The Consequences of Financial Center Conditions for Emerging Market Sovereigns

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Financial Center Conditions

- Consequences of *tight financial conditions* in the US for EM sovereigns?
  - Recessionary, increased default risk
  - Consistent with widespread expressions of concern in EMs

- Less is known about *news* of future conditions
  - The start of a US monetary tightening cycle, policy announcements, etc.

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- What we do...
    1. Identify incentives for borrowing and default in a tractable model
        - Ambiguity in the response of spreads

    2. Model of US yield curve/SDF with news shocks

    3. Sovereign default model to confront the evidence
        - Domestic financial frictions
        - A story of three interest rates: financial center, sovereign's, and domestic
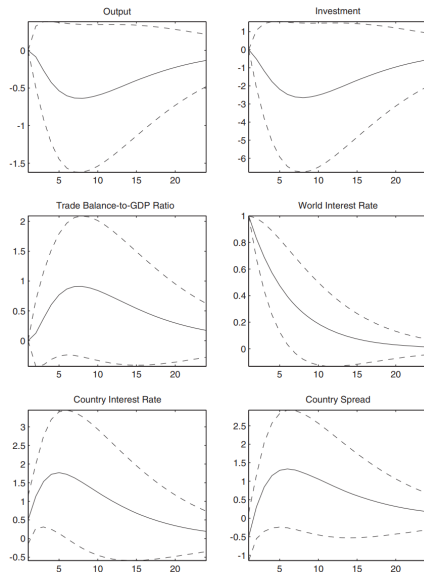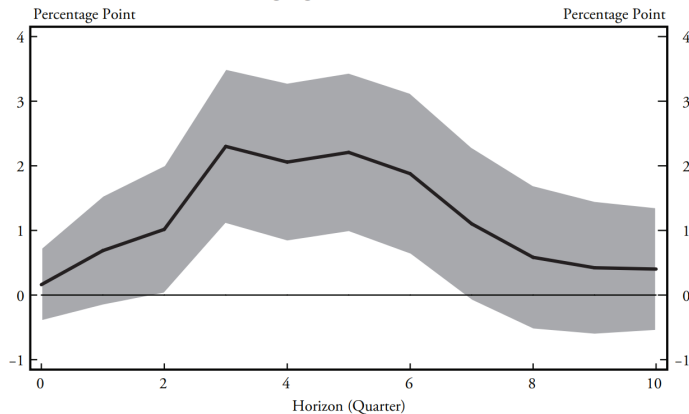
Impulse responses to a 1% increase in the financial center rate (Uribe Yue, 2006)

- *Depressed output* and investment
- Current Account reversal
- Higher yields *and spreads*

Work-in-progress:
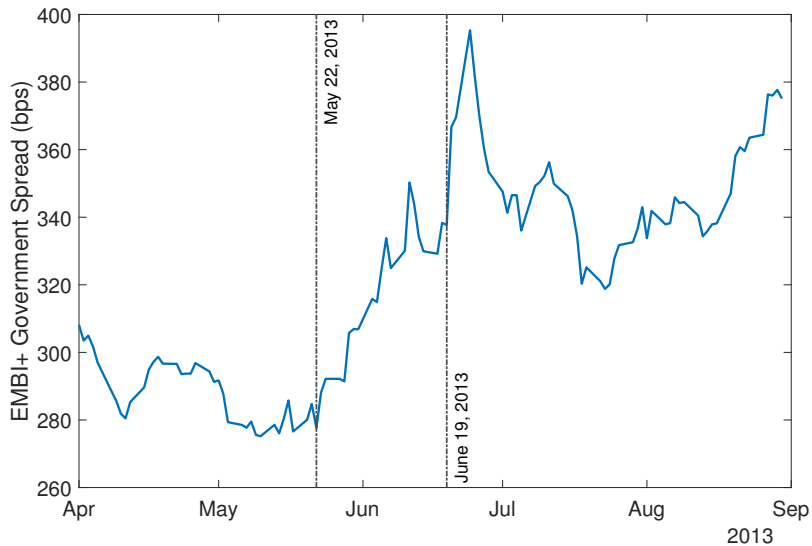extend sample, panel Local Projection, IV

