Have Rising Oil Prices Become a Greater Threat to Price Stability?

By Martin Fukač

The effect of oil prices on inflation has varied considerably over the last 50 years. In the 1970s and early 1980s, oil price increases were associated with high and rising inflation. In the late 1980s and 1990s, however, the effect of oil prices on inflation appeared to moderate. While the experience of the earlier period is unlikely to be repeated today because of a better anchoring of long-term inflation expectations, recent evidence suggests oil prices again may be playing a more significant role in the inflation process.

This article argues that the pass through of oil price changes to inflation—though still low when compared with the 1970s and 1980s—has increased in the last five years. In particular, the average effect of oil prices on inflation today is about double what it was in the early 2000s. One explanation is that consumer spending on petroleum and petroleum products as a share of total spending, which fell in the 1990s, has increased to levels last observed in the 1970s. Other possible explanations include the "financialization" of commodity markets and the highly accommodative stance of monetary policy associated with the global financial crisis of 2008-09.

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Section I explains how changes in oil prices affect inflation. It then presents evidence on, and explanations for, the more moderate effect of oil prices on inflation in the 1990s. Section II shows that the effect of oil prices on inflation, though still muted, has increased since the mid-2000s. The section then provides possible explanations.

I. OIL PRICE PASS THROUGH AND THE GREAT MODERATION

Sharp increases in oil prices typically cause inflation to rise. The extent and persistence of the increase in inflation depends on how inflation expectations respond to the increase in oil prices. In the 1970s and early 1980s, oil price increases were associated with rising inflation expectations, which in turn contributed to a large and persistent increase in inflation. In the 1990s, inflation expectations held relatively steady when oil prices rose, and inflation remained relatively low and stable.

The channels of oil price pass through to inflation

The U.S. economy relies extensively on fossil fuels—petroleum, in particular. According to the U.S. Energy Information Administration, 37 percent of the energy consumed in the United States comes from petroleum. Of the petroleum consumed, 72 percent is used in transportation and the rest is used as inputs in sectors such as agriculture, construction, manufacturing, food processing, and pharmaceuticals (Monthly Energy Review, June 2011). Because of the pervasive role of oil in the economy, oil prices affect the prices of many goods and services as well as the general price level. Moreover, oil price increases have the potential to increase inflation. The increase in inflation caused by an increase in oil prices is referred to as the pass through of oil prices to inflation.

In general, the impact of oil price movements on consumer prices can be broken into first-round and second-round effects. First-round effects mainly reflect the impact of oil prices on the prices consumers pay directly for energy products, such as gasoline and home heating oil. Supply and demand in the consumer market for energy are largely inelastic because there are few, if any, alternatives that consumers and producers can substitute for oil in the short run. Changes in crude oil prices are, therefore, almost immediately and completely passed on to

retail consumer energy prices. The first-round direct effects are often large but mostly short-lived.

In addition to these direct first-round effects, oil prices indirectly affect the prices of consumer goods and services that use petroleum or petroleum products in their production. Assuming other input prices are slow to adjust, an increase in oil prices will cause the prices of goods and services that use petroleum or petroleum products as inputs (such as asphalt roof shingles or public transportation) to rise because production and operating costs will increase. Indirect first-round effects are typically smaller than the original oil price changes. They may also slowly pass through the chain of intermediate products before being fully realized in the price of the final consumer product.

In contrast to first-round effects, which typically imply a one-time change in consumer prices, second-round effects are more persistent and may cause prices to increase steadily, long after first-round effects diminish. Second-round effects come largely as a consequence of rising inflation expectations. If the public is not confident that a low and stable inflation rate will be maintained over the medium to long run, the increase in prices associated with the first-round effects of an oil price increase could become imbedded in inflation expectations. If so, forward-looking workers and employers may build higher inflation into future wages and prices. And once an inflationary cycle begins, it can be difficult and costly to reverse.

The second-round effects of increased oil prices are of particular concern to monetary policymakers. Over the medium to long run, inflation ultimately depends on the stance of monetary policy. A key to controlling inflation is for policymakers to adjust the stance of policy as needed to maintain stable medium- to long-run inflation expectations. An overly accommodative policy that focuses too much on output and employment and too little on inflation can lead to rising inflation. In fact, a number of economists have argued that in the 1970s and early 1980s, the Federal Reserve responded too little to rising inflation that was brought on, in part, by sharp increases in oil prices. As a result of overly accommodative monetary policy, inflation increased during the period. In contrast, a more aggressive response to increases in inflation since the mid-1980s helped anchor long-term inflation expectations and contributed to the low and stable inflation that the U.S. economy

experienced in the 1990s and 2000s (Sargent, 1999; Clarida and others, 2000; Boivin and Gianoni, 2002; Lubik and Schorfheide, 2004; Hamilton and Herrera, 2004).

The decline in pass through since the early 1980s

Research has documented that the pass through of oil prices to inflation declined sharply from the 1970s and early 1980s to the 1990s and early 2000s. The decline in pass through is evident in the relative stability of various measures of inflation since the mid-1980s, even in the face of sharp increases in oil prices. The decline also is documented in more formal analyses that show quantitatively the change in the impact of oil prices on inflation, holding other key variables constant.

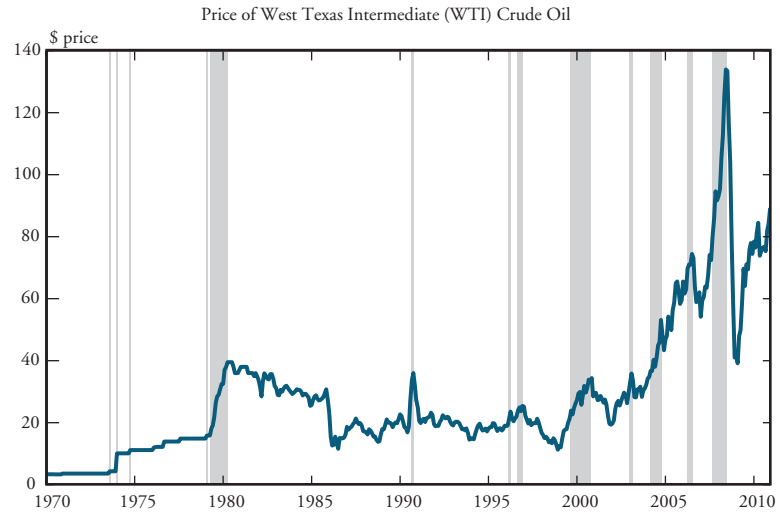
Descriptive evidence. The behavior of inflation and oil prices since 1970 supports the view that the pass through of oil price changes to inflation decreased after the mid-1980s. The decline in pass through can be seen in the behavior of inflation during periods when oil prices rose sharply. Such periods—referred to as oil shock episodes—have occurred periodically since the 1970s, often due to supply disruptions. Examples include the Arab oil embargo of 1973-74, the Iranian revolution of 1978-79, and the Iraqi invasion of Kuwait in 1990. To identify such periods regardless of their cause, economists have developed a number of criteria. For example, Hamilton (1996 and 2003) defines oil shock episodes as periods when the current price exceeds the maximum price in the past four quarters.[1]

