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PROVISIONAL ESTIMATES OF NATURAL RESOURCE WEALTH IN THE NATIONAL BALANCE SHEET ACCOUNTS - A QUARTERLY SECTORED APPROACH

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PROVISIONAL ESTIMATES OF NATURAL RESOURCE WEALTH IN THE NATIONAL *BALANCE SHEET ACCOUNTS - A QUARTERLY SECTORED APPROACH*

Abstract:

Canada is rich in natural resources, such as oil and gas, timber and minerals. In 2010, natural resource wealth - the dollar value of selected resource reserves - stood at $1.16 trillion.

The current treatment of these assets in the Canadian system of national accounts reflects a partial integration. More specifically, these estimates are incorporated into annual estimates of national wealth. National wealth covers produced as well as non-produced assets, which include natural resources by major type.

The revised System of National Accounts (SNA 2008) extends and clarifies SNA93, and presents the same basic set of integrated economic accounts. Natural resources are embedded in two types of assets: non-produced tangible natural assets and intangible assets in the form of licences and leases to extract natural resources. SNA 2008 also recommends that natural resource wealth be sectored, but recognizes certain challenges associated with this task.

Statistics Canada has developed, as a work-in-progress, an approach, data sources and methodology for integrating natural resource wealth into the Canadian *National Balance Sheet Accounts* (NBSA) sector estimates. Inclusion of this missing asset will significantly increase and improve measures of sectoral net worth. In the process we are elaborating SNA08 and are not necessarily inconsistent with it.

First, starting from existing data from Statistics Canada's natural resource stock accounts, estimates of quarterly natural resource wealth in current dollars are constructed; a number of indicators related to sales revenue and extraction costs are used to generate these quarterly wealth estimates. Second, royalty to rent ratios are used to partition natural resource wealth between the corporate sector (i.e. the principal economic owner) and the government sector (the legal owner).

Findings from the provisional estimates produced in the study show that on average two third of natural resource wealth is allocated to the corporate sector and the remaining one third to the provincial, territorial and federal government sectors. In addition, these new assets, and associated measures of sectoral net worth, fluctuate in tandem with resource prices.

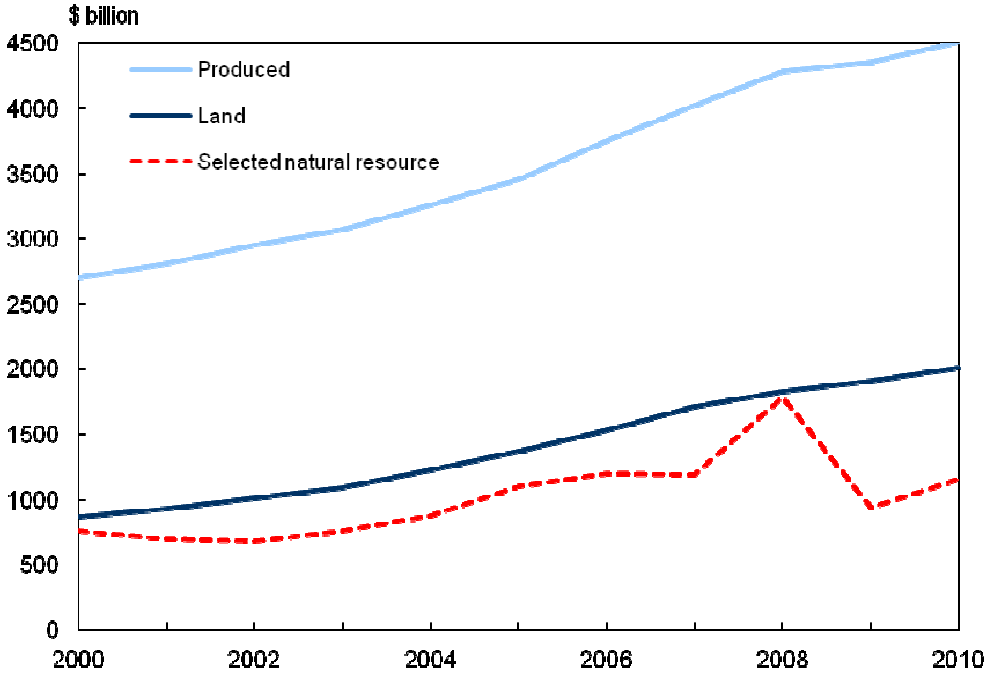
I. Introduction

Canada is endowed with substantial reserves of natural resources, from energy and minerals in the ground to accessible stands of timber in forests. Natural resources are considered non-produced non-financial (tangible) assets in SNA08 and should be included in the calculation of national wealth and sectoral net worth.[1]

[1] This is as recommended in SNA 2008: "The 2008 System of National Accounts," United Nations, New York. This is discussed in the next section.

In concert with increased world demand, the value of natural resource wealth has trended upwards over time. Price fluctuations in recent years have also been significant. In 2010, the value of selected[2] resource reserves stood at $1.16 trillion (Chart 1). Like other non-financial assets, this component of wealth plays a significant role in relation to production in the Canadian economy, generating exports, employment and income.[3]

Chart 1: $ Value of non-financial assets



Source: Statistics Canada, CANSIM table 378-0005

The current treatment of these estimates in the Canadian System of Macroeconomic Accounts (National Accounts) reflects only a *partial* integration. More specifically, natural resources are incorporated into the annual estimates of *National Wealth* at the aggregate level. This presentation is on the *Consolidated National Balance Sheet*[4] (CNBS), which covers non-financial assets adjusted for the net international investment position. This statement covers produced as well as non-produced assets[5], which include natural resources by major type.

Natural resource assets are *not*, however, reflected in *sector* balance sheets of the *National Balance Sheet Accounts* (NBSA) at this time. There are two reasons for this: (i) conceptual challenges in and

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2 The selected natural resources include: coal, crude oil, crude bitumen, natural gas, gold, iron, copper, nickel, molybdenum, uranium, potash, diamonds, and timber. Data necessary to value other resources such as fresh water and fish have not been developed.

3 For details, see Cross, P (2008), The Role of Natural Resources in Canada's Economy," Canadian Economic Observer, Statistics Canada, Catalogue no. 11-010-XIB.

4 Consolidated refers to the elimination of all domestic holdings of domestic liabilities, leaving the net international investment position as the only remaining financial instrument (net foreign asset or net foreign debt)

5 Non-produced assets include the value of agricultural and other developed land and natural resources.

approach to sectoring natural resource assets and (ii) the need to develop quarterly estimates to match the frequency of the NBSA.

This paper presents an approach to the addition of natural resource assets to the current suite of non-financial assets in the sectors of NBSA, and presents a methodology to accomplish this objective. With this goal in mind, the paper is divided into the following sections: Section II discusses the concepts and rationale related to natural resources in the NBSA; Section III presents the methodology for quarterly estimates of natural resources as well as the generation of government and corporate shares; Section IV analyzes the impact of inclusion of natural resources in the sector accounts; and, Section V concludes.

II. Issues and approach to sectoring natural resource wealth

Some preliminaries: The basics of macroeconomic sector balance sheets and the impact of the current data gap in the accounting for natural resources

Balance sheet accounts provide the stock dimension to the national accounts. In Canada, these are comprised of non-financial assets as well as financial assets and liabilities. Together these provide for estimates of sectoral net worth. The *National Balance Sheet Accounts* (NBSA) are tabulated on a quarterly basis for the corporate sector (financial and non-financial sub-sectors), the government sector (by sub-sector), the household sector and the non-resident sector. They also comprise the aggregate *Consolidated National Balance Sheet,* with measures of National Wealth and National Net Worth.

The NBSA facilitate current economic analysis as well as the study of structural changes. Users can make informed assessments of the financial stability of each sector of the economy as well as the economy as a whole, and they can obtain a picture of the composition as well as of the contribution of assets to key macroeconomic and financial aggregates.

The NBSA are timely, comprehensive and coherent in their current form, but lack a full accounting for natural resource assets.[6] Non-financial assets currently recorded in the sectored *National Balance Sheet Accounts* (NBSA) include only land and produced assets[7]. The exclusion of natural resources is a significant data gap that drives a wedge between the NBSA measures of:

- Corporate sector net worth as measured by the market, that is corporate equity at market value; and,
- Corporate sector net asset value as measured on the NBSA (total corporate assets less liabilities).

This data gap gives rise to a corporate sector residual net worth that is intuitively difficult for users to interpret (see Table 1). Since the corporate sector is ultimately owned by other sectors, the net asset value and the market value of equities outstanding should be relatively close with residual corporate net worth capturing one or both of (i) measurement error and (ii) market fluctuations above and below corporate net asset values.

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6 Most countries, except Australia are yet to include natural resources in their national balance sheet accounts. The Australian balance sheet accounts are very similar to Canada's at the moment, recording un-sectored annual natural resource wealth at the aggregate level only alongside other non-financial assets. The natural resource wealth estimate is is primarily used for estimating per capita net worth. For details, see, www.abs.gov.au

7 The produced assets include residential structures, non-residential structures, machinery and equipment (including research and development), consumer durable goods and inventories. For details, see, *The Daily*, National balance sheet accounts www.statcan.gc.ca/daily-quotidien/101213/dq101213a-eng.htm, accessed Feb 2011.

This situation also means that there is currently no link between the sector balance sheets and the *Consolidated National Balance Sheet* in the case of natural resources. Put another way, the sum of the sectoral estimates of net worth (with no accounting for natural resources) is not equal to the *National Net worth* (which accounts for natural resources). This can also be difficult to explain to users (see Table 1).

The illustrative basic example in Table 1 below makes on the following simple assumptions in order to clearly demonstrate the statistical gaps:

- There is a closed economy - that is, there is no non-resident sector, only households, corporations and governments. This implies that there is no net international investment position, such that *National Wealth* (sum of all non-financial assets in the economy) is equal to *National Net Worth*
- No assets-liabilities are assigned to government
- The only non-produced assets relate to natural resources;
- Households own all of the equity of corporations
- Corporations hold two-thirds of their own debt as assets, while households hold the balance

This stylized example illustrates the two main statistical issues associated with the natural resources data gap in the sector accounts: First the corporate sector has a large residual corporate net worth of 1200 The difference between the net asset value[8] and the market value of corporate equity; and second, the 3300 sum of sector net worth excluding natural resources of 1400 does not reconcile with National Net Worth of 4700.

