Fiscal Stimulus: Evidence

Emi Nakamura and Jón Steinsson

UC Berkeley

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Fiscal Stimulus in Theory: Summary

Neoclassical models:

- Positive but small multipliers (less than one)
  - Due to negative wealth effect
  - Hours go up but consumption goes down
- Exception:
  - Persistent spending with "flexible capital"
  - Investment rises a lot but consumption still falls

Fiscal Stimulus in Theory: Summary

New Keynesian models:

- Multiplier highly dependent on monetary policy response
  - Constant real rate: multiplier 1
  - Lean against the wind: multiplier less than 1
  - zero lower bound: multiplier larger than 1
- Multipliers larger with credit constrained agents
  (old Keynesian multiplier logic)

Fiscal Stimulus in Theory: Summary

Other important issues:

- Multiplier dependent of tax response (varies across episodes)
- Multiplier dependent on type of spending
- Etc., Etc.

No single multiplier!

- Challenging to use aggregate multiplier estimates to distinguish between models

Fiscal Stimulus – Measurement

- Government purchases multiplier:
  - When government purchases of goods and services go up by \$1, how many dollars does output go up by?

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- Usually divide through by Y_{t-1}:

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- Why?

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- Why?
  - Reduces heteroskedasticity.

Fiscal Stimulus – Measurement

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- Second specification estimates an elasticity as opposed to a multiplier
- Some papers estimate elasticity and then convert to multiplier by multiplying by average value of Y/G
  (Ramey-Zubairy 18 argue this is not a good practice)

Endogeneity of Government Spending

- Suppose we seek to estimate:

$$\frac{Y_t - Y_{t-1}}{Y_{t-1}} = \alpha + \beta \frac{G_t - G_{t-1}}{Y_{t-1}} + \epsilon_t$$

- An important empirical problem is endogeneity of G_t
- What is the likely nature of the endogeneity?

Endogeneity of Government Spending

Countercyclical spending:

- Governments might systematically spend more when output is low due to other shocks in an effort to counteract these other shocks and stabilize economy
- In this case, OLS would be downward biased

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Procyclical spending:

- Balanced budget rules or credit constraints may lead government to spend more when things are good for other reasons
- In this case, OLS would be upward biased

Fiscal Stimulus – Identification

Methods for identification:

- Wars (Barro-Redlick 11; Hall 09; Ramey 11)
- VARs (Blanchard-Perotti 02; Gali, et al. 07, Perotti 07)
- Regional shocks (Chodorow-Reich et al. 12, Shoag 13, Nakamura-Steinsson 14, Acconcia-Corsetti-Simonelli 14)

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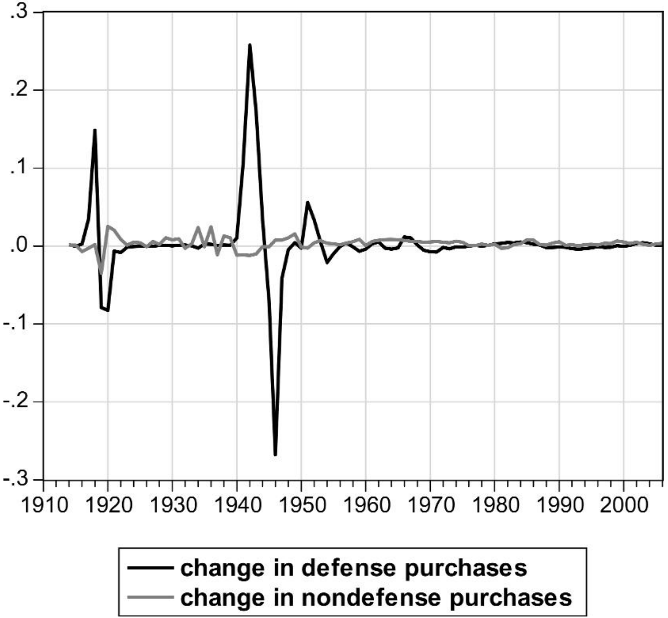
  - Mismeasurement of prices of tanks and wages of soldiers
- Barro-Redlick 11 think war-time multiplier overestimate true multipliers
- Hall 09 thinks they are underestimates

Barro and Redlick (2011)

- Look at variation in military spending from 1917-2006
- Dominated by WWI, WWII, Korean War



Source: Barro and Redlick (2011)

Table: Changes in Defense Spending

Year	DG (% GDP)	Year	DG (% GDP)
WWI		Korea	
1917	3.5	1951	5.6
1918	14.9	1952	3.3
1919	-7.9	1953	0.5
1920	-8.2	1952	-2.1
WWII		Vietnam	
1941	10.6	1966	1.2
1942	25.8	1967	1.1
1943	17.2		
1944	3.6	Reagan	
1945	-7.1	1982-1985	0.4-0.5
1946	-25.8	Bush II	
		2002-2004	0.3-0.4

Source: Barro and Redlick (2011)

Barro and Redlick (2011)

- Empirical specification:

$$\frac{Y_t - Y_{t-1}}{Y_{t-1}} = \alpha + \beta_1 \frac{G_t - G_{t-1}}{Y_{t-1}} + \beta_2 \frac{G_{t-1} - G_{t-2}}{Y_{t-2}} + \beta_3 \frac{G^*_{t-1} - G^*_{t-2}}{Y_{t-2}} + \text{controls} + \epsilon_t$$

- G^*_t captures news at time t about future spending from Ramey 11
    - Gathered from Business Week estimates of changes in spending over next 3 to 5 years

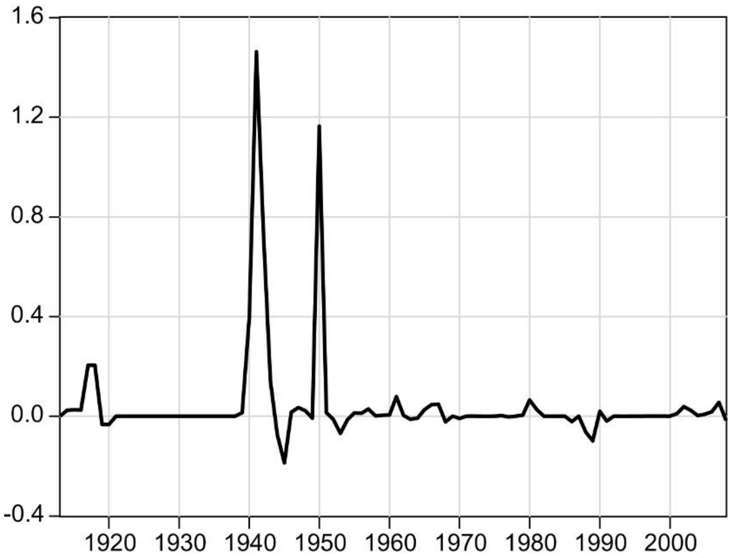


FIGURE II
Defense News Variable, 1913–2008

Source: Barro and Redlick (2011)

