The Pricing of Internationally Traded Gas

LNG Pricing in Asia

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INTRODUCTION

Jonathan Stern

This is the first academic book in any language to be entirely devoted to the pricing of internationally traded gas. The majority of books on gas are notably silent on the issue of pricing.[1] Given the sizeable amount of research dealing with international oil prices, this is extremely surprising and would alone be sufficient justification for this work, but there are additional reasons for believing that such a volume is long overdue. First, the growing importance of natural gas in energy balances worldwide, which is partly a function of the expansion of international gas trade. Second the rise to prominence and importance of natural gas issues – and especially pricing issues – in energy and political relations between countries. The best known example of this was a dispute over gas pricing between Russia and Ukraine, which sparked the January 2009 crisis, when Europe lost around 20 per cent of its gas supplies for a period of two weeks. In North America, a surplus of gas in the early 2010s drove prices down to very low levels, creating the possibility of large-scale LNG exports and also a debate as to the impact of exports on domestic prices. In Europe and Asia, the main debate centres on the extent to which the price of imported gas should remain linked to oil products and crude oil (respectively).

This introduction focuses on some specific issues which have arisen during the preparation of the book, in relation to concepts and terminology, with the aim of explaining why natural gas pricing is such a difficult subject to research.

Defining Regions and Trade

All natural gas literature refers to trade within and between geographical regions, and this book is no exception. However, defining regions in relation to natural gas trade and pricing is analytically problematic.

1 Exceptions are Julius and Mashayekhi (1990), Chapter 10 which dealt mostly with domestic gas pricing; IEA (1998) which focused mainly on early liberalization experience; and ECT (2007), Chapter 4 which includes a major analysis of domestic and international pricing in Europe, North America, and for LNG.

Arguably North America – defined as the USA, Canada, and Mexico – is the best example of a coherent region in relation to pricing, possibly due to the very substantial physical inter-linkages between countries. From the early 1990s to the late 2000s, there was reasonable coherence in continental Europe, with the UK having a different price mechanism. But in the early 2010s, significant gas pricing differences have developed between different parts of the continent of Europe. It is doubtful whether South America can be considered as one gas region, or if it should be divided between the Southern Cone, Brazil and Bolivia, and Colombia and Venezuela. Moreover it is unclear whether the Caribbean should be considered part of North America, South America, or as a separate region, or as a region at all.

Similar problems are encountered elsewhere. The main reason we refer to the 'CIS region' is because the countries in this region used to be part of the Soviet Union. But Central Asia (Kazakhstan, Uzbekistan, and Turkmenistan), the Caucasus (Azerbaijan, Georgia, and Armenia), the western CIS (Ukraine, Belarus, and Moldova), and the Russian Federation could all be considered different gas regions, and some countries within those groupings sit uneasily together. The Middle East and North Africa tend to be spoken of as a single region, but in relation to gas, the differences between countries in the Gulf and the Maghreb are very substantial; although not perhaps as great as the differences between North and sub-Saharan Africa. But probably Asia is the most problematic gas region to define, with the established LNG markets – Japan, Korea, and Taiwan – having little in common with China, India, and the countries of south-east Asia (some of which have been LNG exporters but in the 2000s are becoming importers).

But without individual analysis of each country (and sometimes of regions within a country) there is no way to avoid regional generalizations, despite the fact that geographic, economic, or political shorthand may have little relevance to gas trade or pricing. Attention is drawn in the chapters to the differences between countries, and between groups of countries within regions, but readers should be aware of the analytical problems of approaching the subject in this way.

An extension to this problem is that even the concept of 'trade' is difficult to define in relation to gas. While this book treats all gas which crosses a border as 'internationally traded', there are important distinctions between bilateral pipeline trade between neighbouring countries, and trade involving a number of different states as buyers or transit countries. Nor can this be defined in terms of distance: Canadian gas travels very long distances to the USA, much further than Algerian gas to Spain and Italy. But should the former be deemed 'regional' and the

latter 'international' (or inter-regional).[2] Likewise should Russian deliveries to Ukraine be considered regional, but its exports to EU countries international, and if so why? All LNG trade is generally classified as international, although North African deliveries to southern Europe travel a fraction of the distance involved in the majority of Atlantic and Pacific LNG trade, with the exception of Sakhalin exports to Japan which could reasonably be considered 'regional'. The conclusion is that geographical classifications of international gas trade are impressionistic rather than precise. But definitional problems notwithstanding, the regional approach still manages to capture the major issues in relation to the ongoing transition of natural gas from local to international or global energy commodity.

Long-term contracts

The focus of this book is *pricing* not contracts, but inevitably the role of long-term contracts is an integral part of the pricing story.[3] With OECD gas markets increasingly determined (or at least influenced) by hub/spot prices reflecting short-term market conditions, it is easy to lose sight of the fact that most international trade (outside North America and the UK) is still conducted on the basis of long-term contracts with complex price clauses.[4] The most important pricing elements of those clauses are: the base price (Po), the index (on the basis of which the base price is adjusted), the frequency of adjustment, the opportunities (if any) to reset the base price and/or the index, any other provisions such as minimum (floor) or maximum (ceiling) price levels. Related to pricing is the take-or-pay clause present in the majority of long-term contracts, which requires the buyer to pay for a specified minimum quantity of the annual contract quantity of gas at the contract price, whether or not that volume of gas has been taken. Long-term contracts – with a duration of 15–30 years – between exporters and importing national or regional utilities provided the basis for the establishment and initial decades of the gas industry's growth.[5]

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2 The International Energy Agency's *World Energy Outlook* defines gas trade as 'regional' or 'inter-regional' using its own regional classifications. IEA (2011, 31–5).

3 Conversely, pricing is an integral – but not necessarily the most important – part of a long-term contract.

4 For an encyclopaedic source on long-term gas contracts see ESMAP (1993), which also contains many of the different pricing provisions.

5 Importing utilities traditionally had contracts with large industrial customers

Ownership structures and liberalization

In the majority of exporting countries, national producing/exporting companies were government-owned, but international oil and gas companies also played an important role.[6] In the majority of, but not all, importing countries, the national/regional/municipal utility buyers were owned by the corresponding level of government.[7] These utilities had a *de facto* (and in some cases a *de jure*) monopoly of the customers in their service areas (which in some cases meant the entire country) and consequently governments were responsible for the regulation and pricing of gas to different classes of customer. This determined the structure for the successful development of an industry which depended on very large fixed capital investments in production, pipeline networks, and LNG (liquefaction and regasification) terminals and ships. This structure, and the ownership of the industry, came to be questioned from the mid 1980s onwards, with the privatization of utilities, and the liberalization (demonopolization) of energy markets, first in North America and Britain, and subsequently more widely in Europe and elsewhere.[8]

Government involvement and commercial risk

The ownership structure of the industry, the size of projects and

(including power generators) and municipal distribution companies, although not usually of such long duration.

6 Soviet, Algerian, and (initially) Norwegian exporters were government-owned companies but IOCs played a significant role in Norway; in the Netherlands, IOCs (principally Shell and Exxon) were major producers and part owners of Gasunie with the Dutch state. Some of the LNG suppliers to Japan were state-owned companies but export projects in the USA, Abu Dhabi, and Brunei were owned and operated by IOCs. In North America, all gas was imported and exported by private companies with the exception of Pemex in Mexico, but heavily regulated by federal authorities in the USA and Canada.

7 But in North America investor-owned utilities were the norm although the industry was regulated by national (federal) and regional (state) authorities; in Japan, gas and electricity utilities were also privately owned, and in Germany regional utilities were mainly privately owned. In most of the rest of the industry utilities were government-owned until privatizations started in the 1980s.

8 Liberalization and competition happened first in North America, where the industry was already privately owned; Great Britain saw the first privatization of a large gas utility, which was then followed by market liberalization.

investment requirements, and political sensitivity of gas pricing in exporting and importing countries, meant that governments were often intimately involved in major international pricing decisions. In virtually every country governments reserved for themselves (or their regulatory authorities) the right to accept, change, or reject agreements arrived at in negotiations between the commercial parties. Thus, although in theory gas pricing should be decided by commercial parties, in reality most contractual and pricing decisions are at least approved (and in many cases decided) by energy ministers – if not prime ministers and presidents – in importing and exporting countries.

International contracts, which allowed gas industries to develop and expand beyond their indigenous resource base, needed to be long enough for investments to be recovered in exporting and importing countries, and to provide a guaranteed cash flow, thereby assisting the financing of these investments. The logic of the division of risk inherent in these contracts was that:

- the exporter assumed the price risk, in other words, the risk that the price, however determined, would be sufficient to remunerate the investment in production and transportation of gas to the border of the importing country;
- the importer assumed the volume risk (via the take-or-pay provision), namely, that sufficient market would be developed in order to honour the volume terms of the contract. But in countries where imported gas became a large share of total demand, domestic gas prices needed to have an increasingly close relationship to international prices.

In both cases, the implicit assumption was that transactions entered into by both parties (whether state or privately owned) were financially guaranteed by their governments; an assumption which, from the importing side, became increasingly questionable during the 2000s.

Confidentiality and lack of transparency

An important reason why no book on this subject has previously been attempted is the lack of publicly available information, and the reluctance of a relatively small group of international gas stakeholders to disclose such information. This is summed up by Peebles, a well-known industry practitioner who, having described numerous gas contracts in his 1980 study (Peebles, 1980), observed:

> Not unreasonably … contractual details, in particular pricing arrangements, are confidential matters as between buyers and sellers … The main exception to this generality is in the case of [LNG] projects directed at North America where full contractual details, including prices, have to be filed with the appropriate regulatory bodies and as such become matters of public record.[9]

It might reasonably be asked, since North Americans had no problems in disclosing relatively full details of gas contracts and prices governing volumes – mainly comprising Canadian exports to the USA, but subsequently pipeline trade with Mexico, and LNG exports and imports – which accounted for more than 50 per cent of global gas trade in 1970, and remained well over 10 per cent in 2009, why absolute confidentiality was considered normal practice elsewhere. Despite the plethora of trade journals and price reporting services, near-total lack of transparency of pricing and other commercial contractual terms, remains common practice in long-term international (and many domestic) gas contracts. Many long-term contracts have confidentiality clauses stating that none of the commercial details may be disclosed, although this has become decreasingly tenable during the 2000s as price reporting services expanded, via electronic media, making their quotations (irrespective of accuracy) available to a global audience. However, for this reason, the comprehensiveness of sources in many chapters is less than would be expected in an academic book.

Price Formation in International and Domestic Gas Pricing: classifications and terminology

This book is about international, not domestic, gas pricing. A work on pricing in domestic gas markets would run to several volumes. But domestic pricing has a significant impact on international pricing and vice versa, and for this reason plays an important part in the narrative of many chapters in this book. Looking around the world, there are clearly very different methods of pricing gas, and significant differences in terminology for describing them. The International Gas Union (IGU) created a Task Force which carried out four surveys over the period 2005–10 and developed a classification system for gas prices which is reproduced in Box 1. While the focus of, and terminology used in, this book are different, the IGU data are extremely valuable because they cover the entire gas world and provide a database by price formation mechanism and region using a consistent methodology.

9 Peebles (1980, 31 and 201).

Box 1: IGU Price Formation Classifications

Oil price escalation (OPE): price linked, usually through a base price and an escalation clause, to competing fuels, typically crude oil, gas oil, and/or fuel oil. In some cases coal prices can be used.*

Gas-on-gas competition (GOG): the price is determined by the interplay of supply and demand – gas-on-gas competition – and is traded over a variety of different periods (daily, monthly, annually or longer). Trading takes place at physical hubs (for example Henry Hub in the USA) or notional hubs (such as NBP in the UK). If there are longer term contracts these will use gas price indices to determine the price. Spot LNG is also included in this category.**

Bilateral monopoly (BIM): The price is determined by bilateral discussions and agreements between a large seller and a large buyer, with the price being fixed for a period of time – typically this would be one year. There may be a written contract in place but often the arrangement is at the government or state-owned company level.

Netback from final product (NET): The price received by the gas supplier is a function of the price received by the buyer for the final product the buyer produces. This may occur where the gas is used as a feedstock in chemical plants, such as ammonia or methanol, and is the major variable cost in producing the product.

Regulation cost of service (RCS): The price is determined, or approved, by a regulatory authority, or possibly a Ministry, but the level is set to cover the 'cost of service', including the recovery of investment and a reasonable rate of return.

