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Some Implications of Tightening Regulation of U.S. Deepwater Drilling

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Introduction

The disastrous explosion of the *Deepwater Horizon* drilling rig has resulted in the largest offshore oil spill in U.S. history, with an estimated 1.7 to 3.0 million barrels of crude oil released into the Gulf of Mexico from the blowout on April 20 through mid-June 2010. The ecological damage is severe and clean-up costs are likely to be high. Such a disaster raises questions about unforeseen risks associated with offshore drilling operations—particularly in deepwater areas, such as where the *Deepwater Horizon* was working and where technology is pushed to the edge.

In the wake of the disaster, many Americans are calling for tighter U.S. regulation of offshore drilling operations. For now, new offshore deepwater drilling is at a standstill. On May 27, the Obama administration announced a six-month moratorium on deepwater oil and gas drilling and the shutdown of deepwater exploratory wells already operating in U.S. waters until they meet new safety requirements.

The oil spill and subsequent calls for tighter government controls raise several questions. What role does offshore petroleum and natural gas production play in U.S. energy markets? What would be the implications of tighter controls on deepwater drilling? What would happen if deepwater drilling were banned? How would such changes in deepwater drilling affect U.S. energy prices and the patterns of oil and natural gas consumption, production, and imports?

Another important question is whether markets, the legal system, and current policies provide the proper incentives for producers (and consumers) to consider fully the possibility of oil spills and the risks that could ensue while drilling in deepwater offshore areas. If such risks are not taken fully into account, offshore oil and natural gas production will be too great; oil and

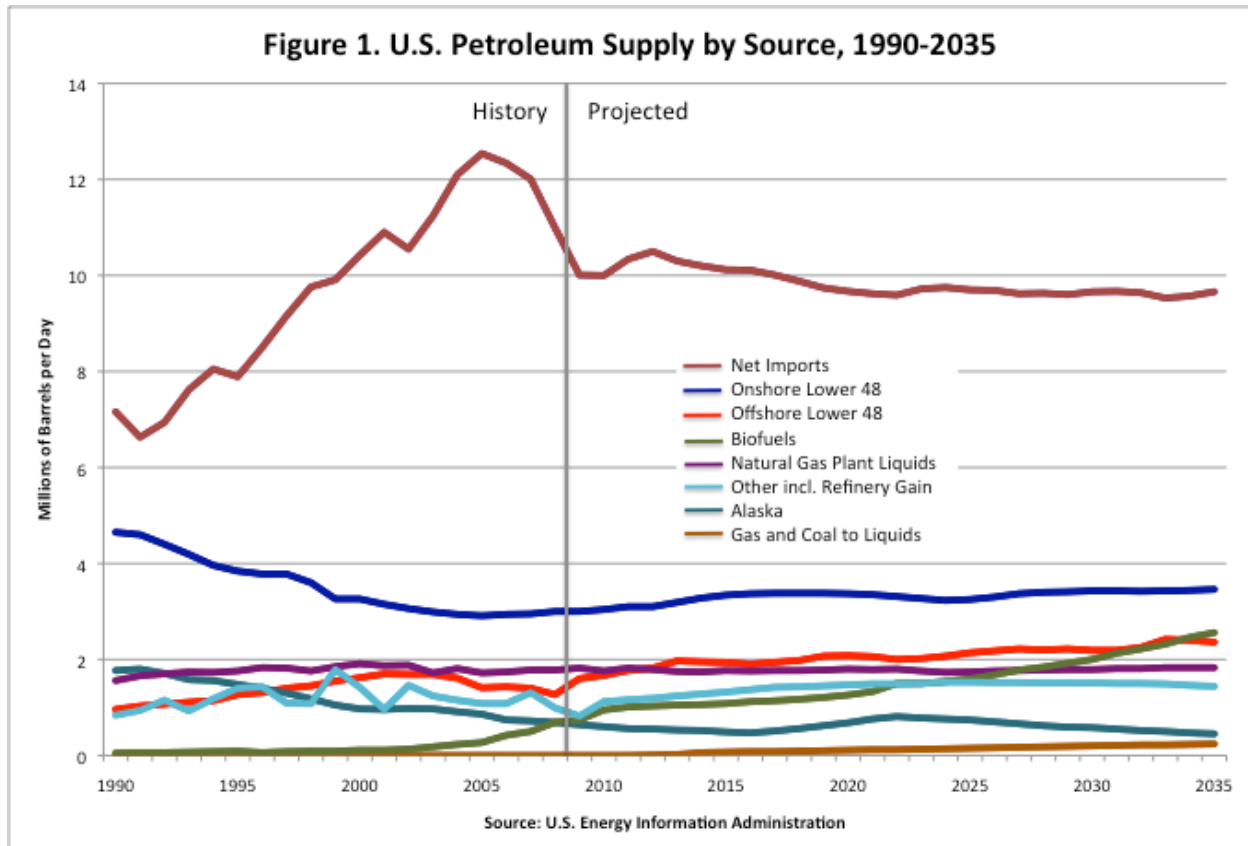
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natural gas prices will be too low; and the consumption of oil and natural gas will be too high. Are tighter controls or a permanent ban on deepwater drilling in the United States a reasonable response to such externalities or an overreaction?