Chart 1 examines the behavior of oil prices and inflation during and after oil shocks. The vertical shaded areas are periods that conform to Hamilton's definition. The top panel shows the price of West Texas Intermediate (WTI) crude; the bottom panel shows the evolution of headline and core inflation as measured by the Personal Consumption Expenditures (PCE) Price Index. Both measures have tended to move notably higher during oil shocks.

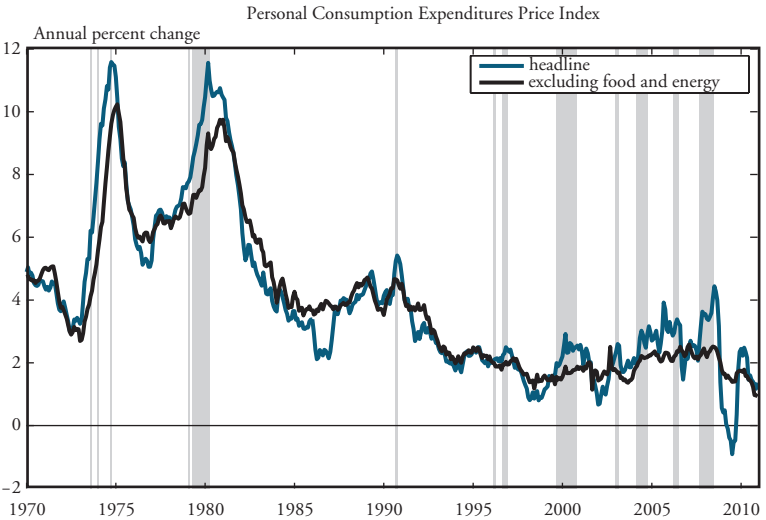
While the magnitude of oil shocks (on a percentage change basis) has remained roughly similar over time, the effect on inflation has changed. In particular, the increase in consumer prices in response to oil shocks is notably smaller in the 1990s and early 2000s than in the 1970s and early 1980s. Until 1983, oil shocks were typically followed by average increases in inflation of 4.5 percent. In contrast, in the late

Chart 1

OIL PRICES AND INFLATION



Source: Energy Information Administration



Notes: The shaded areas are periods that conform to Hamilton's definition of an oil shock as an episode in which the current price of oil exceeds its maximum in the past four quarters. Dates represent the first quarter of the year.
Source: Bureau of Economic Analysis

1990s and early 2000s, the response fell to about 0.7 percent for headline inflation and almost zero for core inflation.

Regression analysis. The reduced pass through of oil prices to inflation observed in the data is confirmed by a formal econometric analysis. Much of the empirical evidence is based on reduced form models that capture the basic characteristics of U.S. business cycles.[2] Models differ among authors (Bernanke and others, 1995; De Gregorio and others, 2007, or Blanchard and Gali, 2009; Chen 2009; Clark and Terry, 2010; Blanchard and Riggi, 2011), but the conclusions are similar: the pass-through effect declined after 1983.

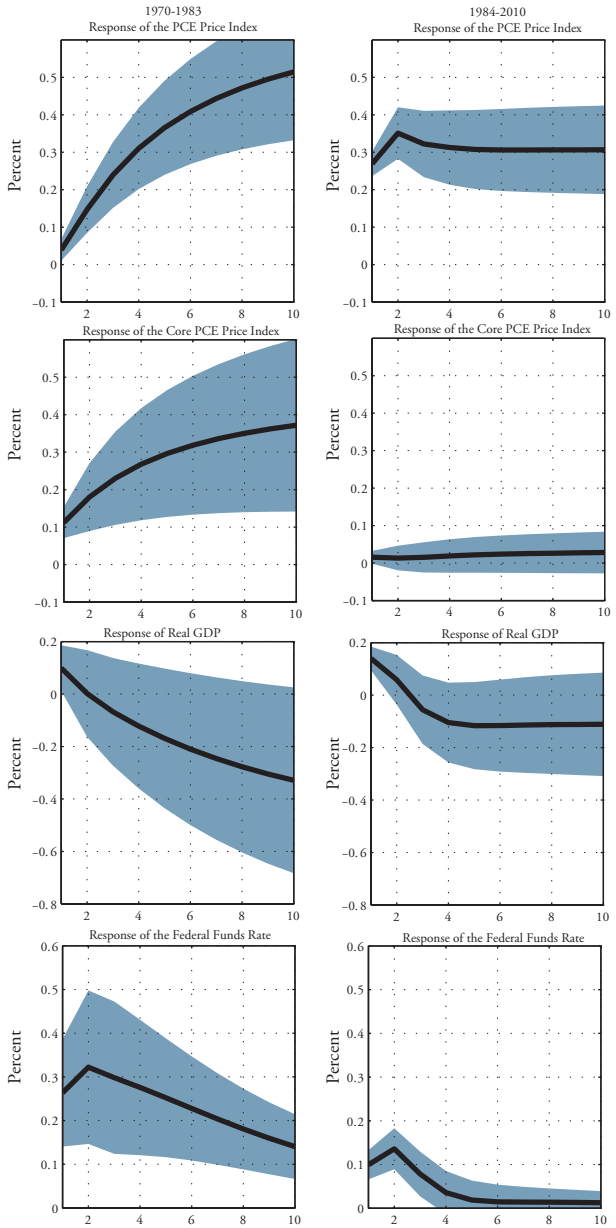
The statistical model used here replicates the results from the literature. It captures the basic behavior of the U.S. economy in response to oil price changes using a vector autoregression (VAR). The baseline model includes five variables: a measure of financial conditions, the real price of oil, real gross domestic product (GDP), the PCE Price Index (alternating headline and core), and the federal funds rate.[3] All variables are measured in growth rates with the exception of the federal funds rate.[4] The model captures the dependence of the transformed variables on one lag of each variable and is estimated across two subsamples—1970-83 and 1984-2010. Technical details of the estimation, oil shock identification, and alternative specifications of the empirical model are discussed in the Appendix.

