King Abdullah Petroleum Studies and Research Center

Assessment of Coronavirus Effects on Oil Demand Implied by Price Elasticities

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Instant Insight

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Overview

There appears to be a significant response in the crude oil markets to the coronavirus outbreak that originated in Wuhan, China, in December 2019 and has since spread globally. Many cities in Hubei, of which Wuhan is the capital, have been quarantined, with many airlines suspending flights to mainland China.

Reports in the media have attributed the fall in the oil price since Monday, January 20, 2020 to the virus. The observed price collapse since then may imply a market expectation of a decline in demand of as much as 810,000 barrels per day (b/d). This expectation may, in turn, imply an expectation of zero economic growth for China over the next several months.

How could the virus affect the oil markets? It should not affect supply, since the majority of cases have been in China. The country is primarily a major consumer, rather than a major supplier, of crude oil, and Wuhan is not a player in Chinese crude oil production. So, the effect will be felt from the demand side. In other words, this is a demand shock to the market.

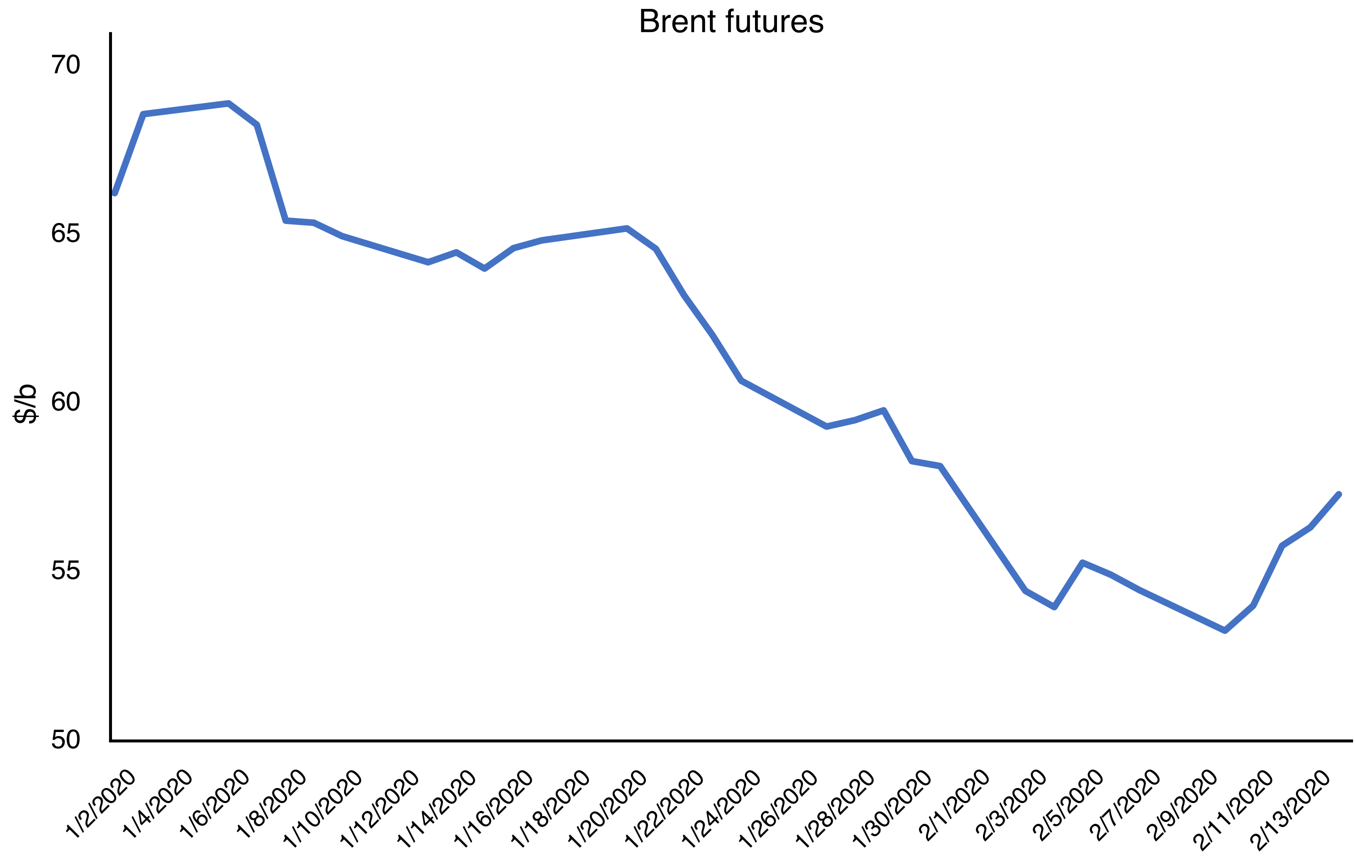
There are several differences between the current market reactions to the coronavirus and the 2003 SARS outbreak. Part of this may be related to the significant difference in the level of reporting of the two virus outbreaks and the degree of global awareness. Beyond this, the world economy is vastly different in 2020 than it was in 2003. According to World Bank data, in 2018, China's share of global gross domestic product (GDP) was 15.9%, substantially greater than its share of 4.3% in 2003. Therefore, any downturn in its economic activity is now expected to have a much larger global impact. The suspension of economic activity to curb the spread of the virus within China could have a negative effect on its exports and production, and limit the availability of Chinese components for use in global manufacturing. The eventual impact of this on countries and sectors will depend on how deeply they are interconnected with Chinese industries. For instance, China's central role in the global petrochemicals industry is causing some uncertainty regarding the short-term market outlook for liquefied petroleum gas (LPG), naphtha and reformate (Richardson 2020).