Regulation social and political (RSP): The price is set, on an irregular basis, probably by a Ministry, on a political/social basis, in response to the need to cover increasing costs, or possibly as a revenue raising exercise.

Regulation below cost (RBC): The price is knowingly set below the average cost of producing and transporting the gas, often as a form of state subsidy to its population.

No Price (NP): The gas produced is either flared, or provided free to the population and industry, possibly as a feedstock for chemical and fertilizer plants. The gas produced may be associated with oil and/or liquids and treated as a by-product.

Notes:
* referred to throughout this book as oil-linked or oil-indexed pricing
** referred to throughout this book as hub-based, spot or market pricing.

Source: IGU (2012, 7).

The first two categories – OPE and GOG – are referred to throughout this book as oil-linked or oil-indexed pricing; and hub-based, spot, or market pricing. These are the two main price formation mechanisms in international gas trade and dominate much of the discussion in this book. The other categories are mainly relevant for domestic gas pricing, but a few international contracts are still priced according to BIM and (in rare cases) RSP. There are some difficulties disentangling the RSP and RBC classifications because of lack of precise definition of, and empirical data on, costs.

Pricing and the subsidy issue

As noted above, the RBC (and potentially also the RSP) category in Box 1 raises the additional conceptual question of whether markets where domestic prices do not reflect international prices are subsidizing consumers. This book uses the term 'subsidy' to denote a situation in which the price paid by consumers does not cover the cost of production and delivery to their premises. However, other literature uses the term to denote prices which are below those in international trade.[10] Using gas domestically, when it could be could be exported, involves a major opportunity cost subsidy, equivalent to the difference between potential export revenues and actual revenues from domestic sales.[11] For importers, it involves governments or state-owned utility companies contributing the difference between the price which needs to be paid for imports, and the revenue which is received from domestic sales. The situation of the exporter is a choice of revenues foregone, which may not be an efficient use of resources, but is one which can be maintained over a long period of time.

Structure of the book

The book is comprised of 14 chapters. Chapter 1 deals with general analytical issues involved in gas pricing. This is followed by a historical chapter covering pricing developments up to the year 2000. Regional

10 For extended discussion of these issues see Chapters 1 and 6, and also Fattouh and El-Katiri (2012a) and (2012b).

11 In many gas exporting countries, gas is being used in the domestic energy market to substitute for oil which is being exported. In those countries, therefore, it can be argued that the correct comparison is not between domestic and exported prices but between export prices for gas and export prices for oil. For a specific discussion of this in an Egyptian context see Darbouche and Mabro (2011).

and national pricing is then dealt with in eight chapters covering: North America, Europe, CIS, Middle East and Africa, Latin America and the Caribbean, south-east Asia, India, and China, with a further chapter dealing with the future of Pacific LNG. These chapters cover pricing developments in the 2000s with a look forward to 2020, and they are followed by two thematic chapters, one on the Gas Exporting Countries Forum and the prospects for cartelization, and the other on the globalization of gas pricing and connections between the three major trading markets. Finally conclusions are offered as to whether the future of international gas pricing in the 2000s is likely to involve globalization, cartelization, or a continuation of regional pricing.

CHAPTER 11

LNG PRICING IN ASIA

Andy Flower and Jane Liao

Introduction

The linkage of LNG prices to crude oil in Asia was established in the 1970s when Japan was the only country in Asia importing LNG (see Chapter 2). As new buyers emerged in Korea (in 1986), Taiwan (1990), India (2004), and China (2006), they adopted an oil price linkage similar to that used by Japanese buyers. There have been variations in the formulae over time as buyers and sellers have responded to changes in the market environment, but the basic approach has remained unchanged.

Linkage to oil prices is still the way in which LNG sold under long-term contracts is priced in Asia in 2012, but alternative ways of pricing short-term cargoes have developed, and the potential for a switch to an alternative pricing method in long-term contracts is increasingly being discussed. In this chapter, we will review how the pricing of LNG in long-term contracts has changed, focusing on the period since 2000, and we will discuss the most recent developments in the pricing of spot and short-term cargoes. We have also contacted some of the players in the Asian LNG markets and asked for their views on whether the oil price linkage, which typically uses JCC – the Japanese customs cleared crude oil price, often referred to as the Japanese Crude Cocktail – as the oil index will continue to be used, or whether we will see a move to an alternative pricing approach, for example using prices at gas hubs in the Atlantic Basin as the basis, or through the development of a pricing hub in Asia.

The Evolution of Asian LNG Pricing 1969 to 2000

The approach to LNG pricing in Asia, including the linkage to crude oil, was established in the 1970s. The early contracts negotiated by Japanese buyers with the Kenai project in Alaska and with Brunei LNG had prices fixed in nominal terms for the duration of the contract. Those prices were at a significant premium to crude oil on a Btu basis, but

after the first oil shock in 1973 they were renegotiated and the oil price link was introduced (see Chapter 2). The contract that has been most influential in establishing the relationship between the LNG price and the oil price is the c.i.f. (cost, insurance, and freight) contract between Indonesia's government-owned oil and gas company, Pertamina, and Japan's Western Buyers consortium (Chubu Electric, Kansai Electric, Kyushu Electric, Osaka Gas, Toho Gas, and Nippon Steel), which was signed in 1973. As described in the appendix to Chapter 2, the price formula in the contract reduced to a simple linear equation of the form:

$$P(LNG) = A \times P(Crude\ Oil) + B$$

Where:

P(LNG) is the price of LNG in $/MMBtu
P(Crude Oil) is the price of crude oil in $/bbl
A and *B* are constants negotiated by the buyer and seller.

The constant *A* is known as the 'slope' and is typically expressed as a percentage, in other words, if *A* was 0.15 it would be referred to as a slope of 15 per cent. In the case of the contract between Pertamina and the Japanese Western Buyers, the constant *A* was 0.1485 (a slope of 14.85 per cent). The constant *B* was partly linked to inflation and partly took into account the actual cost of transporting the LNG from Indonesia to Japan. As a result, it changed over time. When deliveries under the contract started in 1977, the constant *B* was around $0.60/MMBtu.

Chapter 2 described how a pricing formula of the above form, with a slope of less than 17.2 per cent and a positive constant *B*, results in a price which is at a premium to crude oil at low oil prices, but the premium erodes as the price increases and eventually the price moves to a discount to crude oil. In the Japanese LNG market of the 1970s and early 1980s this approach was seen as having benefits for both the buyer and the seller. For the seller, it provided some protection against the impact of low oil prices – and it has to be remembered that this was in an environment where the long-run average price of crude oil was seen as being $20/bbl. Buyers were prepared to provide that protection because security of supply was (and still is) a major concern and they did not want projects to face financial problems, which could have compromised reliability. At higher oil price levels, the reduction in the premium provided support to buyers for the marketing of regasified LNG in their downstream markets in competition with crude oil and oil

products, which was also in the interests of the sellers since it helped ensure security of demand.

The simple linear relationship between the LNG price and the oil price worked well for LNG in Asia until the so-called third oil shock in late-1985 saw the collapse in oil prices to under $10/bbl, re-emphasizing the downside price risk for sellers. Furthermore, by that time the official government selling prices (OGSPs) of crude oil were being used as the oil index in some of the LNG contracts. OGSPs were the prices that members of the Organization of Oil Producing Countries (OPEC) set for the sale of their crude oil but, led by Saudi Arabia, an approach of market pricing, where the prices were set by supply and demand for crude oil, was introduced in late-1985. LNG prices linked to OGSPs no longer reflected energy market conditions, but buyers continued to pay the contract prices, leading to over-payments that had to be taken into account in the negotiations between buyers and sellers to find a new pricing mechanism.

The 'S-curve' and the 'applicable range'

Sellers were looking for increased protection against the impact of low oil prices which Japanese buyers, wanting to ensure that the supply of LNG would not be put at risk by sellers' having to cut costs, were prepared to accept. In return, the buyers wanted reciprocity at high oil prices. As a result the 'S-curve'[1] was born, and by the early 1990s had been adopted into most of the contracts in operation at that time, and into new contracts for the supply of LNG to Japan.

In addition, the concept of an 'applicable range' was introduced, which limited the use of the price formula to a relatively narrow range of oil prices, typically from $11–29/bbl, with the buyer and seller agreeing to 'meet and discuss in good faith' how to price the LNG in the event that the oil price was outside that range, which at the time was seen as constituting 'exceptional circumstances'. Figure 11.1 illustrates the Japanese S-curve and the applicable range as it was applied to long-term LNG contracts from the second half of the1980s.

The typical price formula was of the form:

$$P(LNG) = 0.07 \times JCC + B1 \qquad \$11 < JCC < \$16$$
$$P(LNG) = 0.1485 \times JCC + B2 \qquad \$16 < JCC < \$24$$
$$P(LNG) = 0.07 \times JCC + B3 \qquad \$24 < JCC < \$29$$

The slopes in the lower and upper parts of the price curve, the points at which the slope changes (often referred to as the 'kink' points) and the constants *B1*, *B2*, and *B3* were negotiated by the buyers and sellers

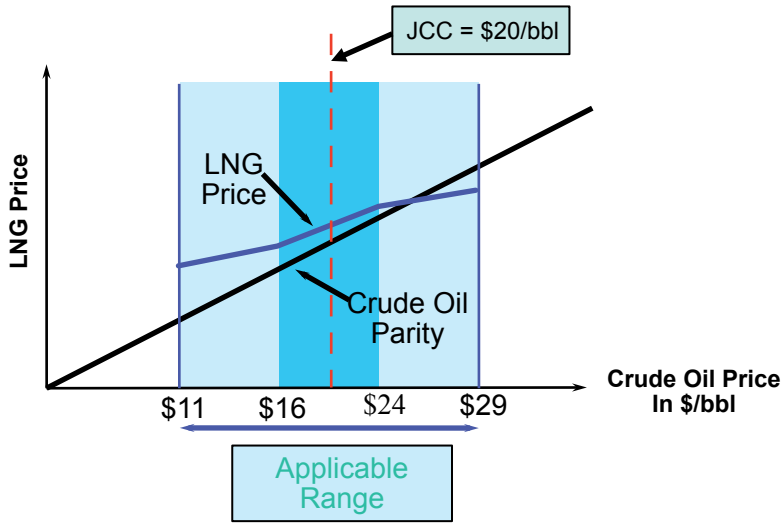

Figure 11.1: The Original 'S-curve'

Source: Authors

and varied from project to project. Generally the differences were small and Japanese LNG prices for the different projects moved within a relatively narrow band.

S-curves were introduced into all Japan's LNG long-term contracts by the early 1990s, with the exception of those with Indonesia. An S-curve was introduced into some Indonesian contracts in the early 2000s, but others retained the 'straight line' pricing formula. Furthermore, the approach of an applicable range was not used in Indonesian contracts.[2]

Korea and Taiwan did not adopt the S-curves in their contracts until after 2000 and even then only in one or two contracts in each country. The average price of LNG imported into Korea and Taiwan moved closely with the prices in Japan over the period January 1992 to December 1999 (as shown in Figure 11.2) despite the use of the S-curve in most Japanese contracts.

