Business Cycles
Economics 210C

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Cost of Business Cycles

- Lucas (2003) assumes that the process for consumption and utility are

$$C_t = C_t^* \exp\{\varepsilon_t - \frac{1}{2}\sigma^2\}$$

$$U_0 = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\gamma} - 1}{1-\gamma}$$

  where $\varepsilon_t \sim N(0, \sigma^2)$

- We construct the certainty equivalent: fraction s of C_t^* consumer is willing to pay to eliminate business cycles

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{[(1-s)C_t^*]^{1-\gamma} - 1}{1-\gamma} = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\gamma} - 1}{1-\gamma}$$

- W.l.o.g., assume $C_t^* = 1$.

Cost of Business Cycles

- Expected utility each period:

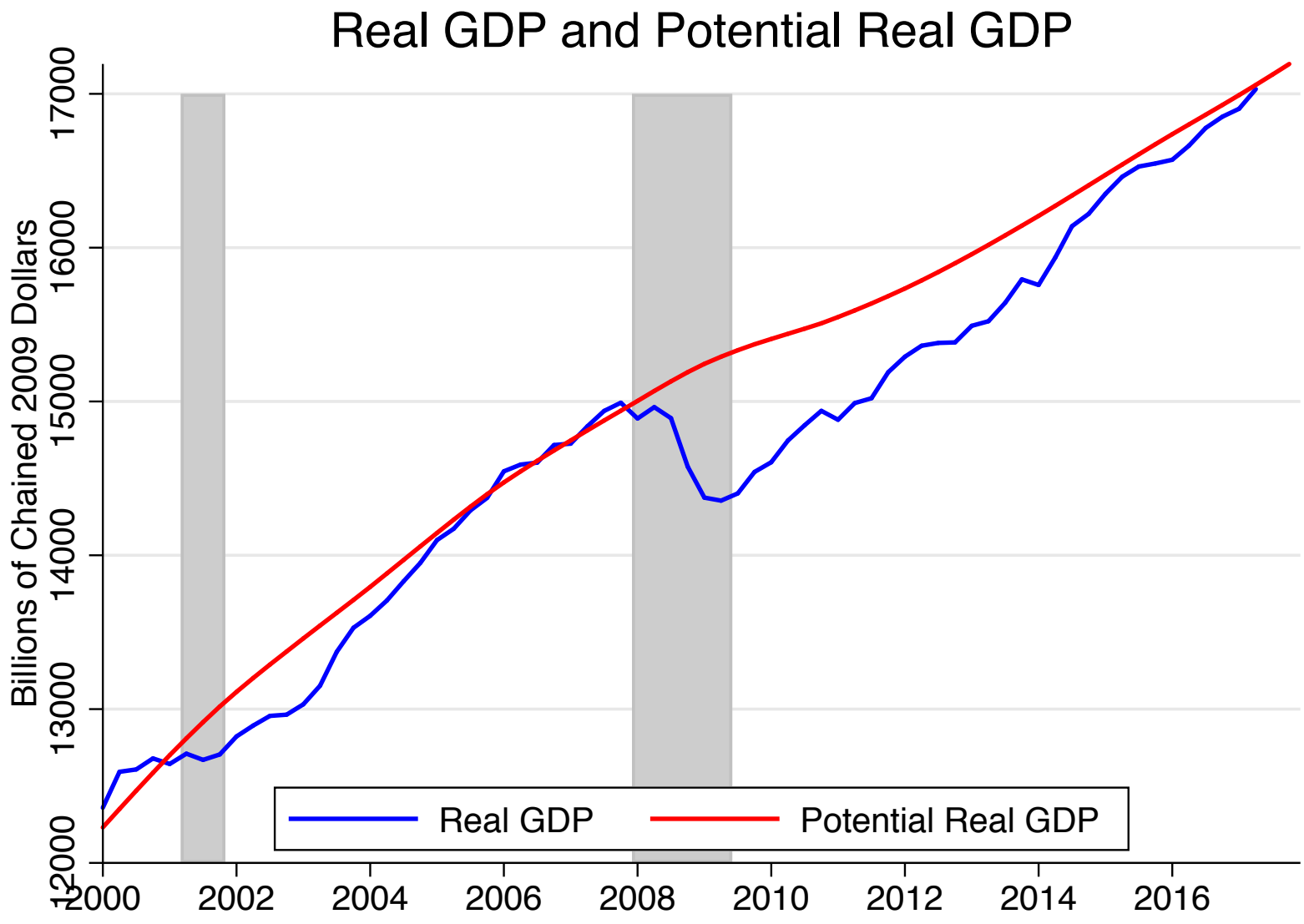
$$\mathbb{E}_0 \frac{C_t^{1-\gamma}-1}{1-\gamma} = \frac{\mathbb{E}[\exp((1-\gamma)\varepsilon_t)\exp(-(1-\gamma)\sigma^2/2)]-1}{1-\gamma}$$
$$= \frac{\exp[(1-\gamma)\mu_\varepsilon + 1/2(1-\gamma)^2\sigma^2]\exp(-(1-\gamma)\sigma^2/2)-1}{1-\gamma}$$
$$= \frac{\exp[-1/2(1-\gamma)\gamma\sigma^2]-1}{1-\gamma}$$

- Solving for the certainty equivalent:

$$\frac{\exp[-1/2(1-\gamma)\gamma\sigma^2]-1}{1-\gamma} = \frac{(1-s)^{1-\gamma}-1}{1-\gamma}$$
$$\exp[-1/2(1-\gamma)\gamma\sigma^2] = \exp[(1-\gamma)\ln(1-s)]$$
$$\exp[-1/2(1-\gamma)\gamma\sigma^2] \approx \exp(-(1-\gamma)s)$$
$$s = 1/2\gamma\sigma^2$$

- With parameters values plausible to Lucas ($\gamma = 1, \sigma = 0.013$), $s < 0.1\%$ of C_t^*.

Are Business Cycles Irrelevant?



Critique of the Lucas Calculation

- Risk aversion given by γ could be much larger.
- Shocks could be serially correlated: $\frac{\sigma^2}{1-\rho^2}$
- Credit markets provide limited insurance against income risk. The cost of business cycles can be very large for households with no financial wealth.
- Unemployment spells could be longer during recessions. Long spells of unemployment could be very costly: stabilization reduces earnings risk.
- Stabilization can affect the level of consumption and investment. Less uncertainty may lead to more investments. Great Recession appears to have long-lasting effects.
- Asymmetric effects of booms and recessions.

(My view:) Total cost of business cycles could be 10% of PV of consumption.

Overview of Methods

- Dynamic stochastic general equilibrium (DSGE) models; a leading example is Smets and Wouters (AER 2007).
- Vector autoregressions (VARs); e.g., Sims (Econometrica 1980).
- Narrative approach; Romer and Romer (NBER Macro Annual 1989)
- Natural experiments; Schwartz and Friedman (1963)
- Everything else (e.g., market-based indicators of expectations)

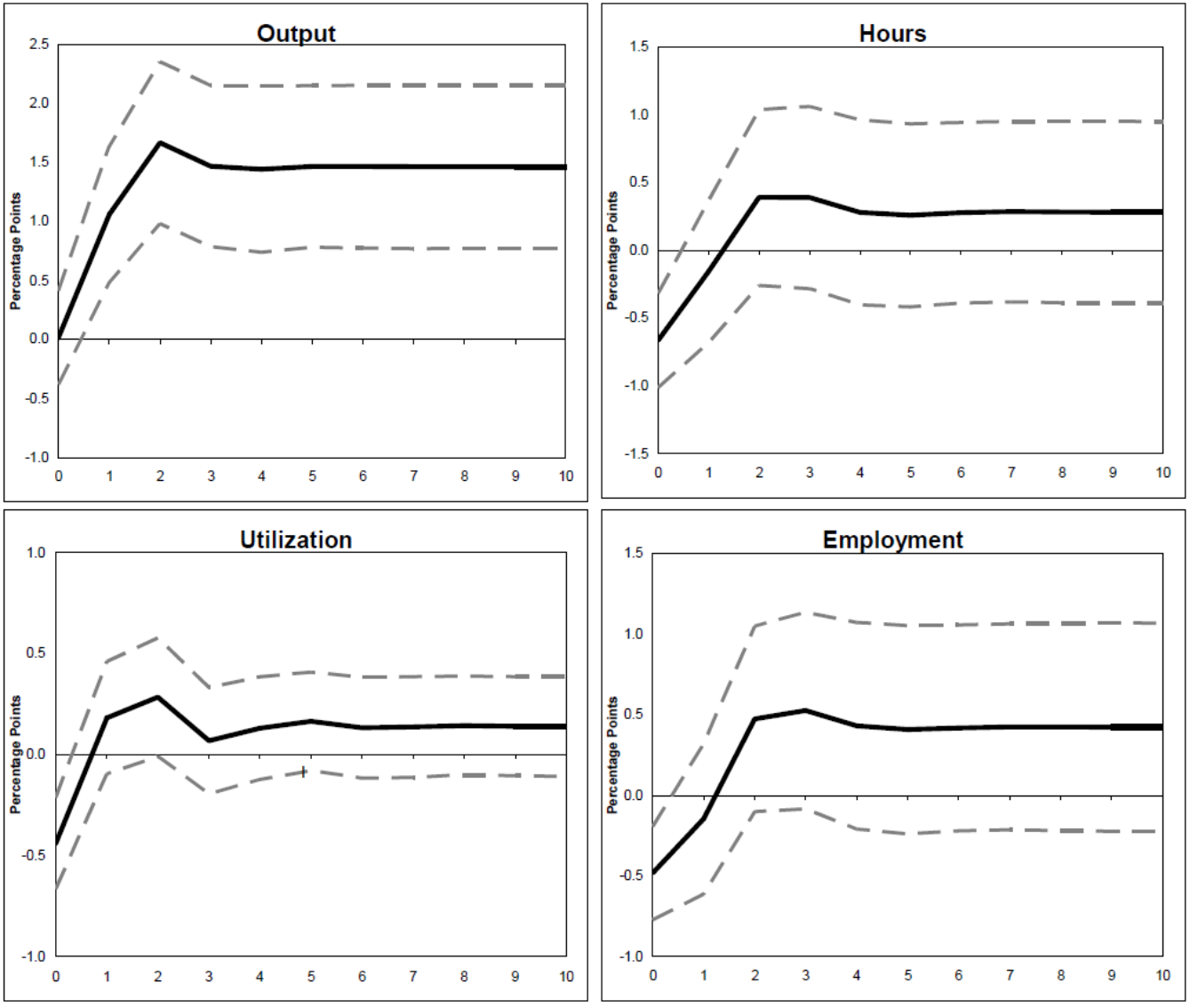
Technology Shocks

- Major source of business cycles in real business cycle models.

- We can use differential predictions of NK and RBC models to the effects of technology shocks to rule out a theory.

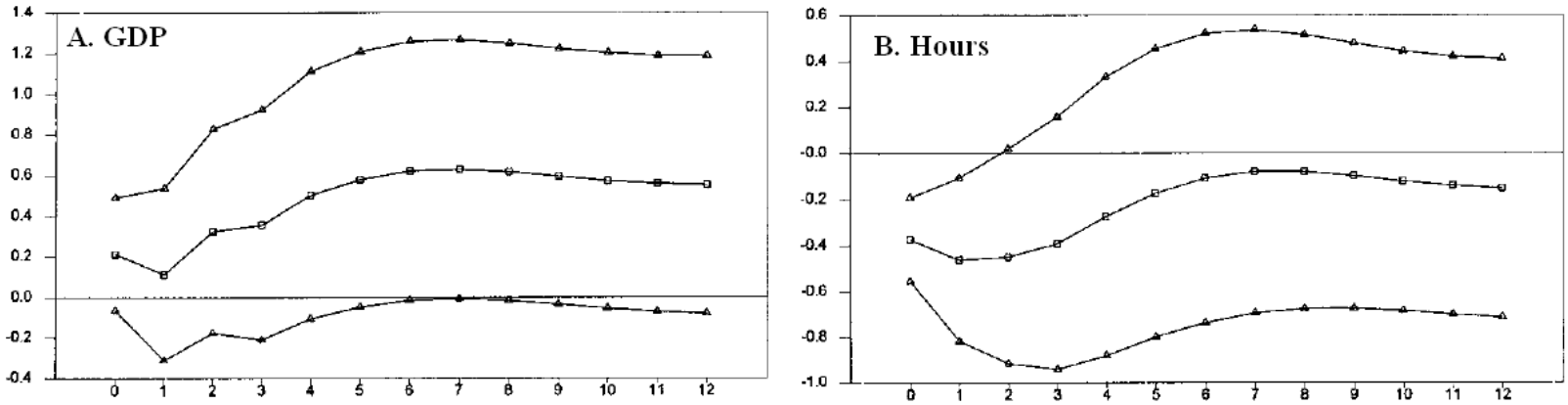
Basu, Fernald and Kimball (AER, 2006)

Impulse Responses to a technology shock:



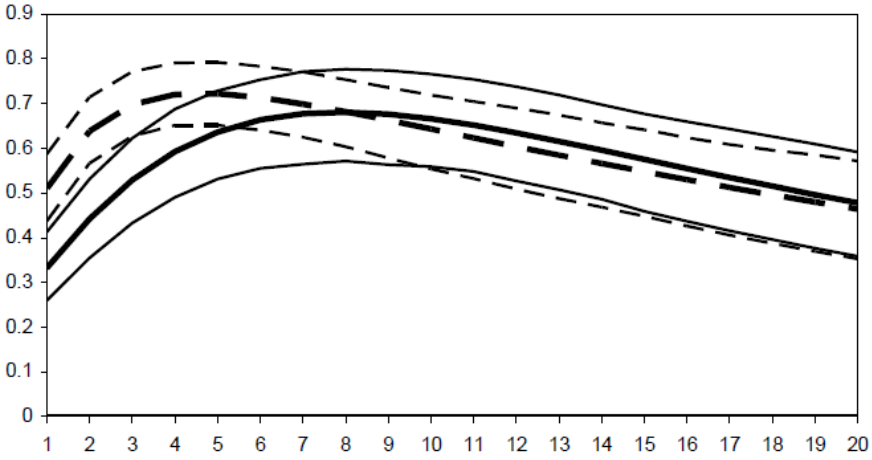
Gali (AER, 1999)

Impulse Responses to a technology shock:

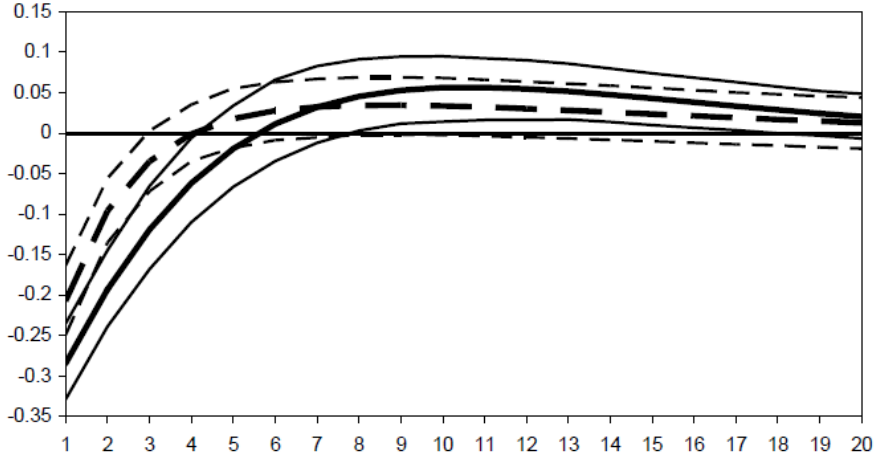


Smets and Wouters (AER, 2007)