The estimation results are summarized in Chart 2, which plots the cumulative effects of an unexpected 10-percent increase in oil prices on real GDP, the PCE and core PCE price indexes, and the federal funds rate. The total effects on the variables are measured by accumulating impulse responses over 10 quarters. Even though oil shocks are usually defined as much larger changes in the price of oil, a 10-percent increase is a useful benchmark because it nearly approximates the actual volatility of quarterly oil prices in normal times.

The results replicate the literature's basic finding that the pass-through effects of oil prices on inflation declined after 1983. Before then, a 10-percent increase in oil prices increased headline prices by 0.5 percent over 10 quarters (Chart 2, first panel in the first column); after 1983, the increase was only 0.3 percent (Chart 2, first panel in the second column). The pass through to core prices diminished completely,

Chart 2

PERSONAL CONSUMPTION EXPENDITURES PRICE INDEX



Notes: The solid black lines depict the impulse response of a 10-percent increase in real oil prices. The impulse responses are based on a VAR model with one lag. The baseline model includes variables ordered as listed: a measure of financial conditions, the real price of oil, real GDP, the PCE Price Index (alternating headline and core), and the federal funds rate. All variables are measured in growth rates with the exception of the federal funds rate. Inflation and real GDP growth rates are annualized. Real oil prices and financial stress are measured in (nonannualized) quarterly growth rates. The shaded areas depict 70-percent confidence intervals based on Monte Carlo simulations.
Source: Author's calculations

from 0.4 percent in 1970-83 to no increase in 1984-2010 (Chart 2, second row).

The effect of oil prices on other variables in the model also became more muted after 1983. Before 1984, a 10-percent oil price shock was associated with a 0.3-percent increase in the federal funds rate, while after 1983, the rate increased by roughly 0.1 percent (Chart 2, fourth row). Some economists (including Evans and Fisher, 2011) use this finding to conclude that oil prices have become generally uninformative as an indicator of inflation pressure. A similarly muted effect of oil shocks is observed on real GDP (Chart 2, third row), suggesting that the shocks have a weaker impact on the economy as a whole. Some economists (including Kilian, 2009) find that it is not the economy but the nature of oil shocks that has changed, leading to the seemingly muted effects. Prior to 1984, supply interruptions most commonly influenced the price of oil, while after 1983 rising worldwide demand largely influenced the price. In the 2000s, the output effects of higher oil prices were offset by the effects of rising global demand on the U.S. economy.

Explanations for the decline in pass through

The literature identifies a number of possible causes of the declining pass through in the 1990s and early 2000s. The four most cited are improved monetary policy, an increase in U.S. energy efficiency, more flexible labor markets, and increased openness to international trade.

Monetary policy. Improved monetary policy after 1983 is one of the main factors that potentially explain the decline in the pass through (Blanchard and Gali, 2009; Blanchard and Riggi, 2011; Evans and Fisher, 2011). According to a number of researchers, the reaction of monetary policy to inflation was insufficiently proactive before 1984, which led to a buildup in inflationary pressures (Sargent, 1999; Clarida and others, 2000; Lubik and Schorfheide, 2004).[5] From 1975 to 1981, annual PCE inflation reached the double-digits. After 1983, monetary policy began to respond more proactively to inflation. Making low inflation a clear policy objective helped to anchor long-term inflation expectations and reduced overall economic uncertainty. Low and stable long-term inflation expectations helped reduce the adverse effects of oil price shocks.

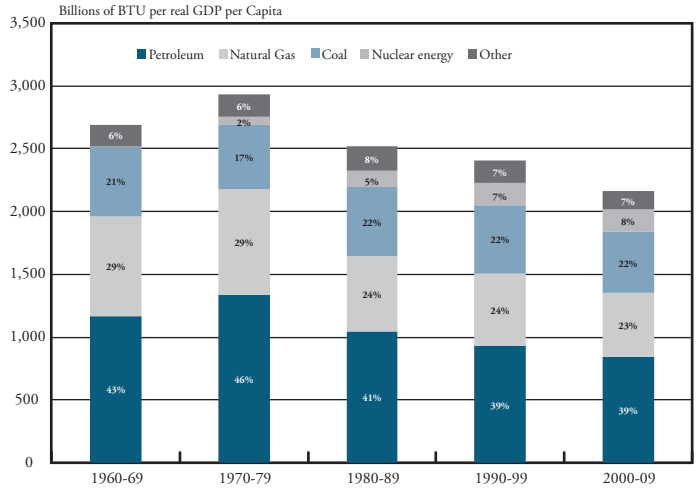
Increased energy efficiency. The severe oil shocks in the 1970s and early 1980s provided economic and political incentives over the next few decades for the United States to increase its energy efficiency. According to the U.S. Energy Information Agency, in the 1990s, 30 percent less petroleum—and almost 20 percent less energy resources in total—was required to produce the same level of GDP as in the 1970s (Chart 3). Similarly, U.S. consumers became less dependent on petroleum. As the fuel efficiency of cars improved, the relative share of gasoline in total consumption expenditures dropped from 4.5 percent in 1983 to 2.5 percent in 2000 (Chart 4). As a result, the first-round pass-through effects declined, and both headline and core consumer prices became less sensitive to oil-price swings (Blanchard and Gali, 2009; Nakov and Prescatori, 2010; Blanchard and Riggi, 2011).

Labor market flexibility. A third explanation is the increased flexibility of the labor market over the past three decades (Blanchard and Gali, 2009; Blanchard and Riggi, 2011). In the 1970s, real wages were relatively rigid and unresponsive to labor market conditions, due, at least in part, to the power of labor unions. Faced with an increase in consumer prices, workers in the 1970s asked for and received increases in nominal wages, which then led to further price increases. Blanchard and Riggi (2011) provide empirical evidence that, in the 2000s, consumer prices led to no increases in nominal wages and, therefore, minimal wage pressure on inflation. As a result, more flexible labor markets today allow for better management of labor and energy inputs in the production of consumer goods. For example, in the face of higher energy bills and falling demand brought on by an oil shock, real wages are more likely to fall. This in turn lessens the incentive of firms to recover the higher energy costs by increasing the prices of their goods.