The LNG Buyers' Market in Asia 2001 to Early 2005

The early 2000s saw the beginning of a move away from S-curves during the buyers' market[3] which lasted from around 2001 to early 2005. This was a period when many projects at the planning stage, both expansions of operating projects and greenfield developments, were

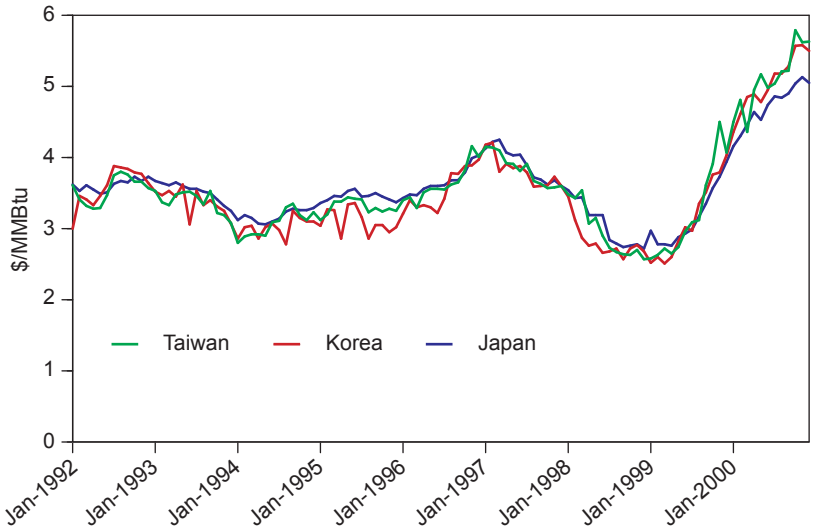

Figure 11.2: Asian LNG prices, January 1992–December 2000

Sources: Japan – Ministry of Finance; Korea and Taiwan – customs data

seeking buyers prepared to make a long-term commitment to purchase LNG to underpin the investment in new capacity The competition between sellers in a market where there was limited demand from buyers for new supplies, resulted in deals being done with much lower slopes than those in contracts negotiated before 2000. In a number of cases, the contracts also included price ceilings and floors which put upper and lower bounds on the LNG price. The buyers who benefited from these more favourable prices during the early stages of the buyers' market were mainly in China and India, with buyers in Korea and Taiwan following in the later stages, rather than Japanese buyers.[4]

The first buyer to recognize and take advantage of the market situation was the Chinese oil and gas company CNOOC, which, in 2001, sought the supply of 3.3 mtpa for 25 years for the Guangdong terminal in southern China, close to Hong Kong. CNOOC invited potential sellers to tender to supply the terminal. It requested bids with a slope of 5.25 per cent, which was much lower than for contracts in operation at that time. It also wanted a price cap at an oil price of $25/bbl and was prepared to offer a floor price at $15/bbl.[5] Seven sellers submitted bids and the short-list was narrowed down to three companies; Indonesia's Tangguh project, Australia's North West Shelf project and Qatar's RasGas project.[6] After further negotiations with the short-listed buyers, the North West Shelf project was selected as

the preferred bidder and a conditional sales and purchase agreement was signed in October 2002. The final contract followed in December 2004 and deliveries under the contract commenced in May 2006.

The price formula in the Guangdong contract, which is on an f.o.b. basis, met the conditions requested by CNOOC. It is a 25-year contract and it does not have a price reopener clause. Since the start of deliveries under the contract, JCC has been above $25/bbl. According to China's Customs Authority data[7] the price of the LNG delivered to the Guangdong terminal (after adding the cost of transportation to the f.o.b. price) has averaged around $3.20/MMBtu, which makes it the lowest priced LNG being delivered into Asia on a long-term basis.

The price in the contract was seen at the time as setting a new benchmark for Asian LNG prices, and several long-term contracts were signed in the period 2002–5 between Asian buyers and suppliers in the Pacific Basin and the Middle East, with prices at a similar level plus a floor and ceiling. The low-price contracts included: the sales by Indonesia's Tangguh project to the Fujian terminal in China and to POSCO and SK-Power in Korea; the supply of LNG from Qatar's RasGas II to CPC in Taiwan; and Korea Gas's contracts with Yemen LNG, Russia's Sakhalin project, and Malaysia's Tiga project.[8] The only contract signed by Japanese buyers at low prices during the buyers' market of the early 2000s was with the Qalhat LNG project in Oman.[9]

The Return to a Sellers' Market from 2005

By 2005 there was a move towards a sellers' market as some of the planned projects found buyers for their output, while others were delayed. In this environment, the sellers were able to increase the slope in the price formula. It was also a time when oil prices began their climb to over $100/bbl by 2008, a level which was reached again in March 2011. Many of the contracts for supply to Japan that were finalized before 2000 retained the S-curve and the applicable range. The JCC price first exceeded the upper limit of $29/bbl in many of the Japanese contracts at the end of 2003, triggering the 'meet and discuss' provisions in the contracts. In many cases, these negotiations had not been concluded by the time the buyers' market gave way to a sellers' market.

These negotiations were referred to as the 'price out of range' (or POR) negotiations. In most cases, the discussions were protracted as buyers and sellers sought to find pricing that would be acceptable to both sides at much higher oil prices than were ever envisaged in the late 1980s and early 1990s, when S-curves and applicable ranges were

first introduced. While the negotiations were underway, prices in many contracts were on a provisional basis and subject to revision when agreement was finally reached.

In a high oil price environment, the downside price protection provided by S-curves was no longer of interest to sellers, who were not prepared to give away the upside potential they provided at high oil prices. Furthermore, in a sellers' market buyers were not in a position to press for a lower relationship with oil at high prices to help protect their margins. As a result, S-curves largely disappeared from Japanese prices and the majority of price formulae in contracts which had come into operation before 2000 reverted to a straight line.[10] Similarly, price formulae in contracts for the supply of LNG from new projects had a straight line relationship with the oil price. Price formulae in the agreements reached from late 2005 to the end of 2008 were generally of the form:

$$P(LNG) = A \times JCC + B$$

Where:

A is in the range 15 per cent to 16.3 per cent
B takes into account transportation costs in DES deals and was close to zero in most f.o.b. deals

The global recession, triggered by the collapse of Lehman Brothers in September 2008, had a major impact on the export-led economies in Asia and resulted in the first annual decline in LNG imports into the region since the initial cargo arrived from Alaska in 1969. This might have been expected to have resulted in a return to a buyers' market or, at least, to a more balanced market with consequent downward pressure on prices. However, the recession had limited impact on the cost of constructing liquefaction plants, which had increased three to five times between 2005 and 2008. As a result, the buyers' ability to press for lower prices was constrained by the need to ensure that new supplies were developed to meet the expected return to growth, and to replace declining production from older plants in Indonesia and Alaska.

The period from the end of 2008 to early 2012 has seen a small reduction in the slope in the pricing formulae to the range 14–15 per cent in new contracts. The constant *B* continues to be based on the transport cost in DES contracts and to be around zero in most f.o.b. contracts. S-curves have also been re-introduced into some recent contracts in Asia, including those for projects supplied with coal bed methane (CBM) from

Queensland. However, the new S-curve is very different from the pre-2000 version (Figure 11.3). The first important change is that the 'S' is centred on a much higher oil price than the old 'S'. In Figure 11.3, it is centred on $60/bbl but in some deals the mid-point has been as high as $80/bbl. The lower kink point has been in the range $30 to $60/bbl with the upper kink between $90 and $110/bbl. The second main change is that the reduction in the slope above and below the kink points is typically about 3 to 3.5 per cent, compared with a reduction of around 7 to 8 per cent in the pre-2000 S-curves. The drive for the re-introduction of the S-curve has generally come from buyers looking for protection against the impact of high oil prices, rather than from sellers. The new S-curves have been agreed for projects under construction in 2012 and it will not be until late 2014, at the earliest, that LNG will be delivered to market under these pricing arrangements.

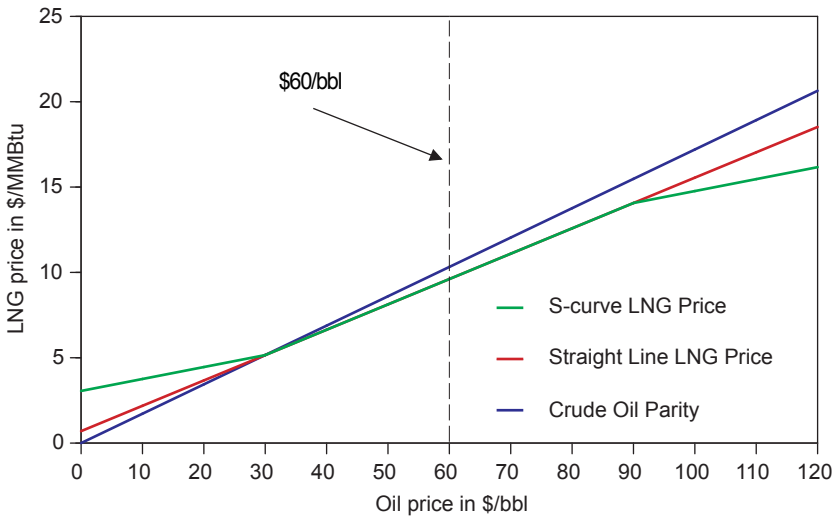

Figure 11.3: The 2010s version of the S-Curve

Source: Authors

Asian LNG Prices 2000 to 2011

Japan

Figure 11.4 shows the average monthly prices of LNG imported into Japan over the period January 2000 to December 2011 and compares them with the JCC price in the same month expressed in $/MMBtu

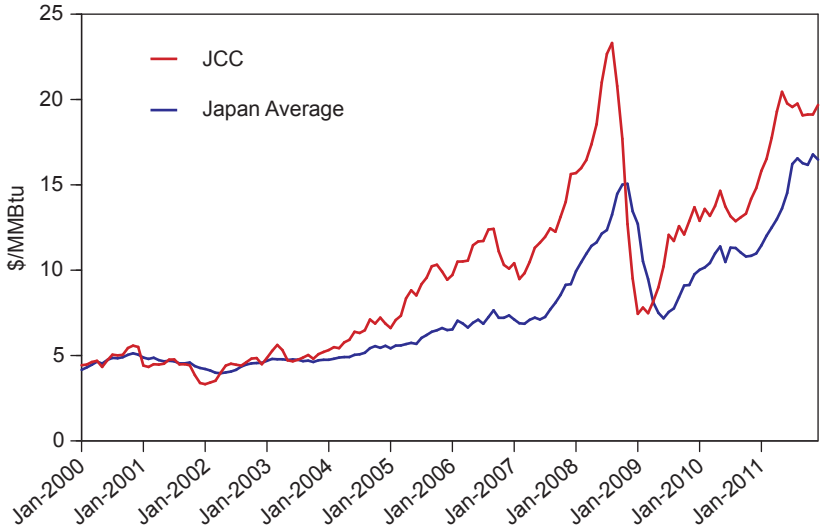

Figure 11.4: Average monthly LNG Prices in Japan and JCC, January 2000–December 2011

Source: Ministry of Finance, Japan

(the conversion has been made by multiplying the JCC price in $/bbl by 0.172).

It shows that in the early 2000s, when JCC prices remained largely in the range $19–29/bbl, the average LNG price moved closely with the JCC price. However as oil prices began their increase in 2003, the reduction in the slope at the top end of the S-curve resulted in LNG prices being at a discount to the oil price, and the discount increased as oil prices continued to rise. JCC peaked at $135.18/bbl in August 2008 and declined to $43.14/bbl by January 2009. In many of the LNG contracts, the LNG price in month *n* is linked to the JCC price in month *n*–3, although in some cases the linkage is to JCC in month *n* or to the average JCC price over a three month period, for example months *n*, *n*–1, and *n*–2 or months *n*–1, *n*–2, and *n*–3. The lag between the JCC price movement and its impact on LNG prices meant that the average Japanese LNG price peaked at around $15.00/MMBtu in October 2008 and fell to about $7.00/MMBtu in June 2009. The increase in oil prices to over $100/bbl in 2011 resulted in the average monthly Japanese LNG price reaching a new peak of over $16/MMBtu in the second half of 2011 as higher oil prices fed through.

As discussed above, during 2004–10 many of the prices were on a provisional basis while the POR negotiations were taking place, and

were restated after agreement was eventually reached. As a result, any additional payments made by the buyers resulting from price revisions are not taken into account in the data shown in Figure 11.4. However, in most cases the settlements did not involve repayments by the buyers so any price adjustments,[11] if they were to be applied to historic data, would have limited impact on average LNG prices.

One important change that has taken place over the past few years is a widening in the range of prices that Japanese buyers pay for the LNG they purchase under long-term contract. Figure 11.5 shows the range from the lowest to the highest price paid for LNG under long-term contract for each month from January 2000 to December 2011. The prices paid for short- and medium-term supplies from countries that do not have a long-term contract with Japan have been excluded from the figures.

