

Current issues in taxation of non-renewable natural resources¹

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Lecture for the Nordic Tax Research Council's conference, Porvoo, Finland, June 1, 2017

Introduction

Non-renewable natural resources are a potential source for large economic value. Many countries, also the Nordic countries, allow firms in the private sector to invest in the resource sector without any upfront payment that could reflect the value. The value will appear as an extraordinary return to investment, above the minimum required return to capital. This extraordinary return is known as the resource rent.

By its very definition, the resource rent is an attractive basis for taxation. Since it exceeds the minimum required return, firms would still be interested in investing even if almost all the rent were taxed away. Economists and advisors have thus recommended special rent taxes at high tax rates to obtain this. The academic literature and the policy advice from economists started right after the OPEC oil price shocks (Garnaut and Clunies Ross, 1975; Institute for Fiscal Studies, 1981), and has reached a degree of consensus with publications from the IMF (Daniel et al., 2010b; IMF, 2012), see also Boadway and Keen (2015). The purpose of this lecture is to examine this consensus and point out some remaining challenges. Along the way, there will be some implications also for the analysis of business and capital income taxation more generally. More references are found in Lund (2009).

The discussion that follows does not pay much attention to the merits and demerits of an alternative way for governments to get paid for resources, namely auctions. The topic here is taxation in the traditional sense. Auctions are discussed in Boadway and Keen (2010, pp. 40f and 62f); see also Mead (1994) and Cramton (2010).

The possibility that extraction and/or use of the resource has externalities, which is well known for fossil fuels, is neglected until section 8.

0. Briefly on current policy advice

From a theoretical viewpoint, the simplest form of a rent tax is a proportional, pure cash flow tax on a firm's non-financial cash flow. "Pure" means that when the yearly net cash flow is negative, the negative tax should be refunded to the firm. In such a system, the cash flows to and from the tax authority is just like the cash flows of another shareholder, and the net value to the actual shareholders is reduced in proportion with the tax rate. This holds under all models of competitive financial market equilibrium, since market values have the property known as value additivity. If they did not, values could be created by splitting or combining ownership shares.

As long as the tax rate is less than one hundred percent, such a system will neither deter nor promote investment according to simple theory. The tax is called neutral.

Governments are reluctant to promise refunds of negative taxes, and some governments may also be unable to commit credibly to such refunds in all possible future circumstances. More common forms of rent taxation involve instead postponement of tax deductions, compared with the pure cash flow tax. The postponed deductions are known as loss carryforward, depreciation deductions, uplift, allowance for corporate equity (ACE), etc. Boadway and

¹ Thanks to Karine Nyborg for valuable comments. I am solely responsible for remaining errors and omissions.

Keen (2015) summarize² (p. 111), "... the cash flow tax, Brown tax and members of the ACE and RRT families of taxes are equivalent in present value ...". That is, by interest accumulation or otherwise, the present value of deductions is unaltered by the postponement.

In practice, many governments impose taxes on gross resource revenue, known as royalties, instead of rent taxes, or in addition. Boadway and Keen (2015, p. 115) show that "... unless royalties are artificially designed to mimic a cash flow rent tax, they will impose distortions on resource production." The IMF (2012, p. 26) nevertheless states that for low-income countries, "combining a modest ad valorem royalty, CIT, and resource rent tax has considerable appeal." Here, CIT denotes a standard corporate income tax, which taxes also the normal return to capital, not only the rent.

Among the reasons to impose royalty in addition to a cash-flow based rent tax are (IMF, 2012, p. 18f) the possible need for early tax revenue and the hope of obtaining high tax revenue without creating incentives for wasteful investment. The latter will be discussed below.

1. Rate of tax?

Much of the discussion about rent taxes concerns which system to use, while relatively little attention is paid to the rate of taxes. Firms, of course, prefer lower tax rates, and recommend comparison of tax rates to those of other countries. Boadway and Keen (2010, pp. 60ff, 2015, pp. 133f) shed considerable doubt on the relevance of such tax competition in the field of resource taxation. The resources are not mobile, and the mobility of other factors should ensure that there is competition among firms who want to exploit a country's resources.

