



The Role of National Oil Companies in the International Oil Market

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Summary

In the United States, the term “big oil companies” is likely to be taken to mean the major private international oil companies, largely based in Europe or America. However, while some of those companies are indeed among the largest in the world, by many important measures, a majority of the largest oil companies are state-owned, national oil companies. By conventional definitions, national oil companies hold the majority of petroleum reserves and produce the majority of the world’s supply of crude oil. Since national oil companies generally hold exclusive rights to exploration and development of petroleum resources within the home country, they also can decide on the degree to which they require participation by private companies in those activities.

The national oil companies typically do not operate strictly on the basis of market principles. Because of their close ties to the national government, in many cases their objectives might include wealth re-distribution, jobs creation, general economic development, economic and energy security, and vertical integration. Although these objectives might be desirable from the point of view of the nation’s government, they are unlikely to be equivalent to the maximization of shareholder value, the stated objective of the private international oil companies.

Differing objectives might be considered to be important only if they lead to different characteristics and outcomes, which is the case for the national oil companies. Many of these companies have been found to be inefficient, with relatively low investment rates. They tend to exploit oil reserves for short-term gain, possibly damaging oil fields, reducing the longer term production potential. Some also have limited access to international capital markets because of poor business practices and a lack of transparency in their business deals. High oil prices since late 2003 have masked the effect of some of these characteristics in the flow of oil revenues. However, if the price of oil moderates, the potential supply constraint related to the inefficient operations of the national oil companies may be a destabilizing factor in the world oil market.

A wide variety of policy directions can be taken to mitigate the potential challenge posed by the dominance of national oil companies. Demand management policy can reduce the U.S. dependence on imports. The U.S. government can use its political influence to try to encourage nations not to use national oil companies to forward the aims of the government, but to follow commercial practices to maximize revenue flows. An expanded supply of oil could be encouraged as a condition for trade and aid agreements in some cases. Finally, promoting international trade and recognized commercial practices could be encouraged.

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In June 2007, ExxonMobil Corporation and ConocoPhillips, two of the largest U.S. oil companies, abandoned their multi-billion dollar investments in the heavy oil deposits of the Orinoco basin in Venezuela. This action followed the breakdown of negotiations between the companies and the government of President Hugo Chavez and Petroleos de Venezuela (PDV), the Venezuelan national oil company. Four other international oil companies, including Total SA from France, Statoil from Norway, BP from Great Britain, and Chevron from the United States, accepted agreements that raised the PDV share in their Orinoco projects from approximately 40% to a controlling interest of about 78%.¹

ConocoPhillips, especially, was adversely affected by the decision. ConocoPhillips recorded 1.1 billion barrels of proved reserves from its Venezuelan ventures. This amounted to approximately 10% of the company's total reserve holdings, and its production from Venezuela amounted to 4% of its total crude oil production. Although ConocoPhillips continues to negotiate compensation for its holdings, the company took a \$4.5 billion dollar write-off against second-quarter 2007 earnings. The company was seen as less likely to be able to meet its reserve replacement targets and the price of its shares fell on the stock market.²

On the Venezuelan side, PDV expanded its reserve and production position, and its strength in the international oil market.³ Venezuela, traditionally, has a large share of crude oil imports into the United States. This oil flow is now more directly under the control of the Venezuelan government which may or may not allow the flow of crude oil to follow economic market forces.

This report assesses the position of national oil companies, and how their evolving strength may affect the availability of supply in the oil market, and hence, oil security. The report also examines the effects of national oil company expansion on the major private international oil companies as well as how these companies might differ in motivation and results. Policy options to deal with the rise of national oil companies by the countries without them are also evaluated.

The Market Position of National Oil Companies⁴

Rankings of companies can be accomplished using a number of different criteria. In the oil industry, based as it is on current production to generate current earnings and on reserve positions to ensure the future viability of the enterprise, several standards need to be applied to assess the evolving nature of the companies in the industry. Additionally, investment, in the form of exploration and development expenditures, serves as a link between the present and the future, ensuring an ongoing continuity for the company so that reserves are not unduly depleted by current activities.

¹ "Exxon, Conoco to Exit Orinoco Oil Projects," *Oil Daily*, Vol. 57, No. 123, June 27, 2007, p. 1.

² "Conoco's Goals in Doubt After Venezuela Exit," *Oil Daily*, Vol. 57, No. 124, June 28, 2007, pp. 1-2.

³ PDV is Petroleos de Venezuela S.A., the state-owned national oil company.

⁴ See **Appendix** for a listing of national oil companies in the tables. All of the rankings presented in this section of the report can be found in *Energy Intelligence Research*, "The Energy Intelligence Top 100: Ranking the World's Oil Companies," 2007.

