henry et al (2010b, p. 233) note that a 100% rent tax would be equivalent to the government "outsourcing exploration and production to private firms." This would create the inappropriate incentives for firms – there would be no incentive to maximize value because any excess return would go to the government and it would not benefit the shareholders and, as such, firms would have no incentive to minimize costs. Henry et al (2010a, p. 48) ends up recommending a 40% flat tax on rent earned from mining projects in Australia.[106]

An issue related to the appropriate rate for the optimal tax rate is the issue of progressivity being built into the royalty rate structure. While not explicitly referring to progressivity, Mintz and Chen (2010, p. 16) suggests:

> *Many of these problems could be avoided by eliminating the different tiers and applying a single royalty rate to cash flow, with costs carried forward at the government bond rate. In other words, future offshore oil and gas projects should be subject to a single royalty rate on rents, similar to Alberta's pre-2009 oil sands royalty structure.*

This idea is corroborated to some degree by Boadway and Keen (2009, p. 30-1). Specifically, they recognize that "…there is thus no difficulty of principle in levying a progressive rent tax" but they indicate that the pure economic rationale for doing so appears to be weak and that "…in the presence of uncertainty a progressive tax is distortionary even if investors are risk-neutral." Although Boadway and Keen (2009) do not see a strong efficiency or equity argument for a progressive rent tax, they do acknowledge that there may be a role for progressivity when one considers the issue of time inconsistency in government tax policy.[107] In particular, Boadway and Keen (2009, p. 58) indicates that progressivity "may help ease political economy pressures to renege on initial agreements." This role for progressivity has been reinforced by Lovas and Osmundsen (2009) when they observe that progressive tax systems "have been under less pressure to change" when economic circumstances change. This is also consistent with the assessment provided by Land (2009, p. 161) when he highlights that a

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with respect to difficulty of distinguishing between "the inherent value of the resource and the effort and entrepreneurial expertise required and value added in developing it" is also made by Hooke (2010, p. 5).

[106] This would come into effect after the project earned a rate of return equal to the long term government bond rate, the so-called risk free rate of return.

[107] The time inconsistency problem relates to the fact that after the capital is invested, government can increase the tax burden on that investment or change the rules of the game under which they were operating and there is very little that the investor can do about it at that time. Therefore, even if a favourable rate is offered before the investment, there should be no presumption that this will persist after the investment is in place.

progressive tax structure would help avoid "…brinkmanship as a means of reconciling the economic interests of governments and investors" because "…Government "take" would rise or fall to correspond to changes in the levels of profitability actually achieved by mining and petroleum projects."

Finally, as Lund (2009, p. 292) notes, it might be desirable to have more than one tier to the resource rent type royalty. The rationale offered for multiple rates (i.e., a progressive rate structure) is as follows: if the correct rate to allow for the return allowance is not known with certainty, then the use of multiple rates opens up the possibility that "…when a rate of return above a lower threshold is realized, the company starts paying RRT at a relatively low rate. If a rate of return above a higher threshold is realized, the company starts paying at a higher rate."[108] In closing off this discussion on the optimal tax rate and the appropriate degree of progressivity, it is important to appreciate that economists do not speak with one voice on this issue. For example, Sunley, Baunsgaard and Simard (2002 p. 18-9) recommend an optimal fiscal regime for the petroleum sector that would "…combine some up-front revenue with sufficient progressivity to provide the government with an adequate share of economic rent under variable conditions of profitability."

6.0 An Alternative Analysis of the Generic Offshore Royalty.

If Newfoundland and Labrador's royalty implicitly subsidizes marginal investments, then it should be possible to simulate a marginal project, one that is just worth undertaking in the presence of Newfoundland and Labrador taxes and the relevant portions of its offshore generic royalty, and observe this subsidy effect for the simulated marginal project. [109] The simulation consists of specifying a project which generates a net present value, after-taxes and royalties, that has a value of zero or a project that has a nominal (and real) after-tax and-royalties rate of return of 6% (the assumed cost of capital).

In this simulation, inflation is assumed away and set at zero percent per annum. Further the project and any associated marginal investments are assumed to be 100% equity financed.[110] That is, there is no debt financing in this simulation.

Having developed this marginal project scenario, it is then possible to test whether the tax/royalty system provides an implicit fiscal subsidy and stimulates sub-marginal investments, as concluded in

[108] Note that RRT in this quote refers to the resource rent tax.

[109] Goldsworthy and Zakharova (2010, p. 4) also uses a simulation model to evaluate Russia's fiscal regime. The purpose of the simulation was "to suggest ways to make it more supportive of investment while still providing the government with an appropriate share of oil sector profits." As well, Hogan (2007, p. 41) used simulation to analyze the impact of a number of resource taxation policy options on a range of hypothetical resource development projects. Plourde (2010, p.4652) simulates the distribution of net returns between government and developers involved in exploiting Alberta's oil sands deposits. Finally, Lund (2002 b, p. 27) simulated petroleum taxes under uncertainty in Norway.

[110] This allows one to abstract from the interaction of the tax system on the cost of capital and having to distinguish between the impact of inflation on project viability through its impact on the depreciation base and focus on the effect of royalties and taxes on marginal investments.

Mintz and Chen (2010). That is, this simulation facilitates a test of whether the fiscal regime provides an incentive for firms to invest, even though the return on the marginal investment is less than their cost of capital.

6.1 Marginal Project – Base Case Scenario

For the purpose of this exercise and to be consistent with the discussion in Mintz and Chen (2010),[111] a marginal project has been modeled that yields a real after-tax-and-royalty rate of return of 6%. Furthermore, since the next project[112] that is expected to be developed in Newfoundland and Labrador will be a Gravity-Base structure (GBS), this model assumes a GBS production technology in order to make the investment decision of local operators as realistic as possible. For the purpose of this analysis, the assumptions for the marginal base case are:

- all prices are in Canadian dollars, unless otherwise indicated;
- it is assumed that inflation is zero so the analysis is undertaken in constant or real dollars and prices;
- the project is 100% equity financed;
- the shareholders need an after-tax and royalty rate of return equal to 6% to invest in this project;[113]
- the crude sells for $34.18 per barrel and remains constant in real terms throughout the life of the project;[114]
- exploration lasts for one year and costs $500 M;
- development drilling costs $1.8 B and occurs over 4 years and ends when extraction commences;
- the structures and equipment associated with development phase investment costs $2.7 B and requires four years to put in place (for the simulation exercise, this overlaps exactly the period of development drilling);[115]
- The combined capital cost is $5 billion;

[111] The choice of 6% as the cost of capital is not that important for the current part of this analysis. It could equally be 10%, reflecting components of risk associated with Newfoundland and Labrador's offshore developments. All that is needed is some definition of when a project is just worth doing and then to check the impact on the project's viability of an incremental increase in investment, where that incremental investment has a rate of return that is less than the cost of capital (6% in the base case or 10%, if that was the cost of capital utilized). That is, the research question addressed is: does the Newfoundland and Labrador offshore generic royalty subsidize investment and stimulate investments that would not otherwise be taken?
[112] The Hebron project is the next project expected to be developed.
[113] Both inflation and debt financing will affect the precise results obtained in both the simulation exercise and in the analytical approach in Mintz (2010). However, neither will significantly influence the conclusion about whether the Newfoundland and Labrador's generic offshore royalty and tax system implicitly subsidizes marginal projects.
[114] The price is the factor that is adjusted to ensure that the project being analyzed just gives a 6% after tax rate of return. As such, when the Atlantic Investment Tax Credit is removed, the assumed price has to be increased to $35.41 to maintain the 6% after-tax-and-royalty rate of return utilized to define a marginal project.
[115] This overlap is also consistent with the modeling approach assumed in Mintz (2010).

- For the purposes of royalty calculation, the project is sanctioned at the start of year two;
- extraction is undertaken over a 20 year period, commencing in year six;
- there is a two year ramp up of production, with 1/3 of peak production occurring in year one; 2/3 of peak production occurring in year two; a plateau production rate of 40 million barrels of oil produced per year or 110,000 barrels per day at peak; and the plateau lasts for a five year period after which production declines geometrically at a 21% annual rate;
- 400 million barrels of oil is assumed to be extracted over the 20 year operating life of the project;
- operating costs are assumed to be $10.00 per barrel;
- transportation costs are assumed to be $2.00 per barrel;
- facilities are depreciated on a declining balance of 25% (no half-year rule assumed);
- development drilling expenditures are depreciated at a 30% declining balance;
- the long-term government bond rate is 6% real;
- the federal corporate income tax rate is 15%;
- the Atlantic Investment Tax Credit on eligible expenses is 10%;
- the provincial income tax rate is 14%;
- provincial royalties are deductible against corporation income taxes;
- exploration expenditure ($500 M) are written off at 100% under Canadian Exploration rules; and
- provincial and federal income taxes can be written off immediately, but royalties are ring-fenced.

While the details associated with this analysis are provided in Appendix C, a summary table of the relevant parameters is presented below in Table 1.

Table 1: Base Case Parameters for Simulation Analysis

Parameter	Base Case Value	Parameter	Base Case Value
Production (Million BBLs)	400	Tier 1 Royalties ($ M)	$0
Price ($/BBL)	$34.18	Tier 2 Royalties ($ M)	$0
Revenue ($ M)	$13,672	Total Royalties ($ M)	$700
Exploration ($ M)	$500	Federal CIT Net of AITC ($ M)	$247
Drilling ($ M)	$1,800	Provincial CIT ($ M)	$483
Facilities ($ M)	$2,700	Gov Revenue DCNF (@6%) ($ M)	$308
Total Capital Expenditure ($ M)	$5,000	Pre-Tax/Royalties DNCF (@6%) ($ M)	$308
Operating Expenditure ($ M)	$4,000	After-Tax/Royalties DNCF (@6%) ($ M)	$0.0
Transport ($ M)	$800	Real After Tax Rate of Return	6.000%
Gross Royalties ($ M)	$700	Real Pre-Tax Rate of Return	6.867%

The base scenario involves 400 M barrels of oil extracted over a 20 year operation period; $5.0 B in capital expenditure; the Canadian price of oil is $34.18; revenue earned on the project is $13.7 B; the total operating cost is $4.0 B; the cost of transporting the oil to market is $0.8 B; provincial corporation income taxes are $0.48 B, the federal corporation income tax, net of the AITC is $0.25 B; and provincial royalties (gross royalties only) $0.7B. This yields an after-tax-and-royalty rate of return of 6.0% and a before tax and royalty rate of return of 6.87%. An after-tax-and-royalty rate of return of 6% defines a marginal project in this simulation. The marginal nature of this project is also indicated by an after-tax-and-royalty net present value of $0 M.

The key parameters in this summary table with respect to the implicit subsidization suggested by Mintz and Chen (2010) are the before- and after-tax-and-royalty rates of return and the after-tax-and-royalty net present value evaluated at the cost of capital (DNFC@6%). If the Newfoundland and Labrador tax and royalty system implicitly subsidizes marginal investments, then the after-tax-and-royalty rate of return should increase above 6% and the correspondingly after-tax-and-royalty NPV (@6%) should increase from zero to some positive number to indicate that the unproductive investment is made more profitable to the investor by Newfoundland and Labrador's offshore generic fiscal regime. This is a test on the claims of Mintz and Chen (2010) with respect to the implicit subsidization associated with the generic royalty system applied to offshore petroleum projects investing and operating within Newfoundland and Labrador.

6.2 Alternative Test of Mintz and Chen (2010)

There are four separate tests conducted to determine whether the claims in Mintz and Chen (2010) can be corroborated by this simulation exercise. The tests or simulations performed are:

1. **Gold-plating test**: does a $100 M investment in unproductive expenditure increase the after-tax-and-royalty profits earned by the investor. In other words, is the level of subsidization claimed by Mintz and Chen (2010) sufficient to induce the investor to spend money unproductively (i.e., it does not result in higher revenues or lower costs) to take advantage of tax saving?
2. **Sub-marginal investments**: These expenditures generate revenue for the company, but the rate of return on the investment is less than the cost of capital. For this simulation, the $100 M investment has a rate of return of 5.9%, which is less than 6% cost of capital.
3. **Marginal Investments**: With this scenario, the $100 M investment has a rate of return equal to 6%, which is equivalent to the assumed user cost of capital for the marginal project.
4. **Investment in the Absence of AITC**: In this scenario, the Atlantic Investment Tax Credit has been removed and the price is adjusted to ensure that the investment earns the assumed 6% rate of return for marginal projects. Then the $100 M investment is assumed to have a 5.9% rate of return, which is slightly less than the 6% assumed for marginal projects.

While the summary results are presented in

Table 2 below, the details for each simulation are presented in full in the data appendix – Appendix C.

Table 2: Summary Parameters for Simulation Analysis

	Base Case	Unproductive Gold Plating (0.0%)	Productive at Lower Than UC (5.9%)	Productive at UC (6%)	NO AITC	Productive at Lower Than UC NO AITC (5.9%)
Production (Million BBLs)	400	400	400	400	400	400
Price ($/BBL)	$34.18	$34.18	$34.18	$34.18	$35.41	$35.41
Revenue ($ M)	$13,672	$13,672	$13,868	$13,871	$14,165	$14,361
Exploration ($ M)	$500	$500	$500	$500	$500	$500
Drilling ($ M)	$1,800	$1,800	$1,800	$1,800	$1,800	$1,800
Facilities ($ M)	$2,700	$2,800	$2,800	$2,800	$2,700	$2,800
Total Capital Expenditure ($ M)	$5,000	$5,100	$5,100	$5,100	$5,000	$5,100
Operating Expenditure ($ M)	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000
Transport ($ M)	$800	$800	$800	$800	$800	$800
Gross Royalties ($ M)	$700	$700	$711	$712	$727	$738
Tier 1 Royalties ($ M)	$0	$0	$0	$0	$0	$0
Tier 2 Royalties ($ M)	$0	$0	$0	$0	$0	$0
Total Royalties ($ M)	$700	$700	$711	$712	$727	$738
Federal CIT Net of AITC ($ M)	$247	$223	$251	$251	$546	$559
Provincial CIT ($ M)	$483	$470	$496	$496	$510	$522
Gov Revenue DCNF (@6%) ($ M)	$308	$276	$308	$309	$571	$579
Pre-Tax/Royalties DNCF (@6%) ($ M)	$308	$208	$307	$308	$571	$570
After-Tax/Royalties DNCF (@6%) ($ M)	$0.0	($67.7)	($1.2)	($0.5)	$0.0	($8.8)
Real After Tax Rate of Return	6.000%	5.745%	5.995%	5.998%	6.000%	5.969%
Real Pre-Tax Rate of Return	6.867%	6.574%	6.839%	6.841%	7.577%	7.529%

6.2.1 Gold-Plating Test

The first test of whether or not the Newfoundland and Labrador generic offshore royalties causes firms to over-invest in offshore oil and gas projects is to test whether a small investment on the margin increases the after-tax rate of return above 6% or whether the net present value evaluated at the cost of capital turns from zero to positive. The first check is to introduce a non-productive additional increase in the investment of $100 M in the first year. This implies that capital expenditure is now $5.1 B, not the $5 B utilized in the base case. It is non-productive in the sense that revenues are unaltered and no other cost is lowered by the investment.

From Table 2, observe that the after-tax-and-royalty rate of return has fallen from 6% to 5.745% and the net present value turns negative (-$67.7 M), implying that it would not be in the firm's interest to undertake this investment because its after-tax-and-royalties profitability would fall. Hence, if the Newfoundland and Labrador royalty and tax system subsidizes investment and encourages over-investment, it would have to be investment that enhances productivity to some degree. In other words, the Newfoundland and Labrador generic offshore fiscal system does not promote gold-plating.

6.2.2 Sub-Marginal Investments

To be fair, Mintz and Chen (2010) did not specify the exact nature of the subsidization and, while gold-plating was not ruled out by their analysis, it was not explicitly considered either. Although they did not explicitly consider a situation that would involve investment that had no marginal contribution to productivity, they suggested that the fiscal system would cause over-investment. In the context of their analysis, this involves investment that would yield a rate of return that falls short of the cost of capital and would not otherwise be undertaken. To test this suggestion with our simulation model, we allow for a $100 M investment in year 1, but we assume that it increases productivity, but it only earns a rate of return of 5.9%, which below the firms cost of capital.

For this test, notice that the after-tax-and-royalty rate of return has fallen from 6% to 5.995% and the net present value turns negative (-$1.2 M). Even though these deviations are not large in absolute value, they do indicate that it would not be in the firm's interest to undertake this investment because its after-tax-and-royalties profitability would fall. Hence, if the Newfoundland and Labrador royalty and tax system subsidizes investment and encourages over-investment, it would have to be for investment that has a productivity that is closer to the cost of capital, 6%.

6.2.3 Marginal Investments

To test whether an investment generating an after-tax-and-royalty rate of return of 6% would yield a tax advantage to the investor, we allow for a $100 M investment in year 1 and we assume that it increases productivity by the firms cost of capital. Notice that the after-tax-and-royalty rate of return has fallen from 6% to 5.998% and the net present value turns negative (-$0.5 M). Even though these deviations are not large in absolute value, they do indicate that it would not be in the firm's interest to undertake this investment because its after-tax-and-royalties profitability would fall.

6.2.4 Removing the AITC

The next step is to remove the AITC and to increase the price so that the after-tax-and-royalty rate of return remains at 6% before any investment is considered. As shown in Table 2, this requires increasing the price from $34.18 to $35.41. Next, an incremental investment of $100 M that earns a rate of return of 5.9% is simulated. Since the after-tax-and-royalty rate of return has fallen from 6% to 5.969% and the net present value turns negative (-$8.8 M), we can conclude that it would not be in the firm's interest to undertake this investment because its profitability would fall.

7.0 Revenue Implications in Switching to 25% Oil Sand Royalty

Table 3, Figure 3 and Figure 4 show the effects of switching from the generic offshore royalty to the 25% flat-rate oil sands royalty suggested in Mintz and Chen (2010) on the present value of government revenues (assuming a 6% discount rate) and on the investor's after-tax, internal rate of return at various prices (ranging from $32.58 to $125 per barrel). To facilitate independent verification, Appendix D provides the detailed tables for the generic offshore royalty for an assumed $75 US per barrel oil price. Appendix E contains the corresponding tables for the 25% flat-rate oil sands royalty.[116] The scenarios run for the generic offshore royalties are identical to the base case, with the exception that the price of oil assumed for each scenario varies. The 25% flat-rate oil sands royalty scenarios are identical to the base case with the following exceptions:

- Price varies by scenario;
- The uplifts on capital and operating expenditures have been removed;
- The return allowance is set at 6% for Tier 1;
- The tax rate for Tier 1 royalties is set at 25%;
- The tax rate for Tier 2 royalties is set to zero; and
- Ad valorem royalties are set to zero.

The impact on government revenue of shifting from the generic offshore royalty to the 25% flat-rate oil sands royalty depends on the price. At prices less than $45 per barrel, the generic royalty generates more revenue than the 25% flat-rate oil sands royalty. The extra revenue comes from the ad valorem royalty that is present in the generic offshore royalty, but is absent from the 25% flat-rate royalty. If the assumed price exceeds $95 per barrel, then the generic royalty also generates more revenue. At higher prices the Tier 2 royalty becomes more important and, as such, the generic offshore royalty yields more revenue to the provincial government in present value terms. The peak difference in the present value of government revenue occurs at $70 per barrel when the 25% flat-rate oil sands royalty yields $450 M more to the provincial treasury.

The impact on the investor is shown by the after-tax, internal rate of return. Except for scenarios with less than $45 per barrel oil prices, the after-tax rate of return is lower with the generic offshore royalty. The most significant impact occurs at $75 per barrel, when the 25% flat-rate oil sands royalty reduces the after-tax, internal rate of return by 2/3 of one percentage point.

Neither the impacts on government revenue nor on the after-tax, internal rate of return for this type of project would be significant enough to warrant changing a fiscal system that appears to be working reasonably well. Whether the provincial government revenue is enhanced and by how much, depends on the change in the tax rate from 20% to 25% for the profit-sensitive royalties and the actual price that prevails. For example, at current prices of approximately $80 per barrel, the incremental revenue from switching to the 25% flat-rate royalty would increase by 7.3% over the

[116] **Because of the number of simulations involved, the $75 US per barrel was chosen as a representative scenario and the summary data is presented in**

Table 3, Figure 3 and Figure 4.

generic royalty for this illustrative project (i.e., $250 M on a base of $3,450 M). While not shown, if the flat-rate tax rate were maintained at 20%, then, at an $80 per barrel price, the flat rate would yield $3,265 M versus $3,450 M for a difference of -$186 M (i.e., a -5.4% decrease).[117]

[117] These additional calculations can be made available to anyone interested.

Table 3: Revenue and Rate of Return Comparisons Shifting from Generic to a 25% Rent Tax

Oil Price	PV (6%) Prov Gov Rev 25% RENT Tax	PV (6%) Prov Gov Rev Generic Royalty	Difference PV (6%) Prov Gov Rev 25% RENT – Generic Royalty	Firm's After-Tax IRR for 25% RENT Tax	Firm's After-Tax IRR for Generic Royalty	Difference After-Tax IRR 25% RENT – Generic Royalty
$32.58	$97	$378	($280)	6.00%	5.09%	0.91%
$34.18	$215	$440	($225)	6.70%	6.00%	0.70%
$40.00	$658	$668	($10)	9.08%	8.97%	0.11%
$45.00	$1,039	$835	$205	10.93%	11.25%	-0.33%
$50.00	$1,419	$1,151	$268	12.63%	13.07%	-0.44%
$55.00	$1,796	$1,483	$313	14.21%	14.70%	-0.49%
$60.00	$2,179	$1,817	$362	15.66%	16.20%	-0.54%
$65.00	$2,562	$2,129	$433	17.02%	17.65%	-0.62%
$70.00	$2,937	$2,487	$450	18.32%	18.93%	-0.61%
$75.00	$3,319	$2,906	$413	19.52%	20.18%	-0.66%
$80.00	$3,701	$3,450	$251	20.67%	21.11%	-0.45%
$85.00	$4,084	$3,945	$139	21.76%	22.09%	-0.33%
$90.00	$4,466	$4,352	$114	22.81%	23.15%	-0.35%
$95.00	$4,835	$4,796	$39	23.82%	24.10%	-0.27%
$100.00	$5,216	$5,257	($41)	24.78%	24.98%	-0.20%
$105.00	$5,598	$5,712	($114)	25.69%	25.83%	-0.14%
$110.00	$5,979	$6,164	($185)	26.57%	26.66%	-0.08%
$115.00	$6,361	$6,612	($251)	27.43%	27.47%	-0.04%
$120.00	$6,742	$7,012	($270)	28.25%	28.32%	-0.07%
$125.00	$7,124	$7,402	($278)	29.05%	29.16%	-0.10%

Figure 3: Difference in PV (@6%) Provincial Government Revenue Under the 25% Oil Sand Flat-Rate Royalty and the Generic Royalty (Flat-Rate Minus Generic Royalty) ($ M)

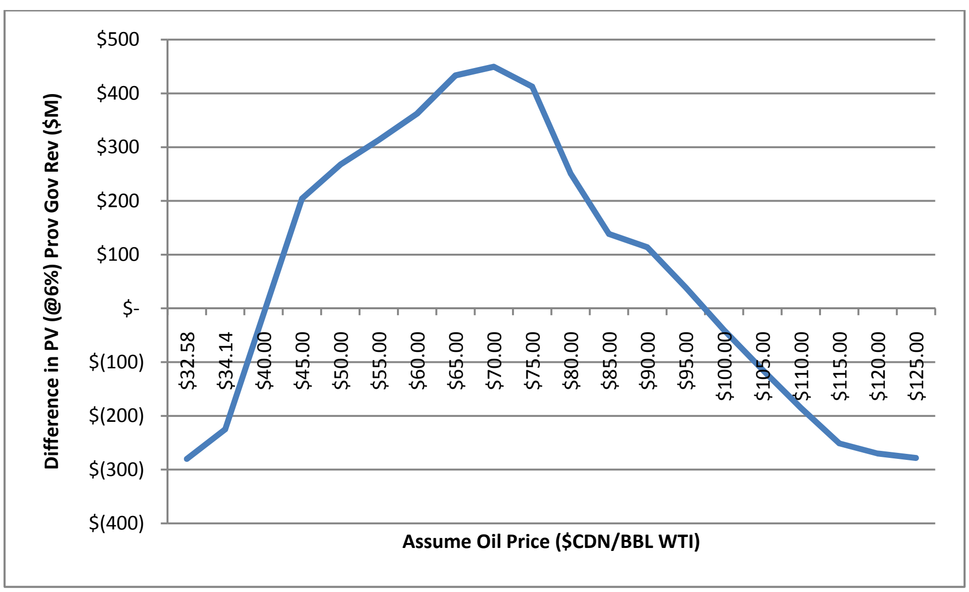
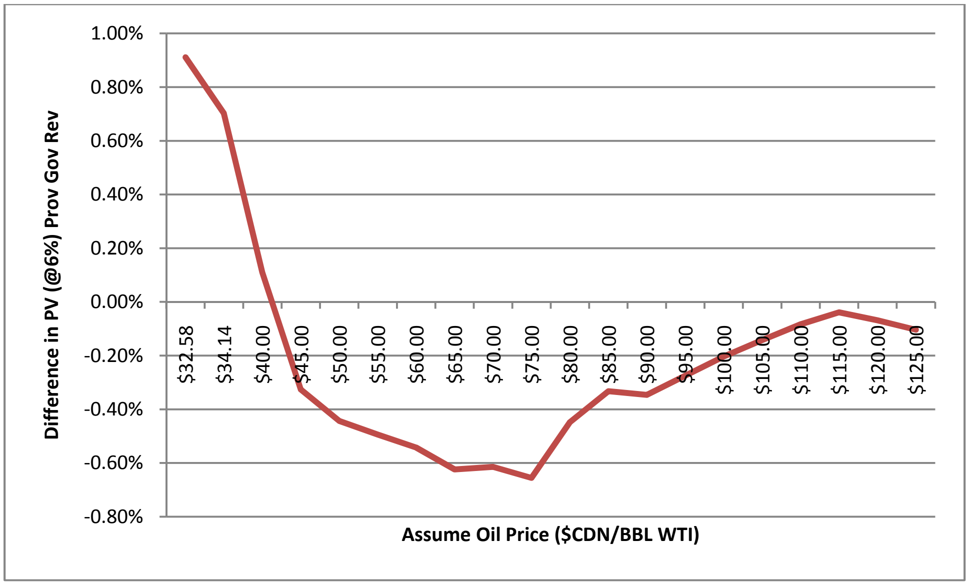


Figure 4: Difference in Investor's After-tax, Internal Rate of Return Under the 25% Oil Sand Flat-Rate Royalty and the Generic Royalty (Flat-Rate Minus Generic Royalty)



8.0 Conclusion

This paper evaluated the implications for Newfoundland and Labrador of the research findings put forward in Mintz and Chen (2010) and Mintz (2010). Their research computed the METRR for marginal oil and gas projects as the difference between the post- and pre-tax-and-royalty rates of returns, expressed as a percentage of the post-tax-and-royalty rate of return. The absolute value of this metric was used by Mintz and Chen (2010) to infer the extent of distortion imposed on marginal investments by Newfoundland and Labrador's generic fiscal regime. A similar analysis was undertaken for other oil and gas producing jurisdictions in Canada and the United States (Texas).

Having found negatively-valued METRR estimates for Newfoundland and Labrador's offshore generic royalty, Mintz and Chen (2010) concluded that marginal investments in the province's offshore oil and gas were implicitly subsidized and distorted. Their basic argument is that generic royalty distorts oil and gas investment in Newfoundland and Labrador's offshore because the permissible return allowances under the generic regime exceed the risk free discount rate needed to preserve the present value of royalty write-offs. If their claims are correct, then the Government of Newfoundland and Labrador would have to at least consider raising the effective tax and royalty rates applicable to its offshore projects in order to capture a fair share of economic rents; to remove the suggested distortions; and to lower the implied excessive investment in that sector.