Table 1. Simplified Illustration: Current treatment of natural resources in the sector accounts

NBSA sectors/assets	House-holds	Corporations	Government	Sum of domestic sectors	Consolidated National balance sheet (CNBS)
Total assets	4500	5300		9800	4700
Non-financial assets		3300		3300	National Wealth: 4700
Produced assets		3300		3300	3300
Non-produced assets					
-- Tangible natural resources (NR)		Not applicable	Not applicable		1400
--Intangible assets related to NR		Not applicable	Not Applicable		
Financial assets	4500	2000		7500	
Liabilities and net worth	4500	5300		9800	4700
Debt		3000		3000	
Equity at market value		3500		3500	
Sectoral net worth (residual corporate net worth in the corporate sector)	4500	**-1200**		**3300**	**National Net Worth: 4700**
MEMO ITEM					
Corporate net worth as a net asset value		2300			

[8] The net asset value is the difference between total assets and total liabilities (debt). It is equivalent, in principle, to the market value of corporate equity; however, in practice the two measures rarely equal.

This statistical situation in the sector accounts detracts from the interpretability and accuracy of the *National Balance Sheet Accounts* estimates. In addition missing the quarterly estimates of natural resources adversely affects the relevance of these accounts, particularly in recent years. The proposal to address these issues is presented later in the section, but first is a review of conceptual issues associated with sectoring natural resources.

Guidance on sectoring natural resources from international standards

a) SNA08

In the chapter devoted to defining assets and wealth (Chapter 13) as well as in the chapter on cross-cutting issues, SNA08 offers two basic approaches:

Economic ownership

In chapter 13, SNA08 puts a premium on economic ownership: "Assets appear on the balance sheet of the unit that is the economic owner of the asset`` (SNA08 13.3). This is a fundamental principle that is accepted in this paper. At the same time, the SNA08 guidance for sectoring natural resource assets is somewhat contradictory, as the discussion of ownership that follows in the chapter is not fully consistent with this principle.

Two explicit examples related to asset ownership underline this point. The first is related to the financial lease of a produced asset, which states: "In many cases this unit [the economic owner] will also be the legal owner but in the case of a financial lease, the leased asset appears on the balance sheet of the lessee, while the lessor has a financial asset of similar amount and a corresponding claim on the lessee" (SNA08 13.3). These financial claims ensure that sectoral net worth is correctly reflected, but these would be cumbersome and problematic to apply in the case of natural resources in Canada.

The second example relates to natural resources: "On the other hand, when a natural resource is the subject of a resource lease, the asset continues to appear in the balance sheet of the lessor even though most of the economic risks and rewards of using the asset in production are assumed by the lessee" (SNA08 13.3). This passage acknowledges that the economic reality of the situation (with government as lessors and corporations as lessees) is misrepresented. For reasons that are not evident, this misrepresentation is not cleared up elsewhere in the SNA08 treatment.

SNA goes further on this issue in Chapter 17.

There are basically three different sets of conditions that may apply to the use of a natural resource. The owner may permit the resource to be used to extinction. The owner may allow the resource to be used for an extended period of time in such a way that in effect the user controls the use of the resource during this time with little if any intervention from the legal owner. The third option is that the owner can extend or withhold permission to continued use of the asset from one year to the next. (SNA08 17.314)

The first option results in the sale (or possibly an expropriation) of the asset. The second option leads to the creation of an asset for the user, distinct from the resource itself but where the value of the resource and the asset allowing use of it are linked. The third option comes back to the treatment of the use as a resource lease. The difference in treatment between the second and third options was articulated in the context of the case of a mobile phone licence and that recommendation (see SNA News and Notes Volume 14, (United Nations, 2002)) is recapitulated before seeing how each of the three options relates to different types of natural resources. (SNA08 17.315)

Sectoring

In the case of natural resource assets, the SNA08 goes further to note that "Because there is no wholly satisfactory way in which to show the value of the asset split between the legal owner and the extractor, the whole of the resource is shown on the balance sheet of the legal owner and the [royalty] payments by the extractor shown as rent" (SNA08 13.50). Thus, according to the SNA 2008, the wealth associated with *in situ* natural resource assets belongs wholly to the government as the legal owner. Two issues come to mind in relation to this: Firstly, there is an implicit admission that this treatment is less than satisfactory; and, secondly, that the rent (royalty payments) associated with the resource would not be in line with the value of the asset on the legal owner`s balance sheet except in cases where royalty payments succeed in extracting the full resource rent from extractors.

Natural resource assets

Natural resource wealth is embedded in two types of assets: non-produced tangible natural assets *and* intangible assets in the form of licences and leases to extract natural resources. SNA08 next refers to natural resource leases as intangible assets under *contracts, leases and licenses*. "Contracts, leases and licenses may be operating leases, licenses to use natural resources, permits to undertake specific activities and entitlement to future goods and services on an exclusive basis ... these sorts of contracts are regarded as assets only if the existence of the legal agreement confers benefits to the holder in excess of the price paid to the lessor, owner of the natural resource or permit issuer and the holder can realize these benefits legally and practically. It is recommended that such assets (the natural resource lease, permit or licenses) be recorded only when the value of the asset is significant and realized, in which case a suitable market price necessarily exists." (SNA08 13.52). it is not clear what the impacts on sectoral net worth of this approach. In any case, Natural resource leases in Canada generally pass the *benefit to the holder* criterion, as well as the *significant value* criterion.

Considerations by type of asset

SNA08 also spells out arrangements associated with natural resource asset types in Chapter 17, and these are reproduced below. This paper is interested specifically in timber and subsoil assets, given that these are the largest resource assets that we value in Canada.

(i) Timber

This paper does not disagree with SNA08 on the points below. In Canada, companies typically acquire the rights to harvest timber, and stumpage fees constitute income of government. In addition, timber is not treated as a non-produced asset in the Canadian national accounts.

If a unit is given permission to clear fell an area of natural forest, or to fell at its discretion without any restriction in perpetuity, the payments made to the owner constitute the sale of an asset. (The sale of forested land may be recorded as the sale of the timber and the land separately, depending on the intended use of each. (SNA08 17.329)

The option to have a lease permitting felling at the lessee's discretion but subject to the restoration of the land, in an acceptable forested state, at some time in the future is improbable. It is more common for timber felling to be allowed under strict limits with a fee payable per unit volume of timber felled (stumpage). The limits are usually such that the harvest of timber is sustainable and so the payments are recorded as rent in the case of a natural forest. (SNA08 17.330)

Forests may also be produced assets, in which case the extraction of timber is treated as the sale of a product. (SNA08 17.331)

(ii) Subsoil assets

This paper does not disagree with SNA08 on most of the points below. Natural resource rights are typically acquired by companies from government. Since it is not possible to distinguish different arrangements, the practical approach is to universally assume that minerals are accounted for as rights acquired in the Canadian national accounts.

Mineral resources differ from land, timber and fish in that although they also constitute a natural resource, there is no way of using them sustainably. All extraction necessarily reduces the amount of the resource available for the future. This consideration necessitates a slightly different set of recommendations for how transactions relating to their use should be recorded. (SNA08 17.340)

When a unit owning a mineral resource cedes all rights over it to another unit, this constitutes the sale of the resource. Like land, mineral resources can only be owned by resident units; if necessary a notional resident unit must be established to preserve this convention. (SNA08 17.341)

When a unit extracts a mineral resource under an agreement where the payments made each year are dependent on the amount extracted, the payments (sometimes described as royalties) are recorded as rent. (SNA08 17.342)

The discussion below does not say much about ownership, but it implies that (for countries Canada) that the government is the (owner) and receives part of the rent (in the form of royalties) as current income. It is somewhat difficult to also view the rent payments to government as a compensation for the depletion of the resources, since (as the section below notes) depletion is not an SNA entry except in the Other Changes in the Volume of Assets Account.

The owner (in many but not all circumstances government) does not have a productive activity associated with the extraction and yet the wealth represented by the resource declines as extraction takes place. In effect, the wealth is being liquidated with the rent payments covering both a return to the asset and compensation for the decline in wealth. Although the decline in wealth is caused by the extractor, even if the resource were shown on the balance sheet of the extractor, the rundown in wealth would not be reflected in the extractor's production account because it is a non-produced asset and thus not subject to consumption of fixed capital. (The SEEA 2003 describes a form of satellite account where such a deduction from national income can be made for minerals as well as for other natural resources used unsustainably.) For these reasons, simple recording of payments each year from the extractor to the owner as rent and changes in the size and value of the resource as other changes in the asset accounts of the legal owner is recommended. (SNA08 17.343)

b) SNA08 conceptual-measurement issues

Most of the key elements needed for an appropriate accounting for natural resource wealth are present in SNA08. However, it seems somewhat incomplete and disjoint — a shortcoming that can give rise to implementation issues. This may partially explain why the vast majority of countries have not implemented many of the recommendations associated with natural resources. The view taken in this paper is the SNA08 treatment of natural resources is a second-best approach. Its main disadvantages include that it:

- is inconsistent with the economic ownership principle
- does not reflect the economic reality of natural resource exploitation in Canada
- is not in line with either corporate or government accounting treatments in Canada
- requires adjustments to produce accurate estimates of sectoral net worth (through lease assets-liabilities), which would affect government net debt (these adjustments are not fully addressed in the SNA08 manual)

- does not adequately explain the link between natural resources as one type of asset and resource leases as another type of asset, despite acknowledging the existence of both (this ambiguity can lead to measurement and implementation issues).

SNA08 makes the valid point that there are different arrangements across economies to acquire the rights to extract various types natural resources, from acquiring the physical assets to short and long-term leasing agreement. In Canada, the most common practice for the assets that are currently valued in national wealth - subsoil assets and standing timber - is the acquisition from government of long-term rights to extract natural resources; and theses rights are transferable in a secondary market.

Also, according to SNA08, *in situ* natural resources belong to the government. It may well be that this treatment was chosen for reasons of expedience rather than substance of argument, but the disadvantages noted above suggest the need to look for other approaches.

c) SEEA 2012 and sectoring

The System of Environmental-Economic Accounting: Central Framework (SEEA 2012) has taken the ownership argument a little further than the SNA08 by exploring options with respect to sectoring natural resource wealth. It proposes that "the value of mineral and energy resources [be] split between the two owners based on their share of the future stream of resource rent[9]. The share accruing to the government should be based on the expected stream of payments of rent by the extractor to the government.[10]"

This option is a useful extension of the SNA treatment, as it acknowledges the existence of both government and corporate sector portions of natural resource assets based on returns. This has the advantage that the assets are closely tied to the income flows, and this paper supports that approach.

