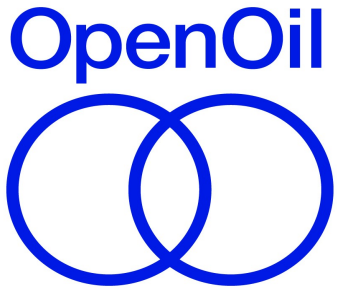

Public Interest Financial Modeling of Extractive Industry Projects

OpenOil June 2015

Table of Contents

1 The four functions of public interest modeling

We, and others, have made the case before that open financial models is the natural next stage of extractives governance. First, because you don't know what you've got til its modeled, and secondly, the models themselves must be open to allow the cumulative learning that is really important for independent expertise to take hold.

In fact, I would go so far as to say that modeling is the prerequisite for any work on the numbers around extractives. An African colleague asked me the other day if we could train the members of his organisation in how to write a financial analysis of a contract but without using a model – just the written report. A moment's reflection brought the realisation that no, this was not possible. Any analysis not based on a model would have no validity. It would be like reviewing a book you haven't read.

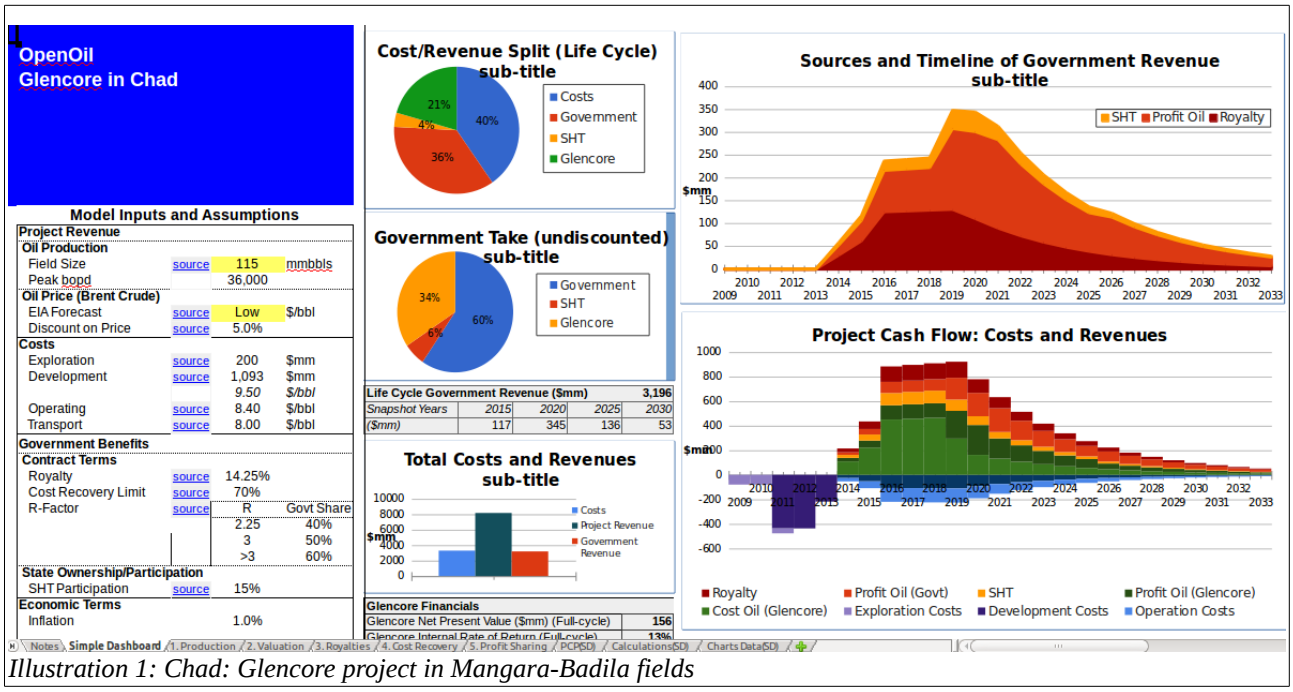

Illustration 1: Chad: Glencore project in Mangara-Badila fields

But what I'd like to do in this series of blogs is consider the role of financial models in the public interest. Because the more we at OpenOil have got into this area, the more it has become clear that the kinds of models needed are both different to, and have more uses than models traditionally used by industry, and governments (when they do use models).

Models have traditionally served companies and the specialist arms of government who negotiateh with them.

Companies run sophisticated analysis of potential profitability before and during their negotiations

with governments. The metrics which dominate here are the Expected Monetary Value of a range of different outcomes, Net Present Value and its twin sister the Internal Rate of Return, adjusted to fine-tuned estimates of risk of all kinds – geological prospectivity, fiscal and political stability, and so on.