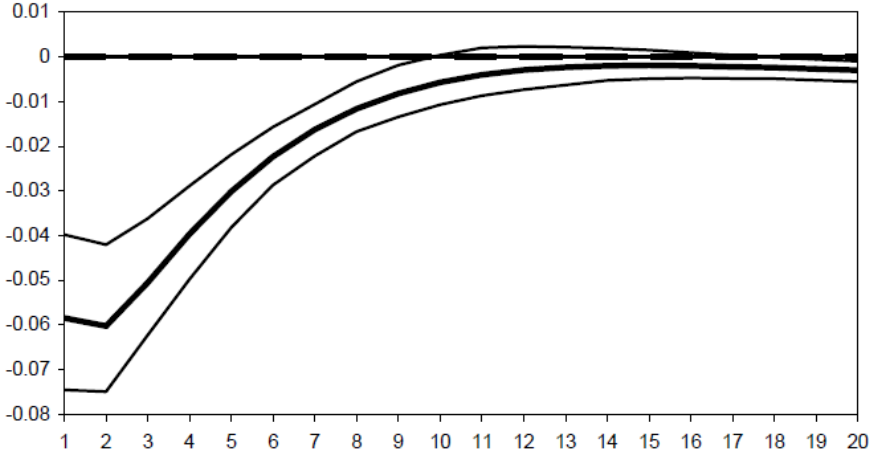
Impulse Responses to a technology shock:



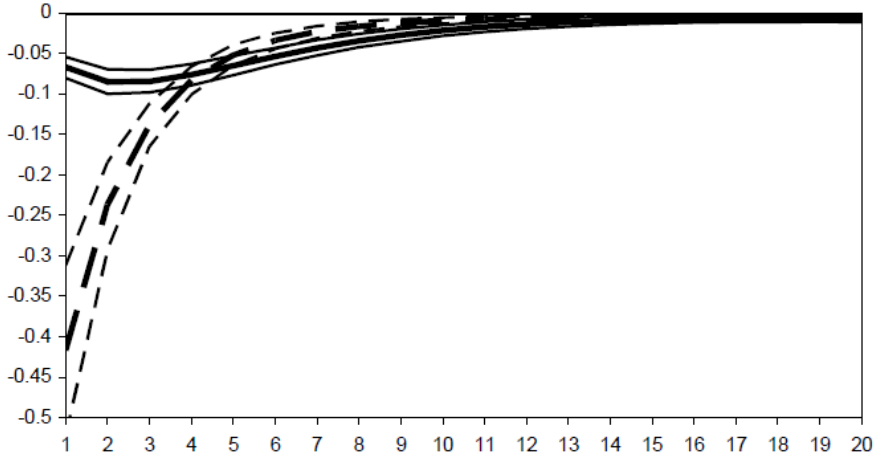
Output



Hours



Inflation



Interest rate

Narrative Approach

- Alexopoulos (AER, 2011)

- Method: read patents, inventions, technological breakthroughs, etc. from specialized and popular press,

$$Y_t = \sum_{s=0}^{k} \alpha_s D_{t-s} + \sum_{q=1}^{m} \beta^q Y_{t-1} + e_t$$

News Shocks about Future Technology

- Empirically plausible
- Attractive source of fluctuations
- Use forward-looking variables to identify news shocks; e.g. Beaudry and Portier (AER 2004) use stock market.
- Need very small wealth effects for these shocks to generate cyclical comovement of macroeconomic variables. (Jaimovich and Rebelo, AER 2009.)
- Arezki Ramey and Sheng (2016): news of oil discoveries more consistent with large wealth effects.

Nominal Shocks

- Traditional dichotomy between nominal and real sides of the economy.
- Neoclassical macroeconomics predicts that nominal shocks have no real effects.
- Keynesian macroeconomics builds on inflexible prices/wages and thus nominal shocks have real effects.
- One of the key questions in macroeconomics.
- Nominal shocks are typically identified with unforecastable innovations in the fed funds rate (FFR).

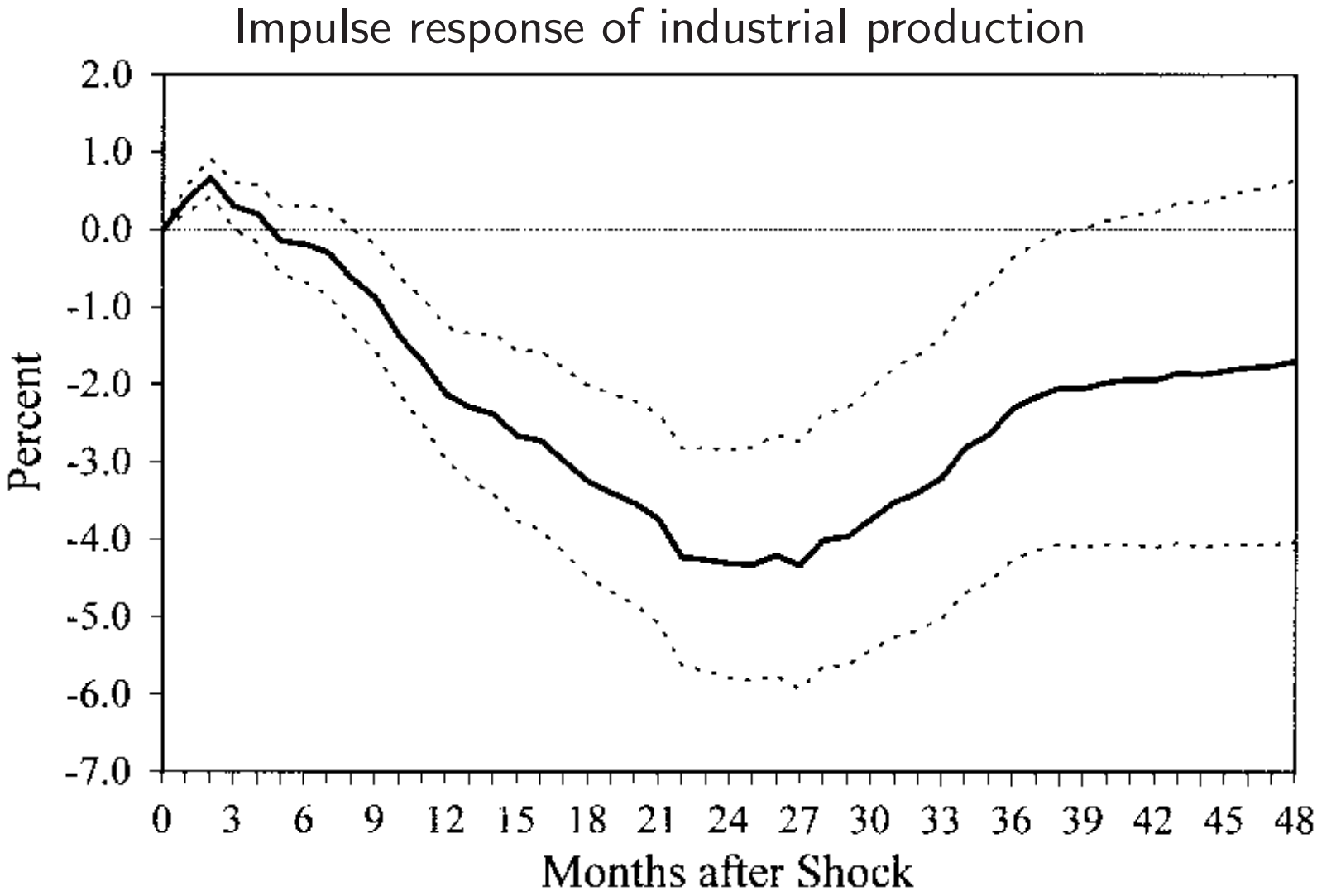
Romer and Romer (2004)

- Use Greenbook forecasts to remove endogenous changes in the FFR
- Run: $i_t = \phi_\pi \pi_{t+1|t} + \phi_y g y_{t+1|t} + \rho_i i_{t-1} + \varepsilon_t$ and interpret the residual ε_t as an exogenous innovation in monetary policy.
- Run:

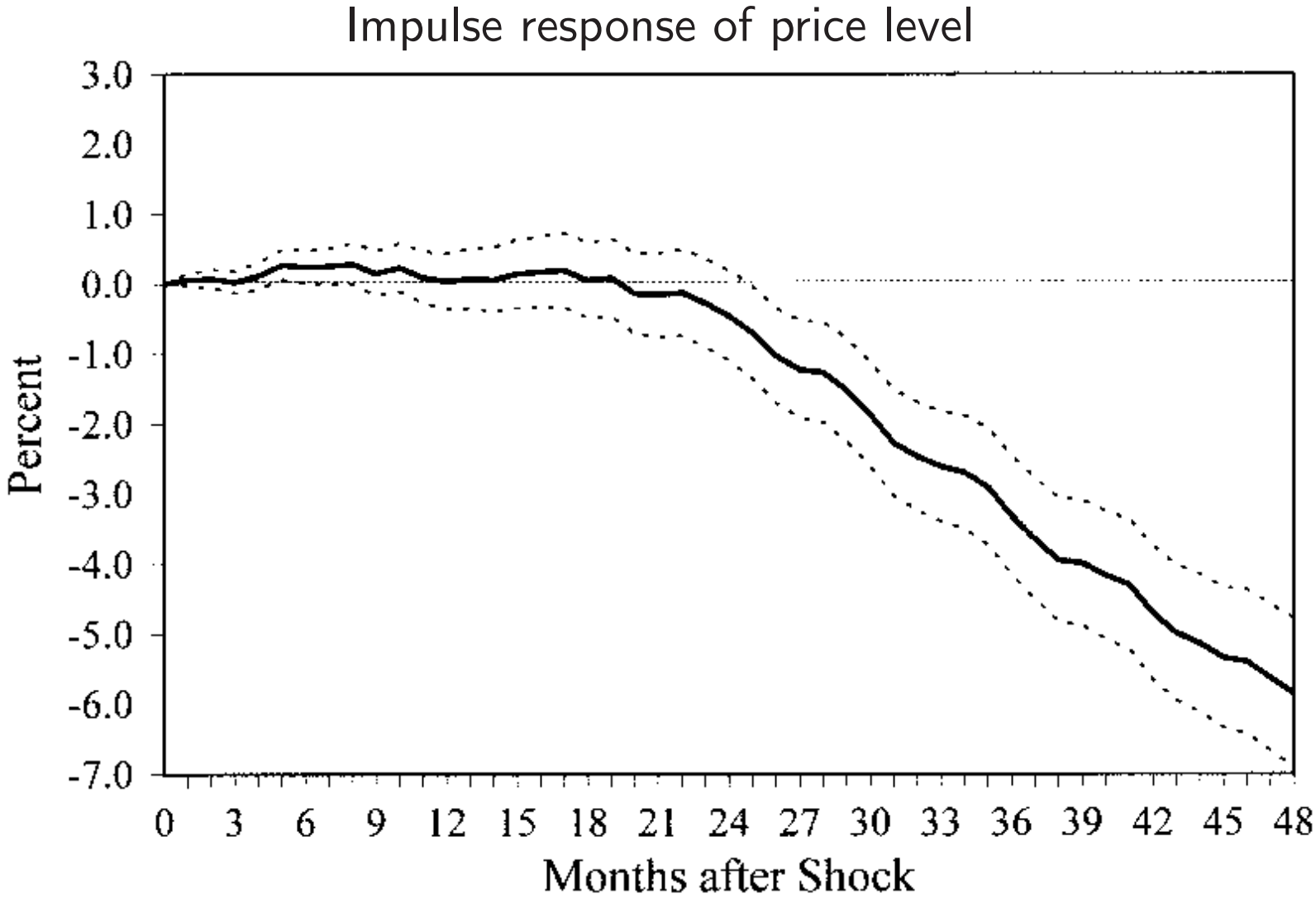
$$Y_t = \sum_{s=0}^{k} \alpha_s \varepsilon_{t-s} + \sum_{q=1}^{m} \beta^q Y_{t-1} + e_t$$

and construct impulse responses

ROMER AND ROMER (2004)



Romer and Romer (2004)



Narrative Approach of Romer and Romer (1989)

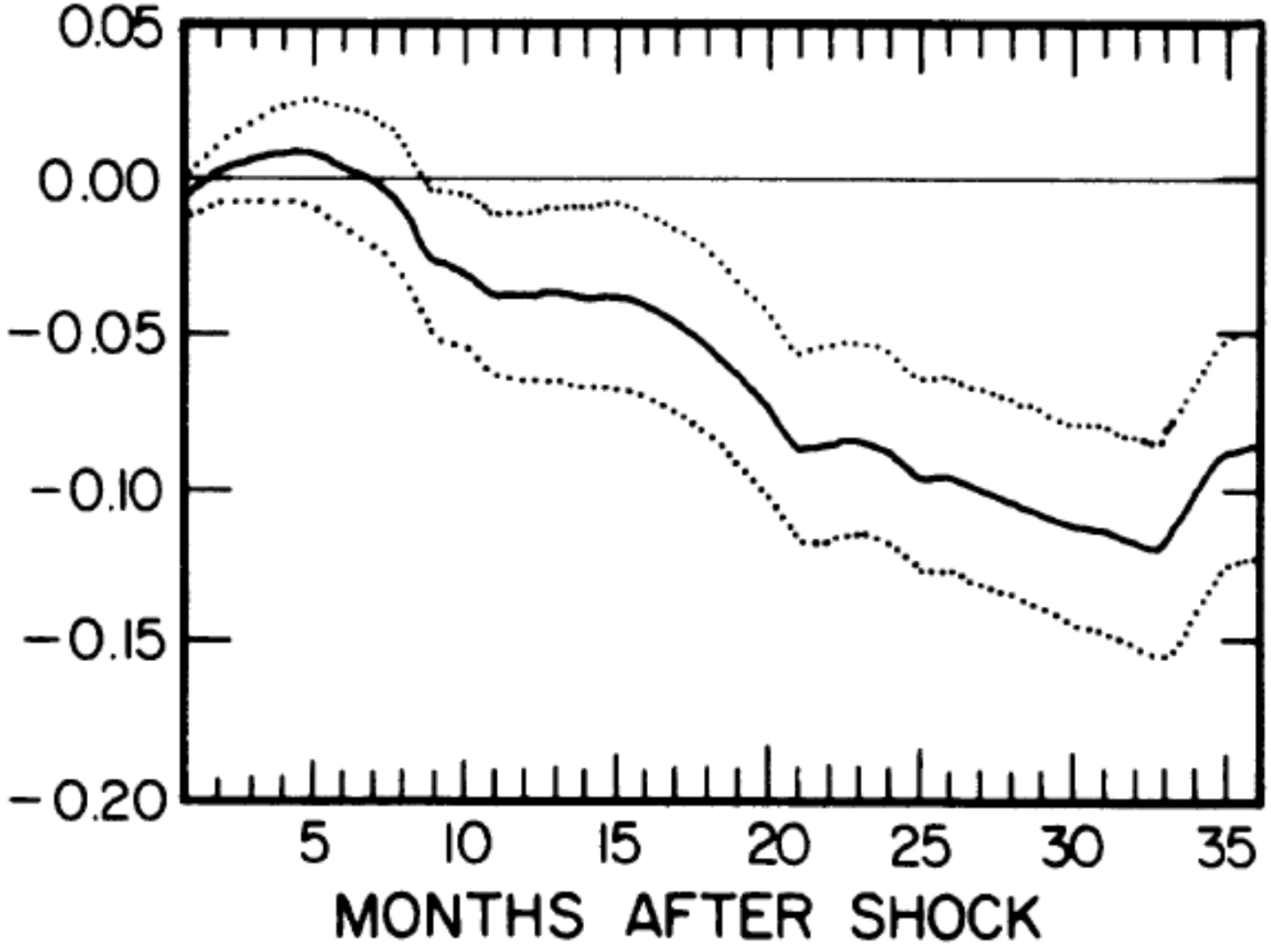
- Read FOMC minutes and try to identify instances when the Fed changed the policy for reasons not related to business cycles.
- Romers identify six instances since World War II (and up to 1989) when the Federal Reserve moved to induce a recession to reduce inflation: October 1947, September 1955, December 1968, April 1974, August 1978, and October 1979.
- Method:

$$Y_t = \sum_{s=0}^{k} \alpha_s D_{t-s} + \sum_{q=1}^{m} \beta^q Y_{t-1} + e_t$$

- Shapiro (1994) criticism: Romer dates are forecastable and thus not exogenous.