TABLE II
Equations for GDP Growth, Various Samples

	(1)	(2)	(3)	(4)	(5)	(6)
Starting date	1950	1939	1930	1930 (w/o 1949)	1917	1954
Δg: *defense*	0.68*	0.44**	0.46**	0.48**	0.47**	0.98
	(0.27)	(0.06)	(0.08)	(0.08)	(0.08)	(0.65)
Δg: *defense* (–1)	0.01	0.20**	0.21*	0.25**	0.16	–0.54
	(0.28)	(0.06)	(0.09)	(0.08)	(0.08)	(0.56)
Δg^*: *defense news*	0.026	0.039**	0.034*	0.034*	0.034*	–0.120
	(0.016)	(0.011)	(0.015)	(0.014)	(0.017)	(0.112)
$U(-1)$	0.50**	0.58**	0.61**	0.58**	0.47**	0.51**
	(0.17)	(0.14)	(0.10)	(0.10)	(0.10)	(0.18)
$\Delta\tau(-1)$	–0.54**	–0.16	–0.26	–0.52*	–0.19	–0.48*
	(0.21)	(0.16)	(0.22)	(0.23)	(0.25)	(0.22)
Yield spread squared	–43.9*	–37.8	–101.5**	–103.4**	–73.6**	–43.1*
	(20.7)	(22.0)	(12.8)	(12.4)	(12.2)	(21.8)
p-value, defense variables	0.030	0.000	0.000	0.000	0.000	0.47
R^2	0.48	0.82	0.75	0.77	0.66	0.45
σ	0.017	0.019	0.027	0.026	0.030	0.018

Source: Barro and Redlick (2011)

BARRO-REDLICK 11

If variation in government spending is truly random, what is the role of the controls in the regressions?

Barro-Redlick 11

If variation in government spending is truly random, what is the role of the controls in the regressions?

- They soak up noise in the regression and make the estimates more precise
- But if they end up affecting the point estimates substantially, this suggests that spending may not be truly random

TABLE III
Nondefense Government Purchases and Transfers

	(1)	(2)	(3)	(4)	(5)	(6)
Starting date	1950	1930	1950	1930	1950	1950
Δg: *defense*	0.89**	0.46**	0.34	0.51**	0.84**	0.46
	(0.27)	(0.08)	(0.32)	(0.10)	(0.24)	(0.26)
Δg: *defense* (–1)	–0.13	0.21*	0.08	0.18*	–0.36	0.02
	(0.27)	(0.09)	(0.28)	(0.09)	(0.25)	(0.26)
Δg^*: *defense news*	0.040**	0.036*	0.028	0.033*	0.014	0.016
	(0.016)	(0.016)	(0.016)	(0.015)	(0.013)	(0.014)
$U(-1)$	0.64**	0.60**	0.43*	0.62**	0.26*	0.55**
	(0.17)	(0.11)	(0.18)	(0.10)	(0.16)	(0.16)
$\Delta\tau(-1)$	–0.45*	–0.25	–0.56**	–0.25	–0.26	–0.38
	(0.20)	(0.23)	(0.21)	(0.22)	(0.19)	(0.20)
Yield spread	–31.2	–100.9**	–28.4	–102.3**	–38.9*	–21.6
squared	(20.0)	(13.3)	(25.4)	(13.0)	(18.1)	(20.5)
Δg: *nondefense*	2.65**	0.12	—	—	—	—
	(0.93)	(0.63)				
Δ(transfers)	—	—	–1.53	0.64	—	—
			(0.92)	(0.68)		
Δ(GM sales)	—	—	—	—	3.66**	—
					(0.86)	
Δ(GE sales)	—	—	—	—	—	17.6**
						(4.7)
R^2	0.54	0.75	0.51	0.75	0.63	0.57
σ	0.017	0.027	0.017	0.027	0.015	0.016

Source: Barro and Redlick (2011)

Blanchard and Perotti (2002)

- Structural VAR based evidence for fiscal stimulus:

$$X_t = A(L)X_{t-1} + U_t$$

- $X_t = [T_t, G_t, Y_t]$
- Four lags (and quarter dependence of coefficients)
- Various different detrending methods plus some dummy variables
- Sample period: 1960:1-1997:4 (No Korean War)

Blanchard and Perotti (2002)

They argue:

- VAR methods better suited for study of fiscal policy than monetary policy
- Variation in government spending occurs for many reasons other than output stabilization
- Implementation lags implies no response of spending to output within, say, a quarter

Simplified Fiscal VAR

- Consider the relationship between ΔG and ΔY
- Blanchard and Perotti's "identifying assumption" for ΔG:
    - Output does not affect government spending contemporaneously

Simplified Fiscal VAR

- Consider the relationship between ΔG and ΔY
- Blanchard and Perotti's "identifying assumption" for ΔG:
  - Output does not affect government spending contemporaneously
- Given this identifying assumption, would it work to simply estimate:

$$\Delta Y_t = \alpha + \beta \Delta G_t + \epsilon_t$$

Simplified Fiscal VAR

- Two things can go wrong in causal inference:
  1. Reverse causality: Causality can go “opposite” way (simultaneity bias)
  2. Omitted variable bias: A third factor can cause movements in both variables

Simplified Fiscal VAR

- Two things can go wrong in causal inference:
  1. Reverse causality: Causality can go “opposite” way (simultaneity bias)
  2. Omitted variable bias: A third factor can cause movements in both variables
- Blanchard and Perotti’s “identifying assumption” deals with reverse causality, but not the omitted variables bias

Blanchard and Perotti (2002)

What is Blanchard and Perotti's strategy for dealing with omitted variables bias?

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General feature of "structural" VARs: identification by controlling for lags

Examples of Omitted Variable

News shocks about future output that are not captured by lags:

- Terrorist attacks
- Wars
- Financial crises
- Oil price shocks
- Regime shifts in monetary policy

Each one may only matter for a few data points. But they can add up.

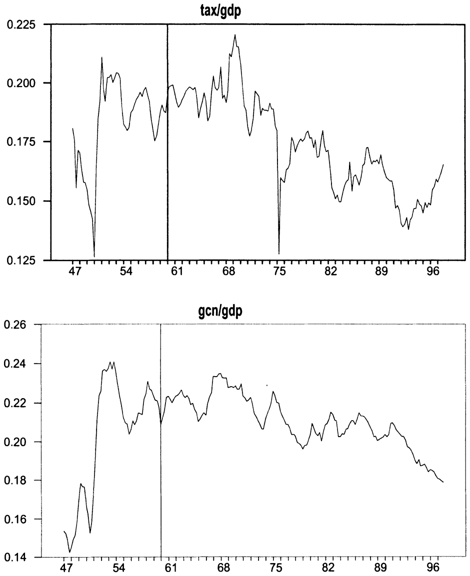

FIGURE I
Net Taxes and Spending, Shares of GDP

Source: Blanchard and Perotti (2002)

Blanchard and Perotti

- They exclude 1950's because "difficult to think of the early 1950's as being generated by the same stochastic process as the post-1960 period."
- But is this an important disadvantage?

