



Oil & Gas Portfolio Economics: Understanding Fiscal Interdependencies Among Projects

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INTRODUCTION

For project evaluation professionals and corporate strategic planners, there is no shortage of sophisticated techniques to aid in the investment decision process. From decision trees for individual projects to efficient frontier analysis for portfolios, these techniques offer disciplined ways to think about uncertainties and strategic fit, based on the best possible analysis of independent single projects.

The problem, however, is that most projects are not at all independent. The fiscal terms of seemingly discrete oil and gas projects within the same country are almost always interconnected at some level. This puts practitioners of portfolio planning—and even single project evaluations—in the position of performing detailed uncertainty analysis and portfolio risk/reward evaluations using incorrect baseline data on each project’s incremental after-tax economics.

For operators looking to expand beyond initial fields or licenses in the same country, this margin of error can be particularly critical. Overlooking the hierarchical relationships between royalty, income tax, cost recovery factors, and cost & profit oil calculations in a possible portfolio of projects can result in NPV estimates that miss the mark by tens of millions of dollars. Year-to-year cash flow planning can also suffer, as the payout time may be significantly affected by these errors—for example, predicting taxes years before they will actually be incurred.

This paper will describe the varying types and degrees of fiscal inter-relationships, and illustrate how some of the traditional methods fail to honor these relationships. It will also describe the impact of such failures—in short, the possibility of widely varying after-tax portfolio profiles and NPVs when fiscal terms are treated independently, vs. considered as a whole.

Finally, we will describe how a “ring fencing” approach to portfolio modeling is possible using off-the-shelf upstream economics software, resulting in increased accuracy for both incremental projects and full portfolio evaluation.

Ring Fence Provisions in Oil and Gas Upstream Economics

In every country in the world, regardless of the type of fiscal system in place, there is either an implicitly or explicitly defined hierarchy of fiscal calculations. These calculations must be performed in a certain order to ultimately determine the after-tax cash flow for a country portfolio of upstream oil and gas projects. There are two sets of variables at play in determining these calculations and their sequencing:

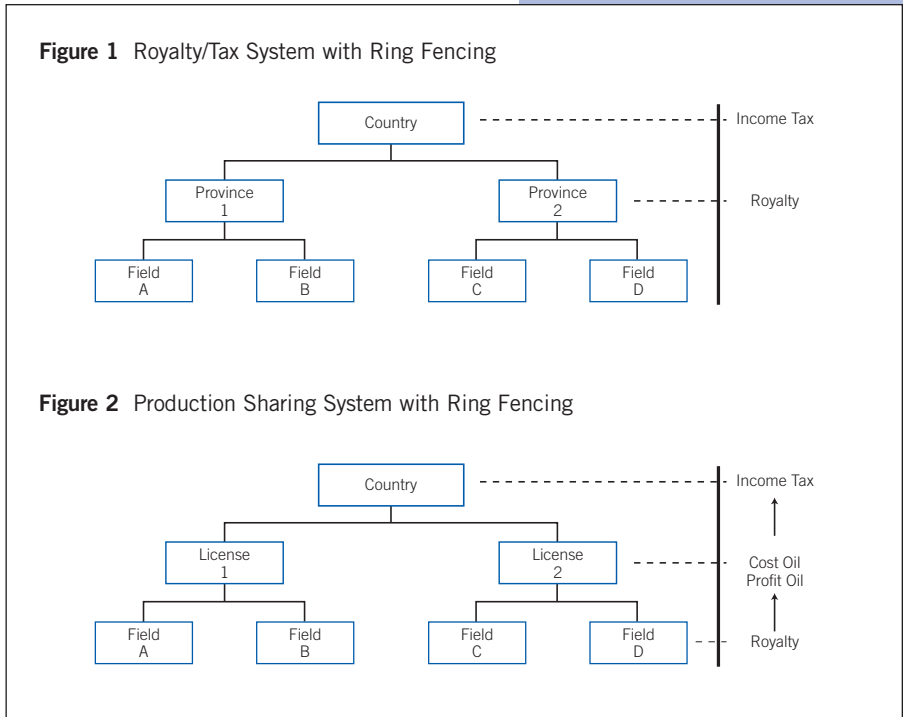
(1) the type of fiscal vehicle, such as income tax, royalty, cost recovery, or profit share, and (2) the political or contractual entities under governance of the fiscal authorities, such as field, province, license or country. For each political entity in the same country, there may be a different fiscal vehicle defining how that level of

