Fiscal News, Imperfect Information and Confidence

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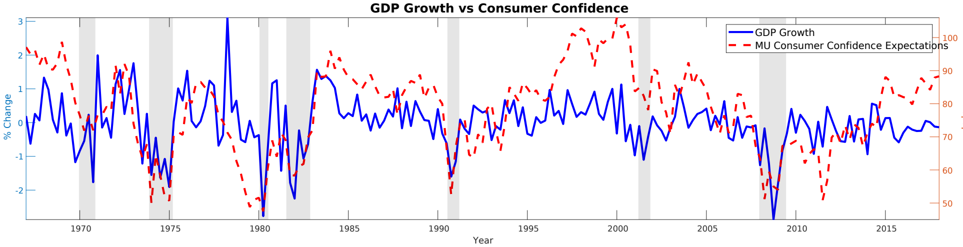
Motivation - I



- MU Consumer Confidence Expectations Index: Weighted average of the individuals' expectations about
  1. their individual (family) income over the next 12 months,
  2. aggregate business conditions over the next 12 months,
  3. the country as a whole over the next five years.
- Correlation: 0.46.
- Confidence Granger causes GDP growth
- Innovations to confidence predict increase in future GDP (Barsky and Sims (2012)).

Motivation - II

- Russell Roberts (2009): "But the economy is not stagnant because of a lack of spending. The economy is stagnant because of a lack of confidence in the future."
- Shiller (2009): "We must be certain that programs to solve the current financial and economic crisis are large enough, and targeted broadly enough, to impact public confidence."
- Cochrane (2009): "Others say that we should have a fiscal stimulus to 'give people confidence,' even if we have neither theory nor evidence that it will work."

Motivation - III

- However, fiscal stimulus had an important feature, news about future government spending (fiscal news).

ARRA, Highway construction in Title XII (in billions)								
	2009	2010	2011	2012	2013	2014	2015	2016
Bugdet Authority	\$27.5							
Estimated Outlays	\$2.75	\$6.875	\$5.5	\$4.125	\$3.025	\$2.75	\$1.925	\$.55

- The agents might form their expectations and behaviours based on the news rather than the actual spendings.
- The anticipation of future government spending is not only inherent to fiscal stimulus:

  Tax Reform Act of 1986, Fall of Berlin Wall, Gulf War I and II

My Paper

1. Empirical:
   i. Fiscal news: revisions to the Survey of Professional Forecasters (SPF) government spending forecasts.
   ii. Structural VAR: to identify fiscal news shocks and to measure the responses of consumer confidence and real variables.
   iii. Structural VAR: to isolate the role of confidence.

2. Theoretical: Lorenzoni (2009) imperfect information island model with government sector
   i. to explain how a fiscal news shock shifts the confidence,
   ii. to estimate the model,
   iii. to perform a counterfactual to assess the role of the confidence in the transmission of fiscal policy.

Main Findings

Empirical:

- Fiscal news shock boosts confidence and crowds-in private consumption.

  One-year fiscal multiplier: 1.80

- When the confidence channel is shut down, the positive response of the private consumption disappears.

  One-year fiscal multiplier: 0.82

Theoretical:

- The private consumption increases if fiscal news shock boosts confidence.
  - How? If fiscal news shock creates expectations of higher future disposable income
    - How? If fiscal news shock induces the agents to expect higher government demand relative to the taxes (Imperfect information is key)

Related Literature

Empirical:

- **Government Spending and Confidence:** Bachmann and Sims (2011), Alesina, Favero and Giavazzi (2015)
  - **My Contribution:** Fiscal news shock boosts consumer confidence.
- **Fiscal News:** Ramey (2011), Auerbach and Gorodnichenko (2012), Forni and Gambetti (2016)
  - **My Contribution:** The consumer confidence is a critical component in the transmission of fiscal news shocks.

Theoretical:

- **Government Spending and Consumption:** Ravn, Schmitt-Grohe and Uribe (2006), Galí, López-Salido and Vallés (2007), Christiano, Eichenbaum and Rebelo (2011)
  - **My Contribution:** The boost in confidence can explain the the crowding-in effect of government spending on private consumption.
- **News Shocks and Imperfect Information:** Beaudry and Portier (2006), Lorenzoni (2009), Barsky and Sims (2012)
  - **My Contribution:** The policy shock generates temporary fluctuations in confidence and output.

Outline

1. Fiscal News
2. SVAR
3. Model
4. Conclusion

Fiscal News

- Government spending: g_t
- The government spending forecast h period ahead by the individual respondent i in the SPF:

$$E_{i,t}g_{t+h}, \qquad h = 1,2,3,4$$

- SPF mean government spending forecast h period ahead:

$$E_t g_{t+h} = \frac{1}{N}\sum_{i=1}^{N} E_{i,t}g_{t+h}$$

- Fiscal news (Forni and Gambetti (2016)):

$$news_t^{1,3} = \sum_{h=1}^{3}\left[E_t g_{t+h} - E_{t-1}g_{t+h}\right]$$

Predictive Power

Nature of SPF Forecasts

- Coibion and Gorodnichenko (2015) specification for government spending augmented with news shock.
- Assume that government spending follows an AR(1) process

$$g_t = \rho g_{t-1} + \varepsilon_{t-1} + u_t$$

- Agents cannot observe g_t and ε_t; rather, receive signals $s^1_{i,t}$ and $s^2_{i,t}$:

$$s^1_{i,t} = g_t + \eta_{i,t}, \quad \eta_{i,t} \sim N(0, \sigma^2_\eta),$$

$$s^2_{i,t} = \varepsilon_t + \omega_{i,t}, \quad \omega_{i,t} \sim N(0, \sigma^2_\omega).$$

- The relationship between the mean forecast errors and the mean forecast revisions:

$$g_{t+h} - E_t g_{t+h} = \frac{1-K}{K}\left(E_t g_{t+h} - E_{t-1} g_{t+h}\right) + \varepsilon_{t+h-1,t} + u_{t+h,t}.$$

- K is the Kalman gain (weight placed on new information relative to previous forecasts).