Romer and Romer (1989)

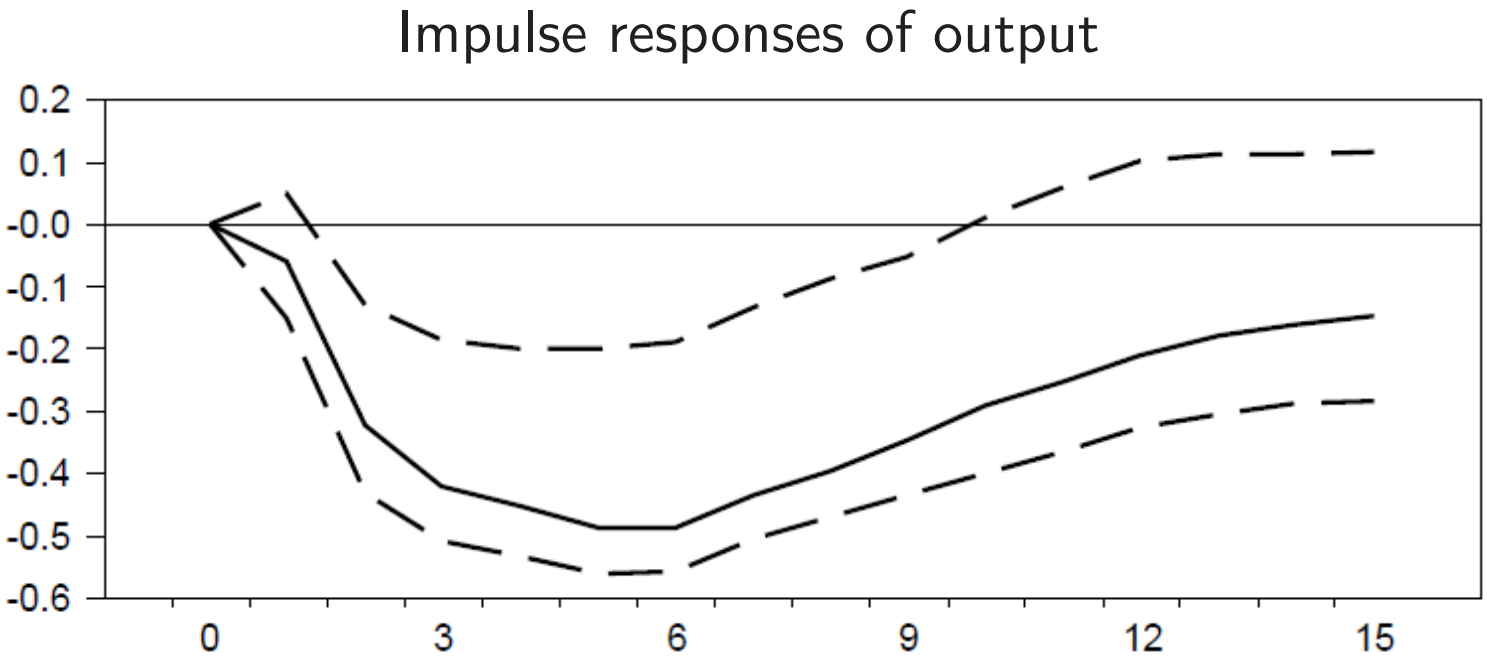
Impulse responses of industrial production



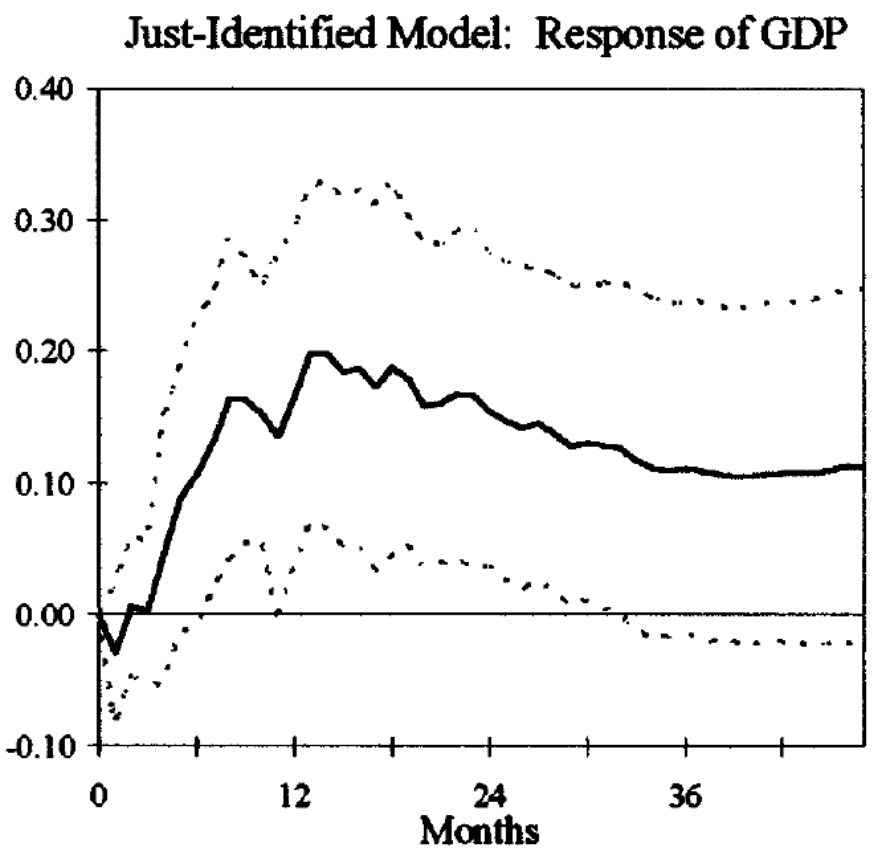
Nominal Shocks in VARs

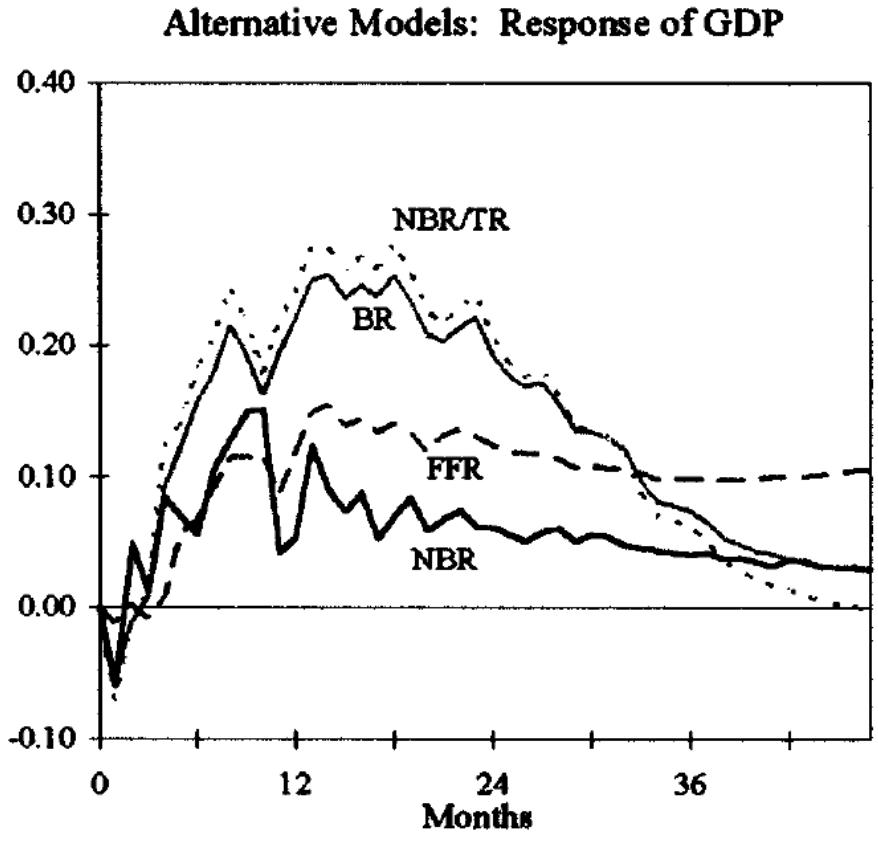
- Filter out predictable movements using projections on own lags and focus on unforecastable innovations (i.e. VAR residuals) in macroeconomic variables.
- VAR residuals are correlated and we need to remove endogenous responses in innovations to FFR.
- Use minimum delay restriction.
- Key concerns: forecastable shocks, omitted variables.

Christiano, Eichenbaum, Evans (1999)



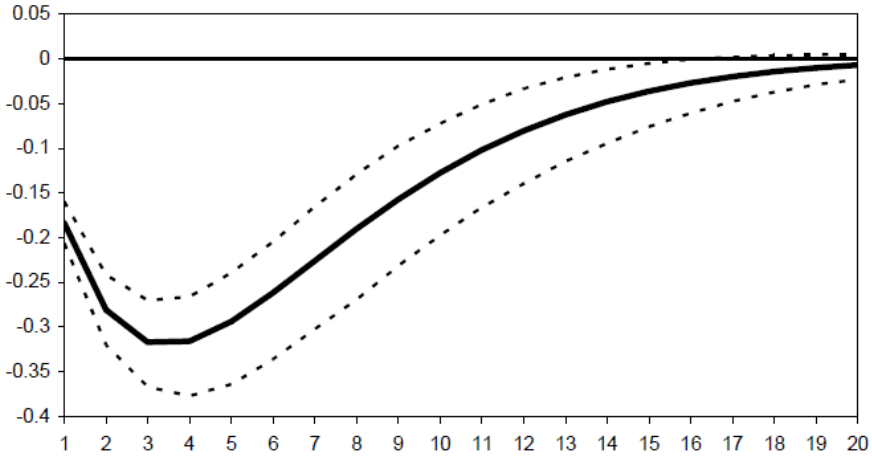
BERNANKE AND MIHOV (QJE, 1998)



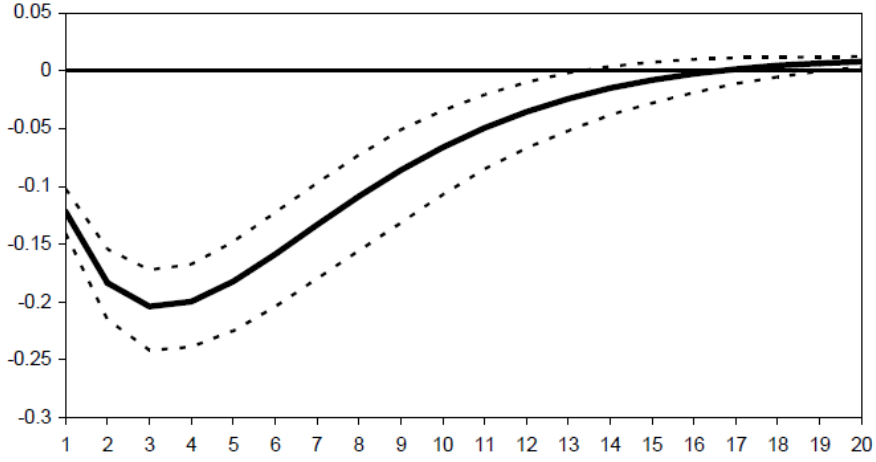


Smets and Wouters (2007)

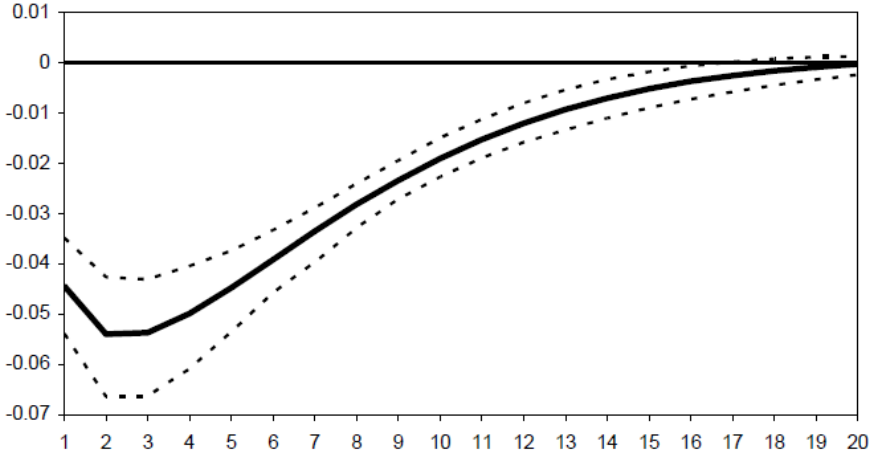
Contractionary monetary policy shock:



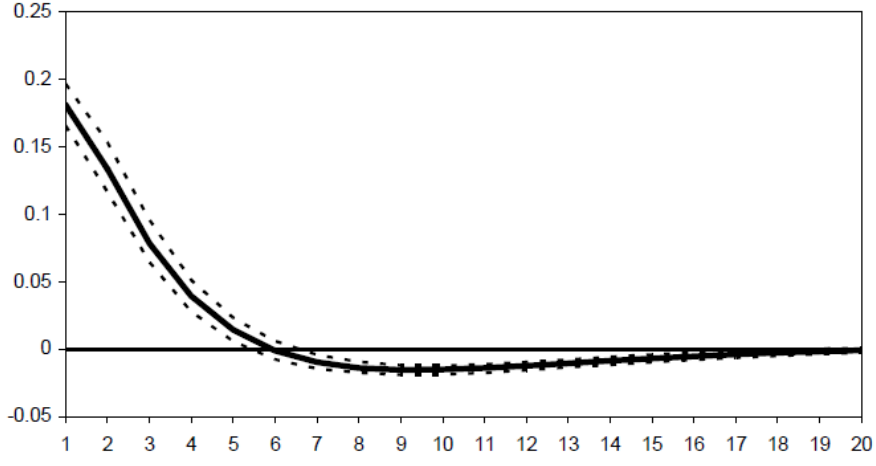
Output



Hours



Inflation



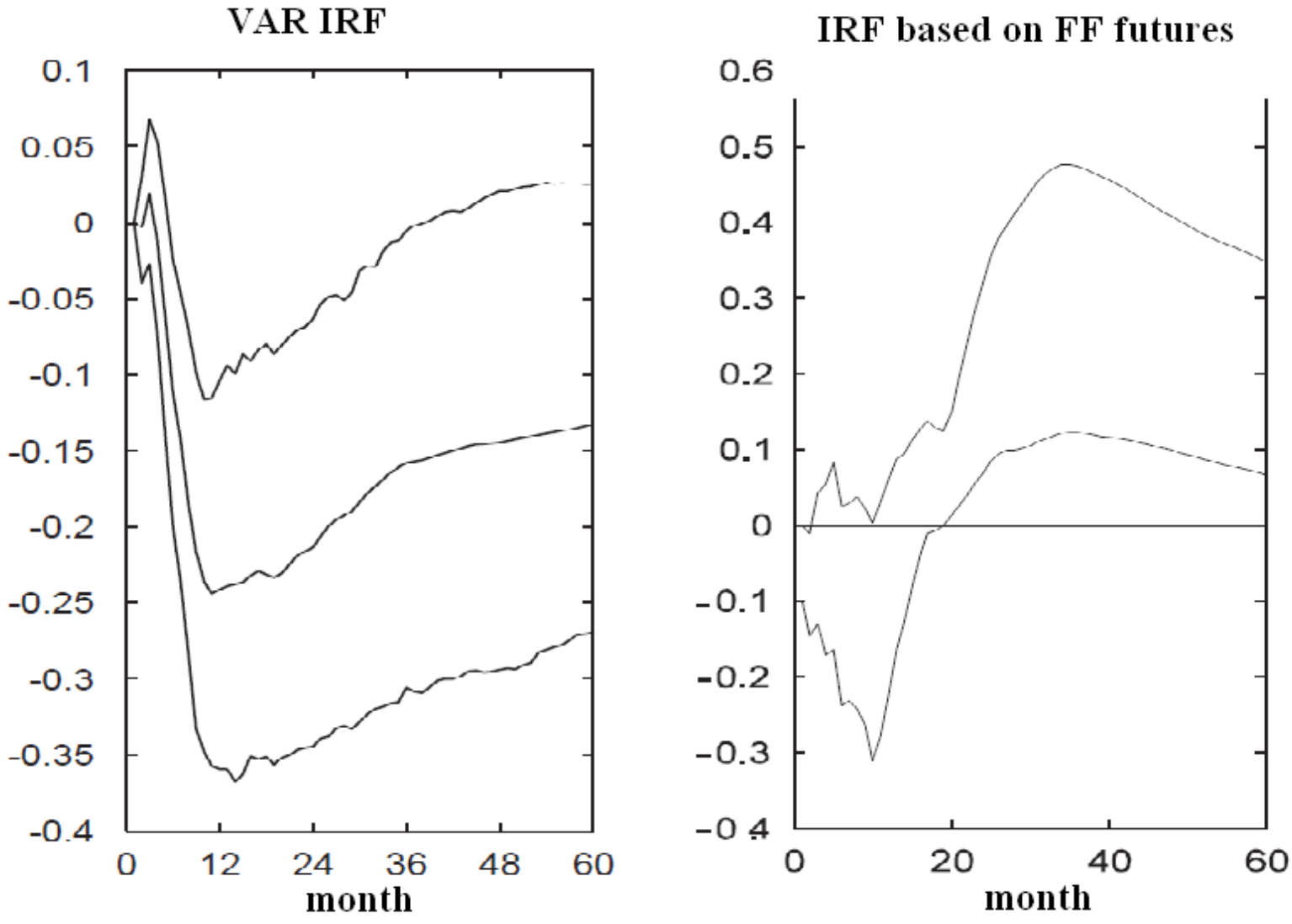
Interest rate

Market-based Expectations

- Fed funds futures have market expectations about the future course of policy. We can use this information to construct unforecastable shocks.
- Do not need a model!
- Use very high frequency data: windows are typically measured in minutes.
- Key concern: unforecastable by market, but may contain private information of the Fed.

FAUST, SWANSON AND WRIGHT (JME, 2007)

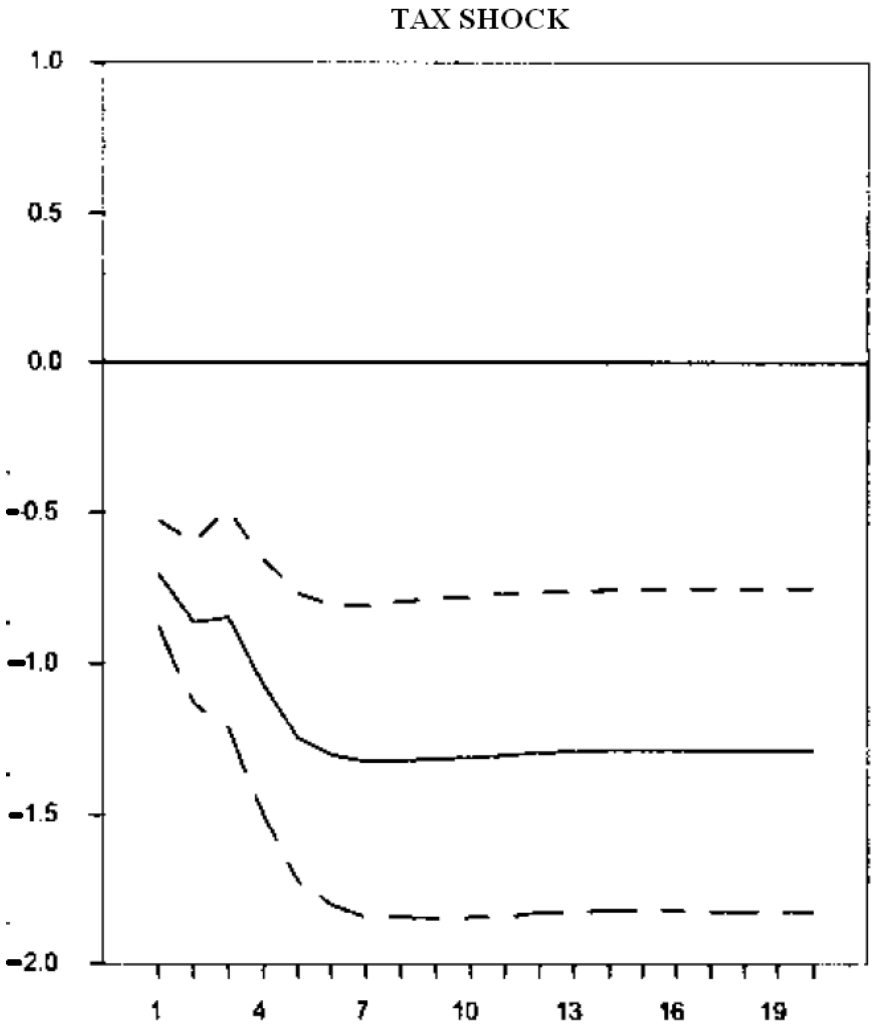
Impulse response of output

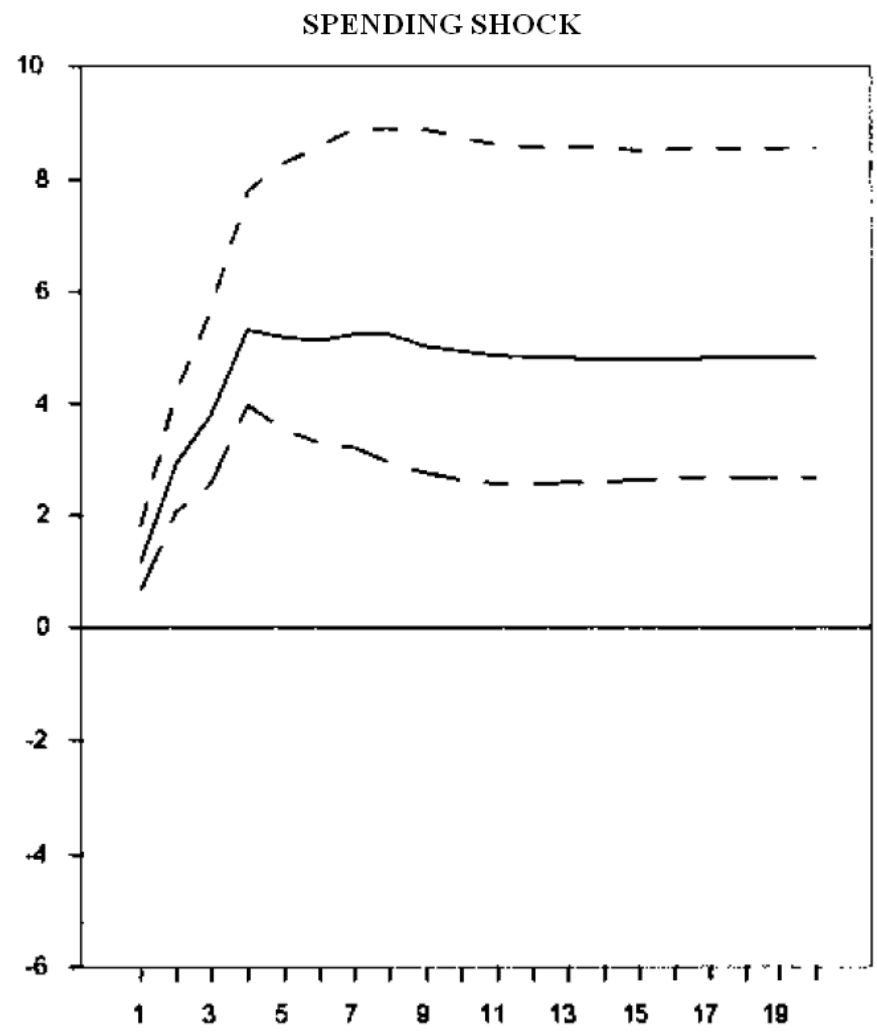


Fiscal Shocks

- Need to identify fiscal shocks if we want to know the effects of fiscal stimuli.
- Identification of unanticipated shocks is tricky because many changes in fiscal policy are anticipated.
- VARs typically assume that
  - Government spending does not respond contemporaneously to current economic conditions.
  - Taxes have a fixed elasticity with respect to output.

BLANCHARD AND PEROTTI (QJE, 2002)



