ISSUE BRIEF

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Background

The ban on US crude oil exports began as a reaction to the oil embargo in the early 1970s and later was codified in law and Department of Commerce rules for granting export permits. Currently, crude oil can be exported to Canada, but only for use there, not for re-export; from Alaska if it comes through the Trans-Alaska pipeline or from Cook Inlet; if it is foreign oil; if it is in conjunction with operation of the Strategic Petroleum Reserve, and for a few other small exceptions. Refined products, however, can be exported without restriction.

Until recently, the possibility of exporting US crude oil was not an issue because the United States was importing so much oil from the rest of the world and

Key Points

- The "fracking" revolution has led to an excess supply of light crude oil in the United States, particularly in the Midwest.
- These excess supplies of light crude oil, combined with a US ban on exporting crude oil and transport bottlenecks, have led to sharply reduced crude oil prices in the Midwest.
- These lower crude oil prices in the Midwest do not seem to have resulted in lower prices for refined products in the Midwest.
- US refineries are better suited to process heavy crude oil, while refineries in other countries are better suited to process light crude oil.
- As a result, lifting the ban on US crude oil exports would allow for a more efficient distribution of crude oil among refineries in the Western Hemisphere and elsewhere in the world.
- A better allocation of refinery activity will result in more gasoline production, which will lower gasoline prices.

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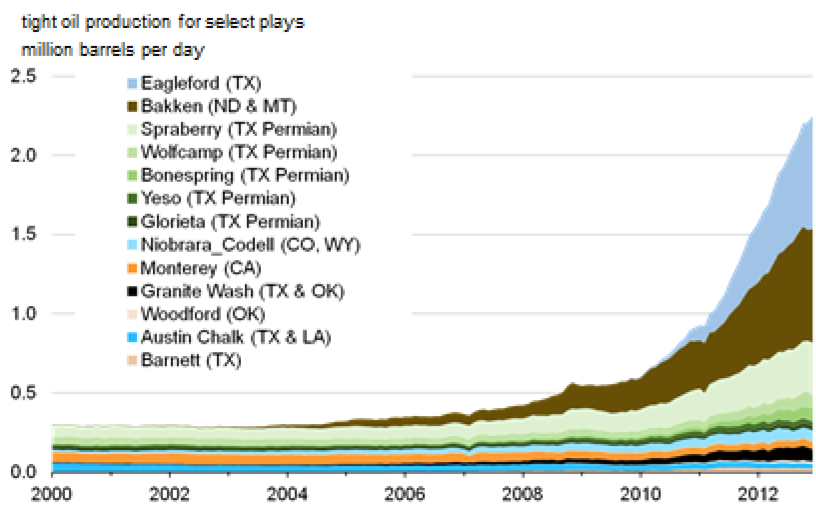
forecasts of US oil production were showing a decline. All this changed with the "fracking" revolution (meaning a combination of hydraulic fracturing, horizontal drilling and seismic imaging technology), which quickly opened up vast resources of "tight" oil to exploitation—primarily in North Dakota (the Bakken play) and Texas (the Eagle Ford play and the Permian play)—and reduced US oil imports to new lows.

Combined with limited pipeline and rail transport capacity, this increase in oil production in the United States (see Chart 1) has led to bottlenecked oil supplies in the Midwest and a reduction in crude prices there. The situation has been exacerbated by the inability of most US refineries to efficiently process the light crude coming from these fields (particularly in refinery hubs along the Louisiana and Texas Gulf Coast, although Valero is an exception).

Chart 1. Growth in Production of Domestic Tight Oil, 2000–2012



Source: EIA 2013c.

Stakeholder Positions

The reaction to this situation has been predictable. Most of the oil and gas industry wants the export ban lifted. The additional demand for US light crude oil will increase profits, although probably not prices because oil is priced in a world market (more to be said about this below). However, some refiners are benefitting from the bottlenecked supplies because they can process the discounted light crude and sell refined products—gasoline primarily—that generally have prices tied to world markets. They oppose lifting the ban.

Environmental groups also oppose lifting the ban. They see increased demand for fossil fuels as contributing to greenhouse gas emissions worldwide and are concerned about other environmental risks posed by expanded production and distribution of such fuels (such as rail accidents and spills).