Consumers also have an interest in the structure and size of firms and their activities if the current production level, as well as the proved reserve position of the companies or industry, is declining. If current production declines in the face of growing world demand, it is likely that prices will rise, and the possibility of physical shortages will be heightened. If exploration and development expenditures are reduced because of problems encountered by some firms in accessing international capital markets, the relative scarcity of oil might increase, leading to higher future prices, as well as potentially restricted supply.

Table 1. Comparative Ranking of the Top 10 Oil Companies

Rank 2006	Company	Ownership	Rank 2000	Company	Ownership
1	Saudi Aramco	State	1	Saudi Aramco	State
2	ExxonMobil	Private	2	PDV	State
3	NIOC	State	3	ExxonMobil	Private
4	PDV	State	4	NIOC	State
5	BP	Private	5	Shell	Private
6	Shell	Private	6	BP	Private
7	PetroChina	90% State	7	Pemex	State
8	Chevron	Private	8	Pertamina	State
9	Total	Private	9	Total	Private
10	Pemex	State	10	KPC	State

Source: *Energy Intelligence Research*, "The Energy Intelligence Top 100: Ranking the World's Oil Companies," 2007 and 2001 editions.

Table 1 shows a ranking of the top 10 world oil companies on the basis of a composite criterion. In 2006, five of the top 10 companies could be classified as state owned and operated. In 2000, six of the top 10 companies were state owned and operated. On the surface, these rankings appear to show a decline in the importance of state-owned firms in the world oil market. However, these rankings may give an unclear picture of the underlying relative strengths of the private and state-owned companies in the world oil market.

Table 2 shows the leading firms in terms of world-wide petroleum liquids reserves.⁵

Table 2. World Liquid Petroleum Reserves Holdings
(millions of barrels)

Rank 2006	Company	Reserves	Rank 2000	Company	Reserves
1	Saudi Aramco	264,200	1	Saudi Aramco	259,200
2	NIOC	137,500	2	INOC	112,500
3	INOC	115,000	3	KPC	96,500
4	KPC	101,500	4	NIOC	87,993
5	PDV	79,700	5	PDV	76,852
6	Adnoc	56,920	6	Adnoc	50,710
7	Libya NOC	33,235	7	Pemex	28,400
8	NNPC	21,540	8	Libya NOC	23,600
9	Lukoil	16,114	9	NNPC	13,500
10	QP	15,200	10	Lukoil	11,432

Source: *Energy Intelligence Research*, "The Energy Intelligence Top 100: Ranking the World's Oil Companies," 2007 and 2001 editions.

Every firm in the top 10 reserve holders, with the exception of Lukoil, in both 2006 and 2000 was state owned. Among the major international oil companies, ExxonMobil is ranked fourteenth, BP seventeenth, Chevron nineteenth, ConocoPhillips, twenty-third, and Shell is ranked twenty-fifth in 2006. These five firms hold only 3.8% of world liquid reserves, and their major holdings are in the United States and Canada. In contrast, the top 10 firms listed in **Table 2** hold 80.6% of the total world liquid reserves. The top 10 companies in 2006 in **Table 2** have an average reserve to production ratio of 78 years, with INOC, the Iraqi National Oil Company, the highest at 173 years and Lukoil, a privately held Russian company, the lowest at 24 years.⁶ The five large international oil companies have reserve to production ratios of 11 years.

These values suggest that the 10 largest reserve holding companies, largely state owned, will be major forces in the world oil market about seven times as long as the five major international oil companies. In a market where reserve position is likely to translate into production and pricing power, the state oil companies are in a dominant position, and the international oil companies are likely to continue to play a lesser role. It is also not likely that the reserve positions of the companies will change in favor of the international oil companies in the future. As nations establish their own national oil companies, territories open for exploration and development by private companies may diminish. As suggested by the example of Venezuela, cited in the opening section of this report, even in countries where there are partnerships between the private oil companies and national oil companies, if there is any revision of ownership shares, it is likely to be in favor of the national oil companies. Two factors affect this observation. Oil-producing nations seem to be displaying an ever more nationalistic attitude toward their natural resource

⁵ Petroleum liquids are mostly crude oil but may contain liquids derived from natural gas as well as other sources.

⁶ The reserve to production ratio is a measure of how long current levels of production can be maintained from existing reserves.

endowments, and the national oil companies are viewed as custodians of that resource. If there is opposition to U.S. foreign policy objectives, or if there is a more general negative reaction to the spread of global markets and private industry, nationalization of oil resources and transference to the national oil company is likely one of the most direct ways to make a political statement. Given the tight balance between global supply and demand, this statement can be made with little or no cost in lost revenues.

Table 3 shows the 10 leading producing companies in the world. A company's ability to produce crude oil depends on access to oil deposits, but it also depends on access to modern technology. The private international oil companies generally have access to state-of-the-art technologies, which are less easily available to some other firms. Gaining access to the best technology for exploration, development, and production is one of the key motivations oil producing nations have for entering production-sharing agreements with the private international oil companies.