Blanchard and Perotti

- They exclude 1950's because "difficult to think of the early 1950's as being generated by the same stochastic process as the post-1960 period."
- But is this an important disadvantage?
  - Not obvious
  - Different perspective: Large variation very valuable for identification
- Also dummy out tax cut in 1975:II

TABLE IV
RESPONSES TO SPENDING SHOCKS

	1 qrt	4 qrts	8 qrts	12 qrts	20 qrts	peak
			DT			
GDP	0.84*	0.45	0.54	1.13*	0.97*	1.29* (15)
GCN	1.00*	1.14*	0.95*	0.70*	0.42*	
TAX	0.13	0.14	0.17	0.43*	0.52*	
			ST			
GDP	0.90*	0.55	0.65	0.66	0.66	0.90* (1)
GCN	1.00*	1.30*	1.56*	1.61*	1.62*	
TAX	0.10	0.18	0.33	0.36	0.37	

Source: Blanchard and Perotti (2002)

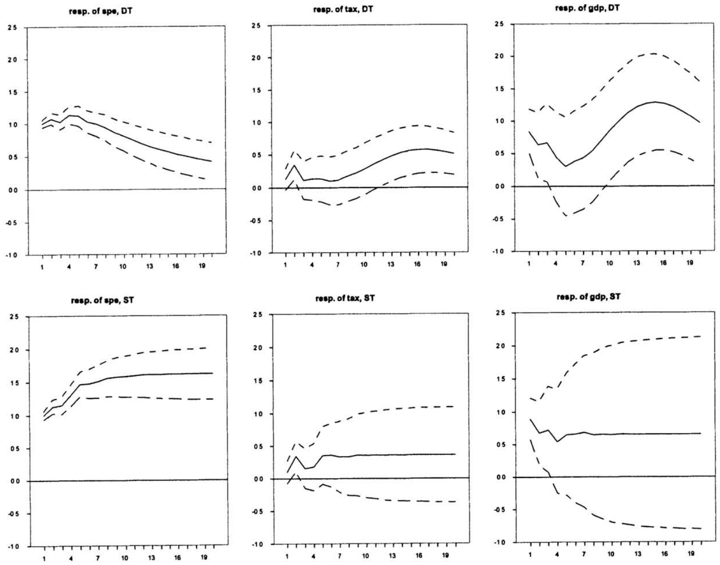

FIGURE V
Response to a Spending Shock

Source: Blanchard and Perotti (2002). Broken lines: One standard deviation bands.

Blanchard-Perotti 02

- Notice the use of one standard deviation bands
- Evidently not much information in 1960-1997 sample

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- Also, max response of output is after 15 quarters,
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Blanchard-Perotti 02

- Notice the use of one standard deviation bands
- Evidently not much information in 1960-1997 sample
- Also, max response of output is after 15 quarters, and after a “wavy response”
- Estimates further out rely heavily on iteration of VAR system
- Alternative way to report results:
  - Cumulative response of output divided by cumulative response of spending (over some horizon)
  - Ramey-Zubairy 18 report such results using Blanchard-Perotti 02 identification for sample period including Korean war and find estimate below one

Gali-Lopez-Salido-Valles 07

- VAR with government spending “ordered first”
  (i.e., is not contemporaneously affected by other variables in VAR)
  - Large: Government spending, GDP, hours, consumption of non-durables and services, private nonresidential investment, real wage, budget deficit, personal disposable income.
  - Small: Government spending, GDP, consumption, deficit
- Quarterly data, four lags
- Baseline sample: 1954:I-2003:IV (No Korean War)
- Alternative sample: 1948:I-2003:IV (Includes Korean War)

TABLE 1. Estimated effects of government spending shocks.

	Estimated Fiscal Multipliers						Implied Fiscal Parameters		
	Output			Consumption					
	1stQ	4thQ	8thQ	1stQ	4thQ	8thQ	ρ_g	ϕ_g	ϕ_b
1948:I–2003:IV									
Baseline spending									
Small VAR	0.51	0.31	0.28	0.04	0.09	0.19	0.85	0.10	0.10
Larger VAR	0.41	0.31	0.68	0.07	0.11	0.49	0.80	0.06	0.06
Excluding military									
Small VAR	0.15	-0.12	0.34	-0.11	0.24	0.32	0.95	0.005	0.60
Larger VAR	0.36	0.62	1.53	0.03	0.51	0.68	0.94	0.005	0.60
1954:I–2003:IV									
Baseline spending									
Small VAR	0.74	0.75	1.22	0.14	0.46	0.73	0.95	0.13	0.20
Larger VAR	0.68	0.70	1.74	0.17	0.29	0.95	0.95	0.10	0.30
Excluding military									
Small VAR	0.63	1.95	2.60	0.25	1.41	1.12	0.95	0.05	0.50
Larger VAR	0.74	2.37	3.50	0.37	1.39	1.76	0.95	0.01	0.50
1960:I–2003:IV									
Baseline spending									
Small VAR	0.91	1.05	1.32	0.19	0.59	0.84	0.95	0.13	0.20
Larger VAR	0.81	0.44	0.76	0.20	0.25	0.45	0.95	0.08	0.20
Excluding military									
Small VAR	0.72	1.14	1.19	0.17	0.78	0.68	0.94	0.03	0.50
Larger VAR	1.13	1.89	2.08	0.40	1.14	1.07	0.98	0.01	0.55

Note: Large VAR corresponds to the 8-variable VAR described in the text; Small VAR estimates are based on a 4-variable VAR including government spending, output, consumption, and the deficit. Government spending excluding military was obtained as GFNEH + GSEH + GFNIH + GSIH. For each specification ρ_g is the AR(1) coefficient that matches the half-life of the estimated government spending response. Parameter ϕ_g is obtained as the difference of the VAR-estimated impact effects of government spending and deficit, respectively. Finally, given ρ_g and ϕ_g, we calibrate the parameter ϕ_b such that the dynamics of government spending (21) and debt (37) are consistent with the horizon at which the deficit is back to steady state, matching our empirical VAR responses of the fiscal deficit.