All parties can agree that lifting the ban confers some advantages to the United States as a whole. It would improve our trade balance and provide us with greater geopolitical leverage.

There are other areas of clear disagreement: the consequences for US energy security and economic growth are two. But the area of greatest and most specific disagreement concerns the effect of lifting the export ban on US gasoline prices. We take up this issue below after first explaining some details about oil markets.

Understanding Petroleum Markets

Crude oil comes in many varieties, the most important here being light (an API specific gravity over 35) and heavy (API gravity of 25 or less). It also has different sulfur contents, which affect the costs of refining. Crude oil also may be found with natural gas and other liquids, called condensates, which are also valuable products. For instance, much of the condensates from the Bakken field are being exported to Canada (their trade to Canada is unrestricted) to serve as diluting agents to make it easier to move the bitumen from oil sands through pipelines.

Crude oil is traded in markets all around the world. Among the most important prices for the debate over exports are those for West Texas Intermediate (WTI, which is priced at Cushing, OK) and Brent (which is produced in the North Sea and priced at Rotterdam). Differing prices for crude oil also exist across the United States, and are conveniently reported by Petroleum Administration for Defense Districts (PADDs) covering the East Coast, Midwest, Gulf Coast, Rocky Mountains, and West Coast. Because the transportation costs of crude oil are relatively low compared to its market prices, these prices tend to track each other very closely, as any imbalance will lead to a shift of oil to the higher priced market. The same holds true for oil traded internationally, which leads to the conclusion that oil is traded and *priced* in a world market (Nordhaus 2009).

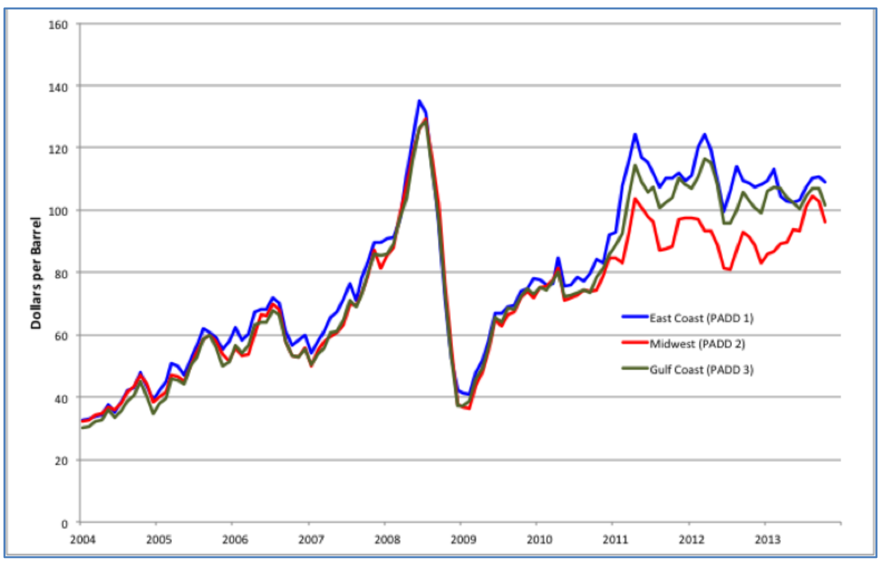
Whether the world oil market is competitive is another matter. Many analyses show that the Organization of Petroleum Exporting Countries (OPEC) exercises sufficient market power to keep the world oil price high. OPEC’s production costs are so low that it can manipulate prices by withholding production. However, it operates under its own internal pressures and each country needs the revenues from selling oil to meet its own economic goals.

Crude oil needs to be refined into products to be useful to consumers. The refining process is very complex and is optimized to be as profitable as possible, given the prices of products that can be produced and the prices of the crude oils that have various properties (for example, light versus heavy, and high versus low sulfur content). Historically, a substantial quantity of US crude oil imports has been of the heavy variety, and so most US refineries are designed to process heavy crude specifically. The US refineries designed to handle heavy crude can process light crude, but they will be underutilizing their facilities and will find it less profitable to do so.

