Globalization, Oil Prices and U.S. Economic Activity

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Globalization, Oil Price Shocks and U.S. Economic Activity

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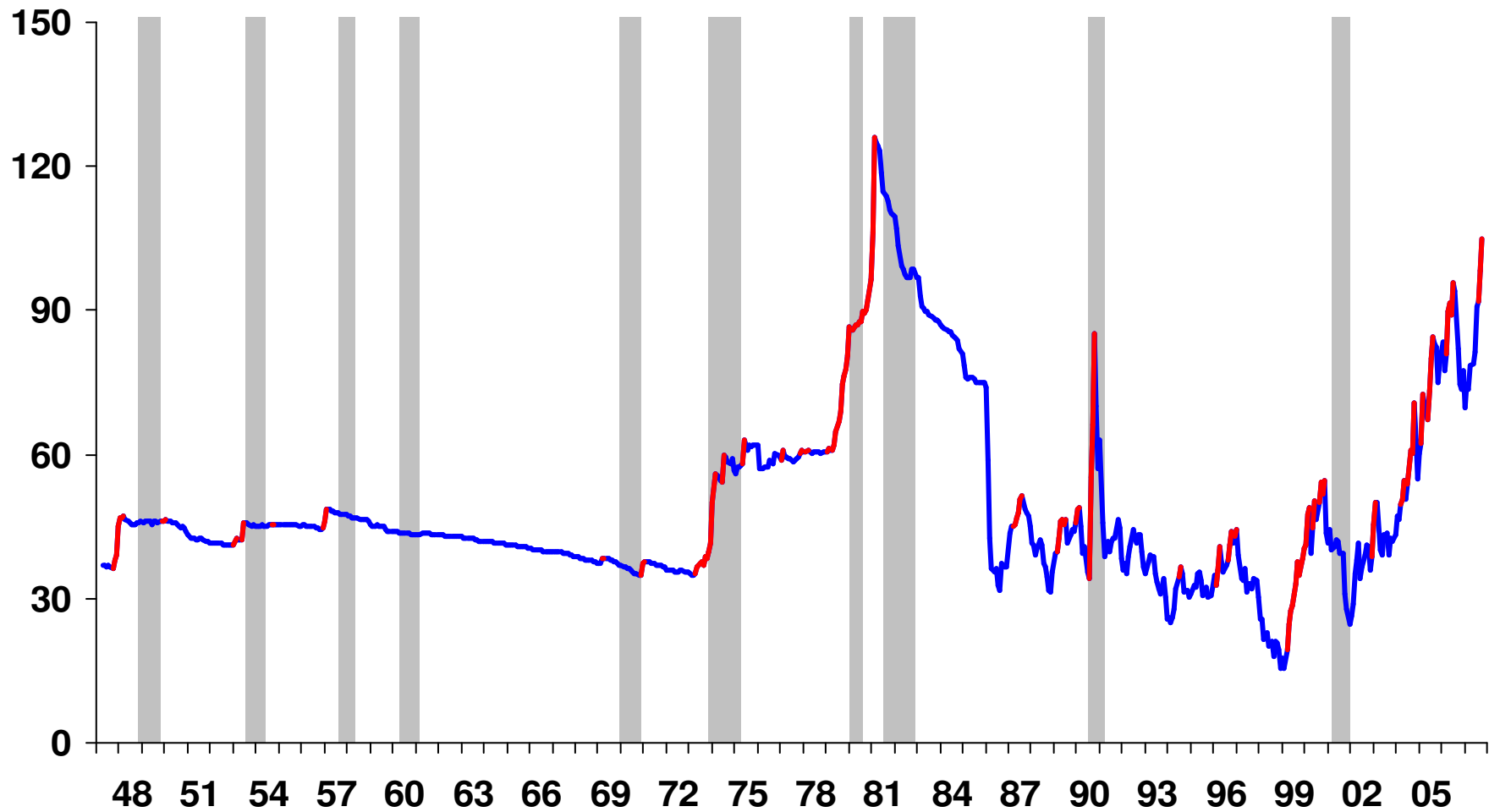
March 31, 2008

I. Introduction.

What are the economic consequences to the United States of an increase in the oil price?

Conventional thinking: oil supply shock

- Higher oil price
- Slower GDP growth
- Increased price level

Real oil price and recessions (shaded)

Index, 1982 = 100

Empirical evidence of a negative relationship is mixed:

For: Mork and Hall (1980), Hamilton (1983, 2003),
Balke, Brown, and Yücel (2002), Hamilton and Herrera (2004),

Against: Bohi (1989, 1991), Hooker (1996), Bernanke, Gertler,
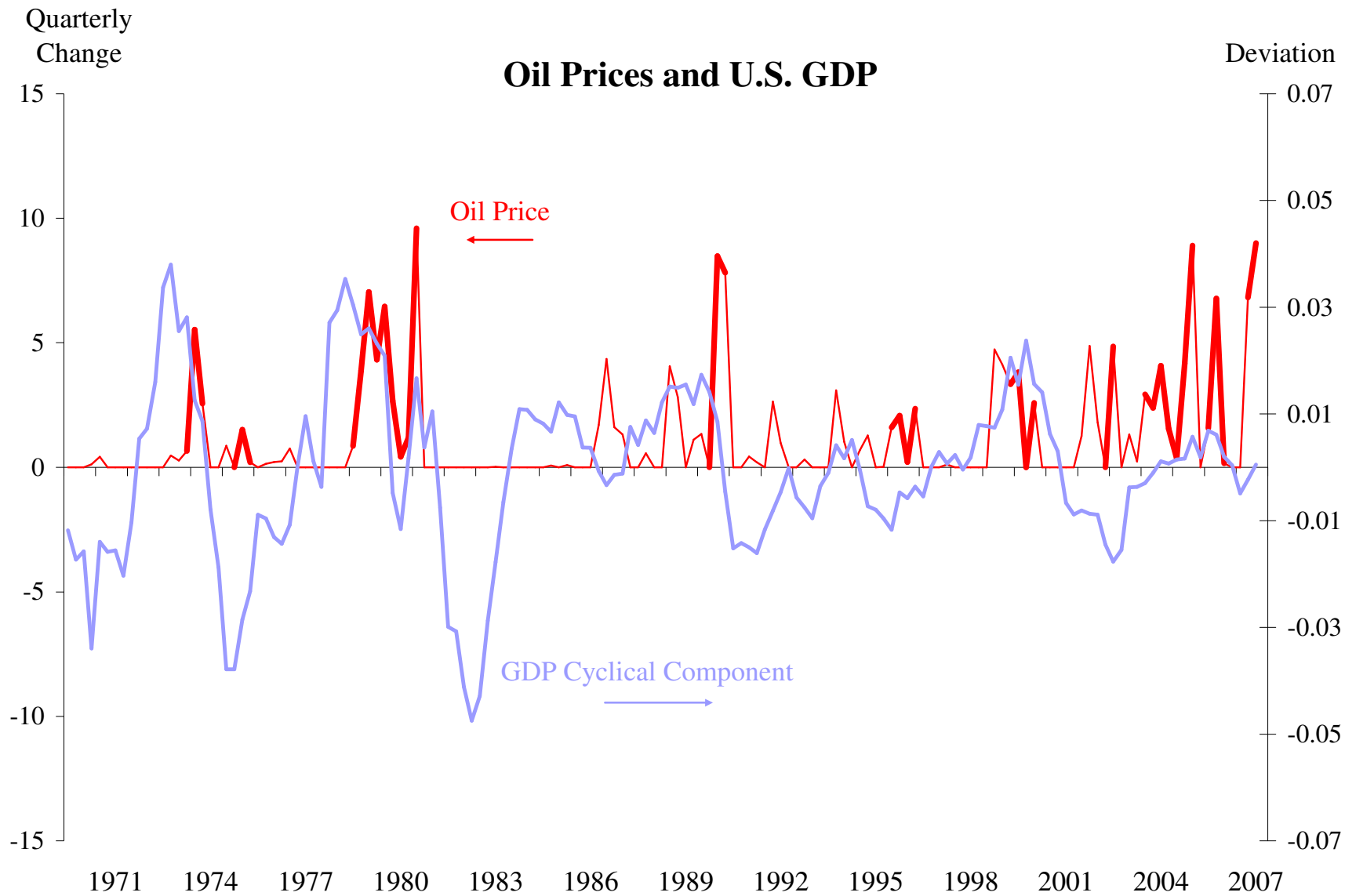and Watson (1997), Barsky and Kilian (2001), Kilian (2005)

A Principal Empirical Issue:
Identifying exogenous oil supply shocks versus other effects

    Nonlinearity (asymmetry):
Mork (1989, 1994), Ferderer (1996), Hamilton (1996, 2003),
Davis and Haltiwanger (2001)

    Hamilton's evolving oil price specification

Oil Prices and U.S. GDP

Why haven't recent oil price gains resulted in weakening U.S. economic activity (yet)?