Figure 11.5 shows that from 2000 to 2003, Japanese prices moved within a relatively narrow range because the formulae in most long-term contracts had similar slopes and constants. However, since the beginning of 2004 the range has widened as the slopes and constants have varied significantly, depending largely on the timing of the finalization of the pricing agreement. At the bottom end of the range are the few contracts finalized during the buyers' market of the early 2000s that

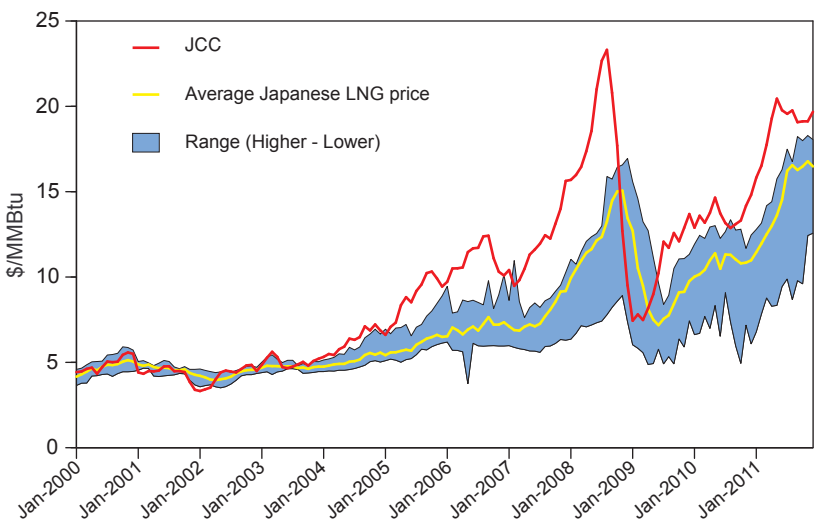

Figure 11.5: Japanese price range in long-term contracts, January 2000–December 2011

Source: Ministry of Finance, Japan.

remain in operation and have not been renegotiated, with slopes below 10 per cent; while at the upper end of the range are the more recent contracts with slopes above 15 per cent.

Korea

As Figure 11.6 shows, the lack of S-curves and an applicable range in most Korean contracts increased the exposure of the country's LNG imports to the effect of escalating oil prices. This resulted in Korea paying, on average, significantly higher prices for its LNG than buyers in Japan over the period 2004 to early 2009, despite the LNG being purchased from many of the same producers.

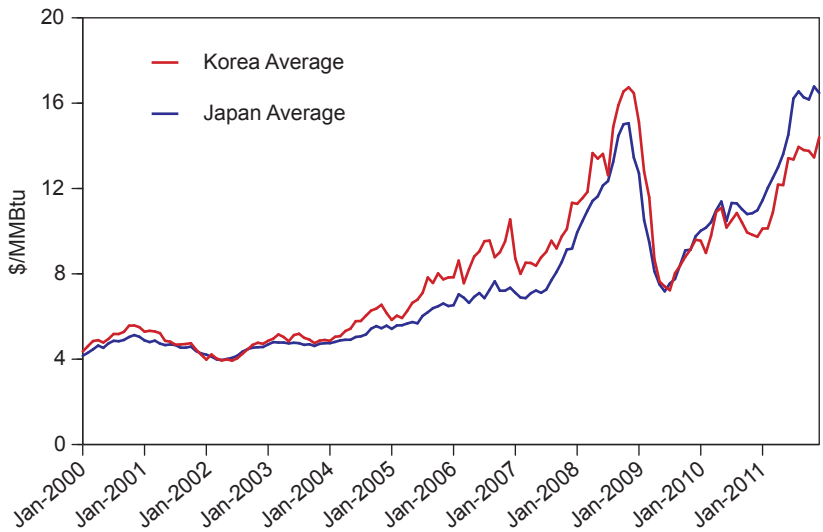

Figure 11.6: Monthly average LNG prices in Korea and Japan, January 2000–December 2011

Sources: Japan – Ministry of Finance; Korea – Customs Data

However, since mid-2009, average Korean prices have been below those in Japan as many of the latter country's contracts moved back to a straight line relationship with crude oil. Furthermore, as noted in the section 'The LNG Buyers' Market in Asia 2001 to Early 2005' above, Korean buyers entered into contracts for a larger volume of LNG in the buyers' market of the early 2000s, than did Japanese buyers.

In early 2005, Korea Gas used a tendering process to secure 2 mtpa from each of Yemen and Malaysia Tiga, and 1.5 mtpa from Russia's Sakhalin project, at prices which reflected the prevailing buyers' market

at that time.[12] Furthermore, POSCO and K-Power, which became buyers after the introduction of new regulations allowing companies to import LNG for their own use, purchased a total of 1.15 mtpa from Indonesia's Tangguh project with a price originally capped at $26/bbl but, following a price renegotiation before the start-up of production, the cap was raised to $38/bbl.[13]

As the market moved from a buyers' to a sellers' market Korea Gas, which needed LNG at short notice to meet demand which was growing more rapidly than expected, was reported to have contracted for 2.1 mtpa from Qatar's RasGas project using a price formula with the slope of around 16 per cent, which at the time, was one of the highest agreed in Asia for a long-term contract.[14]

Taiwan

The state-owned CPC Corporation (formerly the Chinese Petroleum Corporation) was given the monopoly right to import LNG by the Government of Taiwan. Its first contract with Indonesia, was signed in 1987. Pricing was on the same basis as that used for Indonesia's sales to Japan and Korea, including a linkage to the Indonesian crude price (ICP). CPC subsequently entered into three further long-term contracts: a second contract with Indonesia concluded in 1995, at similar prices to the first; a contract with Malaysia's Dua project, also signed in 1995; and a contract with Qatar's RasGas II project signed in 2005. The Malaysian contract was CPC's first contract linked to JCC. CPC's contract with RasGas II was agreed during the late stage of the buyers' market and had a price with low slope and a cap at a JCC price of $26/bbl. By 2011, the price cap had been exceeded for 12 successive months and, in accordance with the terms of the contract, it was increased to a higher level reflecting the prevailing JCC, with a consequent increase in the price that CPC pays RasGas II. However, data from Taiwan's Directorate General of Customs show that it remained the country's lowest cost source of long-term LNG supply in 2011.[15]

The escalation of oil prices in the early 2000s did not trigger POR renegotiations since, at the time, CPC's contracts did not have an applicable range. This meant that the company was fully exposed to the effect of rising oil prices and, as Figure 11.7 shows, paid a premium for its LNG supplies compared with Japan from 2003 to 2008. However, since 2008, prices in Japan and Taiwan have moved closer together, in part because of the removal of the S-curve in many Japanese price formulae and also because of the commencement of deliveries under the relatively low-priced contract with Qatar's RasGas II project.

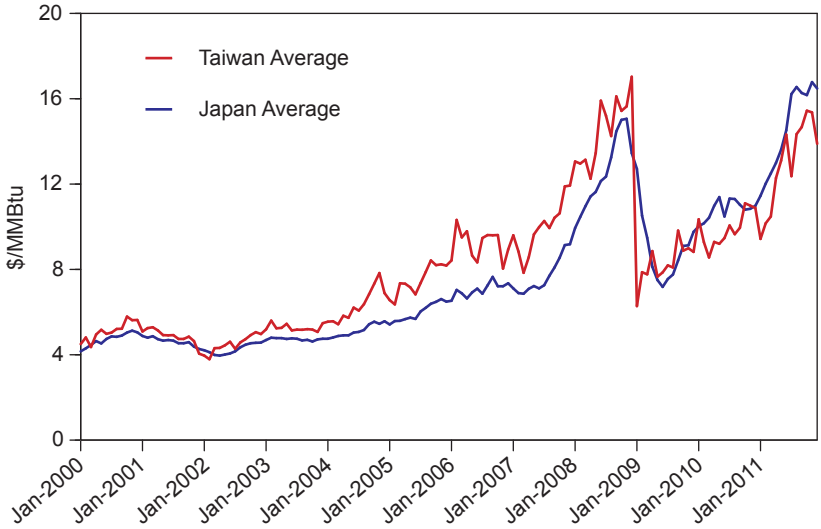

Figure 11.7: Monthly average LNG prices in Taiwan and Japan, January 2000–December 2011

Sources: Japan – Ministry of Finance; Taiwan – Customs Data

China

Prices in long-term contracts for the supply of LNG to China have moved steadily upwards since the first contract with Australia's North West Shelf project for the supply of LNG to the Guangdong terminal was finalized in 2002. The second contract with Indonesia's Tangguh project for the supply of LNG to the Fujian terminal, which was agreed at the same time as that with the North West Shelf project, was originally at the same price as the Guangdong contract, but the price ceiling was increased to $38/bbl before supplies under the contract commenced.[16] The third contract, with Malaysia LNG for supply to the Shanghai terminal, which was agreed in 2006, was also at a lower price than prevailing market prices, but with a slope of around 7 per cent rather than the 5.25 per cent in the Guangdong and Fujian deals, it represented another increase in China's LNG prices. Subsequent contracts with Qatargas and with the French company Total, which were signed in 2008, are understood to have slopes in the 15–16 per cent range, resulting in prices close to crude oil parity, and in line with prices being paid by buyers in Japan, Korea, and Taiwan for contracts entered into around the same time.[17] Chinese buyers have also committed to LNG supply from the Gorgon, Queensland Curtis,

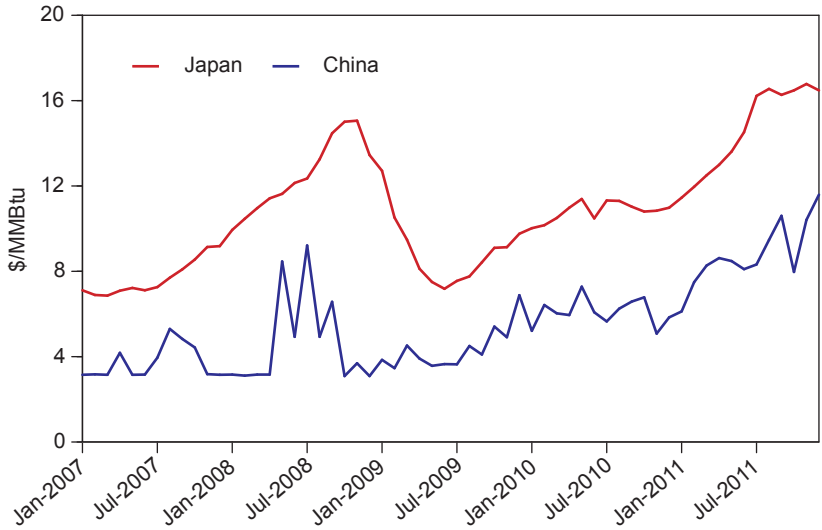

Figure 11.8: Monthly average LNG prices in China and Japan, January 2000–December 2011

Sources: Japan – Ministry of Finance; China – Customs Data

and Australia Pacific LNG projects in Australia and from Papua New Guinea (PNG) LNG, all of which commenced construction between 2009 and 2011 and which are scheduled to come on-stream from late 2014 onwards. The prices for these supplies are linked to crude oil with slopes understood to be in the 14–15 per cent range.

The low-priced supplies in China's first three contracts have resulted in the average price the country pays for its LNG being at a significant discount to Japan, despite the latter's much longer history and experience of importing LNG. However, as the newer contracts have come into operation, China's average price has moved upwards. In 2011 China paid on average $9.06/MMBtu for 12.2 mt of imports, whereas Japanese buyers paid an average of $14.73/MMBtu for the country's 78.5 mt of LNG imports. As deliveries under new contracts build up, the gap between average monthly Chinese and Japanese prices will narrow, but China's early contracts at low prices, which in some cases do not have a price re-opener clause, will probably result in China's average price continuing to be lower than Japan's.

India

India benefited from favourable prices in its first long-term contract

from Qatar's RasGas project, which was initially for 6.7 bcm/year (5 mtpa) and was increased to 10.1 bcm/year (7.5 mtpa) from late 2009. The contract was entered into by Petronet, which owns and operates the Dahej terminal in the north-west of the country. The f.o.b. price was fixed at $2.53/MMBtu for the first five years of supply, which resulted in a DES price of $2.80/MMBtu, after adding transport costs of $0.27/MMBtu. Over the second five years of supply, the f.o.b. price transitions to a 100 per cent oil linkage with a slope of 12.65 per cent.[18]

Deliveries under the contract started in January 2004 and the transition to full oil indexation commenced in January 2009, when one-sixtieth of the price was under the oil-linked formula and fifty-nine sixtieths was fixed. In each subsequent month the oil-linked element increases by one-sixtieth at the expense of the fixed element. Full oil-price indexation will be reached at the beginning of 2014.

