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Signals on the Fritz

Energy Price Volatility Impedes Investment by Creating Uncertainty

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Introduction and summary

Surprises can be fun for birthdays, wedding proposals, and the birth of a child, among other things. But they are less welcome in the economy, where predictability is generally more desirable. A more certain future means business and individuals can plan better and be more confident that they will recoup their initial investments.

It would then be reasonable to assume that brisk and unexpected changes in something as far reaching as the price of energy would have a large effect on consumers and businesses since they wreak havoc on even the best-laid investment plans. The purchase of an energy-efficient vehicle makes sense when gasoline prices are at record highs, but not as much sense when they near lows not seen in years. Energy prices in general and gasoline prices in particular have gone from red hot to stone cold to red hot again in the span of a few months in recent years.[1] From January 2008 to July 2008, for instance, the average monthly national gasoline prices rose by 33.5 percent, before dropping by 58.5 percent in December 2008 and then rising again by 34.3 percent to $2.266 in May 2009.[2]

Businesses and consumers will likely delay economic decisions and economic growth slows as these groups scratch their heads trying to figure out which price will ultimately turn out to be the right one that forms the basis for economic decisions.

In fact, the data shows that energy price volatility does hurt investment by families and businesses while bringing profits to oil companies:

- **Consumers will delay buying a car after extraordinarily high energy price volatility.** There is an 83.3 percent chance that consumers will spend a smaller share of their disposable income on vehicles after they have just gone through a period of high price volatility. In fact, consumers buy about 1.6 percent fewer cars one year after experiencing a year-long episode of large energy price swings.

- **Families also spend less money on buying or upgrading their homes when they just lived through the roller coaster ride of large energy price swings.** Investment in residential structures—new home purchases and upgrades—dropped by 0.5 percentage points relative to gross domestic product on average after energy prices swung wildly for 12 months.

- **Businesses cut their investment spending following large price swings, too.** There is a 91.7 percent chance that business investment in transportation equipment—such as trucks—and tractors—as a share of gross domestic product will decline after extraordinary energy price volatility, largely because businesses will buy 11.0 percent fewer vehicles, delaying purchases of new ones.

- **Not everything declines after high energy price volatility.** The profit rate—profits to assets—of the oil and gas industry tends to surge during periods of high energy price volatility.

This report details the extent to which several categories of consumer and business spending change following periods of high energy price volatility. We also briefly examine whether policymakers can step in, for instance by promoting the use of and investment in renewable energy sources and reducing our dependence on imported oil—or if we are doomed to stay on this energy price roller coaster forever.

What is energy price volatility?

Many families have noticed the sudden changes in energy prices whether they're at the gas station or paying their monthly utility bill—and so have businesses. How do these changes affect these groups' spending and investment? We turned to government data that have tracked the movement of energy prices for over half a century to document energy price changes and their economic effects on consumers and businesses.

The Bureau of Labor Statistics' Consumer Price Index for all Urban Consumers contains a price index that specifically tracks the movement of energy prices. The BLS began compiling the CPI-U for energy on a monthly basis in January 1957, which meant we had a considerable period of time—spanning several oil price spikes—to do our analysis.

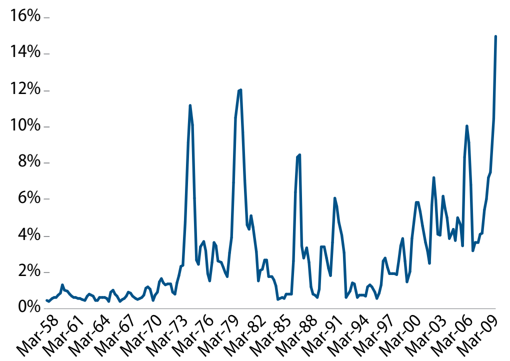
The analysis hinged on our measure of energy price volatility. We first calculated the standard deviation—a statistical measure typically used to capture risk or volatility—of the seasonally adjusted energy price index for 12 consecutive months. We divided it by the average energy price index for that same period to allow for comparisons of the price swings over time.[3] The rest of our analysis used only the relative standard deviation—the standard deviation relative to average over the preceding 12 months—for the end of each quarter, although we had monthly observations available. This method allowed us to compare our energy price data with other economic data—consumption and investment—that are reported with a lower, quarterly frequency.

