Monetary Policy Responses to Oil Price Fluctuations

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Disclaimer: The views expressed in this paper do not necessarily reflect the views of the Federal Reserve Board or of the Asian Development Bank.

The Central Message

How should monetary policy makers respond to oil price fluctuations?

- They should not. This question is ill-posed.

- Instead the best response depends on why the price of oil has changed.

- Policy makers need to disentangle the underlying demand and supply shocks and tailor the response to the observed mix of shocks.

This Insight Is Not New

Kilian (AER 2009):

1. Oil price innovations violate the *ceteris paribus* premise.
2. Source of shocks matters for oil price dynamics.

The real price of oil is merely a symptom of deeper causes. Policy makers need to respond directly to these structural causes, not to the symptom.

Nakov and Pescatori (JMCB 2010):

It is not welfare-maximizing for policy makers to respond to oil price fluctuations.

Kilian and Park (IER 2009), Kilian and Lewis (EJ 2011):

Empirical evidence that the Fed has been responding differently to demand and supply shocks in oil markets.

Policy Makers Have Been Slow to Accept this Point

Why?

1. Old habits from times when the price of oil was still considered exogenous?
2. Not much constructive advice from economists on how to respond to specific shocks.
3. What DSGE model analysis there is, has been based on stylized models designed to make a conceptual point, not to dispense policy advice.
4. Increasing evidence that these questions can only be understood in the context of a global economy DSGE model (e.g., Kilian, Rebucci and Spatafora JIE 2009; Bodenstein, Erceg and Guerrieri JIE 2011).

Oil Prices and Monetary Policy

Bernanke, Gertler and Watson (BPEA 1997):
The oil price shocks of the 1970s arose exogenously with respect to global macroeconomic conditions, but their effects were amplified by the endogenous *reaction of monetary policy makers* within a given monetary policy regime.

The Monetary Policy Reaction Hypothesis

- Consider an exogenous oil price shock.

- Two main channels of transmission:
  - Increased cost of domestic production (adverse AS shock)
  - Reduced purchasing power (adverse AD shock), amplified by increased precautionary savings and increased operating cost of energy using durables.

- Supply channel is weak. The literature on sectoral responses shows that the demand channel dominates (e.g., Lee and Ni JME 2002; Kilian and Park IER 2009).

Bernanke, Gertler and Watson (BPEA 1997):

- Take the stand that the AS shock interpretation is dominant.
- Assert that this shock triggers strong inflationary pressures, while the recessionary impact is weak.
- A hawkish central banker will fight the inflationary pressures by raising the interest rate, thereby deepening the recession.

Why this interpretation?

1. Standard models of the transmission of oil price shocks cannot explain large recessions in the data.
2. The monetary policy reaction serves as an amplifier.

Problem 1: No Rationale for a Monetary Tightening

1. Are exogenous oil price shocks inflationary?

AS shock: $Y \downarrow, P \uparrow$ versus AD shock: $Y \downarrow, P \downarrow$

2. What happened to the dual objective of the Fed?

3. Inflation hawks in the 1970s?

Problem 2: Specification of the Econometric Model

BGW's VAR evidence is based on *censored* oil price changes:

1. Their estimates are <u>inconsistent</u> (see Kilian and Vigfusson QE 2011, MD 2011).

2. Why asymmetry? No evidence for asymmetric responses.

Problem 3: Questionable Identification

BGW's evidence rests squarely on the 1979 oil price shock episode.

Key Issue: Did Volcker raise interest rates in 1979 to fight domestic inflation unrelated to oil prices or in response to the 1979 oil price shock?

Problem 4: BGW's Policy Rule is Ad Hoc

The BGW policy reaction function lacks a solid theoretical rationale (see Kilian, AER 2009; Nakov and Pescatori, JMCB 2010; Kilian and Lewis EJ 2011).