Table 3. World Petroleum Liquids Production
(thousands of barrels per day)

Rank 2006	Company	Production	Rank 2000	Company	Production
1	Saudi Aramco	11,035	1	Saudi Aramco	8,044
2	NIOC	4,049	2	NIOC	3,620
3	Pemex	3,710	3	Pemex	3,343
4	PDV	2,650	4	PDV	2,950
5	KPC	2,643	5	INOC	2,528
6	BP	2,562	6	ExxonMobil	2,444
7	ExxonMobil	2,523	7	Shell	2,268
8	PetroChina	2,270	8	PetroChina	2,124
9	Shell	2,093	9	BP	2,061
10	Sonotrach	1,934	10	KPC	2,025

Source: *Energy Intelligence Research*, "The Energy Intelligence Top 100: Ranking the World's Oil Companies," 2007 and 2001 editions.

In 2006, seven of the top 10 producing companies were state owned, including the five largest producers. Although the three largest international oil companies were among the top 10 producers, and two of them, BP and ExxonMobil, even managed to increase their total output, their production was from relatively small reserve bases, shortening the time they can remain in the market as producers without major new discoveries. The effects of rising world demand and higher prices since 2003 can be seen in the increased output of most of the companies on the list.

One final factor in the power of the national oil companies should be noted. The Organization of Petroleum Exporting Countries (OPEC) allows these companies to compete to a degree they deem compatible with their national goals as specified by their governments and still coordinate their actions through OPEC when it is in their interests to show a more unified front in the world market. This ability to compete or coordinate their activities and decisions when it is in their, and their nations', interests is not available to the private international oil companies.

Objectives and Characteristics of National Oil Companies

The reserve and production positions of the national oil companies might be little cause for concern if the companies operated much like the private international oil companies, and state ownership was only a matter of how the stock shares of the company were held. However, it is likely that the objectives for many national oil companies, as well as the characteristics of their operations, differ from companies in the private sector of the oil industry.

Objectives

Privately held companies have the goal of maximizing shareholder value. The management of the company may accomplish that goal through organizing production so that a profit is made in the current time frame as well as in the future. They also might make investment decisions to take advantage of opportunities to raise the company's rate of return. They also have the motivation to achieve productive efficiency to hold down costs to enhance the profitability of any given revenue level. This activity is thought to benefit consumers by assuring that physical shortages are avoided and that the good is available at the lowest price consistent with demand and supply factors.

In the oil industry, maximization of shareholder value is taken to mean that the value of oil resources should be maximized through managing production, exploration, and development activities to assure a functioning market. To ensure the long-term viability of the company, reserve replacement is necessary. For the company to grow, it must have the ability to expand production and sales to meet demand growth in newly developing economies as well as in developed areas. Technical efficiency in all parts of the supply chain leads to cost minimization as well as improvements in product performance and environmental integrity.

National oil companies do not necessarily follow the shareholder value maximization model alone. Since these companies are totally, or majority, owned by their national governments, maximizing the value of the company might have to compete with other, governmentally mandated objectives. Although all national oil companies respond to their national governments to one degree or another, the amount of influence varies widely. The national oil companies of more developed nations, Statoil in Norway, and Petronas in Malaysia, for example, tend to follow a more commercially oriented strategy than the Nigerian National Petroleum Co. and Petroleos de Venezuela, where government objectives largely supplant commercial objectives, and the companies are under pressure to maximize the flow of funds to the national treasuries.

Wealth Distribution

National oil companies may be involved in redistributing the oil wealth of the nation to the society in general. This redistribution can be accomplished through fuel subsidies, employment policies, and social welfare programs among other programs. Fuel subsidies are common, reducing the price of gasoline in Venezuela to \$0.11 per gallon, \$0.21 per gallon in Iran, and

\$0.64 per gallon in Saudi Arabia.⁷ In contrast, gasoline had an average price of \$5.77 in Norway, one of the higher observed price levels in the world. While subsidized fuel prices reduce energy prices to the general population, enhance industrial and transportation resources, and protect the domestic economy from the damaging effects of volatile world petroleum prices, the downside is that they are very expensive in terms of lost potential revenues for the national oil company. The artificially low price encourages demand growth, corruption, inefficient use of fuels, and even arbitrage-based smuggling schemes. The expanded use of fuels domestically leads to reduced exports and tightens supply in world markets, leading to higher prices in the oil-importing countries. Examples of subsidy programs with these effects include those observed in Iran, Nigeria, and Indonesia among others.⁸

