Economic Costs of America's Dependence on Oil

James D. Hamilton
jhamilton@ucsd.edu
Department of Economics
University of California, San Diego
August 28, 2012

ABSTRACT

This chapter surveys the economic costs of America's dependence on oil. Oil supply disruptions and price spikes were a contributing factor in a number of historical U.S. recessions, and there is a significant likelihood of repeating that experience within the next 5 years. The channels by which oil shocks contributed to historical recessions are reviewed and the financial and geopolitical strains associated with the U.S. oil import bill are discussed. The vulnerability of the United States to another oil-related recession within the next presidential term is evaluated, as are policy options to mitigate the effects.

1. Historical oil supply disruptions and price spikes.

What would happen if the world suddenly had to cope with a 5% drop in oil production? This is not a hypothetical question, but one for which we have ample historical experience on which to base an answer. Figure 1 summarizes what happened in the aftermath of four different historical conflicts in the Middle East. Following the Arab-Israeli War in October 1973, the Arab members of the Organization of Petroleum Exporting Countries announced cutbacks that amounted to 7.5% of global output, as seen in the solid line in the top panel of Figure 1. Increases in production from other countries such as Iran offset only a small part of this, with the net decline in total world production indicated in the dashed line of the top panel. Other comparable disruptions to world oil supplies resulted from the Iranian Revolution in 1978-79, the beginning of the Iran-Iraq War in September 1980, and the First Persian Gulf War which began in August 1990. World oil production after each of these events is graphed in the four panels of Figure 1.

The drop in oil production in the affected countries, the magnitude by which net world production fell, and the amount by which the price of crude oil increased after each of these four events are summarized in Table 1. It is worth noting that each of these episodes was followed by an economic recession in the United States. The dates at which the recessions began are given in the last column of Table 1.

More recently, we have practical experience with a related question-- what happens when oil production has trouble keeping up with growing demand? The solid line in Figure 2 shows total world oil production since 2002. Apart from economic recessions and geopolitical disruptions such as those discussed above, this had been increasing steadily for a century and a half until 2005. However, world oil production was basically stagnant for the next four years, and has increased only modestly since 2009. There are a variety of factors behind this, including declining production from the North Sea and Mexico (which accounted for 13% of world production in 1999) and the failure of Saudi production (13% of world production in 2005) to increase since 2005 (see Hamilton (2012a) for further discussion).

Although supply has been stagnant, the demand curve has continued to shift up. The IMF (2012) estimates that world GDP increased a cumulative 17.5% (logarithmically)[1] during 2005, 2006, 2007, and 2008, while world oil production increased only 2.8% over these same 4 years. If the price of oil had not gone up between 2004 and 2008, what would we have expected oil demand to be? The answer to this question depends on the income-elasticity of demand, which summarizes the expected percent change in the quantity demanded associated with a 1% increase in income if there is no change in the oil price. The income elasticity tends to be around 0.5 for a developed country like the United States, but closer to 1.0 for emerging economies (Gately and Huntington, 2002). Most of the growth in world GDP and oil consumption since 2005 has come from the emerging economies. For illustration, consider the implications if we assume a worldwide average income-elasticity of 0.75. In this case, if the price of oil had

[1] Throughout this chapter we will be reporting percent changes in logarithmic terms. For Δ near 0, it can be shown that the difference in natural logs, $\ln(x + \Delta) - \ln(x)$ is approximately equal to the percentage change expressed as a fraction ($\ln(x + \Delta) - \ln(x) \approx \Delta/x$). Uses of logarithms has numerous advantages over percent changes, however, such as a 4% (logarithmic) increase followed by a 4% logarithmic decrease puts the value exactly where it started, something not true of a 4% increase followed by a 4% decrease as usually defined. This is particularly important for the cumulative calculations reported here. Moreover, economists formally define elasticities in terms of responses of natural logs. Thus whenever we use the expression "percent change" or "percent change (logarithmically)" in the text, we are referring to the value of 100 x $\ln(x_2/x_1)$.

not increased between 2005 and 2008, we might have anticipated global oil demand to have increased by (0.75)(17.5%) = 13.1%. Such calculations suggest that, if the price of oil had not increased since 2004, and if world GDP had grown by the amount observed since then, oil consumption could have reached 93.4 mb/d in 2008 and 99.5 mb/d in 2011, as shown in the dashed line in Figure 2.

Of course, the price of oil would not stay constant in such a situation, but would have to increase to ensure that supply does equal demand. How big a price increase is needed depends on the price-elasticity of demand, which summarizes the percent change in quantity demanded associated with a 1% increase in the price. A number of studies suggest that the price-elasticity may be less than 0.1 in the short run, with somewhat larger responses given more time to adjust, for example, as the fuel efficiency of the stock of automobiles in use gradually adjusts to higher prices (Hamilton, 2009a). If we used a price elasticity of 0.1, in response to the 13.1% - 2.8% = 10.3% supply shortfall in 2008, the price would thus be predicted to rise by a factor of $e^{0.103/0.1} = 2.8$, or from $50 a barrel at the end of 2004 to $140 a barrel in 2008. A greater price elasticity of 0.2 would imply an increase in the price of only $e^{0.103/0.2} = 1.67$, or $84/barrel in 2008. Much if not all of the spike in oil prices in the first half of 2008 can thus be attributed to a relatively inelastic response of demand to the price increases, with the subsequent conservation response one reason in addition to the financial crisis for the collapse in prices later that year (Hamilton, 2009b). Using that same 0.2 price elasticity, the 2011 supply shortfall in Figure 2 would imply a current price around \$50 x $e^{0.134/0.2}$ = $98/barrel.

The oil price spike of 2007-2008 was also followed by a recession. The most important factor in this recession was the financial crisis in the fall of 2008. However, the recession is dated by the National Bureau of Economic Research as having begun in 2007:Q4, a year before the failure of the financial giant Lehman Brothers. As will be discussed below, what happened in the U.S. economy in the year before Lehman is quite similar to what was observed following the four oil supply shocks summarized in Table 1.

There are a number of other examples in the historical record, such as the Suez Crisis of 1956-57, gasoline shortages and price increases in 1948, and a sharp run-up in oil prices in 1999-2000. Each of these was also followed by an economic recession in the United States. In fact, there have been 11 recessions in the United States since World War II, and 10 of these were preceded by a spike up in the price of oil (see Hamilton (2012a)). The price of oil is graphed in relation to the 6 most recent U.S. recessions in Figure 3.[2]

2. Effects on production capabilities.

How do oil shocks affect U.S. GDP? One's first thought might be that because energy is such a fundamental part of any economic activity, a disruption in the supply would have to exert significant economic effects. However, when you dig into the details of this relation, the argument is less compelling than it might initially appear.

