Identifying Fiscal Policy Uncertainty and Its Macroeconomic Consequences

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Two Part Goal

- Quantify fiscal policy uncertainty (FPU)
- Determine what effect FPU has on health of the economy

What is fiscal policy?

- Fiscal policy: Decisions on government expenditure, tax rates, transfers, and accumulated debt.
- U.S. data that aggregates fiscal variables over federal, state and local governments.
- Usually think of *fiscal policy* as movements in fiscal variables to target economic outcomes.
- Aggregate of *discretionary* and *automatic* fiscal policy.

Quantify Fiscal Policy Uncertainty

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

Present Paper

- Market participants behave like statisticians - they estimate fiscal policy rules.
- Least-squares learning re: fiscal policy behavior
- 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

Regression model (i.e. learning process) for each.

Construct an uncertainty measure for each.

Impact on Macroeconomy

Include these measures of fiscal uncertainty in a vector autoregression (VAR) model 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.**"

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.

Expectations Example: Government Spending

- When unemployment is high, increase government spending to boost the economy.
- When spending is low, increase government spending to boost the economy.
- When accumulated debt is high, decrease government spending to keep debt level sustainable.
- Levels of government spending today depend on yesterday's level (*persistent*).

Learning Process / Expectations Mechanism

- Run a regression that determines how fiscal policy variables react to unemployment, spending, debt, previous policy.
- Every period, run a regression for each fiscal policy variable, using data from previous periods.

Constant gain learning mechanism

- Weighted least squares - more recent observations have more weight.
- Regression forecast serves as expectation.
- Root (weighted) mean squared error serves as *fiscal policy uncertainty*.

Fiscal Policy Uncertainty

- Regression will give you a prediction for the fiscal policy variable.
- Also be confronted with reality: actual fiscal policy is realized
- Difference $\equiv$ Forecast error - fiscal policy that was not predicted / not in line with past behavior
- Larger accumulated forecast errors imply greater uncertainty

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

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

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

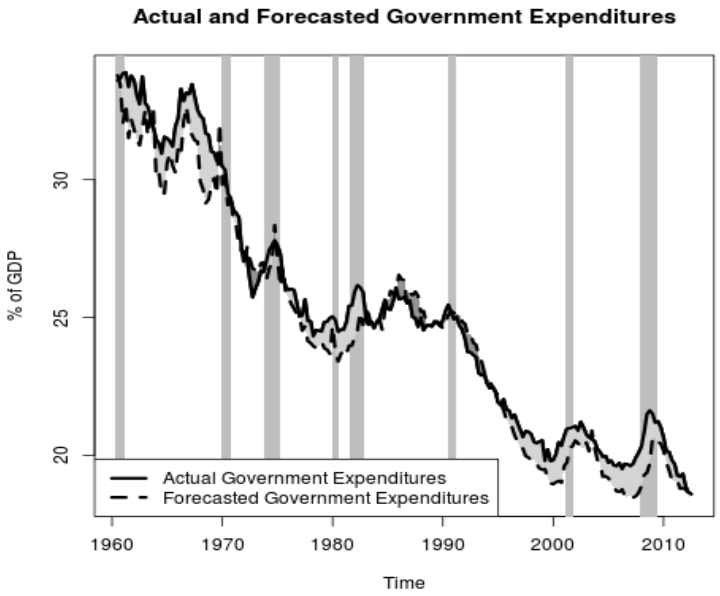
- Unexplained fiscal policy:

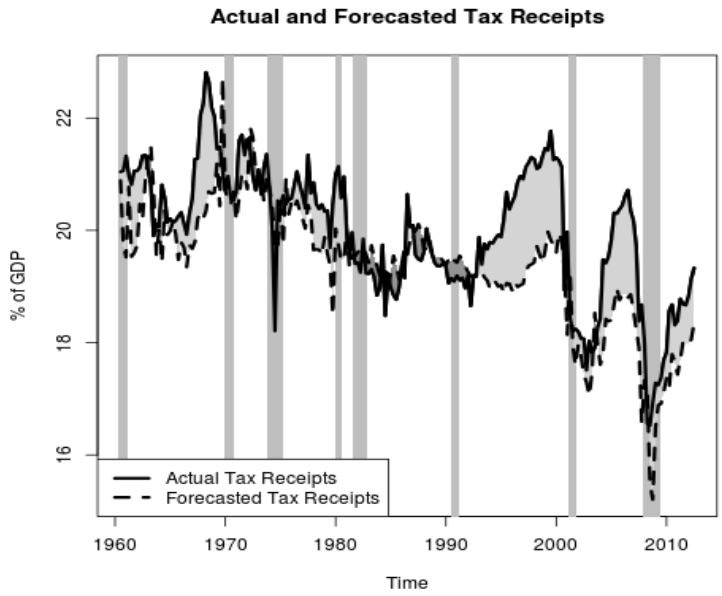
$$\epsilon_{i,t} = f_{i,t} - \hat{\alpha}_{i,t}^{IV\prime} X_t$$

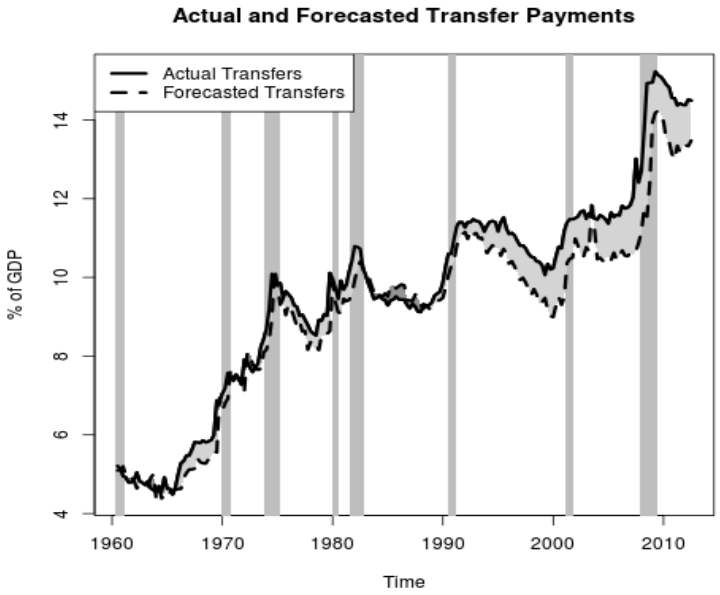
- Forecast uncertainty $\sim$ Root (weighted) mean squared error:

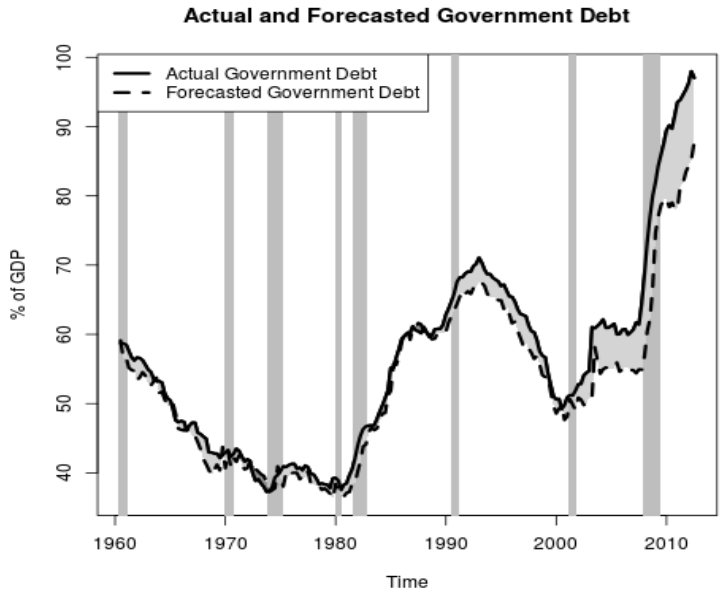
$$m_{i,t}^{IV} = \sqrt{(1-\gamma)\sum_{\tau=1}^{t} \gamma^{\tau} \epsilon_{i,t}^2}$$