When externalities are dealt with otherwise (or neglected), the simple view is that firms will invest in such a way that net value is maximized. If a neutral tax is imposed, those maximizing choices will not be affected. If a neutral tax at 99 percent is imposed, this maximizes the value of the government's tax claim.

In practice we see a variety of tax rates, none of them close to 99 percent. The obvious reason is that this would create too many problems with overreporting of costs and underreporting of revenues. In practice the cost side is the more difficult one, since input factors are numerous and often tailor-made. Thus it is hard to apply the arm's length principle to prevent transfer pricing. On the revenue side, product prices and quantities are more easily monitored.

Lund (2002b) shows that a compromise solution can be found, applying a (perhaps modest) royalty in addition to a neutral rent tax. However, more research is needed to determine which rates are appropriate for the two types of tax. One determining factor will be the weight the government attaches to the after-tax rent left to firms (Boadway and Keen 2015, pp. 121ff). If the government only cares about tax revenue, the distortions created by a royalty are more acceptable.

In any case, the model as it stands cannot explain why one would apply a neutral tax at a high rate, say 80 percent, without a royalty. If the overreporting of costs is so mild that a neutral tax alone is the best solution, there is no reason to keep the tax rate below 99 percent.

² The quote contains the acronym RTT, which must be a typo for RRT, the Resource Rent Tax of Garnaut and Clunies Ross (1975), corrected here.

2. Risk adjustment in discount rate?

In order to maintain neutrality, as mentioned above, deductions that are postponed must accumulate interest. This has different names: There can be loss carryforward with interest, or, in the Resource Rent Tax, carryforward of negative cash flows, with interest. The allowance for corporate equity (or capital) is calculated as an interest accumulation on the book value of equity (or capital). The neutrality results rely on the discounted present value being unaffected by the postponement, i.e., the interest rate applied by the tax rules must be equal to the discount rate applied by firms. They are then indifferent to the postponement, and the incentive effect of the tax is the same as that of a pure cash flow tax.

The most widespread method for taking risk into account in present-value calculations is to add a risk adjustment to the discount rate. The question is whether the deductions should accumulate interest at such an increased, risk-adjusted rate.

The recommendation by tax economists and advisors has been to use a rate that reflects the risk of the tax deductions in question (Summers, 1987; IMF, 2012). Osmundsen et al. (2015) seem to suggest otherwise, to use the general risk-adjustment appropriate for the firm's overall activity. While this is undoubtedly done in practice by many firms and authorities, the IMF, as well as the more theoretical academic literature, does not agree.

If the firm is guaranteed to earn the tax value of the deductions, sooner or later, they are risk free, and a risk free interest rate should be applied. IMF (2012, p. 48) state that, "The benchmark result on this issue is that if deferred tax benefits are certain to be ultimately received by the taxpayer (including, if necessary, as payments from the government), then carry forward of unrealized benefits at a risk-free rate is in principle appropriate (Fane, 1987; Bond and Devereux, 1995 and 2003). Where there is doubt as to the government's commitment to provide these benefits, risk-adjustment for that possibility—which, importantly, does not mean adjusting for the riskiness of companies' own cash flows—is appropriate." Similar formulations are found in Boadway and Keen (2015, p. 109).

This discussion is relevant not only for cash flow taxes, but for the ACE system for business taxation in general, recommended by the Mirrlees review, see, e.g., Griffith et al. (2010, p. 976), "In principle, it is not necessary to include a risk premium in the imputed rate"

How to quantify political risk is far from obvious. There is always a risk that a future political majority will change a tax system, so that deductions will be lost. Alaska is a recent example (Bradner, 2016). Some governments try to commit not to change the tax system by including fiscal stabilization clauses in licenses or contracts offered to firms (Daniel and Sunley, 2010). Such a system is applied in the North Sea agreement in Denmark. Whether it will survive sharp increases or decreases in oil prices without renegotiation is an open question.