However, there remains another challenge with respect to the presentation of these assets in the sequence of accounts in the SNA. Natural resources are *tangible* assets at the national level and, as such, the position in this paper is that these cannot be meaningfully split at the sectoral level - either conceptually or in practice.

d) Going forward

This paper takes the approach that institutional sectors can have claims on, or associated with, natural resources that based on the benefits accruing from extraction. Further, it argues that these claims are intangible assets. As such, the paper is an interpretation of SNA08 and SEEA 2012, and the rationale is further explained below.

Proposed approach for the Canadian SNA

Sectoring natural resource wealth between its legal owners (typically governments) and its economic owners (corporations) is the main challenge for including natural resource wealth in the NBSA. In order to gain some insight into this challenge, it is useful to look at both governments' and corporations' links to natural resources.

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9 This approach was proposed by Statistics Canada in the review of the SEEA 2012 draft.

10 United Nations, 2012, *System of Environmental-Economic Accounting: Central Framework (white cover draft)*, New York.

Governments' accounting and economic considerations

Governments do account for selected income flows arising from economic activity associated with the use of natural resources. However, they do not account for natural resource stocks in their financial statements (public accounts); this is not likely to change in the near future.

Notably, the inclusion of natural resource stocks on government balance sheets is not a feature of the IMF Government Financial Statistics manual that is currently being updated. This presents a first stumbling block to the application of the SNA08 recommendation on sectoring. Further, in order to account for natural resources as government assets, one would also want to attribute the benefits accruing from the resources to governments; however, a significant portion of these benefits accrue to corporations in the extraction/harvesting industries.

The situation in Canada is one where governments have a custodial function with respect to natural resources, holding them "in trust for the nation" and balancing the economic goals associated with their use with a host of other concerns, including economic growth and sustainability. This seems to be what SNA08 suggests in 17.313: ... in many countries permits to use natural resources are generally issued by government since it (the government) claims ownership of the resources on behalf of the community at large.

The fact that natural resource assets are not recognized in public accounts in Canada, which is the general off-balance sheet treatment for assets held in trust, underlines the dual role of governments with respect to natural resources. That said governments do generate revenue streams from the resource assets by charging extraction/harvesting fees. These would include royalties, and to a lesser extent, revenues from the sale of resource rights.[11]

These streams of property income suggest the existence of some type of corresponding asset in the government sector.[12] Arguably, this asset would represent the public sector's share of the rent arising from the natural resources. It could be conceived as an intangible asset related to the government's stream of revenue from resource extraction/harvesting.

Corporations' accounting and economic considerations

Corporations, on the other hand, do account for natural resources in their financial statements. What typically appears on the balance sheets of corporations is an intangible asset related to the right to harvest/extract resources acquired from government. The resource right is a legal document, and constitutes claim on the value of the physical resources. This intangible asset is carried at acquisition cost[13] [14] which may well differ from its market price, with market price values tending to fluctuate in tandem with resource prices.

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11 Sales of resource rights were re-classified from "sales of existing assets" at the time of the 1997 historical revision to the Canadian System of National Accounts to "property income". In light of SNA08 and the reasoning in this paper as well as the current treatment for the spectrum, "sales of existing assets" seem to be the correct treatment. The rights come into being as volume changes at the time of initial sale.

12 Though the SNA 2008 drops the tangible-intangible terminologies, for a lack of better terms this paper uses them.

13 New accounting standards will likely lead to resource rights reflected at values closer to market prices.

14 The asset is also adjusted for depletion, which is treated as a volume change in SNA.

Resource rights can also be sold to other corporations at market prices - values that may be significantly different from acquisition cost - though these prices are only observable when transactions occur. This underscores the need for a methodology to derive current values for resource rights held by corporations as part of the approach to sectoring. These secondary market transactions also underline the reality that corporations have a transferable claim to the value of the physical resources.

Corporations make substantial revenue from harvesting natural resources - included in corporate profits. This factor, in addition to the degree of control/responsibility they have for the assets, make them the *economic owners*. This underlines the existence of a corporate asset related to natural resources (recognized in SNA08 13.52). These revenues, as well as significant fluctuations in resource prices, are reflected in the changes in the market value of outstanding corporate shares on markets. As such, they should also be reflected in corporate net worth measured as assets less liabilities in the NBSA (net asset value). It is therefore important to account for this resource rights asset, at a current or market price value, in the corporate sector balance sheet of the macroeconomic accounts.

The authors' view is that the SNA08 treatment stops short of a full sectoring of natural resource assets by partly sidestepping the existence of an asset in the corporate sector balance sheet related to natural resources and linked to income flows from natural resource extraction. Given this, an important statistical disconnect arises: There is no corporate natural resource asset to act as a counterpart to resource extraction income flows to corporations recorded in the income accounts. This is an important data gap.

Proposal specifics

The position taken here agrees with an implicit point in the SNA08's position that there is no effective way to split the stock of physical resources endowed by nature between sectors. Even if there were agreement on a way to partition the value of the physical resource, this would be far removed from the actual accounting by governments and corporations. It could be argued that a naturally occurring asset belongs to the nation as a whole, and can be extracted / harvested for economic reasons by corporations at the discretion of governments. As a corollary, the institutional sectors` economic aspect of natural resources could be handled by means other than partitioning the value of the physical stock; and, ideally, such *other* means would be more closely aligned with the financial accounting realities with respect to natural resources.

Given the above, an alternative treatment is proposed that recognizes sectoral claims on the stock of physical natural resources as *intangible* assets. Specifically, we suggest treating the sector-level assets as claims on the underlying national natural resources; in other words, the claims can be thought of as assets that derive their value from the claims that governments and corporations have in relation to the physical resource assets on behalf of the nation's population, ultimate owners of these resources[15]. In the case of businesses in the resource industries, this is largely consistent with their accounting for these assets. Both corporate and government sector net worth would be revised upward by the addition of these intangible assets to their balance sheets, but government net debt would be unaffected.

Following this approach, two intangible assets at the sectoral level would be created in the *National Balance Sheet Accounts* (NBSA) and added to the government and corporations' sector accounts of the NBSA. These sectoral assets would be fully reconciled with the value of the aggregate natural resource wealth at the national level; in other words, the sectoral intangible assets related to natural resources would sum to the aggregate value of the tangible natural resource assets measured on the un-sectored national

[15] This treatment is conceptually similar to that already adopted in the CSNA for the electromagnetic spectrum.

balance sheet[16]. The proposed methodology to generate these sectoral estimates would ensure that this identity holds.

This methodology is presented in three parts in the following section: Estimating the annual value of the tangible natural resource assets (annual natural resource wealth); estimating quarterly natural resource wealth; and generating sectored estimates related to quarterly natural resource wealth.

Net changes in the value of the physical tangible natural resource assets (e.g. net depletion plus discoveries) would be shown at the national level in the *Other Changes in Assets Account*, but also apportioned between the two sectoral intangible assets and shown in the same account.

III. Valuation methodology: Producing quarterly natural resource wealth and sectored balance sheet estimates

One of the major challenges in developing quarterly estimates of natural resource assets is the fact that much of the source data to which the estimates must ultimately be benchmarked (i.e. monetary and physical measures) are available on an annual basis only and is not as timely as the *National Balance Sheet Accounts* (NBSA). Thus, methods are needed to: a) allocate annual historical NRAs data series on a quarterly basis, b) produce timely forward estimates of NRAs for inclusion in the CNBSA and, c) reconcile quarterly forward estimates to annual data benchmarks, in accordance with the NBSA revision cycle.

Before discussing the methodology for producing quarterly data specifically, a brief background on the approach to valuing the tangible natural resource assets is given below.

Valuing tangible natural resource assets: A brief background on the net present value approach

Since reserves of natural resources in their natural state (*in situ*) are seldom traded directly in markets, their value must be estimated using indirect approaches. Statistics Canada uses the net present value of future rents approach (NPV). This approach follows the international recommendations for valuing natural resources (SNA2008 13.24; SEEA2012, Chapter 5) and has been the basis of Statistics Canada's *Natural Resource Stock Accounts* (NRSA) program since the early 1990s.

[16] Which are included as part of *annul* national wealth at the aggregate level on the consolidated national balance sheet.

The natural resource asset value is calculated in two steps: a) *resource rent* is derived as the residual of resource sales revenue less extraction costs; and b) the discounted sum (or net present value) of the stream of *resource rents* is estimated.[17] The calculations are based on the following two formulas:

Resource rent (R):

$$R = TR - C - \left[r_k K + \delta\right] \qquad (Eq.1)$$

Where: TR= total revenue
C = operating cost: notably labour, raw materials and fuel costs
K = produced capital stock net of depreciation
r_k = rate of return to capital
δ = depreciation of produced capital

$$NPV = \sum_{t=1}^{T}\left[\frac{R_t}{(1+r_d)^t}\right] = \frac{R_1}{(1+r_d)} + \frac{R_2}{(1+r_d)^2} \cdots\cdots + \frac{R_T}{(1+r_d)^T} \qquad (Eq.2)$$

NPV of rents: $r_d = discount\ rate$

$$T = reserve\ life = \left(\frac{Period\ end\ reserve}{\Pr oduction\ during\ the\ period}\right)$$

Because information on resource extraction paths cannot be forecast with an acceptable degree of certainty, future rents are assumed to be the same as current period rent, i.e., $R=R_1=R_2\ldots.R_T$.

The NRSA currently include annual NPV-based estimates for many natural resource assets[18] using physical and monetary data sources. These detailed annual accounts are disseminated at the national and provincial levels, with time series beginning in 1970 or later depending on the resource.

The relationship between the annual program and proposed quarterly NRA accounts is discussed in the Appendix I.

Estimating quarterly rent and NPV; creating a historical time series and forward estimates for NRAs

As noted previously, Statistics Canada currently estimates the value of tangible natural resource assets using a number of annual data sources. For example, revenue and extraction costs are obtained from Natural Resources Canada's *Annual Census of Mines, Quarries and Gravel Pits* (ACM) and the Statistics Canada's *Energy Program*. In order to distribute these annual data among the four quarters of each calendar year of the historical time series a number of quarterly allocators have been created.

The use of these allocators to construct a quarterly historical time series and project the NRA series forward for current analyses are the mainstays of the approach described in detail below.

While the construction of the historical time series is a one-time exercise, the method used to do so bears explanation, since the same method will be employed as part of a regular revision cycle, whereby the forward quarterly estimates are reconciled (or benchmarked) with foundational annual data at the time of the revision of the NBSA; as noted below, many of the annual data series used to calculate estimates of

[17] For details, see Statistics, 1997, Concepts, sources and methods of the Canadian system of Environmental and Resource Accounts, Statistics Canada Catalogue no.16-505-GIE, Ottawa.

