Online Appendix to

"Ten Years after the Financial Crisis:
What Have We Learned from the Renaissance in Fiscal Research?"
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This online appendix provides details, data and programs for the empirical results presented in Figure 1 and 2 using aggregate data and Table 4, which adjusts Chodorow-Reich's (forthcoming) results in several ways.

1. Figures 1 and 2: Aggregate Multiplier Estimation and Calculation from a Structural vector autoregression (SVAR) model.

A. **Data.** The data, which are in ramey_jep_dat.xlsx, are a subset of the data used by Ramey-Zubairy (JPE 2018). Note that those data were constructed in April 2016, so they do not incorporate the latest post 1947 revisions. FRED refers to the data available at https://fred.stlouisfed.org/ .

ngov	nominal government purchases, post-1947 is FRED series GCE
pgdp	GDP implicit price deflator, post-1947 is FRED series GDPDEF
rgdp	real GDP, post-1947 sample is FRED series GDPC1
ngdp	nominal GDP, created as rgdp*pgdp
pop	total population all ages, including armed forces overseas, post-1947 FRED series POP
news	PV of expected changes in government spending due to military events – See Ramey narrative at https://econweb.ucsd.edu/~vramey/research/Defense_News_Narrative.pdf
nfedcurrreceipts_nipa	nominal Federal current receipts, NIPA accrual basis, post-1947 FRED series FGRECPT
tbill	3-month treasury bill rate, secondary market, FRED series TB3MS
rgdp_pott6	Estimate of real potential GDP, based on 6th degree polynomial fit from 1889:1 - 2015:4, omiting Great Depression and WWII. See Ramey-Zubairy (JPE 2018) for more details.

B. SVAR estimation. The Stata program svar_jep.do estimates the regressions and computes the impulse response functions (IRFs). In both specifications, the Blanchard-Perotti identification method is used. This method identifies the shock to government spending as the forecast error of government spending, i.e., it is the residual in the regression of government spending on its own lags plus the lags of the other four variables in the SVAR.

Note that the Blanchard-Perotti *identification* method is distinct from the Blanchard-Perotti method for calculating multipliers; their method for calculating multipliers could be applied to estimates using any identification method and vice versa.

i. Variables in log specification

Variable	**Form**
Government spending	Ln(ngov/(pgdp*pop)
GDP	Ln(rgdp/pop)
Tax revenue	Ln(nfedcurrreceipts_nipa/(pgdp*pop))
Interest rate	tbill
Inflation	400*ln(pgdp/pgdp(-1))

ii. Variables in Gordon-Krenn specification

Variable	**Form**
Government spending	(ngov/pgdp)/(rgdp_pott6)
GDP	rgdp/(rgdp_pott6)
Tax revenue	(nfedcurrreceipts_nipa/pgdp)/rgdp_pott6
Interest rate	tbill
Inflation	400*ln(pgdp/pgdp(-1))

C. Calculation of Multipliers

The Stata program svar_jep.do creates a table of impulse response estimates. That table is copied from the Stata results window and pasted into the Excel spreadsheet "irfs_multipliers.xlsx" (using "text import wizard") where it is used to calculate the multipliers using the various methods. Click cells to see the formulas used. The formulas are as follows:

i. Log specification

Let $ly(j)$ denote the value of the impulse response of log(GDP) at horizon j and $lg(j)$) denote the impulse response of log(government spending).

The Blanchard-Perotti Quasi-multiplier (h) = $\left(\frac{\bar{Y}}{G}\right) \cdot \frac{ly(h)}{lg(0)}$, where $\left(\frac{\bar{Y}}{G}\right)$ is the sample average of GDP to government spending, equal to 4.78.

Present value (PV) cumulative multiplier (h) = $\left(\frac{\bar{Y}}{G}\right) \cdot \frac{\sum_{j=0}^{h} \beta^j ly(j)}{\sum_{j=0}^{h} \beta^j lg(j)}$ for log SVAR, where $\beta = \frac{1}{1+r}$, where r is the real interest rate, assumed to be 3.6% on an annual basis, or 0.9 on a quarterly basis.

The simple cumulative multiplier is the same as the formula above with $\beta = 1$.

ii. Gordon-Krenn specification

The present value (PV) cumulative multiplier (h) = $\frac{\sum_{j=0}^{h} \beta^j Y_{GK}(j)}{\sum_{j=0}^{h} \beta^j G(j)}$, where Y_{GK} and G_{GK} are the responses of the Gordon-Krenn transformed variables and the estimates are from the alternative SVAR that uses those variables. The simple cumulative multiplier is the same as the formula above with $\beta = 1$.

D. Suggestions to students for explorations using other specifications.

1. To use the alternative "military news" identification method of Ramey (QJE 2011) and Ramey-Zubairy (JPE 2018), remove the commented out portion of the last part of the Stata program svar_jep.do that starts with

   ```
   ******************************************************************;
   ** ESTIMATE THE STRUCTURAL VECTOR AUTOREGRESSIONS USING RAMEY-ZUBAIRY MILITARY NEWS;
   ******************************************************************;
   ```

   This part of the program uses an alternative identification method – the military news variables created in Ramey (QJE 2011) and updated in Ramey-Zubairy (JPE 2018).

2. A very easy alternative way to estimate cumulative government spending multipliers all in one step is the method developed in my 2016 *Handbook of Macroeconomics* chapter "Macroeconomic Shocks and their Propagation" and in Ramey-Zubairy (JPE 2018). This method uses instrumental variables in a local projection and is very easy to implement. See the discussion surround equation (18) in the *Handbook of Macroeconomics* chapter. The accompanying programs are available on my web site at:
   https://econweb.ucsd.edu/~vramey/research.html#data

2. **Table 4: Conversion of Chodorow-Reich's Estimates to Nationally Representative Estimates**

   The estimates presented in Table 4 are based on my modification of the programs posted by Gabriel Chodorow-Reich at the *American Economic Journal: Economic Policy* for his forthcoming article. See Chodorow-Reich's article and online supplemental material for more details on his methods. My modified program is ramey_cr_arra.do, which uses table1_dataset.dta.