Accounting for quantitatively smaller effects:

  More stable aggregate demand
    (better luck or increased global financial integration);
  Reduced energy intensity of the U.S. economy;
  Greater flexibility of the U.S. economy;
  Increased experience with oil price shocks;
  Better monetary policy.

Huntington (2003), CBO (2006), Blanchard and Gali (2007), Bodenstein, Erceg and Guerrieri (2007), Segal (2007).

What if higher oil prices are the result of increased demand rather than oil supply shocks?

Kilian (2007), Elekdag and Laxton (2007)

– Perhaps driven by U.S. productivity gains
– Perhaps driven by foreign productivity gains

Productivity gains can boost global economic growth and push oil prices upward at the same time.

These are qualitatively different effects.

Our research:

1. Identify different sources of oil price shocks

2. Quantify their effects

Approach:

1. Build a DSGE model of the world economy (a simple three-country model).

   - captures demand for and supply of oil (to help with identification of the sources of oil price shocks)

   - allows for different types of shocks that could offset the effects of oil price shocks (possibility of good luck)

2. Use the model to empirically identify sources of shocks.

   - Estimate parameters and unobserved state variables (including shocks) with Bayesian McMC methods.

II. Model

3 country model based on Backus and Crucini (*JIE* 2000):
   2 manufacturing countries; 1 oil-producing country

- 2 manufacturing countries (symmetric) – think US and ROW
   i. Each country produces one good. Both domestic and
       foreign goods are used for consumption and
       investment—home bias.
   ii. Oil and capital combine to produce capital services –
       elasticity of substitution between oil and capital is low
       (or at least different than for labor and capital services).
   iii. This gives us a model with oil demand *and* provides a
       mechanism for oil prices to affect economic activity

- Oil-producing country

  i. Backus and Crucini: oil production has a large exogenous component (OPEC) and an endogenous supply component via a labor-only technology.

  ii. Our model: dynamic model of oil supply and reserves:

     - Oil production depends on labor and reserves of oil

Shocks in the manufacturing countries:

    i.   Total factor productivity shock.

    ii. Labor wedge shock – shock to wedge between measured MRS and MP of labor (preference shock or negative labor supply shock).

    iii. Oil wedge shock—shock to wedge between the measured marginal product of oil and its relative price (reduced energy efficiency or increased energy taxes).

    iv. Investment/capital accumulation shock—shock to rate at which capital is formed (negative investment efficiency shock).

- Shocks in the oil-producing country

  i. Oil productivity shocks (standard oil supply shock).

  ii. Shocks to productivity in creating oil reserves.

III.   Empirical Methodology

- Solve log-linearized model around steady state

- Observables: price of oil, world oil production, US real GDP, US real consumption, US real investment, US hours, US oil consumption, relative price of non-oil imports for US.

- Bayesian estimation of model parameters (not calibration)

- Infer unobserved state variables (capital stocks, oil reserves, and exogenous shocks) – use model to filter data

- Use Metropolis-Hasting algorithm to approximate posterior distribution

IV. Impulse Responses
Oil Market (Figures 3A and 3B):

- Oil production shock is a classic oil supply shock

- Oil reserve shock increases supply in short-run; reduces supply in longer-run.

- Manufacturing TFP, investment efficiency, labor wedge shocks look like oil supply shocks in short-run; TFP and investment efficiency increase demand in longer-run; increased labor wedge reduces demand in longer run.