[18] Energy resources (natural gas, crude oil, crude bitumen and coal), mineral resources (gold, nickel, copper, zinc, lead, iron, molybdenum, uranium, potash and diamonds) and timber. Other natural resource stocks, including water and fish, are not currently valued due to data limitations.

natural resource asset values are lagged by up to two years in comparison with the publication of quarterly NBSA.

Ideally, the approach to allocating annual data over the year would be based on economic theory. In practice, it is constrained by the availability of data. Quarterly revenue and cost functions would be the ideal means of determining underlying quarterly trends in annual data. Owing to data limitations[19], however, relatively simple formulas must be used to derive quarterly revenue and cost data for estimating the quarterly rent.

Quarterly revenue allocation and estimation

(i) Allocation for historical revision and annual revision cycles:

Total revenue (TR) of a resource, say gold, is equal to price times quantity sold, i.e., TR=P*Q. Using quarterly price and quantity data from a number of sources[20] a set of quarterly weights (ω) for each resource are calculated using the following formulas:

$$\begin{bmatrix} \omega_1 \\ \omega_2 \\ \omega_3 \\ \omega_4 \end{bmatrix} = \begin{bmatrix} \frac{tr_1}{tr_T} \\ \frac{tr_2}{tr_T} \\ \frac{tr_3}{tr_T} \\ \frac{tr_4}{tr_T} \end{bmatrix} \quad and \quad \begin{bmatrix} TR_1^E \\ TR_2^E \\ TR_3^E \\ TR_4^E \end{bmatrix} = \begin{bmatrix} \omega_1 * TR^A \\ \omega_2 * TR^A \\ \omega_3 * TR^A \\ \omega_4 * TR^A \end{bmatrix} \qquad (Eq.3a)$$

Where:

ω_i = weights used to distribute annual (benchmark) survey revenue data by quarter, i.e., where $\sum_{i=1}^{4} \omega_i = 1$

tr_i = constructed quarterly sales revenue for the i[th] quarter, based on quarterly price and quantity data, i.e., $tr_i = p_i * q_i$[21]

tr_T = the sum of constructed quarterly revenue over 4 quarters, i.e. $tr_T = \sum_{i=1}^{4} tr_i$

TR^A = reported sales revenue from *annual* survey sources[22]

TR_i^E = estimated total revenue for i[th] quarter, where $\sum_{i=1}^{4} TR_i^E = TR^A$

19 Firm level data on quarterly output, price, input costs are not available.

20 Quarterly production and price data are compiled from several sources including Natural Resources Canada, Alberta Energy Board, Producer Prices Division and CANSIM tables.

21 Quarterly production and price data are compiled from several sources including Natural Resources Canada, Alberta Resource Conservation Board, and Statistics Canada, including Producer Prices Division, International Trade Division, CANSIM, and Metal Prices.com.

22 Sources of annual total revenue include: Natural Resources Canada's Annual Census of Mines, Quarries and Gravel Pits for minerals; Statistics Canada's Manufacturing and Energy Division's Energy Program and Annual Survey of Manufactures and Logging.

Based on these weights, the annual sales revenues are distributed among the quarters of a given calendar year. For example, if ω_s (ω_1=0.20, ω_2=0.26, ω_3=0.30, ω_4=0.24) and TR^A = \$100 then the estimated quarterly revenues, TR_t^E, would be \$20, \$26, \$30 and \$24 respectively.

(ii) Forward projection:

Similar quarterly data sources are also used for *forward projection* of revenues**.** Because annual survey data (benchmarks) are lagged by up to two years in comparison to the quarterly balance sheet schedule, forward estimates are essential.

For the current quarter, the following formula is used for this purpose:

$$TR_t^E = TR_{t-1}^E\left(\frac{p_t}{p_{t-1}} * \frac{q_t}{q_{t-1}}\right) = TR_{t-1}^E\left(\frac{tr_t}{tr_{t-1}}\right) \qquad (Eq.\ 3b)$$

Where:

p_t , q_t = quarterly indicators of price and quantity for the current period

p_{t-1} , q_{t-1} = quarterly indicators of price and quantity for the previous period

In other words, the current period's revenue estimate is the product of three components: the previous period's revenue, TR_{t-1}^E, the inter-period price ratio and the inter-period output ratio. For example, if TR_{t-1}^E = \$100, p_t=\$50, p_{t-1}=40, q_t=10 and q_{t-1}=9, then TR_t^E =\$100(50/40)(10/9)=\$138.89.

(iii) Allocation for annual revision

Once annual data for a given year become available, projected quarterly estimates will be benchmarked to them, using the weighing scheme outlined in equation 3a. This insures coherence and accuracy over the entire time series.

Quarterly extraction costs allocation and estimation

According to equation 1, extraction costs are comprised of operating costs (C) and capital costs (r_kK + δ). These two differ from each other - an operating cost or variable cost is largely dependent upon current output (Q) whereas investment in fixed capital (such as oil rigs or buildings) is a relatively long-term cost commitment of businesses. In the short-term, production continues if the firm can generate sufficient revenue to pay for the variable inputs - notably labour, raw materials and fuel and electricity.

<u>Labour costs</u>

Allocation for historical revision and annual revision cycles

Microeconomic theory tells us that, all other things being equal, variable cost is a function of output. Other things include technology (e.g., introduction of a capital intensive technology could reduce labour cost) and input costs (e.g., hourly wage rate, electricity rate, etc.).[23] Typically, technological change takes time, and any savings in labour costs it affords are reflected in the annual wage bill for a given industry. Thus the variations in labour costs from quarter to quarter are driven largely by the variation in quarterly output and wage rate[24]; i.e.:

$$\Delta C = \phi(\Delta Q, \Delta W) \qquad (Eq.4)$$

Assuming that the variation in labour cost is proportional to variations in output and wage rate, quarterly labour cost allocators can be derived as follows:

$$\begin{bmatrix}\alpha_1\\ \alpha_2\\ \alpha_3\\ \alpha_4\end{bmatrix} = \begin{bmatrix}\frac{Q_1}{Q_T}\\ \frac{Q_2}{Q_T}\\ \frac{Q_3}{Q_T}\\ \frac{Q_4}{Q_T}\end{bmatrix}; \quad \begin{bmatrix}\beta_1\\ \beta_2\\ \beta_3\\ \beta_4\end{bmatrix} = \begin{bmatrix}\frac{W_1}{W_T}\\ \frac{W_2}{W_T}\\ \frac{W_3}{W_T}\\ \frac{W_4}{W_T}\end{bmatrix}; \quad \begin{bmatrix}\gamma_1\\ \gamma_2\\ \gamma_3\\ \gamma_4\end{bmatrix} = \begin{bmatrix}\theta\alpha_1 + (1-\theta)\beta_1\\ \theta\alpha_2 + (1-\theta)\beta_2\\ \theta\alpha_3 + (1-\theta)\beta_3\\ \theta\alpha_4 + (1-\theta)\beta_4\end{bmatrix}; \quad \begin{bmatrix}C_1^E\\ C_2^E\\ C_3^E\\ C_4^E\end{bmatrix} = \begin{bmatrix}\gamma_1 * C^A\\ \gamma_2 * C^A\\ \gamma_3 * C^A\\ \gamma_4 * C^A\end{bmatrix} \qquad \text{(Eq. 5a)}$$

$$\sum_{i=1}^{4}\alpha_i = 1 \qquad \sum_{i=1}^{4}\beta_i = 1 \qquad \sum_{i=1}^{4}\gamma_i = 1$$

Where:

α_1, α_2, α_3, and α_4 are quarterly output ratios,
β_i are wage rate ratios,
θ=weight (assumed 0.5)[25]
γ = weighted average of α and β
Q_1 = production in 1st quarter
Q_T = sum of quarterly production values, i.e. $Q_T = \sum_{i=1}^{4} Q_i$
W_1= hourly wage rates from quarterly sources
W_T= sum of hourly wage rates from quarterly sources, i.e. $W_T = \sum_{i=1}^{4} W_i$
C_1^E =estimated labour cost in quarter 1;
C^A = labour cost from annual (benchmark) survey sources

Forward projection

In a similar fashion to quarterly revenue, quarterly costs are projected forward using the following formula:

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23 Apart from these, there are irregular issues, such as weather and labour unrest, which could impact labour cost.

24 For details, see, Greene, W. (2000), Econometric Analysis, 4th edition (pp. 327-329), Prentice Hall.

25 More precision of θ would require additional quarterly data (i.e., quarterly cost functions), which are currently unavailable.

$$C_t^E = C_{t-1}^E\left(\frac{W_t}{W_{t-1}} * \frac{Q_t}{Q_{t-1}}\right) \qquad \text{(Eq. 5b)}$$

In other words, the current period's cost is the product of three components: the previous period's cost, the inter-period wage rate ratio, and the inter-period output ratio. For example, if C_{t-1}= \$100, W_t=\$25, W_{t-1}=24, Q_t=10, Q_{t-1}=9, then

$$C_t^E = 100\left(\frac{25}{24} * \frac{10}{9}\right) = \$115.74$$

Other operating costs

A similar approach is also used for allocation and forward projections of other cost components of rent such as electricity and raw materials costs; e.g., where hourly electricity rate is used in place of wage rate (W).

Capital costs

According to equation 1, there are two components of capital cost that need to be accounted for in the calculation of resource rent: depreciation (δ) and the return to fixed capital (r_kK). For the former, the perpetual inventory method is used to generate estimates of (geometric) depreciation. While these capital stock and depreciation data are not estimated on a quarterly basis at Statistics Canada, a quarterly investment data series is used to allocate them by quarter.

With respect to calculating a *return to fixed capital*, an often contentious issue is selecting an appropriate rate of return (r_k) to apply to fixed capital stock (K). Appendix II provides a brief discussion regarding conceptual and data considerations surrounding this issue.

Quarterly NPV issues

Calculating the *quarterly* NPV of natural resource assets (vs. annual NPV), requires that minor modifications be made to the NPV formula: a) a quarterly discount rate (r_d/4) must be applied rather than an annual rate; and b) reserve life must be expressed in quarters rather than years.

Data on reserves are updated once per year and are lagged by 12 months or more for a given reference year. In order to reflect changes in reserves that likely occur in the shorter term, however, quarterly reserve life of each resource is adjusted, based on the known annual trends in additions and depletions. For example, since the expected reserve life of coal has remained unchanged in Canada over a long period of time (due to substantial reserves) the quarterly reserve for coal is held fixed in the quarterly rent calculation. On the other hand, the annual reserve life of diamonds is more volatile; as such, the reserve life for diamonds is adjusted quarterly, based on trends in additions and depletions and the relationship between annual production and depletion.

