Chapter 6

The 'Asia Premium' in Crude Oil Markets and Energy Market Integration

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CHAPTER 6

The 'Asia Premium' in Crude Oil Markets and Energy Market Integration

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There is a widely-held perception that Asia has been paying a premium for its crude oil, the so-called "Asia premium." This has led to calls for intervention among some observers of the Asian crude oil market in order to mitigate the so-called premium. More recently, it has been argued that the "premium" has been reversed because Asia has emerged as the dominant consuming region forcing the Middle East oil producers to reduce crude oil prices relative to the other oil consuming regions such as Europe and the US. We analyze the market structure and pricing mechanism of oil to understand whether the analysis supporting the argument for the existence of an "Asia premium" is tenable.

1. Introduction

It has been commonly believed that Asia pays higher prices for crude oil exported from the Middle East relative to their counterparts in Europe and the US. This price differential is referred to as the "Asia premium." There have been several papers by government-funded research institutions in the key Northeast Asian crude oil importing countries Japan, South Korea, and China (Ogawa, Y., *et al.*, 2000; Ogawa, 2002; Ogawa, 2003, Moon *et al.*, 2003; Lee, 2003a; Lee, 2003b; Koyama, 2003; Gong *et al.*, 2003) and by US academics (Soligo *et al.*, 2000) that have analyzed this issue and have estimated the magnitude and the variation of the so-called premium.

Ogawa (2002), a researcher at the Institute for Energy Economics Japan (IEEJ), estimated that the Asia crude oil premium to Europe averaged $0.94/bbl over the period January 1991 to June 2002. In another paper, Ogawa (2003) reported that "crude oil prices for Asia have remained higher than those of European and US markets by $1.00 - $1.50/bbl throughout the 1990s." More recently, Chiu *et al.* (2010) indicated in an article in the Wall Street Journal (WSJ) that the Asia premium was on average "about $1.20 a barrel since 1988."

Utilizing data from the Petroleum Intelligence Weekly (PIW), a leading industry trade publication, for the period 1990 – 97, Soligo *et al.* (2000) found that Saudi Free On Board (FOB) prices for crude oil destined for Asian markets have been on average $0.83 higher per barrel (bbl) than for Western Europe and $0.93 higher than for the United States. In another paper, Soligo *et al.* (2004) calculate the Asia-Europe differential for Saudi Arab Light FOB sales to average $0.90/bbl over 1988 – 2002, increasing to $1.48/bbl over 1997 – 2002. A careful study by Horsnell (1997), covering the period January 1992 – November 1996, came to the conclusion that the Asia-destined loadings for Saudi Arab Light (AL) realized prices were found to be on average $1.00 - $1.20/bbl higher than for European loadings. These quantitative estimates from the cited sources are broadly consistent, with the "Asian premium" estimated to average in the range of $1.00 - $1.50/bbl over the 1990s and the early part of the 2000s.

The IEEJ believes that refiners in Asia are already disadvantaged given poor Asian refining margins. Ogawa (2002) calculates that higher crude oil prices have caused refining margins to becoming negative at around minus $1/bbl since 1999; the Institute estimates that the Asia premium imposes an additional burden of $4-8 billion annually. Furthermore, it is claimed that higher crude oil prices also lead to higher prices for other energy commodities such as LNG and coal, which are linked to oil prices.[1] Similarly, the Korea Energy Economics Institute (KEEI) points out that the financial burden of extra costs adversely affects economic and industrial activity and leads to the deterioration of the competitiveness of Asian economies. Lee (2003) estimates the burden placed by the Asia premium on the Korean economy as being $0.8-0.9 billion a year.

Proposals offered to assuage the so-called premium include suggestions that the Middle East exporters consider adopting Brent crude as the reference price for Asian sales rather than the Oman/Dubai average which is the current reference; charge Asian customers an average of their US and European prices; and allow the spot trade of Arabian Light (AL) crude, thereby making AL effectively the marker crude for Middle East grades in Asia. To date, nothing has come out of the abovementioned proposals.

The world economy is witnessing a paradigm shift with the locus of economic clout shifting to Asia. This is driving a structural change in the oil markets. Chiu *et al.* (2010) assert that the "rising power of Asian oil consumers is increasingly helping them (to) buy oil more cheaply than their counterparts in the West, a reversal of the historical pattern." According to the PIW, Saudi Arabia sold Arab Light crude to Asia for about $6.40 less per barrel than it charged European buyers in March 2010. Tom Wallin, president of PIW, made another comment that "an Asian discount is looking more likely to be the new normal." More dramatically, the Global Oil Director at Platts, an industry price assessment agency, stated that "It's a game changer….the balance of power in pricing is drifting to Eastern markets."

Given this transition, we seek to revisit the question of the existence of the Asia premium. This study will make three contributions. Firstly, we will use a new, high-

[1] LNG and coal sold in Asia are typically indexed to crude oil prices, such as the Japan Customs-cleared Crude (JCC) price which is the average price of customs-cleared crude oil imports into Japan as reported in customs statistics. It is often referred to as the "Japanese Crude Cocktail" price.

frequency dataset to ascertain whether the Asia premium exists. Secondly, we will evaluate the arguments that fault the current formula-based pricing system with the existence of the premium. And thirdly, we will assess the most efficient energy market integration policies that should be adopted in order to mitigate the Asia oil premium if at all. We trace the evolution of the Saudi formula-based pricing mechanism in Section 2 to provide the background for oil pricing. In Section 3, we examine the structural characteristics of the oil markets and how these affect prices paid in different regions of the world. Section 4 analyses the arguments that Saudi Arabia discriminates against Asian buyers of its crude. In Section 5 we calculate difference in the oil price paid by Asia, Europe, and the United States. Section 6 discusses the most efficient policy prescriptions to mitigate the existing intra-regional oil price differentials for Asia. We conclude in Section 7.

2. The Saudi Formula-based Pricing Mechanism

In 1973/4 the Organization of the Petroleum Exporting Countries (OPEC) inherited from the Seven Sisters[2] a pricing regime that effectively administered the price of oil by fiat. The Seven Sisters in the pre-1974 period fixed a "posted price."[3] This was then used to compute royalties and the income tax paid to producing countries. When OPEC countries nationalized their upstream hydrocarbon assets, the administered price effectively was the price at which oil was sold and bought in arms-length transactions from the exporting countries.

[2] The term refers to the seven oil companies, which formed the "Consortium for Iran" and dominated the global petroleum industry from the mid-1940s to the 1970s. The group comprised Standard Oil of New Jersey and Standard Oil Company of New York (now ExxonMobil); Standard Oil of California, Gulf Oil and Texaco (now Chevron); Royal Dutch Shell; and Anglo-Persian Oil Company (now BP). See Sampson, Anthony, "The Seven Sisters: The Great Oil Companies and the World They Shaped," New York: Viking Press (1975).

[3] A posted price is a price that a seller or a buyer makes public in some conventional way to give notice that she/he is prepared to accept or to offer a certain sum for a barrel of crude oil or a tonne of petroleum products. In the past US refiners used to post at the gate of their plant the price at which they were prepared to buy a barrel of crude oil on a given day (see Mabro, R. 2005). "The International Oil Price Regime Origins, Rationale and Assessment." *The Journal of Energy Literature,* Volume XI, No1, pp. 3-20

Mabro (2000) gives a detailed account of the changes in pricing regimes that the oil market witnessed. The administered (or fixed) price system collapsed in 1985. In the years leading to 1985, OPEC members were sharply divided over pricing policy and the fundamental long-term pricing strategy. This was particularly obvious in the 1980 conference in Algiers. OPEC official prices were falling out of line with competing freely-traded crudes in Atlantic Basin spot markets. The problem arose from the difficulty encountered by OPEC in defending a given price in the face of strong competition from emerging, and rapidly growing, non-OPEC sources. Increasing non-OPEC supplies, at a time of stagnant world demand, resulted in the emergence of considerable surplus capacity within the OPEC region. This induced intra-OPEC competition, which meant price discounting by several OPEC member countries to protect their export volumes. By adhering to the system of official prices, which most of OPEC was abandoning, Saudi Arabia was forced to reduce output and take on the role of a swing producer. Saudi Arabia suffered a continuous decline in the volume of their exports, from about 10 million barrels per day (mmbd) to under 3 mmbd between 1980 and 1986. In the end, the OPEC administered price system, which had been in operation since 1974, became unsustainable by the mid-1980s because it cost Saudi Arabia a huge loss in export revenues.

For a relatively short but dramatic period in 1986, "netback pricing" replaced administered prices. Under "netback" arrangements, the price of crude oil was referenced to the value of refined petroleum products derived from the given crude. In effect, netbacks guaranteed a refinery margin which, in periods of excess refining capacity that prevailed at the time, resulted in falling product prices. This, in turn, led to a collapse of crude oil prices. The effects were catastrophic for crude oil exporters. At one point oil prices, which were previously in the $24-26 per barrel (bbl) range, fell to $8-10/bbl.

The ensuing price recovery followed an OPEC meeting in November 1986. This meeting was significant as it changed the overall strategy from charging official administered prices to managing OPEC supply through the quota system in order to stabilize the price around a target level of $18/bbl. Given that neither the administered OPEC prices nor netback prices were acceptable any longer, a system of market-related formulae prices was gradually adopted. It involved setting "official" monthly discounts

(or premiums) relative to the other marker or reference grades such as Brent or West Texas Intermediate (WTI).

We focus on the formula-based pricing mechanism used by Saudi Arabia's national oil company, Saudi Aramco, whose pricing system is loosely tracked by most exporters in the Middle East.[4] Saudi Aramco's sales to international buyers are made under long-term contracts, usually "evergreen" contracts renewable annually. The pricing formula generally has four components: point of sale, a market-related base price, an adjustment factor that is reflective of crude oil quality and the point of sale, and a timing mechanism that stipulates when the value of the formula is to be calculated (PIW, 2009).

The base price is calculated by taking the daily average of market prices of a particular widely-traded *reference* crude oil. The FOB price for European destinations is tied to Brent Weighted Average (Bwave)[5] data for Brent crude oil for the 10 days around the delivery of the cargo, about 40 days after loading at Ras Tanura.[6] For the USA, the FOB price is linked to West Texas Intermediate (WTI) crude oil for the 10 days around the delivery of the cargo about 50 days after loading at Ras Tanura port. For buyers in Asia, crude oil prices are linked to the average spot prices of Oman and Dubai crude oils during the month in which the crude is loaded at Ras Tanura for delivery to the Asian market. The base price is then adjusted by adding or subtracting an *offset* or *adjustment factor*. This adjustment factor takes into account the point of sale (to adjust for the freight costs) and the "quality differential" between the Saudi crude and the reference crude.