In Mintz (2010), the analytical basis for Mintz and Chen (2010), there is no risk. Given the structure of the offshore generic regime, a truly marginal project in the Newfoundland and Labrador context would not generate a subsidy. When one takes into account risk and prospectivity, Newfoundland and Labrador's fiscal regime is neither significantly more onerous nor obviously more generous than comparable fiscal regimes in Canada and around the world.

Another problem identified with Mintz (2010) and Mintz and Chen (2010) was that since the generic fiscal regime is not characterized by full loss offset, the presence of risk requires an adjustment to the discount rate. As well, given the risk factors involved, it would not be out of the realm of possibility that 5% would be a reasonable premium to add to the return allowance, which is exactly what the Newfoundland and Labrador generic royalty system does for the first level of profit-sensitive royalties. If 5% were the appropriate premium to add to the long term government bond rate, then the implicit subsidy identified by Mintz and Chen (2010) through the return allowance associated with Tier 1 royalties would disappear as well.

In addition, several of the assumptions which underlie this approach utilized by Mintz and Chen (2010) and Mintz (2010) are untenable and have direct implications for the accuracy of the estimates METRRs. These include: (1) capital is assumed to be infinitely divisible; (2) investments are reversible, in full and without cost; (3) international tax competition is absent; and (4) perfect certainty is assumed and, as such, risk is ignored.

Finally, how Mintz (2010) modeled Newfoundland and Labrador's generic royalty has problems. Some of the required adjustments to Mintz (2010) are:

(1) Tier 1 royalties continue to apply even in the presence of Tier 2 royalties (i.e., Tier 2 royalties supplement, rather than replace, Tier 1 royalties). Currently, Mintz (2010) does not include any Tier 1 royalties that are payable beyond Tier 2 royalty payout;

(2) eligible capital and operating costs should be uplifted for calculating Tier 1 and Tier 2 royalties and the corresponding royalty payouts. Mintz (2010) omits permissible uplifts on capital and operating costs. Specifically, in calculating royalties and royalty payouts under Newfoundland and Labrador's generic offshore regime, there is an uplift of 1% on eligible capital and 10% on eligible operating costs;

(3) the Atlantic Investment Tax Credit (AITC) also applies to eligible development expenditures. In the current construction of the Mintz (2010) model, the AITC applies only to depreciable capital. Even though the largest benefit from the AITC relates to the non-drilling development expenditures that are grouped in Mintz (2010) under the rubric of exploration and development. Therefore, some portion of the exploration and development expenditure ought to be offset by a credit against federal corporate income taxes;

(4) the gross royalties are deductible from the Tier 1 royalties payout calculations. Specifically, in calculating the return allowance to determine Tier 1 payout, Mintz (2010) omitted the gross royalty which is part of the base for the return allowance;

(5) Assuming that Tier 1 royalties payable exceed the corresponding gross royalties payable, then Tier 1 royalties are deductible from the royalty payout calculations for Tier 2 royalties. In the current version of Mintz (2010), Tier 1 royalties have not been included in the return allowance calculation for determining Tier 2 payout; and

(6) a portion of the exploration and development expenditures is expensed. Even though Mintz (2010) does acknowledge that "exploration is expensed but development is capitalized and written off at the declining balance rate σ," this does not appear to be reflected in the model.

Making these adjustments has significant implications for the cost of capital and the METRR presented in Mintz and Chen (2010).

Given the lack of full-loss offset associated with the Alberta oil sands flat-rate royalty and its 25% royalty rate, the oil sands flat royalty is neither an ideal rent collection mechanism nor a pure rent tax. Without full-loss offsets, the risk-free interest rate is not the correct threshold rate of return to utilize. Moreover, with a 25% tax rate, assuming that the tax base is defined as true economic rents, the provincial government, acting on behalf of its constituents – the owners of the resource, would only collect 25% of the actual rents generated. The residual 75% accrue to the firms investing their capital in this area, which is over and above normal economic profits required to compensate the investors for the opportunity cost of their capital, other explicit costs and any risks they incur.

It is not at all clear the philosophical or economic justifications that one would utilize to make it acceptable for the government to collect one-quarter of the rents on its resources and, after being compensated fully for the opportunity cost of its capital invested, private sector firms would receive over three-quarters of the residual economic rents. Presumably, since rent is over and above the minimum required to exploit the resource, any surplus generated ought to accrue to the resource owners — in this case, the people of Newfoundland and Labrador through the royalties collected by its government.

An alternative test of the claims of Mintz and Chen (2010) was provided in the form of a simulation exercise. The simulation consisted of defining a project that had a 6% nominal after-tax and-royalties real rate of return. Since 6% is the assumed cost of capital, this marginal project generates a net present value (NPV), after-taxes and royalties, of zero. The test of whether the tax/royalty system provides an implicit fiscal subsidy and stimulates sub-marginal investments, as concluded in Mintz and Chen (2010) was whether, in the presence of the sub-marginal investment, the after-tax-and-royalty rate of return exceeded 6% or whether after-tax-and-royalty NPV (@6%) had a positive value.

There were four separate tests conducted. In none of the simulations did the Newfoundland and Labrador generic royalty subsidize marginal investments. Specifically, the net present values for the incremental investments were all negative. A positive finding would have been required to corroborate Mintz and Chen (2010).

Finally, the revenue implications of switching from the generic offshore royalty to the 25% flat rate oil sands royalty were simulated for various price assumptions. The impact of the switch depends on the range of prices considered. Neither the impacts on government revenue nor on the after-tax, internal rate of return for this type of project were significant enough to warrant changing a fiscal system that appears to be working reasonably well.

Without adjustments to their research, this assessment questioned whether the Mintz (2010) and Mintz and Chen (2010) analyses make a significant to contribute to the public policy debate in Newfoundland and Labrador with respect to the appropriate structure of the offshore fiscal regime. Based only on the research presented in Mintz and Chen (2010) and Mintz (2010), there is insufficient evidence to justify changing the royalty system or for adopting the flat rate oil sands royalty in Newfoundland and Labrador.

Appendix A: Derivation of METR for Non-Resource Firm

Adopting the neoclassical approach to investment and assuming no uncertainty,[118] profit-maximizing firms are assumed to invest in physical capital or machinery and equipment (K) by making decisions on the margin.[119,120] In this conceptual framework, firms typically are assumed to be price-takers in both the input and output markets and the capital can be purchased at some constant unit price (P^K).[121] Also, for this stage of the assessment, it will be assumed that inflation is zero (i.e., π=0). As well, capital gains or losses through changing asset prices have been assumed away for this explanation. Finally, the financial structure of a firm's investment is given – that is, firms are assumed to fund their investments with a given proportion of their funding coming from debt and the residual portion coming from equity.[122]

By investing, firms generate (marginal) revenue from the sale of the output (Q) produced with the additional capital stock. For this scenario, the marginal revenue earned by the firm is equal to the value of the marginal product of capital (i.e., it equals the constant output price (P) times the marginal product of the investment ($\frac{\partial Q}{\partial K}$) or the price at which output can be sold times the additional output produced).

An additional concern for firms contemplating an investment is that additional capital put in place will be subject to economic deprecation (δ percent per year) as the wear and tear on the capital, or its obsolescence, reduces its future value or its productive capacity. The consequence of economic depreciation is that a replacement investment ($P^K * \delta$) will be required per unit of investment if the capital stock is to remain at the optimal level chosen by the firm.

A final consideration is that the revenue earned on the marginal investment, net of annual depreciation allowances or capital consumption allowances (D_t), will be subject to corporate income taxation at a constant tax rate (u). That is, the firm will reduce its taxable income by a deduction for deprecation, which in Canada is referred to as the capital consumption allowance.

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[118] Mintz (2010) does not consider uncertainty and risk in his modeling framework. This is maintained here for consistency. But given the large number of risks associated with offshore oil and gas exploration and development, this assumption is at least questionable and may mask other important effects that would otherwise be manifested.

[119] The last investment opportunity undertaken is the one that yields the lowest marginal revenue to the firm; that is, one which yields a return that is just equal to the user cost of capital—a zero net present value when the cash flow is discounted at the user cost of capital. As the user cost of capital rises, the previously marginal projects will be dropped and firms will invest in only those projects that earned a hurdle rate of return in excess of or equal to the new, higher user cost of capital. Since the marginal product of capital curve is assumed to be downward sloping (or, there is a diminishing marginal product of capital) in this framework, this implies a lower capital stock and less investment. In other words, reduced investment is inferred from a higher user cost of capital.

[120] A similar illustrative model can be found in Anastassiou (2006).

[121] While some studies looking at the user cost of capital denote "q" as the purchase price of capital, P^K is used in this paper to avoid possible confusion with output, which is denoted with "Q" in this illustration. Mintz (2010) has defined his analysis so that the purchase price of capital is unity.

[122] This is a standard type of assumption in this type of analysis. For an explanation, see Boadway and Wildasin (1984, p. 325).

Given this neoclassical framework, the investment decision for the firm can be characterized as: if the present value of the income stream generated, net of economic depreciation and taxes, is greater than the purchase price for the capital, then the firm will undertake this investment.

To facilitate comparison to the Mintz and Chen (2010) and Mintz (2010) papers, this framework is also specified in a simple mathematical format that, initially, ignores the impact of royalties and other rent collection devices that may be employed by host governments. As noted above, the net revenue generated at the margin is given by the value of the marginal product ($P * \frac{\partial Q}{\partial K}$) less replacement investment ($P^K * \delta$) and any taxes payable (T_t). This can be represented by Equation 3 as follows:

$$P * \frac{\partial Q}{\partial K} - P^K * \delta - T_t$$

Equation 3

Taxes on the marginal investment are equal to a tax rate (u) times the marginal revenue earned, net of depreciation allowances (D_t) and is specified in Equation 4 as:

$$T_t = u * \left(P * \frac{\partial Q}{\partial K} - D_t\right)$$

Equation 4

The decision to invest is positive if the present value of after-tax revenue exceeds the purchase price of the asset or, in simple mathematical terms, the decision to investment is determined by Equation 5:

$$\sum_{t=1}^{\infty} \frac{(1-u) * P * \frac{\partial Q}{\partial K} - P^K * \delta + u * D_t}{(1+R)^t} \geq P^K$$

Equation 5

where: the discount rate (R) is equal to the weighted[123] *average cost of equity (ρ) and debt (i), adjusted for interest deductibility on debt from corporation income taxes and, as shown in Equation 6, is given by:*

$$R = B * i * (1-u) + (1-B) * \rho$$

Equation 6

Each unit of invested capital will have both a direct depreciation schedule (d_t per dollar of investment “t” periods after the initial investment) and a replacement schedule of investment (δ per dollar investment in each period) that, itself, will have its own depreciation schedule. The initial increase in

[123] The weights utilized are the proportion of funds from each source, with “B” percent from debt and “1-B” percent from equity. As is standard in this kind of analysis, “B” is assumed to be a constant. That is, the optimization problem pertaining to the financial structure of the firm is assumed away. The implication of this assumption is that the firm funds any increment in its capital stock with “B” percent from debt finance and “(1-B)” from equity —either new share issues or retained earnings.

capital stock, or the initial investment, will have a schedule of depreciation allowances associated with it (D_t^{II}) that will have the following present value:

$$PV\ D_t^{II} = \sum_{t=1}^{\infty} \frac{P^K * d_t}{(1+R)^t} = P^K * Z$$

Equation 7

where: the present value of a dollar of investment can be represented by Equation 8:[124]

$$Z = \sum_{t=1}^{\infty} \frac{d_t}{(1+R)^t}$$

Equation 8

and

$$d_t \equiv is\ the\ amount\ of\ depreciation\ per\ dollar\ invested\ "t"\ periods\ after\ the\ investment$$

The replacement investment required in subsequent years to keep the capital stock at its optimal level will also have a schedule of depreciation allowances (D_t^{RI}). This will also have a present value as shown by Equation 9:

$$PV\ D_t^{RI} = \sum_{t=1}^{\infty} \frac{P^K * \delta * d_t}{(1+R)^{t+1}} + \ ... + \sum_{t=1}^{\infty} \frac{P^K * \delta * d_t}{(1+R)^{t+\infty}} = P^K * \delta * Z * \sum_{t=1}^{\infty} \frac{1}{(1+R)^t} = \frac{P^K * Z * \delta}{R}$$

Equation 9

That is, the present value of the combined depreciation is:

$$\sum_{t=1}^{\infty} \frac{D_t}{(1+R)^t} = P^K * Z + \frac{P^K * \delta * Z}{R} = P^K * Z * \frac{R+\delta}{R}$$

Equation 10

This allows the investment decision to be rewritten as Equation 11:

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[124] For a declining balance depreciation rule, where α is the capital consumption allowance rate applied on any undepreciated capital and ignoring the half-year rule, the present value per dollar of investment can be written as: Z= $\sum_{t=1}^{\infty} \frac{\alpha*(1-\alpha)^t}{(1+R)^t} = \frac{\alpha}{(\alpha+R)}$. Mintz (2010) utilizes this identity in his analysis. This relationship will be used later in this assessment, but is not necessary for the current illustration. In other words, this current discussion remains relevant, independent of the depreciation rules that apply.

$$\sum_{t=1}^{\infty} \frac{(1-u) * P * \frac{\partial Q}{\partial K} - P^K * \delta}{(1+R)^t} \geq \frac{P^K * (R - u * Z * (R + \delta))}{R}$$

Equation 11

Or, in this context, the left-hand side of Equation 11 is the present value of a constant stream and is equal to the constant stream divided by the discount rate (R), which yields:

$$\frac{\left((1-u) * P * \frac{\partial Q}{\partial K} - P^K * \delta\right)}{R} \geq \frac{P^K * (R - u * Z * (R + \delta))}{R}$$

Equation 12

This can be written more conveniently as the gross-of-tax, value of the marginal product of capital (i.e., the left hand side of Equation 13 below) being equal to the user cost of capital (i.e., the right hand side of Equation 13 below) as:

$$P * \frac{\partial Q}{\partial K} = \frac{P^K * (R + \delta) * (1 - u * Z)}{(1-u)} = c'$$

Equation 13

where: "c'" is rental price or the user cost of capital in the presence of taxes.

Since Mintz and Chen (2010) considers the Atlantic Investment Tax Credit (AITC or ϕ),[125] it is convenient to include it here. The AITC also reduces the depreciation base. As such, it can be incorporated in the user cost of capital as follows:[126]

$$P * \frac{\partial Q}{\partial K} = \frac{P^K * (R + \delta) * (1 - \emptyset) * (1 - u * Z)}{(1-u)} = c'$$

Equation 14

[125] Finance Canada reports that the Atlantic Investment Tax Credit (AITC) is available at a rate of 10 per cent in respect of eligible expenditures in the Atlantic region – i.e. Newfoundland, New Brunswick, Nova Scotia, Prince Edward Island, the Gaspé region and their associated offshore areas. The AITC is earned on eligible expenditures on new buildings, machinery and equipment employed in the following qualifying activities: farming, fishing, logging, mining, oil and gas, and manufacturing and processing. http://www.fin.gc.ca/taxexp-depfisc/1999/taxexp99_5-eng.asps .

[126] The easiest way to understand the investment tax credit in this context is to assume that the full price of the capital investment is not borne by the firm because the federal government, through the investment tax credit, picks up ϕ* P^K or the firm picks up (1-ϕ) of the price and is permitted to use only this portion of the price in calculating its capital consumption allowance. However, under the actual AITC program, not all of the invested capital expenditures are eligible for the tax credit. For example, drilling capital expenditures are not eligible for AITC, but expenditures on machinery, equipment and buildings in certain industries, such as oil and gas, are eligible. Consequently, this formulation for incorporating the AITC is not entirely correct. This point is dealt with in the detailed discussion of the Mintz (2010) analytical model, where the issue takes on more importance than in this general discussion.

Equation 14 is the key equation in this type of analysis. In the absence of any taxes, the user cost of capital ($\hat{c}$) is given by the following:

$$P * \frac{\partial Q}{\partial K} = P^K * (R + \delta) = \hat{c}$$

Equation 15

To convert these equations into pre-tax and gross-of-tax rates of return for the marginal project,[127] it is necessary to deduct rate of economic depreciation from both sides of Equation 14 and Equation 15 to give Equation 16 and Equation 17, respectively:

$$P * \frac{\partial Q}{\partial K} - P^K * \delta = \frac{P^K * (R + \delta) * (1 - \emptyset) * (1 - u * Z)}{(1 - u)} - P^K * \delta = c''$$

Equation 16

and

$$P * \frac{\partial Q}{\partial K} - P^K * \delta = P^K * R = c$$

Equation 17

where:

$$c = \hat{c} - P^K * \delta$$

Equation 18

In this context, the METR would be given by Equation 19:

$$METR = \frac{c'' - c}{c''}$$

Equation 19

[127] See Boadway et al. (1985, p. 3) and Boadway (1988, p. 77) for discussions of how to convert the gross marginal product of capital into the rate of return on the marginal project.

Appendix B: Mintz and Chen (2010) - An Evaluation

Assuming that the resource is available for extraction in year "T" and beyond, but not before, the optimization problem of the firm in Mintz (2010) is to pick the extraction path (Q_t), the capital to be invested in exploration and development (e_t), and the optimal stock of depreciable capital (K_t) to maximize the present value of the cash flow as given in Equation 20 below:[128]

$$Max\ PV\ of\ Cash\ Flow = \sum_{0}^{\infty} \frac{CF_t}{(1+R)^t}\ dt$$

Equation 20

subject to the constraint that the cumulative amount oil or gas extracted from period "T" onwards (the left-hand side of Equation 21 below) equals the cumulative amount of the resource discovered and developed from the start of the time horizon (time "0") to first period of extraction (time "T"). Specifically, oil and gas resources are discovered and developed utilizing some general technology (f[e_t]) (the right-hand side of Equation 21 below). This exploration/development and extraction constraint is:[129]

$$\sum_{T}^{\infty} Q_t\ dt = \sum_{0}^{T} f[e_t]$$

Equation 21

Assuming a constant corporate income tax rate (u); an annual rate of inflation (π); separate declining balance depreciation schedules for depreciable capital and for exploration and development investment expenditures;[130] royalty systems (T_t^R) that differ across the jurisdictions considered; and that royalties

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[128] Depreciable capital in this model is utilized only to lower the current cost of production. It does not affect the level of output and is employed to reduce the current costs of extraction, such as labour costs. This approach is effectively a restricted cost function, where capital is chosen so as to minimize current cost, given a chosen level of output. The level of output is determined by factors other than depreciable capital. In the Newfoundland and Labrador offshore context, it is not exactly clear what this might involve since most of the invested capital would occur in the development phase and would have a direct impact on the level of output produced both annually and over the project's life.

[129] A concern with this specification is that there is no exploration or development expenditure beyond T_0, the year in which extraction starts. While one could reasonably make that assumption for exploration, implying that new exploration belongs to a new project. The same assumption would not be reasonable for development expenditures, which include capital expenditures associated with drilling production wells and well work-overs. Since the costs of the development wells would normally be part of the development investment stream and a firm would not normally drill all of its development wells prior to commencing extraction, this may create problems for the Mintz (2010) model being utilized to precisely estimate the impacts of taxes and royalties on the incentive to development projects.

[130] While Mintz (2010) utilizes the same "Z" term to represent the present value of capital allowances for both exploration and development and depreciable capital, the capital allowance rate for exploration and development capital (σ) differs from the depreciation allowance for depreciable capital (α). This implies that a new term "Z' = $\sigma/(\sigma + R)$" is needed, assuming, as Mintz (2010) does, that "$Z = \alpha/(\alpha + R)$" represents the present value of the

are deductible from corporate income tax, Mintz (2010) specifies the cash flow faced by the oil and gas firm after extraction begins as:[131]

$$CF_t = \{P * Q_t - C(Q_t, K_t)\} * (1-u) * (1+\pi)^t$$
$$- (\delta * K_t + k_t) * (1 - u * Z) * (1+\pi)^t - T_t^R * (1-u)$$

Equation 22

In addition, Mintz (2010) describes the firm's cash flow prior to extraction as:[132]

$$CF_t = -e_t * (1 - u * Z') * (1+\pi)^t - T_t^R * (1-u)$$

Equation 23

In the absence of royalties but in the presence of corporate income taxes, the optimization problem can be represented as maximizing the following Lagrange equation with respect to Q_t, K_t, e_t, and λ:

$$\mathcal{L} = \sum_{t=T}^{\infty} \frac{\{P * Q_t - C(Q_t, K_t)\} * (1-u) * (1+\pi)^t}{(1+R)^t} - \sum_{t=T}^{T} \frac{(\delta * K_t + k_t) * (1 - u * Z) * (1+\pi)^t}{(1+R)^t}$$
$$- \sum_{t=0}^{T} \frac{e_t * (1 - u * Z') * (1+\pi)^t}{(1+R)^t} + \lambda\left(\sum_{t=0}^{T} f(e_t) - \sum_{t=T}^{\infty} Q_t\right)$$

Equation 24

The final step in the Mintz (2010) analysis is to specify the royalty system (T_t^R) for the jurisdiction being evaluated and carry out the optimization procedure. The optimization process involves deriving the impacts of the tax/royalty system on the after tax return on capital and the corresponding tax-adjusted user cost of capital, which, in turn, have implications for business investment decisions as manifested through the following key variables:[133]

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capital consumption allowance for depreciable capital. Clearly, "Z'" differs from "Z", except in the case where "$\sigma = \alpha$". The required adjustment is that Z' is substituted for Z in the context of exploration and development capital.

[131] Note, Z is the present value of the depreciation and u*Z is the present value of the corresponding tax savings Since gross investment has a future stream of depreciation allowances, adding (1-u*Z) to the gross investment term in the cash flow equation is equivalent to specifying a price today of the investment, net of its tax implications. A similar point was made in Mintz (1996, p. 38). As well, in the Mintz (2010) model, the present value of the declining balance depreciation allowances is given by: α/(α+R), where R is the nominal discount rate. Also, note that k_t is new investment or the change in the capital stock employed by the firm from one period to the next.

[132] Given that Mintz (2010, p. 4) assumes that royalties are "only paid after extraction begins," Equation 23 should not include a royalty term because this equation relates to the period of pre-extraction and with no output, there can be no royalty.

[133] Mintz (2010) also examines how the incentive effects of holding inventories are affected by the presence of taxes and royalties. This is less of an issue for firms operating offshore Newfoundland and Labrador and is not considered further in this assessment of the Mintz (2010) model.

1. the profile of the optimal extraction path;
2. the investment in post-production, depreciable capital; and
3. the optimal investment schedule for exploration and development.

B1: Newfoundland and Labrador Generic Royalty

Mintz (2010, p. 13) adjusts his model to accommodate the fact that Newfoundland and Labrador's offshore generic royalty consists of three distinct parts: (1) gross royalties, which are ad valorem royalties that collects a percentage of the value of oil produced, net of transportation costs. The gross royalty rate varies from 1% to 7.5% as various production, reserve and simple payout triggers are met;[134] (2) profit-sensitive royalties, known as Tier 1 royalties, that come into effect at 20% of net revenues when cumulative revenues exceed cumulative cost plus a return allowance[135] on any net cost carrying forward from one year to the next;[136] and (3) additional profit sensitive royalties, referred to as Tier 2 royalties, that are applied at 10% of net revenues when cumulative revenues exceed cumulative cost plus a return allowance[137] on any net cost carrying forward from one year to the next.

Although Mintz (2010) does model explicitly the impacts of Newfoundland and Labrador's Tier 1 and Tier 2 royalties, there is no specific analysis included of the gross royalty. However, as part of the analysis of conventional oil and gas royalties in Alberta, Mintz (2010) does demonstrate how an ad valorem royalty would impact extraction and investment in both depreciable assets and through exploration and development expenditures. His reason for not including a separate analysis of the gross royalty is that the results for the user cost of capital in the presence of the gross royalty are "similar to the conventional oil and gas project in Alberta."[138] Therefore, one could presumably infer the effects of the gross royalty on the cost of capital from the results derived for Alberta's conventional oil and gas ad valorem royalty.

In the Mintz (2010) analysis applied to the Newfoundland and Labrador generic offshore royalty regime, it is possible to distinguish six time periods, demarcated by three specific years. Since each time period has its own cash flow equation, there are six components to the objective function,[139] which results in a more complex optimization problem than exists with the two cash flow equations in the general model

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[134] While not explicitly considered in the Mintz (2010) analysis, the gross royalty rate will increase to 5% when simple payout is achieved (i.e., the point in time at which cumulative revenues equals cumulative costs), even if the production triggers would imply a lower royalty rate. As well, for small fields, (i.e., fields with less than 250 million barrels of recoverable oil), the gross royalty rate would increase to 2.5% when 20% of the reserves are produced, even though the gross royalty trigger would still imply that 1% should be utilized.

[135] The return allowance for Tier 1 royalty calculations is the sum of 5% and the long term government bond rate.

[136] Assuming 6% as the long-term government bond rate, Tier 1 royalties become effective after the project earns a nominal rate of return of 11% (i.e., 5% + 6%). As well, this would imply that the Tier 2 royalty would become effective after the project earned a rate of return of 21% (i.e., 6% + 15%).

[137] The return allowance for Tier 2 royalty calculations is the sum of 15% and the long term government bond rate.

[138] Mintz (2010, p. 13).

[139] Although in the actual model presented, Mintz (2010, p. 14) only distinguishes five time periods. For some reason, Mintz (2010) combine the pre-extraction and the extraction period that occurs prior to Tier 1 royalty payout into one period consisting of all time periods prior to Tier 1 royalty payout being achieved.

applied to other jurisdictions—the equation for the exploration and development phase and the equation for extraction phase.

The three demarcation years are:

- T_0 — the year in which extraction commences;
- T_1 — the year in which Tier 1 royalty payout is achieved; and
- T_2 — the year in which Tier 2 royalty payout is achieved.

The six periods are:

(1) $t< T_0$ — the period in which only exploration and development are being undertaken. During this period, there is no extraction occurring and no royalties are paid;

(2) $T_0 \leq t < T_1$ — the period in which extraction commences, but neither Tier 1 nor Tier 2 royalty payout is achieved. During this period, only gross royalties are collected;

(3) T_1 is the year in which Tier 1 royalty payout is achieved and for part of the year only gross royalties are paid, while for the rest of the year, Tier 1 royalties are paid;[140]

(4) $T_1<t<T_2$ — the period when Tier 1 royalty payout has been surpassed, but Tier 2 royalty payout is not yet achieved so that only Tier 1 are paid;

(5) T_2 is the period in which Tier 2 royalty payout is achieved and for part of the year, only Tier 1 royalties are paid and for the rest of the year, Tier 1 royalties and Tier 2 royalties are paid; and

(6) $t>T_2$ —the period beyond which Tier 2 royalty payout is satisfied and Tier 2 royalties become payable in addition to Tier 1 royalties. However, return allowances are no longer in effect.[141]

Since the gross royalty is likely to be the only part of the generic royalty to be in effect for marginal projects in offshore Newfoundland and Labrador, the relevant parts of the ad valorem royalty analysis are replicated below. This is followed by the corresponding analysis utilized by Mintz (2010) for Tier 1 and Tier 2 royalties.

B2: Mintz (2010): Ad Valorem Royalty/Gross Royalty

Mintz (2010, p. 6) first applies his model to conventional oil and gas in Alberta where provincial royalties are characterized as ad valorem (i.e., percent of value) royalties. This is similar to the gross royalty under the Newfoundland and Labrador generic offshore royalty, except that the rate is constant

[140] It is assumed throughout this evaluation that any years in which Tier 1 and gross royalties are payable, the value of Tier 1 royalties exceed the value of gross royalties. Hence, since gross royalties are credit against Tier 1 royalties, Tier 1 royalties effectively replace the gross royalties. However, if this were not the case, then the minimum royalty payment is determined by the gross royalty obligation.