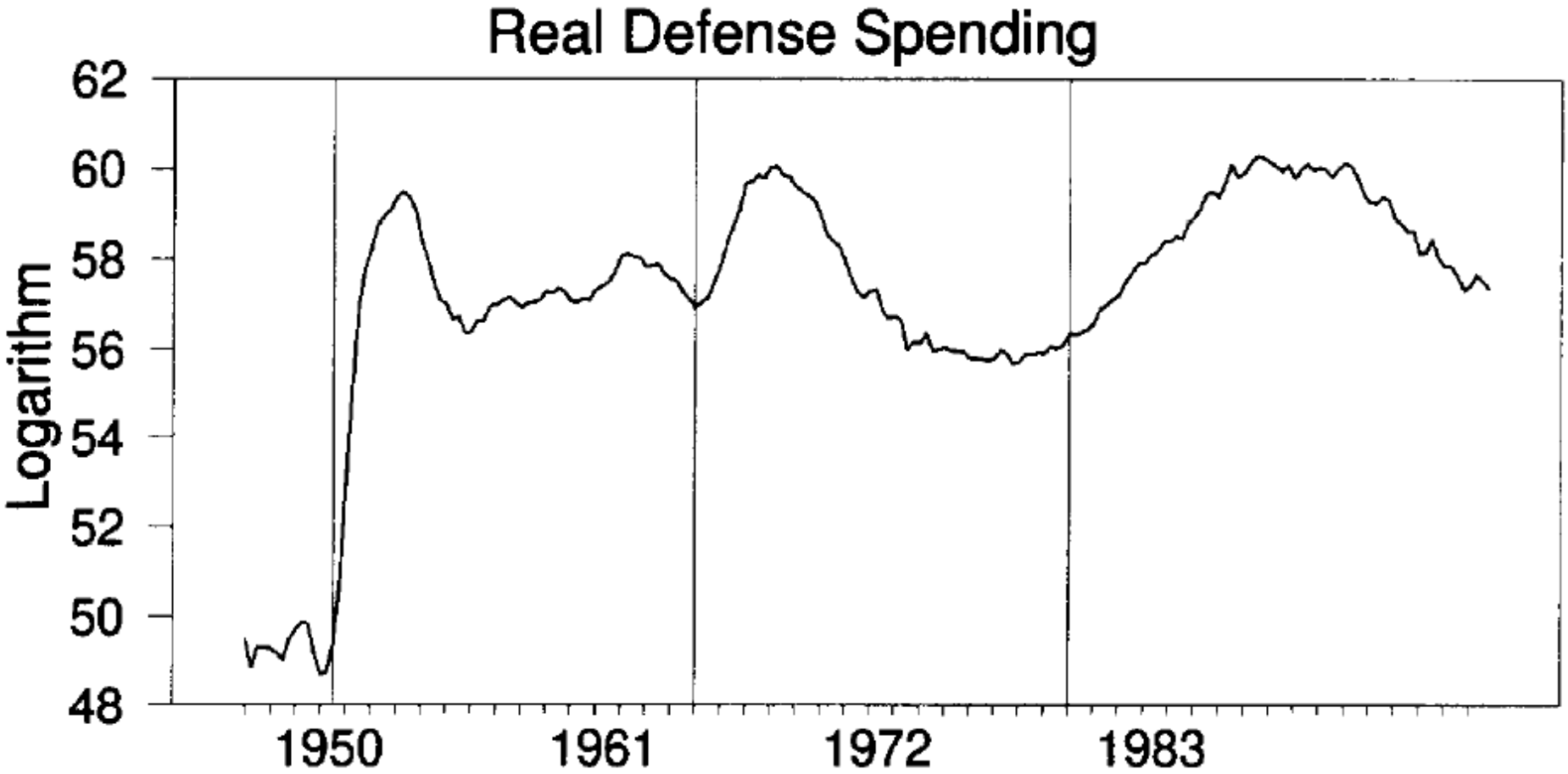


Tax multiplier = -0.8

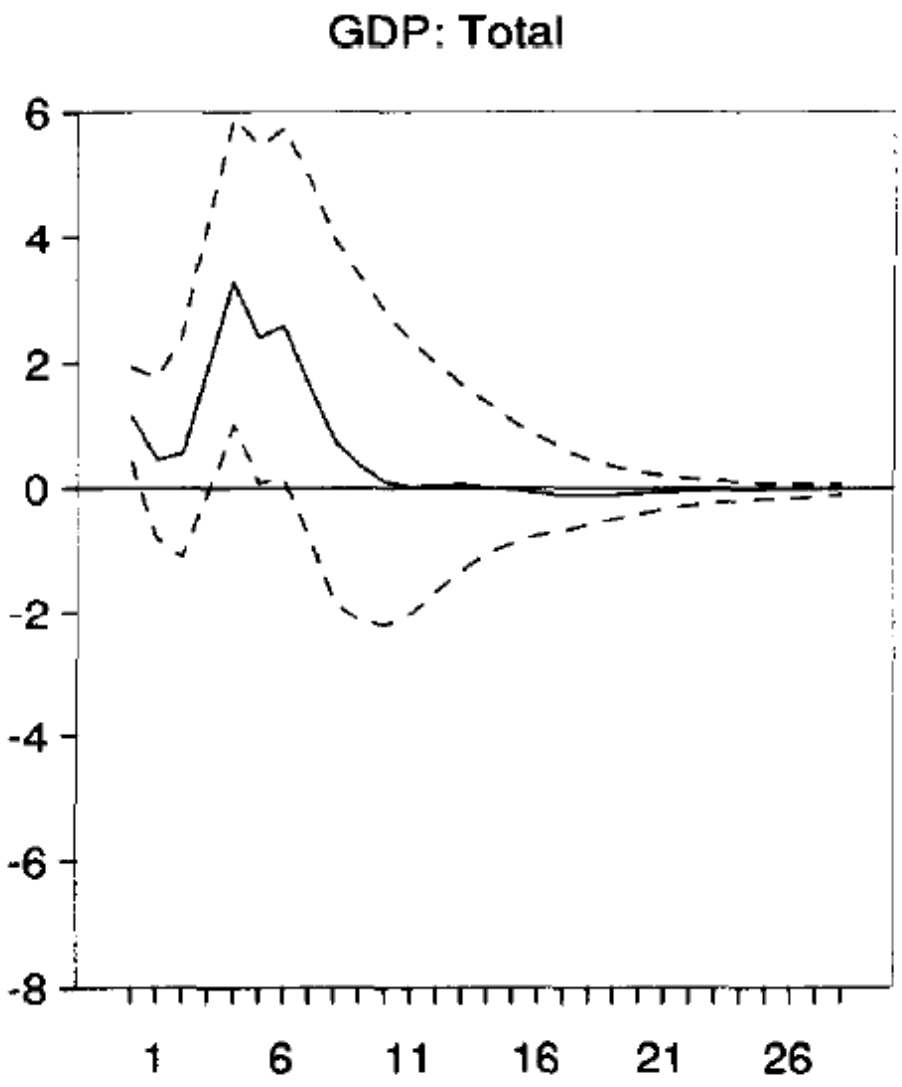
Spending multiplier = 0.9

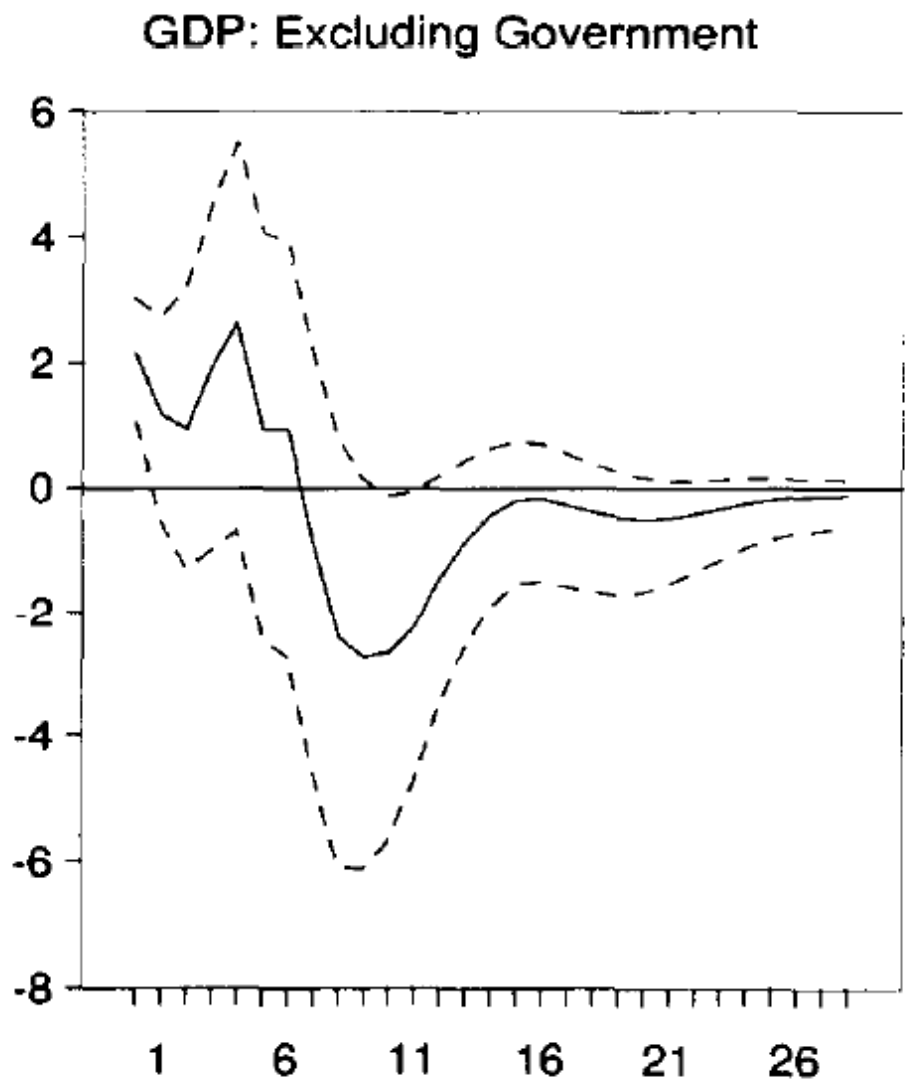
Ramey and Shapiro (1998)

Use military buildups

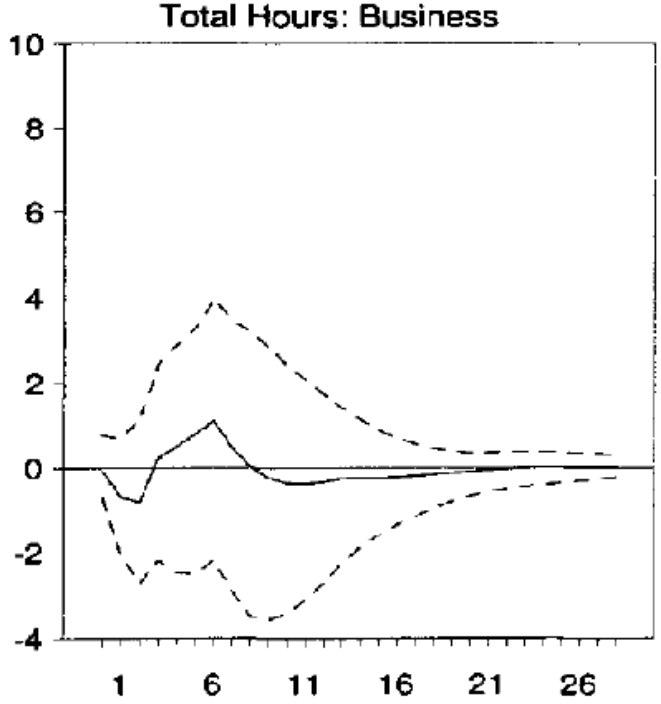


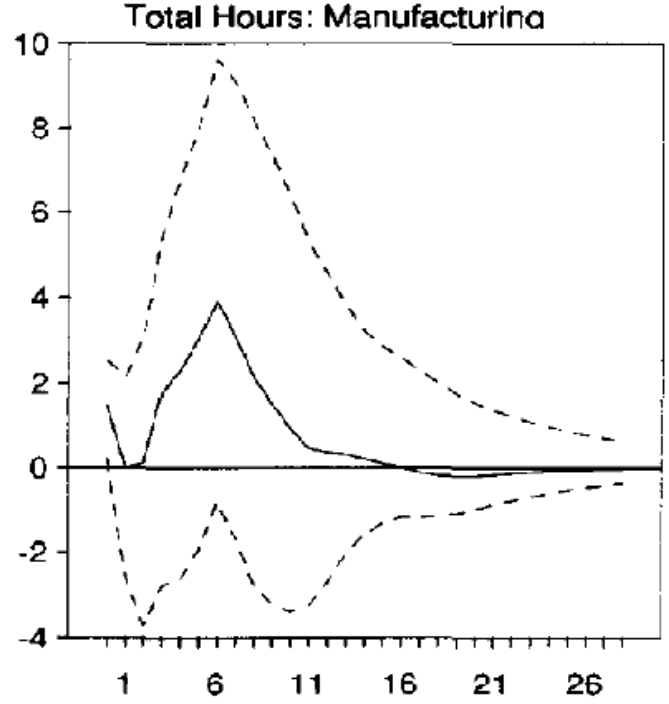
RAMEY AND SHAPIRO (1998)

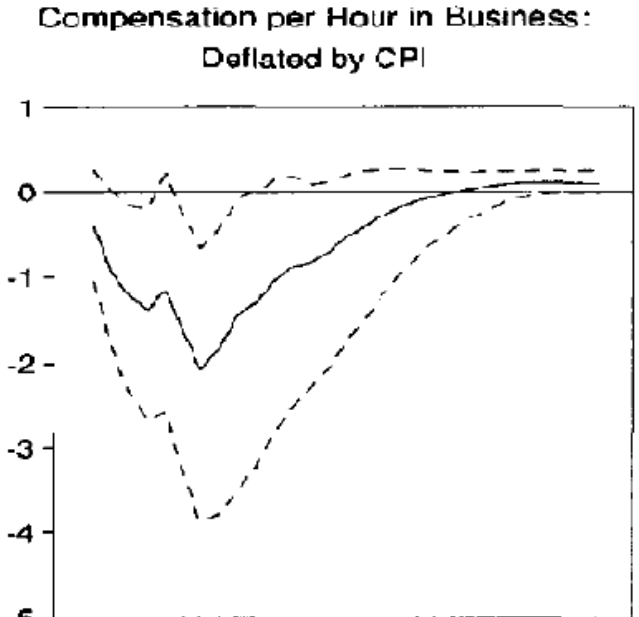


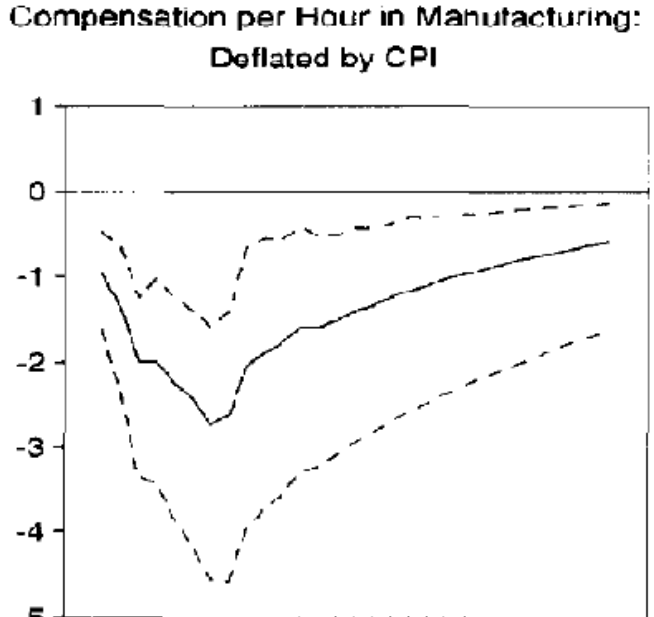


RAMEY AND SHAPIRO (1998)









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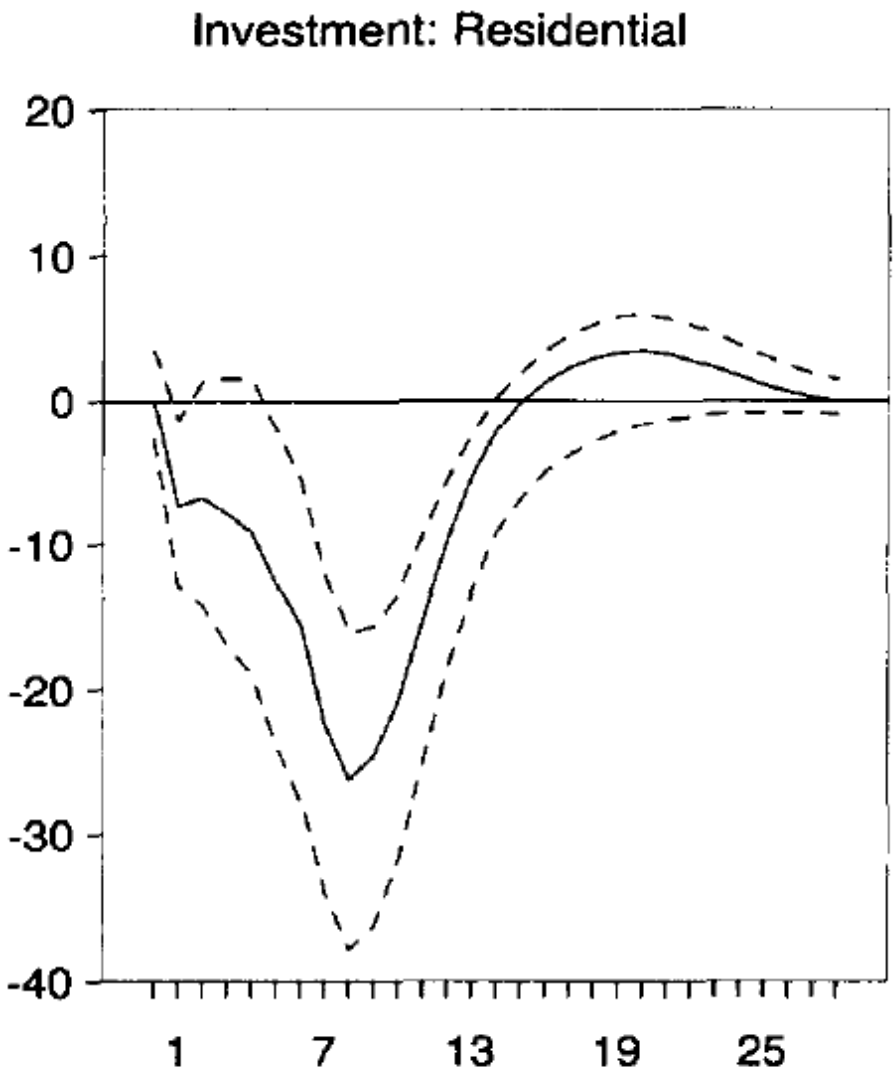
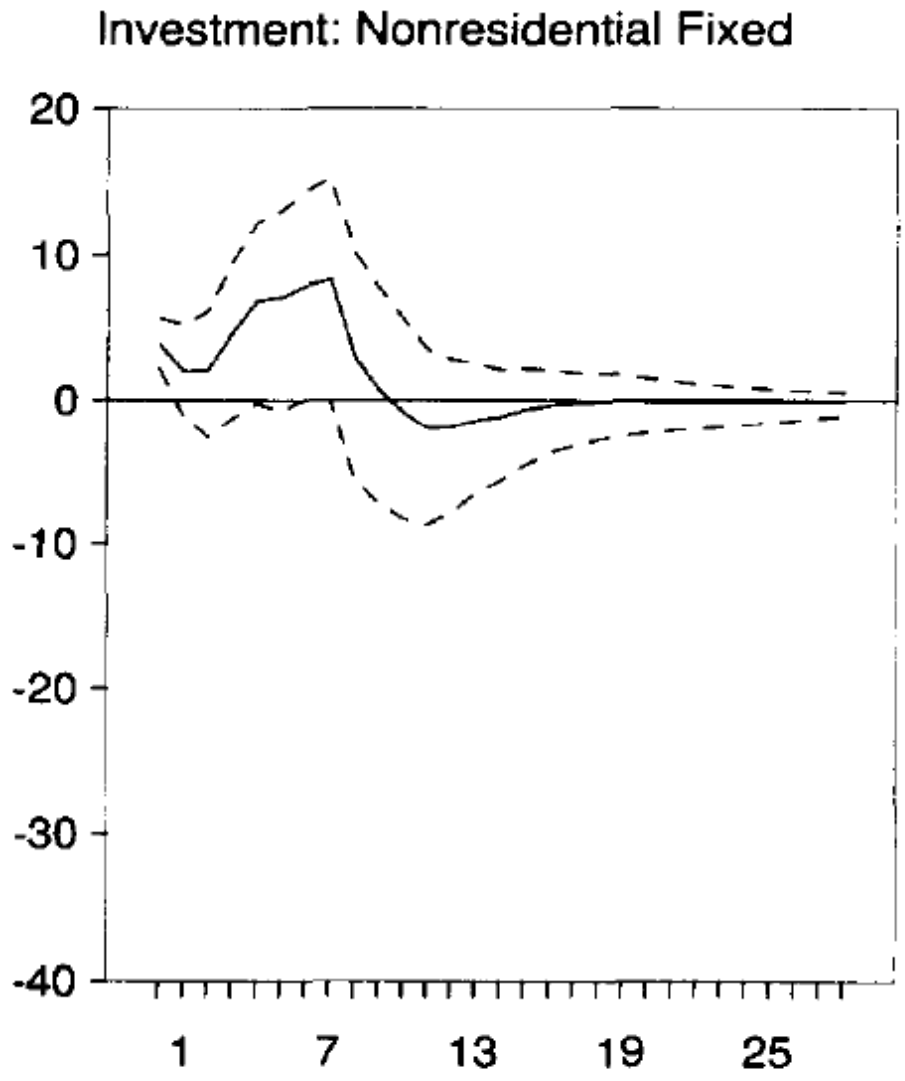
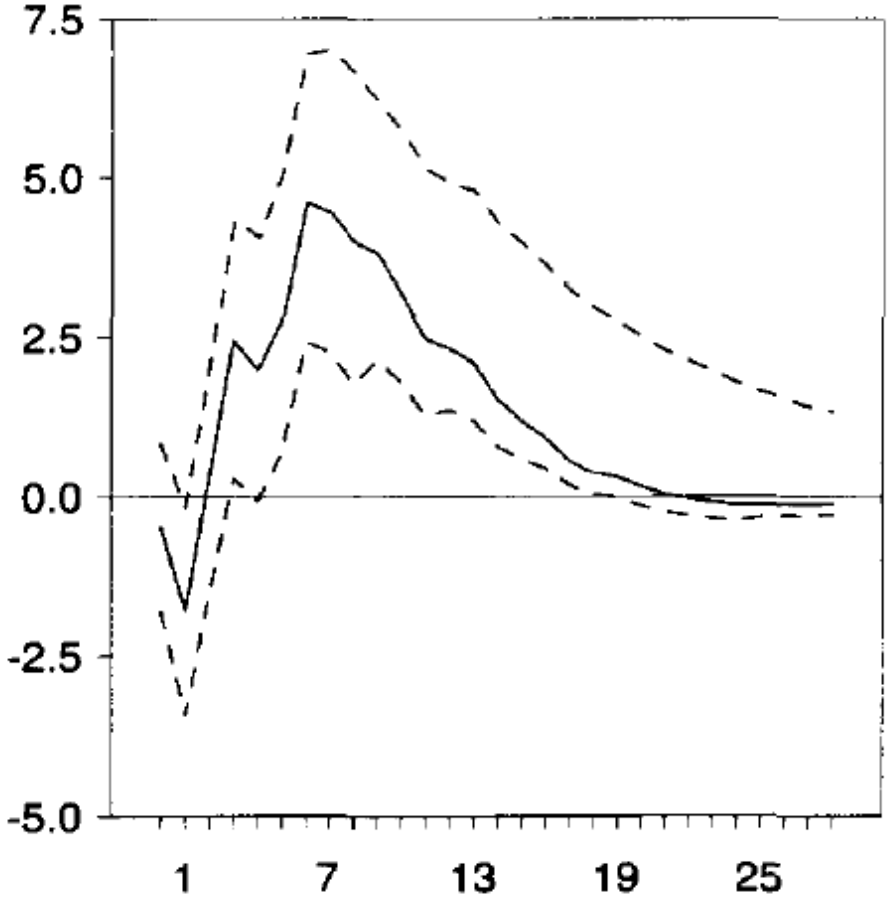
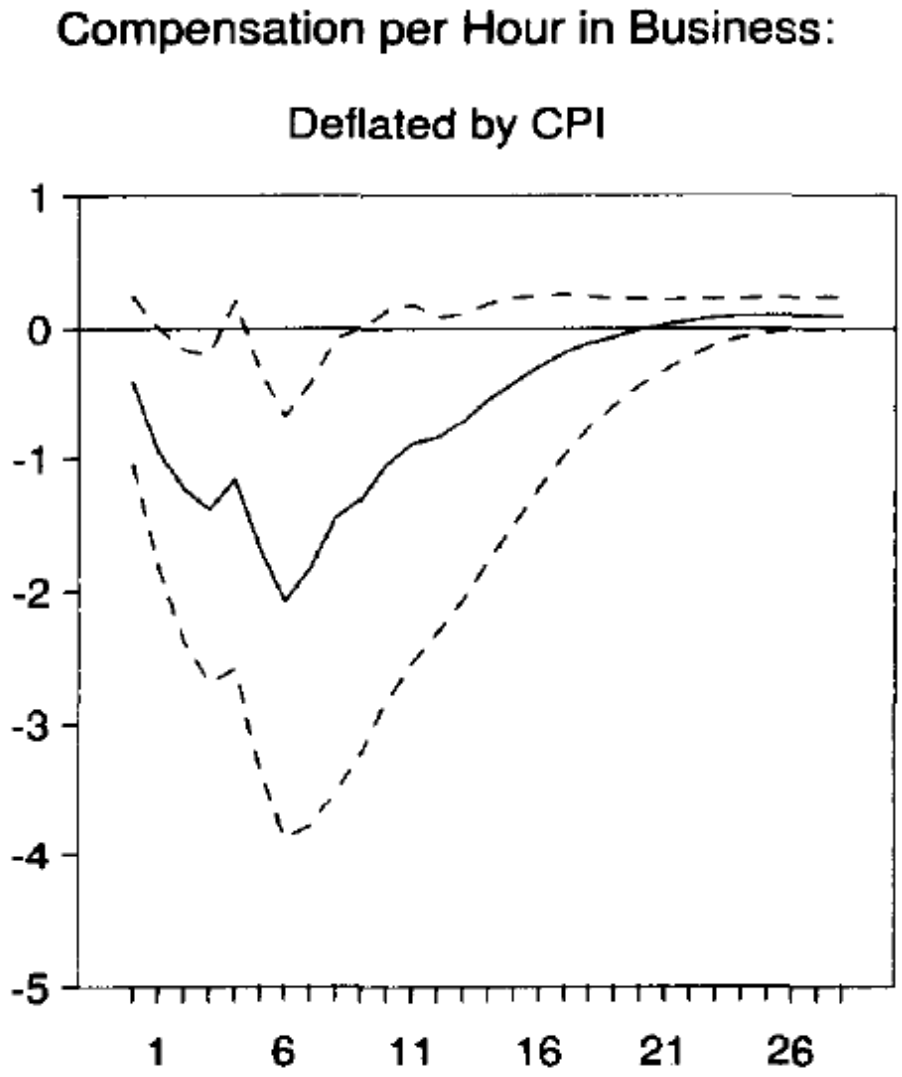