Oil ministries and national oil companies run many of the same metrics, assessing both the position of the companies and themselves. They may also look at what level of guaranteed income they will get from a project under a range of price and production scenarios, how “front-ended” payments are (what proportion of payments might come early in the lifetime of these generation-long projects), the specific implications for the national oil company if it is going to have a role in the project, and above all the “government take” - what proportion of profits relative to project turnover will come back to the state.

To be sure, these metrics will play a role in the analytical function of public interest modeling. But such analysis is only one of four major functions we see for open models (that is to say, published on the Internet), based on public domain information. Below is a headline summary of these functions, each of will be expanded in a dedicated post.

1.1 Analytical Power

Public interest models will deal with many of the same questions as traditional modeling, but with an emphasis on ease of access and understanding, and a responsiveness to local issues and attention. To borrow a horrible phrase from IT marketing, public interest models will be “user centric”. So for instance, the falsifiable test of whether a model succeeds or not might be if it could be used to explain the three or four major characteristics of an oil project to a non-specialist audience within 30 minutes, not whether it had modeled all possible variables, or used a sophisticated future pricing scenario which simulates the volatility of the market. In a country where a defined revenue stream is allocated sub-nationally, to a district administration or the communities around the project, these revenue flows might be given major prominence in the model even if their calculation (5% of state dividends) might be considered trivial from a purely technical point of view.

1.2 Pedagogy

There is a clear pedagogical role for public interest modeling. EITI has achieved tremendous success in process, opening up extractive industries to public debate and legitimising the right to know. But EITI is a means to an end – the systematic understanding of how these industries work, available for public understanding and informed by expertise which is independent of any vested interest, whether companies, governments or international institutions. Modeling is part of that EITI end goal – a big part. Civil society cannot assess questions such as dependency on extractives, public financial planning or whether a particular contract represents a fair deal, without having its own embedded expertise to analyse the many moving parts of finance in an oil or mining project.

Public interest modeling can be said to have succeeded when every EITI national secretariat has access to models from their country which they trust and understand, and when at least five people in every EITI country outside business and the government have enough expertise to manipulate and adapt them.

1.3 Transparency Advocacy

Models based on public domain information have enormous potential to guide advocacy campaigns for more transparency. They are a potent illustration of the value of contract transparency, of course. But beyond that, the many data inputs and estimates needed to make each model run, when they come from public domain, are necessarily imperfect, heterogeneous, and all too often generic. The paradoxical beauty of such a model is that, to exactly the extent that it may have margins of error from an analytical point of view because of the imperfections of its data inputs, it serves as the basis for a targeted campaign to get better data. Think of this as “keyhole surgery transparency”.

> *Generic transparency dialogue:*
> *Activists: The government and industry should publish everything.*
> *Government and Industry: Why?*
> *Activists: Because you should! Because it's the right thing to do!*
> *Keyhole surgery transparency dialogue:*
> *Activists: The government should publish the historic posted prices of crude from this field since the start of production.*
> *Government: Why?*
> *Activists: Because it will close a $300 million margin of error in predicting revenues to the government from this oilfield, caused by having to model between two different equally authoritative estimates, which is the best we have right now. But you have the data to close this gap and create greater certainty.*

1.4 Strengthening Government Capacity

The first and most obvious implication of a model published on the Internet is that it will strengthen the public's ability to get a handle on projects and contracts. It is natural to assume then that such models might challenge governments, since it will open past negotiations and current management of projects to greater scrutiny.

That assumption is not wholly without foundation. But it is important to understand that public interest models will strengthen government capacity in at least two significant ways – whether they acknowledge it or not.

First, governments have access to better data than is in the public domain. So they can download models and put their own data in, whether or not they publish the results.

Second, the model is equally open to all parts of government. Experience suggests contracts and all related information are often a close hold by line ministries and specialist agencies, and indeed this secrecy within government has significant impact both on capacity to manage and in enabling corruption. But with an open model anyone in the finance ministry, tax authorities, audit agency, investment board, regional governments, prime minister's office, ministry of the environment – or anyone anywhere in fact – can achieve a basic understanding of the economics of the project, and factor it into their workflows. Inconspicuously if necessary.

1.5 The Whole Picture

We need to look at the whole picture when it comes to public interest modeling, because although it will be based on the core concepts of project economics, which have been refined over decades by industry and governments, it will have different emphases – and many additional functions.

And a whole bunch of new constituencies. The role of the public interest model could be defined as offering expertise for the non-expert. As such, we will also need to refine our understanding of the various constituencies interested in these financial aspects of governance.

Civil society has had virtually no access to or capacity to deal with financial modeling, so may be considered a new constituency. But there is vital nuance in the way we should think about the other constituencies.

