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A Discussion of US LNG Exports in an International Context

Based on the BIPP Center for Energy Studies publication: "US LNG Exports: Truth and Consequence"

NCAC-USAEE Luncheon Presentation

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Far-reaching implications of shale gas

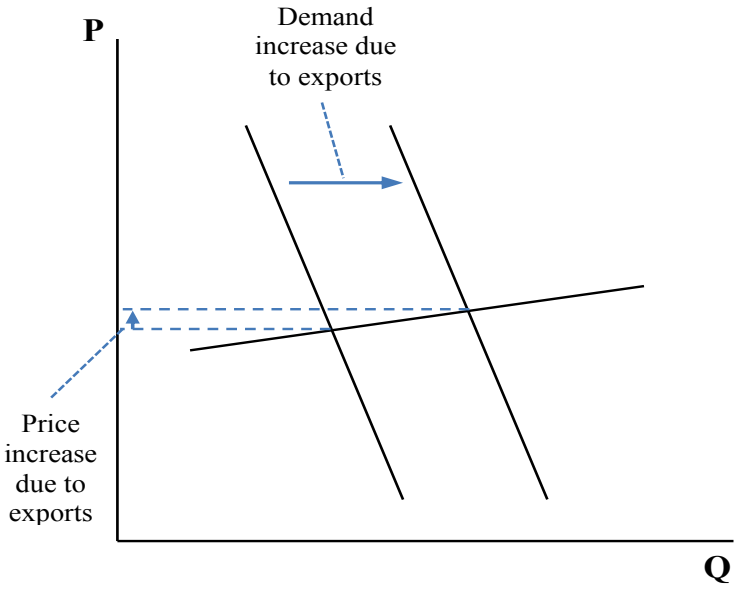
- Expansion of production from shale plays has rendered the utilization of LNG import capacity in the US very low.
- **It has also had an impact on the relative price of oil and gas, and**
- **… it has raised the possibility of US LNG exports.**
  - Domestic price impacts are a central concern, but will not likely be large given domestic elasticity of supply.
  - Recent work by Hartley and Medlock (2012) indicate this apparent opportunity may be highly contingent on the value of the US dollar.
- Current and potential future expansion of shale gas in the US, Europe and Asia effectively makes the *global* natural gas supply curve more elastic.
  - This mitigates the potential for sustained long term increases in price.
  - Greater supply elasticity also pressures traditional pricing paradigms.

The Prospect of US LNG Exports

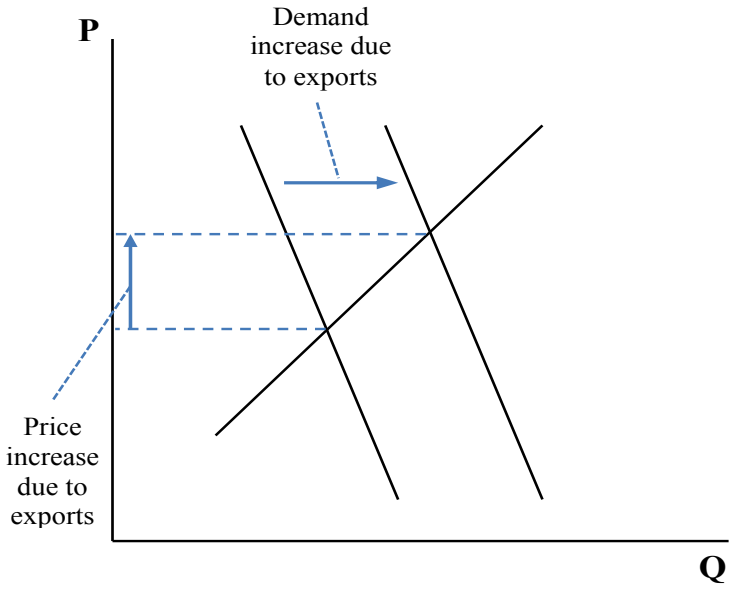
Domestic Price Impacts of US LNG Exports

- Common claim: US price will increase substantially
  - Only true if US domestic supply is highly inelastic (pictured below) and foreign supply is highly elastic (not pictured). This claim is unlikely.