Any individual firm, faced with an increase in the price of energy, has a choice between buying the same amount of energy as before (and just paying more for its total

[2] The price index is reported in units of 100 times the natural logarithm, so that a vertical move of 10 units corresponds to a 10% (logarithmic) increase in price, and is relative to the 1947:M1 value. For example, the value of 76 for the first entry implies that the nominal price of oil in 1971:M1 was 76% above the value in 1947:M1.

energy bill) or cutting back on use of energy (which would leave it able to produce less than it did before or raise other costs). Either option would mean lower profits, and firms would be expected to choose the option whose impact on the bottom line is smaller. But it's easy to calculate the dollar value that firms collectively would lose if they all followed the first option, and this sum is significantly less than the dollar value of the total loss in GDP associated with a typical recession.

Consider for example the oil embargo of 1973-74. Prior to the embargo, the U.S. had been consuming petroleum and products at a rate of 6.3 billion barrels annually. At the January 1974 price of $10.11 per barrel of crude oil, a 7% reduction in the quantity consumed would have an annual value of $4.5 billion. But by 1975:Q1 (the low point in the recession), U.S. real GDP (measured in 1973 prices) was $43 B lower than it had been in 1973:Q3 (right before the embargo began), and $65 B (again in 1973 prices) below the value that the Congressional Budget Office characterizes as "potential" GDP for 1975:Q1. The dollar value of GDP that is lost in an economic recession far exceeds the dollar value of the lost oil itself.

The argument above assumed that one option for an individual firm would have been to go ahead and buy as much oil as before but pay a higher price. While that may be an option for an individual firm, it is not an option for the economy as a whole, since somebody somewhere must reduce their physical consumption of the product given the real nature of the underlying geopolitical disruption. One possibility is that other economic changes besides the price factor into energy users' decisions, and that ultimately it is lower income (and lower demand for the firms' products) rather than the higher price of energy itself that persuades firms to cut back on energy use. However, this leaves unanswered the mechanism behind such adjustments.

Ramey and Vine (2010) maintained that one reason that the economic damages in some of these episodes was larger than the bound calculated above is that, as a result of rationing, many users may want to buy the product but are unable to obtain it, even at the higher price. For example, here is what the *Wall Street Journal* reported on January 10, 1974:

> Service stations and local officials are trying to impose some order on the doling out of skimpy gasoline supplies, to avert a repetition of the panic buying and long lines of the Christmas and New Year's holidays....
>
> some outlets are refusing to sell except by appointment, and then to drivers they know.
>
> Most are imposing limits on how much gasoline they will sell, to stretch available supplies. But in open disgust with motorists who form lines when they need but a few gallons to top out their tanks, some dealers are trying to figure out ways to shoo away motorists who have more than a half tank of fuel.

Similar accounts followed the overthrow of the Shah of Iran in January 1979. Hamilton (2012a) noted this report from the *New York Times*:[3]

> LOS ANGELES, May 4, 1979-- Throughout much of California today, and especially so in the Los Angeles area, there were scenes reminiscent of the nation's 1974 gasoline crisis.
>
> Lines of autos, vans, pickup trucks and motor homes, some of the lines were a half mile or longer, backed up from service stations in a rush for gasoline that appeared to be the result of a moderately tight supply of fuel locally that has

[3] *New York Times,* May 5, 1979, p. 11.

been aggravated by panic buying.

There were also accounts of rationing directly affecting production decisions of some firms. For example, Lee and Ni (2002) noted this description of problems facing chemical manufacturers in 1973[4]

> [t]he valve that limited [chemical] production growth was on the supply end of the flow chart, not the demand end. This was particularly true of organic chemicals where shortage of crude oil and natural gas, and the Arab oil embargo put a squeeze on petroleum feedstocks.

And consider this account of problems facing aluminum manufacturers:[5]

> Kaiser Aluminum & Chemical Corp. declared force majeure effective immediately on aluminum wire and cable product shipments.... Kaiser ... attributed its move to the serious shortage of natural gas needed to operate the rod generator at its Tacoma, Wash., works.

To the extent that rationing has not been a feature of oil shocks since 1981, Ramey and Vine (2010) suggested that this could be one reason why an oil price increase of a given size would be associated with smaller economic disruptions in the more recent data than seemed to be the case in the 1970s.

However, a salient characteristic of any economic recession, including those in the 1970s, is that the key problem facing most firms was not that they were unwilling or unable to produce more, but instead that customers weren't buying the product in the same quantities as earlier. It is therefore worth investigating the channels by which oil supply disruptions and price increases influence the level of demand for other U.S. goods

---

[4] *Chemical and Engineering News*, May 6, 1974, p. 10
[5] *Wall Street Journal*, Jan 10, 1974, p. 4.

and services.

3. Effects on the level and composition of spending.

The short-run response of most consumers to a gasoline price increase is to choose the first option discussed above in the analysis of the production decisions of individual firms. Most consumers try to go on filling their cars with gasoline, despite its higher price, and are therefore forced to make cutbacks in spending elsewhere. Consider the magnitude of this effect on a typical consumer's budget. The portion of the budget that goes to energy goods and services varies substantially over time, rising sharply when energy prices go up (see Figure 4). Spending on energy goods and services also varies significantly across consumers, with energy representing twice as big a share of total spending for households in the lowest income quintile compared to those in the top quintile (see Carroll, 2011). For illustrative calculations, consider a household that spends 5% of its budget on energy goods and services. Suppose that the price of energy goes up 20%, and the consumer tries to buy the same quantity of energy as before and does not change its saving behavior. Then spending on non-energy goods and services would have to decline by 1%.

