HEAVY FUEL – THE NARROWING LIGHT-HEAVY CRUDE OIL SPREAD AND WHAT IT MEANS FOR U.S. REFINERIES

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Since last winter, the price gap between light crude oil and heavy crude — otherwise known as the light-heavy differential — has narrowed considerably. In February, the price difference between Louisiana Light Sweet crude (LLS) and heavy Maya crude on the Gulf Coast was almost $10/bbl, providing an advantage to refiners who have invested in cokers and other equipment that allows them to run a heavier crude slate. But since June Maya has on average sold for only about $5/bbl less than LLS. Today we examine the shrinking price gap between light and heavy crude and its effect on coking and cracking margins.

Crude oils come in a variety of qualities such as light, medium, or heavy (measured by API gravity), sweet or sour (referring to sulfur content), acidity level (denoted by total acid number), etc. Refineries are designed to process crude oils (or a mix of crude oils) meeting certain qualities to utilize their downstream processing units most efficiently while maximizing their profitability. Obviously, crude oil cost is an important factor in selecting crude oils. Heavy crude oil (with lower API gravity; see Don’t Let Your Crude Oils Grow Up to Be Condensates for more on API gravity) is more difficult and expensive to refine because it requires more complex processes to create finished refined products. Therefore, heavy crude oil is generally sold at a discount to light crude oil to account for the extra operating costs and larger investments made in downstream processing units. Lately, that discount has declined due to a number of factors — mostly on the supply side as operational issues in key producing areas have reduced the heavy oil supply, resulting in too few barrels for too many cokers. As a result, the prices for heavier crudes like Maya (see It Ain’t Heavy, It’s My Maya) have been bid up to approach breakeven with lighter crudes. The dashed red line in Figure 1 shows the Maya price as a percentage of the price of LLS, and the solid blue line shows the discount on a $/bbl basis.

Figure 1. Sources: Platts and Baker & O’Brien calculation.
Over the past several years, a number of U.S. refineries along the Gulf Coast (such as Motiva Port Arthur and Marathon Garyville) and in the Midwest (such as BP Whiting and Marathon Detroit) have made major process-upgrading investments (such as cokers) so they can process heavier, cheaper grades of crude oil. In 2016, Gulf Coast refiners (Petroleum Administration for Defense District 3, or PADD 3) imported nearly 2.2 million barrels/day (MMb/d), or 48% of total heavy imports, and Midwest refiners (PADD 2) imported 1.6 MMb/d (34% of total heavy imports). The remainder of the heavy crude oil imports is pretty evenly spread among the three remaining PADDs.

With the exception of San Joaquin Valley (SJV) crude oil in California, most of the heavy oil processed in the U.S. comes from international locations in popular grades such as Western Canadian Select (WCS, Canada), Maya (Mexico) and Merey (Venezuela). Imports of heavy crude have increased significantly since 2007, with strong growth in Canadian crude imports (blue segments at bottom of bars in Figure 2) partially offset by a decline in Mexican imports (red segments).

Some U.S. refining companies rely more on heavy crude oil due to their configurations than others and would potentially be subjected to higher crude costs when the differentials narrow. Figure 3 looks at the relative reliance on heavy crude by company by looking at a few metrics. The x-axis shows 2016 heavy crude oil (<27 API) imports by company divided by their total company crude distillation capacity to show on a percentage basis which companies run more heavy crude oil. (In other words, company reliance on heavy crude rises as you move to the right.) The y-axis shows total coking capacity by company as a percentage of total crude distillation capacity. (This is simply another way of looking at which companies are more capable of processing heavy crude oil since they have...
secondary bottoms upgrading capability; see I’d Like To Buy The World A Coke for more on cokers.) Finally, the size of the bubble represents each company’s installed crude distillation capacity.

Relative Heavy Crude Requirements by Company

Figure 3. Sources: EIA, Baker & O’Brien’s PRISM™ refinery modeling program. PRISM is a trademark of Baker & O’Brien, Inc. All rights reserved.

