Fiscal Policy Uncertainty and Its Macroeconomic Consequences

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Quantify Fiscal Policy Uncertainty

- Time-varying volatility of a DSGE fiscal shock:
  Fernández-Villiverde et. al. (2011), Born and Pfeifer (2011).
- Index based on newspaper headlines and other real world stuff:
  Baker et. al. (2013)

Present Paper

- Market participants behave like empirical economists - they estimate fiscal policy rules.
- Least-squares learning re: fiscal policy behavior
- Eg: Early sections of Fernández-Villiverde et. al. (2011), Born and Pfeifer (2011).
- Forecast uncertainty: Fiscal policy uncertainty should be related to the variance of forecasts.

Fiscal Policy Variables

1. Government Spending
2. Tax Revenue
3. Net Transfers
4. Government Debt

Least-squares learning for each.

Construct an uncertainty measure for each.

Impact on Macroeconomy

Incorporate measures of fiscal uncertainty in a VAR including:

1. Consumption
2. Investment
3. Real GDP
4. Unemployment

Historical Economic and Political Crises

- Financial crisis and historic economic downturn.
- Large monetary and fiscal policy responses, fiscal policy multiplier debate is still active.
- U.S. Government Debt to GDP reaching historical levels.
- Simultaneous calls from left and right calling for opposing fiscal responses.

Ben Bernanke - July 2012 Monetary Policy Report to Congress

"The most effective way that the Congress could help to support the economy right now would be to work to address the nation's fiscal challenges.... **Doing so earlier rather than later would help reduce uncertainty and boost household and business confidence.**"

Time-varying Fiscal Volatility

- Fernández-Villiverde et. al. (2011a): Fiscal policy uncertainty is stagflationary
- Born and Pfeifer (2011):
  - Significant evidence for time-varying volatility in fiscal shocks.
  - Not a significant driver for business cycles.
- Johannsen (2012): Matters more at ZLB.

Macroeconomic Impact of Volatility

- Bloom (2009, *Econometrica*)
- Bloom et. al. (2012)
- Fernández-Villiverde et. al. (2011b, *AER*)

Fiscal Uncertainty

Baker (2013): Reduces economic activity

Fiscal Uncertainty Reduces Economic Activity

- Investment is adversely affected by,
  - Government spending uncertainty
  - Tax uncertainty
- Consumption and real GDP adversely affected by,
  - Tax uncertainty
  - Government debt uncertainty
  - These findings are less robust than above to VAR specification.

But it may boost the labor market!

Unemployment decreases with transfers uncertainty.

Constant gain learning mechanism

- Every period, run a least-squares regression for each fiscal policy variable, using data from previous periods.
- Weighted least squares - more recent observations have more weight.
- Regression forecast serves as expectation.
- Root (weighted) mean squared error serves as *fiscal policy uncertainty*.

Ideal situations for constant gain learning

- Precedence of structural changes
- No a-priori knowledge on menu or evolution of structural changes and probability distributions
- Forecasting rule, but no knowledge of parameter values, or the structure of the whole economy.

Empirical Model for Fiscal Policy Behavior

Each fiscal policy variable ($f_{i,t}$) responds to:

- Lag of all fiscal policy variables (f_{t-1}).
- Above includes lag of government debt (b_{t-1}).
- Macro outcomes: real GDP (y_t), consumption (c_t), investment (I_t), and unemployment (u_t).
- All quantities real, per capita, ratio of past real GDP.

Four regressions

Fiscal policy variables: $f_t = [g_t \ r_t \ n_t \ b_t]$
Govt Spending (g_t), Tax Revenue (r_t),
Net Transfers (n_t), Government Debt / GDP (b_t)

Regression equation:

$$f_{i,t} = \alpha_{t,0} + \alpha'_{t,f} f_{t-1} + \alpha_{t,y} y_t + \alpha_{t,c} c_t + \alpha_{I,t} I_t + \alpha_{t,u} u_t + \epsilon_t$$

OLS Regression

$$\hat{\alpha}_t = \left(\sum_{\tau=0}^{t} X_\tau X_\tau' \right)^{-1} \left(\sum_{\tau=0}^{t} X_\tau' f_{i,\tau} \right)$$

- $X_\tau = [1 \ f'_{\tau-1} \ y_\tau \ c_\tau \ I_\tau \ u_\tau]'$ is vector of regressors.
- Predicted fiscal policy action: $E_t^* f_{i,t} = X_t' \hat{\alpha}_t$
- Unexplained policy: $\hat{\epsilon}_t = f_{i,t} - X_t' \hat{\alpha}_t$

Recursive Formulation

The OLS regression coefficients can be rewritten as:

$$\hat{\alpha}_{i,t} = \alpha_{i,t-1} + \gamma_t R_t^{-1} X_t (f_t - X_t' \hat{\alpha}_t)$$

$$R_t = R_{t-1} + \gamma_t (X_t X_t' - R_{t-1}),$$

where $\gamma_t = 1/t$ is the **learning gain**.