Responses of 12-Month Government Bond Rate Differentials I
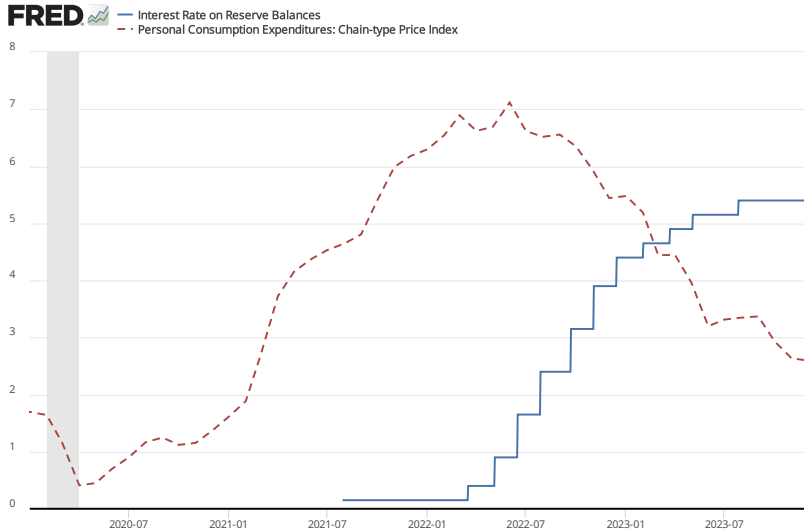
A. Emerging Market Economies

U.S. Three–Month Treasury Rate Shock

2013 "Taper Tantrum" Episode

2022 Tightening Cycle

Sources: Board of Governors; BEA   fred.stlouisfed.org

Roadmap

1. Intuition in the simplest default model

2. A pricing kernel with news, disciplined by the US yield curve

3. A quantitative sovereign default model with domestic financial frictions

Simple Analytics of Risk-free Rate Movements in a Tractable Default Model

A Tractable Default Model

$$V\left(b|r,r'\right) = \max_{b'} \left\{ \bar{y} - b + q(b'|r,r')b' + \beta \mathbf{E}_\nu \max \left\{ V\left(b'|r',r'\right),\ V^d - \nu \right\} \right\}$$

$$q(b'|r,r') = \frac{1}{1+r} \Pr \left[V(b'|r',r') \geq V^d - \nu \right]$$

- Linear utility
- One period debt
- Constant endowment $\bar{y}$
- Default value shock ν, with pdf ϕ and cdf Φ
- Risk-free rate r this period, r' in all future periods

Default Behavior

$$\nu^*(b'|r') \equiv V^d - V\left(b'|r', r'\right) \qquad \text{(Default Threshold)}$$

$$V\left(b|r, r'\right) = \overline{y} - b + \max_{b'} \left\{ q(b'|r, r')b' + \beta \left[\int_{-\infty}^{\nu^*(\cdot)} \left(V^d - \nu\right) d\Phi + \int_{\nu^*(\cdot)}^{\infty} V(b'|r', r') d\Phi \right] \right\}$$

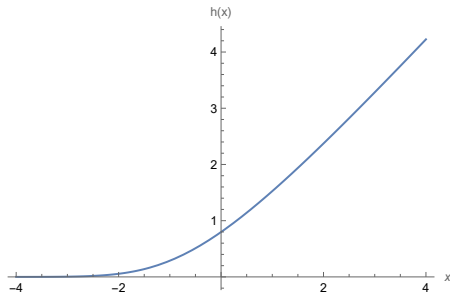$$q(b'|r, r') = \frac{1 - \Phi\left[\nu^*(b'|r')\right]}{1 + r}$$

Borrowing Behavior

$$h\left(\nu^*(b'|r')\right)b' = \underbrace{1 - \beta\left(1 + r\right)}_{>0} \qquad \text{(Optimal Borrowing)}$$

$$h(\nu) \equiv \frac{\phi(\nu)}{[1 - \Phi(\nu)]} \qquad \text{(Hazard Ratio)}$$

A One Time Increase in r

Start at $r = r' = \bar{r}$ and consider a one time increase in today's r:

$$h\left(\nu^*(b'|r')\right)b' = \underbrace{1 - \beta\left(1 + r\right)}_{\downarrow} \qquad \text{(Optimal Borrowing)}$$

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- LHS $\downarrow$, must have RHS $\downarrow$, and therefore $b' \downarrow$
- r' unchanged, so $\nu^*(b'|r') \downarrow$
- *Lower* default probability and spread

