

Identifying Fiscal Policy Uncertainty and Its Macroeconomic Consequences

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Quantify uncertainty concerning fiscal policy

- Realistic framework for forming expectations
- Isolate five sources:

Government expenditures	Government debt
Taxes	Overall fiscal uncertainty
Transfers	

Estimate the Macroeconomic Impact

- Vector autoregression with fiscal uncertainty explanatory variables.
- Four effects:

Real GDP	Investment
Consumption	Unemployment

Time-varying Fiscal Volatility

- Fernández-Villaverde 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.

Other ways of doing it

- Baker et. al. (2013): Index based on headlines, variance of professional forecasts, expiring tax provisions.
- Orlik and Veldkamp (2013):
 - Not about fiscal policy. Macro uncertainty.
 - Uncertainty is margin of error for forecasts.
 - Forecasts are based on Bayesian learning and model uncertainty.

Specific Fiscal Challenges

- Bi, Leeper, and Leith (2013): Time and composition of fiscal consolidations
- Davig, Leeper, and Walker (2010): Unsustainable entitlement programs
- Davig and Foerster (2013): Expiring tax provisions - with uncertain extensions.
- Richter and Throckmorton (2013): uncertain debt targets

Fiscal Uncertainty Reduces Economic Activity

- General measure for fiscal uncertainty associated with:
 - lower real GDP,
 - lower consumption,
 - lower investment.
- Less robust to specification:
 - Expenditures uncertainty → lower investment and real GDP.
 - Tax uncertainty → lower consumption and real GDP.
- Transfers uncertainty associated with *lower unemployment*.
 - Statistically significant
 - Quantitatively tiny.

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:

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

Recursive Formulation

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

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

- 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

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

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

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

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

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

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

- Unexplained fiscal policy:

$$\epsilon_{i,t} = f_{i,t} - \hat{\alpha}_{i,t}^{IV'} X_t$$

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

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

Time-Varying Volatility

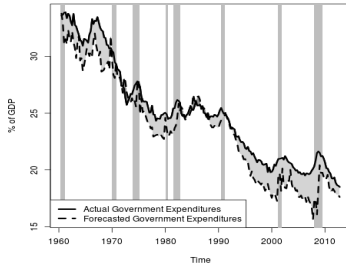
- Eg: Fernández-Villaverde et. al. (2011), Born and Pfeifer (2011), Johansen (2012), etc.
- Can separate causal effects of fiscal shocks from i.i.d. innovations to variance.
- Possibly unrealistic set of knowledge and perceptions.
- Is fiscal policy uncertainty exogenous?

Forecast Uncertainty

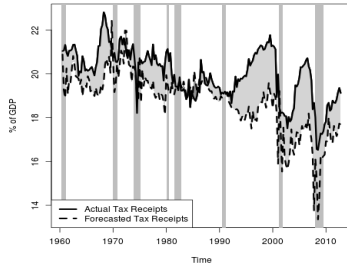
- Agents are learning fiscal policy processes.
- Constant gain learning: accounts for structural change possibility.
- Fiscal shocks can move expectations away from true model.
- Time-varying uncertainty need not depend on time-varying volatility.

- Some basis in the literature:
 - Herro and Murray (2013): Monetary policy uncertainty.
 - Orlik and Veldkamp (2013): Macro uncertainty
- Shortcoming
 - Forecasts do not consider government budget constraint
 - Long-horizon problems.

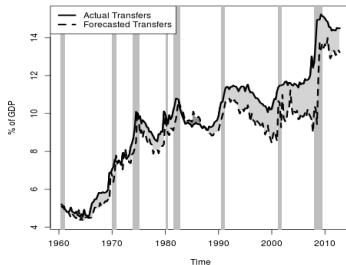
Actual and Forecasted Government Expenditures



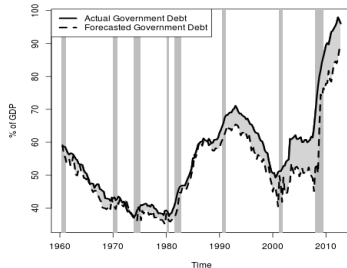
Actual and Forecasted Tax Receipts

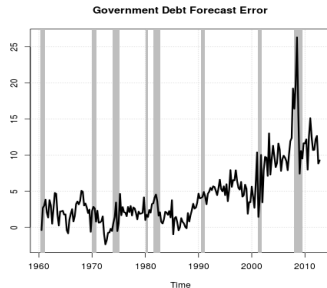
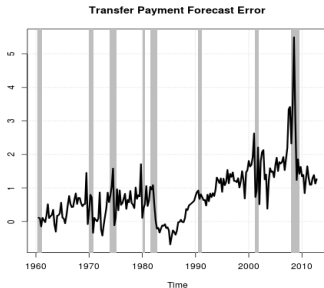
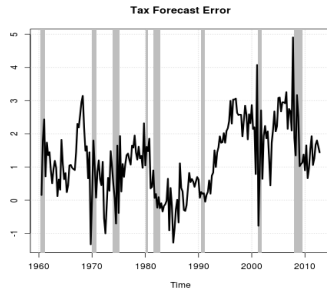
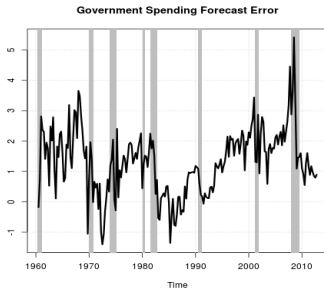