- Oil wedge shock looks like a negative demand shock

Figure 3A. Impulse responses of oil price and oil output
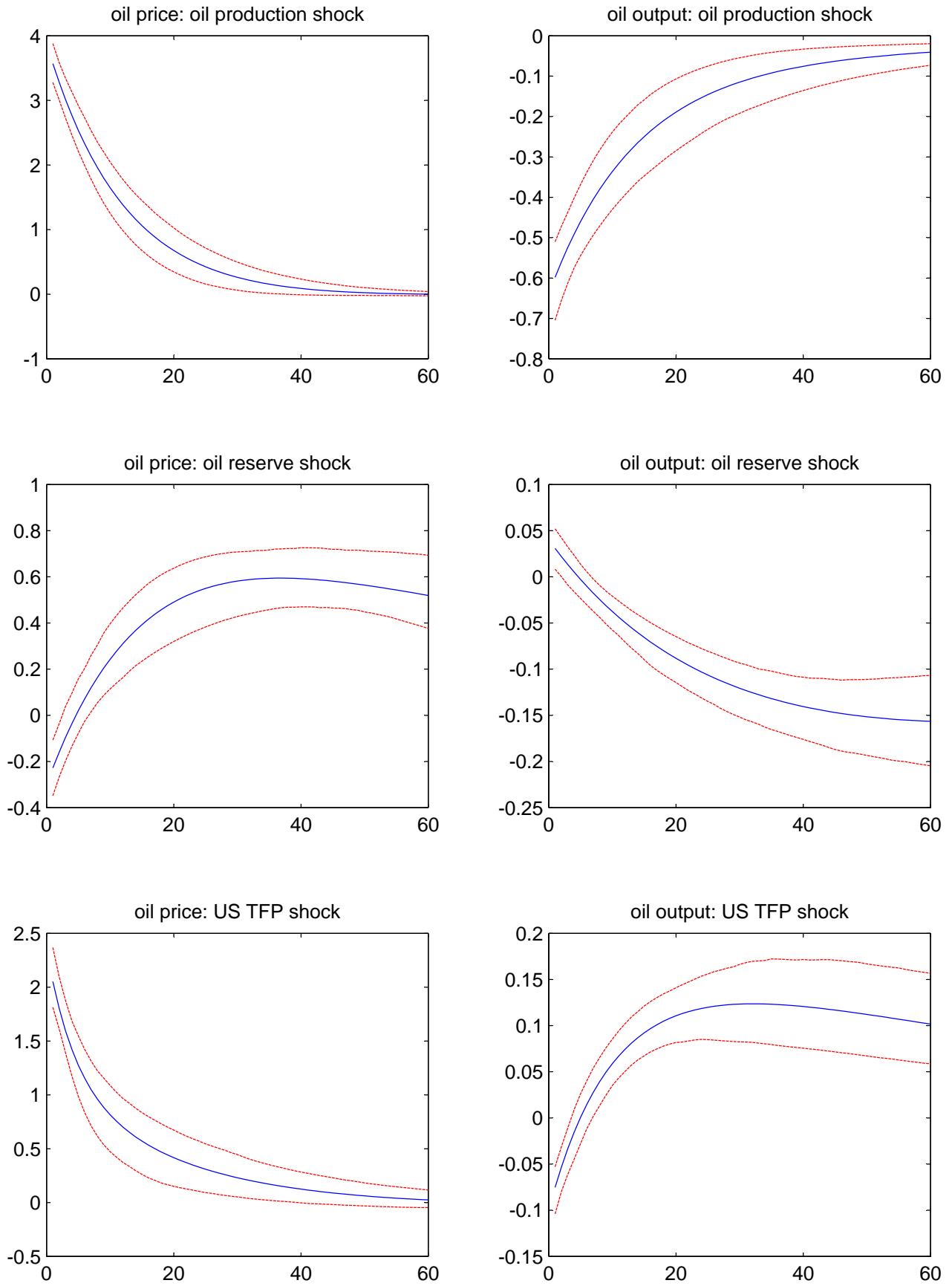
Figure 3B. Impulse responses of oil price and oil output
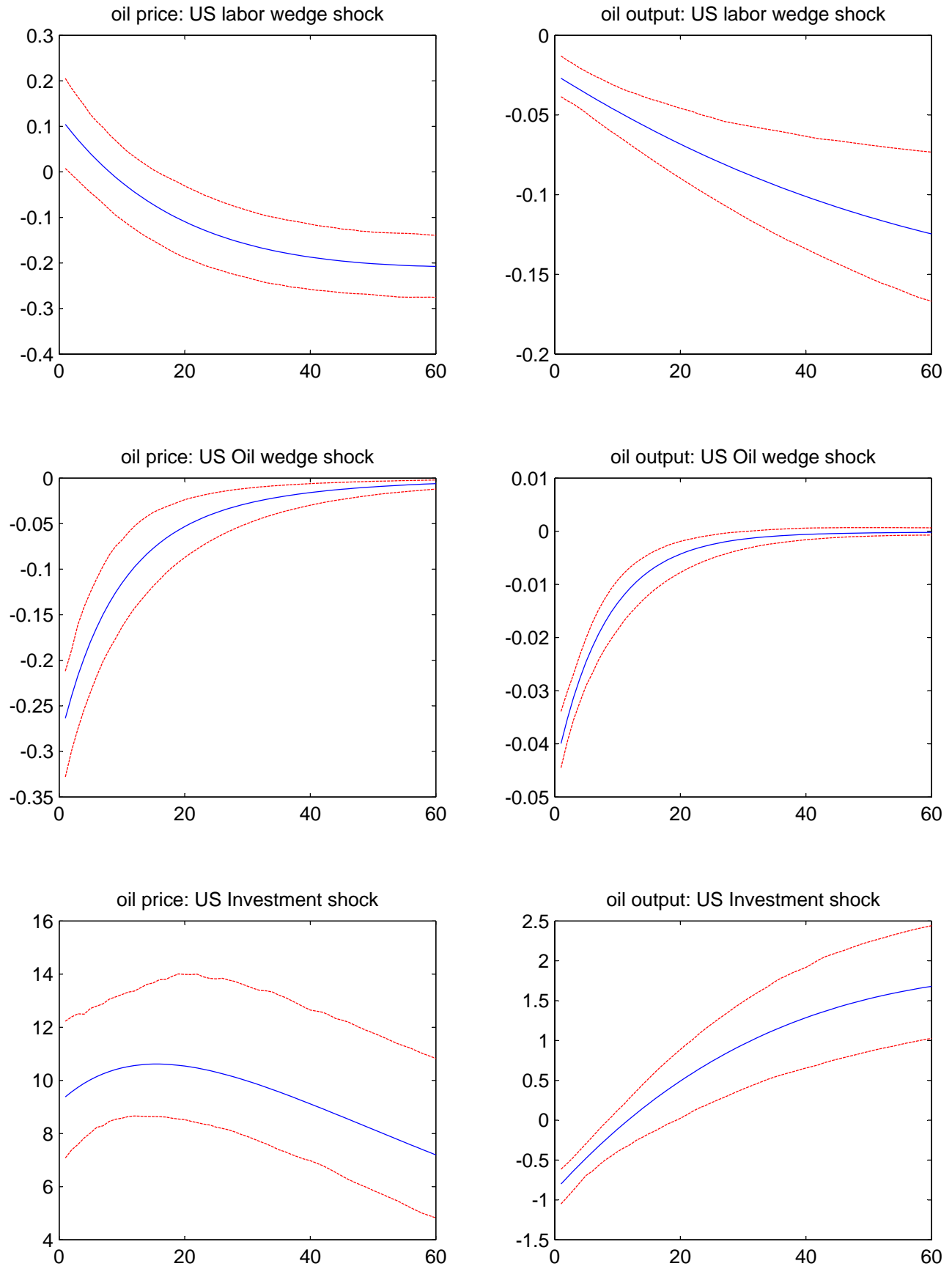
IV. Impulse Responses
U.S. GDP (Figures 4A and 4B):

- Negative oil production and reserve shocks reduce GDP.

- Domestic TFP shocks have a big effect on output; foreign TFP shocks have a small effect.

- Domestic labor wedge shocks have a big effect on output; foreign labor wedge shocks have a small effect.

- Increased U.S. oil wedge and reduced investment efficiency shocks reduce U.S. GDP.

- Increased foreign oil wedge and reduced investment efficiency shocks boost US GDP.