Trade openness. Increasing openness in international trade and declining prices of imported goods and services during the 1990s and early 2000s are among the less-cited explanations. Some economists argue that the United States, as well as other developed countries, benefited from increased imports from emerging market economies (Kamin and others, 2006; Pain and others, 2008; Chen, 2009). Imported goods from emerging market economies were a cheaper alternative to domestic goods. Chart 5 shows that the prices of nonoil imports declined sharply from 1988 to 1998. Thus, when the price of energy increased

Chart 3

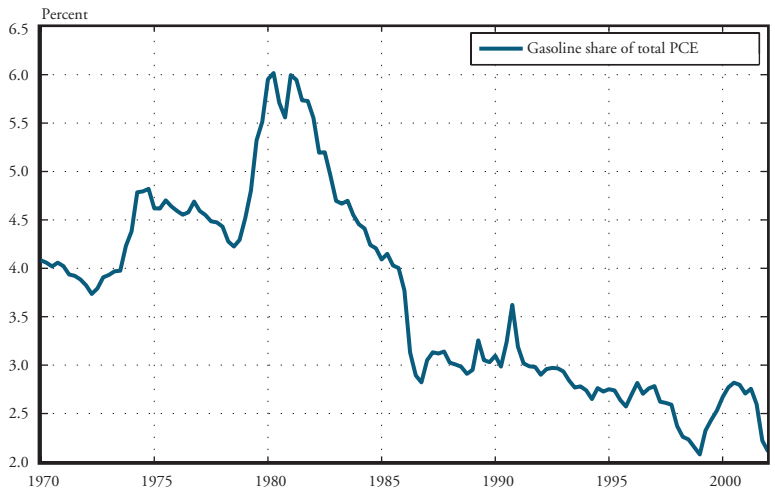
INCREASING ENERGY EFFICIENCY IN THE UNITED STATES



Note: British thermal unit (BTU) is a traditional unit of the energy content of fuels.
Source: U.S. Energy Information Agency

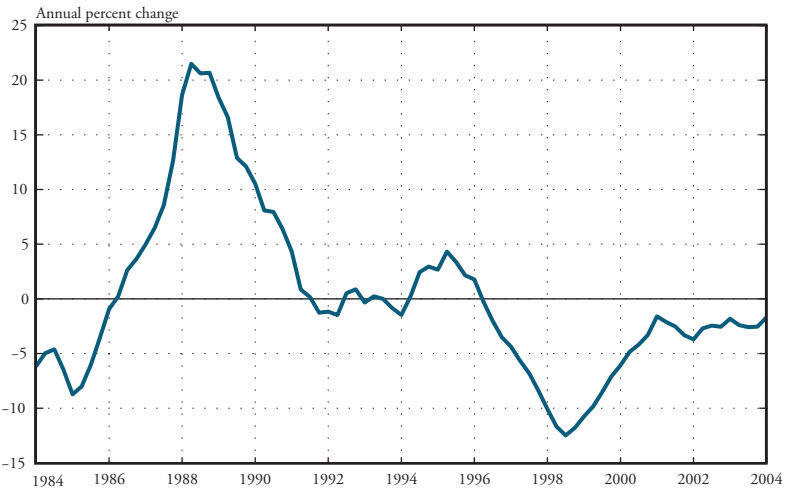
Chart 4

THE SHARE OF GASOLINE IN U.S. HOUSEHOLDS' CONSUMPTION BASKET



Note: Dates represent the first quarter of the year.
Source: Bureau of Economic Analysis

Chart 5
NONOIL IMPORT PRICES



Note: Dates represent the first quarter of the year.
Source: Bureau of Labor Statistics

during this period, households could offset some of the pass-through effect by substituting cheaper imported goods for more expensive domestic goods. Producers similarly benefited from more trade openness. Their ability to import cheaper inputs allowed them to cut their costs of domestic production, making them more price-competitive with their foreign peers.

II. HAS OIL PRICE PASS THROUGH INCREASED RECENTLY?

Although evidence clearly points to a decline in the pass through of oil prices to inflation after 1983, more recent experience suggests the possibility that oil prices again may be playing a larger role in the inflation process. For example, following an increase of 12 percent in the price of oil in the fourth quarter of 2010, the headline PCE Price Index rose 3.9 percent in the first quarter of 2011. Inflation remained elevated throughout the first half of 2011, even after oil prices stabilized.

This section examines the variation of pass through over 10-year periods to determine whether pass through has moved higher recently. After finding evidence of upward movement in the pass through of

oil prices to consumer prices, the section discusses possible reasons for such a change.

Evidence of an increased pass through of oil prices to inflation

A simple correlation of oil prices and inflation measured over 10-year rolling windows shows that pass through has increased sharply since reaching its low in the 10-year period that ended in the second quarter of 2003. A rolling-window VAR analysis shows that this increase is statistically significant, even after accounting for variation in real GDP and the federal funds rate. The results appear to be robust to the ordering of variables in the model and the inclusion of unconventional monetary policy measures.

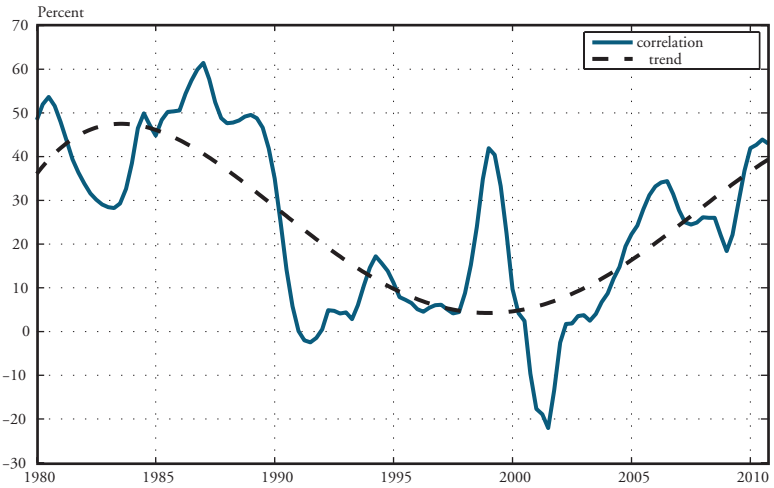
Simple correlations. The correlation between annual changes in crude oil prices and core inflation over the last 10 years suggests that a structural change could have occurred. Chart 6 shows the correlation between oil price changes and annual inflation from the late 1970s to 2010. In particular, the solid line shows the correlation over 10-year periods ending in quarters shown on the horizontal axis. The dotted line indicates the long-run trend.[6] Throughout the 1990s and early 2000s, the correlation of oil price changes and inflation was close to zero. Around 2004, however, the correlation began to rise, and by 2010, the correlation reached levels last observed in the 1980s.