The United States has relatively few remaining refineries that were designed to handle light crude exclusively. Indeed, one of the few major light crude refineries—in Philadelphia—was about to be decommissioned before the tight oil revolution got under way. Valero is in the process of refitting a large refinery in Texas to process Eagle Ford light crude. To accommodate lighter crudes, such as that produced from the Eagle Ford or Bakken shale, US refineries need to invest in specialized distillation units that can yield a variety of light products, such as propane, in addition to gasoline, jet fuel, and diesel.

Combined, the increased production of light crude, a lack of pipeline capacity, and the inability of local refineries to efficiently handle light crude have bottlenecked supplies in the Midwest. One consequence is that railroad use to transport crude oil has spiked dramatically, causing its own problems. (One recent rail accident and oil spill was associated with transport of Bakken crude to an Eastern Canadian refinery.) The transport bottlenecks also have led to sharply reduced crude oil prices in the Midwest, where light crude is in the most excess supply (Chart 2).[2] Contrary to popular belief, however, low crude oil prices in the Midwest do not seem to have resulted in lower prices for refined products in the Midwest (Chart 3).

Chart 2. Refiners' Acquisition Cost (Composite)



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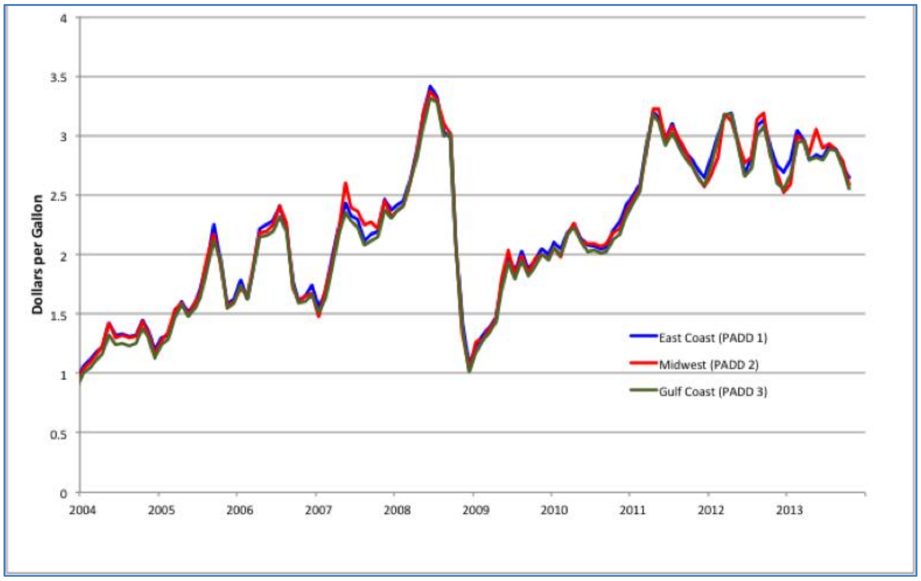
[2] The crude oil refined in PADD 2 has a lower API gravity and higher sulfur content than that refined in PADD 1. It also has a higher API gravity and a lower sulfur content than that refined in PADD 3. Therefore, the data shown in Chart 2 overstate the price differential between PADD 1 and PADD 2 and understate the price differential between PADD 2 and PADD 3.

Chart 3. Wholesale Gasoline Prices



The Economics of Lifting the Ban on Crude Oil Exports

Prior to the fracking revolution, world oil production had been shifting toward heavier crudes. US refiners reacted by investing in facilities (known as "cracking" facilities) that could convert the heavier crudes to the lighter products most valued in the market, such as gasoline, jet fuel, and diesel. Other refiners in the Western Hemisphere and other parts of the world did not invest as heavily in such facilities, and their operations remained more dependent on working with lighter crude oils.

The fracking revolution brought considerably more light crude oil onto the US market and created excess supply. The ban on US exports of crude oil means that the excess supply of light crude oil stuck in the United States cannot be sent to refiners elsewhere in the world, and the surfeit of light crude keeps the heavier crudes produced outside the United States from being refined in the United States. The efficiency of global refinery operations would be improved considerably if the ban on US exports of crude oil were to be lifted—but how would lifting the ban affect prices for crude oil and refined products in the United States?