The Elasticity of Domestic Supply and the Impact of Exports on Price



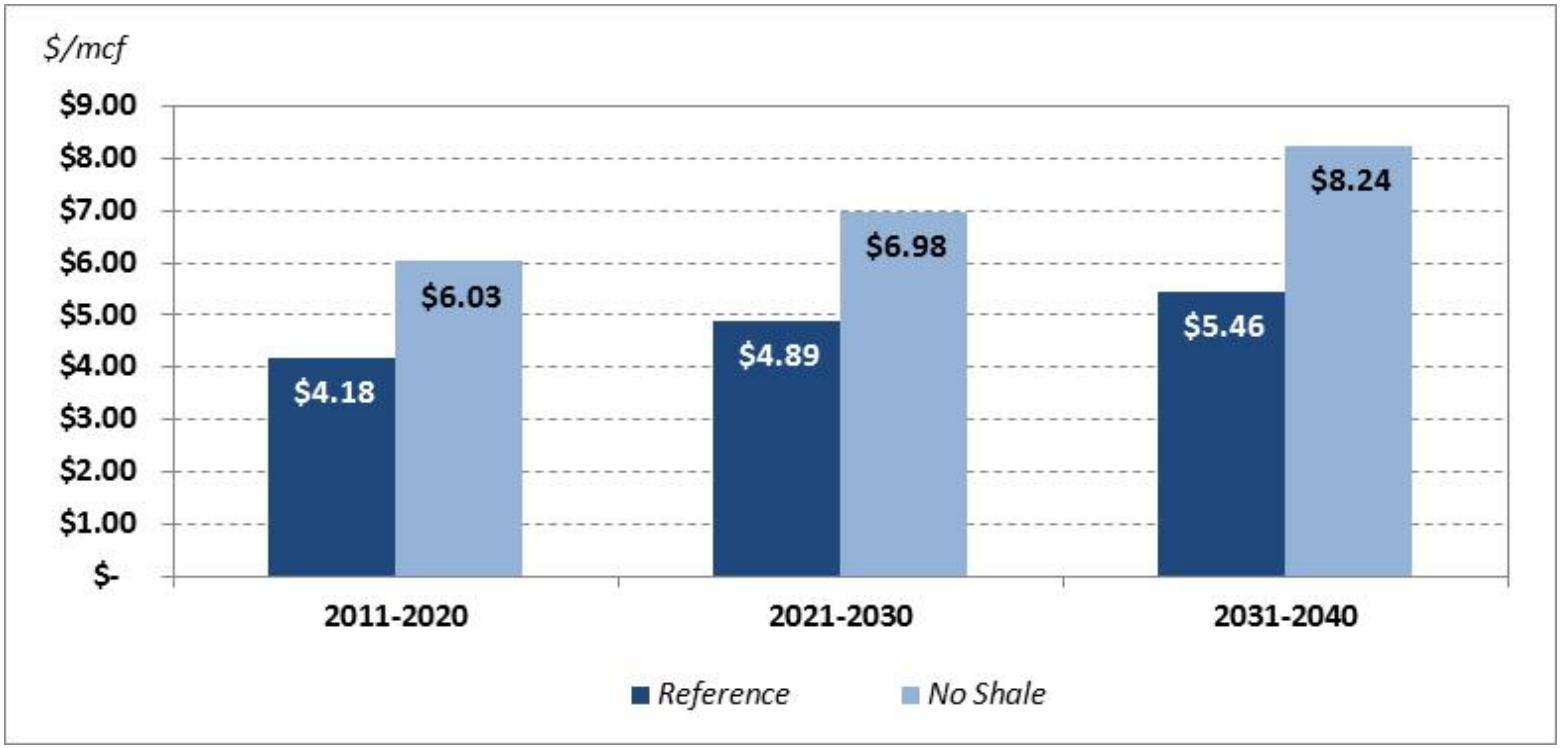
Case 1: Supply elastic



Case 2: Supply inelastic

Impact of Shale on Henry Hub, 2011-2040

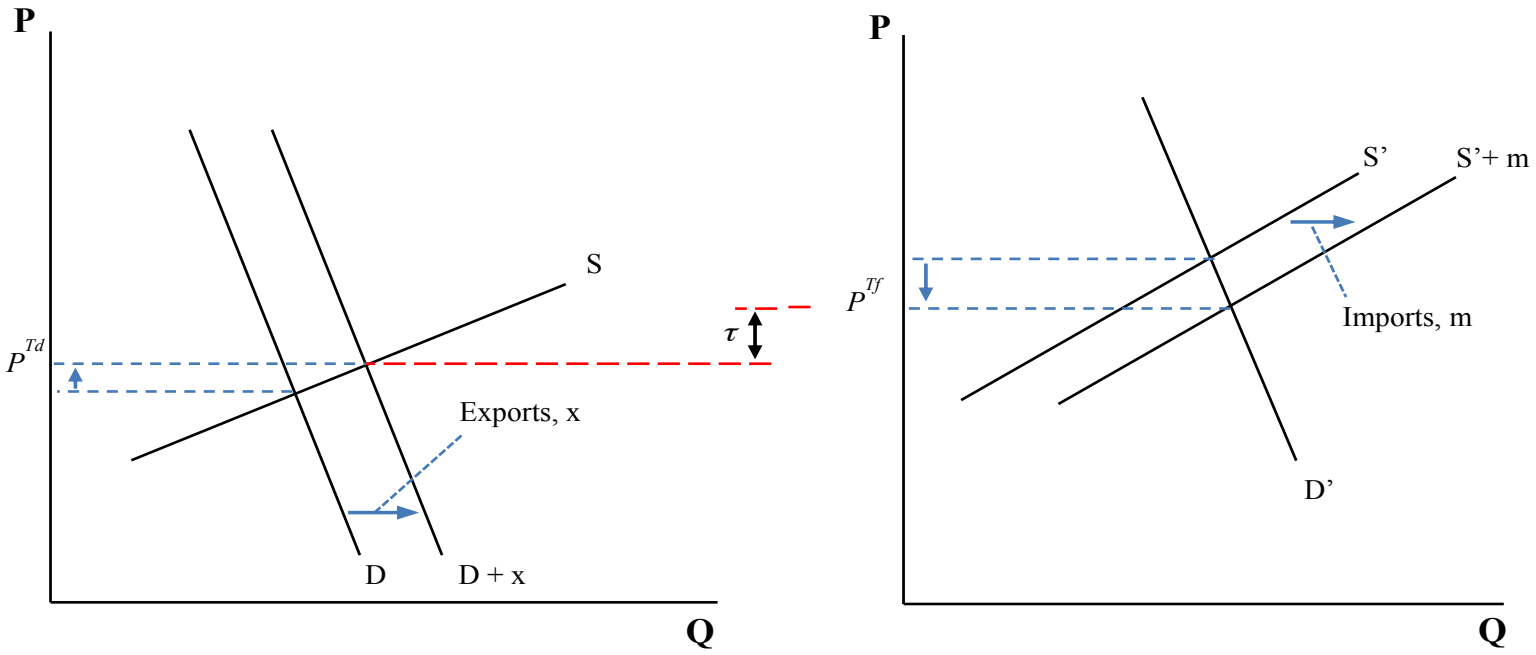
- The domestic supply curve is much more elastic as a result of shale gas developments. Domestic ***long run*** elasticity*
  - with shale = 1.52; without = 0.29.



