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The Energy Dimension in Russian Global Strategy

The Future of Saudi Price Discrimination: The Effect of Russian Production

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Introduction

The existence of the Asian price premium is now well established. Several papers by Jaffe and Soligo (1998, 2000), Fesharaki and Vahidy (2001) and the IEEJ have examined this issue and estimated the size and variation of the premium. Ogawa (2003) states that the premium of Asian prices to those prevailing in Europe and the U.S. averaged 94 cents/barrel over the period 1991-the first half of 2002 and has risen to over $1.50/barrel in some recent periods. As Ogawa points out, the premium amounts to a significant resource transfer from Asian consumers to oil exporters. A premium of $1/barrel would amount to a transfer of $5.5 billion per year, given Asian imports of 15 mm b/d in 2000. The transfer will continue to grow as Asian consumption increases unless the premium can be reduced.

Again, as noted by several authors, the implications of the Asian premium for resource transfers is even greater than rents gained through oil sales because Asian prices of liquefied natural gas (LNG) and coal are tied to crude oil prices. Since both LNG and coal compete with oil for many uses, any reduction in the premium charged for oil would stimulate a reduction the price of these substitute energy supplies.

To be precise, the Asian price premium refers to the fact that under the pricing formulae set by Saudi Aramco, the fob price for deliveries to Asia markets is set higher than for deliveries to the U.S. and European markets. The delivered prices of Saudi oil at various destination ports will depend on transport costs as well as the fob price. Jaffe and Soligo (1998, 2000) explained the Asian oil price premium through the use of a price discrimination model where Saudi Arabia has the power to segment the market for its oil exports and to charge a higher price for Asian delivery than for European and North American deliveries (see appendix for more detailed discussion of this dominant firm model). The paper correctly forecast that the Asian premium would persist as a result of continuing sanctions against Iraq and Iran. It was argued that these sanctions made it difficult for those producers to increase their own production capacity and thereby compete with Saudi Arabia. With Asian demand for oil expected to continue to grow at a robust rate, sanctions would limit alternative supplies to Saudi Arabia. At the same time, Asian

production was expected to decline, potentially enhancing Saudi Arabia's pricing power in the Asian market.

This paper is concerned with policies or options available to Asian consuming nations that would have the effect of reducing the Asian premium. In particular, it investigates whether planned increases in oil production in Russia and the Caspian region will affect the Asian premium.

Saudi Pricing Formulas

Virtually all of Saudi Aramco's sales to international buyers are made under long-term contract, linked to spot market prices in three broad geographic areas–North America, Western Europe and the Far East. The majority of Saudi contracts are for a duration of one year. Prices are generally determined under monthly pricing formulae that include a base price calculated by taking an average of spot market prices of a particular widely-traded "marker" crude oil. The fob price for European destinations is tied to the average spot price of dated North Sea Brent crude for the 10 days around the delivery of the cargo-about 40 days after loading in Saudi Arabia. The fob price to U.S. destinations is tied to West Texas Intermediate crude oil about 50 days after loading in Saudi Arabia. In contrast, Far East prices are linked to a 30-day spot average of Oman and Dubai crude oils during the month in which the crude is delivered to the Asian market. Beside the market-related pricing formulas, Saudi Aramco also offers a tanker rate subsidy to large international oil companies that purchase its oil on a fob basis for delivery to Europe and to the United States.

This base price is then modified by adding or subtracting an adjustment factor that takes into account differences between the market value of the Saudi crude and the spot market indicator crude. In theory, the adjustment factor reflects the monthly changes in the refining value of Saudi crude grades in various geographic markets as well as some of the differences in transportation costs between Saudi crude and the marker crude. This is an accurate description of how adjustment factors are set in the European and U.S. markets where there is a great deal of competition in the market for various crude oils and petroleum products. If the adjustment factor is not set correctly, Saudi crude would be disadvantaged relative to competing crude oils.

Refiners also have the option to reduce refinery throughput rates and to purchase refined products to meet end-user demand if spot products markets provide an economical alternative to processing Saudi crude oil.

In the Asian market, however, it can be argued that crude markets are less competitive, allowing Saudi Arabia to introduce an arbitrary component to the adjustment factor. As we shall discuss below, the degree of arbitrariness is limited. If Saudi Arabia sets its crude oil export prices to Asia too high, crude oil and products will flow in from other areas of the world and undermine Saudi sales to Asia. The costs and risks of bringing these more distant alternative supplies to Asia, nonetheless, permit the kingdom to exploit a certain level of market power that constitutes the Asian premium. This paper will explore the nature of this premium, its causes, and its limits as well as strategies to reduce its potential impact.

The Asian Premium

Table 1 below shows our calculation of the Asia-Europe price differential based on data supplied by Petroleum Intelligence Weekly (PIW). Prices are fob, Saudi Arabia. The differential is simply the difference in the prices reported for Asia and Europe for oil that is lifted in each month. The percent differential is the differential divided by the European price.

These data show that in the period since the introduction of the Saudi price setting formulae in the late 1980s, the Asian premium has averaged 90 cents/barrel. However, since the early 1990s, the average premium has increased to $1.11, and from 1997- 2002 it has further increased to $1.48. It is interesting to note that the Asian premium has increased over time despite a process of deregulation of crude and product markets in Asia.

In percentage terms the premium has averaged 5.9% over the period 1988-2002 and 7.1% over 1991-2002. There were four years in which the premium exceeded 10%.

Table 1: Asia premium: Arab Light–34		
Year	USD/barrel	As % of Europe
1988	0.94	7.10
1989	-0.40	-2.39
1990	-0.34	-1.56
1991	0.57	3.42
1992	0.65	3.78
1993	1.43	10.03
1994	0.75	5.15
1995	1.04	6.65
1996	-0.07	-0.37
1997	2.69	16.79
1998	2.21	22.18
1999	-0.56	-3.15
2000	1.75	6.96
2001	2.29	10.98
2002	0.58	2.44
Average 1988-2002	0.90	5.87
Average 1991-2002	1.11	7.07
Source: PIW		

Determinants of Power to Price Discriminate

In a theoretical world where no producer has the power to price discriminate, delivered prices of different crude oils in different geographical regions will reflect differences in transport costs as well as specific quality of the crude. Since transport costs are governed by distances between producing and consuming areas (size of tanker is of course also a factor), Asian buyers should purchase oil from the closest sources first and extend their purchases only to the extent that more oil is needed from more distant suppliers. Since local Asian oil production is not sufficient to fully cover regional demand, imports from outside the region are required. The Middle East is the closest alternative supplier, and therefore, it would be logical to assume that Asia would primarily depend on the Middle East for its imported supplies. Alternative sources of supply such as West Africa, for example, have to travel much further than Middle East oil to reach Asian consumers and hence would (on a quality adjusted basis) be at a disadvantage. To the extent that Middle East supplies could not satisfy Asian import demand, one would observe oil

from other sources such as West Africa being shipped to Asian markets, and oil produced in the Middle East would earn a premium since prices would be set by the more expensive cost of bringing marginal supplies from West Africa.