CRUDE OIL MARKETS

Because the ban on US exports of crude oil has created a situation in which light crude oil is bottlenecked in the Midwest, lifting the ban would cause the price of light crude oil in the Midwest to rise toward world prices. The increased supply of crude oil reaching the international market would put downward pressure on international crude oil prices, assuming OPEC doesn't respond with matching cutbacks in its output.

In addition, the improved efficiency of refinery operations and competitive pressure would slightly reduce what is known as the crack spread (the difference between prices for refined products and crude oil). A reduced crack spread would increase the supply of refined products and at the same time boost the international demand for crude oil, putting downward pressure on refined product prices and upward pressure on international crude oil prices. Whether international crude oil prices would rise or fall on net would depend on the relative increases in supply and demand.

We find that crude oil in the Midwest is currently priced $6.34 per barrel below the price for comparable crude oil. (See Box 1. Analytical Methods.) If the ban on US crude oil exports were lifted, more oil would be produced in the Midwest and the areas of Canada supplying the Midwest. At the same time, competitive pressures and the increased efficiency of refinery operations would reduce the crack spread and boost world oil demand, pushing world oil prices upward. Assuming no OPEC response, we find that the increase in demand would dominate the increase in supply with an estimated net effect of increasing the world price of crude oil by about $0.15 per barrel. The Midwest would see an increase of about $6.49 per barrel.

Given these price changes, we estimate that oil production in Canada and the Midwest would gradually increase by about 84,000 barrels per day. Production elsewhere in the world would increase by 54,000 barrels per day. In total, world oil production would rise by 138,000 barrels per day.

BOX 1. ANALYTICAL METHODS

The first step in our analysis was to estimate the value of light crude oil, because the price information does not make a distinction between crude type, including its sulfur content and specific gravity. To that end, we collected data from the Energy Information Administration (EIA 2013a, 2013b; EIA 2014) that includes average monthly refinery acquisition costs for each of the five PADDs (the major source of excess supply is PADD 2, which includes North Dakota and, hence, the Bakken play). We augmented these data with information on average sulfur content on crude oil deliveries to refineries and average specific gravity, both by PADD and month. This information is available for each month from January 2004 to November 2013, which allowed us to construct a panel data set for the 5 PADDs for 119 months. Adding data for 2013 is important because we now have observations after the flow reversal of the Cushing pipeline connecting the Gulf Coast area in 2012 and its expansion in 2013.

Using this panel data set, we used a “hedonic regression” approach to explain the difference between regional prices and the average monthly spot price of crude oil at the Brent trading hub (the currently accepted global benchmark). Acquisition costs were broadly similar for PADDs 1, 2, 3 and 5 prior to 2010, the start of the rapid expansion of oil production from the Bakken and Eagle Ford shale plays; after 2010, acquisition costs in PADD 2 and 4 (the land-locked PADDs) differed markedly from PADDs 1, 3 and 5. In light of these observations, we allowed for idiosyncratic effects in PADD 4, both before and after 2010, and for idiosyncratic effects in PADD 2 after 2010.

We found that each one percent increase in specific gravity raises the relative acquisition cost of oil by $0.643 per barrel, while each one percent increase in sulfur content lowers average acquisition cost by $2.88 per barrel. After 2010, PADD 2 refiners received an average discount of $6.34 per barrel. On average, PADD 4 refiners paid $8.84 per barrel less for oil than other refiners prior to 2010, and received an additional discount of $2.62 per barrel after 2010. Much of the oil production from PADD 4 comes from Montana, and in particular the western part of the Bakken play.[a]

We then plugged the price difference for PADD 2 into a small static simulation model similar to that developed by Brown and Kennelly (2013) and modified for purposes of this project. The model is calibrated to world oil market conditions for 2012 and it links the world crude market to a global refined product market via refinery operations. As such, the model represents supply and demand for crude oil with the demand for crude oil derived from the demand for refined products.