Tests of SPF Forecasts

$$g_{t+3} - E_t g_{t+3} = c + \beta\left(E_t g_{t+3} - E_{t-1} g_{t+3}\right) + \delta z_t + error_t$$

$\beta = 0$ if information frictions are not present

	Control: z_t			
Forecast Error: $g_{t+3} - E_t g_{t+3}$	None	Government Spending	Average Federal Tax Rate	Debt-to-GDP Ratio
c	0.587	0.579	-3.429^{**}	3.488
	(0.56)	(0.62)	(1.38)	(2.63)
$E_t g_{t+3} - E_{t-1} g_{t+3}$	0.968^{*}	0.967^{*}	0.933^{*}	0.887
	(0.52)	(0.51)	(0.55)	(0.71)
z_t		0.001	0.439^{***}	-0.044
		(0.12)	(0.16)	(0.03)
Observations	146	146	146	146
R^2	0.02	0.02	0.03	0.03

Implications for Fiscal News Variable

- The following system

$$\begin{aligned} g_t &= \rho g_{t-1} + \varepsilon_{t-1} + u_t, \\ s^1_{i,t} &= g_t + \eta_{i,t}, \quad \eta_{i,t} \sim N(0, \sigma^2_\eta), \\ s^2_{i,t} &= \varepsilon_t + \omega_{i,t}, \quad \omega_{i,t} \sim N(0, \sigma^2_\omega), \end{aligned}$$

implies that the following relation holds:

$$\underbrace{\sum_{h=1}^{3} [E_t g_{t+h} - E_{t-1} g_{t+h}]}_{news^{1,3}_t} = (1-K) \left(\underbrace{\sum_{h=1}^{3} [E_{t-1} g_{t+h} - E_{t-2} g_{t+h}]}_{news^{1,3}_{t-1}} \right) + \psi \varepsilon_t,$$

where $\psi = K \sum_{h=1}^{3} \rho^h$.

- Current news variable has two component:
  i. Lagged news variable ($(1-K)news^{1,3}_{t-1}$): Adjustment of information from previous period
  ii. News shock ($\psi \varepsilon_t$): Arrival of new information in the current period

Estimation

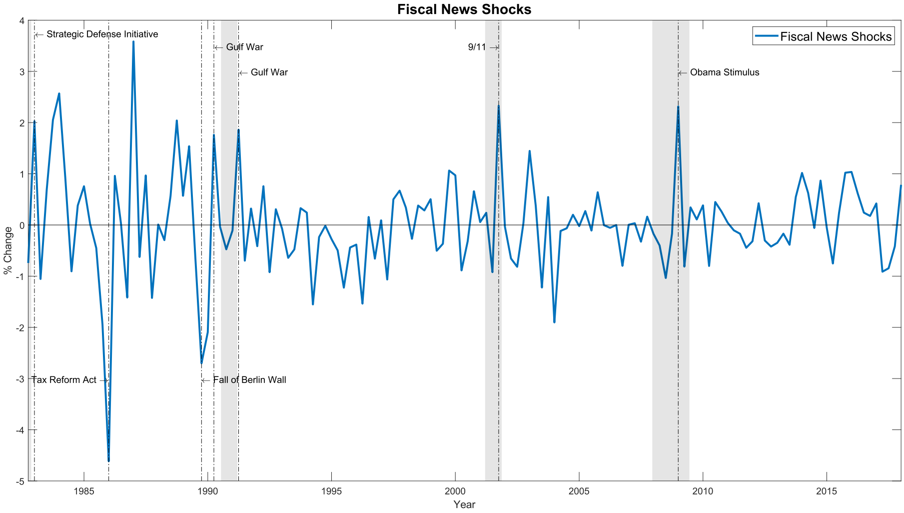
- I estimate following VAR:

$$X_t = M + B(L)X_{t-1} + u_t$$

- X_t is a vector of endogenous variables in following order:
  - Consumer Confidence Expectations Index from Michigan Survey CCE
  - Real federal government consumption and investment less consumption of fixed capital
  - Average Federal Tax Rate: Federal Tax Receipts/GDP
  - Real Consumption
  - Real GDP
  - Federal Funds Rate
  - Fiscal News Variable: $news_t^{1,3}$
- The sample: 1981Q4:2018Q1. AIC lag-length: 4.
- Identification: Cholesky ordering

Imperfect

Fiscal News Shocks



Fiscal News Shocks - Orthogonality

- If the variables used in the VAR span the information set of the agents, then the fiscal news shocks must be orthogonal to all available past information.

- Two tests:

  1. Granger causality test based on a bi-variate VAR with one lag involving fiscal news shocks and Ramey military news Ramey

     Ramey military news does not Granger cause fiscal news shocks

  2. Fundamentalness test (Forni and Gambetti(2014)) Fundamentalness

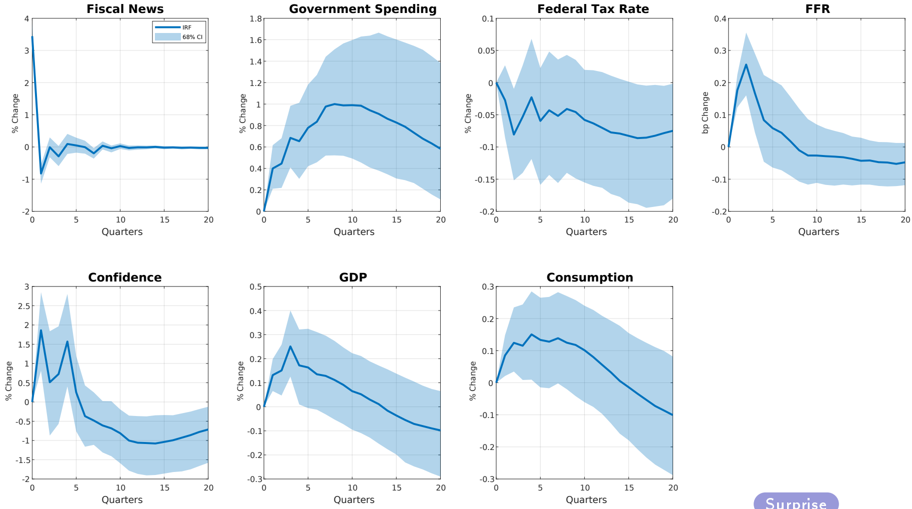
     The first one to six principal components up to four lags does not Granger cause fiscal news shocks

Fiscal News Shocks - Correlation Test

$$\hat{\varepsilon}_t = \gamma + \beta_i z_{it} + u_{it}$$

Shock	Source	z_{it}	Obs
Military News	Ramey & Zubairy (2018)	14.58^{***}	1982Q4-2015Q4
Tax	Romer and Romer (2010)	-0.15	1982Q4-2006Q4
Surprise Tax	Mertens and Ravn (2012)	0.12	1982Q4-2006Q4
Anticipated Tax	Mertens and Ravn (2012)	-0.28	1982Q4-2006Q4
Consumer Sentiment	Forni et. al (2017)	0.03	1982Q4-2011Q1
Anticipated Monetary	Nakamura and Steinsson (2018)	-0.96	1995Q1-2014Q1
Surprise Monetary	Nakamura and Steinsson (2018)	-0.90	1995Q1-2014Q1
Uncertainty	Baker et al. (2016)	0.01	1982Q4-2018Q1
TFP	Fernald (2014)	-0.01	1982Q4-2018Q1
News	Barsky and Sims (2012)	0.07	1982Q4-2007Q3
News	Beaudry and Portier (2014)	0.13	1982Q4-2012Q3