Indian buyers have also been actively purchasing spot and short-term[19] cargoes at international prices for both the Dahej and the Hazira terminals in north-west India. Hazira was developed by Shell (76 per cent share) and Total (24 per cent) and operates on a merchant basis, with no long-term supply commitments by either owner. In early 2012, the only other long-term contract that had been entered was Petronet's commitment to purchase 1.5 mtpa on a DES basis from ExxonMobil's share of output from Australia's Gorgon project. The formula in that contract is understood to be linked to crude oil with a slope of between 14.5 and 15 per cent. The LNG will be delivered to the Kochi terminal in the south-west of the country starting in late 2014 or in 2015.[20]

Price Re-Openers and Price Reviews

Price reopener clauses were not included in most long-term LNG contracts in Asia until the 1990s. However, in the case of Japan, buyers and sellers have taken the pragmatic approach of reviewing and revising the price formulae as and when circumstances result in the price no longer reflecting market conditions. This has led to fundamental changes to the pricing structure, including the move from fixed prices to oil-linked prices in the 1970s, and the introduction of S curves from the second half of the 1980s in response to changes in the oil price environment. Since the early 1990s, Japanese buyers and their sellers have generally adopted an approach of agreeing contractually to review prices at regular intervals, typically every five years but in some cases every 10 years. The use of an applicable range, under which the parties agreed

'to meet and discuss in good faith' the pricing formula when JCC prices moved out of an agreed oil price range, resulted in many price negotiations being triggered after 2003. The experience in the other established markets – Korea and Taiwan – has been different, with relatively few price reviews taking place and only limited modifications to prices being implemented.

Price negotiations with Japanese buyers have often been protracted, for example, pricing provisions for Abu Dhabi's ADGAS project took over six years to resolve. However, the delivery and receipt of LNG has not been interrupted, even when the parties have been wide apart in the negotiations. Furthermore, up to the end of 2011, there had not been a case where a price dispute in an Asian LNG contract had been referred to arbitration,[21] although there are arbitration clauses in all the contracts.[22] This is in contrast with the situation in the Atlantic Basin, where referring price reviews to arbitration has become a relatively common event.

Although contracts with Asian buyers that have been finalized in recent years have generally included price reopeners triggered after a set number of years from the time of deliveries starting, and at regular intervals thereafter, they typically say very little about the factors that will be taken into account in any resulting renegotiation. Where they have occurred, the outcome has generally been the retention of the oil price linkage with changes to the constant and, less frequently, the slope, rather than a move to a fundamentally different approach, such as introducing a full or partial linkage to alternative indices.

Pricing of Short and Spot LNG Cargoes

Since early 2005, a combination of unexpected increases in demand, including the effect of nuclear problems in Japan, and a shortfall in supplies from some producers in the Pacific Basin, in particular Indonesia, have resulted in Asian buyers turning to Atlantic Basin producers for LNG cargoes to supplement supplies from producers in the Pacific Basin and the Middle East with whom they have long-term contracts. A large share of the Atlantic Basin supplies has been on a spot or short-term basis, although there are now some medium-term agreements in place. In 2008 the volume of LNG imported from the Atlantic Basin into Asia reached 20.2 bcm (15.0 mt). It declined in 2009 to 10.0 bcm (7.4 mt) as demand fell in Japan, Korea, and Taiwan, but increased again to 11.6 bcm (8.6 mt) in 2010.[23] In 2011, Japan's need for additional LNG because of the reduction of output from its nuclear

power stations in the aftermath of the 11 March 2011 earthquake and tsunami, together with growing demand in other Asian markets, resulted in imports from the Atlantic Basin to Asia reaching a record 20.7 bcm (15.3 mt).[24] Asian buyers have also purchased cargoes on a spot and short-term basis from suppliers in the Pacific Basin and the Middle East. However, it is impossible to identify the price of short-term cargoes from countries where Asian buyers have long-term contracts, as the published data only give the average price for all the LNG supplied from the country in question.

The pricing of spot and short-term cargoes has generally been on a very different basis from supplies under long-term contract. LNG sellers have the option of delivering divertible LNG cargoes to the flexible markets of north-west Europe or the USA rather than selling them to Asian buyers. Therefore, to secure these cargoes, Asian buyers have had to offer prices which provide a higher netback to the sellers than that available from the highest price in the flexible markets. This has meant that the higher of the USA's Henry Hub price or the UK's National Balancing Point (NBP) price has effectively provided the floor for the price of spot and short-term cargoes delivered to Asian buyers. In 2010 and 2011, the UK had the higher of the prices of alternative destinations, following the collapse of US prices caused by the shale gas revolution. However, a further factor, especially in 2011, was competition amongst buyers to secure additional supply. This resulted in a much higher premium over the prices in the flexible markets being paid than was required to cover the additional transport costs and to provide an additional margin for the seller.

Figure 11.9 shows the average price paid by Japanese buyers for cargoes of LNG from the Atlantic Basin between January 2006 and December 2011 and compares it with the higher of the Henry Hub or NBP price.[25]

Figure 11.10 shows that during the period January 2006 to December 2011, Atlantic Basin cargoes were, on the whole, at a premium to the average price of all Japan's imports. However, from September 2010 to December 2011 they were generally at a discount, despite the increased demand for spot and short-term LNG in Asia following the Fukushima nuclear crisis in March 2011. This suggests that increasing oil prices feeding through to oil-linked long-term contract prices have had a greater effect on LNG prices than the competition for spot and short-term supplies amongst Japanese and other Asian buyers.

Several trade publications have responded to the increase in trading activity by publishing estimates of spot and short-term prices on a daily or weekly basis.[26] These are made by asking sellers and traders

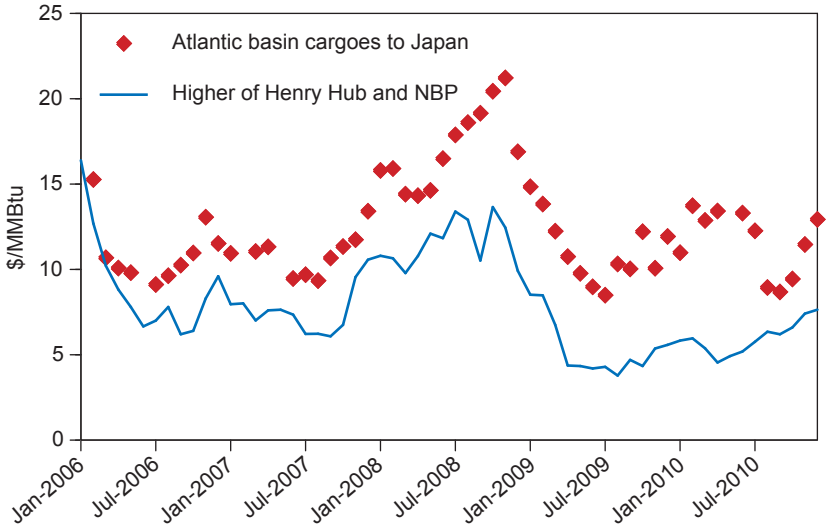

Figure 11.9: Average price of Atlantic Basin cargoes delivered to Japan and the higher of the UK NBP price and the US Henry Hub price, January 2006–December 2011

Sources: Japan – Ministry of Finance; Henry Hub/NBP: ICIS Heren

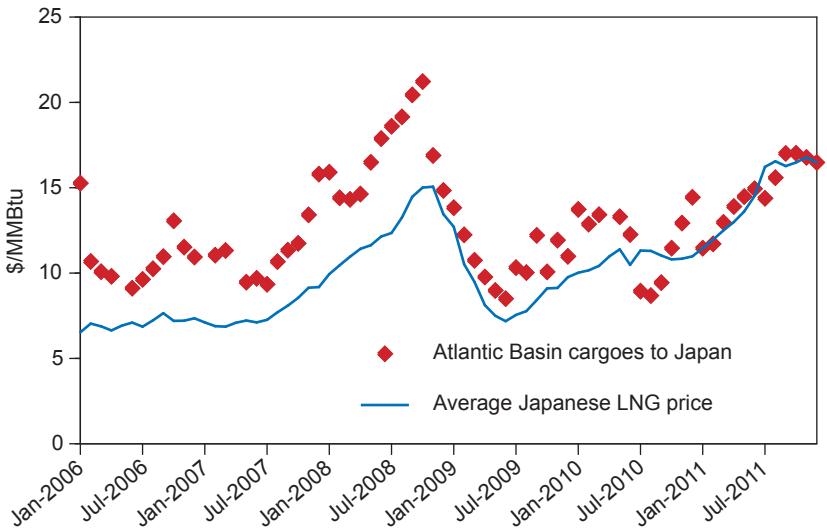

Figure 11.10: Average price of Atlantic Basin cargoes delivered to Japan and the average price of all Japan's LNG imports, January 2006–December 2011

Source: Japan Ministry of Finance.

the price at which they are prepared to offer cargoes, and buyers the price at which they would be prepared to buy. The spot price is then assessed taking into account the responses. These so-called 'marker prices' are beginning to be used for some spot and short-term deals, but do not yet have the credibility or reliability to be used in long-term contracts. They are also providing an indication of pricing trends in a market where relatively few spot cargoes are bought and sold, and where there are no trading hubs to provide transparent price information. Platts[27] has taken the lead in making these assessments, which it started to publish at the beginning of February 2009. Figure 11.11 shows Platts so-called Japan Korea Marker (JKM) price as published on the first working day of each month for the price in the following month. The JKM is compared with the closing UK National Balancing Point (NBP) month-ahead price on the same day. It indicates that the JKM prices have moved reasonably closely with NBP (which has been higher than the US Henry Hub price over most of the period covered by Figure 11.11). The premium over NBP widened in 2011 as competition amongst buyers for available cargoes increased. In addition, a tightening shipping market resulted in higher transport costs for moving LNG from the Atlantic Basin to Asia.

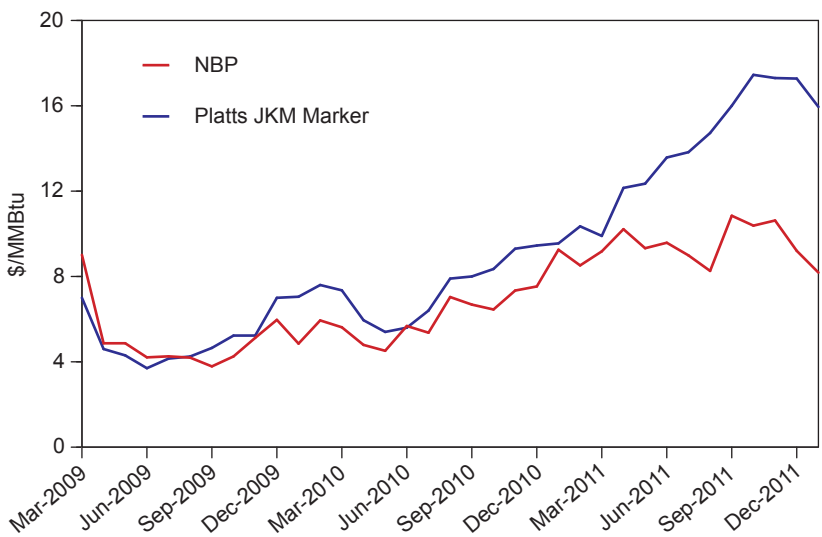

Figure 11.11: Platts Japan Korea Marker (JKM) and the UK NBP price for LNG/natural gas for delivery in the following month

Source: Platts LNG Daily

The Price Outlook in Asia – Will JCC Pricing Continue?

As discussed above, the way in which LNG is priced in Asia has evolved over the 40 years since the first cargoes from the Kenai project in Alaska were delivered to Japan. The oil price linkage was introduced after the first oil shock in 1973, and remained the method of pricing all the LNG supplied under long-term contract to Asia at the end of 2011. The prices in most of the contracts in operation at that time were concluded or revised in the 2000s, a period when there were major changes in the market that influenced the price formulae agreed between buyer and seller. The oil-price link has continued to be used by operating projects and in the contracts for new supply from projects that were under construction in early 2012. JCC remains the predominant index, although there are reports that Brent crude oil prices may have been introduced in at least one contract for supply from a project under construction, and the Indonesian Crude Price (ICP) index is still used in some existing Indonesian contracts.