Jobs Programs

Although the results vary with the demographic of the country, national oil companies can be viewed as jobs programs for the domestic economy. **Table 4** shows that private oil companies have varying levels of employment for each one million barrels of oil equivalent produced, but the degree of variation is higher for the national oil companies. The data shows Saudi Aramco with the lowest ratio of employees to oil produced. The low ratio may be the result of efficiency within the organization, the large quantities of oil produced, or it may reflect the small population and overall wealth of Saudi Arabia that minimizes the need for a jobs program. The two Chinese national oil companies, CNOOC and PetroChina, are near the lowest and also the highest in terms of number of employees per barrel of oil equivalent produced. This outcome is likely the result of different operational requirements, or different treatment of the companies by the government. The Russian based-companies are also near the highest jobs producers, perhaps reflecting policies still in place from the old Soviet Union, or inefficient technologies.

⁷ These values represent the average gasoline prices over the period 2002 to 2004 and compare to an average price of \$2.10 in the United States for the same period. Amy Myers Jaffe, *The Changing Role of National Oil Companies in International Energy Markets, Introduction and Summary Conclusions*, Presentation at the James A. Baker III Institute for Public Policy, Rice University, March 1, 2007.

⁸ Ibid.

Table 4. Total Employees per Million Barrels Equivalent Produced, 2004

National Oil Companies	Employees	Private Oil Companies	Employees
Saudi Aramco	11	ExxonMobil	19
PDVSA	16	ConocPhillips	20
CNOOC	18	Chevron	24
NNPC	20	Shell	27
Petromas	38	BP	27
Statoil	39		
NIOC	43		
ONGC	94		
Rosneft	172		
PetroChina	267		

Source: Ann Myers Jaffe, *The Changing Role of National Oil Companies, Introduction and Summary Conclusions*, James A. Baker III Institute for Public Policy, March 1, 2007.

Economic Development

National oil companies are also used by their governments as tools in the overall process of economic development. In some nations, the petroleum industry is the first large economic sector opened to the world economy. As such, the petroleum industry may be the first to introduce concepts of international investment contract and property law, as well as accepted accounting and financial standards, all necessary for economic development to proceed. The industry may serve as a conduit for technology transfers to the larger economy. Local content rules may be imposed to ensure the development of ancillary service businesses to spread development dollars. The national oil company may also be required to supply subsidized fuels to industries targeted in the nations' development plans.

An example of the development responsibilities of a national oil company is in Kazakhstan, where KMG has clearly stated its aims. These objectives include integrating Kazakhstan into the world economy and ensuring that KMG's growth and development translates into more general economic growth in the nation.⁹

Foreign Policy

National oil companies can also be used by their national governments as a tool to achieve foreign policy goals, leading to direct alliances as well as national oil company to national oil company ties that can pave the way to political relationships. Oil is a strategic commodity in the world economy, and its production and use can foster strategic relationships. For example, Saudi Aramco's decision to raise oil output in the wake of the Iraqi invasion of Kuwait, and China's oil-based relationships with Iran, Venezuela, Russia, and others can be viewed as partly politically motivated.

⁹ Olcott, Martha Brill, *Kazmunaigaz: Kazakhstan's National Oil and Gas Company*, Presentation at the James A. Baker III Institute for Public Policy, Rice University, March 1, 2007, p. 3.

Perhaps the most recent and assertive example of national oil companies being tied to the geopolitical aims of their government is PDVSA and President Chavez and his Bolivarian Revolution.¹⁰ Some believe that Chavez sees the United States and its promotion of democracy and global markets as a threat to his revolution. To counter what Chavez sees as U.S. expansionism, he is using the promise of economic aid, joint energy projects, and favorable oil pricing to gain influence in Latin America, the Caribbean, and other areas. PDVSA plays an important role in these policies. Recently, the Chavez government has completed deals with Ecuador, Bolivia, Argentina, Nicaragua, and others.¹¹

Iran has used the possibility of oil cut-offs to the West as a threat, and possible deterrent, in the controversy over its pursuit of nuclear weapons. Russia has interrupted natural gas deliveries to Europe as a result of its conflicts with members of the former Soviet Union over supply prices and transport fees.

Energy Security

Broadly based energy security is among the objectives of the national oil companies. Security on the demand side means not allowing one consumer to become critical to the national oil company. For example, PDVSA has recently tried to direct its oil sales away from the United States in the hope of reducing U.S. economic influence, and as a way to develop other consuming markets for Venezuelan crude oil. However, in some cases technological factors make this strategy difficult. A long-standing relationship between an oil exporter and importer may lead to the investment in more-or-less specialized facilities that facilitate the use of the exporting nation's oil. In the United States-Venezuela case, Venezuela produces relatively heavy crude oils, especially from the Orinoco basin projects. The United States has refineries designed to use this crude oil. As Venezuela seeks to diversify its customer base, it must find locations with refinery capacity suited to its crude oil.

