The Impacts of Increased Corporate Average Fuel Economy (CAFE) Standards on the U.S. Auto Sector

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INTRODUCTION

Oil and transportation are inextricably linked. In the United States, oil provides over 95% of the energy used in transportation, and 40% of all oil consumed in the U.S. goes to transportation for light-duty vehicles (*i.e.*, cars and light trucks).[1] Transportation, in turn, plays a critical role in economic growth. Businesses and consumers have come to rely so heavily on mobility and transport services powered by petroleum products that swings in the price of oil can have substantial and long-lasting impacts on the national economy. As we continue to import a greater share of our oil, an increasing share of our trade deficit is directly attributable to oil purchases, making oil critically important not only to the daily functioning of the economy, but also to domestic and international finance.

Oil has several qualities that make it desirable as an energy source. It is relatively energy dense and easy to handle. It can be refined into a number of different products suited to a variety of applications. At the same time, oil has several well-known drawbacks. Principal among them are the various forms of pollution that come as a byproduct of burning refined petroleum products and the geopolitical problems related to the fact that much of the world's oil reserves are concentrated in the Middle East. Like many other products, but at a scale unlike any other, oil is a two-edged sword. It has become a critical input for meeting the needs and desires of American consumers, but its side-effects are putting increasing stress on the economy, the environment, and international politics.

Unlike many commodities, oil is not often consumed as an end, but rather as a means to an end; consumers and businesses demand oil and petroleum products not because of some intrinsic value, but rather for the transportation and other energy services they can help provide. Technology plays a critical role in transforming the demand for transportation services into demand for petroleum products, and increased energy efficiency makes it possible, at least in part, to dissociate the benefits of oil consumption from its costs.

In the transportation sector, the primary policy tool for influencing efficiency has been the Corporate Average Fuel Economy (CAFE) Standards legislation. Originally passed in 1975, CAFE standards have required automakers to increase the fuel efficiency of the autos they produced. The efficiency standards are applied to the average fuel economy of an automakers' entire fleet, divided into two categories: cars and light trucks. Not all autos in a category are required to meet the standard, but the average fuel economy of all the autos in a category must be at least as good as the standard for that category. The current standard for cars is 27.5 miles per gallon (mpg) and 20.7 mpg for light trucks. Automakers can thus produce and sell cars with mileage less than 27.5 mpg, but these sales must be offset by sales of models that get better mileage than the standard. Since 1987, the fleet wide average fuel economy has fallen from a peak of 22.1 mpg to 20.8 mpg in 2003,[2] resulting from a shift in consumer preferences away from cars and toward light trucks (including sport utility vehicles).

CAFE standards have helped increase fleet wide fuel economy, slowing the growth of oil consumption and the associated costs. A major concern among many regarding CAFE standards is how they impact the domestic auto sector, particularly employment. Much of this concern

[1] Energy Information Administration (EIA), 2005. *Annual Energy Outlook 2005 with Projections to 2025*. Washington, DC: United States Department of Energy.

[2] Carl Hellman and Robert Heavenrich, 2004. *Light-Duty Automotive Technology and Fuel Economy Trends: 1975 through 2004*. Washington, DC: United States Environmental Protection Agency, Advanced Technology Division, Office of Transportation and Air Quality.

derives from the fear that foreign automakers hold a competitive advantage in producing more fuel efficient vehicles. If so, increased CAFE standards might threaten the market share of domestic producers, resulting in job losses in the sector.

This competitive advantage—presumed by many—is supported, at least in part, by the observation that foreign automakers' sales are weighted more heavily toward smaller and more fuel efficient vehicles than their American competitors and, in recent years, by the fact that foreign producers have been first to market with new technologies such as gasoline-electric hybrid engines. Overseas producers currently dominate the fuel efficient end of the auto model spectrum, with 40 of the 64 most fuel efficient cars being produced by foreign, mainly Japanese, automakers.[3]

The experience of the late 1970s and early 1980s is often cited as additional prima facie evidence of such a competitive advantage. From 1978 to 1981, oil prices (as measured by the crude oil domestic first-purchase price) rose from $20 to $54 per barrel, falling to $35 per barrel by 1985 and $18 per barrel in 1986. Retail gasoline prices rose by about 60% between 1978 and 1981.[4] During that period and the years immediately following, the market share held by foreign producers soared, rising from 18.2% of domestic auto sales in 1975 to 31.1% in 1987.[5] The oft cited reason for this is that, when faced with record high gasoline prices, American consumers' preferences shifted toward more fuel efficient models. Foreign producers, again mainly Japanese relying on experience in producing smaller and more efficient cars for European and Asian markets, were better able to meet this shift in demand. Although high oil prices may have opened American markets to Japanese automakers, the price and quality of their products appealed to American consumers, allowing them to retain and grow their market share even after oil prices began to fall.

Another lesson can be drawn from the experience of the 1970s and 1980s, however. While American auto buyers are often considered to be relatively insensitive to increases in gasoline prices, past experience shows otherwise. As high gasoline price increases persisted into the mid 1980s, American consumers clearly shifted their preferences towards more fuel efficient vehicles. Although demand for less-efficient SUVs and cars remained consistently high through the 1990s, even as gasoline prices rose significantly from 1998 to 2001, these price increases were half the size, in real terms, of the increases of the late 1970s and early 1980s and were ultimately transitory, lasting less than four years. Historical evidence supports more strongly the hypothesis that, while relatively small and short-lived jumps in gasoline prices have little impact on auto purchasing patterns, American consumers are sensitive to large and sustained increases in oil and gasoline prices.