China's role in the global oil markets has changed significantly since 2003. According to BP's Statistical Review of World Energy, in 2003 China accounted for 7.2% of global oil consumption, compared to 13.5% in 2018. China's share of global oil imports also increased from 5.5% in 2003 to 15.5% in 2018; it is now the world's largest oil importer. So, while the SARS outbreak did not appear to have significantly influenced world oil prices in 2003, it is quite understandable why the current coronavirus outbreak is sending shockwaves through the global oil market, leading to significant price effects. An anticipated economic slowdown in China will be reflected in expectations of reduced energy usage. This will, in turn, have spillover effects on oil demand within China and, to some extent, on oil demand globally if the disruption continues.

Analysis

China is a major consumer of crude oil and a major oil importer. Between Monday, January 20, 2020 and Monday, January 27, 2020, the March 2020 futures price (the current near-month contract) on the London Intercontinental Exchange (ICE) fell by 9.02% from US$65.2 to US$59.32. The price hit a low of US$53.27 on February 10, 2020 before recovering to US$57.32 on February 14, 2020 (Figure 1).

Figure 1. ICE Brent Futures in 2020.



Source: Bloomberg 2020.

Employing the inverted Smith (2009) price elasticity model[1], with short-run price elasticity of demand at -0.05 and short-run price elasticity of supply at 0.04, the fall in price from January 20 – 27, 2020 implies that the market expected a decrease in the quantity demanded (an unexpected demand shock) of approximately 810,000 b/d, based on global production of 100 million barrels per day (MMb/d). The prices observed during the week of January 21 indicate there was no retrenchment of this market assessment. What may this imply the market's underlying expectation is for an economic slowdown in China as a result of the impacts of the coronavirus?

[1] See the model background section below. Subsequent follow-up insights on this topic will continue to monitor the changes in oil prices and what they imply for changes in oil demand. Various sensitivity analyses of oil demand will also be presented in forthcoming Insights, including comparisons with other studies and previous analogous episodes, such as the SARS outbreak in 2003.

The first question to address is whether or not the entire expected decrease in quantity demanded will come from China. And the second question is, what may this imply the market's expectation is for a decrease in Chinese economic activity?