Using a more sophisticated testing method, Clark and Terry (2010) found similar evidence of a structural shift in the pass through of oil prices to inflation. Allowing for a time-varying pass through of oil shocks to inflation in a model similar to the one used in Section I, they found that a structural break possibly occurred in the mid-2000s (Clark and Terry, 2010; Figure 1).[7] Their analysis, however, ends with the data available in 2008. The analysis that follows in this article takes a less sophisticated estimation approach; nevertheless, the findings echo those of Clark and Terry and provide the important gauge on magnitude of pass-through effects beyond 2008.

Rolling-window regression analysis. The methodology employed here is a simple extension of the approach taken in the previous section. The same reduced-form model and the same set of variables are used, but with a rolling-window regression instead of a standard regression. The rolling window provides an estimate of pass through that varies

Chart 6

CORRELATION BETWEEN OIL PRICE CHANGES AND CORE PCE INFLATION



Notes: The solid line depicts the correlation coefficient for WTI crude oil price changes and core PCE inflation computed with a 10-year rolling window. The dashed line depicts a smoothed long-run trend.
Source: Author's calculations

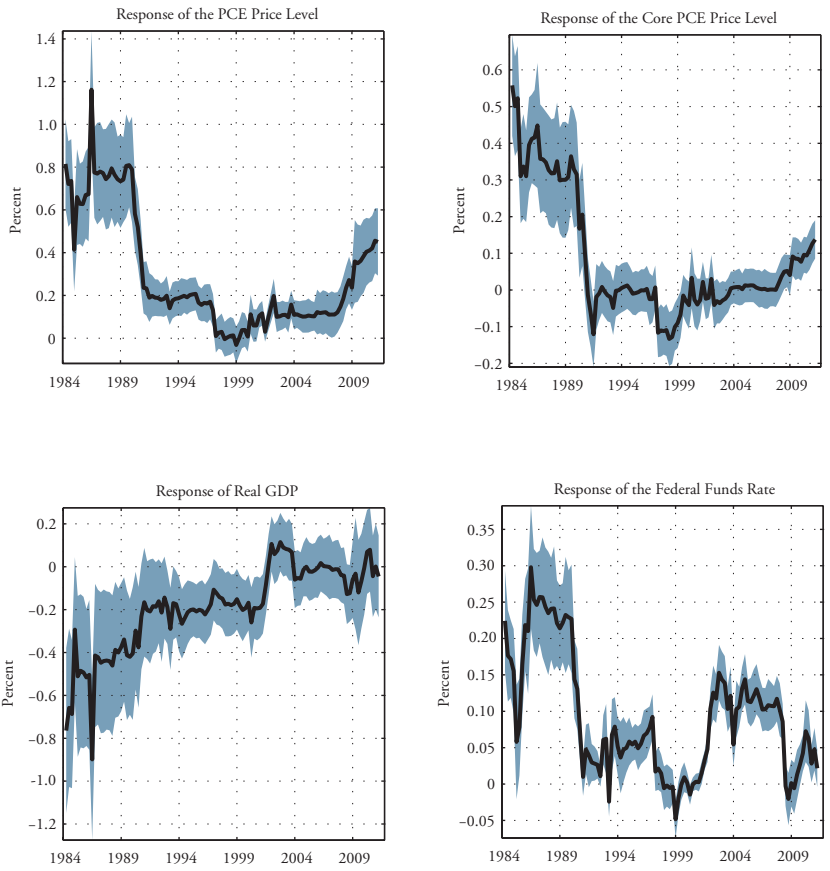
over time, taking into account changes in other variables that might also influence inflation. A useful feature of this approach is that the results are directly comparable to the results from the previous section. The rolling-window estimates meander around the previous estimates, which are the mean values of the rolling-window estimates.

The analysis uses a 10-year rolling window starting in the first quarter of 1983 and ending in the third quarter of 2011. The window span reflects the average length of U.S. business cycles, balanced against the degrees of freedom required to make the regression within each window statistically reasonable. Details are in the Appendix.

The baseline rolling-window results are summarized in Chart 7. For each rolling window, the estimated model is used to produce response functions to a 10-percent oil shock similar to those depicted in Chart 2. A snapshot of the response of the PCE and core PCE price level at 10 quarters following the oil shock is then taken and collected for each 10-year sample. Chart 7 depicts these responses of the price level to the oil shock over time, along with 70-percent confidence intervals as indicated by the shaded areas. Each point in the chart gives the average response of price level to the oil price shock in the 10-year period ended in the quarter indicated on the horizontal axis.

Chart 7

TIME-VARYING EFFECT OF A 10-PERCENT INCREASE IN OIL PRICES



Notes: Solid black lines depict the value of a cumulative impulse response at 10 quarters. The impulse responses are based on 10-year rolling window estimation of the VAR model with one lag. The baseline model includes variables ordered as listed: a measure of financial conditions, the real price of oil, real GDP, the PCE Price Index (alternating headline and core), and the federal funds rate. All variables are measured in growth rates with the exception of the federal funds rate. Inflation and real GDP growth rates are annualized. Real oil prices and financial stress are measured in (nonannualized) quarterly growth rates. The shaded intervals depict 70-percent confidence intervals obtained from Monte Carlo simulations.
Source: Author's calculations

The rolling-window results replicate the muted pass-through effects estimated with the regressions from the previous section. After the 1979-89 window, the pass through of oil price shocks to inflation dropped sharply. For 10-year periods ended in the first quarter of 1983 through the second quarter of 1989, the pass through of oil prices to inflation was historically high. A 10-percent increase in oil prices led to an increase in the headline consumer price level to about 0.8 percent. By the 10-year period ended in the second quarter of 1999, the pass through of a 10-percent shock to oil prices dropped to 0.1 percent (Chart 7, top left panel).[8]

The pass through to core prices followed the same pattern as the pass through estimated for headline prices. Beyond 1993 and through about mid-2008, the value of the pass-through effect hovered around zero as found earlier (Chart 7, top right panel). But as conjectured, the mid-2000s signified a turning point.[9]

The rolling-window regression also confirms the earlier findings on the muted reaction of real GDP and the federal funds rate to oil shocks. Real GDP became less sensitive to oil shocks in the 1990s (Chart 7, bottom left panel), and became virtually insensitive to oil shocks in 2000. This change in the reaction of real GDP can be viewed as additional empirical evidence of the changing nature of oil shocks documented by Kilian (2009). While oil shocks in the 1970s and 1980s were driven by supply disruptions, oil shocks in the 2000s were driven by demand. The response of the federal funds rate to oil shocks has remained fairly stable over the past three decades. It fluctuates around 0.05 percent, 0.20 percentage point lower than before 1984 (Chart 7, bottom right panel).