Recursive Formulation

$$\hat{\alpha}_{i,t} = \alpha_{i,t-1} + \gamma R_t^{-1} X_t (f_{i,t} - X_t' \hat{\alpha}_{i,t})$$

$$R_t = R_{t-1} + \gamma (X_t X_t' - R_{t-1}),$$

- Learning gain, $\gamma \in (0, 1)$, is constant, equal to the weight assigned to most recent observation.
- Typical estimates for $\gamma \sim 0.02$ (Milani (2008), Slobodyan and Wouters (2008)).

Standard Formulation

$$\hat{\alpha}_{i,t} = \left((1-\gamma) \sum_{\tau=1}^{t} \gamma^\tau X_{t-\tau} X_{t-\tau}' \right)^{-1} \left((1-\gamma) \sum_{\tau=1}^{t} \gamma^\tau X_{t-\tau} f_{i,t-\tau} \right).$$

Weight on $t - \tau$ observation declines geometrically with τ: $\omega_\tau = (1-\gamma)\gamma^\tau$.

Endogeneity Problem

- Macro outcomes (real GDP, consumption, investment, and unemployment) are likely endogenous.
- Maybe market participants account for that.
- Use instruments: lags of macro outcomes and fiscal variables

Instrumental Variables Notation

- Let $W_t = [y_t \ c_t \ I_t \ u_t]'$ denote the possibly endogenous regressors in X_t,
- Let $V_t = [1 \ f'_{t-1}]'$ denote the remaining exogenous regressors
- Then, $X_t = [V'_t \ W'_t]'$.
- Let $S_t = [W'_{t-1} \ W'_{t-2} \ f'_{t-2}]$ denote vector of instruments.
- Let $Z_t = [V'_t \ S'_t]'$ denote vector Stage 1 IV regressors.

Stage 1: Endogenous macro variable on instruments + exogenous

$$W_{i,t} = Z_t'\beta_i + \upsilon_{i,t}.$$

$$\hat{\beta}_{i,t} = \hat{\beta}_{i,t-1} + \gamma \left(R_t^{S1}\right)^{-1} Z_{t-1}\left(W_{i,t-1} - Z_{t-1}'\hat{\beta}_{i,t-1}\right)$$

$$R_t^{S1} = R_{t-1}^{S1} + \gamma\left(Z_{t-1}Z_{t-1}' - R_{t-1}^{S1}\right)$$

Save Stage 1 Predicted Values

$$\hat{W}_{i,t} = Z_t'\hat{\beta}_{i,t}, \quad \hat{X}_t = [V_t' \ \hat{W}_t']'$$

Stage 2: Constant Gain Learning with IV

$$\hat{\alpha}_{i,t}^{IV} = \hat{\alpha}_{i,t-1}^{IV} + \gamma \left(R_t^{S2}\right)^{-1} \hat{x}_{t-1}\left(f_{i,t-1} - \hat{X}_{t-1}'\hat{\alpha}_{i,t-1}\right)$$

$$R_t^{S2} = R_{t-1}^{S2} + \gamma\left(\hat{X}_{t-1}\hat{X}_{t-1}' - R_{t-1}^{S2}\right).$$

- Unexplained fiscal policy:

$$\epsilon_{i,t} = f_{i,t} - \hat{\alpha}_{i,t}^{IV\prime} X_t$$

- Forecast uncertainty $\sim$ Root (weighted) mean squared error:

$$m_{i,t}^{IV} = \sqrt{(1-\gamma)\sum_{\tau=1}^{t} \gamma^{\tau} \epsilon_{i,t}^2}$$