Source: Gali, Lopez-Salido, Valles (2007)

Gali-Lopez-Salido-Valles 07

- Multipliers much smaller if Korean war included
  (perhaps due to large tax increases)
- Multiplier bigger for non-defense spending
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- Measure of multipliers: dY_{t+k}/dG_t
  - Tricky to interpret
  - Not only dG_t that is affecting dY_{t+k}, also $dG_{t+1}...dG_{t+k}$
  - Alternative: Ratio of cumulative impulse responses
  - Fahri and Werning 16 has a nice discussion of this

Ramey-Shapiro 98

- Use narrative approach to identify shocks to government spending
- Dates when Business Week suddenly began forecasting large increases in defense spending
- War dates: 1950:III (Korean War), 1965:I (Vietnam War), 1980:I (Carter-Reagan Buildup)
- Ramey 11 adds: 2001:III (9/11)

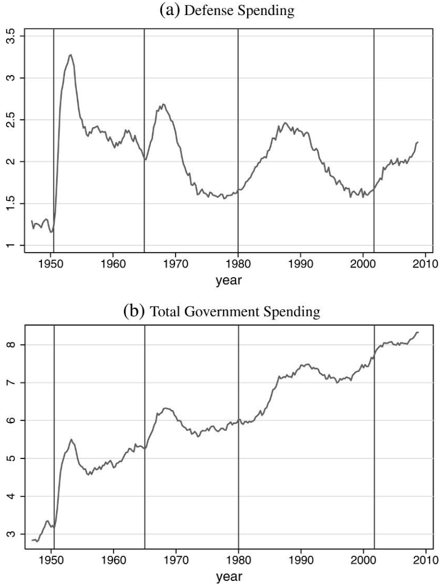

FIGURE I
Real Government Spending Per Capita (in thousands of chained dollars, 2005)

Source: Ramey (2011)

Ramey 11: "It's all about the timing"

War dates "Granger cause" VAR shocks

- Government spending "shocks" are anticipated!
- Doesn't mean they are necessarily endogenous
- Invalidates VAR method for constructing impulse response
  - Some of the effects occur when news arrives
  - Some of the effects occur when spending occurs
  - VAR misses effects that occur prior to spending
  - VAR misspecified, impulse response potentially way off

(My discussion here is somewhat different than Ramey's)

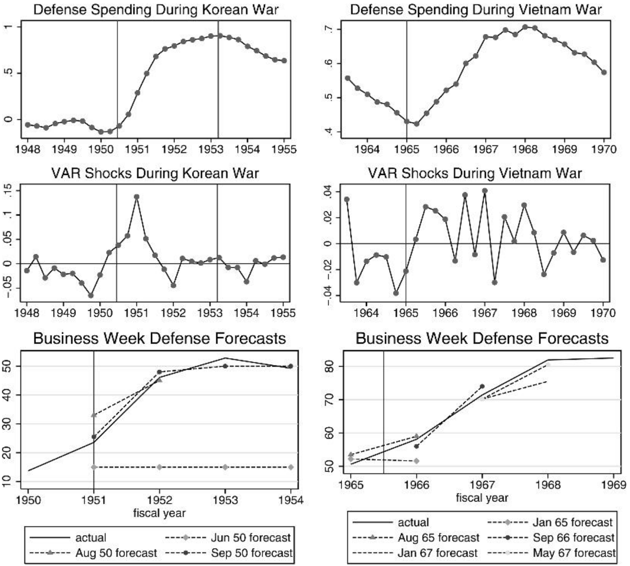

FIGURE V
Comparison of VAR Defense Shocks to Forecasts: Korea and Vietnam

Source: Ramey (2011)

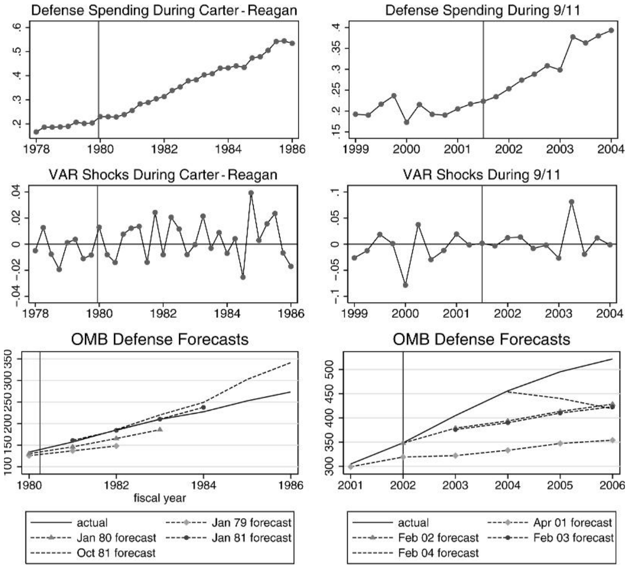

FIGURE VI

Comparison of VAR Defense Shocks to Forecasts: Carter–Reagan and 9/11

Source: Ramey (2011)

Anticipated Government Spending

How should anticipation of spending affect results?

- Suppose $G \uparrow$ is announced one period in advance
- What happens upon announcement?

Anticipated Government Spending

How should anticipation of spending affect results?

- Suppose $G\uparrow$ is announced one period in advance
- What happens upon announcement?
  - Negative wealth effect: $C\downarrow$, $H\uparrow$
  - Anticipatory investment: $I\uparrow$
- If you measure shock as occurring when spending occurs, you will miss these effects

RAMEY (2011)

- War dates variable embedded in a VAR — ordered first
- VAR with: War Dates, G, Y, H, C, I, Barro-Redlick tax rate, W
- Quadratic trend, four lags
- Sample period: 1947-2008

- War Dates essentially an instrument for spending

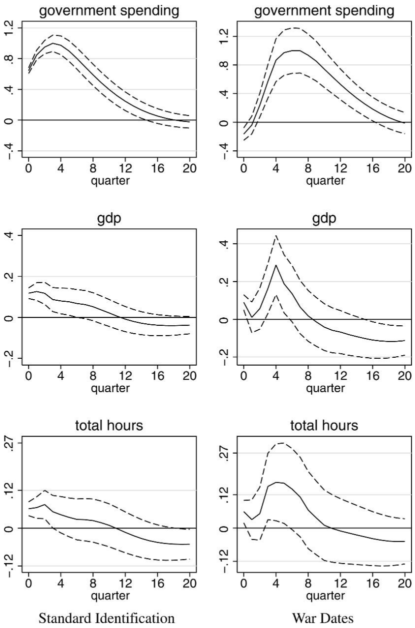

FIGURE IV
Comparison of Identification Methods: Response to a Government Spending Shock (Standard error bands are 68% confidence intervals)

Source: Ramey (2011)