In other cases, energy security objectives for national oil companies are defined in terms of security of supply. Supply security objectives in the well-functioning world oil market are usually defined in terms of the diversity of producers and the security of oil supply lanes. For some countries and their national oil companies, oil supply security means the ownership, or exclusive rights to, desired supplies of oil. Some analysts have identified China as a nation following this type of strategy. The attempted purchase of Unocal, the U.S. based oil and natural gas company, by CNOOC in 2006 likely was of interest to the Chinese mainly to gain access to natural gas fields in southeast Asia, controlled by Unocal.

¹⁰ For a fuller discussion of U.S. concerns about Venezuelan policies under Chavez, see CRS Report RL32488, *Venezuela: Political Conditions and U.S. Policy*, by (name redacted).

¹¹ Mares, David R., and Altamirano, Nelson, *Venezuela's PDVSA and World Energy Markets: Corporate Strategies and Political Factors Determining its Behavior and Influence*, Presentation at the James A. Baker III Institute for Public Policy, Rice University, March 1, 2007, p. 62.

Vertical Integration

Although national oil companies in oil-producing nations have their roots in upstream operations, some are striving to achieve vertical integration.¹² On an economic level, vertical integration allows the national oil company to capture the value added from producing and selling petroleum products. PDVSA's acquisition of Citgo in the United States provided refining as well as retail marketing outlets for Venezuelan oil. In addition, demand security was enhanced through gaining a position in the large U.S. gasoline market. In other cases, national oil companies might be able to gain access to markets otherwise not available to them. The national oil companies may also be able to achieve a greater degree of diversification and mitigation of risk through vertical integration. Oil prices have tended to be volatile. Profits may accrue to different parts of the supply chain at different times and during various market conditions. Vertical integration may enhance the ability of national oil companies to be profitable in changing markets.

Characteristics of National Oil Companies

Because national oil companies may be motivated by different objectives than private oil companies, their performance characteristics are also likely to be different. This might be of little consequence to consuming countries except that, in a tight oil market, the national oil companies may become an impediment to the smooth functioning of the world oil market in the future.

Efficiency

Productive efficiency is normally defined as maximizing the output associated with any given level of inputs. Measuring productivity in the oil industry, compared to a typical manufacturing industry, is difficult because geological factors enter into the process on the input side and may not be controllable by management in the normal sense. However, comparative econometric productivity studies within the oil industry do exist.¹³

Eller, Hartley, and Medlock (EHM) developed a series of empirical models to estimate the behavior of international private, as well as national, oil companies with respect to their relative efficiency. Model 1 is the basic model that views revenue as the output of the firm and uses gas reserves, oil reserves, and number of employees as the productive inputs. An estimated efficiency value of 1.0 is the highest score and 0.0 is the lowest score. **Table 5** presents the results of the EHM Model 1 for the top 10 oil companies as presented in **Table 1** for the three-year period 2002 through 2004. The efficiency scores represent averages for that period.

¹² Vertical integration is a characteristic of firms that are active in all stages of their supply chain. In the oil industry, vertically integrated firms operate in both upstream and downstream markets.

¹³ This analysis of technical efficiency is based on empirical work in, Eller, Stacy L., Hartley, Peter, and Medlock III, Kenneth B., *Empirical Evidence on the Operational Efficiency of National Oil Companies*, Paper prepared for *The Changing Role of National Oil Companies in International Markets*, part of a study at the James A. Baker Institute for Public Policy of Rice University, March 2007.

Table 5. Relative Technical Efficiency of the Top 10 Oil Companies, 2002-2004

National Oil Companies	Employees	Private Oil Companies
Saudi Aramco	11	ExxonMobil
PDVSA	16	ConocoPhillips
CNOOC	18	Chevron
NNPC	20	Shell
Petromas	38	BP
Statoil	39	
NIOC	43	
ONGC	94	
Rosneft	172	
PetroChina	267	

Source: *Empirical Evidence on the Operational Efficiency of National Oil Companies*, Eller, Stacy L., Hartley, Peter, Medlock III, Kenneth, Table 5, p. 19.

International private oil companies were near the top of the study efficiency rankings, and the national oil companies tended to be near the bottom of the rankings. The average efficiency score in the seventy-six firm sample was 0.40. The five major international oil companies' (ExxonMobil, BP, Shell, Chevron, and ConocoPhillips) average score was 0.73, and the average for the national oil companies in the sample was 0.27.

Efficiency in producing revenues, as defined in EHM, is likely affected by the national oil companies' objectives that in general include a greater range of motivating factors than value maximization. Subsidized sales and wealth distribution are unlikely to be favorable to maximizing revenues, and in fact, when adjusted for degree of vertical integration and government share of revenues, most of the apparent inefficiency of Saudi Aramco, PDVSA, and Pemex is explained. NIOC and PetroChina retain efficiency scores near the bottom of the sampled firms even with the specified adjustments. The addition of vertical integration and government share as explanatory variables suggest that the former is a desirable goal for national oil companies, and the latter suggests that the national oil companies would be more profitable without government participation. However, that outcome is unlikely.