[141] In a real world environment, a significant expansion of a project with substantial capital outlays could be sufficient to cause the return allowance to restart, but this is unlikely for the kinds of projects being considered in Mintz (2010).

in Mintz (2010) but varies under the generic offshore regime.[142] As well, the gross royalty base in the Mintz (2010) model does not include an explicit deduction for transportation cost to the well head.[143] In this formulation, the ad valorem royalties in Mintz (2010) are calculated as:

$$T_t^R = \tau * P * (1+\pi)^t * Q_t$$

Equation 25

The addition of ad valorem royalties changes the previous optimization problem by applying an adjustment factor $(1-\tau)$[144] only to the revenue earned by the firm. Mechanically, wherever P showed up previously, $(1-\tau) * P$ replaces it and the optimization procedure is otherwise unaltered. This would involve rewriting Equation 22 and Equation 23 as follows:

$$CF_t = \{(1-\tau) * P * Q_t - C(Q_t, K_t)\} * (1-u) * (1+\pi)^t - (\delta * K_t + k_t) * (1 - u * Z) * (1+\pi)^t$$

Equation 26

$$CF_t = -e_t * (1 - u * Z') * (1+\pi)^t$$

Equation 27

When Equation 26 and Equation 27 are substituted for Equation 22 and Equation 23, the optimization procedure is undertaken in an identical manner to the "no-royalty" case, except for the adjustment on revenue. The optimization problem can be represented as maximizing the following Lagrange equation with respect to Q_t, K_t, e_t, and λ:

$$\mathcal{L} = \sum_{t=T}^{\infty} \frac{\{(1-\tau) * P * Q_t - C(Q_t, K_t)\} * (1-u) * (1+\pi)^t}{(1+R)^t} - \sum_{t=T}^{\infty} \frac{(\delta * K_t + k_t) * (1 - u * Z) * (1+\pi)^t}{(1+R)^t} - \sum_{t=0}^{T} \frac{e_t * (1 - u * Z') * (1+\pi)^t}{(1+R)^t} + \lambda * \left(\sum_{t=0}^{T} f(e_t) - \sum_{t=T}^{\infty} Q_t\right)$$

Equation 28

B2.1 Output Effect of Ad Valorem Royalty/Gross Royalty

[142] The gross royalty rate under the Newfoundland and Labrador offshore generic royalty increases from 1% to 7.5% of the value of output less transportation costs as various production, reserve, and/or simple payout triggers are met.

[143] While not explicitly acknowledged, it is possible that Mintz (2010) is interpreting the price and current costs to be net of transportation cost. If this is the case, then no other adjustment is required to these equations.

[144] Here τ is the ad valorem royalty rate.

The first order condition for this optimization with respect to extraction in any given time period "t" from year "T" and beyond is derived by taking the derivative of Equation 28 with respect to Q_t and rearranging to yield:

$$\frac{[(1-\tau)*P - C']*(1+\pi)^t*(1-u)}{(1+R)^t} = \frac{[(1-\tau)*P - C']*(1-u)}{(1+r)^t} = \lambda$$

Equation 29

where λ is the Lagrangian multiplier and indicates how the present value of profits net of taxes and royalties changes per increment in the quantity of resources discovered and developed. Alternatively, it is the scarcity rent or the user cost of the resource.

Utilizing Equation 29, the first order condition for period t+1, and rearranging to eliminate λ yields the standard Hotelling rule result for the optimal extraction between adjacent time periods. Specifically, the scarcity rent from extracting the resource ought to grow at the rate of interest and is illustrated by:[145]

$$\frac{p*(1-\tau) - C''}{P*(1-\tau) - C'} = \frac{p - \frac{C''}{(1-\tau)}}{P - \frac{C'}{(1-\tau)}} = r$$

Equation 30

where p is the time change in the output price, C' is the first derivative of the current cost function with respect to amount of output extracted and C'' is the corresponding second derivative.

There are no changes required to Equation 30 to reflect the impact of Newfoundland and Labrador's gross royalty on the optimal extraction path.[146]

Equation 30 is the standard Hotelling's rule result that the optimal extraction path is delayed in the presence of ad valorem royalties. That is, as is well-established in the literature, if there were no other factors to take into account, or *ceteris paribus*, the introduction of an ad valorem royalty in the Mintz (2010, p. 6) model would induce a competitive, price-taking firm to behave like a conservationist and delay or tilt extraction to the future. In this scenario, the ad valorem royalty would be equivalent to an increase in cost.[147]

However, everything is not the same in that Mintz (2010) is comparing the introduction of the ad valorem royalty in combination with a corporate income tax to the situation that would exist if there were neither taxes nor royalties. The additional complication when the impacts of royalties and

[145] Note that this is similar to Equation 8 in the Mintz (2010, p. 6), except the C'' and C' have been transposed because there appears to be a typo in the original Mintz (2010) equation. Interestingly, this typo appears to have been picked up in a corresponding equation for the oil sands royalty. That is, Equation 14 in Mintz (2010, p. 9).
[146] This assumes that both price and current costs are net of transportation cost so that the price is a net back price to the wellhead.
[147] In particular, the result would be the same as cost being increased or scaled up by the factor $1/(1-\tau)$.

corporate taxes are considered together is that the interest deductibility allowed through the corporation income tax does lower the after-tax cost of finance. A lower cost of finance implies that more projects will pass the hurdle rate and output will increase. Consequently, the combination of the ad valorem royalty and the interest deductibility work in opposite directions. Their combined impact could be to increase or decrease the amount of extraction in the earlier periods. At this point, it is important to appreciate that impact of the royalty in isolation is to delay production and the impact of the interest deductibility is to increase production by lowering the cost of capital. It is an empirical question which effect dominates.

B2.2 Depreciable Capital Effects of Ad Valorem Royalty/Gross Royalty

Taking the first order condition with respect to depreciable capital (K_t) and rearranging yields the following cost of capital for the Alberta illustration:

$$C_K = \frac{(\delta + R - \pi) * (1 - u * Z)}{(1 - u)}$$

Equation 31

To convert this into the corresponding cost of depreciable cost of capital in the Newfoundland and Labrador context, the AITC ($\emptyset$) needs to be incorporated into the optimization. Making this adjustment generates the following:

$$C_K = \frac{(\delta + R - \pi) * (1 - u * Z) * (1 - \emptyset)}{(1 - u)}$$

Equation 32

Since, in the Mintz (2010) model, investments in depreciable capital do not affect output, but only contribute to the current cost of extracting the output through the substitution capital for labour, the ad valorem royalty does not impact directly the cost of depreciable capital. That is, τ does not show up in Equation 31 and Equation 32, above. However, the corporate income tax and its various depreciation rules do impact the cost of capital in exactly the same way as it would in the absence of royalties.

B2.3 Exploration and Development Effects of Ad Valorem Royalty/Gross Royalty

The first derivative of the Lagrange function (Equation 28) with respect to e_t yields Equation 33:

$$\lambda * f_t' = \frac{(1 - u * Z')}{(1 + r)^t}$$

Equation 33

Using Equation 29 to eliminate λ gives Equation 34:

$$\frac{[(1-\tau)*P_T - C_T'] * (1-u)}{(1+r)^T} * f_t' = \frac{(1-u*Z')}{(1+r)^t}$$

Equation 34

This can be more conveniently rewritten as Equation 35:

$$\frac{[P_T - C_T' - \tau * P_T] * (1-u)}{(1+r)^T} * f_t' = \frac{(P_T - C_T') * [1 - \tau * \frac{P_T}{P_T - C_T'}] * (1-u)}{(1+r)^T} * f_t' = \frac{(1-u*Z')}{(1+r)^t}$$

Equation 35

Rearranging gives the cost of capital for exploration and development represented by Equation 36:

$$(P_T - C_T') * f_t' = \frac{(1-u*Z') * (1+r)^{(T-t)}}{(1-u) * \{1 - \tau * \frac{P_T}{P_T - C_T'}\}}$$

Equation 36

The left-hand side of Equation 36 illustrates the marginal increase in extractable resource (f_t') per dollar invested in exploration and development (e_t) times the rent earned per unit extracted $(P_T - C_T')$ in the first year of extraction. That is, it is the marginal revenue from investing in exploration and development. The right-hand side of Equation 36 corresponds to the marginal cost or the user cost of capital. Since Mintz (2010, p.7) suggests that $\tau * \frac{P_T}{P_T - C_T'} < 1$, the cost of exploration and development capital is increased in the presence of an ad valorem royalty. This implies that some exploration at the margin will be discouraged, but the interest deductibility in the corporate tax, working through the discount rate, tends to lower the cost of capital, which increases the incentive to explore and develop marginal oil and gas projects. That is, whether a combined ad valorem royalty and a corporate tax raises or lowers the cost of capital is an empirical issue.

At this point, it is important to recognize that only part of the pre-production expenditures (i.e., the portion related to exploration), can be expensed and claimed immediately.[148] The remaining exploration and development expenditures (i.e., the development expenditures) are depreciated over time at the rate "σ" on a declining balance basis, with any undepreciated development expenditures carried forward.[149] Even though Mintz (2010, p.5) does acknowledge that "exploration is expensed but development is capitalized and written off at the declining balance rate σ," this does not appear to be reflected in the model. That is, it is not clear whether the portion of $e_t * (1+\pi)^t$ associated with exploration has been expensed in this formulation. In fact, it appears that none of exploration

[148] In Canada, this is consistent with the Canadian Exploration Expenses being fully expensed. While Mintz (2010) does acknowledge that part of the exploration and development expenditures is expensed, it is not clear that this acknowledgement has been reflected in the mathematical model he utilizes. This is dealt with in detail below.
[149] This is consistent with the Canadian Development Expenses being depreciated on a declining balance.

expenditures has been expensed because the full amount of e_t is considered as part of the capital allowance base. This may require adjusting exploration and development expenses as follows:

$$e_t = a_t * e_t + (1 - a_t) * e_t$$

Equation 37

where: "a" is the fraction of exploration and development expenditures that come under the Canadian Exploration Expenses (CEE) and would normally be written off immediately and "(1-a)" would be the part of exploration and development expenses that would be written off over time at the rate "σ" per year for the purposes of assessing corporation income tax liabilities.

An additional issue that affects value of the METRR calculated by Mintz and Chen (2010) is that the Atlantic Investment Tax Credit in the Mintz (2010) model applies only to depreciable capital. In fact, the largest benefit from the AITC relates to the non-drilling development expenditures that are grouped in Mintz (2010) under the rubric of exploration and development. Therefore, some portion (δ_t) of the exploration and development expenditure that is offset by a credit against federal corporate income taxes or the exploration and development expenditure (Equation 37) can be represented by:

$$e_t = a_t * e_t + (1 - a_t) * (1 - \emptyset * \delta_t) * e_t$$

Equation 38

Incorporating the impact of the Atlantic Investment Tax Credit ($\emptyset$) on depreciable capital and on the relevant portion of exploration and development capital and the expensing of exploration investment would require re-specifying the optimization problem as follows:

$$\mathcal{L} = \sum_{t=T}^{\infty} \frac{\{(1-\tau) * P * Q_t - C(Q_t, K_t)\} * (1-u) * (1+\pi)^t}{(1+R)^t}$$

$$- \sum_{t=T}^{T} \frac{(\delta * K_t + k_t) * (1 - u * Z) * (1 - \emptyset) * (1+\pi)^t}{(1+R)^t}$$

$$- \sum_{t=0}^{T} \frac{e_t * (1 - u * (a_t + Z' * (1 - a_t) * (1 - \emptyset * \delta_t)) * (1+\pi)^t}{(1+R)^t}$$

$$+ \lambda * (\sum_{t=0}^{T} f(e_t) - \sum_{t=T}^{\infty} Q_t)$$

Equation 39

Making this adjustment to reflect actual tax laws, this would require rewriting Equation 36 as:

$$(P_T - C_T') * f_t' = \frac{(1 - u * [a_t + Z' * (1 - a_t) * (1 - \emptyset * \delta_t)]) * (1 + r)^{(T-t)}}{(1 - u) * \{1 - \tau * \frac{P_T}{P_T - C_T'}\}}$$

Equation 40

Note that if a_t and δ_t are zero in Equation 40, then this equation reduces to Equation 36, the equation utilized in Mintz (2010). However, if a_t has a positive value, which it would if some portion of the exploration and development expenditure is fully expensed as would be the case under the Canadian Exploration Expense provisions of the corporate income tax in Canada and δ_t has a positive value, which it does under the current legislation pertaining to the AITC, then an adjustment to the Mintz (2010) model would be needed. The user cost of exploration and development capital would be lower. This, of course, would have implications for the value of the METRR that are calculated in Mintz and Chen (2010).

B2.3 Mintz (2010): Introducing Tier 1 and Tier 2 Royalties

To help the reader appreciate how Tier 1 and Tier 2 royalties work in the Newfoundland and Labrador context, Mintz (2010) first provides a mathematical description of how the present value of each royalty is calculated. The present value of Tier 1 royalties is represented by Mintz (2010) as:[150]

$$NR_1 = \sum_{T_1+1}^{T_2} \frac{\tau_1 * RB_t}{(1+R)^t} + \frac{\tau_1}{(1+R)^{T_1}} * \sum_0^{T_1} RAB_t^1 * (1+\varphi_1)^{T_1-t}$$

Equation 41

where RB_t will be referred to as the royalty base and RAB_t^1 will denote the return allowance base for calculating the Tier 1 royalty payout and are given by:

$$RB_t = P * (1+\pi)^t * Q_t - C(Q_t, K_t) * (1+\pi)^t - (\delta * K_t + k_t) * (1+\pi)^t$$

Equation 42

$$RAB_t^1 = RB_t - e_t * (1+\pi)^t$$

Equation 43

and Mintz (2010) models the present value of Tier 2 royalties as:

$$NR_2 = \sum_{T_{2+1}}^{\infty} \frac{\tau_2 * RB_t}{(1+R)^t} + \frac{\tau_2}{(1+R)^{T_2}} * \sum_0^{T_2} RAB_{t_t}^{\ 2} * (1+\varphi_2)^{T_2-t}$$

Equation 44

[150] Note the terms RB_t and RAB_t^1 and RAB_t^2 were not utilized in Mintz (2010). These terms are employed here only for notational simplicity and to facilitate comparison across equations.

where RAB_t^2 indicates the return allowance base for calculating the Tier 2 royalty payout. Even though this is specified as being identical to RAB_t^1 in Mintz (2010), it should not be and to facilitate further assessment of the Mintz (2010) approach, it is, for the moment, reproduced below as a separate equation:

$$RAB_t^2 = RB_t - e_t * (1+\pi)^t$$

Equation 45

Equation 41 and Equation 44 epitomize some of the problems with how Mintz (2010) analyzes Newfoundland and Labrador's generic royalties. The first problem relates to the fact that Equation 41 corresponds to the present value of Tier 1 royalties up to and including the year of Tier 2 payout.[151] It does not include any Tier 1 royalties that are payable beyond T_2. In other words, even though Tier 1 royalties continue to be payable even when Tier 2 royalties come into effect, Mintz (2010) does not include Tier 1 royalties beyond year T_2.

While one might be tempted to assume that the Tier 2 royalty rate (τ_2) is really the sum of the 20% Tier 1 rate and the 10% Tier 2 rate, this is not what was assumed explicitly. Moreover, if τ_2 is really the sum of 10% and 20%, then the equation for Tier 2 royalties (Equation 44 above) is incorrect. In particular, the last term of Equation 44 is only correct if τ_2 is 10% because the return allowance applied in this part of the equation that relates to φ_2 (i.e., 15% plus the long-term government bond rate). Otherwise, the Tier 1 royalties that are payable for the rest of year T_2 are either missing or the portion of Tier 1 royalties that occurs after Tier 2 payout in year T_2 are double counted because they are already included in Equation 41 to the end of year T_2.

The second problem relates to the fact that in calculating the return allowance to determine Tier 1 payout, Mintz (2010) omitted the gross royalty which is part of the base for the return allowance. This adjustment requires rewriting Equation 43 as follows:

$$\widehat{RAB_t^1} = RB_t - e_t * (1+\pi)^t - \tau * P_t * Q_t$$

Equation 46

The third problem with the Mintz (2010) specification is that Tier 1 royalties are included in the return allowance calculation for determining Tier 2 payout. This involves rewriting Equation 45 as:

$$\widehat{RAB_t^2} = (1-\tau_1) * RB_t - e_t * (1+\pi)^t$$

Equation 47

The fourth problem is that the Mintz (2010) formulation omits permissible uplifts on capital and operating costs. Specifically, in calculating royalties and royalty payouts under Newfoundland and

[151] The failure to include Tier 1 royalties beyond Tier 2 payout is surprising since Mintz and Chen (2010, p. 4) notes that the "second-tier net royalty rate is 10% (added to the 20% first-tier rate)…resulting in a potential royalty rate of 30% on net revenues…"

Labrador's generic offshore regime, there is an uplift on eligible capital and eligible operating costs. The uplift is 1% for capital and 10% for operating costs. Hence, in calculating the base for Tier 1 and Tier 2 royalties and for the calculating the return allowance for the royalty payout calculation, a firm would utilize 101% of the amount it actually spent on eligible capital costs and 110% of what it actually spent on eligible operating costs.[152]

Incorporating the uplift provisions of the generic offshore royalty would require adding additional parameters to the Mintz (2010) model to reflect the eligible uplifts. This uplift would apply to both eligible depreciable capital and eligible development expenditures so that Equation 42, Equation 46 and Equation 47 would be rewritten as:

$$\widehat{RB}_t = P * (1+\pi)^t * Q_t - (1+UL^O) * \varepsilon_t^O * C(Q_t, K_t) * (1+\pi)^t$$
$$-(1+UL^C) * \varepsilon_t^C * (\delta * K_t + k_t) * (1+\pi)^t$$

Equation 48

$$\widehat{RAB}_t^1 = RB_t - (1+UL^C) * \varepsilon_t^D * e_t * (1+\pi)^t - \tau * P_t * Q_t$$

Equation 49

$$\widehat{RAB}_t^2 = (1-\tau_1) * RB_t - (1+UL^C) * \varepsilon_t^D * e_t * (1+\pi)^t$$

Equation 50

where UL^O is the 10% uplift on eligible operating costs, UL^C is the 1% uplift on eligible capital costs and ε_t^O, ε_t^C and ε_t^D are, respectively, the proportion of current expenditures that are eligible for an uplift in year t, the proportion of depreciable capital expenditures that are eligible for an uplift in year t and the proportion of exploration and development expenditures that are eligible for the uplift in year t.

Making these corrections causes the present value of Tier 1 and Tier 2 royalties to be written, respectively, as:

$$NR_1 = \sum_{T_1+1}^{\infty} \frac{\tau_1 * \widehat{RB}_t}{(1+R)^t} + \frac{\tau_1}{(1+R)^{T_1}} * \sum_0^{T_1} \widehat{RAB}_t^1 * (1+\varphi_1)^{T_1-t}$$

Equation 51

$$NR_2 = \sum_{T_{2+1}}^{\infty} \frac{\tau_2 * \widehat{RB}_t}{(1+R)^t} + \frac{\tau_2}{(1+R)^{T_2}} * \sum_0^{T_2} \widehat{RAB}_{t_t}^{2} * (1+\varphi_2)^{T_2-t}$$

Equation 52

[152] In calculating royalties, transportation and transshipment costs are not subject to an uplift.

These omissions will both overestimate the size of Tier 1 and Tier 2 royalties payable in any given period and will tend to overstate the extent to which φ_1 and φ_2 in the Mintz (2010) formulation acts as a "subsidy" on marginal investments. The implication of these omissions for the METRR will be dealt with below. The next section will continue on with the Mintz (2010) analysis as presented originally in his paper.

B2.4 Mintz (2010): Decomposing the Objective Function by Time Periods

The cash flow equations considered by Mintz (2010) are provided below. While there are specific concerns with this particular specification, it will be presented as provided in Mintz (2010), but suggested corrections will be explained in the next section.

For time periods beyond of T_2 (i.e., after the Tier 2 royalty payout is achieved and Tier 2 royalties are payable), Mintz (2010) specifies the company's objective function (cash flow) as:

$$CF_t = [P * Q_t - C(Q_t, K_t)] * (1+\pi)^t * (1-u) * (1-\tau_2)$$
$$-(\delta * K_t + k_t) * (1+\pi)^t * [(1-u*Z)*(1-\emptyset) - \tau_2 * (1-u)]$$

Equation 53

During the year in which Tier 2 royalty payout is achieved, the objective function in Mintz (2010) becomes:

$$CF_t = [P * Q_t - C(Q_t, K_t)] * (1+\pi)^t * (1-u) * (1-\tau_2)$$
$$-(\delta * K_t + k_t) * (1+\pi)^t * [(1-u*Z)*(1-\emptyset) - \tau_2 * (1-u)] +$$
$$\tau_2 * (1-u) * \sum_0^{T_2-1} RAB_t^2 * (1+\varphi_2)^{T_2-1}$$

Equation 54

For the years after which Tier 1 royalty payout is achieved, but before Tier 2 royalty payout is reached (i.e., $T_2>t>T_1$), Mintz (2010) specifies the objective function for the firm as:

$$CF_t = [P * Q_t - C(Q_t, K_t)] * (1+\pi)^t * (1-u) * (1-\tau_1)$$
$$-(\delta * K_t + k_t) * (1+\pi)^t * [(1-u*Z)*(1-\emptyset) - \tau_1 * (1-u)]$$

Equation 55

For the year in which Tier 1 royalty payout is achieved (i.e., $t=T_1$), the objective function in Mintz (2010) becomes:

$$CF_t = [P * Q_t - C(Q_t, K_t)] * (1+\pi)^t * (1-u) * (1-\tau_1)$$
$$-(\delta * K_t + k_t) * (1+\pi)^t * [(1-u*Z)*(1-\emptyset) - \tau_1 * (1-u)] +$$

$$\tau_1 * (1-u) * \sum_0^{T_1-1} RAB_t^1 * (1+\varphi_1)^{T_1-1}$$

Equation 56

For the period prior to the year of Tier 1 payout (i.e., $0<t<T_1$), Mintz (2010) models the company's objective function as:

$$CF_t = -e_t * (1 - u * Z) * (1+\pi)^t$$

Equation 57

B2.5 Mintz (2010): The Optimization Problem – Tier 1 and Tier 2 Royalties

Mintz (2010) derives the optimal conditions for extraction. He focuses only on the optimizing decisions that would occur under either Tier 1 or Tier 2, but not under the ad valorem or gross royalty. Given how Mintz (2010) decomposes the cash flow periods,[153] the optimization problem faced by the firm becomes:

[153] Since the period $0<t<T_1$ is really two distinct time periods – $0<t<T_0$ (pre-extraction) and $T_0<t<T_1$ (extraction prior to Tier 1 payout), the optimization problem has been adjusted to reflect this.

$$\mathcal{L} = -\sum_{t=0}^{T_0} \frac{e_t * (1 - u * Z') * (1 + \pi)^t}{(1 + R)^t} + \sum_{t=T_0}^{T_1 - 1} \frac{\{(1 - \tau) * P * Q_t - C(Q_t, K_t)\} * (1 - u) * (1 + \pi)^t}{(1 + R)^t}$$

$$- \sum_{t=T_0}^{T_1 - 1} \frac{(\delta * K_t + k_t) * (1 - u * Z) * (1 - \emptyset) * (1 + \pi)^t}{(1 + R)^t}$$

$$+ \tau_1 * (1 - u) * \frac{\sum_{t=0}^{T_1 - 1} RAB_t^1 \ * (1 + \varphi_1)^{T_1 - t}}{(1 + R)^{T_1}} + \tau_2 * (1 - u) * \frac{\sum_{t=0}^{T_2 - 1} RAB_t^2 \ * (1 + \varphi_2)^{T_2 - t}}{(1 + R)^{T_2}}$$

$$+ \sum_{t=T_1}^{T_2 - 1} \frac{[P * Q_t - C(Q_t, K_t)] * (1 + \pi)^t * (1 - u) * (1 - \tau_1)}{(1 + R)^t}$$

$$- \sum_{t=T_1}^{T_2 - 1} \frac{(\delta * K_t + k_t) * (1 + \pi)^t * [(1 - u * Z) * (1 - \emptyset) - \tau_1 * (1 - u)]}{(1 + R)^t}$$

$$+ \sum_{t=T_2}^{\infty} \frac{[P * Q_t - C(Q_t, K_t)] * (1 + \pi)^t * (1 - u) * (1 - \tau_2)}{(1 + R)^t}$$

$$- \sum_{t=T_2}^{\infty} \frac{(\delta * K_t + k_t) * (1 + \pi)^t * [(1 - u * Z) * (1 - \emptyset) - \tau_2 * (1 - u)]}{(1 + R)^t} + \lambda * (\sum_{t=0}^{T} f(e_t) - \sum_{t=T}^{\infty} Q_t)$$

Equation 58

B2.5.1 Output Effect – Tier 1 and Tier 2 Royalties

Mintz (2010, p. 14) suggests that the impact of the Newfoundland and Labrador generic offshore royalty depends upon whether Tier 1 or Tier 2 royalties are in effect. For the period T_1<t<T_2 (the period before Tier 2 royalties are payable, Mintz (2010) derives the first order condition for the optimal extraction path from Equation 58 as follows in Equation 59:

$$\frac{(P - C') * (1 - u) * \{(1 - \tau_1) + \tau_2 * (1 + \varphi_1 - R)^{T_2 - t}\}}{(1 + r)^t} = \lambda$$

Equation 59

There appears to be a typo in Equation 59 (the original Equation 25 in Mintz (2010)) and φ_1 should be replaced by φ_2 and Equation 59 should be rewritten as Equation 60:

$$\frac{(P - C') * (1 - u) * \{(1 - \tau_1) + \tau_2 * (1 + \varphi_2 - R)^{T_2 - t}\}}{(1 + r)^t} = \lambda$$

Equation 60

For periods in which the Tier 2 royalty is payable (i.e., $t>T_2$), the optimal extraction path is derived from Equation 61:

$$\frac{(P - C') * (1 - u) * (1 - \tau_2)}{(1 + r)^t} = \lambda$$

Equation 61

If only Tier 1 is reached, then the optimal extraction path in Mintz (2010) is solved from Equation 62:

$$\frac{(P - C') * (1 - u) * (1 - \tau_1)}{(1 + r)^t} = \lambda$$

Equation 62

B2.5.2 Depreciable Capital Effect – Tier 1 and Tier 2 Royalties

Similarly, Mintz calculates the user cost associated with depreciable capital for two distinct time periods —the period for which $t>T_2$ and the period for which $T_1<t<T_2$. The user cost of capital for $t>T_2$ is given by Equation 63:

$$-C_k = (\delta + R - \pi) * \frac{(1 - u * Z) * (1 - \emptyset) - \tau_2 * (1 - u)}{(1 - u) * (1 - \tau_2)}$$

Equation 63

If Tier 2 is never reached and only Tier 1 is in effect, then Mintz (2010, fn 8, p. 16) suggests that the user cost of capital would ignore Tier 2 royalties. This would involve rewriting Equation 63 as Equation 64:

$$-C_k = (\delta + R - \pi) * \frac{(1 - u * Z) * (1 - \emptyset) - \tau_1 * (1 - u)}{(1 - u) * (1 - \tau_1)}$$

Equation 64

For $T_1<t<T_2$, the user cost of capital for depreciable capital is given by Equation 65:

$$-C_k = (\delta + R - \pi) * \frac{(1 - u * Z) * (1 - \emptyset) - (1 - u) * [\tau_1 + \tau_2 * (\delta + \pi) * (1 + \varphi_2 - R)^{(T_2 - t)}]}{(1 - u) * [1 - \tau_1 - \tau_2 * (1 + \varphi_2 - R)^{(T_2 - t)}]}$$

Equation 65

B2.5.3 Exploration and Development – Tier 1 and Tier 2 Royalties

The key equation in the Mintz (2010) model and in the Mintz and Chen (2010) conclusion that Newfoundland and Labrador's generic offshore royalty "subsidizes" investment and leads to overinvestment in Newfoundland and Labrador's offshore developments is his Equation (28) and the corresponding equation in footnote (8). The user cost of capital for the exploration and development investment if Tier 2 payout is eventually achieved is given by Equation 66:

$$(P - C') * f_t' = (1+r)^{(T_2-t)} * \frac{1 - u * Z' - (1-u) * [\tau_2 * (1+\varphi_2 - R)^{(T_2-t)} + \tau_1 * (1+\varphi_1 - R)^{(T_1-t)}]}{(1-u) * (1-\tau_2)}$$

Equation 66

If only Tier 1 payout is achieved and Tier 2 is not expected to be reached, then the user cost of capital is represented by:[154]

$$(P - C') * f_t' = (1+r)^{(T_1-t)} * \frac{1 - u * Z' - (1-u) * \tau_1 * (1+\varphi_1 - R)^{(T_1-t)}}{(1-u) * (1-\tau_1)}$$

Equation 67

The suggested subsidization comes through φ_1 and φ_2 exceeding R (the nominal discount rate) in the above equations.