What do consumers actually do in practice?[6] Edelstein and Kilian (2009) studied this question on the basis of a system of regression equations that summarized the historical relation between energy prices and consumer spending. With these one can answer questions like the following. Suppose that at time 0, consumers face an increase

[6] This discussion closely follows Hamilton (2009b).

in energy prices that would imply a 1% decrease in their ability to buy other goods or services if they make no change in energy consumption (for example, if energy costs go up 20% at a time when energy costs constitute 5% of average consumer spending). Figure 5 plots what is known as the "impulse-response function" from Edelstein and Kilian's estimated system. This indicates the change in the model's forecast of real consumption spending *k* months after energy costs go up. This is essentially a statistical summary of what actually did happen on average historically over the period for which the model was estimated (in this case, 1970:M7 to 2006:M7). The evidence shows, not surprisingly, that when energy costs go up, consumers indeed spend less on other items. But two details of the estimated response are surprising. The first is the magnitude. The graph shows how consumers respond following a 1% loss in their overall purchasing power, which, if they bought the same number of gallons of gasoline and watts of electricity, would force them to consume 1% less of other items. But the observed response is that over time, consumption spending drops by a little over 2%. Why should consumption fall by even more than the direct hit to household budgets? A second puzzle concerns the timing. The impact on household budgets occurs at time 0, but the biggest response doesn't come until 6 months later.

To try to answer these puzzles, Edelstein and Kilian (2009) looked at the specific components of consumption spending. Figure 6 displays the responses broken down in terms of the three main categories of consumption spending-- services, nondurable goods, and durable goods, the latter consisting of items like appliances, furniture, and motor vehicles. Durable goods, the big-ticket items that consumers can postpone purchasing, is the category in which the most significant responses are observed. Within this category, spending on motor vehicles (first panel of Figure 7) is by far the most dramatic. In contrast to the response of overall consumption spending, a big drop in motor vehicles purchases comes fairly quickly after energy prices go up. Another indicator for which we see a big immediate response is consumer sentiment (second panel of Figure 7).

Researchers have found related patterns in the response of the output of individual firms or sectors to an oil price increase. Herrera (2012) found that motor vehicles sales and production fall immediately in response to an oil price increase, with additional later declines as firms try to liquidate unintended inventory accumulation. Production from industries that sell to the auto sector, such as rubber and primary metals, follow autos down with a lag. Such results suggest that the growing impact over time results from macroeconomic feedback effects. As consumers spend less on key sectors such as autos, the loss in income and jobs in those sectors leads to further cutbacks in spending for other sectors. The eventual loss in GDP turns out to be significantly larger than the effect arising from reduced purchasing power alone.

Is the automobile sector big enough by itself to make a difference for the overall economy? Although autos are usually a small percentage of total GDP, they are a much bigger part of the drop in GDP that is observed during postwar recessions. Table 2 summarizes what happened following the 5 episodes highlighted in Section 1. U.S. real GDP fell in the 5 quarters following each of these oil price increase. Moreover, if auto production and sales had simply stayed constant instead of falling, real GDP would have increased instead of fallen in 3 of these 5 episodes. Ramey and Vine (2010) documented extensively the important role that the auto sector historically played and continues to play in U.S. economic recessions.

The contribution of oil prices to the beginning of the most recent recession is worth examining in more detail. Hamilton (2009b) used the models that Edelstein and Kilian (2009a) had fit to data through the first half of 2006 to try to describ what subsequently happened in the U.S. up until the collapse of Lehman in September 2008. The dotted lines in Figure 8 indicate the baseline forecasts of the models, given no information about what was about to happen after September 2007, while the solid lines indicate the actual paths of consumer spending, spending on motor vehicles, and consumer sentiment. The dashed lines indicate the contribution to those paths of energy prices alone, based on the relations estimated on earlier data. Energy prices can account for about half of the slowdown in overall consumer spending prior to the financial crisis. Most of the decline in auto sales and consumer sentiment through the early part of 2008, and about half of the decline through the summer of 2008, would be attributed to the role of energy prices alone.

None of this is to deny that the financial crisis itself in the fourth quarter of 2008 was the key reason that we now refer to the entire episode from 2007:Q4 to 2009:Q2 as the "Great Recession." However, it seems indisputable that energy prices made a material contribution to the first year of this downturn, and that these declines in income and consumer sentiment unquestionably aggravated problems households faced in making their mortgage payments. Hamilton (2009b), Cortright (2008), and Sexton, Wu, and Zilberman (2012) noted that the biggest house price declines and foreclosure rates were experienced by areas for which the commuting distance from central work places was greatest.

The evidence thus strongly suggests that oil supply disruptions and price spikes were a contributing factor in a number of U.S. recessions, including the most recent one.

4. Financial consequences of U.S. dependence on imported oil.

A separate channel from the mechanisms analyzed above arises from the wealth transfer involved in U.S. imports of oil. In 2011, the U.S. spent $462 billion on imports of petroleum and petroleum products.[7] Adding petroleum together with imports of all other goods and services, last year the U.S. spent $568 billion more on imported goods and services than we sold to other countries, with petroleum imports accounting for more than 80% of the total current account deficit. Because the dollar value of our total imports exceeds that of our exports, payment for imported oil involves a wealth transfer, either in the form of borrowing from foreign lenders to pay for the oil we buy today, or transferring ownership of U.S. assets to foreigners.

The cumulative consequences of this over the last generation have been enormous. One way to accumulate the history of U.S. oil imports in terms of 2011 dollars is to consider the consequences if each dollar of imported oil had ultimately been financed by foreign purchases of U.S. Treasury debt.[8] That calculation leads to a cumulative wealth transfer of U.S. oil imports since 1973 equal to $10.3 trillion when valued in 2011 dollars. That works out to almost $33,000 for every person in America or $131,000 for a family of four.

---

[7] See Bureau of Economic Analysis, Table 4.2.5.

[8] In other words, calculate $D_t = (1+i_{t-1})D_{t-1} + P_t$ for P_t the dollar value of U.S. petroleum imports in year t and i_{t-1} the annual interest rate on a 10-year U.S. Treasury bond as of the end of year t - 1 (expressed as a fraction of 1, e.g., a 5% annual interest rate corresponds to $i_t = 0.05$) and starting with $D_0 = 0$ for t corresponding to 1972.

Much of this huge transfer of wealth has gone to support regimes and individuals that are openly hostile to the United States. For example, a principal motivation for the U.S. military intervention in Iraq was concern about the military power that oil revenues were bringing to Saddam Hussein, and money from wealthy Middle East families appears to have helped finance direct terrorist attacks against U.S. interests. The government of Iran has used its oil revenues in a way that destabilizes the region and directly threatens U.S. interests.

Aside from the sheer size and geopolitical consequences, the transfer of wealth from the United States to oil-producing countries raises a number of other economic concerns as well. The U.S. current account deficit is a key element of the global imbalances that raise a number of challenges for the U.S. and the world economy. Caballero and Krishnamurthy (2009) and Portes (2009) are among the economists who have suggested that the accumulation of wealth by foreigners seeking high-yield but low-risk investments in the United States was an important cause of the proliferation of toxic leveraged assets that proved to be instrumental in the housing boom and subsequent bust. This is an additional channel, separate from those discussed in Section 3, by which oil may have made a contribution to the financial crisis of 2008.

