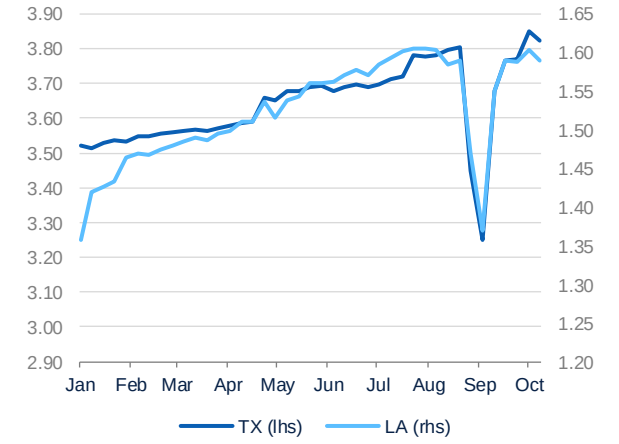
4. Hurricane Harvey and the oil and gas sector

More than two months since Hurricane Harvey wreaked havoc in Texas and Louisiana, the oil and gas sector seems to have recovered almost entirely. Available information provides an overall view on the sector's reaction to one of the most devastating storms registered in the U.S. as well as its consequences and implications for the future of energy markets.

Starting with production, Harvey forced several platforms in the U.S. Gulf Coast to evacuate their personnel and shut-in production. At the peak of the storm, about 15% of production platforms were evacuated and 25% of oil and gas production (equivalent to 428,568 b/d and 835 bcf/d) was shut in, according to data from the Bureau of Safety and Environmental Enforcement (BSEE).

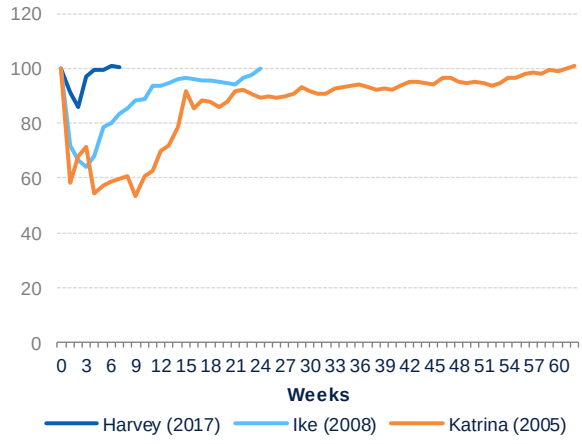
Onshore production was also affected. Operators in the Eagle Ford region scaled down drilling, completion and production activities as the storm battered the area. However, most of the shut-ins were done for precaution or in response to refinery and transportation outages rather than for actual damages to the wells. How much shale production was shut-in is uncertain since no government agency recorded the actions taken by operators (as it was the case with the BSEE and offshore platforms), and companies do not always disclose that information. However, a day after Harvey reached land, the Texas Railroad Commission calculated that between 300,000 and 500,000 b/d of crude oil and 3 bcf/d of natural gas production had been shut-in in the Eagle Ford from a pre-storm production estimate of 870,000 b/d and 6 bcf/d. As more crude oil production data has become available, our estimates point to a lower figure of approximately 250,000 b/d.

Figure 4.1 U.S. estimated crude oil production in 2017 (million b/d)



Source: BBVA Research and Haver Analytics

Figure 4.2 U.S. estimated crude oil production after hurricanes (Index, t_0=100)



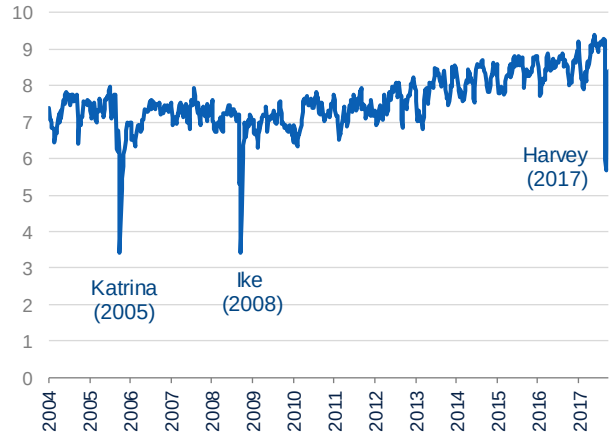
Source: BBVA Research and Haver Analytics

Once the super-storm dissipated, it took about four weeks for total crude oil production in Louisiana and Texas to return to their combined pre-storm levels of 5.4 million b/d. In contrast, it took production around 22 and 62 weeks to return to pre-storm levels after Hurricane Ike (2008) and Hurricane Katrina (2005), respectively.