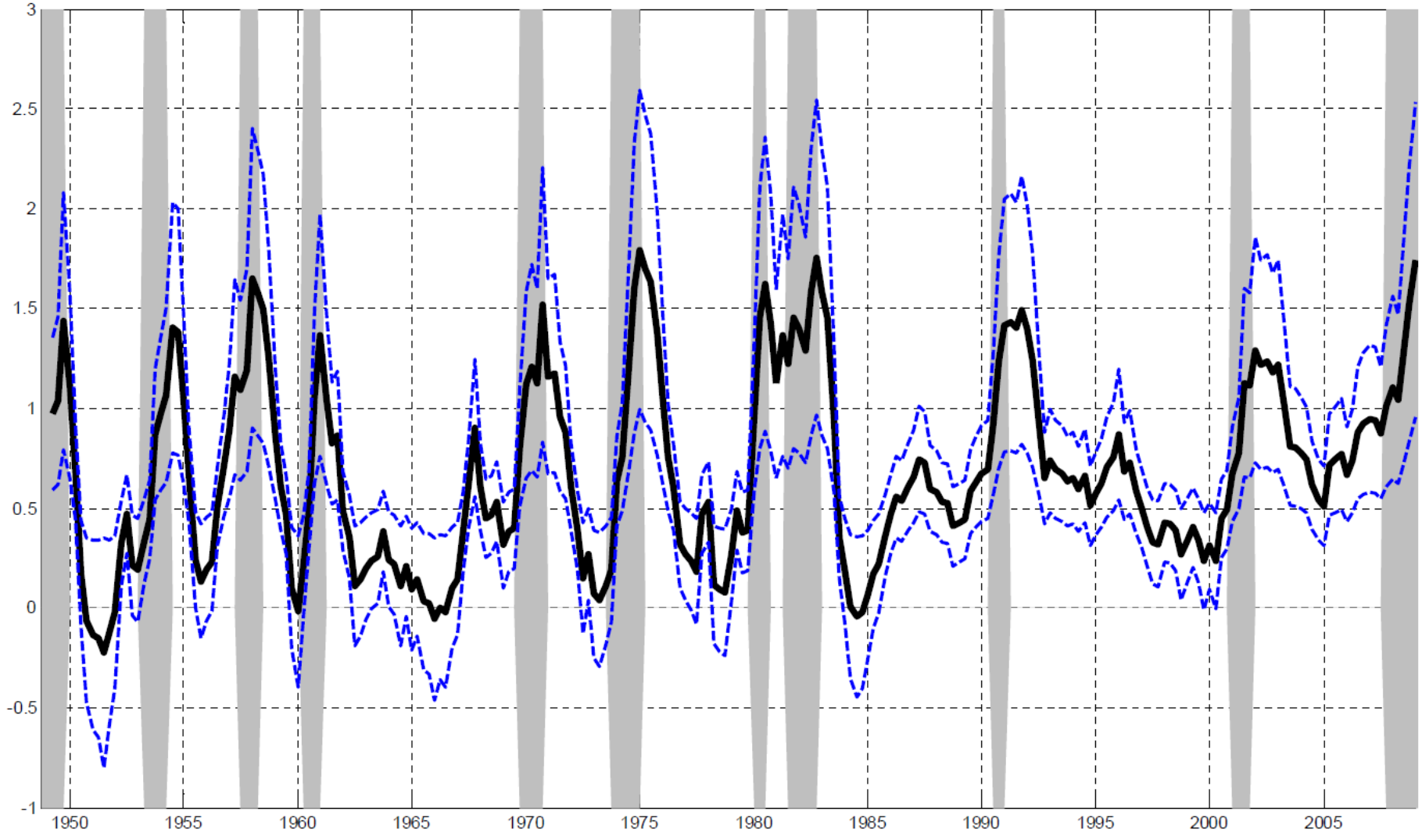
RAMEY AND SHAPIRO (1998)



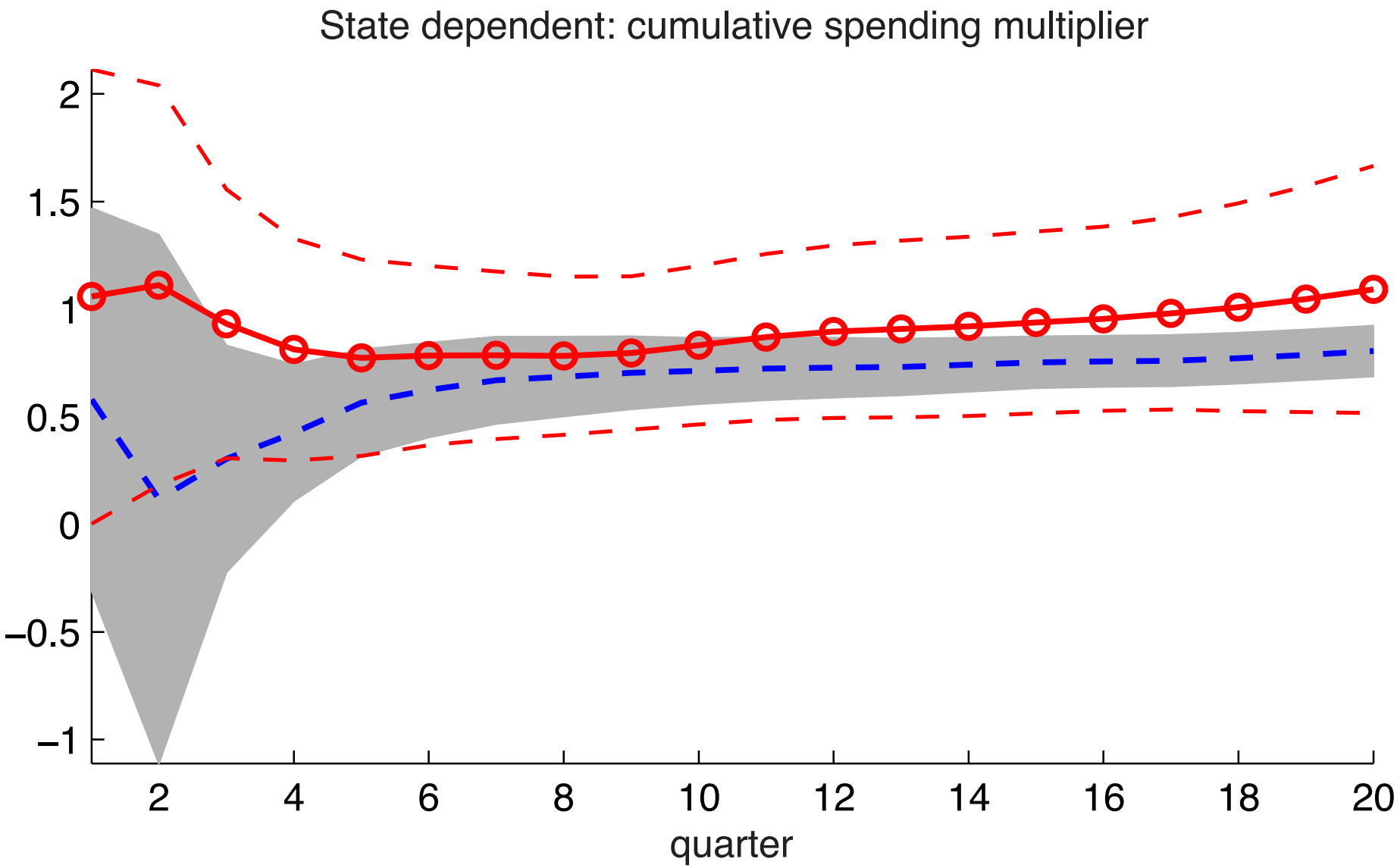


Auerbach and Gorodnichenko (AEJ, 2012)

State-dependence of fiscal multiplier:



Ramey and Zubeiry (2018)



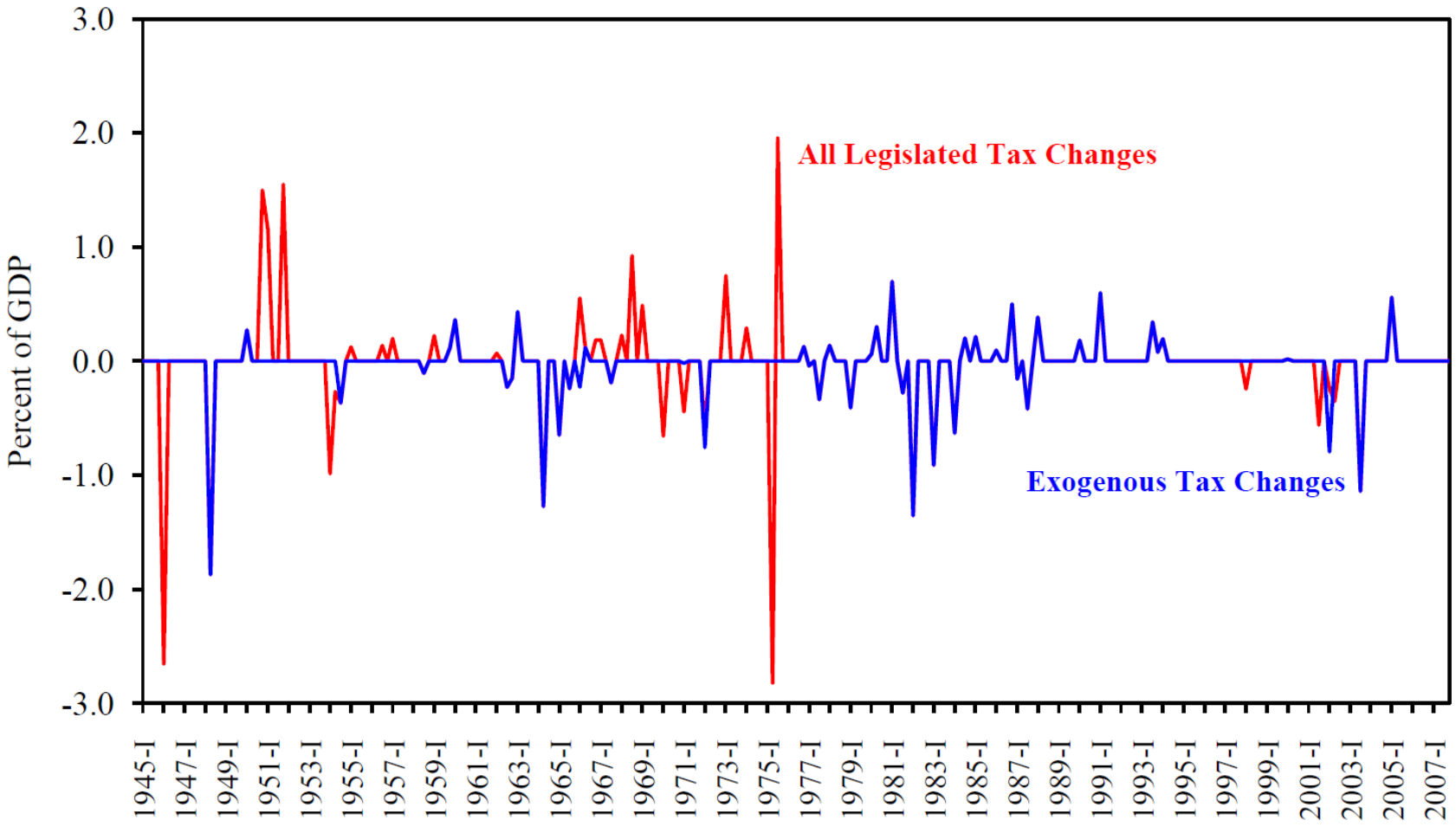
Romer and Romer (AER, 2010)