It will be too simplistic, for example, to talk about how “government” uses financial models. Are we talking two or three experts in the line ministry or national oil company, who may already have complex models based on their specific projects, or much broader circles of civil servants in a wider range of institutions – central bank, finance ministry, tax authorities, audit agencies, regional administrations – who could benefit from independent insight into project economics?

Even in the private sector, public interest models are likely to attract interest among sectors who are not themselves the primary deal makers – the integrated oil companies - whether it is local compliance companies involved in the accounting and legal aspects of the industry or service companies downstream of the main contracts.
There is growing interest and advocacy for open financial modeling to bring about the next stage of transparency. But unless we think through the full potential and implications, we could waste a couple of years producing models exactly like they always have been – for very different audiences and needs.

2 Analytical Power: Don't Let the Perfect Be the Enemy of the Good

I opened this series by saying that public interest models of extractive industry projects did not

serve only the purposes financial models have been used for to date but had, in addition to their analytical function, the three other main functions of pedagogy, advocacy and strengthening government support.

In this post I will focus on how public interest models – published on the Internet and relying on public domain data – measure up purely in the traditional modeling role of financial analysis, and at the project level. I will make two main arguments:

- Public interest models can put useful system-level analysis of the upstream oil and gas industry into public understanding now.
- That using public domain data alone is viable in many cases, even purely from an analytical point of view.

In a follow-up post I will deal with the analytical power that open project models can deliver cumulatively.

2.1 Who is Your Model For?

But first it would be good to get a bit of context: what do financial models do, anyway? What don't they do? What are the strengths and limitations of models? How would any of that change under a public interest modelling approach?

What a model does depends on what you want it to do – which depends on who you are. This might seem like a truism but actually isn't. There can be a tendency for outsiders to be so in awe of the very process of modeling – all those numbers and charts! - that modeling can take on a kind of aura of transcendent knowledge. Wisdom from on high which defines its own terms. It is that which it is!

But there are differences of economic sector. Extractives modeling, for example, is more focused on the assets on its balance sheet like, say, banking, compared with other industries such as consumer goods. The cyclicality and volatility within commodities are more crucial aspects of financial modeling than in other sectors. And even within the oil and gas industry, there are at least two different schools of thought over how to account for exploration costs, “full cost” or “successful effort”, and assets tend to deplete rather than acquire value as they do in many other industries.

A large oil company might need modeling to compare the relative attractiveness of one potential investment project with another one on the other side of the world. Or the juggling act of how to manage operations simultaneously in many producing fields to maximise profit, while maintaining both reserves and cash flow, against constantly shifting price and cost bases. A company focused on exploration and production can stop its modeling where the crude has been shipped to market, which is just where a model for a refining and processing project starts.
In the market at large, the oil company itself is often the unit of analysis. Analysts look at the

market valuation of listed companies and try to work out whether to buy or sell – and you can bet there is a lot of that happening at the moment with falling prices. These models can look very different to models of projects that might predominate in the upstream – check out this one of Occidental which ranges from exploration right through to petrochemicals, or watch this video about how to model the significant hedging used to trade gas in the continental US.

As we are focused on the governance aspect of the oil industry, it might seem safe to say we can focus on the government side of things. But of course that will also vary from country to country. Some countries have active national oil companies and some don't. Some countries are invested in every part of the value chain, others are not. Gas is different to oil in many aspects – term contracts, regional markets – and mining is different again.
The point here is not, oh the mind-blowing complexity of so many considerations. Precisely because you don't have to consider them all at once. The point is specificity.

The definition of a successful model is one which reliably serves a particular audience for a particular purpose. Every successful model was created by some specific people for themselves, or for other specific people. It doesn't get simpler than that. Any model maker should be able to answer with an individual name the question: who is this model for?

2.2 The Governance World – welcome to FARI

If we zoom in on the upstream model for governance purposes – which is probably where public interest type models though probably not where they will end – we can make a few observations about what these kinds of models do.

Probably the largest practitioner of this kind of model is the International Monetary Fund, which regularly advises governments on this. In the 2000s, as the pace of technical missions stepped up, the IMF developed a tool to evaluate upstream economics known as the Fiscal Analysis of Resource Industries, or FARI for short. Originally used in-house to inform macroeconomic advice to governments, FARI quickly caught the interest of governments, and there is talk now of **FARI being open sourced**, as a contribution to public interest modeling.
FARI has developed a number of uses, such evaluation of negotiations, bid reviews, revenue forecasting, and tax gap analysis. But it is perhaps best known for its evaluation of fiscal regimes.