Crude oils differ from one another in chemical and physical properties which play an important part in their refining and subsequent value as refined petroleum products. The two most important characteristics of crude oils are specific gravity measured in degrees API (a scale devised by the American Petroleum Institute) and percentage of sulfur content by weight. Lighter crudes (those with higher API) produce a larger

[4] Kuwait, Iran, Qatar and Abu Dhabi are among the other large oil producers using some form of formula prices for long-term contracts. Among the few Gulf crudes sold on the "spot" market (i.e. not based on term contracts with end-user and re-sale restrictions) are Oman and Dubai.

[5] It is a weighted index of Intercontinental Exchange (ICE) Brent crude oil futures contracts traded on any given day on the exchange.

[6] Ras Tanura is a city in the Eastern Province of Saudi Arabia located on the peninsula extending into the Persian Gulf.

number of lighter products, such as gasoline, which have higher market value. So other qualities being equal, lighter crude grades are expected to sell at a premium over heavier crude grades.

High sulfur content has an adverse effect on the value of crude oil, because it leads to higher operating costs for refineries due to special processing technologies (such as oxidative desulphurization technology) and maintenance requirements. In addition, new environmental legislation in many countries mandates lower sulfur content for gasoline and diesel. Therefore, high-sulfur (sour) crude is expected to sell at a discount relative to low-sulfur (sweet) crude of the same API. The "quality differential" is essentially the difference between the "gross product worth" (GPW) of the Saudi crude and the reference crude. GPW is calculated by multiplying the refined product yield of each barrel under a given refinery process configuration with the price of the resulting refined products in the spot market.

The Official Selling Price (OSP) for any particular Middle East export crude oil is simply the sum of the reference crude price and the announced monthly offset for given regional destinations, as explained above. For Atlantic markets, the reference crudes WTI[7] and B-Wave are traded in highly liquid markets with prices set competitively, both in physical barrel trades as well as in the organized futures markets of New York and London. In contrast, Asia has no well-established formal futures markets for crude oil.

In the absence of an established crude oil futures market, the Dubai Blend crude forward market successfully developed in the 1980s due to a number of conditions it fulfilled: its relatively large production volumes were not dominated by term contracts;

[7] Saudi Aramco switched over to the Argus Sour Crude Index (ASCI) for its crude oil sales in the US in 2010. The Argus Sour Crude Index (ASCI) represents the daily value of US Gulf coast medium sour crude, based on physical spot market transactions. The ASCI price is the volume-weighted average of all deals done in three grades of sour crude traded in the US Gulf Coast, namely, Mars, Poseidon, and Southern Green Canyon. Saudi Aramco switched over from Platts WTI assessments to ASCI because WTI prices would often get "decoupled" from relative values in global crude oil markets (as measured by the WTI-Brent differential for example) whenever storage facilities at Cushing, Oklahoma become a binding constraint. See, for instance, a blog entitled "Cushing Cushion Oil Pricing Problem Reappears" by Peter Fusaro in the Energy Hedge Fund website in February 2009 where he states… "The long term WTI Cushing Cushion pricing problem has resurfaced. This occurs when US midcontinent crude oil markets detach from international oil markets… Rising crude oil stocks, which are stored in tanks at Cushing, are oversupplied depressing WTI prices in both the physical and paper markets." Accessed at http://energyhedgefunds.com/ehfc/modules/weblog/details.php?blog_id=67.

it was not marketed by a government monopoly but rather by a number of equity producers; and there were no re-sale restrictions. Price quotes for Dubai crude traded in the forward market[8] were based on assessments of deals done and bids and offers by energy pricing agencies such as Argus and Platts. However, as Dubai crude production went into decline in the early 1990s, there was a corresponding fall in liquidity in outright deals that provided absolute price signals. As a result, the Dubai market no longer served as an indicator of absolute prices, and instead became a relative price market where its price was set relative to Brent, and relative to the time structure of Dubai prices. The markets for Brent-Dubai spreads and Dubai inter-month spreads are well established, and Platts' assessed Oman-Dubai prices became the basis for pricing Middle East crude exports on term contracts to Asia.[9]

There has been extensive commentary in industry media regarding the imperfections of the Platts' Oman-Dubai price quotation. The fact remains, however, that the world's largest flow of crude oil – that is, the flow from the Middle East to Asia amounting to some 15 million b/d – is largely priced on the basis of this agency's assessments. The price assessment, based on the Platts "partials assessment methodology" and which allows delivery of Oman and Upper Zakum crude oils in lieu of Dubai, remains the reference quotation for Middle East term contracts.[10]

The Dubai Mercantile Exchange (DME) launched its Oman futures contract in June 2007, and since then has established itself as the key arena for physical Oman crude oil delivery. In the third quarter 2010, the exchange delivered 41.4 million barrels of Oman crude oil, an 82% increase on the same period last year.[11] However, its average daily volumes – which are typically below 3,000 lots (three million barrels) – pale in comparison with the150,000 lots (one hundred and fifty million barrels) normally traded in front month Brent contracts. The viability of Oman futures as an instrument for establishing a reference price for Middle East crude oil exports to Asia is uncertain. To

[8] The forward market refers to deals made for crude oil sales with delivery commitments in the future.

[9] The role of Dubai and Oman as reference crude oils for Saudi crude oil export pricing is discussed below in Section 4.

[10] The "partials" methodology is described in the Platt's website accessed at http://www.platts.com/IM.Platts.Content/MethodologyReferences/MethodologySpecs/crudeoilspecs.pdf

[11] See DME official website news items, accessed at http://www.dubaimerc.com/news/03nov10.aspx

date, the Saudi, Kuwaiti, Iranian and other Middle East OSPs for Asia-destined crude oil sales are based on Platts' assessments, and there is no indication that this will necessarily change anytime soon. No official announcements have been made by the region's national oil companies or their governing Ministries regarding any move towards adopting the Oman futures contract as their pricing basis.[12]

3. Structural Characteristics of the Market

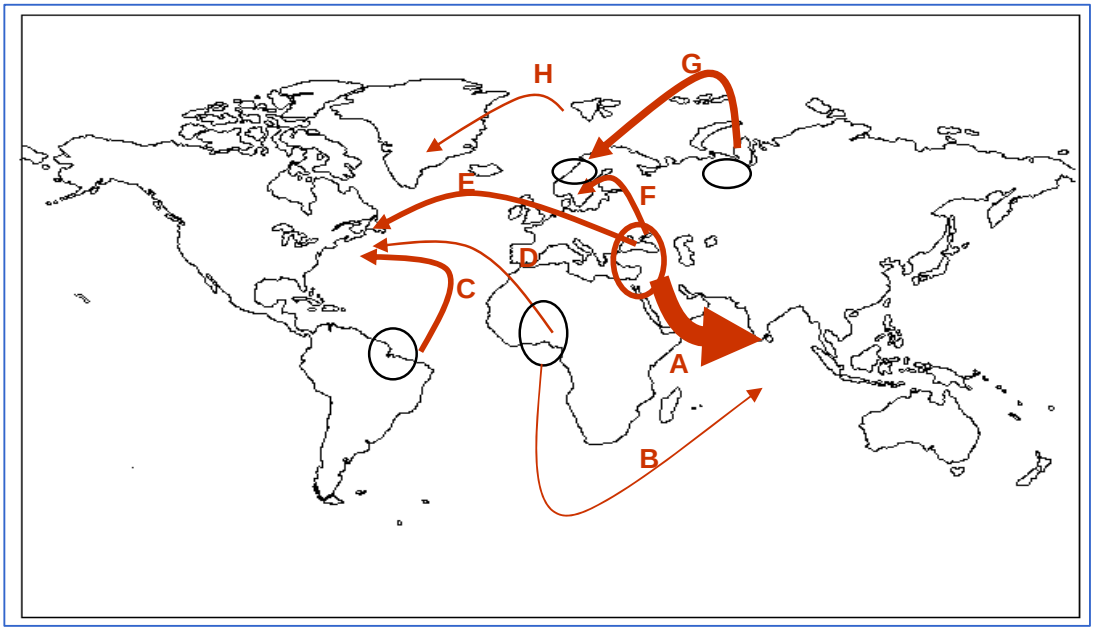
To help identify key patterns of the global oil trade, Figure 1 gives the estimated major inter-regional oil trade movements for 2009.[13] By far the largest single flow of crude oil trade is from the Middle East (Arab Gulf or AG) to the Far East (FE), of around 14.5 million barrels per day (MMBD); this reflects both the large base of demand in Asia (of around 25 MMBD) with limited intra-regional supplies from countries such as Australia, Indonesia, Malaysia, Brunei and Vietnam. The only other significant inter-regional flow of crude into the Far East is crude from West Africa (WAF), approximating some 0.9 MMBD. Part of the West African crude traded into the Far East is base-load, but the total quantum fluctuates depending on the Brent-Dubai differential (since West African crude is priced off Brent). More recent estimates suggest that West African imports into Asia increased by over 60% to some 1.75 million b/d in the first quarter of 2010 (Chiu *et al.*, 2010).

The North American (including the US and Canada) market not only produces significant proportions of its own crude requirements, but also has access to short haul and long haul crudes from Latin and Central America (LA, 3.8 MMBD), Europe (EUR, 0.8 MMBD), West Africa (WAF, 2.3 MMBD) as well as Arabian Gulf (AG, 1.9 MMBD). Europe is a large recipient of Former Soviet Union crude (FSU, 7.5 MMBD), apart from being a significant exporter of crude to other regions, but less so over time given the depletion of crude oil production in the North Sea. West African crude flows into the

[12] For a careful assessment of the DME Oman futures contract and its outlook, see Fattouh, B. "Prospects of the DME Oman crude oil futures contract", Oxford Energy Comment, March 2008.
[13] The figures include some refined product flows as well, but the broad magnitudes for crude flows are reasonably approximated by Figure 1.

Far East and its volumes increase as the arbitrage window allows. Urals and North Sea crudes occasionally flow into the Far East, also when the economics of inter-regional arbitrage allow. The base-load of crude supply for the Far East however remains the Middle East.