- Use a narrative approach
- Identify changes in taxes and spending which are not due to cyclical factors.
- Assess the size of the changes and label them as shocks ε_t.
- Run

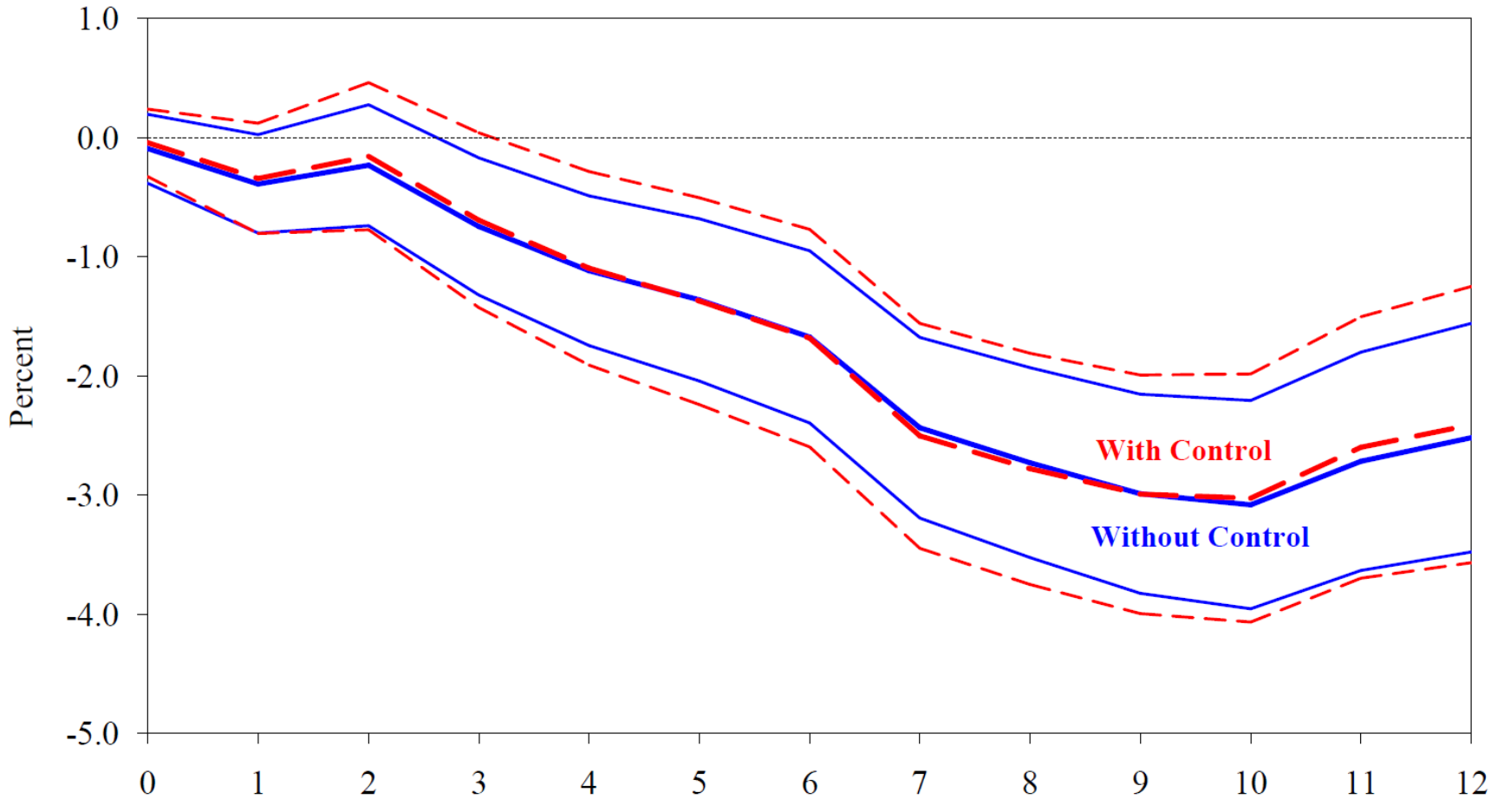
$$Y_t = \sum_{s=0}^{k} \alpha_s \varepsilon_{t-s} + \sum_{q=1}^{m} \beta^q Y_{t-1} + e_t$$

and construct impulse responses

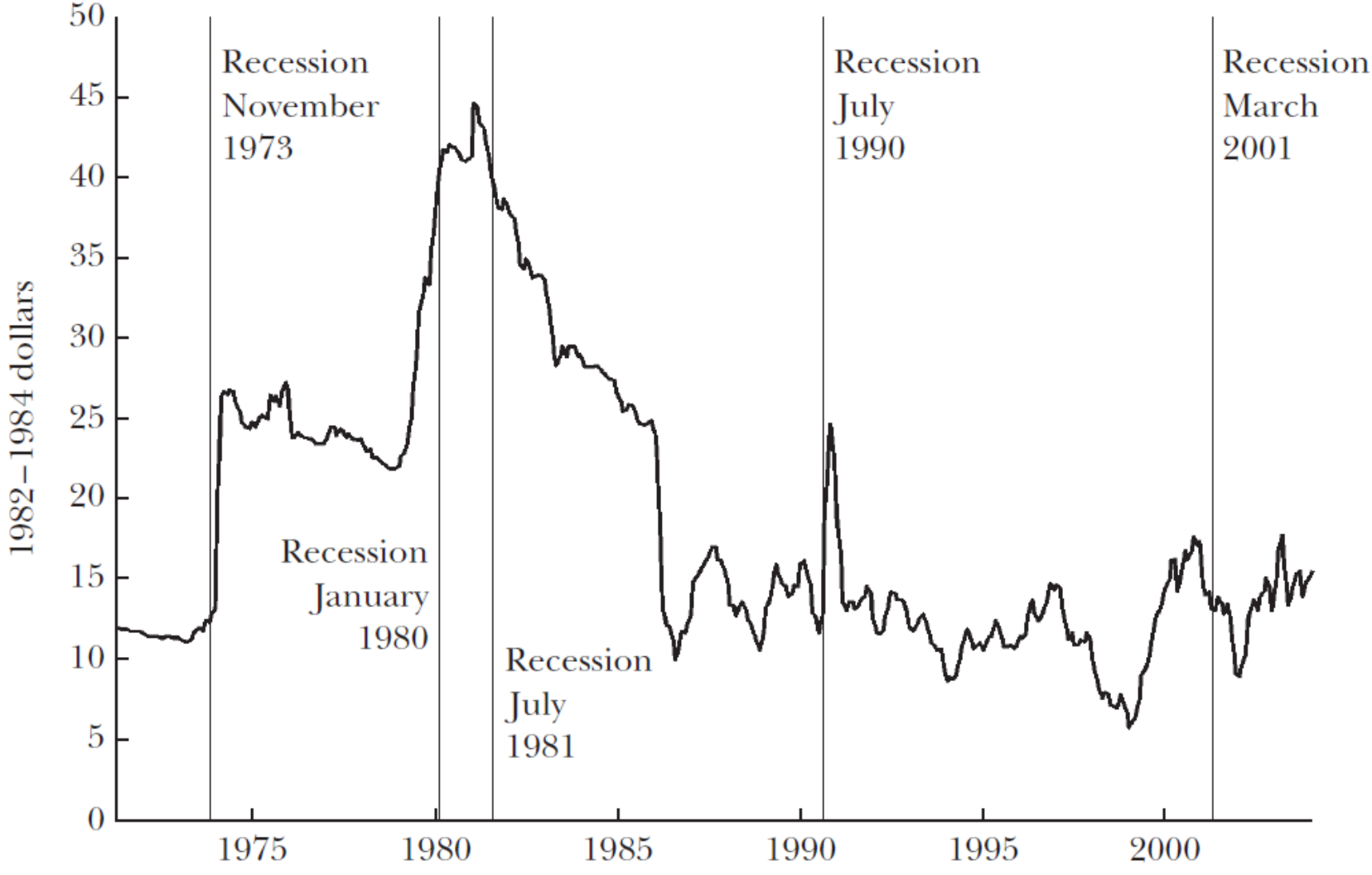
ROMER AND ROMER (AER, 2010)



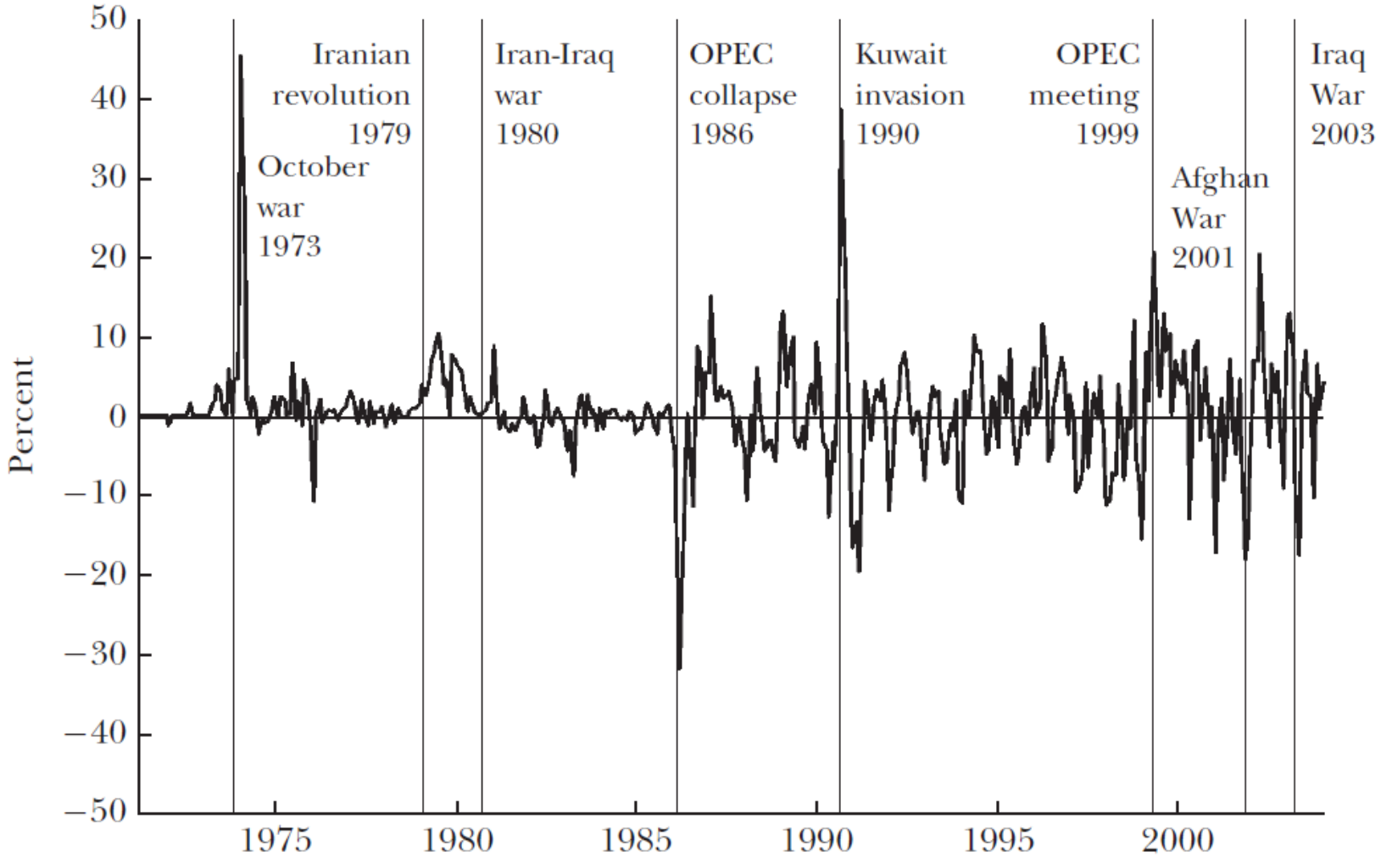
ROMER AND ROMER (AER, 2010)