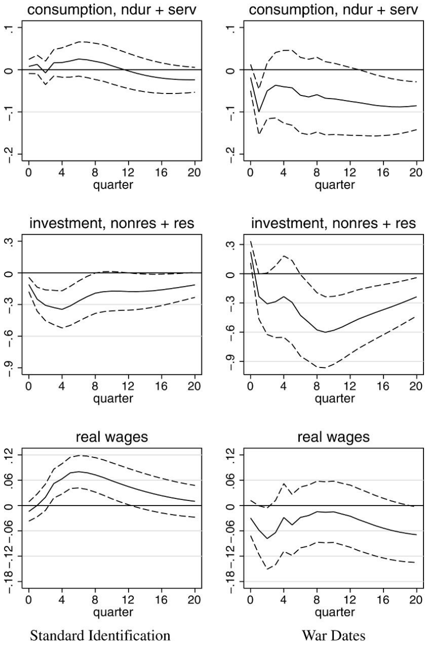

FIGURE IV
(CONTINUED)

Source: Ramey (2011)

Ramey (2011)

- Ramey argues that difference between results based on structural VAR identification and War Dates identification has to do with timing
- War dates recognize that news about spending occurs before spending occurs

Ramey (2011)

- Ramey argues that difference between results based on structural VAR identification and War Dates identification has to do with timing
- War dates recognize that news about spending occurs before spending occurs
- VARs miss initial drop in consumption
- Delaying War dates yields VAR type results
  - Delayed dates: 1951:1, 1965:3, 1980:4, 2003:2
  - Original dates: 1950:3, 1965:1, 1980:1, 2001:3

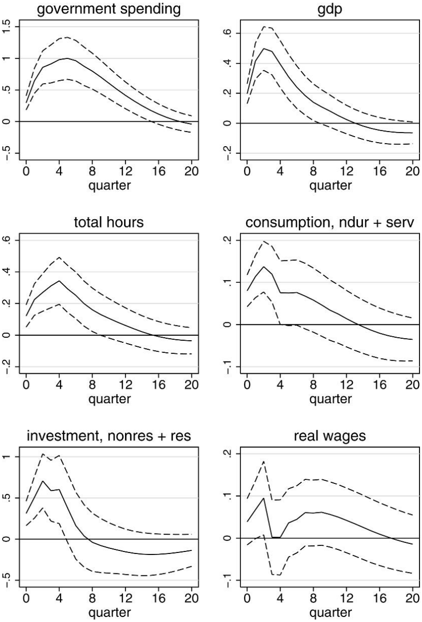

FIGURE VIII
The Effect of Mistiming the Ramey–Shapiro Dates (Standard error bands are 68% confidence intervals)

Source: Ramey (2011)

VARs versus War Dates

- Structural VAR studies: $G \uparrow => C \uparrow, W/P \uparrow$
- Ramey-Shapiro "war dates": $G \uparrow => C \downarrow, W/P \downarrow$

VARs versus War Dates

- Structural VAR studies: $G \uparrow \Rightarrow C \uparrow, W/P \uparrow$
- Ramey-Shapiro "war dates": $G \uparrow \Rightarrow C \downarrow, W/P \downarrow$

- Massive focus on whether $C \uparrow$ or $C \downarrow$ in literature

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- Structural VAR studies: $G \uparrow => C \uparrow, W/P \uparrow$
- Ramey-Shapiro "war dates": $G \uparrow => C \downarrow, W/P \downarrow$

- Massive focus on whether $C \uparrow$ or $C \downarrow$ in literature
- Suggestion that this distinguishes between Neoclassical models and New Keynesian models
- In fact Keynesian models can generate both depending on monetary policy

Regional Multipliers

Regional Multipliers

Since the Great Recession:

- Explosion of empirical work estimating regional multipliers
- Wide array of identification strategies:
  - Windfall returns on state pension plans (Shoag 15)
  - Military buildups (Nakamura-Steinsson 14)
  - Crackdown on Mafia infiltrated municipalities in Italy (Acconcia et al. 14)
  - Spending discontinuities at decadal census population revisions (Suarez Serrato-Wingender 16)
  - Evidence from ARRA (Chodorow-Reich et al. 12, Wilson 12, Dupor-Mehkari 16)
- Survey: Chodorow-Reich 17

Regional Multipliers: Pros and Cons

- A lot more data, a lot more variation
- Allows for difference-in-difference identification
- Allows for powerful class of instruments:
  - Differential regional exposure to aggregate shocks
- Regional multiplier not the same as aggregate multipliers
  - Not answering the “right” question?
  - What do we learn?

Nakamura and Steinsson (2014)

$$\left(\frac{Y_{it} - Y_{it-2}}{Y_{it-2}}\right) = \alpha_i + \gamma_t + \beta \left(\frac{G_{it} - G_{it-2}}{Y_{it-2}}\right) + \epsilon_{it}$$

- G_{it} is prime military contract spending
- State fixed effects (state specific trends)
- Year fixed effects (controls for aggregate shocks)
- Variables measured per capita
- Biannual regressions (in lieu of dynamics)
- Government spending potential endogenous and measured with error

Subcontracting

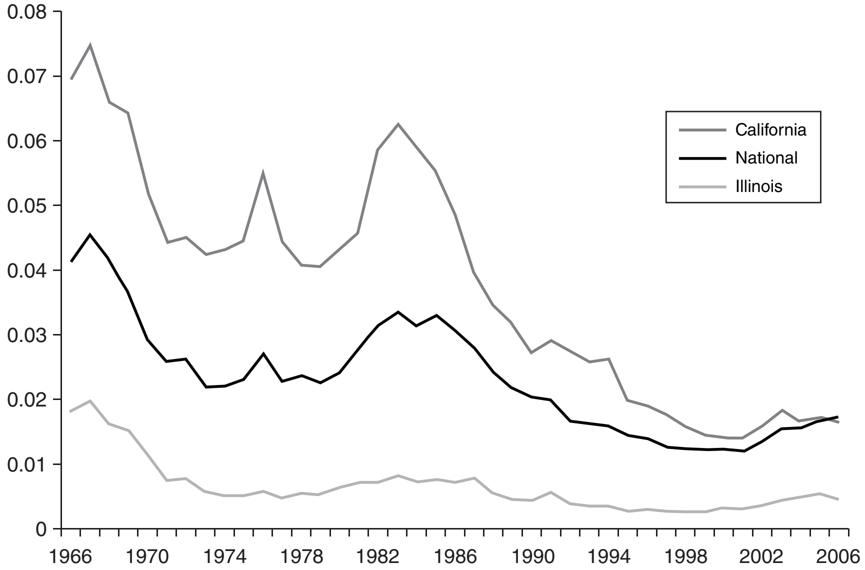

FIGURE 1. PRIME MILITARY CONTRACT SPENDING AS A FRACTION OF STATE GDP

Source: Nakamura and Steinsson (2014)

Identification

- National military buildups exogenous to **relative conditions** in states receiving disproportionate procurement spending
- Use **differential sensitivity** to national shocks across states to identify effects on state output

Intuition:

- When $\Delta G_{US} > 0$, $\Delta G_{CA} > \Delta G_{IL}$
- What is effect on ΔY_{CA} vs ΔY_{IL}?

