

The Upstream Opportunity Index Assesses E & P Investments

Rafael Sandra, PhD

The year 2000 was a stellar year for the upstream end of the oil and gas industry. Finding and Development (F&D) expenditures worldwide reached \$40 billion, contributing an additional 6.6 billion barrels of oil equivalent (bnboe) reserves, consisting of 3.9 billion barrels of crude oil and 15.4 TCF of dry natural gas. The split in F&D outlays was roughly 53:47 between the United States (\$21 billion) and the rest of the world. The areas overseas that stood out as targets for F&D were: Europe (\$4 bn), South America (\$3.5 bn), Asian-Pacific countries (\$3.3 bn), Canada (\$3 bn), and Africa (\$2.5 bn).

More oil and gas is being discovered by international companies in non-OECD countries. The need to measure project risks and compare similar projects in different countries has become an ever complex task for investors. Credit rating agencies have teams of analysts assessing and grading the credit worthiness of the projects and the energy companies involved. More importantly, the financial institutions that fund these massive investments are demanding project risk be better understood before financing can be arranged. Ratings also serve other purposes. They determine the interest rate a company pays on its debt and the price at which debt trades.

The objective of this paper is to propose a composite rating index for the upstream industry that strikes a balance between downside risks (political, fiscal, and environmental) and upside rewards or offsets (high potential reserves, low F&D costs, and a solid company financial performance). The intent is to sift the risk and financial data published by industry standard agencies and construct an index - the *Upstream Opportunity Index* - integrating existing proven ratings and rankings indexes for the risk and offset parameters used by the financial institutions to establish the investment grade of a project.

Proposed Model

The proposed *Upstream Opportunity Index* is a five-tier unitless grading system with a range of 1 to 5, where 1 represents investments with the highest overall level of attractiveness and 5, those with the highest risk. It is defined as:

$$UpstreamOpportunityIndex(UOI) = \frac{\sum Risks}{\sum Offsets}$$

or

$$UOI = \frac{w_1 * PR + w_2 * FR + w_3 * ER}{w_4 (RI + CI + PI)}$$

where, **PR** is Political Risk assessed on the basis of an analysis of the political stability, economic, and business environment in a country. This analysis incorporates the political risk rating from IHS Energy's Petroleum Economics and Policy Solutions (PEPS) database. The overall political risk index in PEPS is composed of four political risk factors (weighted 60 percent), four socio-economic risk factors (weighted 20 percent) and three commercial risk factors (weighted 20 percent).

FR is Fiscal Risk which compares the terms and attractiveness of fiscal regimes for upstream investments offered by selected countries and is based on several economic criteria as viewed from both a country and investor perspective. This analysis incorporates fiscal risk rankings from IHS Energy's PEPS database. PEPS fiscal risk rankings are derived from eight weighted economic indicators as calculated for a range of hypothetical oil field developments based on a selected fiscal regime for each country.

ER refers to Environmental Risk. There are essentially two generic indexes of this risk, each with a different perspective. One index assesses risk on the basis of event frequencies and consequences for hazards normally encountered in the oil and gas industry. The other measures the state of the environmental systems in the country (air, water, land, biodiversity), stresses on the system (pollution, etc.), human vulnerability to environmental change, the social and institutional capacity to cope with environmental challenges, and the country's ability to participate in efforts to conserve international environmental resources. This analysis incorporates the latter index which is referred to as ESI (Environmental Sustainability Index) and was developed by the World Economic Forum.

w₁, w₂, w₃ are weighting factors, on a scale of 0 to 1, that reflect how each risk component has historically affected investments on a global scale. These factors are generally adjusted by the users to fit their own scenarios.

