Which Financial Shocks Drive the Business Cycle?

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(joint with Andrea Ajello & Ander Perez-Orive - Federal Reserve Board)

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Introduction

Asset prices driven by discount rates

- Cochrane 2010; Gilchrist and Zakrajsek 2012

Underlying mechanisms

- Intermediaries' risk-bearing capacity (e.g. He and Krishnamurthy 2013), sentiment or behavioral (Shiller 2014), liquidity and liquidity risk (Acharya and Pedersen 2005), heterogeneous beliefs,...

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Monetary DSGE with rich corporate finance structure

- Long-term nominal debt
- Strategic default
- Match debt flows, default rates, idiosyncratic volatility, credit spreads
- Study how corporate finance frictions propagate shocks to debt demand

What are Corporate Debt Preference Shocks?

Financial and agency frictions at intermediaries

- Risk-bearing capacity: Gabaix, Krishnamurthy, and Vigneron (2007), He and Krishnamuarthy (2013), Adrian, Etula, and Muir (2014)
- Reach for yield: Rajan (2006), Jimenez, Ongena, Peydro, and Saurina (2014), Hanson and Stein (2015), Gertler and Karadi (2015)

Sentiment or behavioral

- Minsky (1986), Shiller (2014), Greenwood and Shleifer (2014), Barberis, Greenwood, Jin and Shleifer (2018)

Liquidity and liquidity risk

- Acharya and Pedersen (2005) and Lin, Wang, and Wu (2011)

Safety, flight to quality, knightian uncertainty

- Krishnamurthy and Vissing-Jorgensen (2012)

Household-level idiosyncratic risk

- Constantinides and Duffie (1996)

Heterogenous preferences or beliefs

- Garleanu and Panageas (2015), Basak (2005), Bhamra and Uppal (2015)

Regulatory shocks and regulatory uncertainty

- Danıelsson, Shin, and Zigrand (2004), Baker, Bloom, and Davis (2016)

Why Focus on Corporate Debt?

Relevant for mechanisms driving discount rates

- Highly intermediated (He Kelly Manela 2017; Haddad and Muir 2018)
- Relatively illiquid (He and Xiong 2012; Bao Pan Wang 2011)
- More exposed to downside risk (Geanakoplos 2009; Gennaioli Shleifer and Vishny 2012; Gourio 2012)

Economically relevant

- Major source of external finance for corporations
- Credit spreads have substantial predictive power for business cycles
  - Important info is risk premium not expected defaults (Gilchrist Zakrajsek 2012)
- In contrast, stock prices do not have robust predictive power for aggregate activity (Fama 1981; Campbell 1999; Lopez-Salido Stein Zakrajsek 2015)
- Net debt issuance is cyclical and negatively correlated with net equity issuance

Focus on corporate debt

Two types of debt demand shocks

- Demand for corporate debt
- Demand for long-term debt (corporate or government)
- Do these shocks affect economic activity through very different mechanisms?

Main Insights

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Results hold when including risk shocks (shocks to supply of corporate bonds)

Model: Agents, Frictions and Shocks

Households

- Shocks to investors' preference for:
  - corporate bonds $\longrightarrow$ excess bond premium ϕ_t^B
  - long-term bonds (Treasury & corporate bonds) $\longrightarrow$ term premium ϕ_t^{TP}
- Akin to money-in-utility approach (Sidrauski 1976, Krishnamurthy and Vissing Jorgensen 2012, Fisher 2015)

Entrepreneurs

- Buy capital and rent it out. Issue defaultable debt.
- Firm-specific capital quality shock with time-varying volatility $\sigma_{z,t}$ (risk shock)

Final Goods Producers
Intermediate Capital Goods Producers (Rotemberg price and wage rigidities)
Capital Producers (Investment adjustment costs)
Monetary Policy Authority (Taylor rule)

Model: The Household–Preferences

$$U_t = \frac{C_t^{1-\psi}}{1-\psi} + \phi_t^{TP} u(Q_t^{TB} TB_t) + (\phi_t^{B} + \phi_t^{TP}) u(Q_t^{B} B_t).$$

Household owns and derives utility from

- Treasury bonds (TB_t) with price Q_t^{TB}
- Corporate bonds (B_t) with price Q_t^{B}

Demand shocks for corporate bonds (ϕ_t^{B}) and long-term bonds (ϕ_t^{TP})