One explanation for the rapid normalization of production is that, since the shale revolution, most of the oil and gas extraction has moved inland where rigs and wells are less vulnerable to hurricanes and tropical storms. Today, only 19% of crude oil is produced offshore as opposed to 2005 when this share was 26%. Another explanation is that the rapid weakening of the hurricane prevented devastating winds from severely damaging production facilities. In any case, the upstream sector seems to have weathered the storm without significant harm.

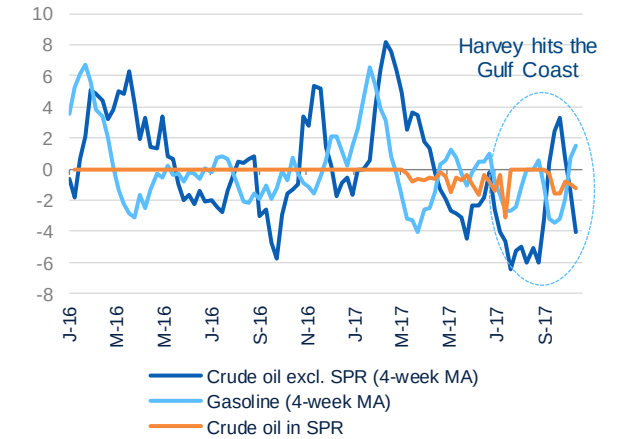
This wasn't the case of refineries which experienced substantial damage from floodwaters. According to the Department of Energy, about 34% (3,268,449 b/d) of refining capacity in the Gulf Coast (18% of total U.S.) was shut-down during the worst part of the storm. This included six refineries in the Corpus Christi area, seven refineries in the Houston-Galveston area and one refinery in the Beaumont-Port Arthur area. In addition, one more refinery in the Houston-Galveston area, two refineries in the Beaumont-Port Arthur area, and two refineries in the Lake Charles area had to operate at reduced rates. These refineries had a capacity of 1,777, 276 b/d, equivalent to 18.3% of total capacity in the Gulf Coast and 9.6% of total capacity in the U.S. Some of the biggest refinery complexes in the country were temporarily shut-down. Crude oil input to refineries, a proxy of refining demand, declined by 3.6 million b/d in the two weeks following the storm or 35% down from pre-storm levels. Contrary to what happened with production, input to refineries has not recovered entirely. In the week of October 13, it was still 14% below pre-storm levels. Data from the Energy Information Administration shows that capacity utilization has gone up from 60.7% to 83.7%, but it still below the 97% registered in early August. Notwithstanding, losses appear to have been less than in the aftermath of Hurricane Katrina, when input to refineries declined by about 4.3 million b/d (55% from pre-storm levels). In fact, seven weeks after Katrina, input to refineries was still 33% below the levels observed before the storm. Today most of the refineries are operating at full or reduced rates, in contrast with some refineries during Hurricane Katrina for which it took months to restart.

Figure 4.3 Crude oil input into refineries in the Gulf Coast region (million b/d)



Source: BBVA Research and Energy Information Administration

Figure 4.4 U.S. stocks of crude oil and gasoline (1-week change, eop, million barrels)