In reality, the Middle East produces more than Asian import demand. Excess Middle East production flows to Europe and U.S. markets (hereafter referred as the Atlantic market). In a world of no price discrimination, fob Middle East prices would be set low enough to encourage additional buyers outside of Asia in other markets farther away from the Middle East than Asia such as Europe or the U.S. These Atlantic Basin buyers would be the marginal buyers and, as such, would set the prices for Middle East crude worldwide. Asian buyers would be in an advantageous position, as Middle East suppliers would have to set prices low enough to reflect the transport cost disadvantage of competing in the Atlantic market. If there was no price discrimination, the delivered price of Saudi oil in relatively close markets such as Singapore would be lower than the price delivered in Rotterdam–reflecting the differences in transport costs.

However, as we have discussed above, Saudi Arabia has been able to compete in the Atlantic market without granting Asian buyers the same fob price given to buyers in Europe and the U.S. As the data in Table 2 shows, the delivered price of Saudi oil in Singapore is actually higher than for Rotterdam, suggesting that transportation costs are not the major determinant of price differentials among the various geographic markets.

Table 2: Delivered Price of Arab Light–34

	1	2	3	4
Year	Rotterdam	Singapore	Col (2)-Col (1)	Col(3)/COL(1)
1996	20.16	19.62	-0.54	-2.7%
1997	18.25	18.88	0.63	3.5%
1998	11.84	12.98	1.14	9.6%
1999	17.01	17.12	0.11	0.6%
2000	27.17	27.68	0.51	1.9%
2001	23.13	24.00	0.87	3.8%
2002	23.47	24.42	0.95	4.0%
Average	20.15	20.67	0.52	3.0%

Source: PIW

Charging different buyers different prices not based on differences in marginal costs is the definition of price discrimination. Since the marginal cost of oil at the point of shipping is the same regardless of the destination of that oil, any difference in the fob price represents price discrimination. In order for a firm to be able to price discriminate, a number of conditions must be present. First, the firm must possess some power to set price. Second, it must be able to identify separate markets in which the price elasticity of demand for its product is different. Third, it must be able to prevent resale of its product from the low priced to higher priced markets. These conditions are satisfied for Saudi Arabia.

In making the case that Saudi Arabia is able to price discriminate in oil markets, we consider all three of these conditions. In evaluating Saudi Arabia's power to set prices, it is first important to distinguish between the power to set average world prices and the power to set prices in a particular region. Saudi Arabia has had varying success in setting world prices, depending on the overall balance between world demand, production capacity of other oil producers, and the degree of cooperation among OPEC producers. Pricing power has been greatest when growth in demand has outstripped growth in production capacity so that Saudi Arabia, by fine-tuning its output, can set world prices. In situations where demand has grown less than capacity, Saudi pricing power is weak.

The same logic applies to Saudi pricing power in geographical markets. Saudi pricing power is strong in Asia relative to Europe and the U.S. because there is little spare oil production capacity among Asian and other Middle East producers. Table 3 shows the share of Asian exports to total production for Middle East producers in 2002. Note that 60% of Middle East exports went to the Asian market. (The share of Middle East crude and condensate in total Asian imports was roughly 70% in 2002).

Countries such as the United Arab Emirates (UAE), Oman and Qatar are already exporting the vast majority of their exports to Asia. Kuwait exports over half of its production to Asia, with the remainder being shipped to Kuwaiti-owned refineries in Europe. Throughout the 1990s, Iraq was constrained in the amount of oil it shipped to Asia because of damage to export infrastructure in the Gulf War. In the 1990s, most of its exports were transported to the Turkish port of Ceyhan on

the Mediterranean Sea through a pipeline from Iraq through Turkey. During this same time period, sanctions on both Iraq and Iran limited capacity expansion in those countries. More recently, following the U.S. campaign in Iraq in 2003, Persian Gulf export facilities have been repaired, and exports are being diverted to the Gulf because of frequent sabotage of the pipeline to Turkey. Sabotage and other technical and security-related problems have so far prevented Iraq from expanding its production capacity since 2003.

Table 3: Middle east Producers' Crude And Condensate
Exports To Asia-Pacific (thousands b/d) 2002

Country	Production	Exports to Asia	Share
Iran	3,440	1,360	39.5%
Iraq	2,020	140	6.9%
Kuwait	1,890	1,070	56.6%
Oman	897	760	84.7%
Qatar	680	670	98.5%
Saudi Arabia	7,630	3,120	40.9%
UAE	2,080	1,810	87.0%

Source: Output data from EIA, Asia Export Data from MEES

At present, Saudi Arabia and Iran are the only two countries that could increase exports to Asia and have a significant effect on prices. In other words, these two countries can, by selectively allocating their exports between Asia and other markets, create a price differential between the Asian and non-Asian markets. Iranian pricing has followed that of Saudi Arabia, appearing to tacitly collude in the price discrimination policy.

The closest alternative to Saudi (and Iranian) oil in terms of transport costs is West African crude. However, West African has three important disadvantages in competing with Saudi crude in the Asian market.

First, the transport cost to bring West African crude oils to Asia is higher because the supplies are more distant from the Asian market than Middle East supplies. It takes a tanker 36 and 27 days respectively to travel from Nigeria to Japan and Singapore but only 22 and 12 days from Saudi Arabia.

Second, compared with Saudi oil, West African crude is lighter with lower sulfur content and hence is priced higher than Saudi oil, because it can produce a greater proportion of higher valued lighter products and can do so without large investments in sophisticated refinery equipment. Many Asian refineries, with the notable exception of older facilities in China, have already invested heavily in desulphurization capacity, reflecting long-standing dependence on Middle East crude oils. The significance of this factor is that sophisticated Asian refineries will not be willing to pay a premium for the lighter West African crude oils if cheaper Middle East oil is available. By contrast, less sophisticated refineries (such as those in China, the U.S. or Europe), not designed to process the heavier crude oils without producing too much lesser valued fuel oil, will compete for these higher quality crude oils.

Atlantic Basin refiners are willing to pay a premium for West African supply because U.S. and European markets demand a higher proportion of lighter to heavier products than the Asian market. In particular, light transportation fuels are a relatively larger portion of product demand in the West as compared to Asia. Also, natural gas represents a greater competitor to fuel oil in the U.S. and Europe, reducing the value of heavy sour crude in the Atlantic Basin markets as compared to Asia. Finally, Atlantic Basin refiners are willing to pay a premium for West African crude oils because they are located physically closer than Middle East crude oils.

There may be circumstances when Asian refineries with desulphurization and conversion facilities are willing to pay a premium for West African oil. For example, where Asian product demand has temporarily shifted towards lighter products and prices for the lighter products are atypically high, the higher crude price would be justified by the higher product prices if the sweeter crude was necessary to meet that atypical demand.