While the inflows of reinvested petrodollars can be destabilizing, an even greater concern arises from the possibility of rapid outflows. Unless the U.S. could find a way to reduce oil imports, the most likely means by which the U.S. current account could be restored to balance would be through a significant depreciation of the dollar. If this happens gradually, the disruptions should be manageable. But another possibility is that it could come in the form of a sudden capital flight and acute currency crisis which could be highly destructive. Obstfeld and Rogoff (2005) warned that:

> It would seem to us that any sober policymaker or financial market analyst ought to regard the United States current account as a potential Sword of Damocles hanging over the global economy.

5. Vulnerability of the U.S. economy to further shocks.

This chapter began with a review of 4 historical episodes-- the OPEC oil embargo of 1973-74, Iranian Revolution of 1978-79, Iran-Iraq War beginning in 1980, and the First Persian Gulf War in 1990-91-- which were associated with major disruptions in world petroleum production and significant economic costs to the United States. To these one could add the Suez Crisis of 1956-57 (which was also followed by an economic recession), and more minor disruptions in which only 2% or so of world production was lost and no economic recession was experienced, such as the Venezuelan unrest and Second Persian Gulf War beginning in 2003 or the Libyan Revolution in 2011. Anyone looking at this history objectively, and aware of the fact that 42% of the world's oil is currently coming from Africa and the Middle East, would have to judge the probability of another significant disruption some time over the next 5-10 years as quite high.

Moreover, someone who knew none of the history, but was simply taking note of current geopolitical tensions, would reach a very similar conclusion. It takes little imagination to picture the current unrest in Syria or tensions with Iran developing into a much bigger conflict within a matter of weeks. Sporadic fighting in places like Sudan and Nigeria has also been a feature of the daily news that could easily develop into something much bigger very quickly. Rapid political changes and unrest could also come for oil producers such as Russia (which accounts for 12% of current oil supply), Venezuela (3%), or Kazakhstan (2%). Twenty percent of the world's oil currently is transported through the Strait of Hormuz. If military conflict were to halt these shipments, it would represent a shock to global supplies 3 times as big as any of those detailed in Table 1.

Moreover, as noted above the damaging oil spike of 2007-2008 was caused not by any geopolitical disruption but instead by the longer-run pressure of growing demand for oil from the emerging economies running up against the fact that the world had a hard time increasing total production. The extent to which those trends are going to continue to hold is of course difficult to forecast. If there is a major economic downturn in China, or if Iraq succeeds even in small part in its extremely ambitious plan to add 11 million barrels/day of production, we would likely see a significant drop in the price of oil. However, the most likely scenario is that we will see similar developments over the next decade as we did over the previous. Despite the enormous growth over the last decade, per capita oil consumption of China today is only 1/3 that of Mexico. The baseline forecast should call for continued rapid growth in oil consumption from the emerging economies, and growing oil consumption (meaning lower net oil exports) from the oil producers themselves. It is hard to see how world oil production could continue to keep pace with this growing demand. The single most likely scenario is that the next 10 years will look much like the last, with a possible replay of what we saw in oil markets in 2007-2008 a very good possibility.

In conclusion, whoever wins the presidential election in 2012 should consider the very likely possibility that during his first term in office he will have to deal with a situation like those reviewed in this chapter. Obviously the best plan would be to try to begin programs immediately that would minimize the economic (and political) losses that accompanied the historical episodes reviewed in this chapter.

6. The case for presidential action.

If relying so heavily on oil has such significant economic costs, some might ask why wouldn't it be in consumers' and firms' own best interests to choose on their own to make more use of alternative fuels, without needing any government action to encourage those decisions? One answer has to do with the economic concept of externalities. While some of the costs are indeed borne by the individual user, the broader economic costs discussed above as the downturn develops into an economic recession are not. Of additional relevance is the economic concept of network externalities, a phenomenon studied for example by Katz and Shapiro (1986). These arise in the present case from the fact that even if I as an individual consumer perceive it would be in my interests to drive a car that operated on a fuel other than gasoline, unless there are significant numbers of other consumers already doing the same thing, I would not choose to make the change on my own. The reason is that I rely on a larger infrastructure to support my decision, needing multiple and convenient locations for refueling and repair. The result is, if America relies on the "private market" to make these changes by itself, we would not make the transition at the point that is optimal from a societal point of view.

There are many government activities, such as operation of municipal fleets, for which the refueling and maintenance can be highly localized, and which, if the public is offered access to those same facilities, could serve as the nucleus for change. Use of natural gas for municipal transportation needs is already being adopted to some degree, and its broader use (and opportunity for the private sector to share the facilities) could be further encouraged.

Moreover, there are numerous government regulations that significantly add to the cost of marketing private transportation vehicles that rely on alternative fuels. While this regulatory approach made sense for dealing with a mature industry in which anticipated volumes are huge and annual changes are relatively minor, they can be crippling for small innovative entrepreneurs, who are exactly the creative force that the private market (and the country) needs to tap in order to deal with the energy challenges facing America's future.

Moreover, the key to a constructive vision of America's future is to recognize areas in which the U.S. has been successful and make sure we take maximal advantage of them. Although the challenges for keeping petroleum production up with growing demand are significant, there have been important breakthroughs in terms of the supply situation for some alternative fuels. For example, the graph of "total oil supply" in Figure 2 includes biofuels and natural gas liquids, which in fact account for about half of the total increase in global production since 2005. Natural gas liquids are hydrocarbons with a higher energy content than methane (the component of conventional natural gas) which can be separated out from methane at natural gas processing facilities. Ethane and propane account for 80% of the natural gas liquids currently being produced. Ethane currently is not used as a transportation fuel at all, and propane relatively little. New production methods have produced very significant new quantities of methane, which again sees relatively little use in the United States as a transportation fuel.

Developing technologies to make use of these resources would create dynamic new industries for the United States. If we could develop an early lead in the race to do so, it could be a significant source of U.S. exports as well.

The President faces a choice. One option is to wait for the next disaster before reacting. The other option is to develop a vision of an America that is more diversified in the kinds of energy we rely on, communicate that vision to the public, and begin right now the process of assisting in the transition.