Figure 1. Major Crude Oil Flows 2009 (MMBD)



Note: A: AG => FE 14.5, B: WAF => FE 0.9, C: LA => US 3.8, D: WAF => US 2.3, E: AG => US 1.9, F: AG => EUR 2.3, G: FSU => EUR 7.5, H: EUR => US 0.8
Source: BP Statistical Review of World Energy (2010)

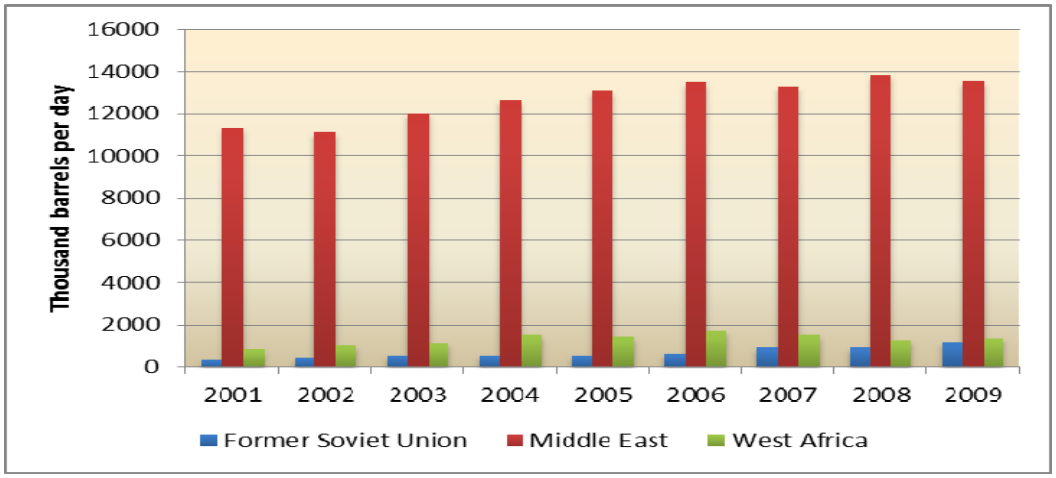
A substantial portion of the incremental non-OPEC supply is located in short-haul Europe/Mediterranean (North Sea/Russia/Caspian) and US Gulf Coast (Latin America/deepwater Gulf of Mexico) regions. However, most of the incremental global demand is located in the Far East. West Africa is a source of swing crude exports, flowing East or West (Atlantic markets) as arbitrage economics dictate.[14] Thus the pattern of global oil demand has a key asymmetric attribute: while the major portion of global incremental demand in the past two decades has come from the Far East, the

[14] West African producers are the closest potential suppliers to the Asia market in the sense that they are in the position to shift sales from other markets to Asia (Jaffe and Soligo, 2000). Essentially, when crude oil prices in the Far East are high enough relative to the European or North American regions, traders will re-direct West African crude oil flows into Asia.

majority of non-OPEC incremental crude supply has been Atlantic market focused as noted by Horsnell (1997).

To the extent that arbitrage makes it viable, North Sea, Russian, but particularly West African crudes flow into the Far East. The claim that lack of competition in Asia's crude oil market results in higher prices in Asia is thus an artifact of the pattern of global crude flows, which in turn is a function of geographic resource endowments, demand sources and transport costs. Thus, it seems apparent that higher crude oil prices in Asia, relative to the US and Europe, is in part reflective of a market that has access to few alternative sources of crude oil. As shown in Figure 2, crude oil supplies into Asia predominantly flow from the Middle East, with West African and FSU crudes constituting supplies at the margin. Roughly 82% of crude oil supplies into Asia originate in the Middle East.

Figure 2. Crude oil supplies into Asia from the Middle East, the Former Soviet Union, and West Africa



Source: BP Statistical Review of World Energy (2002-2010)

The different characteristics of oil markets between Atlantic (US and Europe) and Asia are summarized in the Table 1 below. The willingness to pay by buyers in Asia reflects their concerns with "security of supply". Term contracts constitute a predominant source of crude oil for Asian buyers, and regional crude markets have limited spot cargoes. This allows for far less supply and demand flexibility than can be

observed in the Atlantic markets. In contrast, oil refiners in Europe and the US require crude oil supplies from the Middle East to be competitive with available short haul crude supplies in actively traded spot markets. Quite naturally, to remain competitive, Atlantic Basin refiners will be unwilling to pay higher prices for crude supplied under term contracts. In other words, Middle East crude exported to Atlantic markets under term contracts need to have spot market characteristics to remain competitive. Indeed, one may argue that it is not a premium that is charged to Asian customers as much as it is a discount that Middle East exporters need to bear in order to maintain market share in European and North American markets.[15]

Table 1. The structural differences between the Asian and Atlantic (US and European) markets

Atlantic Markets	Asian Markets
Spot crude competes actively with term crudes from the Arabian Gulf.	Far less spot traded crude competing with term contracts.
Buyers highly conscious of short term trading and business risks – risk management critical to refiner's loading program.	Buyers highly conscious of long-term supply security risk – term supply management dominate refiner's loading program.
Key refining regions (USGC, Rotterdam) can access multiplicity of short and long haul crudes in effective competition.	Total region massively net crude short, with heavy dependence on Middle East crude.
Supply and demand flexible and competitive among many alternative grades (demand is more "price elastic").	Less flexible supply and demand responses in crude markets, less alternative grades, fewer short haul sources (demand is less "price elastic").

While the liberalized markets of Europe and North America required refiners to actively manage risk in their crude oil loading schedules, the more regulated oil markets of Asia made supply security a dominant concern of Asian refiners in their purchasing and loading programs. In economic terminology, then, the markets in Atlantic and Pacific Basins differed in the price elasticities of demand, i.e. customers differed in their willingness to pay for crude oil between the two regions.

[15] See for instance Horsnell (1997) who argues that growth of non-OPEC short haul crude supplies in the 1990s in Europe and the US were "forcing" discounts on Middle East oil exporters for them to remain competitive (pg 305).

4. Does Saudi Arabia Act as a Price Discriminator?

Among the various reasons given by researchers in the Northeast Asian institutes for the existence of the Asian premium, the following seem to be the most often cited:

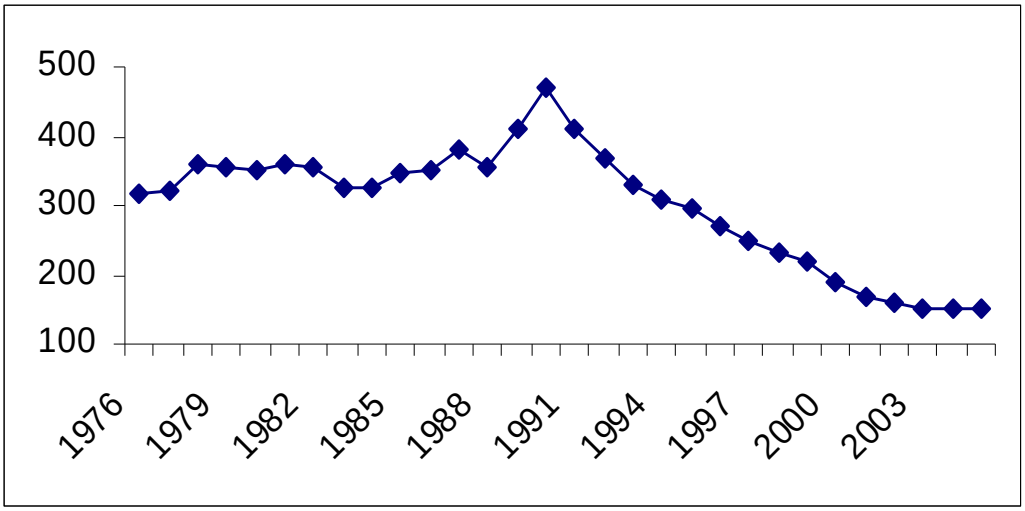
- **"Dubai illiquidity"**
  - "The price formation of Dubai is "in question due to its low liquidity and low transparency" (Ogawa, 2002)
  - "Since shipment of Oman crude is also limited to the Asian market, the problem of relatively higher crude oil prices for the Asian market is also seen when Oman is selected as the marker crude" (Ogawa, 2002)

The progressive reduction in Dubai crude oil exports, from its peak of over 400,000 b/d in early the 1990s, have long been noted (Ogawa, 2002). Figure 3 below shows the fall off in volumes by the mid-2000s, and industry estimates of current production range from 50,000 to 70,000 b/d. Limited and falling volumes of Dubai crude production has led to reports of "manipulation" and the need for an alternative marker since the 1990s (Ogawa, 2003). In response to media reports of "market squeezes", Platts introduced a new price assessment for Dubai crude in 2001 which allowed Oman deliverability in lieu of Dubai at sellers' choice on contract execution. This expanded the pool of cargoes significantly (from about 5 – 6 cargoes a month of Dubai to at least 30 – 35 cargoes of Dubai and Oman together). This made it difficult for any single player in the market to "squeeze" Dubai, i.e. corner the market for Dubai crude oil.

In 2006, Platts further revised its Far East benchmark assessment by allowing alternative deliveries of Upper Zakum into the Oman-Dubai pool, in order to counter the drop in Dubai production which exposed it to pricing plays (where market players take large position in the forward and paper markets which then allows them to control the physical supply of the crude stream) which proliferated in the 1990s and early 2000s. These changes to the Platts price assessment methodology seem to have resolved the problem at least for the present. Few observers now would argue that the "Asian premium" is driven by the paucity of Dubai cargoes.[16]

[16] See, for instance, "Platts copes with Shell buying spree", APS Review Oil Market Trends, October 8th, 2007.

Figure 3. Dubai Crude Oil Production



Source: Industry Sources

- **"Unresponsive adjustment factors"**

– "The largest factor for these premiums lies in the oil-producing countries' failure to have their adjustment factors respond adequately to market factors, when the Brent-Dubai differential narrows rapidly" (Ogawa, 2002)

In assessing the impact of Saudi's monthly offsets, and whether they are "responsive" in any precise use of the term, the first thing to note is the insignificant size of these offsets relative to the price of crude oil. Over the two years January 2007 – December 2009, when the Platts Oman/Dubai average quote was $74.65/bbl, the average value of the Arab Light (AL) offset was $0.70/bbl, or just about 0.93% of the Oman/Dubai price (See Appendix 1). When absolute prices of Oman/Dubai have been in the $20 - $26/bbl as they has been for much of the 1990s and 2000, average AL offsets would have been in a range closer to $0.15 - $0.25/bbl.

As explained in Section 2 on formula pricing, the offset needs to adjust AL (and other Arabian crude oil grades) values for two factors: refining value and freight cost, relative to the reference Oman/Dubai barrel. If freight values are held constant, then the AL offsets are primarily reactive, to changes in refining values of AL relative to Oman/Dubai.

Naturally, the monthly setting of Saudi Aramco OSPs (Official Selling Prices) is a widely watched variable among crude customers' pricing departments as well as the global industry media. Any competent analyst could set up models of refining values and track freight markets to investigate whether there is any systematic tendency for monthly movements of the Saudi offsets to overstate improvements in AL refining value relative to the Oman/Dubai barrel. It is therefore difficult for one to argue that Saudi Aramco marketing and planning departments would intentionally bias their in-house measures of refining values and freight market conditions in order to systematically "over-charge" its Asian customers. To date there is no empirical analysis that establishes this.[17] In Appendix 4, we present econometric test results which show that Saudi monthly offsets do not "cause" inter-regional crude oil price differentials.

