Fiscal Volatility Shocks and Economic Activity

Jesús Fernández-Villaverde, Pablo Guerrón Quintana,
Keith Kuester, Juan Rubio Ramírez

University of Pennsylvania

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Motivation: policymakers’ travails

- From 2010 to 2013, many policymakers and observers saw the U.S. economy as buffeted by larger-than-usual uncertainty about fiscal policy.

- There was little consensus among policymakers about the fiscal mix and timing going forward.

Ben Bernanke [July 18, 2012]:

“The recovery in the United States continues to be held back by a number of other headwinds, including still-tight borrowing conditions for some businesses and households, and – as I will discuss in more detail shortly – the restraining effects of fiscal policy and fiscal uncertainty.”
Motivation: electoral history

- 8 patterns of party control at the Federal level (combination of President-Senate-House).

- The 6 elections between 2004 and 2014 have produced 5 out of these 8 patterns.

- Tie with 1878-1896 and 1910-1920 for the highest electoral instability in U.S. history.

- Ideological indexes suggest that the electoral instability of 1878-1896 and 1910-1920 had less severe consequences than electoral instability now.
Ideological position of members of Congress (DW-Nominate)
Objective

- *Quantify* the effects of fiscal volatility shocks on economic activity.

- We estimate tax and spending processes for the U.S. with time-variant volatility using a Particle filter and a McMc.

- We feed the estimated rules into an estimated equilibrium business cycle model of the U.S. economy.

- We simulate the equilibrium using a third-order perturbation (new formulae for analytic non-linear IRFs).
Main results I

1. We find a considerable amount of time-varying volatility in all four fiscal instruments.

2. After a fiscal volatility shock, output, consumption, hours, and investment drop on impact and stay low for several quarters. Main transmission mechanism: an endogenous increase in mark-ups. Upward pricing bias due to the shape of the profit function.

3. Fiscal volatility shocks are “stagflationary”: inflation goes up while output falls.

4. We estimate a CEE-style VAR and an ACEL-style VAR to document that, after a fiscal volatility shock, markups significantly increase.
Why the “stagflation”?  

- Steady-state profits: \( \left( \frac{P_j}{P} \right)^{1-\varepsilon} y - mc \left( \frac{P_j}{P} \right)^{-\varepsilon} y \)

![Diagram showing period profits over relative price \((P_j/P)\).]
5. A two-standard deviations fiscal volatility shock has an effect similar to a 30 b.p. innovation in the FFR as estimated by a SVAR.

6. At the ZLB, the effects are much bigger: 1.7 percent fall of output if we are at the ZLB for 8 quarters.

7. Most important channel: larger uncertainty about the future tax rate on capital income.

8. An accommodative monetary policy increases the effect of fiscal volatility shocks.
How do we quantify fiscal volatility shocks?

- Volatility is not directly observed.

- No data (surveys, asset prices...) or very limited (SPF for $g$, but short horizon (5qtrs)).

- Instead, we estimate a stochastic volatility process as in Fernández-Villaverde et al. (2011).
Empirical model

- Fiscal instruments follow:

\[ x_t = \rho_x x_{t-1} + \phi_{x,y} \tilde{y}_{t-1} + \phi_{x,b} \left( \frac{b_{t-1}}{y_{t-1}} \right) + \exp(\sigma_{x,t}) \varepsilon_{x,t} \]

\[ \sigma_{x,t} = (1 - \rho_{\sigma_x}) \sigma_x + \rho_{\sigma_x} \sigma_{x,t-1} + \left( 1 - \rho_{\sigma_x}^2 \right)^{1/2} \eta_x u_{x,t} \]

- \( x \in \{ g, \tau_c, \tau_l, \tau_k \} \).

- Fiscal shocks: \( \varepsilon_{x,t} \).

- Volatility shock: \( u_{x,t} \).

- No direct effect on taxes.
Data

- Construct aggregate (average) effective tax rates from NIPA (Mendoza et al., 1994; Leeper et al., 2010): consumption, labor and capital income taxes.

- General government (federal + state + local).

- Spending rule: ratio of government expenditures to GDP.

- Federal debt (held by the public) from St. Louis Fed.

- Data sample: 1970Q1 - 2010Q2.
Estimation of fiscal rules

- Instrument by instrument (easily extended).
- No correlation of shocks (easily extended).
- Particle filter+Bayesian methods.
- Flat priors.
- 20,000 draws from posterior (5,000 additional burn-in draws) using McMc.
- 10,000 particles to perform the evaluation of the likelihood.