Risks indexes are modeled and published by several prominent agencies: The Petroleum Intelligence Unit, IHS Energy Group, Euromoney, ESI, Battelle, and Peter Carr Consultants Ltd., just to name a few. In general, these agencies use different scale values for their rankings. IHS uses a scale of 0 to 5, where 0 represents the lowest risk. The ESI index is based on a percentage scale, where 100 percent represents the lowest risk. The index values of IHS and ESI, used in this paper, were converted to the standard 1 to 5 scale, where 1 represents the lowest risk.

Regarding the Offsets in the denominator of our model:

RI is the Reserves Index, on a scale of 1 to 5, which indicates the *potential* reserves (expressed in millions of barrels of crude oil equivalent, mnboe) associated with the country project. Historical data (see Table 1) on the average size of new field discoveries during the 5-year period, 1997-2001, was used to establish the following upper and lower limits of this index:

$$\begin{aligned} < 40 \text{ mnboe} &= 1 \\ > 500 \text{ mnboe} &= 5 \end{aligned}$$

where, the top end of the scale refers to Giant Fields defined as those with recoverable reserves in excess of 500 million barrels of crude oil or 3 TCF of dry natural gas. Gas is converted to barrels of crude oil equivalent on the basis of 0.178 barrels of oil per thousand cubic feet of gas (mcf). The lower end of the scale corresponds to the quartile limit of the smallest fields discovered during the 5-year period.

CI is the Finding and Development (F&D) Cost Index, which represents *regional* Finding Costs (\$ per boe) measured as a weighted average over a 3-year period in order to accommodate leads and lags in data reporting. This data, published by the Energy Information Administration –EIA (see Table 2), shows variations from \$2.78 per boe for Africa to \$9.99 for US Offshore, with a worldwide average of \$5.83. The following upper and lower limits refer to the top and bottom quartiles of the EIA data, for the period 1998-2000:

$$\begin{aligned} > 7.43 \text{ \$ per boe} &= 1 \\ < 4.37 \text{ \$ per boe} &= 5 \end{aligned}$$

PI is the Performance Index representing the financial performance of a peer group of twenty integrated and E&P companies from Europe and North America. This upstream returns analysis (see Table 3), developed by the oil and gas team at Schroder Salomon Smith Barney, combines cost efficiency and profitability for the exploration and production process and is defined as “cash revenue” as a percentage of “cash cost”. A performance of 100 percent indicates that the revenue from the produced barrels has covered all F&D costs of the added reserves. The following upper and lower limits represent the top and bottom quartiles of the 5-year average (period 1996-2000) upstream returns in Table 3:

$$\begin{aligned} < 123\% &= 1 \\ > 195\% &= 5 \end{aligned}$$

w₄ is a weighting factor, on a scale of 0.5 to 1, that allows the users to adjust the degree of impact of offsets on risks.

Figures 1, 2 and 3 illustrate the correlation between the Reserves, Finding and Development, and Financial Performance data in Tables 1, 2 and 3, respectively, and the corresponding index values on a scale of 1 to 5.

For visual effects, the *Upstream Opportunity Index* can also be presented on a color scale: Green - Amber - Red. The correspondence to the numerical 1 to 5 scale is as follows:

Green (<1.60) is the highest rating.

Amber (1.60 to 2.45) indicates that improvement is needed in the conditions to support investment.

Red (>2.45) indicates that *substantial* improvement is needed in the conditions necessary to support investment.

This color chart representation allows for a convenient display of the individual Risks and Offsets indexes in a consistent manner.

Results and Analysis

A broad spectrum of sixteen prospective oil and gas producing countries was selected as a sample to evaluate the *Upstream Opportunity Index*. IHS Energy's political and fiscal risks indexes and ESI's environmental risk index were used as risks indexes for the test group of countries. Likewise, for consistency, the weighting factors (w_1 , w_2 , w_3) for the three risks components were each set at a value of 1.

