Lecture 7: Government Expenditure Multiplier

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Of Multipliers and Parameters

- Macroeconomists oftentimes interested in two types of objects
  - Invariant structural parameters. Usually they are primitives related to preferences, or technologies. They are invariant to shocks.
  - Elasticities: functions of parameters, prices, equilibrium outcomes
- Caveat: Complicate models: structural parameter $\rightarrow$ elasticities
- Caveat II: Simplify models: elasticities $\rightarrow$ structural parameter

Of Multipliers and Parameters

- In our models the multiplier is **NOT** an structural parameter
- Implications of that: In principle
  - Depends on policy regimes (lean against the wind)
  - Depends on how is financed (taxes vs. transfers from abroad)
  - Depends on the real interest rate (crowding out)
  - Depends on the underlying structure of the economy (is there capital? is the economy open?)
- There is not **ONE** multiplier
- Also, notice that households do not care about output on itself, they care about consumption and leisure. It is not obvious that more production is good for welfare.

Multipliers in the Neoclassical Model

- Suppose

$$\max_{C_t, H_t} \sum_{t=0}^{\infty} \beta^t \left[u(C_t) - v(H_t) + \Gamma(G_t) \right]$$

$$Y = f(H_t)$$

$$Y_t = C_t + G_t$$

- All prices flexible. All markets competitive
- No capital. No durables. No assets in net supply
- The government picks G (not the household!)
- Taxation in lump-sum taxes
- What is the effect of increases in G_t on Y_t

Multipliers in the Neoclassical Model

Intratemporal optimization yields

$$\frac{v'(H_t)}{u'(C_t)} = \frac{W_t}{P_t}$$

Profit maximization yields

$$f'(H_t) = \frac{W_t}{P_t}$$

Combined yield

$$\frac{v'(H_t)}{u'(C_t)} = f'(H_t)$$

Multipliers in the Neoclassical Model

Rearrange

$$\frac{v'(H_t)}{f'(H_t)} = u'(C_t)$$

- RHS: marginal utility of consumption
- LHS: Marginal disutility of producing output.

Use the production function and the resource constraint $Y = C + G$ And the production function $Y = f(H)$

$$u'(Y_t - G_t) = \tilde{v}'(Y_t)$$

Multipliers in the Neoclassical Model

$$u'(Y_t - G_t) = \tilde{v}'(Y_t)$$

Then the multiplier $\frac{dY}{dG}$ is given by

$$\frac{dY}{dG} = \frac{\eta_u}{\eta_u + \eta_{\tilde{v}}}$$

Where

- $\eta_u > 0$ is the negative of the elasticity of u' $(-\bar{Y}u''/u')$
- $\eta_{\tilde{v}} > 0$ is the elasticity of $\tilde{v}'$ $(\bar{Y}\tilde{v}''/\tilde{v}')$

That is, the multiplier is between zero and one.

Multipliers in the Neoclassical Model

$$\frac{dY}{dG} = \frac{\eta_u}{\eta_u + \eta_{\tilde{v}}}$$

- Multiplier between zero and one
- Government spending “crowds-out” private spending
- Government consumes some stuff
- Households are poorer. Negative wealth effects.
- Consume less normal goods (leisure and consumption), so work (and produce) more!
- Multiplier is small iff
  - there is more crowding out
  - Disutility of producing more output rises fast
  - Households have large elasticity of intertemporal substitution

Multipliers in the Neoclassical Model

- Suppose G is temporarily high today. What happens to the real rate?

$$u'(C_t) = \beta R_t u'(C_{t+1})$$

- There is crowding out, R_t must be high today. (notional interest rate).
- Notional interest rate. The interest rate that maintains assets in zero net supply and induces the observed path of consumption

Multipliers in the Neoclassical Model

- No mention of whether taxes occur today or the future
- It does not show up in any first order condition.
- Irrelevant. Ricardian equivalence
- Depends on lots of assumptions, including lump-sum taxes.
- What it says: Variation in the timing of lump-sum taxes is irrelevant
- What it does not say: Government spending does not matter for output. Obviously it does! $dY/dG > 0$.
  Please remember that. The whole department and the profession are counting on you, and I will be judged by my colleagues if you forget.

Multipliers in the Neoclassical Model

- Same environment. News in period t about G_{t+1}. No change in G_t
- What is the reaction of Y_t?

Multipliers in the Neoclassical Model

- Same environment. News in period t about G_{t+1}. No change in G_t
- What is the reaction of Y_t?
- Nothing. There is no link between periods.
- Household knows it will be poorer tomorrow. Nothing it can do about it
- Think of Robinson Crusoe. Output will increase tomorrow of course.

Multipliers in the Neoclassical Model

- Shock to G_t but in a world with capital accumulation
- Multiplier smaller or larger?