Forecast Uncertainty vs. Time-Varying Volatility

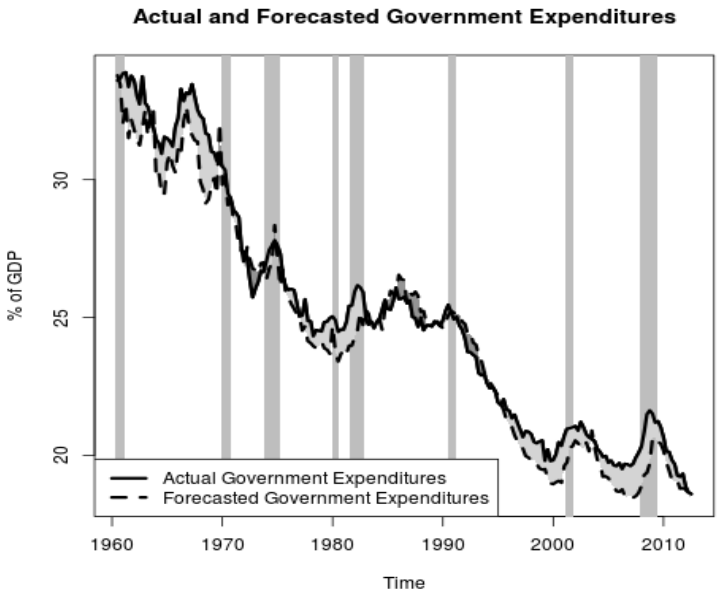
Time-varying Volatility

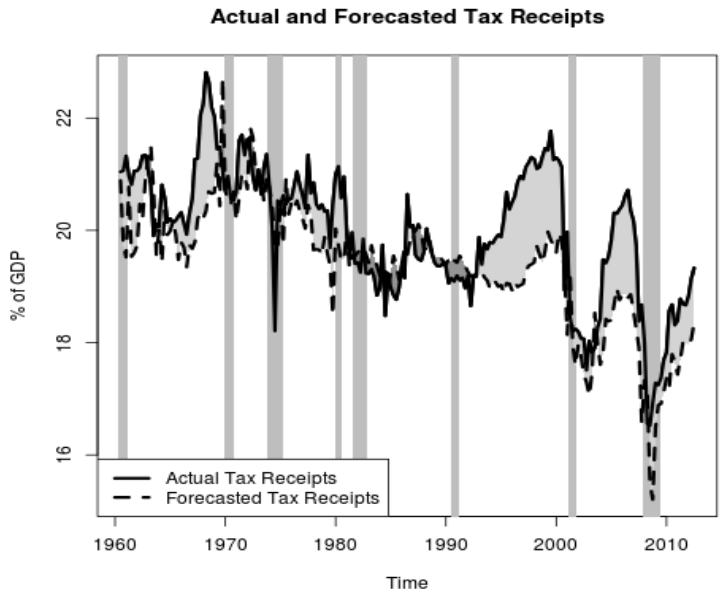
- Eg: Fernández-Villiverde et. al. (2011), Born and Pfeifer (2011), Johannsen (2012), etc.
- Can separate causal effects of fiscal shocks from i.i.d. innovations to variance.
- Possibly unrealistic set of knowledge and perceptions.
- Is fiscal policy uncertainty exogenous?

