Price risk reduction effect by importing shale gas

—How much would importing U.S. domestic natural gas price linked LNG contribute to depress fluctuation in import price?—

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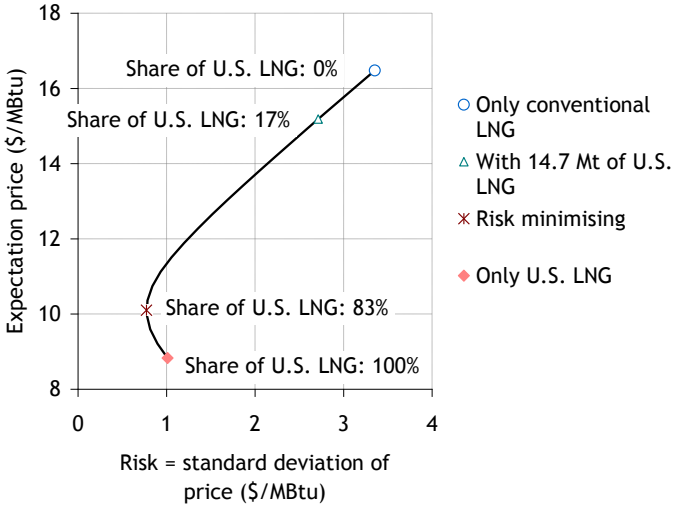
Summary

The price of liquefied natural gas, or LNG, in Asia has skyrocketed due to the rise in oil price and increase in LNG demand in Japan. Natural gas price in the United States, by contrast, has dipped very low due to the shale revolution. A clamour toward importing U.S. natural gas to Japan had been a subject of serious discussion currently.

In addition to the direct effect of the introduction of cheap LNG, some expect that importing U.S. LNG will bring other benefits to Japan as follows: (1) diversification of supply source that could lead to reduction of supply interruption risk, (2) enhancement of bargaining power for other LNG contracts that could lead to lowering the prices of other LNG, and (3) diversification of pricing formula that could lead to reduction of price fluctuation risk. We analysed how much would be the reduction effect of U.S. LNG—strictly speaking, U.S. domestic natural gas price–linked LNG—on Japan's LNG price fluctuation risk.

If the 14.7 Mt of U.S. LNG that will be produced with Japanese companies' participation are imported to Japan, the risk and the price could reduce by 19% and 8%, respectively based on data from 2009 to March 2013. A portfolio that minimises risk consisting of 17% of conventional LNG and 83% of U.S. LNG could reduce the risk and the price by 77% and 39%, respectively. The price of the portfolio is higher but the risk is lower by 23% than a portfolio of 100% of U.S. LNG. Conventional LNG and U.S. LNG could complement each other well in this period.

Risk and price of risk minimising portfolio (March 2013)



However, the share of U.S. LNG in the risk minimising portfolio depends on the period of analysis. For instance, it lowers to about 50% if we consider the period from July 2011 onwards. The introduction of U.S. LNG does not result in a favourable portfolio when the analysis period covers only around 2001 or around 2006 when natural gas price at Henry hub gyrated.