* - Results derived from the Rice World Gas Trade Model (RWGTM). The RWGTM was developed by Ken Medlock and Peter Hartley at Rice University using the MarketBuilder software provided by Deloitte MarketPoint .

Price Impacts of US LNG Exports: Introducing the Foreign Market Response

- When trade between two markets is introduced, price in each adjusts. The adjustments will depend on the relative elasticities of supply and demand.

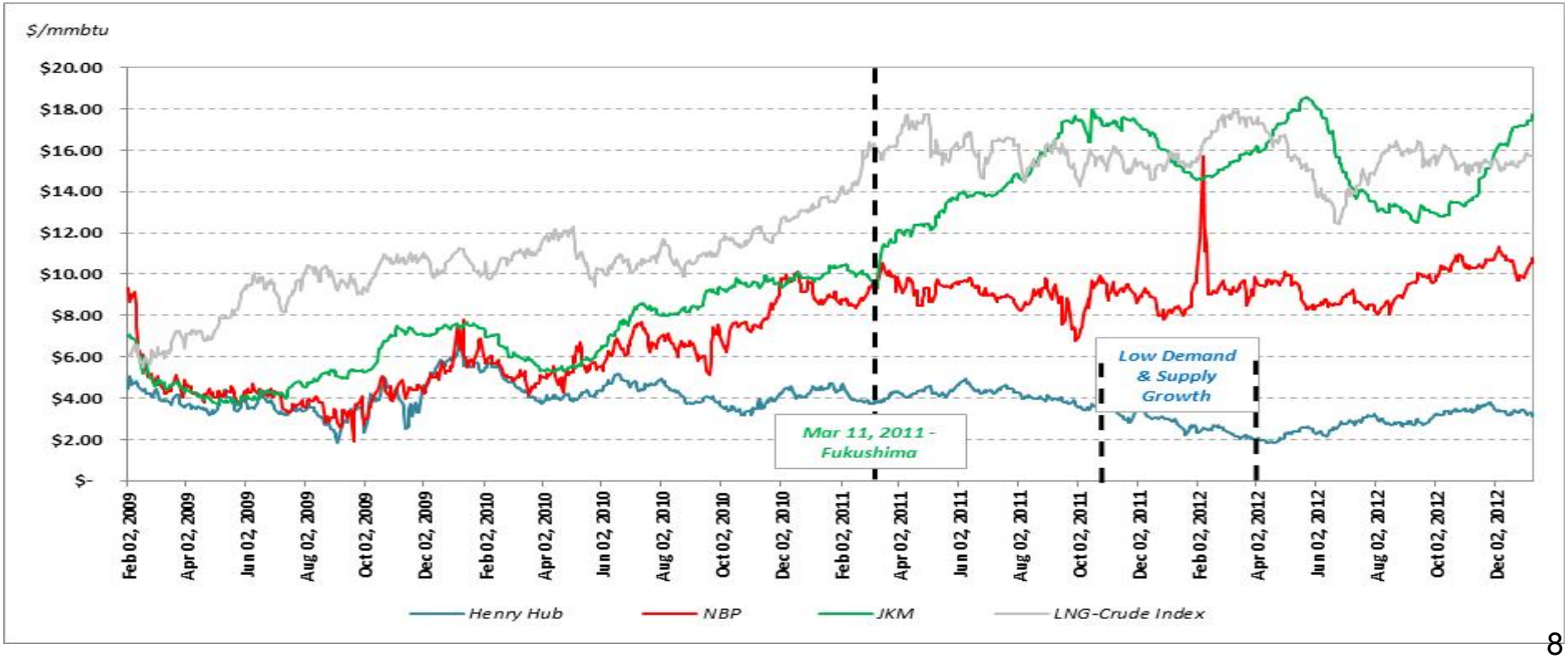


The Impact of US LNG Exports

- Lots of attention given to current international spot price, but several factors are often ignored, such as
  - short term capacity constraints, which are important when considering where we are today,
  - domestic market interactions with markets abroad, and
  - a weak US dollar.
- "Spot" price of natural gas in Asia changed after Fukushima.
- US LNG exports could put significant downward pressure on international price.
