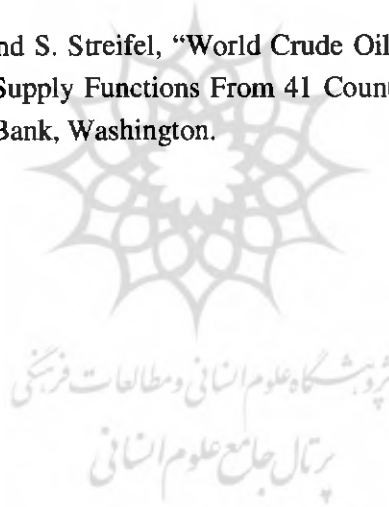


References:

1. Adelman, M. A. 1990, Mineral Depletion, with special Reference to Petroleum, *The Review of Economics and Statistics*, 72 (1), Pp. 1-10.
2. Horsnell, Paul, 2004, Why Oil Prices Have Moved Higher, *Oxford Energy Forum*, August, pp. 10-12.
3. Jalali-Naini, A. R. and H. Karimi, "Rent Seeking and Economic Growth," ERF 10th Annual Conference, December 2003, Marrakech, Morocco.
4. Miller, Merton H. and Charles W. Upton (1985), "A Test of the Hotelling Valuation Principle," *Journal of Political Economy*, 95 (1), pp. 1-25.
5. Romer, David, *Advanced Macroeconomics*, McGraw-Hill Education, 2001.
6. Watkins, G. C. and S. Streifel, "World Crude Oil Resources: Evidence From Estimating Supply Functions From 41 Countries," Working Paper 1756, The World Bank, Washington.



reaction to both high prices and a much lower excess capacity in the OPEC during 2004 and 2005 compared to the preceding years--particularly by the International Oil Companies (IOCs). The hedge funds and commodity funds have increased their oil exposure, mainly in the form of paper oil trade and short-term investment; they have not and will not be supplying funds for long-term investment in the upstream. Most National Oil Companies in the producing countries have limited investment funds due to their fiscal constraints. Given the mismatch between the geographical sources of supply and consumption location and the above mentioned constraints, the balancing factor in the investment equation is the international capital. However, the bulk of international capital investment in the upstream sector has gone to those regions with higher costs of production. This should not be taken as indication of market failure due to uncertainties associated with investment in the upstream sector rather due to low accessibility of high quality oil properties by IOCs and their reluctance thus far to act as service companies. Recently, more interest has been shown by a number of Asian countries to increase their direct lending and investment in the upstream oil sector. The international capital market inflow to this sector is a function of the reward/risk ratio. The improved price signals and lower perceived risks in locations where there is more access to quality oil property will certainly attract more international capital to the upstream sector.

The estimated average annual investment in the upstream oil and gas sector is \$81 billion per annum. Since the cash flows generated from the oil and gas projects are expected to be strong the banks might increase their project finance loans, given that the assessment of long-term prices by the market and the oil companies have risen far above the \$ 18-20 forecast only a few years ago. Increased project financing by banks is an effective means through which sufficient investment flows to the upstream sector in the producing countries, given currently low interest rates. The oil producing and exporting countries can initiate arrangements to reduce the risk of investments in the upstream sector thereby reducing the cost of capital and raising much needed capital investment.

reserves with high return investment opportunities. There is a shortage of such assets where the international companies have access to oil properties. The prospects for high yield reserves should be much better in the Middle East and in Russia. However, access to these reserves is limited due to a host of geopolitical, legal, and financial factors.

Although upstream investment projects in the oil producing countries are highly profitable, exploration and development plans are often constrained by limited investment funds. As have been observed in a number of oil exporting countries, the fiscal relationship between the government and the national oil company is not conducive to adequate investment. National Oil Companies (NOCs) are not given more control on how they spend their revenue and manage their capital expenditures because of the existence of potentially strong principal-agent problems in NOCs. This is one reason why the capital budget for NOCs is controlled by the fiscal authorities. In the budgetary process the limited government financial resources must be allocated to different projects in different sectors. Each ministry has its own priorities and justification to get a larger share of the national budget and on that basis it forms a lobbying apparatus. As a result, the magnitude of funds allocated to capital investment in a representative NOC is not dictated by the feasible and profitable investment opportunities available but is constrained by the exigencies of the fiscal allocation. This makes the investment budget for the nationally owned oil companies smaller than is justified on economic and commercial grounds. Rent seeking in the budgetary process can even worsen the outcome of the budgetary allocation process. There is evidence of significant budgetary rent-seeking in oil producing countries (Jalali-Naini and Karimi 2004). Moreover, the agency problem need not be limited to NOCs, if the legal structure of public enterprises and the lack of transparency and effective monitoring is the problem, it can exist in other government-owned companies not only in NOCs.