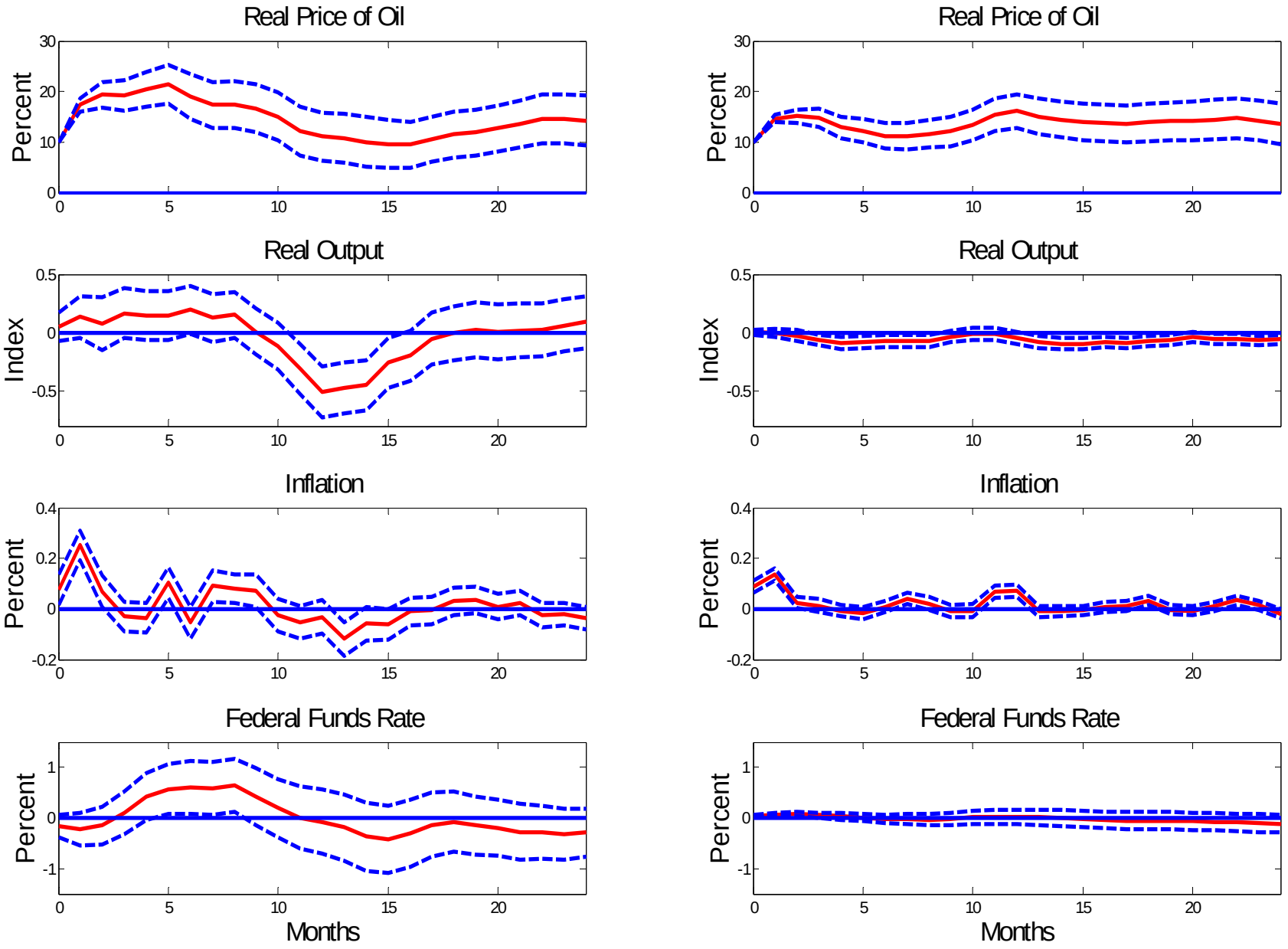
Problem 5: Interest Rate Rule Not a Good Description of Monetary Policy in the 1970s

Barsky and Kilian 2002; Kozicki and Tinsley 2009

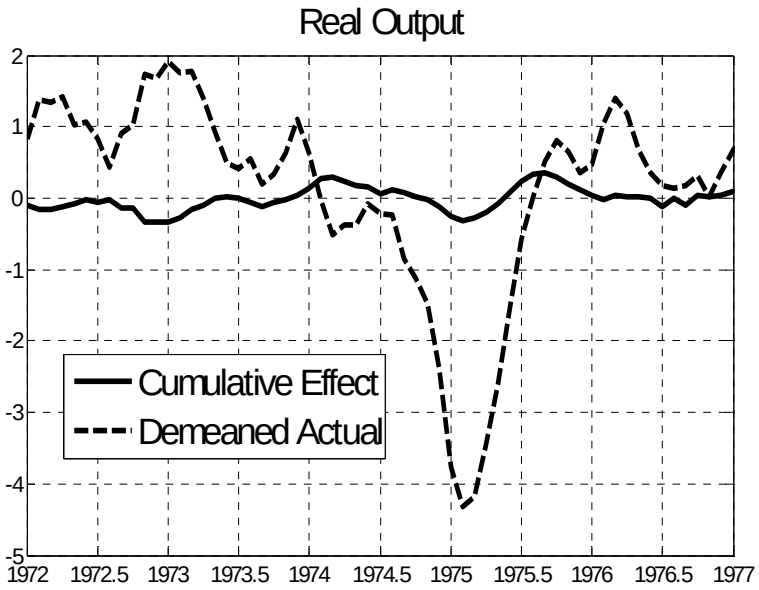
Problem 6: The Policy Reaction Hypothesis Does Not Fit the Data