Figure 1 shows our volatility measures, which indicate a considerable movement over the last half century in the price of energy as well as dramatic differences in the size of the change in energy prices.

We defined periods of high energy price volatility as quarters when the ratio of the standard deviation of the energy price index to the average energy price index over the preceding 12 months was at least twice as large as the long-term average ratio from 1957 to 2009.[4] Fourteen percent of all 12-month periods from 1958 to 2009 were thus classified as periods of extraordinary energy price volatility.[5]

Energy price volatility from 1957 to 2009

Fourteen percent of all 12-month periods from 1958 to 2009 were classified as periods of extraordinary energy price volatility



Standard deviation as a percent of average over preceeding 12 months

Notes: Data are seasonally adjusted. Authors' calculations based on Bureau of Labor Statistics, "Consumer Price Index, All Urban Consumers (Chained Series), Energy" (Washington, 2009).

So what do these changes mean for families and businesses? We studied changes in consumer and business spending after high-price volatility. We specifically looked at the changes in consumer spending on cars and homes as well as personal savings during the 12-month period after a period of extraordinarily volatile energy prices. We also considered the changes in business investment spending in general and on structures, equipment, and transportation equipment in particular. The changes in consumer spending on cars and personal saving were set relative to personal disposable income and the changes in business investments and residential investment were calculated relative to GDP to account for the fact that incomes and the economy have substantially grown during the period that we analyze.[6]

Consumer spending decisions affected by high energy price volatility

Vehicle purchases

We turned to data from the Bureau of Economic Analysis' National Income and Product Accounts tables to look at how volatile energy prices affected consumer spending and saving. We examined what happened to consumer spending and saving relative to personal disposable income in the year following a period of high energy price volatility because of the lag time between a rise in energy prices and the decision to purchase—or not to purchase—something affected by it. If we looked at what happened to consumer spending and saving in the same period as the observed volatility, it wouldn't allow for the consumer to react to the price swing—they would still be basing their decision on what energy prices had done leading up to that moment in time.

Consider, for example, that you have been thinking of replacing the SUV you bought in the mid-1990s—when a gallon of gas cost about $1 and some change—with a new, more fuel-efficient car. This seems like a smart decision for the environment and—after last summer's gas costing over $4 a gallon—your wallet. But what happens when gas plummets to $2.00? Do you continue to look for the new more fuel-efficient car, or do you decide to hold off and wait to see whether gasoline prices will rise again enough to justify your purchase?

Behavioral economics tells us that people base their decisions about major purchases—at least partly—on what they think will be the most likely future economic scenario. Consumers know buying the new, more fuel-efficient car may be more expensive upfront than holding onto an older vehicle, but savings from not spending money on higher fuel prices in the future may help the new fuel-efficient car "pay for itself."

This "cost-benefit" calculation depends on what consumers think the future price of gasoline will be. Families and businesses don't have a crystal ball, so they base their decisions about the future on their past experiences. But periods of high volatility negate people's general experiences since periods of high volatility are the exception and not the rule. Consumers and businesses simply don't know what to make of large swings in prices and would rather hold on to their money than make the wrong decision.[7]

It is a standard insight in economics that the past is a guide to the future for investment decisions. Economists, however, disagree on whether consumers and individuals consider all past experiences equally or if they overemphasize their most recent experiences. Research in behavioral economics, for instance, has shown that individuals tasked with financial decisions tend to put too much weight on their most recent experiences. This can give rise to boom-and-bust cycles because investors value the most recent path a lot more than the more distant past. Recent good times thus lead to a build up of euphoria, while recent bad times can contribute to a common sense of dread and panic.

