MOTIVATION

Key policy questions

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    - Post-WWII data: standard
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- Nonlinear models: sensitive estimates + how to model feedback/dynamics?
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A GREAT PAPER!
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A GREAT PAPER!

Why are the RZ results different from the results in Auerbach-Gorodnichenko and others?

- Measurement
- Specification
- Estimation
- Identification
**RZ APPROACH**

\[ Y_t = \alpha_0 \text{shock}_t + \text{error}_t \]
\[ Y_{t+1} = \alpha_1 \text{shock}_t + \text{error}_{t+1} \]
\[ Y_{t+2} = \alpha_2 \text{shock}_t + \text{error}_{t+2} \]

\[ \ldots \]
\[ Y_{t+h} = \alpha_h \text{shock}_t + \text{error}_{t+h} \]

\[ IRF^Y = \{ \alpha_h \}_{h=0}^H \]
RZ APPROACH

\[ Y_{t+h} = \alpha_h \text{shock}_t + \text{error}_t \Rightarrow IRF^Y = \{\alpha_h\}_{h=0}^H \]
\[ G_{t+h} = \beta_h \text{shock}_t + \text{error}_t \Rightarrow IRF^G = \{\beta_h\}_{h=0}^H \]
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Instrumental variable interpretation: Regress $Y_{t+h}$ on $G_{t+h}$ and use $\text{shock}_t$ as an IV.
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The logic extends to state-dependent multipliers

\[ Y_{t+h} = M_h^R G_{t+h} \times I(recession_t) + M_h^E G_{t+h} \times I(expansion_t) + error_t \]
\[ shock_t \times I(recession_t) \] and \( shock_t \times I(expansion_t) \) as IVs.
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**Single equation approach**

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FIRST STAGE FIT: FULL SAMPLE

Note: controls are included. F-stat in the figure is capped at 45.
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FIRST STAGE FIT: RECESSION

Horizon $h = 8$

- Fit all observations: $b = 0.77 (0.11)$
- Exclude WWII observations: $b = 0.45 (0.39)$

$\frac{(G_{t+h}-G_{t-1})}{Y_{t-1}}$ vs. shock
Question: which shocks should one use to design/assess the fiscal stimulus in 2009?
RAMEY-ZUBAIRY VS. BLANCHARD-PEROTTI

Ramey-Zubairy:

- \( Y_{t+h} - Y_{t-1} = M_h (G_{t+h} - G_{t-1}) + controls + error_t \)
- use military spending shocks as the instrument
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**Blanchard-Perotti**
- \( Y_{t+h} - Y_{t-1} = M_h(G_{t+h} - G_{t-1}) + controls + \text{error}_t \)
- Use \((G_t - G_{t-1}) \perp controls\) as the instrument
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Strength of 1\textsuperscript{st} stage: RZ vs. BP

- BP (AG) instrument is nearly impossible to beat over short horizons.
- RZ can perform better over longer horizons b/c it measures present values.
CHALLENGES IN CONSTRUCTING AND ANALYZING LONG-TIME SERIES

- Data quality is likely to vary
  - Linear interpolation
    ⇒ Attenuate differences between recession/expansion
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- Structural changes
  - Changes in the volatility of government spending
% CHANGE IN REAL PER CAPITA GOVERNMENT SPENDING

![Graph showing the change in real per capita government spending over time. The x-axis represents years from 1890 to 2010, and the y-axis represents the standard deviation of the log of per capita government spending with a 5-year moving window. The graph displays fluctuations and trends in government spending over the century.]
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    ⇒ avoid using variables in levels, use differences or/and growth rates

RZ: \[ \frac{Y_{t+h} - Y_{t-1}}{Y_{t-1}} = M_h \frac{G_{t+h} - G_{t-1}}{Y_{t-1}} + \sum_k \psi_k \ln Y_{t-k} + \sum_q \gamma_q \ln G_{t-q} + \sum_s \phi_s t^s + \text{error} \]

Alt.: \[ \frac{Y_{t+h} - Y_{t-1}}{Y_{t-1}} = M_h \frac{G_{t+h} - G_{t-1}}{Y_{t-1}} + \sum_k \psi_k \Delta \ln Y_{t-k} + \sum_q \gamma_q \Delta \ln G_{t-q} + \sum_s \phi_s t^s + \text{error} \]
**NORMALIZATION**

Typical approach: \[ \Delta \log Y_t = b \times \Delta \log G_t + error \quad \Rightarrow \text{multiplier} \quad M = b \times \left( \frac{Y_t}{G_t} \right) \]
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Alternative approach: \[ \frac{Y_t - Y_{t-1}}{Y_{t-1}} = b \times \frac{G_t - G_{t-1}}{Y_{t-1}} + \text{error} \] \[ \Rightarrow \text{multiplier} \ M = b \]
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\[ \frac{G_t - G_{t-1}}{Y_{t-1}} \approx \Delta \log G_t \times \frac{G_{t-1}}{Y_{t-1}} \]
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Potential concerns

- \( \frac{Y_t - Y_{t-1}}{Y_{t-1}} \) and \( \frac{G_t - G_{t-1}}{Y_{t-1}} \) are correlated because \( Y_{t-1} \) shows up in the denominator
- \( \frac{G_t}{Y_t} \) varies systematically over the business cycle
Notes: post 1960 data; potential GDP is from the CBO.
MULTIPLIERS: RAMEY-ZUBAIRY

Spec: baseline, IV implementation
Spec: IV implementation, include more lags, normalize by potential GDP, controls include variables in growth rates rather than levels.

These estimates are similar to the Auerbach-Gorodnichenko results.
EQUALITY OF MULTIPLIERS OVER THE BUSINESS CYCLE

![Graph showing the p-value for Recession vs. Expansion over a 11-year horizon for Blanchard-Perotti and Ramey-Zubairy models.](image-url)
CONCLUDING REMARKS

We need more variation/data to identify G shocks and estimate their effects

- Cross-state variation (e.g., Nakamura and Steinsson 2014)
- Natural experiments (e.g., Joshua Hausman 2013)
- Asset prices and high frequency data (e.g., Johannes Wieland 2012)
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- Consumption, investment, durables/non-durables
- Prices, wages, interest rates
- Employment, capacity utilization
- Export, import, exchange rates
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“The problem with QE is it works in practice but it doesn’t work in theory.” – Bernanke