B2.6 Correcting the Mintz (2010) the Objective Function by Time Periods

There are a number of specification issues in Mintz (2010) and, by extension, Mintz and Chen (2010) that need to be addressed. Specifically, Mintz (2010) needs to recognize that: (1) Tier 1 royalties continue to apply even in the presence of Tier 2 royalties (i.e., Tier 2 royalties supplement, rather than replace, Tier 1 royalties); (2) eligible capital and operating costs should be uplifted for calculating Tier 1 and Tier 2 royalties and the corresponding royalty payouts; (3) the AITC applies to eligible development expenditures; (4) the gross royalties are deductible from the Tier 1 royalties payout calculations; (5) Tier 1 royalties are deductible from the royalty payout calculations for Tier 2 royalties; (6) a portion of the exploration and development expenditures is expensed; and (6) the period prior to Tier 1 payout really consist of two sub-periods —pre-extraction and extraction up to the point when the Tier 1 royalty

[154] Note that the original specification, (Mintz (2010, fn 8, p. 16), had $(1+r)^{(T_2-t)}$had on the right-had side of Equation 67**Error! Reference source not found.**. This has been replaced by $(1+r)^{(T_1-t)}$ because T_2 no longer has any meaning in the context of Tier 2 royalty payout not being achieved.

payout is achieved. Making these adjustments has significant implications for the cost of capital and the METRR presented in Mintz and Chen (2010).

For instance, the adjusted cash flow for time periods beyond of T_2 requires adding uplift factors for current operating expenditures and for capital expenditures to lower the effective royalty rates. That is, the uplift factors reduce the base which statutory rates apply to so that the effective tax rates are correspondingly reduced by the uplift factors. For period T_2 and beyond, the adjusted cash flow becomes:

$$CF_t = (1+\pi)^t * (1-u) * \{[P * Q_t - C(Q_t, K_t)] - (\tau_1 + \tau_2) * [P * Q_t - C(Q_t, K_t) * \varepsilon_t^O * (1 + UL^O)]\}$$
$$-(\delta * K_t + k_t) * (1+\pi)^t * [(1 - u * Z) * (1 - \emptyset) - (\tau_1 + \tau_2) * \varepsilon_t^C * (1 + UL^C) * (1-u)]$$

Equation 68

During the year in which Tier 2 royalty payout is achieved, the objective function in Mintz (2010) is modified as follows:

$$CF_t = (1+\pi)^t * (1-u) * \{[P * Q_t - C(Q_t, K_t)] - (\tau_1 + \tau_2)[P * Q_t - C(Q_t, K_t) * \varepsilon_t^O * (1 + UL^O)]\}$$
$$-(\delta * K_t + k_t) * (1+\pi)^t * [(1 - u * Z) * (1 - \emptyset) - (\tau_1 + \tau_2) * \varepsilon_t^C * (1 + UL^C) * (1-u)] +$$
$$\tau_2 * (1-u) * \sum_0^{T_2 - 1} \widehat{RAB}_t^2 * (1 + \varphi_2)^{T_2 - 1}$$

Equation 69

For the years after which Tier 1 royalty payout is achieved, but before Tier 2 royalty payout is reached (i.e., $T_2 > t > T_1$), the cash flow for the firm is represented as:

$$CF_t = (1+\pi)^t * (1-u) * \{[P * Q_t - C(Q_t, K_t)] - \tau_1[P * Q_t - C(Q_t, K_t) * \varepsilon_t^O * (1 + UL^O)]\}$$
$$-(\delta * K_t + k_t) * (1+\pi)^t * [(1 - u * Z) * (1 - \emptyset) - \tau_1 * \varepsilon_t^C * (1 + UL^C) * (1-u)]$$

Equation 70

The year in which Tier 1 royalty payout is achieved (i.e., $t = T_1$) has its cash flow equation altered as follows:

$$CF_t = (1+\pi)^t * (1-u) * \{[P * Q_t - C(Q_t, K_t)] - \tau_1[P * Q_t - C(Q_t, K_t) * \varepsilon_t^O * (1 + UL^O)]\}$$
$$-(\delta * K_t + k_t) * (1+\pi)^t * [(1 - u * Z) * (1 - \emptyset) - \tau_1 * \varepsilon_t^C * (1 + UL^C) * (1-u)] +$$
$$\tau_1 * (1-u) * \sum_0^{T_1 - 1} \widehat{RAB}_t^1 * (1 + \varphi_1)^{T_1 - 1}$$

Equation 71

For the period prior to the year of Tier 1 payout but after extraction has commenced (i.e., $T<t<T_1$), the cash flow is specified as:

$$CF_t = \{(1-\tau) * P * Q_t - C(Q_t, K_t)\} * (1-u) * (1+\pi)^t - (\delta * K_t + k_t) * (1-u*Z) * (1+\pi)^t$$

Equation 72

The cash flow for the pre-extraction period can be represented by:

$$CF_t = e_t * (1 - u * (a_t + Z' * (1-a_t) * (1 - \emptyset * \delta_t)) * (1+\pi)^t$$

Equation 73

Making these adjustments yields the following optimization problem:

$$\mathcal{L} = -\sum_{t=0}^{T_0} \frac{e_t * (1 - u * (a_t + Z' * (1 - a_t) * (1 - \emptyset * \delta_t)) * (1 + \pi)^t}{(1 + R)^t}$$

$$+ \sum_{t=T_0}^{T_1-1} \frac{\{(1 - \tau) * P * Q_t - C(Q_t, K_t)\} * (1 - u) * (1 + \pi)^t}{(1 + R)^t}$$

$$- \sum_{t=T_0}^{T_1-1} \frac{(\delta * K_t + k_t) * (1 - u * Z) * (1 - \emptyset) * (1 + \pi)^t}{(1 + R)^t}$$

$$+ \tau_1 * (1 - u) * \frac{\sum_{t=0}^{T_1-1} \widehat{RAB_t^1} * (1 + \varphi_1)^{T_1 - t}}{(1 + R)^{T_1}} + \tau_2 * (1 - u) * \frac{\sum_{t=0}^{T_2-1} \widehat{RAB_t^2} * (1 + \varphi_2)^{T_2 - t}}{(1 + R)^{T_2}}$$

$$+ \sum_{t=T_1}^{T_2-1} \frac{(1 + \pi)^t * (1 - u) * \{[P * Q_t - C(Q_t, K_t)] - \tau_1 [P * Q_t - C(Q_t, K_t) * \varepsilon_t^O * (1 + UL^O)]\}}{(1 + R)^t}$$

$$- \sum_{t=T_1}^{T_2-1} \frac{(\delta * K_t + k_t) * (1 + \pi)^t * [(1 - u * Z) * (1 - \emptyset) - \tau_1 * \varepsilon_t^C * (1 + UL^C) * (1 - u)]}{(1 + R)^t}$$

$$+ \sum_{t=T_2}^{\infty} \frac{(1 + \pi)^t * (1 - u) * \{[P * Q_t - C(Q_t, K_t)] - (\tau_1 + \tau_2) * [P * Q_t - C(Q_t, K_t) * \varepsilon_t^O * (1 + UL^O)]\}}{(1 + R)^t}$$

$$- \sum_{t=T_2}^{\infty} \frac{(\delta * K_t + k_t) * (1 + \pi)^t * [(1 - u * Z) * (1 - \emptyset) - (\tau_1 + \tau_2) * \varepsilon_t^C * (1 + UL^C) * (1 - u)]}{(1 + R)^t}$$

$$+ \lambda * (\sum_{t=0}^{T} f(e_t) - \sum_{t=T}^{\infty} Q_t)$$

Equation 74

B2.6.1 Corrected Output Effect – Tier 1 and Tier 2 Royalties

For the period $T_1<t<T_2$ (the period before Tier 2 royalties are payable, the corrected version of Equation 60 is Equation 75:

$$\frac{(P-C')*(1-u)*[1-\{(\tau_1+\tau_2)+\ (1-\tau_1)*\tau_2*(1-\varphi_2-R)^{T_2-t}\}*\frac{P-C'*\varepsilon_t^O*(1+UL^O)}{P-C'}]}{(1+r)^t}=\lambda$$

Equation 75

For periods in which the Tier 2 royalty is payable (i.e., $t>T_2$), the corrected version of Equation 61 is Equation 76:

$$\frac{(P-C')*(1-u)*[1-(\tau_1+\tau_2)*\frac{P-C'*\varepsilon_t^O*(1+UL^O)}{P-C'}]}{(1+r)^t}=\lambda$$

Equation 76

If only Tier 1 is reached, then the corrected version of Equation 62 is Equation 77:

$$\frac{(P-C')*(1-u)*[1-\tau_1*\frac{P-C'*\varepsilon_t^O*(1+UL^O)}{P-C'}]}{(1+r)^t}=\lambda$$

Equation 77

B2.6.2 Corrected Depreciable Capital Effect – Tier 1 and Tier 2 Royalties

Similarly, Mintz calculates the user cost associated with depreciable capital for two distinct time periods —the period for which $t>T_2$ and the period for which $T_1<t<T_2$. The user cost of capital for $t>T_2$ is given by Equation 78:

$$-C_k=(\delta+R-\pi)*\frac{(1-u*Z)*(1-\emptyset)-(\tau_1+\tau_2)*\epsilon_t^C*(1+UL^C)*(1-u)}{(1-u)*(1-(\tau_1+\tau_2)*\epsilon_t^O*(1+UL^O))}$$

Equation 78

If Tier 2 is never reached and only Tier 1 is in effect, then Mintz (2010, fn 8, p. 16) suggests that the user cost of capital would ignore Tier 2 royalties. This would involve rewriting Equation 78 as Equation 79:

$$-C_k=(\delta+R-\pi)*\frac{(1-u*Z)*(1-\emptyset)-\tau_1*\epsilon_t^C*(1+UL^C)*(1-u)}{(1-u)*(1-\tau_1*\epsilon_t^O*(1+UL^O))}$$

Equation 79

For $T_1<t<T_2$, the corrected version of Equation 65 is Equation 80:

$$-C_k = (\delta + R - \pi) * \frac{(1 - u * Z) * (1 - \emptyset)]}{(1-u) * [1 - \epsilon_t^O * (1 + UL^O) * (\tau_1 + \tau_2 * (1 + \varphi_2 - R)^{(T_2 - t)})]}$$

$$-(\delta + R - \pi) * \frac{(1-u) * \epsilon_t^C * (1 + UL^C) * ([\tau_1 + \tau_2 * (\delta + \pi) * (1 + \varphi_2 - R)^{(T_2 - t)}]}{(1-u) * [1 - \epsilon_t^O * (1 + UL^O) * (\tau_1 + \tau_2 * (1 + \varphi_2 - R)^{(T_2 - t)})]}$$

Equation 80

B2.6.3 Corrected Exploration and Development – Tier 1 and Tier 2 Royalties

The corrected version of Equation 66 is Equation 81:

$$(P - C') * f_t' = (1+r)^{(T_2 - t)} * \frac{1 - u * [a_t + Z' * (1 - a_t) * (1 - \emptyset * \delta_t)]}{(1-u) * [\, 1 - \tau_1 * \frac{P - C' * \varepsilon_t^D * \left(1 + UL^O\right)}{P - C'}]}$$

$$-(1+r)^{(T_2 - t)} * \frac{(1-u) * [\, \tau_1 * (1 + UL^C) * \varepsilon_t^D * (1 + \varphi_1 - R)^{(T_1 - t)}]}{(1-u) * [1 - \tau_1 * \frac{P - C' * \varepsilon_t^D * \left(1 + UL^O\right)}{P - C'}]}$$

$$-(1+r)^{(T_2 - t)} * \frac{(1-u) * [\, \tau_2 * (1 + UL^C) * \varepsilon_t^D * (1 + \varphi_1 - R)^{(T_2 - t)}]}{(1-u) * [1 - \tau_1 * \frac{P - C' * \varepsilon_t^D * \left(1 + UL^O\right)}{P - C'}]}$$

Equation 81

If only Tier 1 payout is achieved and Tier 2 is not expected to be reached, then the corrected version of Equation 67 is Equation 82:

$$(P - C') * f_t' = (1+r)^{(T_1 - t)} * \frac{1 - u * [a_t + Z' * (1 - a_t) * (1 - \emptyset * \delta_t)]}{(1-u) * \left[1 - \tau_1 * \frac{P - C' * \varepsilon_t^D * (1 + UL^O)}{P - C'}\right]}$$

$$-(1+r)^{(T_1 - t)} * \frac{(1-u) * \tau_1 * (1 + UL^C) * \varepsilon_t^D * (1 + \varphi_1 - R)^{(T_1 - t)}}{(1-u) * [1 - \tau_1 * \frac{P - C' * \varepsilon_t^D * (1 + UL^O)}{P - C'}]}$$

Equation 82

Appendix C: Alternative Test of Mintz and Chen (2010)

Table C - 1: Base Case Project

Year	Production	Cumulative Production	Revenue	PV Revenue	Exploration Capex	Drilling Capex	PV Drilling Capex	Facilities Capex	PV Facilities Capex	Capex
1	0.0	0.0	$0.0	$0.0	$500.0	$0.0	$0.0	$0.0	$0.0	$500.0
2	0.0	0.0	$0.0	$0.0	$0.0	$600.0	$566.0	$900.0	$849.1	$1,500.0
3	0.0	0.0	$0.0	$0.0	$0.0	$400.0	$356.0	$600.0	$534.0	$1,000.0
4	0.0	0.0	$0.0	$0.0	$0.0	$400.0	$335.8	$600.0	$503.8	$1,000.0
5	0.0	0.0	$0.0	$0.0	$0.0	$400.0	$316.8	$600.0	$475.3	$1,000.0
6	13.3	13.3	$455.7	$340.5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
7	26.7	40.0	$911.5	$642.5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
8	40.0	80.0	$1,367.2	$909.3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
9	40.0	120.0	$1,367.2	$857.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
10	40.0	160.0	$1,367.2	$809.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
11	40.0	200.0	$1,367.2	$763.4	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
12	40.0	240.0	$1,367.2	$720.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
13	32.4	272.4	$1,108.2	$550.7	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
14	26.3	298.7	$898.3	$421.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
15	21.3	320.0	$728.1	$322.1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
16	17.3	337.3	$590.2	$246.3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
17	14.0	351.3	$478.4	$188.3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
18	11.3	362.6	$387.8	$144.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
19	9.2	371.8	$314.3	$110.1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
20	7.5	379.3	$254.8	$84.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
21	6.0	385.3	$206.5	$64.4	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
22	4.9	390.2	$167.4	$49.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
23	4.0	394.2	$135.7	$37.7	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
24	3.2	397.4	$110.0	$28.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
25	2.6	400.0	$89.2	$22.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total	**400.0**	**0.0**	**$13,672.2**	**$7,312.1**	**$500.0**	**$1,800.0**	**$1,574.7**	**$2,700.0**	**$2,362.1**	**$5,000.0**

Table C - 1: Base Case Project (Continued)

Year	Opex	PV Opex	Transport	PV Transport	Undepreciated Facilities Base	Facilities Depreciation Allowance 25%	PV Facilities Depreciation	Undepreciated Drilling Capex Base	Drilling Capex Depreciation Allowance 30%	PV Drilling Depreciation
1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
2	$0.0	$0.0	$0.0	$0.0	$810.0	$202.5	$191.0	$600.0	$180.0	$169.8
3	$0.0	$0.0	$0.0	$0.0	$1,147.5	$286.9	$255.3	$820.0	$246.0	$218.9
4	$0.0	$0.0	$0.0	$0.0	$1,400.6	$350.2	$294.0	$974.0	$292.2	$245.3
5	$0.0	$0.0	$0.0	$0.0	$1,590.5	$397.6	$315.0	$1,081.8	$324.5	$257.1
6	$133.3	$99.6	$26.7	$19.9	$1,192.9	$298.2	$222.8	$757.3	$227.2	$169.8
7	$266.7	$188.0	$53.3	$37.6	$894.6	$223.7	$157.7	$530.1	$159.0	$112.1
8	$400.0	$266.0	$80.0	$53.2	$671.0	$167.7	$111.6	$371.1	$111.3	$74.0
9	$400.0	$251.0	$80.0	$50.2	$503.2	$125.8	$78.9	$259.7	$77.9	$48.9
10	$400.0	$236.8	$80.0	$47.4	$377.4	$94.4	$55.8	$181.8	$54.5	$32.3
11	$400.0	$223.4	$80.0	$44.7	$283.1	$70.8	$39.5	$127.3	$38.2	$21.3
12	$400.0	$210.7	$80.0	$42.1	$212.3	$53.1	$28.0	$89.1	$26.7	$14.1
13	$324.2	$161.1	$64.8	$32.2	$159.2	$39.8	$19.8	$62.4	$18.7	$9.3
14	$262.8	$123.2	$52.6	$24.6	$119.4	$29.9	$14.0	$43.7	$13.1	$6.1
15	$213.0	$94.2	$42.6	$18.8	$89.6	$22.4	$9.9	$30.6	$9.2	$4.1
16	$172.7	$72.1	$34.5	$14.4	$67.2	$16.8	$7.0	$21.4	$6.4	$2.7
17	$140.0	$55.1	$28.0	$11.0	$50.4	$12.6	$5.0	$15.0	$4.5	$1.8
18	$113.5	$42.1	$22.7	$8.4	$37.8	$9.4	$3.5	$10.5	$3.1	$1.2
19	$92.0	$32.2	$18.4	$6.4	$28.3	$7.1	$2.5	$7.3	$2.2	$0.8
20	$74.5	$24.6	$14.9	$4.9	$21.3	$5.3	$1.8	$5.1	$1.5	$0.5
21	$60.4	$18.8	$12.1	$3.8	$15.9	$4.0	$1.2	$3.6	$1.1	$0.3
22	$49.0	$14.4	$9.8	$2.9	$12.0	$3.0	$0.9	$2.5	$0.8	$0.2
23	$39.7	$11.0	$7.9	$2.2	$9.0	$2.2	$0.6	$1.8	$0.5	$0.1
24	$32.2	$8.4	$6.4	$1.7	$6.7	$1.7	$0.4	$1.2	$0.4	$0.1
25	$26.1	$6.4	$5.2	$1.3	$5.0	$1.3	$0.3	$0.9	$0.3	$0.1
Total	**$4,000.1**	**$2,139.3**	**$800.0**	**$427.9**	**$0.0**	**$2,426.2**	**$1,816.5**	**$0.0**	**$1,799.4**	**$1,390.9**

Table C - 1: Base Case Project (Continued)

Year	Simple Payout Calculation	Prod Trigger 50 MM BBLs	Reserves 20% Trigger	Prod Trigger 100 MM BBLs	Prod Trigger 200 MM BBLs	Prod Trigger 200 MM BBLs	Gross Royalty Rate with Simple Payout	Gross Royalty Rate	Ad Valorem or Gross Royalty	PV Gross Royalty
1	($505.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
2	($2,020.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
3	($3,030.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
4	($4,040.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
5	($5,050.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
6	($4,767.6)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$4.3	$3.2
7	($4,202.8)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$8.6	$6.0
8	($3,355.6)	0.00%	0.00%	2.13%	0.00%	0.00%	0.00%	2.13%	$27.4	$18.2
9	($2,508.5)	0.00%	2.50%	0.00%	3.75%	0.00%	0.00%	3.75%	$48.3	$30.3
10	($1,661.3)	0.00%	2.50%	0.00%	5.00%	0.00%	0.00%	5.00%	$64.4	$38.1
11	($814.1)	0.00%	2.50%	0.00%	5.00%	0.00%	0.00%	5.00%	$64.4	$35.9
12	$33.1	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$96.5	$50.9
13	$719.8	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$78.3	$38.9
14	$1,276.4	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$63.4	$29.7
15	$1,727.6	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$51.4	$22.7
16	$2,093.4	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$41.7	$17.4
17	$2,389.8	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$33.8	$13.3
18	$2,630.1	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$27.4	$10.2
19	$2,824.9	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$22.2	$7.8
20	$2,982.8	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$18.0	$5.9
21	$3,110.8	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$14.6	$4.5
22	$3,214.5	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$11.8	$3.5
23	$3,298.6	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$9.6	$2.7
24	$3,366.8	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$7.8	$2.0
25	$3,422.0	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$6.3	$1.6
Total									**$699.9**	**$342.8**

Table C - 1: Base Case Project (Continued)

Year	Tier 1 Return Allowance 11%	Tier 1 Net Royalty 20%	PV Tier 1 Net Royalty	Tier 2 Return Allowance 21%	Tier 2 Net Royalty 10%	PV Tier 2 Net Royalty	Total Royalties	PV Royalties
1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
2	-$2,158.9	$0.0	$0.0	-$2,285.1	$0.0	$0.0	$0.0	$0.0
3	-$3,461.9	$0.0	$0.0	-$3,881.1	$0.0	$0.0	$0.0	$0.0
4	-$4,908.3	$0.0	$0.0	-$5,812.1	$0.0	$0.0	$0.0	$0.0
5	-$6,513.7	$0.0	$0.0	-$8,148.7	$0.0	$0.0	$0.0	$0.0
6	-$6,936.8	$0.0	$0.0	-$9,552.6	$0.0	$0.0	$4.3	$3.2
7	-$7,113.1	$0.0	$0.0	-$10,944.1	$0.0	$0.0	$8.6	$6.0
8	-$7,030.6	$0.0	$0.0	-$12,336.4	$0.0	$0.0	$27.4	$18.2
9	-$6,961.1	$0.0	$0.0	-$14,044.3	$0.0	$0.0	$48.3	$30.3
10	-$6,901.0	$0.0	$0.0	-$16,128.6	$0.0	$0.0	$64.4	$38.1
11	-$6,834.2	$0.0	$0.0	-$18,650.6	$0.0	$0.0	$64.4	$35.9
12	-$6,794.0	$0.0	$0.0	-$21,737.7	$0.0	$0.0	$96.5	$50.9
13	-$6,899.5	$0.0	$0.0	-$25,630.3	$0.0	$0.0	$78.3	$38.9
14	-$7,138.1	$0.0	$0.0	-$30,467.7	$0.0	$0.0	$63.4	$29.7
15	-$7,501.5	$0.0	$0.0	-$36,424.2	$0.0	$0.0	$51.4	$22.7
16	-$7,984.8	$0.0	$0.0	-$43,715.1	$0.0	$0.0	$41.7	$17.4
17	-$8,586.0	$0.0	$0.0	-$52,605.1	$0.0	$0.0	$33.8	$13.3
18	-$9,305.8	$0.0	$0.0	-$63,416.8	$0.0	$0.0	$27.4	$10.2
19	-$10,147.3	$0.0	$0.0	-$76,543.7	$0.0	$0.0	$22.2	$7.8
20	-$11,116.0	$0.0	$0.0	-$92,463.2	$0.0	$0.0	$18.0	$5.9
21	-$12,219.1	$0.0	$0.0	-$111,755.2	$0.0	$0.0	$14.6	$4.5
22	-$13,466.2	$0.0	$0.0	-$135,122.2	$0.0	$0.0	$11.8	$3.5
23	-$14,868.9	$0.0	$0.0	-$163,415.6	$0.0	$0.0	$9.6	$2.7
24	-$16,440.7	$0.0	$0.0	-$197,666.1	$0.0	$0.0	$7.8	$2.0
25	-$18,197.6	$0.0	$0.0	-$239,121.9	$0.0	$0.0	$6.3	$1.6
Total		**$0.0**	**$0.0**		**$0.0**	**$0.0**	**$699.9**	**$342.8**

Table C - 1: Base Case Project (Continued)

Year	CIT Base	Federal CIT 15%	PV Federal CIT before AITC	AITC 10%	Federal CIT Net of AITC	PV Federal CIT Net of AITC	Provincial CIT 14%	PV Provincial CIT
1	($500.0)	($75.0)	($75.0)	$0.0	($75.0)	($75.0)	($70.0)	($70.0)
2	($382.5)	($57.4)	($54.1)	$90.0	($147.4)	($139.0)	($53.6)	($50.5)
3	($532.9)	($79.9)	($71.1)	$60.0	($139.9)	($124.5)	($74.6)	($66.4)
4	($642.4)	($96.4)	($80.9)	$60.0	($156.4)	($131.3)	($89.9)	($75.5)
5	($722.2)	($108.3)	($85.8)	$60.0	($168.3)	($133.3)	($101.1)	($80.1)
6	($234.0)	($35.1)	($26.2)	$0.0	($35.1)	($26.2)	($32.8)	($24.5)
7	$200.2	$30.0	$21.2	$0.0	$30.0	$21.2	$28.0	$19.8
8	$580.8	$87.1	$57.9	$0.0	$87.1	$57.9	$81.3	$54.1
9	$635.2	$95.3	$59.8	$0.0	$95.3	$59.8	$88.9	$55.8
10	$673.9	$101.1	$59.8	$0.0	$101.1	$59.8	$94.3	$55.8
11	$713.9	$107.1	$59.8	$0.0	$107.1	$59.8	$99.9	$55.8
12	$710.8	$106.6	$56.2	$0.0	$106.6	$56.2	$99.5	$52.4
13	$582.4	$87.4	$43.4	$0.0	$87.4	$43.4	$81.5	$40.5
14	$476.5	$71.5	$33.5	$0.0	$71.5	$33.5	$66.7	$31.3
15	$389.5	$58.4	$25.8	$0.0	$58.4	$25.8	$54.5	$24.1
16	$318.1	$47.7	$19.9	$0.0	$47.7	$19.9	$44.5	$18.6
17	$259.6	$38.9	$15.3	$0.0	$38.9	$15.3	$36.3	$14.3
18	$211.7	$31.8	$11.8	$0.0	$31.8	$11.8	$29.6	$11.0
19	$172.5	$25.9	$9.1	$0.0	$25.9	$9.1	$24.2	$8.5
20	$140.5	$21.1	$7.0	$0.0	$21.1	$7.0	$19.7	$6.5
21	$114.4	$17.2	$5.3	$0.0	$17.2	$5.3	$16.0	$5.0
22	$93.1	$14.0	$4.1	$0.0	$14.0	$4.1	$13.0	$3.8
23	$75.7	$11.4	$3.2	$0.0	$11.4	$3.2	$10.6	$2.9
24	$61.6	$9.2	$2.4	$0.0	$9.2	$2.4	$8.6	$2.3
25	$50.0	$7.5	$1.9	$0.0	$7.5	$1.9	$7.0	$1.7
Total		**$517.0**	**$104.2**	**$270.0**	**$247.0**	**($132.0)**	**$482.5**	**$97.2**