Impulse Responses

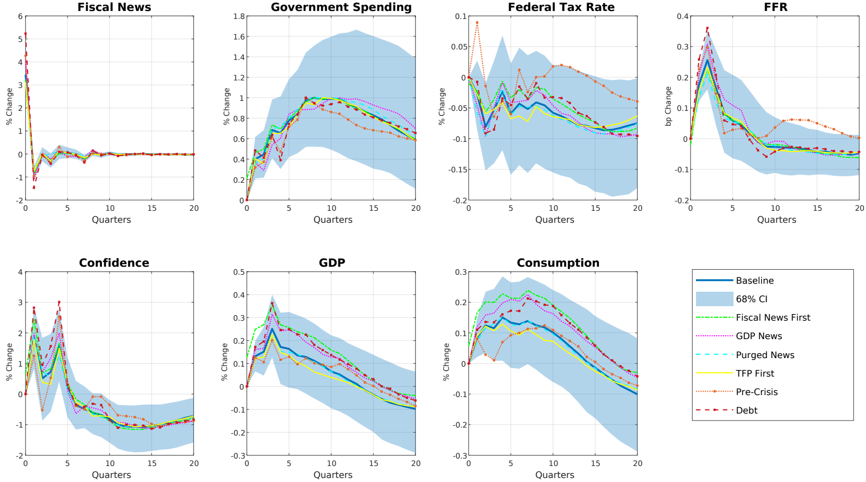


Surprise

Robustness Checks

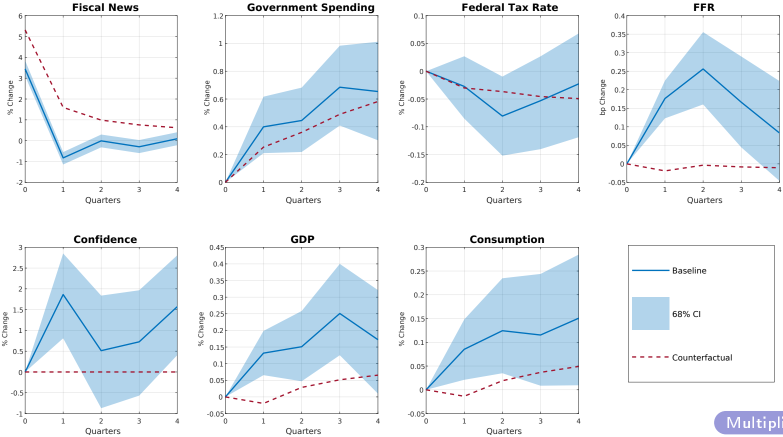
- Alternative ordering 1: Fiscal News ordered first in VAR
- GDP News: Forecasts of GDP growth included second in VAR
- Purged Fiscal News: Fiscal News Variable regressed on forecasts of GDP Growth, unemployment and inflation
- TFP: utilization adjusted Total Factor Productivity included and ordered first in VAR
- Subsample: Pre-crisis period (1981Q4-2007Q4)
- Debt-to-GDP Ratio: Debt-to-GDP ratio included and ordered after average federal tax rate

Robustness Checks



Isolating the Role of Confidence

- To isolate the role of confidence, I follow Sims and Zha (1996) and Bachmann and Sims (2010).
- I create sequence of confidence shocks to shut down the response of confidence to the fiscal news shock.



Multipliers

Model Setup

- Imperfect information model of Lorenzoni (2009) with government sector.
- The economy consists of a continuum of islands indexed by $l \in [0,1]$.
- A representative agent in each island l that owns a continuum of price-setting firms producing differentiated goods indexed by $m \in [0,1]$.
- The agent in island l consumes the goods produced in a subset $D_{l,t} \subset [0,1]$ of other islands.
- The firms in island l are visited by a subset $F_{l,t} \subset [0,1]$ of consumers from other islands.
- The information is common within island level, but not across islands.
- The agents do not observe the aggregate states; instead, they receive island-specific noisy signals as a function of those states.

Households and Preferences

- The problem of the consumer in island l

$$\max_{C_{l,t},N_{l,t},B_{l,t+1}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\log C_{l,t} - \frac{N_{l,t}^{1+\chi}}{1+\chi}\right],$$

with

$$C_{l,t} = \left(\int_{D_{l,t}} \int_0^1 C_{m,j,l,t}^{(\gamma-1)/\gamma} dm dj \right)^{\gamma/(\gamma-1)}.$$

$C_{m,j,l,t}$ is the consumption of the good m produced in island j by the consumer in island l.

- The budget constraint of the consumer in island l

$$Q_t B_{l,t+1} + \overline{P}_{l,t} C_{l,t} = B_{l,t} + W_{l,t} N_{l,t} + \Pi_{l,t} + T_{l,t}$$

- Local PPI

$$P_{l,t} = \left(\int_0^1 P_{m,l,t}^{1-\gamma} dm \right)^{1/(1-\gamma)}$$

- Local CPI

$$\overline{P}_{l,t} = \left(\int_{D_{l,t}} P_{j,t}^{1-\gamma} dj \right)^{1/(1-\gamma)}$$

Households and Preferences

- Demand by l:

$$C_{m,j,l,t} = \left(\frac{P_{m,j,t}}{\overline{P}_{l,t}} \right)^{-\gamma} C_{l,t}$$

- Labor Supply:

$$N_{l,t}^{\chi} = \frac{W_{l,t}}{\overline{P}_{l,t} C_{l,t}}$$

- No-Arbitrage:

$$Q_t = \beta \mathbb{E}_{l,t} \left[\frac{C_{l,t}}{C_{l,t+1}} \frac{\overline{P}_{l,t}}{\overline{P}_{l,t+1}} \right]$$

- Demand for goods produced by l:

$$Y_{m,l,t}^{P} = \int_{F_{l,t}} \left(\frac{P_{m,l,t}}{\overline{P}_{j,t}} \right)^{-\gamma} C_{j,t} dj$$

Government

- The aggregate government budget constraint

$$P_t G_t = T_t$$

$$\int_0^1 \int_0^1 P_{m,l,t} Y^G_{m,l,t} dm dl = \int_0^1 T_{l,t} dl$$

- I assume that government demand for the output good of firm m in island l is

$$Y^G_{m,l,t} = \left(\frac{P_{m,l,t}}{P_t} \right)^{-\gamma} G_t Z^G_{l,m,t}$$

Firms

- The total demand for the firm m in island l is

$$Y_{m,l,t} = Y^P_{m,l,t} + Y^G_{m,l,t}$$

- The production function

$$Y_{m,l,t} = N_{m,l,t}$$

- Each period, on each island, a fraction $1-\theta$ of firms are allowed to reset their price.
- The problem of the optimizer firm in island l

$$\max_{P_{m,l,t+s}} \mathbb{E}_{l,t} \sum_{s=t}^{\infty} \theta^t Q_{l,t+s} \left(P_{m,l,t+s} Y_{m,l,t+s} - W_{l,t+s} N_{m,l,t+s} \right)$$

subject to demand relation, production function and $P_{m,l,t+s} = P^*_{l,t}$.