5. Concluding remarks

Investment in the upstream sector is sensitive to oil prices and excess capacity but upstream investment has not picked up quite vigorously in

4. The Investment Prospects

During the high-price 1974-85 period the average representative crude price¹ was \$21.1, much higher than the previous decade both in nominal and real terms. Consequently, capital expenditures were high resulting in large excess capacity in the industry. During the 1982-84 interval the OPEC excess capacity stood around 14 million barrels per day. In the low price period of 1986-1999, when average crude prices were 17.08 in nominal terms per barrel, new investments declined and excess capacity was reduced. However, during the 1999-2004 period the average crude price per barrel rose to \$24.13 but the excess capacity declined further though at a much lower pace. Can we expect a new investment boom resulting in creation of a large capacity build up in the near future as a result of the recent surge in prices? It seems that a big boom in upstream sector has not been in the offing in the near future for the reasons mentioned below.

The major oil companies and the OPEC producers account for much of the investment in the upstream sector. The former group has experienced a big surge in profits. However, during the recent price boom exploration and production expenditures in the international oil companies did not follow the increase in prices and profits. A number of major companies have decided to return the surplus cash flow to their share holders, mostly in the form of stock buy-backs. Three factors explain the behavior of the major companies. Firstly, in a mature industry such as oil with lower future growth rates, shareholders may prefer cash than plowing back earnings to acquire oil assets. Secondly, uncertainty over prices, as was alluded to earlier, can result in postponement of investments. Thirdly, companies seem to be following stringent return on capital employed (ROCE) for allocation of investment fund. They must accelerate spending on their more mature fields to keep up production on the old fields that accounts for about 60 per cent of their output² but the International Companies are willing to replace their depleting

¹. The representative crude price until 1982 and OPEC reference basket price after 1982. The data for 2004 includes 11 months.

². Petroleum Economist, October 2004, p. 17.

Table 4.

	Brent	Active Rigs North America	Active Rigs OPEC	Other Active Rigs	Dubal
Brent	1	0.754	0.482	0.498	0.991
Active Rigs North America	0.754	1	0.604	0.772	0.786
Active Rigs OPEC	0.482	0.604	1	0.264	0.499
Other Active Rigs	0.498	0.772	0.264	1	0.494
Dubal	0.991	0.7861	0.499	0.494	1

Based on data presented in OPEC Annual Statistical Bulletin, Vienna: OPEC, various years.

Table 5. Active Rigs Regression

Dependent Variable: Log of Active Rigs in North America (Y)				
Sample (adjusted): 1984 2003				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.097419	1.485904	3.430518	0.0041
Log(Yt-1)	0.477	0.18766	2.541826	0.0235
The Rate of Change of the Log of Brent	0.597582	0.111682	5.350728	0.0001
DUM	-0.34624	0.106231	-3.25927	0.0057
Log of OPEC Excess Capacity	-0.17294	0.080055	-2.1602	0.0486
AR(1)	0.701811	0.12087	5.80631	0
R-squared	0.859874	Mean dependent var		7.15054
Adjusted R-squared	0.809829	S.D. dependent var		0.279244
S.E. of regression	0.121774	Akaike info criterion		-1.12997
Sum squared resid	0.207606	Schwarz criterion		-0.83125
Log likelihood	17.29968	F-statistic		17.182
Durbin-Watson stat	2.306972	Prob(F-statistic)		0.000016
Inverted AR Roots	0.7			

variable. As expected the coefficient of this variable is negative, indicating that higher excess capacity in OPEC reduces the incentive to invest in up stream in North America because of the bearish future price implications of higher excess capacity.