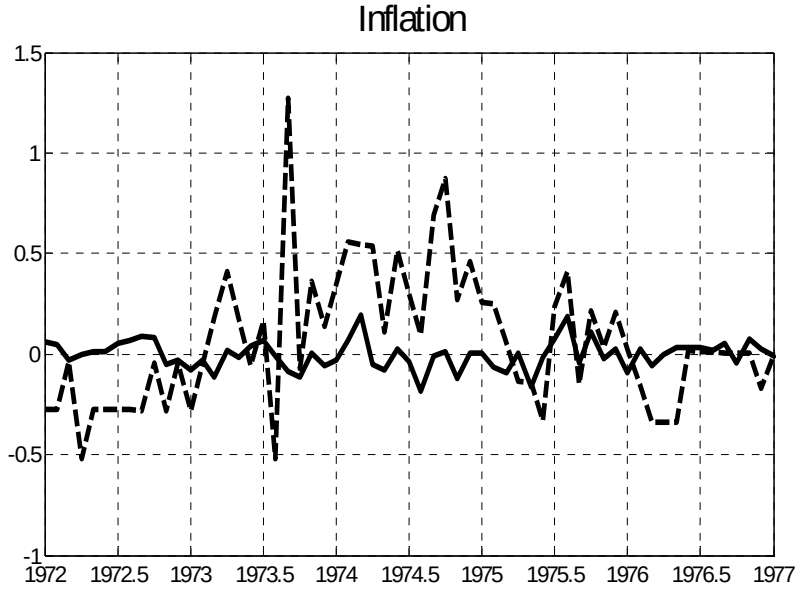
U.S. Responses to Real Oil Price Shocks (with One-Standard Error Bands)

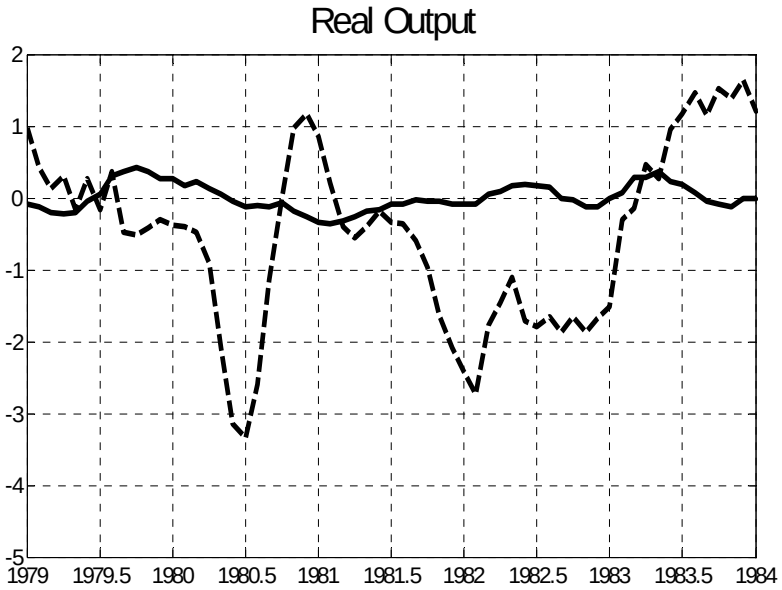
1967.5-1987.7 | **1987.8-2008.6**

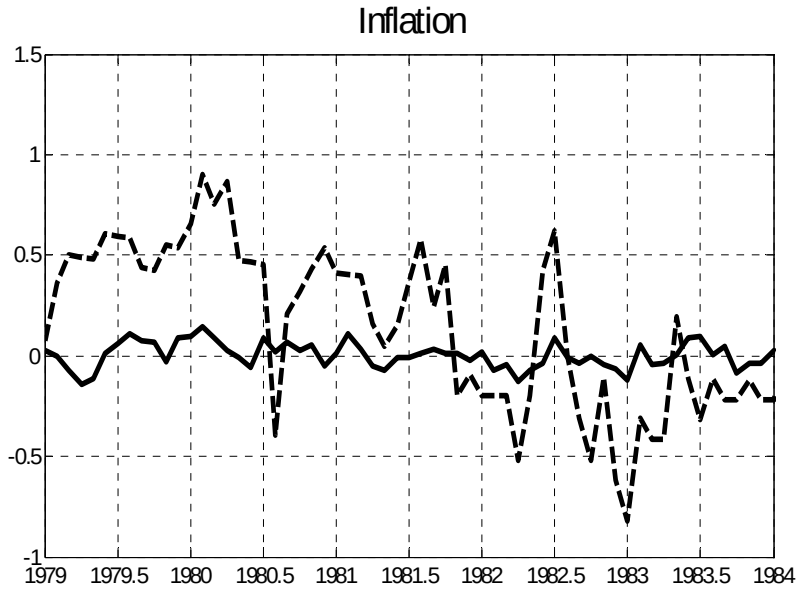


Cumulative Effect of Real Oil Price Shocks: Selected Episodes









Summary of the Evidence for the BGW Model

1. There is no empirical support for the BGW hypothesis in pre-1987 data (e.g., Hamilton and Herrera JMCB 2004; Kilian and Lewis EJ 2011).