The question follows whether in an era of sustained and significantly higher oil prices, would domestic automakers be better served by higher CAFE standards.[6] If foreign automakers hold a competitive advantage in making more fuel efficient vehicles, would increasing CAFE standards in advance, or in the early stages, of a large and persistent increase in gasoline prices help eliminate this advantage and serve to protect employment in the auto sector? This question is particularly relevant now as global oil prices approach levels last seen during the early

3 American Council for an Energy Efficient Economy, 2004. *ACEEE's Green Book Online*, Washington, DC: ACEEE, www.greenercars.com/.

4 EIA, 2004. *Annual Energy Review*, 2003. Washington, DC: United States Department of Energy. Prices in constant 2000 dollars.

5 Stacy Davis and Susan Diegel, 2004. *Transportation Energy Data Book: Edition 24*. Washington, DC: United States Department of Energy, Energy Efficiency and Renewable Energy.

6 For a review of previous research on this topic as well as the results of a similar modeling exercise, see Roger Bezdek and Robert Wendling, 2005. "Potential Long-Term Impacts of Changes in US Vehicle Fuel Efficiency Standards," *Energy Policy*, vol. 33, pp. 407-419.

1980s, when domestic automakers and auto workers suffered because domestic producers did not fulfill consumers' demands for more efficient cars and trucks. If, as many worry, we are entering a long-term period of tighter world oil markets and higher gasoline prices, will history repeat itself, with potentially dire consequences for domestic producers and their employees? If we are entering such a period, would higher CAFE standards help shield the domestic auto industry from the effects of high oil prices?

This paper attempts to answer these and other questions by analyzing the impacts of higher CAFE standards in scenarios of persistently low and persistently high global oil prices. Using a structural model of the U.S. economy, we analyzed four different scenarios:

> **Low CAFE, low oil prices:** In this scenario, both CAFE standards and global oil prices are presumed to remain low.[7]

> **Low CAFE, high oil prices:** In this scenario, CAFE standards are presumed to remain at their current levels, but oil prices are substantially higher, as described below.

> **High CAFE, high oil prices:** In this scenario, both oil prices and CAFE standards are presumed to increase by about 53%.

> **High CAFE, low oil prices:** In this scenario, oil prices remain low, but CAFE standards are presumed to increase as above.

By comparing the results of these four scenarios, we are able to address such questions regarding the impacts of higher oil prices on the domestic auto sector, the impacts of higher CAFE standards on the domestic auto sector, and how CAFE standards reinforce or mitigate the economic stress caused by higher oil prices.

In the following sections we will (1) discusses the possible threat of sustained high oil prices in the short to medium term; (2) describe the modeling process and the alternate scenarios we analyzed; (3) present a summary of our results; and (4) offer our conclusions.

THE POTENTIAL FOR SUSTAINED HIGH OIL PRICE LEVELS

In addition to the economic changes yielded by large swings in oil prices, they also tend to produce a large number of predictions over future oil and energy prices. During and immediately following the oil shocks of the 1970s, many analysts felt that the record oil prices of the time were merely a prelude to even higher oil prices for the foreseeable future. Predictions of $50 per barrel prices were common, which would translate to well over $100 in today's terms. With the steep increases of the past year, many analysts were originally sanguine about the likelihood of continued high prices. As prices have continued to rise, crossing $55 per barrel, predictions of persistently high and climbing prices are again common. Many energy market analysts and fund managers expect long term oil prices to remain between $35 and $40 per barrel.[8] Other energy market analysts are predicting even higher

[7] We assumed that CAFE standards would remain at their current levels and that oil prices would conform to the EIA *Annual Energy Outlook 2004* forecast through 2020. In light of the dramatic increases in actual oil prices over the past year, the AEO 2004 forecasts seem unrealistically low, but they were the only final and complete set of forecasts available from the Department of Energy at the time the analysis was undertaken. We ran sensitivity cases in which oil prices were presumed to be high in the short run but gradually decreasing to the long run 2004 forecasts and the results were not substantially different from those based on the 2004 forecasts.

[8] "Get Used to High Oil Prices, They are Here to Stay," *Dow Jones Newswire*, September 17, 2004, and Fereidun Fesharaki, 2004. "The Global Oil Market: Have We Reached a New Plateau or Just Another Cycle?" International Association for Energy Economics *Newsletter*, 2004 (4). Cleveland, OH: IAEE.

prices, with some predicting prices to exceed $80 per barrel for the rest of the decade, possibly rising as high as $160.[9]

The critical question is whether or not there is reason to believe that the predictions this time around are more likely to be borne out than in the past. While a detailed assessment of the long-term prospects of global oil prices is beyond the scope of this paper, there are a number of reasons to believe that a new and higher plateau in global oil prices is at least a possibility worth considering. One factor that makes the current experience different from the oil price shocks of the 1970s is that those price spikes were driven mainly by large supply disruptions. The Arab oil embargo of 1972 and the Iranian revolution of 1978 yielded steep declines in global oil supply, causing prices to rise steeply. While there have been some actual and threatened supply disruptions recently, including hurricane damage in the Gulf of Mexico, labor unrest in Africa, and disruptions relating to the war in Iraq, these incidents are minor compared to those of the 1970s and likely responsible for only a fraction of the current increase in prices.