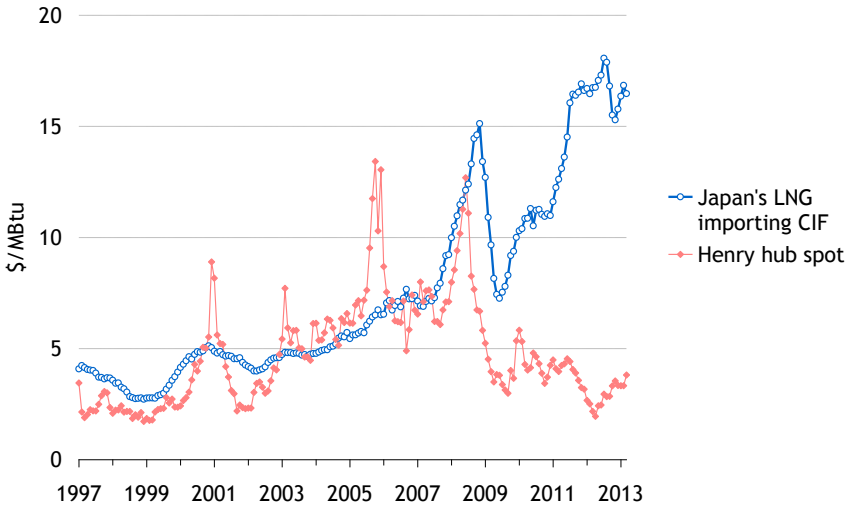
An expectation that Japan can substitute as much as 50% to 80% of its LNG imports with U.S. LNG—or U.S. domestic price–linked LNG—in the near future is unrealistic. We need also clear assessment of the sustainability of cheap natural gas price in the United States and margins. We should refrain from having excessively optimistic expectation based on prejudiced assumptions and/or wishes.

Keywords: Shale gas, LNG, price fluctuation risk, oil price–linked, U.S. natural gas price–linked

Sharp rise in Japan's LNG import price and expected price reduction effect of shale gas imports

The price of liquefied natural gas, or LNG, in Asia has skyrocketed since 2011 due to the rise in oil price and increase in LNG demand for thermal power generation in Japan (Figure 1)[1]. Natural gas price in the United States, by contrast, has dipped very low as the supply and demand balance loosened up due the shale revolution[2]. The idea of liquefying U.S. natural gas and importing it to Japan has been discussed in the Cabinet level due to the price difference between the regions, e.g. "Action plan for reducing fuel procurement costs" by the Japanese Government (26th April 2013).

Figure 1: LNG and natural gas prices



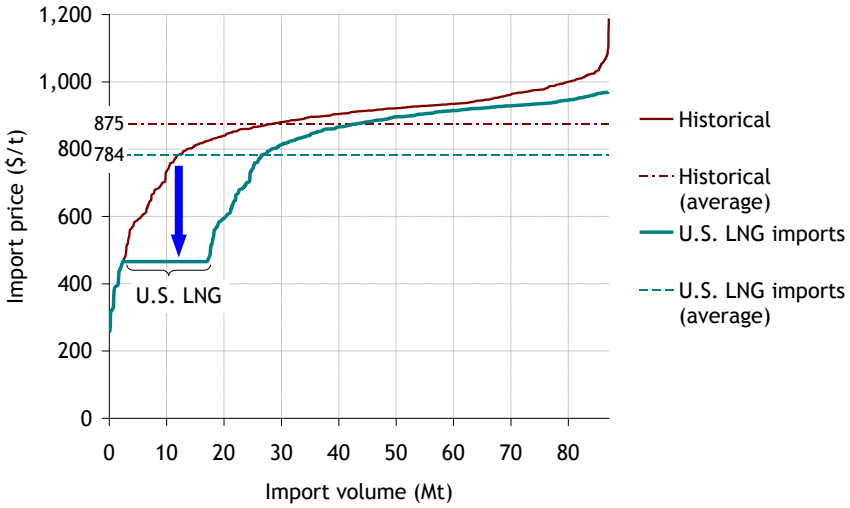
Source: IEEJ "EDMC Energy Trend", U.S. Energy Information Administration

The U.S. Department of Energy approved Freeport LNG to export its LNG to non–free trade agreement countries including Japan in May 2013. Osaka Gas and Chubu Electric Power are involved in Freeport LNG. How much will be the import prices of LNG of U.S. origin in Japan in general? Although many factors are uncertain, the International Energy Agency (2012) estimates Japan's import price will be $9/MBtu or less if natural gas price in the United States is around $4/MBtu, which is almost the same as today, with liquefaction and transport costs are added but not excess margin. Yanagisawa (2013) estimates Japan's average LNG import price will be reduced by $91/t or 10% if U.S. LNG is imported at $9/MBtu (Figure 2)[3].