Table C - 1: Base Case Project (Continued)

Year	Net Cash Flow	DCF @ 6%	Pre-Tax/Royalty Net Cash Flow	Discounted Pre-Tax/Royalty Net Cash Flow @6%	Gov Rev	DCF Gov Rev @ 6%
1	($355.0)	($355.0)	($500.0)	($500.0)	($145.0)	($145.0)
2	($1,299.1)	($1,225.5)	($1,500.0)	($1,415.1)	($200.9)	($189.6)
3	($785.5)	($699.1)	($1,000.0)	($890.0)	($214.5)	($190.9)
4	($753.7)	($632.8)	($1,000.0)	($839.6)	($246.3)	($206.8)
5	($730.6)	($578.7)	($1,000.0)	($792.1)	($269.4)	($213.4)
6	$359.3	$268.5	$295.7	$221.0	($63.6)	($47.5)
7	$524.8	$370.0	$591.5	$417.0	$66.6	$47.0
8	$691.4	$459.8	$887.2	$590.0	$195.8	$130.2
9	$654.7	$410.8	$887.2	$556.6	$232.5	$145.9
10	$627.4	$371.3	$887.2	$525.1	$259.8	$153.8
11	$615.8	$343.9	$887.2	$495.4	$271.4	$151.5
12	$584.5	$307.9	$887.2	$467.4	$302.7	$159.4
13	$472.0	$234.6	$719.1	$357.4	$247.1	$122.8
14	$381.3	$178.8	$582.9	$273.3	$201.6	$94.5
15	$308.1	$136.3	$472.5	$209.0	$164.4	$72.7
16	$249.1	$103.9	$383.0	$159.8	$133.9	$55.9
17	$201.4	$79.3	$310.5	$122.2	$109.1	$42.9
18	$162.9	$60.5	$251.7	$93.5	$88.8	$33.0
19	$131.8	$46.2	$204.0	$71.5	$72.2	$25.3
20	$106.6	$35.2	$165.3	$54.6	$58.7	$19.4
21	$86.3	$26.9	$134.0	$41.8	$47.8	$14.9
22	$69.8	$20.5	$108.6	$32.0	$38.8	$11.4
23	$56.5	$15.7	$88.1	$24.4	$31.5	$8.8
24	$45.8	$12.0	$71.4	$18.7	$25.6	$6.7
25	$37.1	$9.2	$57.9	$14.3	$20.8	$5.1
Total	**$2,442.6**	**$0.0**	**$3,872.1**	**$308.1**	**$1,429.4**	**$308.1**
	Real After-Tax IRR	**6.000%**		**6.867%**		

Table C - 2: Gold-Plating Test – Non-Productive Marginal Investment

Year	Production	Cumulative Production	Revenue	PV Revenue	Exploration Capex	Drilling Capex	PV Drilling Capex	Facilities Capex	PV Facilities Capex	Capex
1	0.0	0.0	$0.0	$0.0	$500.0	$0.0	$0.0	$100.0	$100.0	$600.0
2	0.0	0.0	$0.0	$0.0	$0.0	$600.0	$566.0	$900.0	$849.1	$1,500.0
3	0.0	0.0	$0.0	$0.0	$0.0	$400.0	$356.0	$600.0	$534.0	$1,000.0
4	0.0	0.0	$0.0	$0.0	$0.0	$400.0	$335.8	$600.0	$503.8	$1,000.0
5	0.0	0.0	$0.0	$0.0	$0.0	$400.0	$316.8	$600.0	$475.3	$1,000.0
6	13.3	13.3	$455.7	$340.5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
7	26.7	40.0	$911.5	$642.5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
8	40.0	80.0	$1,367.2	$909.3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
9	40.0	120.0	$1,367.2	$857.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
10	40.0	160.0	$1,367.2	$809.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
11	40.0	200.0	$1,367.2	$763.4	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
12	40.0	240.0	$1,367.2	$720.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
13	32.4	272.4	$1,108.2	$550.7	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
14	26.3	298.7	$898.3	$421.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
15	21.3	320.0	$728.1	$322.1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
16	17.3	337.3	$590.2	$246.3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
17	14.0	351.3	$478.4	$188.3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
18	11.3	362.6	$387.8	$144.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
19	9.2	371.8	$314.3	$110.1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
20	7.5	379.3	$254.8	$84.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
21	6.0	385.3	$206.5	$64.4	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
22	4.9	390.2	$167.4	$49.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
23	4.0	394.2	$135.7	$37.7	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
24	3.2	397.4	$110.0	$28.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
25	2.6	400.0	$89.2	$22.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total	**400.0**	**0.0**	**$13,672.2**	**$7,312.1**	**$500.0**	**$1,800.0**	**$1,574.7**	**$2,800.0**	**$2,462.1**	**$5,100.0**

Table C - 2: Gold-Plating Test – Non-Productive Marginal Investment (Continued)

Year	Opex	PV Opex	Transport	PV Transport	Undepreciated Facilities Base	Facilities Depreciation Allowance 25%	PV Facilities Depreciation	Undepreciated Drilling Capex Base	Drilling Capex Depreciation Allowance 30%	PV Drilling Depreciation
1	$0.0	$0.0	$0.0	$0.0	$90.0	$22.5	$22.5	$0.0	$0.0	$0.0
2	$0.0	$0.0	$0.0	$0.0	$877.5	$219.4	$207.0	$600.0	$180.0	$169.8
3	$0.0	$0.0	$0.0	$0.0	$1,198.1	$299.5	$266.6	$820.0	$246.0	$218.9
4	$0.0	$0.0	$0.0	$0.0	$1,438.6	$359.6	$302.0	$974.0	$292.2	$245.3
5	$0.0	$0.0	$0.0	$0.0	$1,618.9	$404.7	$320.6	$1,081.8	$324.5	$257.1
6	$133.3	$99.6	$26.7	$19.9	$1,214.2	$303.6	$226.8	$757.3	$227.2	$169.8
7	$266.7	$188.0	$53.3	$37.6	$910.7	$227.7	$160.5	$530.1	$159.0	$112.1
8	$400.0	$266.0	$80.0	$53.2	$683.0	$170.7	$113.6	$371.1	$111.3	$74.0
9	$400.0	$251.0	$80.0	$50.2	$512.2	$128.1	$80.3	$259.7	$77.9	$48.9
10	$400.0	$236.8	$80.0	$47.4	$384.2	$96.0	$56.8	$181.8	$54.5	$32.3
11	$400.0	$223.4	$80.0	$44.7	$288.1	$72.0	$40.2	$127.3	$38.2	$21.3
12	$400.0	$210.7	$80.0	$42.1	$216.1	$54.0	$28.5	$89.1	$26.7	$14.1
13	$324.2	$161.1	$64.8	$32.2	$162.1	$40.5	$20.1	$62.4	$18.7	$9.3
14	$262.8	$123.2	$52.6	$24.6	$121.6	$30.4	$14.2	$43.7	$13.1	$6.1
15	$213.0	$94.2	$42.6	$18.8	$91.2	$22.8	$10.1	$30.6	$9.2	$4.1
16	$172.7	$72.1	$34.5	$14.4	$68.4	$17.1	$7.1	$21.4	$6.4	$2.7
17	$140.0	$55.1	$28.0	$11.0	$51.3	$12.8	$5.0	$15.0	$4.5	$1.8
18	$113.5	$42.1	$22.7	$8.4	$38.5	$9.6	$3.6	$10.5	$3.1	$1.2
19	$92.0	$32.2	$18.4	$6.4	$28.8	$7.2	$2.5	$7.3	$2.2	$0.8
20	$74.5	$24.6	$14.9	$4.9	$21.6	$5.4	$1.8	$5.1	$1.5	$0.5
21	$60.4	$18.8	$12.1	$3.8	$16.2	$4.1	$1.3	$3.6	$1.1	$0.3
22	$49.0	$14.4	$9.8	$2.9	$12.2	$3.0	$0.9	$2.5	$0.8	$0.2
23	$39.7	$11.0	$7.9	$2.2	$9.1	$2.3	$0.6	$1.8	$0.5	$0.1
24	$32.2	$8.4	$6.4	$1.7	$6.8	$1.7	$0.4	$1.2	$0.4	$0.1
25	$26.1	$6.4	$5.2	$1.3	$5.1	$1.3	$0.3	$0.9	$0.3	$0.1
Total	**$4,000.1**	**$2,139.3**	**$800.0**	**$427.9**	**$0.0**	**$2,516.1**	**$1,893.4**	**$0.0**	**$1,799.4**	**$1,390.9**

Table C - 2: Gold-Plating Test – Non-Productive Marginal Investment (Continued)

Year	Simple Payout Calculation	Prod Trigger 50 MM BBLs	Reserves 20% Trigger	Prod Trigger 100 MM BBLs	Prod Trigger 200 MM BBLs	Prod Trigger 200 MM BBLs	Gross Royalty Rate with Simple Payout	Gross Royalty Rate	Ad Valorem or Gross Royalty	PV Gross Royalty
1	($606.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
2	($2,121.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
3	($3,131.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
4	($4,141.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
5	($5,151.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
6	($4,868.6)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$4.3	$3.2
7	($4,303.8)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$8.6	$6.0
8	($3,456.6)	0.00%	0.00%	2.13%	0.00%	0.00%	0.00%	2.13%	$27.4	$18.2
9	($2,609.5)	0.00%	2.50%	0.00%	3.75%	0.00%	0.00%	3.75%	$48.3	$30.3
10	($1,762.3)	0.00%	2.50%	0.00%	5.00%	0.00%	0.00%	5.00%	$64.4	$38.1
11	($915.1)	0.00%	2.50%	0.00%	5.00%	0.00%	0.00%	5.00%	$64.4	$35.9
12	($67.9)	0.00%	2.50%	0.00%	0.00%	7.50%	0.00%	7.50%	$96.5	$50.9
13	$618.8	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$78.3	$38.9
14	$1,175.4	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$63.4	$29.7
15	$1,626.6	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$51.4	$22.7
16	$1,992.4	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$41.7	$17.4
17	$2,288.8	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$33.8	$13.3
18	$2,529.1	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$27.4	$10.2
19	$2,723.9	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$22.2	$7.8
20	$2,881.8	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$18.0	$5.9
21	$3,009.8	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$14.6	$4.5
22	$3,113.5	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$11.8	$3.5
23	$3,197.6	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$9.6	$2.7
24	$3,265.8	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$7.8	$2.0
25	$3,321.0	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$6.3	$1.6
Total									**$699.9**	**$342.8**

Table C - 2: Gold-Plating Test – Non-Productive Marginal Investment (Continued)

Year	Tier 1 Return Allowance 11%	Tier 1 Net Royalty 20%	PV Tier 1 Net Royalty	Tier 2 Return Allowance 21%	Tier 2 Net Royalty 10%	PV Tier 2 Net Royalty	Total Royalties	PV Royalties
1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
2	-$2,271.0	$0.0	$0.0	-$2,407.3	$0.0	$0.0	$0.0	$0.0
3	-$3,586.3	$0.0	$0.0	-$4,028.9	$0.0	$0.0	$0.0	$0.0
4	-$5,046.4	$0.0	$0.0	-$5,991.0	$0.0	$0.0	$0.0	$0.0
5	-$6,667.0	$0.0	$0.0	-$8,365.2	$0.0	$0.0	$0.0	$0.0
6	-$7,107.0	$0.0	$0.0	-$9,814.6	$0.0	$0.0	$4.3	$3.2
7	-$7,302.0	$0.0	$0.0	-$11,261.1	$0.0	$0.0	$8.6	$6.0
8	-$7,240.3	$0.0	$0.0	-$12,720.0	$0.0	$0.0	$27.4	$18.2
9	-$7,193.9	$0.0	$0.0	-$14,508.4	$0.0	$0.0	$48.3	$30.3
10	-$7,159.3	$0.0	$0.0	-$16,690.1	$0.0	$0.0	$64.4	$38.1
11	-$7,121.0	$0.0	$0.0	-$19,330.1	$0.0	$0.0	$64.4	$35.9
12	-$7,112.4	$0.0	$0.0	-$22,559.9	$0.0	$0.0	$96.5	$50.9
13	-$7,252.8	$0.0	$0.0	-$26,625.1	$0.0	$0.0	$78.3	$38.9
14	-$7,530.3	$0.0	$0.0	-$31,671.4	$0.0	$0.0	$63.4	$29.7
15	-$7,936.8	$0.0	$0.0	-$37,880.7	$0.0	$0.0	$51.4	$22.7
16	-$8,468.0	$0.0	$0.0	-$45,477.5	$0.0	$0.0	$41.7	$17.4
17	-$9,122.4	$0.0	$0.0	-$54,737.5	$0.0	$0.0	$33.8	$13.3
18	-$9,901.2	$0.0	$0.0	-$65,997.2	$0.0	$0.0	$27.4	$10.2
19	-$10,808.2	$0.0	$0.0	-$79,665.8	$0.0	$0.0	$22.2	$7.8
20	-$11,849.6	$0.0	$0.0	-$96,241.1	$0.0	$0.0	$18.0	$5.9
21	-$13,033.4	$0.0	$0.0	-$116,326.4	$0.0	$0.0	$14.6	$4.5
22	-$14,370.1	$0.0	$0.0	-$140,653.4	$0.0	$0.0	$11.8	$3.5
23	-$15,872.2	$0.0	$0.0	-$170,108.2	$0.0	$0.0	$9.6	$2.7
24	-$17,554.4	$0.0	$0.0	-$205,764.2	$0.0	$0.0	$7.8	$2.0
25	-$19,433.7	$0.0	$0.0	-$248,920.6	$0.0	$0.0	$6.3	$1.6
Total		**$0.0**	**$0.0**		**$0.0**	**$0.0**	**$699.9**	**$342.8**

Table C - 2: Gold-Plating Test – Non-Productive Marginal Investment (Continued)

Year	CIT Base	Federal CIT 15%	PV Federal CIT before AITC	AITC 10%	Federal CIT Net of AITC	PV Federal CIT Net of AITC	Provincial CIT 14%	PV Provincial CIT
1	($522.5)	($78.4)	($78.4)	$10.0	($88.4)	($88.4)	($73.2)	($73.2)
2	($399.4)	($59.9)	($56.5)	$90.0	($149.9)	($141.4)	($55.9)	($52.7)
3	($545.5)	($81.8)	($72.8)	$60.0	($141.8)	($126.2)	($76.4)	($68.0)
4	($651.8)	($97.8)	($82.1)	$60.0	($157.8)	($132.5)	($91.3)	($76.6)
5	($729.3)	($109.4)	($86.6)	$60.0	($169.4)	($134.2)	($102.1)	($80.9)
6	($239.3)	($35.9)	($26.8)	$0.0	($35.9)	($26.8)	($33.5)	($25.0)
7	$196.2	$29.4	$20.7	$0.0	$29.4	$20.7	$27.5	$19.4
8	$577.8	$86.7	$57.6	$0.0	$86.7	$57.6	$80.9	$53.8
9	$632.9	$94.9	$59.6	$0.0	$94.9	$59.6	$88.6	$55.6
10	$672.2	$100.8	$59.7	$0.0	$100.8	$59.7	$94.1	$55.7
11	$712.6	$106.9	$59.7	$0.0	$106.9	$59.7	$99.8	$55.7
12	$709.9	$106.5	$56.1	$0.0	$106.5	$56.1	$99.4	$52.4
13	$581.7	$87.2	$43.4	$0.0	$87.2	$43.4	$81.4	$40.5
14	$476.0	$71.4	$33.5	$0.0	$71.4	$33.5	$66.6	$31.2
15	$389.1	$58.4	$25.8	$0.0	$58.4	$25.8	$54.5	$24.1
16	$317.8	$47.7	$19.9	$0.0	$47.7	$19.9	$44.5	$18.6
17	$259.4	$38.9	$15.3	$0.0	$38.9	$15.3	$36.3	$14.3
18	$211.5	$31.7	$11.8	$0.0	$31.7	$11.8	$29.6	$11.0
19	$172.4	$25.9	$9.1	$0.0	$25.9	$9.1	$24.1	$8.5
20	$140.4	$21.1	$7.0	$0.0	$21.1	$7.0	$19.7	$6.5
21	$114.3	$17.1	$5.3	$0.0	$17.1	$5.3	$16.0	$5.0
22	$93.0	$14.0	$4.1	$0.0	$14.0	$4.1	$13.0	$3.8
23	$75.7	$11.4	$3.1	$0.0	$11.4	$3.1	$10.6	$2.9
24	$61.5	$9.2	$2.4	$0.0	$9.2	$2.4	$8.6	$2.3
25	$50.0	$7.5	$1.9	$0.0	$7.5	$1.9	$7.0	$1.7
Total		**$503.5**	**$92.7**	**$280.0**	**$223.5**	**($153.6)**	**$469.9**	**$86.5**

Table C - 2: Gold-Plating Test – Non-Productive Marginal Investment (Continued)

Year	Net Cash Flow	DCF @ 6%	Pre-Tax/Royalty Net Cash Flow	Discounted Pre-Tax/Royalty Net Cash Flow @6%	Gov Rev	DCF Gov Rev @ 6%
1	($438.5)	($438.5)	($600.0)	($600.0)	($161.5)	($161.5)
2	($1,294.2)	($1,220.9)	($1,500.0)	($1,415.1)	($205.8)	($194.2)
3	($781.8)	($695.8)	($1,000.0)	($890.0)	($218.2)	($194.2)
4	($751.0)	($630.5)	($1,000.0)	($839.6)	($249.0)	($209.1)
5	($728.5)	($577.0)	($1,000.0)	($792.1)	($271.5)	($215.0)
6	$360.8	$269.6	$295.7	$221.0	($65.1)	($48.7)
7	$526.0	$370.8	$591.5	$417.0	$65.5	$46.2
8	$692.3	$460.4	$887.2	$590.0	$194.9	$129.6
9	$655.4	$411.2	$887.2	$556.6	$231.8	$145.4
10	$627.9	$371.6	$887.2	$525.1	$259.3	$153.5
11	$616.2	$344.1	$887.2	$495.4	$271.0	$151.3
12	$584.8	$308.1	$887.2	$467.4	$302.4	$159.3
13	$472.2	$234.7	$719.1	$357.4	$246.9	$122.7
14	$381.4	$178.8	$582.9	$273.3	$201.5	$94.5
15	$308.2	$136.3	$472.5	$209.0	$164.3	$72.7
16	$249.2	$104.0	$383.0	$159.8	$133.8	$55.8
17	$201.5	$79.3	$310.5	$122.2	$109.0	$42.9
18	$162.9	$60.5	$251.7	$93.5	$88.7	$32.9
19	$131.8	$46.2	$204.0	$71.5	$72.2	$25.3
20	$106.6	$35.2	$165.3	$54.6	$58.7	$19.4
21	$86.3	$26.9	$134.0	$41.8	$47.7	$14.9
22	$69.8	$20.5	$108.6	$32.0	$38.8	$11.4
23	$56.5	$15.7	$88.1	$24.4	$31.5	$8.7
24	$45.8	$12.0	$71.4	$18.7	$25.6	$6.7
25	$37.1	$9.2	$57.9	$14.3	$20.8	$5.1
Total	**$2,378.7**	**($67.7)**	**$3,772.1**	**$208.1**	**$1,393.3**	**$275.8**
	Real After-Tax IRR	**5.745%**		**6.574%**		

Table C - 3: Mintz/Chen Subsidization Test – Productive Marginal Investment at Lower than Cost of Capital

Year	Production	Cumulative Production	Revenue	PV Revenue	Exploration Capex	Drilling Capex	PV Drilling Capex	Facilities Capex	PV Facilities Capex	Capex
1	0.0	0.0	$0.0	$0.0	$500.0	$0.0	$0.0	$100.0	$100.0	$600.0
2	0.0	0.0	$0.0	$0.0	$0.0	$600.0	$566.0	$900.0	$849.1	$1,500.0
3	0.0	0.0	$0.0	$0.0	$0.0	$400.0	$356.0	$600.0	$534.0	$1,000.0
4	0.0	0.0	$0.0	$0.0	$0.0	$400.0	$335.8	$600.0	$503.8	$1,000.0
5	0.0	0.0	$0.0	$0.0	$0.0	$400.0	$316.8	$600.0	$475.3	$1,000.0
6	13.3	13.3	$460.2	$343.9	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
7	26.7	40.0	$920.9	$649.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
8	40.0	80.0	$1,382.1	$919.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
9	40.0	120.0	$1,383.0	$867.7	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
10	40.0	160.0	$1,383.9	$819.1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
11	40.0	200.0	$1,384.9	$773.3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
12	40.0	240.0	$1,386.0	$730.1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
13	32.4	272.4	$1,124.3	$558.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
14	26.3	298.7	$912.1	$427.6	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
15	21.3	320.0	$740.0	$327.3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
16	17.3	337.3	$600.4	$250.5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
17	14.0	351.3	$487.2	$191.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
18	11.3	362.6	$395.3	$146.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
19	9.2	371.8	$320.8	$112.4	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
20	7.5	379.3	$260.3	$86.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
21	6.0	385.3	$211.3	$65.9	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
22	4.9	390.2	$171.5	$50.4	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
23	4.0	394.2	$139.2	$38.6	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
24	3.2	397.4	$113.0	$29.6	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
25	2.6	400.0	$91.7	$22.7	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total	**400.0**	**0.0**	**$13,868.3**	**$7,411.0**	**$500.0**	**$1,800.0**	**$1,574.7**	**$2,800.0**	**$2,462.1**	**$5,100.0**

Table C - 3: Mintz/Chen Subsidization Test – Productive Marginal Investment at Lower than Cost of Capital (Continued)

Year	Opex	PV Opex	Transport	PV Transport	Undepreciated Facilities Base	Facilities Depreciation Allowance 25%	PV Facilities Depreciation	Undepreciated Drilling Capex Base	Drilling Capex Depreciation Allowance 30%	PV Drilling Depreciation
1	$0.0	$0.0	$0.0	$0.0	$90.0	$22.5	$22.5	$0.0	$0.0	$0.0
2	$0.0	$0.0	$0.0	$0.0	$877.5	$219.4	$207.0	$600.0	$180.0	$169.8
3	$0.0	$0.0	$0.0	$0.0	$1,198.1	$299.5	$266.6	$820.0	$246.0	$218.9
4	$0.0	$0.0	$0.0	$0.0	$1,438.6	$359.6	$302.0	$974.0	$292.2	$245.3
5	$0.0	$0.0	$0.0	$0.0	$1,618.9	$404.7	$320.6	$1,081.8	$324.5	$257.1
6	$133.3	$99.6	$26.7	$19.9	$1,214.2	$303.6	$226.8	$757.3	$227.2	$169.8
7	$266.7	$188.0	$53.3	$37.6	$910.7	$227.7	$160.5	$530.1	$159.0	$112.1
8	$400.0	$266.0	$80.0	$53.2	$683.0	$170.7	$113.6	$371.1	$111.3	$74.0
9	$400.0	$251.0	$80.0	$50.2	$512.2	$128.1	$80.3	$259.7	$77.9	$48.9
10	$400.0	$236.8	$80.0	$47.4	$384.2	$96.0	$56.8	$181.8	$54.5	$32.3
11	$400.0	$223.4	$80.0	$44.7	$288.1	$72.0	$40.2	$127.3	$38.2	$21.3
12	$400.0	$210.7	$80.0	$42.1	$216.1	$54.0	$28.5	$89.1	$26.7	$14.1
13	$324.2	$161.1	$64.8	$32.2	$162.1	$40.5	$20.1	$62.4	$18.7	$9.3
14	$262.8	$123.2	$52.6	$24.6	$121.6	$30.4	$14.2	$43.7	$13.1	$6.1
15	$213.0	$94.2	$42.6	$18.8	$91.2	$22.8	$10.1	$30.6	$9.2	$4.1
16	$172.7	$72.1	$34.5	$14.4	$68.4	$17.1	$7.1	$21.4	$6.4	$2.7
17	$140.0	$55.1	$28.0	$11.0	$51.3	$12.8	$5.0	$15.0	$4.5	$1.8
18	$113.5	$42.1	$22.7	$8.4	$38.5	$9.6	$3.6	$10.5	$3.1	$1.2
19	$92.0	$32.2	$18.4	$6.4	$28.8	$7.2	$2.5	$7.3	$2.2	$0.8
20	$74.5	$24.6	$14.9	$4.9	$21.6	$5.4	$1.8	$5.1	$1.5	$0.5
21	$60.4	$18.8	$12.1	$3.8	$16.2	$4.1	$1.3	$3.6	$1.1	$0.3
22	$49.0	$14.4	$9.8	$2.9	$12.2	$3.0	$0.9	$2.5	$0.8	$0.2
23	$39.7	$11.0	$7.9	$2.2	$9.1	$2.3	$0.6	$1.8	$0.5	$0.1
24	$32.2	$8.4	$6.4	$1.7	$6.8	$1.7	$0.4	$1.2	$0.4	$0.1
25	$26.1	$6.4	$5.2	$1.3	$5.1	$1.3	$0.3	$0.9	$0.3	$0.1
Total	**$4,000.1**	**$2,139.3**	**$800.0**	**$427.9**	**$0.0**	**$2,516.1**	**$1,893.4**	**$0.0**	**$1,799.4**	**$1,390.9**

Table C - 3: Mintz/Chen Subsidization Test – Productive Marginal Investment at Lower than Cost of Capital (Continued)

Year	Simple Payout Calculation	Prod Trigger 50 MM BBLs	Reserves 20% Trigger	Prod Trigger 100 MM BBLs	Prod Trigger 200 MM BBLs	Prod Trigger 200 MM BBLs	Gross Royalty Rate with Simple Payout	Gross Royalty Rate	Ad Valorem or Gross Royalty	PV Gross Royalty
1	($606.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
2	($2,121.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
3	($3,131.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
4	($4,141.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
5	($5,151.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
6	($4,864.2)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$4.3	$3.2
7	($4,290.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$8.7	$6.1
8	($3,427.9)	0.00%	0.00%	2.13%	0.00%	0.00%	0.00%	2.13%	$27.7	$18.4
9	($2,564.9)	0.00%	2.50%	0.00%	3.75%	0.00%	0.00%	3.75%	$48.9	$30.7
10	($1,700.9)	0.00%	2.50%	0.00%	5.00%	0.00%	0.00%	5.00%	$65.2	$38.6
11	($836.0)	0.00%	2.50%	0.00%	5.00%	0.00%	0.00%	5.00%	$65.2	$36.4
12	$30.0	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$97.9	$51.6
13	$732.8	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$79.5	$39.5
14	$1,303.3	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$64.5	$30.2
15	$1,766.3	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$52.3	$23.1
16	$2,142.3	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$42.4	$17.7
17	$2,447.5	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$34.4	$13.6
18	$2,695.3	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$27.9	$10.4
19	$2,896.6	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$22.7	$7.9
20	$3,060.0	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$18.4	$6.1
21	$3,192.7	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$14.9	$4.7
22	$3,300.6	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$12.1	$3.6
23	$3,388.2	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$9.8	$2.7
24	$3,459.3	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$8.0	$2.1
25	$3,517.2	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$6.5	$1.6
Total									**$711.5**	**$348.2**

Table C - 3: Mintz/Chen Subsidization Test – Productive Marginal Investment at Lower than Cost of Capital (Continued)