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the government shares in the overall “take.” For example, a province may claim a royalty, while the country as a whole receives income tax. Below we discuss two examples in greater detail to illustrate the impact on NPV.

Figure 1 gives an example of a country portfolio containing four fields in two provinces that is governed by a **basic royalty/tax fiscal system**. There are three government entities involved in this portfolio, each of which will exercise its taxing authority. The two provincial governments will receive a royalty from the total production occurring in their individual provinces while the federal taxing authorities will collect taxes on the total operations occurring in the country. It is important to note, however, that the provincial royalties are deductible for income tax and thus must be calculated prior to the calculation of income tax. Note also that the royalties are calculated based on the sum of the production of both fields in the respective province rather than on each individual field’s production.

Figure 2 provides an example of a country portfolio containing four fields in two licenses under a **production sharing contract**. In this example, the contract specifies that royalties are calculated based on the production of each individual field, whereas the cost oil and profit oil are based on the summed results of all operations in the respective license. Further, the federal taxing authorities will



collect income taxes on the combined profits of all operations in the country. The hierarchy outlined here must be precisely followed since the royalty payments at the lowest level must be known before the cost oil and profit oil may be calculated at the second level. In addition, the cost oil and profit oil must be calculated before the income taxes.

Even though these two fiscal systems are very different, the common feature between them—and among all fiscal systems—is that there is a very clearly defined calculation sequence that must be followed in order to determine all fiscal components and ultimately the after-tax net cash flow of the portfolio.

All fiscal systems have either explicitly or implicitly defined ring fence provisions.

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The term “ring fence” is often used to describe this hierarchy. For upstream economics, then, ring fencing can be defined as the accurate drawing of boundaries around projects, or sets of projects, such that fiscal calculations are performed in the proper sequence and honor the proper interrelationships among the various fiscal components. The aim of ring fencing is accurate after-tax NPV calculations for the entire country portfolio.

In Figure 1, for instance, the royalties are said to be “ring fenced around the province,” whereas in Figure 2, royalties are “ring fenced around the field” and the cost oil and profit oil are “ring fenced around the license.” In both figures, the income tax is calculated at the country level; thus it could be said that income tax is “ring fenced around the country.”

Figure 3 presents a sample of ring fence provisions currently in place in various contracts and countries around the world, illustrating the variety of inter-relationships that may be found.

Figure 3 Examples of Ring Fence Provisions

COUNTRY

Cote D'Ivoire

Fiscal Terms: Late 1990s PSA Terms— On & Offshore less than 200m

Ring Fence Provisions: Production bonuses, cost recovery and profit sharing are ring fenced around the contract area; income tax is ring fenced around all petroleum exploration, production, and transportation activities.

Gabon

Fiscal Terms: 1998 Model PSA Terms— Ultra Deep Water greater than 1000m

Ring Fence Provisions: Royalty, cost recovery, profit sharing, and income tax are all ring fenced around the contract area.

Norway

Fiscal Terms: Royalty Tax Terms

Ring Fence Provisions: Income tax is ring fenced around the country while the special tax is ring fenced around offshore upstream petroleum activities.

Venezuela

Fiscal Terms: 3rd Round Operating Services Agreement

Ring Fence Provisions: The Service Fee is ring fenced around the contract area while income tax is ring fenced around the country.