IV. Sectored estimates of quarterly natural resource wealth

Sectoring measurement issues and corrected estimates of sectoral net worth

The second major methodological challenge is apportioning these quarterly estimates by economic sector.

The approach proposed in this paper - one that is also supported in the SEEA 2012 - is to base the government's share of natural resource wealth on the NPV of the expected revenue stream paid by resource extractors to governments (i.e., royalties and special taxes).[26] As argued above, this represents the value of an intangible asset reflecting governments' roles in overseeing natural resource extraction. To estimate the value of this asset, data on royalties and special taxes are needed for each natural resource asset for provincial, federal and territorial governments.

The corresponding *corporate* sector asset is calculated as a residual; total resource wealth less the NPV of the expected stream of royalties and special taxes is allocated to the corporate sector as *its* share of resource wealth. Assuming that the government's share is estimated accurately, this is equivalent to the value of an intangible corporate asset reflecting the (government-conferred) right to extract and sell the nation's natural resources.

The value of the corporate sector's share of NR assets as derived through this method would in principle be equal to the current dollar value of these claims (resource rights), thus largely ensuring that non-financial assets and sectoral net worth (net asset basis) are correctly measured.

Table 2 is a corrected version of Table 1, with the same assumptions and values. It clearly demonstrates the advantages, in terms of more coherent balance sheet data, of the inclusion of estimates of sectoral natural resource based assets.

Table 2 reflects full coverage of sectoral natural resource-based assets in the institutional sectors, and thereby complete measures of net worth on a net asset basis. In the case of residual corporate sector net worth, the numerical value is reduced such that the net asset value of net worth is more coherent with the market value of corporate equity.

Further, sectoral net worth (including natural resources) now sums to National Net Worth (including natural resources). However, in order to move from the sectoral to National Wealth, the sector natural resource claim assets (corporate plus government sectors) must be reclassified from intangible assets to national tangible natural resource stocks.

[26] The amount of royalties depends on a number of factors, such as resource price, quantity of production and governments' policies

Table 2. Simplified illustration: Incorporation of natural resources in the sector accounts

NBSA sectors/assets	House-holds	Corporations	Government	Reclassification from sector accounts to National Wealth	Consolidated National balance sheet (CNBS)
Total assets	4500	6300	400		
Non-financial assets		4300	400		National Wealth: 4700
Produced assets		3300			3300
Non-produced assets			400		
-- Tangible natural resources (NR)				+1400	1400
--Intangible assets related to NR		1000 (derived)	400 (calculated)	-1400	
Financial assets	4500	2000			
Liabilities and net worth	4500	6300			
Debt		3000			
Equity at market value		3500			
Sectoral net worth (residual corporate net worth in the corporate sector	4500	**-200**	**400**		**National Net Worth: 4700** (equals sum of domestic sectors' net worth)
MEMO ITEM					
Corporate net worth as a net asset value		3300			

Sector detail

Ideally, the NPV of quarterly royalties and special taxes would be calculated for each resource individually and then summed over all resources to arrive at the governments' share of total resource wealth on a quarterly basis. However, detailed quarterly data on royalty payments are not available, so it is necessary to use the quarterly ratio of *total government royalties to total resource rent* as a means of allocating quarterly resource wealth between the government and corporate sectors. There are minor computational challenges associated with this method. Specifically, calibration is needed to account for the fact that reserve life as well as royalty rates vary from one resource to the next[27]. The calibration to correct for this difference is made through the use of detailed *annual* royalties' data by commodity. The adjustment is marginal.

[27] As can be proven mathematically, if either reserve life or royalty rate differs amongst a group of resources, the royalty to rent ratio for that group can differ from the ratio of total government sector resource wealth to total corporate sector resource wealth.

A consequence of the approach described above is that the quarterly sectoral intangible asset values of governments and corporations will be an aggregate of claims on all types of natural resources, whereas the annually published values of natural resource wealth will be broken down by natural resource type.

V. Provisional estimates: Sectored natural resource wealth

Preliminary findings suggest that the inclusion of sectoral natural resource assets in the quarterly *National Balance Sheet Accounts* (NBSA) would increase the average net worth of governments and corporations in excess of 200% (Chart 2 to 4). The most significant change to sectoral assets would occur in the corporate sector, with a large upward revision to non-financial assets.

Corporate sector results

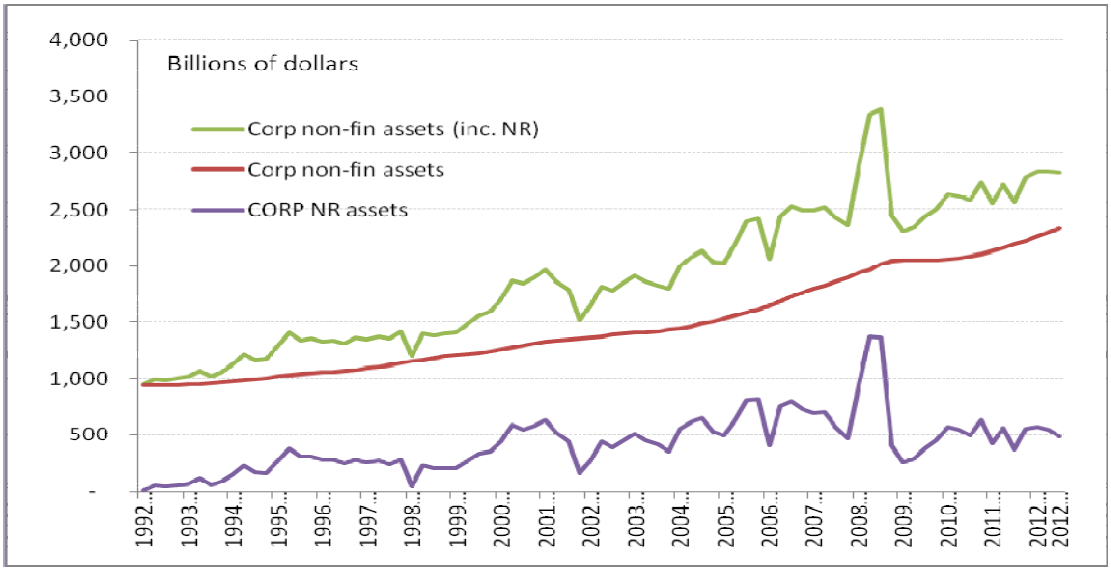
The inclusion of assets related to natural resources on the balance sheet, has a substantial effect on the measures of non-financial assets and corporate sector net worth.

Corporations' non-financial assets

The corporate sector accounts for on average 88% of the value of natural resources in Canada in the current value of the rights to extract. This share has remained relatively constant over time. As a result, non-financial assets of corporations are revised up substantially with the inclusion of natural resource based assets (Chart 2). Natural resources account for 22% (on average) of corporations' non-financial assets. This significant revision underlines the importance of natural resources to the economy as well as the need to deal with the associated sectoral data gap.

The natural resource based assets allocated to the corporate sector display the fluctuations in the markets for natural resource commodities that are evident in the quarterly estimates of aggregate natural resource wealth. Therefore the new provisional estimates for corporate sector non-financial assets also reflect this volatility, and make for a notable departure from the published data largely based on capital stocks and land.

Chart 2: Non-financial assets of the corporate sector with and without accounting for natural resource assets; corporate sector natural resource based assets



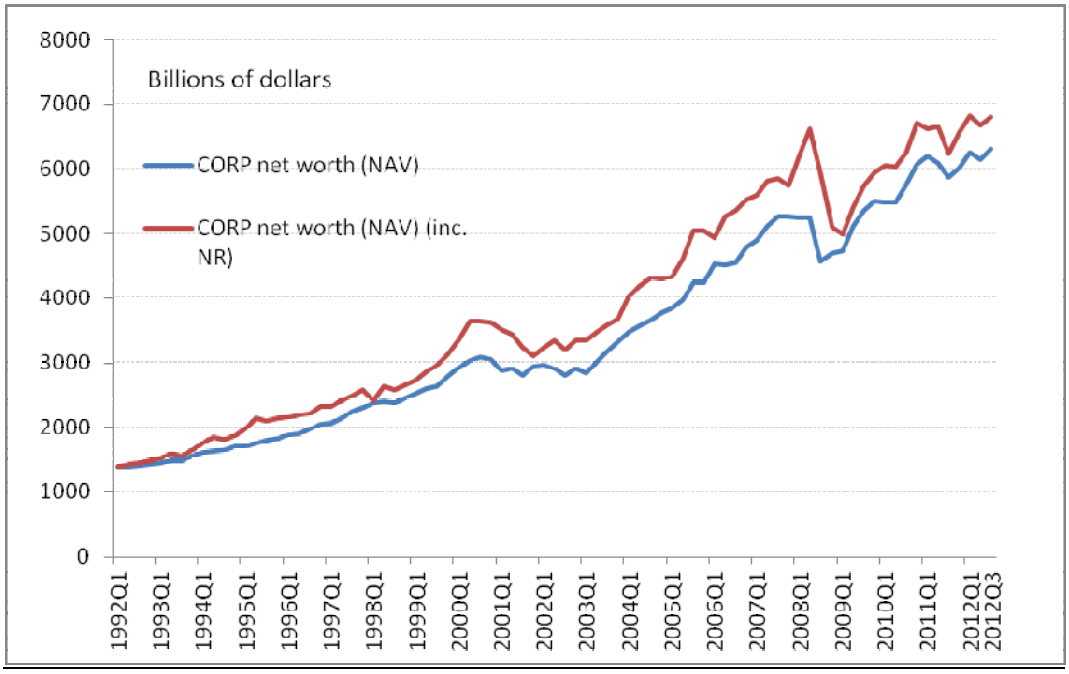
The net asset value of corporations' net worth

The new provisional net asset value measure of corporate net worth (sectoral balancing item of assets less liabilities, excluding corporate equity liabilities) is revised up substantially (Chart 3).

The published net asset values (NAV) estimates had some degree of ups and downs when based on the net of assets and liabilities, excluding claims on natural resources. Some of these movements (in assets-liabilities) would have reflected the ups and downs of financial markets, and therefore would have incorporated some effects (one-sided effects) of price changes for resource commodities.

However, the direct inclusion of natural resource assets intensifies the volatility of the new net asset value (NAV), largely in tandem with fluctuations in resource commodity markets. In particular, the build up, and the subsequent collapse, of resource prices in 2008 are visible in the new quarterly estimates of the net asset value measure of corporate net worth.