Identifying assumption:

- No other shock $\alpha_i \mathcal{E}_t$ correlated with ΔG_{US} in the time series and differentially affects same set of states as our instrument (i.e., α_i correlated with differential cross-sectional sensitivity of our instrument)

Instruments

Baseline instrument:

- National spending interacted with state dummy
- In effect, we estimate sensitivity of state spending to national spending in "first stage"

INSTRUMENTS

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- National spending interacted with state dummy
- In effect, we estimate sensitivity of state spending to national spending in "first stage"

Bartik (1991) type instrument:

- National spending scaled by each state's average spending in the first five years of sample
- Idea: Spending varies more in states with a lot of spending

Table 2—The Effects of Military Spending

	Output		Output defl. state CPI		Employment		CPI	Population
	States	Regions	States	Regions	States	Regions	States	States
Prime military contracts	1.43	1.85	1.34	1.85	1.28	1.76	0.03	−0.12
	(0.36)	(0.58)	(0.36)	(0.71)	(0.29)	(0.62)	(0.18)	(0.17)
Prime contracts plus military compensation	1.62	1.62	1.36	1.44	1.39	1.51	0.19	0.07
	(0.40)	(0.84)	(0.39)	(0.96)	(0.32)	(0.91)	(0.16)	(0.21)
Observations	1,989	390	1,989	390	1,989	390	1,763	1,989

Notes: Each cell in the table reports results for a different regression with a shorthand for the main regressor of interest listed in the far left column. A shorthand for the dependent variable is stated at the top of each column. The dependent variable is a two-year change divided by the initial value in each case. Output and employment are per capita. The regressor is the two-year change divided by output. Military spending variables are per capita except in Population regression. Standard errors are in parentheses. All regressions include region and time fixed effects, and are estimated by two-stage least squares. The sample period is 1966–2006 for output, employment, and population, and 1969–2006 for the CPI. Output is state GDP, first deflated by the national CPI and then by our state CPI measures. Employment is from the BLS payroll survey. The CPI measure is described in the text. Standard errors are clustered by state or region.

Source: Nakamura and Steinsson (2014)

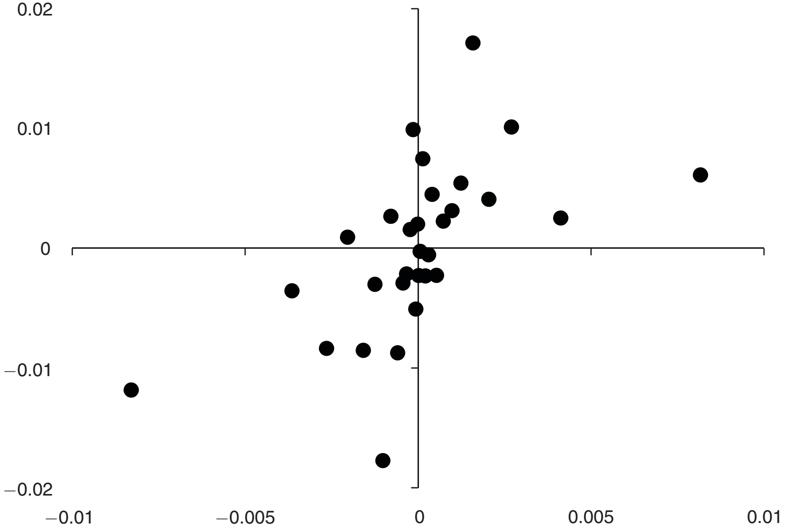

FIGURE 3. QUANTILES OF CHANGE IN OUTPUT VERSUS PREDICTED CHANGE IN MILITARY SPENDING

Source: Nakamura and Steinsson (2014). Binned Scatter plot.

TABLE 3—ALTERNATIVE SPECIFICATIONS FOR EFFECTS OF MILITARY SPENDING

	1. Output level instr.		2. Employment level instr.		3. Output per working age		4. Output OLS	
	States	Regions	States	Regions	States	Regions	States	Regions
Prime military contracts	2.48	2.75	1.81	2.51	1.46	1.94	0.16	0.56
	(0.94)	(0.69)	(0.41)	(0.31)	(0.58)	(1.21)	(0.14)	(0.32)
Prime contracts plus military compensation	4.79	2.60	2.07	1.97	1.79	1.74	0.19	0.64
	(2.65)	(1.18)	(0.67)	(0.98)	(0.60)	(1.00)	(0.19)	(0.31)
Observations	1,989	390	1,989	390	1,785	350	1,989	390

	5. Output with oil controls		6. Output with real int. controls		7. Output LIML		8. BEA employment	
	States	Regions	States	Regions	States	Regions	States	Regions
Prime military contracts	1.32	1.89	1.40	1.80	1.95	2.07	1.52	1.64
	(0.36)	(0.54)	(0.35)	(0.59)	(0.62)	(0.66)	(0.37)	(0.98)
Prime contracts plus military compensation	1.43	1.72	1.61	1.59	2.21	1.90	1.62	1.28
	(0.39)	(0.66)	(0.40)	(0.84)	(0.67)	(1.02)	(0.42)	(1.16)
Observations	1,989	390	1,989	390	1,989	390	1,836	360

Source: Nakamura and Steinsson (2014)

Cyclical Sensitivity

- Potential threat to identification:
  - Sensitivity of military spending correlated with overall cyclical sensitivity
- In fact cyclical sensitivity uncorrelated with military sensitivity
- Consider:

$$\Delta Y_{it} = \alpha_i + \gamma_t + \beta s_i \Delta Y_t + \epsilon_{it}$$

  where
  - s_i is average level of military spending in state i
- If states with high s_i are more cyclically sensitive, $\beta > 0$
- In fact $\beta < 0$

Weak / Many Instruments

- Baseline results have 50 instruments

  Potential weak / many instrument problem
- When instruments are weak / many, IV is biased towards OLS
  - Intuition: Overfitting – i.e., fitting endogenous noise in 1st stage
  - Good read: Stock-Wright-Yogo 02
- Rule of thumb: First stage F-stat of excluded instruments > 10
  - In our case, state reg with baseline instruments: First state F-stat = 5
  - Multiplier biased by about 10% towards OLS

    (we ran extensive Monte Carlo simulations)

IV versus OLS

- Large difference between IV (1.4-2.8) and OLS (0.1-0.6)
- Why?