U.S. Offshore Oil and Natural Gas Production

A substantial portion of total U.S. oil and natural gas production comes from offshore wells. As shown in Figure 1, the U.S. Energy Information Administration (EIA) projects U.S. offshore oil production at 1.7 million barrels per day (8.7 percent of total U.S. supply) in 2010 (U.S. EIA 2010a). Prior to the oil spill, EIA projected U.S. offshore oil production would grow to 2.4 million barrels per day (10.7 percent of total U.S. supply) by 2035. Most of the growth in U.S. offshore oil production would come from deepwater and ultra-deepwater areas.



In the Gulf of Mexico, for example, we have seen a transition from oil production in shallow water (water depth of less than 1,000 feet) to deepwater (water depth between 1,000 and 4,999 feet), and more recently to ultra-deepwater (water depth greater than 4,999). Shallow water production peaked in 1998. Deepwater production peaked in 2004. In contrast, ultra-deepwater

production has risen sharply since that time—reversing a decline in overall Gulf of Mexico oil production that began in 2003 (U.S. EIA 2010b).

The shift in Gulf of Mexico oil production is in line with proved reserves. About 20 percent of the proved oil reserves in the Gulf of Mexico are in shallow water, whereas about 80 percent occur in deepwater and ultra-deepwater areas (Table 1). As the petroleum industry advances its exploitation of oil resources, ultra-deepwater oil production is expected to continue growing in importance. Additional offshore production is expected in areas opened up by the removal of the Congressional moratorium on drilling in the Eastern Gulf of Mexico, Atlantic, and Pacific regions of the Outer Continental Shelf.

In natural gas, the big story is the rapid growth of production from shale formations (as shown in Figure 2), but EIA projects U.S. offshore natural gas production gradually rebounding from a low at 2.65 trillion cubic feet (11.6 percent of total U.S. supply) in 2010 to reach 4.33 trillion cubic feet (17.5 percent of total U.S. supply) in 2035.¹ Current production and reserves in the Gulf of Mexico suggest that deepwater and ultra-deepwater areas will contribute to the growth of offshore natural gas production, but not by nearly as much as they contribute to oil production (Table 2). As is the case for oil, additional offshore production is expected in areas that were opened up by the removal of the Congressional moratorium on drilling.