  - In 2011, LNG trade totaled about 32 bcfd. Current US filings total over 29 bcfd.
- Effects of international trade are contingent on both domestic and foreign elasticities of supply and demand.

International Prices

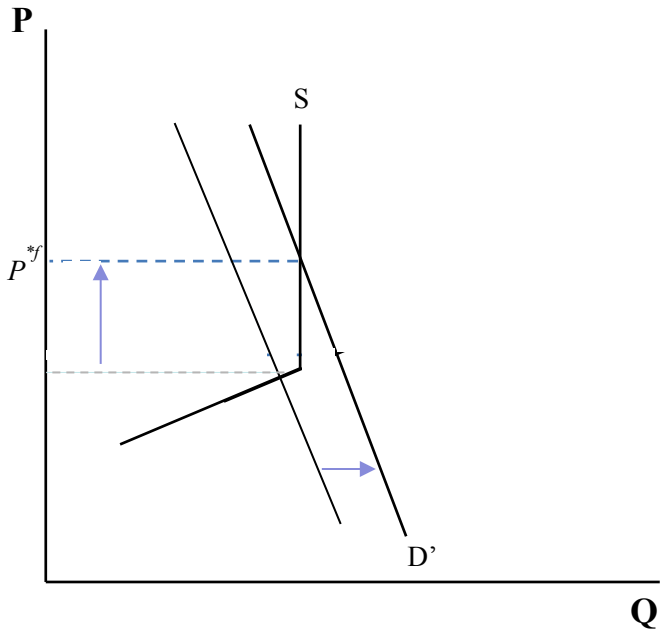
- Will the change in regional natural gas price relationships since March 2011 persist?
  - Unexpected demand shocks have had an influence.
  - It is reasonable to expect that US price will rise to reflect marginal cost and JKM premium will subside with relief of deliverability constraint



Price data from Platts; LNG Oil-Index author's calculation

The Short Term

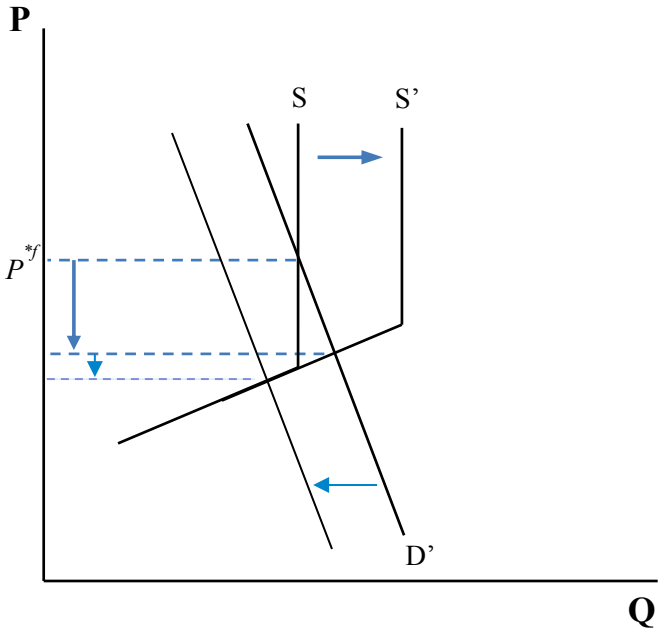
- A wide divergence in price is exactly what we should expect to see if the ability to deliver is constrained…
  - Increased Japanese demand for natural gas in the wake of Fukushima is an *unexpected* demand shock. These sorts of shocks stress delivery capability and create rents in the marketplace.