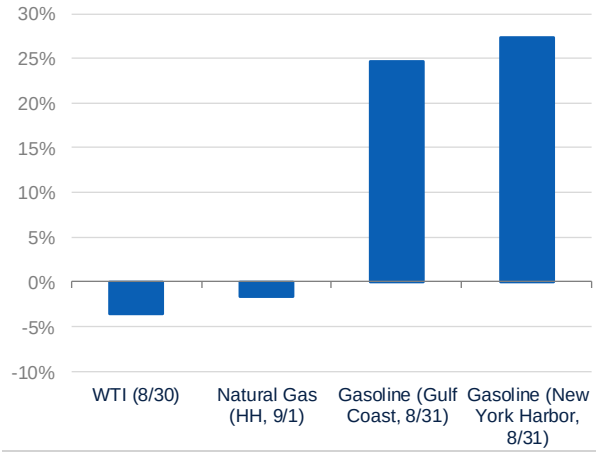


Source: BBVA Research and Energy Information Administration

Refinery outages forced producers to store crude oil for a while, which pushed inventories up. Stocks of crude oil excluding strategic reserves temporarily broke a downward trend and went up by 15.262 million barrels in the three weeks after the storm, causing a 3.5% decline in the price of WTI crude, and expanding the gap between this and Brent. Although it took about four days for WTI to return to pre-storm levels, the WTI-Brent differential continued to expand, reflecting the impact of refining capacity below normal and other domestic factors such as robust production and historically high stocks that have partially offset the positive effects of solid global demand and OPEC cuts. In contrast, natural gas prices were the least affected by Harvey as production is regionally more diversified and less vulnerable to refinery outages.

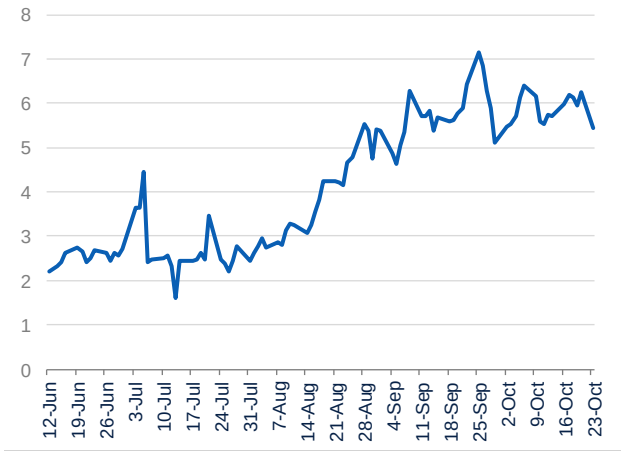
Prices of refined products experienced a significant boost in the aftermath of Harvey. In particular, gasoline prices in the Gulf Coast jumped almost 16%. Higher prices at the pump were also felt in other parts of the U.S., particularly in the South and the East. This is because the Texas portion of the 5,500 miles Colonial Pipeline system that connects refineries and consumers between the Gulf Coast and the New York Harbor area was also impacted. Until September 5, when the line going from Houston to Lake Charles was finally repaired and restarted, products such as gasoline, heating oil and jet fuel, could not reach their markets normally, resulting in widespread price increases. To stabilize the market, the federal government authorized the release of 1 million barrels of crude oil (400,000 barrels of sweet crude and 600,000 barrels of sour crude) from the strategic reserves and sent them to the Phillips 66 refinery in Lake Charles, LA. In addition, the fact that Harvey arrived at the end of the holiday season, that gasoline stocks remained at high levels, and that some regulations on fuel quality were temporarily suspended could have helped prevent a more pronounced increase in fuel prices. As refineries gradually return to normal, gasoline prices have slowed down, but remain slightly above pre-storm levels.

Figure 4.5 Energy prices
(% change from August 25 to highest/lowest)



Source: BBVA Research and Haver Analytics

Figure 4.6 Brent-WTI price differential
($)

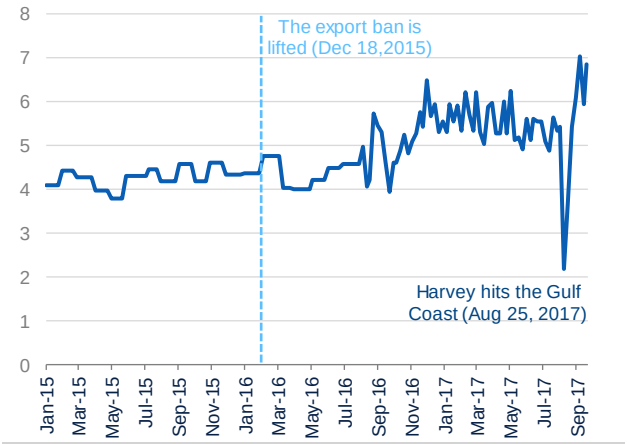


Source: BBVA Research and Haver Analytics

Harvey also caused significant damage to the port's infrastructure. Floodwaters dumped several tons of silt and sand into the Houston Ship Channel and throughout Galveston Bay, and the Sabine Pass that gives access to the Port of Beaumont