Figure 4A. Impulse response of US real GDP
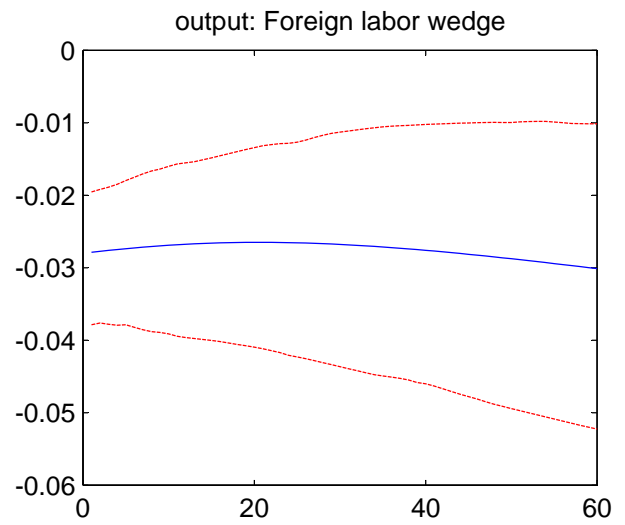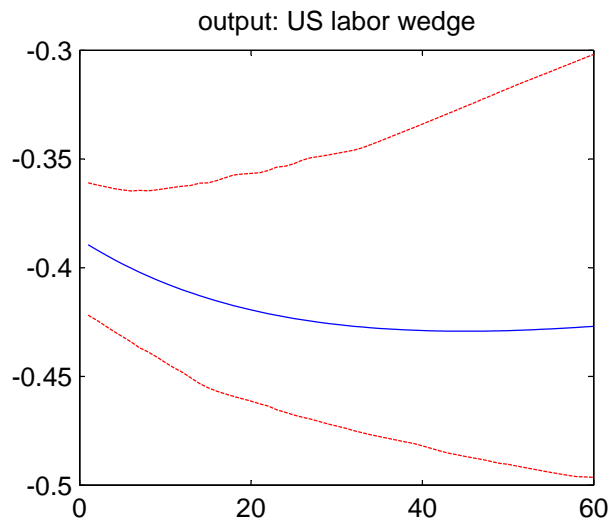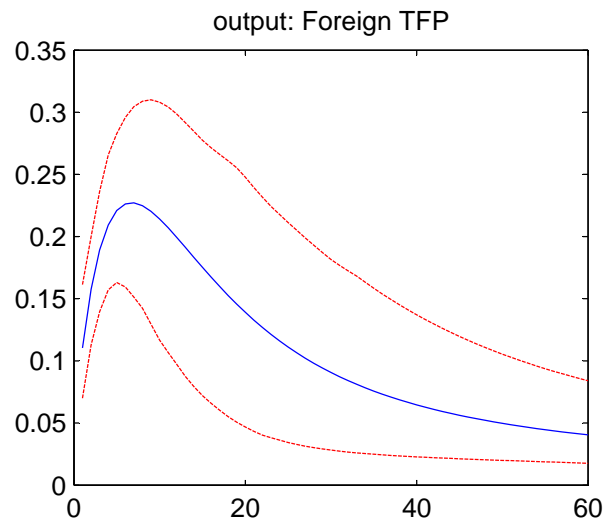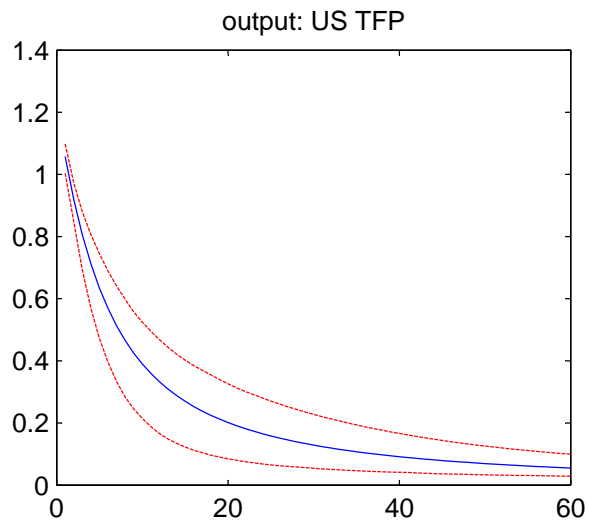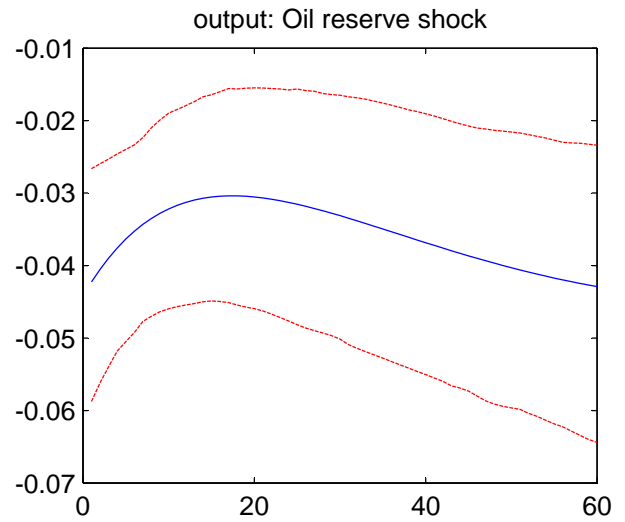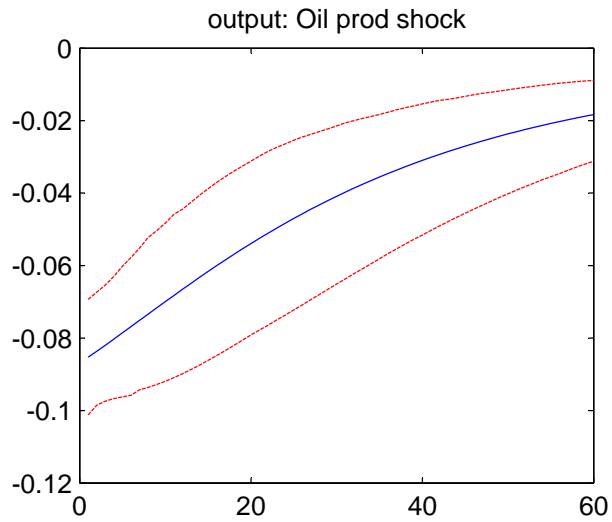
Figure 4B. Impulse response of US real GDP

output: US oil wedge

output: Foreign oil wedge

output: US Investment shock

output: Foreign Investment shock
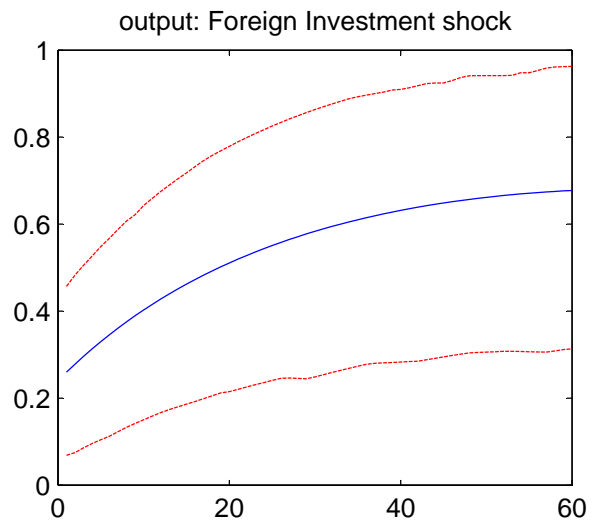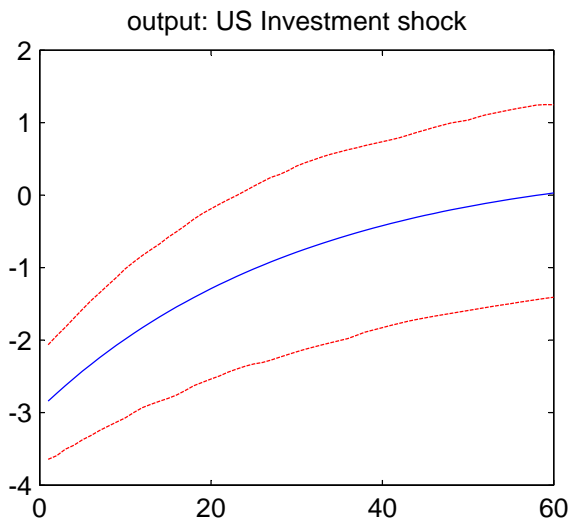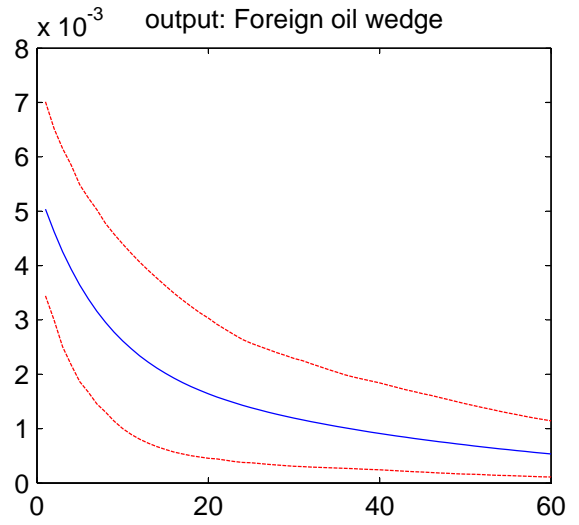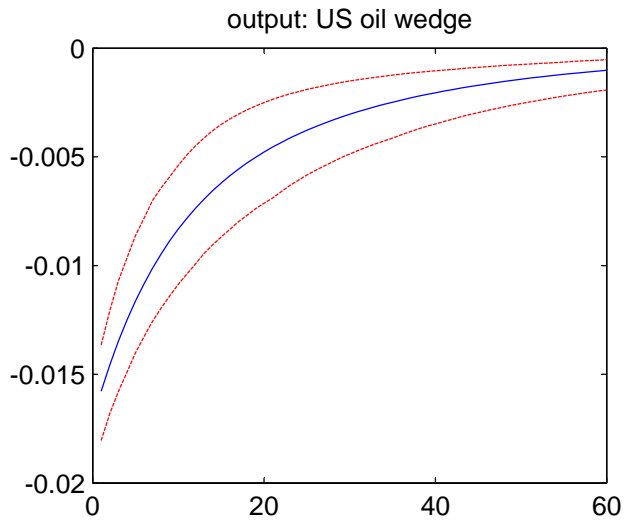
V. Historical Decompositions
Oil Prices (Figures 5A, 5B, 5C):