Another factor indicating that a long-term price increase may loom is the increasing global demand for oil which appears likely to grow for the foreseeable future. Demand growth has been particularly strong in China and India, increasing by 7% in the past decade, over five times faster than the global average.[10] While higher oil prices are likely to slow this rate of growth, population dynamics and economic growth in both these countries indicate a continued strong demand trend for the foreseeable future.

The prospects for new additions to global oil supplies are unclear. There is some possibility of increased production among OPEC members, but their capacity to develop these resources quickly enough to match global demand growth is questionable, given political and social issues. Higher production by non-OPEC countries is less promising, particularly with ongoing problems in Russia, which may have the largest untapped reserves outside of OPEC. Russian and other oil supplies are likely to find their way to market eventually, but the key question is whether or not they can grow fast enough to meet increasing global demand. The prospects for this are questionable at least for the short to medium term.[11]

In addition to these concerns about market fundamentals, there is growing concern about whether or not global oil production is at or near its peak levels. This position is often based on an application of analysis first employed by M. King Hubbert. In the 1950s Hubbert correctly predicted that U.S. oil production would peak in the early 1970s. Recent analysts have applied Hubbert's methodology to global oil production and are predicting a peak in global production by 2010. Under this theory, global production would continue after reaching "Hubbert's peak," but would begin to fall, with the production path resembling the shape of a bell-curve. If such predictions prove correct, global supplies would decline as oil demand may begin accelerating due to economic and population growth in Asia and elsewhere. The combination of falling supply and rising demand could result in rising and persistently high oil prices.[12]

In comparison to these estimates, the Department of Energy does not emphasize the idea of a peak oil year estimate but shares an optimistic view that turns in part on the question of estimated total supply and unconventional sources. According to the Department's Energy Information Administration:

> Much of the pessimism about oil resources has been focused entirely on conventional

[9] For example, see Philip K Verleger, Jr., 2004. "Energy: The Gathering Storm." Washington, DC: Institute for International Economics.

[10] British Petroleum, 2004. *The BP Statistical Review of World Energy 2004.* London: British Petroleum.

[11] Fesharaki, 2004.

[12] Kenneth Deffeyes, 2001. *Hubbert's Peak: The Impending World Oil Shortage.* Princeton, NJ: Princeton University Press.

> resources. However, there are substantial nonconventional resources, including production from oil sands, ultra-heavy oils, gas-to-liquids technologies, coal-to-liquids technologies, biofuel technologies, and shale oil, which can serve as a buffer against prolonged periods of very high oil prices.[13]

This perspective reflects the fact that increasing oil prices can make currently uneconomical oil supplies (including nonconventional alternatives) economical.

None of these factors provides irrefutable proof that high oil prices will be a persistent or permanent economic factor to be accounted for. Resource prices tend to have a counter cyclical impact on extraction rates. As oil prices increase, oil supplies will also increase, reflecting not only a faster development of currently available resources, but also the development of existing resources that had previously gone untapped because prices were not high enough to make them profitable. This increased production puts downward pressure on prices.

There are a large number of factors that will come into play in determining the long run path of oil prices. While it is certainly not proven, the possibility that world oil markets are entering a new regime of permanently or persistently higher oil prices can not be dismissed. CAFE standards and other efficiency measures can be seen as investments to hedge against the possibility of high oil prices in the long term.

CAFE MODELING SCENARIOS

To assess the impact of increased CAFE standards, we modeled four separate scenarios with a structural economic model of the U.S. economy. We used the LIFT (Long-term Interindustry Forecasting Tool) model, a 97-sector inter-industry macroeconomic model created by the Inforum modeling group. Inforum, an academic research and consulting group based at the University of Maryland, has a well-respected, 20-year track record performing macroeconomic modeling. The LIFT model tracks more than 800 macroeconomic variables, and is unique in the extent to which it builds up aggregate demand from individual industry demands at a high level of industrial detail. The consumption side of the model has 92 demand categories, arranged in functional groups that allow substitution and complementarity effects to be explicitly estimated. Equipment investment for each industry is estimated using a two-stage, three-equation system that simultaneously determines investment, labor, and energy demand. Industry wage trends are determined primarily by industry-specific labor productivity equations. The model also has a rich array of tax and fiscal policy handles and a highly detailed government sector.

In addition to the baseline or business as usual projection, we ran the model under three alternate scenarios:

> **High oil prices with current CAFE standards:** Global oil prices are assumed to fall from their current levels to approximately $40 per barrel in 2005 and to fluctuate between $37 and $42 per barrel through 2020.

> **High oil prices with increased CAFE standards:** Global oil prices behave as above, and CAFE standards are increased

[13] EIA, *Annual Energy Outlook 2005*, p. 43.

from current levels to 36 miles per gallon in 2019. This alternate CAFE policy also eliminates the differential standards for cars and light trucks. This is accompanied by incentives for producing and purchasing fuel efficient vehicles as well as for research and development, totaling $20 billion over 15 years. The fuel economy standards are phased in beginning in 2010, increasing linearly through 2019. The tax incentives are assumed to commence in 2005 at a constant rate of $1.3 billion annually.