Finally, price volatility also facilitates price discrimination in that it presents an additional cost, in the form of time risk, to importing oil from distant, geographical areas such as West Africa instead of closer Saudi crude oil. In addition, Saudi contracts contain an element of risk sharing between the buyer and Saudi Aramco. Saudi crude is priced as a 30 day average of “spot” Dubai/Oman crude oils. The risk that prices at the date of delivery differ from that at the date of

lifting is shared by the Saudis and the buyers. When world prices are rising, the Saudis absorb the loss as the formula price trails spot prices. When prices are falling, buyers lose. By contrast, hedging costs for a spot cargo are borne by the buyer, and those costs will be a function of the time during which the price risk is being incurred. In addition, hedging costs are higher in Asia than elsewhere because the Asian derivatives market is thin, and Asian prices are influenced in large part by the pricing policies of the largest sellers such as Saudi Arabia. The costs of hedging represent another difference that can be exploited between the cost of importing West African crude to Asia and importing Middle East crude under a 30 day formula price.

The second requirement for successful price discrimination is that the seller must prevent resale of its product between the lower and higher priced markets. Saudi Arabia is able to prevent traders from diverting cargoes destined for European and U.S. markets to the higher priced Asian market. It does so by refusing to sell its crude oil to any company that will not refine its oil directly. Moreover, Saudi Aramco restricts the terms under which end-user refiners can resell or shift Saudi crude from one geographic region to another. Its contracts with the major oil companies stipulate that resale of Saudi crude cannot take place without Saudi Aramco's permission. Resale to traders is barred, and sales to another refiner (say, in a case where the original purchaser has a refinery outage or other technical problem) are approved on the basis that the new purchaser pays the formula price for the geographic location where the crude will be refined. Firms that refine Saudi crude in more than one geographic location must specify the ultimate destination for every cargo purchased and pay the formula price for that destination. Major oil companies that buy Saudi oil have an incentive to honor these contract terms since they expect to be in a long-term relationship with Saudi Aramco.

The third requirement for successful price discrimination is that the price elasticity of demand for the firm's product be different in the segmented markets. Assuming that the marginal cost of supplying the two markets is the same, the firm will maximize profits by equating the marginal revenue, not the price, in the two markets. This results in a higher price in the market where the firm's demand curve is less elastic (more inelastic).

A useful model for Saudi Arabia is that of the "dominant firm" where there is one large firm that acts as a residual supplier and hence sets price. In this model, the elasticity of demand facing the dominant firm (Saudi Arabia) for its product is a function of the overall demand curve for the product and the elasticity of supply of the smaller rivals, referred to as the "competitive fringe." In this model the elasticity of demand for Saudi oil in the Atlantic market (the U.S. and Europe) is given by:

$$\varepsilon_{se} = \frac{Q_e}{Q_s} \cdot \varepsilon_e + \frac{Q_{oe}}{Q_s} \cdot \varepsilon_{oe}$$

where ε_{se} is the elasticity of demand for Saudi oil in the Atlantic market,

ε_e is the elasticity of demand for oil in the Atlantic market,

Q_e is equal to the quantity of oil consumed in the Atlantic market,

Q_s is the quantity of Saudi oil consumed in the Atlantic market,

ε_{oe} is the elasticity of supply of oil, other than Saudi, to the Atlantic market

Q_{oe} is the quantity of oil, other than Saudi, consumed in the Atlantic market.

A similar equation for Asia would determine the elasticity of demand for Saudi oil in that market.

In other words, the elasticity of demand for Saudi oil in each market is a weighted average of the overall elasticity of demand for oil and the elasticity of supply of non-Saudi oil in that market. The weights are, respectively, the inverse of the share of Saudi oil in total supply and the ratio of non-Saudi to Saudi oil in the market. All else being the same, the elasticity of demand for Saudi oil is greater the greater the elasticity of demand for oil in general, the lower is the Saudi share in that market and the greater the elasticity of supply from other producers.
For our purposes, it is not necessary to assume that the elasticity of demand for oil or the elasticity of fringe supply is different in the two markets in order for there to be a difference in the elasticity of demand for *Saudi* oil in the two markets. The difference in elasticity between the Atlantic and Asian markets can occur solely as a result of the Saudi decision to allocate its exports so that there will be a difference in the share of Saudi oil in the two markets. If the overall demand elasticity and the supply elasticity of the competing fringe are the same, the

elasticity of Saudi oil will be less elastic in the market where its share is the largest. So, for example, in 2003 the Saudi share of the Asian market was approximately 15% while its share in the Atlantic was roughly 8%. The demand for Saudi oil in Asia would be less elastic than in the Atlantic even if the elasticity of demand for oil or of fringe supply is the same in the two markets.

The effect of different Saudi shares on the demand elasticity of Saudi oil in Asian and Atlantic markets could be offset if the elasticity of demand for all oil or if the supply from the competitive fringe is more elastic in Asia than in the Atlantic market. However, both of these possibilities are unlikely. In the Atlantic region, oil competes head to head with natural gas to a greater extent than in Asia. This gas on oil competition will increase the elasticity of demand for oil. On the supply side, we have already pointed out that there is very little additional oil that can be supplied from non-Saudi sources in Asia and the Middle East. The largest potential sources are from Iran and Kuwait, which have an incentive to collude with Saudi policies. In the case of Kuwait, Kuwaiti owned refineries in Europe process their own oil and Kuwait has not exhibited an inclination to divert its oil from its own refineries in Europe to the Asian market. In the Atlantic market there are many more sources of crude oil or petroleum products so the elasticity of non-Saudi supply would, if anything, be greater than in Asia.

Given a difference in demand elasticities for its product, a price discriminating firm will set prices in the two markets inversely to the elasticities in those markets. In the case of Saudi Arabia where the marginal fob cost of supplying the Asian and Atlantic markets is similar, the Saudis will maximize the income from oil sales if they set prices so as to equate the marginal revenue in each market. Marginal revenue is a function of the demand elasticity and is given by:

$$MR = p \cdot \left(1 - \frac{1}{\varepsilon_d}\right)$$

where ε_d is the demand elasticity for Saudi oil and p is the fob price of oil.

If the marginal revenue is equalized in both markets, the ratio of prices in the two markets which maximizes revenue will be:[1]

$$\frac{p_{fe}}{p_e} = \frac{\left(1 - \frac{1}{\varepsilon_{se}}\right)}{\left(1 - \frac{1}{\varepsilon_{sfe}}\right)}$$

In the case of Saudi pricing policy, the price ratio is limited by the fact that at some differential, it will be profitable to bring West African crude and other non-Saudi oil from the Atlantic Basin into Asia. At that point, the supply of non-Saudi oil in the Asian market becomes much more elastic–and that increases the elasticity of demand for Saudi oil in Asia–reducing the benefit from further increases in the Asian price.

For the moment, we ignore this kink in the non-Saudi Asian supply curve and calculate the profit maximizing Asian-Atlantic fob price ratio for alternative values of the demand and non-Saudi supply elasticities for oil–using no kink and assuming that Saudi exports account for 15% and 8% of the Asian and Atlantic markets respectively. We assume that both the elasticity of demand for crude as well as the elasticity of supply of non-Saudi oil is the same for both European and Asian markets. As we have indicated above, the price ratio would be higher if oil demand and non-Saudi supply elasticities in Asia were more inelastic than in Europe. Table 4 shows the fob price ratio for demand elasticities in the range of 0.3 to unity, which is in line with the range given by various authors.[2] For the elasticity of supply of non-Saudi oil we follow Griffen and Steele and use a range from 0.1 to 0.5.[3] Optimal prices for the Far East range from 3.8% to 23.0% higher than for Europe, depending on the value of the parameters used. The price differential increases as either the demand for oil or non-Saudi supply becomes more inelastic.