- relative contribution to oil price fluctuations

    i.   Oil production shocks important;
       oil reserve shocks much less so.

    ii. US and foreign oil wedge shocks important.

    iii. US and foreign TFP, labor wedge, and investment
        shocks are less important.

    iv. Oil supply and demand shocks about equally
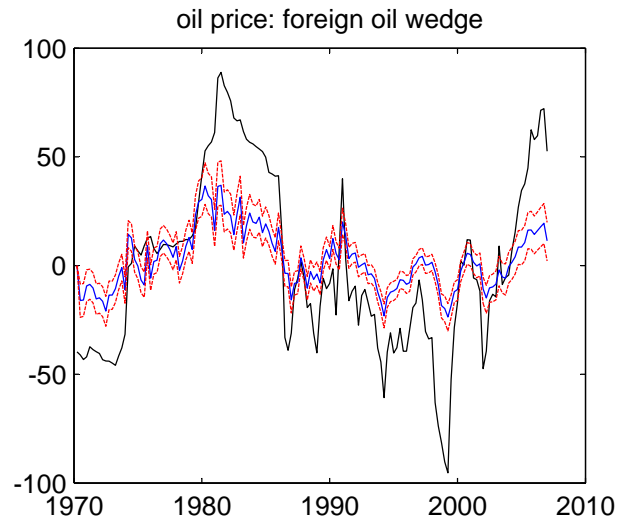   important.

Figure 5A. Historical Decomposition of Real Oil Price
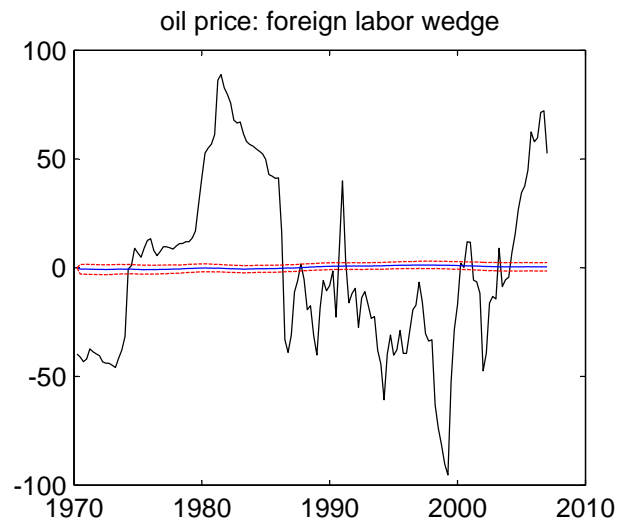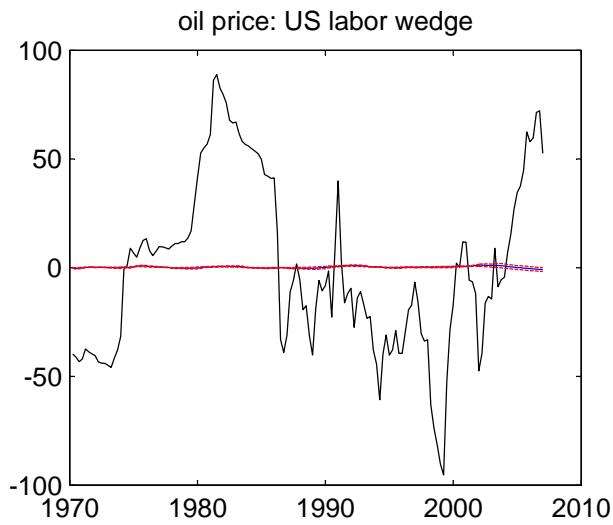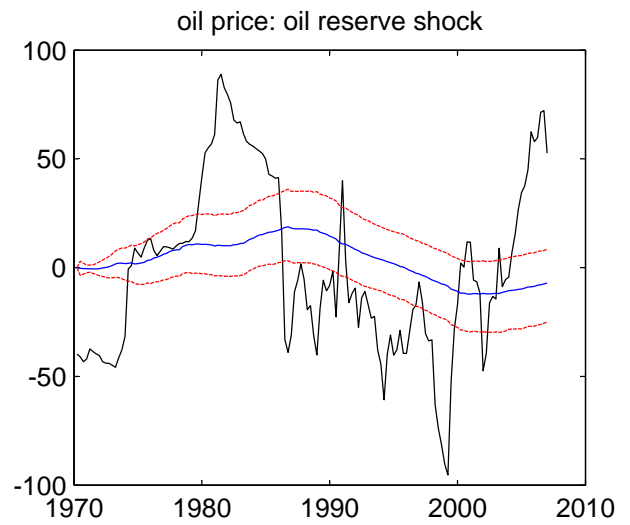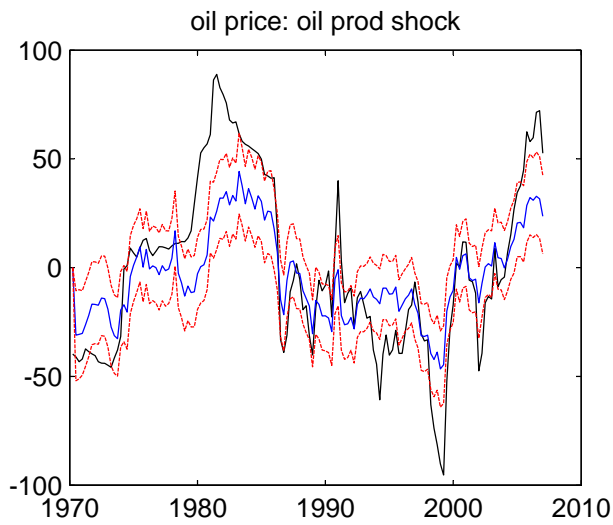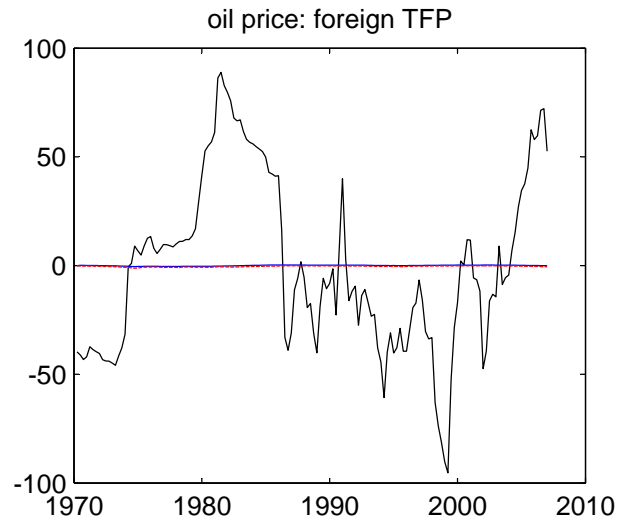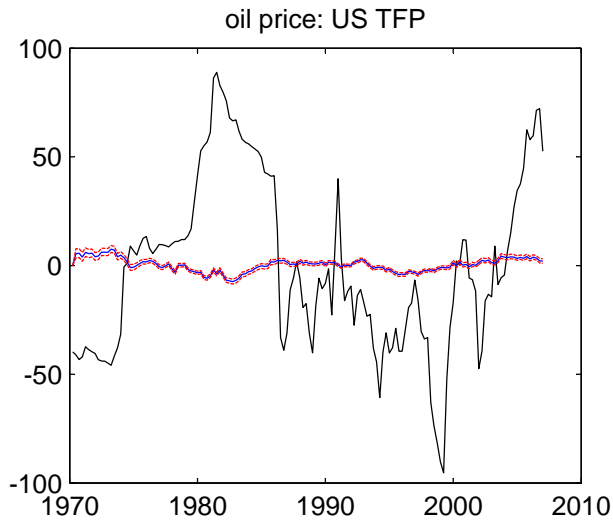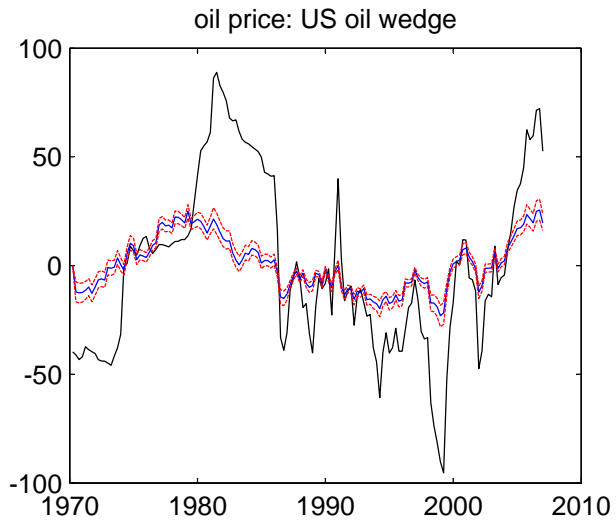
Figure 5B. Historical Decomposition of Real Oil Price