Estimated Parameters
Smoothed volatility: tax on capital income
An age of uncertainty: 1973-1975, I

The Washington Post [September 16, 1973]:

"Is the Nixon administration inclined to favor a tax increase? The authoritative answer last week was: (1) Yes; (2) No; (3) Maybe; (4) It is under consideration."

- Watergate scandal.

- George Shultz resigns on May 8, 1974, substituted by William E. Simon.

- Richard Nixon resigns on August 9, 1974.

- Evidence from Arthur Burns’ diary.
An age of uncertainty: 1973-1975, II

The New York Times [January 15, 1975]:

“President Ford has not turned the economy around with his new energy and economic proposals, but at least he has turned himself around.”

- Gerald Ford becomes president: Nixon’s pardon erodes his credibility.

- Constant fights between Nelson Rockefeller, Donald Rumsfeld, and Dick Cheney.

- Tax increase announced on October 8, 1974.

- After ferocious infighting within the administration, a tax reduction announced on January 16, 1975.

- Continuous changes in Congress. Ford close to veto final tax cut.
An age of uncertainty: 1973-1975, III

The Presidency of Gerald Ford [John Robert Greene]:

“The new mood in Capitol Hill made any kind of a coalition virtually impossible even for such an experienced legislative hand as Gerald Ford. More so than any other time since 1945, American government was truly divided...."

- Class of 1974 Congressman.
- Breakdown of old committee system.
- Wilbur Mills’ car stopped on October 9, 1974.
- Al Ullman is less powerful.
- Humphrey-Javits act about indicative planning.
The Congressman and the Argentine Firecracker
Forecast dispersion: tax on capital income
Relation with other measures of uncertainty

- How much do we believe our empirical results?

- Bloom et al. (2014) measure uncertainty using news media coverage, tax provisions set to expire, and disagreement among forecasters.

- Surprisingly high correlation of their uncertainty measure with our smoothed volatilities.

- For instance, correlation of uncertainty with volatility of capital taxes: 0.56.
Key ingredients

- Representative household.

- Labor supply flexible, but wages with quadratic adjustment cost.

- Investment adjustment costs, but flexible utilization margin of capital.

- Prices with quadratic adjustment cost.

- Fiscal rules as discussed above + Taylor rule for monetary policy.
Households I

- Household maximizes:

\[
E_0 \sum_{t=0}^{\infty} \beta^t d_t \left\{ \frac{(c_t - b h c_{t-1})^{1-\omega}}{1 - \omega} - \psi \int_0^1 \frac{l_{j,t}^{1+\varphi}}{1 + \varphi} dj \right\}
\]

- Intertemporal shock \( d_t \):

\[
\log d_t = \rho_d \log d_{t-1} + \sigma_d \varepsilon_{dt}, \varepsilon_{dt} \sim \mathcal{N}(0, 1)
\]

- Savings:

1. Invest, \( i_t \).

2. Hold government bonds, \( B_t \), with nominal gross interest rate \( R_t \).
Households II

- Budget constraint:

\[(1 + \tau_{c,t})c_t + i_t + b_t + \Omega_t + \int_0^1 AC_{j,t}^w dj = \]

\[(1 - \tau_{l,t}) \int_0^1 w_{j,t}l_{j,t} dj + (1 - \tau_{k,t}) r_{k,t}u_t k_{t-1} + \tau_{k,t} \delta k_{t-1}^b + \]

\[+ b_{t-1} \frac{R_{t-1}}{\Pi_t} + F_t.\]

- Real wage adjustment costs for labor type \(j\):

\[AC_{j,t}^w = \frac{\phi_w}{2} \left( \frac{w_{j,t}}{w_{j,t-1}} - 1 \right)^2 y_t\]

- Quadratic cost \(\neq\) Calvo. Remember: non-linear solution!

- We also computed the model with Calvo pricing.
Households III

- Labor packer:

$$l_t = \left( \int_0^1 l_{j,t}^{\epsilon_w / (\epsilon_w - 1)} dj \right)^{\epsilon_w / (\epsilon_w - 1)}$$

- Demand for each type of labor:

$$l_{j,t} = \left( \frac{w_{j,t}}{w_t} \right)^{-\epsilon_w} l_t$$

- By a zero-profit condition:

$$w_t = \left( \int_0^1 w_{j,t}^{1 - \epsilon_w} dj \right)^{1 / (1 - \epsilon_w)}$$
Households IV

► Capital accumulation:

\[ k_t = (1 - \delta(u_t)) k_{t-1} + \left(1 - S \left[ \frac{i_t}{i_{t-1}} \right] \right) i_t \]

where:

\[ \delta(u_t) = \delta + \Phi_1(u_t - 1) + \frac{1}{2}\Phi_2(u_t - 1)^2 \]

► Quadratic adjustment cost:

\[ S \left[ \frac{i_t}{i_{t-1}} \right] = \frac{\kappa}{2} \left( \frac{i_t}{i_{t-1}} - 1 \right)^2 \]

which implies \( S(1) = S'(1) = 0 \) and \( S''(1) = \kappa \).