While the Saudi monthly offset changes may sometimes have "overshot" in favor of the seller, it would be difficult to maintain that, on the whole, these offset changes support systematic, year-in and year-out overpricing by $1.00 - $2.00/bbl as claimed by the East Asian analysts. According to the empirical analysis conducted by Horsnell (1997), changes in AL offsets were "reactive to observed market conditions, with the results implying that $0.75 out of every $1 monthly change in refinery value differentials are reflected in the adjustment terms".

- **"Lack of competition" and "rigid supply rules"**

– "Due to the high dependence of Asia on Middle East crude oil, … the Middle East countries do not see any reason for price reduction on crude oil being sold to Asia…while they offer a price discount to the US and Europe" Soligo *et al.* (2000)

– "…oil producing countries intentionally widen the East-West price differential under the judgment that Asian oil-consuming countries have no option but to lift crude oil even if that crude oil prices is relatively high" Soligo *et al.* (2000)

– "Middle East crude oil suppliers restrict their sales to long term customers, and prohibit resale to third parties" Soligo *et al.* (2000)

Soligo *et al.* (2000) explain the existence of the premium via a static model of constrained price discrimination. They argue that Saudi Aramco's ability to restrict and

[17] The most careful study of Saudi pricing policy is Horsnell, op. cit. None of the econometric tests in his wide-ranging work support the "intentionality" argument.

monitor the destination of its oil sales and charge a price according to the destination are prerequisites for the existence of the premium. At the margin, the price differential between Asia and the US and European markets is limited by the difference between the freight costs of transporting West African crude oil cargoes to Asia and to the Atlantic markets. The static constrained optimization model presented by Jaffe *et al.* (2000, 2004) shows how region-specific prices can be set by the seller in order to allocate crude oil exports to maximize global revenues, so long as the regions cannot freely trade that commodity with one another. This is a straightforward exposition of the micro-economics model of price discrimination with segmented markets exhibiting different own-price elasticities of demand.[18]

These models however cannot explain why it is that these markets can *remain* segmented without resorting to a depiction of the Saudi role as a unilateralism practiced by a price discriminator. Here, we come to the essence of the argument asserting the existence of the "Asia premium" – which is that an imposition is made by the large oil producers in the Arabian Gulf to segment otherwise globally fungible markets. Jaffe and Soligo's positive analysis of Saudi pricing policy based on a price discrimination model might be read as implying that the Arabian Gulf exporters are not behaving as they "ought" to behave, as *non-discriminating* - read "responsible" – exporters.

The failure of the administered pricing system of the 1980s made it imperative that Gulf OPEC countries switch to selling crude oil to end-users in each of the major consuming regions through term contracts using reference crude oil prices. The switch occurred because the central imperative for Saudi crude oil pricing policy, in the aftermath of the 1985/86 price collapse was, and is, a "market responsiveness with a low profile"[19] in order to avoid being a price leader. Saudi crude exports, and by extension, Gulf OPEC crude exports, had to be price responsive to growing non-OPEC crude oil supplies in the 1980s and 1990s such that there did not emerge a two-tier pricing regime as it did under the Administered Price system.

Saudi crude prices had to be market determined, not market determining, and this could only be achieved by fixing a relationship with regional reference crude oils whose

[18] See, for instance, Tisdell, C. (1972), "Microeconomics: the theory of economic allocation", Wiley & Sons, Sydney.

[19] We are in debt to Hosnell (1997) who uses this apt and concise phrase to describe Saudi oil policy (p. 295).

prices are discovered in large, liquid markets. As remarked by Ali Naimi, the Saudi Minister of Petroleum and Mineral Resources, "The fact is that within the existing complex market framework, with its wide diversity of players, no one can claim to have a Midas touch. We aim at a reference price, leaving markets to determine actual prices through their own dynamics."[20]

If Saudi policy were to allow re-sale of crudes by its customers, this would immediately lead to further transactions downstream, re-directing crude oil to higher priced markets from lower priced markets so long as inter-regional price differentials were higher than freight costs. This would in turn lead to an absolute price discovery, and once again, such independent price signals would lead to the creation of a global absolute spot price for Arabian crudes. In terms of physical flows, this situation would lead to Saudi Aramco crude exports "sloshing" from one region to another[21] depending on inter-regional price differentials relative to freight costs. For extended periods, Saudi exports would likely be fully concentrated in the closest and highest valued market, the East of Suez. Whilst oil-exporting countries could "globalize" their prices by ending end-user and re-sale restrictions on their crude oil exports, this would entail, in effect, a regression back to a situation approximating the pre-1985 administered pricing system, and discarding the current formula-based market-responsive pricing system.

Saudi Aramco's marketing strategy, as the world's largest crude oil exporter, is based on the objective of maintaining "significant" market share in key consuming regions around the world. The very size of Saudi Aramco's annual crude oil sales program necessitates a global presence. As for any global corporate actor with a significant export stake in the world market for any particular commodity or class of commodities, its legitimate concern would be to seek a share in all large markets, and not allow a total concentration of sales into one region. This makes sense to the extent that different markets do not have perfectly correlated refined oil product markets and business cycles. Given the scale of Saudi Arabia's role as crude oil producer and exporter, it would quite naturally be a strategic imperative for Saudi Aramco to be "a

[20] H. E. Ali Al-Naimi, "OPEC and the Changing World Energy Scene," OPEC Seminar Vienna, September 2001, pg. 5.

[21] Among economists, such extreme "sloshing" would be described as "corner solutions" where market share trade-offs would not be movements along a smooth market share curve but a non-contiguous movement from one end of the curve, crossing one axis, to the other end, crossing the other perpendicular axis.

large and preferred long term supplier of crude oil to the major consuming regions" of North America, Europe and the Far East. To achieve this risk-optimizing marketing strategy, a necessary corollary of Saudi oil policy would be to disable the customer's right to "onward-sell" its allotment of crude oil and thereby create independent selling price signals.[22]

In this context, it is a question not of an "Asian premium" but of European and US "discounts". These discounts were a burden on Arabian Gulf producers – Saudi Arabia in particular – had to bear, given the imperative to maintain market share in Pacific Basin markets in the face of competing non-OPEC short haul crudes. Put this way, it then becomes apparent that it is entirely possible that Saudi marketing strategy in fact *reduced* the potential net present value (NPV) of its hydrocarbon assets by having to discount its crude price into the Pacific Basin, in order to achieve some reduction in risk across a geographical portfolio of markets. This implied maintaining a higher share of Atlantic Basin markets than would otherwise be the case under unconstrained revenue maximization. One could argue that Saudi pricing policy reduced the NPV of its oil assets, in order to prudently reduce its market risk across regional markets. To achieve its role as a supplier of choice for crude oils around the world, Saudi policy endeavored to avoid putting all or most of its barrels in one region; it acted as would be required of any global risk-optimizing enterprise.

5. FOB Price Differentials 2007-2009: Reversal of the Asia Premium?

In a new twist to the "Asia premium" debate, Chiu *et al.* (2010) in the Wall Street Journal asserted that the "rising power of Asian oil consumers is increasingly helping them (to) buy oil more cheaply than their counterparts in the West, a reversal of the

[22] One way of putting this in more intuitive terms is the following thought experiment: a Japan-incorporated Toyota Corporation tells independent wholesale and resale car dealers around the world that they have been appointed to sell Toyota cars in their domestic markets (where such independent dealers are domiciled). Independent car dealers would therefore be forbidden from holding auctions to sell Toyota cars in non-domestic markets. This would be a requirement if the corporation wanted to set the effective price for Toyota car buyers around the world, and not have independent dealers setting absolute price signals for sales on a global basis.

historical pattern."[23] According to the *Petroleum Intelligence Weekly* (PIW), a leading industry journal, Saudi Arabia sold Arab Light (AL) crude to Asia for about $6.40 less per barrel than it charged European buyers in March 2010. The same Wall Street Journal article featured a comment by Tom Wallin, president of PIW, who opined that "an Asian discount is looking more likely to be the new normal." More dramatically, the Global Oil Director of Platts, an industry price assessment agency, stated that "It's a game changer….the balance of power in pricing is drifting to Eastern markets".

In our analysis, we focus on the biggest player in the Middle East, namely Saudi Arabia and its national oil company Saudi Aramco. We estimate the differentials in Arab Light (AL)[24] Official Selling Prices (OSPs) which are loaded on FOB terms at Ras Tanura port and destined for three major regions – United States (US), Western Europe (WE), and the Far East (FE) for the period over January 2007 to December 2009. For Asia, the monthly OSP is generated by adding the announced Asia offset for the month of loading to the reference crude price (the monthly average of Oman and Dubai price reported by Platts) for that same month of loading. For the US market, the buyer is charged the 10-days average of reference crude price (the front month WTI price settled at NYMEX) taken 50 days after the time of loading at Ras Tanura port, adjusted by the announced US offset for that same month of loading. Similar to US, the buyer in Western Europe market is charged the reference crude price (B-wave, a weighted average of Brent futures prices)[25] averaged over 10-days, adjusted by the announced Saudi Aramco offset for AL for European sales. This 10-day average price is taken 40 days after the time of loading at Ras Tanura. The offset will be negative if AL crude is at a discount to the reference crude and will be positive if AL is at a premium.

For all three regions, we used the daily price data for 2007, 2008, and 2009.[26] We

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[23] See also an earlier article along the same lines by Demongeot, M., "The Asian oil premium? Almost gone, not coming back", Reuters, April 23, 2009.

[24] Arab Light is the largest stream of Saudi crude oil exports; the others are Arab Heavy, Arab Medium, Arab Extra Light, and Arab Super Light (this last stream exported only to the Far East).

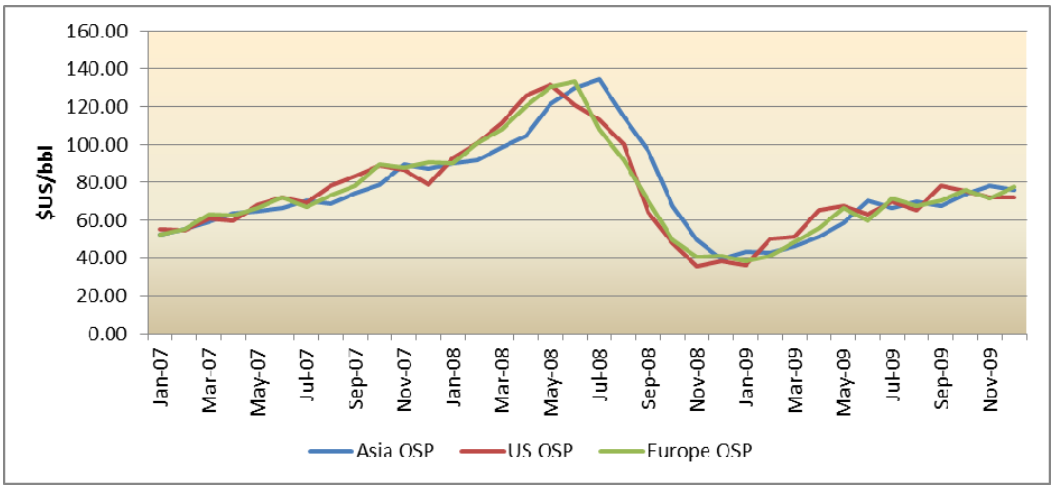
[25] This new 'B-wave' price linkage was first adopted by Saudi Arabia in July 2000, followed by Kuwait and, six months later, by Iran for oil pricing in its term contract sales to Europe. It replaced the traditional dated Brent benchmark after extensive reports of price manipulation and market "squeezes".