Hub-based prices (principally the UK's National Balancing Point price) are used in the pricing of spot and short-term cargoes supplied to Asia, and may also have been included in some medium-term contracts. However, these mainly involve the diversion of cargoes from the Atlantic Basin and the Middle East, that would otherwise have been delivered to flexible markets in north-west Europe and the USA. In these markets, the UK's NBP price was the highest alternative price available to producers and sellers in 2010 and 2011. The starting point for sellers in pricing these cargoes has been the price for the cargo in the alternative market, plus the additional transportation and other costs incurred by the sellers seeking to earn a profit from the diversion.

The use of hub-based pricing has not been employed for LNG sold under long-term contract in Asia, but the debate on whether there should be a move away from oil-linked prices has been gaining momentum. In 2011, an 'end to oil price indexation' became a common theme at conferences and in comments made by senior representatives of Asian buyers, but there is no consensus on what might replace oil indexation and how a change to a well-established pricing methodology could be implemented. The limited competition between oil products and natural gas for market share, as oil becomes increasingly a transport fuel while gas is a fuel in the stationary sectors (industry, power generation, and the residential and commercial sector) is one reason that is often given in support of the need for changing the pricing mechanisms to reflect market realities.

Why was the oil price link introduced?

The oil-price link was introduced into LNG pricing in Japan in the 1970s when oil was the main competing fuel to natural gas for the power utilities, which burnt crude oil directly in some of their power plants (in addition to using fuel oil), and for the gas utilities who used gas manufactured from naphtha as a source of gas supply. This meant that linking the LNG price to crude oil ensured that it was competitive with alternative sources of supply of gas and power. The linkage to oil prices was initiated by the sellers which, in the 1970s, were generally led by an international oil company (IOC). When Korea and Taiwan emerged as LNG buyers, the oil-linkage was well established and they adopted the same approach.

China and India both took advantage of the buyers' market at the time they started importing LNG to secure their first supplies at a fixed price, in the case of India; and using a price formula with a much lower linkage to crude oil than was being used at that time by the established buyers, in the case of China. However, JCC was used by China's first buyer, CNOOC, while India's first buyer, Petronet, agreed that, after the first five years of supply from Qatar's RasGas project, when prices would be fixed, the pricing formula would move over the subsequent five years to a linkage with JCC.

Why has the oil price linkage been retained?[28]

Buyers in Asia share a common view that an oil index is the most familiar and reliable index after nearly 40 years of use. They have a good understanding of oil indices, which are based on prices in deep, transparent, and liquid global markets in which large quantities are traded. In contrast, while natural gas price indices such as NBP or HH are based on liquid markets, they are regional indexes which do not necessarily reflect global trends. Japanese power companies, which together accounted for around 30 per cent of Asian, and close to 20 per cent of global, LNG purchases in 2011, appear relatively comfortable in staying with JCC because of the fuel cost adjustment system which is used to set electricity tariffs.[29] Under this system, an adjustment is made to tariffs every month, based on the average prices of crude, LNG, and coal imported into Japan. For LNG as fuel for power generation, the JCC-linked prices account for the majority of LNG imported into Japan, and, hence, the average imported price of LNG (sometimes referred to as JLC, the Japanese LNG Cocktail) moves in line with oil prices.

A similar system is in place for downstream gas prices.[30] The cost pass-through mechanism allows Japanese utilities to adjust their gas and power tariffs to end users by the same percentage as the country's average LNG procurement cost movements, regardless of an individual buyer's actual purchase costs. For each utility, it is therefore important to keep its LNG procurement costs in line with the average import price. As a representative of one utility commented,

> … it is safer for a Japanese utility to use the JCC-linked price as long as the fuel cost adjustment system exists and other utilities continue using JCC as an index. The JCC indexed pricing mechanism for long-term contracts is acceptable and preferable to us.

Japanese gas utilities have been more open to the use of alternative indices, probably reflecting dissatisfaction with the fuel cost adjustment system, which limits their competitiveness with the power utilities.[31] Osaka Gas has been a pioneer amongst Asian LNG importers in pursuing a replacement for JCC in LNG pricing formulae. Osaka Gas representatives have, for example, written research papers promoting the concept of a market netback approach to pricing.[32] The Osaka Gas president, Hiroshi Ozaki, made a keynote speech at the Asia Oil and Gas Conference in Kuala Lumpur in June 2010 arguing that linking LNG to oil was rational when the formula was first introduced but this is no longer the case.[33] The competitive fuel mix has changed and a replacement for the link to JCC is needed to keep LNG competitive. Although several options were considered by Osaka Gas, Ozaki also conceded that all those approaches have practical problems, since natural gas markets in Asia's LNG importing countries suffer from low liquidity and insufficient liberalization.

Japanese electricity and gas utilities have one thing in common: they are all concerned about the risk of economic loss by using hub prices (or other mechanisms) when the fuel cost adjustment system is applied. Consequently, the Japanese utilities tend to have limited motivation to challenge oil-indexed pricing. Having said that, the question has to be asked: 'is the fuel cost adjustment system the main reason for Japanese buyers choosing to stick with the oil index pricing mechanism or it is the JCC-linked import pricing mechanism that is responsible for the adjustment system?' If the world's biggest LNG importer, Japan, decides to stick with the JCC linked pricing formula, the rest of Asian LNG importers can only be followers, in order to secure their LNG supplies. Not surprisingly, sellers also want to retain oil linkage for LNG prices since it has provided the returns needed to underpin the financing of new projects, especially in the current market where construction costs

for new liquefaction plants increased three to five-fold between 2005 and 2008, and remained at that level despite the economic recession up to 2012. However, the comments from sellers when asked about oil linkage, revealed a difference between LNG greenfield project developers, who generally want to retain the JCC-linkage, and LNG sellers with a global portfolio of LNG supplies, who are more flexible in the choice of which price index to use.[34]

The use of oil linkage has been of importance for the development of LNG projects supplied with unconventional coal bed methane (known as coal seam gas (CSG) in Australia). As one company involved in the development of a CSG project in Australia pointed out:

> The current CSG to LNG developments in Pacific region were started by domestic gas producers. Oil indexation is sought as a diversification by the producers who developed CSG to LNG because they wanted to gain oil index exposure. If a gas index had been used, there would have been no motivation for them to pursue CSG to LNG.

A developer of a conventional greenfield LNG project also insisted on the need for an oil index, stating that:

> We see oil linked pricing remaining in Asia Pacific for some time. Buyers and sellers have lived with it for a long time and therefore have a good understanding. … there may be a move away from JCC to something like Brent – this is better for both buyers and sellers from a hedging perspective (and this is becoming increasingly important).

Sellers acknowledge that Asian buyers have argued for change because they see lower prices in other markets, but they want to remind Asian buyers that:

> … markets are cyclic and capex still dominates the business. New projects in Pacific region would not be sanctioned on a 'lower of' formula.[35] Ultimately, this would harm buyers more than sellers. Finally, regular price reviews should ensure contracts remain relevant and appropriate over the contract life.

Some sellers expressed more flexibility in moving to a different price index, but pointed out that the level has to be right. As one buyer has said 'It doesn't matter if the prices are oil linked or not – only the absolute price level matters.' This could be achieved by, for example, a price linked to Henry Hub but with a high constant added, as has been the case with Argentina's purchases of LNG in 2011 and 2012.[36] However, these were prices for LNG on a spot or short-term basis (up to two years duration) and would probably be seen as too risky by buyers of LNG on a long-term basis. Eventually, sellers and

buyers will have to reach consensus on a durable price which ensures development of sufficient competitively priced gas resources. As one seller said:

> Prices are often structured to be responsive to market conditions and linked to alternate energy supplies taking into consideration gas to gas and/or crude oil to gas competition. The question may not be whether to link to crude oil or gas, but to understand fully the market and to price based on alternative energy supplies.

Indonesia and Malaysia, the world's second and third largest LNG exporters in 2011, are due to commission LNG receiving terminals in 2012. It is noteworthy that a JCC-linked pricing formula has still been used in the long-term contracts that buyers in these countries have concluded with their suppliers (in the case of Indonesia the LNG supply will be from the country's own liquefaction plants, but pricing is understood to be linked to JCC). It suggests that host country governments and national oil companies (NOCs) are comfortable with an oil index rather than with alternative pricing approaches, whether they are importers or exporters.[37]

The view that an LNG project needs an oil-linked pricing mechanism to gain financial support from project lenders (commercial banks, export credit agencies, and capital markets) seems broadly accepted for LNG projects in the Pacific Basin, although projects in the Atlantic Basin and in the Middle East, which contracted with buyers in the USA and the UK using hub-based prices, were able to raise finance before the escalation in construction costs. In an attempt to cover as many players as possible, bankers from leading international investment banks, which have had a long-term involvement in financing LNG projects globally, were also asked to provide their views on the connection between the LNG pricing mechanism and the bankability of LNG projects.

The most pertinent comment from one of the bankers was that they do, indeed, care about the indices being used to price LNG in long-term contracts, and the reliability of these indices in terms of being used to forecast future prices based on past performance. The main focus for lenders is, of course, whether the project can service the debt and repay the loans on time. Therefore, the statement that projects with hub-based prices are 'not bankable' probably reflects the potentially more limited debt capacity of these projects in comparison to projects with a more conventional pricing formula. An LNG project's bankability, in part, depends on the level of the project's anticipated revenues, and as such the consequence of using different indices can have an impact on the 'debt capacity'. As one banker commented:

> … the term bankability refers to the ability of a project to raise project finance, but the definition of the term can be quite wide. Numerous projects can exhibit the ability to raise project finance, but what differs is the amount of debt it can attract, e.g. the level of debt can vary from as little as 30 per cent up to as high as 85 per cent.

Another said that:

> … the bankers' bottom line is strong economics through a project that maintains its competitiveness in a distressed market environment.

In summary, comments from players with different roles in the LNG business indicate wide support for the continuing use of an oil index to price LNG sold under long-term contract in Asia. Some sellers raised the possibility of a move from JCC to a different oil price index such as Brent to facilitate hedging the price risk. In addition, some Asian buyers indicated their flexibility to the prospect of finding a new price mechanism. There was a clear message from all parties that it is the price *level* that is important, and the key question is whether adopting an alternative to a JCC linkage would result in a price that supports the development of the projects and the sale of regasified LNG in the downstream market. So what are the possible alternatives?

Alternatives to JCC and their Feasibility

This section discusses alternative pricing indices and whether they would be workable, taking into account views from key players in the LNG business in Asia.

Atlantic hub pricing

As discussed in the section 'Pricing of Short and Spot LNG Cargoes' earlier in this chapter, the price of natural gas at Atlantic Basin trading hubs, including NBP in the UK and Henry Hub in the USA, have been used as the basis for pricing short-term and spot sales to ensure the economic incentive for sellers to divert cargoes to Asia. Asian buyers recognized that 'Henry Hub or NBP plus a constant to reflect additional costs and premium'[38] is the price needed to secure supply in competition with buyers in other markets.

Some Asian buyers, especially in Japan, have indicated that they are prepared to consider applying a natural gas index for long-term purchases to diversify their price exposure and, more importantly, in the hope of taking advantage of the considerable price differential

that has developed between oil and natural gas prices, especially in the USA since 2008. However, they appear to want to limit the portion of their overall import volume linked to a natural gas price index. Firstly, because the regulated Japanese fuel cost adjustment system does not provide an incentive to purchase LNG using an alternative to a JCC-linked price. Secondly, NBP and Henry Hub prices are more volatile than oil prices because of weather and production and operational problems which can affect supply and demand.[39] In addition, prices can be influenced by the activity of traders speculating on future price movements, which are difficult for Asian buyers to monitor. Thirdly, the use of a three-month rolling average of JCC[40] in many of the price formulae can smooth price volatility, which does not generally apply with a gas index.[41]

Despite the potential risks of introducing a new pricing mechanism, some Asian buyers still want to take advantage of the large price differential between US and, to a lesser extent, European prices, and those in Asia. The expected export of US natural gas production as LNG has brought that possibility closer.

In 2011 and early 2012, proposals were made for the building of eight liquefaction plants in the USA, six in the Gulf of Mexico region and one each on the east and west coasts. Five of the projects were planned to be built at existing, underutilized LNG receiving terminals, allowing the sharing of the site and port and storage facilities, with a saving in costs, and three were greenfield projects. In the unlikely event that all are approved and developed, the total volume of LNG to be exported would be around 155 bcm/year (or 115 mtpa). This represents just under 50 per cent of global LNG production in 2011 and the required gas supply to the liquefaction plants (including the use of gas in the plant) would be approximately 25 per cent of US gas production in 2011.