**Table 1. Oil Production and Proved Reserves
in Offshore Gulf of Mexico Federal Areas, 2008**

Water depth	Proved reserves (million barrels)	Production (million barrels)
Shallow (0-999 feet)	719	112
Deepwater (1000-4999 feet)	1,538	273
Ultra-deepwater (5000+ feet)	1,516	182
All areas	3,773	567

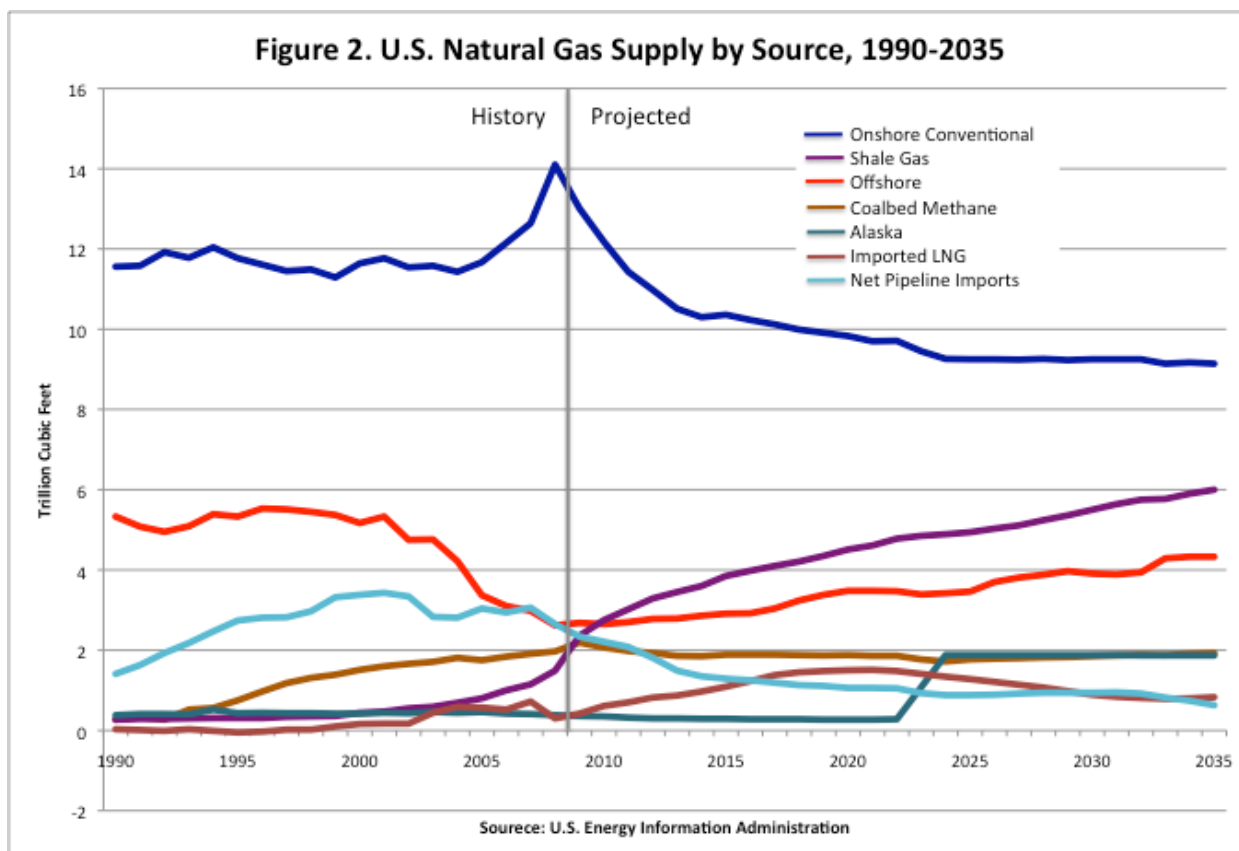
Source: U.S. Energy Information Administration

¹ Brown, Gabriel, and Egging (2010) find that if U.S. shale gas resources are greater than EIA assumes, then U.S. offshore natural gas production will be substantially lower than projected.