Figure 3

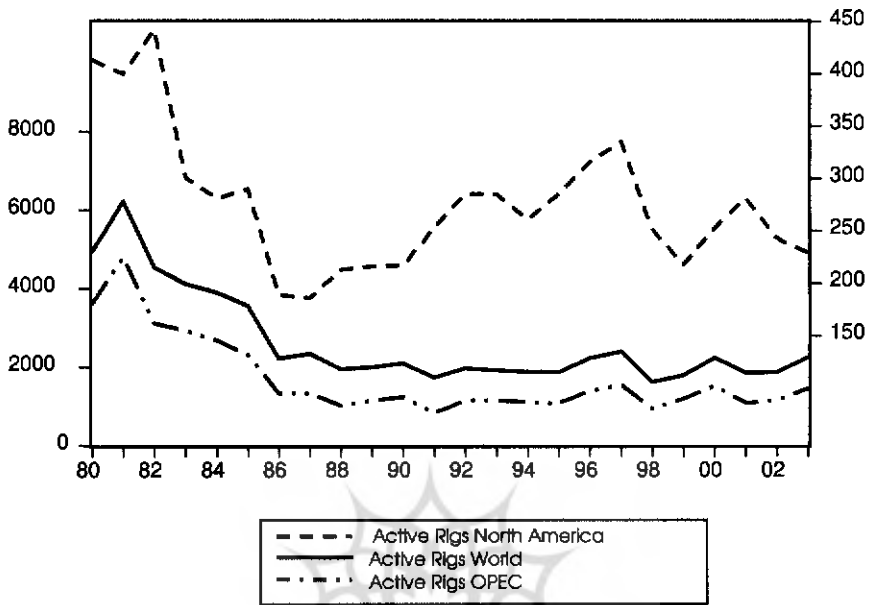
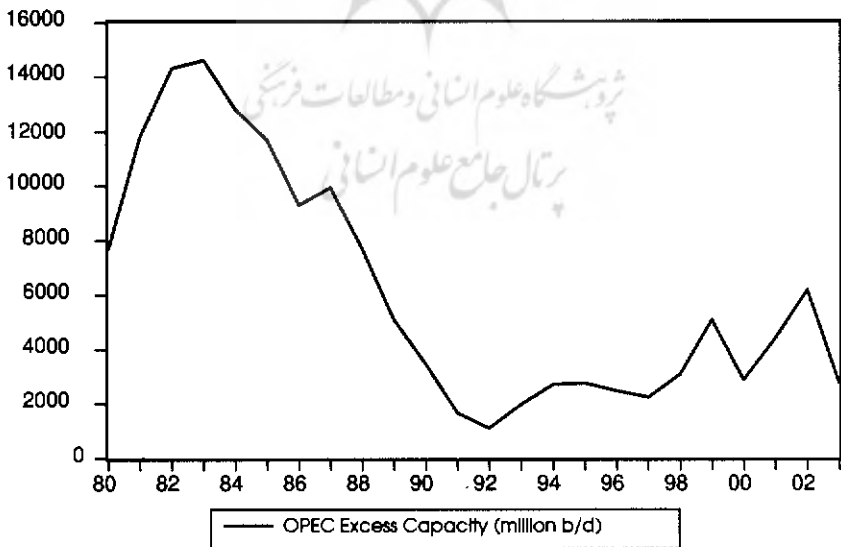