oil price: US oil wedge

oil price: foreign oil wedge

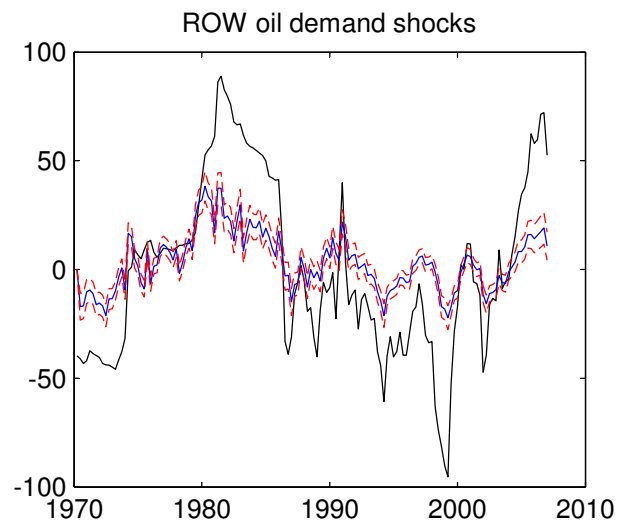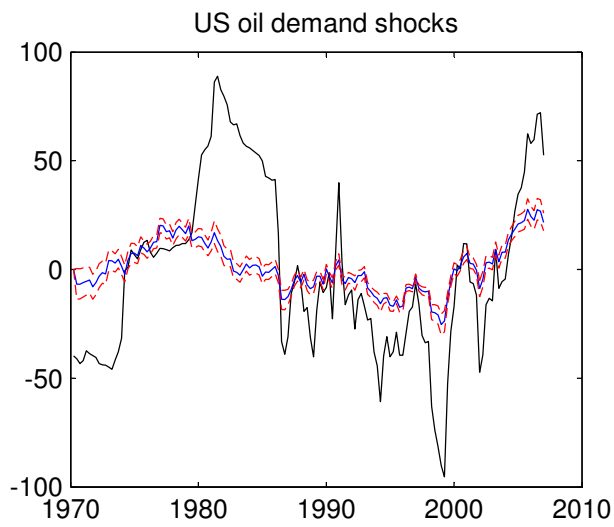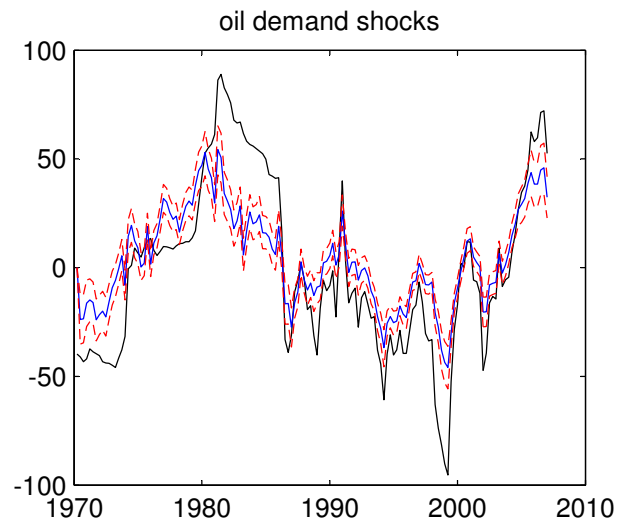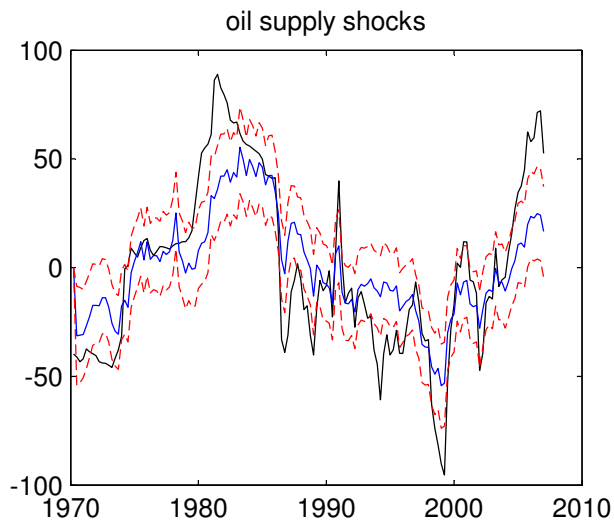oil price: US investment

oil price: foreign investment
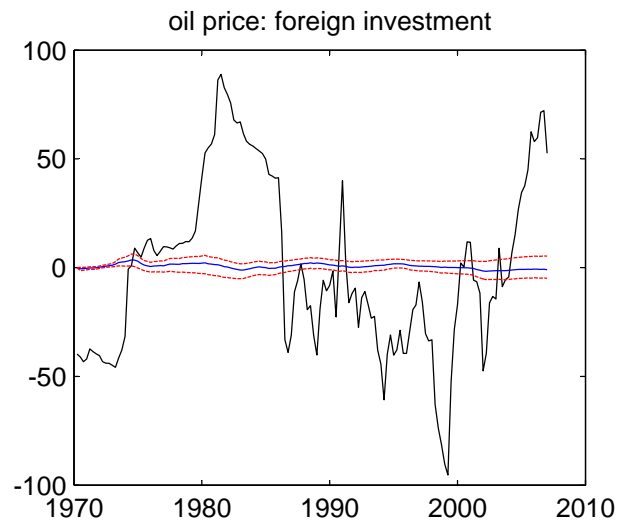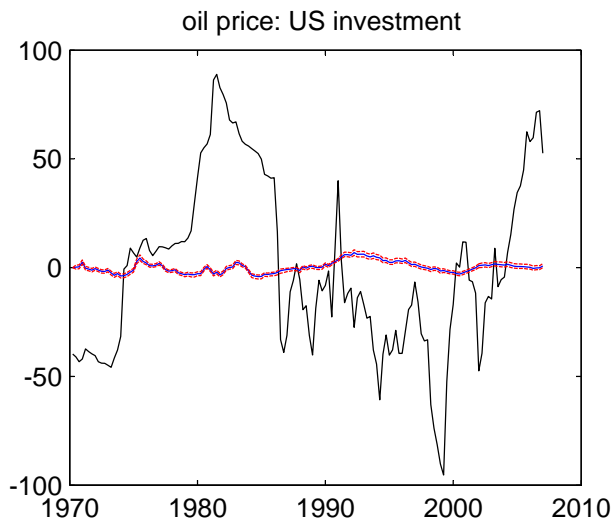
Figure 5C. Historical Decomposition of Real Oil Price: Supply Shocks vs Demand Shocks

- Some specific historical episodes

  Oil price increases of the 1970s and early 1980s driven
  largely by supply shocks (also by ROW demand in the
  early 1980s).

  Recent oil price gains have a large demand component.