The analogous economic argument is that large price swings can conceal the longer-term price trend that, as Figure 1 shows, has been going up since the mid-1990s. Businesses and individuals thus become overly focused on the price confusion in the short run rather than the long-term signal of higher energy prices. As a result greater price volatility should lead to fewer car purchases, less spending on homes, and possibly to more saving.

BEA and BLS data show that consumers indeed spend less money on cars over the 12-month period after a period of high energy price volatility.[8] Spending on motor vehicles and parts expenditures as a share of personal disposable income dropped on average by 0.3 percentage points and the probability of such a decline was 83.3 percent (Table 1). In other words there was only a 16.7-percent chance of vehicle purchases increasing after volatility. We can therefore be almost certain that spending on cars will decline in the year after a year of extraordinarily high energy price volatility based on this information.

This decline, however, could mean that consumers bought fewer vehicles or bought less expensive cars. We also examined the change in the quantity index of consumer expenditures on motor vehicles and parts declines in a year following a period of high energy price volatility to see what was really happening. The quantity index counts the number of cars over time and strips out price effects. The quantity index for personal vehicles declined on average by 1.6 percent in the year following a period of high energy price volatility, which means that consumers in fact bought fewer cars after seeing large energy price swings (Table 1).

Home improvements

Homeowners are increasingly faced with more consumption choices that are susceptible to changes in energy prices, and this susceptibility extends beyond the price of their commute to work. Americans are increasingly learning ways to make their home more efficient as they become more energy-conscious. However, “greening” a home often comes with a substantial upfront cost. Energy prices and future savings potential therefore would seem to affect a family’s decision to go green at home, similar to their decision to purchase a more fuel-efficient car.

We thus also looked at what happened to investment in homes following a period of major energy price fluctuation. Data from the BEA's NIPA tables show that residential structures investment as a share of GDP declined by an average of 0.5 percentage points one year after a period of high energy price volatility (Table 2). This means there is a 75-percent chance that residential structures investment as a share of GDP will decline a year after a period of high energy price volatility (Table 2).

Saving rate

If consumers are spending less on vehicles and homes after a period of high energy price volatility, they must be spending all that extra cash on something, right? We examined what happened to personal saving as a share of disposable income—a ratio commonly known as the personal saving rate—one year following a period of high energy price volatility in order to see if consumers were putting their money away instead of spending it. The data are once again from the BEA's NIPA tables.

We found that the personal saving rate does in fact increase in the year following periods of high energy price volatility, on average by 0.2 percentage points (Table 1). Our conclusion is that extraordinary energy price volatility causes families to hold on to their cash more than they would during periods of price stability.

TABLE 1

Household consumption and investment changes one year after periods of high energy price volatility

Families tend to hold on to their money after periods of high energy price volatility

	Motor vehicles and parts expenditures as a share of disposable personal income	Quantity index for personal motor vehicles and parts	Personal saving as a share of disposable income	Residential structures investment as a share of GDP
Average change	-0.3	-1.6	0.2	-0.5
Probability of decline (or increase in the case of personal saving)	83.3	58.3	43.5	75.0

Notes: Changes of ratios are percentage point differences and changes in quantity indexes and probabilities are percentages. All data are seasonally adjusted. Authors' calculations based on Bureau of Economic Analysis, "National Income and Product Accounts Table 1.1.5 Gross Domestic Product" (Washington, 2009); Bureau of Economic Analysis., "National Income and Product Accounts Table 1.5.5 Gross Domestic Product, Expanded Detail" (Washington, 2009); Bureau of Economic Analysis, "National Income and Product Accounts Table 1.6.4 Price Indexes for Gross Domestic Purchases" (Washington, 2009); Bureau of Economic Analysis, " National Income and Product Accounts Table 2.1 Personal Income and Its Disposition" (Washington, 2009(Bureau of Economic Analysis," National Income and Product Accounts Table 2.3.5 Personal Consumption Expenditures by Major Type of Product" (Washington, 2009); Bureau of Economic Analysis,"National Income and Product Accounts Table 5.3.5 Private Fixed Investment by Type (Washington, 2009); and Bureau of Labor Statistics, "Consumer Price Index, All Urban Consumers (Chained Series), Energy" (Washington, 2009).