Inefficiency is a problem not only for the national oil companies themselves but for the world oil market as a whole. If the most inefficient firms tend to be in control of the majority of the world's exploitable oil reserves and the market demand is projected to expand by approximately 30% by 2030, it would seem more likely that the expansion could be accomplished by more efficient firms.¹⁴ However, those firms, the international oil companies, hold a shrinking fraction of the world's reserve base.

¹⁴ Energy Information Administration, *Annual Energy Outlook 2007, With Projections to 2030*, Table B.1, February 2007, p. 169.

Investment

Because of the demands of the government and national treasuries, national oil companies may have a shorter time horizon for operational decisions than the international oil companies. The national oil companies may have an undue focus on earning current revenues and maximizing current production. This could result in mis-management of existing fields, which allows a smaller recovery percentage than theoretically possible, and a neglect of exploration and development. In the longer term, damage to the world oil market could be enhanced by the dominant position the national oil companies have in terms of potential reserve access.

For consumers, the national oil companies' focus on current production may work to keep the world price of oil relatively lower in the near term. However, if the national oil companies ignore investment in exploration and development, it could mean higher oil prices in the future. Some estimates of the needs for oil industry investment total \$16 trillion over 30 years.¹⁵ If the national oil companies do not undertake investment on this scale, and if they and their governments exclude the international oil companies from developing reserves in their countries, the world oil market could be supply-constrained in the future, and prices might be higher than if higher investment took place.

Table 6 shows the top 10 companies with respect to upstream, or exploration, development, and production, capital expenditures (Capex). Eight of the top 10 companies are private, or in the case of Petrobras from Brazil, 68% privately held. Only PetroChina and Statoil, among the publicly held national oil companies, are among the world leaders in upstream Capex. The eight private oil companies account for 75% of the total of \$94.5 billion invested upstream by the top 10 companies. The two entirely publicly held companies in the top 10 accounted for about 18% of the total. The Capex values do not reflect the limited access international oil companies have to potential oil deposits, or the preferred access to potential reserves that national oil companies are likely to enjoy.

However, even with the leading companies being privately held, some critics of the industry contend that these companies are not investing enough, especially in light of their record profit levels since 2004.

The private international oil companies' ability to make the investments needed to meet projected demand for oil is limited by a number of factors. The international oil companies may not have access to what they consider to be favorable prospects. Beyond the restricted access to potential reserve areas around the world, it may be that large companies have expertise in developing and operating large fields, a type of oil deposit in diminishing availability. In this sense, there may be a mismatch between the capabilities of the companies and the reserves to which they have access. The price of oil is volatile over time. As a result, a conservative investment policy, based on an expected price, not necessarily fully reflecting high current prices, might be in the companies' interest. The international oil companies may be making investment decisions on the basis of a future market price of oil lower than the current price, leading to lower levels of investment. Tight markets in trained manpower, specialized equipment, and materials likely leads to higher project costs as well as delays that may make investments less attractive.¹⁶ The private firms may be

¹⁵ International Energy Agency, *World Energy Investment Outlook*, 2003, p. 1.

¹⁶ Cambridge Energy Associates, *Record High Oil and Gas Project Costs Expected for 2007*; IHS/CERA Launch CPI-Like Index to Track Equipment, Materials and Personnel Costs, CERA Press Release, February 12, 2007. CERA found that the costs of major oil and gas production projects rose more than 53% over the past two years.

under financial market pressure to generate current returns. Upstream capital expenditure is a long-term investment that likely reduces current dividend pay-outs while using large amounts of current income. Finally, as a result of the mergers that have taken place in the industry over the past decade, the number of potential investors attracted to any particular exploration tract may have declined, slowing the need to respond rapidly with investment plans.

Table 6. Top Companies Upstream Capital Expenditures, 2006

(billions of dollars)

Rank	Company	Capex
1	ExxonMobil	14,470
2	Shell	12,046
3	BP	10,237
4	PetroChina	10,160
5	Total SA	10,040
6	ConocoPhillips	8,844
7	Chevron	8,389
8	Petrobras	7,194
9	EnCana	6,650
10	Statoil	6,423

Source: *Energy Intelligence Research*, "The Energy Intelligence Top 100: Ranking the World's Oil Companies," 2007 edition.