Moving past the short term

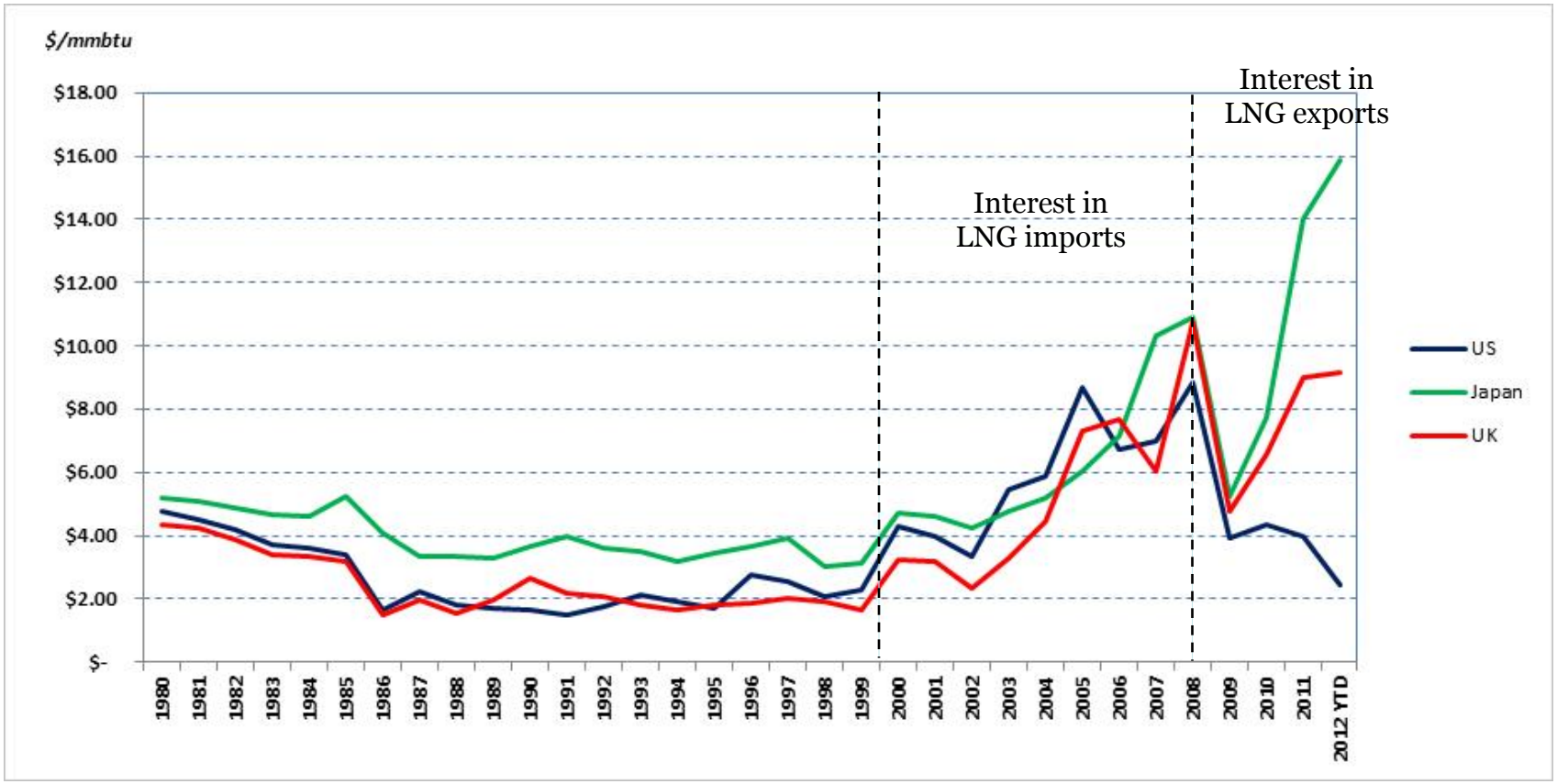
- Alleviating the deliverability constraint will have a large impact on international prices.
  - US exports could put downward pressure on international price.
  - This will be exacerbated by (a) demand reductions and (b) other supplies (for example, China shale, East Africa, Australia, Russia) .

The extent is highly uncertain, but the direction is not…



A Longer Term View of Prices

- The recent divergence is new… but can it persist? Or, is it a result of short term constraints?



Sources: Compiled from Platts, IEA, EIA

Exchange Rate Effects

- Other factors that are important to the issue are the exchange rate, the role of liquidity in pricing paradigms, and foreign supply developments.
  - Exchange rate impacts: $P_{US} - P_{UK} \cdot XR \cdot HR = arb\ value$