The model relies on elasticities of supply and demand taken from the economics literature, such as Brown and Huntington (2003), Smith (2009), Dahl (2009, 2010a, 2010b, 2010c, 2010d, and 2010e), Serletis et al. (2010), and Allaire and Brown (2012). For the wholesale price of gasoline, the assumed long-run elasticities for US and world gasoline demand are -0.58 and -0.39, respectively. The latter elasticity is lower because many European countries have high gasoline taxes that blunt the response of consumption to changes in the wholesale price. Combined with the elasticity of demand for other refined products, we obtain an overall elasticity for world crude oil demand of -0.45. The assumed elasticity of crude oil supply is 0.4.

With a greater equalization of crude oil prices across regions and an assumed reduction in the cost of global refinery operations of 0.5 percent, we find world oil prices will rise by $0.15 per barrel. With higher crude oil prices in the Midwest, we estimate that production in the region and Canada will increase by 84,000 barrels per day. Higher world oil prices boost production elsewhere by 54,000 barrels per day for a total increase of 138,000 barrels per day.

With the world's refineries operating more efficiently and processing more crude oil, world gasoline production is estimated to increase by 35,000 to 104,000 barrels per day. We find that the addition of that much more gasoline to global markets reduces its price by $0.017 to $0.045 per gallon.

A sensitivity analysis conducted by altering underlying assumptions yields a range of estimates. For instance, if we assume that there is no cost reduction in global refinery operations as the result of the United States lifting its ban on crude oil exports, the world price of oil will sink by $0.10 per barrel, and the wholesale price of gasoline will fall by $0.007 to $0.016 per gallon. Even though the price of oil falls, a smaller decline in gasoline prices occurs because refinery costs are not reduced. On the other hand, if global refinery costs are reduced by 1.0 percent, the world price of oil will rise by $0.40 per barrel, but the wholesale price of gasoline will fall by $0.027 to $0.074 per gallon. The increase in refinery efficiency pushes up the price of crude oil at the same time it reduces the price of gasoline.

Changes in the assumed elasticity of crude oil supply slightly affect gasoline pricing. If we assume the elasticity of crude oil supply is 0.3 (instead of 0.4), lifting the ban on US crude oil exports will increase the world price of crude oil by $0.20 per barrel, and the wholesale price of gasoline will fall by $0.015 to $0.039 per gallon. If we assume the elasticity of crude oil supply is 0.5, lifting the ban will boost the world price of crude oil by $0.11 per barrel, and the wholesale price of gasoline will fall by $0.019 to $0.050 per gallon.

Changes in the assumed elasticities of demand also have only a small effect on gasoline pricing. If we assume the elasticity of world crude oil demand is -0.55 (with a world elasticity of demand for gasoline of -0.48), lifting the ban on US oil exports will increase the world price of crude oil by $0.18, and the wholesale price of gasoline will fall by $0.015 to $0.041 per gallon. If we assume the elasticity of world crude oil demand is -0.35 (with a world elasticity of demand for gasoline of -0.30), lifting the ban will boost the world price of crude oil by $0.10 per barrel, and the wholesale price of gasoline will fall by $0.019 to $0.051 per gallon.

[a] This aspect of our results suggests the regional pricing effects of rising tight oil production might extend beyond PADD 2. As such, one could view our analysis as somewhat conservative.

OPEC'S LIKELY RESPONSE

With changes in world oil demand and non-OPEC supply, many would look to OPEC for a possible response. With the relatively small changes in global market conditions that would result from lifting the US export ban, OPEC may do relatively little. Nonetheless, if OPEC acts to hold global crude oil prices firm, oil prices may not change as described above.

Would OPEC seek to push oil prices even higher? Those modeling OPEC behavior have not reached a consensus about how OPEC responds to changes in world oil market conditions. Some argue that OPEC targets market share, and some argue that elements within OPEC behave more like a cartel that pursues monopoly pricing.

IF OPEC acts to maintain market share, its response to increased oil production from Canada and the United States will be to increase its own production, which will contribute to downward pressure on the price of oil.

If OPEC exerts some form of monopoly power, its actions will be affected by the demand for its oil production. In particular, we might think of OPEC as a monopolist facing some supply competition. Changes in market conditions that increase the demand for OPEC oil and make demand less price sensitive (less elastic) will foster price increases. Changes in market conditions that decrease the demand for OPEC oil and make demand more price sensitive (more elastic) will foster price decreases. So even in the monopolist case, a crude oil price increase is not a given.