Year	Tier 1 Return Allowance 11%	Tier 1 Net Royalty 20%	PV Tier 1 Net Royalty	Tier 2 Return Allowance 21%	Tier 2 Net Royalty 10%	PV Tier 2 Net Royalty	Total Royalties	PV Royalties
1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
2	-$2,271.0	$0.0	$0.0	-$2,407.3	$0.0	$0.0	$0.0	$0.0
3	-$3,586.3	$0.0	$0.0	-$4,028.9	$0.0	$0.0	$0.0	$0.0
4	-$5,046.4	$0.0	$0.0	-$5,991.0	$0.0	$0.0	$0.0	$0.0
5	-$6,667.0	$0.0	$0.0	-$8,365.2	$0.0	$0.0	$0.0	$0.0
6	-$7,102.4	$0.0	$0.0	-$9,809.8	$0.0	$0.0	$4.3	$3.2
7	-$7,287.0	$0.0	$0.0	-$11,244.9	$0.0	$0.0	$8.7	$6.1
8	-$7,208.3	$0.0	$0.0	-$12,684.3	$0.0	$0.0	$27.7	$18.4
9	-$7,142.3	$0.0	$0.0	-$14,448.4	$0.0	$0.0	$48.9	$30.7
10	-$7,085.2	$0.0	$0.0	-$16,599.9	$0.0	$0.0	$65.2	$38.6
11	-$7,021.0	$0.0	$0.0	-$19,202.3	$0.0	$0.0	$65.2	$36.4
12	-$6,983.0	$0.0	$0.0	-$22,386.1	$0.0	$0.0	$97.9	$51.6
13	-$7,093.5	$0.0	$0.0	-$26,398.3	$0.0	$0.0	$79.5	$39.5
14	-$7,339.9	$0.0	$0.0	-$31,382.8	$0.0	$0.0	$64.5	$30.2
15	-$7,713.9	$0.0	$0.0	-$37,519.3	$0.0	$0.0	$52.3	$23.1
16	-$8,210.6	$0.0	$0.0	-$45,029.9	$0.0	$0.0	$42.4	$17.7
17	-$8,828.1	$0.0	$0.0	-$54,186.9	$0.0	$0.0	$34.4	$13.6
18	-$9,567.3	$0.0	$0.0	-$65,323.2	$0.0	$0.0	$27.9	$10.4
19	-$10,431.3	$0.0	$0.0	-$78,843.8	$0.0	$0.0	$22.7	$7.9
20	-$11,425.7	$0.0	$0.0	-$95,240.7	$0.0	$0.0	$18.4	$6.1
21	-$12,558.3	$0.0	$0.0	-$115,111.1	$0.0	$0.0	$14.9	$4.7
22	-$13,838.7	$0.0	$0.0	-$139,178.7	$0.0	$0.0	$12.1	$3.6
23	-$15,279.0	$0.0	$0.0	-$168,320.3	$0.0	$0.0	$9.8	$2.7
24	-$16,893.0	$0.0	$0.0	-$203,597.7	$0.0	$0.0	$8.0	$2.1
25	-$18,697.1	$0.0	$0.0	-$246,296.5	$0.0	$0.0	$6.5	$1.6
Total		**$0.0**	**$0.0**		**$0.0**	**$0.0**	**$711.5**	**$348.2**

Table C - 3: Mintz/Chen Subsidization Test – Productive Marginal Investment at Lower than Cost of Capital (Continued)

Year	CIT Base	Federal CIT 15%	PV Federal CIT before AITC	AITC 10%	Federal CIT Net of AITC	PV Federal CIT Net of AITC	Provincial CIT 14%	PV Provincial CIT
1	($522.5)	($78.4)	($78.4)	$10.0	($88.4)	($88.4)	($73.2)	($73.2)
2	($399.4)	($59.9)	($56.5)	$90.0	($149.9)	($141.4)	($55.9)	($52.7)
3	($545.5)	($81.8)	($72.8)	$60.0	($141.8)	($126.2)	($76.4)	($68.0)
4	($651.8)	($97.8)	($82.1)	$60.0	($157.8)	($132.5)	($91.3)	($76.6)
5	($729.3)	($109.4)	($86.6)	$60.0	($169.4)	($134.2)	($102.1)	($80.9)
6	($234.9)	($35.2)	($26.3)	$0.0	($35.2)	($26.3)	($32.9)	($24.6)
7	$205.5	$30.8	$21.7	$0.0	$30.8	$21.7	$28.8	$20.3
8	$592.4	$88.9	$59.1	$0.0	$88.9	$59.1	$82.9	$55.2
9	$648.2	$97.2	$61.0	$0.0	$97.2	$61.0	$90.7	$56.9
10	$688.1	$103.2	$61.1	$0.0	$103.2	$61.1	$96.3	$57.0
11	$729.5	$109.4	$61.1	$0.0	$109.4	$61.1	$102.1	$57.0
12	$727.3	$109.1	$57.5	$0.0	$109.1	$57.5	$101.8	$53.6
13	$596.6	$89.5	$44.5	$0.0	$89.5	$44.5	$83.5	$41.5
14	$488.8	$73.3	$34.4	$0.0	$73.3	$34.4	$68.4	$32.1
15	$400.1	$60.0	$26.5	$0.0	$60.0	$26.5	$56.0	$24.8
16	$327.3	$49.1	$20.5	$0.0	$49.1	$20.5	$45.8	$19.1
17	$267.5	$40.1	$15.8	$0.0	$40.1	$15.8	$37.4	$14.7
18	$218.5	$32.8	$12.2	$0.0	$32.8	$12.2	$30.6	$11.4
19	$178.3	$26.8	$9.4	$0.0	$26.8	$9.4	$25.0	$8.7
20	$145.5	$21.8	$7.2	$0.0	$21.8	$7.2	$20.4	$6.7
21	$118.7	$17.8	$5.6	$0.0	$17.8	$5.6	$16.6	$5.2
22	$96.8	$14.5	$4.3	$0.0	$14.5	$4.3	$13.6	$4.0
23	$78.9	$11.8	$3.3	$0.0	$11.8	$3.3	$11.0	$3.1
24	$64.3	$9.6	$2.5	$0.0	$9.6	$2.5	$9.0	$2.4
25	$52.4	$7.9	$1.9	$0.0	$7.9	$1.9	$7.3	$1.8
Total		**$531.2**	**$106.7**	**$280.0**	**$251.2**	**($139.5)**	**$495.8**	**$99.6**

Table C - 3: Mintz/Chen Subsidization Test – Productive Marginal Investment at Lower than Cost of Capital (Continued)

Year	Net Cash Flow	DCF @ 6%	Pre-Tax/Royalty Net Cash Flow	Discounted Pre-Tax/Royalty Net Cash Flow @6%	Gov Rev	DCF Gov Rev @ 6%
1	($438.5)	($438.5)	($600.0)	($600.0)	($161.5)	($161.5)
2	($1,294.2)	($1,220.9)	($1,500.0)	($1,415.1)	($205.8)	($194.2)
3	($781.8)	($695.8)	($1,000.0)	($890.0)	($218.2)	($194.2)
4	($751.0)	($630.5)	($1,000.0)	($839.6)	($249.0)	($209.1)
5	($728.5)	($577.0)	($1,000.0)	($792.1)	($271.5)	($215.0)
6	$364.0	$272.0	$300.2	$224.3	($63.8)	($47.7)
7	$532.6	$375.5	$600.9	$423.6	$68.3	$48.1
8	$702.7	$467.3	$902.1	$600.0	$199.5	$132.7
9	$666.2	$418.0	$903.0	$566.6	$236.8	$148.6
10	$639.2	$378.3	$903.9	$535.0	$264.8	$156.7
11	$628.1	$350.7	$904.9	$505.3	$276.8	$154.6
12	$597.1	$314.6	$906.0	$477.3	$308.9	$162.7
13	$482.8	$239.9	$735.3	$365.4	$252.5	$125.5
14	$390.5	$183.1	$596.8	$279.8	$206.2	$96.7
15	$316.0	$139.8	$484.4	$214.2	$168.3	$74.5
16	$255.9	$106.8	$393.2	$164.1	$137.3	$57.3
17	$207.2	$81.6	$319.2	$125.7	$112.0	$44.1
18	$167.9	$62.3	$259.2	$96.2	$91.3	$33.9
19	$136.0	$47.7	$210.4	$73.7	$74.4	$26.1
20	$110.3	$36.4	$170.9	$56.5	$60.6	$20.0
21	$89.4	$27.9	$138.8	$43.3	$49.4	$15.4
22	$72.5	$21.3	$112.7	$33.2	$40.2	$11.8
23	$58.8	$16.3	$91.6	$25.4	$32.7	$9.1
24	$47.7	$12.5	$74.4	$19.5	$26.6	$7.0
25	$38.8	$9.6	$60.4	$14.9	$21.7	$5.4
Total	**$2,509.8**	**($1.2)**	**$3,968.2**	**$307.0**	**$1,458.4**	**$308.3**
	Real After-Tax IRR	**5.995%**		**6.839%**		

Table C - 4: Mintz/Chen Subsidization Test – Productive Marginal Investment at Cost of Capital

Year	Production	Cumulative Production	Revenue	PV Revenue	Exploration Capex	Drilling Capex	PV Drilling Capex	Facilities Capex	PV Facilities Capex	Capex
1	0.0	0.0	$0.0	$0.0	$500.0	$0.0	$0.0	$100.0	$100.0	$600.0
2	0.0	0.0	$0.0	$0.0	$0.0	$600.0	$566.0	$900.0	$849.1	$1,500.0
3	0.0	0.0	$0.0	$0.0	$0.0	$400.0	$356.0	$600.0	$534.0	$1,000.0
4	0.0	0.0	$0.0	$0.0	$0.0	$400.0	$335.8	$600.0	$503.8	$1,000.0
5	0.0	0.0	$0.0	$0.0	$0.0	$400.0	$316.8	$600.0	$475.3	$1,000.0
6	13.3	13.3	$460.2	$343.9	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
7	26.7	40.0	$920.9	$649.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
8	40.0	80.0	$1,382.2	$919.3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
9	40.0	120.0	$1,383.1	$867.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
10	40.0	160.0	$1,384.1	$819.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
11	40.0	200.0	$1,385.1	$773.4	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
12	40.0	240.0	$1,386.2	$730.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
13	32.4	272.4	$1,124.5	$558.9	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
14	26.3	298.7	$912.3	$427.7	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
15	21.3	320.0	$740.2	$327.4	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
16	17.3	337.3	$600.6	$250.6	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
17	14.0	351.3	$487.3	$191.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
18	11.3	362.6	$395.4	$146.9	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
19	9.2	371.8	$320.9	$112.4	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
20	7.5	379.3	$260.4	$86.1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
21	6.0	385.3	$211.4	$65.9	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
22	4.9	390.2	$171.6	$50.5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
23	4.0	394.2	$139.3	$38.7	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
24	3.2	397.4	$113.1	$29.6	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
25	2.6	400.0	$91.8	$22.7	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total	**400.0**	**0.0**	**$13,870.6**	**$7,412.1**	**$500.0**	**$1,800.0**	**$1,574.7**	**$2,800.0**	**$2,462.1**	**$5,100.0**

Table C - 4: Mintz/Chen Subsidization Test – Productive Marginal Investment at Cost of Capital (Continued)

Year	Opex	PV Opex	Transport	PV Transport	Undepreciated Facilities Base	Facilities Depreciation Allowance 25%	PV Facilities Depreciation	Undepreciated Drilling Capex Base	Drilling Capex Depreciation Allowance 30%	PV Drilling Depreciation
1	$0.0	$0.0	$0.0	$0.0	$90.0	$22.5	$22.5	$0.0	$0.0	$0.0
2	$0.0	$0.0	$0.0	$0.0	$877.5	$219.4	$207.0	$600.0	$180.0	$169.8
3	$0.0	$0.0	$0.0	$0.0	$1,198.1	$299.5	$266.6	$820.0	$246.0	$218.9
4	$0.0	$0.0	$0.0	$0.0	$1,438.6	$359.6	$302.0	$974.0	$292.2	$245.3
5	$0.0	$0.0	$0.0	$0.0	$1,618.9	$404.7	$320.6	$1,081.8	$324.5	$257.1
6	$133.3	$99.6	$26.7	$19.9	$1,214.2	$303.6	$226.8	$757.3	$227.2	$169.8
7	$266.7	$188.0	$53.3	$37.6	$910.7	$227.7	$160.5	$530.1	$159.0	$112.1
8	$400.0	$266.0	$80.0	$53.2	$683.0	$170.7	$113.6	$371.1	$111.3	$74.0
9	$400.0	$251.0	$80.0	$50.2	$512.2	$128.1	$80.3	$259.7	$77.9	$48.9
10	$400.0	$236.8	$80.0	$47.4	$384.2	$96.0	$56.8	$181.8	$54.5	$32.3
11	$400.0	$223.4	$80.0	$44.7	$288.1	$72.0	$40.2	$127.3	$38.2	$21.3
12	$400.0	$210.7	$80.0	$42.1	$216.1	$54.0	$28.5	$89.1	$26.7	$14.1
13	$324.2	$161.1	$64.8	$32.2	$162.1	$40.5	$20.1	$62.4	$18.7	$9.3
14	$262.8	$123.2	$52.6	$24.6	$121.6	$30.4	$14.2	$43.7	$13.1	$6.1
15	$213.0	$94.2	$42.6	$18.8	$91.2	$22.8	$10.1	$30.6	$9.2	$4.1
16	$172.7	$72.1	$34.5	$14.4	$68.4	$17.1	$7.1	$21.4	$6.4	$2.7
17	$140.0	$55.1	$28.0	$11.0	$51.3	$12.8	$5.0	$15.0	$4.5	$1.8
18	$113.5	$42.1	$22.7	$8.4	$38.5	$9.6	$3.6	$10.5	$3.1	$1.2
19	$92.0	$32.2	$18.4	$6.4	$28.8	$7.2	$2.5	$7.3	$2.2	$0.8
20	$74.5	$24.6	$14.9	$4.9	$21.6	$5.4	$1.8	$5.1	$1.5	$0.5
21	$60.4	$18.8	$12.1	$3.8	$16.2	$4.1	$1.3	$3.6	$1.1	$0.3
22	$49.0	$14.4	$9.8	$2.9	$12.2	$3.0	$0.9	$2.5	$0.8	$0.2
23	$39.7	$11.0	$7.9	$2.2	$9.1	$2.3	$0.6	$1.8	$0.5	$0.1
24	$32.2	$8.4	$6.4	$1.7	$6.8	$1.7	$0.4	$1.2	$0.4	$0.1
25	$26.1	$6.4	$5.2	$1.3	$5.1	$1.3	$0.3	$0.9	$0.3	$0.1
Total	**$4,000.1**	**$2,139.3**	**$800.0**	**$427.9**	**$0.0**	**$2,516.1**	**$1,893.4**	**$0.0**	**$1,799.4**	**$1,390.9**

Table C - 4: Mintz/Chen Subsidization Test – Productive Marginal Investment at Cost of Capital (Continued)

Year	Simple Payout Calculation	Prod Trigger 50 MM BBLs	Reserves 20% Trigger	Prod Trigger 100 MM BBLs	Prod Trigger 200 MM BBLs	Prod Trigger 200 MM BBLs	Gross Royalty Rate with Simple Payout	Gross Royalty Rate	Ad Valorem or Gross Royalty	PV Gross Royalty
1	($606.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
2	($2,121.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
3	($3,131.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
4	($4,141.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
5	($5,151.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
6	($4,864.1)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$4.3	$3.2
7	($4,289.9)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$8.7	$6.1
8	($3,427.7)	0.00%	0.00%	2.13%	0.00%	0.00%	0.00%	2.13%	$27.7	$18.4
9	($2,564.6)	0.00%	2.50%	0.00%	3.75%	0.00%	0.00%	3.75%	$48.9	$30.7
10	($1,700.5)	0.00%	2.50%	0.00%	5.00%	0.00%	0.00%	5.00%	$65.2	$38.6
11	($835.4)	0.00%	2.50%	0.00%	5.00%	0.00%	0.00%	5.00%	$65.3	$36.4
12	$30.8	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$98.0	$51.6
13	$733.8	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$79.5	$39.5
14	$1,304.4	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$64.5	$30.2
15	$1,767.7	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$52.3	$23.1
16	$2,143.7	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$42.5	$17.7
17	$2,449.1	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$34.4	$13.6
18	$2,697.0	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$28.0	$10.4
19	$2,898.4	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$22.7	$7.9
20	$3,061.9	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$18.4	$6.1
21	$3,194.7	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$14.9	$4.7
22	$3,302.7	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$12.1	$3.6
23	$3,390.3	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$9.9	$2.7
24	$3,461.6	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$8.0	$2.1
25	$3,519.5	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$6.5	$1.6
Total									**$711.6**	**$348.3**

Table C - 4: Mintz/Chen Subsidization Test – Productive Marginal Investment at Cost of Capital (Continued)

Year	Tier 1 Return Allowance 11%	Tier 1 Net Royalty 20%	PV Tier 1 Net Royalty	Tier 2 Return Allowance 21%	Tier 2 Net Royalty 10%	PV Tier 2 Net Royalty	Total Royalties	PV Royalties
1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
2	-$2,271.0	$0.0	$0.0	-$2,407.3	$0.0	$0.0	$0.0	$0.0
3	-$3,586.3	$0.0	$0.0	-$4,028.9	$0.0	$0.0	$0.0	$0.0
4	-$5,046.4	$0.0	$0.0	-$5,991.0	$0.0	$0.0	$0.0	$0.0
5	-$6,667.0	$0.0	$0.0	-$8,365.2	$0.0	$0.0	$0.0	$0.0
6	-$7,102.4	$0.0	$0.0	-$9,809.7	$0.0	$0.0	$4.3	$3.2
7	-$7,286.9	$0.0	$0.0	-$11,244.8	$0.0	$0.0	$8.7	$6.1
8	-$7,208.1	$0.0	$0.0	-$12,684.1	$0.0	$0.0	$27.7	$18.4
9	-$7,141.9	$0.0	$0.0	-$14,448.0	$0.0	$0.0	$48.9	$30.7
10	-$7,084.7	$0.0	$0.0	-$16,599.3	$0.0	$0.0	$65.2	$38.6
11	-$7,020.2	$0.0	$0.0	-$19,201.3	$0.0	$0.0	$65.3	$36.4
12	-$6,982.0	$0.0	$0.0	-$22,384.8	$0.0	$0.0	$98.0	$51.6
13	-$7,092.2	$0.0	$0.0	-$26,396.5	$0.0	$0.0	$79.5	$39.5
14	-$7,338.3	$0.0	$0.0	-$31,380.5	$0.0	$0.0	$64.5	$30.2
15	-$7,712.0	$0.0	$0.0	-$37,516.3	$0.0	$0.0	$52.3	$23.1
16	-$8,208.3	$0.0	$0.0	-$45,026.1	$0.0	$0.0	$42.5	$17.7
17	-$8,825.5	$0.0	$0.0	-$54,182.2	$0.0	$0.0	$34.4	$13.6
18	-$9,564.2	$0.0	$0.0	-$65,317.4	$0.0	$0.0	$28.0	$10.4
19	-$10,427.7	$0.0	$0.0	-$78,836.7	$0.0	$0.0	$22.7	$7.9
20	-$11,421.7	$0.0	$0.0	-$95,232.0	$0.0	$0.0	$18.4	$6.1
21	-$12,553.7	$0.0	$0.0	-$115,100.5	$0.0	$0.0	$14.9	$4.7
22	-$13,833.6	$0.0	$0.0	-$139,165.8	$0.0	$0.0	$12.1	$3.6
23	-$15,273.2	$0.0	$0.0	-$168,304.6	$0.0	$0.0	$9.9	$2.7
24	-$16,886.5	$0.0	$0.0	-$203,578.7	$0.0	$0.0	$8.0	$2.1
25	-$18,689.8	$0.0	$0.0	-$246,273.4	$0.0	$0.0	$6.5	$1.6
Total		**$0.0**	**$0.0**		**$0.0**	**$0.0**	**$711.6**	**$348.3**

Table C - 4: Mintz/Chen Subsidization Test – Productive Marginal Investment at Cost of Capital (Continued)

Year	CIT Base	Federal CIT 15%	PV Federal CIT before AITC	AITC 10%	Federal CIT Net of AITC	PV Federal CIT Net of AITC	Provincial CIT 14%	PV Provincial CIT
1	($522.5)	($78.4)	($78.4)	$10.0	($88.4)	($88.4)	($73.2)	($73.2)
2	($399.4)	($59.9)	($56.5)	$90.0	($149.9)	($141.4)	($55.9)	($52.7)
3	($545.5)	($81.8)	($72.8)	$60.0	($141.8)	($126.2)	($76.4)	($68.0)
4	($651.8)	($97.8)	($82.1)	$60.0	($157.8)	($132.5)	($91.3)	($76.6)
5	($729.3)	($109.4)	($86.6)	$60.0	($169.4)	($134.2)	($102.1)	($80.9)
6	($234.9)	($35.2)	($26.3)	$0.0	($35.2)	($26.3)	($32.9)	($24.6)
7	$205.5	$30.8	$21.7	$0.0	$30.8	$21.7	$28.8	$20.3
8	$592.5	$88.9	$59.1	$0.0	$88.9	$59.1	$82.9	$55.2
9	$648.3	$97.2	$61.0	$0.0	$97.2	$61.0	$90.8	$56.9
10	$688.3	$103.2	$61.1	$0.0	$103.2	$61.1	$96.4	$57.0
11	$729.6	$109.4	$61.1	$0.0	$109.4	$61.1	$102.1	$57.0
12	$727.4	$109.1	$57.5	$0.0	$109.1	$57.5	$101.8	$53.6
13	$596.7	$89.5	$44.5	$0.0	$89.5	$44.5	$83.5	$41.5
14	$489.0	$73.3	$34.4	$0.0	$73.3	$34.4	$68.5	$32.1
15	$400.3	$60.0	$26.6	$0.0	$60.0	$26.6	$56.0	$24.8
16	$327.4	$49.1	$20.5	$0.0	$49.1	$20.5	$45.8	$19.1
17	$267.6	$40.1	$15.8	$0.0	$40.1	$15.8	$37.5	$14.7
18	$218.6	$32.8	$12.2	$0.0	$32.8	$12.2	$30.6	$11.4
19	$178.4	$26.8	$9.4	$0.0	$26.8	$9.4	$25.0	$8.8
20	$145.6	$21.8	$7.2	$0.0	$21.8	$7.2	$20.4	$6.7
21	$118.8	$17.8	$5.6	$0.0	$17.8	$5.6	$16.6	$5.2
22	$96.9	$14.5	$4.3	$0.0	$14.5	$4.3	$13.6	$4.0
23	$79.0	$11.8	$3.3	$0.0	$11.8	$3.3	$11.1	$3.1
24	$64.4	$9.7	$2.5	$0.0	$9.7	$2.5	$9.0	$2.4
25	$52.5	$7.9	$1.9	$0.0	$7.9	$1.9	$7.3	$1.8
Total		**$531.5**	**$106.8**	**$280.0**	**$251.5**	**($139.4)**	**$496.1**	**$99.7**

Table C - 4: Mintz/Chen Subsidization Test – Productive Marginal Investment at Cost of Capital (Continued)

Year	Net Cash Flow	DCF @ 6%	Pre-Tax/Royalty Net Cash Flow	Discounted Pre-Tax/Royalty Net Cash Flow @6%	Gov Rev	DCF Gov Rev @ 6%
1	($438.5)	($438.5)	($600.0)	($600.0)	($161.5)	($161.5)
2	($1,294.2)	($1,220.9)	($1,500.0)	($1,415.1)	($205.8)	($194.2)
3	($781.8)	($695.8)	($1,000.0)	($890.0)	($218.2)	($194.2)
4	($751.0)	($630.5)	($1,000.0)	($839.6)	($249.0)	($209.1)
5	($728.5)	($577.0)	($1,000.0)	($792.1)	($271.5)	($215.0)
6	$364.0	$272.0	$300.2	$224.3	($63.8)	($47.7)
7	$532.6	$375.5	$600.9	$423.6	$68.3	$48.1
8	$702.7	$467.4	$902.2	$600.0	$199.5	$132.7
9	$666.3	$418.0	$903.1	$566.6	$236.9	$148.6
10	$639.3	$378.4	$904.1	$535.1	$264.8	$156.7
11	$628.2	$350.8	$905.1	$505.4	$276.8	$154.6
12	$597.2	$314.6	$906.2	$477.4	$308.9	$162.7
13	$482.9	$240.0	$735.4	$365.5	$252.5	$125.5
14	$390.7	$183.2	$596.9	$279.9	$206.3	$96.7
15	$316.1	$139.8	$484.5	$214.3	$168.4	$74.5
16	$256.0	$106.8	$393.4	$164.1	$137.4	$57.3
17	$207.3	$81.6	$319.3	$125.7	$112.0	$44.1
18	$167.9	$62.4	$259.3	$96.3	$91.3	$33.9
19	$136.1	$47.7	$210.5	$73.8	$74.4	$26.1
20	$110.3	$36.5	$171.0	$56.5	$60.6	$20.0
21	$89.5	$27.9	$138.9	$43.3	$49.4	$15.4
22	$72.6	$21.3	$112.8	$33.2	$40.2	$11.8
23	$58.9	$16.3	$91.6	$25.4	$32.8	$9.1
24	$47.8	$12.5	$74.5	$19.5	$26.7	$7.0
25	$38.8	$9.6	$60.5	$14.9	$21.7	$5.4
Total	**$2,511.3**	**($0.5)**	**$3,970.5**	**$308.1**	**$1,459.2**	**$308.6**
	Real After-Tax IRR	**5.998%**		**6.841%**		

Table C - 5: Base Case Without Atlantic Investment Tax Credit Removed (Prices Adjusted to Give 6%)

Year	Production	Cumulative Production	Revenue	PV Revenue	Exploration Capex	Drilling Capex	PV Drilling Capex	Facilities Capex	PV Facilities Capex	Capex
1	0.0	0.0	$0.0	$0.0	$500.0	$0.0	$0.0	$0.0	$0.0	$500.0
2	0.0	0.0	$0.0	$0.0	$0.0	$600.0	$566.0	$900.0	$849.1	$1,500.0
3	0.0	0.0	$0.0	$0.0	$0.0	$400.0	$356.0	$600.0	$534.0	$1,000.0
4	0.0	0.0	$0.0	$0.0	$0.0	$400.0	$335.8	$600.0	$503.8	$1,000.0
5	0.0	0.0	$0.0	$0.0	$0.0	$400.0	$316.8	$600.0	$475.3	$1,000.0
6	13.3	13.3	$472.1	$352.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
7	26.7	40.0	$944.3	$665.7	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
8	40.0	80.0	$1,416.4	$942.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
9	40.0	120.0	$1,416.4	$888.7	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
10	40.0	160.0	$1,416.4	$838.4	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
11	40.0	200.0	$1,416.4	$790.9	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
12	40.0	240.0	$1,416.4	$746.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
13	32.4	272.4	$1,148.1	$570.6	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
14	26.3	298.7	$930.7	$436.3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
15	21.3	320.0	$754.4	$333.7	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
16	17.3	337.3	$611.5	$255.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
17	14.0	351.3	$495.7	$195.1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
18	11.3	362.6	$401.8	$149.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
19	9.2	371.8	$325.7	$114.1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
20	7.5	379.3	$264.0	$87.3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
21	6.0	385.3	$214.0	$66.7	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
22	4.9	390.2	$173.4	$51.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
23	4.0	394.2	$140.6	$39.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
24	3.2	397.4	$114.0	$29.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
25	2.6	400.0	$92.4	$22.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total	**400.0**	**0.0**	**$14,164.6**	**$7,575.4**	**$500.0**	**$1,800.0**	**$1,574.7**	**$2,700.0**	**$2,362.1**	**$5,000.0**

Table C - 5: Base Case Without Atlantic Investment Tax Credit Removed (Prices Adjusted to Give 6%) (Continued)