Future Interest Rates

Start at $r = r' = \bar{r}$ and consider an increase in all future rates r':

$$h\left(v^*(b'|r')\right)b' = \underbrace{1 - \beta(1 + r)}_{\text{no change}} \qquad \text{(Optimal Borrowing)}$$

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$$\frac{\partial}{\partial r'} V(b'|r', r') \overset{?}{<} 0 \qquad \text{(Value of Market Access)}$$

$$r' \uparrow \;\;\Rightarrow\;\; V(b'|r', r') \downarrow \;\;\Rightarrow\;\; v^*(b'|r') \uparrow \;\;\Rightarrow\;\; b' \downarrow$$

Spread and Borrowing Response to Risk-free Rate Shocks
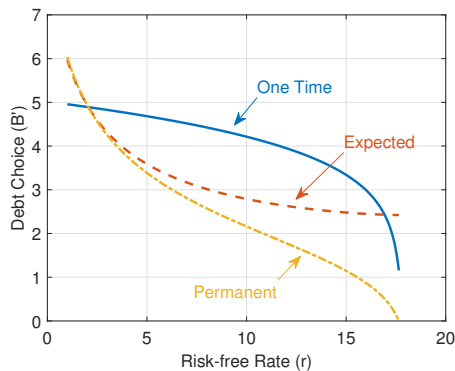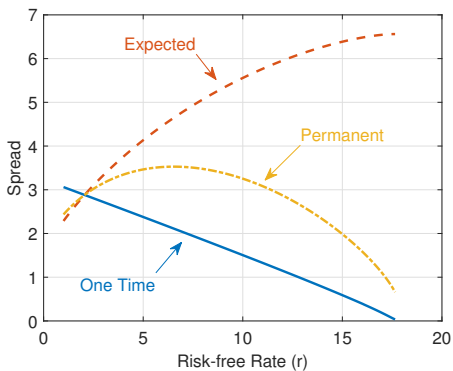
- One Time: $r > \bar{r}, r' = \bar{r} = 2\%$
- Expected: $r = \bar{r}, r' > \bar{r}$
- Permanent: $r = r' > \bar{r}$

A Pricing Kernel with News

A One-Factor SDF with News

$$q_t^{\$,n} = \mathbf{E}_t \left\{ \frac{m_{t+1}}{\Pi_{t+1}} q_{t+1}^{\$,n-1} \right\}, \qquad q_t^{\$,0} = 1 \qquad \text{(ZC Bond Prices)}$$

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$$-\log m_{t+1} = x_t + 0.5\lambda_m^2 + \lambda_m \varepsilon_{t+1} \qquad \text{(Real SDF)}$$

$$x_{t+1} = (1-\rho)\nu_t + \rho_x x_t + \sigma_x \varepsilon_{t+1} \qquad \text{(Factor)}$$

$$\nu_{t+1} = \begin{cases} \nu_t, & \text{w.p. } p \\ \text{iid } N(\mu_\nu, \sigma_\nu^2), & \text{otherwise} \end{cases} \qquad \text{(News)}$$

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$$-\log \Pi_{t+1} = \mu_\pi + \iota_\nu \nu_t + \iota_x x_t + A_4(L)\eta_{t+1} \qquad \text{(Inflation)}$$

SDF Parameter Estimates

	Estimate	95% CI
First Stage		
ρ_x	0.7395	[0.6123, 0.8183]
σ_x	0.0036	[0.0000, 0.0048]
σ_η	0.0045	[0.0000, 0.0524]
J	9	
p	0.9672	
μ_ν	$-8.2e^{-4}$	
σ_ν	0.0109	
Second Stage		
ι_x	-0.7425	
A_1	-0.4676	
A_2	-0.1445	
A_3	0.0369	
A_4	-0.0578	
λ_m	-0.2359	

Two stage procedure...