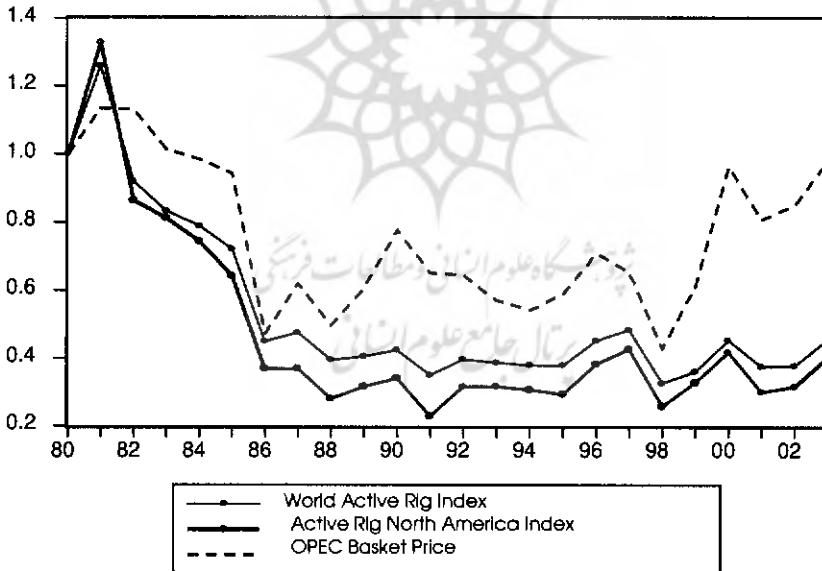
Figure 4. Excess Capacity in the Oil Sector



cent.¹ The share of reserve net of cumulative output has also increased in OPEC and also the Middle East.

There is a positive though not a strong correlation between crude prices and upstream investments. This implies price cycles can result in investment cycles as has been experienced during the last three decades.² The data indicates that historically the number of active rigs, a proxy for investment in the upstream sector, is significantly correlated with the price of oil for the non-OPEC producers but it has a weak correlation with that in OPEC countries (figures 2 and 3). The correlation coefficients for the number of active rigs in different regions of the world and two different crude spot prices are shown in table (4). A regression test for the sensitivity of the number of active rigs to oil prices was performed for the North American region (table 5). The number of active rigs is positively influenced by the rate of change (the first log difference) of the price of oil (Brent). We also included excess capacity in the OPEC members as an additional explanatory

Figure 2

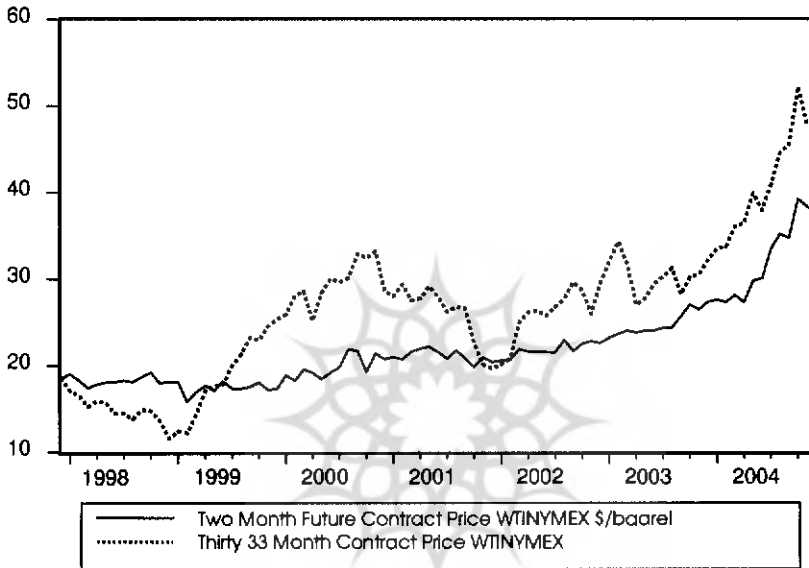


¹. For more details see, OPEC, Annual Statistical Bulletin, 2003, Vienna.

². For more details see OPEC Review, Special Issue, Vol. XXVII, No. 3, Special Issue, JOINT OPEC/IEA Workshop on Oil Investment Prospects.

the manufacturing companies; they are both risky and rewarding. In the aftermath of oil price increases in 1973/74 and in 1979/80, capacity increased both in OPEC and Non-OPEC regions and capital expenditures tracked oil prices to higher levels. But with the price collapse in the mid-

Figure 1



1980s cap-ex also decreased sharply. Exploration and development expenditures outside OPEC declined and after the collapse of crude prices in 1986, active rigs, a proxy for upstream investment activity, fell throughout the world and remained flat. It was only in the OPEC member countries (the numbers indicated on the right-hand side scale) that the number of active rigs shows a partial rebound (figures 1 and 2). With lower investments rates in the OPEC countries excess capacity also gradually declined (figure 3). However, OPEC has been able to add to its proven reserves more than the rest of the world producers did. During the last two decades the share of OPEC in total proven crude oil reserves has increased from 67.4 per cent in 1983 to 78.3 per cent in 2003. During the same period the share of Middle East producers in total reserves has increased from 56.3 per cent to 64.7 per

implied by the theory of irreversible investment under conditions of uncertainty is that, it is better to make an error and under produce than err and over produce. A sustained period of firm oil prices should stimulate larger investments in the upstream sector.