[1] Note: We use the convention of ignoring the negative sign on demand elasticities and treating elasticity as a positive number. The formulae reflect this practice.
[2] See (Moran 1982), (Daly et.al., 1982) and (Gately, 1984) for some discussion of estimates of demand elasticites.
[3] Griffen and Steele's range refers to the supply elasticity of non-OPEC rather than non-Saudi crude.

What the analysis in Table 4 establishes is that for reasonable values of the assumed elasticities of demand for oil and of supply from the competitive fringe, Saudi Arabia has an incentive to establish and maintain an Asian premium. The analysis does not allow us to calculate the precise value for premium because as we do not know the true values of the various parameters used in the calculation. But the most likely value for the long run elasticity of demand for oil is closer to unity than to 0.3. So, for example, using a demand elasticity of unity, if the elasticity of supply of non-Saudi oil is between 0.5 and 0.1, the Asian price premium would vary between 4.9% and 6.5%. A demand elasticity of 0.7 would yield a premium between 6.4% and 9.6%. These numbers are consistent with actual price differentials as shown in Table 1. Given that the absolute price differentials shown in Table 1 are close to the point where Atlantic Basin oil would be profitable to be shipped to Asia, it appears that the Saudis have indeed allocated their exports in such a way as to maximize their total export revenues.

Table 4: Optimal Ratio of Far East to European Prices

Elasticity of Demand for Crude	Elasticity of Supply of Non-Saudi Oil	P_{fe}/P_e
1.0	0.5	1.049
0.7	0.5	1.064
0.5	0.5	1.081
0.3	0.5	1.110
1.0	0.1	1.065
0.7	0.1	1.096
0.5	0.1	1.140
0.3	0.1	1.258

The observed Asian premium will vary from month to month due to are a number of other factors that will affect its size in any particular period. The model presented above uses long run elasticities for both demand and non-Saudi supply. In the short run, both elasticities are very small so that the "optimal" differential could rise substantially for short periods of time. So, for example, a particularly cold month in Asia that was unanticipated will drive up prices of crude in Asia relative to other markets due to the long lags in the demand and supply responses. An unanticipated period of good summer weather in Europe may increase the demand for automobile fuel, raising the relative price of crude in Europe as refineries attempt to meet the

rising demand. These types of events produce short-term volatility in demand and will cause temporary deviations from the longer term relationship between crude prices in the different geographical markets.

Indeed, even swings in the *composition* of demand for petroleum products, as distinct from changes in the *level* of demand, can affect geographical price differentials. For example, if light refined product prices (gasoline, jet fuel and distillate) rise relative to heavier product prices (fuel oil and other heavier products) in European and/or U.S. markets. (The spread between prices light refined products (white) and heavier refined products (black) is referred to in the industry as the white/black spread). Refiners will bid up the prices of lighter crude oils relative to heavier crude oils. From the perspective of Asian markets, a relative rise in the price of lighter (West African) crude oils raises the price at which African oil will flow to Asia, thereby increasing the premium that Saudi Arabia can charge for its crude oil. On the other hand, if the white/black differential falls in European and/or U.S. markets relative to Asia or rises in the Asian market relative to Western markets, Asian refiners will be willing to increase the price they pay for lighter crude oils that yield more of the white products. As white product prices rise, West African crude oils become relatively more attractive. In this case, Saudis may have to reduce the Asian premium in order to maintain Asian sales.

So long as Saudi Aramco has the flexibility to allocate its exports between the two markets, it will have an incentive to do so in order to create a price differential between them. All that is required is that Saudi Arabia can maintain a more inelastic demand for its oil in Asia. This can be accomplished by manipulating its market share in Asia to be greater than in the Atlantic Basin. If its ability to determine its market share in each market is constrained–say by a flood of non-Saudi Middle Eastern and Russian oil–it could conceivably loose the incentive to price discriminate in this fashion.

The Effect of Increased Russian Supplies on the Asian Premium

As discussed above, Saudi Arabia has the technical ability to price discriminate so long as it can enforce destination pricing. It has an incentive to price discriminate so long as the demand for its

oil is more inelastic in Asia than in Europe or the U.S. We have shown that the elasticity of demand for Saudi oil in a market is a function of the Saudi share of that market–along with other variables. We have suggested that Saudi Aramco has come close to setting market shares so as to fully exploit the transport cost differences in shipping oil from outside the Middle East to the Asian market and to maximize its oil revenues.

The model we have drawn is a static one. Over time, both Asian demand and oil production from various sources will grow. In particular, Russia and the Caspian region (FSU) are expected to increase oil production and exports substantially over the next decade. This section focuses on whether increases in crude production and exports from the FSU and/or the non-Saudi Middle East will change the variables that permit the Asian premium to exist and continue. We also consider whether the destination of FSU exports, eastward toward China and Japan, or westward towards Europe and the U.S. can affect the Asian premium.

Table 5 shows IEA projections of net oil imports for various regions in the world while Table 6 shows the change in net imports for the period 2000-2010 and 2010-2020. North America and OECD Europe will experience significant increases in imports but by far the largest increase will occur in Asia. During the period 2000-2010, significant increases in Asian imports will come from the former Soviet Union (FSU), (mostly Russian and the Caspian producers), the Middle East and rest of world (Africa and Latin America). The FSU is not expected to increase net exports very much after 2010.

Table 5: Projections of Net Imports by Region
(Millions b/d)

	2000	2010	2020	2030
OECD Europe	7.4	10.1	12.5	13.9
OECD North America	8.6	10.8	15.4	20.9
Asia	12.5	19.5	26.6	34.0
FSU	-3.5	-7.3	-7.6	-7.8
Middle East	-19.0	-23.1	-33.0	-44.6
Rest of World	-7.0	-11.0	-15.1	-17.2

Source: IEA, World Energy Outlook 2002

Table 6: Changes in Net Imports and Exports (Millions b/d**)**		
	2000-2010	2010-2020
OECD Europe	2.7	2.4
OECD North America	2.2	4.6
Asia	7.0	7.1
FSU	-3.8	-0.3
Middle East	-4.1	-9.9
Rest of World	-4.0	-4.1
Source: IEA, World Energy Outlook 2002		

The Middle East will continue to produce more than the Asian market can absorb; so oil will continue to flow into the Atlantic market from the Middle East. Given this fact, it is likely that an Asian premium will continue so long as Saudi Aramco can continue to prevent arbitrage of its oil between regional markets.

To the extent that exports from Russia can have an impact on Saudi price discrimination, that influence will come in the near term–over the next 5-8 years–when Russian exports could increase by as much as 2 million b/d. Table 8 on page 23 examines the possible impact of Russian exports under several scenarios. All of these scenarios are based on an optimistic forecast, given in Table 7, regarding non-Saudi Middle East oil exports. Under these projections, Saudi Arabia would only have room to increase its oil exports by 0.48 million b/d between 2000 and 2010 to balance the market.