Year	Opex	PV Opex	Transport	PV Transport	Undepreciated Facilities Base	Facilities Depreciation Allowance 25%	PV Facilities Depreciation	Undepreciated Drilling Capex Base	Drilling Capex Depreciation Allowance 30%	PV Drilling Depreciation
1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
2	$0.0	$0.0	$0.0	$0.0	$900.0	$225.0	$212.3	$600.0	$180.0	$169.8
3	$0.0	$0.0	$0.0	$0.0	$1,275.0	$318.8	$283.7	$820.0	$246.0	$218.9
4	$0.0	$0.0	$0.0	$0.0	$1,556.3	$389.1	$326.7	$974.0	$292.2	$245.3
5	$0.0	$0.0	$0.0	$0.0	$1,767.2	$441.8	$349.9	$1,081.8	$324.5	$257.1
6	$133.3	$99.6	$26.7	$19.9	$1,325.4	$331.3	$247.6	$757.3	$227.2	$169.8
7	$266.7	$188.0	$53.3	$37.6	$994.0	$248.5	$175.2	$530.1	$159.0	$112.1
8	$400.0	$266.0	$80.0	$53.2	$745.5	$186.4	$124.0	$371.1	$111.3	$74.0
9	$400.0	$251.0	$80.0	$50.2	$559.1	$139.8	$87.7	$259.7	$77.9	$48.9
10	$400.0	$236.8	$80.0	$47.4	$419.4	$104.8	$62.1	$181.8	$54.5	$32.3
11	$400.0	$223.4	$80.0	$44.7	$314.5	$78.6	$43.9	$127.3	$38.2	$21.3
12	$400.0	$210.7	$80.0	$42.1	$235.9	$59.0	$31.1	$89.1	$26.7	$14.1
13	$324.2	$161.1	$64.8	$32.2	$176.9	$44.2	$22.0	$62.4	$18.7	$9.3
14	$262.8	$123.2	$52.6	$24.6	$132.7	$33.2	$15.6	$43.7	$13.1	$6.1
15	$213.0	$94.2	$42.6	$18.8	$99.5	$24.9	$11.0	$30.6	$9.2	$4.1
16	$172.7	$72.1	$34.5	$14.4	$74.6	$18.7	$7.8	$21.4	$6.4	$2.7
17	$140.0	$55.1	$28.0	$11.0	$56.0	$14.0	$5.5	$15.0	$4.5	$1.8
18	$113.5	$42.1	$22.7	$8.4	$42.0	$10.5	$3.9	$10.5	$3.1	$1.2
19	$92.0	$32.2	$18.4	$6.4	$31.5	$7.9	$2.8	$7.3	$2.2	$0.8
20	$74.5	$24.6	$14.9	$4.9	$23.6	$5.9	$2.0	$5.1	$1.5	$0.5
21	$60.4	$18.8	$12.1	$3.8	$17.7	$4.4	$1.4	$3.6	$1.1	$0.3
22	$49.0	$14.4	$9.8	$2.9	$13.3	$3.3	$1.0	$2.5	$0.8	$0.2
23	$39.7	$11.0	$7.9	$2.2	$10.0	$2.5	$0.7	$1.8	$0.5	$0.1
24	$32.2	$8.4	$6.4	$1.7	$7.5	$1.9	$0.5	$1.2	$0.4	$0.1
25	$26.1	$6.4	$5.2	$1.3	$5.6	$1.4	$0.3	$0.9	$0.3	$0.1
Total	**$4,000.1**	**$2,139.3**	**$800.0**	**$427.9**	**$0.0**	**$2,695.8**	**$2,018.4**	**$0.0**	**$1,799.4**	**$1,390.9**

Table C - 5: Base Case Without Atlantic Investment Tax Credit Removed (Prices Adjusted to Give 6%) (Continued)

Year	Simple Payout Calculation	Prod Trigger 50 MM BBLs	Reserves 20% Trigger	Prod Trigger 100 MM BBLs	Prod Trigger 200 MM BBLs	Prod Trigger 200 MM BBLs	Gross Royalty Rate with Simple Payout	Gross Royalty Rate	Ad Valorem or Gross Royalty	PV Gross Royalty
1	($505.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
2	($2,020.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
3	($3,030.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
4	($4,040.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
5	($5,050.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
6	($4,751.2)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$4.5	$3.3
7	($4,153.6)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$8.9	$6.3
8	($3,257.2)	0.00%	0.00%	2.13%	0.00%	0.00%	0.00%	2.13%	$28.4	$18.9
9	($2,360.7)	0.00%	2.50%	0.00%	3.75%	0.00%	0.00%	3.75%	$50.1	$31.4
10	($1,464.3)	0.00%	2.50%	0.00%	5.00%	0.00%	0.00%	5.00%	$66.8	$39.6
11	($567.9)	0.00%	2.50%	0.00%	5.00%	0.00%	0.00%	5.00%	$66.8	$37.3
12	$328.5	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$100.2	$52.8
13	$1,055.2	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$81.2	$40.4
14	$1,644.1	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$65.9	$30.9
15	$2,121.6	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$53.4	$23.6
16	$2,508.6	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$43.3	$18.1
17	$2,822.3	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$35.1	$13.8
18	$3,076.5	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$28.4	$10.6
19	$3,282.6	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$23.0	$8.1
20	$3,449.7	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$18.7	$6.2
21	$3,585.1	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$15.1	$4.7
22	$3,694.9	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$12.3	$3.6
23	$3,783.9	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$9.9	$2.8
24	$3,856.0	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$8.1	$2.1
25	$3,914.5	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$6.5	$1.6
Total									**$726.7**	**$356.0**

Table C - 5: Base Case Without Atlantic Investment Tax Credit Removed (Prices Adjusted to Give 6%) (Continued)

Year	Tier 1 Return Allowance 11%	Tier 1 Net Royalty 20%	PV Tier 1 Net Royalty	Tier 2 Return Allowance 21%	Tier 2 Net Royalty 10%	PV Tier 2 Net Royalty	Total Royalties	PV Royalties
1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
2	-$2,158.9	$0.0	$0.0	-$2,285.1	$0.0	$0.0	$0.0	$0.0
3	-$3,461.9	$0.0	$0.0	-$3,881.1	$0.0	$0.0	$0.0	$0.0
4	-$4,908.3	$0.0	$0.0	-$5,812.1	$0.0	$0.0	$0.0	$0.0
5	-$6,513.7	$0.0	$0.0	-$8,148.7	$0.0	$0.0	$0.0	$0.0
6	-$6,919.7	$0.0	$0.0	-$9,534.7	$0.0	$0.0	$4.5	$3.3
7	-$7,059.8	$0.0	$0.0	-$10,886.5	$0.0	$0.0	$8.9	$6.3
8	-$6,920.6	$0.0	$0.0	-$12,213.4	$0.0	$0.0	$28.4	$18.9
9	-$6,789.0	$0.0	$0.0	-$13,843.1	$0.0	$0.0	$50.1	$31.4
10	-$6,660.6	$0.0	$0.0	-$15,833.4	$0.0	$0.0	$66.8	$39.6
11	-$6,518.0	$0.0	$0.0	-$18,241.8	$0.0	$0.0	$66.8	$37.3
12	-$6,395.0	$0.0	$0.0	-$21,192.7	$0.0	$0.0	$100.2	$52.8
13	-$6,417.6	$0.0	$0.0	-$24,930.1	$0.0	$0.0	$81.2	$40.4
14	-$6,571.6	$0.0	$0.0	-$29,587.3	$0.0	$0.0	$65.9	$30.9
15	-$6,847.1	$0.0	$0.0	-$35,332.1	$0.0	$0.0	$53.4	$23.6
16	-$7,237.6	$0.0	$0.0	-$42,372.0	$0.0	$0.0	$43.3	$18.1
17	-$7,739.8	$0.0	$0.0	-$50,962.3	$0.0	$0.0	$35.1	$13.8
18	-$8,353.0	$0.0	$0.0	-$61,414.8	$0.0	$0.0	$28.4	$10.6
19	-$9,078.6	$0.0	$0.0	-$74,109.6	$0.0	$0.0	$23.0	$8.1
20	-$9,920.7	$0.0	$0.0	-$89,508.6	$0.0	$0.0	$18.7	$6.2
21	-$10,885.1	$0.0	$0.0	-$108,172.5	$0.0	$0.0	$15.1	$4.7
22	-$11,979.6	$0.0	$0.0	-$130,781.0	$0.0	$0.0	$12.3	$3.6
23	-$13,214.0	$0.0	$0.0	-$158,157.7	$0.0	$0.0	$9.9	$2.8
24	-$14,600.0	$0.0	$0.0	-$191,300.1	$0.0	$0.0	$8.1	$2.1
25	-$16,151.2	$0.0	$0.0	-$231,415.7	$0.0	$0.0	$6.5	$1.6
Total		**$0.0**	**$0.0**		**$0.0**	**$0.0**	**$726.7**	**$356.0**

Table C - 5: Base Case Without Atlantic Investment Tax Credit Removed (Prices Adjusted to Give 6%) (Continued)

Year	CIT Base	Federal CIT 15%	PV Federal CIT before AITC	AITC 10%	Federal CIT Net of AITC	PV Federal CIT Net of AITC	Provincial CIT 14%	PV Provincial CIT
1	($500.0)	($75.0)	($75.0)	$0.0	($75.0)	($75.0)	($70.0)	($70.0)
2	($405.0)	($60.8)	($57.3)	$0.0	($60.8)	($57.3)	($56.7)	($53.5)
3	($564.8)	($84.7)	($75.4)	$0.0	($84.7)	($75.4)	($79.1)	($70.4)
4	($681.3)	($102.2)	($85.8)	$0.0	($102.2)	($85.8)	($95.4)	($80.1)
5	($766.3)	($115.0)	($91.1)	$0.0	($115.0)	($91.1)	($107.3)	($85.0)
6	($250.8)	($37.6)	($28.1)	$0.0	($37.6)	($28.1)	($35.1)	($26.2)
7	$207.8	$31.2	$22.0	$0.0	$31.2	$22.0	$29.1	$20.5
8	$610.3	$91.5	$60.9	$0.0	$91.5	$60.9	$85.4	$56.8
9	$668.6	$100.3	$62.9	$0.0	$100.3	$62.9	$93.6	$58.7
10	$710.2	$106.5	$63.1	$0.0	$106.5	$63.1	$99.4	$58.9
11	$752.8	$112.9	$63.1	$0.0	$112.9	$63.1	$105.4	$58.8
12	$750.5	$112.6	$59.3	$0.0	$112.6	$59.3	$105.1	$55.3
13	$614.9	$92.2	$45.8	$0.0	$92.2	$45.8	$86.1	$42.8
14	$503.1	$75.5	$35.4	$0.0	$75.5	$35.4	$70.4	$33.0
15	$411.3	$61.7	$27.3	$0.0	$61.7	$27.3	$57.6	$25.5
16	$335.9	$50.4	$21.0	$0.0	$50.4	$21.0	$47.0	$19.6
17	$274.1	$41.1	$16.2	$0.0	$41.1	$16.2	$38.4	$15.1
18	$223.5	$33.5	$12.5	$0.0	$33.5	$12.5	$31.3	$11.6
19	$182.2	$27.3	$9.6	$0.0	$27.3	$9.6	$25.5	$8.9
20	$148.4	$22.3	$7.4	$0.0	$22.3	$7.4	$20.8	$6.9
21	$120.8	$18.1	$5.7	$0.0	$18.1	$5.7	$16.9	$5.3
22	$98.3	$14.7	$4.3	$0.0	$14.7	$4.3	$13.8	$4.0
23	$80.0	$12.0	$3.3	$0.0	$12.0	$3.3	$11.2	$3.1
24	$65.0	$9.8	$2.6	$0.0	$9.8	$2.6	$9.1	$2.4
25	$52.9	$7.9	$2.0	$0.0	$7.9	$2.0	$7.4	$1.8
Total		**$546.4**	**$111.5**	**$0.0**	**$546.4**	**$111.5**	**$510.0**	**$104.0**

Table C - 5: Base Case Without Atlantic Investment Tax Credit Removed (Prices Adjusted to Give 6%) (Continued)

Year	Net Cash Flow	DCF @ 6%	Pre-Tax/Royalty Net Cash Flow	Discounted Pre-Tax/Royalty Net Cash Flow @6%	Gov Rev	DCF Gov Rev @ 6%
1	($355.0)	($355.0)	($500.0)	($500.0)	($145.0)	($145.0)
2	($1,382.6)	($1,304.3)	($1,500.0)	($1,415.1)	($117.5)	($110.8)
3	($836.2)	($744.2)	($1,000.0)	($890.0)	($163.8)	($145.8)
4	($802.4)	($673.7)	($1,000.0)	($839.6)	($197.6)	($165.9)
5	($777.8)	($616.1)	($1,000.0)	($792.1)	($222.2)	($176.0)
6	$380.4	$284.3	$312.1	$233.2	($68.3)	($51.0)
7	$555.1	$391.3	$624.3	$440.1	$69.2	$48.8
8	$731.0	$486.2	$936.4	$622.8	$205.4	$136.6
9	$692.4	$434.4	$936.4	$587.5	$244.0	$153.1
10	$663.6	$392.8	$936.4	$554.3	$272.8	$161.5
11	$651.3	$363.7	$936.4	$522.9	$285.1	$159.2
12	$618.5	$325.8	$936.4	$493.3	$317.9	$167.5
13	$499.5	$248.2	$759.0	$377.2	$259.6	$129.0
14	$403.5	$189.2	$615.3	$288.5	$211.8	$99.3
15	$326.1	$144.2	$498.7	$220.6	$172.7	$76.4
16	$263.6	$110.0	$404.3	$168.7	$140.7	$58.7
17	$213.1	$83.9	$327.7	$129.0	$114.6	$45.1
18	$172.4	$64.0	$265.6	$98.6	$93.3	$34.6
19	$139.4	$48.8	$215.3	$75.4	$75.9	$26.6
20	$112.8	$37.3	$174.5	$57.7	$61.7	$20.4
21	$91.3	$28.5	$141.5	$44.1	$50.2	$15.6
22	$73.9	$21.7	$114.7	$33.7	$40.8	$12.0
23	$59.8	$16.6	$93.0	$25.8	$33.1	$9.2
24	$48.4	$12.7	$75.3	$19.7	$26.9	$7.0
25	$39.2	$9.7	$61.1	$15.1	$21.9	$5.4
Total	**$2,581.4**	**$0.0**	**$4,364.5**	**$571.4**	**$1,783.1**	**$571.4**
	Real After-Tax IRR	**6.000%**		**7.577%**		

Table C - 6: Base Case Without Atlantic Investment Tax Credit Removed (Prices Adjusted to Give 6%) – Lower than Cost of Capital

Year	Production	Cumulative Production	Revenue	PV Revenue	Exploration Capex	Drilling Capex	PV Drilling Capex	Facilities Capex	PV Facilities Capex	Capex
1	0.0	0.0	$0.0	$0.0	$500.0	$0.0	$0.0	$100.0	$100.0	$600.0
2	0.0	0.0	$0.0	$0.0	$0.0	$600.0	$566.0	$900.0	$849.1	$1,500.0
3	0.0	0.0	$0.0	$0.0	$0.0	$400.0	$356.0	$600.0	$534.0	$1,000.0
4	0.0	0.0	$0.0	$0.0	$0.0	$400.0	$335.8	$600.0	$503.8	$1,000.0
5	0.0	0.0	$0.0	$0.0	$0.0	$400.0	$316.8	$600.0	$475.3	$1,000.0
6	13.3	13.3	$476.6	$356.1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
7	26.7	40.0	$953.7	$672.3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
8	40.0	80.0	$1,431.4	$951.9	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
9	40.0	120.0	$1,432.2	$898.6	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
10	40.0	160.0	$1,433.2	$848.3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
11	40.0	200.0	$1,434.2	$800.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
12	40.0	240.0	$1,435.2	$756.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
13	32.4	272.4	$1,164.3	$578.6	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
14	26.3	298.7	$944.5	$442.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
15	21.3	320.0	$766.3	$338.9	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
16	17.3	337.3	$621.7	$259.4	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
17	14.0	351.3	$504.4	$198.6	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
18	11.3	362.6	$409.3	$152.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
19	9.2	371.8	$332.1	$116.4	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
20	7.5	379.3	$269.5	$89.1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
21	6.0	385.3	$218.7	$68.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
22	4.9	390.2	$177.5	$52.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
23	4.0	394.2	$144.1	$40.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
24	3.2	397.4	$117.0	$30.6	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
25	2.6	400.0	$95.0	$23.5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total	**400.0**	**0.0**	**$14,360.7**	**$7,674.4**	**$500.0**	**$1,800.0**	**$1,574.7**	**$2,800.0**	**$2,462.1**	**$5,100.0**

Table C - 6: Base Case Without Atlantic Investment Tax Credit Removed (Prices Adjusted to Give 6%) – Lower than Cost of Capital (Continued)

Year	Opex	PV Opex	Transport	PV Transport	Undepreciated Facilities Base	Facilities Depreciation Allowance 25%	PV Facilities Depreciation	Undepreciated Drilling Capex Base	Drilling Capex Depreciation Allowance 30%	PV Drilling Depreciation
1	$0.0	$0.0	$0.0	$0.0	$100.0	$25.0	$25.0	$0.0	$0.0	$0.0
2	$0.0	$0.0	$0.0	$0.0	$975.0	$243.8	$230.0	$600.0	$180.0	$169.8
3	$0.0	$0.0	$0.0	$0.0	$1,331.3	$332.8	$296.2	$820.0	$246.0	$218.9
4	$0.0	$0.0	$0.0	$0.0	$1,598.4	$399.6	$335.5	$974.0	$292.2	$245.3
5	$0.0	$0.0	$0.0	$0.0	$1,798.8	$449.7	$356.2	$1,081.8	$324.5	$257.1
6	$133.3	$99.6	$26.7	$19.9	$1,349.1	$337.3	$252.0	$757.3	$227.2	$169.8
7	$266.7	$188.0	$53.3	$37.6	$1,011.8	$253.0	$178.3	$530.1	$159.0	$112.1
8	$400.0	$266.0	$80.0	$53.2	$758.9	$189.7	$126.2	$371.1	$111.3	$74.0
9	$400.0	$251.0	$80.0	$50.2	$569.2	$142.3	$89.3	$259.7	$77.9	$48.9
10	$400.0	$236.8	$80.0	$47.4	$426.9	$106.7	$63.2	$181.8	$54.5	$32.3
11	$400.0	$223.4	$80.0	$44.7	$320.2	$80.0	$44.7	$127.3	$38.2	$21.3
12	$400.0	$210.7	$80.0	$42.1	$240.1	$60.0	$31.6	$89.1	$26.7	$14.1
13	$324.2	$161.1	$64.8	$32.2	$180.1	$45.0	$22.4	$62.4	$18.7	$9.3
14	$262.8	$123.2	$52.6	$24.6	$135.1	$33.8	$15.8	$43.7	$13.1	$6.1
15	$213.0	$94.2	$42.6	$18.8	$101.3	$25.3	$11.2	$30.6	$9.2	$4.1
16	$172.7	$72.1	$34.5	$14.4	$76.0	$19.0	$7.9	$21.4	$6.4	$2.7
17	$140.0	$55.1	$28.0	$11.0	$57.0	$14.2	$5.6	$15.0	$4.5	$1.8
18	$113.5	$42.1	$22.7	$8.4	$42.7	$10.7	$4.0	$10.5	$3.1	$1.2
19	$92.0	$32.2	$18.4	$6.4	$32.1	$8.0	$2.8	$7.3	$2.2	$0.8
20	$74.5	$24.6	$14.9	$4.9	$24.0	$6.0	$2.0	$5.1	$1.5	$0.5
21	$60.4	$18.8	$12.1	$3.8	$18.0	$4.5	$1.4	$3.6	$1.1	$0.3
22	$49.0	$14.4	$9.8	$2.9	$13.5	$3.4	$1.0	$2.5	$0.8	$0.2
23	$39.7	$11.0	$7.9	$2.2	$10.1	$2.5	$0.7	$1.8	$0.5	$0.1
24	$32.2	$8.4	$6.4	$1.7	$7.6	$1.9	$0.5	$1.2	$0.4	$0.1
25	$26.1	$6.4	$5.2	$1.3	$5.7	$1.4	$0.4	$0.9	$0.3	$0.1
Total	**$4,000.1**	**$2,139.3**	**$800.0**	**$427.9**	**$0.0**	**$2,795.7**	**$2,103.8**	**$0.0**	**$1,799.4**	**$1,390.9**

Table C - 6: Base Case Without Atlantic Investment Tax Credit Removed (Prices Adjusted to Give 6%) – Lower than Cost of Capital (Continued)

Year	Simple Payout Calculation	Prod Trigger 50 MM BBLs	Reserves 20% Trigger	Prod Trigger 100 MM BBLs	Prod Trigger 200 MM BBLs	Prod Trigger 200 MM BBLs	Gross Royalty Rate with Simple Payout	Gross Royalty Rate	Ad Valorem or Gross Royalty	PV Gross Royalty
1	($606.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
2	($2,121.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
3	($3,131.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
4	($4,141.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
5	($5,151.0)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$0.0	$0.0
6	($4,847.8)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$4.5	$3.4
7	($4,240.7)	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.00%	$9.0	$6.3
8	($3,329.4)	0.00%	0.00%	2.13%	0.00%	0.00%	0.00%	2.13%	$28.7	$19.1
9	($2,417.1)	0.00%	2.50%	0.00%	3.75%	0.00%	0.00%	3.75%	$50.7	$31.8
10	($1,504.0)	0.00%	2.50%	0.00%	5.00%	0.00%	0.00%	5.00%	$67.7	$40.0
11	($589.8)	0.00%	2.50%	0.00%	5.00%	0.00%	0.00%	5.00%	$67.7	$37.8
12	$325.4	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$101.6	$53.5
13	$1,068.2	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$82.5	$41.0
14	$1,671.0	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$66.9	$31.4
15	$2,160.3	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$54.3	$24.0
16	$2,557.5	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$44.0	$18.4
17	$2,879.9	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$35.7	$14.1
18	$3,141.7	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$29.0	$10.8
19	$3,354.3	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$23.5	$8.2
20	$3,526.9	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$19.1	$6.3
21	$3,667.1	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$15.5	$4.8
22	$3,780.9	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$12.6	$3.7
23	$3,873.4	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$10.2	$2.8
24	$3,948.6	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$8.3	$2.2
25	$4,009.6	0.00%	2.50%	0.00%	0.00%	7.50%	5.00%	7.50%	$6.7	$1.7
Total									**$738.3**	**$361.3**

Table C - 6: Base Case Without Atlantic Investment Tax Credit Removed (Prices Adjusted to Give 6%) – Lower than Cost of Capital (Continued)

Year	Tier 1 Return Allowance 11%	Tier 1 Net Royalty 20%	PV Tier 1 Net Royalty	Tier 2 Return Allowance 21%	Tier 2 Net Royalty 10%	PV Tier 2 Net Royalty	Total Royalties	PV Royalties
1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
2	-$2,271.0	$0.0	$0.0	-$2,407.3	$0.0	$0.0	$0.0	$0.0
3	-$3,586.3	$0.0	$0.0	-$4,028.9	$0.0	$0.0	$0.0	$0.0
4	-$5,046.4	$0.0	$0.0	-$5,991.0	$0.0	$0.0	$0.0	$0.0
5	-$6,667.0	$0.0	$0.0	-$8,365.2	$0.0	$0.0	$0.0	$0.0
6	-$7,085.2	$0.0	$0.0	-$9,791.8	$0.0	$0.0	$4.5	$3.4
7	-$7,233.7	$0.0	$0.0	-$11,187.3	$0.0	$0.0	$9.0	$6.3
8	-$7,098.2	$0.0	$0.0	-$12,561.3	$0.0	$0.0	$28.7	$19.1
9	-$6,970.1	$0.0	$0.0	-$14,247.2	$0.0	$0.0	$50.7	$31.8
10	-$6,844.8	$0.0	$0.0	-$16,304.8	$0.0	$0.0	$67.7	$40.0
11	-$6,704.7	$0.0	$0.0	-$18,793.4	$0.0	$0.0	$67.7	$37.8
12	-$6,583.9	$0.0	$0.0	-$21,841.1	$0.0	$0.0	$101.6	$53.5
13	-$6,611.6	$0.0	$0.0	-$25,698.1	$0.0	$0.0	$82.5	$41.0
14	-$6,773.4	$0.0	$0.0	-$30,502.4	$0.0	$0.0	$66.9	$31.4
15	-$7,059.5	$0.0	$0.0	-$36,427.2	$0.0	$0.0	$54.3	$24.0
16	-$7,463.5	$0.0	$0.0	-$43,686.7	$0.0	$0.0	$44.0	$18.4
17	-$7,982.0	$0.0	$0.0	-$52,544.1	$0.0	$0.0	$35.7	$14.1
18	-$8,614.4	$0.0	$0.0	-$63,321.1	$0.0	$0.0	$29.0	$10.8
19	-$9,362.6	$0.0	$0.0	-$76,409.7	$0.0	$0.0	$23.5	$8.2
20	-$10,230.5	$0.0	$0.0	-$92,286.1	$0.0	$0.0	$19.1	$6.3
21	-$11,224.3	$0.0	$0.0	-$111,528.4	$0.0	$0.0	$15.5	$4.8
22	-$12,352.2	$0.0	$0.0	-$134,837.5	$0.0	$0.0	$12.6	$3.7
23	-$13,624.1	$0.0	$0.0	-$163,062.4	$0.0	$0.0	$10.2	$2.8
24	-$15,052.3	$0.0	$0.0	-$197,231.7	$0.0	$0.0	$8.3	$2.2
25	-$16,650.7	$0.0	$0.0	-$238,590.3	$0.0	$0.0	$6.7	$1.7
Total		**$0.0**	**$0.0**		**$0.0**	**$0.0**	**$738.3**	**$361.3**

Table C - 6: Base Case Without Atlantic Investment Tax Credit Removed (Prices Adjusted to Give 6%) – Lower than Cost of Capital (Continued)

Year	CIT Base	Federal CIT 15%	PV Federal CIT before AITC	AITC 10%	Federal CIT Net of AITC	PV Federal CIT Net of AITC	Provincial CIT 14%	PV Provincial CIT
1	($525.0)	($78.8)	($78.8)	$0.0	($78.8)	($78.8)	($73.5)	($73.5)
2	($423.8)	($63.6)	($60.0)	$0.0	($63.6)	($60.0)	($59.3)	($56.0)
3	($578.8)	($86.8)	($77.3)	$0.0	($86.8)	($77.3)	($81.0)	($72.1)
4	($691.8)	($103.8)	($87.1)	$0.0	($103.8)	($87.1)	($96.9)	($81.3)
5	($774.2)	($116.1)	($92.0)	$0.0	($116.1)	($92.0)	($108.4)	($85.9)
6	($252.4)	($37.9)	($28.3)	$0.0	($37.9)	($28.3)	($35.3)	($26.4)
7	$212.7	$31.9	$22.5	$0.0	$31.9	$22.5	$29.8	$21.0
8	$621.6	$93.2	$62.0	$0.0	$93.2	$62.0	$87.0	$57.9
9	$681.3	$102.2	$64.1	$0.0	$102.2	$64.1	$95.4	$59.8
10	$724.3	$108.6	$64.3	$0.0	$108.6	$64.3	$101.4	$60.0
11	$768.2	$115.2	$64.3	$0.0	$115.2	$64.3	$107.6	$60.1
12	$766.8	$115.0	$60.6	$0.0	$115.0	$60.6	$107.4	$56.6
13	$629.0	$94.3	$46.9	$0.0	$94.3	$46.9	$88.1	$43.8
14	$515.4	$77.3	$36.2	$0.0	$77.3	$36.2	$72.2	$33.8
15	$421.8	$63.3	$28.0	$0.0	$63.3	$28.0	$59.1	$26.1
16	$345.0	$51.8	$21.6	$0.0	$51.8	$21.6	$48.3	$20.2
17	$282.0	$42.3	$16.6	$0.0	$42.3	$16.6	$39.5	$15.5
18	$230.3	$34.5	$12.8	$0.0	$34.5	$12.8	$32.2	$12.0
19	$188.0	$28.2	$9.9	$0.0	$28.2	$9.9	$26.3	$9.2
20	$153.4	$23.0	$7.6	$0.0	$23.0	$7.6	$21.5	$7.1
21	$125.1	$18.8	$5.9	$0.0	$18.8	$5.9	$17.5	$5.5
22	$102.0	$15.3	$4.5	$0.0	$15.3	$4.5	$14.3	$4.2
23	$83.2	$12.5	$3.5	$0.0	$12.5	$3.5	$11.6	$3.2
24	$67.8	$10.2	$2.7	$0.0	$10.2	$2.7	$9.5	$2.5
25	$55.2	$8.3	$2.0	$0.0	$8.3	$2.0	$7.7	$1.9
Total		**$559.1**	**$112.7**	**$0.0**	**$559.1**	**$112.7**	**$521.8**	**$105.2**