For the first question, in the short run, i.e., for the month of March for which the January 20-27 price changes are specifically relevant, it is reasonable to expect that the brunt of the decrease will come from China. It will take some time for the direct effect on China to spill out to the rest of the world, and the severity of the latter will be contingent on how dependent overseas industries are on Chinese manufacturing. If the full 810,000 b/d decrease comes from Chinese demand, this implies a roughly 6% decrease in Chinese oil demand based on BP statistics (the BP Statistical Review of World Energy shows Chinese demand for 2018 to have averaged 13.525 MMb/d). The KAPSARC Oil Market Outlook (KOMO) (2020) reported growth in Chinese oil demand of 520,000 b/d in 2019, and forecast Chinese oil demand growth of 360,000 b/d in 2020. The implied expectation of an 810,000 b/d decline in demand from China would almost completely offset its oil demand growth during 2019-2020. An assessment of the impact of the coronavirus on the global oil market will be presented in a forthcoming KAPSARC Instant Insight.

Some estimates place Chinese income elasticity of demand for crude oil at about 1 (e.g., Ashraf, et al. [2018]). This implies that we would expect a 1% increase in quantity demanded for a 1% increase in GDP, all other factors held constant. The flipside of this measure implies that a decrease of 1% in the quantity of crude oil demanded would be associated with a decrease in GDP of 1%.

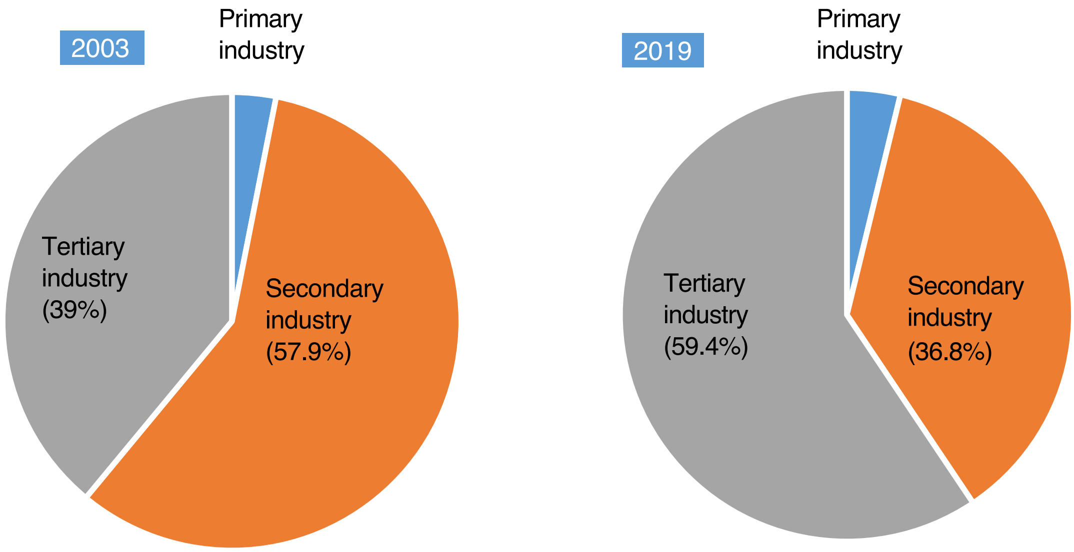
Income elasticity estimates are typically produced on an annual basis. If the full 810,000 b/d decrease in crude oil demand were carried by China alone for an entire year, this would imply a roughly 6% decrease in China's GDP (0.5% monthly and 1.5% quarterly). If the consensus prior to the coronavirus effect was for 6% annual GDP growth in China, we would now expect GDP to be flat for at least March and into the next quarter. Any longer-term effect will depend on how rapidly its economy comes back to full output.

If, on the other hand, the market expects that only a portion of the 810,000 b/d decrease will be borne directly by China, or if China's economic changes have significantly reduced the income elasticity of demand for oil, the expected impact on China's GDP will be moderated accordingly. The impact on global GDP and oil demand will then depend on what portion of the decrease fell on China, how the remainder is spread around the globe, and on the effective income elasticities of demand.