[26] In 2010, Saudi Aramco changed the methodology for the US and started using Argus Sour Crude Index (see footnote 24 above). For this reason, we excluded data from 2010 except when it was used to price crude loaded at the end of 2009 (note that Europe and USA-delivered crude oil cargoes arrive 40 and 50 days after date of loading at Ras Tanura respectively).

chose two different dates for the loading or bill of lading[27] (B/L) day. The loading day chosen first was middle of each month (15th). Then we assumed that the oil to be delivered to all three markets was loaded on this very same date, clearly to compare the prices of the same barrels for the three different regions on the same temporal basis. Once we worked out the time series and obtained results, we chose another, arbitrary date (5th day of each month of loading) and calculated another set of prices. This was done to test for sensitivity of our results to the choice of B/L date.

Before we start a discussion of the results, it is worth examining the general trends in the price of oil over the period under consideration. Figure 3 shows the movement of the OSPs.

Figure 3. AL OSPs For by Major Region



Source: Platts, Authors' calculations

Three distinctive trends are immediately noticeable: One uptrend from January 2007 to July 2008 prior to the financial crises, reaching almost $140/bbl on a monthly average basis; secondly, the collapse of the prices, from $140/bbl to below $40/bbl following the financial crises which began in the third quarter of 2008; thirdly, a recovery and uptrend from the end of 2008 and early 2009.

[27] It is document issued by a carrier to a shipper, acknowledging that specified goods have been received on board as cargo for conveyance to a named place for delivery to the consignee who is usually identified.

Table 3 below summarizes our results for Asia/Europe differentials for two different assumed B/L dates and compares them with the *Petroleum Intelligence Weekly* (PIW) estimates presented in the Wall Street Journal article.

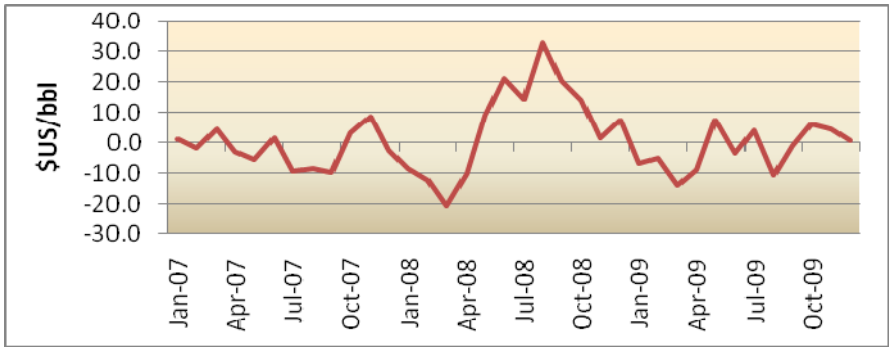
Table 3. Asia-Europe FOB Price Differentials for Arab Light

Year	B/L (5th)	B/L (15th)	PIW
2007	-2.24	-3.57	-2.00
2008	4.59	5.06	7.00
2009	-0.04	-0.91	-0.50

Source: Author's calculations; Chiu *et al.* (2010).

The price differentials between Asia and Europe, as can be seen, are large and highly volatile. In 2007, Asia experienced a large 'discount' relative to Europe ranging from $2.00/bbl to $3.57/bbl. Then, in 2008, Asia experienced a very large 'premium' to Europe, ranging from $4.59/bbl to $7.00/bbl. In 2009, the premium reverses again, and Arab Light sold to Asian buyers was at a discount to Europe ranging from $0.04/bbl to $0.50/bbl. Over the three years studied, Asia paid a small premium of $0.19 relative to Europe.

Figure 4. Asia-US AL FOB Price Differential

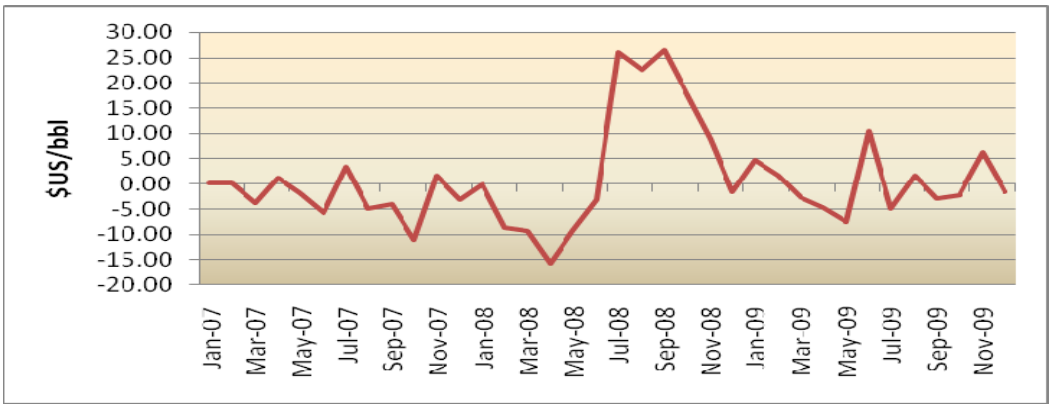


Source: Platts, Authors' calculations

Figure 4 shows that the OSP differential between Asia and US for Arab Light (AL) ranges from a negative $20/bbl to over $30/bbl over 2007-2009. In 2007, we estimate that Asia paid on average $2.00/bbl less for its FOB purchases of AL crude, while it

paid about $4.70/bbl more in 2008 (when the differential spikes starting in March 2008) and $1.90/bbl less in 2009.

Figure 5. Asia-Europe AL FOB Differential



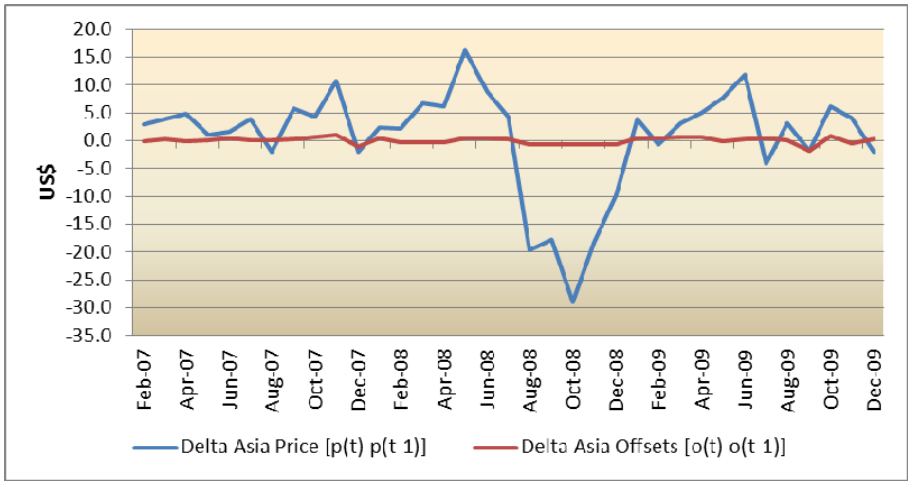
Source: Platts, Authors' calculations

Similarly, Figure 5 shows that the OSP differential for FOB AL between Asia and Europe also ranges from a negative ($15/bbl) to a positive ($25/bbl) number. On average, Asia paid $2.24/bbl less in 2007, $4.60/bbl more in 2008, and $0.04/bbl less in 2009. Therefore, akin to the Asia-US differentials, annual averages for OSP differentials between Asia and Europe are also volatile.

We measured the FOB differentials for AL sold in the three markets utilizing a different arbitrary loading date. The arbitrary loading date chosen for all three markets was the 5th of each month. This advanced the pricing for crude destined to both Europe and the US by 10 days (from 15th to the 5th of the consecutive month). Note that Asian pricing always remains the same with regards to the loading date, since for Asian sales the pricing period is the average of the month of loading irrespective of the actual B/L date in the month.

Figure 6 below shows a plot of the change in the Asia offsets along with a plot of the change in the Asia OSP. During 2007-2009 the change in Asia offsets is insignificant compared to change in the Asia Official Selling Prices (OSPs). We can see that the magnitude of the change in the Asia offsets is very small compared with the magnitude of the change in the Asia OSPs.

Figure 6. Change in the price of the Asia OSPs and the Asia offsets ($/bbl)



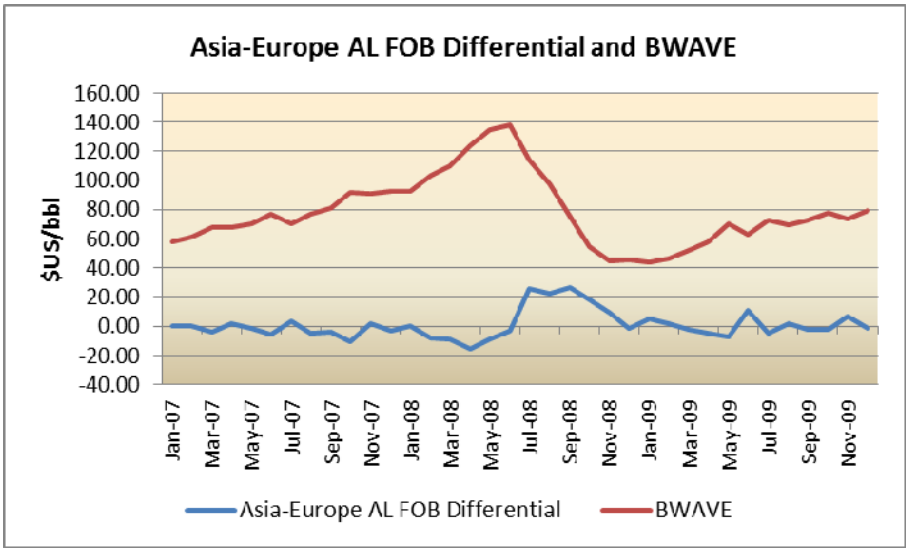
Source: Platts, Authors' calculations

As can be seen in Figure 7, the Asian AL OSPs increase to a discount of between $10 - $20/bbl to European AL OSPs in March – May 2008 as B-wave trends up sharply from $90/bbl to $140/bbl. When B-wave trends upward, pricing on a 10-day average 40 forward will be higher than pricing the Oman/Dubai average monthly price for the month of loading for Asian sales. That is, in a rising market for B-Wave reference crude, one expects crude oil arriving in Europe some 40 days after loading at Ras Tanura to be higher priced than that loaded for the Far East which is priced on the average of the month of loading at Ras Tanura. When B-Wave falls off steeply from the $140/bbl peak to around $40 beginning around June/July 2008, we see the Asian OSP quickly becoming a premium over the European OSP of up to $20/bbl (around July to September 2008). A similar relationship of Asian OSP to US OSP holds, as shown in Figure 8. In short, whether Asian customers were paying a premium or enjoying discounts over the past 3 years, relative to their counterparts in the Pacific Basin, seems to be determined by whether absolute reference crude prices in the US or European markets were on an uptrend or a downtrend.