Table 3. Natural Gas Reserves, the end of 2003

Country/Region	Share of Total (%)	Reserve/Production ratio
USA	3.0%	9.5
Canada	0.9%	9.2
North America	4.2%	9.5
South and Central America	4.1%	60.6
Europe & Eurasia	35.4%	60.8
Iran	15.2%	*
Saudi Arabia	3.8%	*
Middle East	40.8%	*
Africa	7.8%	97.5
Asia-Pacific	7.7%	43.4
World	100.0%	67.1

Source British Petroleum: Annual Statistical Review of World Energy, June 2004.

Secondly, it is argued that while short-term prices have not sent the correct signals for investment in the upstream sector, long-term prices have in the recent years have sent the correct signals for investors and in spite of this investment in the up stream has lagged (Horsnel 2004). As indicated by figure (1) long-term prices tend to be more stable and over the last two years both short dated and long-dated prices have sent the necessary signal. We will return to this issue in section 3.

3. Oil Prices, Investment and Excess Capacity

Expenditures on exploration and discovery of new reservoirs in the oil business are similar to research and development expenditures undertaken by

the prevailing mood and expectations in the oil sector. Consequently, cap-ex in this industry significantly slowed-down. Moreover, during the 1990s the

Table 2. Proven Oil Reserves, the end of 2003

Country/Region	Share of Reserves (%)	Reserve/Production ratio
USA	2.7	11.3
Canada	1.5	15.5
North America	5.5	12.2
South and Central America	8.9	41.5
Europe & Eurasia	9.2	17.1
Iran	11.4	92.9
Saudi Arabia	22.9	73.3
Middle East	63.3	88.1
Africa	8.9	33.2
Asia-Pacific	4.2	16.6
World	100	41

Source British Petroleum: Annual Statistical Review of World Energy, June 2004.

expected return on equity in the high-tech industries were quite high but because of relatively low crude prices prevailing during this period the rate of return on was lower in upstream oil and gas. With the rebound in oil prices during the last few years, oil companies have had a much better return on their equities than the high-tech and the dotcoms, consequently cap-ex is beginning to rise in the upstream activities, though not as quickly as it was expected. There are tow different interpretations regarding the effect of prices on investment.

Firstly, when prices and the rates of return are volatile and uncertain, as it has been the case in the oil industry during the last six years, a profit-maximizing investor might decide to postpone investment until additional information about prices and market conditions are obtained. The point

advantageous trade for both parties: the oil exporters have the reserves and the international companies have both the technology and financial capital. What can bring the two sides closer to boost capital investment in the upstream is a reduction in the perceived financial risks, and some relaxation in the foreign investment laws.

The IEA study (2003) indicates that it is to the benefit of both the consuming and the producing nations if upstream oil and gas investments are channeled to the regions with more reserves, i.e. ME. If investment and output is restricted in ME, oil output will be lower, oil prices higher, the world economic growth lower, and ME producer's revenue lower.¹ Given the volume of investments needed to expand production capacity during the 2001-2030 period, the bulk of which has to come from ME producers, and the fact that such investments absorbs a large part of their oil revenues, leaving little to spend on their economic development, foreign capital inflow should fill the gap. It is expected that private foreign capital, in the form of finance, equity, or other arrangements, will grow significantly compared to the previous two decades to fund the required investment in the energy sector. Capital mobilization on such a large scale faces challenges and difficulties. One such challenge is the issue of mobility of international capital. World saving is expected to be sufficiently large enough to provide for investment in the energy sector and maintain the current world economic growth rate. However, due to international capital imperfections and institutional barriers, particularly in the developing countries, international capital may not be sufficiently mobile to be allocated in a timely manner to energy projects with above average rates of return or the implied discount rate for the projects are assessed at high rates.