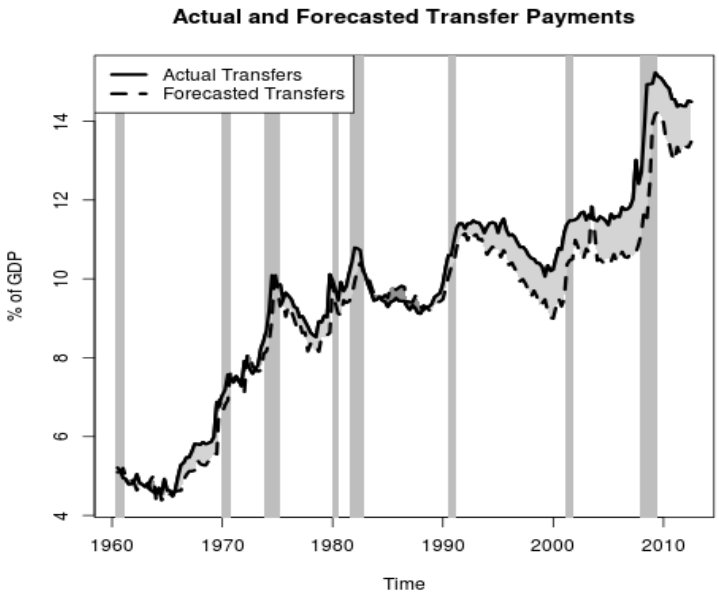
Forecast Uncertainty

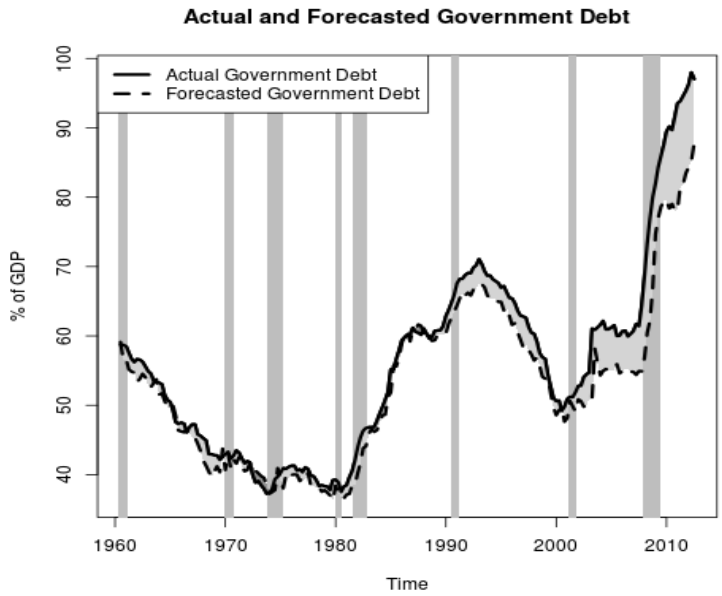
- Agents are learning fiscal policy processes.
- Constant gain learning: accounts for structural change possibility.
- Fiscal shocks can move expectations away from true model.
- Time-varying uncertainty need not depend on time-varying