While Saudi Aramco aspires to be a major and preferred long term supplier of crude oil to each of the major consuming regions of North America, Europe and Far East, nevertheless, Saudi Aramco crude exports to Asia have grown significantly over time as a proportion of total crude exports over 1995 – 2008, from less than 50% to over 60%

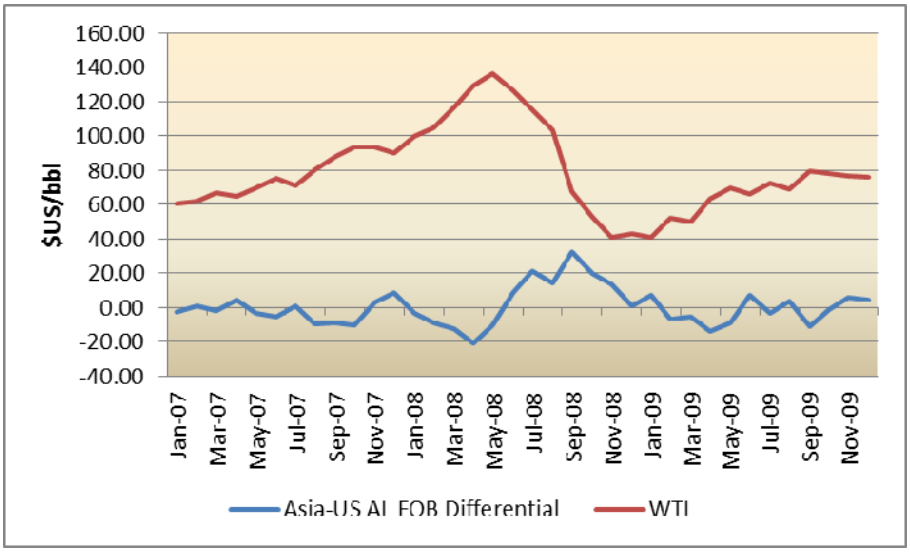
(see Figure 9). This is not unexpected, given that Asia constitutes a natural market for Middle East oil both geographically and logistically.

Figure 7. Asia-Europe AL FOB Differential and BWAVE



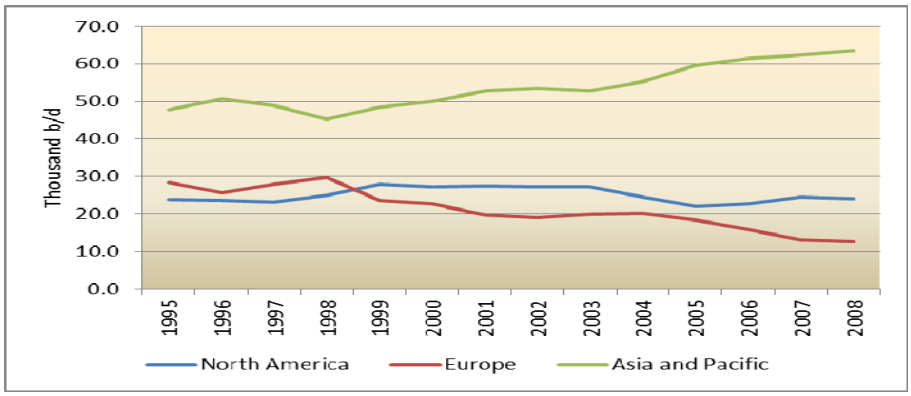
Source: Platts, Authors' calculations

Figure 8. Asia-US AL FOB Differential and WTI



Source: Platts, Authors' calculations

Figure 9. Saudi Arabia's Crude Oil Exports by Destination



Source: UN Comtrade Database

There have been important developments that have expanded the crude oil diet for many Asian customers, introducing newer crude oil grades from non-traditional sources. The Saudi crude oil share of the key China and India markets has reduced from 2009 to 2010, while those of West and Central Africa and Latin America have increased in both countries.[28] Arabian Gulf crudes accounted for nearly 45% of China's crude oil imports in the first 7 months of 2010, compared to the 52% in the year-ago period, while West African and Latin American market shares increased. In India, the crude oil purchasing decisions by Reliance in favor of Latin and African sources reduced the Middle East share of the country's crude oil imports in the first 7 months of 2010, relative to the previous year's comparable period.[29]

Another recent development is the completion of the East Siberia–Pacific Ocean (ESPO) pipeline, the first phase of which was completed in 2009. ESPO crude (32.6 API and about 1% sulfur) is not too dissimilar from Omani crude (33.3 API and 1.06% sulfur). ESPO is almost exclusively sold on tender basis by the main producers: Rosneft, Surgutneftegaz, TNK-BP and Gasprom. The sales are priced with reference to Platts Oman or Dubai average monthly quotations. According to reports, ESPO has quickly gained a foothold at the expense of Middle Eastern grades, buoyed by shorter

[28] See Hua, J. and Tan, F. "Mideast crude battles to recoup lost ground", Thomson Reuters Petroleum Review, November 2010 issue, pg. 6.
[29] See, Verma, N. "India's Mideast crude import slump may reverse", Thomson Reuters Petroleum Review, November 2010 issue, pg. 9.

transit times and lower freight rates to northeast Asia, and reduced restrictions on usage than Middle Eastern crudes.[30]

In the context of the analysis presented in this section, the claim in the Wall Street Journal article that "the rising power of Asian oil consumers is increasingly helping them (to) buy oil more cheaply than their counterparts in the West, a reversal of the historical pattern" (see endnote 36 above) seems rather inapt. Oil prices, i.e. Arabian Gulf OSPs, are not "bargained" between Arabian Gulf producers and Asian buyers, and have precious little to do with "the rising power of Asian consumers" as such. They are set by relatively mechanical formulas which add the reference crude prices to announced monthly regional offsets. To the extent that added supplies of ESPO, African and Latin crude oils put pressure on Arabian Gulf supplies into Asia at the margin, this would indeed support lower crude oil acquisition costs for Asian customers.

6. Policy Implications

In the literature on the so-called Asian premium that has emerged from Asian research institutes, several policy proposals have been put forth as possible measures Asian consuming countries can take to challenge this cost burden.

One proposal is to source oil from regions other than the Middle East, primarily Central Asia and Russia (Calder, 2005). Of course, it is self-evident that if Asian consuming countries could source their crudes from regions outside the Middle East at a cost less that the value of the perceived Asian premium, they (or their agents, the Asian state-owned and private oil companies) would already have done so. As discussed, whenever Brent-related prices were low relative to the Oman-Dubai prices, larger volumes of West African crudes would flow East.

Another policy proposal mentioned was the subsidization of freight costs of crude oil sourced from outside the Middle East. For example, Korea's Ministry of Commerce, Industry and Energy proposed subsidizing non-Middle Eastern crude imports by paying for the difference in freight costs between shipping crude from non-Middle Eastern

[30] See, for instance, Hall, S. "IEA: Russia's ESPO Crude May Become an Asian Benchmark", January 18, 2011, Dow Jones Newswires.

sources and shipping crude from the Middle East. In theory, if the cost of freight subsidies can measurably reduce the risk profile of any particular country, and if that improvement could be quantified in terms of potential benefits to societal welfare, one could make a theoretical justification for such a policy.

But it is difficult to argue that geographical diversification can reduce price volatility. Today's liquid global oil markets make various crude oils highly fungible and refining values rapidly get arbitraged to approximate their shadow price according to location and quality. Other suggestions to reverse this phenomenon have for the most part focused on getting the oil producers to deviate from their marketing strategy by seeking to form a consortium that raises the countervailing bargaining power of Asian consumers in demanding an alteration of the status quo. We have seen in Sections 2, 3, and 4 that this strategy has neither been successful in the past. Given the market structure and heterogeneous interest of the concerned agents, be they oil producers or consumers, continued implementation of this strategy is likely to continue to be unsuccessful. Most observers of crude oil markets would find it difficult to believe that several Asian countries would unite to take some sort of joint stand on price negotiations.

In any case, any such negotiations would only affect the level of *offsets* that Middle East producers actually determine to adjust the reference crudes. That is, the producers determine the offsets that they announce monthly for their official selling prices, they do not determine the price of the reference crude to which the offsets are applied. In Asia, the reference crude is Oman-Dubai (as reported by Platts), and Asian consumers would need to explain what Middle East producers can do about the reference crude prices at any specific time in order to alleviate inter-regional price differentials which burden the Asian consumer more relative to their European and US counterparts.

There are significant structural differences between the Asian markets and their Atlantic counterparts. Asia is massively net short of crude oil that creates a strong dependency on the Middle East for supplies. There have been few alternative sources to replace crude oil imports from the Middle East such as West African crudes. One recent new entrant into the Asian crude market is the ESPO crude from Russia, priced mostly off Dubai, and according to some recent reports, has already begun to make Asian markets more competitive. In general, Asian markets are still characterized by

risk averse behavior given the tendency to lay a greater emphasis on security of supply where buyers are locked into term contracts which translates into a lower price elasticity of demand in Asia. The spot markets in the East of Suez region, though active and liquid, still constitute a small volume of crudes relative to term contract volumes.