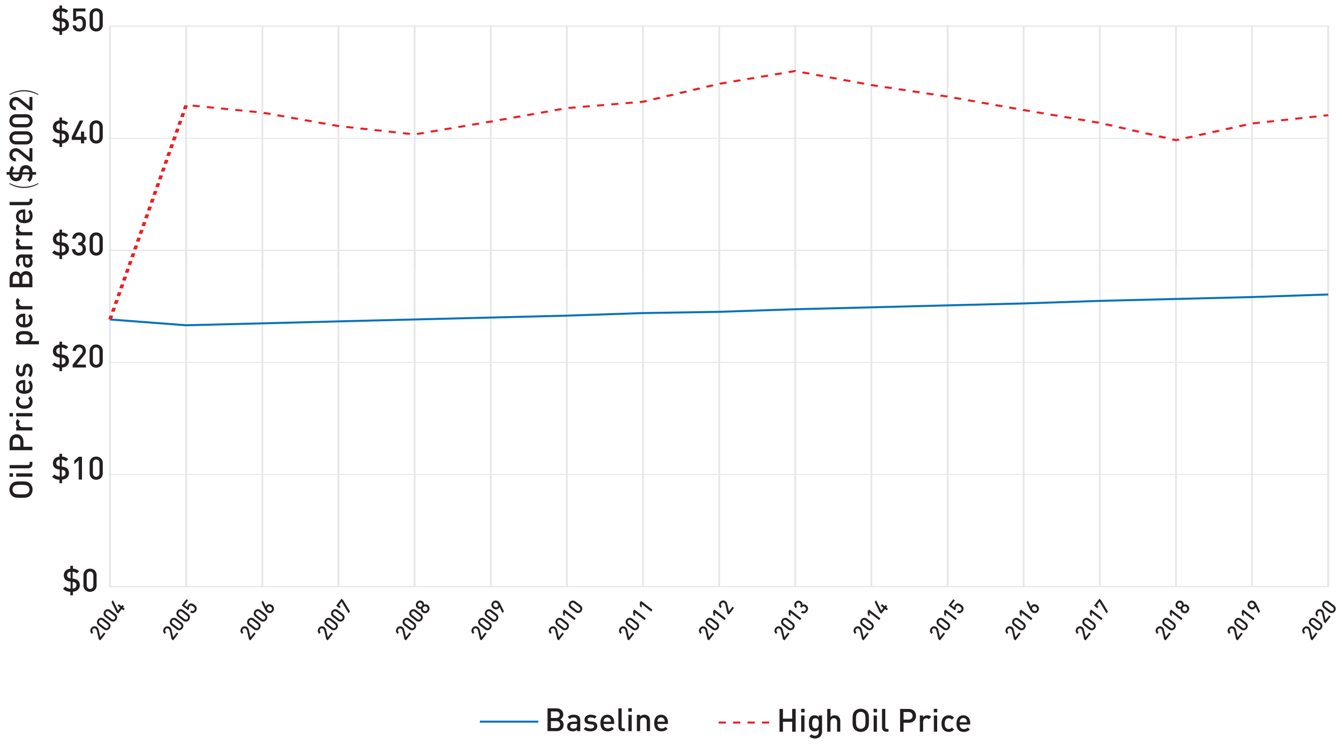
Business as usual with higher CAFE standards: Oil prices are assumed to behave as in the business-as-usual case (based on current projections from the Energy Information Administration of the Department of Energy), with increased CAFE standards as described above.

Figure 1 shows the two oil price scenarios.

Modeling the CAFE standard policy set is done through four main avenues. The main impact on the auto sector is modeled as an increase in per-unit production costs. Costs are assumed to remain at baseline levels through 2009, with increases beginning in 2010, the first year that efficiency standards begin to rise. The time path of cost increases follows the same pattern as the increase in CAFE standards. These costs are based in part on an analysis of a similar policy modeled by the Oak Ridge and Lawrence Berkeley National Laboratories in their report *Scenarios for a Clean Energy Future.*[14] The cost factors implemented were scaled back to reflect the fact that the policy set they modeled included a larger increase in CAFE standards than those considered here.

Increased fuel efficiency is modeled similarly, accounting both for the gradual phase-in of the

FIGURE 1: Oil Price Scenarios



[14] Interlaboratory Working Group, 2000. *Scenarios for a Clean Energy Future*. Oak Ridge, TN; Oak Ridge National Laboratory and Berkeley, CA; Lawrence Berkeley National Laboratory.

higher standards and automobile fleet turnover rates. Fuel consumption in the non-residential transportation sector is implemented as a reduction in per-unit consumption of fuel. Residential sector consumption is modeled as a direct reduction in fuel expenditures based on fleet penetration rates and accounting for "give back" effects in which the reduced total cost of driving (resulting from lower gasoline costs) induces a secondary effect of an increase in driving and thus of gasoline expenditures.