Table 7: Middle East Production Forecast				
	2000	2005	2010	2010-2000
Iran	3.75	3.80	5.00	1.25
Iraq	2.90	2.30	4.50	1.60
Kuwait	2.40	2.40	3.00	0.60
UAE	2.40	2.50	2.50	0.10
Qatar	0.73	0.75	0.80	0.07
Total	12.18	11.75	15.80	3.62
Authors estimates				

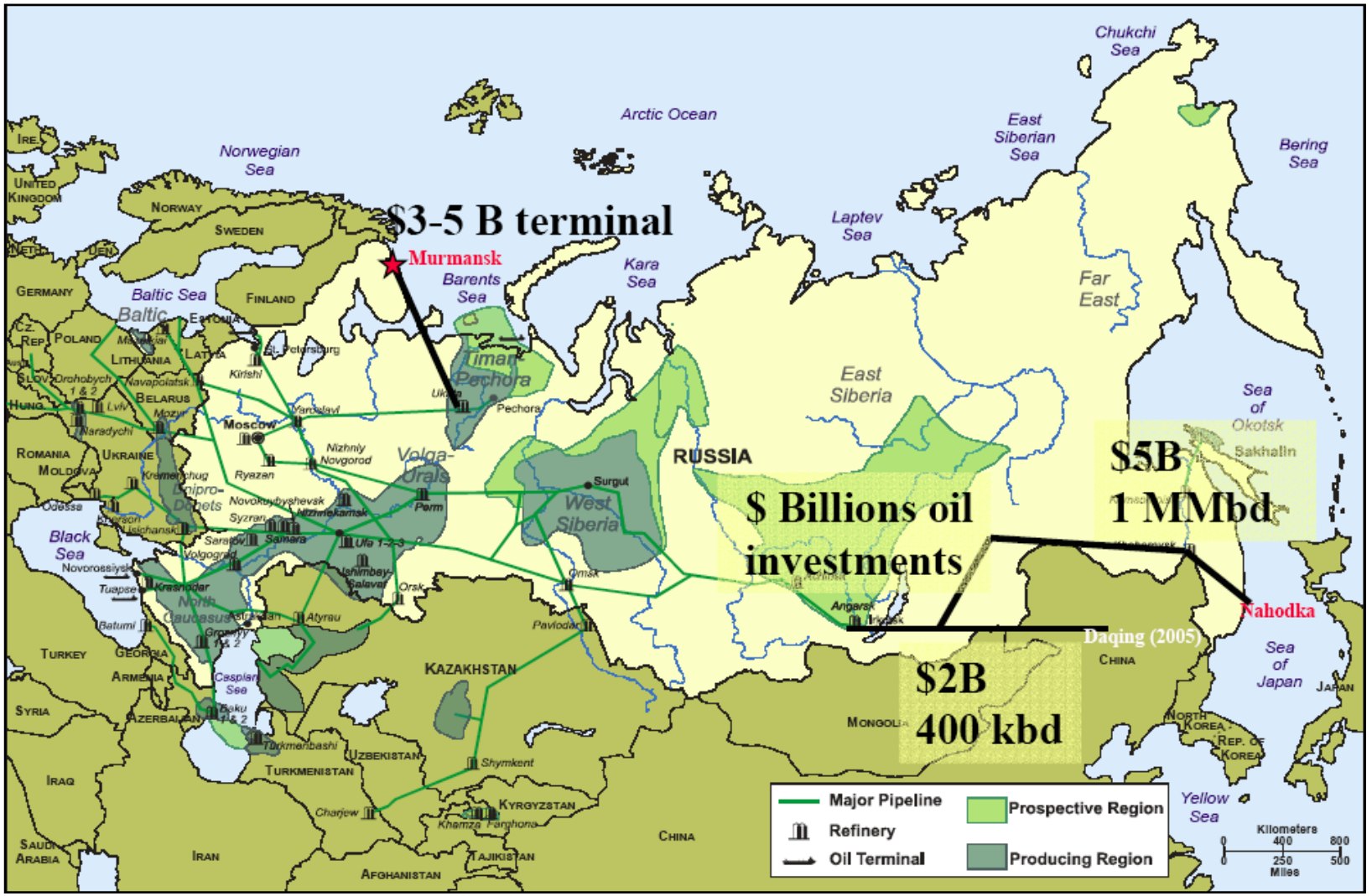
In order to see under what circumstances Saudi power to price discriminate might be weakened, we consider several scenarios highlighting different assumptions about the destination for incremental oil exports from the Middle East and Russia over the coming years. For the sake of illustration and because our focus is on the largest possible impact of exports from the FSU and non-Saudi Middle East, we assume in all scenarios that all incremental non Saudi Middle East oil production is exported to Asia. For expositional purposes, these incremental exports are rounded off to 3.6 million b/d. We also assume in all of the scenarios that increases in "Other" exports (Africa, Latin America and non-conventional oil) are exported to the Atlantic Basin. This is consistent with the fact that these sources are closest to the Atlantic market and most likely to be mainly absorbed in those markets. But even if some of this oil were exported to Asia, our conclusions would not be affected.

Under current market conditions, most of the increase in Russia production will likely be exported westward through Europe, the Baltic Sea or the Mediterranean. However, three export routes have been proposed to ship Russian oil directly to Asia: oil by ship from Sakhalin oil fields to Asia; oil by pipeline from Eastern Siberia field to the Chinese refining center at Daqing; and oil by pipeline from West and East Siberia via eastern Russia to the Russian port of Nakhodka on the Pacific coast (see map of Russian routes in Figure 1 on the following page). The proposed pipeline to Nakhodka received a recent boost when Transneft won approval from East Siberia's Irkutsk region to proceed with the project.[4] Additionally, the Russian Ministry of Energy is requesting that the government consider tapping the Stabilisation Fund to help pay for the line.[5]

The proposed capacities of pipelines to China or Japan are 600,000 b/d and 1 million b/d respectively. These pipelines from East Siberia are viewed as competing rather than complementary projects. Sakhalin oil production is expected to add roughly half a million barrels a day to Russian exports by 2008.

[4] Platts Global Alert, March 31, 2004.
[5] Gorst, Isabel, Russian Oil Pipelines: Business Vs. Politics, working paper, James A. Baker III Institute for Public Policy

Figure 1: Major Russian Pipelines and Proposed Pipelines



CNPC also recently signed a contract to build a pipeline to carry Kazak oil eastward to China by 2006. The Kazakh-Chinese line will originate in the South Turgai Basin in central Kazakhstan some 2,000 kilometers east of the Caspian Sea. West Siberian oil could be brought south to South Turgai via the existing line from Omsk to Central Asian refineries at Pavlodar, Chimkent and Chardzhou. So far, however, no Russian throughput contracts have been seriously investigated since, as operator of the line from Omsk, Transneft's blessing would certainly be needed for any such deals.[6]

The increase in Russian production and exports will come primarily from Timan-Pechora in northern Russia as well as East Siberia. Private interests have also promoted a pipeline from the Timan-Pechora region to Murmansk where the oil would then be loaded on tankers bound for the U.S. market. An alternative is the Northern Gateway proposal that would export this oil through Vandey. Discussion of the route to the East has been limited to exporting oil from the Irkutsk area in Eastern Siberia and has focused on the alternatives of building pipelines to Daqing in China (600,000 b/d) versus Nakhodka on the Pacific coast of Russia (1 million b/d). The consensus is, for the near future, East Siberian production will not be sufficient to supply both pipelines. The result has been competition between Japan and China over which route should take precedence.