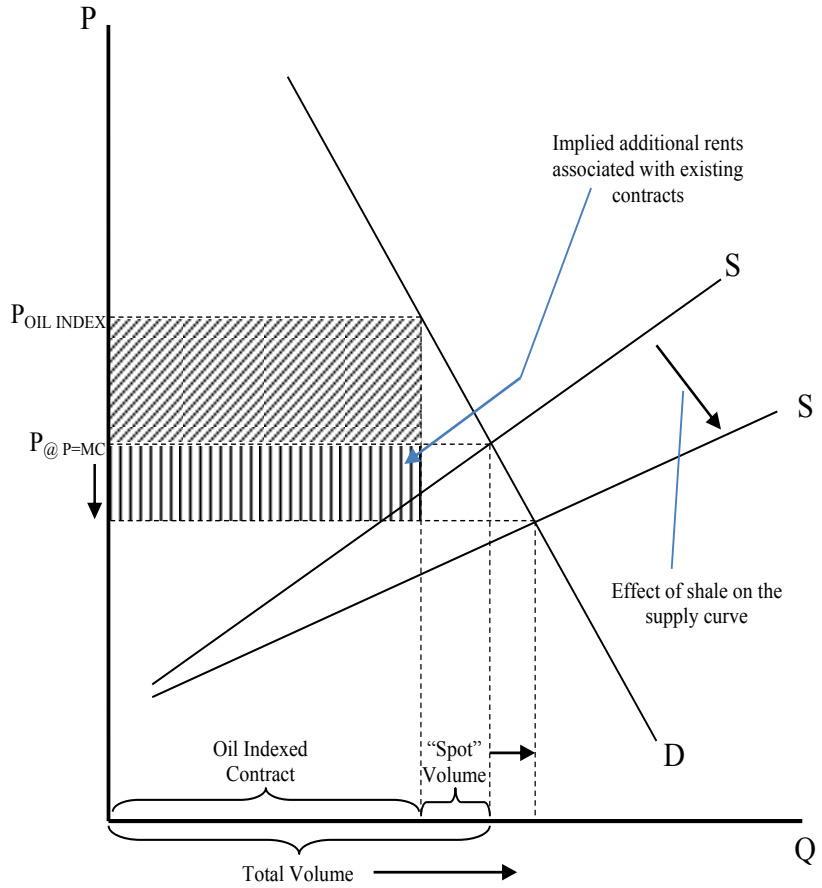
Trade-Weighted Value of US $, Major Currencies (Daily, Jan 1973 – Jan 2013)

Source: US Federal Reserve Bank

Contracts and Liquidity

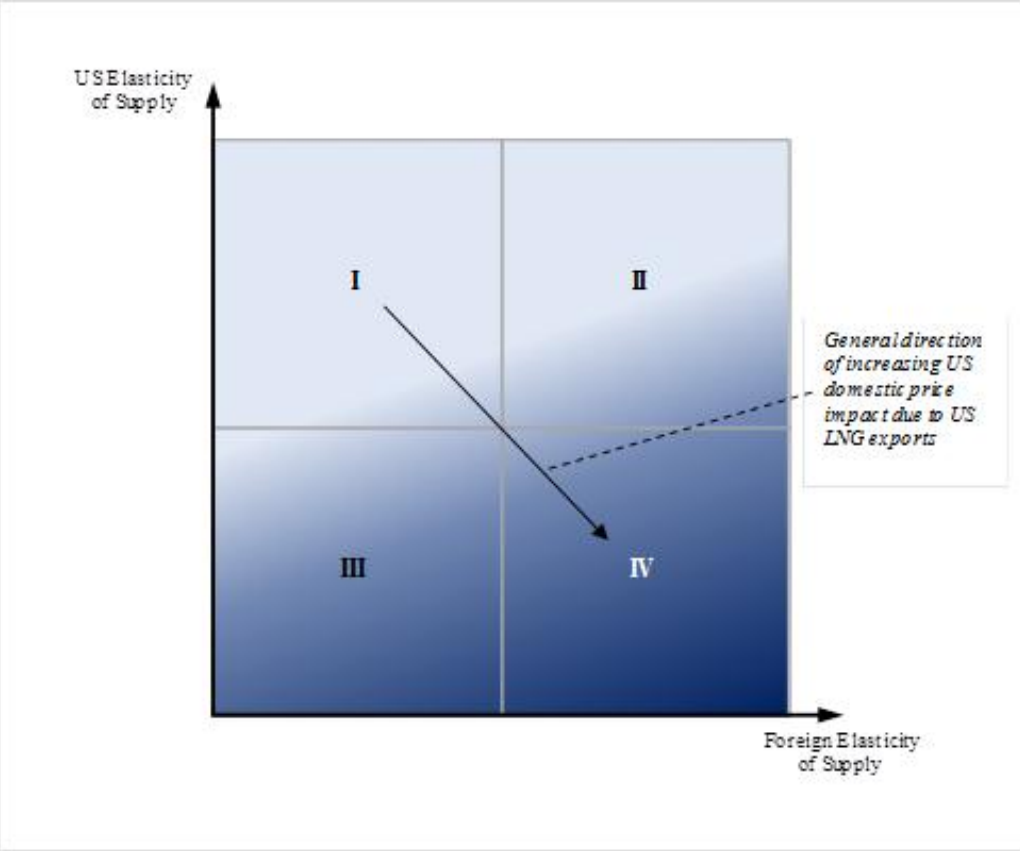
- Absent storage and physical liquidity, oil indexation provides an element of price certainty.
- Oil indexation is a form of price discrimination
  - (1) Firm must be able to distinguish consumers and prevent resale.
  - (2) Different consumers have different elasticity of demand.
- Increased ability to trade between suppliers and consumers (physical liquidity) violates condition (1).
  - This will happen in a liberalized market, or as LNG trade grows, or as hubs emerge in end-use markets.

The Supply Curve Effect of Shale and Implications for Price



The Marginal Profitability of Trade

- To understand what a license to export means for actual exports, we must examine the incidence on price of trade. Unfortunately, most analyses have focused on the US only. This ignores the interaction between the US domestic market and the market abroad.