By having built a library of terms across a range of projects, and a number of different “fiscal regimes” - all the interlocking terms of a contract and its surrounding legal environment – FARI can run numerical comparisons on different contracts against the same oil field or mine. This comes with a health warning, of course. Quantitative comparability tells us nothing about investor perceptions of risk, which dominate what returns a company is seeking and therefore influence project economics, or the market strength of a particular government. Be careful, therefore, to compare apples to apples. But FARI is characterised by this ability to create such evaluations, built

on top of a bottom-up, project-specific approach to the modeling itself.

2.3 What Models Don't Do

Given the lack of familiarity with modeling at the moment, we should also lay down a few things models, including FARI, don't do.

- They don't allow you by themselves to conclude a deal was good or bad, since this question cannot be settled by financial analysis alone, as noted above.

- Although they compare different fiscal regimes, they don't pay much attention to the different legal modes of contracts *per se*, that is to say, differences between a production sharing contract, a concession agreement, or a service agreement, which are often hot political topics in producing countries. That makes sense, in fact, because what is commonly misunderstood is that the differences between such legal approaches are deceptively small. In economic terms it is possible to produce the same financial results in a project from any contract mode.

- Nor do these models concentrate on giving direct analysis of headline terms, such as two different royalty rates, or the impact of a rise in corporate income tax. Such analytical capacity is certainly implicit – you can enter one of these models and change any of these inputs and see what happens. But the driving emphasis of the model as a whole is the project as a whole. It is there to represent all the interactions between multiple terms, not single terms standing alone.

- Last but not least, such models rarely provide a direct line to “actuals”, the real world payments made by companies to governments. They certainly provide a useful start. But even with good data (the inputs) and accurate characterisation of the fiscal regime (the engine in the middle) there are so many artefacts in the process that such a match to actuals, when it happens, requires a great deal of reconciliation, somewhat similar to some of the more challenging EITI reports.

In fact one of the characteristics of modeling large upstream oil projects compared to other economic sectors is that there is such large variation of terms (the number and configuration of possible rules inside the model) over a relatively small data set (the number of projects modeled). The literature describes dozens of individual fiscal tools, each capable of being implemented in several ways at least and most of them combinable with most of the others. This tends to confirm that idea that direct comparison will always be an art rather than a science, and that, even if harder, project-specific modeling (bottom up) is what needs to happen to build the foundations of solid understanding of the money flows in extractives, rather than a top-down approach led from, for example, trying to run numbers across a whole sector without its constituent projects.

2.4 “All Models Are Wrong But Some Are Useful”

A quote yes but from?... George Box, professor of statistics at Princeton and one time president of the American Statistical Association.

We are faced with the paradox that we are proposing to introduce models into the public domain because they can create greater certainty around the massive volatility of the oil and mining industries. And yet at the same time we must expose their limitations.

The imperfection of modeling has been openly acknowledged by leading economists since it was first deployed.

Alfred Marshall spearheaded the quantification of economics at Cambridge in the late nineteenth century which led to economics as we know it today, a social science (none of Smith, Ricardo or Mill were economists by today's criteria). His view: “The laws of economics are to be compared with the laws of the tides, rather than with the simple and exact law of gravitation. For the actions of men are so various and uncertain, that the best statement of tendencies, which we can make in a science of human conduct, must needs be inexact and faulty.”

John Maynard Keynes wrote that “Economics is a science of thinking in terms of models joined to the art of choosing models which are relevant”. But this art of choosing is scarce, he added, “because the gift for using 'vigilant observation' to choose good models, although it does not require a highly specialised intellectual technique, appears to be a very rare one”.

Both Marshall and Keynes attributed uncertainty to the fact that economics seeks to describe the actions of humans. This is undoubtedly true. One way in which all extractives models must necessarily fail is in predicting the agency of human management, for example. Will a consortium continue production through a period of operating losses to keep a project running? Will they revise the risk premium they attach to a project or country over time? Will they invest in secondary enhancement techniques to boost or extend production?

But there is another generic class of errors in models which we are more familiar with in modern times: the understanding, as George Soros says, that human economic activity involves feedback loops across networks which have the potential to amplify. System complexity. And that therefore the classical assumption of equilibrium as a natural underlying state, against which all disturbances are local and to which they will always ultimately return, is an illusion.

The most obvious impact of this is on future pricing. Everyone now knows that anyone who predicts the price of oil beyond a year out is either a knave or a fool. And in an age of financialisation this volatility cannot only be taken as the extreme but measurable sensitivity of the market to fluctuations in supply of a highly inelastic commodity. Not when trading volumes of

derivatives and options are maybe 30 times larger than physical oil.

This is not just a philosophical nod at human imperfection. These two general principles together – any model is only for a defined purpose or set of purposes, and all models are flawed – have specific implications when we consider the implications of public interest models.