References

Caballero, Ricardo J., and Krishnamurthy, Arvind (2009), “Global Imbalances and Financial Fragility,” *American Economic Review Papers and Procedings,* 99: 584-588.

Cortright, Joe. 2008. "Driven to the Brink: How the Gas Price Spike Popped the Housing Bubble and Devalued the Suburbs," Discussion paper, CEOs for Cities.

Carroll, Daniel (2011), “The Cost of Food and Energy across Consumers,” *Economic Trends* (March 14), Federal Reserve Bank of Cleveland (http://www.clevelandfed.org/research/ trends/2011/0411/01houcon.cfm).

Edelstein, Paul and Kilian, Lutz (2009), “How Sensitive are Consumer Expenditures to Retail Energy Prices?”, *Journal of Monetary Economics,* 56: 766-779.

Gately, Dermot, and Huntington, Hillard G. (2002), “The Asymmetric Effects of Changes in Price and Income on Energy and Oil Demand,” *Energy Journal* 23(1): 19-55.

Hamilton, James D. (2009a), “Understanding Crude Oil Prices,” *Energy Journal* 30, pp. 179-206.

_____ (2009b), “Causes and Consequences of the Oil Shock of 2007-2008,” *Brookings Papers on Economic Activity,* Spring 2009: 215-261.

_____ (2012a), “Historical Oil Shocks,” in Randall Parker and Robert Whaples eds., *Handbook of Major Events in Economic History*, Routledge.

_____ (2012b), “Oil Prices, Exhaustible Resources, and Economic Growth,” in Roger Fouqet, ed., *Handbook of Energy and Climate Change*, Edward Elgar Publishing.

Herrera, Ana Maria (2012), “Oil Price Shocks, Inventories and Macroeconomic Dynamics,” working paper, University of Kentucky.

International Monetary Fund (2012), *World Economic Outlook* (http://www.imf.org/external/pubs/ft/weo/2012/01/pdf/text.pdf).

Katz, Michael L., and Shapiro, Carl (1986), “Technology Adoption in the Presence of Network Externalities,” *Journal of Political Economy* 94: 822-841.

Obstfeld, Maurice and Rogoff, Kenneth S. Rogoff (2005), “Global Current Account Imbalances and Exchange Rate Adjustments,” *Brookings Papers on Economic Activity*, 2005 (no. 1): 67-123.

Portes, Richard (2009), “Global Imbalances”, in *Macroeconomic Stability and Financial Regulation: Key Issues for the G20,* edited by Mathias Dewatripont, Xavier Freixas, and Richard Portes, CEPR.

Ramey, Valerie A. and Vine, Daniel J. (2010), “Oil, Automobiles, and the U.S. Economy: How Much have Things Really Changed?”, in Daron Acemoglu and Michael Woodford, eds., *NBER Macroeconomics Annual 2010,* pp. 333-368.

Sexton, Steven, Wu, JunJie and Zilberman, David (2012), “How High Gas Prices Triggered the Housing Crisis: Theory and Empirical Evidence,” working paper, U.C. Berkeley.

Table 1. Major historical oil supply disruptions.

Date	Event	Supply cut (local)	Supply cut (global)	Price change	Recession start
Nov 1973	OPEC embargo	7%	7%	51%	Dec 1973
Nov 1978	Iran revolution	7%	4%	57%	Feb 1980
Oct 1980	Iran-Iraq War	6%	4%	45%	Aug 1981
Aug 1990	First Gulf War	9%	6%	93%	Aug 1990

Table 2. Real GDP growth (annual rate) and contribution of autos to the overall GDP growth rate in five historical episodes.

Period	GDP growth rate	Contribution of autos
1974:Q1-1975:Q1	-2.5%	-0.5%
1979:Q2-1980:Q2	-0.4%	-0.8%
1981:Q2-1982:Q2	-1.5%	-0.2%
1990:Q3-1991:Q3	-0.1%	-0.3%
2007:Q4-2008:Q4	-0.7%	-0.7%

Source: Hamilton (2012a).