► Book value of capital:

\[ k_t^b = (1 - \delta)k_{t-1}^b + i_t \]
Firms I

- Competitive producer of a final good:
  \[ y_t = \left( \int_0^1 y_{it}^{\frac{\varepsilon-1}{\varepsilon}} \, di \right)^{\frac{\varepsilon}{\varepsilon-1}} \]

- Buys intermediate goods at price \( P_{i,t} \) and charges \( P_t \).

- Demand:
  \[ y_{it} = \left( \frac{P_{it}}{P_t} \right)^{-\varepsilon} y_t \]

- Price index:
  \[ P_t = \left( \int_0^1 P_{it}^{1-\varepsilon} \, di \right)^{\frac{1}{1-\varepsilon}} \]
Intermediate good producer with market power:

\[ y_{it} = A_t k_{it}^{\alpha} l_{it}^{1-\alpha} - \phi \]

\( A_t \) is neutral productivity:

\[ \log A_t = \rho_A \log A_{t-1} + \sigma_A \varepsilon_{At}, \varepsilon_{At} \sim \mathcal{N}(0, 1) \text{ and } \rho_A \in [0, 1) \]

Intermediate producer sets prices at cost:

\[ AC_{i,t}^p = \frac{\phi p}{2} \left( \frac{P_{i,t}}{P_{i,t-1}} - \Pi \right)^2 y_{i,t} \]
Government

- Monetary authority follows Taylor rule:

\[
\frac{R_t}{R} = \left( \frac{R_{t-1}}{R} \right)^{1-\phi_R} \left( \frac{\Pi_t}{\Pi} \right)^{(1-\phi_R)\gamma_{\Pi}} \left( \frac{y_t}{y} \right)^{(1-\phi_R)\gamma_y} e^{\sigma_m \xi_t}
\]

- Fiscal authority’s budget constraint:

\[
b_t = b_{t-1} \frac{R_{t-1}}{\Pi_t}
\]

\[
+ g_t - (c_t \tau_{c,t} + w_t l_t \tau_{l,t} + r_k,t u_t k_{t-1}^b \tau_{k,t} - \delta k_{t-1}^b \tau_{k,t} + \Omega_t)
\]

- Transfers:

\[
\Omega_t = \Omega + \phi_{\Omega,b} (b_{t-1} - b)
\]

where \( \phi_{\Omega,b} > 0 \).
Aggregation and solution

- Aggregate demand:

\[ y_t = c_t + i_t + g_t + \frac{\phi_p}{2} (\Pi_t - \Pi)^2 y_t + \frac{\phi_w}{2} \left( \frac{w_t}{w_{t-1}} - 1 \right)^2 y_t \]

- Aggregate supply:

\[ y_t = A_t (u_t k_{t-1})^\alpha l_t^{1-\alpha} - \phi \]

- Market clearing.

- Definition of equilibrium is standard.
Estimation

- General point: problems for calibration in non-linear models.


- We use a SMM to estimate most parameters.

- Parameters for fiscal instruments laws of motion: median of our posteriors.

- Third-order perturbation solution. Why?

- Non-linear IRFs. Why?
Experiment

\[ x_t = \rho x x_{t-1} + \phi_{x,y} \tilde{y}_{t-1} + \phi_{x,b} \left( \frac{b_{t-1}}{y_{t-1}} \right) + \exp(\sigma_{x,t}) \varepsilon_{x,t} \]

\[ \sigma_{x,t} = (1 - \rho_{\sigma_x}) \sigma_x + \rho_{\sigma_x} \sigma_{x,t-1} + \left(1 - \rho_{\sigma_x}^2\right)^{1/2} \eta_x u_{x,t} \]

- At time 0, the economy is hit by a fiscal volatility shock to capital income tax.
- Taxes are constant today.
- Two-standard deviation shocks to \( u_{k,t} \).
  Meant to capture current fiscal outlook.
Fiscal volatility shocks

output  cons.  invest.  hours

marg. cost  inflation (bps)  nom. rate (bps)  wages

FV-G-K-R  Fiscal Volatility  31/45
Fiscal volatility shocks (black solid) vs. 30bps monetary shock (red dots)