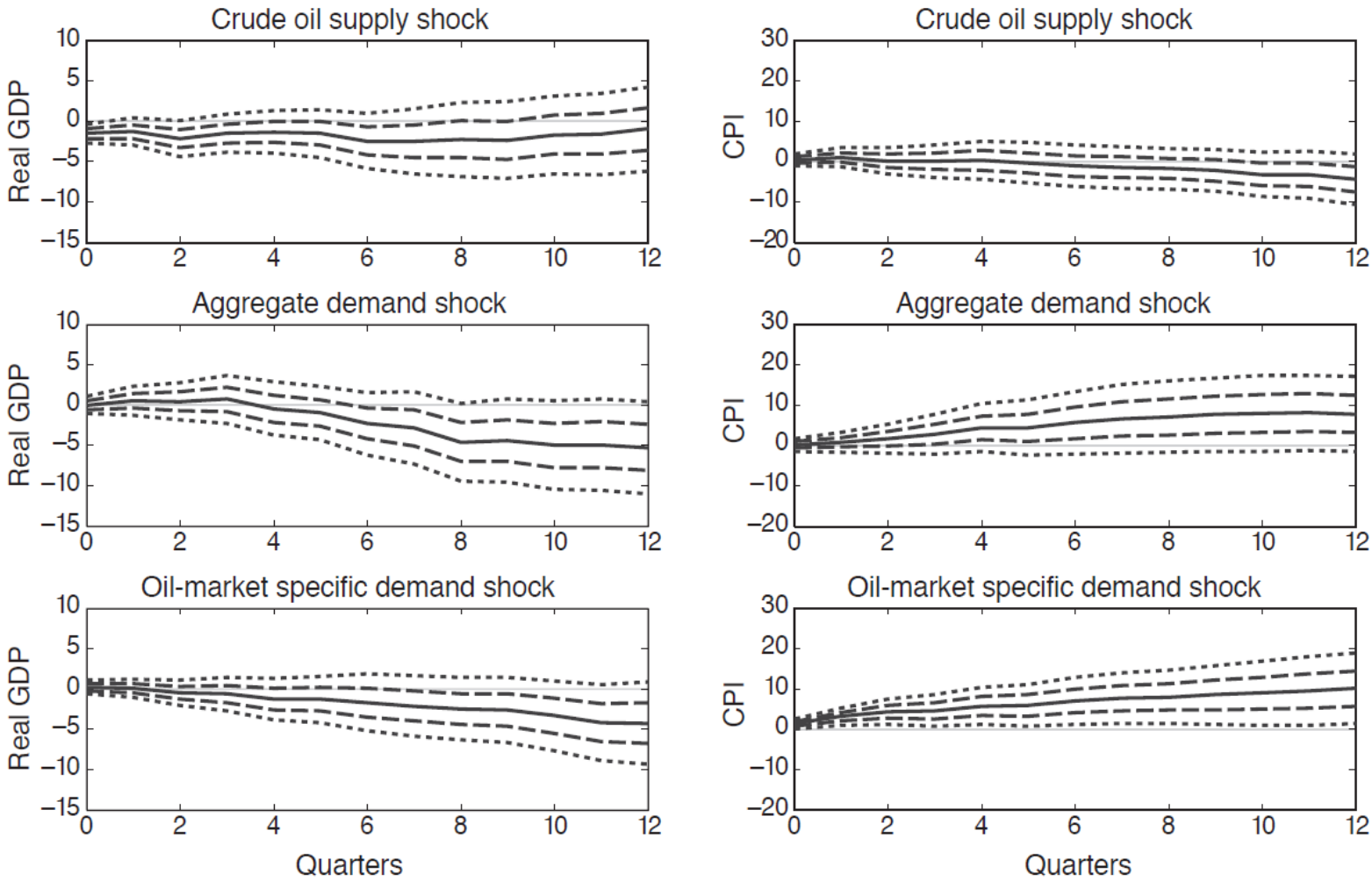
Oil Price Shocks and Recessions



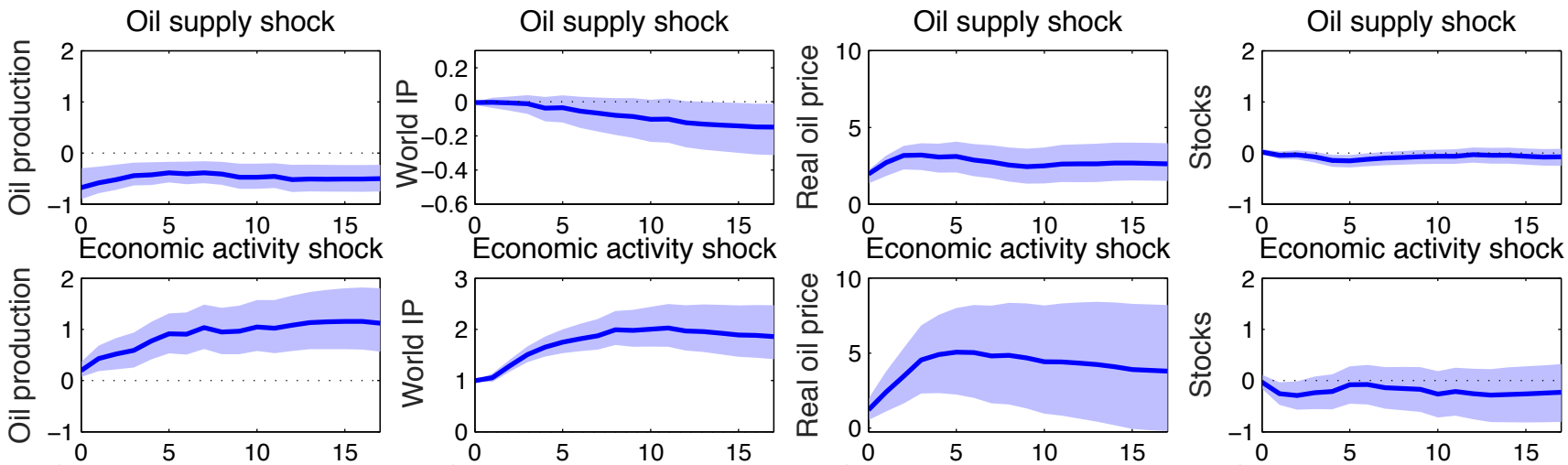
Oil Price Changes



KILIAN (2009)


Crude oil supply shock
Real GDP
10
5
0
−5
−10
−15
0
2
4
6
8
10
12
Crude oil supply shock
CPI
30
20
10
0
−10
−20
Aggregate demand shock
Aggregate demand shock
Oil-market specific demand shock
Oil-market specific demand shock
Quarters
Quarters

BAUMEISTER AND HAMILTON (2015)



Relative Importance of Shocks

- IRFs are useful tools to rule out theories but they do not provide information on what constitutes quantitatively important sources of fluctuations.
  - RBC models can have demand shocks
  - NK models can have TFP shocks
- We need to do "variance decomposition" to compare relative contributions.
- VARs and (especially) DSGE models are the best tools for variance decompositions.

BLANCHARD AND QUAH (AER, 1988)

(CHANGE IN OUTPUT GROWTH AT 1973/1974; UNEMPLOYMENT DETRENDED)

Percentage of Variance Due to Demand:		
Horizon (Quarters)	Output	Unemployment
1	99.0	51.9
	(76.9, 99.7)	(35.8, 77.6)
2	99.6	63.9
	(78.4, 99.9)	(41.8, 80.3)
3	99.0	73.8
	(76.0, 99.6)	(46.2, 85.6)
4	97.9	80.2
	(71.0, 98.9)	(49.7, 89.5)
8	81.7	87.3
	(46.3, 87.0)	(53.6, 92.9)
12	67.6	86.2
	(30.9, 73.9)	(52.9, 92.1)
40	39.3	85.6
	(7.5, 39.3)	(52.6, 91.6)

NOTE.—Numbers in parentheses are the boundaries of the associated 95 percent confidence interval.

CHRISTIANO, EICHENBAUM AND EVANS (JPE, 2004)

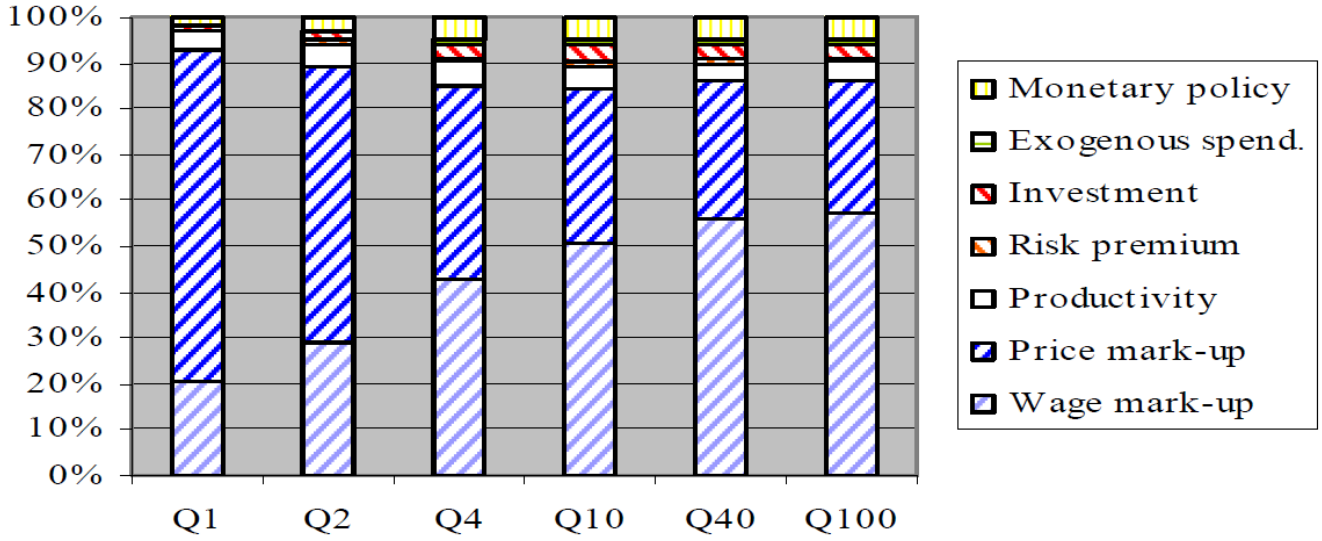
PERCENTAGE VARIANCE DUE TO MONETARY POLICY SHOCKS

	4 Quarters Ahead	8 Quarters Ahead	20 Quarters Ahead
Output	15	38	27
	(4,26)	(15,48)	(9,35)
Inflation	1	4	7
	(0,8)	(1,11)	(3,18)
Consumption	14	21	14
	(4,26)	(5,37)	(4,26)
Investment	10	26	23
	(2,21)	(7,39)	(6,32)
Real wage	2	2	4
	(0,8)	(0,14)	(0,15)
Productivity	15	14	10
	(3,25)	(3,26)	(3,20)
Federal funds rate	32	19	18
	(18,44)	(8,27)	(5,27)
M2 growth	19	19	19
	(8,29)	(8,26)	(8,24)
Real profits	13	18	7
	(5,25)	(6,31)	(2,20)

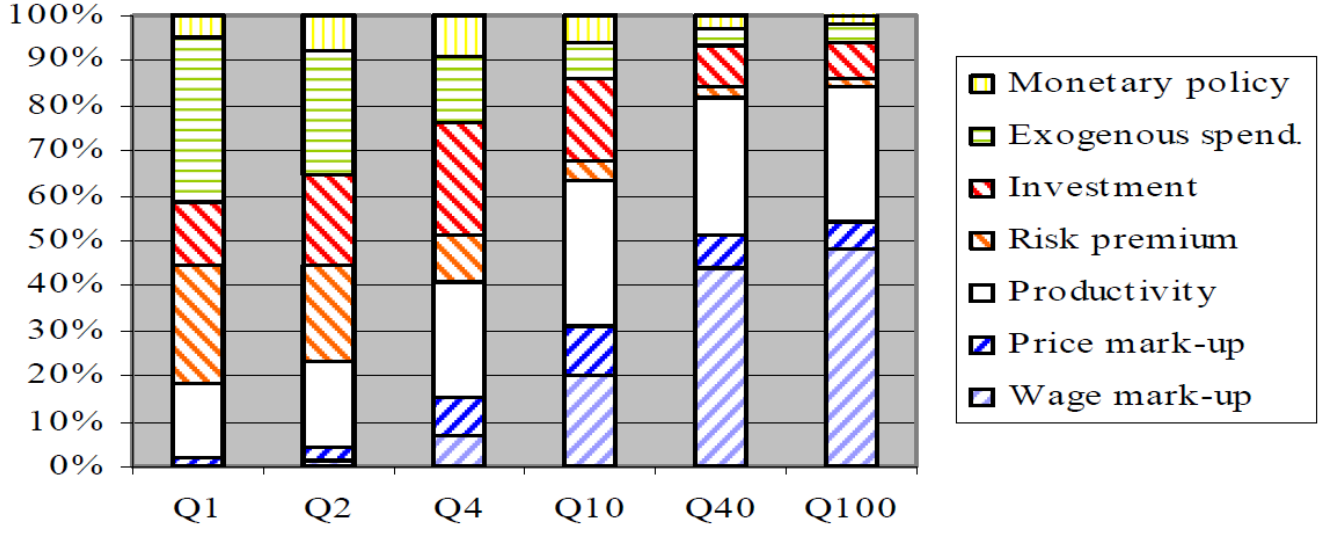
NOTE.—Numbers in parentheses are the boundaries of the associated 95 percent confidence interval.

SMETS AND WOUTERS (2007)

Variance decomposition of inflation:

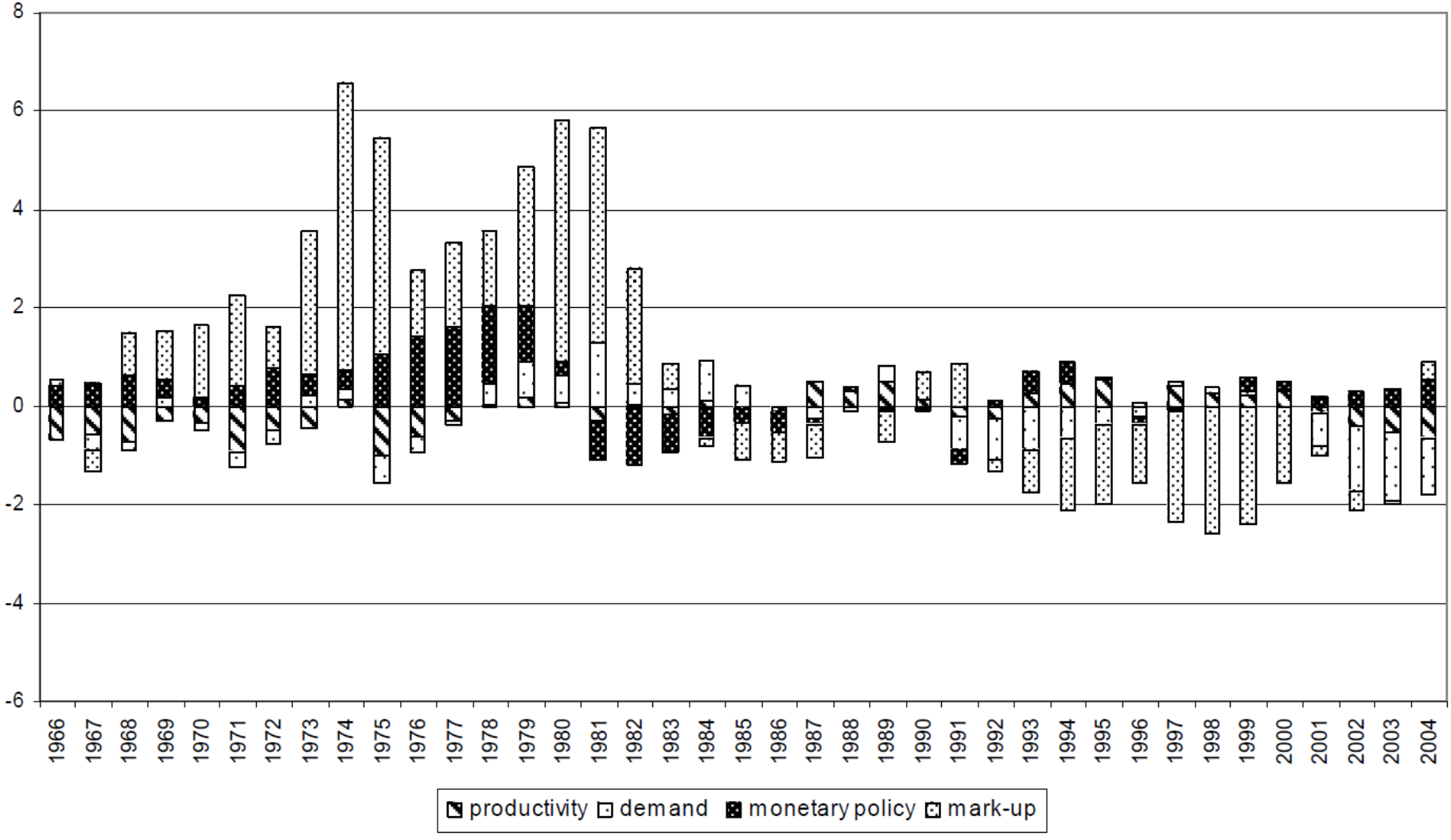


Variance decomposition of output:



Smets and Wouters (2007)

Historical decomposition of inflation:



Sources of Business Cycle Fluctuations

- Most economists (informal survey) now view demand shocks as (relatively) more important than supply side shocks.

- General agreement that monetary shocks and government spending shocks are not the major source of demand-side shocks. (That does not mean systematic changes in policy is unimportant.)

Long Live Business Cycles

- Many people many times suggested that business cycles are dead or will be dead shortly.
- Perennial questions in business cycles:
  - What is the source of TFP shocks?
  - What is the source of preference shocks?
  - Why shocks identified with particular events are small?
  - Why do we see massive comovement of variables in the business cycle?
  - What is the relationship between long-term growth and business cycles?
  - What are the costs of business cycles?