Although the evidence confirms the earlier finding that the pass through of oil price shocks to consumer prices moderated in the mid-1980s, it also shows that the pass through has increased recently. The rolling-window regressions reveal that prior to the Great Recession in 2007, the pass through appears to exhibit a structural break (Chart 7, top panels). PCE prices seem to be twice as sensitive to oil-price changes in 2000-2010 as in 1998-2008. Although the pass through is still relatively low, its increase is statistically significant. This turnaround is noteworthy because the effect of oil prices on the core price level had been statistically indistinguishable from zero for the previous 20 years.

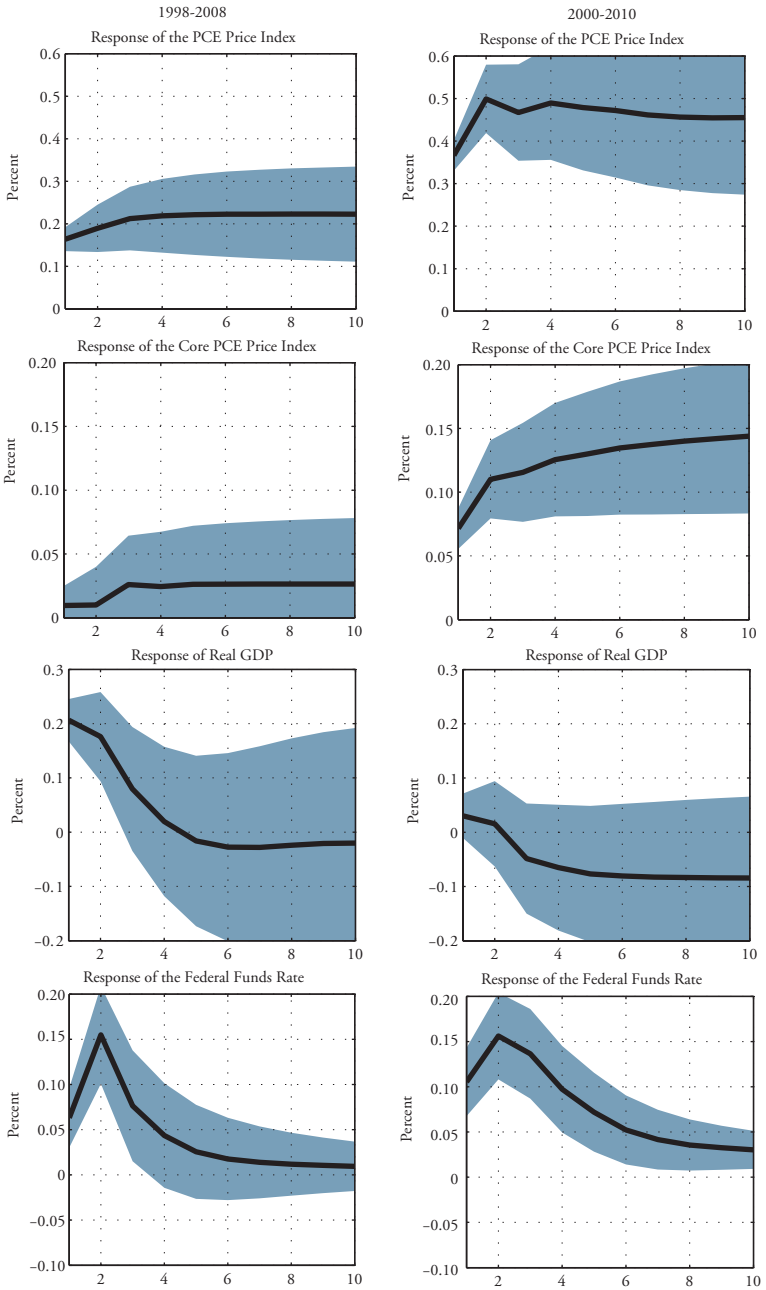
The increase in the pass through is also evident in a comparison of the impulse responses estimated for the 1998-2008 and 2000-2010 windows. In Chart 8, which is similar to Chart 2 in the previous section, the panels on the left depict the average reaction of headline and core PCE price levels, real GDP, and the federal funds rate to a 10-percent oil price shock over the 1998-2008 period; the right panels depict the same reactions over the 2000-2010 period. Although the interest rate and real GDP responses remain largely unchanged in the two periods, the reaction of PCE prices is notably different. The impact of the oil price shocks on headline PCE prices rose from 0.2 percent in 1998-2008 to 0.5 percent in 2000-2010. The impact of the oil shock on core inflation rose from 0.03 percent to 0.15 percent and became statistically significant in the 2000-2010 the period.

Robustness to unconventional monetary policy. The timing of the increased oil price pass through coincides with a turbulent time in the U.S. economy—as evidenced by soaring oil prices, financial collapse, and nominal interest rates falling to the zero lower bound—making verification of the robustness of the results important. A possible pitfall of working with rolling-window regressions is that a shorter data sample potentially makes the results more sensitive to model misspecification, as different time periods may be dominated by unique economic factors that are difficult to capture in a model. In general, model misspecification gives rise to biased and inconsistent estimates. Clearly, unconventional policy actions of the late 2000s are a major factor that could lead to misspecification.

Adding a variable to account for unconventional monetary policy has limited quantitative impact on the baseline pass through. Because the expansion of the Federal Reserve's balance sheet through large-scale asset purchases and other programs from 2007 to 2011 was omitted from the baseline model, the regression may have falsely attributed to energy prices the (latent) effect that expansionary policy may have had on inflation. This may have resulted in an upward bias in the estimated effect of oil prices on inflation. However, augmenting the model with a measure of the size of the Fed's balance sheet had negligible effects on the results.[10] The mean value of the pass-through effect still exhibits an increasing tendency starting in 2008, with values in 2011 slightly higher than those reported in Chart 7, but surrounded by higher uncertainty.