The tax incentives are modeled as cuts in indirect business taxes on the auto sector, based on sales. The cuts are assumed to start in 2005 and continue through 2020 at a constant rate of $1.3 billion per year. An alternative assumption that they would begin in 2010 and continue through 2020 at a rate of $2 billion per year did not produce a notable difference in the outcomes.

To reflect possible differential impacts on domestic and foreign producers, the CAFE standards are modeled so that foreign auto producers are able to meet the higher standards at a lower incremental cost than domestic producers. The sales mix of auto imports is weighted more heavily toward relatively more efficient passenger cars than domestic producers (that sell a higher proportion of less efficient light trucks). Eliminating the dual-fleet distinction would thus make a higher fleet-wide standard more costly to meet for domestic producers than for foreign producers. We were unable to derive a robust indication of how large this impact would be under a number of specifications. In the absence of solid empirical guidance, we assumed that foreign automakers would be able to meet the higher standards at half the incremental costs of domestic producers.

Increasing Japanese market share would have a mixed impact on domestic auto workers. While declines in production at American-owned facilities would obviously have negative impacts on auto sector employment, Japanese automakers are increasing their physical presence in the United States, making an increasing share of their American market autos in this country. In 2003, over 27% of foreign cars sold in the U.S. were built in the U.S. In 1993, the share of so-called "transplants" was 15%.[15] This trend appears likely to continue, particularly if the value of the American dollar continues to fall against foreign currencies.

All of these policies were implemented in a standard version of the LIFT model. Higher oil prices are modeled not only as a part of the domestic economy, but were also included in a set of runs with our major international trading partners. Higher prices are thus allowed to affect both domestic and foreign prices and quantities, and the impacts on international trade flows are included as part of the high oil price scenarios.

[15] Davis and Diegel, 2004

RESULTS

The results of our analysis of the scenarios are consistent with economic theories surrounding multifactor productivity and product complementarity. The principal result surrounds the impacts of oil prices and CAFE standards on auto sector employment. As shown in Figure 2, persistently high oil prices slow the growth of auto sector employment significantly, resulting in reduced employment, averaging about just under 10,000 jobs or 1.61% annually. Importantly, CAFE standards can act as a buffer against the impacts of higher oil prices. In the high oil price scenarios, auto sector employment is higher with higher CAFE standards in place. This is due to a combination of the reduction in multifactor productivity growth and higher revenues for domestic auto producers. As shown in Figure 3, the value of domestic auto production is significantly higher with CAFE standards in place, reflecting the fact that domestic autos with higher fuel economies are more competitive when oil prices are high.

In fact, the dollar value of the domestic auto output is actually higher with higher oil prices and CAFE standards than in the baseline scenario, indicating that the increase in the price of autos caused by higher CAFE standards are not entirely offset by reduced sales volume as measured in physical units (rather than dollars). This reflects the relatively inelastic nature of demand for auto ownership (both for household and business consumers), as owning a car or truck is increasingly treated as a necessity rather than a luxury. Figures 4 and 5 show the results for auto sales in physical units and unit prices.

The impacts of CAFE standards on oil imports are substantial as shown in Figure 6. It is worth noting that the reduction in imports resulting from higher oil prices and increased CAFE standards is more than twice the reduction resulting from higher oil prices alone. Because oil consumption is relatively insensitive to oil price changes, at least in the short run, oil imports fall disproportionately little in relation to the increase in oil prices (which are about 66% higher in the two high oil price scenarios). Oil imports are much more responsive to increases in CAFE standards, however. This leads to the conclusion that in the short to medium term, increasing CAFE standards or other efficiency measures are more likely to reduce oil imports and consumption than economic factors like rising oil prices or economic policies such as taxes on gasoline or pollution emissions.