- Output, Consumption, Investment, Hours
- Marginal Cost, Inflation (bps), Nominal Rate (bps), Wages
VAR evidence: IRFs
The effect of the ZLB

output  cons.  invest.  hours

marginal cost  inflation (bps)  nominal rate (bps)  wages
Monetary policy

\[ \frac{R_t}{R} = \left( \frac{R_{t-1}}{R} \right)^{1-\phi_R} \left( \frac{\Pi_t}{\Pi} \right)^{(1-\phi_R)\gamma_{\Pi} \uparrow=1.5} \left( \frac{y_t}{y} \right)^{(1-\phi_R)\gamma_{y} \uparrow=0.5} e^{\sigma m\xi_t} \]
Degree of nominal rigidities

- blue: (Calvo) $\phi_p = 0.1$
- red: (Calvo) $\phi_w = 0.1$
- magenta: (Calvo) $\phi_p = 0.1$ and $\phi_w = 0.1$
The role of precautionary price setting
The future

- So far, I have dealt with two-sided risk.

- This may not capture what many observers have in mind: one-sided risk. For instance, taxes will increase, but we do not know why how much.

- A simple alternative: innovation to shock+volatility shock.

- A more appealing alternative: one-sided risk.

- Formally: shocks to skewness.

- One-Sided Risk and Economic Activity (2014).
One-side risk

- Stochastic process:

\[
x_t = \rho x_{t-1} + (1 - \rho) \nu_t \\
+ (1 - \rho^2)^{1/2} e^{\tau_t} \omega_t + (1 - \rho) e^{\alpha_t} \xi^1_t - (1 - \rho) e^{\beta_t} \xi^2_t
\]

where

\[
\nu_t = (1 - \rho_\nu) \overline{\nu} + \rho_\nu \nu_{t-1} + \eta_\nu (1 - \rho^2_\nu)^{1/2} \varepsilon_t^1 \\
\tau_t = (1 - \rho_\tau) \overline{\tau} + \rho_\tau \tau_{t-1} + \eta_\tau (1 - \rho^2_\tau)^{1/2} \varepsilon_t^2 \\
\alpha_t = (1 - \rho_\alpha) \overline{\alpha} + \rho_\alpha \alpha_{t-1} + \eta_\alpha (1 - \rho^2_\alpha)^{1/2} \varepsilon_t^3 \\
\beta_t = (1 - \rho_\beta) \overline{\beta} + \rho_\beta \beta_{t-1} + \eta_\beta (1 - \rho^2_\beta)^{1/2} \varepsilon_t^4 \\
\omega_t \sim \mathcal{N}(0, 1), \, \xi^i_t \sim \exp(1), \, \varepsilon^j_t \sim \mathcal{N}(0, 1)
\]
Conclusion

- High fiscal volatility is a concern for policymakers.

- But, how big are the effects of fiscal volatility shocks?

- Our simulations indicate that the effect can be important.

- Key role for monetary policy in propagation.

- Modeling of political-economic equilibrium that leads to these shocks remains an open issue.
## Estimated parameters

<table>
<thead>
<tr>
<th></th>
<th>Tax rate on</th>
<th></th>
<th>Government Spending</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Labor</td>
<td>Consumption</td>
<td>Capital</td>
</tr>
<tr>
<td>( \rho_x )</td>
<td>0.99</td>
<td>0.99</td>
<td>0.97</td>
</tr>
<tr>
<td></td>
<td>[0.975,0.999]</td>
<td>[0.981,0.999]</td>
<td>[0.93,0.996]</td>
</tr>
<tr>
<td>( \sigma_x )</td>
<td>-6.01</td>
<td>-7.09</td>
<td>-4.96</td>
</tr>
<tr>
<td></td>
<td>[-6.27,-5.75]</td>
<td>[-7.34,-6.78]</td>
<td>[-5.29,-4.66]</td>
</tr>
<tr>
<td>( \phi_{x,y} )</td>
<td>0.031</td>
<td>0.001</td>
<td>0.044</td>
</tr>
<tr>
<td></td>
<td>[0.011,0.055]</td>
<td>[0.000,0.005]</td>
<td>[0.004,0.109]</td>
</tr>
<tr>
<td>( \phi_{x,b} )</td>
<td>0.003</td>
<td>0.0006</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>[0.00,0.007]</td>
<td>[0.00,0.002]</td>
<td>[0.00,0.016]</td>
</tr>
<tr>
<td>( \rho_{\sigma_x} )</td>
<td>0.31</td>
<td>0.65</td>
<td>0.76</td>
</tr>
<tr>
<td></td>
<td>[0.06,0.57]</td>
<td>[0.08,0.91]</td>
<td>[0.47,0.92]</td>
</tr>
<tr>
<td>( \eta_x )</td>
<td>0.94</td>
<td>0.60</td>
<td>0.57</td>
</tr>
<tr>
<td></td>
<td>[0.73,1.18]</td>
<td>[0.31,0.93]</td>
<td>[0.33,0.88]</td>
</tr>
</tbody>
</table>