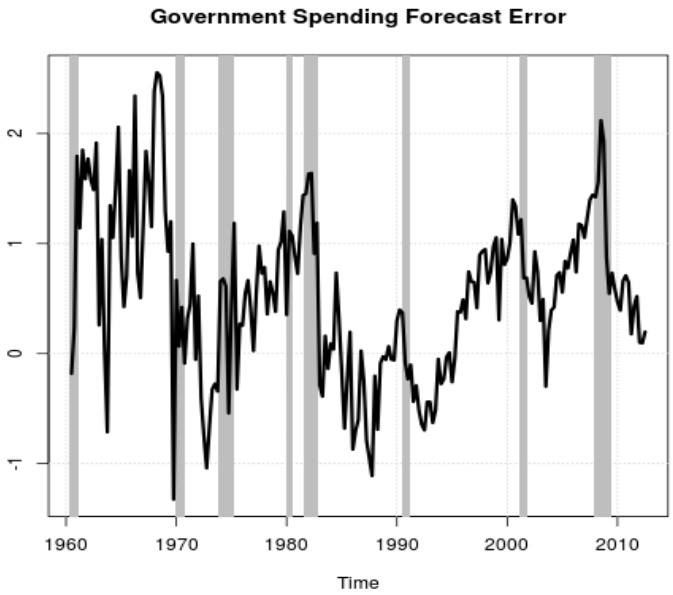
Fiscal Policy - Actual and Predicted

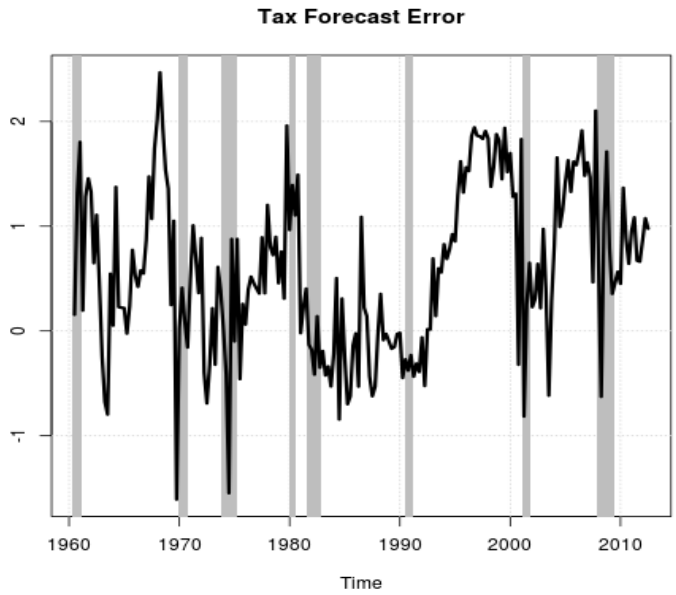


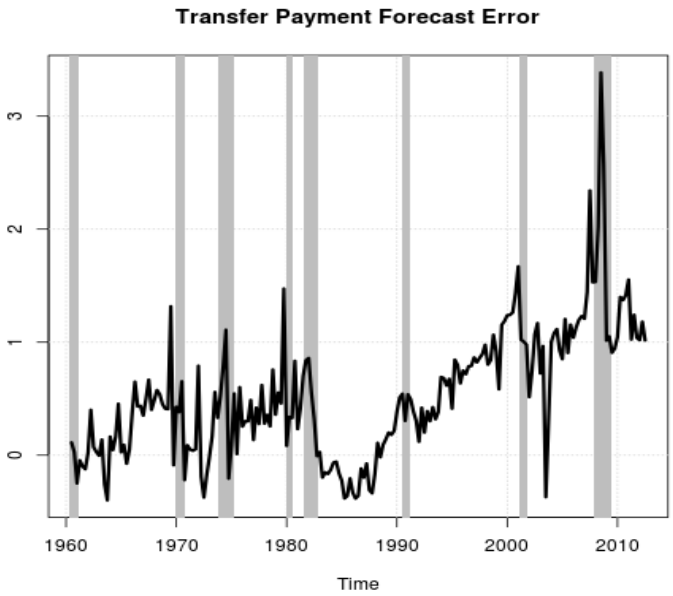


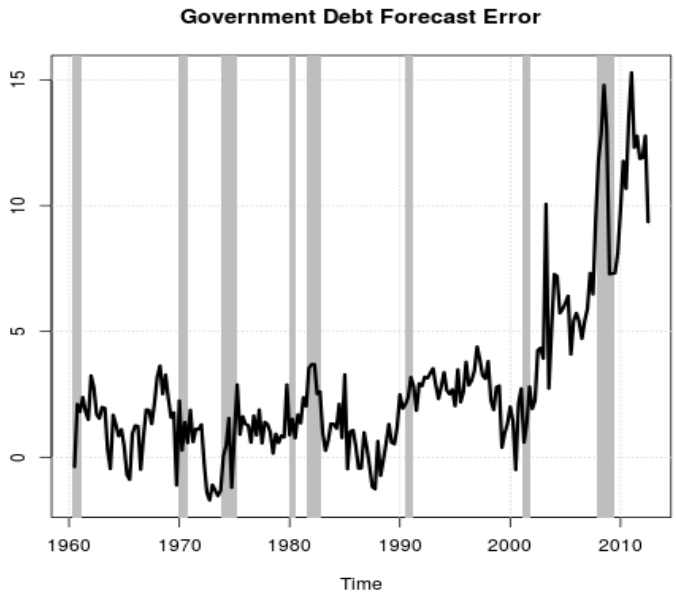


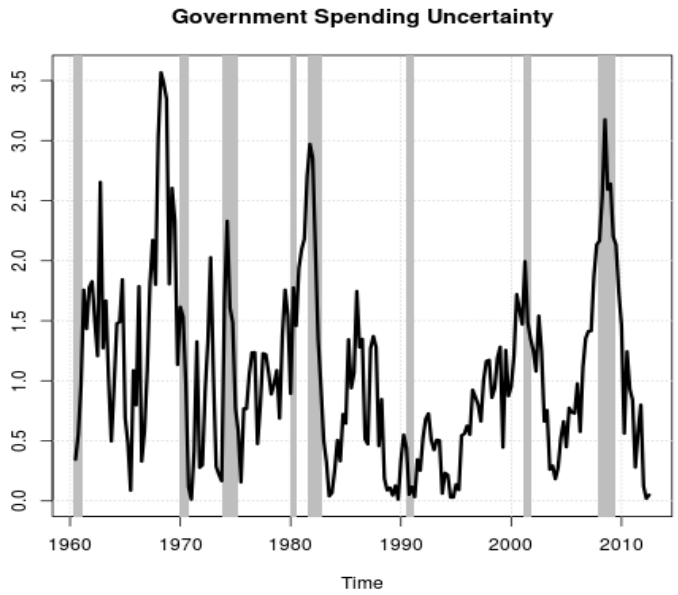


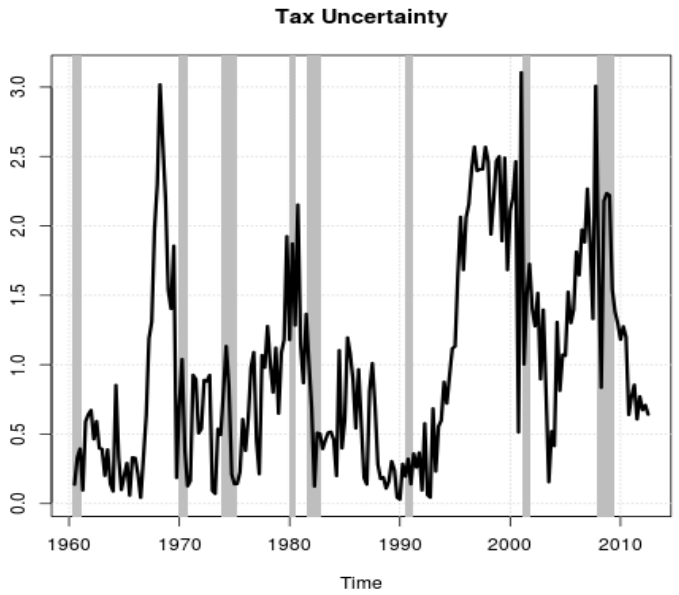

Government Spending Forecast Error
2
1
0
-1
1960
1970
1980
1990
2000
2010
Time

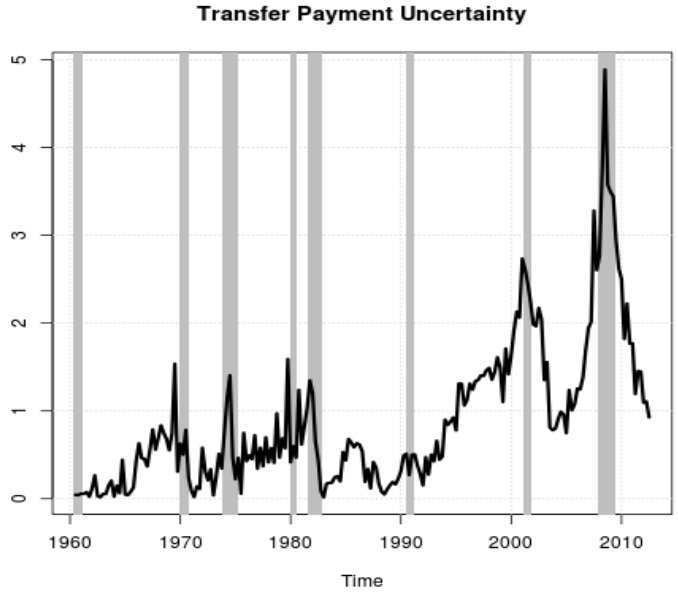