Reserves and Production

The non-commercial objectives of the national oil companies could lead to constraints on their ability to replace reserves and expand oil and gas production. The top 10 companies in terms of oil reserve replacement ratios do not include any of the top 10 oil companies as shown in **Table 1**. More importantly, the list also does not include any of the companies in **Table 2** or **Table 3** that list the top holders of oil reserves and the top oil producers. This implies that the national oil companies, while holding the largest reserve base, as well as drawing from that base at the highest production rate, are not restoring their positions through exploration and discovery. The highest ranking attained by a national oil company was PetroChina at number 26, having replaced 101% of produced reserves.

It is less surprising that none of the major private international oil companies is in the top 10 with respect to oil reserve replacement. Their reserves tend to be in older deposits, in areas like onshore United States, which has been extensively explored, and is unlikely to yield huge discoveries in the future. The highest-ranked international oil company is ConocoPhillips at number 30, having replaced 96% of produced reserves, while ExxonMobil replaced only 43%, BP, 11%, and Shell, -11%.

The inability of the industry to replace reserves implies that absent significant technological innovation, it will be increasingly difficult to maintain, let alone increase, oil production levels in the future. Only part of the problem may be due to the limitations of the industry, however. It is likely, from a geological viewpoint, that the largest oil reserve pools have already been discovered. The future may hold only smaller deposits to be discovered, meaning that many more discoveries must be made each year to replace ever-increasing levels of production.

Access to Capital

The International Energy Agency has estimated that over the period 2001 to 2030, the world will need to invest \$16 trillion in energy infrastructure to meet the needs of projected demand. The oil sector is expected to account for \$3 trillion of the total.¹⁷ To accomplish this level of investment, it is likely that the industry will need to draw on many sources of financial capital.

Since 2004, the international oil companies have had record-setting profit performances. This financial strength allows them substantial latitude in accessing financial resources. Because their own cash reserves have risen, internal financing has become a viable option. Because of their strong balance sheet and income statements, it is likely that they can access world capital markets for financing on relatively favorable terms.¹⁸

National oil companies are in a weaker position with respect to the capital markets. Their relative inefficiency in turning oil into revenues as discussed in this report makes them less likely to receive favorable terms from international capital markets. Their obligations to the national treasury to finance domestic welfare programs, along with the below market price sale of their products at home, make it less likely that they will have access to enough retained internal earnings to finance optimal levels of exploration and development of oil resources. To the extent that such companies experience a shortage of financial capital, it could result in higher prices and the potential for physical shortages in the future.

If national oil companies do gain wide-spread access to the world financial markets, this might not only spur upstream capital investment but might also provide benefits to the companies and their interface with the global market. Compliance with international accounting standards, more business transparency, as well as certain basic standards of corporate responsibility might result from the national oil companies' exposure to international financial markets.

¹⁷ International Energy Agency, *World Energy Investment Outlook*, 2003, p. 42.

¹⁸ CRS Report RL34044, *The Use of Profit by the Five Major Oil Companies*, by (name redacted).

Policy Analysis¹⁹

Recognition of national oil companies' growing dominance of the world oil market has led some experts to view this as an energy security issue. The growing strength of the national oil companies implies, at least in a relative sense, the diminished importance of the private international oil companies. This dynamic could transform the reaction of the market to demand and supply signals. Since a major thread of current policy toward oil is "let the market take care of it," a change in the way the market works might call for significant adjustments in the policies of oil-consuming nations.

Some of the policy options presented below have been extensively debated in the past as features of broadly based energy strategies, while others are controversial and would likely be difficult to implement. Others, such as the creation of a U.S. national oil company are extremely unlikely to be considered while the world oil market continues to function as a viable market.

Demand-Based Policy

The success of many economic policy measures designed to alter market outcomes requires consideration of likely actions by both those who demand the product as well as those who supply it. As a result, if oil-importing countries believe that the growing importance of national oil companies are a potential threat to their ability to gain access to desired supplies, not only should importers seek to change the behavior of national oil companies, but they might also change their own energy strategies. The key elements in such a demand-side policy are well known. They include diversifying the supply base, so that potential political problems are less likely to result in economic damage through reduced oil supply. In addition, conservation that reduces demand, or at least reduces the growth in demand, perhaps through taxes on imported oil or petroleum products, for example, might serve to reduce the potential influence that oil-based actions have on the domestic economy.

Supply-Based Policy

Oil importing nations might also use their political influence to try to encourage the national oil companies and their governments to alter their behaviors. The companies might be encouraged to improve their efficiency and respond to market signals more like privately owned firms. If the national oil companies find a need to access international capital markets more regularly, this result might be achieved as a natural result of exposure to the requirements of lenders. On a more political level, governments might try to encourage the governments of national oil companies to reduce their intervention in the operational decisions of the companies. This might be difficult to achieve in countries like Venezuela under the Chavez government, but progress likely can be made in more democratic environments. The clearest example might be Statoil and Norway, which operates largely on market principles.