Yet, shipments to the East need not be limited to East Siberian production. A pipeline already exists from West Siberian fields to Angarsk, near Irkutsk. Oil is being shipped to supply refineries in the far eastern part of Russia–using a combination of this pipeline and thereafter, railcar. While it is true that production in the west Siberian fields is not expected to increase significantly, crude from Timan-Pechora could be funneled into the western oriented pipeline at Perm replacing crude that would be diverted to the east. Indeed, a pipeline already exists from Ukhta to Yaroslavl that connects to the Baltic pipeline system (BPS) and an existing pipeline to Poland. Capacity of the line from Ukhta could be increased to a point north of Perm where a spur could be built to connect to the main pipeline to the European heartland via Druzba. This might rule out the need

[6] Ibid

for a pipeline to Murmansk–a project that has recently lost favor with the Russian administration.

The point is that flexible links could mean that West and Eastern Siberian oil production taken together could potentially support the construction of two pipelines to Asia. But even if both were built, the combined exports from Russia, including Sakhalin production, would not be much more than 2 million b/d. This increased flow in and of itself would not be sufficient to reduce Saudi share of the Asian market and hence reduce the capacity to maintain the Asian premium. However, increased Russian exports, combined with increased exports from other Middle East producers such as Iraq and Iran would undermine Saudi pricing power in Asia as discussed above as long as these other suppliers did not cooperate with Saudi Arabia.

There are other pipelines that have been proposed to bring Caspian oil to the Asian market. Proposals to transit Caspian oil via Iran are not viable for the foreseeable future due to continuing U.S. economic sanctions against Iran. Another proposed route to bring oil from Central Asia through Afghanistan and Pakistan to the Arabian Sea remains in limbo due to heightened political instability along the route.

Increased oil exports from Azerbaijan are soon to flow to the Mediterranean via the Baku-Tibilsi-Ceyhan (BTC) pipeline, which is slated for completion in 2005. Depending on the market balance in Europe, incremental supplies from the FSU to Europe could be directed to the Asian market through an existing pipeline via Israel with a capacity of 1 million b/d running from Ashkelon to the Red Sea port of Elat.[7] This oil route has already been utilized for shipments of Russian oil eastwards.

In analyzing what the increased flows of Russian oil to Asia, combined with rising oil production in Iraq, Iran and Kuwait, might mean for Asian pricing, we consider several scenarios. The first scenario is one where all of the incremental exports from the FSU are shipped westward to the Atlantic Basin. Between 2000 and 2010, imports by OECD

[7] Quoted from radio News Netherlands at http://www.rnw.nl.hotspots/html/oil030718.html

Europe and North America are projected to increase by 4.9 million b/d. Exports by producers in South America, Africa and the FSU will increase 7.5 million b/d. If all exports from Russia and the Caspian region are shipped westward to Europe and the U.S., the increase in exports will exceed projected increase in imports in the Atlantic basin by 2.6 million b/d. Thus, either Middle Eastern producers will have to withdraw by this amount from the Atlantic market or some oil will begin to flow from the Atlantic to the Asian market. From the perspective of transport efficiency (as well as price), it makes sense for the Gulf producers to shift their exports to Asia and make room for increased supplies from other areas in the Atlantic market.

Middle East exports are forecast to increase by only 4.1 million b/d while Asian demand will increase by 7 million barrels a day between 2000 and 2010. So, implicit in the IEA forecast is the assumption that some growth in Asian demand will have to be met by non-Middle East sources or that Middle East suppliers will shift some output from the Atlantic to the Asian market. For scenario one, we will assume that Saudi Arabia withdraws sufficient oil from the Atlantic to accommodate increased exports from the FSU. The amount required would be 2.9 million b/d–essentially wiping out their presence in the Atlantic market.

Under a second scenario, we assume that all incremental exports from the FSU (roughly 3.8 million b/d) go to Asia. This is a less likely scenario as discussed above. If the FSU exports are added to the optimistic estimates extra production of non-Saudi Middle East oil of 3.6 million b/d, the total oil available for shipment to Asia would total 7.4 million barrels a day or 0.4 million b/d in excess of the projected increase in Asian demand. We assume under this scenario that Saudi Arabia will accommodate FSU supplies and redirect 0.4 million b/d of existing Asian exports to the Atlantic market. When this volume is added to their additional projected 0.5 million barrels a day increase in overall exports, total Saudi flows to the Atlantic Basin expand by 0.9 million b/d.

In scenario three, we assume that incremental FSU exports are split evenly between the Asian and Atlantic markets. This is a more realistic scenario than the second since

transport costs of oil from western Russia and the Caspian region are lower if that oil is shipped westward rather than eastwards to Asia.

As the numbers in Table 8 on the following page show, the first scenario results in Saudi Arabia attaining a 25% share in the Asian market and withdrawing from the Atlantic market. In this case, by definition, since the Saudis would be selling in only one market, their sales could not be characterized as price discrimination. However, even in this case, Saudi Arabia might have an incentive to reduce output and drive the Asian price above the Atlantic price up to the point where Atlantic oil would flow into Asia. While this is not a necessary outcome, it would be a possibility. It is also possible under this scenario that another Middle Eastern exporter that is still exporting to both markets would attempt to price discriminate either alone or in cooperation with other producers. It would be in their economic interests to do so. Saudi Arabia would have a strong incentive to fight for a share in the Atlantic market because it has the ability to enforce destination pricing and hence can benefit by price discriminating. Since the other Middle East countries would also gain from the higher Asian prices, they would have an incentive to yield Atlantic share to Saudi Arabia and free ride on the Asian premium.

In scenario two, Asia is flooded with oil, prompting Saudi Arabia to reduce exports to Asia and increase them to the Atlantic region. Such a reallocation of exports would not be consistent with minimizing transportation costs but could be forced on Saudi Arabia if Asian buyers aggressively tried to increase supply competition in their market by favoring non-Saudi suppliers. In this case, the Saudi share in Asia would drop to 10.7%, slightly above its share of 9.5% in the Atlantic market. Following our earlier discussion, Saudi Arabia would still have an incentive to price discriminate since the demand for its oil in Asia will be more inelastic than in the Atlantic market. Again, it can be expected that Saudi Arabia would fight for a share of the Atlantic market that would permit it to raise the Asian price as high as is consistent with avoiding large inflows from the Atlantic Basin. It would still be in the interests of other Middle East producers to adjust the allocation of their exports between the two markets to accommodate the Saudi strategy and free ride to collect the Asian premium.