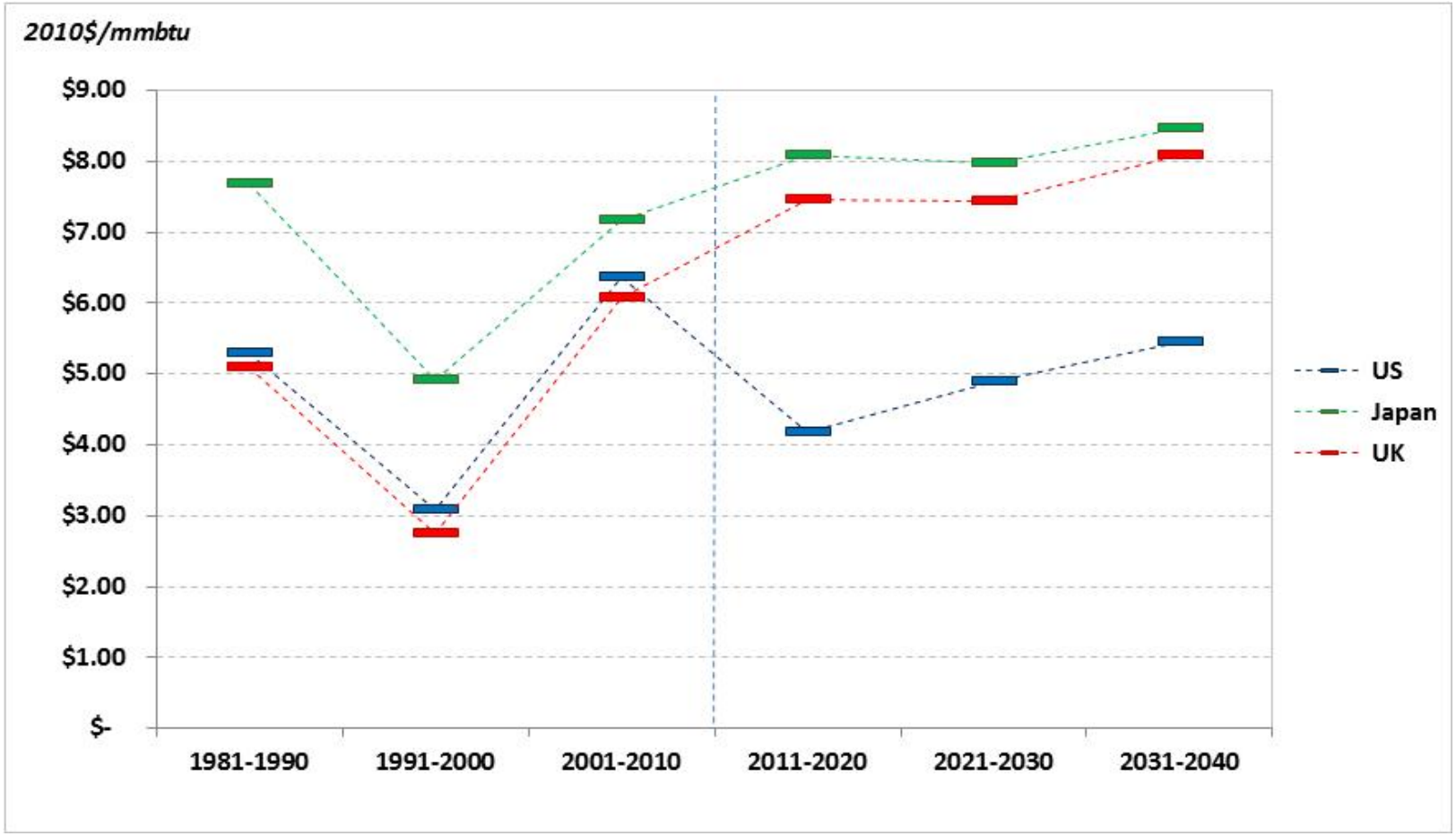
Results from the RWGTM: Case of US Gulf Coast LNG Arbitrage, 2011-2040

- Modeling indicates the current arbitrage value may be transitory. In fact, the positive export margin tends to disappear after 2015, contingent upon demand and supply-side developments in the Pacific basin.
- Even substantial changes to the table values indicate the result is robust.

	2011	2011-2020	2021-2030	2031-2040
Feed gas cost ($/mcf)	$ 3.80	$ 3.98	$ 4.69	$ 5.26
Liquefaction ($/mcf)	$ 2.92	$ 2.92	$ 2.92	$ 2.92
Transport cost ($/mcf)				
UK	$ 1.07	$ 1.07	$ 1.07	$ 1.07
Japan	$ 2.15	$ 2.15	$ 2.15	$ 2.15
Landed cost ($/mcf)				
UK	$ 7.79	$ 7.97	$ 8.67	$ 9.25
Japan	$ 8.87	$ 9.05	$ 9.75	$ 10.33
Market price ($/mcf)				
NBP	$ 8.93	$ 7.47	$ 7.44	$ 8.09
JKM	$ 13.86	$ 8.08	$ 7.98	$ 8.46
Export Margin ($/mcf)				
UK	$ 1.14	$ (0.49)	$ (1.23)	$ (1.16)
Japan	$ 4.99	$ (0.96)	$ (1.77)	$ (1.87)

How do the RWGTM results compare to history?