Chart 8

A STRUCTURAL CHANGE IN THE EFFECT OF A 10-PERCENT INCREASE IN OIL PRICES



Notes: See Chart 2.
Source: Author's calculations

Possible explanations for the increased oil pass through

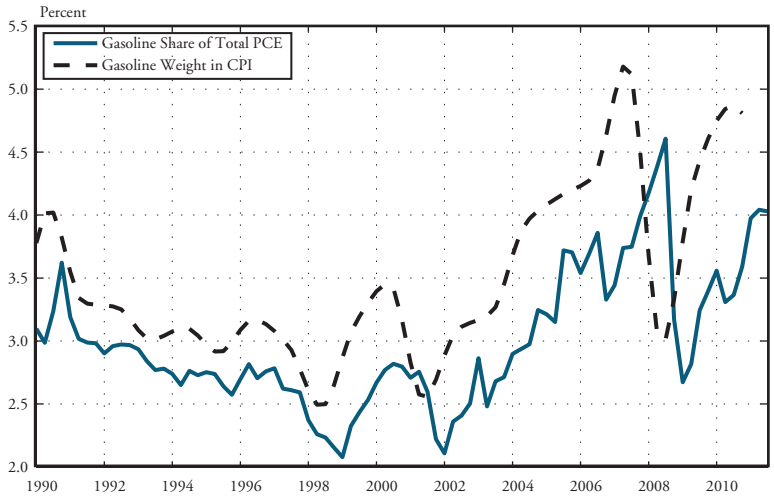
Possible explanations for the increase in oil price pass through identified in mid-2008 include a rising share of oil in consumer spending, the financialization of commodity markets, and the highly accommodative monetary policy put in place during the financial crisis.

Oil shares. An increasing share of oil in private consumption is among the leading explanations for an increase in the oil price pass through. Following the oil shocks in the 1980s, the share of gasoline in household consumer spending declined. The trend, however, reversed itself in the mid-2000s when consumers again started spending a greater share of total consumption on gasoline. Chart 9 shows that gasoline became more important in total private consumption expenditures and that gasoline prices played an increasingly important role in the aggregate price level. By 2007, the gasoline share had climbed to 4 percent, a level comparable only to the 1970s. Although the Great Recession briefly interrupted this trend as the share dropped, recent data indicate that the upward drift has resumed and the gasoline share again is nearing pre-recession levels. The same development is observed in the weights that the U.S. Department of Labor applies to gasoline and other energy sources in computing the official Consumer Price Index (Chart 9, dashed line).

Financialization of commodity markets. Financialization of commodity prices is a second factor that may have contributed to a structural change in pass through. Since 2004, the prices of nonenergy commodities in the United States have become increasingly correlated with oil prices (Tang and Xiong, 2010). For example, Chart 10 shows the comovement of the prices of oil, copper, cotton, and soybeans. Tang and Xiong attribute the comovement in oil and nonenergy commodity prices to increased financialization of commodity markets. In an effort to hedge against inflation and a possible depreciation of the dollar, investment in commodity market indexes (such as Goldman Sachs Commodity Index or Dow-Jones UBS Commodity Index) has become increasingly popular among institutional investors. This investor behavior has helped create a comovement of energy and nonenergy commodity prices and has increased the pass through of oil prices to consumer prices. This situation is similar to the 1970s and

Chart 9

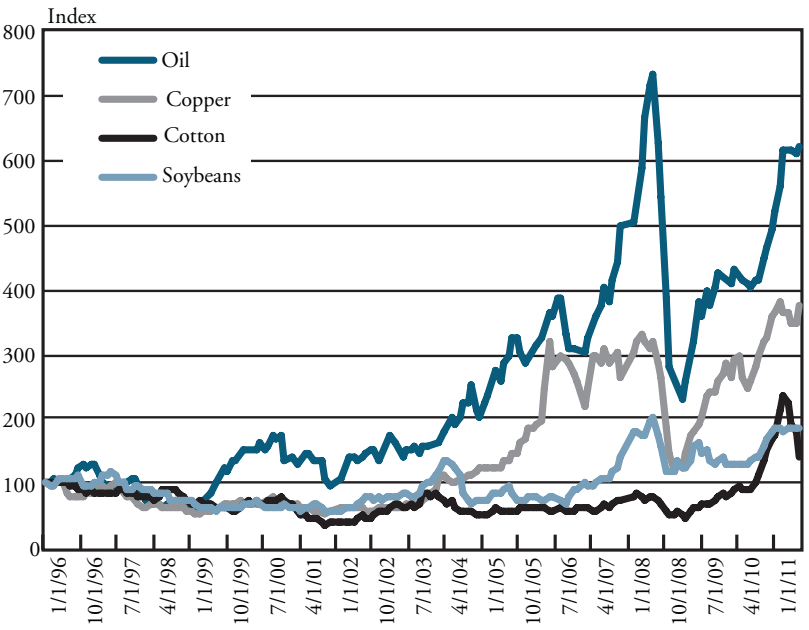
GASOLINE SHARE IN U.S. HOUSEHOLD CONSUMPTION



Source: Bureau of Economic Analysis

Chart 10

PRICE OF OIL AND NONENERGY COMMODITIES



Note: 1996 equals 100 percent.
Source: Bloomberg

early 1980s when nonenergy commodity prices rose in tandem with oil prices (Blanchard and Gali, 2009; Harris and others, 2009).

Conduct of monetary policy. Monetary policy may also have contributed to the increase in pass through since 2007. For example, several researchers (including Taylor, 2010) have argued that monetary policy was too accommodative from 2004 to 2006.[11] Harris and co-authors (2009) suggest that the overly accommodative policy stance increased the volatility of short-term inflation expectations in response to rising oil prices and thus contributed to a greater pass through. The structural break in the conduct of monetary policy that occurred when the zero lower bound on the federal funds rate was reached in late 2008 may have further contributed to higher pass through compared with previous experience. As the target funds rate approached zero in 2008, the Federal Reserve turned to a number of unconventional policies, including large-scale asset purchases, to provide additional monetary accommodation. Under these policies, consistent with the arguments of Harris and co-authors, monetary conditions may have also contributed to an increase in inflation and volatility of inflation expectations.[12] A lack of experience with unconventional policy makes the policy transmission mechanism to output and inflation more uncertain than in normal times, and, when combined with rising oil prices, may have contributed to an increase in pass through to inflation. However, the increase in core inflation over this period was limited, and both headline and core inflation have recently receded to more moderate levels.

III. CONCLUSION

Based on the simple analysis presented in this article, the pass through of oil prices to consumer prices—though low in comparison to the U.S. experience during the 1970s and early 1980s—may be higher today than it was five years ago. After a period of disinflation in the early 1980s, the average pass through sharply declined and remained at its historically low levels for more than two decades. This change was brought on by a combination of possible factors, including better monetary policy, a smaller share of oil in production and consumption, better functioning labor markets, and more openness to international trade. In the past decade though, some of those factors may have reversed their trend.