Thailand

Fiscal Terms: THAI III Royalty Tax Terms Offshore less than 200m

Ring Fence Provisions: Royalty and Special Remuneratory Benefit (SRB) are ring fenced around each concession while income tax is ring fenced around all areas other than those awarded under Thai I concession terms.

Peru

Fiscal Terms: 2000 Royalty Tax Terms

Ring Fence Provisions: Royalty is ring fenced around the contract area while income tax is ring fenced around the country.

Malaysia

Fiscal Terms: 1997 PSA Terms On & Offshore less than 200m

Ring Fence Provisions: Cost recovery, profit sharing and income tax are all ring fenced around the contract area.

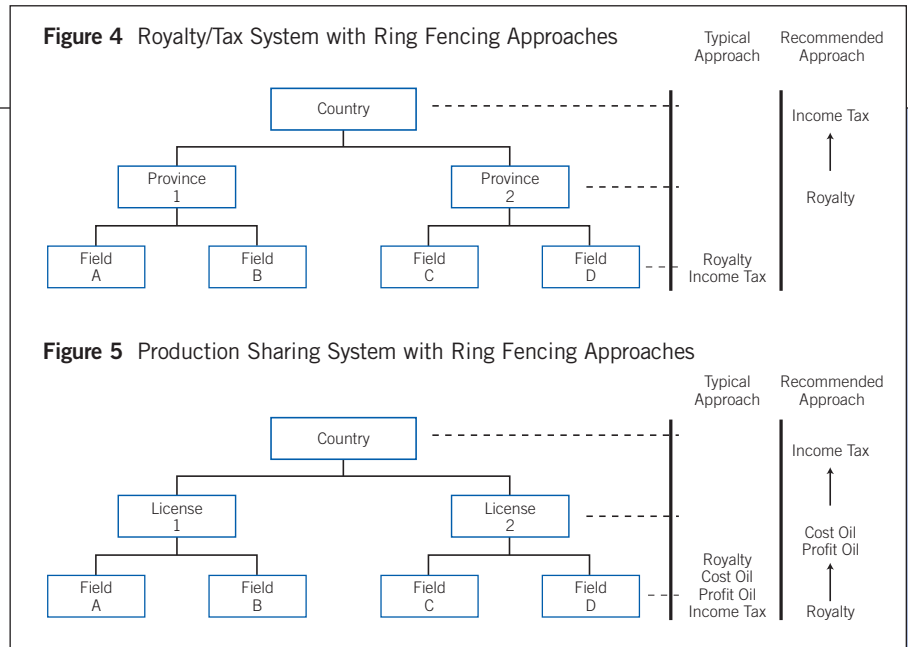
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Problems with Common Methodologies for Portfolio Economics

It is common practice to determine the economics of an oil and gas portfolio by simply summing the NPVs of each project in the portfolio. **Figure 4** illustrates this process for the same portfolio and royalty/tax fiscal system originally described in Figure 1. It can be seen that under these assumptions, the royalties and federal income taxes are both calculated based on individual field results rather than following the hierarchy actually specified in the tax laws. **Figure 5** shows the same problem applied to the production sharing example in Figure 2. Once again, fiscal components are calculated at the field level rather than following the contractual hierarchy.

In both examples, using the terminology previously defined, the default method of most approaches is to assume “ring fencing around the field.” If the ring fence provisions are so clearly specified in laws and contracts, then why are they so often ignored? Based on our experience, there are two fundamental reasons:

- *The mathematical models required to properly honor all ring fence provisions are much more complex to create and maintain than those that always assume ring fencing at the field level.* When ring fencing is assumed at the field level, then all fields are assumed to be fiscally independent of one another and thus the calculation of a portfolio NPV becomes a