Business investment decisions affected by high energy price volatility

Business investment

Consumers aren't the only player in the economy, so it would follow that they are not the only group whose purchasing choices are affected by high swings in energy prices. Businesses arguably have an even more detailed—or at least complex—planning process than households. We used data from the BEA's NIPA tables to examine what tends to happen to business investment following periods of high energy price volatility.

Our discovery was that business investment—which includes buildings but also equipment such as computers and trucks—also drops after periods of high price volatility. Business investment as a share of GDP declined on average by 0.3 percentage points following a period of high energy price volatility (Table 2). The data also show that the probability of a decline in nonresidential investment as a share of GDP after high energy price volatility is 70.8 percent (Table 2).

We wanted to understand which parts of business investment were responsible for the declines, so we looked at the subcategories of business investment, including equipment and software investment and vehicle investment.

Equipment and software investment

One important subcategory of business investment is software and equipment spending, which includes vehicles. Here again, the data show that nonresidential equipment and software spending decreased on average by 0.3 percentage points one year after periods of high energy price volatility (Table 2). The data also show that there is a pretty good chance—87.5 percent—that investment will decline in the year after a huge swing in energy prices (Table 2).

Vehicle investment

A subcategory of equipment investment is transportation equipment. We were curious whether the decline in equipment investment mentioned above was largely related to a decline in transportation investment—similar to the decline in consumer's expenditures on vehicles—or something else entirely. The data show that there is a 91.7 percent likelihood that private nonresidential investment in transportation equipment—including vehicles—will decline a year after a period of high energy price volatility and that the average drop is equal to 0.2 percentage points relative to GDP (Table 2). On average the decline in spending on transportation equipment explains two-thirds of the drop in equipment spending after extraordinarily large energy price volatility.

We also looked at the change in the quantity index for nonresidential transportation equipment to see whether businesses bought fewer vehicles or simply cheaper trucks and tractors, among other vehicles. This index decreased on average by a notable 11.0 percent in the year following a period of high energy price volatility (Table 2), which indicates that like individual consumers, businesses purchase fewer vehicles following periods of high energy price swings.

TABLE 2

Business investment changes one year after periods of high energy price volatility

Businesses also tend to hold on to their money and make fewer investments after periods of high energy price volatility

	Total nonresidential investment as a share of GDP	Nonresidential equipment and software investment as a share of GDP	Nonresidential transportation equipment investment as a share of GDP	Quantity index for nonresidential transportation equipment expenditures
Average decline	-0.3	-0.3	-0.2	-11.0
Probability of decline	70.8	87.5	91.7	75.0

Notes: Changes of ratios are percentage point differences and changes in quantity indexes and probabilities are percentages. All data are seasonally adjusted. Authors' calculations based on Bureau of Economic Analysis, "National Income and Product Accounts Table 1.1.5 Gross Domestic Product" (Washington, 2009); Bureau of Economic Analysis, "National Income and Product Accounts Table 1.5.5 Gross Domestic Product, Expanded Detail" (Washington, 2009); Bureau of Economic Analysis, "National Income and Product Accounts Table 5.3.5 Private Fixed Investment by Type (Washington, 2009); Bureau of Economic Analysis, "National Income and Product Accounts Table 1.6.4 Price Indexes for Gross Domestic Purchases" (Washington, 2009); Bureau of Economic Analysis, "National Income and Product Accounts Table 5.3.5 Private Fixed Investment by Type (Washington, 2009); and Bureau of Labor Statistics, "Consumer Price Index, All Urban Consumers (Chained Series), Energy" (Washington, 2009).