A simple analysis looking at time variation in the pass through indicates that the mid-2000s signify a possibly important structural break. The pass though of a 10-percent oil price increase to headline prices gradually increased from 0.15 percent in the mid-2000s to 0.45 percent in 2011. Similarly, the pass through into core prices increased from zero to 0.15 percent. These values are the highest since 1990. Possible explanations for this change include an increasing share of oil in the consumer's market basket, comovements of other commodity prices with oil prices, and highly accommodative monetary policy. However, future research is needed to confirm the magnitude of the structural break and possible explanations for it.

APPENDIX

This Appendix provides technical details on the statistical model and estimation methodology used in this article.

Vector autoregressive model

The vector autoregressive (VAR) model captures the dependence of transformed variables (generically denoted as y_t) on their past values (y_{t-1}, y_{t-2},…, y_{t-p}). Formally, the relationship is expressed as

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \ldots + A_p y_{t-p} + e_t.$$

The matrices A_1 through A_p contain parameters that encapsulate the dynamic interactions among the variables in y_t and capture the U.S. business cycle. The total count of the matrices (p) determines the order of the autoregressive process. Finally, e_t captures independent residual.

The five variables in the model are ordered as listed in the main text: a measure of financial conditions, the real price of oil, real GDP, the PCE Price Index (alternating headline and core), and the federal funds rate.

Model order choice and estimation

Ivanov and Kilian (2005) recommend the Schwarz Information Criteria for the identification of the order of the VAR model (p), which they found preferable to Akaike and other criterion for small samples of quarterly data (less than 120 observations). Based on this criteria, the data favor the VAR of order 1, but the presented results in Chart 2 are qualitatively robust up to the VAR order of 4, which is the order often seen in the literature. In the literature on the oil price effects on GDP, economists sometimes choose the order of 4 to capture the pass-through effects to the real economy, which typically take a longer time than the pass-through effects to consumer prices. Imposing higher orders of autoregression comes at the cost of statistical significance of the results.

A VAR of order 1 is also the preferred order in the rolling-window regressions in the second section of the article. Because the length of the rolling window is only 40 quarters, estimation of higher order models yields unstable models.

The model was estimated using the ordinary least squares method on two subsamples.

Recursive identification of oil shocks

A recursive identification schema is used to identify the oil shock. Information about structural disturbances, like the oil shock, lies in the residual terms of the regressions. There is no unique way to determine structural disturbances from these residual—an economic theory is needed. A simple and widely used assumption in the literature is that the price of oil is determined on the world market and therefore exogenous to the U.S. economy. This assumption is popular because it simplifies the identification problem of oil shocks.

Any identification assumption can be challenged and this is no exception. In particular, the collapse in oil prices following the global downturn is sometimes viewed as endogenous to developments in the United States because it was a change in the U.S. economy that led to the global downturn. This argument, however true, is irrelevant because the global effect of the U.S. downturn was not immediate, which is strictly required by the methodology identifying the oil shock. Oil prices were surging until July 2008, eight months after the NBER date for the beginning of the U.S. recession, making the subsequent oil price collapse exogenous to the U.S. downturn of December 2007.

Notes on robustness

The baseline model used in the article was kept parsimonious but different specifications were considered before reporting the final results.

The baseline model was experimentally extended for the nominal exchange rate. If the dollar depreciates, oil exporters tend to compensate for losses in revenue by increasing the price of crude oil. A similar tendency exists also in the opposite direction. Including the nominal exchange rate as the first variable in the VAR (before oil prices and instead of the KCFSI) mostly affects the reaction of the federal funds rate to oil shocks, which becomes more responsive than under the baseline specification. The response of headline and core prices becomes more volatile but is fundamentally unchanged, suggesting a limited pass-though effect from exchange rate to consumer prices.

The main results are robust if measures of unconventional policy (the nominal size of the Federal Reserve's balance sheet or the monetary aggregate M2) are included or measures of financial stress are excluded from the baseline model.

Finally, the results are largely insensitive to ordering of the variables in the baseline model specification. Similarly to the findings by Clark and Terry (2010) and others, swapping the position of the PCE Price Index with the oil price does not qualitatively alter the results; the same is true for swapping PCE Price Index with real GDP, and making PCE Price Index exogenous to demand shocks.

ENDNOTES

[1]Although economists view oil shocks as periods of sharp oil price increases, definitions differ. For example, Blanchard and Gali (2009) define an oil shock period as a continual increase in the average dollar price of a barrel of oil of more than 50 percent that is sustained for more than a year.

[2]The pass-through effects are typically studied in linear models such as the one used here. The empirical literature does not distinguish between oil price increases and decreases, because their effects appear to be similar in absolute value (Kilian and Vigfusson, 2011).

[3]The measure of financial stress is the Kansas City Financial Stress Index (KCFSI). The real price of oil is the U.S. refiner acquisition cost of crude oil deflated by the core PCE Price Index, which is the measure of oil prices most commonly used in the literature. The variables are ordered in the VAR as listed. The main results are largely insensitive to whether the measure of the financial stress index is excluded from the model. Including the measure downplays a positive impulse response of real GDP to an oil shock that tends to occur as a result of demand driven oil shocks toward the end of the sample. The work by Benk and others (2005) may be used to economically justify the inclusion of such a financial variable. Benk and co-authors provide empirical evidence that about one-third of U.S. business cycle volatility is caused by credit shocks. The KCFSI carries information about the credit conditions prevailing in the U.S. economy and thus has the potential to improve the model fit.

[4]Inflation and real GDP growth rates are annualized. Real oil prices and financial stress are measured in (nonannualized) quarterly growth rates.

[5]Some economists argue that the response of policy to inflation was similar across the two periods. However, in the earlier period, policymakers may have overestimated the size of the output gap in determining the stance of policy in real time (Orphanides, 2003).

[6]The trend line is fitted as a simple cubic trend function.

[7]Clark and Terry specified their VAR model with time-varying coefficients and stochastic volatility of the shocks.

[8]Due to the 10-year rolling window, the estimates carry information about the pass through before 1983 up to 1993.

[9]Again due to the 10-year rolling window, the estimated change of the pass through in 2008 is the average effect between 1998 and 2008, which is why the turning point is dated in the mid-2000s.

[10]If a measure of the money stock is used instead, the results are similar.

[11]Some prominent economists and policymakers disagree with this view. For example, Federal Reserve Chairman Ben Bernanke, in his address to the American Economic Association in 2010, argued that movements in the federal funds rate were consistent with historical experience.

[12]Economists disagree on the effects of these policies (Gagnon and others, 2010; Doh, 2010; Taylor, 2011; Goodfriend 2011; Krishnamurthy and Vissing-Jorgensen, 2011).

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