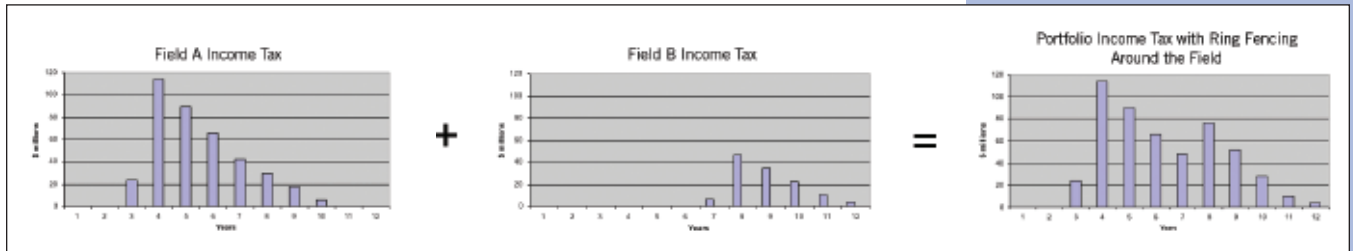
simple matter of summing the after-tax NPVs of each field. However, when proper ring fencing rules are applied, the yearly values of many variables (production, revenues, operating costs, etc.) must be maintained throughout the calculation sequence so that they are available for fiscal variable calculations at the appropriate level. For instance, a 30-year project in a simple royalty/tax country with ring fencing at various levels might require up to 500 pieces of data to be available at each level of ring fencing compared to the single NPV value required with the more commonly used technique.

- *The assumption of fiscal independence that is created by always ring fencing at the field level is a requirement of some standard uncertainty and portfolio analysis techniques.* For many traditional software systems, correctly honoring the ring fence provisions invalidates this required assumption of project independence and

Most roll-ups don't properly consider ring fencing provisions.

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Figure 6 Royalty/Tax System with Ring Fencing



thus invalidates these techniques. While a full discussion is beyond the scope of this paper, techniques that typically incorrectly assume this type of project independence include expected value and efficient frontier analyses.

Because of the limitations described above—typical of most software traditionally used for portfolio analysis—it is understandable that many companies have opted to ignore ring fence provisions in their economic and portfolio modeling. Some additional justifications surrounding the decision to ignore ring fencing are based on the following common misunderstandings about the overall impact.

Myth: The answers are the same, whether or not ring fence rules are followed.

The reality is that both the NPV and the timing of taxes, for a project on an incremental basis and for a portfolio, can be significantly over- or under-estimated.

In certain combinations of fiscal terms and forecasted data, it is true that assuming ring fencing around the field will generate the same results as following the specific ring fencing rules outlined in the legislation and contracts. However,

there are many instances in which significant differences in results will be found, as in the following examples.

Tax Deferral

Suppose a company has two fields in its country portfolio—Field A and Field B. This country has a royalty/tax type of system with no royalties but a 60% income tax rate payable on the combined taxable income from all operations in the country. **Figure 6** illustrates the methodology typically used by oil companies, ring fencing around the field, to calculate the total tax payable for Fields A and B.

The first two graphs show the income tax payments due for Fields A and B individually. The far left graph shows the tax paid for Field A when the country level income tax provisions were applied to Field A alone as though it was the only field in the country. The middle graph shows the tax paid for Field B when the country-level income tax provisions were separately applied to Field B as though it were the only field in the country. The graph on the far right represents the simple summation of the taxes calculated individually in the two left graphs. In this graph, the total income tax for the portfolio

Figure 7 Portfolio Income Tax with Ring Fencing Around the Country

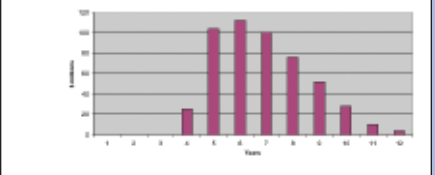
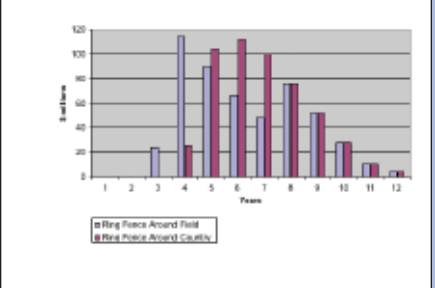


Figure 8 Portfolio Income Tax



Timing and amount of taxes may be significantly affected by ring fence provisions.