V. Historical Decompositions
US GDP (Figures 6A, 6B, 6C)

    - relative contribution to US GDP fluctuations

        i.   US Labor wedge most important source of shocks

        ii. US TFP, oil wedge, and investment shocks are
              somewhat important

        iii. Oil prod shocks moderately important

        iv. Foreign shocks less important
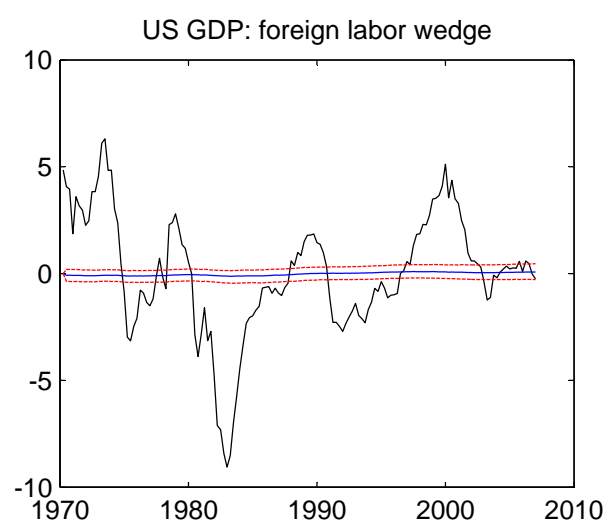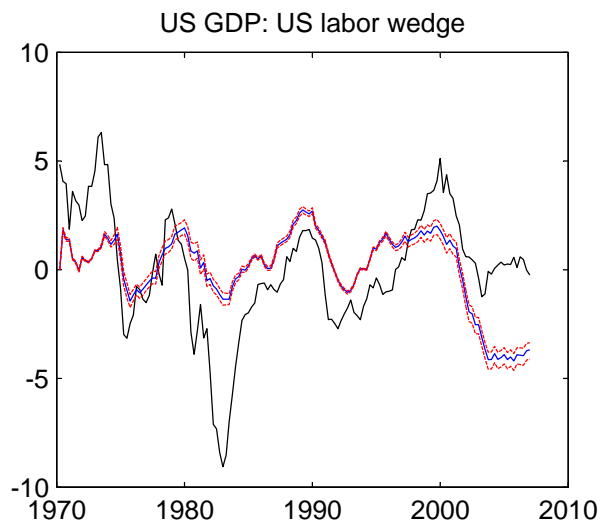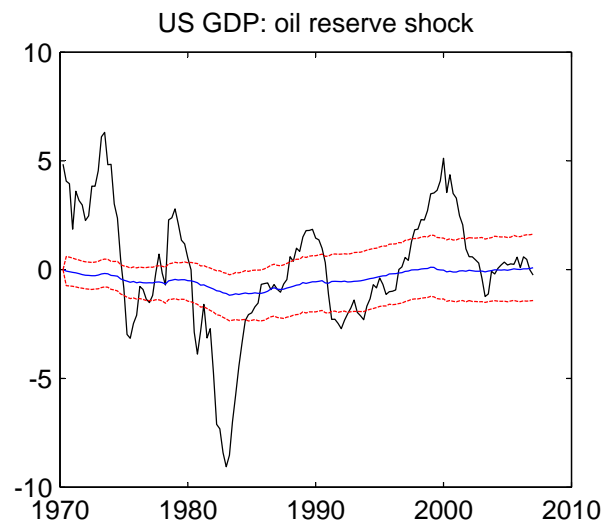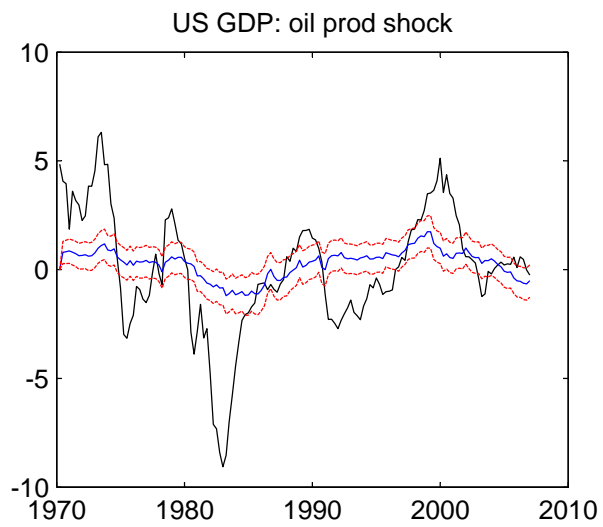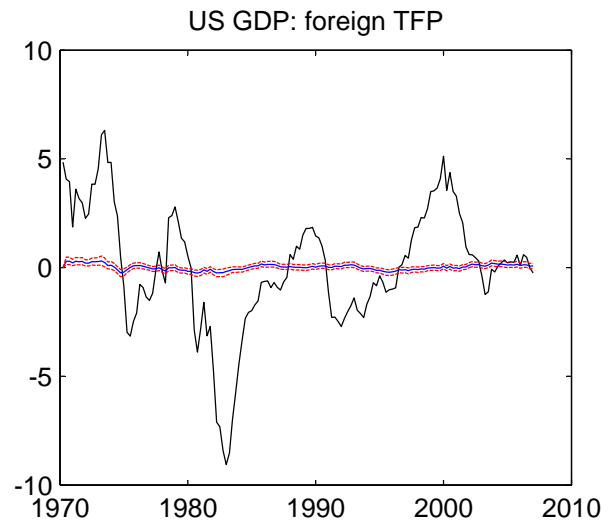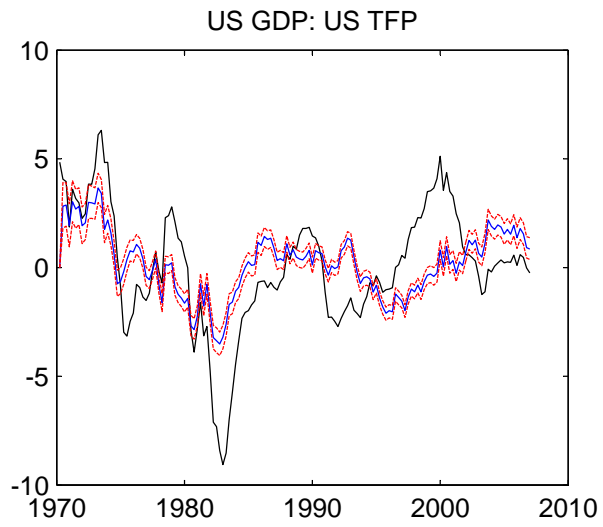
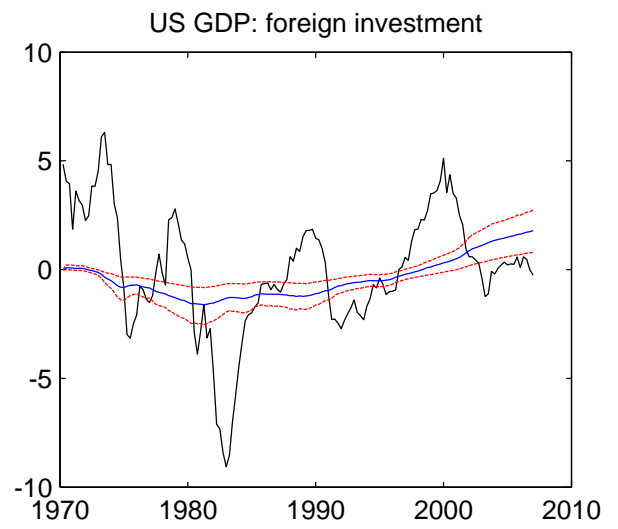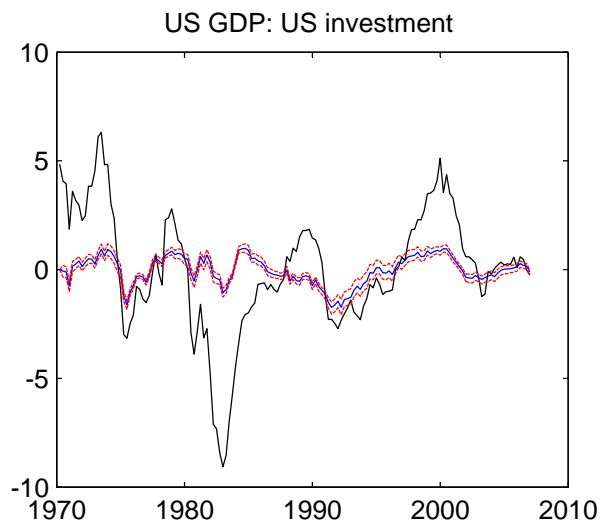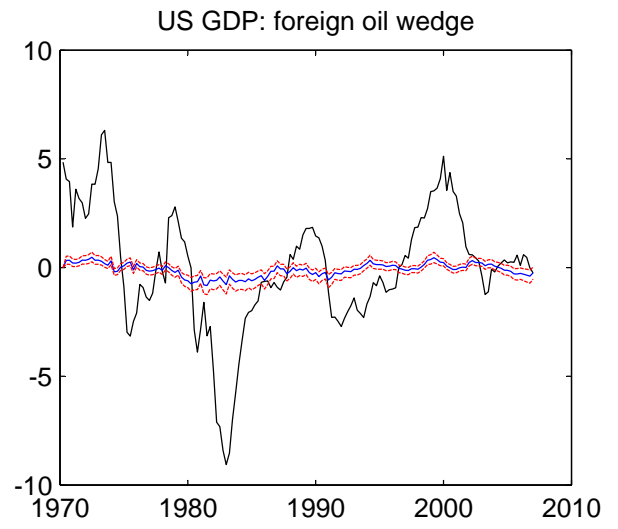# Figure 6A. Historical Decomposition of US GDP
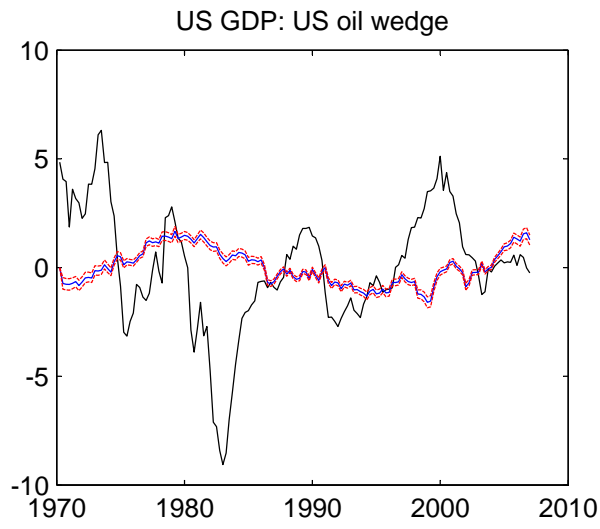
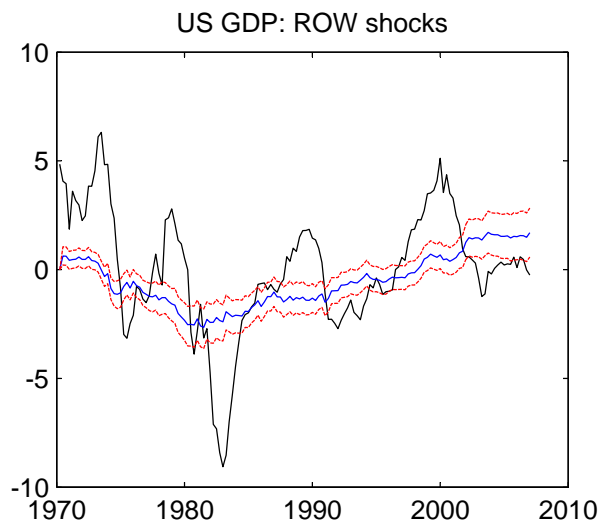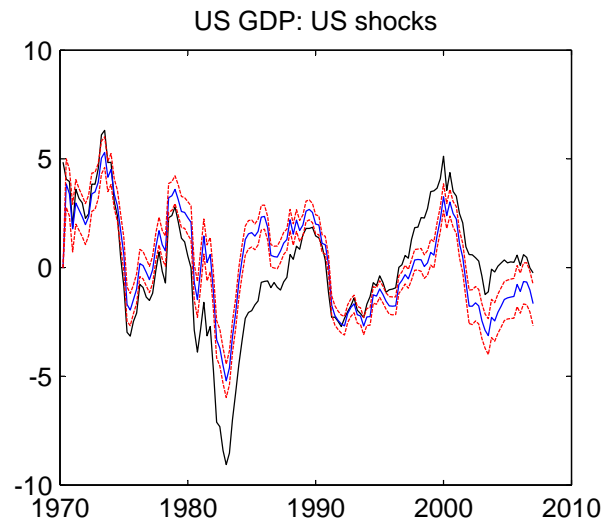Figure 6B. Historical Decompositon of GDP