Mobilization and allocation of capital in the upstream sector can also be influenced by price signals in commodity markets and the expected return signals from the equity markets. Until a few years ago price pessimism was

¹. Investment and output growth restriction by ME produces will increase world investment cost by 8 per cent and lowers demand by 8 per cent due to higher prices. See IEA (2003) for details.

2001-2030 period. The projected 16 trillion dollars energy investment will be a small fraction, 1.6 per cent, of the predicted world GDP, and the projected cap-ex requirement in the oil and gas sector will be an even smaller fraction of the world GDP, 0.3 percent, in the above period. However, the implied investment-GDP ratio will be much higher for the major oil exporting countries. Based on the projected geographical sources of world consumption and production of oil and gas, the Middle East, and especially the Persian Gulf oil producers, will deliver much of the additional expansion in the world oil and gas output.

The interesting observation, based on the past distribution of upstream cap-ex in the oil and gas sector as well as the above mentioned future investment projections is that, while much of the additional growth in output is expected to be delivered by the Middle Eastern producers, the bulk of cap-ex spending is projected to be allocated in other regions of the world. From a commercial point of view investments should be allocated to those regions and countries that have the richer reserves, and lower costs of exploration and extraction, in order to sustain higher production rates at more favorable prices. The Middle East, more specifically the Persian Gulf, region are the areas with abundant reserves (see tables 2 and 3) but historically have been under-invested. This indicates a geographical mismatch between the sources of reserves and uses of investment funds. This mismatch that has persisted over a relatively long time span and can be attributed to several factors: incomplete international capital mobility; perceived risks by oil consuming countries to observe complete specialization along natural endowments; difference in the discount rate between oil consumers and oil producers; legal and institutional barriers for foreign investment by oil producing countries; incorrect price signals.

The international oil companies have access to technology but have limited reserves. Their reserve/production ratio are much lower than the Persian Gulf oil exporters and control a much lower percentage of the world oil proven reserves (14 per cent). Moreover, their reserve replacement ratios have fallen significantly in the recent years. There is a mutually

increase output capacity is required. Based on modest growth projections, 1.6 per cent annual growth in demand for oil and gas and 1.7 per cent for all energy carriers over the 2001-2030 period, IEA projects a hefty 16 trillion US dollars investment requirement in the energy sector for the world economy. The world demand for oil will increase from 77 million barrels a day (mb/d) to 120 mb/d, therefore based on this projection 43 mb/d of additional capacity must be created. Projections from OPEC indicate similar, though a slightly higher, growth in the world oil demand until 2025 (table 1) and this implies an even higher cap-ex requirement.¹ It should be noted that much of the expected growth in oil demand will come from the developing countries, particularly from China and South Asia.

Table1. World Oil Demand Outlook in the OPEC Reference Case, in million barrels a day

	2005	2010	2015	2020	2025
North America	25	26.1	27.2	28.3	29.4
Western Europe	15.4	15.9	16.3	16.6	16.8
OECD	49.3	51.2	52.9	54.5	55.8
Developing countries	26.9	32.3	38.5	45.3	52.5
Transitional economies	4.8	5.3	5.7	6	6.3
World	81	88.7	97.1	105.8	114.6

Source: A. Shihab-Eldin, M. Hamel, and G. Brennan, OPEC REVIEW, Vol. XXVIII, No. 3, September 2004, p. 161.

Nearly two-thirds of the projected total capital expenditures in the world energy sector are to be invested for modernizing old power plants and building of new ones. The amount of investment needed for the oil and gas sector is 3.1 trillion dollars, of which 2.2 trillion dollars is projected to be invested in the conventional oil exploration and development during the

¹ The projections made by the OPEC and IEA do not cover exactly the same period. For the former the period is 2000-2025 and for the latter is 2001-2030.

at today's prices given today's technology. The cost of reserves is closely related to the capital investments required to find them, that is, to drill, complete the wells, and connect it to a pipeline. The discounted net cash flows determine the value of investments in the upstream project.

