Chapter 3: Access to Resources

> In reality, most large wars have contained within them a violent and persistent economic conflict. The War of the Austrian Succession, for example, could be more grittily described as "the war for the coal and iron resources of Silesia." . . . For my great-great-grandfather, the Napoleonic Wars didn't mean charging across the plains of Waterloo but trudging through the pepper vines of Java in order to seize the riches of the Dutch East Indies from Napoleon's ragtag defenders. Even more than sugar and spices, the British were after the amazing tin deposits on the island of Belitung, whose name is still preserved in the title of the world's biggest mining company, BHP Billiton.
>
> —*Ferdinand Mound (2019)*

Are All Conflicts about Resources?

The preceding quote from Ferdinand Mound reflects a common sentiment among historians and the public alike. Politicians may declare that they fight wars to liberate a country or spread democracy, but the true reason behind the armed conflict, many argue, is to gain access to resources.

In the late 18th century, the Industrial Revolution started in England and quickly spread across Europe. The Industrial Revolution is arguably the most important economic event of the last 800 years. Readers may be surprised to learn what is considered the most important economic event before that—the introduction to the Western world of the number zero, to indicate nothingness.[1]

The Industrial Revolution allowed civilizations to escape the "Malthusian trap," which describes the cyclical outbreak of famines as a population grew too large to sustain itself with food and water. Thanks to steam-powered machines, it became possible to mechanize agriculture and mass-produce all kinds of household goods. But to build and run these machines,

[1]The number zero has been in widespread use in Mesopotamia since the third century BCE and in India since the fourth century CE but did not reach Europe and the Western world until the 12th century CE, enabling the invention of accounting and other important economic innovations.

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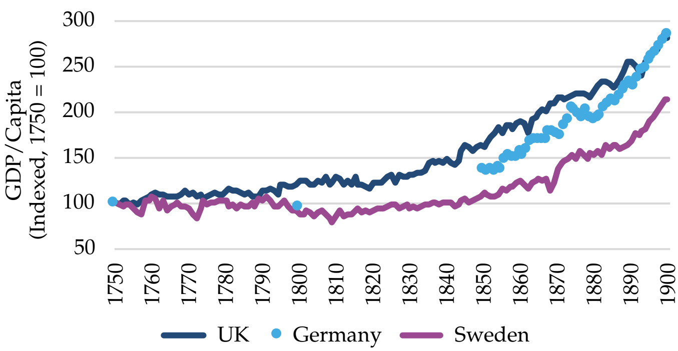
the industrialized world needed coal and minerals of all sorts. And soon enough, the domestic supply of these minerals would not suffice to power the factories.

The easiest way to expand access to crucial resources was to invade resource-rich lands around the globe. Thanks to the Industrial Revolution, England and other colonial powers had better guns and could make short shrift of indigenous people wherever they dared to resist. And once an area was colonized, it not only provided access to resources but also featured a large number of potential customers for industrial goods produced in England. In other words, colonization and the Industrial Revolution went hand in hand. The Industrial Revolution created a need for resources, which triggered the colonization of foreign lands. This colonization, in turn, created more growth opportunities for British exports, which, in turn, intensified the need for resources, and so on.

As **Exhibit 1** shows, the GDP per capita of England increased sooner and faster than in such countries as Germany and Sweden, which did not have colonies or acquired their colonies only in the late 1800s. It is doubtful that this early advantage of the British Empire is solely due to the country's head start in the Industrial Revolution. Rather, a combination of geographical expansion and increased mechanization gave the British Empire a growth advantage in the first half of the 19th century. Noncolonial powers took longer to catch up with the growth the British Empire experienced in the first half of the 19th century, but by the onset of the 20th century, this advantage of colonial powers had largely disappeared.

So, who could argue with this view that many international conflicts revolve around access to scarce resources? In the remainder of this chapter,

Exhibit 1. GDP Per Capita Growth after the Industrial Revolution



Source: Maddison Project Database, version 2018.

I will briefly review the competing theories on the link between natural resources and geopolitical conflict. After that, I will dive into the most important natural resource of our day: oil. Because oil is the most important commodity in the world, most of the research on geopolitics and resources has focused on the impact of oil supply disruptions on economic growth, inflation, and financial markets. As we will see, oil shocks cannot and should not be ignored by investors.

After the discussion of oil, I will briefly focus on other resources that are of geopolitical importance, ranging from industrial and rare earth metals to the most important renewable resource—water.

Resources and Geopolitics: Two Explanations for Conflict

Many geopolitical conflicts seem to center around resource-rich countries, whether one is considering the US war in Iraq, the Civil War in Libya, or the standoff between the United States and Iran over the Iranian nuclear program, which triggered a renewed US embargo against Iranian oil exports. To explain why resource-rich countries seem to attract conflict so often, political scientists and economists have come up with two competing explanations (Bayramov 2018).

First is the school of thought that *resource abundance* leads to more aggressive behavior and an increased likelihood of conflict. The main impetus for this view comes from the seminal work of Paul Collier and Anke Hoeffler, who claimed that civil war is more likely to happen in countries that are rich in natural resources (Collier and Hoeffler 1998). They argued that in resource-rich countries, unrest may start as disadvantaged segments of the population start to rebel against the government and the powerful elites. Whether this conflict is due to legitimate grievances or simple greed, the idea is that rebel groups form to capture the state's assets and distribute them differently (i.e., typically, to their own advantage). There is certainly a lot of truth in this argument, but the greedy rebel argument is also likely to be an oversimplified one. As Cramer (2002) argued, many factors have to come together to trigger civil strife. Without social inequality or a lack of opportunities in general, an outbreak of civil unrest would be unlikely even in a resource-rich country.

Furthermore, this school of thought does not have an easy time explaining interstate conflict. One argument why resource-rich countries should be more aggressive internationally is the so-called great power theory, which states that resource-rich countries want to expand their influence and have the financial means to do so because of their exports. This line of thought argues that resource-rich countries are more likely to attack neighboring countries if there are substantial additional resources located close to the border. A successful international campaign secures more resources and leads not only to more geopolitical influence but also to higher revenue from the resource extraction that finances these nations.

Another explanation why resource-rich countries may be more aggressive has been put forward by Colgan (2014), who found that revolutionary petrostates are more than three times as likely to start an international conflict than nonrevolutionary non-petrostates. The argument here is that oil-rich countries have the financial means to fight wars and that revolutionary leaders are less bound by domestic checks and balances. However, Colgan's claim was largely debunked by Caselli, Morelli, and Rohner (2015), who examined a more comprehensive set of international conflicts and found that petrostates are less likely to initiate interstate conflicts.

In summary, the argument that resource abundance leads to increased geopolitical conflict seems to have merits for civil strife but has significant shortcomings in explaining international conflict. Thus, we must look for other reasons why resource-rich countries remain mired in geopolitical conflict so frequently. And here the resource scarcity school of thought may be able to help.

The *resource scarcity* view of geopolitical conflict takes the opposing view to the resource abundance approach and argues that countries with a scarcity of natural resources try to gain influence over resource-rich countries via political or military means. There are two common explanations why resource-poor countries might try to gain influence over resource-rich lands.

The first line of thought uses the Malthusian trap to come to its conclusions. If a country faces significant shortages of resources, it might endanger the population's living standards or, in modern times, the country's economic growth. As a result, countries want to ensure that they have access to natural resources, either by directly owning them or by installing friendly governments in resource-rich countries. As previously discussed, the colonization of much of the developing world in the 19th century was likely driven by these Malthusian motivations. Moreover, modern oil wars, such as the Iraq War and the ongoing Second Libyan Civil War, where both sides of the civil war are supported by competing foreign countries, are arguably examples of this line of thought.

Today, however, this neo-Malthusian view of the world is considered oversimplified. Nevertheless, advocates of the peak oil theory, which states that we are approaching the all-time peak in oil production and that we will face increasing supply shortages in coming decades, argue along these lines. As I will show later in my discussion of hydraulic fracturing, or fracking, these peak oil theories, which gained some popularity about a decade ago when oil prices were far above $100 per barrel, have largely been invalidated by the developments of the last decade.[2]

The second line of thought expands the reasons for why a lack of resources may lead to international conflict. Gleditsch and Theisen (2010) claimed that it is not a scarcity of resources *per se* that leads to conflict but inefficient distribution and access to them. Thus, these researchers argued, one can overcome resource-driven conflict in two ways. First, one can ensure easier access to natural resources through trade liberalization and globalization. Second, one can introduce market-driven mechanisms that ensure a more efficient use of resources.

The cap-and-trade policies introduced around the world to limit CO_2 emissions are policy tools derived from this line of argument. The idea is that if there is a market price for a resource, then more expensive resources will be used only for applications that have higher added value or higher productivity, whereas low-productivity or low-value-added applications will be forced to develop alternatives. Finally, part and parcel of this line of thought are so-called cornucopian theories that state that resource scarcity is merely a mirage and that technological progress will enable mankind to circumvent any resource scarcity it may encounter. Of course, human ingenuity is virtually endless, but in order to motivate the search for new technologies, scarce resources must first be priced correctly. Nobody is going to develop a technology to reduce the consumption of a resource that is free.

The empirical evidence seems to agree with many of these resource scarcity arguments, though there is certainly a need to define scarcity more broadly than just the amount of proven reserves of a specific commodity. But by using this resource scarcity theory of geopolitical conflict, we can see how this plays out in real life in the case of the world's most traded and important commodity of all: oil.