2.5 "In modelling there is God, Exxon, and everybody else"

Not all margins of error are equal. Once we are comfortable with the idea that all models are flawed, the question, or rather questions that occur about any given margin of error is: first, how big is it? And second, how material is it to the specific purpose in hand?

That is the wisdom behind the old saw I heard from a seasoned analyst in the Middle East. "God" (or choose other culturally appropriate expression of omniscience) alone knows the future. "Exxon", or the incumbent large integrated company, alone knows the geological prospectivity and cost basis of the project. Everyone else is left guessing from the outside. And the potential scale of margin of error at each level, in absolute terms, approaches an order of magnitude.

This might seem like bad news for public interest models since they are, by definition, looking in from the outside.

But there is still cause to stay hopeful. The first is that there are plenty of models out there already in a not dissimilar situation. Governments in theory of course have access to full information about geological prospectivity and costs, so they should – in theory again – be up there with Exxon. Globally, some are, in some aspects of both these key data inputs. But there are dozens of governments around the world, including those the governance community is trying the hardest to work with, who are effectively nowhere near either, whatever their contractual rights of access. Where governments don't have good access to project level data, then neither does anyone else downstream of them such as international financial institutions.

So in these cases, modeling relying on public data will not necessarily be worse off, and the distinction between public interest and other kinds of models should not be placed into a paradigm of "more accurate/less accurate" so much as "more openly imperfect/less openly imperfect".

2.6 The perfect as the enemy of the good?

To demonstrate the relative materiality of margins of error, let's take an example oil project and some data input estimates going into it and try to see what margin of error may be generated by what estimates – and how these margins of error relate to a range of different purposes the model might have.

A project in Africa is run under a Production Sharing Contract. There are some documents the company issued to investors which have entered the public domain and the full text of the contract has been published. In order to make a model, we have to extract the terms from the contract and combine them with other legislation to produce a fiscal regime analysis. Then we have to estimate various inputs to feed the model in order to get outputs.

Our default scenario assumes a $68 per barrel price, total lifetime production of 115 million barrels, exploration costs of $200 million, capital costs of just under $1.1 billion and operating costs at $34 million a year fixed plus $2.50 per barrel variable.

If we have a model, we can test what the impact of margins of error in various inputs might be on the various things that we are using the model to test. The table below shows the sensitivity of the model to variations in each of the major classes of inputs:

Input Category	**Default**	**Range**	**Govt. Take**	**Government Revenues**	
				Full Cycle	**2020**
Exploration	$200m	$100m-$300m	2%	7%	0%
Operating Costs	$34m p.a.	$17m-$68m p.a.	0%	21%	8%
Capital Expenditure	$1.1bln	$800m-$1.5 bln	3%	21%	38%
Price	$68 (2015)	$91 (2015)	5%	110%	92%
Production	2P	1P,3P	30%	259%	221%

Illustration 1: Variation in results relative to variation in inputs: Glencore PSC of Mangara-Badila fields in Chad (illustrative)

From this it quickly becomes clear that the accuracy of some classes of input matter more than others when related to possible variations in results. Exploration, operating costs and capital expenditures produce variations of 3% or less in an assessment of the government take. Price is more significant at 5%. But it is production which makes a huge difference in determining government take. At a lower production figure for the project (1P) there is hardly any profit left to be distributed, whereas at the highest of three production scenarios (3P) six times more oil is produced, the company reaches positive cash flow sooner, and the government graduates to a higher share of profits quicker.

In estimating government revenues there is a similar differentiation in the impact of variation in data inputs. Exploration costs again have the lowest impact. Operating costs and capex both have considerable impact. But using a lower or higher price estimate can create a difference of double, and the difference between the lowest and highest production profiles available represent almost an order of magnitude.

This is a purely illustrative example. Some of the differentials relate to the particular terms of this

contract and would vary in projects which were structured differently.

But it demonstrates the basic principle: the perfect risks being the enemy of the good in public interest modeling. There is reason to believe that public domain data can be used to create models, and we are the beginning of a debate about which data can reliably be used for what purpose, not the end of it.

3 Modeling as the Start Point of Transparency not its Grand Finale

Models are powerful tools. So powerful in fact that the discussion of whether they should be unleashed into the public space has sometimes been accompanied by a discussion of the “dangers” of doing so – reminiscent of the first debates around the idea of transparency itself.
General thinking has been that models are a stage to aspire to, to work up towards - perhaps because they involve a degree of technical complexity, and because they have traditionally been built by experts for experts.

But I'd like to suggest this should be inverted. Models are the natural entry point, not the grand finale, of work on governance in extractive industries. Not because they are easy – although we definitely believe they can be made more accessible than they have been. But because, brutally speaking, it is not possible to get system-level understanding of how the oil and mining industries work without them. They are not nice-to-haves, in other words. They are essential.