The bubbles fall into three distinct categories. To the upper-right, we’ve got Houston Refining (owned by LyondellBasell) and Deer Park Refining (owned by a joint venture of Shell and Petróleos Mexicanos, or Pemex); they run 65%+ heavy crude out of their total installed capacity. However, each is actually a standalone refinery so their installed crude distillation unit (CDU) capacity is smaller than the big boys in the bottom left corner. In the middle of the chart, we have a cluster of companies that are mostly tied to Canadian crude oil in the Midwest, with the exception of Chevron (which has refineries in California and Mississippi). In the bottom-left, we have some of the larger refiners who have multiple locations in different markets. So while some of their refineries process heavy crude oil, on a systemwide basis they are lower on the scale of heavy crude processing.

So, does a narrow light-heavy differential lower the margins for refiners with cokers? The short answer is “yes,” but it’s not a perfect relationship. Figure 4 shows the historical light-heavy differential versus the Gulf Coast Maya Benchmark Coking Margin (red line). As you can see, the benchmark margin follows a similar trajectory as the light-heavy differential (blue line) but there are periods when they haven’t perfectly aligned. For example, since early 2015 we have had a relatively narrow light-heavy differential, but the Maya coking margin remained pretty robust due to other market factors such as strong demand for refined products because of low and flat product prices.
Narrowing in on recent history, let’s look at the disconnect between the Maya coking margins and the light-heavy differential. Figure 5 compares the Maya coking margin with the LLS cracking margin. Over the last year and a half, the LLS cracking margin (green line) has improved while the Maya coking margin (red line) has remained flat, so any improvement in cracks on the product side have been offset by the decline in light-heavy differential.
While there are some differences in the yields of light oil products, both the LLS Cracking Gross Margin and the Maya Coking Gross margin have benefited from improved product pricing. Figure 6 contains two “waterfall” charts from January 2016 to July 2017 for the LLS Cracking (left chart) and Maya Coking (right chart) margins. Starting with the LLS Cracking Margin chart, we estimate the January 2016 margin to have been $7.08/bbl (blue bar). Between January 2016 and July 2017, prices for all of the major products changed, which impacted their relative margins. For example, if we take the increase in gasoline prices over the last year and a half and multiply that difference by the gasoline yield from an LLS Cracking refinery, we get a net benefit of $7.93/bbl (first green bar in chart to left). After taking the price change times yield impact for the remaining products, we subtract the price change of the crude (LLS or Maya), bringing us to the July 2017 gross margin. Both charts clearly show that gasoline and distillate prices improved significantly, but these increases were offset (and in the case of Maya, more than offset) by increased crude oil costs. Thus, the LLS Cracking margin benefitted both from its preferable yield structure and a more modest increase in crude costs when compared to the Maya Coking margin.
Does all of this mean that coking refiners are suffering? Not necessarily, but they are realizing lower profits than previously. Still, as we’ve said in other blogs in the past, refiners have at least some degree of operational flexibility and are experts at optimizing. When heavy crude oil prices increase relative to light crude, they adjust operations to maximize light crude oil throughput, which many refiners mentioned on their second-quarter earnings calls is being done right now. That doesn’t mean all heavy crude oil is backed out of their systems, because installed hardware may limit how much a refinery can change its crude slate, but there is some wiggle-room.

As for what the future holds for heavy crude oil refiners, a lot will depend upon heavy crude oil supply. If the U.S. were to impose economic sanctions banning imports of Venezuelan crude, for instance, other heavy crude oils would need to be imported to fill the void. Depending upon global heavy crude oil supply, this could bid up the price for heavy crude oil and further narrow the light-heavy differential. At the same time, U.S. production of light crude oil has been rising, which could put additional downward pressure on the light-heavy differential. Running on heavy fuel could get pricey for heavy crude oil refiners should some of these supply situations play out, setting the stage for sweet crackers (those that refine light, sweet crudes) to once again outperform sour cokers, as we saw in the 2012-13 time frame.

“Heavy Fuel” is a single off of British rock band Dire Straits’ 1991 album, On Every Street. While not as big a hit as the group’s “Money for Nothing” or “Sultans of Swing,” the song reached #1 on the Billboard Mainstream Rock Tracks chart in the U.S.


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