3. Tax adjustment in discount rate?

Some tax systems apply an explicit method to find an interest rate to apply for interest accumulation. This method could involve the use of market data for, e.g., government bond rates, LIBOR, or other rates. In this case the design of the system must choose between a before-tax rate (directly observed, or with some non-tax adjustment) or an after-tax rate, obtained by multiplication with the factor one-minus-a-relevant-tax-rate.

The general idea is that the discount rate applied should compensate some typical shareholder or other taxpayer to obtain the indifference mentioned above. The alternative rate for savings

or loans for these should be applied. One problem is that these rates differ between different firms and/or persons, and, in particular, differ between domestic taxpayers and others, who may not be paying any taxes at the margin.

In my own country, Norway, the rules involve after-tax rates, based on the idea that most taxpayers at home and abroad are taxed on the alternative rate. In Denmark the thinking has been different, see Skatteministeriet (2001, p. 212). The Danish tax on pension returns had been reformed the previous year, based on the assumption that the marginal investor was foreign and not subject to taxation on the alternative return. Thus an interest rate with no tax adjustment was suggested for the ACE-like tax for petroleum, consistent with the previous year's reform. For carryforward of losses, however, an after-tax interest rate was suggested (p. 147). It is not clear how the same firm's shareholders could be indifferent with the use of one rate in one case, another rate in another case.

The widespread calculations of effective marginal tax rates (EMTR, also known as METR) use a method developed in OECD (1991) and Devereux and Griffith (2003). In this method the differential treatment in personal income taxes of dividends, capital gains, and interest is taken care of. But the application in Norway by our tax commission in 2014 explicitly neglects these differences (NOU 2014:13, p. 164), effectively assuming that the marginal investor is not taxed. This seems to be inconsistent with the tax rules using after-tax interest rates.

More details are discussed in Lund (2002a).

4. Tax the normal rate of return?

The quote above from IMF (2012, p. 26) suggested a combination of a rent tax and a modest royalty with a CIT, i.e., a corporate income tax. A standard CIT will tax the normal return to equity, but let the interest on debt be deductible. The tax on the normal return to equity will lead to reduced investment except in a model where all investors are taxed on their personal hands on all types of return from capital except the dividends and capital gains from firms subject to the CIT. This is not a good assumption in today's world, where capital flows internationally.

An alternative would be to let the resource sector be exempt from the CIT paid by other sectors, but let it pay a specially designed rent tax instead, perhaps also a modest royalty. The intention would be that the rent tax, applied alone, would be neutral, i.e., not affect the decisions of firms.

The combination of a CIT and a rent tax, on the other hand, could have the intention, explicit in Norway, that the rent tax is a neutral addition to the CIT. In that case, a project will be accepted under the combined CIT and rent tax if and only if it will be accepted under the CIT alone.

The main argument for application of a neutral rent tax alone, is that the sector attracts capital from abroad, so there is no crowding out of domestic investment. A project that is acceptable under a rent tax, but not under the CIT, would have positive net value before tax, and it would pay some rent tax if the net value is not very close to zero.

The argument for applying the CIT also, is that a significant amount of tax revenue would be lost if the normal return to capital is exempted from taxation altogether. Due to the

government's budget constraint, this might lead to higher tax on the normal return to capital in other sectors, which would be distortionary there. The general rule is to distort broadly with as low rates as possible.

5. How to include uncertainty in theoretical models?

In the following, there is no distinction between the concepts “risk” and “uncertainty.”

While section 2 above was about risk adjustment, most of tax theory assumes that there is no risk at all. The same holds for most of the theory of resource economics, such as the famous model of Hotelling (1931). Of course, there are attempts to extend models to include risk, but these attempts have large missing parts. There is no realistic stochastic model that describes an equilibrium price process as an extension of what is done in the simple Hotelling model.