The offset indexes for potential reserves, finding costs, and company financial performance were determined by cross matching the data in Tables 1, 2 and 3, for each country, with the corresponding index scale values in Figures 1, 2 and 3, respectively. The weighting factor (w_4), which establishes the desired degree of balance between offsets and risks, was set at 0.5. This value was arrived at from the observation that the spread of the published risks indexes is fairly narrow. For instance, the ESI environmental index varies between 1.50 for the countries with the best record, and 3.00 for those at the bottom end of the 142 countries rated on a scale of 1 to 5. In contrast, the index values for the offsets cover the entire spectrum of 1 to 5.

The results of the evaluation are shown in Table 4, which summarizes the risks and offsets indexes used for each of the countries in the sample, and their corresponding calculated *Upstream Opportunity Index*. The selected countries were originally ranked from 1 to 16, based on the sum of their three risks indexes. Ireland is rated #1, with a total risk value of 5.57, while Nigeria occupies position #16, with a total risk index of 9.71. The maximum sum of the three risks (political, fiscal and environmental) is 15.

The new *UOI* rankings of the sample countries, perhaps, best reflect the impact of the proposed *Opportunity Index*. Iran, Kazakhstan, Trinidad & Tobago and Angola now occupy positions #1, #2, #3 and #4, respectively, mainly on the strength of high potential reserves and low F&D costs. They displaced Ireland, the United Kingdom, Norway and Australia, which dropped several notches in their rankings because of low potential reserves and high F&D costs. Ireland's original strength was due to its very favorable fiscal index – the best in the world.

Among the original group of lower ranking countries, Venezuela, Iraq and Nigeria made spectacular gains, jumping more than 6 notches in their rankings. High potential reserves and low F&D costs clearly offset their disadvantages of high political, fiscal and environmental risks. Among the other countries in the test sample, Russia dropped 8 notches in its rankings because of its low reserves potential and high F&D costs; China dropped only one point; Azerbaijan gained 5 points; Georgia and Malaysia dropped 5 and 3 notches, respectively, mainly on high F&D costs and low potential reserves. Overall, the role of the offsets indicators, reflected in the *Opportunity Index*, was the key in accounting for these subtle, and sometimes major, shifts in the levels of opportunity for investments in the countries sampled.

Finally, the chart in Figure 4 is designed to provide a quick-look comparative assessment of the investment opportunities in the different countries. Total risks, total offsets and the reserves index of the country project are graphically displayed in a bubble chart. Typically, the investment required would be proportional to the size of the potential reserves. Countries with high risks fall in the red zone above the *45 degree* diagonal while those that are the most attractive plays would lie in the green zone below the diagonal. It should be emphasized that in this graphical solution there is no need for the offsets weighting factor (w_4). Its value is therefore set at 1.

Conclusions

The *Upstream Opportunity Index* provides a simple but highly effective approach to integrating risk indexes - political, fiscal, and environmental - and diversified offset indicators, such as, potential oil and gas reserves associated with the project, country finding and developing (F&D) costs, and company financial performance, into a single composite index. This composite index proved to be a very useful tool for comparing not only the relative attractiveness of investments in upstream projects as well as the attractiveness of the portfolio of a company with E&P activities in several countries. The model has the added advantage of utilizing industry standard indexes and indicators, and allows the user to conveniently customize the data to accommodate specific scenarios.

Acknowledgments

My thanks go to Dr. Pete Stark (IHS Energy, Denver), to the Oil and Gas Teams (London) of Merrill Lynch and Schroder Salomon Smith Barney, and to Dr. Rene Peels (ITS, Venezuela) for providing valuable data for this research and, more importantly, for their inspiring suggestions during the course of this study.

The Author

Rafael Sandra (rafael@its.com.ve) is President and CEO of ITS Servicios Técnicos, an engineering company he founded 28 years ago to provide services to the oil and gas industry. He holds a PhD in Petroleum Engineering from Penn State University and has written more than 25 technical publications, including the book: “ Dynamics of Petroleum Reservoirs under Gas Injection”, Gulf Publishing, 1974.