Oil, the Ultimate Geopolitical Commodity

Energy security is a top priority for every country in the world. Without energy, economic growth grinds to a halt and the economy starts to shrink rapidly. According to the US Department of Energy's Energy Information Administration (EIA), the United States spent $1.1 trillion, or 5.8% of GDP, in 2017 on energy. Just 10 years ago in 2010, this portion was much higher, about 8%–9% of GDP, which is about the global average. Thanks to the

[2]Marion K. Hubbert proposed the peak-oil theory (that oil production would peak and then decline) in 1956. A peak was observed around 1970, but the subsequent decline was not permanent; moreover, oil discoveries led to the substantial postponement of the expected peak. It still has not been reached.

boom in fracking, as well as increased energy efficiency, the United States has become less dependent on imports and thus spends less today on energy than it used to. Given this high share of energy expenditures, it is no wonder that energy commodities—in particular, oil—have become a major driver of geopolitics in the 20th century.

Securing access to energy at affordable prices has led to the introduction of the Strategic Petroleum Reserve in the United States, strategic reserves of natural gas in the United Kingdom, and other forms of stockpiling in countries that try to ensure the country has sufficient supply to keep the economy going in case of a major supply outage. And it is behind the push of politicians around the world to allow oil exploration in offshore fields and hard-to-access fields in the Arctic and the Antarctic. Finally, witnessing the energy revolution triggered by fracking technologies in the United States, other countries are also promoting fracking as a way to increase energy safety. That these efforts to access oil in ecologically vulnerable areas lead to political backlash and diplomatic strains is visible in many countries today.

Energy markets have been liberalized since the 1970s when futures on energy commodities began trading on international commodity exchanges. With this liberalization of the price of oil and other energy commodities came massive fluctuations in the price. Looking at the last 20 years, the price of a barrel of West Texas Intermediate (WTI) crude oil on the New York Mercantile Exchange rose from a low of around $17.50 per barrel in 1999 to a high of about $145 per barrel in the summer of 2008—a 728% increase in less than 10 years. It has since fallen almost as dramatically; as of this writing (August 2020), it is around $40. The annualized volatility of crude oil is 33%, much higher than the roughly 20% annualized volatility of most stock markets. And because oil is so important for the global economy yet so volatile, it should not be a surprise that oil price shocks can have a significant influence on the global economy and financial markets.

Not All Oil Shocks Are Alike. As Kilian (2009) so aptly put it, "Not all oil shocks are alike." The economy reacts differently to demand shocks than it does to supply shocks. Kilian differentiated between three different types of oil price shocks, a classification system that has become standard and is important for investors to remember:

- *Supply shocks* are driven by unanticipated changes in the production of oil. Supply shocks can be negative, such as when Saudi Arabia had to shut down its Abqaiq oil processing plant after a drone attack in 2019, leading to a 5% decline of global output overnight. As Kilian (2009) showed, such supply disruptions generally are short term in nature, and although they do lead to a spike in oil prices, they rarely have a lasting impact on the economy or financial markets.

- However, the fear of lasting supply disruptions can lead to *oil-specific demand shocks* if oil importers start to stockpile crude oil in anticipation of a longer outage. For example, if the Abqaiq outage had led to a general concern that Saudi outages could not be recovered quickly, oil consumers might have started to stockpile oil and drastically increased the global demand for this commodity. Similarly, the expectation of a prolonged war in an oil-exporting country or an open-ended restriction of production (e.g., the OPEC embargoes of the 1970s) can trigger such a demand shock. These oil-specific demand shocks are the biggest danger for the global economy because study after study has shown that they lead to spikes in oil prices, drops in stock markets, and a decline in economic growth. Worse still, such oil-specific demand shocks can last a long time and thus can cause significant damage to the global economy and financial markets.
- Finally, Kilian (2009) showed that the most common shocks are *aggregate demand shocks* that are triggered by a general increase or decline in demand for crude oil. These aggregate demand shocks are essentially a reflection of the global business cycle and will thus not be discussed in detail in this chapter. It suffices to say that aggregate demand shocks, if in an upward direction, are the best kind of shocks since they lead to higher oil prices but also to rising stock markets because investors understand that the higher oil prices are a reflection of strong economic growth.

In this chapter, I will focus only on supply shocks and oil-specific demand shocks, since these shocks can be and often are triggered by geopolitical events. In the end, the nature of the event that triggered the shock will determine the reaction of investors.

If the event is a brief disruption of supply, investors will increase the risk premium they use to discount future cash flows of an asset, but there will be little impact on the expected long-term inflation rate (since the shock is expected to be transitory) or expected cash flows. As a result, the prices of risky assets tend to decline sharply in reaction to such a supply shock but then recover as investors realize the spike in oil prices is going to be short-lived. In essence, such a supply shock leads to a stock market reaction that is similar to a terrorist attack, something I discussed in the last chapter.

If the disruption in supply leads to precautionary demand for crude oil, the shock will be longer lasting and the impact on asset prices will be more fundamental. In a first step, the risk premium for risky assets will increase, leading to a sharp sell-off in those assets and a flight to safety. In a second step, inflation expectations are likely to rise because the lasting nature of the demand shock means that oil prices remain high for longer; thus, inflation should increase at least in the next one to three years. This situation, in turn, means that expected cash flows will be discounted with even higher nominal rates and the present value of assets will decline.

However, not all risky assets will necessarily suffer a lasting decline in prices, as I will show. As the oil-specific demand shock is unfolding, investors will also adjust the expected future cash flows of their assets. While net consumers of oil and other energy commodities will likely see their future cash flows decline, net oil-producing industries will experience an increase in future cash flows that may compensate for the increase in discount rates. Thus, these assets may either decline or increase in price depending on which factor dominates.

Things get even more complicated if the high price of oil lasts long enough to trigger a reaction by central banks. If the inflation shock caused by the spike in oil prices is no longer deemed transitory, central banks are inclined to hike interest rates, thus increasing the real risk-free rate of return (and thus the discount rate) and influencing the expected future cash flows of businesses. The net effect of such a central bank reaction to fight inflation is usually a decline in the aggregate stock market, though again, some industries (e.g., insurance) may benefit from it.

How big the adjustments to expected cash flows, inflation, and so on will be depends on the size of the oil spike, which, in turn, depends on the size of the disruption of the balance in supply and demand. A group of economists has investigated the link between disruptions in the supply and demand for crude oil and the price of oil. The results all tend to fall in the same range. Aastveit, Bjørnland, and Thorsrud (2015) estimated that a 1% decline in oil supply leads to a 5%–10% increase in the price of oil. Similarly, Caldara, Cavallo, and Iacoviello (2019) showed with their model that a supply shock of 0.75% creates a 6% increase in the price of oil. For the rest of this chapter, I will use the assumption that a disruption of supply of 1%–2% will trigger a 10% spike in oil prices, and I will investigate how such a 10% spike in oil prices propagates through the economy and financial markets.

Oil Price Shocks and Economic Growth. The impact of oil prices on economic growth has been the subject of intensive research. Oladosu, Leiby, Bowman, Uría-Martínez, and Johnson (2018) found 149 papers published since 2000 that examined the oil price elasticity of GDP in net oil-importing countries. Out of this vast sample, they focused on the results of

19 international studies. **Exhibit 2** shows the results of a 10% increase in the price of oil on developed market economies. The table shows the worst-case model outcome (i.e., the biggest decline in GDP found in the literature), the best-case model outcome (i.e., the smallest decline or biggest increase in GDP), and the average and median of all models. Furthermore, the table differentiates between short-term impact on GDP (defined as up to one year), medium-term impact (defined as one to three years), and long-term impact (defined as more than three years).

Exhibit 2 shows that a 10% oil price shock leads to a decline in GDP growth of 0.2–0.3 percentage points, on average, in the short term. The eurozone economy seems to be somewhat sheltered from the negative effects of the price shock and experiences, on average, smaller declines in GDP growth. This result has been found in many studies and can also be seen in the case of China, which seems to be more sheltered from oil price shocks than other economies, as shown in **Exhibit 3**. The most common explanation of this observation is that oil price shocks lead to stronger growth in oil-exporting countries and thus to more demand in them. Countries with

Exhibit 2. Impact of a 10% Oil Price Shock on GDP: Developed Markets

Country	Horizon	Worst Case	Average	Median	Best Case
US	ST	−1.24	−0.19	−0.08	0.16
	MT	−1.32	−0.36	−0.32	0.17
	LT	−0.40	−0.25	−0.36	0.00
UK	ST	−1.66	−0.31	−0.14	0.04
	MT	−1.74	−0.28	−0.08	0.02
	LT	−0.13	−0.08	−0.12	0.00
Eurozone	ST	−1.55	−0.14	−0.10	0.14
	MT	−1.62	−0.19	−0.13	0.05
	LT	−0.28	0.01	−0.05	0.03
Japan	ST	−1.54	−0.28	−0.03	0.24
	MT	−0.78	−0.18	−0.01	0.21
	LT	−0.68	−0.45	−0.67	−0.01
Australia	ST	−1.19	−0.34	−0.20	0.22
	MT	−1.31	−0.67	−0.67	0.00

Note: ST is short-term impact (up to one year), MT is medium-term impact (one to three years), and LT is long-term impact (more than three years).
Source: Oladosu et al. (2018).

Exhibit 3. Impact of a 10% Oil Price Shock on GDP: Developing Markets

Country	Horizon	Worst Case	Average	Median	Best Case
China	ST	−0.96	−0.15	0.09	0.24
	MT	−0.30	0.03	0.15	0.21
	LT	−0.26	−0.25	−0.25	−0.01
India	ST	−0.46	−0.30	−0.35	−0.09
	MT	−0.08	−0.07	−0.07	−0.05
Northern Africa	ST	−0.11	−0.07	−0.07	−0.03
Sub-Saharan Africa	ST	−0.30	−0.08	−0.06	0.00

Note: ST is short-term impact (up to one year), MT is medium-term impact (one to three years), and LT is long-term impact (more than three years).
Source: Oladosu et al. (2018).

a large export-oriented economy, such as China and Germany, benefit from this increase in demand and thus experience a boost in exports that partially offsets the decline in domestic demand triggered by the higher oil prices.