2. There is no empirical support for the BGW hypothesis in post-1987 data (e.g., Herrera and Pesavento MD 2009; Kilian and Lewis EJ 2011).

And yet the model lives on ...

Blanchard and Galí (2010) take for granted that the BGW model fits pre-1987 (notwithstanding the evidence to the contrary). The alleged puzzle is why the model does not fit post-1987.

Explaining the "Puzzle" of the Declining Responses of Real Output to Oil Price Shocks since the mid-1980s

$\Rightarrow$ Improved monetary policy responses to oil price shocks?

The central bank – by completely quenching inflationary pressures from unexpectedly high oil prices – prevents stagflation from arising at the cost of a sharp recession.

Problem: No sharp recession in the data.

$\Rightarrow$ Alternative: Oil price shocks are not as inflationary as they used to be, allowing a less aggressive monetary policy response.

Have Oil Price Shocks Become Less Inflationary?

Possible rationales:

1. Changes in the composition of oil demand and oil supply shocks (Kilian, AER 2009)? Yes, but that violates the premise of BGW's analysis.

2. Lower energy share in the economy? No. (Edelstein and Kilian, JME 2009).

3. Reduced real wage rigidities? (Blanchard and Gali 2010)

Reduced Real-Wage Rigidities?

Bruno and Sachs (1985):
Downward rigidity in real wage explains (European) unemployment following oil price shocks of 1970s.

Blanchard and Gali (2010):
The same required decline in the real wage in response to the exogenous oil price shock is achieved with a smaller increase in unemployment, consistent with reduced U.S. real wage rigidities.

Problem:
The smaller response of unemployment is also explained by changes in the composition of oil demand and oil supply shocks without appealing to structural change.

Towards a New Class of Structural Models

1. The traditional BGW policy reaction model is empirically unsuccessful and lacks theoretical support.

2. We need a different class of structural models to address this question than the models customarily used by policy makers:

    Endogenous determination of the real price of oil
    Model of world economy
    Explicit role for monetary policy

Some Predecessors of Our Analysis

1. DSGE models with monetary policy responses under counterfactual premise of exogenous real price of oil:

    Leduc & Sill 2004; Carlstrom & Fuerst 2006; Kormilitsina 2011; Natal 2012.

2. DSGE models with endogenous real price of oil, but without monetary policy:

    Backus & Crucini 1998; Balke, Brown, & Yücel 2010; Bodenstein, Erceg & Guerrieri 2011; Nakov & Nuño 2011.

3. DSGE models with endogenous real price of oil and monetary policy, but without global economy framework:

    Bodenstein, Erceg & Guerrieri 2008; Nakov & Pescatori 2010a,b.

Our Key Insights

1. The distinction between oil demand shocks and other structural shocks in the DSGE model becomes moot, once it is recognized that all shocks affect oil demand.

2. No two structural shocks call for the same response.

3. Even after controlling for the impact effect on the real price of oil, the sign, magnitude, shape, and persistence of the monetary policy response will differ.

4. We refute the popular notion that an increase in the real price of oil driven by Chinese demand from the point of view of oil importers is just like an exogenous oil supply disruption (see, e.g., Blanchard and Galí 2010).

5. The optimized average policy response may differ substantially from the policy responses implied by estimated policy rules based on historical data.

6. This optimized rule is well approximated by a rule that targets the output gap and attaches zero weight to inflation and the lagged interest rate.

7. Oil trade enhances the welfare gains from international policy coordination.

DSGE model based on Bodenstein and Guerrieri (2011), who in turn build on Backus and Crucini (1998) and Smets and Wouters (2007):

- Two blocs with symmetric structure: U.S. and ROW. Country-specific values for the parameters allow for differences in population size, oil intensities, oil endowments, and in nonoil and oil trade flows.
- Oil and nonoil goods are traded across countries.
- While asset markets are complete at the country level, asset markets are incomplete internationally.

The model is estimated by MLE on data for 1984.I-2008.III.

DSGE Model: Production and Trade

- In each country, a continuum of firms produces differentiated varieties of an intermediate good under monopolistic competition.