Table 2. Natural Gas Production and Proved Reserves in Offshore Gulf of Mexico Federal Areas, 2008

Water depth	Proved reserves (billion cubic feet)	Production (billion cubic feet)
Shallow (0-999 feet)	7,112	1,340
Deepwater (1000-4999 feet)	3,881	531
Ultra-deepwater (5000+ feet)	2,194	571
All areas	13,187	2,442

Source: U.S. Energy Information Administration



Some Implications of Tighter Government Control

EIA estimates that the six-month moratorium on deepwater offshore drilling will reduce U.S. crude oil production about 26,000 barrels per day in the fourth quarter of 2010 and roughly 70,000 barrels per day in 2011 (EIA 2010c). Similarly, EIA estimates the moratorium will reduce natural gas production in the Gulf of Mexico by about 0.03 billion cubic feet per day in

September 2010 and about 0.24 billion cubic feet per day in December 2011. These estimated reductions take context against projected U.S. oil and natural gas consumption of 19.5 million barrels per day and 61 billion cubic feet per day, respectively.

To assess the implications of a permanent tightening of U.S. government control on deepwater offshore drilling, we examine three cases. The first case represents business as usual, in which energy industry activities resume as previously projected at the end of the current six-month U.S. moratorium against deepwater and ultra-deep-water drilling. This case matches EIA's projections for world oil and U.S. natural gas markets (U.S. EIA 2010a).

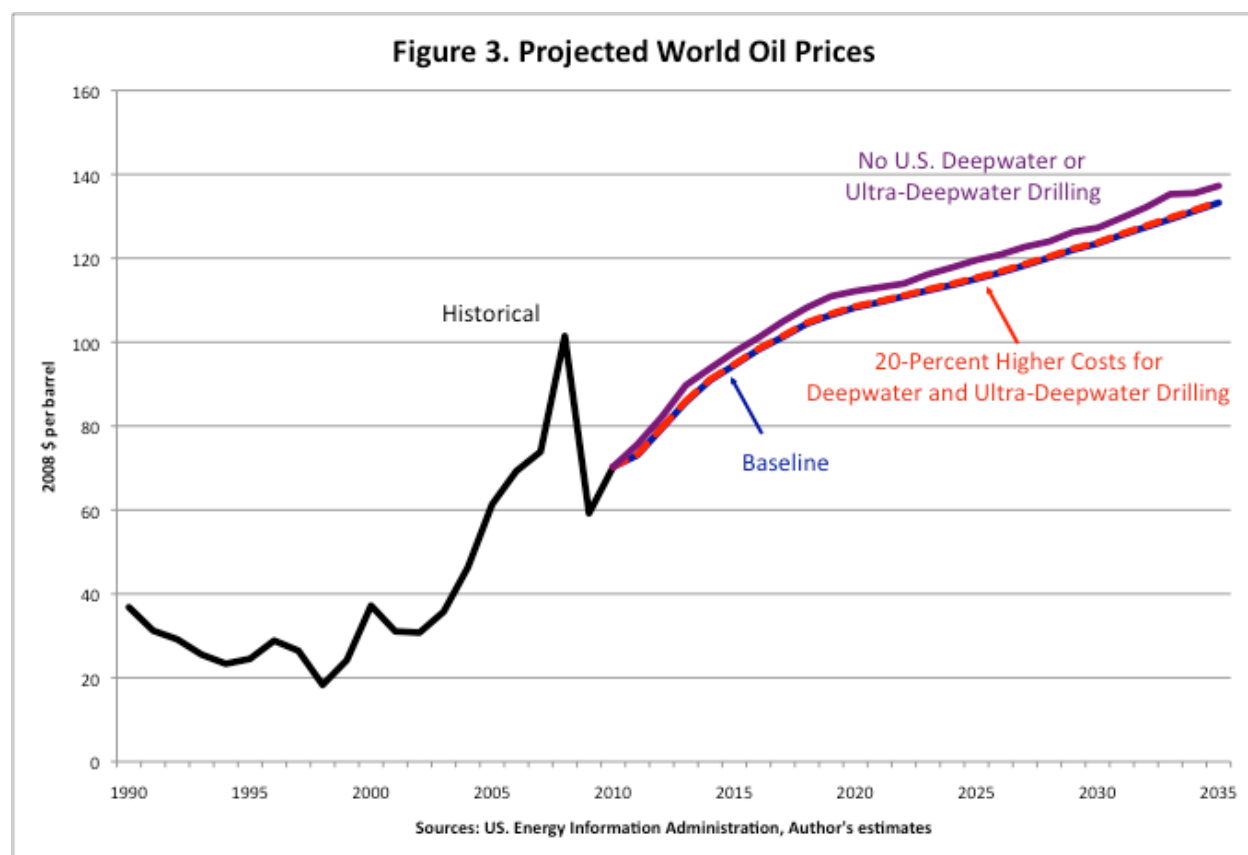
A simulation model of U.S. and world oil and natural gas markets generates the other two cases, using the EIA projections as a point of departure. One of these cases examines the consequences of additional regulatory safeguards that would increase the cost of exploration, development, and production in U.S. deepwater and ultra-deepwater areas by a combined 20 percent. Against the \$35 million to \$100 million cost of drilling in deepwater and ultra-deepwater areas, industry sources suggest that a 10-20 percent increase will cover the likely costs of raising U.S. safety standards for deepwater and ultra-deepwater drilling to those set by other countries, such as Brazil, Canada, Norway and the United Kingdom. The other case examines the implications of a permanent U.S. ban on drilling in deepwater and ultra-deepwater areas—which represents the outer bound of possible policies.²