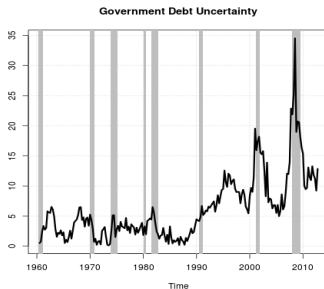
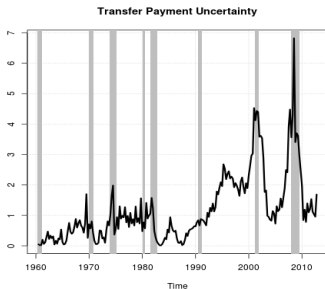
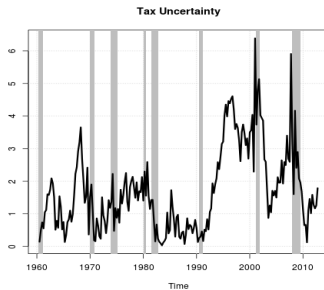
Actual and Forecasted Transfer Payments



Actual and Forecasted Government Debt







- Uncertainty concerning transfers and debt reached unprecedented levels during Great Recession.
 - Government expenditures uncertainty: Nearly 7% of GDP
 - Tax uncertainty: Nearly 6% of GDP
 - Transfers uncertainty: Nearly 7% of GDP
 - Government debt uncertainty: Nearly 35% 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, little volatility prior to 1991)
- All are highly correlated with each other.

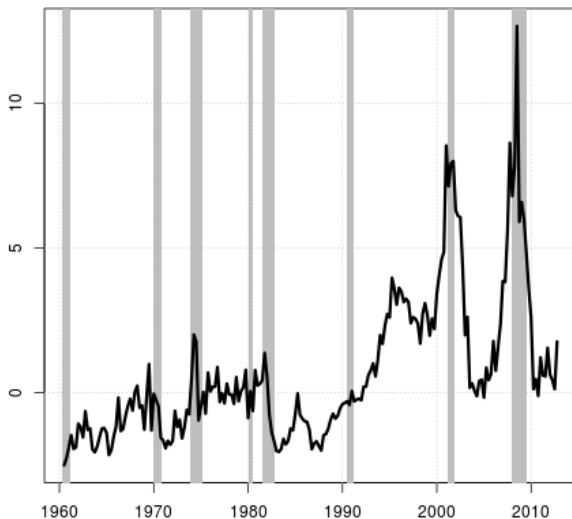
- Stock and Waston (1989) coincident indicator model
- Latent variable: General fiscal uncertainty

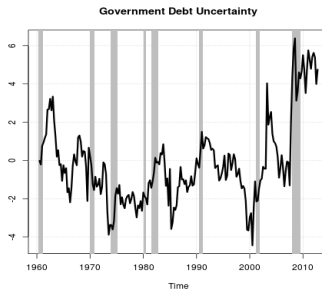
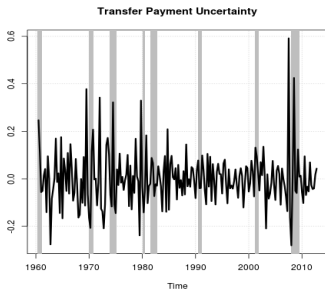
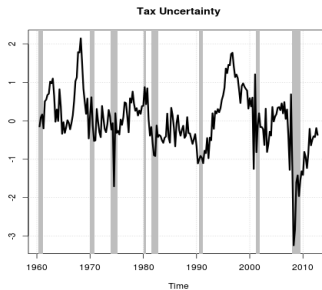
$$m_t = m_0 + A\lambda_t + e_t$$

$$\lambda_t = b_1\lambda_{t-1} + b_2\lambda_{t-2} + v_t$$

$$e_t = Ce_{t-1} + \eta_t$$

- Notation:
 - m_t : 4x1 vector of fiscal uncertainty variables
 - λ_t : general fiscal uncertainty
 - e_t : “unique” component of fiscal uncertainty.