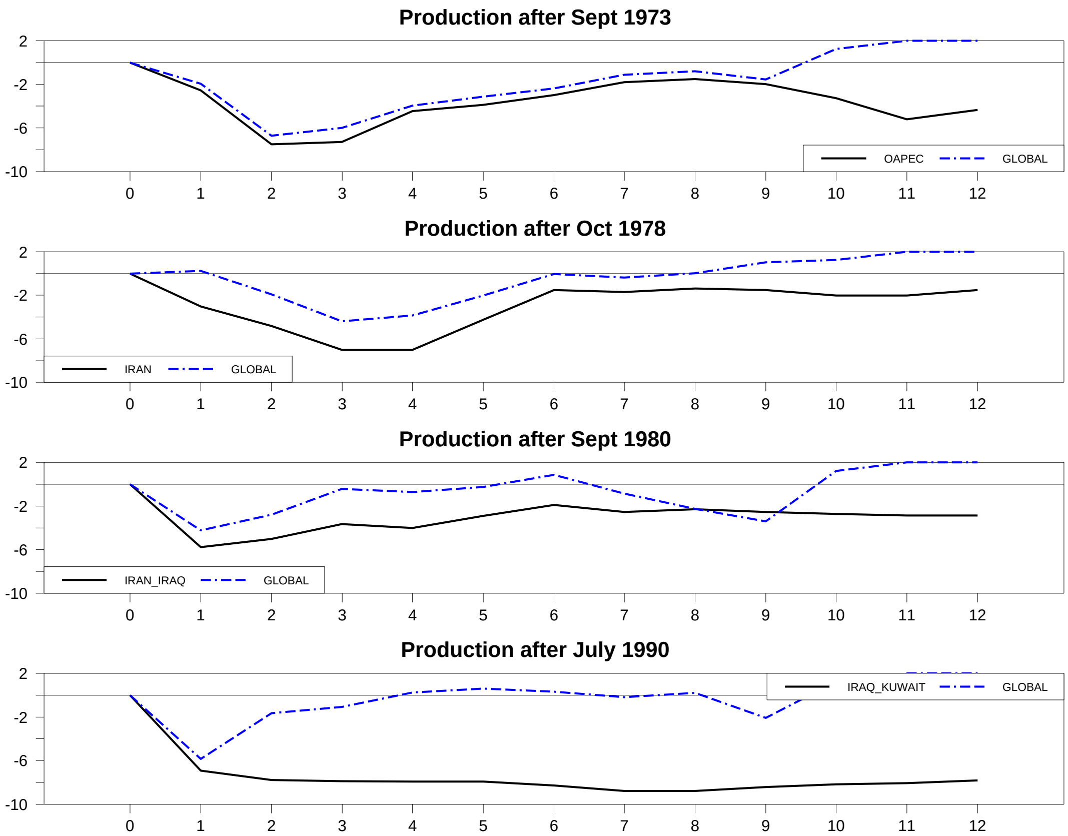

Figure 1. Losses as a percentage of world oil production associated with selected episodes. Top panel: oil production after the 1973 Arab-Israeli War. Dashed line: change in monthly global crude oil production from September 1973 as a percentage of September 1973 levels. Solid line: change in monthly oil production of Arab members of OPEC from September 1973 as a percentage of global levels in September 1973. Horizontal axis: number of months from September 1973. Second panel: oil production after the 1978 Iranian revolution. Dashed line: change in monthly global crude oil production from October 1978 as a percentage of October 1978 levels. Solid line: change in monthly Iranian oil production from October 1978 as a percentage of global levels in October 1978. Horizontal axis: number of months from October 1978. Third panel: oil production after the Iran-Iraq War. Dashed line: change in monthly global crude oil production from September 1980 as a percentage of September 1980 levels. Solid line: change in monthly oil production of Iran and Iraq from September 1980 as a percentage of global levels in September 1980. Horizontal axis: number of months from September 1980. Fourth panel: oil production after the first Persian Gulf War. Dashed line: change in monthly global crude oil production from August 1990 as a percentage of August 1990 levels. Solid line: change in monthly oil production of Iraq and Kuwait from August 1990 as a percentage of global levels in August 1990. Horizontal axis: number of months from August 1990. Source: adapted from Hamilton (2012a).

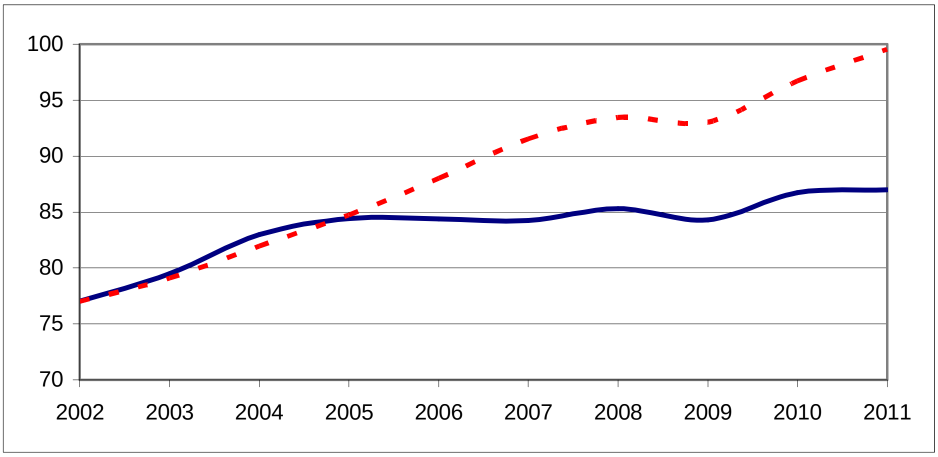

Figure 2. Actual world oil production and potential demand, 2002-2011. Solid line: total world oil production (includes natural gas liquids and biofuels), in millions of barrels per day. Source: EIA (http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm). Dashed line: anticipated world oil consumption if the price had not increased based on IMF (2012) estimates of growth of world GDP and assuming a global income elasticity of 0.75.

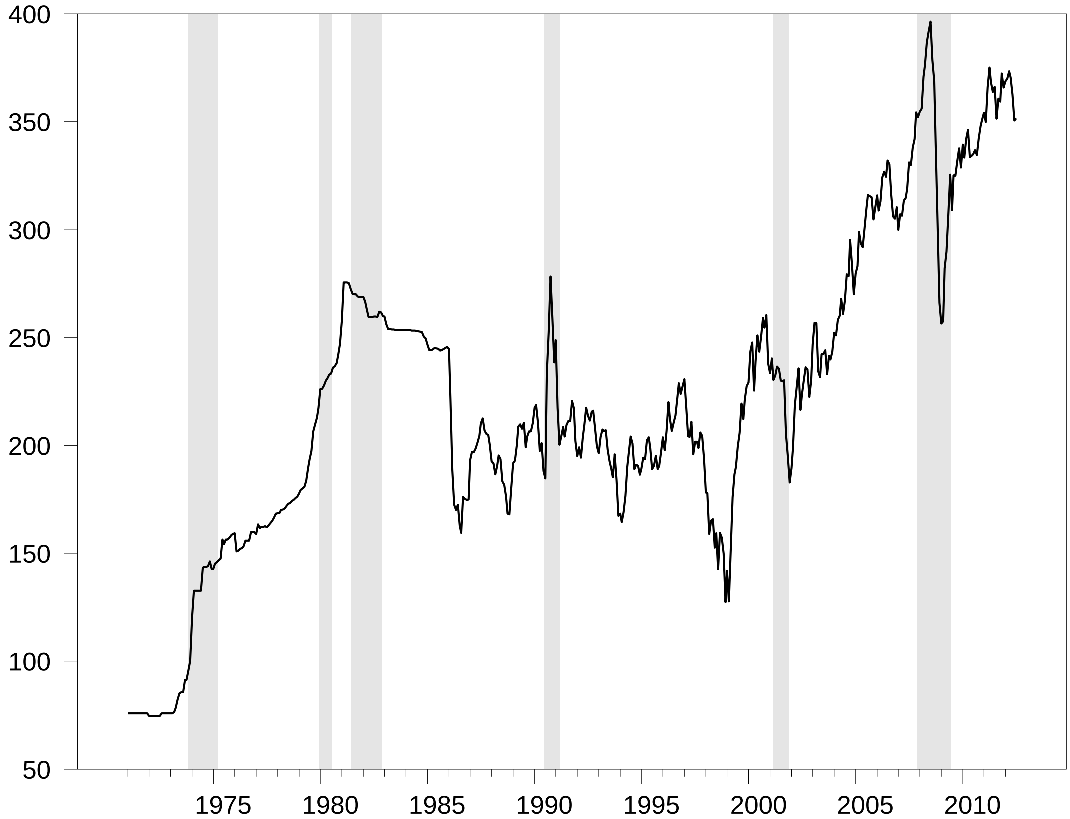

Figure 3. Oil prices and recessions. Solid line shows producer price index for crude petroleum (measured in units of 100 times natural log of ratio relative to 1947:M1), 1971:M1 to 2012:M7, with NBER-determined dates of U.S. recessions indicated with shaded regions.