Potential Effects on Oil Markets

As shown in Figure 3, a 20 percent increase in the cost of drilling in U.S. deepwater and ultra-deepwater areas would likely have relatively little effect on world oil prices. Projected oil prices rise by about 18 cents per barrel (0.25 percent) above the baseline case in 2011 and 28 cents per barrel (0.21 percent) above baseline in 2035.³ These changes would translate to gains in the price of gasoline of about one-half cent per gallon in 2011 and eight-tenths of a cent per gallon in 2035.

² The analysis abstracts from the employment effects in the oil and gas industry or U.S. regions supporting offshore drilling.

³ All reported prices are in 2008 constant dollars.



A total ban on further drilling in U.S. deepwater and ultra-deepwater areas would have a stronger effect on world oil prices than additional regulation. Projected oil prices would rise by about \$2.58 per barrel (3.54 percent) above baseline in 2011 and by about \$4.03 (3.03 percent) above baseline in 2035. Projected gasoline prices would be about 7.2 cents per gallon higher in 2011 and 11.3 cents per gallon higher in 2035.

The estimated effect of 20 percent higher costs for U.S. deepwater and ultra-deepwater drilling on the world oil price is relatively slight because the change in U.S. offshore production is very small when seen in the context of the world oil market (Table 3). With higher costs for U.S. deepwater and ultra-deepwater drilling, U.S. oil consumption would be reduced slightly and U.S. oil imports would be increased slightly. Overall, world oil production would be reduced, but by less than the reduction in U.S. offshore production.

A permanent ban on U.S. deepwater and ultra-deepwater drilling would have a greater effect on world oil prices than would a 20 percent increase in costs because a moratorium would cause a more significant reduction in U.S. offshore oil production. Nonetheless, the large international oil market would blunt the effect on prices. The United States would import more oil to offset some of its reduced oil production—with imports running about 0.2 million barrels

per day higher in 2011 and approximately 1.2 million barrels per day higher in 2035 than in the reference case.

Table 3. Projected World Oil Prices and Production and U.S. Oil Consumption, Production and Imports, 2035

	Baseline	20 percent higher costs for deepwater and ultra-deepwater drilling	No deepwater or ultra- deepwater drilling
World oil price (2008 \$ per barrel)	133.22	133.50	137.25
World oil production (million barrels per day)	110.60	110.49	108.99
U.S. consumption (million barrels per day)	22.00	21.97	21.59
U.S. onshore production (million barrels per day)	7.42	7.43	7.52
U.S. offshore production (million barrels per day)	2.36	2.23	0.50
U.S. biofuels (million barrels per day)	2.56	2.56	2.65
Total U.S. production (million barrels per day)	12.34	12.22	10.67
U.S. net imports (million barrels per day)	9.66	9.75	10.92