¹⁹ This section of the report is based on policy directions explored at the conference, *The Changing Role of National Oil Companies in International Energy Markets*, at the James A. Baker III Institute for Public Policy, Rice University, March 1, 2007.

Oil Investment

If an important goal of U.S. energy strategy is to enhance the development of oil and natural gas resources around the world to expand market supply, there are many ways that goal can be achieved. Many of the appropriate policy measures are those that the U.S. government has used in other contexts.

Trade agreements, both bilateral and multilateral, can facilitate U.S. economic goals by allowing foreign nations preferential access to the lucrative U.S. market in return for progress in areas of interest to the United States, in this case expanded oil supply. Even though oil production can make a nation relatively rich, in many cases virtually all sectors of the economy remain poor, except for oil. Such nations might still require some form of foreign assistance to attain their development goals. In some cases, a poor nation just beginning to develop an oil industry might need more traditional forms of aid. In all cases, whether through foreign aid requirements or through access to trading opportunities and international financial markets, national oil companies and their governments could be encouraged to use standard business and accounting practices and employ transparent decision-making processes.

U.S. National Oil Company²⁰

Among the more radical, and unlikely, policy directions is a non-market strategy based on establishing a U.S. national oil company. Such a company, depending on how its mission might be defined, could act as both an offset to other national oil companies or act in cooperation with other nations' national oil companies when such opportunities might arise. Potential benefits to this approach might be a more direct linkage between oil issues and the interests of the U.S. government. For example, while an oil-producing nation's government might be willing to try to coerce private oil companies, they might be less willing to do so to a company directly tied to the U.S. government. A U.S. national oil company might also respond more directly to energy policy directions established by the government. Some might believe that the profit motive prevents the international oil companies from providing U.S. consumers with low-cost petroleum products. These concerns might be allayed if a U.S. national oil company were established.

However, a number of factors argues against the establishment of such a company. In times of governmental conflicts, host governments might be more willing to expropriate, or oust, a U.S. national oil company than a private international oil company. Such an action might make a larger political statement and also not disrupt the actual working of the host nation's oil sector as much.

Deals between national oil companies are not always successful. Examples of outcomes that failed to meet expectations include China and Iran, and China and Saudi Arabia.

Perhaps the most persuasive reason for not creating a U.S. national oil company is that the private international oil companies are very effective, in terms of efficiency and productivity, in finding and developing new oil resources. Their performance is especially impressive in light of growing difficulties in gaining access to areas of the world where potential discoveries may be made. If the U.S. government established a national oil company, it would send a signal that might

²⁰ This alternative was analyzed by Amy Myers Jaffe, *The Changing Role of National Oil Companies in International Energy Markets, Introduction and Summary Conclusions*, a Presentation at the James A. Baker III Institute for Public Policy, Rice University, March 1, 2007.

accelerate a weakening of the position of the private companies, a result unlikely to enhance U.S. energy security.

Conclusion

As the world oil market changes its structure to include the growing importance of national oil companies, a recognition of the likely consequences of this trend is an important first step in helping to secure oil supply. If the national oil companies hold the title to ever greater portions of actual and potential oil reserves, production, and exploration and development activities, and if they are relatively less capable of utilizing those resources, oil supplies are likely to be relatively constrained in the future. Given projections of demand growth of about 50% by 2030, constrained supply might imply sharply rising oil prices.

Venezuela provides an early example of how the political influence of a government can affect the supply of oil, disturb existing market partnerships, both with companies and with the United States, and forward the interests of U.S. competitors. The private international oil companies are unlikely to be able to counter national oil companies to preserve their own profit-seeking interests as well as those of the U.S. market, which requires adequate physical supply at moderate prices.

Various policy directions are available to counter the effects of national oil companies, but the recognition that a potential problem exists, as well as a long-term commitment to any chosen policy direction, will likely be needed to minimize the threat to U.S. oil market stability and energy security.

Appendix. Oil Company Acronyms

The national oil companies cited in this report and their acronyms are identified below.

Adnoc is the state-owned company of the United Arab Emirates

CNOOC is a 71% state-owned company of China

INOC is the state-owned company of Iraq

KPC is the state-owned company of Kuwait

Libya NOC is the state-owned company of Libya

NIOC is the state-owned company of Iran

NNPC is the state-owned company of Nigeria

ONGC is the 71.4% state-owned company of India

PDVSA is the state-owned company of Venezuela

Pemex is the state-owned company of Mexico

Pertamina is the state-owned company of Indonesia

PetroChina is the 90% state-owned company of China

Petronas is the state-owned company of Malaysia

QP is the state-owned company of Qatar

Rosneft is the 75.16% state-owned company of Russia

Saudi Aramco is the state-owned company of Saudi Arabia

Sonatrach is the state-owned company of Algeria

Statoil is the 70.9% state oil company of Norway

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