- These firms use capital, labor and oil as factor inputs.

- Goods prices are determined by Calvo-Yun staggered contracts.

DSGE Model: Households

- Households supply differentiated labor services under monopolistic competition. They consume oil and the nonoil consumption good, they save, and they invest.

- Wages are determined by Calvo-Yun staggered contracts.

DSGE Model: Oil Market

- Focus on the oil demand side - consistent with all empirical work.

- With foreign and domestic nonstorable oil endowment determined exogenously, the real price of oil adjusts endogenously to clear the oil market.

- Little loss from ignoring short-run endogenous oil production responses to oil demand shocks.

DSGE Model: Monetary Policy

- Monetary policy follows a modified version of the interest rate rule suggested by Taylor (1993):

$$i_{US,t} = \overline{i_{US}} + \gamma_{US}^{i}(i_{US,t-1} - \overline{i_{US}}) +$$

$$(1-\gamma_{US}^{i})\left[(\pi_t^{core} - \overline{\pi_{US}^{core}}) + \gamma_{US}^{\pi}(\pi_{US,t}^{core} - \overline{\pi_{US}^{core}}) + \gamma_{US}^{y} y_{US,t}^{gap}\right] + \varepsilon_{US,t}^{i}$$

Bars indicate steady-state values. y_t^{gap} denotes the log deviation of gross output from the value of gross output in the same model when excluding all nominal rigidities.