Log-linear Approximation - Government

- Government spending

$$g_t = \rho_g g_{t-1} + \phi_e e_t$$

- Fiscal news

$$e_t = \rho_e e_{t-1} + \varepsilon_{t-1}, \qquad \varepsilon_t \sim N(0, \sigma_\varepsilon^2)$$

- Aggregate government budget constraint

$$\tau_t = \theta_G (p_t + g_t)$$

where $\tau_t = \int_0^1 \tau_{l,t} dl = \int_0^1 \frac{T_{l,t} - T_l}{Y} dl$ and $\theta_G = \frac{G}{Y}$.

Island-Specific Signals - Price and Private Demand

	Local CPI	Local Private Demand
Levels	$\overline{P}_{l,t} = \left(\int_{D_{l,t}} P_{j,t}^{1-\gamma} dj \right)^{1/(1-\gamma)}$	$\mathsf{Y}_{l,t}^{P} = \int_{F_{l,t}} \left(\frac{P_{l,t}}{\overline{P}_{j,t}} \right)^{-\gamma} C_{j,t} dj$
Log-Linear	$\overline{p}_{l,t} = p_t + \eta_{l,t}^{CPI}$	$\mathsf{y}_{l,t}^{P} = c_t - \gamma \left(p_{l,t} - p_t \right) + \eta_{l,t}^{P}$
Noise	$\eta_{l,t}^{CPI} \sim N(0, \sigma_{\eta^{CPI}}^2)$	$\eta_{l,t}^{P} \sim N(0, \sigma_{\eta^{P}}^2)$
Signal	$\mathsf{s}_{l,t}^{P} = p_t + \eta_{l,t}^{CPI}$	$\mathsf{s}_{l,t}^{D} = c_t + \gamma p_t + \eta_{l,t}^{P}$

Island-Specific Signals - Government Demand and Tax

	Local Government Demand	Local Tax
Levels	$Y_{l,t}^{G} = \left(\frac{P_{l,t}}{P_t}\right)^{-\gamma} G_t Z_{l,t}^{G}$	$\int_0^1 P_{l,t} Y_{l,t}^{G} dl = \int_0^1 T_{l,t} dl$
Log-Linear	$y_{l,t}^{G} = g_t - \gamma(p_{l,t} - p_t) + \xi_{l,t}^{G} + \eta_{l,t}^{G}$	$\tau_{l,t} = \tau_t + \xi_{l,t}^{\tau} + \eta_{l,t}^{\tau},$
Persistent	$\xi_{l,t}^{G} = \rho_\xi \xi_{l,t-1}^{G} + \mu_{l,t}^{1}$	$\xi_{l,t}^{\tau} = \rho_\xi \xi_{l,t-1}^{\tau} + \mu_{l,t}^{2}$
Error Term	$\mu_{l,t}^{1} \sim N(0, \sigma_{\mu_1}^2)$	$\mu_{l,t}^{2} \sim N(0, \sigma_{\mu_2}^2)$
Noise	$\eta_{l,t}^{G} \sim N(0, \sigma_{\eta^G}^2)$	$\eta_{l,t}^{\tau} \sim N(0, \sigma_{\eta^\tau}^2)$
Signal	$s_{l,t}^{G} = e_t + \gamma p_t + \xi_{l,t}^{G} + \eta_{l,t}^{G}$	$s_{l,t}^{\tau} = \theta_G(p_t + e_t) + \xi_{l,t}^{\tau} + \eta_{l,t}^{\tau}$

Aggregate Signals

- The nominal interest rate

$$i_t = (1-\rho_i)i^* + \rho_i i_{t-1} + (1-\rho_i)\varphi\tilde{\pi}_t,$$

where $\tilde{\pi}_t$ is a noisy signal of inflation

$$\tilde{\pi}_t = \pi_t + \omega_t,$$

with $\omega_t \sim N(0, \sigma_\omega^2)$.

Equilibrium

- Euler Equation

$$c_{l,t} = \mathbb{E}_{l,t}\left[c_{l,t+1}\right] - i_t + \mathbb{E}_{l,t}\left[\overline{p}_{l,t+1}\right] - \overline{p}_{l,t}$$

- Budget Constraint

$$y_{l,t} - \tau_{l,t} = \beta b_{l,t+1} - b_{l,t} - p_{l,t} + \theta_C \overline{p}_{l,t} + \theta_C c_{l,t},$$

where $b_{l,t} = \frac{B_{l,t} - B_l}{Y}$.

- Confidence:

$$conf_t = \frac{\sum_{h=1}^{4} \int \mathbb{E}_{l,t}\left[y_{l,t+h} - \tau_{l,t+h}\right] + \sum_{h=1}^{4} \int \mathbb{E}_{l,t}\left[y_{t+h}\right]}{2}$$

Aggregation Analytic

Calibrated

	Parameter	Value	Source
β	Discount factor	0.99	Standard value
χ	Inverse Frisch elasticity	1.00	Standard value
θ_G	Steady-state government spending/output ratio	0.19	Sample mean
θ	Probability of fixed price	0.83	Iacoviello&Neri 2010
ϕ	Response of monetary policy rule to inflation	1.44	Iacoviello&Neri 2010
σ_v	Std. dev. of technology shock	0.0077	Lorenzoni 2009
σ_ω	Std. dev. of noise in inflation	0.0015	Lorenzoni 2009
σ_{η^A}	Std. dev. of noise in productivity signal	0.15	Lorenzoni 2009
$\sigma_{\eta^{CPI}}$	Std. dev. of noise in CPI signal	0.02	Lorenzoni 2009
σ_{η^P}	Std. dev. of noise in private demand signal	0.11	Lorenzoni 2009
σ_ε	Std. dev. of fiscal news shock	0.0201	SVAR

Estimation

- $\hat{\Psi}$ is the vector of VAR impulse responses: $\hat{\Psi} = (g_t, i_t, conf_t, c_t, y_t)$.
- Θ is the parameter vector to be estimated and $\Psi(\Theta)$ is the model impulse responses.
- The estimate of Θ solves

$$\min_{\Theta} \left(\Psi(\Theta) - \hat{\Psi}\right)' \Omega \left(\Psi(\Theta) - \hat{\Psi}\right),$$