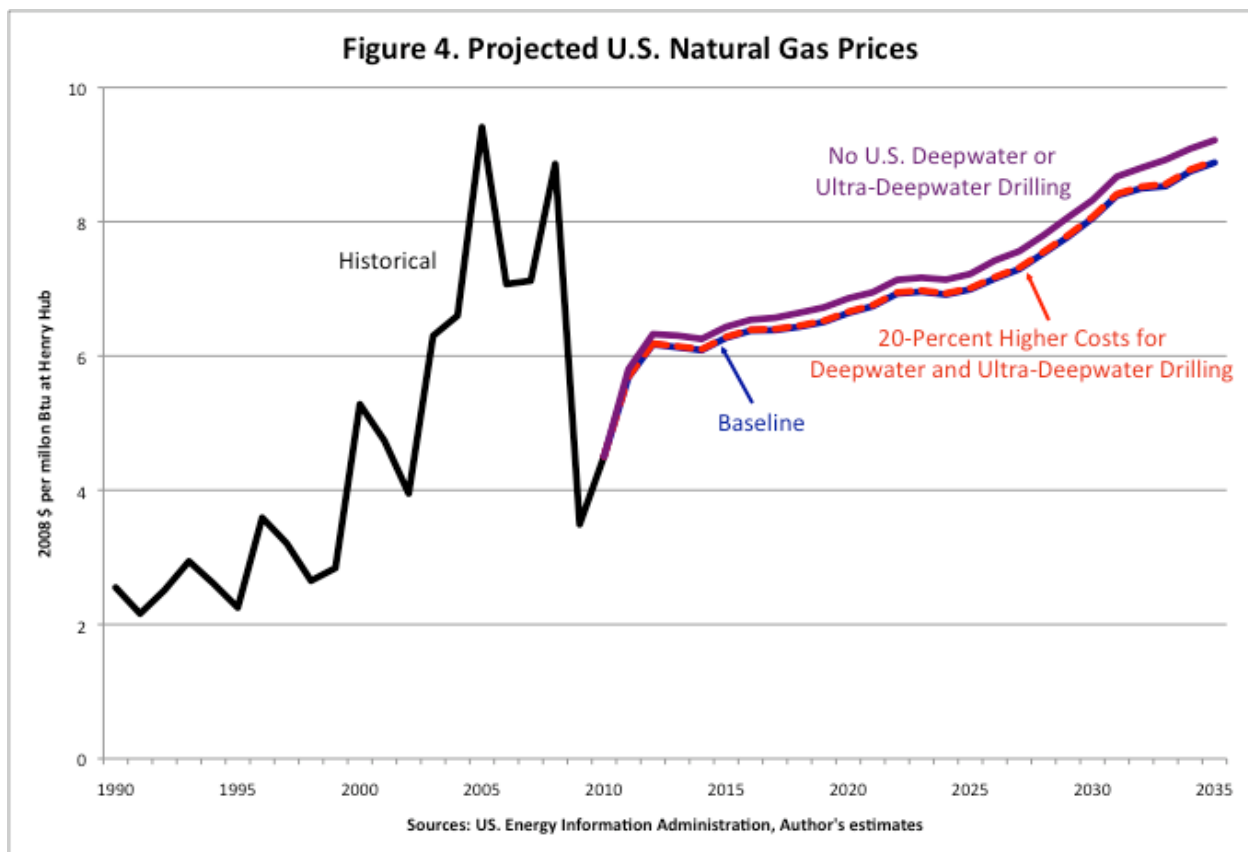
Sources: U.S. Energy Information Administration and Author's Estimates

Potential Effects on Natural Gas Markets

As shown in Figure 4, a 20 percent increase in the cost of drilling in U.S. deepwater and ultra-deepwater areas is also likely to have relatively little effect on U.S. natural gas prices. The projected Henry Hub price of natural gas would rise by about 1.3 cents per million Btu (0.23 percent) above baseline in 2011 and 2.8 cents per million Btu (0.32 percent) above baseline in 2035.⁴ With a total ban on further drilling in U.S. deepwater and ultra-deepwater areas, projected natural gas prices would rise by about 12.1 cents per million Btu (2.13 percent) above baseline in 2011 and by about 33.4 cents (3.76 percent) above baseline in 2035.