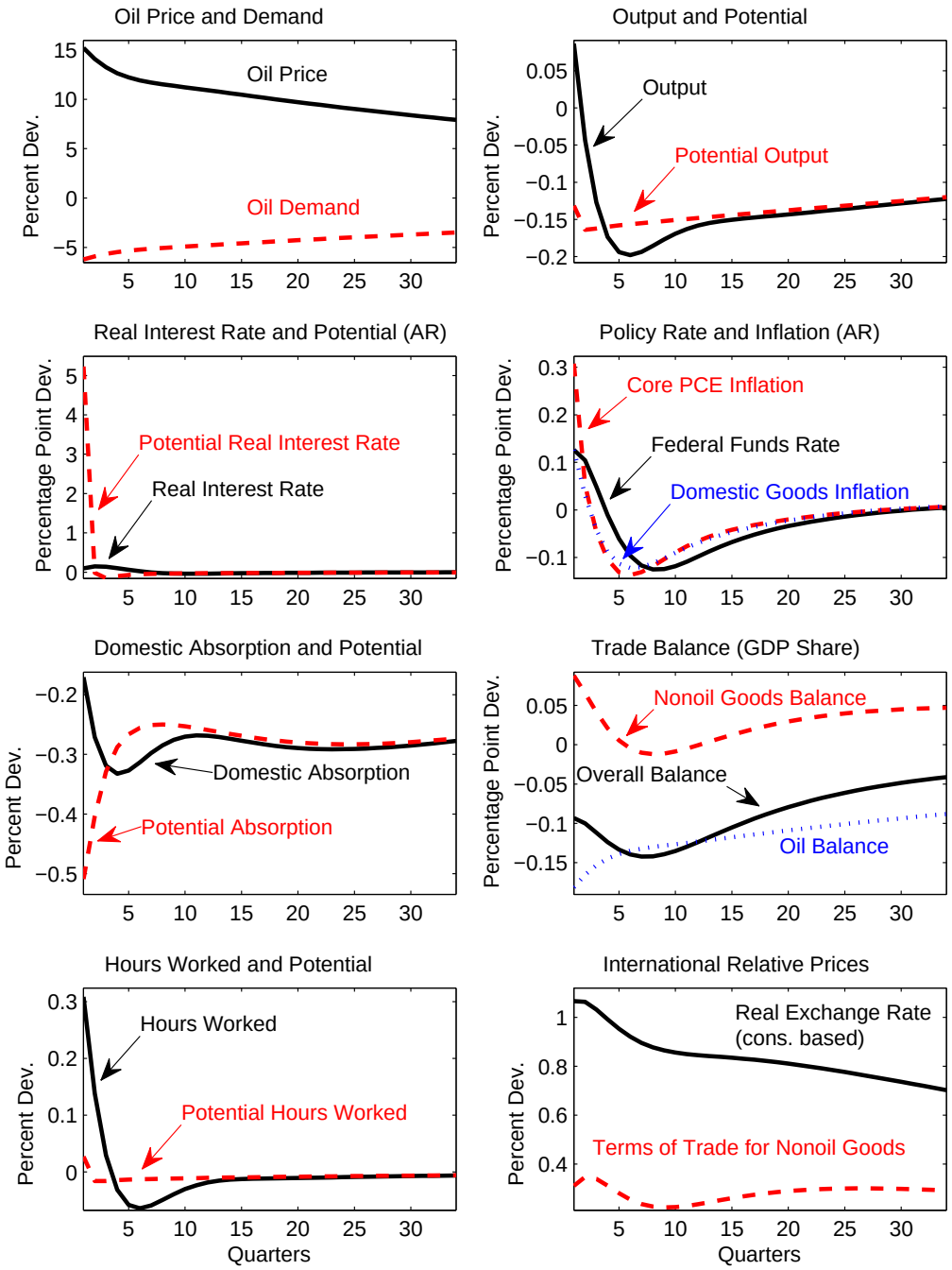
DSGE Model: Structural Shocks

Fifteen separate sources of shocks. Some examples:

- U.S. and foreign technology
- U.S. and foreign oil supply
- U.S. and foreign autonomous spending
- U.S. and foreign consumption preferences
- U.S. and foreign wage and price markup
- U.S. and foreign labor supply
- U.S. and foreign monetary policy

The foreign oil intensity shock is the primary driver of real price of oil during 2003-08.

Figure 1: The Effects of a One-Standard Deviation Increase in Foreign Oil Intensity: Deviations from the Balanced Growth Path



How the Origin of the Structural Shocks Matters

We consider one shock at a time. It is understood that in real life central bankers face a composite of shocks:

1. No two shocks induce the same policy response.

2. The same type of shock has different effects depending on where in the world it originates from.

Figure 6: The Effects of Different Shocks on the Real Dollar Price of Oil and on U.S. Interest Rates (the shocks are sized at 1 standard deviation)