**Notes:** The posterior median and a 95% probability interval.

- Persistent mean-dynamics.
- Stochastic volatility is significant and moderately persistent.
### Preferences and consumer

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>0.9945</td>
<td>Estimated.</td>
</tr>
<tr>
<td>$\omega$</td>
<td>2</td>
<td>Standard choice.</td>
</tr>
<tr>
<td>$\vartheta$</td>
<td>2</td>
<td>Chetty (2011).</td>
</tr>
<tr>
<td>$\psi$</td>
<td>75.66</td>
<td>Estimated.</td>
</tr>
<tr>
<td>$b_h$</td>
<td>0.75</td>
<td>CEE (JPE, 2005).</td>
</tr>
<tr>
<td>$\phi_w$</td>
<td>4889</td>
<td>ACEL (RED, 2011).</td>
</tr>
<tr>
<td>$\epsilon$</td>
<td>21</td>
<td>ACEL (RED, 2011).</td>
</tr>
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</table>

### Cost of utilization and investment

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Phi_1$</td>
<td>0.0165</td>
<td>From utilization FOC.</td>
</tr>
<tr>
<td>$\Phi_2$</td>
<td>0.0001</td>
<td>Estimated.</td>
</tr>
<tr>
<td>$\kappa$</td>
<td>3</td>
<td>Estimated.</td>
</tr>
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### Estimation II

#### Firms

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Source</th>
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</thead>
<tbody>
<tr>
<td>$A$</td>
<td>1</td>
<td>Normalization</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>0.36</td>
<td>Standard choice.</td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.011</td>
<td>Estimated.</td>
</tr>
<tr>
<td>$\phi_p$</td>
<td>236.10</td>
<td>Gali and Gertler (JME, 1999).</td>
</tr>
<tr>
<td>$\epsilon_w$</td>
<td>21</td>
<td>ACEL (RED, 2011).</td>
</tr>
</tbody>
</table>

#### Monetary policy and lump-sum taxes

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Pi$</td>
<td>1.0045</td>
<td>Estimated.</td>
</tr>
<tr>
<td>$\phi_R$</td>
<td>0.6</td>
<td>Estimated.</td>
</tr>
<tr>
<td>$\gamma_\Pi$</td>
<td>1.25</td>
<td>FGR (2010).</td>
</tr>
<tr>
<td>$\gamma_y$</td>
<td>1/4</td>
<td>FGR (2010).</td>
</tr>
<tr>
<td>$\Omega$</td>
<td>-4.3e-2</td>
<td>Follows from gov. budget constraint.</td>
</tr>
<tr>
<td>$\phi_{\Omega,b}$</td>
<td>0.0005</td>
<td>Small number to stabilize debt.</td>
</tr>
<tr>
<td>$b$</td>
<td>2.64</td>
<td>Estimated.</td>
</tr>
</tbody>
</table>
Estimated III

<table>
<thead>
<tr>
<th>Shocks</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\rho_A$</td>
<td>0.95</td>
<td>King and Rebelo (1999).</td>
</tr>
<tr>
<td>$\sigma_A$</td>
<td>0.001</td>
<td>Estimated.</td>
</tr>
<tr>
<td>$\rho_d$</td>
<td>0.18</td>
<td>Smets and Wouters (AER, 2007).</td>
</tr>
<tr>
<td>$\sigma_d$</td>
<td>0.078</td>
<td>Estimated.</td>
</tr>
<tr>
<td>$\sigma_m$</td>
<td>0.0001</td>
<td>Estimated.</td>
</tr>
</tbody>
</table>

- Parameters for fiscal instruments laws of motion: median of our posteriors.
Decomposing fiscal volatility shocks

- output
- cons.
- invest.
- hours

- marg. cost
- inflation (bps)
- nominal rate (bps)
- wages

▶ black: benchmark.
▶ red: volatility shock only on capital income taxes.