Another important observation in Exhibit 2 is that oil price shocks take a while to fully unfold. In most countries, the medium-term impact of an oil price shock is worse than the short-term impact. The timing of when the oil price shock has the biggest impact on an economy depends on structural factors, such as labor market rigidities, share of consumption in the economy, and share of energy prices in the overall consumption basket. For most countries, however, the peak of the oil price shocks tends to be felt four to eight quarters after the shock (that is, in the second year after the price spike). The numbers should also make investors aware that in the vast majority of cases, an oil price shock will not lead to a slowdown in GDP growth that is large enough to trigger a recession. However, an economy that is already teetering on the brink of recession or that is slowing down rapidly can be pushed into recession by an unexpected oil price shock.

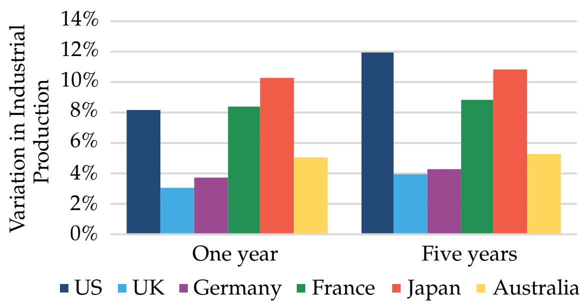
Exhibit 3 shows the same data as Exhibit 2 for a selection of developing countries. The lesson learned from this table and from the research on the impact of oil price shocks on GDP is that most developing countries suffer a decline in GDP growth similar to that of developed countries if they are net importers of oil. I have already mentioned the special case of China as a major global exporter. Another exception is African countries, which barely react to an increase in oil prices. This is simply a reflection of the fact that most African countries are so underdeveloped that they do not depend much on oil imports. This lower oil intensity of their economies means that they withstand an oil price shock better than other developing countries.

Structural Differences of Economies Determine the Different Reactions to Oil Shocks. How much an oil price shock will affect an economy depends on the structure of the economy. These structural differences between countries determine not only the vulnerability of an economy to significant oil-specific demand shocks but also its reaction to smaller changes in oil prices. After all, a 10% increase in oil prices does not happen every day. Most of the time, oil prices are (relatively) well behaved and react to smaller disruptions in the balance between supply and demand, such as unplanned refinery outages or surprising strength in investment demand. Furthermore, seemingly unrelated effects can trigger stock market and commodity volatility. After Hurricane Katrina hit New Orleans in 2005, for example, the supply of gasoline and other distillates in the United States was severely disrupted because of the large number of refineries and shipping facilities in that region, triggering spikes in gasoline prices that were not observed in other countries. Thus, while global oil supply remained unchanged, regional weather effects created shocks to the US economy.

Kang, Ratti, and Vespignani (2017) set out to measure how the interaction between stock markets and commodity markets influenced the variability of industrial production over time. **Exhibit 4** shows that in the long run, about 11.9% of the variation in industrial production in the United States is driven by variation in oil prices. This number is a little higher than in France and Japan and substantially more than in Germany and the United Kingdom.

In the case of Germany, the export-oriented economy provides an internal buffer to domestic demand when oil prices fluctuate. In the United Kingdom

Exhibit 4. Share of Volatility in Industrial Production Explained by Oil: Developed Countries



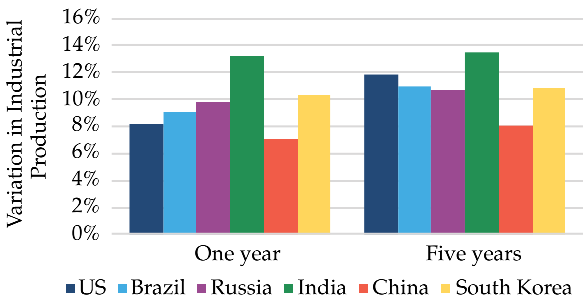
Source: Kang et al. (2017).

and other commodity-exporting countries, such as Australia, a similar effect arises from the substantial share of output generated by commodity-related businesses located in these countries. If oil prices rise, domestic demand for industrial goods declines but output from energy and mining companies increases, thus providing a natural hedge against the negative effects of oil price volatility. The economies of the United States, France, and Japan are far more dependent on domestic demand than commodity exporters are and thus experience a larger influence of commodity volatility on their economic activity over time.

Exhibit 5 shows the results of Kang et al.'s (2017) analysis for two high-income (i.e., developed) countries, the United States and South Korea, and four middle-income (i.e., developing) countries, Brazil, Russia, India, and China. Again, commodity exporters, such as Russia and Brazil, tend to have a lower sensitivity to commodity volatility than the United States, although the effect is mild compared with China. The reason for this rather small effect is that Russia and Brazil are so dependent on their commodity exports that these economies are unbalanced in the other extreme. Rising oil prices lead to a significant increase in national income and thus domestic demand, triggering a sharp increase in industrial production. The lack of diversification in the economy leads to a bigger impact of commodity volatility but with the opposite sign relative to commodity importers, such as South Korea or India.

Oil Price Shocks and Consumption. The main transmission mechanism of oil price shocks to domestic demand is, however, not via industrial production but via consumer demand. Kilian (2008) traced the effects of higher oil prices through the US economy.

Exhibit 5. Share of Volatility in Industrial Production Explained by Oil: United States, Brazil, Russia, India, China, and South Korea



Source: Kang et al. (2017).

The important thing to note here is that consumer demand only indirectly depends on the price of crude oil. Private consumers do not buy barrels of crude oil and refine them in their basement. Instead, they go to the gas station and fill up their cars, they use heating oil and gas to heat their homes, and they feel the pinch of higher energy prices whenever they go to the supermarket and pay more for groceries because of higher costs for packaging and transportation. Thus, consumption reacts to the price of distillates, not crude oil.

Most of the time, the correlation between crude oil and distillates, such as gasoline and heating oil, is high, but as Hurricane Katrina showed, in some circumstances the two can decouple. New Orleans and southern Louisiana, the region directly hit by Katrina, are the location of a large fraction of the total refining capacity in the United States. When the hurricane hit, these refineries had to go offline for a long time, creating a shortage in gasoline and other distillates that could be felt throughout the country in the weeks after the hurricane.

Weather phenomena are not geopolitical events (although in the age of climate change, they might become just that), but imagine that instead of a hurricane, either a terrorist attack or an armed conflict destroys the refining capacity of a country. Such shocks in the energy infrastructure can lead to supply shocks or oil-specific demand shocks in a country or region.

The case of Ukraine should be a warning for every investor. Ukraine relies heavily on natural gas exports from Russia, and Russia is not afraid to use these exports as a geopolitical tool.

- In 2005, the Russian state-owned energy giant Gazprom demanded higher prices for natural gas deliveries to Ukraine. A new price of $160 per 1,000 cubic meters was agreed on, but in return, Ukraine asked that the price increases be introduced gradually and that it be able to charge higher transit fees for Russian gas flowing through its pipelines to Western Europe. After the two countries failed to resolve the dispute, Gazprom stopped delivering natural gas to Ukraine on 1 January 2006, in the middle of winter. Only three days later, Ukraine settled the dispute and agreed to pay $230 per 1,000 cubic meters for the next six months to obtain Gazprom's gas that was mixed with cheaper gas from central Asia. The effective cost for Ukraine was then $95 per 1,000 cubic meters.
- In 2009, Ukraine and Gazprom wanted to renew their agreement, but Gazprom refused to negotiate until Ukraine had paid its debt for previous deliveries: $2.4 billion. Ukraine partially paid the debt by year-end 2008, but the discussions about an extension of the gas contract broke down again. On 1 January 2009, Gazprom stopped the delivery of 90 million

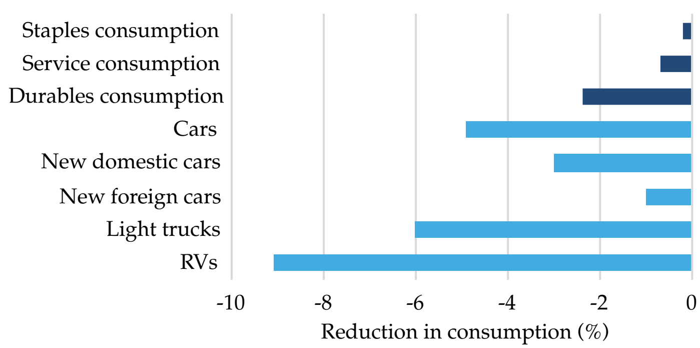
cubic meters of natural gas per day to the Ukraine. On 2 January 2009, Hungary, Romania, Poland, and Bulgaria all reported that their gas pressure had dropped as well, and the UK government was prepared to tap into its strategic gas reserves since pipeline pressure from the continent had dropped. On 7 January 2009, all Russian gas exports through Ukrainian pipelines ceased and were redirected to Europe through other pipelines. Nevertheless, gas pressure in European pipelines dropped even more. On 18 January 2009, Ukraine and Russia finally managed to settle the dispute. Ukraine agreed to leave its transit fees for natural gas unchanged and pay Western European prices for natural gas from Russia (less a 20% rebate for 2009).

Ostensibly, these gas disputes between Russia and Ukraine were about the price of gas delivered to Ukraine, but the political dimension was hard to overlook. Russian president Vladimir Putin was strictly opposed to the Eastern expansion of NATO that led to Hungary, Poland, and other former Warsaw Pact countries becoming members of the Western military alliance. Ukraine oriented itself more and more toward the West, with the aim to eventually become a NATO member. The gas disputes were often seen as a warning shot by Putin to "reconsider" these plans.