  where Ω is a $n \times n$ weighting matrix. In my case, $n = 105$.
- I specify

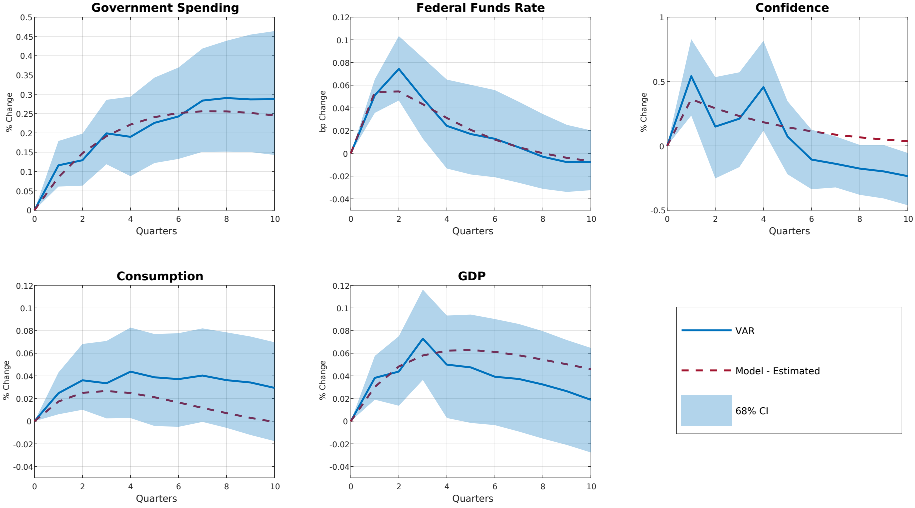
$$\Omega = \Gamma \Lambda^{-1},$$

  where Γ is a $n \times n$ matrix that puts smaller weights to the distant responses and Λ^{-1} is the matrix that has the variance of the VAR impulse responses on the diagonal.

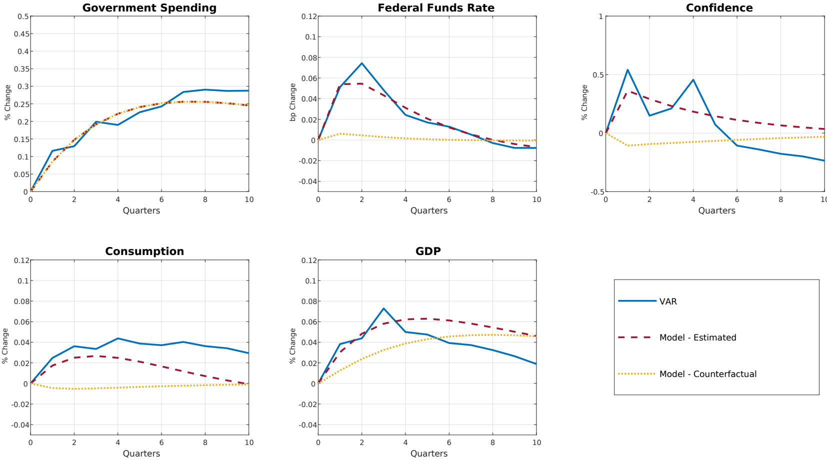
Estimated

	Parameter	Value	Std. Err.
ρ_i	Persistency of monetary policy rule	0.26	0.18
γ	Elasticity of substitution	1.5	0.98
ρ	Persistency of government spending	0.93	0.27
ρ_ε	Persistency of fiscal news	0.80	0.38
ϕ_ε	Elasticity of gov. spending to fiscal news	0.09	0.01
ρ_ξ	AR parameter in persistent gov. demand and tax	0.99	0.01
$\sigma_{\mu^{1,2}}$	Std. dev. of persistent gov. demand and tax	0.09	0.72
σ_{η^G}	Std. dev. of noise in gov. demand signal	0.01	0.19
σ_{η^τ}	Std. dev. of noise in tax signal	1.99	18.65

VAR vs Estimated Model Responses



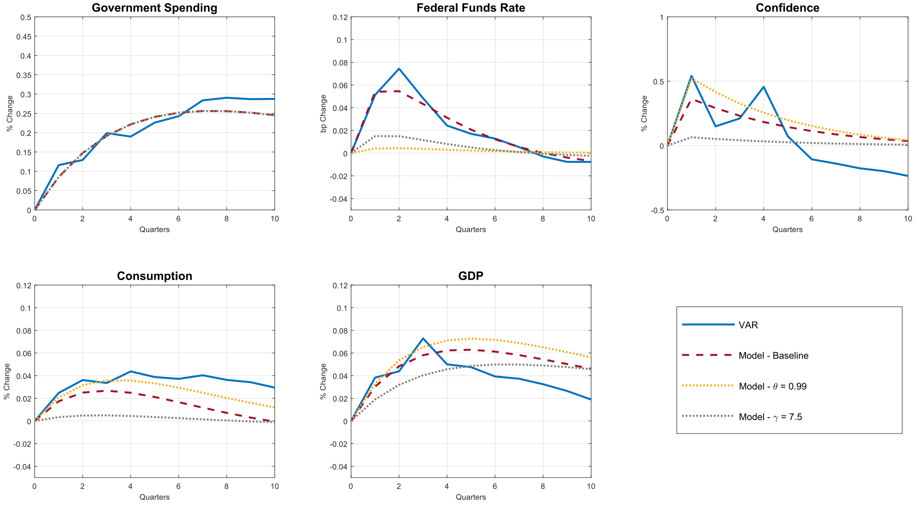
VAR vs Estimated Model vs Counterfactual Model



	Signal	Estimated	Counterfactual
Demand	$\mathbf{d}^G_{l,t} = e_t + \gamma p_t + \xi^G_{l,t} + \eta^G_{l,t}; \eta^G_{l,t} \sim N(0, \sigma^2_{\eta^G})$	$\sigma_{\eta^G} = 0.01$	$\sigma_{\eta^G} = 0.01$
Tax	$\mathbf{d}^\tau_{l,t} = \theta_G(p_t + e_t) + \xi^\tau_{l,t} + \eta^\tau_{l,t}; \eta^\tau_{l,t} \sim N(0, \sigma^2_{\eta^\tau})$	$\sigma_{\eta^\tau} = 1.99$	$\sigma_{\eta^\tau} = 0.01$

Analytic

Sensitivity



Summary

- This paper:
  - shows confidence is an important component in the transmission of fiscal spending shocks
  - upswings in confidence can explain the crowding-in effect of government spending on private consumption
- Policy perspective: managing expectations is a powerful tool in the conduct of fiscal policy
- In the future:
  - VAR with imperfect information of other variables
  - richer fiscal policy variables, state-dependence
  - compare the fit of the model to data relative to the behavioral models such as myopia and rational inattention

Granger Test: Confidence vs GDP

Granger-causality test: MU Consumer Confidence Expectations Indexvs. GDP Growth

Explained Variable	$conf_{t-1}$	gdp_{t-1}
gdp_t (VAR(2))	**0.001**	
gdp_t (VAR(6))	**0.001**	
$conf_t$ (VAR(2))		0.865
$conf_t$ (VAR(6))		0.790

VAR(2) is one lag-length VAR with two variables; confidence and GDP growth. VAR(6) is one lag-length VAR with six variables; confidence, GDP growth, government spending, average federal tax rate, private consumption, and federal funds rate. Sample is 1967Q1-2018Q1.