Short-term and long-term growth are hurt by high energy price volatility

Lower levels of business investment can mean big problems for the overall U.S. economy. Higher business investment is necessary for faster productivity growth, which in turn gives the economy more bang for its buck. For example, a restaurant that spends money to upgrade its kitchen is able to cook more food faster, and thus complete more sales and make higher profits. Similarly, more business investment can lead to higher future productivity growth in the overall economy via an enlarged capital base.

Not surprisingly, business investment increases—relative to GDP—have preceded faster productivity growth in the United States since 1947 and accelerations in productivity growth—over a span of five years—have tended to follow periods of stronger growth in business investment.[9]

There are even more benefits to the economy from business investment—for businesses and consumers. In the short term, more business investment also means that businesses are buying more capital inputs, which in turn boosts economic demand and leads to faster economic growth today. Faster economic growth in the short term also translates into more jobs, which again means that more people have more money to buy things in the economy. Businesses have an incentive to continue to increase their investment levels if consumers are spending more money to buy their goods and services. As we noted in our 2008 paper, "Investing for Widespread, Productive Growth," "This chain of events results in faster output growth in the short run and, if all goes well, in faster productivity growth in the long run."[10]

The damaged caused by the drop in consumer and business investment in vehicles and housing can thus extend far wider than the auto industry's profit rate. Business investment levels can fall without proper incentives and productivity decreases can follow. The result: Energy price volatility and the resulting changes in consumer and business spending and investment ultimately mean that the chance of strong economic growth is reduced.

Our analysis raises concerns over the U.S. economy's short-term health. The purchase of fewer cars by consumers and businesses means that manufacturers and dealers make fewer sales, which means fewer jobs and lower investment in these industries. Similarly, lower residential investment as a share of GDP means fewer jobs and lower investment in related industries, and less money moving throughout the economy, which translates into lower economic growth overall.

As the economy does not grow as fast as it otherwise would in the wake of high energy price volatility, the basis for faster, long-term growth also erodes. Consumers and businesses are investing less in more fuel-efficient cars and homes. This can mean we are missing opportunities for technological improvements and thus faster productivity growth and quicker increases in future living standards.

Previous economic research following the high energy volatility era of the 1970s and 1980s has indeed found that energy price volatility is detrimental to long-term economic growth.[11] We can then assume that the current period of high energy price volatility could also result in less future economic growth than would have otherwise been the case.

Oil companies benefit from high energy price volatility

Spikes and drops in energy prices do benefit someone—oil companies tend to gain from high volatility. This follows largely from our previous discussion. Businesses and consumers delay big, energy-relevant purchases—such as cars and home improvements—even a year after extraordinary energy price swings. Oil prices are also very inelastic because it is very difficult for people to quickly reduce oil use in response to high prices. They cannot quickly move closer to work, school, or a place of worship. In other words they are stuck with their cars during and after prices move sharply higher, allowing oil companies to sell more than they otherwise would.

This increase in sales translates into higher profits for oil companies. Corporate profit data from the BEA's NIPA tables and from the BEA's Fixed Assets database show that high volatility is beneficial to the oil industry's profit rate—or profits to assets.

We examined what happened to oil profits during periods of high energy price volatility rather than in the following year—as we did with investment and consumption—because there should not be a lag between prices and profits. The data show that the profit rate of oil—and coal—companies increased on average by 0.8 percentage points during periods of high energy price volatility and that there is a 63.0 percent chance that the profit rate will increase during periods of extraordinary price volatility (Table 3).

TABLE 3

Oil industry profit rate change during periods of high energy price volatility

Oil profits increased on average by 0.8 percentage points during periods of high volatility

Average increase	0.8
Probability of increase	63.0

Notes: Changes of ratios are percentage point differences and changes in quantity indexes and probabilities are percentages. All data are seasonally adjusted. Authors' calculations based on Bureau of Economic Analysis, "National Income and Product Accounts Tables 6.16 B, C and D. Corporate Profits by Industry" (Washington, 2009) and Bureau of Labor Statistics, "Consumer Price Index, All Urban Consumers (Chained Series), Energy" (Washington, 2009).