The potential impact of the coronavirus on China's macro economy

Cities across the country are taking measures to curb the disease's spread, such as halting public transport, closing cinemas, and cancelling public events. It is said that upwards of 60 million inhabitants are affected in Hubei Province, of which Wuhan is the capital; this figure is roughly 50% larger than the population of California. As a result, major sectors in the tertiary industry, including transport, wholesale and retail trade, accommodation and the catering trade, entertainment and tourism, are being heavily affected.

Figure 2. Composition of China's GDP growth.



Source: KAPSARC based on CEIC.

The share of secondary industry in China's total GDP shrunk from 57.9% in 2003, when SARS occurred, to 36.8% in 2019, while the tertiary industry grew from 39% to 59.4% in the same period (Figure 2). The impact of the current coronavirus control measures on China's tertiary industry and domestic consumption will be expected to be higher than in 2003.

The restrictive control measures aimed at containing the coronavirus occurred one week before the Chinese Spring Festival, the most important holiday in Chinese culture. Many workers had already traveled back to their hometowns for family gatherings. In 2003, measures to control SARS were taken in March, after people had already returned to their workplaces. The delay in workers returning to work in 2020 will cause larger disruptions to production, investment, and exports than in 2003.

The results of our elasticity-based analysis are consistent with the first quarter 2020 outlook for China presented in KOMO. The assessment presented herein reflects possible expectations by oil market participants if all of the indicated crude oil decline occurred within China, and the effects continue beyond the first quarter. Moreover, our results presented in this Insight are a relatively broad-brush view, while the KOMO analysis presents a more disaggregated examination of separate oil consuming segments of the Chinese economy.

KOMO first quarter 2020: China

The analysis presented in this document reflects the facts at the time of writing. However, the subsequent emergence of the coronavirus shifts our expectations. The Chinese government is taking serious actions to address the situation by halting many forms of mass transport and suspending schools and universities until February 17. Many in China are also choosing to stay at home rather than travel during the Chinese New Year season. We expect this to result in stronger quarter-on-quarter (QoQ) declines in oil demand.

Indeed, we assume demand for transportation fuels will be weaker, but assume some increases for LPG and other heating fuels. As a result, we estimate total fuel consumption growth will decline by 830 thousand barrels per day (Kb/d) QoQ, with gas/diesel oil taking the strongest hit (370 Kb/d). We expect LPG to remain in decline, although at a more moderate level of -20 Kb/d. We expect demand for jet fuels/kerosene to decline from an estimated 190 Kb/d growth to -150 Kb/d QoQ.

KOMO's sensitivity modeling suggests a decline of between US$1.10 – US$2.88 throughout the first quarter of 2020 if the situation is contained in February or early March. Nevertheless, Brent prices dropped by US$5.40 between January 20 and 26. However, if the situation is prolonged, we would estimate a drop in prices throughout the year of US$3.8, or even lower, depending on how governments react.

Nevertheless, this incident is not the first of its kind in China's recent history. In the early 2000s, China faced the SARS and avian flu viruses. These viruses were more lethal and spread more rapidly than the current coronavirus. Today, China is taking stronger measures to address the situation. Hence, although the situation is not new, the only changes that are truly significant have to do with reduced consumption of transportation fuels and a generally weakening economy when compared to its growth levels in 2002 and 2003.

Table 1. Effect of the coronavirus across Chinese economic sectors.

	Q1 2020 - QoQ growth - Kb/d	
	No coronavirus	With coronavirus
Liquefied petroleum gases	-0.19	-0.02
Naphtha	0.01	-0.04
Motor and aviation gasoline	0.03	-0.23
Jet fuel/kerosene	0.21	-0.15
Gas/diesel oil	-0.43	-0.37
Fuel oil	0.28	0.04
Other oil products	0.09	-0.07
Total oil products	0.00	-0.83

Roles of futures market traders

Such significant, relatively short-run movements in crude oil prices are frequently attributed to market overreaction, including the activity of speculative traders in the market. According to the ICE's Commitment of Traders reports, OI grew by 9,502 contracts from Tuesday, January 21 (2,578,381 contracts) to Tuesday, January 28. While this is a modest increase, it may be the result of market participants sensing greater riskiness in the market and turning to the futures market to mitigate risk, or speculators taking positions in a potentially more volatile market. We will examine the role of speculative trading activity more closely in an upcoming study.

