

BAKER & O'BRIEN
I N C O R P O R A T E D

U.S. REFINING MARGINS EXHIBIT MODEST INCREASES IN LATEST QUARTER

Special Topic: Will the U.S. “Shale Revolution” Permanently Change Perspectives on Refining Margin Cycles and the Advantages of Upgrading?

Houston, August 19, 2014

Baker & O'Brien, Inc.'s 14Q2 release to *PRISM*¹ subscribers reflects a modest overall average increase in U.S. refining margins compared to the prior quarter. Generally improved refined product crack spreads were offset to some extent by higher refiner acquisition costs for domestic crude oils. Compared to the prior quarter, the U.S. Gulf Coast (USGC) gasoline crack spread was more than \$9/Bbl. Higher, while the distillate crack spread was more than \$1.50/Bbl. lower. This benefited refiners with the ability to “swing” from distillate to gasoline production.

PRISM Cash Margins vs. Previous Periods (\$/Bbl.)

	<u>14Q2 vs. 14Q1</u>	<u>14Q2 vs. 13Q2</u>
PADD 1	0.66	-0.09
PADD 2	0.50	-2.65
PADD 3	0.91	3.65
PADD 4	-1.31	-6.57
PADD 5	1.92	-0.66
U.S. Overall	0.89	1.18

Only PADD 4, the five sparsely-populated Rocky Mountain states, saw a decline in margins. This was largely due to rising prices for this district's regional crude oils.

On a year-over-year basis, refining margins were lower on average in each PADD except for PADD 3. PADD 3 was the beneficiary of a weakening in its crude oil price structure, as evidenced by LLS trading at more than a \$4/Bbl. discount to Brent – compared to a slight premium in 13Q2. Year-over-year margin declines in the other PADDs were primarily the result of a generally narrowing WTI-Brent price differential.

Key Refining Margin Metrics, \$/Bbl.

	2014	2014	2014	2013	2012
	<u>June</u>	<u>Q2</u>	<u>Q1</u>	<u>Annual</u>	<u>Annual</u>
WTI	105.24	103.05	98.68	97.93	94.16
LLS	108.22	105.55	104.36	107.31	111.72
Brent	111.65	109.63	108.20	108.62	111.58
LLS – Maya	9.69	9.77	15.08	9.94	12.14
USGC LLS 321*	15.95	16.64	10.92	10.63	9.81
USGC LLS 6321**	10.54	11.51	7.12	6.92	6.58
Chicago WTI 321***	22.71	22.51	19.21	22.83	29.24