[1] Japan's imported LNG is converted at 13,043 kcal/kg. The same hereinafter.
[2] Imported LNG in Japan and non–liquefied natural gas in the United States are not strictly comparable.
[3] Precondition is as follows: (1) LNG import cost curve is derived from trade statistics of November 2011 to October 2012, (2) imports of U.S. LNG is 14.7 Mt based on projects with Japanese companies

The Development Bank of Japan (2013) estimates that Japan's average LNG importing price in 2020 will drop by $1/MBtu or 6.8% if LNG from the United States and others are procured with prices linked with U.S. domestic natural gas price[4]. Although importing U.S. LNG is expected to lower Japan's average import price to a certain extent, both of the two analyses conclude that it offsets only a limited part of the price increase of about $5/MBtu, or 50% in last two years.

Figure 2: Changes in LNG import cost curve induced by U.S. LNG imports



Note: Estimated with data from November 2011 to October 2012.
Source: Yanagisawa (2013)

Expected additional benefits by introduction of U.S. LNG

In addition to the direct effect of the introduction of cheap LNG of about 15 Mt, some expect that importing U.S. LNG will have other benefits to Japan as follows:

(1) Diversification of supply source,
→ Reduction of supply interruption risk
(2) Enhancement of bargaining power for other LNG contracts,
→ Lowering prices of other LNG
(3) Diversification of pricing formula.
→ Reduction of price fluctuation risk

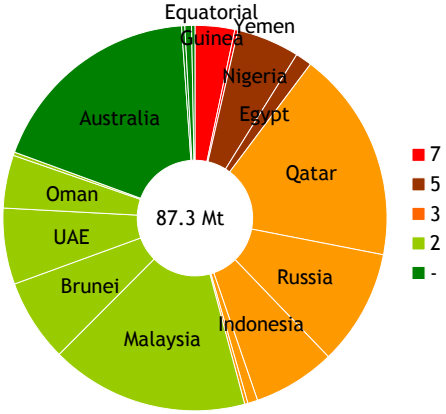
Diversification of supply source is valuable to a certain extent even for LNG that has more

involvement, and (3) prices of other LNG are not affected by importing U.S. LNG, which replaces these LNG in decreasing order according to price.

[4] Precondition is as follows: (1) Japan's procurement of LNG in 2020 is 83.95 Mt including 15.2 Mt of U.S. domestic natural gas price linked, and (2) prices of LNG U.S. domestic natural gas price linked and oil price linked are $9.7/MBtu and $15.5/MBtu, respectively.

dispersed import origins compared with oil (Figure 3). Imports from the United States that has no geopolitical risk contribute to supply security[5].

Figure 3: Japan's LNG import origin by country risk (2012)



Note: The larger number means higher country risk.
Source: OECD "Country Risk Classifications of the Participants to the Arrangement on Officially Supported Export Credits", Ministry of Finance "Trade Statistics of Japan"