Tax Forecast Error
2
1
0
-1
1960
1970
1980
1990
2000
2010
Time

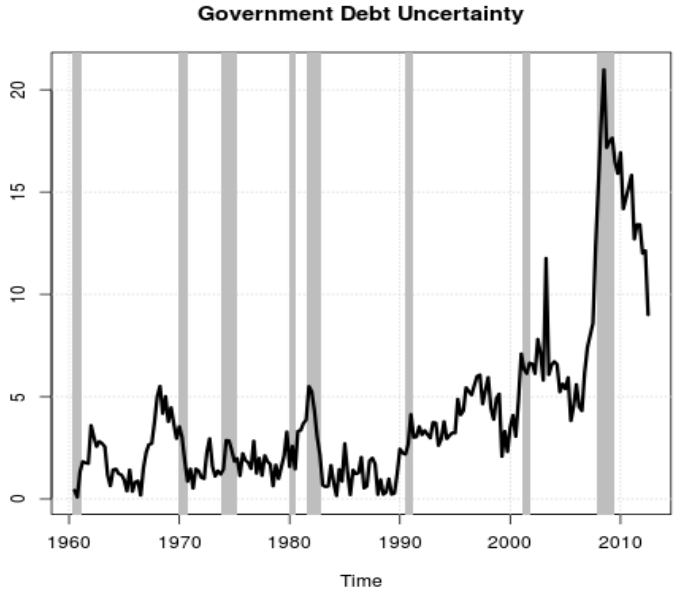

Transfer Payment Forecast Error
3
2
1
0
1960
1970
1980
1990
2000
2010
Time


Government Debt Forecast Error
15
10
5
0
1960
1970
1980
1990
2000
2010
Time


Government Spending Uncertainty
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
1960
1970
1980
1990
2000
2010
Time