⁴ Near New Orleans, Henry Hub handles the highest volume of natural gas of any U.S. transportation node and is close to the largest concentration of natural gas producing regions in the country. Henry Hub is a commonly used pricing point for natural gas in the United States, and its price movements are highly correlated with the NYMEX futures price, which is the most widely traded natural gas contract in the world.

As we find for the oil market, a 20 percent cost increase for U.S. deepwater and ultra-deepwater drilling will have a relatively slight impact on the U.S. natural gas price because the change in U.S. offshore production is very small in comparison to the size of the total U.S. natural gas market (Table 4).⁵ The estimated effect of a permanent moratorium on U.S. deepwater and ultra-deepwater drilling on U.S. natural gas prices is stronger than for a 20 percent increase in costs because a moratorium would cause a greater reduction in U.S. offshore natural gas production. Nonetheless, gains in other domestic sources of natural gas and imports would blunt the effects on prices.



⁵ In the case of natural gas, it should be noted that a smaller share of U.S. offshore production comes from deepwater and ultra-deepwater areas.

Table 4. Projected U.S. Natural Gas Prices, Consumption, Production and Imports, 2035

	Baseline	20 percent higher costs for deepwater and ultra-deepwater drilling	No deepwater or ultra- deepwater drilling
Henry Hub price (2008 \$ per million Btu)	8.88	8.91	9.21
U.S. consumption (trillion cubic feet)	24.73	24.70	24.45
Conventional onshore production (trillion cubic feet)	9.14	9.15	9.30
Shale gas and coalbed methane production (trillion cubic feet)	7.93	7.95	8.17
Offshore production (trillion cubic feet)	4.33	4.26	3.54
Alaska production (trillion cubic feet)	1.87	1.87	1.87
Total U.S. production (trillion cubic feet)	23.27	23.23	22.88
U.S. net imports (million barrels per day)	1.46	1.47	1.57

Sources: U.S. Energy Information Administration and Author's Estimates

Implications for Energy Security

Changes in U.S. oil consumption and oil imports raise issues about energy security. Practical experience and a long-established economics literature—assessed by Brown and Yücel (2002), Jones et al. (2004), Kilian (2008), and Hamilton (2009)—have found that oil supply shocks can lead to sharply rising oil prices and weakened U.S. economic activity. Because the U.S. economy is vulnerable to oil supply shocks, reducing the potential size or economic consequences of such shocks is at the heart of energy security.

Because oil is fungible and its transportation costs are relatively low, its prices are determined on an integrated world oil market in which market forces transmit oil supply shocks to oil prices worldwide. U.S. oil consumption plays an important role in national energy security because oil consumption determines the extent to which economic activity is exposed to internationally transmitted oil price shocks. Brown and Huntington (2010) find that such consumption leads to oil security externalities because individual consumers do not take into account how their consumption affects aggregate economic activity.

According to Brown and Huntington, consumption of imported oil carries greater externalities than consumption of domestically produced oil because imports affect the expected size of future supply shocks by changing how much potentially unstable producers contribute to the world oil supply. Because historically unstable producers adjust their production to world oil market conditions, they are among the marginal sources of world oil—even though more stable producers have higher costs. For the market conditions the EIA projects for 2011, Brown and Huntington estimate externalities of \$2.59 per barrel of domestic oil consumed and \$4.36 per barrel of imported oil consumed. For the market conditions the EIA projects for 2035, the comparable figures are \$4.45 and \$6.82.