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IV versus OLS

- Large difference between IV (1.4-2.8) and OLS (0.1-0.6)
- Why?
  - Endogeneity: States doing badly get more spending
  - Measurement error in spending variable
- Eliminate only measurement error by instrumenting for prime contract spending with shipments data
  - Sample period 1966-1982
  - Results: 1.3 (0.5), versus OLS of 0.2 (0.2) and Bartik of 2.0 (0.4)

Multiplier in Times of Slack

- Is the multiplier larger in times of slack?

$$\frac{Y_{it} - Y_{it-2}}{Y_{it-2}} = \alpha_i + \gamma_t + \beta_h \frac{G_{it} - G_{it-2}}{Y_{it-2}} + (\beta_l - \beta_h) I_{it} \frac{G_{it} - G_{it-2}}{Y_{it-2}} + \epsilon_{it}$$

- I_{it} is an indicator for periods of low slack
  - Based on unemployment at the start of interval
  - National slack: National unemployment rate is below its median
  - State slack: State unemployment rate is below its median
- β_h: Multiplier in high slack periods
- $\beta_l - \beta_h$: Difference in multiplier between low and high slack periods

Table 5—Effects of Military Spending in High versus Low Unemployment Periods

	Output		Employment	
	National slack	State slack	National slack	State slack
β_h	3.54	4.31	1.85	1.32
	(1.55)	(1.80)	(0.87)	(0.81)
$\beta_l - \beta_h$	−2.80	−3.37	−0.75	0.03
	(1.49)	(1.84)	(0.89)	(0.84)

Notes: A shorthand for the dependent variable is stated at the top of each column. The dependent variable is a two-year change divided by the initial value in each case. All variables are per capita. Standard errors are in parentheses. The unit of observation is US states for all regressions in the table. The two regressors are (i) the two-year change in military spending and (ii) the two-year change in military spending interacted with a dummy indicating low slackness. We employ two different measures of slackness: "National slack" refers to whether the national unemployment rate is below its median value over the sample period; "State slack" refers to whether the state unemployment rate is below its median value over the sample period. This yields the effect of spending during high unemployment periods (β_h) and the difference between the effect of spending during low and high unemployment periods ($\beta_l - \beta_h$). The national slack regressions include state and time fixed effects. The state slack regressions include state and time fixed effects interacted with the low slackness dummy. The regression are estimated by two-stage least squares. The sample period is 1966–2006. Output is state GDP. Employment is from the BLS payroll survey.

Source: Nakamura and Steinsson (2014)

What Do We Learn?

- Relative multiplier we estimate, not the same as aggregate multiplier
  - States don't have to pay for spending (financed federally)
  - Monetary policy can't react in cross-section
  - Spillovers to other states

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What Do We Learn?

- Relative multiplier we estimate, not the same as aggregate multiplier
  - States don't have to pay for spending (financed federally)
  - Monetary policy can't react in cross-section
  - Spillovers to other states
- One reaction:
  - Not so useful since this it not what we are really interested in (which is aggregate multiplier)
- Different reaction:
  - Perhaps relative multiplier is a powerful statistic in distinguishing between different models (e.g., RBC vs. New Keynesian)
  - Aggregate multiplier is actually not very strong on that front

What Do We Learn?

- We can use relative multiplier estimate as a moment to distinguish between competing structural models
- To this end, we write down a two-region macro model that nests competing models (RBC and New Keynesian)
- Calculate relative multiplier in different versions of the model

The Model

- Two regions
  - Home and foreign goods imperfect substitutes
    - Use commodity flow data to estimate “openness” (US regions $\approx$ Spain)
  - Labor immobile (regressions in per capita terms)
  - Common monetary policy
  - Common tax policy
- Households consume and supply labor
- Firms hire labor and set prices
  - Neoclassical model: Prices adjust frictionlessly, economy responds efficiently to shocks
  - New Keynesian model: Sluggish price response, output may be inefficiently low

Aggregate Policy

Consider several different cases:

- Aggregate Monetary Policy:

$$\hat{i}_t = \rho_i \hat{i}_{t-1} + (1 - \rho_i)(\phi_\pi \hat{\pi}_t^{ag} + \phi_y \hat{y}_t^{ag} + \phi_g \hat{g}_t^{ag})$$

  - Volcker-Greenspan: $\rho = 0.8$, $\phi_\pi = 1.5$, $\phi_y = 0.5$, $\phi_g = 0$
  - Constant real interest rate (r unresp. to G)
  - Constant nominal interest rate (i unresp. to G)

- Aggregate Tax Policy:
  - Constant labor income tax (lump-sum taxes vary)
  - Labor income tax balances budget

Table 6—Government Spending Multiplier in Separable Preferences Model

	Closed economy aggregate multiplier	Open economy relative multiplier
Panel A. Sticky prices		
Volcker-Greenspan monetary policy	0.20	0.83
Constant real rate	1.00	0.83
Constant nominal rate	∞	0.83
Constant nominal rate ($\rho_g = 0.85$)	1.70	0.90
Panel B. Flexible prices		
Constant income tax rates	0.39	0.43
Balanced budget	0.32	0.43

Notes: The table reports the government spending multiplier for output deflated by the regional CPI for the model presented in the text with the separable preferences specification. Panel A presents results for the model with sticky prices, while panel B presents results for the model with flexible prices. The first three rows differ only in the monetary policy being assumed. The fourth row varies the persistence of the government spending shock relative to the baseline parameter values. The fifth and sixth rows differ only in the tax policy being assumed.

Source: Nakamura and Steinsson (2014)

Unresponsive to Policy

- Key advantage of relative multiplier: Not sensitive to changes in monetary and tax policy
- Intuition: Aggregate policy is “differenced out”
- Yields multiplier for relatively “unresponsive” monetary/tax policy
- Same as multiplier for small open economy with fixed exchange rate

Open Economy Relative Multiplier and ZLB

- Relative nominal interest rate fixed
- May seem analogous to zero lower bound situation
  - Stimulus lowers short-term real interest rate

Open Economy Relative Multiplier and ZLB

- Relative nominal interest rate fixed
- May seem analogous to zero lower bound situation
  - Stimulus lowers short-term real interest rate
- Crucial difference:
  - **Long-term** real interest rate doesn't fall
  - Purchasing power parity must hold
  - Any rise in relative price level will be reversed
  - Demand determined by long-term real rate

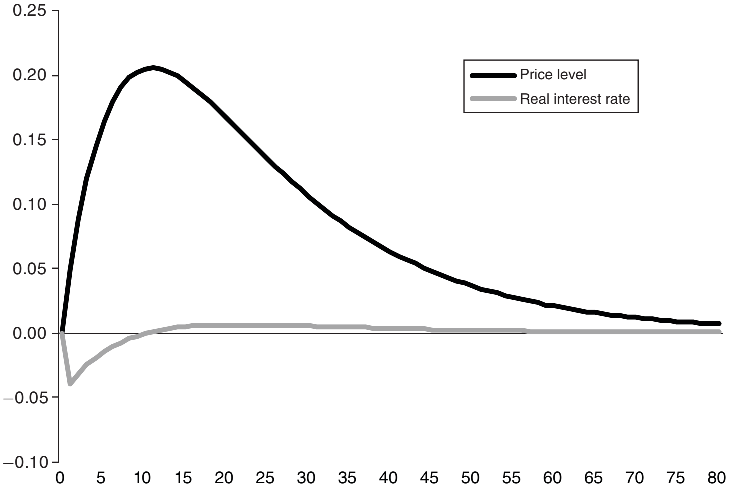

FIGURE 4. PRICES AND REAL INTEREST RATES AFTER A GOVERNMENT SPENDING SHOCK

Note: The figure plots the relative price level and the relative real interest rate in the two regions for the model with separable preferences after a positive government spending shock to the home region.