**Table 1. Average Size of Oil & Gas Discoveries
in Selected Countries, 1997-2001**
(reserves in millions of barrels of oil equivalent, mnboe)

Country	Avg. Size of Find mnboe	Country	Avg. Size of Find mnboe
Kazakhstan	1900	Venezuela	90
Azerbaijan	1800	China	65
Iran	1130	Malaysia	50
Angola	230	Australia	43
Iraq	205	Russia	25
Trinidad & Tobago	185	United Kingdom	21
Nigeria	180	Georgia	0
Norway	150	Ireland	0

Source: IHS Energy Group

**Table 2. Finding Costs by Region for Peer Companies
1997-1999 and 1998-2000**
(\$ per boe)

Region	1997-1999	1998-2000	Change Percent
United States			
Onshore	5.26	4.95	-5.9
Offshore	9.55	9.99	4.6
Total United States	6.72	6.51	-3.1
Foreign			
Canada	5.43	6.84	25.0
OECD Europe	7.63	7.43	-2.7
Former Soviet Union	6.27	7.01	11.8
Africa	3.71	2.78	-25.1
Middle East	4.18	5.61	34.2
Other Eastern Hemisphere	4.84	7.49	54.8
Other Western Hemisphere	2.99	4.37	46.0
Total Foreign	4.86	5.26	8.2
Worldwide	5.65	5.83	3.1

Notes: The above figures are 3-year weighted averages of exploration and development expenditures (current dollars), excluding expenditures for proven acreage, divided by reserve additions, excluding net purchases of reserves.

Source: Energy Information Administration, Form EIA-28 (Financial Reporting System).

**Table 3. Financial Performance of E & P Companies
1995-2000 Upstream Returns, (%)**

Company	1995	1996	1997	1998	1999	2000	5-yr avg.
Amerada	110%	136%	160%	106%	137%	164%	141%
Anadarko	200%	287%	259%	-188%	206%	352%	183%
Apache	131%	180%	185%	179%	179%	252%	195%
BG Group	-	-88%	43%	131%	194%	178%	92%
BP	133%	189%	192%	132%	181%	339%	207%
Burlinton	173%	158%	179%	177%	152%	214%	176%
Chevron	147%	186%	189%	127%	150%	247%	180%
Conoco	122%	154%	237%	197%	207%	280%	215%
Eni	-	239%	173%	115%	143%	254%	185%
Enterprise	19%	67%	106%	137%	108%	196%	123%
Exon-Mobil	139%	189%	183%	137%	169%	269%	189%
N.Hydro	46%	126%	71%	66%	76%	93%	87%
Phillip	144%	166%	157%	100%	122%	211%	151%
RD/Shell	110%	183%	209%	188%	292%	385%	251%
Repsol-YPF	381%	240%	126%	58%	190%	309%	185%
Statoil	-	-	-	128%	90%	109%	109%
Talisman	730%	276%	181%	149%	139%	228%	195%
Texaco	141%	175%	173%	125%	155%	268%	179%
Total FinaElf	129%	145%	157%	134%	253%	283%	194%
Unocal	118%	147%	132%	89%	96%	152%	123%
Average	178%	162%	161%	113%	160%	239%	187%

Source: Company reports and Schroder Salomon Smith Barney estimates

Table 4. The Upstream Opportunity Index for Selected Countries
(Index scale: 1 to 5)