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has been calculated under the assumptions that income taxes are ring fenced around the field.

Figure 7 shows the correct amount of the portfolio income tax when the tax rules are applied to the combined revenues and costs of both fields—that is, income tax is ring fenced around the country.

Figure 8 shows a comparison of the portfolio income tax paid with and without the ring fence rules. It can be seen that the tax payments begin in year 3 under the field ring fencing assumption and are quite substantial in year 4. When the ring fencing is applied at the country level, as per the tax laws, the tax payments don't begin until year 4 and are not nearly of the magnitude payable under the ring fence case. You may also notice that for the next three years the trend reverses and more taxes are paid out under the country ring fence case, and that the last five years of tax are identical.

This tax deferral occurs when depreciation of the capital expenditures of one field helps to reduce taxable income for the combined operations but does not help reduce taxable income when applied to a single field.

This is an example of how accurate ring fencing can incorporate the effects of tax deferral into portfolio modeling. Even though the total amount of tax payable over the life of the portfolio is exactly the same in both cases, some taxes can be deferred to later years when country ring

fencing is assumed. This deferral of taxes provides a positive benefit to any economic indicators (net present value, rate of return, etc.) that take into account the time value of money.

For this particular example, the after-tax NPV at 10% for the field ring fenced case was \$55 million while the NPV for the country ring fenced case was \$70 million, resulting in a difference of \$15 million in NPV.

Sliding Scale Rates

Suppose a country portfolio contains Fields A and B and both reside in the same license. The fiscal terms indicate that no royalties are payable on the first 10,000 barrels per day of oil production but a royalty of 20% is applied to all production above this amount. In addition, royalties are ring fenced around the license.

Figure 9 and **Figure 10** show that no royalties will be payable if it is incorrectly assumed that royalties are ring fenced around the field, since neither field individually exceeds the minimum 10,000 barrel per day threshold. **Figure 11** shows that when the ring fence rules are correctly applied to the license, then a considerable amount of royalties will be generated. If this ring fence provision is ignored, the portfolio economics will generate incorrect results for the royalties, resulting in an overstated NPV of the portfolio.

Figure 9 Field A with Ring Fencing Around Field

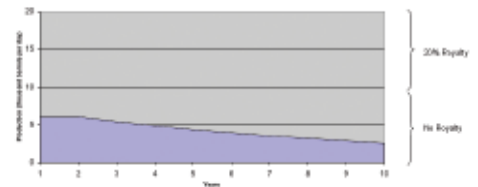


Figure 10 Field B with Ring Fencing Around Field

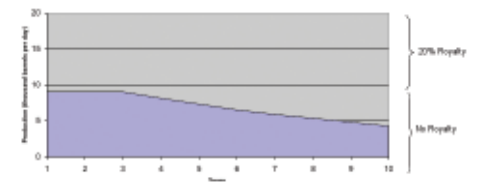
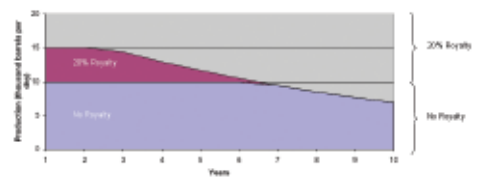


Figure 11 Field A + Field B with Ring Fencing Around License



Ring fence provisions become particularly significant when royalty, tax and profit share rates are based on sliding scales.

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Myth: It's easy to predict for which kinds of situations honoring ring fence rules is necessary.

The reality is that the range of possibilities for fiscal terms and production forecast values makes it nearly impossible to know when ring fencing matters.