We see this in “single term” debates in many countries: demands by the public for a royalty rate, or income tax, to be raised to gain more income, and company, and sometimes government resistance to those demands. And nowhere in the debate any projection of how much money this or that measure would raise.

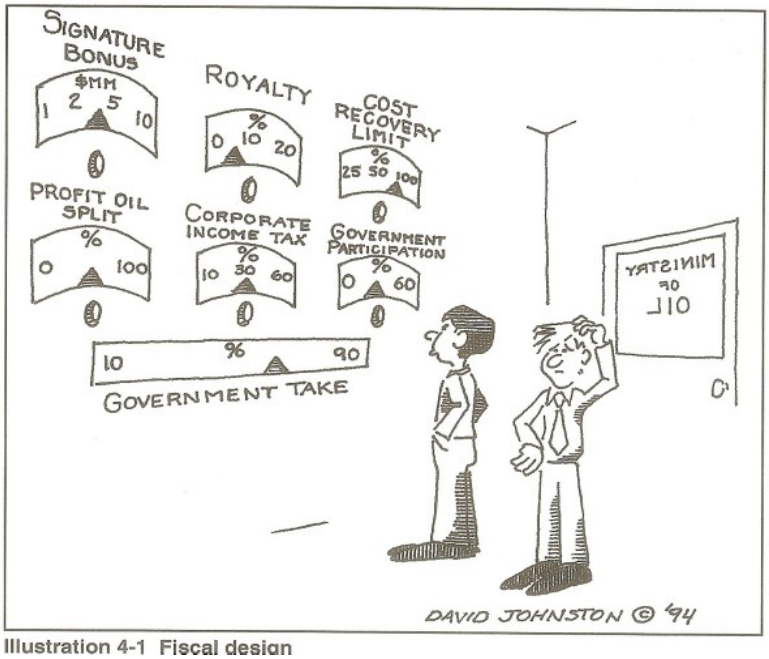

Illustration 4-1 Fiscal design
Illustration 2: the "Single Term" dilemma - David Johnston

Economic nationalism only sharpens the need for modeling because we see the headline terms of contracts adapted to political window-dressing without an overview of how it all actually plays out in reality. In Iraq, the Baghdad government claims its service contracts are superior to the production sharing contracts of the Kurdish region because companies don't get to

own a single drop of the oil – but that tells us nothing about how investor metrics in the two fiscal regimes stack up against each other. Libya's last round of PSCs fixed profit share at 92 percent to the government and a mere eight percent to the companies, a supposed triumph for the government.

But how does that fit into the broader picture of total costs and revenues allocated to the companies?

In other words, models don't create the complexity – don't shoot the messenger! They simply make the complexity inherent in the arrangements and render it transparent. So much so that it becomes hard to imagine any credible analysis of any financial aspect of the extractive industries which is not supported by a model of some kind.

But just how possible is it that all this weft of interlocking terms can be laid out neatly, and made accessible to non-specialists?

To test this proposition, I recently traveled to Chad for a week of training with local civil society groups on a model developed around an oil project there run by Glencore. At the end of two days, half the group had assimilated what a model could do and what the main features of that project were. At the end of five days there were several members of the group who could themselves present the model to each other.

Although there were aspects in the prototype which didn't work I was convinced that public interest models can work and be adopted by civil society and others in the independent space like journalists. In order to achieve this pedagogical function, a couple of simple things need to happen.

- A certain *ruthless and meritocratic elitism* in selection of participants for training. Modeling isn't for everyone and doesn't need to be for everyone. Think of this like the layperson's interaction with the many complex issues of science. Few of us know much about the science of genetically modified crops, climate change or stem cell research. But we don't feel a need to all go and become experts in such fields because we trust (perhaps naively!) that we live in a free enough society that there are genuinely independent experts who will explain the issues to us when they touch the public interest. This doesn't mean that all the experts will agree on everything, or that there is only one possible position to adopt even in the face of scientific consensus. If in any country there are several genuinely independent people able to model, that is enough.

- The *development of friendly messaging* is key here. One thing which worked well in Chad was to try and differentiate the various possible relationships people can have with a financial model by analogy with a car. A car is a stupendously complex machine. But are you seeking to create a new one (“Designer”)? Maintain or fix an existing one (“Mechanic”)? Or simply use it to go places (“Driver”)? This in turn should lead to much

more adapted materials for each of those roles, since, continuing the analogy, nobody would expect driving lessons and the exam to include how to replace the engine.