Tax Uncertainty
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1960
1970
1980
1990
2000
2010
Time


Transfer Payment Uncertainty
0
1
2
3
4
5
1960
1970
1980
1990
2000
2010
Time


Government Debt Uncertainty
0
5
10
15
20
1960
1970
1980
1990
2000
2010
Time

- Uncertainty concerning transfers and debt reached unprecedented levels during Great Recession.
  - Transfers uncertainty: Nearly 5% of GDP
  - Government debt uncertainty: Exceeded 20% of GDP
- Tax and government spending uncertainty reached near highs of about 3% of GDP
- Uncertainty seems to run up for several years preceding recessions:
  - Early 1980s, 2001, 2007.
  - Not the rule though (eg: declines prior to 1970s, not much action prior to 1991)

- Answer this with a reduced form vector autoregression in:
  1. Real GDP
  2. Consumption
  3. Investment
  4. Unemployment
- Augment explanatory variables with fiscal policy uncertainty variables (first lag)
- Consider VAR lag lengths: 1, 2, and 4.
- Consider learning gain parameters: $\gamma = 0.01,\ 0.02,\ 0.03$.

Dependent Variable: Real GDP
Learning Gain: $\gamma = 0.01$

	1 Lag	2 Lags	4 Lags
Expenditures Uncertainty	-0.191^{*}	-0.091	-0.234^{**}
(Standard Error)^2	(0.116)	(0.113)	(0.121)
Tax Uncertainty	-0.050	-0.170	-0.226
(Standard Error)	(0.208)	(0.216)	(0.219)
Transfers Uncertainty	0.270	0.410	0.465
(Standard Error)	(0.191)	(0.141)	(0.112)
Debt Uncertainty	-0.077^{**}	-0.071^{**}	-0.031
(Standard Error)	(0.039)	(0.040)	(0.046)
Joint F-test	4.1^{***}	2.7^{**}	2.8^{**}
Adjusted R-square	0.240	0.346	0.409
AIC	478.9	456.7	451.6
BIC	532.3	543.5	605.1

Dependent Variable: Real GDP
Learning Gain: $\gamma = 0.01$

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Some evidence expenditures uncertainty decreases real GDP.

Dependent Variable: Real GDP
Learning Gain: $\gamma = 0.01$

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Expenditures Uncertainty	-0.191^{*}	-0.091	-0.234^{**}
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Fiscal policy uncertainty matters one way or another.

Dependent Variable: Consumption
Learning Gain: $\gamma = 0.01$

	1 Lag	2 Lags	4 Lags
Expenditures Uncertainty	0.073	0.065	0.010
(Standard Error)^2	(0.072)	(0.067)	(0.058)
Tax Uncertainty	−0.080	−0.179*	−0.065
(Standard Error)	(0.083)	(0.119)	(0.129)
Transfers Uncertainty	0.070	0.123	0.089
(Standard Error)	(0.089)	(0.081)	(0.081)
Debt Uncertainty	−0.052***	−0.035*	−0.026
(Standard Error)	(0.020)	(0.026)	(0.026)
Joint F-test	3.8***	2.6**	0.8
Adjusted R-square	0.980	0.980	0.981
AIC	179.4	187.7	198.2
BIC	232.8	274.5	351.7

Dependent Variable: Consumption
Learning Gain: $\gamma = 0.01$

	1 Lag	2 Lags	4 Lags
Expenditures Uncertainty	0.073	0.065	0.010
(Standard Error)^2	(0.072)	(0.067)	(0.058)
Tax Uncertainty	−0.080	−0.179*	−0.065
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Some evidence that debt uncertainty decreases consumption.