Figure 6C. Historical Decomposition of US GDP: contributions of oil, domestic, and foreign shocks
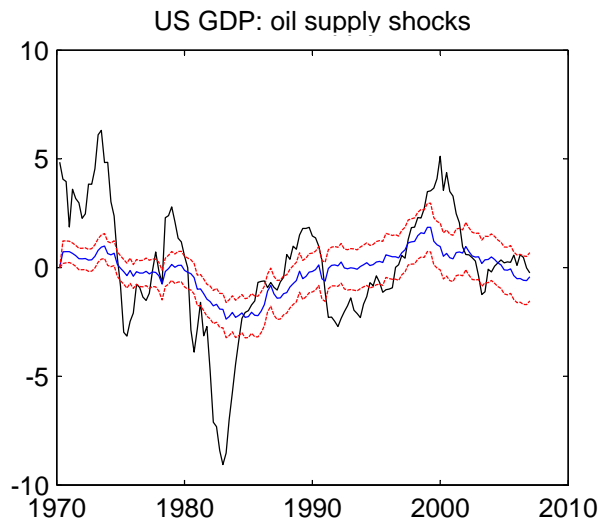
- Some specific historical episodes

   The relatively poor economic performance of the 1970s
   and early 1980s is the result of an unhappy confluence of
   bad shocks — negative oil supply and TFP shocks.

   In recent years, we've seen a confluence of negative oil
   supply shocks and favorable TFP and other oil demand
   shocks — with both contributing upward pressure on the
   price of oil and having offsetting effects on economic
   activity where the stimulus to economic activity
   dominates.

   Increased economic efficiency in the use of oil has also
   contributed to a positive relationship between crude oil
   prices and U.S. economic activity.

- Some specific historical episodes (continued)

Labor wedge shocks have been a drag on economic
activity despite positive contributions from TFP and oil
efficiency improvements since 2001.

Recessions are associated with shocks to labor wedge.

Strong economic activity in the 1990s is due first to
positive investment shocks and later TFP shocks.

VI. Summary and Conclusions

Identify the sources of world oil price and U.S. GDP
fluctuations using a DSGE model of world economy and
Bayesian McMC methods for estimation of the model.

Find the factors driving oil price increases determine the effect
on overall economic activity.

In recent years, we've seen a confluence of negative oil supply
shocks and favorable TFP and other oil demand shocks — with
both contributing upward pressure on the price of oil and having
offsetting effects on economic activity where the stimulus to
economic activity dominates (better luck than in the 1970s).

VII. Extensions and Future Work

- Relax complete markets framework: oil shocks will have more significant wealth effects for US.

- Add additional observation variables: net exports, interest rates, information about economic activity in ROW

- Add nominal frictions and monetary policy—more channels for shocks to work through the economy.