•*Concentration on the interface*. If we assume that the open publication of models quickly (within a year) allows competent engineering of the guts of models to be established, the need in training and pedagogy will be to concentrate on delivering interfaces which work for new and vastly expanded audiences. One approach is to constantly evolve and modify a User Dashboard on a single spreadsheet and to clearly demarcate between Input areas – boxes where you change stuff – and Output areas – where you see what happens when you change stuff.

•And in turn, because there will be no single right or wrong answer to this question, *experimentation and a healthy diversity of approaches* will be the order of the day in building public interest models. To assume that technical robustness requires a one-size-fits-all approach would be like assuming that safety standards required any other form of central planning and production.

There are also clearly benefits to spreading modeling as a training mechanism above and beyond specific knowledge of individual projects. Generic features of the industry such as the Investor Curve (the long lead-time of investments and the need to structure revenues so investor recover costs), or State Participation (the complex arrangements of national oil companies inside the producing consortium) become embedded in understanding through models in a way they simply don't with words and explanation. Using a model, you can actually *see* these features play out.

They are no longer abstract principles. The model gives them a specific shape and contours. How would a higher public understanding of the revenue flows play out in the governance and politics of managing these industries? We can only speculate because it hasn't happened yet but, for example:

•Analysis of mining contracts in the 2000s would have clearly shown governments and their publics how “un-progressive” many mining contracts were – how incapable they were, in other words, of capturing an increased share of profitability as a commodities boom took hold. This earlier awareness might have played into the renegotiation debate very differently. As it was, awareness of the issue only reached a critical mass in decision-forming circles round about 2010-11, just when mineral prices started to come off historic highs, making potential conflict with companies around demands for renegotiation at that time that much more intense.

•In the coming period, how would any debate on sweetening terms of oil contracts for producers play out if there was a general awareness, through models, of **the difference to investors between revenues and profits over the lifetime of a project, and operating**

cash flows?

To sum up: public interest models are the key to an independent understanding of the economics of these industries to a new level. As such, they are an essential part of the transparency and governance armoury. It would be great to see how models, for example, could be integrated into the EITI process.

4 Modeling as a "Keyhole Transparency Tool"

Open financial models can clearly put analysis into a genuinely independent public space, and also trigger a rise in public understanding which could enrich the governance debate in many countries.

But there is a third function public models can serve: that of advocacy for targeted disclosure of information.

The stress here is on "targeted". A lot of transparency debates are generic – the need to disclose data as a matter of principle.

It is striking that as the transparency agenda has advanced, and won many battles, so has a debate about whether it is contributing to an increase in accountability. As Paul Collier said: "transparency has to lead to accountability otherwise we're just ticking loads of boxes".

We need all these campaigns to continue, and we need to pursue maximum disclosure. Because while transparency does not guarantee accountability, it is its essential prerequisite. Necessary but not sufficient.

But here's where modeling can help to provide some examples of how data can be used, in a very specific way, to advance accountability.

Let's take the example of an oil project in Africa. A financial model has to deal with uncertainty and so provides three scenarios for future production and prices, which all have a radical impact on the revenues the government could expect to see. That's unavoidable. Under the "God, Exxon and everyone else" principle, future price and to some extent production are hard to foresee.

But then there is a second layer of uncertainty caused specifically by the model having to use public domain data. The company, and the government if it exercised its rights of access to information, does not face this second layer because it has access to real data, whereas the public interest model must use estimates and extrapulations. These can be justified, written out and explained – they can be well-informed guesses, in other words, and in the blog on the analytical power of public models, we argue that you can still arrive at useful analysis and conclusions despite this handicap.

Nevertheless, they are guesses. And unlike the first layer of uncertainty, relating to future prices and the ever-changing global market, this second layer can be directly addressed by information the government already has to hand – or could get under its contractual right of access to information.

In the case of this African project, the estimate for how much the government will get would vary over the lifetime of the project by between $2.3 billion and $3 billion – even using exactly the same price and production scenario. This gap of $700 million could be closed by the provision of three simple sets of information. In this case:

- The historic prices recorded from the field calculated using the formula in the contract. This would resolve a $170 million uncertainty gap. In the absence of hard data, the model has to use the crude grade's API quality and two-year-old investor documents estimating a discount to the Brent benchmark.

- Details of financing costs approved by the government. The contract simply states the Contractor can pass on finance costs at a reasonable market rate without specifying what percentage of its costs it would seek to borrow against, and at what rate. A reasonable guess of the upper and lower parameters of this gives another $250 million range of uncertainty in revenues to the state, a gap which the government could close simply by stating what terms of finance used in the project are.

- Transport costs. The oil from this field has to pass through a local loop pipeline that was built especially for this project to a trunk pipeline to export which was already built. A reasonable guess based on investor documents and analogous data gives costs of about $9.50 per barrel. But if this was wrong either way by just $2 – say it was $7.50 or $11.50 – this could have another $300 million impact on government finances. The contract states a separate transport protocol will be signed and lays out some general principles to be included in it. So if the government published the protocol, and the actual transportation costs charged, this uncertainty could also be cleared.