Dependent Variable: Consumption
Learning Gain: $\gamma = 0.01$

	1 Lag	2 Lags	4 Lags
Expenditures Uncertainty	0.073	0.065	0.010
(Standard Error)^2	(0.072)	(0.067)	(0.058)
Tax Uncertainty	−0.080	−0.179*	−0.065
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Fiscal policy uncertainty likely influences consumption.

Dependent Variable: Investment
Learning Gain: $\gamma = 0.01$

	1 Lag	2 Lags	4 Lags
Expenditures Uncertainty	-0.248^{***}	-0.152^{***}	-0.216^{***}
(Standard Error)^2	(0.064)	(0.058)	(0.063)
Tax Uncertainty	-0.223^{*}	-0.209^{*}	-0.296^{***}
(Standard Error)	(0.163)	(0.141)	(0.126)
Transfers Uncertainty	0.319	0.339	0.391
(Standard Error)	(0.115)	(0.103)	(0.092)
Debt Uncertainty	0.008	0.012	0.035
(Standard Error)	(0.035)	(0.021)	(0.020)
Joint F-test	5.3^{***}	3.0^{**}	4.2^{***}
Adjusted R-square	0.943	0.958	0.962
AIC	304.0	249.7	243.4
BIC	357.4	336.4	396.9

Dependent Variable: Investment
Learning Gain: $\gamma = 0.01$

	1 Lag	2 Lags	4 Lags
Expenditures Uncertainty	-0.248^{***}	-0.152^{***}	-0.216^{***}
(Standard Error)^2	(0.064)	(0.058)	(0.063)
Tax Uncertainty	-0.223^{*}	-0.209^{*}	-0.296^{***}
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AIC	304.0	249.7	243.4
BIC	357.4	336.4	396.9

Expenditures uncertainty decreases investment.

Dependent Variable: Investment
Learning Gain: $\gamma = 0.01$

	1 Lag	2 Lags	4 Lags
Expenditures Uncertainty	-0.248^{***}	-0.152^{***}	-0.216^{***}
(Standard Error)^2	(0.064)	(0.058)	(0.063)
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AIC	304.0	249.7	243.4
BIC	357.4	336.4	396.9

Tax uncertainty likely decreases investment.

Dependent Variable: Investment
Learning Gain: $\gamma = 0.01$

	1 Lag	2 Lags	4 Lags
Expenditures Uncertainty	-0.248^{***}	-0.152^{***}	-0.216^{***}
(Standard Error)^2	(0.064)	(0.058)	(0.063)
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AIC	304.0	249.7	243.4
BIC	357.4	336.4	396.9

Fiscal policy uncertainty likely influences investment.

Dependent Variable: Unemployment
Learning Gain: $\gamma = 0.01$

	1 Lag	2 Lags	4 Lags
Expenditures Uncertainty	0.049	−0.002	0.018
(Standard Error)^2	(0.035)	(0.031)	(0.030)
Tax Uncertainty	0.185	0.115	0.119
(Standard Error)	(0.099)	(0.088)	(0.079)
Transfers Uncertainty	−0.107**	−0.115**	−0.108***
(Standard Error)	(0.048)	(0.052)	(0.045)
Debt Uncertainty	0.008	0.016	0.013
(Standard Error)	(0.023)	(0.015)	(0.015)
Joint F-test	7.6***	2.6**	2.1*
Adjusted R-square	0.977	0.982	0.982
AIC	23.8	−22.1	1.2
BIC	77.2	64.7	154.7

Dependent Variable: Unemployment
Learning Gain: $\gamma = 0.01$

	1 Lag	2 Lags	4 Lags
Expenditures Uncertainty	0.049	−0.002	0.018
(Standard Error)^2	(0.035)	(0.031)	(0.030)
Tax Uncertainty	0.185	0.115	0.119
(Standard Error)	(0.099)	(0.088)	(0.079)
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Transfers uncertainty *decreases* **unemployment.**

Dependent Variable: Unemployment
Learning Gain: $\gamma = 0.01$

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Expenditures Uncertainty	0.049	−0.002	0.018
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Fiscal policy uncertainty likely influences unemployment.

Fiscal Uncertainty Reduces Economic Activity

- Investment is adversely affected by,
  - Government spending uncertainty
  - Tax uncertainty
- Consumption and real GDP adversely affected by,
  - Tax uncertainty
  - Government debt uncertainty
  - These findings are less robust than above to VAR specification.

But it may boost the labor market!

Unemployment decreases with transfers uncertainty.