R

Predictive Power

Single Forecasts: $g_{t+h} = c + \beta_h E_t g_{t+h} + error_t, \quad h = 1,2,3,4$

Cumulative Forecasts: $\sum_{h=1}^{H} g_{t+h} = c + \beta_H \sum_{h=1}^{H} E_t g_{t+h} + error_t, \quad H = 2,3,4$

Predictive Power of SPF forecasts

	Single Forecasts				Cumulative Forecasts		
	$E_t g_{t+1}$	$E_t g_{t+2}$	$E_t g_{t+3}$	$E_t g_{t+4}$	$\sum_{h=1}^{2} E_t g_{t+h}$	$\sum_{h=1}^{3} E_t g_{t+h}$	$\sum_{h=1}^{4} E_t g_{t+h}$
Dep. Var.	R^2	R^2	R^2	R^2	R^2	R^2	R^2
g_{t+1}	0.29						
g_{t+2}		0.26					
g_{t+3}			0.25				
g_{t+4}				0.24			
$\sum_{h=1}^{2} g_{t+h}$					0.43		
$\sum_{h=1}^{3} g_{t+h}$						0.54	
$\sum_{h=1}^{4} g_{t+h}$							0.59

R

Consumer Confidence Expectations Index

- Michigan Survey asks the following questions:

X1 = "*Now looking ahead--do you think that a year from now you (and your family living there) will be better off financially, or worse off, or just about the same as now?*"

X2 = "*Now turning to business conditions in the country as a whole--do you think that during the next twelve months we'll have good times financially, or bad times, or what?*"

X3 = "*Looking ahead, which would you say is more likely--that in the country as a whole we'll have continuous good times during the next five years or so, or that we will have periods of widespread unemployment or depression, or what?*"

- Computes the relative scores (the percent giving favorable replies minus the percent giving unfavorable replies, plus 100) for each of the three index questions.
- Calculates the Consumer Confidence Expectations Index (CCE) as following:

$$CCE = \frac{X_1 + X_2 + X_3}{4.1134} + 2.0.$$

R

Imperfect Information in VAR

- The following system

$$
\begin{aligned}
g_t &= \rho g_{t-1} + \kappa y_{t-1} + \varepsilon_{t-1} + u_t, \\
y_t &= y_t^e + g_t \\
y_t^e &= \rho_y y_{t-1}^e + v_t \\
s_{i,t}^1 &= g_t + \eta_{i,t}, \quad \eta_{i,t} \sim N(0, \sigma_\eta^2), \\
s_{i,t}^2 &= \varepsilon_t + \omega_{i,t}, \quad \omega_{i,t} \sim N(0, \sigma_\omega^2),
\end{aligned}
$$

  implies that the following relation holds:

$$
\underbrace{\sum_{h=1}^{3} [E_t g_{t+h} - E_{t-1} g_{t+h}]}_{news_t^{1,3}} = (1-K)\left(\underbrace{\sum_{h=1}^{3} [E_{t-1} g_{t+h} - E_{t-2} g_{t+h}]}_{news_{t-1}^{1,3}} \right) + \gamma_1 y_t^e + \gamma_2 y_{t-1}^e + \gamma_3 y_{t-2}^e + \psi \varepsilon_t,
$$

- Current news variable has three component:
  i. Lagged news variable ($(1-K)news_{t-1}^{1,3}$): Adjustment of information from previous period
  ii. Reaction to other variables ($\gamma_1 y_t^e + \gamma_2 y_{t-1}^e + \gamma_3 y_{t-2}^e$)
  iii. News shock ($\psi \varepsilon_t$): Arrival of new information in the current period

R

Fiscal News Shocks vs Ramey Military News

Granger-causality test: Fiscal News Shocks ($\hat{\varepsilon}_t$) vs. Ramey Military News ($Ramey_t$)

Explained Variable	$\hat{\varepsilon}_{t-1}$	$Ramey_{t-1}$
$Ramey_t$ (1981Q4:2015Q4)	0.138	
$Ramey_t$ (1986Q4:2013Q1)	0.093*	
$\hat{\varepsilon}_t$ (1981Q4:2015Q4)		0.451
$\hat{\varepsilon}_t$ (1986Q4:2013Q1)		0.276

p-values related to the exclusion Wald-test of one period-lagged covariate of interest. Results are based on a bivariate VAR with one lag. Null hypothesis: column variable does not Granger cause the alternative news shock.

R

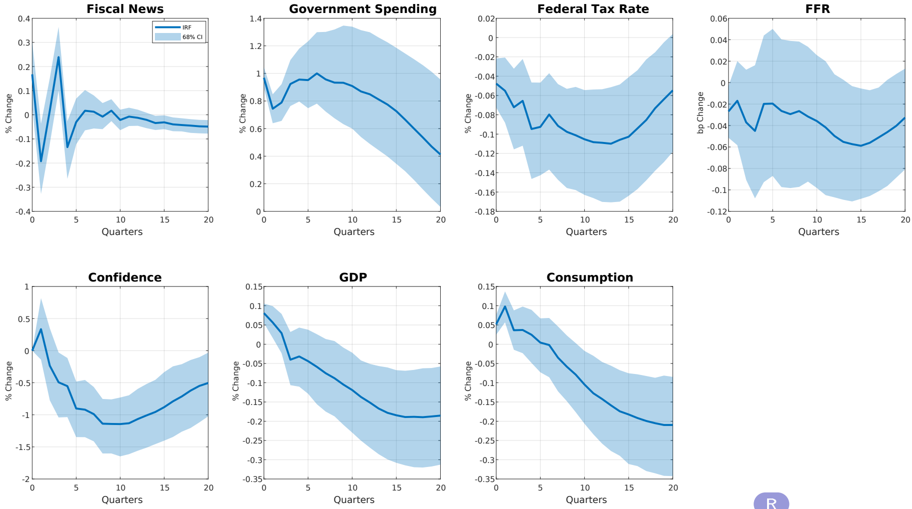
Fiscal News Shocks - Fundamentalness Test

No. of principal components	1	2	3	4	5	6
1 lag	0.90	0.92	0.98	1.00	0.33	0.45
2 lag	0.92	0.99	0.99	1.00	0.52	0.65
3 lag	0.56	0.76	0.81	0.92	0.33	0.38
4 lag	0.71	0.89	0.84	0.94	0.50	0.46

p-values related to the exclusion Wald-test of in a regression of the shock on k lags of the first j principal components, $k = 1,...,4$ and $j = 1,...,6$. Null hypothesis: column variable does not Granger cause the fiscal news shock.