The project which had made most progress by April 2012 was at Sabine Pass in Louisiana where the US company, Cheniere, was close to taking a final investment decision on a liquefaction plant with four 6.1 bcm/year (4.5 mtpa) production trains on the site of its LNG receiving terminal, which has been operating at throughput rates of under 10 per cent since it was commissioned in 2008. It was the first liquefaction project to receive approval from the US Department of Energy for the export of LNG to any country (except those where trade is prohibited by US law or policy). In April 2012, it also received approval from the Federal Energy Regulatory Commission (FERC) for the construction and operation of the plant. Finalizing financing arrangements was the only hurdle to a final investment decision on the first two trains.

Cheniere's business model is to sell LNG to buyers on an f.o.b. basis at Sabine Pass using the following price formula:

$$P(LNG) = 1.15 \times HH + B$$

Where *HH* is the Henry Hub futures price on the New York Mercantile Exchange (NYMEX) for the month of lifting and *B* is a constant agreed between Cheniere and each buyer.

Cheniere has signed contracts, subject to a final investment decision being taken, with four buyers for a total of 21.6 bcm/year (16 mtpa).[42] The UK's BG Group had contracted to lift 7.4 bcm/year (5.5 mtpa) and Spain's Gas Natural Fenosa, India's GAIL, and Korea Gas had each contracted for 4.7 bcm/year (3.5 mtpa). The constant *B* in the price formula increased from the $2.25/MMBtu in the first contract for 4.7 bcm/year with the BG Group, to $2.49/MMBtu for the second contract with the Spanish company, Gas Natural Fenosa, and to $3/MMBtu in the contracts with GAIL and with Korea Gas, and for the additional 2.7 bcm/year (2 mtpa) contracted by BG Group. The constant *B* provides Cheniere with the revenues to cover the capital and operating cost of the liquefaction plant, and it has said that the increase in the constant *B* in successive contracts reflects the level of interest in securing output from the facility.

The cost of LNG from the project delivered to Asian markets will depend on the Henry Hub gas price and the shipping cost. At a Henry Hub price of $5/MMBtu, the f.o.b. price will be $8–8.75/MMBtu, and the shipping cost probably $2.50–3.50/MMBtu, depending on charter rates, fuel costs, and the transit fee for the Panama Canal, which will be accessible to conventional-sized LNG ships after its expansion is completed in 2014 or 2015. The resulting price of LNG delivered to Asian destinations will, therefore, be $10.50–12.25/MMBtu, which is lower than the average prices paid for LNG by buyers in Japan, Korea, and Taiwan in 2011, but higher than the average price paid by China in the same year. If the constant *B* is $3, and assuming a shipping cost of $3/MMBtu, exports from Sabine Pass would break even with average 2011 import prices at a Henry Hub price of $7.60/MMBtu for Japan, $5.65/MMBtu for Korea, and $2.70/MMBtu for China.

GAIL and Korea Gas were the first two buyers in Asia to commit to purchase LNG from the USA. However, buyers in some other Asian LNG importing countries have indicated an interest in imports from the USA, and there have been preliminary commitments to LNG production from other proposed projects, which are following Sabine

Pass in obtaining permits to export LNG to countries with which the USA does not have a Free Trade Agreement (FTA), and in securing approval for the construction and operation of the liquefaction plant from FERC. The Japanese trading houses, Mitsui and Mitsubishi, have each signed a preliminary agreement with Sempra committing to the capacity of one 5.4 bcm/year (4 mtpa) train at the proposed Cameron liquefaction project in Louisiana.[43] Sempra plans a tolling structure for the project, with Mitsui and Mitsubishi paying an agreed fee for the liquefaction of natural gas that they have produced or procured. The resulting cost of LNG delivered to Japan is likely to be similar to the prices for LNG from Sabine Pass. A third Japanese trading house, Sumitomo, has teamed up with the gas utility, Tokyo Gas, to negotiate an agreement with Dominion Resources for 3.1 bcm/year (2.3 mtpa) of capacity at the proposed liquefaction plant at the Cove Point LNG receiving terminal in Maryland.

The supply of LNG to Asia from the USA at prices linked to Henry Hub will not start until 2016 at the earliest, and it is uncertain just how much LNG will eventually be produced and exported to Asia. However, LNG exports from the USA will provide Asian buyers with access to long-term LNG supply linked to US Henry Hub prices. If Henry Hub prices remain at low levels – they averaged around $2.30/MMBtu in the first four months of 2012 – then the LNG will be at a discount to JCC-linked prices at $100/bbl and, unless there is a collapse in oil prices, it could put pressure on the continuation of JCC-pricing in Asia. However, there remains considerable uncertainty over how much LNG will be exported from the USA[44] and what proportion will be contracted to Asian buyers, many of whom will probably want to limit their exposure to Henry Hub prices, at least for the first few years after US exports commence. Furthermore, the increase in US gas production that will be required to supply US liquefaction plants is likely to result in higher US gas prices, but there are differing views on how large any increase will be.[45] Overall, the initial impact of US LNG at lower prices than supplies under JCC-linked prices may be to put downward pressure on the level of prices rather than on the JCC-linkage itself.

The marketers of LNG from the planned US export plants are the ones who have offered long-term LNG supply with prices indexed to Henry Hub or other hubs. The sellers of LNG from both operating and new projects in the Pacific Basin and the Middle East have maintained prices that are in most cases linked to JCC, although Brent has been used in at least one deal, and some sellers have indicated a preference for Brent to facilitate the hedging of the price risk. Exports from the west coast of Canada also have the potential to offer Asian buyers

LNG linked to hub prices, but the promoters of the most advanced project, Kitimat LNG, have said that they need oil-linked prices to remunerate the investment in the project. As the representative of one seller responded:

> Sellers need reliable revenues to cover their costs of production and buyers need supply at an affordable cost. Hub prices will take many years before becoming predictable and reliable. Not in the short term.

Netback market value mechanism

As discussed in the section 'Why has the Oil Price Linkage Been Retained?' earlier in this chapter, Osaka Gas has promoted the idea at LNG conferences and through publications of using netback pricing from the sales price for their industrial customers. In theory, the methodology looks reasonable, but in practise it would be difficult to implement in Asia. Even if sellers and buyers conceptually agreed such an idea, it would take a long time to reach a consensus on the factors to be taken into account – such as which statistics and weighting to use.

For instance, in Japan, the prices for the sale of regasified LNG by the gas companies to their downstream customers are subject to negotiation and are not transparent. Unless LNG importers and their downstream customers were prepared to disclose all the information and cost structure in a transparent manner, LNG sellers will not be comfortable with applying such a mechanism. In addition, since different LNG importing gas companies have different netback values, there would not be a standard rate to be applied, and they would probably differ from buyer to buyer and from country to country. Would an LNG supplier be comfortable in having different pricing mechanisms for the different markets in Asia? Would the LNG only go to the market (or buyer) able to offer the highest netback values? Would the importer with a lower market value still have to pay the same price to secure LNG supply? For these reasons, the use of 'netback market value' appears difficult to implement in Asia, where markets are not yet open and governments are still involved in setting domestic prices.

Asian natural gas hub?

China imports gas by pipeline from Turkmenistan and it will start importing gas by pipeline from Myanmar in 2012 or 2013. It is also in negotiation for pipeline supply from Russia. The country is a gas producer and is estimated by the US Energy Information Administration

to have 36 tcm of technically recoverable shale gas reserves, the largest in the world. In early 2012, it had five LNG receiving terminals in operation, a further five under construction, and many more at the planning stage. China had committed to purchase around 45 bcm/year (33 mtpa) of LNG on a firm basis from Australia, Indonesia, Malaysia, and Qatar and had provisional agreements to purchase a further 14 bcm/year (10.5 mtpa). India has domestic pipeline gas supply and could, possibly, import gas by pipeline, in addition to having three operating LNG terminals, one under construction, and several more planned. There is speculation on how the availability of domestic production and pipeline gas imports could affect pricing in these markets and whether it might weaken the use of JCC, firstly in these countries and then, eventually, in the established markets of Japan, Korea, and Taiwan and other emerging importers in south-east and south Asia.

There is little doubt that, in the Pacific region, the main potential for the establishment of a gas hub is in China (see Chapter 10). In addition to having a large demand base, multiple sources of supply, and storage capacity, it has the potential to add to domestic supply through the development of its unconventional gas reserves.[46] However, the Government's control of natural gas prices and the subsidies paid to consumers make it likely that it will be many years before a Chinese hub might develop with the liquidity needed to make the price acceptable as a basis for trading LNG and natural gas in other Asian markets. It could, however, provide a basis for pricing in China and could, possibly, be used as price reference for spot sales, in the same way as NBP and Henry Hub operate in the UK and the USA respectively. Another possibility for the development of a trading hub in Asia is at the LNG receiving terminal in Singapore, which is scheduled to be commissioned in 2013. This is being developed primarily to import LNG for use in Singapore, but it has also been designed for the trading of LNG, with extra storage being provided over and above that needed to support imports for domestic consumption (see Chapter 8). The level of trading, and the liquidity that develops, will determine whether Singapore terminal prices could be used as a basis for pricing LNG elsewhere in Asia.

Other options – JLC,[47] JKM,[48] and cost-plus

A number of other pricing mechanisms have been used in Asia, or have been proposed. These include the Japanese LNG Cocktail (JLC), which is analogous to JCC in that it is the average price of all the LNG imported into Japan each month, the Japan Korea Marker (JKM)

price, an assessment of spot LNG prices published daily by Platts, and 'cost-plus' pricing. Only JLC has been used to price LNG under long-term contract. The fact that there are recent cases of buyers and sellers adopting JLC may be a signal of the desire of some LNG players to find alternatives to the prevailing use of oil-linked prices in Asia. However, the failure of these options to gain widespread acceptance is an indication of the difficulty of changing what has become the main pricing methodology. Cost-plus was effectively the pricing mechanism for the early contracts from Alaska and Brunei, which had prices fixed in money-of-the-day terms, but has not been used since then.

JLC

JLC has been used not only in the 'Japanese Fuel Cost Adjustment System' for setting domestic electricity and gas tariffs, but also as an index in some long-term LNG contracts, albeit for relatively small volumes. However, it is an index which can only be used for a limited share of the LNG supplied to Japan, since it can only be representative of market prices if the majority of supply is priced using other mechanisms. Furthermore, it is a Japanese index which may not be accepted by buyers outside Japan.

JKM

There have been some spot and short-term deals concluded by using JKM as the reference price, and it has also been used for financially settled price swaps to manage the price risk on spot sales and purchases. Its use is basically due to the lack of an Asian spot price that can be used by sellers of LNG from the Atlantic Basin to price spot cargoes. As two players commented:

> Given that JKM is the spot market benchmark, whether we like it or not, it's the best 'index' for both buyer and seller to ensure fair spot market price …

and

> … the collection/survey method used to estimate JKM is questionable. But it is the only benchmark that everyone refers to for current spot prices in Asia. The crude price doesn't reflect Atlantic spot prices, and Henry Hub or NBP doesn't reflect Far East prices. So JKM is the spot benchmark by default.

'Cost-plus' price

The foundation of LNG business is long-term relationship between buyers and sellers. This is often forgotten when attention is focused on diversions and finding lower-priced LNG. As one player commented:

> It would be ideal for long-term LNG pricing to include an element linked to project cost. In a sense, sellers and buyers both make long-term commitments to an LNG project, and should share the risks of cost overruns and the potential benefit of profits when production costs are low and market prices are high. Cost plus pricing would achieve this risk balance, and it could be included as one factor in a price formula. However, cost plus is not practical either. Sellers may not want to share cost information, and checking that information to produce a price is difficult.

The increasing number of cases in Asia where buyers have acquired an equity share in the project as part of the commitment to purchase the output could support the use of cost-plus pricing, since it gives the buyer access to information on costs in a business where each project has its own development costs depending on the nature of reserves, location, geopolitics, and the timing of project development. Indeed cost-plus pricing is used for LNG shipping, where the time charter hire rate typically includes a capital element plus operating costs, with the latter element either based on a pass-through of actual costs or on a base cost indexed to a consumer price index. In this way, the ship owner's investment is protected. Similarly, in a tolling arrangement for a liquefaction plant, which involves the gas producer paying a fee to the owner of the liquefaction company for the gas to be liquefied, the fee is typically based on a return on capital invested plus the operating cost. This approach has the advantage, in the development of an LNG project, of transferring the price and volume risk to the gas producer and LNG seller. The owners of the liquefaction plant only have to manage the technical and operational risk, which could facilitate financing. Cost-plus pricing has been proposed by some buyers in emerging markets, but it has not been accepted by sellers, many of whom are oil and gas companies whose business model is to generate value by managing price and volume risk.