Multipliers in the Neoclassical Model

- Shock to G_t but in a world with capital accumulation
- Multiplier smaller or larger?
- Smaller. You have more margins to adjust. C, I, N
- In our models the solution is to adjust all of them by less

Multipliers in the Neoclassical Model

- Same environment with capital. No G_t but news about G_{t+1}.
- What happens to Y_t?

Multipliers in the Neoclassical Model

- Same environment with capital. No G_t but news about G_{t+1}.
- What happens to Y_t?
- In $t+1$ will work more. That raises MPK_{t+1}.
- Therefore invest in t so that K_{t+1} is higher
- Higher effect on Y_t

Does it matter what the government does with the G?

Two options

- Throws the goods in the ocean (or buys tanks and blows them up in some foreign country)
- Provides services that households would have bought in the marketplace (childcare, daycare, transportation, education)

When is the multiplier higher?

Does it matter what the government does with the G?

- Multiplier higher if the government engages in “wasteful” spending
- It’s all about wealth effects in this model
- Buys tanks $u(C_t) - v(H_t) + \Gamma(G_t)$. Higher G reduces C, increases u', raising H.
- Alternative extreme assumption. $u(C_t + G_t)$. Reallocations of C_t vs G_t do not change u'. So H_t does not change.

Multipliers in the NK Model

- Let's move to the NK model
- No capital. Sticky prices. Flexible wages
- Firms set prices. Commit to meet demand

$$f'(H_t) \neq \frac{W_t}{P_t}$$

- Then what determines labor demand?

Multipliers in the NK Model

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- No capital. Sticky prices. Flexible wages
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$$f'(H_t) \neq \frac{W_t}{P_t}$$

- Then what determines labor demand?
- Product demand!
- Pump up wages to hire more workers since households **are** on their labor supply schedule

Multipliers in the NK Model

Mechanics of the NK model multipliers

- Total demand must hold $Y_t = C_t + G_t$
- G_t is exogenous
- Dynamics of Y depend on the dynamics of C.
- What determines C?

$$u'(C_t) = \beta R_t u'(C_{t+1})$$

- Key variable: the real interest rate

Multipliers in the NK Model

$$u'(C_t) = \beta R_t u'(C_{t+1})$$

- What determines the real interest rate?

Multipliers in the NK Model

$$u'(C_t) = \beta R_t u'(C_{t+1})$$

- What determines the real interest rate?
- Monetary policy and price setting behavior (due to inflation expectations and the Fisher equation)
- The response of monetary policy is a crucial determinant of NK multiplier
- Imagine a policy in which the central bank implements $R_t = R$
- Then $C_t = C_{t+1}$. So $\frac{dY}{dG} = 1$ because $\frac{dC}{dG} = 0$

Multipliers in the NK Model

$$u'(C_t) = \beta R_t u'(C_{t+1})$$

Imagine now a Taylor rule

- Fiscal stimulus is inflationary (someone tells me why)
- interest rates go up
- Consumption today goes down
- Multiplier is less than one

Notice that the NK model has no trouble predicting $dC/dG < 0$ and $dY/dG < 1$.

Multipliers in the NK Model

- What happens if $i_t = 0$ (the Zero Lower Bound)
- G is just as Inflationary
- nominal interest rates do not react
- real rates **decrease**
- $\frac{dC}{dG} > 0$. so $\frac{dY}{dG} > 1$

Main messages

- Can have multipliers of the same magnitude in both models.
- Monetary policy reaction function is key in the NK model
- The mechanisms are crucially different though
  - In the neoclassical model, all about wealth effects
  - In the NK model, demand determination, price stickiness, and central bank reaction functions are crucial.

Evidence on the *G* multiplier

Several approaches

- VARs (Blanchard Perotti ’02, Gali et al. ’07, Perotti ’07)
- Wars as natural experiments (Hall ’09, Ramey ’11, Barro Redlick ’11)
- Regional Shocks (Nakamura Steinsson ’14, Chodorow-Reich ’19)

Blanchard Perotti ’02

- Pioneered VARs based estimation for fiscal stimulus:

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

- where $X_t = [T_t, G_t, Y_t]$
- Four lags
- Various detrending methods plus dummy variables for seasonality
- Data from 1960:1-1997:4 (No Korean War)

Blanchard Perotti ’02

- They argue:
  - VARs better suited to understand fiscal stimulus than monetary policy
  - Reason. Implementation lags imply no response of G to Y within a period (effectively, a quarter).
- Identifying assumption is framed as contemporaneous correlation between G_t and Y_t goes from G_t to Y_t, not from Y_t to G_t
- If that’s the only assumption, why don’t we just run

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

- Because that’s not the only assumption! Bigger concern is OVB
- Something that affects Y_t (so goes into ϵ_t) correlates with G_t
- VAR assumption is that $A(L)X_t$ control for all those things. Really?