The gas disputes showed that access to energy can become a geopolitical tool. Thus, it is instructive to look at the results of Kilian (2008) on the effect that oil price spikes have on household consumption. Unfortunately, there is a significant gap in the economic literature in estimating these effects for countries other than the United States, so we have to make do with US estimates.

Exhibit 6 shows the estimated reduction in consumer demand in the United States given a 10% increase in retail energy prices (note the difference

Exhibit 6. Impact of a 10% Increase in Retail Energy Prices on US Consumption



Source: Kilian (2008).

between crude oil and retail energy prices). In his study, Kilian (2008) showed that the reaction of US consumption to changes in energy prices is far less pronounced today than in the 1970s and 1980s. Thus, in Exhibit 6, I show only the results for the time period 1988–2006.

As can be expected, the consumption of food and other staples is hardly affected by rising energy prices. A 10% increase in retail energy prices leads to a mere 0.2% decline in staples consumption and 0.7% in service consumption. The main impact is felt in the consumption of durable goods, which drops by about 2.4%, on average. However, here the decline in consumption is extremely focused on cars. When gasoline becomes more expensive, consumers either postpone the purchase of a new car or buy smaller, more economical cars instead of SUVs and other light trucks. This phenomenon can be seen in the data. Consumer spending on cars and car parts declines by 4.9%, spending on new domestic vehicles declines by 3%, and sales of new imported cars decline by just 1%. The reason for this discrepancy is presumably that US car manufacturers build, on average, a higher share of SUVs and other big cars, whereas imported cars tend to be smaller. The strong decline in sales of light trucks (SUVs, vans, and pickup trucks) shows that manufacturers of these cars suffer more than manufacturers of cars that use less gasoline.

Interestingly, the type of vehicle that is most sensitive to increases in gas prices is recreational vehicles (RVs), which gives rise to the RV indicator. Most people need a car to get to work or go shopping, but not many people need an RV. Thus, RV sales are the first to decline before a recession and the last to recover afterward. This highly cyclical demand for RVs in the United States not only affects the stocks of RV manufacturers but also can be used as a remarkably reliable recession indicator.

Oil Price Shocks and Inflation. Oil price spikes have a significant impact on the expected inflation rate in a country. If energy prices directly make up 4.4% of the Consumer Price Index (CPI) basket, as was the case for the United States in September 2019, then a 10% increase in retail energy prices will lead to a 0.44% increase in headline inflation. Of course, the impact of energy prices goes beyond these first-round effects and filters through to rents and prices of all kinds of goods and services. But in a first estimate, the impact of higher energy prices on inflation is easy to calculate for any country.

Most of the time, central banks will ignore oil price increases due to supply shocks, knowing full well that such price shocks are transitory in nature. Unlike in the 1970s, when central banks in the United States and Western Europe reacted to the oil crisis by hiking interest rates to curb inflation, monetary policy today has evolved to a stance where such transitory shocks do not create a monetary policy reaction. Instead, central banks let these supply shocks work their way through the system and expect inflation rates to settle down after 12–18 months. Of course, the main challenge for central bankers then is to differentiate between transitory shocks and persistent shocks that are triggered by precautionary increases in oil-specific demand. Doing so is part of what makes monetary policy decisions so hard. In real life, it is simply very difficult to decide whether an energy price shock is going to be transitory or persistent.

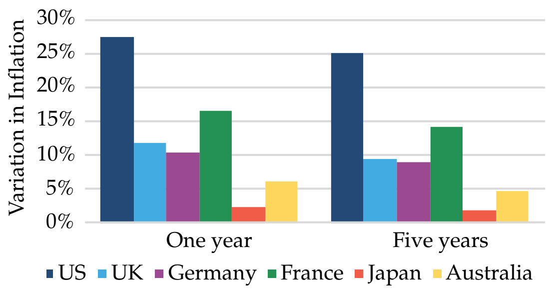
On top of that, not all central banks are equally concerned about energy price spikes and their impact on inflation. **Exhibit 7** shows the share of variation in inflation that is driven by oil price volatility. In the United States, about a quarter of the volatility in inflation is driven by energy price fluctuations, whereas in Europe, this share is typically around only 10%–15%. In Japan, it is even lower. The main driver behind this smaller influence of energy prices on inflation is simply the lower energy dependency of countries in Europe compared with the United States.

Exhibit 8 shows a similar picture for middle-income countries. The share of variation in inflation explained by energy price volatility is much lower outside the United States. It is no wonder US politicians are much more obsessed with energy security than politicians in Europe or Asia! The US economy is simply more vulnerable to energy price shocks than other countries.

Why Have Oil Shocks Become Less Impactful to the US Economy?

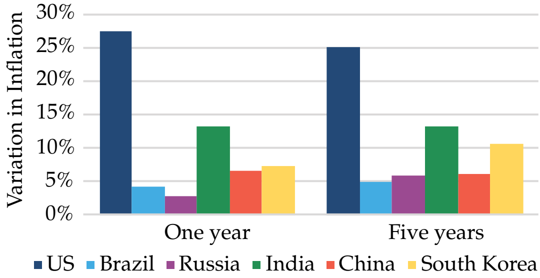
One consistent finding in studies of the impact of oil price shocks on the economy is that both demand and supply shocks have a much smaller impact on most developed economies today than in the 1970s and 1980s. Blanchard and Gali (2007) investigated the drivers behind these changes for the United States, the United Kingdom, France, Germany, Italy, and Japan.

Exhibit 7. Share of Volatility in Inflation Explained by Oil: Developed Countries



Source: Kang et al. (2017).

Exhibit 8. Share of Volatility in Inflation Explained by Oil: United States, Brazil, Russia, India, China, and South Korea



Source: Kang et al. (2017).

Their analysis covered two historical periods: 1970–1983 and 1984–2005. The break date was chosen because it roughly corresponds to the end of the high inflation era of the 1970s and early 1980s and the beginning of the so-called Great Moderation of relatively benign swings in the business cycle, inflation, and monetary policy.

Blanchard and Gali (2007) showed that three effects were responsible for the declining impact of oil price shocks on the economy:

- Most developed economies reacted to the oil price shocks of the 1970s by introducing energy-saving measures in households and cars. Over time, these measures have reduced the energy dependency of these economies. The energy intensity of the US economy roughly halved between 1980 and 2010. In Europe, the energy intensity of the economy declined by about one-third over the same time period but from a much lower starting point, so European countries typically have an energy intensity that is less than half that of the United States.
- Labor markets have become more flexible since the 1980s. Oil price shocks may lead to higher inflation, but these inflationary shocks no longer automatically lead to increased wages. Furthermore, businesses have an increased flexibility to react to higher commodity prices with cost reductions through layoffs.
- Finally, central banks have become smarter in managing inflationary shocks triggered by higher oil prices. In the 1970s, many central banks reacted to the oil crises with higher interest rates to curb inflation. Today, central banks will likely ignore such transitory inflation shocks and react only once an oil price shock filters through to core inflation.

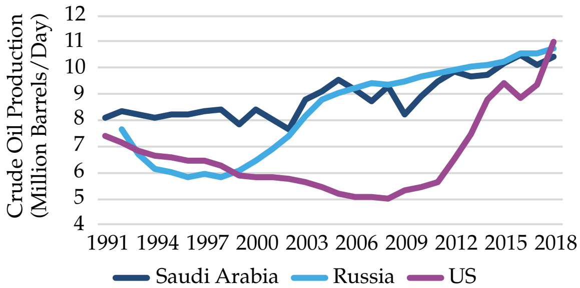
Although these three factors can explain the declining sensitivity of developed economies to oil price shocks from the 1970s to the early 2000s, the US economy has gone through an even more dramatic transformation over the last decade. Driven by a new technology, the geopolitics of oil is changing rapidly.

Fracking: A Geopolitical Game Changer

Until about 2008, crude oil production in the United States was in steady decline. Conventional oil fields in Texas and Alaska were quickly being depleted, and offshore fields were either inaccessible or not productive enough to make up for the decline in onshore production. But with the advent of hydraulic fracturing (i.e., fracking) techniques, US oil production started to increase rapidly. Horizontal drilling techniques and fracking allowed US energy companies to access vast reservoirs of shale oil and shale gas all over the mainland United States. The US production of crude oil rose so fast that by 2015, the United States became a net exporter of oil and oil derivatives, and in 2018, it overtook both Russia and Saudi Arabia to become the world's largest oil producer, as shown in **Exhibit 9**.

The impact of this fracking boom on the US economy is huge. During the early 2000s, an oil price shock would have led to an economic slowdown that would have depressed private investment by up to 6% over three years. With the onset of the fracking boom, however, investment in the energy industry started to increase whenever oil prices rose, which led to a reduction in the negative response of investment to oil price shocks. By 2015, the relationship between oil price shocks and investment in the United States had completely reversed. Today, a 1% oil price shock leads to an estimated *increase* in investment of 5% after three years (Bjørnland and Zhulanova 2019).

Exhibit 9. US Oil Production



Source: US Department of Energy's EIA.

Increased investment means higher income for private households. The research of Bjørnland and Zhulanova (2019) showed that in the early 2000s, personal income *declined* by up to 1.5% in reaction to a 1% oil price increase, but today, personal income in the United States *increases* by 1%. This increase is mostly driven by better job prospects and higher wages in the energy industry and is not equally distributed across the United States. The states that tend to benefit the most from oil price shocks are North Dakota, South Dakota, and Texas, where the biggest shale oil basins are located.

Higher income also means that higher retail energy prices no longer lead to a sharp decline in consumption. Consumption still declines a bit in reaction to higher oil prices, but compared with the early 2000s, the decline in consumption is now only about a quarter as large. In short, the fracking boom has made the US economy much more robust with regard to oil price shocks.

