Globalization, Oil Prices and U.S. Economic Activity

Stephen Brown
Federal Reserve Bank of Dallas

2008 Energy Conference
U.S. Energy Information Administration
Globalization, Oil Price Shocks and U.S. Economic Activity

Nathan Balke, Stephen Brown, Mine Yücel

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:


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

Nonlinearity (asymmetry):

Hamilton’s evolving oil price specification
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.

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


– 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


- 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

- Oil price: oil production shock
- Oil output: oil production shock
- Oil price: oil reserve shock
- Oil output: oil reserve shock
- Oil price: US TFP shock
- Oil output: US TFP shock
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

- Output: Oil prod shock
- Output: Oil reserve shock
- Output: US TFP
- Output: Foreign TFP
- Output: US labor wedge
- Output: Foreign labor wedge
Figure 4B. Impulse response of US real GDP
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

- US GDP: US TFP
- US GDP: foreign TFP
- US GDP: oil prod shock
- US GDP: oil reserve shock
- US GDP: US labor wedge
- US GDP: foreign labor wedge
Figure 6B. Historical Decomposition 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.
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.