Ramey 2011

Narrative approach

- Identify shocks to government spending
- Idea: Business Week forecasted large increases in defense spending
- Main episodes: Korean War (1950Q3), Vietnam War (1965Q1), Carter-Reagan buildup (1980Q1), 9/11 (2001Q3)

Great paper with a great title: “it’s all about the timing”

- News dates precede increases in G, so G shocks are anticipated!
- Recall our theoretical discussion. With capital, news about future G_{t+1} increase H_t, and decrease C_t. If you start measuring in $t+1$, you miss those effects.

Why Wars?

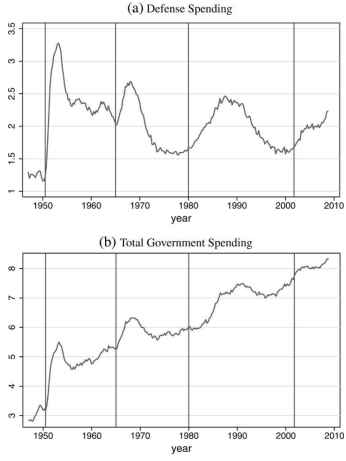

FIGURE I
Real Government Spending Per Capita (in thousands of chained dollars, 2005)

Why Wars?

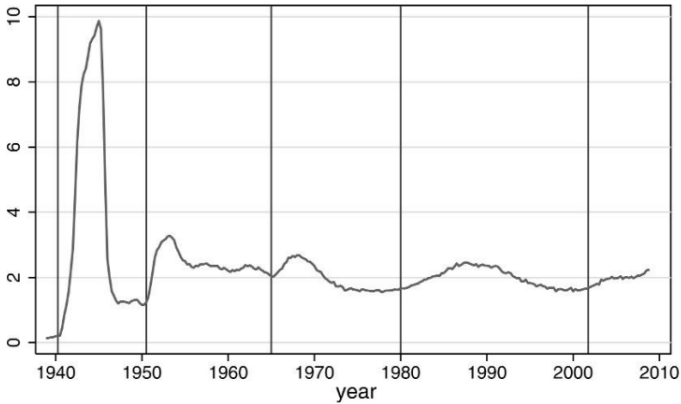

FIGURE II
Real Defense Spending Per Capita, Including WWII (in thousands of chained dollars, 2005)

VAR Shocks vs. War Dates

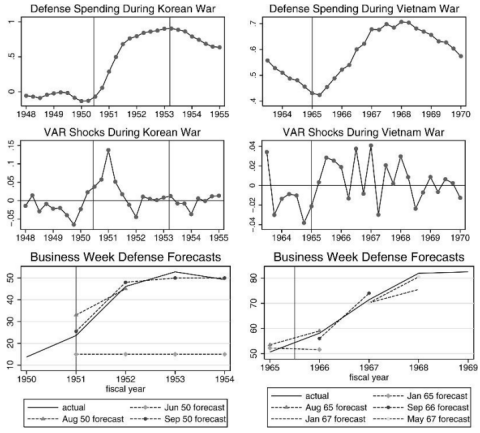

FIGURE V

Comparison of VAR Defense Shocks to Forecasts: Korea and Vietnam

Notes. The top and middle panels are based on log per capita real defense spending on a quarterly calendar year basis. The bottom panels are nominal, annual data on a fiscal year basis.

Research Design

- Use the War Dates as shocks
- Use a VAR to compute the Impulse Response Functions
- VAR with: War Dates, G, Y, H, C, I, τ, W/P
- Quadratic trends, four lags
- Sample period: 1947-2008

IRFs

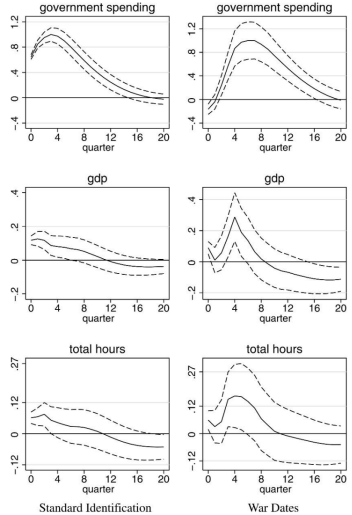

FIGURE IV
Comparison of Identification Methods: Response to a Government Spending Shock (Standard error bands are 68% confidence intervals)

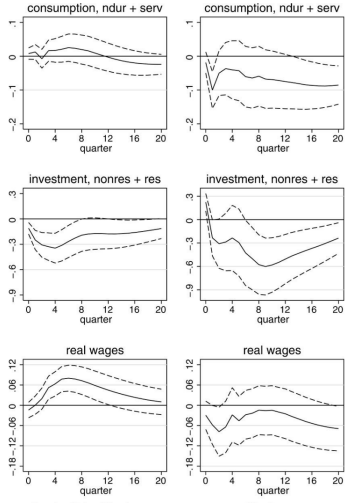

FIGURE IV
(CONTINUED)