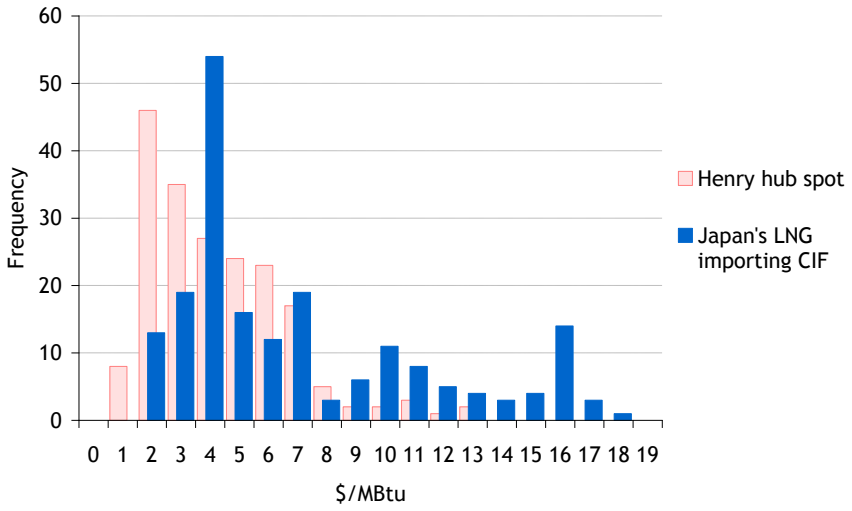
The contribution to enhancement of bargaining power for other LNG contracts is controversial. For instance, the Electricity Price Examination Committee under the Advisory Committee on Energy and Natural Resources that approves applications for electricity price increases of Kansai Electric Power and Kyushu Electric Power companies expected reduction in fuel costs in the future assuming the importation of shale gas from the U.S. The committee offset partially proposed electricity price increases against the expectation. On the other hand, it is hard to conclude immediately that importing U.S. LNG contributes to enhanced bargaining power for other LNG contracts, especially for long–term contracts, due to the characteristics of LNG itself and the existing trading practices considering an analysis by Tsutsui, et al. (2013). Further analyses are required to determine whether Japan can reap favourable terms from other LNG contracts due to the importation of U.S. LNG.

Reduction of price fluctuation risk will be a great benefit to Japan that suffers not only from high price levels but also from price gyration (Figure 4).

People, however, now have expectation on the reduction on price fluctuation risk by importing U.S. LNG before any quantitative analyses are made. We analysed how much would be the reduction effect of U.S. LNG and other LNG that is linked with U.S. domestic natural gas price on Japan's LNG price fluctuation risk.

[5] It, however, is necessary to pass a choke point, i.e. the Panama Canal.

Figure 4: Distribution of LNG and natural gas price (frequency by price)



Note: January 1997 to March 2013
Source: Derived from IEEJ "EDMC Energy Trend", U.S. Energy Information Administration

Reduction effect on price fluctuation risk

Modern portfolio theory, or MPT, a basic theory of finances, defines fluctuation in return as risk and measures it by standard deviation. We conducted analysis by utilising the methodology replacing return in MPT with LNG import price. Here we assumed that the import price of U.S. LNG is the sum of the previous month's natural gas price at Henry hub multiplied by 1.15 (which corresponds to the procurement costs in the United States) and $5/MBtu of liquefaction and transport costs.

Analysis covering 2009 to March 2013

The period from 2009, when (historical) the oil price–linked import price of "conventional" LNG was almost the same as the (theoretical) import price of U.S. LNG, to March 2013, was chosen for the analysis. While average price of conventional LNG was $13.1/MBtu during this period, U.S. LNG averaged at $9.4/MBtu, cheaper by $3.7/MBtu. The difference was not seen throughout the period but only from 2011 onwards. The risk—the standard deviation of the price—of U.S. LNG was $1.0/MBtu, much less than that of conventional LNG of $3.4/MBtu. This means that U.S. LNG was a fine good with both low price and low risk.

LNG projects in the United States with involvement of Japanese companies will produce 14.7 Mt whilst Japan's LNG imports in FY2012 totalled 86.9 Mt. If all of the 14.7 Mt were imported[6] to Japan and substitute conventional LNG, the U.S. LNG would account for 17% of Japan's LNG imports. The risk and expectation price of a portfolio with 14.7 Mt of U.S.

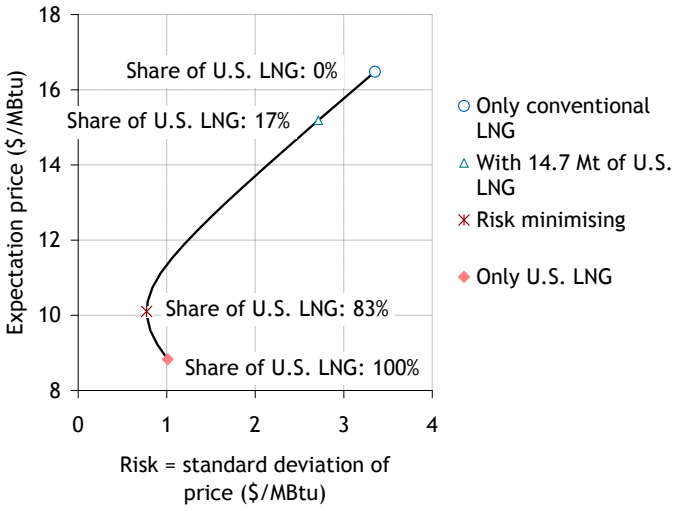
[6] Actual import will start after 2017.