Source: Nakamura and Steinsson (2014)

GHH Preferences

Introduce "ultra-Keynesian" features

- Consumption and work are complements
  (Aguiar-Hurst, 2005; Schmitt-Grohe-Uribe, 2010)
- Such complementarities can raise fiscal multiplier
  (Monacelli-Perotti, 2008; Bilbii, 2009; Hall, 2009)
- Intuition:
  - Higher output raises marginal utility of consumption
  - This leads to even higher output

Table 7–Government Spending Multiplier in GHH Model

	Closed economy aggregate multiplier	Open economy relative multiplier
Panel A. Sticky prices		
Volcker-Greenspan monetary policy	0.12	1.42
Constant real rate	7.00	1.42
Constant nominal rate	∞	1.42
Constant nominal rate ($\rho_g = 0.50$)	8.73	2.04
Panel B. Flexible prices		
Constant income tax rates	0.00	0.30
Balanced budget	−0.18	0.30

Notes: The table reports the government spending multiplier for output deflated by the regional CPI for the model presented in the text with the GHH preferences specification. Panel A presents results for the model with sticky prices, while panel B presents results for the model with flexible prices. The first three rows differ only in the monetary policy being assumed. The fourth row varies the persistence of the government spending shock relative to the baseline parameter values. The fifth and sixth rows differ only in the tax policy being assumed.

Source: Nakamura and Steinsson (2014)

Federal vs. Local Financing

Varible Capital

Cross-Sectional Identification in Macro

- Increasingly important in macro:
  - Mian-Sufi 14, Nakamura-Steinsson 14, Autor-Dorn-Hansen 13, Baraja-Hurst-Ospina 16, Martin-Phillipon 17, ...
- Key challenge:
  - How to go from regional responses to aggregate responses
  - Cross-sectional responses don't directly answer key aggregate questions
  - GE effects absorbed by time fixed effects
  - Common to do "back-of-envelope" calculation
  - Typically invalid
- Fully specified general equilibrium model needs to translate regional responses to aggregate responses
- Regional responses helpful in distinguishing between models

Appendix

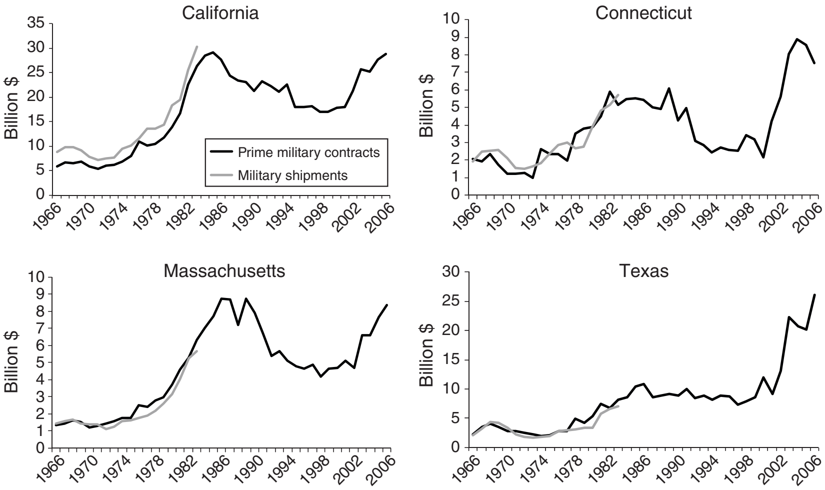

FIGURE 2. PRIME MILITARY CONTRACTS AND MILITARY SHIPMENTS

Source: Nakamura and Steinsson (2014). State of prime contractor is where majority of work is done.

Back

Federal vs. Local Financing

- Baseline model has complete markets
  (local vs. federal financing doesn't matter)
- As robustness, we consinder incomeplete markets model and compare multipliers with local and federal financing
- Differences are small for our calibration
  (see Fahri-Werning 16 for cases where differences are bigger)
- Multiplier slightly larger with federal financing when prices are sticky
  (demand effect from increased wealth)

TABLE 8—GOVERNMENT SPENDING MULTIPLIERS IN INCOMPLETE MARKETS MODEL

	Closed economy aggregate multiplier	Open economy relative multiplier
Panel A. Sticky prices		
Baseline model (complete markets)	0.20	0.83
Incomplete markets, locally financed	0.18	0.84
Incomplete markets, federally financed	0.18	0.90
Panel B. Flexible prices		
Baseline model (complete markets)	0.39	0.43
Incomplete markets, locally financed	0.39	0.41
Incomplete markets, federally financed	0.39	0.40

Notes: The table reports the government spending multiplier for output deflated by the regional CPI for a version of the model presented in the text with separable utility in which the only financial asset traded across regions is a noncontingent bond. Panel A presents results for the model with sticky prices, while panel B presents results for the model with flexible prices.

Source: Nakamura and Steinsson (2014)

Back

Variable Capital

- Baseline model has fixed amount of capital per firm
- Does allowing for variable capital change results?
- Two versions:
  - Firm-specific capital (Woodford, 2003, 2005, Altig et al., 2011)
  - Regional capital markets (Christiano et al., 2005)
- Firm-specific capital model yields similar results to baseline
- Regional capital markets reduce strategic complementarity in price setting (highly unrealistic model)

TABLE 9—OPEN ECONOMY RELATIVE MULTIPLIER IN MODELS WITH VARIABLE CAPITAL

	Output	CPI inflation
Baseline model (fixed capital)	1.42	0.17
Firm-specific capital model	1.47	0.15
Regional capital market model	0.98	0.09
Firm-specific capital model, flexible prices	0.25	0.36

Notes: The table reports the open economy relative government spending multiplier for output and CPI inflation for our baseline model with GHH preferences and the two models with variable capital, also with GHH preferences. Output is deflated by the regional CPI.

Source: Nakamura and Steinsson (2014)

Back