FIGURE 2: Auto Sector Employment

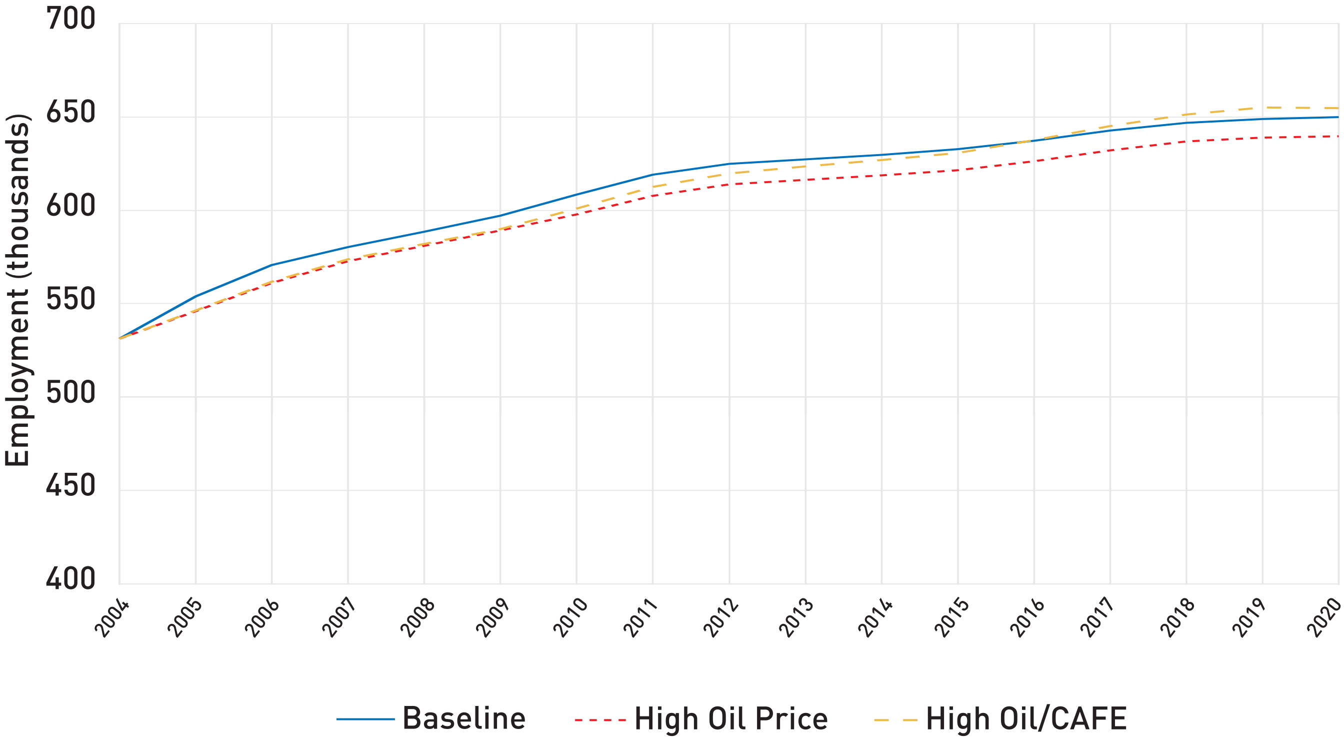


FIGURE 3: Auto Sector Output

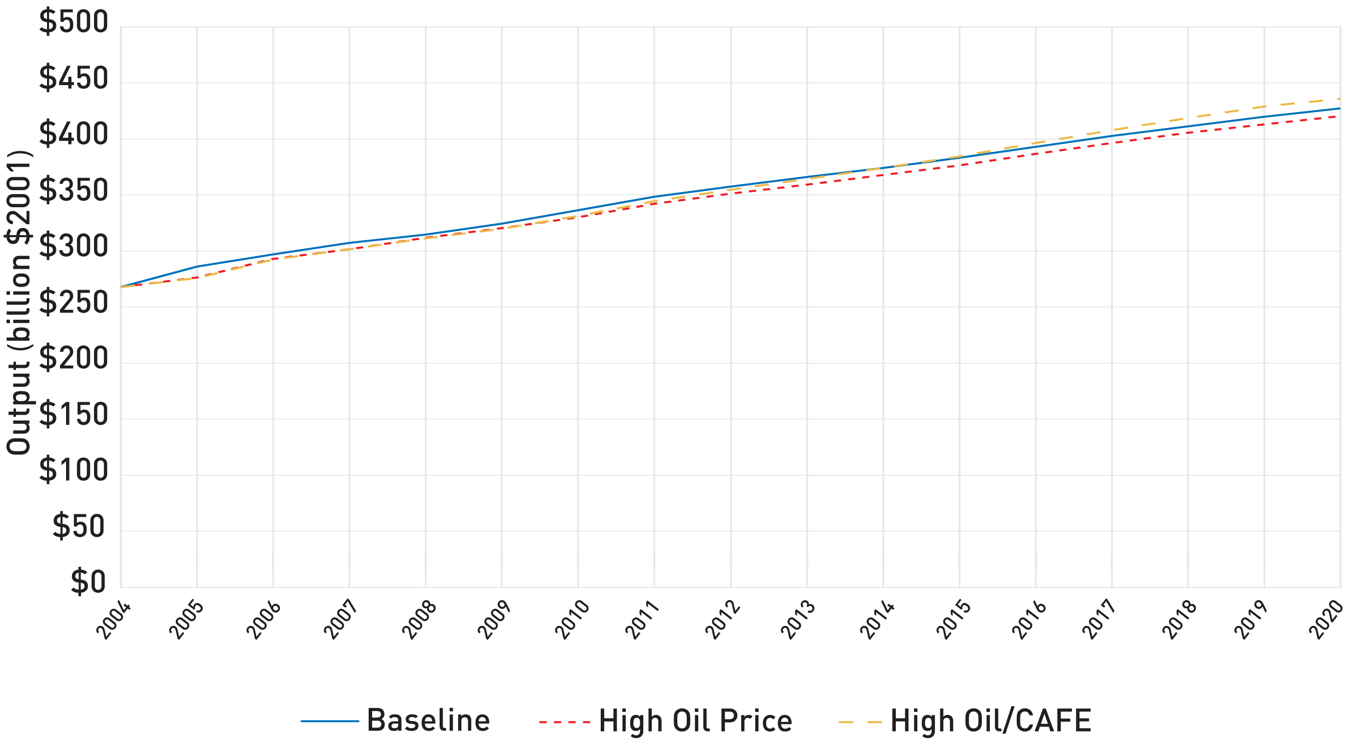


FIGURE 4: Auto Sector Output

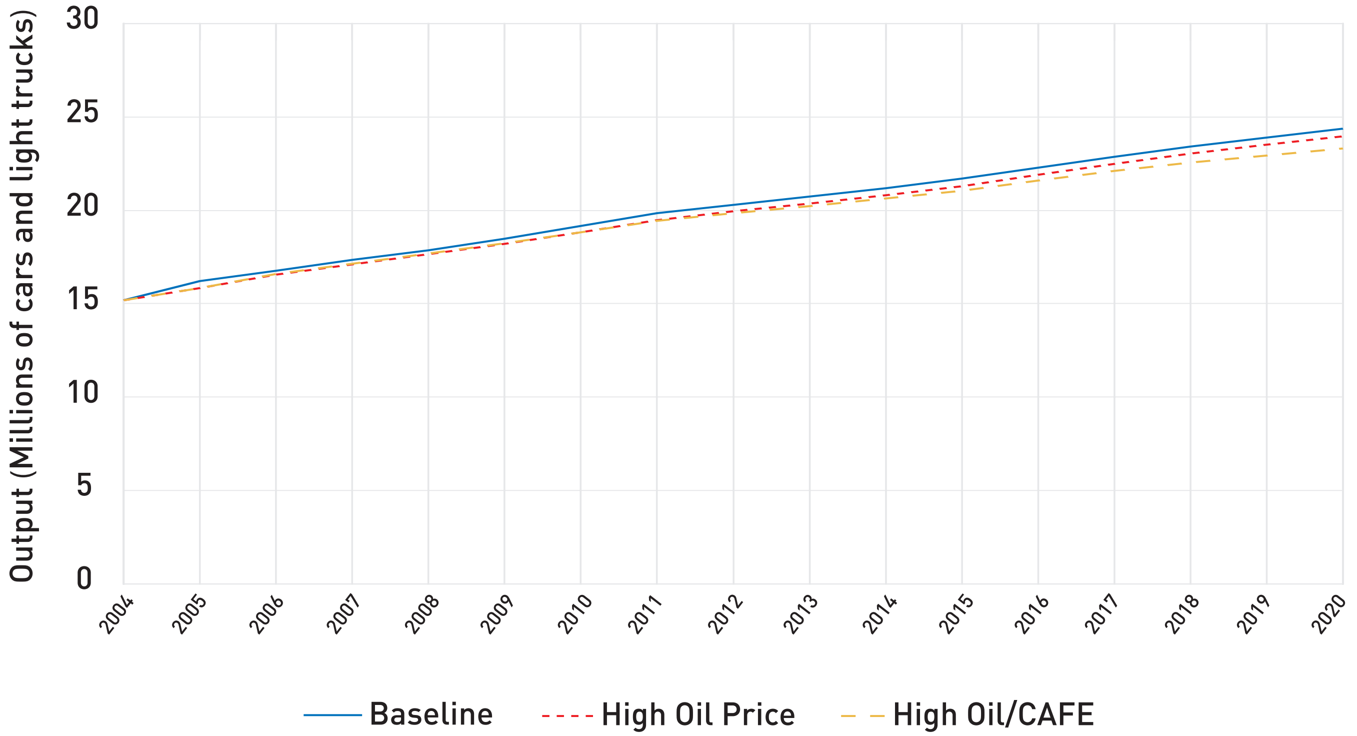


FIGURE 5: Domestic Auto Prices

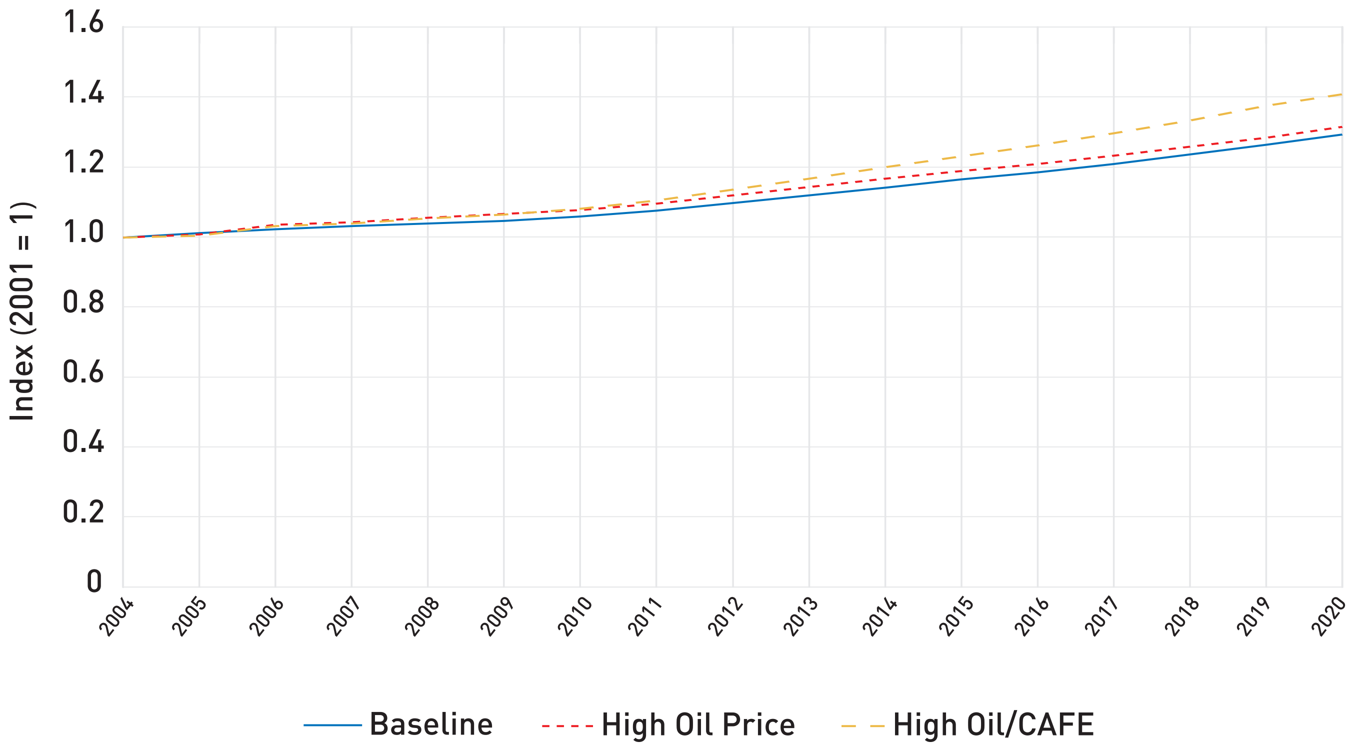
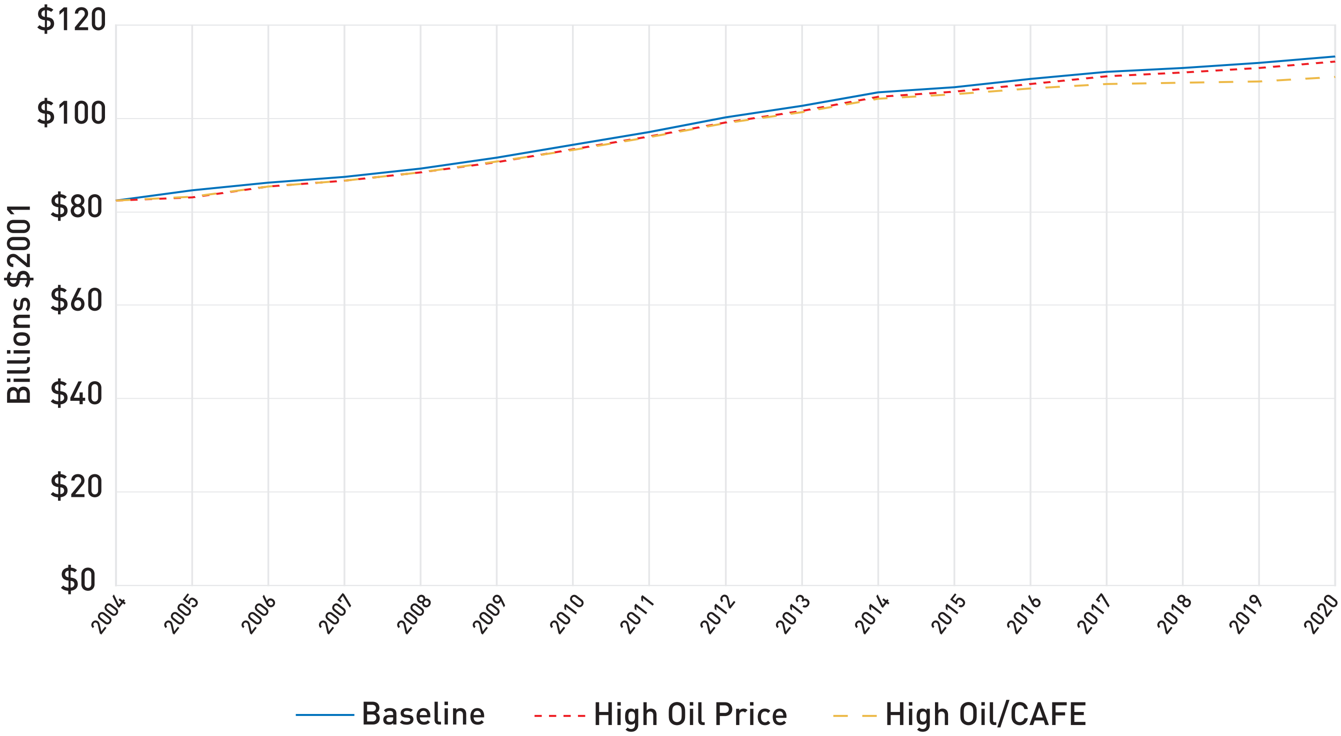


FIGURE 6: Oil Imports



CONCLUSIONS

The main conclusion of our scenario analysis is that increased fuel economy standards are consistent with growing employment in the U.S. auto sector. While many fear that updating CAFE standards would cause widespread unemployment in auto and related sectors, our analysis indicates that the opposite is true. Particularly in future scenarios with persistently high global oil prices, increased CAFE standards can help preserve the competitiveness of domestic automakers. While persistently high oil prices are not a certainty, CAFE standards appear to provide some measure of insurance, at least for auto sector employment, against such an event.

In addition to these impacts, our analysis implies that CAFE standards are far more effective at reducing oil consumption and the associated pollution than economic stimulus (either through global oil price increases or pollution reduction policies).