Table 8: Alternative Export Scenarios of Incremental Production (2000 to 2010)

	Import Sources								
	Net Import Increase	Other	FSU	Non Saudi Mideast	Saudi	Total Increase in Supply	Saudi Exports 2000	Saudi Exports 2010	Saudi Share of 2010 Demand
Scenario 1. All FSU New Exports go to Atlantic. Saudis reduce exports to Europe to accommodate FSU exports.									
Europe + N. America	4.9	4.0	3.8	0.0	-2.9	4.9	2.9	0.0	0.0%
Asia	7.0	0.0	0.0	3.6	3.4	7.0	3.2	6.6	25.2%
Scenario 2. All FSU New Exports go to Asia, Saudis reduce exports to Asia to accommodate									
Europe + N. America	4.9	4	0	0	0.9	4.9	2.9	3.8	9.5%
Asia	7	0	3.8	3.6	-0.4	7	3.2	2.8	10.7%
Scenario 3. FSU New Exports are evenly split between Asia and the Atlantic.									
Europe + N. America	4.9	4.0	1.9	0.0	-1.0	4.9	2.9	1.9	4.7%
Asia	7.0	0.0	1.9	3.6	1.5	7.0	3.2	4.7	17.9%

Finally, the third scenario is one that lays half way between the other two. It is the most realistic of the scenarios in that it is economically impractical to export oil from western Russia and the Caspian to Asia and even, if it was economical, it is unlikely that the required infrastructure could be built before 2010. By that time, Asian demand will have increased further, and FSU supply will have leveled off.

For the period 2010 to 2030, the data in Table 6 show that both Atlantic Basin and Asian markets will become increasingly dependent on Middle East oil. Net imports are projected to increase by 7 million b/d for Europe and North America and 7.1 million b/d for Asia. Exports from the FSU and Rest of World are projected to increase by only 4.4 million b/d, leaving a shortfall of an additional 9.9 million b/d to be made up by Middle East producers. A significant part of this incremental supply would have to come from Saudi Arabia. Unless incremental oil supplies from Russia, Iraq and Iran greatly exceed optimistic forecast expectations, Saudi Arabia is likely to be in a position to price discriminate so long as it can maintain destination pricing.

The Effect of Deregulation

Soligo and Jaffe (1998, 2000) argued that deregulation of Asian energy markets was unlikely, in and of itself, reduce the Asian premium. This conclusion was based on the proposition that the conditions for price discrimination existed independent of market regulation. To be sure, regulation of energy markets, especially those, such as existed in Japan that prohibited the importation of refined products, served to reduce competition in petroleum products and guarantee refineries a price based on cost plus refinery costs. Since all refiners were treated the same, none had an incentive to bargain strongly on the price of crude. Since the removal of the import prohibition in 1996, product prices have fallen in Japan and the Asian product market has become much more competitive. But the Asian premium has not narrowed, and the main effect of a more competitive products market has been low or negative refinery margins.

The effect of regulations was to reduce the elasticity of demand for crude in those markets. However, we showed that even under the assumption that the elasticity of demand for oil is the same in all markets, there was a basis for price discrimination. Hence, while deregulation may have increase price sensitivity there apparently was still ample opportunity to maintain the price premium.

With respect to refinery margins, it is not surprising that these declined after deregulation. Under a policy of prohibiting product imports, a country like Japan would have invested in capacity to accommodate fluctuations in product demand. The effect of competition on refinery margins may reflect the rationalization of the refinery industry in Asia. With product free to move throughout the region there was undoubtedly some excess capacity as it was no longer necessary to maintain capacity in every country to meet peak demands. Since refineries are very capital intensive the production of products is characterized by high fixed costs and relatively low variable costs. Refineries will produce as long as they can cover variable costs. Low margins will persist until that excess capacity is absorbed, either by a growth in product demand or the eventual shut down of some production units.

One element of regulation that might continue to affect the Asian premium is the practice of engaging in long term contracting with Saudi Arabia and other producers. The Saudi contract allows for some flexibility in purchases each month after Saudi Aramco announces the pricing formula for that month. But by committing to a lower bound to Saudi imports, buyers also limit the scope for imports from other areas to compete with Saudi crude. Commitments are made on the basis of the formula and the announced "adjustments" to be made relative to the marker fuel. The actual price paid for the oil will not be known for two months after the commitment has been made. So imports of say, West African crude, have limited ability to undermine Saudi prices. The situation might be quite different, for example, if Asian countries bought a substantial amount of their Saudi crude on a spot market where buyers had the option of substituting West African crude. In this case, the Saudis would bear a much greater and more immediate

effect of setting a premium that was "too high." But selling Saudi oil in a spot market essentially means giving up geographically targeted pricing.

Concluding remarks

It is important to emphasize that the Asian premium has been maintained because the conditions necessary for price discrimination have existed. In particular, Saudi Aramco has been able to restrict and monitor the destination of its oil sales and charge a price according to that destination. If Saudi Aramco lost this ability, arbitrage would occur and the fob price of Saudi oil would be the same for all buyers.

Our analysis shows that it may not be possible to identify enough incremental supplies of Russian, Caspian and non-Saudi Middle East oil to end Saudi Arabia's ability to impose destination pricing during the next ten years. Instead, buyers may have to consider other means than to diversify suppliers to eliminate the Asian premium. Saudi Arabia's largest oil purchasers who have refineries in more than one destination could try to refuse to accept destination pricing, but given the importance of Saudi Arabia as an oil supplier, this might be hard to implement. However, a multinational institution or Western government might be in a position to regulate the practice of destination pricing in purchase contracts with oil companies operating in their jurisdiction. Such frameworks as the World Trade Organization or Energy Charter might be referenced as a basis to intervene to regulate the contracting process, or Asian governments or businesses could consider bringing a legal action to bar international oil companies from facilitating destination pricing on anti-competitive grounds. It would easier for oil buyers to resist contractual restrictions imposed by Saudi Aramco if those restrictions were declared illegal in a market where Saudi oil is refined.

If eliminating destination pricing does not prove possible, another way to weaken Saudi Arabia's market power in Asia would be actively institute policies that would further reduce the Saudi share of the Asian oil market. As our scenario analysis demonstrates, it is unlikely that Saudi Arabia's market power will be reduced solely from purchases of

increased supplies of non-Saudi oil in the Asian market given the limitation on the expected available incremental volumes. Therefore, effort must focus on both purchasing these additional supplies and simultaneously reducing demand for oil.

Japan has been very successful in the past in limiting its rise in oil use. Other Asian countries could follow this path. Among the policy options that can be pursued to limit the rise in oil use are 1) increasing energy efficiency; 2) increasing substitutability between oil and other fuels–including the conversion of gas to liquids; 3) developing clean coal technology and more advanced nuclear technology to reduce the environmental handicaps that these fuels possess; and 4) aggressively promoting alternative energy sources–such as wind and solar energy.