- 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: $\gamma = 0.02$

	1 Lag	2 Lags	4 Lags
Expenditure Uncertainty (Standard Error) ²	-0.093 (0.105)	-0.156 (0.127)	-0.226** (0.128)
Tax Uncertainty (Standard Error)	0.886 (0.429)	-0.680 (0.743)	-0.390 (0.704)
Transfers Uncertainty (Standard Error)	0.404 (0.128)	0.475 (0.143)	0.572 (0.123)
Debt Uncertainty (Standard Error)	0.014 (0.042)	0.006 (0.041)	0.055 (0.047)
Fiscal Uncertainty Index (Standard Error)	-0.141*** (0.041)	-0.098*** (0.039)	-0.117*** (0.039)
Joint F-test	4.0***	2.1*	2.3*
Adjusted R-square	0.250	0.343	0.407
AIC	478.6	459.9	454.0
BIC	535.4	550.1	611.1

Dependent Variable: Real GDP

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General fiscal uncertainty is followed by a decrease in real GDP

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At least one fiscal uncertainty variable influences real GDP

- Typical fluctuations in uncertainty over the sample period is not an important driver of business cycles.
 - Like Fernández-Villaverde et. al. (2011a) and Born and Pfeifer (2011)
- Buildup of fiscal uncertainty index from 2004 through 2007: Increase from 0.0 to 12.5.
- Coefficient on coincident index = -0.098.
- Impact on real GDP growth: $12.5 \times (-0.098) = -1.2\%$

Dependent Variable: Consumption

Learning Gain: $\gamma = 0.02$

	1 Lag	2 Lags	4 Lags
Expenditure Uncertainty (Standard Error) ²	0.041 (0.067)	-0.028 (0.071)	-0.057 (0.059)
Tax Uncertainty (Standard Error)	-0.051 (0.275)	-0.588* (0.413)	-0.653* (0.401)
Transfers Uncertainty (Standard Error)	0.028 (0.061)	0.108 (0.071)	0.041 (0.071)
Debt Uncertainty (Standard Error)	-0.043** (0.025)	-0.032 (0.026)	-0.024 (0.029)
Fiscal Uncertainty Index (Standard Error)	-0.055*** (0.017)	-0.055*** (0.022)	-0.013 (0.026)
Joint F-test	2.7**	2.1*	0.8
Adjusted R-square	0.980	0.980	0.981
AIC	182.7	189.5	198.6
BIC	239.6	279.7	355.7

Dependent Variable: Consumption

Learning Gain: $\gamma = 0.02$

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General fiscal uncertainty is followed by a decrease in consumption

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At least one fiscal uncertainty variable influences consumption

Dependent Variable: Investment

Learning Gain: $\gamma = 0.02$

	1 Lag	2 Lags	4 Lags
Expenditure Uncertainty (Standard Error) ²	-0.096* (0.062)	-0.061 (0.078)	-0.085 (0.088)
Tax Uncertainty (Standard Error)	0.702 (0.329)	-0.096 (0.371)	0.247 (0.368)
Transfers Uncertainty (Standard Error)	0.416 (0.084)	0.326 (0.112)	0.401 (0.090)
Debt Uncertainty (Standard Error)	0.064 (0.034)	0.044 (0.027)	0.075 (0.025)
Fiscal Uncertainty Index (Standard Error)	-0.104*** (0.033)	-0.048** (0.029)	-0.077*** (0.024)
Joint F-test	6.4***	2.5**	3.5***
Adjusted R-square	0.945	0.958	0.962
AIC	296.6	251.9	245.7
BIC	353.4	342.1	402.8

Dependent Variable: Investment

Learning Gain: $\gamma = 0.02$

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At least one fiscal uncertainty variable influences investment

Dependent Variable: Unemployment
Learning Gain: $\gamma = 0.02$

	1 Lag	2 Lags	4 Lags
Expenditure Uncertainty (Standard Error) ²	0.031 (0.035)	0.004 (0.046)	0.016 (0.042)
Tax Uncertainty (Standard Error)	-0.260* (0.194)	-0.026 (0.193)	-0.128 (0.215)
Transfers Uncertainty (Standard Error)	-0.178*** (0.048)	-0.127*** (0.043)	-0.147*** (0.045)
Debt Uncertainty (Standard Error)	-0.006 (0.024)	0.013 (0.017)	0.010 (0.017)
Fiscal Uncertainty Index (Standard Error)	0.077 (0.020)	0.040 (0.018)	0.056 (0.019)
Joint F-test	9.0***	2.3**	2.2*
Adjusted R-square	0.979	0.983	0.982
AIC	11.1	-22.5	-0.9
BIC	67.9	67.7	156.2

Dependent Variable: Unemployment
Learning Gain: $\gamma = 0.02$

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At least one fiscal uncertainty variable influences unemployment

- Labor supply story? Uncertainty on transfers increases job search effort?
 - Farber and Velletta (2013): Extension on unemployment benefits leads to (small) increases in unemployment / duration.
- Magnitude
 - Buildup of fiscal uncertainty index from 2004 through 2007: Increase from -0.01 to 0.06.
 - Coefficient on coincident index = -0.127.
 - Impact on unemployment rate: $0.07 \times (-0.127) = -0.0089\%$

Fiscal Uncertainty Reduces Economic Activity

- General measure for fiscal uncertainty associated with:
 - lower real GDP,
 - lower consumption,
 - lower investment.
- Less robust to specification (not shown):
 - Expenditures uncertainty → lower investment and real GDP.
 - Tax uncertainty → lower consumption and real GDP.
- Transfers uncertainty associated with *lower unemployment*.
 - Statistically significant
 - Quantitatively tiny.