The US fracking boom can be felt around the globe. As Kilian (2017) reported, the most important source for oil imports into the United States used to be Saudi Arabia. With the rise of domestic oil production, crude oil imports from Arab OPEC countries dropped from 20% of US oil use in 2008 to less than 10% in 2015. Saudi Arabia, as the biggest producer in the region, suffered the brunt of this decline, with US imports from Saudi Arabia declining from 12% of US oil use to 6%. But other regions were also hard hit. Oil exports from West Africa to the United States almost completely disappeared between 2008 and 2015.

Until late 2015, the United States had an export ban for crude oil, except for limited amounts that could be exported to Canada, but unlimited amounts of refined products could be exported everywhere. Between 2008 and 2015, the export of refined products from the United States increased from 2 million barrels per day to 4.5 million barrels per day. In comparison, in the seven years from 2001 to 2008, exports rose from 1.25 million barrels per day to 2 million barrels per day. This increase, of course, put pressure on oil prices outside the United States. Kilian (2017) estimated that between late 2012 and mid-2015, the price of a barrel of Brent crude oil was about $10 lower because of increased US oil exports. However, oil prices found a new equilibrium after declining by about 50% in 2014 and 2015. Today, prices for Brent crude oil are no longer depressed because of US exports.

The rapid decline in oil prices, which was driven more by a slowdown in global aggregate demand than by the US shale boom, meant that traditional oil exporters, especially Saudi Arabia, faced significant losses of revenue. Normally, OPEC would have been able to counteract the decline in oil prices through production cuts, but with the United States importing less and less oil from OPEC countries, Saudi Arabia and other countries were forced to keep production high to generate necessary revenues for their economy. Nevertheless, starting in 2014, Saudi Arabia suffered a decline in its net foreign assets of about $150 billion, which continues to this day, as shown in **Exhibit 10**.

The loss of oil revenues has had significant consequences for the Saudi Arabian government. Faced with lower revenues, the government could either reduce government spending or raise revenues through other sources. A reduction of government spending is politically very risky since almost all Saudis depend on the generous social services and heavily subsidized energy offered by the government. Reducing government expenditures could easily trigger civil unrest in Saudi Arabia.

Thus, since 2014, the country has increasingly tried to raise funds from alternative sources. In 2014, the debt-to-GDP ratio of Saudi Arabia was a mere 1.6%. By the end of 2018, the ratio had risen to 19.0%, mostly because Saudi Arabia's budget deficit reached 15% in 2015 and 12% in 2016. However, the budget deficit remains very high, at around 5% per year, and is expected to increase as global demand for oil declines in reaction to slower global growth in the coming years. At the current rate, Saudi Arabia's debt-to-GDP ratio could hit 100% by 2040.

Thus, it is no wonder that Saudi Arabia is starting to sell its crown jewels. The IPO of Saudi Aramco is an attempt to raise desperately needed funds from international investors and at the same time transfer some of the risk to these investors. This situation, in turn, makes Saudi Arabia increasingly vulnerable to geopolitical tensions. The attacks against the Saudi Aramco facilities in Abqaiq in 2019, as well as attacks against Saudi pipelines in the same

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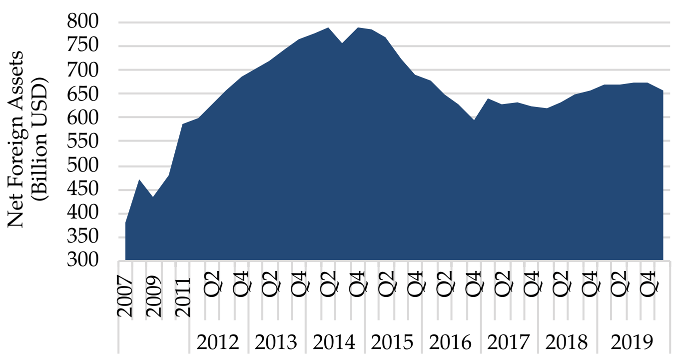
Exhibit 10. Saudi Arabian Net Foreign Assets



Source: Saudi Arabian Monetary Authority (SAMA).

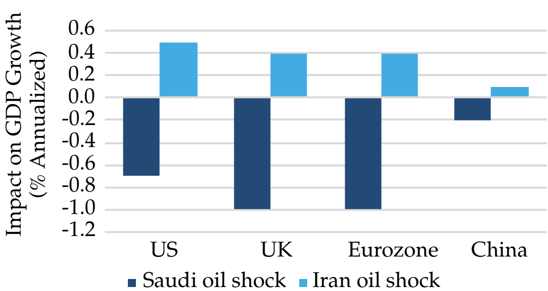
year, showed that Saudi oil infrastructure is vulnerable to armed attacks from Iran and other adversaries. As the fiscal situation of Saudi Arabia becomes more precarious, we should expect such vulnerabilities to be exploited more frequently, making supply disruptions in Saudi Arabia more likely in the future. And this is not good news, as I will show next.

Saudi Arabia Is Special

Every nation believes it is special, but when it comes to oil, Saudi Arabia truly is special. The country may no longer be the biggest oil producer in the world and no longer have the world's largest proven reserves (that distinction now belongs to Venezuela), but Saudi Arabia remains the country with the most spare capacity to produce additional oil should it be needed. This fact means that if a country reduces its oil production for geopolitical or other reasons, Saudi Arabia, together with its fellow OPEC members, can compensate for this production shortfall. Because Saudi Arabia is the largest oil producer in the Middle East, it typically has to shoulder most of the burden. Similarly, if Saudi Arabia is unwilling or unable to increase oil production in the face of a demand shock, other OPEC members and Russia typically do not expand their production either. Therefore, Saudi Arabia has the geopolitical clout to trigger an oil crisis if it so wishes.

A study by two economists from the University of Cambridge, Mohaddes and Pesaran (2016), used historical production outages of 27 oil-exporting countries to build a model of the likely global impact of supply shocks in various countries. The contrast between Saudi Arabia and the other countries could not be more striking. **Exhibit 11** shows the impact of a one standard deviation decline in oil production in Saudi Arabia and Iran on GDP growth around the world. For Saudi Arabia, such a decline would mean that its oil

Exhibit 11. Impact of a Supply Shock in Saudi Arabia vs. Iran: GDP Growth



Source: Mohaddes and Pesaran (2016).

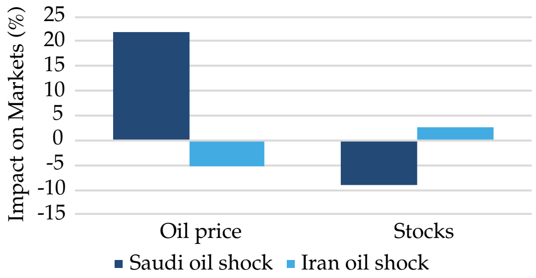
production would decline by about 11%, which implies a decrease in global oil supply of about 1%.

A supply outage in Saudi Arabia has the opposite impact on the global economy of a supply outage in Iran. If Iran cannot sell oil in the global market anymore (e.g., because of the Western sanctions against the country), Saudi Arabia and other OPEC countries can easily substitute their own production for Iranian oil. In fact, to calm down global oil importers, OPEC typically overcompensates for a supply shock by one of its smaller members by producing more oil after the supply shock than before. Doing so creates a positive oil supply shock that boosts the global economy. For most of Europe and the United States, this boost in growth accounts for an estimated 0.4% of GDP, whereas for China, it results in a smaller acceleration, about 0.1%.

In contrast, if supply from Saudi Arabia declines, the other OPEC countries do not have enough spare capacity to make up for the lost output. Hence, a decline in Saudi oil production filters through to global markets, and the resulting shock to GDP growth is substantial. Mohaddes and Pesaran (2016) estimated it to be about 1% of GDP (annualized) for the United Kingdom and the eurozone for the duration of the Saudi output disruption. The US economy is a bit more resilient because it can tap into its strategic petroleum reserve and thus buffer some of the negative impact. Even in this case, however, US GDP growth is expected to decline by an annualized 0.7%.

The transmission mechanism through which the economy is boosted or slowed is shown in **Exhibit 12**. In reaction to a supply shock in Iran, oil prices drop as other suppliers overcompensate for the loss of supply. Thanks to this supply boost, stocks rally slightly as well, but the effect is minimal. A supply shock in Saudi Arabia, in contrast, leads to a more than 20% spike in oil prices and an approximate 10% drop in global stock markets. Both oil and

Exhibit 12. Impact of a Supply Shock in Saudi Arabia vs. Iran: Stock Markets and Oil Price



Source: Mohaddes and Pesaran (2016).

stock markets in this instance reflect the dramatic economic impact a Saudi supply shock has. At the same time, higher oil prices and lower stock markets reinforce a Saudi oil shock because the decline in stock markets affects economic sentiment and may create a reluctance of private households and businesses to invest.

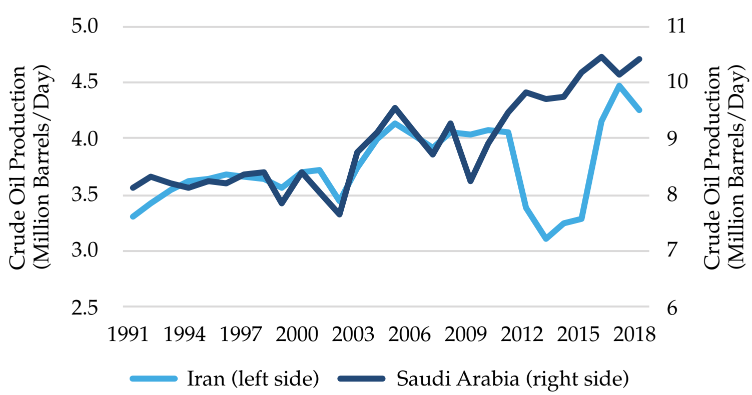
How this played out in real time could be observed during the first episode of Iranian oil embargoes from 2012 to 2016. The United Nations, the United States, and the EU had issued a variety of sanctions against Iran that effectively cut the country off from the international financial markets. These sanctions were designed to force the Iranian government to stop its nuclear enrichment program and start negotiations for a permanent solution. In early 2012, the United States and the EU introduced embargoes on Iranian oil exports that led to a decline of Iranian oil production by about a quarter in 2012.