Conclusion

Data from the Bureau of Economic Analysis show that large swings in energy prices have a measurable effect on future consumption and investment choices of individuals and businesses alike. High energy price volatility sends confusing price signals, which seem to at best tell consumers in the market for energy-related items to "wait and see."

Consumers tend to buy fewer cars, devote less of their income to investments in their homes, and save more in general one year after a period of high energy price volatility. By extension this means that following periods of higher volatility, individuals purchase fewer new, more fuel-efficient cars and invest less in their homes, which translates into lower investment and fewer jobs in the auto and home renovation industries.

Businesses also change their behavior and lower their investment in vehicles following periods of high energy price volatility, again meaning lower investment and fewer jobs in the auto industry. This lowered investment can in turn hurt short-term and long-term economic growth.

Another noteworthy effect of high energy price volatility is that oil companies see particularly high profits during these periods and the data show the industry benefits from increased sales. The big five oil companies—BP, Chevron, Conoco Phillips, ExxonMobil, and Shell—have invested much of these profits in purchasing their own stock[12] rather than making investments in clean alternative fuels less subject to the volatility of oil prices.

Policymakers should help create an environment with fewer large fluctuations in order to help the country deal with energy price volatility and the associated problems. Promoting investment in and the use of renewable energy sources—and reducing dependence on imported oil—could help domestic energy prices become less susceptible to pressures that cause oil prices to spike and plummet.

One possible avenue for policymakers is the renewable electricity standard, requiring that utilities produce a certain percentage of electricity from renewable sources. Because these sources use zero-cost fuels like wind, sun or geothermal energy, the cost of production tends to remain stable over time. As the percentage of electricity derived from renewable sources grows, the resulting price stability will benefit consumers and businesses.

High energy price volatility and its negative impacts cannot go away overnight, but they also will not disappear without increased attention. A strong effort by policymakers to help create an atmosphere with fewer large swings in energy prices would certainly be a welcomed step for consumers, businesses, and the overall economy.

Appendix

APPENDIX TABLE 1

Household spending and investment changes after periods of high and normal energy price volatility

	Motor vehicles and parts expenditures as a share of disposable personal income	Quantity index for personal motor vehicles and parts	Personal saving as a share of disposable income	Residential structures investment as a share of GDP
Average change after high volatility				
Annual	0.0	-1.6	0.2	-0.5
Quarterly	-0.1	-1.8	0.2	-0.2
Average change after normal volatility				
Annual	0.0	5.5	-0.2	0.0
Quarterly	0.0	1.6	-0.1	0.0
Probability of decline (or increase in the case of personal saving) after high volatility				
Annual	83.3	58.3	43.5	75.0
Quarterly	63.0	44.4	42.3	77.8
Probability of decline (or increase in the case of personal saving) after normal volatility				
Annual	45.2	28.2	54.4	44.6
Quarterly	49.2	36.2	52.7	47.5