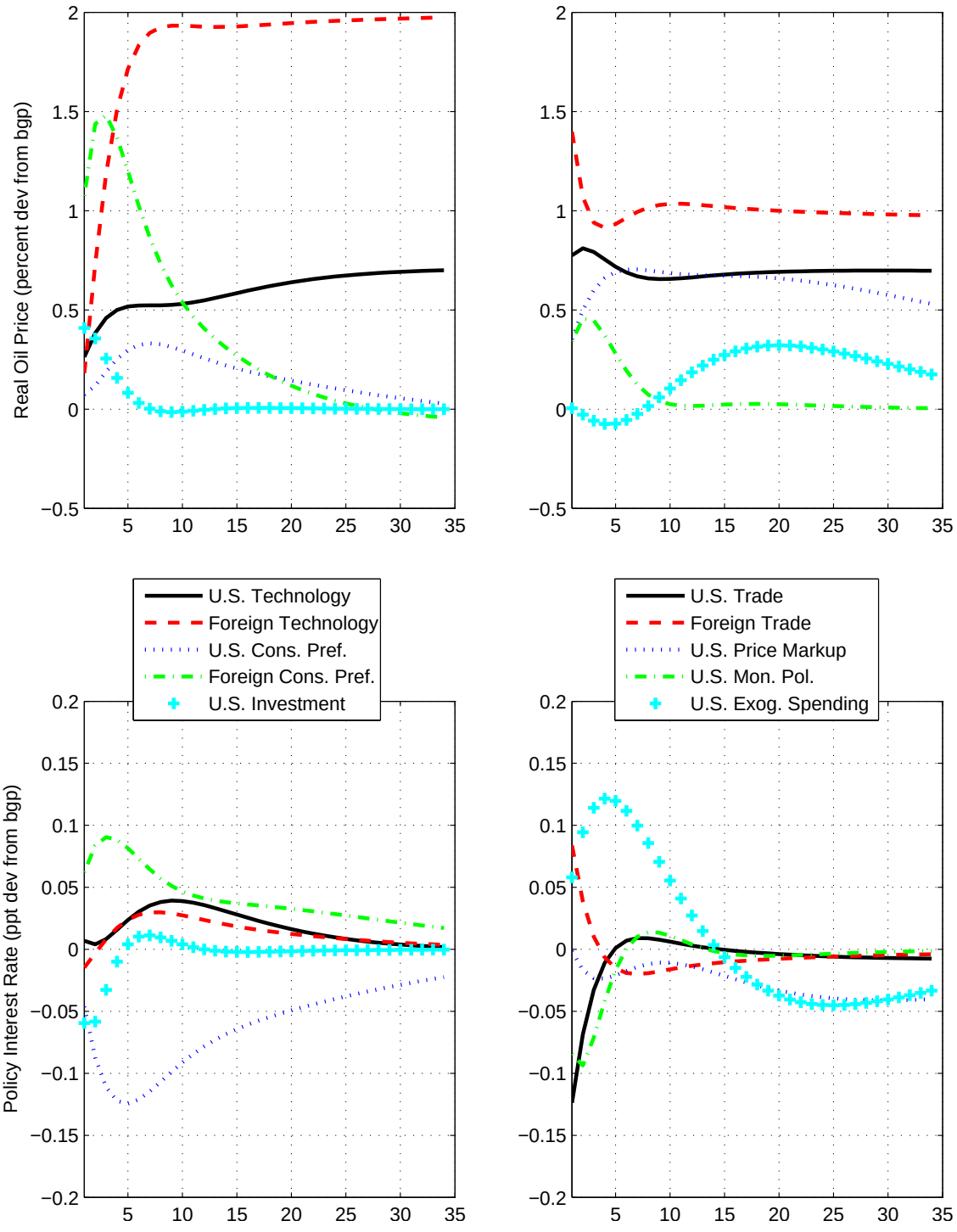
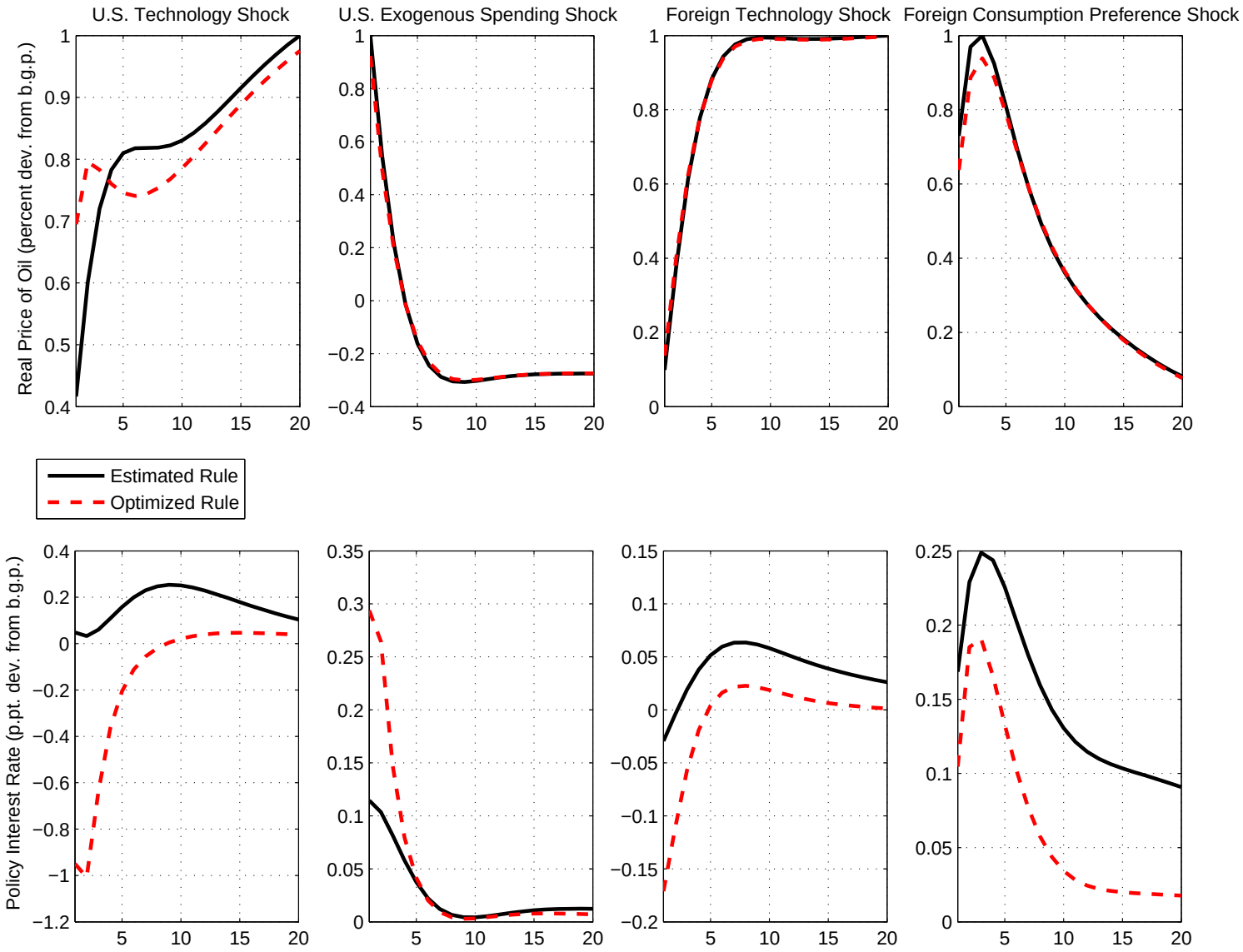
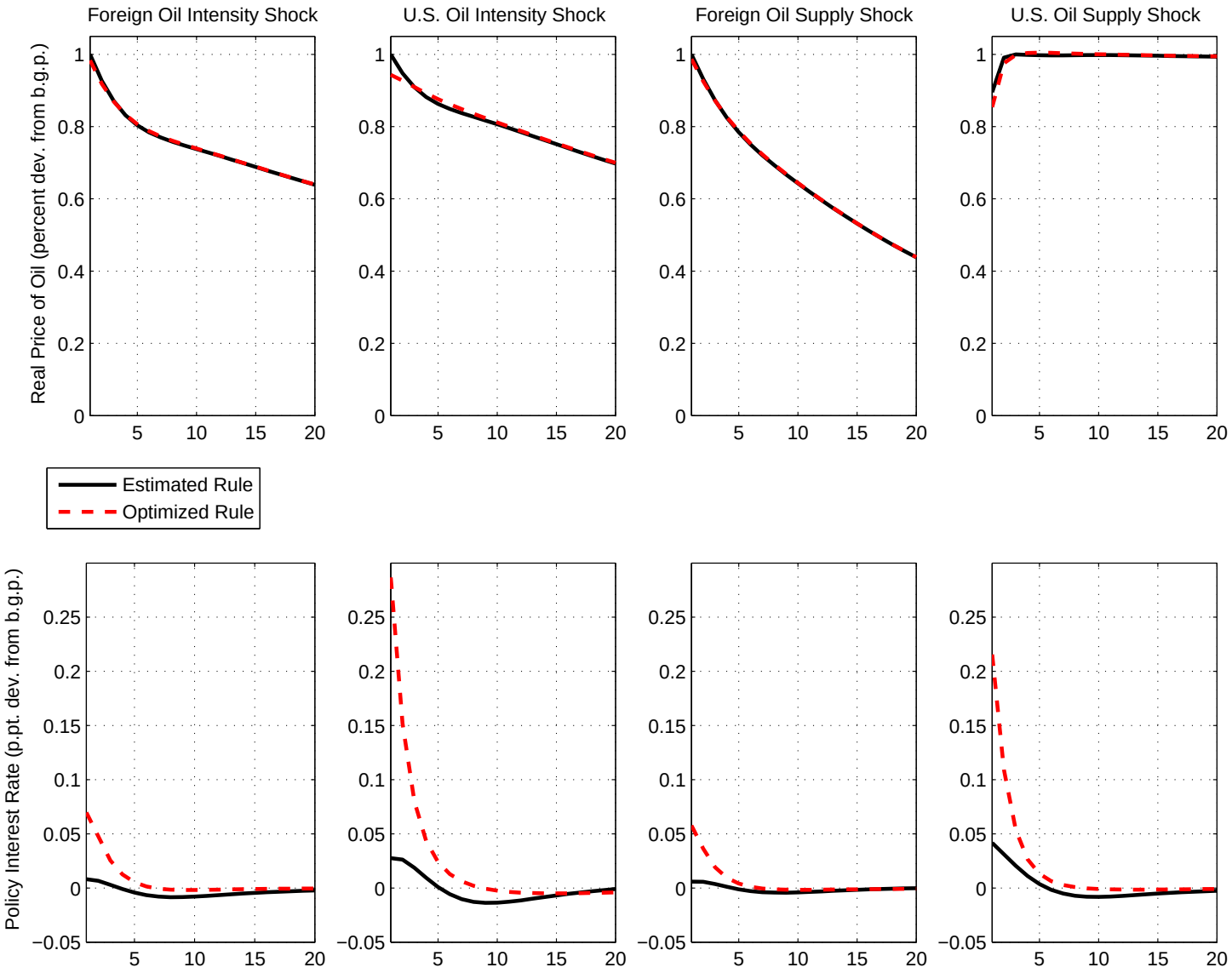


Figure 8: A Comparison of the Effects of Key Shocks Affecting Oil Prices under Alternative Policy Rules* (the shocks are scaled to induce a one percent increase in real price of oil at peak)



* The scale of the U.S. technology shock is 1.5632 standard deviations The scale of the U.S. autonomous spending shock is 2.0453 standard deviations. The scale of the foreign technology shock is 0.51361 standard deviation. The scale of the foreign consumption preference shock is 0.66794 standard deviation.

Figure 9: A Comparison of the Effects of Key Shocks Affecting Oil Prices under Alternative Policy Rules* (the shocks are scaled to induce a one percent increase in the real price of oil at peak)



* The scale of the foreign oil intensity shock is 0.06584 standard deviation. The scale of the U.S. oil intensity shock is 0.78125 standard deviation. The scale of the foreign oil supply shock is 0.23862 standard deviation. The scale of the U.S. oil supply shock is 2.264 standard deviations.