LNG at the end of the analysis period are $2.7/MBtu and $15.2/MBtu, respectively. The risk and the price could be reduced by 19% and 8%, respectively, compared with a case where all of imports are met by conventional LNG.

Apart from the portfolio mentioned above, we sought another portfolio that minimises risk by adjusting the share of U.S. LNG in total imports of LNG, without considering various restrictions in the real life. The risk minimising portfolio consists of 17% of conventional LNG and 83% of U.S. LNG. It is located at the leftmost in Figure 5, which follows a risk–return graph in financial engineering placing risk and price in X–axis and Y–axis, respectively[7]. The risk and expectation price of the portfolio at the end of the analysis period are $0.8/MBtu and $10.2/MBtu, respectively. The price level is higher than a case of 100% of U.S. LNG (risk: $1.0/MBtu, price: $8.8/MBtu) but the risk is reduced by 23%.

Conventional LNG and U.S. LNG correlated negatively from 2009 and onwards, therefore they could complement each other well.

Figure 5: Risk and price of each portfolio

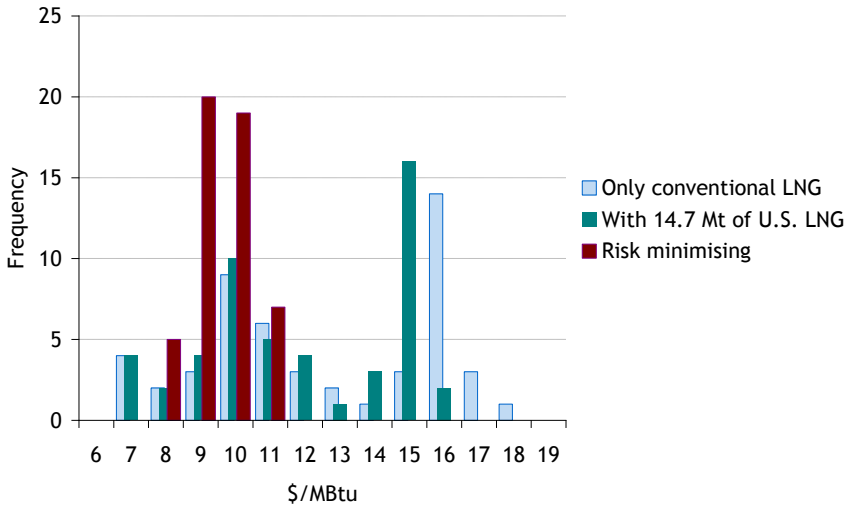


Note: Estimated as of March 2013 with data from January 2009 to March 2013.

Frequency by price of each portfolio is shown in Figure 6.

[7] In this case, group with same risks and expected low prices corresponds to the efficient frontier in the MPT. That is a curve lower than the risk minimising portfolio since Y–axis stands for price rather than return meaning lower position is preferable.