Risks Rank	Country	Risk Indexes				Offset Indexes				Opportunity Index	
		Political	Fiscal	Environmental	Sum	Potential Reserves	F&D Costs	Financial Performance	Sum	UOI	UOI Rank
1	Ireland	2.06	1.25	2.26	5.57	1.00	1.00	3.00	5.00	2.83	11
2	U.K	2.06	1.51	2.70	6.27	1.00	1.00	3.00	5.00	2.51	12
3	Norway	1.82	3.42	1.35	6.59	1.96	1.00	3.00	5.96	2.21	10
4	Australia	1.86	2.76	1.98	6.60	1.05	1.00	3.00	5.05	2.61	13
5	Kazakhstan	2.31	2.60	2.68	7.59	5.00	1.56	3.00	9.56	1.59	2
6	Russia	2.58	2.80	2.55	7.93	1.00	1.56	3.00	5.56	2.85	14
7	China	2.57	2.57	3.08	8.22	1.22	3.84	3.00	8.06	2.04	8
8	Trinidad	2.48	2.79	3.00	8.27	2.26	5.00	3.00	10.26	1.61	3
9	Iran	2.80	2.76	2.78	8.34	5.00	3.39	3.00	11.39	1.46	1
10	Azerbaijan	2.74	2.97	2.91	8.62	5.00	1.56	3.00	9.56	1.80	5
11	Georgia	3.03	2.99	2.90	8.92	1.00	1.56	3.00	5.56	3.21	16
12	Malaysia	3.00	3.43	2.50	8.93	1.61	1.00	3.00	5.61	3.18	15
13	Angola	2.93	3.35	2.88	9.16	2.65	5.00	3.00	10.65	1.72	4
14	Venezuela	3.34	3.75	2.35	9.44	1.43	5.00	3.00	9.43	2.00	7
15	Iraq	3.33	2.99	3.35	9.67	2.43	3.39	3.00	8.82	2.19	9
16	Nigeria	4.00	2.55	3.16	9.71	2.22	5.00	3.00	10.22	1.90	6
	Average	2.68	2.78	2.65	8.11	2.24	2.62	3.00	7.86	2.06	

Notes: The Reserves Index was established from the correlation between the data on the average size of new field discoveries by country in Table 1, and the index values in Figure 1. The Finding Cost Index corresponds to the correlation of regional average values in Table 2, for the period 1998-2000, and the index scale in Figure 2. The Financial Performance Index normally would be obtained by correlating the 5-year average values for the peer group of companies in Table 3 with the graphical relationship in Figure 3. In this test, however, for the sake of consistency, the median index value of 3 was assumed constant for the entire group of companies. The weighting factor for offsets, w_4 , was set at a value of 0.5. Sources: IHS Energy provided the Political and Fiscal Indexes. The ESI index was used as the Environmental Index.