Table C - 6: Base Case Without Atlantic Investment Tax Credit Removed (Prices Adjusted to Give 6%) – Lower than Cost of Capital (Continued)

Year	Net Cash Flow	DCF @ 6%	Pre-Tax/Royalty Net Cash Flow	Discounted Pre-Tax/Royalty Net Cash Flow @6%	Gov Rev	DCF Gov Rev @ 6%
1	($447.8)	($447.8)	($600.0)	($600.0)	($152.3)	($152.3)
2	($1,377.1)	($1,299.2)	($1,500.0)	($1,415.1)	($122.9)	($115.9)
3	($832.1)	($740.6)	($1,000.0)	($890.0)	($167.9)	($149.4)
4	($799.4)	($671.2)	($1,000.0)	($839.6)	($200.6)	($168.4)
5	($775.5)	($614.2)	($1,000.0)	($792.1)	($224.5)	($177.9)
6	$385.3	$287.9	$316.6	$236.6	($68.7)	($51.3)
7	$563.0	$396.9	$633.7	$446.7	$70.7	$49.8
8	$742.4	$493.7	$951.4	$632.7	$209.0	$139.0
9	$703.9	$441.7	$952.2	$597.4	$248.3	$155.8
10	$675.5	$399.8	$953.2	$564.2	$277.7	$164.4
11	$663.7	$370.6	$954.2	$532.8	$290.5	$162.2
12	$631.2	$332.5	$955.2	$503.2	$324.0	$170.7
13	$510.3	$253.6	$775.2	$385.2	$264.9	$131.6
14	$412.8	$193.5	$629.1	$295.0	$216.3	$101.4
15	$334.0	$147.7	$510.6	$225.8	$176.6	$78.1
16	$270.4	$112.8	$414.5	$172.9	$144.1	$60.1
17	$218.9	$86.2	$336.4	$132.4	$117.5	$46.3
18	$177.4	$65.9	$273.1	$101.4	$95.8	$35.6
19	$143.7	$50.3	$221.8	$77.7	$78.1	$27.3
20	$116.5	$38.5	$180.1	$59.5	$63.6	$21.0
21	$94.4	$29.4	$146.2	$45.6	$51.8	$16.1
22	$76.6	$22.5	$118.8	$34.9	$42.2	$12.4
23	$62.1	$17.2	$96.5	$26.8	$34.3	$9.5
24	$50.4	$13.2	$78.4	$20.5	$27.9	$7.3
25	$40.9	$10.1	$63.7	$15.7	$22.7	$5.6
Total	**$2,641.5**	**($8.8)**	**$4,460.6**	**$570.4**	**$1,819.2**	**$579.2**
	Real After-Tax IRR	**5.969%**		**7.529%**		

Appendix D: Generic Offshore Royalty - $75 per Barrel Scenario

Table D - 1: Generic Royalty - $75 per Barrel Scenario

Year	Production	Cumulative Production	Revenue	PV Revenue	Exploration Capex	Drilling Capex	PV Drilling Capex	Facilities Capex	PV Facilities Capex	Capex
1				$0	$500		$0	$0	$0	$500
2				$0		$600	$566	$900	$849	$1,500
3				$0		$400	$356	$600	$534	$1,000
4				$0		$400	$336	$600	$504	$1,000
5				$0		$400	$317	$600	$475	$1,000
6	13.3	13.3	$1,000	$747						
7	26.7	40.0	$2,000	$1,410						
8	40.0	80.0	$3,000	$1,995						
9	40.0	120.0	$3,000	$1,882						
10	40.0	160.0	$3,000	$1,776						
11	40.0	200.0	$3,000	$1,675						
12	40.0	240.0	$3,000	$1,580						
13	32.4	272.4	$2,432	$1,209						
14	26.3	298.7	$1,971	$924						
15	21.3	320.0	$1,598	$707						
16	17.3	337.3	$1,295	$540						
17	14.0	351.3	$1,050	$413						
18	11.3	362.6	$851	$316						
19	9.2	371.8	$690	$242						
20	7.5	379.3	$559	$185						
21	6.0	385.3	$453	$141						
22	4.9	390.2	$367	$108						
23	4.0	394.2	$298	$83						
24	3.2	397.4	$241	$63						
25	2.6	400.0	$196	$48						
Total	**400.0**		**$30,001**	**$16,045**	**$500**	**$1,800**	**$1,575**	**$2,700**	**$2,362**	**$5,000**

Table D - 1: Generic Royalty - $75 per Barrel Scenario (Continued)

Year	Opex	PV Opex	Transport	PV Transport	Undepreciated Facilities Base	Facilities Depreciation Allowance 25%	PV Facilities Depreciation	Undepreciated Drilling Capex Base	Drilling Capex Depreciation Allowance 30%	PV Drilling Depreciation
1										
2					$810	$203	$191	$600	$180	$170
3					$1,148	$287	$255	$820	$246	$219
4					$1,401	$350	$294	$974	$292	$245
5					$1,590	$398	$315	$1,082	$325	$257
6	$133	$100	$27	$20	$1,193	$298	$223	$757	$227	$170
7	$267	$188	$53	$38	$895	$224	$158	$530	$159	$112
8	$400	$266	$80	$53	$671	$168	$112	$371	$111	$74
9	$400	$251	$80	$50	$503	$126	$79	$260	$78	$49
10	$400	$237	$80	$47	$377	$94	$56	$182	$55	$32
11	$400	$223	$80	$45	$283	$71	$40	$127	$38	$21
12	$400	$211	$80	$42	$212	$53	$28	$89	$27	$14
13	$324	$161	$65	$32	$159	$40	$20	$62	$19	$9
14	$263	$123	$53	$25	$119	$30	$14	$44	$13	$6
15	$213	$94	$43	$19	$90	$22	$10	$31	$9	$4
16	$173	$72	$35	$14	$67	$17	$7	$21	$6	$3
17	$140	$55	$28	$11	$50	$13	$5	$15	$4	$2
18	$113	$42	$23	$8	$38	$9	$4	$10	$3	$1
19	$92	$32	$18	$6	$28	$7	$2	$7	$2	$1
20	$75	$25	$15	$5	$21	$5	$2	$5	$2	$1
21	$60	$19	$12	$4	$16	$4	$1	$4	$1	$0
22	$49	$14	$10	$3	$12	$3	$1	$3	$1	$0
23	$40	$11	$8	$2	$9	$2	$1	$2	$1	$0
24	$32	$8	$6	$2	$7	$2	$0	$1	$0	$0
25	$26	$6	$5	$1	$5	$1	$0	$1	$0	$0
Total	**$4,000**	**$2,139**	**$800**	**$428**		**$2,426**	**$1,817**		**$1,799**	**$1,391**

Table D - 1: Generic Royalty - $75 per Barrel Scenario (Continued)

Year	Simple Payout Calculation	Prod Trigger 50 MM BBLs	Reserves 20% Trigger	Prod Trigger 100 MM BBLs	Prod Trigger 200 MM BBLs	Prod Trigger 200 MM BBLs	Gross Royalty Rate with Simple Payout	Gross Royalty Rate	Ad Valorem or Gross Royalty	PV Gross Royalty
1	($505)	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	$0	$0
2	-$2,020	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	$0	$0
3	-$3,030	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	$0	$0
4	-$4,040	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	$0	$0
5	-$5,050	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	$0	$0
6	-$4,223	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	$10	$7
7	-$2,570	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	$19	$14
8	-$90	0.0%	0.0%	2.1%	0.0%	0.0%	0.0%	2.1%	$62	$41
9	$2,390	0.0%	2.5%	0.0%	3.8%	0.0%	5.0%	5.0%	$146	$92
10	$4,870	0.0%	2.5%	0.0%	5.0%	0.0%	5.0%	5.0%	$146	$86
11	$7,350	0.0%	2.5%	0.0%	5.0%	0.0%	5.0%	5.0%	$146	$82
12	$9,830	0.0%	2.5%	0.0%	0.0%	6.3%	5.0%	6.3%	$183	$96
13	$11,840	0.0%	2.5%	0.0%	0.0%	7.5%	5.0%	7.5%	$178	$88
14	$13,470	0.0%	2.5%	0.0%	0.0%	7.5%	5.0%	7.5%	$144	$67
15	$14,791	0.0%	2.5%	0.0%	0.0%	7.5%	5.0%	7.5%	$117	$52
16	$15,861	0.0%	2.5%	0.0%	0.0%	7.5%	5.0%	7.5%	$95	$39
17	$16,729	0.0%	2.5%	0.0%	0.0%	7.5%	5.0%	7.5%	$77	$30
18	$17,433	0.0%	2.5%	0.0%	0.0%	7.5%	5.0%	7.5%	$62	$23
19	$18,003	0.0%	2.5%	0.0%	0.0%	7.5%	5.0%	7.5%	$50	$18
20	$18,465	0.0%	2.5%	0.0%	0.0%	7.5%	5.0%	7.5%	$41	$13
21	$18,840	0.0%	2.5%	0.0%	0.0%	7.5%	5.0%	7.5%	$33	$10
22	$19,143	0.0%	2.5%	0.0%	0.0%	7.5%	5.0%	7.5%	$27	$8
23	$19,389	0.0%	2.5%	0.0%	0.0%	7.5%	5.0%	7.5%	$22	$6
24	$19,589	0.0%	2.5%	0.0%	0.0%	7.5%	5.0%	7.5%	$18	$5
25	$19,751	0.0%	2.5%	0.0%	0.0%	7.5%	5.0%	7.5%	$14	$4
Total									**$1,588**	**$781**

Table D - 1: Generic Royalty - $75 per Barrel Scenario (Continued)

Year	Tier 1 Return Allowance 11%	Tier 1 Net Royalty 20%	PV Tier 1 Net Royalty	Tier 2 Return Allowance 21%	Tier 2 Net Royalty 10%	PV Tier 2 Net Royalty	Total Royalties	PV Royalties
1			$0			$0	$0	$0
2	-$2,159	$0	$0	-$2,285	$0	$0	$0	$0
3	-$3,462	$0	$0	-$3,881	$0	$0	$0	$0
4	-$4,908	$0	$0	-$5,812	$0	$0	$0	$0
5	-$6,514	$0	$0	-$8,149	$0	$0	$0	$0
6	-$6,368	$0	$0	-$8,957	$0	$0	$10	$7
7	-$5,345	$0	$0	-$9,033	$0	$0	$19	$14
8	-$3,382	$0	$0	-$8,258	$0	$0	$62	$41
9	-$1,292	$0	$0	-$7,413	$0	$0	$146	$92
10	$1,028	$206	$122	-$6,397	$0	$0	$206	$122
11	$0	$496	$277	-$5,198	$0	$0	$496	$277
12	$0	$496	$261	-$3,784	$0	$0	$496	$261
13	$0	$402	$200	-$2,577	$0	$0	$402	$200
14	$0	$326	$153	-$1,495	$0	$0	$326	$153
15	$0	$264	$117	-$494	$0	$0	$264	$117
16	$0	$214	$89	$468	$47	$20	$261	$109
17	$0	$174	$68	$0	$87	$34	$260	$102
18	$0	$141	$52	$0	$70	$26	$211	$78
19	$0	$114	$40	$0	$57	$20	$171	$60
20	$0	$92	$31	$0	$46	$15	$139	$46
21	$0	$75	$23	$0	$37	$12	$112	$35
22	$0	$61	$18	$0	$30	$9	$91	$27
23	$0	$49	$14	$0	$25	$7	$74	$20
24	$0	$40	$10	$0	$20	$5	$60	$16
25	$0	$32	$8	$0	$16	$4	$49	$12
Total		**$3,182**	**$1,483**		**$436**	**$152**	**$3,855**	**$1,789**

Table D - 1: Generic Royalty - $75 per Barrel Scenario (Continued)

Year	CIT Base	Federal CIT 15%	PV Federal CIT before AITC	AITC 10%	Federal CIT Net of AITC	PV Federal CIT Net of AITC	Provincial CIT 14%	PV Provincial CIT
1	-$500	-$75	-$75	$0	-$75	-$75	-$70	-$70
2	-$383	-$57	-$54	$90	-$147	-$139	-$54	-$51
3	-$533	-$80	-$71	$60	-$140	-$125	-$75	-$66
4	-$642	-$96	-$81	$60	-$156	-$131	-$90	-$76
5	-$722	-$108	-$86	$60	-$168	-$133	-$101	-$80
6	$305	$46	$34	$0	$46	$34	$43	$32
7	$1,278	$192	$135	$0	$192	$135	$179	$126
8	$2,179	$327	$217	$0	$327	$217	$305	$203
9	$2,170	$326	$204	$0	$326	$204	$304	$191
10	$2,165	$325	$192	$0	$325	$192	$303	$179
11	$1,915	$287	$160	$0	$287	$160	$268	$150
12	$1,944	$292	$154	$0	$292	$154	$272	$143
13	$1,582	$237	$118	$0	$237	$118	$221	$110
14	$1,287	$193	$91	$0	$193	$91	$180	$84
15	$1,046	$157	$69	$0	$157	$69	$146	$65
16	$804	$121	$50	$0	$121	$50	$113	$47
17	$604	$91	$36	$0	$91	$36	$85	$33
18	$491	$74	$27	$0	$74	$27	$69	$26
19	$399	$60	$21	$0	$60	$21	$56	$20
20	$324	$49	$16	$0	$49	$16	$45	$15
21	$263	$39	$12	$0	$39	$12	$37	$11
22	$214	$32	$9	$0	$32	$9	$30	$9
23	$174	$26	$7	$0	$26	$7	$24	$7
24	$141	$21	$6	$0	$21	$6	$20	$5
25	$114	$17	$4	$0	$17	$4	$16	$4
Total		**$2,493**	**$1,197**	**$270**	**$2,223**	**$961**	**$2,327**	**$1,117**

Table D - 1: Generic Royalty - $75 per Barrel Scenario (Continued)

Year	Net Cash Flow	DCF @ 6%	Pre-Tax/Royalty Net Cash Flow	Discounted Pre-Tax/Royalty Net Cash Flow @6%	Gov Rev	DCF Gov Rev @ 6%
1	-$355	-$355	-$500	-$500	-$145	-$145
2	-$1,299	-$1,226	-$1,500	-$1,415	-$201	-$190
3	-$785	-$699	-$1,000	-$890	-$215	-$191
4	-$754	-$633	-$1,000	-$840	-$246	-$207
5	-$731	-$579	-$1,000	-$792	-$269	-$213
6	$742	$554	$840	$628	$98	$73
7	$1,290	$909	$1,680	$1,184	$390	$275
8	$1,826	$1,214	$2,520	$1,676	$694	$462
9	$1,745	$1,095	$2,520	$1,581	$775	$486
10	$1,686	$998	$2,520	$1,492	$834	$493
11	$1,469	$820	$2,520	$1,407	$1,051	$587
12	$1,460	$769	$2,520	$1,328	$1,060	$558
13	$1,182	$587	$2,043	$1,015	$861	$428
14	$957	$449	$1,656	$776	$699	$328
15	$775	$343	$1,342	$594	$568	$251
16	$594	$248	$1,088	$454	$494	$206
17	$446	$176	$882	$347	$436	$171
18	$361	$134	$715	$265	$353	$131
19	$293	$103	$579	$203	$287	$100
20	$237	$78	$470	$155	$233	$77
21	$192	$60	$381	$119	$189	$59
22	$155	$46	$309	$91	$153	$45
23	$126	$35	$250	$69	$124	$34
24	$102	$27	$203	$53	$101	$26
25	$83	$20	$164	$41	$82	$20
Total	**$11,796**	**$5,174**	**$20,201**	**$9,041**	**$8,405**	**$3,867**
	Real After-Tax IRR	**20.175%**		**22.821%**		

Appendix E: 25% Flat-Rate Oil Sands Royalty - $75 per Barrel Scenario

Table E - 1: 25% Flat-Rate Oil Sands Royalty $75 per Barrel Scenario

Year	Production	Cumulative Production	Revenue	PV Revenue	Exploration Capex	Drilling Capex	PV Drilling Capex	Facilities Capex	PV Facilities Capex	Capex
1					$500					$500
2						$600	$566	$900	$849	$1,500
3						$400	$356	$600	$534	$1,000
4						$400	$336	$600	$504	$1,000
5						$400	$317	$600	$475	$1,000
6	13.3	13.3	$1,000	$747						
7	26.7	40.0	$2,000	$1,410						
8	40.0	80.0	$3,000	$1,995						
9	40.0	120.0	$3,000	$1,882						
10	40.0	160.0	$3,000	$1,776						
11	40.0	200.0	$3,000	$1,675						
12	40.0	240.0	$3,000	$1,580						
13	32.4	272.4	$2,432	$1,209						
14	26.3	298.7	$1,971	$924						
15	21.3	320.0	$1,598	$707						
16	17.3	337.3	$1,295	$540						
17	14.0	351.3	$1,050	$413						
18	11.3	362.6	$851	$316						
19	9.2	371.8	$690	$242						
20	7.5	379.3	$559	$185						
21	6.0	385.3	$453	$141						
22	4.9	390.2	$367	$108						
23	4.0	394.2	$298	$83						
24	3.2	397.4	$241	$63						
25	2.6	400.0	$196	$48						
Total	**400.0**		**$30,001**	**$16,045**	**$500**	**$1,800**	**$1,575**	**$2,700**	**$2,362**	**$5,000**

Table E - 1: 25% Flat-Rate Oil Sands Royalty $75 per Barrel Scenario (Continued)

Year	Opex	PV Opex	Transport	PV Transport	Undepreciated Facilities Base	Facilities Depreciation Allowance 25%	PV Facilities Depreciation	Undepreciated Drilling Capex Base	Drilling Capex Depreciation Allowance 30%	PV Drilling Depreciation
1										
2					$810	$203	$191	$600	$180	$170
3					$1,148	$287	$255	$820	$246	$219
4					$1,401	$350	$294	$974	$292	$245
5					$1,590	$398	$315	$1,082	$325	$257
6	$133	$100	$27	$20	$1,193	$298	$223	$757	$227	$170
7	$267	$188	$53	$38	$895	$224	$158	$530	$159	$112
8	$400	$266	$80	$53	$671	$168	$112	$371	$111	$74
9	$400	$251	$80	$50	$503	$126	$79	$260	$78	$49
10	$400	$237	$80	$47	$377	$94	$56	$182	$55	$32
11	$400	$223	$80	$45	$283	$71	$40	$127	$38	$21
12	$400	$211	$80	$42	$212	$53	$28	$89	$27	$14
13	$324	$161	$65	$32	$159	$40	$20	$62	$19	$9
14	$263	$123	$53	$25	$119	$30	$14	$44	$13	$6
15	$213	$94	$43	$19	$90	$22	$10	$31	$9	$4
16	$173	$72	$35	$14	$67	$17	$7	$21	$6	$3
17	$140	$55	$28	$11	$50	$13	$5	$15	$4	$2
18	$113	$42	$23	$8	$38	$9	$4	$10	$3	$1
19	$92	$32	$18	$6	$28	$7	$2	$7	$2	$1
20	$75	$25	$15	$5	$21	$5	$2	$5	$2	$1
21	$60	$19	$12	$4	$16	$4	$1	$4	$1	$0
22	$49	$14	$10	$3	$12	$3	$1	$3	$1	$0
23	$40	$11	$8	$2	$9	$2	$1	$2	$1	$0
24	$32	$8	$6	$2	$7	$2	$0	$1	$0	$0
25	$26	$6	$5	$1	$5	$1	$0	$1	$0	$0
Total	**$4,000**	**$2,139**	**$800**	**$428**		**$2,426**	**$1,817**		**$1,799**	**$1,391**

Table E - 1: 25% Flat-Rate Oil Sands Royalty $75 per Barrel Scenario (Continued)

Year	Simple Payout Calculation	Prod Trigger 50 MM BBLs	Reserves 20% Trigger	Prod Trigger 100 MM BBLs	Prod Trigger 200 MM BBLs	Prod Trigger 200 MM BBLs	Gross Royalty Rate with Simple Payout	Gross Royalty Rate	Ad Valorem or Gross Royalty	PV Gross Royalty
1	-$505	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
2	-$2,020	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
3	-$3,030	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
4	-$4,040	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
5	-$5,050	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
6	-$4,223	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
7	-$2,570	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
8	-$90	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
9	$2,390	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
10	$4,870	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
11	$7,350	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
12	$9,830	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
13	$11,840	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
14	$13,470	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
15	$14,791	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
16	$15,861	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
17	$16,729	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
18	$17,433	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
19	$18,003	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
20	$18,465	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
21	$18,840	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
22	$19,143	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
23	$19,389	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
24	$19,589	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
25	$19,751	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$0	$0
Total									**$0**	**$0**

Table E - 1: 25% Flat-Rate Oil Sands Royalty $75 per Barrel Scenario (Continued)

Year	Tier 1 Return Allowance 6%	Tier 1 Net Royalty 25%	PV Tier 1 Net Royalty	Tier 2 Return Allowance 0%	Tier 2 Net Royalty 0%	PV Tier 2 Net Royalty	Total Royalties	PV Royalties
1			$0			$0	$0	$0
2	-$2,075	$0	$0	$0	$0	$0	$0	$0
3	-$3,230	$0	$0	$0	$0	$0	$0	$0
4	-$4,453	$0	$0	$0	$0	$0	$0	$0
5	-$5,750	$0	$0	$0	$0	$0	$0	$0
6	-$5,230	$0	$0	$0	$0	$0	$0	$0
7	-$3,814	$0	$0	$0	$0	$0	$0	$0
8	-$1,447	$0	$0	$0	$0	$0	$0	$0
9	$1,062	$265	$167	$0	$0	$0	$265	$167
10	$0	$630	$373	$0	$0	$0	$630	$373
11	$0	$630	$352	$0	$0	$0	$630	$352
12	$0	$630	$332	$0	$0	$0	$630	$332
13	$0	$511	$254	$0	$0	$0	$511	$254
14	$0	$414	$194	$0	$0	$0	$414	$194
15	$0	$336	$148	$0	$0	$0	$336	$148
16	$0	$272	$113	$0	$0	$0	$272	$113
17	$0	$220	$87	$0	$0	$0	$220	$87
18	$0	$179	$66	$0	$0	$0	$179	$66
19	$0	$145	$51	$0	$0	$0	$145	$51
20	$0	$117	$39	$0	$0	$0	$117	$39
21	$0	$95	$30	$0	$0	$0	$95	$30
22	$0	$77	$23	$0	$0	$0	$77	$23
23	$0	$63	$17	$0	$0	$0	$63	$17
24	$0	$51	$13	$0	$0	$0	$51	$13
25	$0	$41	$10	$0	$0	$0	$41	$10
Total		**$4,676**	**$2,269**		**$0**	**$0**	**$4,676**	**$2,269**

Table E - 1: 25% Flat-Rate Oil Sands Royalty $75 per Barrel Scenario (Continued)

Year	CIT Base	Federal CIT 15%	PV Federal CIT before AITC	AITC 10%	Federal CIT Net of AITC	PV Federal CIT Net of AITC	Provincial CIT 14%	PV Provincial CIT
1	-$500	-$75	-$75	$0	-$75	-$75	-$70	-$70
2	-$383	-$57	-$54	$90	-$147	-$139	-$54	-$51
3	-$533	-$80	-$71	$60	-$140	-$125	-$75	-$66
4	-$642	-$96	-$81	$60	-$156	-$131	-$90	-$76
5	-$722	-$108	-$86	$60	-$168	-$133	-$101	-$80
6	$315	$47	$35	$0	$47	$35	$44	$33
7	$1,297	$195	$137	$0	$195	$137	$182	$128
8	$2,241	$336	$224	$0	$336	$224	$314	$209
9	$2,051	$308	$193	$0	$308	$193	$287	$180
10	$1,741	$261	$155	$0	$261	$155	$244	$144
11	$1,781	$267	$149	$0	$267	$149	$249	$139
12	$1,810	$272	$143	$0	$272	$143	$253	$134
13	$1,473	$221	$110	$0	$221	$110	$206	$103
14	$1,199	$180	$84	$0	$180	$84	$168	$79
15	$975	$146	$65	$0	$146	$65	$137	$60
16	$793	$119	$50	$0	$119	$50	$111	$46
17	$644	$97	$38	$0	$97	$38	$90	$36
18	$524	$79	$29	$0	$79	$29	$73	$27
19	$425	$64	$22	$0	$64	$22	$60	$21
20	$345	$52	$17	$0	$52	$17	$48	$16
21	$280	$42	$13	$0	$42	$13	$39	$12
22	$228	$34	$10	$0	$34	$10	$32	$9
23	$185	$28	$8	$0	$28	$8	$26	$7
24	$150	$23	$6	$0	$23	$6	$21	$5
25	$122	$18	$5	$0	$18	$5	$17	$4
Total		**$2,370**	**$1,125**	**$270**	**$2,100**	**$889**	**$2,212**	**$1,050**

Table E - 1: 25% Flat-Rate Oil Sands Royalty $75 per Barrel Scenario (Continued)

Year	Net Cash Flow	DCF @ 6%	Pre-Tax/Royalty Net Cash Flow	Discounted Pre-Tax/Royalty Net Cash Flow @6%	Gov Rev	DCF Gov Rev @ 6%
1	-$355	-$355	-$500	-$500	-$145	-$145
2	-$1,299	-$1,226	-$1,500	-$1,415	-$201	-$190
3	-$785	-$699	-$1,000	-$890	-$215	-$191
4	-$754	-$633	-$1,000	-$840	-$246	-$207
5	-$731	-$579	-$1,000	-$792	-$269	-$213
6	$749	$560	$840	$628	$91	$68
7	$1,304	$919	$1,680	$1,184	$376	$265
8	$1,870	$1,244	$2,520	$1,676	$650	$432
9	$1,660	$1,041	$2,520	$1,581	$860	$540
10	$1,385	$820	$2,520	$1,492	$1,135	$672
11	$1,373	$767	$2,520	$1,407	$1,147	$640
12	$1,365	$719	$2,520	$1,328	$1,155	$608
13	$1,105	$549	$2,043	$1,015	$938	$466
14	$894	$419	$1,656	$776	$762	$357
15	$724	$320	$1,342	$594	$618	$273
16	$586	$245	$1,088	$454	$502	$209
17	$475	$187	$882	$347	$407	$160
18	$384	$143	$715	$265	$331	$123
19	$311	$109	$579	$203	$268	$94
20	$252	$83	$470	$155	$218	$72
21	$204	$64	$381	$119	$177	$55
22	$165	$49	$309	$91	$143	$42
23	$134	$37	$250	$69	$116	$32
24	$109	$28	$203	$53	$94	$25
25	$88	$22	$164	$41	$76	$19
Total	**$11,213**	**$4,833**	**$20,201**	**$9,041**	**$8,987**	**$4,208**
	Real After-Tax IRR	**19.520%**		**22.821%**		

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