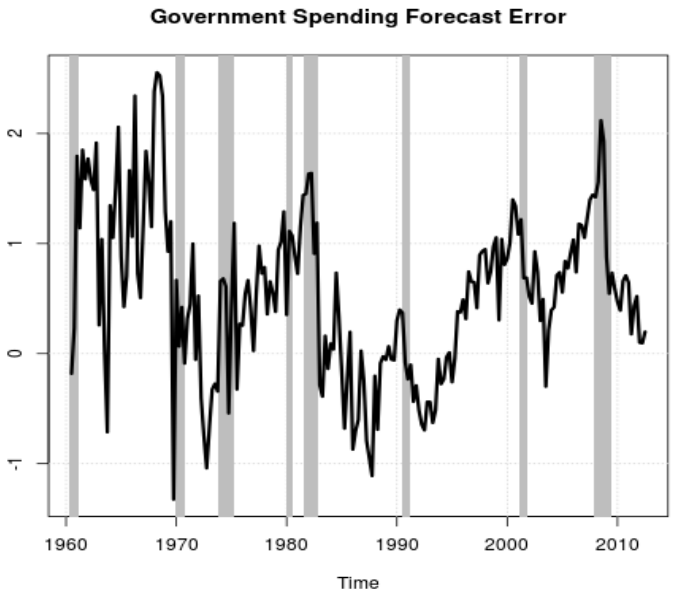
Fiscal Policy - Actual and Predicted

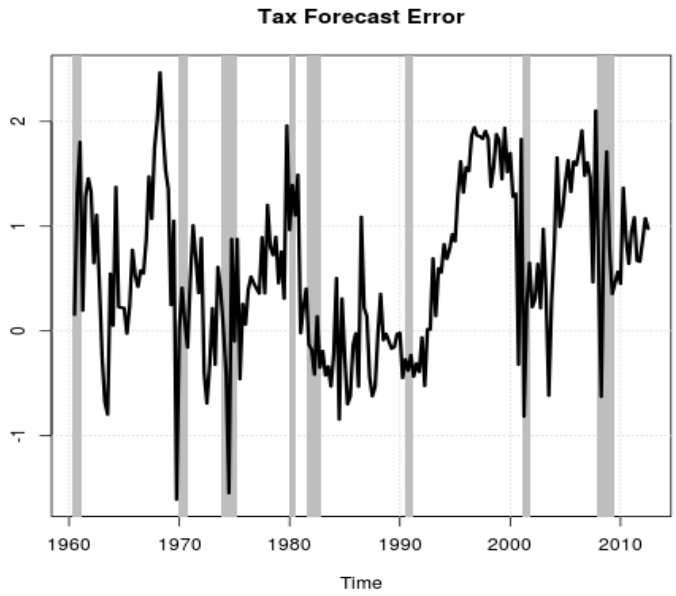


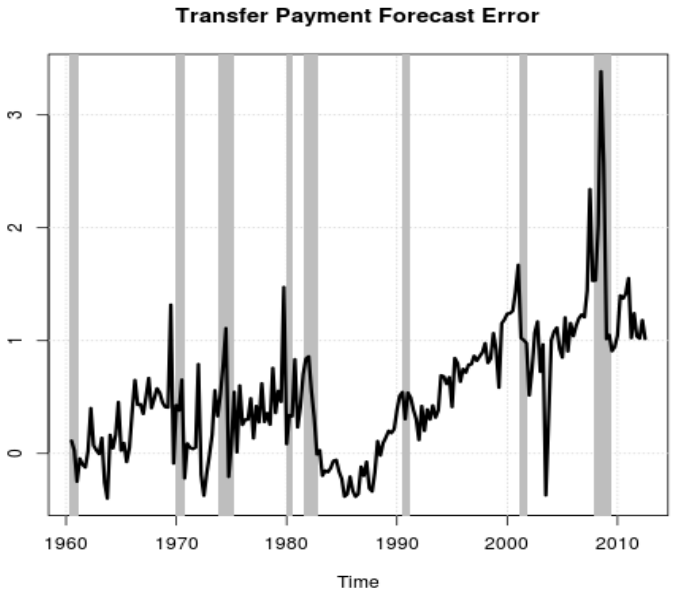


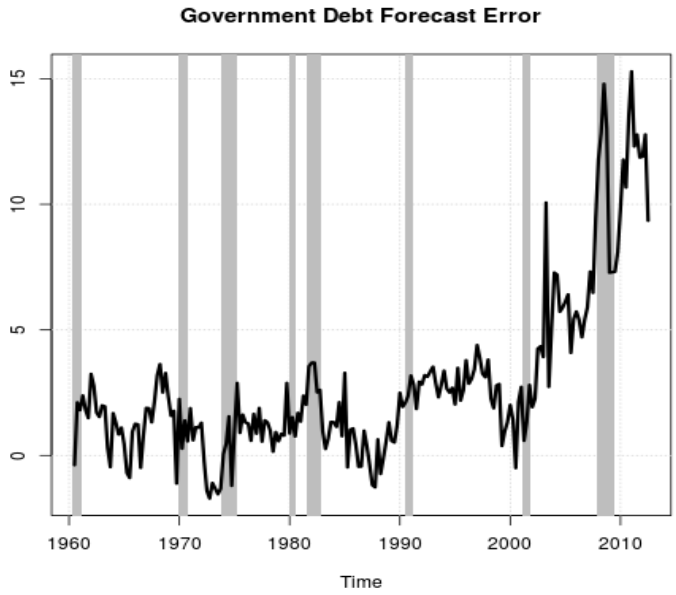


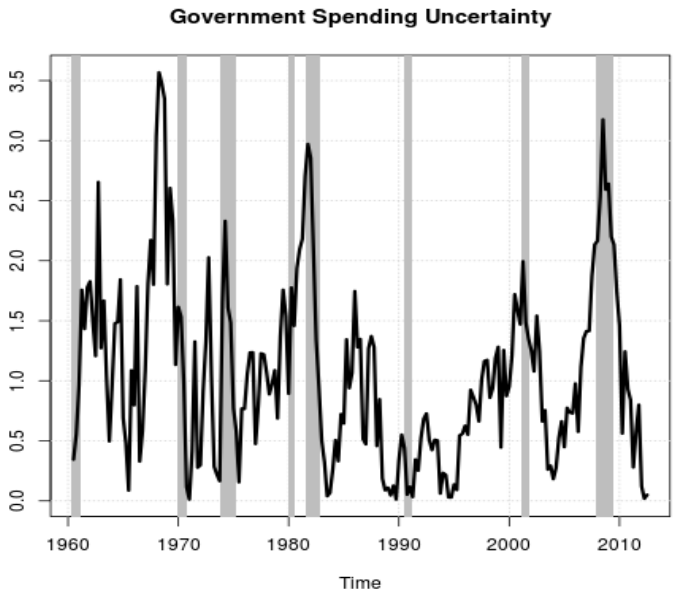


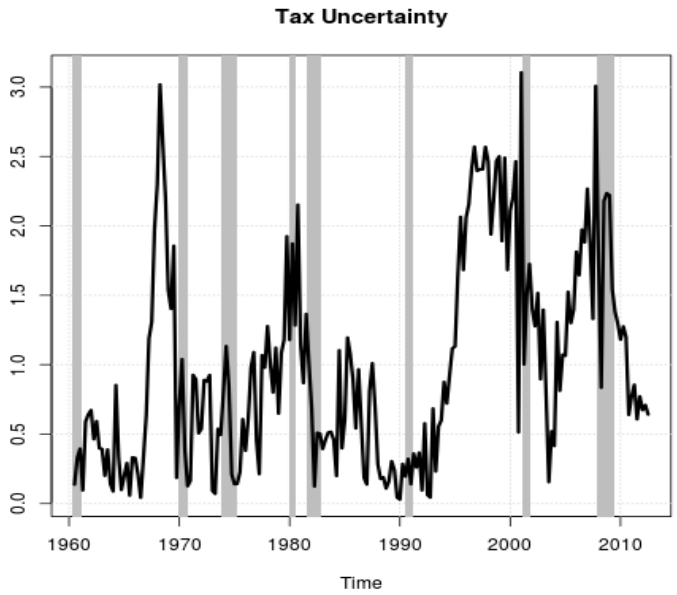

Government Spending Forecast Error
2
1
0
-1
1960
1970
1980
1990
2000
2010
Time


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
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0.5
1.0
1.5
2.0
2.5
3.0
1960
1970
1980
1990
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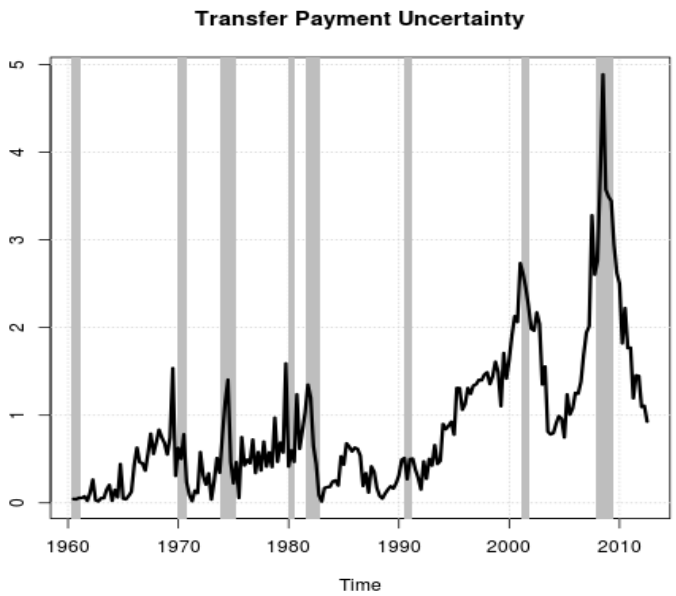
Time


Transfer Payment Uncertainty
0
1
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1960
1970
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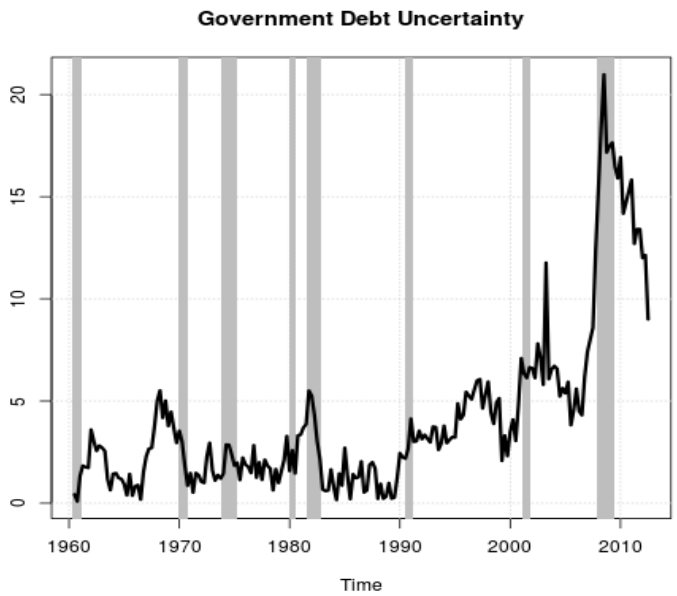
Time


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)

Dependent Variable: Real GDP

	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

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Some evidence expenditures uncertainty decreases real GDP.

Dependent Variable: Real GDP

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Fiscal policy uncertainty matters one way or another.

Dependent Variable: Consumption

	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

	1 Lag	2 Lags	4 Lags
Expenditures Uncertainty	0.073	0.065	0.010
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Some evidence that debt uncertainty decreases consumption.

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	1 Lag	2 Lags	4 Lags
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Fiscal policy uncertainty likely influences consumption.

Dependent Variable: Investment

	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

	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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Expenditures uncertainty decreases investment.

Dependent Variable: Investment

	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)
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Tax uncertainty likely decreases investment.

Dependent Variable: Investment

	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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BIC	357.4	336.4	396.9

Fiscal policy uncertainty likely influences investment.

Dependent Variable: Unemployment

	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

	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

Transfers uncertainty *decreases* **unemployment.**

Dependent Variable: Unemployment

	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

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.