Chart 3: Net asset value measure of corporate sector net worth with and without natural resource assets



Links to the market value of corporate equity

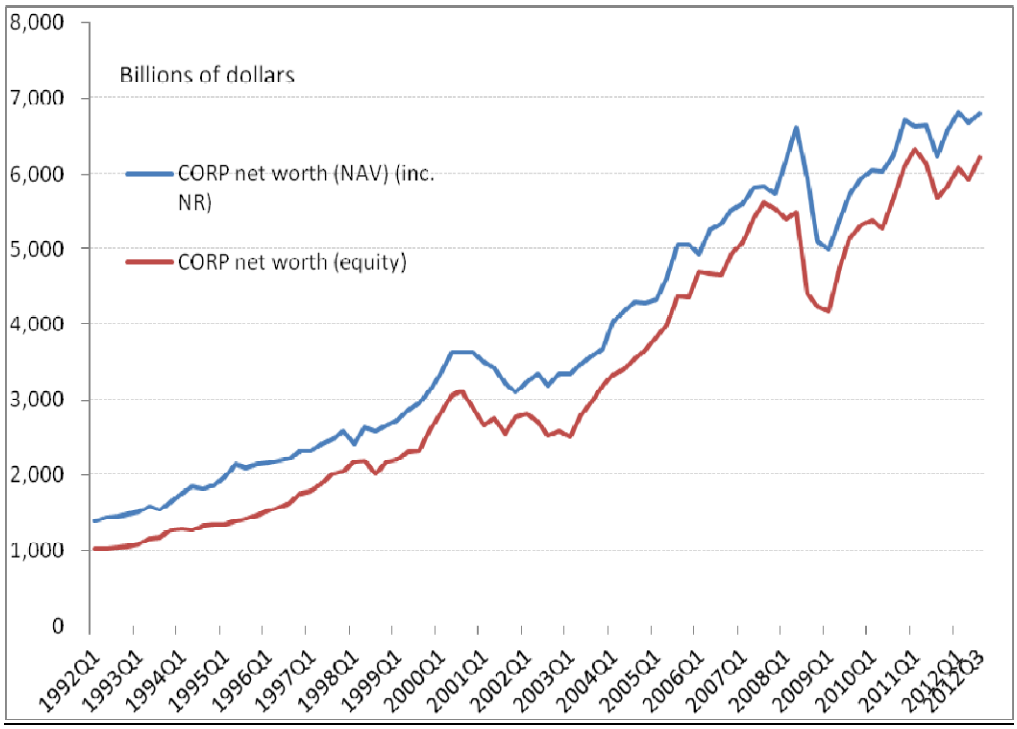
The increased magnitude and volatility of the new net asset value measure of corporate sector net worth (NAV) makes for improved coherence with the market value of corporate equity outstanding (MVCE), which is a second measure of corporate sector net worth (Chart 4).

The MVCE is the measure that brings the equity assets and equity liabilities in the NBSA matrix into line with each other, by setting the matrix control total for this financial instrument. Estimates of the market value of corporate equities outstanding are generated using actual market values for listed companies and a mark-up factor for unlisted companies (using a size cut-off).

In particular we see that the turning points in the new NAV estimates largely correspond to those of the MVCE. This is not the case with the published NAV time series.

On the new basis both measures reflect, among other things, the relative impact of the natural resource sector in Canada. This increased coherence makes for a substantial improvement in data quality.

Chart 4: New net asset value measure of corporate sector net worth and the market value of corporate equity outstanding



Given that the NAV and the MVCE are in principle equal, statistical improvements - in this case, extending the coverage of assets to include natural resource based assets - should bring them closer together. This, however, is the not case; the upward revision to the NAV, pushes the NAV above the MVCE, and the gap between the two measures actually increases. This, in turn, impacts the absolute value of residual corporate sector net worth.

Impact on residual corporate net worth

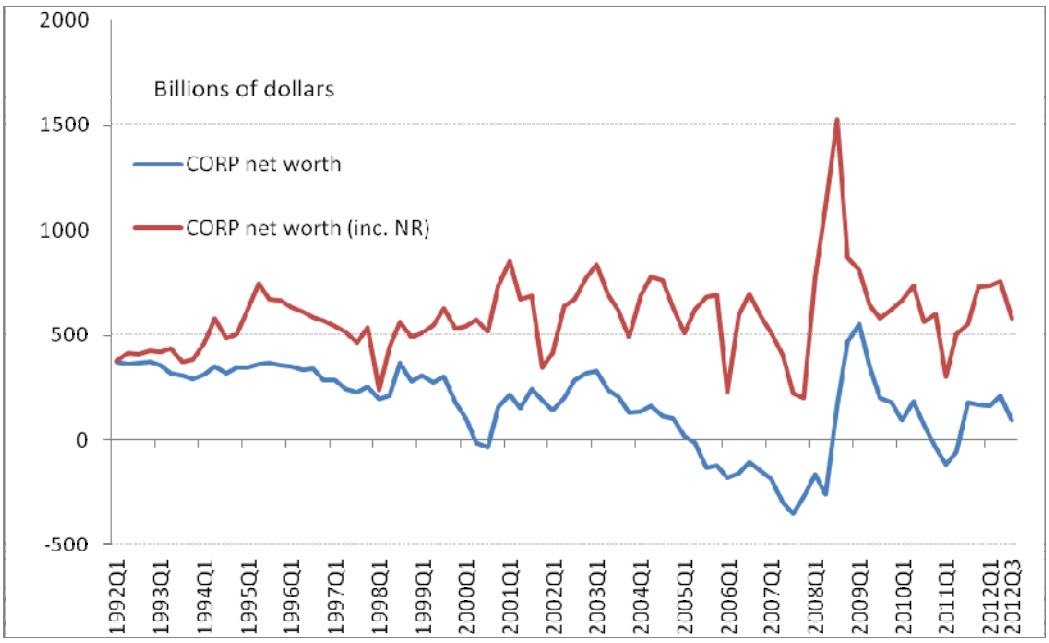
Because corporations are ultimately owned by other sectors, they should have zero net worth. Otherwise stated, the NAV should be equal to the MVCE - equity which is held as assets by other sectors[28]. Because of measurement error and sharp fluctuations in the stock markets (not reflected in NAV), this is rarely the case. The difference is residual corporate net worth (RCNW) or unallocated corporate net worth.

[28] Corporate equity at market value is treated as a liability on the balance sheet of the corporate sector in the NBSA matrix, since it represents a claim by shareholders on the corporate sector.

RCNW is used to sum sectoral measures of net worth to National Net Worth. National Net Worth is also derived as National Wealth adjusted for the country`s Net International Investment Position. In this way, the NBSA balances in all dimensions.

Residual corporate sector net worth with natural resources included remains positive throughout the period above and is larger than without an accounting for corporate claims on natural resources (Chart 5). Since, in principle, RCNW should be absolutely smaller over the time period this result requires further investigation.

Chart 5: Residual corporate sector net worth with and without natural resource assets



There are a few reasons why RCNW might increase over the time series, with the inclusion of a new NAV estimate. For one thing it is possible that the corporate sector natural resource based asset is overstated to an extent. It is also possible that the MVCE is understated in the NBSA. For example, if a number of small and medium sized unlisted enterprises in the resource extraction industries are not marked up (under the size cut-off), this could account for a significant portion of an understatement of MVCE. In addition, we could be misstating other assets-liabilities, especially overstating financial assets and/or understating liabilities. For example, we could be understating to some extent corporate liabilities related to defined benefit pension plans.

The fluctuations in the new provisional estimates of RCNW do not match the movements in the published time series, which would have been affected by a partial accounting for natural resources - that is, reflected in the MVCE and not in the published NAV.

Digression on quality

The above discussion leads to a last point. A full balance sheet account (including non-financial assets increases the quality of the sector accounts by generating net worth estimates as a means to help confront the quality of the non-financial assets as well as the financial balances (sometimes referred to as financial net worth). Similarly, inclusion of missing assets such as natural resources in the sector accounts improves the net asset value measure of corporate net worth, and allows for confrontation of this measure with independently constructed estimates of the market value of corporate equity. This in turn generates

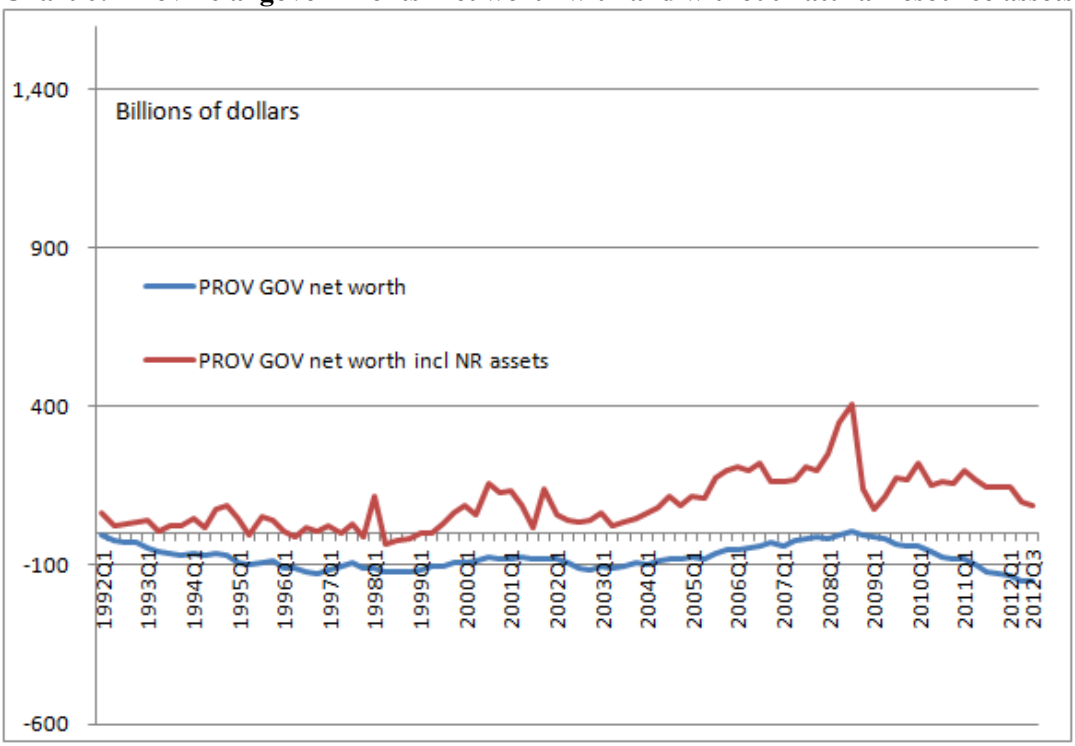
new estimates of residual corporate net worth that provide a new perspective on the quality (coverage and valuation) across all corporate sector assets and liabilities. This data confrontation exercise can, in turn, lead to accuracy improvements across the sectors in the *National Balance Sheet Accounts*.