Notes: In this table, we used the seasonally adjusted CPI-U for Energy, and calculated the average percentage point change in motor vehicles and parts expenditures as a share of disposable personal income, the average change in the quantity index for personal motor vehicles and parts, the average percentage point change in personal saving as a share of disposable income, and the average percentage point change residential structures investment as a share of GDP one year and one-quarter after periods of high and normal energy price volatility as well as the probability of decline one year and one quarter after periods of high and normal energy price volatility. For robustness, we also made the same calculations using the non seasonally adjusted CPU-U for Energy as well as the seasonally adjusted CPI-U for Household Energy and the non seasonally adjusted CPI-U for Household Energy. The CPI-U for Energy has been reported by the BLS for 52 years while the CPI-U for Household Energy has only been reported for 42 years. All data are seasonally adjusted. Changes of ratios are percentage point differences and changes in quantity indexes and probabilities are percentages. Authors' calculations based on Bureau of Economic Analysis, "National Income and Product Accounts Table 1.1.5 Gross Domestic Product" (Washington, 2009); Bureau of Economic Analysis, "National Income and Product Accounts Table 1.5.5 Gross Domestic Product, Expanded Detail" (Washington, 2009); Bureau of Economic Analysis, "National Income and Product Accounts Table 1.6.4 Price Indexes for Gross Domestic Purchases" (Washington, 2009); Bureau of Economic Analysis, "National Income and Product Accounts Table 2.1 Personal Income and Its Disposition" (Washington, 2009); Bureau of Economic Analysis," National Income and Product Accounts Table 2.3.5 Personal Consumption Expenditures by Major Type of Product" (Washington, 2009); Bureau of Economic Analysis, "National Income and Product Accounts Table 5.3.5 Private Fixed Investment by Type (Washington, 2009); and Bureau of Labor Statistics, "Consumer Price Index, All Urban Consumers (Chained Series), Energy" (Washington, 2009).

APPENDIX TABLE 2

Business investment changes after periods of high and normal energy price volatility

	Total nonresidential investment as a share of GDP	Nonresidential equipment and software investment as a share of GDP	Nonresidential transportation equipment investment as a share of GDP	Quantity index for nonresidential transportation equipment expenditures
Average change after high volatility				
Annual	-0.3	0.0	-0.2	-11.0
Quarterly	-0.1	0.0	-0.1	-5.0
Average change after normal volatility				
Annual	0.1	0.0	0.0	5.8
Quarterly	0.0	0.0	0.0	1.5
Probability of decline after high volatility				
Annual	70.8	50.0	91.7	75.0
Quarterly	48.1	37.0	74.1	74.1
Probability of decline after normal volatility				
Annual	35.6	46.3	49.7	35.0
Quarterly	40.7	47.5	48.6	45.2

Notes: In this table, we used the seasonally adjusted CPI-U for Energy, and calculated the average percentage point change in total nonresidential investment as a share of GDP, the average percentage point change in nonresidential equipment and software investment as a share of GDP, the average percentage point change in nonresidential transportation equipment investment as a share of GDO, and the average change in the quantity index for nonresidential transportation equipment expenditures one year and one-quarter after periods of high and normal energy price volatility as well as the probability of decline one year and one quarter after periods of high and normal energy price volatility. For robustness, we also used the non seasonally adjusted CPU-U for Energy as well as the seasonally adjusted CPI-U for Household Energy and the nonseasonally adjusted CPI-U for Household Energy for our calculations The CPI-U for Energy has been reported by the BLS for 52 years while the CPI-U for Household Energy has only been reported for 42 years. None of these data changed our calculations. All data are seasonally adjusted. Changes of ratios are percentage point differences and changes in quantity indexes and probabilities are percentages. Authors' calculations based on Bureau of Economic Analysis, "National Income and Product Accounts Table 1.1.5 Gross Domestic Product" (Washington, 2009); Bureau of Economic Analysis, "National Income and Product Accounts Table 1.5.5 Gross Domestic Product, Expanded Detail" (Washington, 2009); Bureau of Economic Analysis, "National Income and Product Accounts Table 5.3.5 Private Fixed Investment by Type" (Washington, 2009); Bureau of Economic Analysis, "National Income and Product Accounts Table 1.6.4 Price Indexes for Gross Domestic Purchases" (Washington, 2009); and Bureau of Labor Statistics, "Consumer Price Index, All Urban Consumers (Chained Series), Energy" (Washington, 2009).