Accelerating the adoption of gas/diesel electric hybrid technology in the transportation sector will also reduce the incremental growth in oil demand. This is a longer run strategy since vehicle stocks take many years to be replaced. The process would be hastened if China, which will experience a rapid increase in vehicle stocks over the next decade, were to adopt hybrid technology now before a stock of conventional vehicles has been built up. A combination of such oil conservation measures and efforts to bring more oil from Russia and the Caspian region to Asia could seriously undermine Saudi Aramco's power to maintain the Asian premium. Under our second scenario where all incremental exports from the FSU and non-Saudi Middle East between 2000 and 2010 were to go to the Asian market, Saudi Arabian exports to Asia would fall to 2.8 million b/d. A reduction in consumption of 1 million b/d in the 26.2 million b/d 2010 forecast would reduce the Saudi Arabian share in the Asian market to only 7.1%-below its share in the Atlantic market. Once the Saudi share in the Asian market approaches that in the Atlantic market, the primary basis for discrimination would be eliminated. Gas to liquids technology is likely to allow Qatar to export an additional 800,000 barrels a day of liquid fuels by 2010, for example, leaving open the possibility that use of unconventional fuels and demand management policies, combined with increased purchases from Russia and Iraq, might be enough to dent Saudi Arabia's ability to maintain the Asian premium.

While it is possible that a combination of policies to reduce the rate of growth in demand and increase non-Saudi Asian supplies might end the Asian premium, we should stress that the window for action is very small and that the time required to build the necessary pipeline infrastructure and implement the policies to contain demand may be too long to be effective. The increase in Russia exports may not be sustainable over the longer term and therefore, several strategies will need to be combined to eliminate the Asian premium on a more permanent basis.

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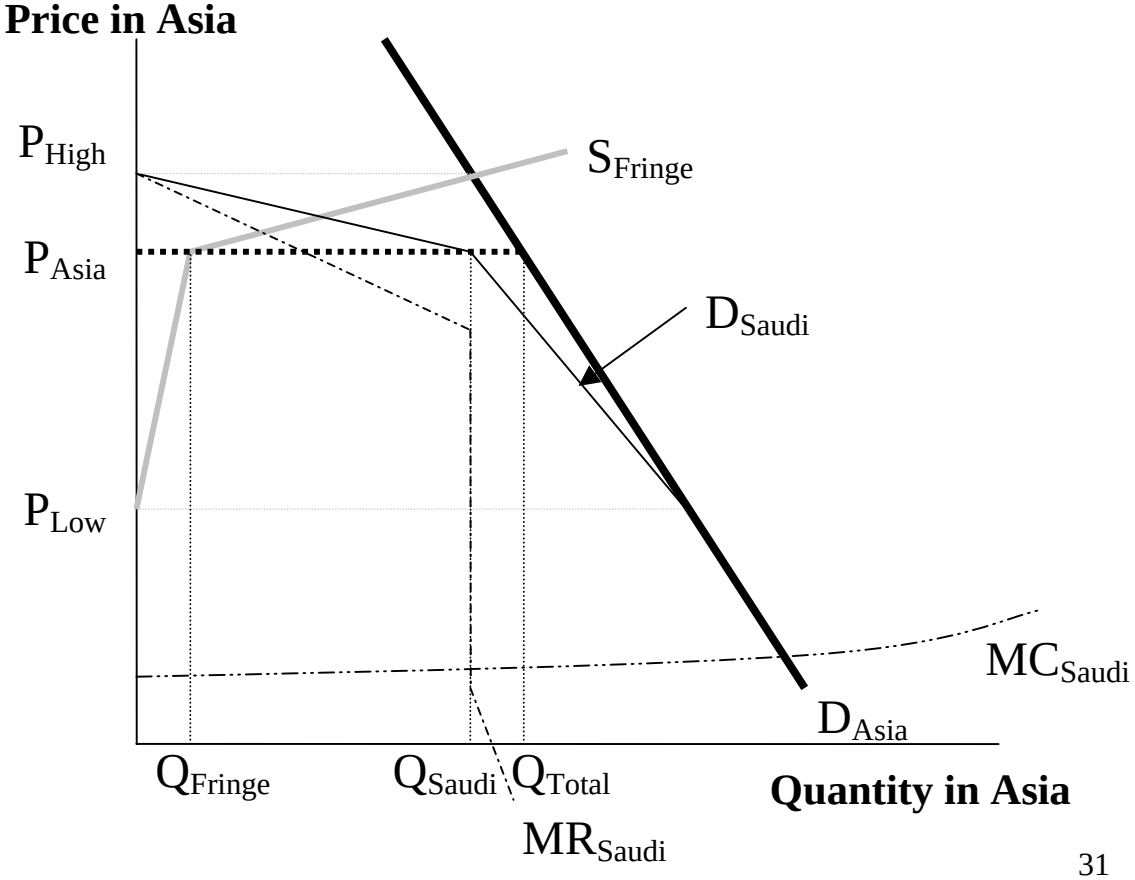
Appendix

Saudi Arabia as a Dominant Firm

There have been many attempts to model the OPEC cartel and its individual members. One model that has been very useful is that of the "dominant firm." The idea behind the model is that there is one large producer and many smaller ones. Smaller producers– characterized as the "competitive fringe"- produce what they want given the price they face in the market. The dominant firm then is a "residual producer." The demand curve it sees for its output-the residual demand-is the difference between the total demand for oil at any price and the amount that the competitive fringe will supply at that price. The dominant firm then sets the price by producing the output level at which it maximizes its profits–where its marginal revenue and marginal cost curves intersect.

The figure below illustrates the model as applied to Saudi Arabia in its relationship to the Asian market.

Figure 1: Dominant Firm Model



The Asian demand curve for oil is given by the curve labeled D_{Asia}. The supply curve of the competitive fringe is given by S_{Fringe}. The non-Saudi supply curve is fairly steep (inelastic) at first reflecting the fact that not much additional oil would be made available to the Asian market if the incremental supply comes from Asian producers. As discussed in the text, most Asian and middle Eastern suppliers are either already selling most of their output in the Asian market, or there are good reasons for them not to divert oil from other markets to Asia for small changes in Asian prices. At price P_{Asia}, the non-Saudi supply curve becomes flatter (more elastic) representing the fact that at some price, oil will begin to flow to the Asian market from West African–or other non- Middle East or Asian sources.

The demand curve for Saudi oil is the residual demand curve $D_{Saudi.}$ The output level at which Saudi Arabia will maximize its profits-where its marginal revenue labeled as MR_{Saudi} is equal to its marginal cost MC_{Saudi}. Saudi Arabia produces Q_{Saudi}, and sets price equal to P_{Asia}. The fringe produces Q_{Fringe} and total output is Q_{Total}.

The market power of the dominant firm is measured by the extent to which it can set price above marginal cost and is given by the equation:

$$\frac{P}{MC} = \frac{1}{1+(1/\varepsilon_d)}$$

Market power is determined by the elasticity of the residual demand curve-which is a weighted average of the elasticity of aggregate demand and the elasticity of fringe supply where the weights are the inverse of the market share of the dominant firm and the ratio of outputs on fringe producers to that of the dominant firm respectively. It is given by the equation:

$$\varepsilon_d = \varepsilon \times (Q_d / q_d) \; + \; \varepsilon_f \times (Q_d - q_d)/q_d$$

where ε_d is the elasticity of the residual demand curve,

ε is the elasticity of the aggregate demand curve,

ε_f is the elasticity of the competitive fringe.

Holding all else constant, pricing power of the dominant firm is enhanced the more inelastic the aggregate demand and the fringe supply curves and the larger its market share.