Figure 6: Frequency by price of the portfolios



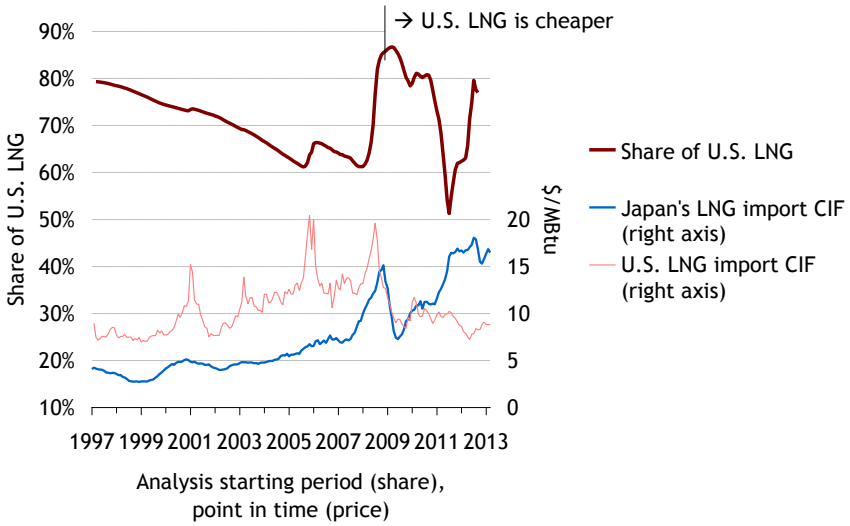
Note: Estimated with data from January 2009 to March 2013.

Influence on risk minimising portfolio by change in the analysis period

The variances of conventional LNG price and U.S. LNG price, and the covariance between them determine the share of U.S. LNG in total imports in the risk minimising portfolio. These statistical values are estimated from historical value since their true values are unknown. The estimation results, however, depend on the estimation period to a certain extent. Therefore, we sought the risk minimising portfolios in accordance with the estimation period: we changed the starting period from March 1997 to September 2012 but fixed the ending period to March 2013, the latest.

The share of U.S. LNG in the risk minimising portfolios varies from 50% to 80% depending on the analysis period (Figure 7). The share tends to be large when the starting period of the analysis is the second half of 2008 or later in particular. On the other hand, the introduction of U.S. LNG does not result in a favourable portfolio when the analysis period covers *only* around 2001 or around 2006 when natural gas price at Henry hub gyrated. Yet the incentive for introduction of U.S. LNG seems to be little if we assume the structure as before 2009 because the introduction contributes to reduced risk but not reduced price.

Figure 7: Changes in share of U.S. LNG in risk minimising portfolios by analysis starting period



Conclusion

This article identified and analysed the benefit of reduction of LNG price fluctuation risk among benefits expected from U.S. LNG imports. Conventional LNG and U.S. LNG correlated negatively from 2009 and onwards. This means that they could complement each other well. The risk of the portfolio with 14.7 Mt of U.S. LNG is less than that of a portfolio consisting of 100% of conventional LNG. The share of U.S. LNG in the risk minimising portfolio is estimated at 83%. The best share, however, depends on the analysis period and varies from 50% to 80%.

We should note that an expectation that Japan could substitute as much as 50% to 80% of its LNG imports with U.S. LNG—or U.S. domestic price–linked LNG—in the near future is unrealistic. In addition, the risk reduction effect realised in the risk minimising portfolio should be examined carefully whether there is significant benefit or not compared to the price level.

Given the current Japanese situation that is suffering from the burden of huge LNG import bills and its contribution to energy security, importing U.S. LNG should be promoted. However, the direct price reduction effect by importing U.S. LNG is around 10% at most. How much would importing U.S. LNG contribute to the enhancement of bargaining power for other LNG contracts is unclear. We need clear assessment of the two biggest factors which affect import price of U.S. LNG, i.e. sustainability of cheap natural gas price in the United States[8], and margins added in liquefaction of natural gas and LNG transport. Furthermore,

[8] The current natural gas price in the United States is said to be below production cost of unconventional natural gas. The price reached the bottom of $1.95/MBtu in April 2012 and is doubling

the acceptance of Japanese importing price being determined by supply and demand balance in the United States may become controversial once U.S. domestic natural gas price rises significantly. We should refrain from having excessively optimistic expectation on the effects of importing shale gas based on prejudiced assumptions and/or wishes.

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in mere about one year ($4.17/MBtu in April 2013).