Three fairly simple sets of information can close a three quarters of a billion prediction gap in a country whose annual government budget is only about five times that.

Public interest models can add a lot of power to transparency demands because they can demonstrate, quite precisely and ahead of time, why the information asked for is important and how it will be used. Think of it as keyhole transparency surgery.

But beyond individual data points, it will also become clear over time and repeated use that there are entire classes of information missing from the transparency agenda which are needed to build a full picture.

Financing costs allowed to producers are key to what a country sees from its extractive project at the end of the day. There has been little focus yet on this area. But I believe many public interest models will show the same uncertainty and significant impact on state revenues depending on what financing terms have been agreed, and it will emerge then as a key transparency demand – supported by empirical data (or the lack of it) from many real world cases.

Trading too is largely information dark. EITI has begun to pay attention to it, and there are plenty of examples which show how trading is a huge area for rent-seeking and cronyism in many countries. Global Witness's recent study of SOCAR's arrangements to trade Azerbaijani oil is a case in point. Modeling can create demand for the historic prices recorded field by field, and used in formulae to calculate direct state revenues such as the base on which royalties and profit splits are calculated.

Above all, accurate and independent reserves estimates would reduce unnecessary uncertainty around revenue flows and share of the profits. In a year or two, with models popping up all over the place showing large ranges of uncertainty caused by this fact, a campaign to get all state-owned natural resource reserves regularly and independently certified would be practical – and backed by empirical data.

Finally, the beauty of the advocacy function of public interest models is that it serves as a perfect foil to the analytical function. To the extent that the models have margins of uncertainty caused by having to rely on the partial and dated information in the public domain, they become proof of the need for more comprehensive and timely provision of all relevant data sets.

5 A Help to Governments Whether They Acknowledge it or not

We have seen how public interest models can put the power of analysis into the public domain, help raise the level of understanding around the financial engine of oil and gas projects, and channel advocacy into highly targeted requests for information to produce still more clarity.

But where are governments in all this? If public interest models can reveal weak spots in the negotiations or monitoring process, are they simply going to be a stick to beat officials with?

We believe not. Some officials in some governments might stand to be embarassed by the new insights that modeling will bring and the insight they will provide into decisions that have been taken in the past. But the net impact of public interest models will be to help government fulfill its management roles in two key ways.

First, they will act as a great leveller across all arms of government.

We know that part of the problem of Resource Curse, when it happens, is dysfunctionality within

government – crucial documents and information held by a few individuals, the big picture they represent often not embedded as institutional knowledge even within agencies dedicated to management of these industries. And then there is exclusion of broader arms of government, despite the fact that many institutions have some role to play in and around extractive industries, such as finance ministries, investment boards, tax and revenue authorities and district administrations.

In theory, the raw documents reaching the public domain are available to them as to anyone else.

But in practice the resources to sift and compare, to synthesise and analyse all these different sources are beyond many state institutions in the Global South.

Models can act as a good point of departure for this broader constituency. Line ministries, national oil companies and other specialised agencies will no longer be sole authority on these projects and their financial flows. The impact of this may be more subtle than outright civil society campaigning, but potentially it is just as transformative.

Once open financial models are normal, we might even think of a Panopticon principle at work. Officials who currently have sole say in how new projects are developed may think carefully about positions taken in negotiation if they know that others will at some time in the not too distant future have the tools to be able to assess those decisions for themselves. For those involved in contract monitoring, in making sure existing projects deliver what they are supposed to, that time lapse is shorter, since models can provide notional results of what should be happening as up to date as the data that goes into them.

The second way in which public interest models can help government officials is that in any well constructed model the inputs are held and adjusted separately to the calculation engine. This means that government officials who have better data than the model has been able to source from public domain can easily plug their own data in, instead of the model's default assumptions, and get a better version of the analysis.

I realised this when I happened to see a state company official in front of a model immediately go to the production estimate of a field in a model and change it to a very specific number. I would put money on it being the current estimate for recoverable reserves for that field within the company as a whole.

In an ideal world, such better information would be returned to the public domain and we could create a virtuous circle of ever improving information. But even if not, the government's own knowledge base will have been strengthened. The model will have reduced the "asymmetry of information" it faces compared to the big and capable companies.

What this means is that there should be every effort to bring governments into an open modeling

approach, even as the commitment to publish models for broad public scrutiny remains unwavering. Dialogue and training in broad government circles will be a key part of any public modeling agenda. It also means that the international community should support public modeling as a support to and potential tool for the government – whether this is officially acknowledged or not.