Figure 4. Consumer purchases of energy goods and services as a percentage of total consumer spending, 1959:M1-2012:M6. Data source: BEA, Table 2.4.5U.

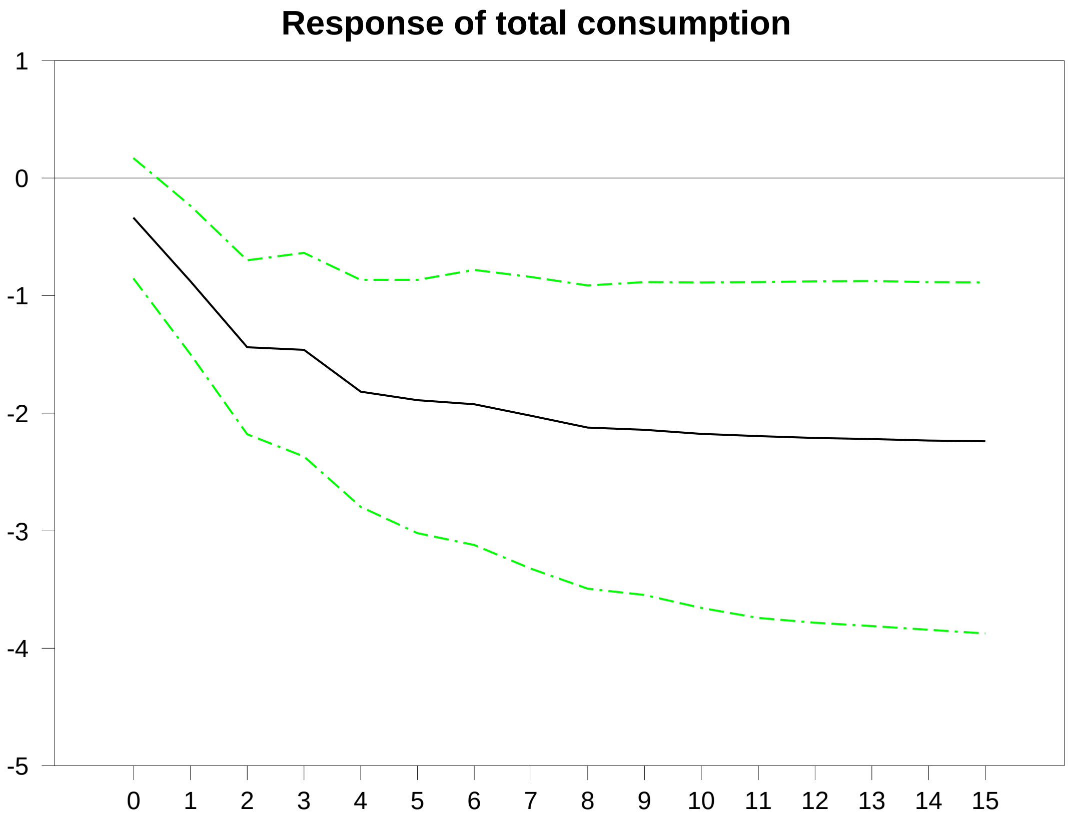

Figure 5. Impulse-response function showing percentage change in total real consumption spending *k* months following an energy price increase that would have reduced spending power by 1%. Dashed lines indicate 95% confidence intervals. Source: adapted from Edelstein and Kilian (2009) and Hamilton (2009b).

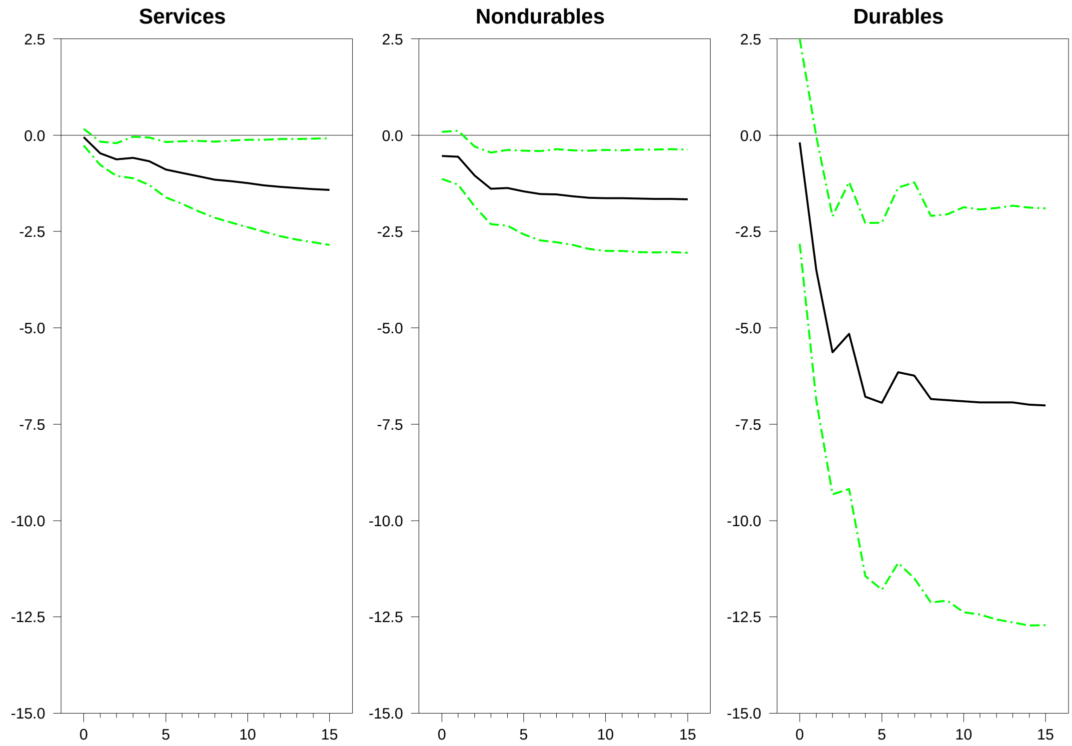

Figure 6. Impulse-response function showing percentage change in components of real consumption spending *k* months following an energy price increase that would have reduced spending power by 1%. Dashed lines indicate 95% confidence intervals. First panel: spending on services. Second panel: spending on nondurable goods. Third panel: spending on durable goods. Source: adapted from Edelstein and Kilian (2009) and Hamilton (2009b).