*LLS deemed conversion to 67% conventional 87R gasoline and 33% ULSD

**LLS deemed conversion to 50% conventional 87R gasoline, 33% ULSD and 17% Fuel Oil

***WTI deemed conversion to 33% conventional 87R gasoline, 33% RBOB and 33% ULSD

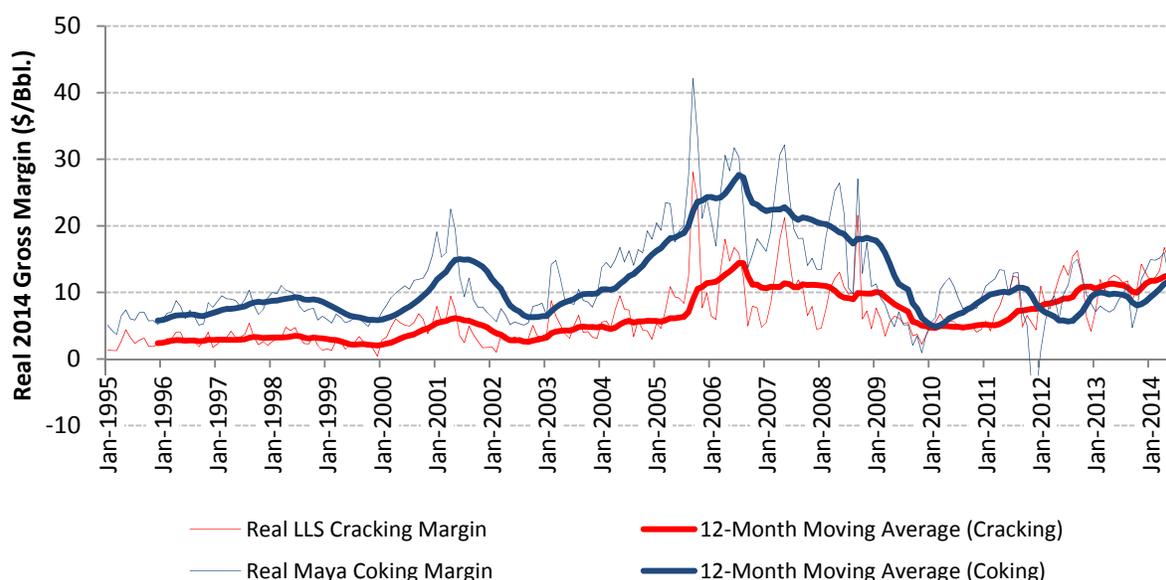
The shrinking WTI-Brent price differential in 14Q2 compared to 14Q1 (almost \$3/Bbl. less) kept margins in check for inland cracking refineries whose crudes are priced relative to WTI. However, heavy crude coking refineries were not immune to this effect as well – with the LLS-Maya price differential falling by more than \$5/Bbl. during the period.

¹ *PRISM*TM is Baker & O'Brien's refinery modeling and database system that includes operational and economic performance details for refineries in the U.S., Canada, Europe, and Asia.

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Whether one perceives historical refining margins through the prism of an unpredictable “random walk” theory, or as a series of “boom or bust” cycles, it is undeniable that over the last 20 years U.S. refiners have experienced the full spectrum – from an extended “bust” period for most of the 1990s; through to the “golden age” of the mid-to-late 2000s; followed by a margin collapse during the global financial crisis starting in late 2008. However, throughout almost all of this 20-year period of volatility, one relationship appeared axiomatic – heavy sour coking refineries consistently outperformed light sweet cracking refineries on the USGC. This is clear from the figure below, which compares USGC average coking refiner margins (Maya basis) with USGC cracking refiner margins (LLS basis). Until 2012, with the exception of a very short period in early 2010, coking always produced better margins than simple cracking.

USGC Historical Gross Refining Margins
(LLS Cracking, Maya Coking)



Since 2012, the “shale revolution” appears to have turned this axiom, temporarily at least, on its head. In late 2010 and early 2011, the first tangible signs of the shale revolution appeared, and WTI prices at Cushing dropped precipitously relative to comparable quality global crude benchmarks. As a result, during 2011 and 2012, many Mid-Continent refineries processing light crudes – some of which had even been targeted for closure – began to enjoy record margins. Today, steadily increasing production from the Bakken, the Eagle Ford, and the Permian Basin, as well as new or enhanced capacity to move such inland production southward, has expanded the lower-cost crude oil “bubble” to include many USGC refineries. USGC plants capable of processing large volumes of light crude oils are today’s margin leaders in that region.

As the above figure shows, gross refining margins for USGC light sweet cracking refineries are back to levels experienced during the “golden age.” In contrast – and virtually unprecedented – gross refining margins for USGC heavy sour coking refiners have been stubbornly lower than

those for the light sweet cracking plants. In fact, in 22 out of the last 31 months, the LLS cracking margin has been higher than the Maya coking margin. The question is: Is this just a temporary phenomenon, or has the shale revolution permanently altered these historic margin relationships? The answer to this question will be determined by a number of regulatory, economic, political, and logistical factors, many of which are difficult to predict with any certainty.