1. Use 3mo yield and inflation to estimate and filter x_t and ν_t (including breaks/jumps)

2. Use higher maturities to estimate Π_{t+1} equation and market price of risk λ_m
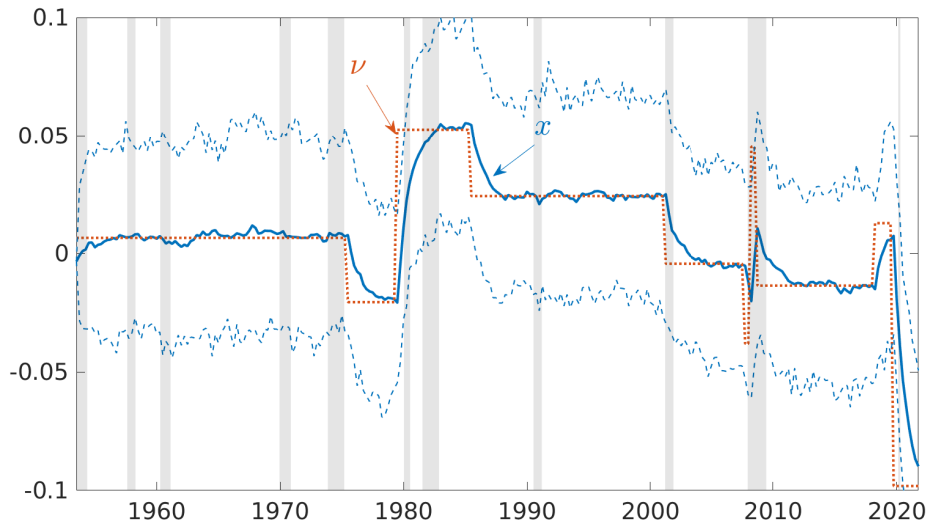
A Quantitative Sovereign Default Model

Model Outline

- Domestic private sector
    - Households
    - Financial Intermediaries
    - Producers

- The sovereign
    - Operates in international financial markets
    - Long-term defaultable bond
    - Transfers (or taxes) lump sum proceeds to household

- International lenders
    - Price and hold the sovereign's bond
    - One factor SDF with news

- Equilibrium default (Markov Perfect equilibrium)

The Household and the Domestic Interest Rate

$$\max_{\{\ell_t, b^h_{t+1}\}} \mathbf{E}_0 \sum_{t=0}^{\infty} \beta^t u\left(c_t, \ell_t\right) \text{ s.t. } c_t = w_t \ell_t + \Pi_t + \Pi^f_t + T_t - b^h_t + \frac{1}{1+i_t} b^h_{t+1}$$

$$u_\ell(c_t, \ell_t) + u_c(c_t, \ell_t) w_t = 0 \qquad\qquad \text{(FOC } \ell_t\text{)}$$

$$u_c(c_t, \ell_t) = \beta(1 + i_t)\mathbf{E}_t u_c(c_{t+1}, \ell_{t+1}) \qquad\qquad \text{(FOC } b^h_{t+1}\text{)}$$

$$b^h_t = b^h_{t+1} = 0 \qquad\qquad \text{(Zero Net Supply)}$$

Producers and the Working Capital Constraint

$$\Pi_t = \max_{\ell_t} \left\{ A_t \ell_t^\alpha - \left[(1 - \theta) w_t \ell_t + \theta (1 + i_t) w_t \ell_t \right] \right\}$$

$$\ell_t = \left(\frac{\alpha}{1 + \theta i_t} \cdot \frac{A_t}{w_t} \right)^{1/(1-\alpha)} \qquad \text{(FOC } \ell_t)$$

$$\log A_{t+1} = \rho_A \log A_t + \sigma_A \varepsilon_{t+1} \qquad \text{(Productivity)}$$

Domestic Financial Intermediaries

$$\Pi_t^f = -a_t + (1 + i_t) a_t = i_t a_t$$

$$a_t = \theta w_t \ell_t \qquad \text{(Market Clearing)}$$

$$i_t = \frac{u_c (c_t, \ell_t)}{\beta \mathbf{E}_t u_c (c_{t+1}, \ell_{t+1})} - 1 \qquad \text{(Domestic Rate)}$$

The Sovereign

$$T_t = q_t \left[B_{t+1} - (1 - \delta) B_t \right] - \kappa B_t - \overline{G}$$

Transfer to household

- proceeds from sale of new issuance $B_{t+1} - (1 - \delta)B_t$ at market price q_t,
- minus debt service payment κB_t,
- minus government spending

In default, $T_t = -\overline{G}$

International Lenders

$$q_t = \mathbf{E}_t \left\{ m_{t+1} \left(1 - d_{t+1}\right) \left[\kappa + (1 - \delta)q_{t+1}\right] \right\} \qquad \text{(Sovereign Bond Price Schedule)}$$

$$q_t^{\text{rf}} = \mathbf{E}_t \left\{ m_{t+1} \left[\kappa + (1 - \delta)q_{t+1}^{\text{rf}}\right] \right\} \qquad \text{(Risk-free Bond)}$$