Indeed, if the primary effect of lifting the ban is to increase the efficiency of refinery operations and increase their demand for oil, the demand for OPEC oil (and non-OPEC oil) will increase and become less elastic. OPEC would have an incentive to increase its output, but not by enough to prevent an increase in world oil prices.

On the other hand, if the primary effect of lifting the ban is to increase the supply of non-OPEC oil, the demand for OPEC oil will likely decrease and become more elastic, both of which would induce OPEC to produce less, but with the net effect of increased global supplies. In such an event, the market price would fall. It has been argued that such dynamics governed the world oil market in the 1980s, when North Sea oil came on line. During that period of time, OPEC's ability to prop up prices was badly compromised, with member states in the cartel consistently exceeding their quotas. Either way, the changes in oil market conditions will be sufficiently small that the effect on prices will be slight.

US REFINED PRODUCT PRICES

With the increased efficiency of Western Hemisphere refinery operations that would come from lifting the ban, US prices for refined products will be reduced—even as world oil prices increase.[3] Because consumers in the Midwest do not appear to be seeing any price reductions for refined products as the result of the depressed crude oil prices in that part of the country, we conclude refined product prices in the Midwest move with prices in the rest of the country. Consequently, we expect the Midwest will see declines in prices for refined products that are comparable to those in the rest of the country.

Given our projections for the change in crude oil prices and increased efficiency in refinery operations, we estimate US gasoline prices would be reduced by 1.7 to 4.5 cents per gallon.[4] This range reflects two assumptions. The lower bound counts only the oil production increase, not a change in the mix of refinery outputs. The upper bound represents the oil production increase and change in the mix of refinery outputs. Realization of this price decline may take a few years—depending on how quickly additional oil is produced in the United States and how quickly the industry is able to shift its crude oil supplies between refineries.

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[3] Because any increase in world oil prices is the result of increased demand from more efficient refinery operations, product prices will be reduced.

[4] Using annual data, we estimate oil in the Midwest is priced $14.83 per barrel below the price of comparable oil elsewhere. In that case, we find lifting the U.S. ban on oil exports reduces gasoline prices by somewhat more than using monthly data (2.8 to 6.9 cents per barrel using annual data, 1.7 to 4.5 cents using monthly data). Using monthly data is preferred because of the greater detail.

OIL SECURITY AND CARBON DIOXIDE EMISSIONS

The impact on oil security and world carbon dioxide (CO_2) emissions will depend on the extent to which there is increased production of crude oil. Any increases of oil production in North America or other politically stable areas of the world will improve world oil security (Brown and Huntington 2013). These increases in crude oil production and consumption also will increase CO_2 emissions by 1.16 million Mcf per day, which corresponds to 21.98 million metric tons per year,[5] although the substitution of more abundant petroleum products for coal in parts of the world that use both fuels may result in some offsetting reductions in CO_2 emissions.

Conclusions

One of the most contentious issues in the debate about whether the crude oil export ban should be lifted is how US gasoline prices will be affected. Commenters span the full range from finding that gasoline prices will increase, decrease, and remain unchanged. In this issue brief, we offer economic logic and estimates from our modeling and data analysis suggesting that the price of gasoline will likely fall by around three to seven cents a gallon. These results are driven by the increase in refinery efficiency made possible by lifting the ban and from a nuanced consideration of OPEC behavior. Indeed, Box 1 presents sensitivity analyses showing that falling gasoline prices are quite robust to alternative assumptions about demand and supply elasticities, as well as assumed refinery cost reductions. Even with more equivocal results, we believe that the economic arguments for lifting the ban are strong, based primarily on the gains from free trade and the example it sets when we live by our market principles. Such action will create winners and losers, however, and may lead to increases in greenhouse gases.

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[5] On average, every barrel of oil refined and combusted generates 8.4 Mcf (Van't Veld et al, 2013). The conversion between Mcf and tonnes is not constant—it depends on things like atmospheric pressure—but a reasonable rule of thumb is 19.25 Mcf per tonne.

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