Government sector results

Provincial governments

The net worth of provincial governments, when natural resource wealth is included, has been positive since 1999Q3 (Chart 6). This reflects the increased value of natural resources in this period. In addition, the volatility of net worth in the provincial government sector increased with the addition of a natural resource asset.

Chart 6: Provincial governments' net worth with and without natural resource assets

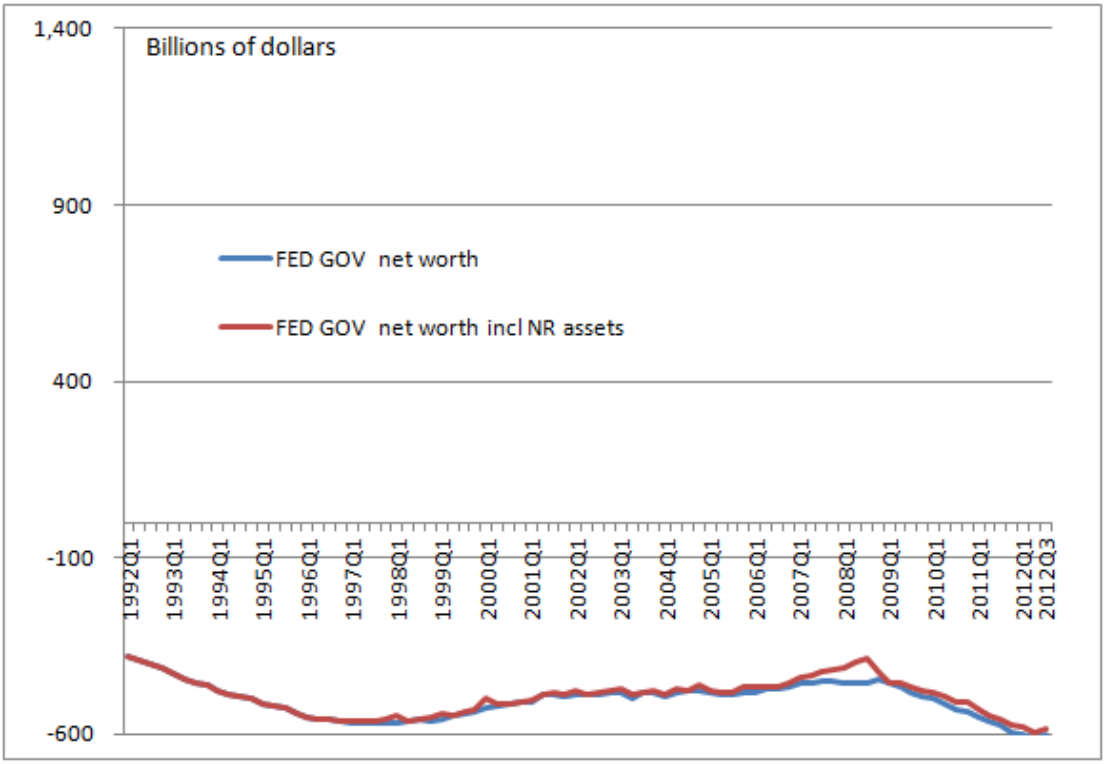


Between 1989Q3 and 2008Q3 provincial government net worth with and without a natural resource asset exhibited a generally upward trend, with a few exceptions (Chart 2). Since the global economic downturn, however, published net worth has trended downward as debt advanced, declining at an average rate of 25% or more from 2009Q1 and 2012Q3. Adding the natural resource assets, provincial government net worth was relatively flat over this period.

Federal Government

As natural resources are largely the domain of provincial and territorial governments, the value of the federal government sector natural resource asset is relatively small. The overall impact of adding a natural resource asset to federal government net worth, then, is fairly inconsequential (Chart 7).

Chart 7: Federal government net worth with and without natural resource assets



VI. Summary and concluding remarks

Both government and corporate sectors derive a substantial amount of income from Canada's natural resource wealth. Governments collect royalties from businesses, and in return, accord businesses the right to extract resources at profit. These royalties and earnings are included in the CSNA - as components of the sectoral *Income and Expenditure Accounts*. The sectoral *National Balance Sheet Accounts (NBSA)* are yet to include the underlying income-generating assets of each sector; in the case of the corporate sector, this is a major gap.

SNA08 provides an impetus to account for the missing assets by recognizing the existence of both the value of tangible assets in the form of the physical resources and intangible assets associated with rights to extract resources. This paper takes the view that SNA08 does not, clearly link (i) income flows to resource assets or (ii) the natural resource stocks and the rights to extract; nor does it adequately address sectoring issues in the balance sheet account, at least one that reflects the economic reality in Canada. This paper builds on SNA08 and fleshes out these issues to some extent, so as to complete the accounting for assets in the NBSA.

In doing so, the paper follows the economic ownership principle. It also takes the position that the governments' share of natural resource wealth should be based on the expected income from royalties and special taxes collected from extractors for according them the right to extract. Although the physical reserve belongs to the nation as a whole, the governments' share in the monetary value should be considered as an intangible government sector asset; and, the remaining portion should be allocated to the corporate sector, as an estimate of the current value of the rights to extract. In both cases the values would be representative of expected stream of incomes, with the corporate sector derived as a residual.

With natural resource wealth included, the net worth of both sectors increases - significantly, in the case of the corporate sector. Corporate net worth estimates will also align more closely with the market value estimates of equities. This makes for more complete and coherent sector balance sheets.

Incorporating a natural resource asset into the sector accounts of the balance sheet will put natural resources on equal footing with other income-generating assets that are already included in the balance sheet.

The inclusion of quarterly, sectored, natural wealth better integrates the stocks and flows as well as enhances the relevance and interpretability of the macroeconomic balance sheet account in Canada and more generally the Canadian System of National Accounts.

Appendix I – Linkages between quarterly and annual estimates of NRA values

Statistics Canada maintains NRA accounts for many types of natural resources[29] through its existing *natural resource stock accounts program* (NRSA). These long-published accounts are disseminated (in physical and monetary terms) at the Canada and province levels and form the core of the NRSA program. The proposed quarterly accounts will be a useful addition to the core program and will be published separately as such, but will cover a much shorter time period (Q1-1990 onward) and will be disseminated as broad aggregations of assets only (namely, Energy, Timber and Minerals).

As noted in section III, the core accounts are compiled from annual data sources. Revenues and expenses used in the calculation of natural resource rent, for example, are derived from the Annual Census of Mines and the Annual Survey of Manufactures and Logging, among many others. As the reference period for these surveys covers a full calendar year, the prices that underlie financial variables are in fact average prices.[30] Quarterly accounts, by contrast, reflect prices that prevail in a given quarter.

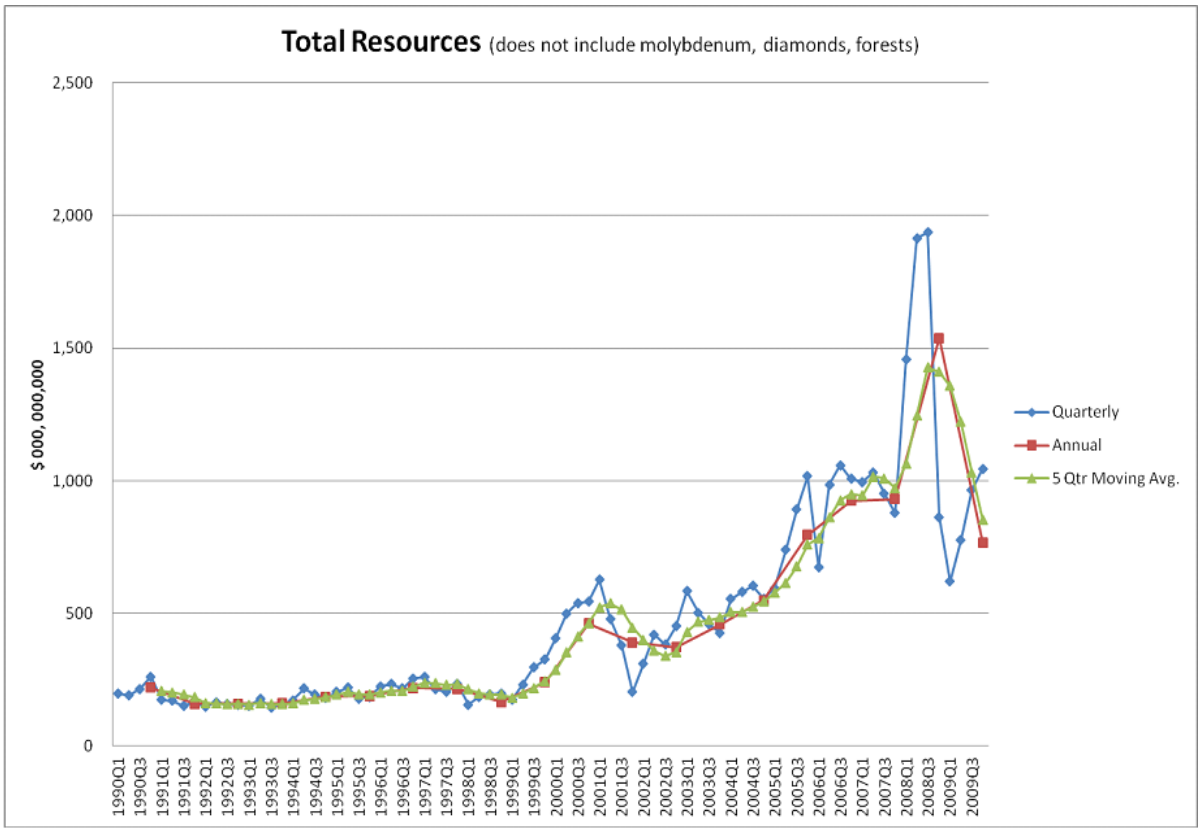
As a consequence of their differing price perspectives, the mathematical relationship between the two sets of accounts is not a perfect one. The nature of the relationship, however, can be illustrated by comparing the core accounts with a smoothed version of the quarterly. As chart 6 shows, the 5-quarter moving average trend line of quarterly series approximates very closely the annual NRAs accounts series.

Since these two series will coexist in future, it will be very important to explain to users that, despite differences in methodology, there is coherence between them. In addition to providing more detail in commodity and geographic space, the core accounts will continue to be valuable in demonstrating long-term trends and will feed into other related indicator sets, such as, for example, a proposed *natural capital index*.