- m_t driven by x_t factor and news ν_t (real SDF)
- Same duration for sovereigns' and risk-free bonds
- Yield-to-maturity spread

$$sp_t = \kappa \left(\frac{1}{q_t} - \frac{1}{q_t^{\text{rf}}} \right)$$

Adding Up

Consolidate sovereign, household, and domestic firms...

$$w_t \ell_t + \Pi_t + \Pi_t^f = A_t \ell_t^\alpha = c_t + \overline{G} + tb_t \qquad \text{(GDP)}$$

$$tb_t = \kappa B_t - q_t[B_{t+1} - (1-\delta)B_t] \qquad \text{(BoP)}$$

Equilibrium $\ell_t(A_t, i_t, B_t, B_{t+1})$

Outcomes in Default

- Productivity penalty

$$A_t \rightarrow h(A_t) \leq A_t$$

- Market exclusion of random length (stops w.p. χ)

- Return to market without outstanding debt (full repudiation)

Why is the domestic rate i_t not the yield on the sovereign's bond?

$$u_c(c_t, \ell_t) = \beta(1 + i_t)\mathbf{E}_t u_c(c_{t+1}, \ell_{t+1}) \qquad \text{(Household FOC)}$$

$$u_c(c_t, \ell_t) = \beta \frac{\kappa}{q_t + \frac{\partial q_t}{\partial B_{t+1}} B_{t+1}} \mathbf{E}_t(1 - d_{t+1}) u_c(c_{t+1}, \ell_{t+1}) \qquad \text{(Sovereign FOC)}$$

- Sovereign as monopolist in own bonds: internalize slope of demand
- Marginal cost of borrowing only in repayment (default option)
- Difference in maturity: one period vs long-term with δ

	Value	Comment
σ	2.0	CRRA
β	0.99	Discounting
ψ	1.0	Normalization, mean ℓ
μ	1.0	Inverse of Frisch elasticity (GHH)
α	0.67	Returns to scale
θ	1.5	Working capital constraint
$\overline{G}$	0.0	Public spending
δ	0.05	5 year debt Macaulay duration
κ	$\delta + \mu_\nu$	Normalization
λ_0	-0.24	Penalty, linear
λ_1	$+0.27$	Penalty, quadratic
χ	$1/8$	Market return probability
ρ_x	0.74	Autocorrelation of pricing kernel factor
σ_x	0.0036	Volatility of factor
μ_ν	$-8.3e^{-4}$	Average factor level
σ_ν	0.011	Volatility of factor trend shocks
p	0.9672	Probability of renewal
λ_m	-0.236	Market price of risk
ρ_A	0.95	Autocorrelation of productivity
σ_A	0.005	Volatility of productivity shock
η_D	$1e^{-6}$	Default taste shock
η_B	$5e^{-5}$	Borrowing taste shock

	Model
Mean	
Spread	1.96
Debt to GDP	12.3
Standard Deviations	
Spread	1.37
GDP	3.91
Consumption	4.87
Domestic Rate	3.51
Correlations	
Spread and GDP	-24.1
Trade Balance/GDP and GDP	-67.4

Stochastic IRFs

- Default model $\Rightarrow$ no steady state, but ergodic distribution
- *Where* to shock for IRFs?

- Idea, based on Koop, Pesaran, and Potter (1996), . . .
    - Simulate long and wide panel of model economies (independent)
    - Eventually, cross section $\Rightarrow$ ergodic distribution
    - Then, shock all panel units by the same amount
    - Trace out average responses