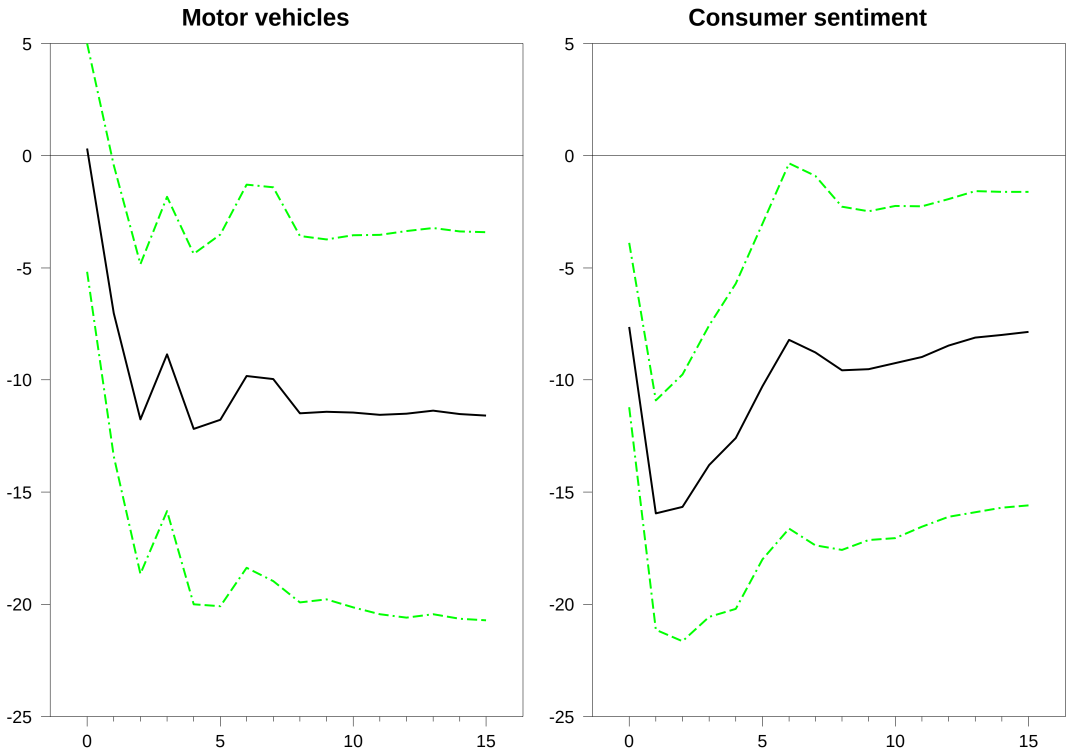

Figure 7. Impulse-response function showing (a) percentage change in real consumption spending on motor vehicles and parts, and (b) index of consumer sentiment *k* months following an energy price increase that would have reduced spending power by 1%. Dashed lines indicate 95% confidence intervals. Source: adapted from Edelstein and Kilian (2009) and Hamilton (2009b).

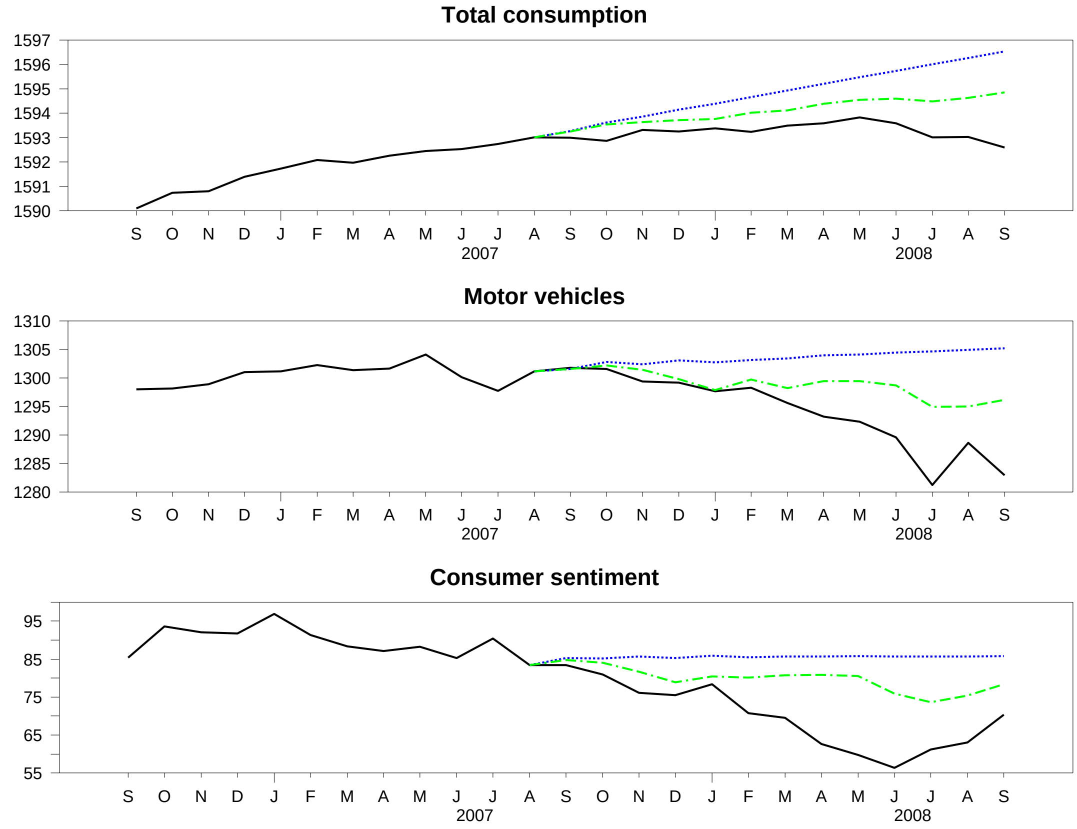

Figure 8. Observed behavior of key series in 2007-2008 and portions attributable to energy prices. Solid lines: actual path of real consumption spending and motor vehicle spending (in units of 100 times the natural log) and actual path of index of consumer sentiment. Dotted line: forecast as of September 2007 of the Edelstein-Kilian models described in the text. Dashed line: forecast as of September 2007 if one could also know the subsequent path of energy prices. Adapted from Hamilton (2009b).