Summary and Conclusions

The linkage of LNG prices to crude oil in Asia became established in the 1970s when Japan was the only buyer of LNG in the region. Japan had no other sources of gas supply, apart from a very small volume of domestic production. With essentially no pipeline gas supplies to set a market price, it was left to LNG buyers and sellers to develop a pricing approach which generated the returns needed by sellers to remunerate the investment in gas production, the liquefaction plant and (in DES deals) the LNG ships, and provide gas supply to the buyers at prices

that customers in the downstream market were prepared to pay. After initial deals were done at fixed prices, linkage to oil prices was adopted in the 1970s, when the main competition for regasified LNG came from crude oil and oil products used by the power utilities to generate electricity, and by the gas companies to manufacture gas.

Both Korea and Taiwan were in a similar position to Japan when they started to import LNG. They had little or no domestic gas production and no access to pipeline imports and, therefore, had no choice but to follow Japan in accepting oil-linked prices. When India and China emerged as LNG buyers after 2000, the oil-linkage was well established in Asia and, while India was able to secure initial supplies at fixed prices for a limited period of time, and China's first contracts had a low linkage to oil prices, each country's subsequent long-term commitments have all been linked to JCC, with slopes similar to those in contracts entered into by buyers in Japan, Korea, and Taiwan.

Brent crude oil prices are reported to have been used in at least one Asian contract signed since 2000, and the Indonesian crude price is still used in a number of existing contracts with that country, but JCC remains the predominant price index in most long-term contracts signed between 2009 and 2011. The only deviation from the oil linkage has been for spot and short-term cargoes supplied to Asia from the Atlantic Basin, where the prices at gas trading hubs in the UK (the National Balancing Point) and the USA (Henry Hub) have provided a floor price to which a premium is added.[49]

Escalating oil prices post 2008, resulted in Asia becoming the highest priced LNG market in the world. In 2011, the average price of LNG imported into Japan was $14.73/MMBtu, which compared with an average Henry Hub price of $4/MMBtu and an average NBP price of $9.30/MMBtu. Not surprisingly, the disparity in prices has intensified the debate in Asia amongst buyers on whether the retention of JCC-linked prices is in their best interests.

In the preparation of this chapter, buyers, sellers, traders, and bankers active in this market were asked for their views on the outlook for pricing. The general response can be summarized as one of retaining the pricing approach that has worked over many years, and which buyers and sellers know and feel comfortable using. Some buyers are more actively seeking an alternative to crude oil-linkage, but there is not yet a consensus on what that might be. Linking the price to those at the traded hubs in Europe and North America is seen as risky because of the volatility of these prices, and the fact that they are influenced by regional factors such as weather, demand and local production, and operational issues, rather than global trends.

However, the transformation of the US market from one which was expected to be a major importer in 2005 to one where, seven years later, plans are at an advanced stage for significant volumes of exports, has brought with it the potential for Asian buyers to be able to access LNG supplies on a 'Henry Hub plus a premium' basis. The only buyers in Asia that had committed to purchase US LNG by early 2012 were India's GAIL and Korea Gas, which had signed contracts with Cheniere for output from the Sabine Pass plant in Louisiana; by April 2012, the plant had all the necessary approvals in place to commence construction. However, other Asian buyers were known to be interested in US LNG including Japanese trading houses Mitsui, Mitsubishi, and Sumitomo, and Japanese gas utility Tokyo Gas, which signed preliminary agreements in the second quarter of 2012 for capacity at the proposed Cameron and Cove Point liquefaction projects. If the USA becomes a major exporter, it has the potential to bring significant volumes of LNG into Asia using an alternative pricing mechanism to crude oil linkage. The potential impact on Asian markets, and the supply of LNG from high-cost projects in the Pacific Basin, are developments which buyers and sellers in the region will be watching closely.

The potential for US imports is just one factor in a rapidly changing LNG business which will almost certainly put pressure on the JCC price linkage in Asia. The general consensus of those consulted in the research for this chapter was that JCC pricing would survive for many years to come, but history shows that buyers and sellers in Asia have been able to adjust to changes in the market environment, and this could lead to an earlier move away from JCC pricing than is currently expected.

Notes

1 The term 'S-curve' refers to a pricing formula in which the relationship between the LNG price and the oil price (i.e. the slope) varies over different oil price ranges. Figure 11.1 illustrates an 'S-curve' as it is used in Asian LNG pricing. The price follows the blue line labelled 'LNG' price rather than the straight line labelled 'crude oil parity'. The slope is reduced at low oil prices and high oil prices compared with its level in the middle price range, resulting in a line which changes gradient at two points (generally referred to as 'kink points') and, consequently, resembles an 'S'.

2 Since the Indonesian contracts did not include an S-curve, it was not involved in Price Out of Range Negotiations, which were required for most of Japan's other long-term contracts (see the section 'Return to a Sellers' Market').

3 In the early stages of the buyers' market the established buyers in Japan, Korea, and Taiwan were not in a position to purchase new supplies because of the Asian financial crisis in the case of Korea, energy market deregulation in the case of Japan, and an oversupply position in the case of Taiwan's CPC.
4 The deals with low slopes and floors and ceilings were, in most cases, concluded through tender. Japan was the only LNG importer that did not use tenders to procure LNG.
5 The 5.25% slope was much lower than the slope in contracts in operation at that time, and it was the first time that a price floor and ceiling had been introduced into a long-term LNG contract.
6 'China Opens Bidding for Guangdong LNG Supply Contract', *People's Daily Online*, 8 November 2001, http://english.people.com.cn/200111/08/eng20011108_84170.shtml; 'Three Firms on List for China's First LNG Project', *People's Daily Online*, 23 January 2002, http://english.people.com.cn/200201/23/print20020123_89184.html;
7 General Administration of Customs of the People's Republic of China http://english.customs.gov.cn/publish/portal191/.
8 *Platts LNG Daily*, 16 February 2005
9 Authors' information.
10 Straight line here means that the relationship with crude oil (the slope) is the same at all oil prices.
11 In many cases, the issue of under- or over-payments was taken into account in the price formula going forward rather than a lump sum being paid by one party to the other.
12 *Platts LNG Daily*, 16 February 2005
13 Authors' information.
14 It is understood that the price is around $17/MMBtu at a JCC price of $100/bbl.
15 Directorate General of Customs, Ministry of Finance, http://web.customs.gov.tw/np.asp?ctNOde=6675
16 *Platts LNG Daily*, 22 March 2006 and 5 January 2012.
17 Authors' information.
18 Authors' information.
19 There is no LNG industry accepted definition of spot and short- and medium-term sales. In this chapter, spot covers single cargo deals or those involving up to five cargoes over a period of a few months. Short-term covers deals of up to two years duration, while medium-term contracts are those for two to seven years duration. Any contracts of over seven years are treated as long-term.
20 *ICIS Heren Global LNG Markets*, 14 August, 2009.
21 Maintaining a good relationship between buyer and seller is an important factor in preventing disputes having to be settled through arbitration.
22 Liao (2009).
23 GIIGNL (2008), GIIGNL (2009), and GIIGNL (2010).

24 Authors' estimates based on published data for LNG imports into Asia in 2011.
25 Not all of the cargoes delivered to Japan from the Atlantic Basin have been on a spot or short-term basis. A number are under medium-term deals, but it is not possible to separate out these cargoes in published data. Before 2009, it is believed that most of the Atlantic Basin cargoes delivered to Japan were on a spot or short-term basis and were priced at a premium to the higher of Henry Hub or NBP. In 2008, BG Group, which was the supplier of around 60% of the Atlantic Basin cargoes delivered to Japan, decided to enter into medium-term deals for some of these sales because of the uncertainty created by the collapse of oil prices in the middle of that year. Prices in these medium-term deals are believed to be linked either to crude oil prices (JCC) or the higher of a JCC-linked price and an NBP or Henry Hub-linked price
26 For example, *Platts*, *ICIS Heren*, *World Gas Intelligence*, and *RIM Intelligence*.
27 JKM Prices are published in Platts LNG Daily.
28 This section is partly based on industry interviews conducted by Jane Liao in the second half of 2011. The authors would like to express their special appreciation to the LNG players who contributed by sharing their views.
29 'Fuel cost adjustment system' is a system designed to adjust, automatically, monthly electricity tariffs based on fluctuations in (actual recorded) fuel prices for crude oil, liquefied natural gas (LNG), and coal. www.tepco.co.jp/en/customer/guide/fuelcost-e.html.
30 The price of gas is determined on the basis of the fuel cost adjustment mechanism taking into account external factors of foreign exchange rate and crude oil prices. www.osakagas.co.jp/en/ir/library/ar/pdf/2010/10_12.pdf
31 One gas company commented with reference to the fuel cost adjustment: 'gas companies have been trying to promote Co-Generation System (CGS) in order to increase their demand. However, grid power prices are usually a combination of hydro, nuclear, coal-fired, and natural gas fired output, and significantly lower than that of a gas-fired CGS. Thus, LNG fired co-generation system cannot survive under current price mechanism.'
32 Miyamoto and Ishiguro (2009); Kawamoto et al.
33 'Analysis – Japan's Osaka Gas urges LNG pricing rethink', *Argus*, 23 June 2010, www.argusmedia.com/pages/NewsBody.aspx?id=712093&menu=yes.
34 The sources of supply for these sellers include LNG cargoes they have contracted for delivery to Atlantic Basin markets and which are, in many cases, indexed to hub prices. This provides the sellers with some flexibility in choosing the price index for cargoes diverted to alternative markets in Asia. However, their preference has generally been to use an oil-linked price.
35 A 'lower of' formula defines the price as being the lower of for example a JCC-linked price or an NBP (or HH) linked price.
36 'Enarsa Hunts for More LNG' *World Gas Intelligence*, Volume XXIII No 1, 4 January 2012 and 'Trades', *ICIS Heren Global LNG Markets*, 5 April 2012, 6.

37 It may also reflect the fact that NOCs in the Pacific Basin region have limited experience with hub-based prices. In addition, using an oil index for both imports and exports makes it easier to ensure that the two prices do not diverge.
38 They might be at fixed prices or using a formula.
39 Alterman (2012).
40 The JCC that is used in many pricing formulae is the average of JCC in the months n; n–1 and n–2, (or months n–1, n–2, n–3), that is:

$$JCCa = (JCC_{n} + JCC_{n-1} + JCC_{n-2})/3$$

where n is the month that the cargo unloaded.
41 Using a 'rolling' JCC can ease the immediate impact when oil prices are changing rapidly.
42 'UPDATE 2-U.S. regulators approve Cheniere LNG export plant', *Reuters* 16 April, 2012. http://www.reuters.com/article/2012/04/17/cheniere-sabine-idUSL2E8FGI7N20120417.
43 'Sempra Energy Unit Signs Commercial Development Agreements With Mitsubishi Corporation, Mitsui & Co., Ltd. to Develop Louisiana Liquefaction Facility', Sempra Mediaroom, 17 April 2012, http://sempra.mediaroom.com/index.php?s=19080&item=126964.
44 There are concerns amongst Asian buyers about whether environmental problems could constrain shale gas production, forcing up prices, and possibly reducing the amount of LNG available for export. They are also concerned at the risk that any export permits granted by the US Government could be withdrawn in the future, for example, in the event of an energy crisis. This could limit their appetite for US LNG.
45 Although most estimates suggest that the increase in prices are likely to be relatively modest, see Ebinger et al. (2012).
46 Gao (2012).
47 JLC: Japan LNG Cocktail, see the section 'Why has the Oil Price Linkage Been Retained?'
48 JKM: Japan Korea Marker, see the section 'Pricing of Short and Spot LNG Cargoes'.
49 Given that divertible LNG cargoes can be delivered to the UK or the USA, NBP or HH, whichever is higher, plus a premium to take into account additional costs, is the minimum price that Asian buyers have to pay in order to secure cargoes from the Atlantic Basin.

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