R

Impulse Responses - Surprise Shock



R

Fiscal Multipliers

Horizon	1-year	2-year	3-year	4-year
	1.80	1.21	0.80	0.58
Baseline	$[0.86, 3.14]$	$[0.29, 2.64]$	$[0.03, 2.04]$	$[-0.22, 1.71]$
Counterfactual	0.82	0.78	0.78	0.80
(w/o confidence)	$[0.22, 1.68]$	$[0.39, 1.36]$	$[0.40, 1.45]$	$[0.38, 1.65]$

Estimated fiscal multipliers for a fiscal news shock. The first row presents the multipliers from baseline estimation and the second row from counterfactual estimation in which confidence is not allowed to respond to the fiscal news shock. The numbers in brackets indicate the 68% *confidence intervals from the distribution of multipliers.*

R

Learning and Aggregation

- The variables $z_{l,t} = \left(g_t, e_t, \varepsilon_t, c_t, p_t, i_t, \xi^G_{l,t}, \xi^\tau_{l,t}\right)'$ describe the dynamics of aggregate macro variables. The state of the economy is captured by the infinite dimensional vector $Z_{l,t} = (z_{l,t}, z_{l,t-1}, \ldots)$. I am looking for a linear equilibrium where the law of motion for

$$Z_{l,t} = \mathrm{A}Z_{l,t-1} + \mathrm{B}\mathrm{u}^1_{\mathrm{l,t}}$$

with $u^1_{l,t} = \left(\varepsilon_t, \omega_t, \mu^1_{l,t}, \mu^2_{l,t}\right)'$.

$$Z_{l,t} \begin{pmatrix} \begin{bmatrix} \rho_g & \phi_\varepsilon & \mathbf{0} \end{bmatrix} \\ \begin{bmatrix} 0 & \rho_e & 1 & \mathbf{0} \end{bmatrix} \\ \mathbf{0} \\ \mathrm{A_c} \\ \mathrm{A_p} \\ \begin{bmatrix} \mathbf{0}_{1x4} & -\phi_i & \rho_i & \mathbf{0} \end{bmatrix} + \mathrm{A_p} \\ \begin{bmatrix} \mathbf{0}_{1x6} & \rho_\xi & \mathbf{0} \end{bmatrix} \\ \begin{bmatrix} \mathbf{0}_{1x7} & \rho_\xi \end{bmatrix} \end{pmatrix} Z_{l,t-1} + \begin{pmatrix} \mathbf{0} \\ 0 \\ \begin{bmatrix} 1 & \mathbf{0} \end{bmatrix} \\ \mathrm{B_c} \\ \mathrm{B_p} \\ \begin{bmatrix} 0 & \phi_i & \mathbf{0} \end{bmatrix} + \phi_i \mathrm{B_p} \\ \begin{bmatrix} \mathbf{0}_{1x2} & 1 & \mathbf{0} \end{bmatrix} \\ \begin{bmatrix} \mathbf{0}_{1x3} & 1 \end{bmatrix} \end{pmatrix} \mathrm{u}^1_{\mathrm{l,t}}$$

- To solve for a rational expectations equilibrium, I conjecture that $p_{l,t}$ and $c_{l,t}$ follow the rules

$$p_{l,t} = q_b b_{l,t} + q_p p_{l,t-1} - q_\tau \tau_{l,t} + q_d d_{l,t} + q_z \mathbb{E}_{l,t}\left[\mathrm{Z}_t\right]$$

$$c_{l,t} = -\overline{p}_{l,t} + m_b b_{l,t} + m_p p_{l,t-1} - m_\tau \tau_{l,t} + m_d d_{l,t} + m_z \mathbb{E}_{l,t}\left[\mathrm{Z}_t\right].$$

Learning and Aggregation

- The agents use the Kalman filter to form expectations of the state variables

$$\mathbb{E}_{l,t}\left[Z_{l,t}\right] = \mathbb{E}_{l,t-1}\left[Z_{l,t}\right] + C\left(s_{l,t} - \mathbb{E}_{l,t-1}\left[s_{l,t}\right]\right),$$

where $s_{l,t}$ is the vector of signals observed by the agents in island l

$$s_{l,t} = \left(s_{l,t}^{P}, s_{l,t}^{D}, s_{l,t}^{G}, s_{l,t}^{\tau}, i_t\right)'.$$

- There exists a matrix Ξ such that:

$$\Xi Z_t = \int_0^1 \mathbb{E}_{l,t}\left[Z_{l,t}\right] dl.$$

- Using the Bayesian updating rule and aggregating across islands gives

$$\int \mathbb{E}_{l,t}\left[Z_{l,t}\right] = (I - CF)\, A\mathbb{E}_{l,t-1} Z_{l,t-1} + CFZ_{l,t},$$

- Aggregating the individual decision rules

$$p_t = q_p p_{t-1} + q_d\left(\theta_C c_t + \theta_G e_t + \gamma p_t\right) - q_\tau \theta_G (p_t + e_t) + q_z \Xi Z_{l,t}$$

$$c_t = -\overline{p}_t + m_p p_{t-1} + m_d\left(\theta_C c_t + \theta_G e_t + \gamma p_t\right) - m_\tau \theta_G (p_t + e_t) + m_z \Xi Z_{l,t}.$$

Learning and Aggregation

- Expressing everything in terms of the state $\mathrm{Z_{l,t}}$, the equilibrium coefficients must satisfy

$$\left[-\left(1+m_\tau\theta_G-m_d\gamma\right)e_p+m_pe_{p-1}+\left(m_d\theta_G-m_\tau\right)e_e+m_d\theta_Ce_c+m_z\Xi\right]\mathrm{Z_{l,t}}=0$$

$$\left[\left(q_\tau\theta_G-q_d\gamma\right)e_p+q_pe_{p-1}+\left(q_d\theta_G-q_\tau\right)e_e+q_d\theta_Ce_c+q_z\Xi\right]\mathrm{Z_{l,t}}=0,$$

- In the numerical computation, I replace the state vector $z_{l,t}$ with a truncated vector of states $z_{l,t}^T=\left\{z_{l,t},...,z_{l,t-T}\right\}$. I set $T=50$.
- I set $z_{l,t-T-1}^T=0$ and plugg truncated vector into aggregated Bayesian updating rule which gives

$$\Xi z_{l,t}^T=\left(\mathrm{I}-\mathrm{CF}\right)\mathrm{A}Mz_{l,t}^T+\mathrm{CF}z_{l,t}^T,$$

$$M=\begin{bmatrix}0 & 0\\ 0 & I\end{bmatrix}$$

- This gives the following relation, which is used iteratively to compute

$$\Xi=\left(\mathrm{I}-\mathrm{CF}\right)\mathrm{A}M+\mathrm{CF}$$

- I then apply the updating rule

$$A_c=\left[-\left(1+m_\tau\theta_G-m_d\gamma\right)e_p+m_pe_{p-1}+\left(m_d\theta_G-m_\tau\right)e_e+m_d\theta_Ce_c+m_z\Xi\right]A$$

$$B_c=\left[-\left(1+m_\tau\theta_G-m_d\gamma\right)e_p+m_pe_{p-1}+\left(m_d\theta_G-m_\tau\right)e_e+m_d\theta_Ce_c+m_z\Xi\right]B$$

$$A_p=\left[\left(q_\tau\theta_G-q_d\gamma\right)e_p+q_pe_{p-1}+\left(q_d\theta_G-q_\tau\right)e_e+q_d\theta_Ce_c+q_z\Xi\right]A$$

$$B_p=\left[\left(q_\tau\theta_G-q_d\gamma\right)e_p+q_pe_{p-1}+\left(q_d\theta_G-q_\tau\right)e_e+q_d\theta_Ce_c+q_z\Xi\right]B$$