In the current situation, it appears that risk mitigation played a much larger role in driving price than speculation. The largest changes in OI, either long or short positions, were seen in the producers/merchant category (considered to be commercial hedgers), followed by managed money (considered to be non-commercial speculators). While every trade, every open position, has both a long and a short party, when market prices decline it is typically the short positions that get the most attention. In this case, producers/merchants increased their short positions by 28,098 contracts, while managed money increased theirs by 12,176. On the long side, managed money decreased their positions by 22,132 contracts, but these were more than absorbed by the producers/merchants increase of 42,198. By far the largest changes in the marketplace came from producers/merchants in both long and short positions. There was relatively little change in OI (either long or short) for swap dealers, other reporters, and non-reporters.

Elasticity model background

One approach to assessing the potential magnitude of price or quantity changes as a consequence of geopolitical or other shocks is to examine supply and demand and their associated price elasticities. Smith (2009) develops a model for expected percentage changes in the price of crude oil, given a percentage change in quantity. Those familiar with the economic concept of price elasticity will see that this direction of influence is an inversion of the 'normal' price elasticity relationship, but it is nonetheless valid. The model/equation[2] is

$$\%\Delta P = \frac{1}{(\varepsilon_s - \varepsilon_d)} * \%\Delta Q$$

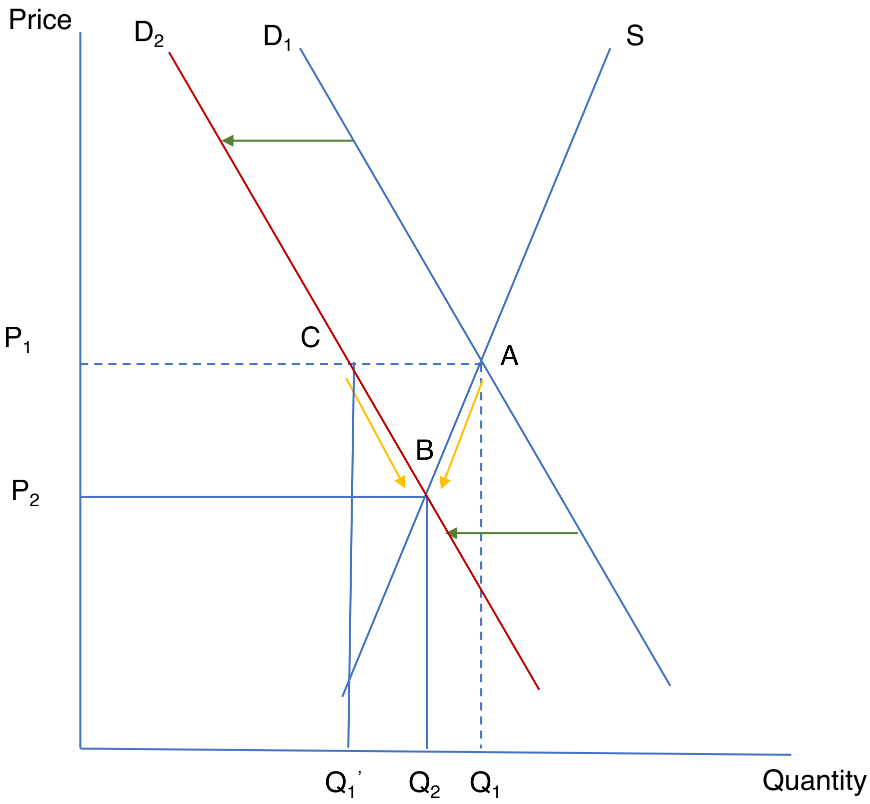
where ε_s is the price elasticity of supply, ε_d is the price elasticity of demand, P is the price of oil, Q is the quantity produced, and %Δ represents percentage change. The basic price elasticity model relates a percentage change in price to a percentage change in quantity. Smith (2009) is an inversion of this: it assesses the percentage change in price that occurs from a designated/observed percentage change in quantity. In addition, the equation differs from the basic elasticity metric in that it includes the effects of both supply and demand elasticities.