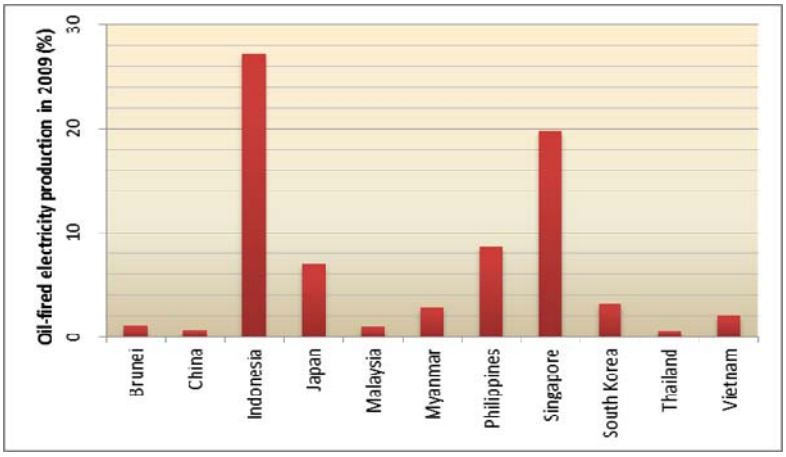
Most importantly, contrary to previous studies that used data prior to 2002, our analysis reveals that for the three years from 2007–2009 there is no secular Asian premium. In fact in 2007 and 2009, Asia received a *discount* in its crude oil bill relative to the Atlantic markets. Given that the price differential between the Asian and Atlantic markets fluctuates between being a discount and a premium, there is an option value in maintaining the status quo. Taking any action to mitigate the so-called premium will be premature and inefficient. Furthermore, our analysis reveals that the prices of the reference crudes drive the discount or premium. As these prices are determined in world markets, energy market integration will do precious little to affect the price differential either way. In effect, there is no obvious link between the so-called Asia premium and energy market integration.

This is not to say that energy market integration will not prove beneficial. Energy market integration provides the impetus for the efficient utilization of resources, deepening of investments, and increasing trade flows between countries. Energy market integration would necessarily entail improving the competitiveness of the energy industry in Asia via liberalization, harmonization of rules, regulations, and standards across countries in the region. All these would enable countries in the region to achieve gains from trade in natural resources and to benefit from market-led investments and trade. It should be noted however that the heterogeneity of income levels and environmental standards across Asia militate against a region-wide conformity in energy services/products.

Countries in the region need to let the markets set the price for energy. Several countries in East Asia subsidize fossil fuel-based energy consumption. Subsidies cause distortions in the price signal resulting in the inefficient consumption of energy. Figure 10 reveals that approximately 26% of Indonesia's electricity is produced by fuel oil, a relatively expensive fuel, given the elevated levels of crude oil prices since the temporary slump in prices during the 2008 financial crises. Subsidies for electricity as well as petroleum products have resulted in inefficient fuel-fired power plants being

used in electricity generation, let alone being unsustainable burdens on public finance, at the expense of crucial investments in infrastructure and public goods necessary for the rapidly growing Asian economies.

Figure 10. Oil-fired Electricity Production in 2009 (%)



Source: Enerdata, Global Energy and CO_2 Database

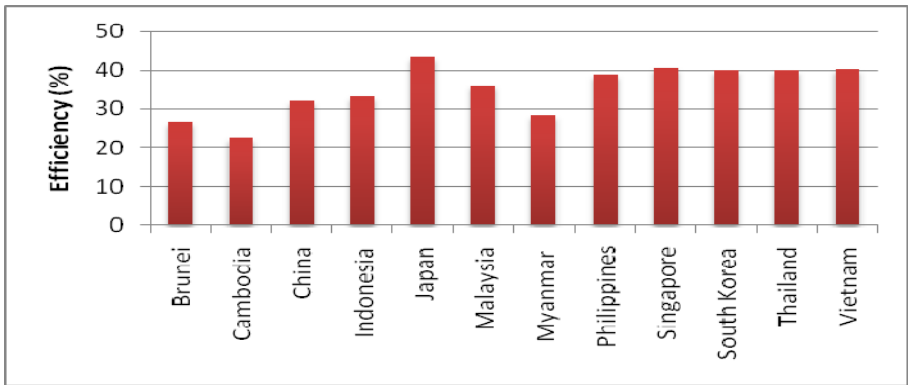
A more competitive energy sector would increase investment in a country's electricity sector and probably shift electricity generation away from fuel oil to natural gas reducing the demand for crude oil.[31] Furthermore, a switch to natural gas-fired power plants from fuel oil-fired plants would raise the efficiency of the electricity sector in the country. Figure 11 indicates that Indonesia's energy efficiency is lower than that of Japan, Malaysia, Indonesia, Thailand, Singapore, etc. Thus, promoting competitive markets and gradually phasing out energy subsidies would be lead to efficient use of energy resources.

Market integration also implies a sharing of information and processes. In the case of electricity generation, there exists an opportunity for countries in the region to build on the expertise of one another. This will happen if energy markets are opened up to competition, allowing more efficient entrants to operate. Figure 12 highlights the differences is the technical characteristics of energy systems in different countries

[31] A competitive levelized cost of electricity and the short time required to build a combined cycle gas turbine (CCGT) power plant have resulted in the rapid deployment of natural gas-fired plants for electricity generation. Cases in point are the UK and Singapore electricity markets after liberalization.

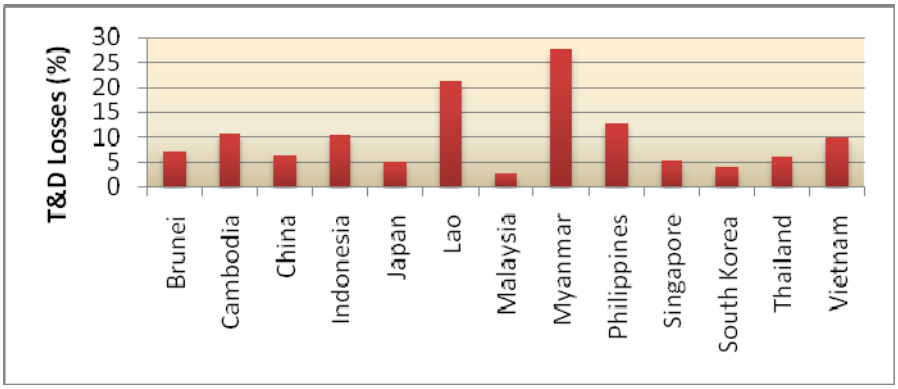
throughout East Asia. Transmission and distribution losses vary considerably amongst the countries with the worst performer being Myanmar with losses of approximately 27%. The best performer is Malaysia with losses of approximately 3%.

Figure 11. Efficiency of Thermal Power Plants in 2009 (%)



Source: Enerdata, Global Energy and CO_2 Database

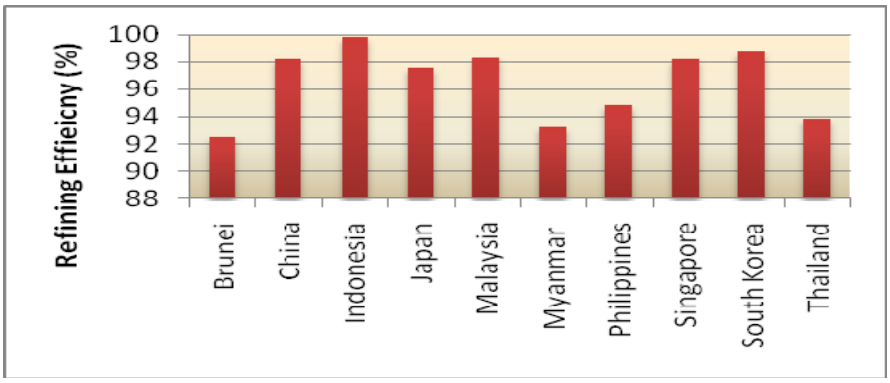
Figure 12. Transmission and Distribution Losses in 2009 (%)



Source: Enerdata, Global Energy and CO_2 Database

The strategy of sharing technical expertise in design and operation of could extend to the crude oil-intensive petrochemical sector. Figure 13 shows us the efficiencies of the refinery sector in 2009. The differences in efficiency are of course reflective of the vintage of capital stock; however, there might be the possibility of a gain from knowledge sharing. National oil companies in the petrochemical sector might improve their efficiency when exposed to competition. Hence market reform is crucial in the petrochemical industry as well.

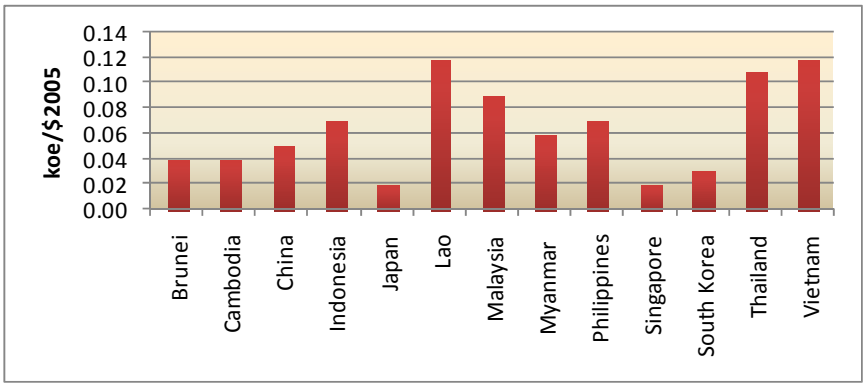
Figure 13. Refining Efficiency in 2009 (%)



Source: Enerdata, Global Energy and CO_2 Database

The substantial differences in energy intensity in the transport sector, as illustrated in Figure 14, point to the scope of energy demand reduction via pragmatic transport policies. This is again an area where the sharing of transportation policy experiences can bring about some positive outcomes in energy consumption reductions as some countries in the region, such as Singapore, have had considerable success in designing operational and efficient transport policies.

Figure 14. Energy Intensity of the Transport Sector in 2009



Source: Enerdata, Global Energy and CO_2 Database

7. Conclusions

Several studies suggest a historical price differential of US$1-1.5 between the Asian and Atlantic markets. However, analysts are divided over the interpretation of this differential. Some view it as a premium that Asia pays for its crude oil supplies from the Middle East. Others interpret it as a discount that the Atlantic markets receive given the imperative of Middle Eastern national oil companies, which have large export programs, to diversify exports by region to mitigate risk.

Since 1986, Saudi prices are set only in relation to reference or marker crude prices, never independently signaling absolute price levels. Saudi Aramco, and by extension, the other Arabian Gulf NOCs who essentially follow its lead, are more appropriately seen as a *price takers* in international markets for crude oil, in that Arabian Gulf crude oil prices are market-determined.[32] This conclusion fits well with what observers know about the overall Saudi exporting strategy.

[32] Note that this is quite different from the argument often made that OPEC as a group sets global crude oil prices by imposing production quotas on its members. This "OPEC as cartel" argument is not the subject of this paper.