APPENDIX TABLE 3

Oil industry profit rate changes during periods of high and normal energy price volatility

Average change during high volatility	
Annual	0.8
Quarterly	0.7
Average change during normal volatility	
Annual	-0.2
Quarterly	-0.1
Probability of increase during high volatility	
Annual	63.0
Quarterly	63.0
Probability of increase during normal volatility	
Annual	46.3
Quarterly	45.8

Notes: In this table, we used the seasonally adjusted CPI-U for Energy, and calculated the average percentage point change in the oil and coal industry's profit rate during years and quarters with high and normal energy price volatility as well as the probability of increase the oil and coal industry's profit rate during a year and quarter with high and normal energy price volatility. For robustness, we also used the non seasonally adjusted CPU-U for Energy as well as the seasonally adjusted CPI-U for Household Energy and the non seasonally adjusted CPI-U for Household Energy for our calculations. The CPI-U for Energy has been reported by the BLS for 52 years while the CPI-U for Household Energy has only been reported for 42 years. None of these data changed our calculations. All data are seasonally adjusted. Changes of ratios are percentage point differences and changes in quantity indexes and probabilities are percentages. Authors' calculations based on Bureau of Economic Analysis, "National Income and Product Accounts Tables 6.16 B, C and D. Corporate Profits by Industry" (Washington, 2009); and Bureau of Labor Statistics, "Consumer Price Index, All Urban Consumers (Chained Series), Energy" (Washington, 2009).

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1 Amanda Logan and Christian E. Weller. "Pain in the Gas: Volatile Gasoline Prices Wreak Havoc on Household Finances" Center for American Progress, 2007, available at http://www.americanprogress.org/issues/2007/05/pain_in_the_gas.html.

2 Authors' calculations based on Energy Information Agency, "Monthly Retail Gasoline and Diesel Prices" (Washington, Department of Energy, 2006).

3 We relate the standard deviation in one year to the average price in that year because since the CPI-U for Energy is an index, the average price is inherently going to increase every year and this additional calculation allows us to compare volatility over multiple years by taking this into account.

4 The appendix also shows our calculations. We also looked at when the threshold is set at one and a half times the long-term average of the ratio of the standard deviation to the average price index. The results did not change any of our conclusions.

5 The share drops to 13 percent, when we use the nonseasonally adjusted index. The share of periods with extraordinarily high price volatility is also 13 percent when we use only the CPI-U for household energy from 1967 to 2009. Our calculations are thus not a result of the price index that we have chosen here. All calculations are detailed in the appendix.

6 We treat residential investment as investment and not as consumption as is common in macroeconomic statistics.

7 It is a standard insight in economics that the past is a guide to the future for investment decisions. Economists, though, disagree on how well the information gathered about the past reflects potential future outcomes and they disagree on whether consumers and individuals consider all past experiences equally or if they overemphasize the most recent experiences. Research in behavioral economics, for instance, has shown that individuals tasked with financial decisions tend to put too much weight on their most recent experiences. This can give rise to boom and bust cycles. The analogous economic argument here is that large price swings can obfuscate the longer term price trend, which, as Figure 1 shows, is going up since the mid-1990s.

8 Data extracted and calculations made on or before May 27, 2009.

9 Christian E. Weller and Amanda Logan, "Investing for Widespread, Productive Growth" Center for American Progress, 2008, available at http://www.americanprogress.org/issues/2008/12/productivity_report.html.

10 Ibid.

11 James D. Hamilton, "What is an Oil Shock?" *Journal of Econometrics* 113 (2) (2003): 363-398; J. P. Ferderer, "Oil Price Volatility and the Macroeconomy" *Journal of Macroeconomics* 18 (1) (1996): 1-26; Rebecca Jiménez-Rodriguez and Marcelo Sánchez , "Oil Price Shocks and Real GDP Growth: Empirical Evidence for Some OECD Countries," *Applied Economics* 37 (2) (2005): 201-228; and Roy Boyd and Tony Caporale, "Scarcity, Resource Price Uncertainty, and Economic Growth," *Land Economics 72 (3) (1996):* 326-335.

12 Daniel J. Weiss and Alexandra Kougentakis, "Big Oil Misers," Center for American Progress, March 31, 2009, available at http://www.americanprogress.org/issues/2009/03/big_oil_misers.html.

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