R

Simple Model

- I make the following assumptions;
  1. Prices and interest rates are perfectly rigid: $p_t = p_{l,t} = \bar{p}_{l,t} \approx 0, i_t \approx 0$
  2. The present value of agents' bond holdings remains nearly constant: $b_{l,t+1} \approx \beta b_{l,t+2}$
  3. All idiosyncratic noises except in demand and tax signals are zero.
  4. Governmet spending is i.i.d: $g_t = \varepsilon_{t-1}$.
- Since prices are fully rigid, the Euler equation is given by

$$c_{l,t} = \mathbb{E}_{l,t}\left[c_{l,t+1}\right]$$

- Budget constraint at time $t+1$

$$\beta b_{l,t+2} = b_{l,t+1} + y_{l,t+1} - \theta_C c_{l,t+1} - \tau_{l,t+1}$$

- Plugging the one period ahead budget constraint gives

$$c_{l,t} = \frac{1}{\theta_C}\mathbb{E}_{l,t}\left[y_{l,t+1} - \tau_{l,t+1}\right]$$

- The time t expectations of total demand and taxes in time $t+1$ as

$$\mathbb{E}_{l,t}\left[y_{l,t+1}\right] = \mathbb{E}_{l,t}\left[\theta_C c_{t+1} + \theta_G\left(\varepsilon_t + \rho_\xi \xi^G_{l,t}\right)\right]$$

$$\mathbb{E}_{l,t}\left[\tau_{l,t+1}\right] = \mathbb{E}_{l,t}\left[\theta_G \varepsilon_t + \rho_\xi \xi^\tau_{l,t}\right]$$

- Euler equation becomes

$$c_{l,t} = \mathbb{E}_{l,t}\left[c_{t+1}\right] + \frac{\theta_G}{\theta_C}\rho_\xi \mathbb{E}_{l,t}\left[\xi^G_{l,t}\right] - \frac{\rho_\xi}{\theta_C}\mathbb{E}_{l,t}\left[\xi^\tau_{l,t}\right]$$

Simple Model

- The expected value of idiosyncratic government demand and tax signals are equal to

$$\mathbb{E}_{l,t}\left[\xi^G_{l,t}\right] = K_{11}s^G_{l,t} + K_{12}s^\tau_{l,t}$$

$$\mathbb{E}_{l,t}\left[\xi^\tau_{l,t}\right] = K_{21}s^G_{l,t} + K_{22}s^\tau_{l,t}$$

- Signals

$$s^G_{l,t} = e_t + \xi^G_{l,t} + \eta^G_{l,t}; s^\tau_{l,t} = \theta_G e_t + \xi^\tau_{l,t} + \eta^\tau_{l,t}$$

- Aggregating expected values

$$\int_0^1 \mathbb{E}_{l,t}\left[\xi^G_{l,t}\right] = K_{11}e_t + K_{12}\theta_G e_t$$

$$\int_0^1 \mathbb{E}_{l,t}\left[\xi^\tau_{l,t}\right] = K_{21}e_t + K_{22}\theta_G e_t$$

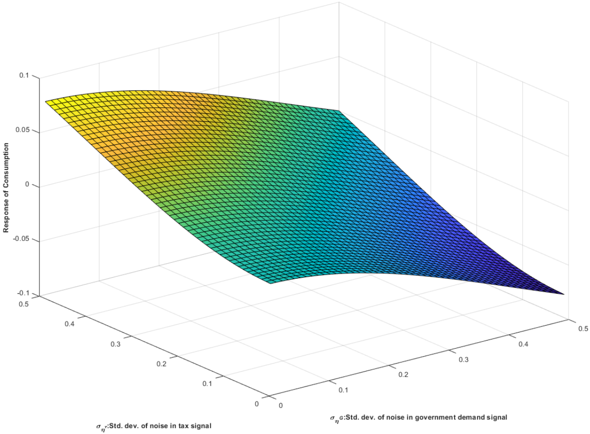
- Now aggregating the indiviudal Euler equations

$$c_t = \int_0^1 c_{l,t} = \int_0^1 \mathbb{E}_{l,t}\left[c_{t+1}\right] + \frac{\theta_G}{\theta_C}\rho_\xi \int_0^1 \mathbb{E}_{l,t}\left[\xi^G_{l,t}\right] - \frac{\rho_\xi}{\theta_C}\int_0^1 \mathbb{E}_{l,t}\left[\xi^\tau_{l,t}\right]$$

across the islands gives the aggregate consumption

$$c_t = \int_0^1 \mathbb{E}_{l,t}\left[c_{t+1}\right] + \frac{\theta_G}{\theta_C}\rho_\xi\left(K_{11} + K_{12}\theta_G - \frac{K_{21}}{\theta_G} - K_{22}\right)e_t$$

Simple Model



- **Response of Consumption:** $\left(K_{11} + K_{12}\theta_G - \frac{K_{21}}{\theta_G} - K_{22}\right)$ R

Simple Model

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Simple Model

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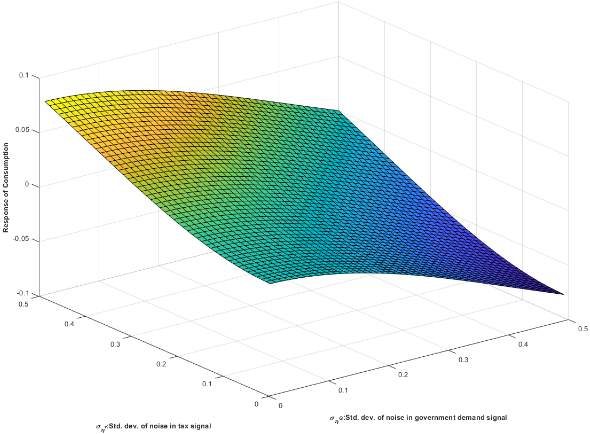
across the islands gives the aggregate consumption

$$c_t = \int_0^1 \mathbb{E}_{l,t}\left[c_{t+1}\right] + \frac{\theta_G}{\theta_C}\rho_\xi\left(K_{11} + K_{12}\theta_G - \frac{K_{21}}{\theta_G} - K_{22}\right)e_t$$

Simple Model



- Response of Consumption: $\left(K_{11} + K_{12}\theta_G - \frac{K_{21}}{\theta_G} - K_{22}\right)$ R