The basic elasticity metric focuses on either demand or supply. However, when examining markets, which always involve both, it is appropriate to include the effect of both price elasticities. To illustrate this, examine a basic market model with upward-sloping supply and downward-sloping demand intersecting to produce an equilibrium market price and quantity (Figure 1). A shock to demand, e.g., a reduction, will see the demand curve shifting back/down to the left. Less quantity is demanded at each price, leading to excess supply at the original price. To transition to a new equilibrium to eliminate the excess supply, the price will decline, effectively moving downward along both the demand and supply curves. The price decline will stimulate the quantity demanded and decrease the quantity supplied, and each adjustment to the price decrease will eliminate excess supply on the way to a new equilibrium.

[2] The equation represents the relationship for a shift in demand, which means a movement up or down along the supply curve. The equation for a shift in supply will have a negative sign on the elasticity factor.

In Figure 1, the initial equilibrium is at point A, where P_1 and Q_1 result from the intersection of the initial demand and supply curves, D_1 and S. A demand shock occurs, shifting demand from D_1 to D_2, as indicated by the green arrows. The initial effect is excess supply in the market (Q_1 – Q_1'). This is because at price P_1 only Q_1' will be demanded (see point C), while there will still be supply at the Q_1 level. Excess supply will lead to the price being driven downward. Such a move effectively travels down both the new demand curve, D_2, and the supply curve, S, (indicated by the yellow arrows) until the new equilibrium is reached at point B. Since the transition from equilibrium at point A to that at point B (note that point C is NOT an equilibrium) involves changes along both the supply and demand curves, both price elasticities are called for, as in Smith (2009).

Figure 3. Price and quantity evolution from a demand shock.



Source: KAPSARC analysis.

Smith (2009) evaluates a large number of published estimates of supply and demand price elasticities for both the short and long run. From this meta-study, Smith puts forward reasonable estimates for the short-run elasticities as $\varepsilon_s = 0.04$ and $\varepsilon_d = -0.05$. So, from the equation, the elasticity factor will be 11.1. This implies that a 1% change in quantity will drive an 11.1% change in price in the short run. Smith (2009) employed this model to demonstrate that, in the short run, relatively modest percentage changes in quantity may result in very large percentage changes in prices, obviating the need to claim speculation as the driving force.

The Smith model can be inverted, as used in our analysis, to assess the implied level of disruption to supply quantity the market expects, given an observed percentage change in price. The inverted model is as follows:

$$\%\Delta Q = \%\Delta P * (\varepsilon_s - \varepsilon_d)$$

Employing the short-run price elasticities from Smith (2009), and substituting the observed 9.02% decrease in the price of Brent into the equation for %ΔP, results in an estimate of the market's expectation of %ΔQ decrease of 0.81%, which implies a decrease of 810,000 b/d for world consumption of over 100 MMb/d.

References

Ashraf, Hina, Irfan Hussain Khan, Amber Javaid, and Muhammad Awais. 2018. "Price and Income Elasticities of Crude Oil Demand: Cross Country Analysis." *European Online Journal of Natural and Social Sciences*, 7(1[s]).

Bloomberg. 2020. Bloomberg Terminal. Retrieved February 16, 2020.

Richardson, John. 2020. "The coronavirus: petrochemicals' perfect storm." Oxford Energy Comment. The Oxford Institute for Energy Studies.

Smith, James L. 2009. "World Oil: Market or Mayhem?" *The Journal of Economic Perspectives* 23(3): 145-164.

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