Uncertainty over prices (or costs) is a complicating issue. Without price uncertainty, the Hotelling Valuation Principle implies that investors should be willing to pay more for reserves when oil prices net of extraction cost go up (Miller and Upton 1985). However, with the presence of price uncertainty over the future course of prices the investment decision process becomes more complicated. In fact these factors can induce postponement of capital investments by raising its option value. To complicate the matters even more, the big players in the oil field are the large international oil companies and the producing countries and they do not always have the same objective function. Some years ago, the difference in their behavior was perceived to be due to differences in their discount rates, implying that the former prefers to have more production hence investment sooner than later. In contrast to the producers who wish to smooth output flow over a longer time span. To put it in another way, profit maximization and share holder value is the dominant consideration for the companies while for the producers, in particular, the OPEC, market share and the security of oil supply are also important variables in their output and investing decisions.

In section 2 of this paper the projected oil demand in the world economy and the investment requirements consistent with these projections will be reviewed. Section 3 examines the trends in excess capacity, prices, and investment in the global oil industry. In section 4 we review the outlook for investment in the upstream sector.

2. Future World Demand for Oil and Global Investment in the Oil Sector

Production plans are based on expected future demand and when demand is expected to grow in the intermediate and long-run more capital investment to

1. Introduction:

With the recent pickup in the world demand for oil, the dwindling OPEC excess capacity and rising oil prices the issue of adequacy of investment in new capacity has become topical. The major issues are: how much investment is needed, the geographical location of future investments, and who is going to finance it. The investment pattern in the oil industry during the last three decades prior to 2000 followed the price trends. During the high-price periods (1973-1984) capital expenditures were high resulting in large excess capacity in the industry. In the low price years (1986-1999) new investments declined and excess capacity shrank. However, during the 1999-2004 period while the average crude price per barrel rose excess capacity declined further approaching critical levels in 2004. With continued price strength into 2005 should we expect a new investment boom resulting in creation of a additional upstream capacity in the near future?

Investment behavior in the oil industry and its responsiveness to prices and market conditions are more complex than described by the standard competitive models of the optimal capital stock¹ or the simple Hotelling valuation models. In the simple Hotelling models a fixed quantity of discovered reserves are assumed; the finding costs are sunk costs and there is no development cost. The *insitu* value of the reserves depends on the discounted net profit such a reserve can generate. More sophisticated versions of the model allows for development cost of the reserves. In a competitive market the price of an *insitu* reserve is equal to the per barrel marginal development cost plus per barrel marginal user cost (Watkins and Streifel 1996). For those who do not subscribe to the idea of exhaustibility of oil, there is no fixed stock of oil and a stream of investment adds to proven reserve inventory from a larger under ground inventory (Adelman 1990). In this view the oil industry's supply problem is one of inventory renewal. The simple industry-wide rule calls for holding about 15 years' supply under the ground as proven reserves. Proven reserves are defined as those recoverable

¹. The basic result in the theory of business investment is that, the optimal stock of capital is a function of the rental or the real cost of capital. For instance see Romer 1996.

Prices, Excess Capacity in Oil and the Investment in the Upstream Sector

Ahmad R. Jalali-Naini (Ph.D.)¹

Abstract

With the growing world demand for oil, the dwindling OPEC excess capacity, and the sharply increasing crude oil prices the need to investment in new upstream capacity has become a critical issue. The empirical evidence presented in this paper indicates that while the current environment should be quite conducive for higher cap-ex in upstream oil the actual growth in investment has not been growing very briskly. In this paper we argue that whilst there are sufficient resources to fund the required investments in the world financial markets some structural impediments limit efficient allocation of capital to this sector. Much of the quality oil reserves are located in the Middle East, particularly in the Persian Gulf region, however, due to the inaccessibility of these reserves to IOCs, the fiscal constraints facing NOCs, and the perceived risks of projects, investment flows are not moving to those geographical areas with the most productive potential.

Keywords: *investment, upstream oil, excess capacity, oil prices*

¹. Member of the scientific board, Institute for advanced research and education in management and planning, Management and Planning Organization (MPO), and Consultant, PMAD, OPEC, Vienna, Email: AJalali-Naini@opec.org and ahmad_jalali@hotmail.com.