[29] Energy resources (natural gas, crude oil, crude bitumen and coal), mineral resources (gold, nickel, copper, zinc, lead, iron, molybdenum, uranium, potash and diamonds) and timber. Other natural resource stocks, including water and fish, are not currently valued due to data limitations.

[30] This makes the estimates less responsive to short-term changes in economic conditions, as explained in section 2.

Chart 6: Concordance between annual and quarterly time series



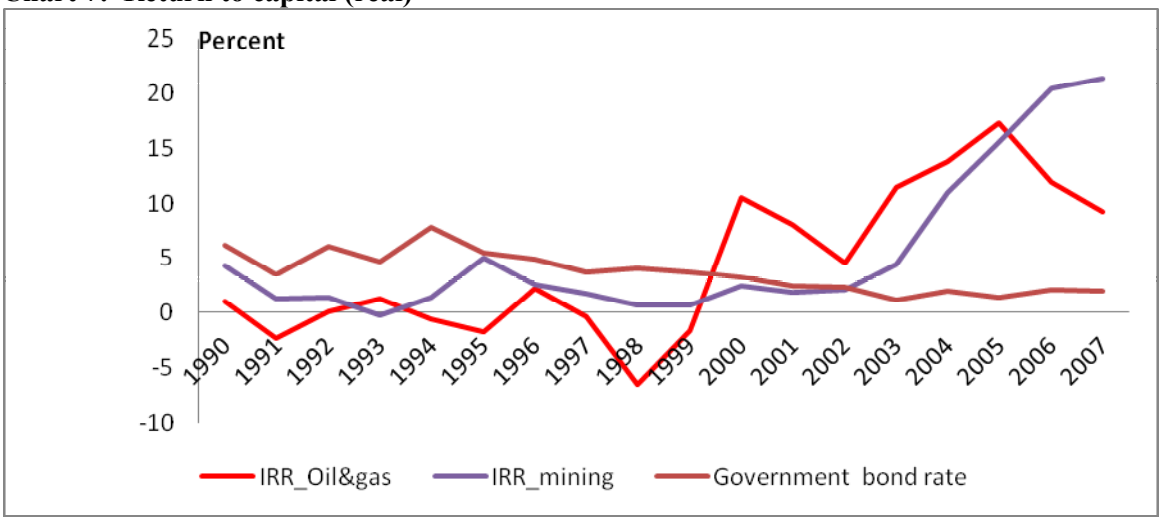
Appendix II – Return to capital (conceptual and data considerations)

Assigning a positive rate of return to fixed capital is seen to have a number of benefits with respect to data quality: a) it reflects the reality that there *is* an opportunity cost of capital that producers take into account when making decisions[31], i.e. capital used elsewhere requires a positive return; b) If this cost is not incorporated the resulting estimates of resource rents can be biased – i.e., rent is over-estimated for resources such as gold where extraction is relatively capital-intensive[32]; and c) the new international standard for environmental economic accounting, SEEA 2012, advocates taking return to capital into account and provides some guidance on choice of rates of return.

Choosing an appropriate rate of return to capital can be challenging, however, as there are many rates to choose from. Moreover, because resource extraction is a capital-intensive activity, small changes in r_k can significantly impact estimates of resource wealth.

Broadly, two approaches can be taken to deriving an expected rate of return on produced assets: the endogenous approach (i.e. "internal rate of return" (IRR)) and the exogenous approach (e.g., sector-specific corporate bond rates, government bond rates and others).

Chart 7: Return to capital (real)



Source(s): Statsitics Canada, Bank of Canada

Endogenous approach: The endogenous (i.e. "internal rate of return (IRR)") approach sets the rate of return to produced capital equal to *net operating surplus*[33] *divided by the value of capital assets.* It yields an ex-post rate of return on capital assets. In principle, this rate of return comprises three components: a component attributable to the produced assets themselves, a small component of intangible assets, and a component attributable to the "natural capital" built up from exploration and development[34]. Unfortunately, there is no straightforward and statistically robust way to separate these three components.

31 For details, see SEEA (2003), paragraph 7.197. "Integrated Environmental and Economic Accounting, Handbook of National Accounting", United Nations, New York

32 For details, See Islam, K. (2010), "Resource Rent and Return to Produced Capital - is iron brighter than gold?" EASD, Unpublished paper.

33 Calculated as *operating surplus* less consumption of fixed capital

34 Statistics Canada, Economic Analysis Division, personal communication.

By default, all three are attributed to produced assets. As a result, the endogenous approach overstates the return to produced capital for the resource extraction industries (see chart 7) and consequently leads to understated resource rents and NRA values. For this reason, the SEEA 2012 advises against using endogenous rates specific to the extractive industries *(SEEA 2012, 5.143)*.

Exogenous approach: The exogenous approach assumes that the expected rate of return on produced assets is equal to an external (exogenous) rate of return. Ideally, the expected rate of return should take into account industry or activity-specific returns thus implicitly taking into account risks in investing in particular activities *(SEEA 2012, 5.143)*.

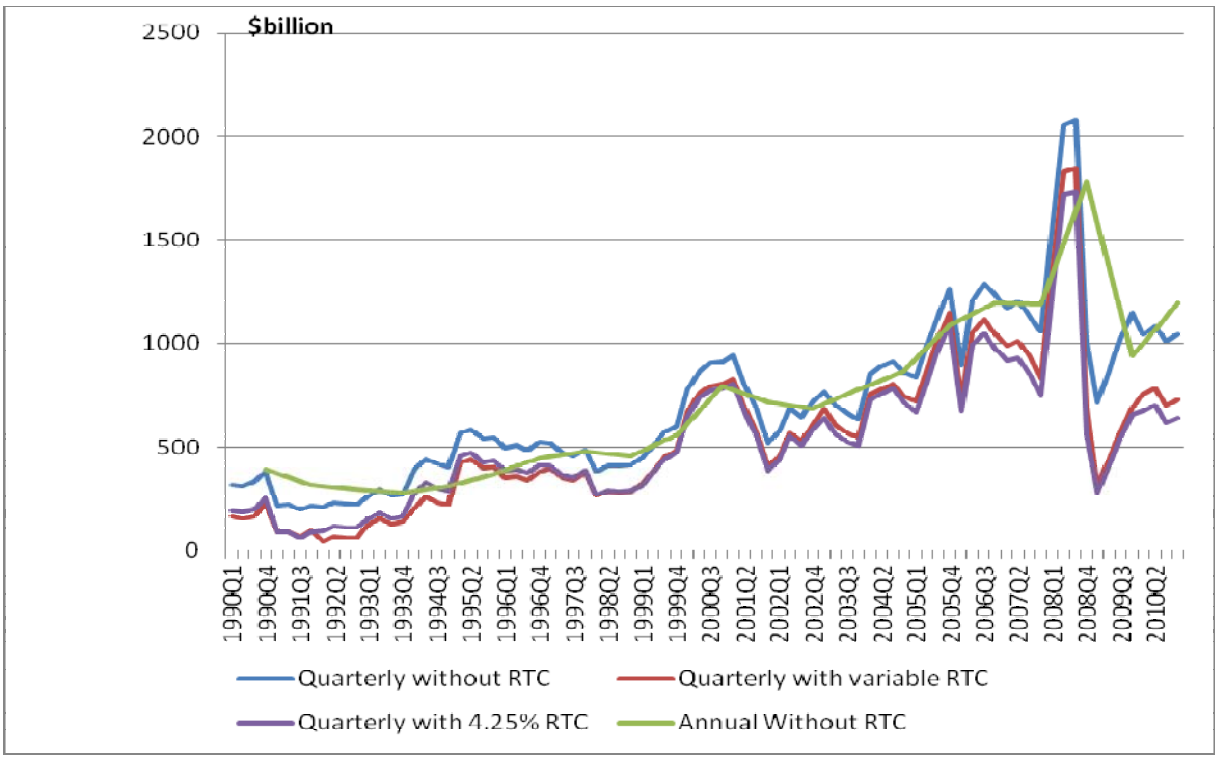
Corporate bond rate data, however, can be difficult to maintain on a consistent basis, and in most cases, resource extraction companies (E.g. Canadian Natural Resources, Shell, BHP etc.) sell other products and operates in more than one country. I.e., a company's bond rate does not necessarily reflect the return to investment in oil rigs or trucks used in producing oil and gold, for example. For these (somewhat pragmatic) reasons, SEEA 2012 recommends using a real government bond rate for r_k.

> *(SEEA 2012, 5.144) A realistic approach is to use an economy wide rate of return perhaps based on government bond rates where these exist. In all cases a real return should be used. While exogenous rates or return are unlikely to be perfect proxies for rates of return on individual produced assets, it is likely that they provide a reasonable reflection of normal returns for the derivation of estimates using the NPV approach.*

Following the SEEA recommendation, the Canadian government bond rate (Chart 5: 5-yr bond rate from the Bank of Canada) is being applied.

Quarterly natural resource assets; results: Based on the proposed methodology, the quarterly rent and thereby quarterly value of each tangible natural resource asset is estimated. The sum of the value of all assets forms the value of natural resource wealth. For comparison, four series of NPV are presented in Chart 8.

Chart 8: Quarterly Natural Resource Asset values under various return to capital scenarios; draft results



Among the four series, the quarterly series derived using a variable return to fixed capital is more consistent with current economic conditions and aligns with SEEA 2012 recommendations, as noted. However, volatility is slightly higher for this series than is the case when a fixed rate of return is used, i.e. a rate of 4.25%[35] is currently used by Statistics Canada's annual natural resource stock accounts program. Low interest rates (e.g., Bank of Canada's overnight lending has reached 1%) have contributed to the volatility in recent years.

[35] Standard deviation with a 4.25% return to capital is 331 but with a variable RTC (Government of Canada bond rate) goes up to 368.

References

ABS (2003), "Accounting for Subsoil Assets in the Australian National Accounts," London Group Meeting 2003, Rome, Italy.

Bartelmus, P. et al (1991), "Integrated Environmental and Economic accounting: framework for SNA satellite system," Review of Income and wealth, ser. 37, no. 2, pp. 111-148.

Cross, P (2008), The Role of Natural Resources in Canada's Economy," Canadian Economic Observer, Statistics Canada, Catalogue no. 11-010-XIB.

Islam, K., and Adams, P. (2010), "Natural Resource Wealth: 1990 to 2009," Statistics Canada, Catalogue no. 16-002-X

Statistics Canada (1997), "E-connections, linking the environment and the Economy". Catalogue no. 16-505-GPE

SEEA (2003). "Integrated Environmental and Economic Accounting, Handbook of National Accounting", United Nations, New York

SNA (2008). "System of National Accounts," United Nations, New York.