We have undertaken several studies attempting to pinpoint characteristics of portfolios and fiscal systems that would indicate, in advance, when it is important to include a full analysis of ring fencing provisions. Unfortunately, the results of these studies indicate that the size of the error margin between simplified (i.e. ring fencing around the field) and full ring fencing is very difficult to predict. Ring fencing at a certain level may be beneficial to the company for one fiscal variable but detrimental to the company for another fiscal variable. The difficulty of prediction is magnified when this variable interplay changes with each different production data scenario.

For example, in the case depicted in Figures 9, 10 and 11, a significant difference in royalty was seen depending on the ring fence assumption. However, if the production for each field had been reduced by 50%, there would have been no difference at all between the results.

The only way to know for sure that the results will be correct for every data set under every possible fiscal system is to follow the ring fence rules every time.

Myth: Even though honoring ring fence rules is a better way, the additional work to implement computerized mathematical models to calculate them properly is too costly.

The reality is that while this may be true with spreadsheets and many other economics systems, IHS Energy's AS\$ET system allows users to specify the fiscal hierarchy of their portfolio in a tree diagram (Figure 12) using easy point-and-click technology and to further specify all ring fence provisions by simply checking or not checking an automatically generated ring fence screen (Figure 13). Although there are scores of calculations going on behind the scenes, AS\$ET provides users with a complete audit trail so that every calculation is transparent and may be verified for accuracy.

AS\$ET not only applies the ring fence provisions to the standard economic analyses but also to all uncertainty techniques as well, sometimes using newly developed methodologies to accomplish this task. Thus, when using sensitivity, expected value, decision tree or Monte Carlo simulation methodologies to evaluate the uncertainties in a portfolio, economists and strategic planners can rest assured that the ring fence provisions will always be honored.

Figure 12 AS\$ET's Portfolio Tree

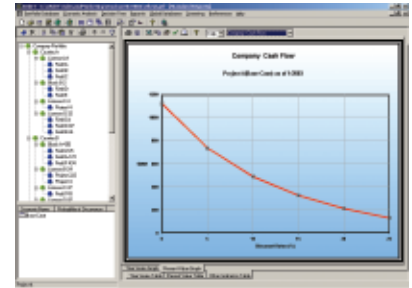
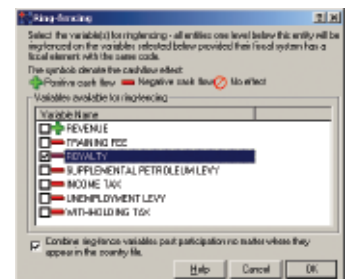


Figure 13 AS\$ET's Ring Fence Screen



Although ring fence provisions are present at various levels in every fiscal system, AS\$ET allows users to specify these terms in a single user-friendly interface.

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The benefits of modeling an entire portfolio in AS\$ET extend also to single project economic analysis since the true incremental effect of adding a new project to an existing portfolio may be easily calculated. By subtracting the after-tax value of the entire portfolio excluding the new project from the after-tax value of the entire portfolio including the new project, with both portfolio values honoring the appropriate ring fence provisions, AS\$ET can provide much more accurate results for a single project analysis than could be provided by traditional “stand-alone” approaches.

For purposes of this paper, we have limited the discussion to the portfolio of projects within a single country rather than among multiple countries. However, it is important to note that, in evaluating the opportunities of Country A vs. Country B portfolios, proper ring fencing for both portfolios would enable a highly accurate comparison.

Summary

While considerable time and resources have been committed over the last few years to modeling variables that are uncertain, many companies have not given a priority to correctly modeling ring fence provisions, which are absolutely certain. Companies that choose not to include ring fence rules in their evaluations are stacking an extra—and unnecessary—level of uncertainty in their analysis of after-tax NPV. While the limitations of spreadsheets and other economics software have provided good reasons for historically ignoring ring fence provisions, the AS\$ET system now removes this obstacle, enabling better decisions to be made in the future.

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