For taxes, much of the analysis assumes that there exists a “normal” rate of return, and we discuss “the” cost of capital. Of course, in any realistic model, there are risk adjustments to the required rates of return, both before and after tax. But different tax systems will affect the after-tax cash flow of a firm in different ways, so that risk measures after tax are affected, cf. Lund (2014a).

In particular, most calculations of EMTRs rely on full certainty. “A major limitation of most AETR and METR estimates is that they ignore risk” (Daniel et al. 2010a, p. 200). The differences in required returns due to differences in risk are missing. Moreover, the effects of imperfect loss offset are not captured. The standard EMTR calculations cannot measure the effect of loss carryforward without interest compensation and with the possibility of never being able to deduct. High uncertainty and sometimes high tax rates imply that these effects may be substantial in resource taxation. Such effects are difficult to model analytically, and simulation models may be needed in order to evaluate them. This links to the weakness mentioned previously: One will need to know a stochastic process at least for the output price in order to model such effects. For instance, imperfect loss offset is clearly a much stronger disincentive to investment if the output price follows a geometric Brownian motion than if it follows a rapidly mean-reverting process. At present, the best one can do seems to be to consider alternative price processes.

In fairness, it should be mentioned that McKenzie (1994) extends the EMTR framework to cover risk. He finds interesting results on the Canadian tax system at the time. But his approach has been neglected by most subsequent studies, also on resource taxation, where uncertainty should be a prominent concern.

6. What are governments' attitudes towards risk?

In order to analyze taxation of firms under uncertainty, we need to know the attitudes towards risk both in firms and governments. Firms' attitudes have been analyzed in various ways, with three main strands, maximization of expected utility of profits, maximization of market value, or maximization of expected profits. There has been less focus on different attitudes among governments.

Arrow and Lind (1970) has been interpreted to imply that governments are risk neutral. Their analysis was not directed to natural resources, but has later been found particularly relevant in this area. Lind (1982) modified the view on risk neutrality, and there exist many subsequent studies that reach different conclusions. For resource rent taxation, there are some issues that deserve attention.

Governments and firms can have different attitudes to risk, cf. Boadway and Keen (2015, sect. 5.4.2). This will have implications for who should bear the risk, with consequences for design of the tax system, see, e.g., Blitzer et al. (1984) and Skatteministeriet (2001, pp. 246ff). For different governments and firms, the answer may go different ways. In theoretical models, the answer is often that one party should bear all the risk, but this is seldom achieved in practice. It should be noted that auctions could be part of such a solution if governments want no risk at all.

Particularly relevant for low-income countries is the possibility that the country and its inhabitants have little involvement in capital markets. Collier (2010) discuss resource taxation in these countries in more detail, and Lund (2014b) discuss whether they could learn from the Norwegian experience. In the Nordic region, Greenland is the example, see Nielsen (2013). When potential resource wealth is high, relative to total national wealth, it may be impossible to diversify the national portfolio well. Accordingly, the government cannot look to markets for valuation. It should measure the relevant risk by the covariance with national wealth (Boadway and Keen, 2015, p. 117), but this is hardly observable. Instead the government could simply apply a risk-averse utility function to the possible resource revenue seen in isolation. Or, as in Lund (2015), the government could impose the constraint that it will never risk to refund taxes, typically under negative outcomes for resource prices or quantities. In that study, the resource firms are assumed to be foreign, with well-diversified shareholders. This simplifies the model, since their objective is to maximize market values in international capital markets.

7. How to measure distortions?

Tax economists like to summarize distortionary effects of business taxation with as few numbers as possible. The EMTR is supposed to measure the distortion to scale of investments. It measures the distortion as a change in the required marginal rate of return, or, more precisely, the relative change. However, the impact of a particular EMTR on investment clearly depends on production possibilities, typically summarized in a production function.