- Henry Hub remains below the relationship that persisted historically, although the Asia price and NBP grow slightly closer.



Sources: Compiled from Platts, IEA, EIA and RWGTM

Viability of US LNG Exports

- Current arbitrage value is high, but there is risk
  - Price impact in foreign market could be significant
    - Relative supply and demand elasticities matter.
  - Risk of foreign supply developments
    - Asia can be served by pipeline supplies from Russia, Central Asia, and South Asia, by LNG from the Middle East, Africa, Australia, Asia-Pacific, North America, and by local supplies.
  - Exchange rate risk is present
    - Recent paper by Hartley and Medlock (2012) indicates exchange rates are important in the crude oil-natural gas price differential when (i) there is limited capability for direct arbitrage and (ii) fuel-switching is limited. So, oil-indexed flows are potentially exposed.
    - Gas-indexed trades are also exposed. Foreign gas is traded in own currencies, so exchange rates effect the arbitrage opportunity.
  - Higher supply elasticity challenges pricing paradigms

Viability of US LNG Exports (cont.)

- Export capacity will be built on the expectation that current rents from arbitrage will "pay" for the upfront fixed cost.
  - But, once the fixed cost is sunk, operation no longer hinges on the payment to capital. It is possible that some terminals will not earn the *ex-ante* required rate of return, contingent on the off-take agreement.
- US LNG export capacity could be used for seasonal arbitrage. While the annual load factor would be lower in this circumstance, if seasonal price differences among the regional markets are sufficient, US exports would be profitable.
- LNG exports from the US will link global markets to storage in the US. By providing this link, liquidity benefits could spill over and contribute to very different market paradigm.
- LNG project success could hinge on who bears risk in contractual relationships.

Questions/Comments

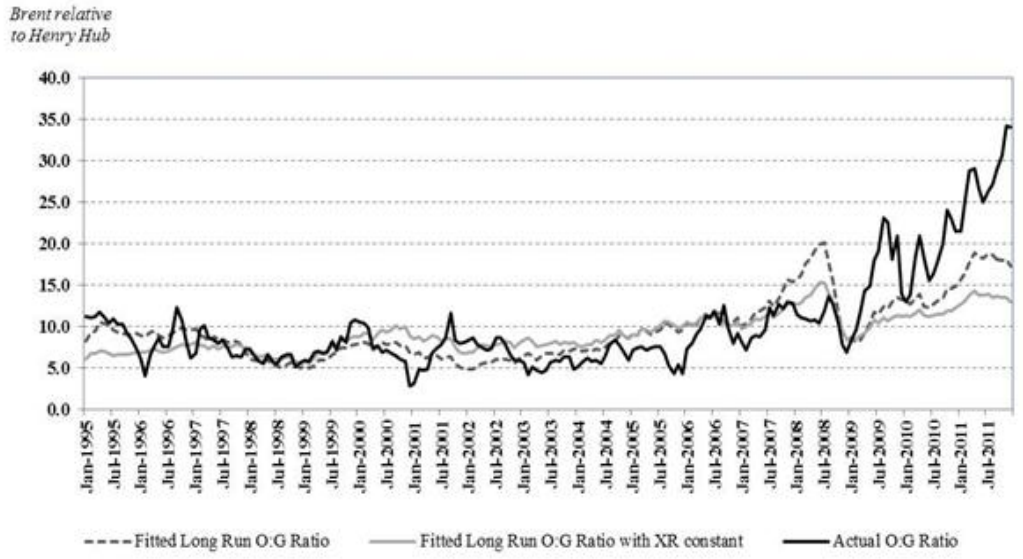
Appendix:
The Oil-Gas Price Relationship

The Oil-Gas Price Relationship

- In the US, crude oil and natural gas prices have diverged from each other.
- Shale gas developments have contributed to this…
  - Increased available supply and contributed to storage overhang
  - Driven fuel substitution in power generation sector diminishing the margin of substitution with residual fuel oil
- Recent work by Hartley and Medlock (2012) indicate the price relationship is highly contingent on the value of the US dollar.
  - One commodity is fully fungible while the other is a non-traded good
  - Both commodities are potential substitutes for one another
  - Arbitrage between prices occurs de facto through fuel switching, unless the ability to switch is absent.
  - In this case, the exchange rate becomes the point of arbitrage between the commodities, meaning the exchange rate will be important in determining the price relationship.
  - Importantly, we also show that if fuel switching capability is present, the exchange rate effect is negligible.

The Oil-Gas Price Relationship (cont.)

- The long run relationship and the impact of the exchange rate, up to 40% of drift is explained by XR movements.



- Accounting for transitory factors explains the remainder of drift.
  - In the very recent history, warm winter and continued production growth combined to push storage well above normal ranges