That this supply shock did not lead to a spike in oil prices was due to the other OPEC member states, led by Saudi Arabia, expanding their production. Between 2011 and 2015, Saudi oil production increased by 710,000 barrels per day—replacing almost the entire amount of Iranian oil production decline of 760,000 barrels per day, as shown in **Exhibit 13**. But other OPEC countries expanded their production as well. Iraqi oil output grew by 1.24 million barrels per day, creating a significant increase in global oil supply that kept oil prices in check and boosted global economic growth.

Oil Shocks and the Stock Market

We have seen that oil-specific demand shocks can be quite detrimental to economic growth. They can lead to a substantial decline in GDP growth and

Exhibit 13. Saudi Oil Production during Iran Sanctions



Source: US Department of Energy's EIA.

consumer demand for cars and other durable goods if the reduction in supply or the unexpected increase in precautionary demand cannot be compensated for by Saudi Arabia and other major oil producers. This is not only the case when there are supply disruptions in Saudi Arabia; it can also happen when there is already significant aggregate demand from a booming world economy. In such a boom scenario, we should expect oil-specific demand shocks to have a bigger effect because it is less likely that OPEC countries and other producers will have sufficient spare capacity. In contrast, during an economic slowdown, there typically is sufficient spare capacity to offset additional demand or a supply disruption. Nevertheless, oil-specific demand shocks and short-term supply shocks do lead to slower economic growth and higher inflation most of the time.

For stock markets, this means that the present value of stocks may decline as expected inflation rates and risk premiums increase while expected cash flows decline—at least for most businesses. As I discussed earlier, however, the reactions of expected cash flows to changing oil prices are not homogenous. Oil-producing businesses and businesses that produce other commodities that benefit from higher oil prices will experience an increase in expected cash flows, whereas oil consumers may experience decreasing cash flows. This means that at an aggregate level (be it a sector or country level), it is not necessarily clear how stock markets will react to oil price shocks.

A lot of work has gone into the exploration of the connection between oil prices and stock markets, especially since 2008, when oil prices surpassed $100 per barrel for the first time and subsequently declined dramatically again to near $30 per barrel. Smyth and Narayan (2018) produced a comprehensive literature review of all the work that has been done over the last decade. Here, I want to focus on the results that are most important for investors.

The type of oil shock determines the stock market reaction. In most countries, the dominant effect of an oil price shock is a decline in stock markets, but these effects tend to be small—especially for large, well-diversified stock markets, such as the US and global stock market indices. Furthermore, the impact of oil price shocks depends significantly on the type of shock. Supply shocks tend to have a small and transitory effect not only on the economy but also on stock markets, whereas oil-specific demand shocks and aggregate demand shocks have much larger and longer-lasting effects. Aggregate demand shocks lead not only to higher oil prices but also to higher returns for stocks since, in this case, the demand shock is triggered by stronger economic growth. Oil-specific demand shocks, in contrast, tend to have a negative effect on stock markets, since these demand shocks typically reflect precautionary demand in reaction to geopolitical events or expected supply shortages that last a long time (Kilian and Park 2009).

Wang, Wu, and Yang (2013) investigated a set of nine oil-importing countries and seven oil-exporting countries. They found that in reaction to a supply shock, the stock markets tended to have only a short-lived, transitory response, but the effect differed by type of market. In oil-exporting countries, the response tended to be positive, whereas in oil-importing countries, it tended to be negative.

Oil-specific demand shocks and precautionary oil demand, in contrast, lead to negative effects in the stock markets of oil-importing countries. Notably, though, Wang et al. (2013) found smaller effects for the United States than did Kilian and Park (2009) but bigger effects for China than in previous studies. Wang et al.'s data, covering 1999–2011, showed that an oil-specific demand shock creates a roughly 6% decline in Chinese stocks over 12 months but only an approximate 1%–2% decline in US and UK stocks. Investors should also be aware that oil-importing countries tend to react to oil-specific demand shocks with some delay. Most of the decline in stock markets happens about 6–12 months after the shock as the impact on the economy unfolds.

Oil-exporting countries benefit from such oil-specific demand shocks because the higher oil price leads to a net increase in national income, driven by oil exports. The reaction of stock markets in such countries is quite a bit faster than that for oil-importing countries, with stock markets peaking three to six months after the initial shock. The rally in stock markets is particularly pronounced in Canada, Norway, Saudi Arabia, and Russia but is not statistically significant in Mexico, Kuwait, and Venezuela. Wang et al. (2013) argued that this finding results from Canada, Norway, Saudi Arabia, and Russia having not only a large oil sector but also a well-developed oil services and engineering sector that benefits from higher demand for oil exploration and engineering works in response to higher oil prices.

A number of studies have looked at stock market reactions to oil price shocks in the short run. Gogineni (2010) examined the abnormal market return for more than 80 industries in the US stock market on the day of an oil price jump. Arouri and Nguyen (2010) investigated the weekly abnormal return of European sectors in the week of an oil price shock; **Exhibit 14** shows their results, which are in agreement with the more granular results of Gogineni. As expected, sectors that are net oil consumers—such as health care, automobiles, and food and beverages—had a negative stock market reaction to an oil price shock, whereas the energy sector had a significantly positive reaction. Basic materials had the second largest positive reaction. The slightly positive reaction

Exhibit 14. Expected Return of Stock Markets Conditional on Extreme Oil Price Movements

Sector/Industry	Expected Weekly Return
Oil and gas	2.06%
Basic materials	0.32%
Financials	0.29%
Consumer services	0.23%
Industrials	0.16%
Utilities	0.08%
Telecom	−0.26%
Automobiles	−0.31%
Household goods	−0.35%
Technology	−0.43%
Food and beverages	−0.49%
Health care	−0.75%

Note: Expected returns are stock market returns for a jump in oil prices in the 5th percentile of the distribution.
Source: Arouri and Nguyen (2010).

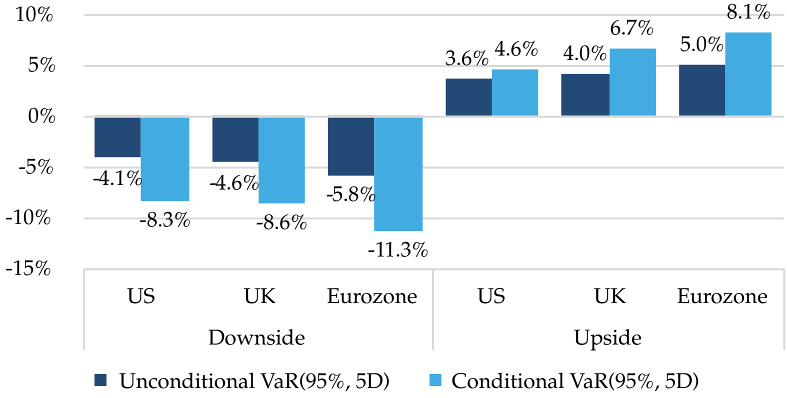
of financials to oil price shocks can be traced back to the change in expected inflation and thus the increase in interest rates that goes along with it.

However, Gogineni (2010) also noted that the reaction of stock markets to oil price shocks is nonlinear in the short run. Small daily changes in oil prices tend to trigger small positive stock market reactions, whereas large daily changes in oil prices and changes in times of elevated war risks for the United States trigger stock market declines.

Bittlingmayer (2005) also found a more pronounced negative stock market reaction in those periods when the United States was expected to go to war in an oil-producing country. Since neither Gogineni (2010) nor Bittlingmayer differentiated between types of oil price shocks in their studies, we can only speculate that increased war risk, such as that during the run-up to the Iraq War, leads to additional precautionary demand for oil that drives this adverse stock market reaction.

The nonlinear reaction of stock markets to oil price shocks has been at the center of interest in recent years. Reboredo and Ugolini (2016) used a copula approach to investigate spillovers from oil markets to stock markets and found that more extreme oil price shocks lead to outsized stock market reactions. **Exhibit 15** shows the weekly stock market reaction to the 5% most

Exhibit 15. Returns of Stock Markets Conditional on Extreme Oil Price Movements: Developed Markets



Notes: Returns are average returns for an oil price movement at the 5th and 95th percentiles of the distribution over 5 trading days (5D). VaR = Value at Risk = the expected change in share prices from the oil shock.
Source: Reboredo and Ugolini (2016).

extreme oil price moves in developed markets. The dark bars show the unconditional upside and downside risks of these stock markets, and the light bars show the upside and downside risks given an oil price shock that is in the top 5% or bottom 5% of the historical distribution.