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Appendix 1. Asia Offsets as a percentage of the Oman/Dubai Reference Prices

Month	Platts Oman/Dubai ($US/bbl)	Asia Offsets	Offsets as a % of the Oman/Dubai Price
Jan-07	52.25	0.15	**0.29**
Feb-07	55.23	0.05	**0.09**
Mar-07	58.83	0.25	**0.42**
Apr-07	63.70	0.15	**0.24**
May-07	64.69	0.15	**0.23**
Jun-07	65.94	0.55	**0.83**
Jul-07	69.78	0.55	**0.79**
Aug-07	67.83	0.55	**0.81**
Sep-07	73.46	0.75	**1.02**
Oct-07	77.19	1.35	**1.75**
Nov-07	86.97	2.35	**2.70**
Dec-07	86.01	1.35	**1.57**
Jan-08	87.96	1.75	**1.99**
Feb-08	90.35	1.55	**1.72**
Mar-08	97.31	1.25	**1.28**
Apr-08	103.75	1.05	**1.01**
May-08	119.65	1.45	**1.21**
Jun-08	128.07	1.85	**1.44**
Jul-08	132.04	2.05	**1.55**
Aug-08	113.09	1.35	**1.19**
Sep-08	96.02	0.70	**0.73**
Oct-08	67.69	0.00	**0.00**
Nov-08	49.94	-0.65	**-1.30**
Dec-08	40.76	-1.25	**-3.07**
Jan-09	44.29	-0.85	**-1.92**
Feb-09	43.31	-0.45	**-1.04**
Mar-09	45.71	0.25	**0.55**
Apr-09	50.13	0.90	**1.80**
May-09	57.84	0.80	**1.38**
Jun-09	69.44	1.00	**1.44**
Jul-09	64.95	1.40	**2.16**
Aug-09	68.05	1.50	**2.20**
Sep-09	67.90	-0.25	**-0.37**
Oct-09	73.24	0.60	**0.82**
Nov-09	77.80	0.15	**0.19**
Dec-09	75.45	0.50	**0.66**

Source: Platts; authors' calculations

Appendix 2. (B/L is the 15th of the month)

Month	Asia OSP	US OSP	Euro OSP	Asia Premium to the US	Asia Premium to Europe
Jan-07	52.4	54.491	54.596	-$2.10	-$2.20
Feb-07	55.28	56.3	59.153	-$1.03-	-$3.88
Mar-07	59.08	57.337	62.638	$1.74	-$3.56
Apr-07	63.85	60.953	64.592	$2.90	-$0.74
May-07	64.84	70.309	67.092	-$5.47	-$2.26
Jun-07	66.49	70.988	71.896	-$4.50	-$5.41
Jul-07	70.33	72.547	66.725	-$2.22	$3.60
Aug-07	68.38	77.839	75.138	-$9.46	-$6.75
Sep-07	74.21	88.673	83.273	-$14.46	-$9.06
Oct-07	78.54	83.786	90.686	-$5.25	-$12.15
Nov-07	89.32	89.008	89.841	$0.31	-$0.52
Dec-07	87.32	78.926	87.273	$8.40	$0.05
Jan-08	89.71	97.321	95.506	-$7.61	-$5.80
Feb-08	91.9	101.976	98.517	-$10.07	-$6.62
Mar-08	98.56	113.505	112.708	-$14.95	-$14.15
Apr-08	104.8	126.237	126.501	-$21.43	-$21.70
May-08	121.1	136.43	133.251	-$15.33	-$12.15
Jun-08	129.92	114.144	121.498	$15.78	$8.42
Jul-08	134.09	107.327	109.167	$26.76	$24.92
Aug-08	114.44	87.969	94.656	$26.47	$19.79
Sep-08	96.72	61.339	60.294	$35.38	$36.42
Oct-08	67.69	42.738	46.775	$24.95	$20.91
Nov-08	49.29	40.885	36.944	$8.41	$12.35
Dec-08	39.51	39.299	41.158	$0.21	-$1.65
Jan-09	43.44	41.297	36.975	$2.14	$6.46
Feb-09	42.86	50.872	45.837	-$8.02	-$2.98
Mar-09	45.96	57.272	46.601	-$11.32	-$0.65
Apr-09	51.03	72.196	59.164	-$21.17	-$8.13
May-09	58.64	63.841	65.396	-$5.20	-$6.76
Jun-09	70.44	68.126	65.627	$2.31	$4.81
Jul-09	66.35	67.76	70.839	-$1.41	-$4.49
Aug-09	69.55	66.471	66.32	$3.08	$3.23
Sep-09	67.65	78.402	75.268	-$10.75	-$7.62
Oct-09	73.84	72.903	75.999	$0.94	-$2.16
Nov-09	77.95	77.046	74.506	$0.90	$3.44
Dec-09	75.95	70.553	72.022	$5.40	$3.93

Source: Platts; authors' calculations

Appendix 3. (B/L is the 5th of the month)

Date	US OSP	Europe OSP	Asia Premium to the US	Asia Premium to Europe
Jan-07	54.99	52.17	-2.6	0.22
Feb-07	54.37	55.04	0.9	0.23
Mar-07	61	62.86	-1.92	-3.78
Apr-07	59.58	62.5	4.27	1.35
May-07	68.07	66.62	-3.23	-1.78
Jun-07	72.09	72.08	-5.6	-5.6
Jul-07	69.2	66.8	1.12	3.53
Aug-07	78.1	73.28	-9.72	-4.9
Sep-07	82.95	78.19	-8.74	-3.98
Oct-07	88.57	89.53	-10.03	-10.99
Nov-07	86.43	87.59	2.89	1.72
Dec-07	78.93	90.31	8.43	-2.95
Jan-08	92.76	89.79	-3.05	-0.08
Feb-08	100.55	100.44	-8.65	-8.54
Mar-08	111.2	107.7	-12.65	-9.14
Apr-08	125.63	120.37	-20.82	-15.57
May-08	131.62	130.26	-10.52	-9.16
Jun-08	121.03	133.05	8.89	-3.13
Jul-08	112.96	108.02	21.14	26.07
Aug-08	100.09	91.84	14.36	22.6
Sep-08	64.04	70.12	32.68	26.6
Oct-08	47.75	49.64	19.94	18.05
Nov-08	35.57	40.36	13.72	8.93
Dec-08	38.37	41.06	1.14	-1.55
Jan-09	36.15	38.57	7.29	4.87
Feb-09	49.87	41.02	-7.02	1.84
Mar-09	51.17	48.58	-5.21	-2.62
Apr-09	65.01	55.57	-13.98	-4.54
May-09	67.73	66.19	-9.09	-7.54
Jun-09	63.25	59.92	7.19	10.52
Jul-09	69.86	71.18	-3.51	-4.83
Aug-09	65.52	67.69	4.04	1.86
Sep-09	78.37	70.4	-10.72	-2.75
Oct-09	75.1	75.91	-1.25	-2.07
Nov-09	72.16	71.64	5.79	6.31
Dec-09	71.87	77.48	4.08	-1.53

Source: Platts; authors' calculations

Appendix 4. Econometric Tests for Causality

In this appendix we test whether the hypothesis that there exists a causal relationship between the adjustment factors and the price differential, i.e., the adjustment factors are the *cause* and the price differentials are the *effect*. We use a simple test of causality proposed by Sims.[1] The intuition behind the test is as follows: If the adjustment factors cause the price differential, it must mean that future values of the adjustment factor would not have any effect on the current price differential (as the cause should precede the effect). If this is not true, then we would be remiss in making the claim that the adjustment factors cause the price differential.

Accordingly, we ran the following regression:

$Y_t=\alpha+\beta_{t-1}X_{t-1}+ \beta_tX_t+ \beta_{t+1}X_{t+1}+u_t$

For our case, X represents the Saudi monthly adjustment factor for Asia bound crude and Y represents the price differential between Arab Light (AL) free on board (FOB) crude for delivery to Asia and the US or Europe. We then test the null hypothesis that $\beta_{t+1} = 0$. If X is to "Granger cause" Y,[1] then the coefficient of the lead term, $\beta_{t+1,}$ must be statistically equal to zero. We find that when we regress the price differential on the adjustment factor, the null hypothesis is rejected (see tables A and B below). This means that causality does not run from the adjustment factor to the price differentials for FOB-priced AL crude at Ras Tanura. We also tested the hypothesis that the monthly change in the adjustment factors (from one month to the next) causes the change in the price differential (from one month to the next). We found that there was no causal relationship between them.

Our analysis reveals that for the three years from 2007–2009 there is no secular Asian premium. In fact in 2007 and 2009, Asia received a *discount* in its crude oil bill relative to the Atlantic markets. We find that the existence of the price differential between markets is a function of the reference price levels. Given that the price differential fluctuates between being a discount and a premium, there is an option value in maintaining the status quo. Taking any action to mitigate the so-called premium will be premature and inefficient.

Energy market integration provides the impetus for the efficient utilization of resources, deepening of investments, and increasing trade flows between countries. However, in the context of the so-called Asian oil premium with globally integrated oil markets, there is no necessary link with energy market integration. The crucial question that now needs answering is how efficient is the oil price discovery mechanism, which is currently performed by price assessment agencies such as Platts and Argus. This is our future research direction.

Table A. Regression of the Asia-Europe AL FOB price differential on the adjustment factor for Asia-bound crude

Dependent Variable: Price Differential Europe-Asia
Method: Least Squares

Sample(adjusted): 2 35
Included observations: 34 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.360739	2.068010	1.141551	0.2627
Adjustment Factor(-1)	3.910083	2.780538	1.406233	0.1699
Adjustment Factor	3.593386	3.606695	0.996310	0.3271
Adjustment Factor (1)	-9.447022	2.782326	-3.395368	0.0019
R-squared	0.327688	Mean dependent var		0.852353
Adjusted R-squared	0.260457	S.D. dependent var		10.01486
S.E. of regression	8.612451	Akaike info criterion		7.254426
Sum squared resid	2225.229	Schwarz criterion		7.433998
Log likelihood	-119.3252	F-statistic		4.874044
Durbin-Watson stat	1.094883	Prob(F-statistic)		0.007048

Table B. Regression of the Asia-US AL FOB price differential on the adjustment factor for Asia-bound crude

Dependent Variable: Price Differential US-Asia
Method: Least Squares

Sample(adjusted): 2 35
Included observations: 34 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.776658	2.315243	0.767374	0.4489
Adjustment Factor (-1)	4.507220	3.112955	1.447891	0.1580
Adjustment Factor	4.446161	4.037881	1.101113	0.2796
Adjustment Factor (1)	-10.91271	3.114957	-3.503325	0.0015
R-squared	0.340371	Mean dependent var		0.237647
Adjusted R-squared	0.274409	S.D. dependent var		11.31943
S.E. of regression	9.642080	Akaike info criterion		7.480282
Sum squared resid	2789.091	Schwarz criterion		7.659854
Log likelihood	-123.1648	F-statistic		5.160047
Durbin-Watson stat	1.156157	Prob(F-statistic)		0.005381