    Equivalent to shocking everywhere and weighting by ergodic distribution
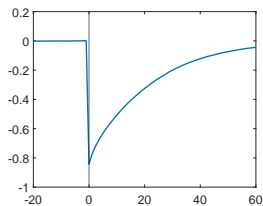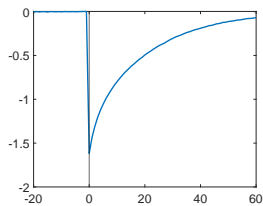
Productivity (A) GDP Consumption (c) Share in Default
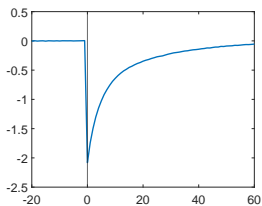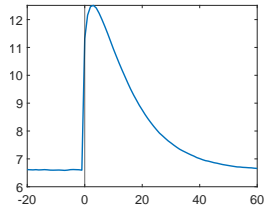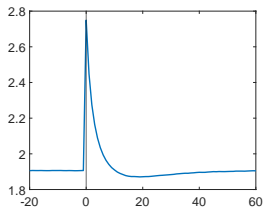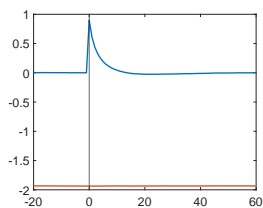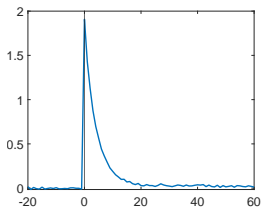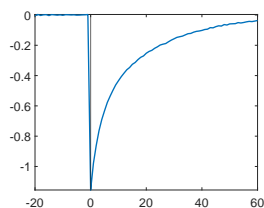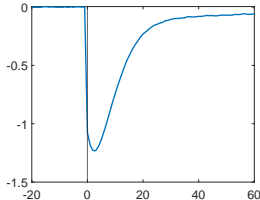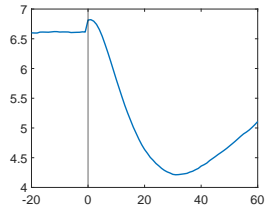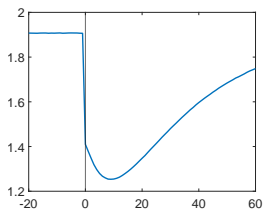
Spread Yields Domestic Rate (i) Labor (ℓ)
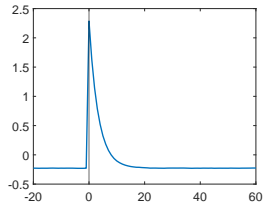
Factor (x)

GDP

Consumption (c)
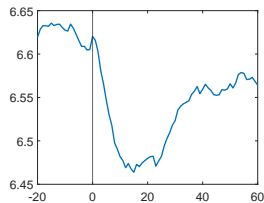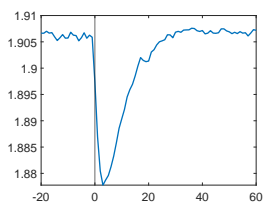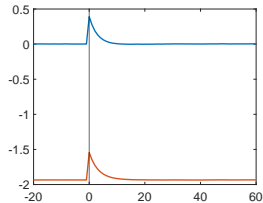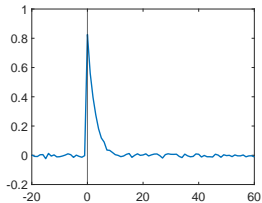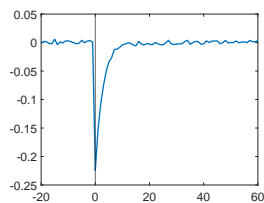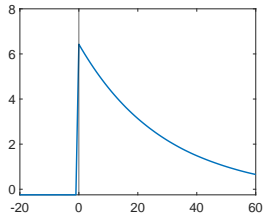
Share in Default

Spread

Yields

Domestic Rate (i)

Labor (ℓ)
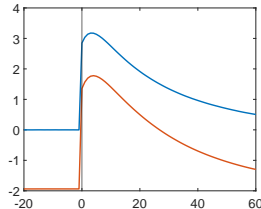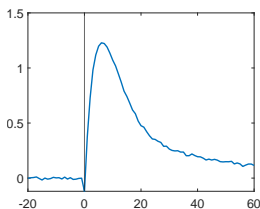
News (ν)

GDP
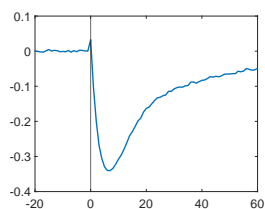
Consumption (c)

Share in Default

Spread

Yields

Domestic Rate (i)

Labor (ℓ)

Summing Up
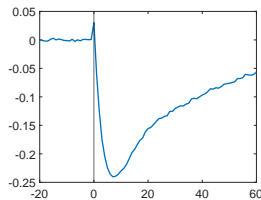
- Simple theory highlights ambiguity for spreads: shock persistence and news

- Preliminary evidence on news and anticipated movements for US yield curve

- Quantitative model
  - Financial frictions key for output response
  - Domestic interest rate volatility is a costly side-effect of sovereign borrowing
  - A "puzzle:" spreads consistently fall (too willing to drop B'?)