Interpretation

- Ramey argues that the difference has to do with timing
- War dates recognize the release of information about future *G*. VAR does not.
- Placebo: delay the war dates manually, and show you recover the IRFs by the VAR

The Power of Theory

- VARs estimate an increase in consumption and real wages
- War dates estimate a decrease in consumption and real wages
- Literature spent too much time on this difference arguing it was informative on whether the world was Keynesian or not.
- But you know better thanks to Woodford (2011): Keynesian models can predict $\uparrow C_t$ or $\downarrow C_t$ as a function of monetary policy!
- The size of the multiplier, or its effects on consumption are not a testable implication of the NK model

The Pros of using wars

- Wars are used because they are more plausibly exogenous
- Example. The American Recovery and Reinvestment Act enacted in the Obama years is clearly endogenous to the state (and future expected state) of the national US economy during the Great Financial Crisis.
- Easier to argue that the US does not go to war because the economy is doing/expect to do poorly. WWII a great example.
- Some episodes are also very large. Example: WWII also a great example for this. Even if other confounders, they should have small effects relative to G.

External Validity

- Now, even if we were to accept wars are exogenous, wars are special
  - They trigger patriotism. So perhaps workers supply labor at constant wages, or firms more products at constant prices
  - in a way that would not happen in normal times
  - They come together with other policies that mediate the effects that would not take place. Examples: Wage and Price controls.
  - State planning more relevant. Inefficiencies?
- Not obvious if the multiplier is too large or too small compared to normal periods
- Barro thinks wars overestimate the multiplier. Hall thinks the contrary.

Regional Shocks

- A subsequent literature estimated the effects of changes in federal expenditures at the local level on local economic conditions
- Institutional background: When the federal US government increases military spending, it does so disproportionally in some states (a lot in CA, almost nothing in IL)
- Variation advantage: In the time series, military spending moves very little after the Korean War.
- 50 times more data at the state-level
- Variation at the local level is larger.
- Research design: Confounders that affect the national economy will be soaked by time fixed effects

Nakamura Steinsson 2014

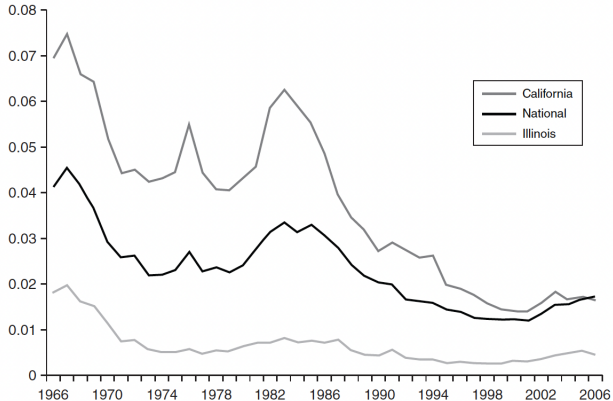

FIGURE 1. PRIME MILITARY CONTRACT SPENDING AS A FRACTION OF STATE GDP

Specification

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

- State fixed effects. State-specific trends
- Time fixed effects. Controls for aggregate shocks.
- Every variable measured in per-capita terms
- Biannual regressions
- G_{it} potentially endogenous

Instruments

- Baseline Instrument. Sensitivity instrument
  - National spending interacted with state dummy
  - How much G_{it} increases when G_t increases
- Alternative instrument. Shift-Share/Bartik
  - National spending (shifts) interacted with state average-spending in the first five years of the sample (shares)
- Note that this weakens the identifying assumption in the literature. The US does not go to war because California is doing poorly relative to Illinois. It would be ok (for identification) if the US went to wars because the US economy is doing poorly.

Results

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.

Regional vs. Aggregate Multipliers

- Now, the object Nakamura and Steinsson are estimating is **not** the aggregate multiplier
- Aggregate multiplier: What happens to US *GDP* when US *G* increases
- NS2014: What happens to CA's GDP vs. IL's when *G* increases in CA vs. IL.
- Some advantages and disadvantages
- Pros:
  - Time fixed effects control for the reaction of the fed. Keeps nominal rates constant.
  - Argue that Keynesian models (not neoclassical models) rationalize large cross-sectional multipliers
  - Causal inference: fixed effects and IVs purge bad variation
- Cons:
  - We are not directly learning about the object of interest
  - Many spillovers between treated and control states
  - Violations of SUTVA
  - Need to add a model to the causal inference exercise to infer the value of the aggregate multiplier

Will not go into details. Johannes and I teach a whole 2nd year class about these topics.