Factors that would tend to sustain the recent margin relationship include:

- **Realization of anticipated growth in North American crude oil production** – Many industry observers believe that the U.S. oil production, if left unfettered by any draconian environmental restrictions, can continue to grow at recently-demonstrated rates. If this happens, the increasing supplies of light crude oil looking for a home should keep light sweet cracking margins robust.
- **Reduced foreign demand for U.S. refined products** – Reduced foreign demand for refined products in South America and/or Europe, key destinations for U.S. refined product exports, could reduce U.S. refining runs and corresponding crude oil demand. Under such circumstances the light-heavy crude “spread” could narrow, allowing light crude refiners to maintain their competitive advantage.

Factors that might cause a return to the traditional margin relationships include:

- **Regulatory changes that limit shale drilling and “fracking”** – If federal, state, or local governments restrict or prohibit new shale developments for environmental reasons, this would result in reduced production growth, a rise in light crude oil prices and an increase in the light-heavy “spread” which favors heavy crude refiners. The same would be true if technical issues in some way caused lower-than-expected production plateaus.
- **Regulatory changes allowing more U.S. crude oil exports** – A significant debate is currently underway regarding a lifting (or partial lifting) of the existing federal ban on U.S. crude oil exports. If this long-standing ban is relaxed in some way, the North American crude oil price advantage would decrease. To the extent that this occurs, U.S. light crude oil prices would increase relative to heavy crude oil, narrowing the advantage currently enjoyed by light sweet crude refiners.
- **Increased Availability of Heavy Crude Oil** – Approval of the Keystone XL pipeline would increase heavy crude oil volumes and price competition on the USGC, and result in improved margins for heavy sour refiners. Likewise, higher-than-anticipated global demand for crude oil, similar to what happened during the “golden age,” might require incremental heavy OPEC supply, widening the light-heavy spread and improving the prospects of coking refineries.
- **Inability of U.S pipeline infrastructure to keep up with new production** – If inland U.S. crude production expands faster than the transportation infrastructure needed to deliver the new production to the USGC, the lower-cost crude oil “bubble” might begin

to shrink back to only the inland refiners again and the margin advantage enjoyed by USGC light sweet refiners would be eroded.

- **Overbuilding of US refining/distillation capacity** – If expansion activities of refiners overshoots the availability of light crude oil, light-heavy differentials could narrow.

Clearly, there are a host of interrelated factors that will impact USGC refining margin relationships in the future, but the “cycles” or “random walks” (depending on your viewpoint) are expected to continue. On balance, however, and considering the likelihood of occurrence of each of the various issues, we believe that USGC light sweet cracking margins will remain robust and continue to equal or exceed those of their heavy sour counterparts at least for the next year or two. Beyond that, depending on how the various regulatory, environmental, political, economic, and logistical issues unfold, heavy sour refiners could conceivably rebound. In the very long term, despite expanded U.S. light oil production, heavy sour crude oils still comprise approximately 70% of total world reserves. Assuming a continually expanding world economy, these reserves must eventually be tapped, and refiners capable of processing them will achieve higher margins.

About Baker & O'Brien

Baker & O'Brien is an independent professional consulting firm specializing in technology, economics, and management practice for the international oil, gas, chemical, and related industries. With offices in Dallas, Houston, and London, the firm focuses primarily on the downstream industry and assists clients with strategic studies, mergers and acquisitions, and technology evaluations. The firm also provides expert services to support insurance claims, investigate operating incidents, and support a wide range of commercial disputes in the energy industry.

About PRISM

Baker & O'Brien's *PRISM* software is used to perform detailed analysis of individual refineries and the refining value chain from crude oil load port to products truck rack. The system combines a large historical database with a robust refinery simulator to provide analytical support to competitive assessments, strategic planning, crude oil valuation, and delivered cost of supply. The *PRISM* database currently includes operational and economic performance details for all refineries in the U.S. and Canada, most refineries in Europe, and over 50 refineries in the Asia Pacific region. The *PRISM* system is available for license and is used in consulting assignments for Baker & O'Brien clients.

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