Consequently, reductions in U.S. oil consumption would slightly enhance the nation's energy security, while increases in U.S. oil imports would reduce energy security slightly. Using the Brown–Huntington estimates of U.S. oil security externalities, a 20 percent increase in drilling costs in U.S. deepwater and ultra-deepwater areas would increase estimated U.S. oil security externalities by a total of about \$2.1 million in 2011 and by about \$29.5 million in 2035. Similarly, a permanent ban on drilling in U.S. deepwater and ultra-deepwater areas would increase estimated U.S. oil security externalities by a total of about \$31 million in 2011 and by about \$405 million in 2035.

Are Tighter Controls Needed?

In light of the *Deepwater Horizon* oil spill, industry risk managers evaluating deepwater drilling programs are likely to update their expectations about the risks and costs involved.⁶ Henceforth, we can expect to see new industry standards pertaining to safety equipment and procedures used when drilling in U.S. deepwater and ultra-deepwater areas. Such changes can be expected to increase the out-of-pocket costs of drilling in deepwater and ultra-deepwater areas.

Nonetheless, there can be a tendency within any industry to dismiss low-probability, catastrophic events such as the *Deepwater Horizon* disaster as a one-off occurrence, resulting from poor judgment or human error. That tendency could mean that industry standards would not tighten by as much as society deems appropriate. In such a case, society will want higher safety standards than the industry would adopt on its own accord.

⁶ Cohen (2010a,b) examines the likely costs of the *Deepwater Horizon* oil spill and issues associated with deterring such spills in the future.

Additional regulation could help push the industry toward higher safety standards. If industry pursues higher safety standards on its own accord, additional government safety requirements that point to the best practices and are capable of evolving with new technology will at worst be redundant to safety practices that the industry is adopting on its own. Of course, poorly designed regulations could unnecessarily impede deepwater and ultra-deepwater drilling without significantly improving safety.

Whether the result of industry or government action, higher safety standards could raise the costs of U.S. deepwater and ultra-deepwater drilling by 10-20 percent. As we have seen, the market will shift some these costs forward to consumers in the form of higher prices. Although the anticipated gains are far from a complete environmental pricing, higher prices will assure that those using oil and natural gas face at least some of the environmental costs associated with production, and at the same time provide incentives for conservation.

Given the scale of the markets in which these changes might occur, however, the expected effects on world oil prices and U.S. natural gas prices are quite small. Therefore, it would be unwise to mistake the apparent lack of these prices to respond to the *Deepwater Horizon* oil spill as a sign that the industry will not adopt safer, more costly drilling procedures unless forced to do so. In that regard, it is interesting to note that market prices also did not seem to respond to the temporary U.S. moratorium on deepwater offshore drilling or to the likelihood that the United States will impose additional safety requirements for such drilling.

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Appendix: Quantifying the Effects on U.S. Oil and Natural Gas Markets

To quantify the effects of additional regulation or a ban on drilling in U.S. deepwater and ultra-deepwater areas, I use a small simulation model of the international oil and U.S. natural gas markets to estimate the effects on these markets of eliminating U.S. oil and gas company tax preferences.

Following Brown and Yücel (2008) and Huntington (2007), oil prices are determined on an international market in which natural gas prices have relatively little effect. The model represents U.S. and rest of the world oil consumption, U.S. production (including biofuels and onshore, shallow water, deepwater, and ultra-deepwater production), and production by the Organization of the Petroleum Exporting Countries (OPEC) as well as the rest of the world. OPEC’s cartel behavior is modeled as managing its market share.

U.S. natural gas prices are determined in a North American market in which oil prices play an important role. For natural gas, the model represents U.S. consumption, U.S. production (including shale gas, coalbed methane, conventional onshore gas, shallow water, deepwater and ultra-deepwater production), U.S. imports of liquefied natural gas (LNG), and net pipeline imports.

The model uses as its baseline the projected domestic and international oil market conditions and domestic natural gas conditions reported in EIA’s Annual Energy Outlook 2010. The EIA outlooks assume no new policy initiatives and are widely available, well documented, frequently compared with other major energy outlooks, and often evaluated for their ability to track the historical record. Specific estimates depend on the baseline assumptions and model parameters, but the qualitative findings do not.