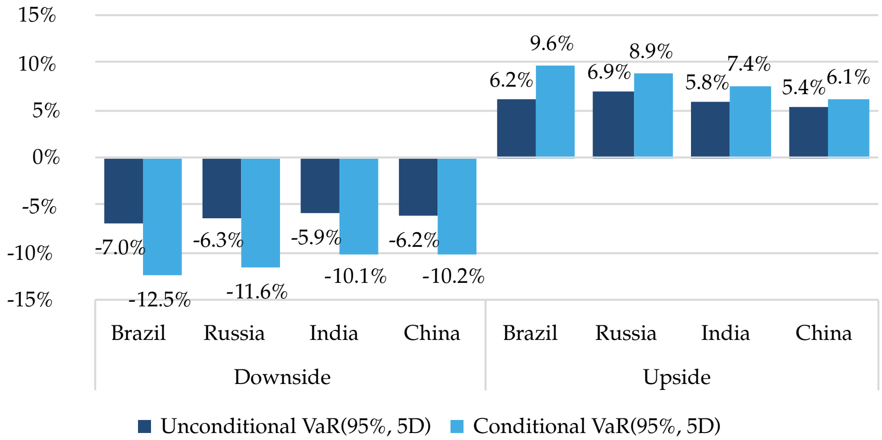
The figure shows that stock markets react much more sensitively to bad news than to good news. For example, the lower end of the weekly downside risk for the US stock market is –4.1%, on average. But in times of adverse oil price shocks, this downside risk more than doubles to –8.3%. In reaction to positive oil price shocks, the upside risk increases only from 3.6% to 4.6%.

The same pattern can be seen in the stock market reaction of Brazil, Russia, India, and China, shown in **Exhibit 16**. Again, adverse oil price movements create a bigger spillover and larger drawdown risks than positive oil price shocks do.

Oil Shocks and Currencies

Stock markets are not the only financial markets that have a significant reaction to oil price shocks. Interest rates have only a small, mostly insignificant reaction to oil price shocks, but currencies do react to swings in oil prices. Paul Krugman (1983) was probably the first economist to investigate the link between oil prices and exchange rates, but nothing much happened in this field after his study until the study of Radhamés Lizardo and André Mollick

Exhibit 16. Returns of Stock Markets Conditional on Extreme Oil Price Movements: Developing Countries



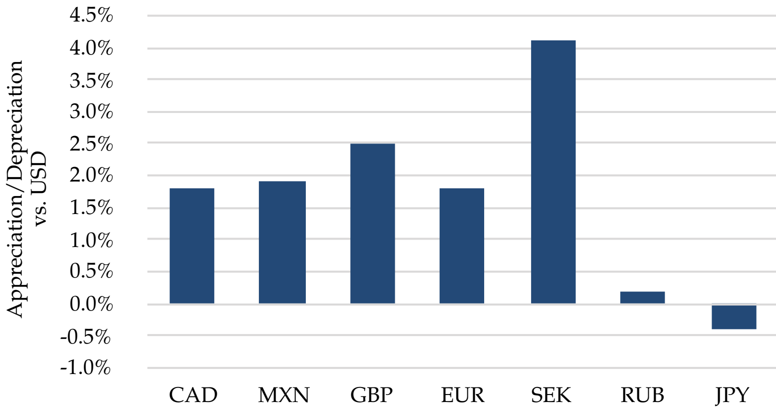
Notes: Returns are average returns for an oil price movement at the 5th and 95th percentiles of the distribution over 5 trading days (5D). VaR = Value at Risk = the expected change in share prices from the oil shock.
Source: Reboredo and Ugolini (2016).

was published in 2010. They investigated the behavior of US dollar exchange rates against the currencies of both oil-exporting and oil-importing economies from the 1970s to 2008. **Exhibit 17** shows that the US dollar depreciates against most currencies in reaction to a 10% increase in the real oil price, with the biggest decline, 4.1%, against the Swedish krona. Only the Japanese yen weakens against the US dollar in reaction to an oil price shock.

However, the study of Lizardo and Mollick did not differentiate between types of oil shocks, a shortcoming that was addressed by Basher, Haug, and Sadorsky (2016). They found that exchange rates hardly move in reaction to short-term supply shocks. However, oil demand shocks lead to a significant appreciation of the currencies of oil-exporting countries versus the US dollar and most oil-importing countries' currencies. They also found that the appreciation of oil-exporting countries' currencies was stronger in regimes with higher currency volatility, indicating that oil demand shocks have a bigger impact on exchange rates if markets are already under stress for one reason or another.

The relationship between the US dollar and the currencies of oil-importing countries is more complex, however, and depends largely on the nature of the demand shock and the relative competitive position of each economy in reaction to these demand shocks. In times of high currency market volatility,

Exhibit 17. Estimated Impact of a 10% Increase in Real Oil Price on US Dollar Exchange Rates



Source: Lizardo and Mollick (2010).

the Japanese yen and the Indian rupee tend to depreciate against the US dollar, and they tend to appreciate against the US dollar in times of low currency market volatility. The South Korean won, in contrast, showed little movement against the US dollar in these calmer periods.

Supply Shocks in Metals

So far, this chapter has focused on oil price shocks, but there are obviously other important commodities used in the global economy. I have focused so much on oil because the total consumption of other nonrenewable commodities, such as metals, is much lower than the consumption of oil and energy commodities. As I discussed previously, the annual consumption of energy commodities in the United States amounts to roughly $1.1 trillion, or 5.8% of GDP. The US Geological Survey reported that US consumption of iron and steel in 2018 was a mere $135 billion (0.7% of GDP); the numbers for copper and aluminum were $11.1 billion (0.06% of GDP) and $11.3 billion (0.06% of GDP), respectively. In other words, a price shock in steel, copper, or any other industrial metal will not have a material influence on the economy of the United States or its stock market.

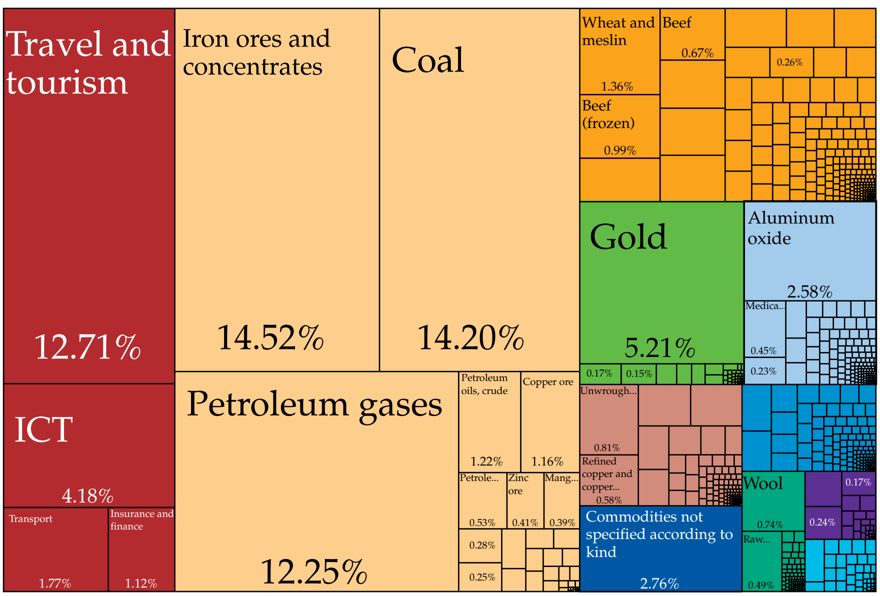
That is not to say that for some major commodity producers, a price shock in some metals cannot have a significant economic impact that will reverberate through the local stock markets. Chile, for example, is the world's largest copper producer and is responsible for about 27% of global copper production. The mining sector accounts for 10% of Chile's GDP, and copper exports make up 50% of all of Chile's exports. Similarly, the mining sector accounts for about 10% of the GDP of Peru and about 60% of the country's exports.

Bigger commodity exporters, such as Australia, also have a large mining sector. The mining sector accounts for 9% of Australian GDP. But the difference between Australia and such countries as Chile is that the mining sector itself is much more diversified. **Exhibit 18** shows that iron ore and coal are the two biggest exports of the Australian economy, each amounting to about 14.5% of total exports. Thus, a price shock in any one mineral hurts the Australian economy much less than a price shock in copper hurts Chile's or Peru's economy.

Nevertheless, both copper and tin prices have a rich history of market manipulation and collusion that lead to significant price shocks. This is possible in these markets because, unlike the market for iron ore, aluminum, and other minerals, the copper and tin markets are characterized by oligopolistic structures and dominated by a handful of producers.

- Rausser and Stuermer (2014) recounted the major episodes of collusion and price manipulation in the copper market since 1850, shown in

Exhibit 18. Australian Exports, 2017

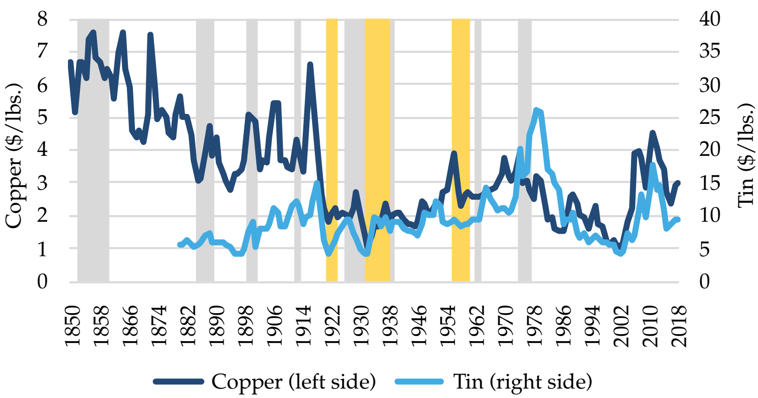


Source: Atlas of Economic Complexity, using raw trade data on goods derived from the UN Commodity Trade Statistics Database (UN Comtrade) and trade data on services from the IMF Direction of Trade Statistics (DOTS).

Exhibit 19: From 1852 to 1860, the Second Copper Trade Association, which controlled at least 70% of British smelter production and 32%–39% of global production, introduced production quotas and fixed prices. By 1856, the real price of copper had risen 46% from the lows of 1851.