Fig. 1. Reserves Index

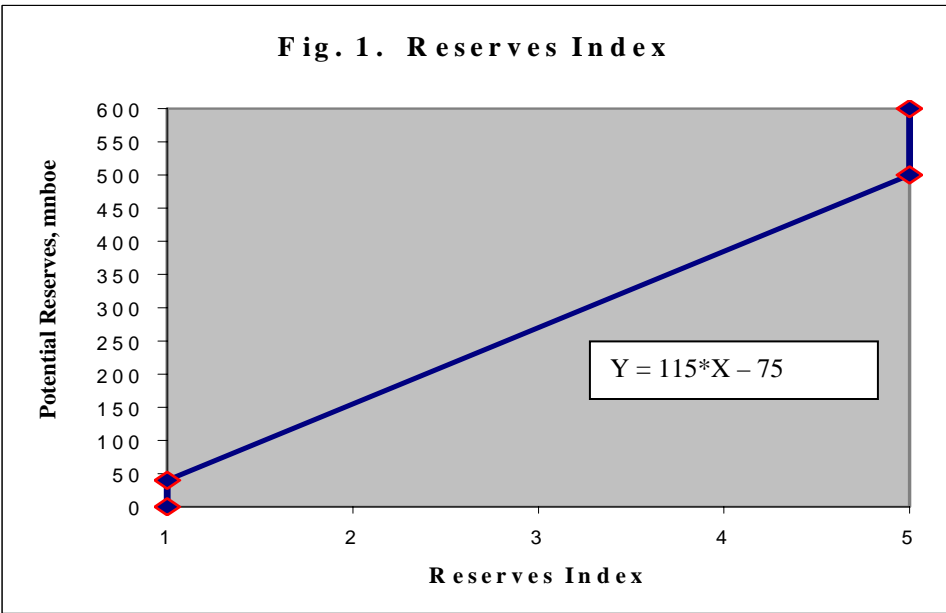


Fig. 2. F & D Cost Index

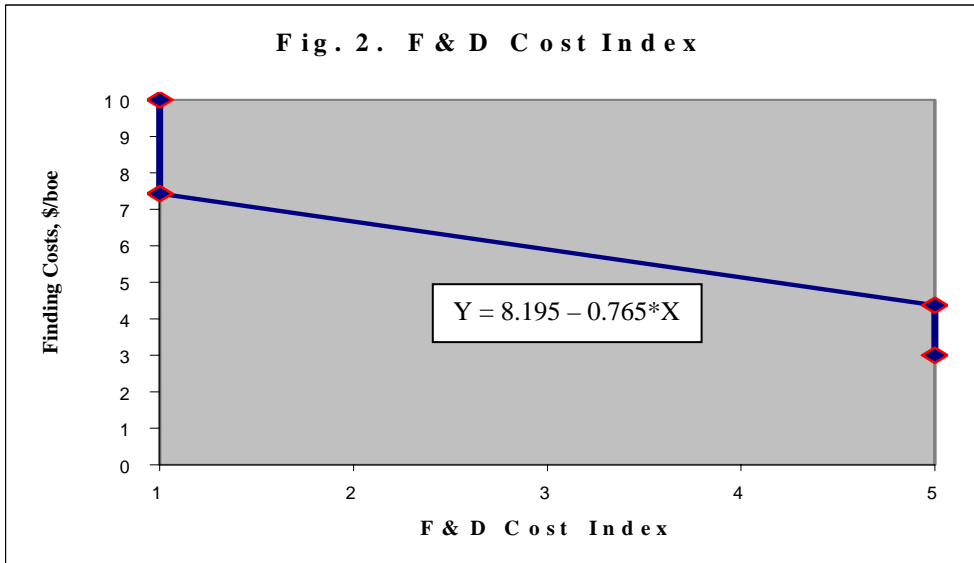


Fig. 3. Financial Performance Index

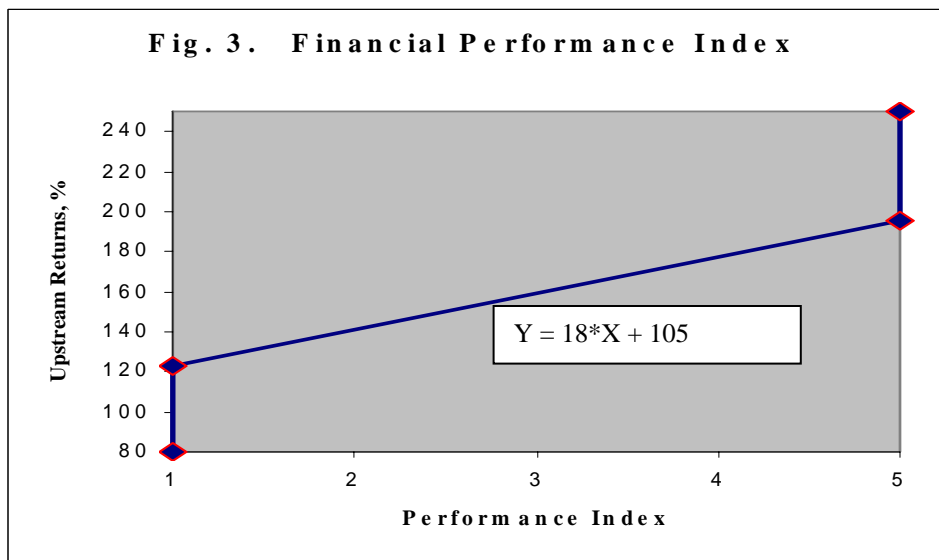


Fig.4 Assessing Upstream Investment Plays