Many studies of distortionary effects of resource taxation try to quantify the combined effect of tax systems and production possibilities. Smith (2013, 2014) gives an overview and an example. For petroleum in Norway, some studies find that distortionary effects are “small” (Berg et al., 2016), while others find “serious” effects (Nystad, 1985). But, of course, it is almost impossible to compare such results, as opposed to comparing two EMTR numbers. There are several reasons why these two (and other) studies seem to find opposing results:

- They model the production possibilities differently. This can, in part, be remedied by studying many tax systems applied to the same production possibilities, as in Blake and Roberts (2006) or Smith (2014). But there is no universally agreed-upon model of production possibilities. There exist models that are estimated empirically (e.g., for petroleum, Favero, 1992; Deacon, 1993), but these rely on different maintained assumptions, and a consensus seems far away.
- They make different assumptions on output prices, on financing decisions by firms, and on details of tax systems.
- They measure the outcome differently. While tax economists typically will look at distortions to total net value (Lund 1992), there are some who consider the effects on one of the two parts of this value, the after-tax value to firms or the tax value to governments. Moreover, some will consider distortions to the invested amount, as if

this is an objective in itself. It may be for some politicians, but for economists, it is a cost.

One recommendation is to analyze different tax systems under the same assumptions on other variables, but to consider some different assumptions on production possibilities, including flexibility.

8. For fossil fuels, what about climate policy?

Fossil fuels (oil, natural gas, and coal) are an important subset of nonrenewable resources. One should not discuss rent taxation without consideration for climate policy. The negative externality from combustion of fossil fuels is global. The efficient way to deal with the externality is a global tax on emissions or globally tradeable emission quotas.

Policies to restrict emissions could address the supply side of fossil fuel markets or the demand side. When responsibilities are put on national governments, a supply side policy would involve restrictions on the nation's extraction of fossil fuels, while a demand side policy restricts combustion or other sources of emission, such as leakage. Due to international trade, the responsibilities will be substantially different between supply and demand side policies.

A concrete case is Norwegian petroleum. The current policy is to restrict emission from use and leakage in Norway by taxes on emissions. There are national targets to be reached, in some respects following from association with European or international agreements. A broad majority in the Storting (the Norwegian parliament) has agreed (in the "klimaforlik") that the national restrictions should be more ambitious than what is required by those agreements. This could be interpreted as a willingness to engage in supply side restrictions, or as more ambitious demand side restrictions.

For the petroleum sector, demand side policy means that emissions during exploration, extraction, and transportation face an emission tax. This works as an incentive to keep those emissions down, by, e.g., efficient use of energy in the sector, possibly using energy from other sources, by strict control of leakage, etc. This may actually result in more oil and gas being sold, since less is used (or lost) out of a fixed total reserve.

A supply side policy means to reduce the sale of petroleum from Norwegian licenses. This could also be done by a tax (or royalty), but a tax on a different flow. An important question is: If petroleum sales should be restricted, should this be achieved by a tax on the sold quantity, or should the government simply restrict the awarding of new licenses?

An economist would see the argument for using a tax: The most costly reserves would be left behind, i.e., the most costly within each license area, and/or the most costly license areas. This is an efficient application of a price mechanism to obtain a politically specified (perhaps inefficient) goal. (Whether that policy goal is efficient will not be discussed here.) But the main counterargument is that reserves left behind will be even more costly to extract later, often prohibitively, due to the loss of natural pressure and other reservoir features, and also the lost economies of scale in extraction and transportation. Instead of reducing extraction by, e.g., 50 percent in licenses that are awarded, one could reduce the number of licenses by 50 percent. One would be left with undisturbed resources, that could possibly have future value, if, e.g., carbon capture and storage becomes cheap, or petroleum becomes more valuable for other purposes. Lower risk of local pollution would be an added benefit. A preliminary conclusion is that neutral taxation of a lower number of licenses has an advantage over non-

neutral taxation of a higher number. Seriously asymmetric information about cost conditions could possibly change this conclusion, if the government has no clue which license areas are the least costly to explore and develop.

9. Conclusion

There are many unresolved issues in taxation of nonrenewable resources.

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