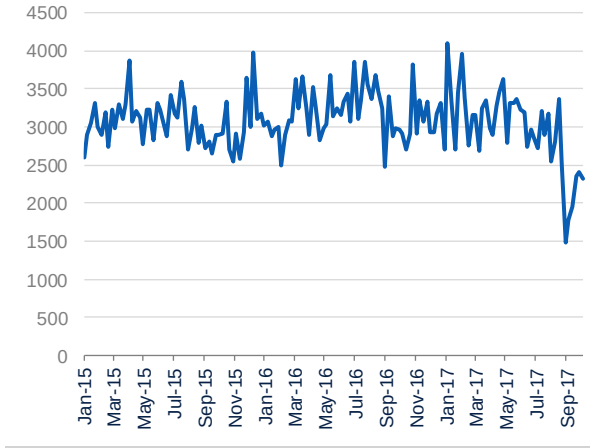
and Port Arthur. This and the subsequent dredging efforts have prevented cargo from moving normally even after the ports were reopened. Impairments to port infrastructure together with refinery outages led to a strong decline in crude oil imports, which dropped 56% in the two weeks since August 18 and to date have not recovered to pre-storm levels. Similarly, exports plummeted by 83% in the week of the storm; however, they rebounded quickly and sharply as refinery outages and arbitrage opportunities from the widening Brent-WTI gap prompted producers to sell more crude overseas. In the week of September 29, crude oil shipments went up by 1.98 million b/d, the highest level since the start of government weekly exports data (1993). This wouldn't be possible without the repealing of the export ban in 2015, which allowed exports to serve as an effective escape valve in response to refinery disruptions. Exports of refined products also fell sharply, but recovered a few weeks later reaching 4.8 million b/d in the week of October 13, the highest level since May.

Figure 4.7 U.S. total crude oil exports (million b/d)



Source: BBVA Research and Energy Information Administration

Figure 4.8 Gulf Coast crude oil imports excluding SPR (thousand b/d)



Source: BBVA Research and Energy Information Administration

Despite the unprecedented magnitude of Hurricane Harvey, the damaged caused to oil and gas infrastructure proved to be manageable and short-lived. This was the result of learning from past experiences, specifically Hurricanes Katrina and Ike, and of a fundamental change in the market structure characterized by the increasing relevance of onshore production and the possibility of selling crude oil outside of the country. The relatively modest decline in oil prices contrasting with the sharp increase in gasoline prices confirms that the storm wasn't as detrimental for production as it was for refining, which was not prepared for the excessive amount of water brought by Harvey.

In this sense, Harvey has revealed a new type of risk coming from more frequent and severe flooding, and the consequent disruptions to refining and transportation capacity. The scientific community has pointed out that the next super-storms could be more frequent and as strong as or even stronger than Harvey due to the warming of the Gulf of Mexico. As a result, substantial investments need to be done in order to improve the resiliency of the entire value chain. However, resources are limited, and it is not clear what would be the best option. Should more refinery capacity and pipelines be built in order to avoid disruptions to domestic markets? If so, should they be built outside the Gulf Coast? Would a more

fragmented system of refineries compensate the risks of the more concentrated system that we have today? As the industry comes up with an optimal solution, Hurricane Harvey has also built a case for preserving and using the strategic reserves, not necessarily as a buffer to geopolitical risks, as they were meant to be when created, but as a tool to deal with supply shocks resulting from climate change. Finally, as the U.S. oil and gas industry increases its participation in global markets via exports of crude oil and LNG, the vulnerability of the Gulf Coast infrastructure to future natural disasters will most likely impact international markets. This would imply that, without the appropriate preparations, the effects of the next Harvey will be felt at the global level.

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