- In October 1887, US producers, together with Rio Tinto and two South African producers, formed the Sécretan Copper Syndicate, which bought 160,000 metric tons of copper, financed by French banks and investors. By 1888, the price of copper had risen 56%. The syndicate eventually collapsed when the main financing bank, Comptoir d'Escompte, could no longer finance the stockpiling activities of the syndicate and was forced into bankruptcy.
- In 1899, the Amalgamated Copper Company in the United States, which controlled about 20% of global copper production, together with international partners, started to restrict output and eventually reduced output by 25 million pounds in 1901. Copper prices jumped 35% between 1898 and 1901, before the company decided to no longer limit production.
- From 1918 to 1923, the Copper Export Association controlled 89% of US copper production, the equivalent of 69% of global production. The association started stockpiling copper in 1921 and influenced prices until its dissolution in 1923, which resulted from defections and international competition. From 1921 to 1923, copper prices rose 49%.

Exhibit 19. Real Price of Copper and Tin in 2018 Dollars



Note: Episodes of copper collusion marked in grey; episodes of tin collusion in yellow.
Sources: US Geological Survey; Jordà, Schularick, and Taylor (2017); Rausser and Stuermer (2014); Stuermer (2018).

- During the Great Depression, Copper Export Inc., which controlled between 65% and 95% of global copper production, sought to stabilize prices through price controls and output restrictions. The cartel managed to reverse the initial slump in copper prices and stabilize them at levels around pre-1930 averages.
- From 1974 to 1978, the Intergovernmental Council of Copper Exporting Countries, similar to OPEC but for copper, which controlled about 37% of global mine production, introduced production and export quotas that led to a 17% increase in copper prices in 1975.

Similarly, Stuermer (2018) recounted three major episodes of price manipulation in tin markets that led to significant price shocks:

- In 1921, the governments of the Malay States and the Dutch East Indies established the Bandoeng Pool, which controlled 50% of global tin production. The cartel withheld about 15% of global production and sold it gradually as prices for tin rose 50% between 1921 and 1923. The pool dissolved once its stockpiles were exhausted in 1924.
- During the Great Depression, the International Tin Agreement introduced output restrictions that led to a 142% jump in tin prices between 1932 and 1934. The agreement was finally dissolved in the run-up to World War II.
- Between 1956 and 1960, the major tin producers outside the United States formed a new International Tin Agreement to control exports and prices, which did not lead to massive price spikes but eventually created an oversupply of tin when the agreement was abandoned in 1960.

This history of price and production controls by international cartels shows that, especially in copper and tin, price shocks are a potential threat for investors, as depicted in Exhibit 19. Cartels have formed throughout history when producers were afraid of potential oversupply from new mines or a decline in aggregate demand. With the rise of globalization, however, these cartels have become less common and less effective.

Rare Earth Metals Are Not a Geopolitical Threat

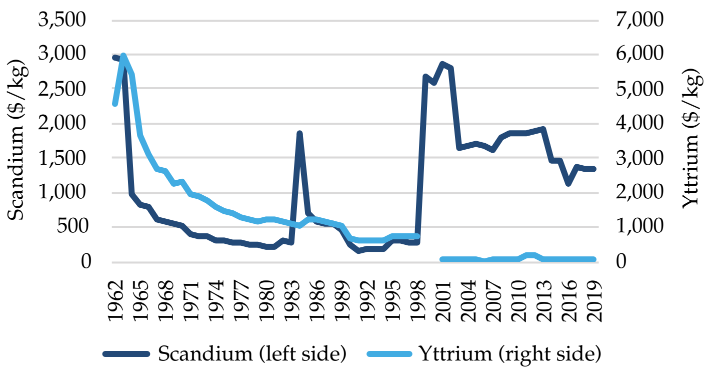
In recent years, the demand for rare earth metals has increased substantially because these metals are used in the production of batteries, IT hardware, and other high-tech products. Investors are worried about the potential use of rare earth metals as a geopolitical weapon by China. In 2018, China was responsible for 70% of the global rare earth metal supply, with Australia a distant second at 11% of global production. The United States has to import all the rare earth metals it needs at the moment, though several US mines are ramping up production, which will reduce the import dependency of the United States. Nevertheless, China can theoretically control the global market price of rare earth metals because of its dominant position.

However, China has little incentive to drive prices for rare earth metals higher since these metals are used in applications that create demand for Chinese intermediate products. In a world of global supply chains, reducing the US output of products that require rare earth metals would eventually create a backlash in the demand for Chinese products, so export or production controls by China would be counterproductive. Additionally, the impact of production restrictions for rare earth metals on the US economy would be very small indeed. The total imports of rare earth metals into the United States amounts to a paltry $160 million. Except for some specialized manufacturers, nobody in the United States would even notice a reduction in rare earth metal exports by China. **Exhibit 20** shows price fluctuations of two rare earth metals, scandium and yttrium.

Water as a Source of Geopolitical Conflict?

Another commodity that is sometimes connected to geopolitical risks and geopolitical tensions is water. Water scarcity could theoretically lead to internal and external conflict. With climate change creating increased water supply stress, particularly in sub-Saharan Africa and the Middle East, some argue that water scarcity could even lead to water wars. However, the empirical evidence for geopolitical conflict over water is weak or nonexistent.

Exhibit 20. Real Price of Rare Earth Metals in 2018 Dollars, 1959–2019



Sources: US Geological Survey and Jordà et al. (2017).

Brochmann (2012) found that conflicts over water are most commonly resolved by cooperation.

One prominent example of such water cooperation is the International Boundary and Water Commission, or the *Comisión Internacional de Limites y Aguas*, which was set up between the United States and Mexico in 1889 to determine the boundary between the two countries along the Rio Grande and other parts of the border. Over time, the mission of the commission expanded, and today it also includes the determination of water usage rights along the Rio Grande and the Colorado River.

Another example showing that differences over water resources are unlikely to lead to conflict is the Mekong River Commission, an intergovernmental organization that manages water rights along the Mekong River in Cambodia, Laos, Vietnam, and Thailand. With origins going back to 1957, the organization was able to facilitate cooperation between its members even during the Vietnam War in the 1960s and 1970s. Koubi, Spilker, Böhmelt, and Bernauer (2014) concluded that trade relations and cross-border payments between neighboring countries act as a check on escalating conflicts over water. If conflicts arise, they remain at the political level and do not escalate into armed conflict.

Of course, just because no evidence exists of intense geopolitical conflict over water in the past does not mean we can rule out a potential water war in the future. However, the resolution of water scarcity issues between countries that are otherwise, shall we say, not the best of friends, such as Israel and its neighbors, indicates that armed conflict over access to water seems a very remote possibility at the moment.

Conclusion

In this chapter, I reviewed the empirical evidence on how conflict over natural resources can affect the global economy and financial markets. The commodity that has by far the biggest impact on the global economy is oil. A 1% decline in oil supply typically leads to an increase in oil prices of 10%. Similarly, a 1% increase in demand leads to an oil price increase of the same magnitude.

How the economy and financial markets react to such oil price shocks depends on the source of the shock. Aggregate demand shocks are driven by rising economic growth and thus lead not only to higher oil prices but also to stronger economic growth and higher stock market returns. Supply shocks and oil-specific demand shocks (e.g., through precautionary demand for oil in anticipation of lasting supply shortages), in contrast, lead to a slowdown in economic growth and a decline in stock market returns.

The impact of rising oil prices on the global economy is declining but remains significant. For oil-exporting countries, higher oil prices mean higher growth, whereas oil-importing countries experience declines in growth typically on the order of 0.3% of GDP in response to a sustained 10% increase in oil prices. However, oil-specific demand shocks seem to have less of an effect on export-oriented countries, such as Germany and China, which benefit from increased demand from oil-exporting countries, dampening some of the negative effects of higher oil prices on domestic consumption.

The United States is a special case, having shifted from an oil-importing country to an oil-exporting country over the last decade. The fracking boom has had significant geopolitical ramifications not only for the United States, which now has an economy that is much more robust in the face of oil price shocks than in the past, but also for traditional oil importers. Most important, Saudi Arabia is facing significantly lower oil revenues than in the past, leading to a quickly deteriorating fiscal position and an increased vulnerability of the country to international conflicts. This situation is particularly concerning since Saudi Arabia is the country with the most spare capacity in the world; supply disruptions in Saudi Arabia cannot be compensated by other oil producers. Thus, oil price shocks originating in Saudi Arabia are more consequential than oil price shocks originating in other countries.

Once oil prices spike, both stock markets and currency markets show significant reactions. In stock markets, the overall market reaction is muted, but energy-related sectors and markets in oil-exporting countries experience a significant boost, whereas markets in oil-importing countries and stocks of businesses that depend on oil as a major input factor (e.g., food and health care companies) suffer. Oil price shocks also tend to lead to an appreciation of oil currencies against the US dollar, whereas the reaction of non-oil currencies against the US dollar is mixed and depends on the individual circumstances of each oil shock.

Finally, in this chapter I discussed the potential for price shocks in markets for metals to influence the global economy and financial markets. I showed that demand for metals tends to be such a small part of the global economy that spikes in metal prices do not have a significant effect on major economies. However, some countries that depend heavily on the export of one specific metal, such as Chile and Peru, can have strong reactions to price shocks in these metals.

This argument also extends to a range of metals that have been much discussed in recent years: rare earth metals. China possesses a near monopoly on rare earth metal production, but imports of rare earth metals to the United States are so miniscule that a price shock in these metals would have no impact on the US economy overall. Nevertheless, shares of companies in IT and other high-tech areas that rely on rare earth metals might suffer transitory price declines in reaction to higher rare earth metal prices.

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