Not shown:

- Habits (Campbell-Cochrane (1999))
- Disutility of labor with constant Frisch elasticity

Asset-class-specific SDFs

Treasury bonds:

$$SDF^{TB}_{t,t+1} = \frac{1}{1 - \frac{1}{C_t^{-\psi}}(\phi_t^{TP})(Q_t^{TB}\,TB_t)^{-\kappa}} \frac{C_{t+1}^{-\psi}}{C_t^{-\psi}}$$

Corporate bonds:

$$SDF^{B}_{t,t+1} = \frac{1}{1 - \frac{1}{C_t^{-\psi}}(\phi_t^{B} + \phi_t^{TP})(Q_t^{B}\,B_t)^{-\kappa}} \frac{C_{t+1}^{-\psi}}{C_t^{-\psi}}$$

Model: The Household-Asset Pricing

Treasury bond price:

$$Q_t^{TB} = \beta E_t[SDF_{t,t+1}^{TB}(c + \lambda + (1-\lambda)Q_{t+1}^{TB})]$$

$$yield_t^{TB,\frac{1}{\lambda}} = \frac{c+\lambda}{Q_t^{TB}} - \lambda$$

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$$yield_t^{B,\frac{1}{\lambda}} = \frac{c+\lambda}{Q_t^{B}} - \lambda$$

Corporate spread:

$$Spread_t = yield_t^B - yield_t^{TB}$$

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- Debt and dividend adjustment costs

- Strategic default choice:

$$J(B_{t-1}/\pi_t, \overline{K}_{t-1}, z_t, S_t) =$$

$$\max\left[0, \Pi_t(z_t) - \left\{(1-\tau)c + \left[1 - \tau(1 - Q_t^B)\lambda\right]\right\}\frac{B_{t-1}}{\pi_t} + V(B_{t-1}/\pi_t, \mathbf{S}_t)\right],$$

where the value of continuation for firm shareholders is

$$\begin{aligned} V(B_{t-1}/\pi_t, \mathbf{S}_t) &= \max_{B_t, \overline{K}_t} Q_t^B \Delta B_t - \upsilon(B_t) - Q_t^k \overline{K}_t \\ &\quad + E_t\left[\beta SDF_{t,t+1} \int_0^\infty J(B_t, \overline{K}_t, z_{t+1}, \mathbf{S}_{t+1}) d\Phi(z_{t+1})\right] \end{aligned}$$

Model Solution and Estimation

- FOCs solved using first-order perturbation methods
- State-space model estimated via Bayesian methods

Observable Variables

- Sample: 1982Q1 to 2017Q4.
- Standard real (CEE/SW) variables (per capita GDP, C, Inv, Real Wage growths, Hours, FFR, Inflation);
- Financial variables [measured with error (*)]
  - Non-farm Business Debt Repurchases (*)

$$DRP_t = -\frac{(B_t - B_{t-1})}{GDP_t}$$

  - Baa corporate bond spread (*)

$$Spread_t = yield_t^B - yield_t^{TB,\frac{1}{\lambda}}$$

  - Term spread (*)

$$TS_t = yield_t^{TB,\frac{1}{\lambda}} - yield_t^{TB,1}$$

  - Default Rate of Corporate Bonds

$$DR_t = \Sigma_{i=0}^{3} \Phi(z_{t-i}^*)$$

  - Idiosyncratic Volatility of Stock Returns (*)

$$Vol_t = \sigma_{z,t}$$

Comparison of Financial Observables

	Our paper	Jermann and Quadrini (2012)	Christiano, Motto, and Rostagno (2014)
Debt Repurchases	x	x	x
Baa corporate bond spread	x		x
Term spread	x		x
Default Rate of Corporate Bonds	x		
Idiosyncratic Volatility of Stock Returns	x		
Stock Market			x

Exogenous Shocks

- Exogenous shocks to be identified:
  - Macro Shocks: TFP, MP, Price and Wage Mark-up, Intertemporal Pref Shock, Government spending
  - Corporate Credit Supply Shock: Risk Shock (CMR)
  - Portfolio Preference Shocks: Corporate Bond and Long Maturity Bond preference shock.

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  - Corporate Credit Supply Shock: Risk Shock (CMR)
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- Identification strategy:
  - Risk shocks (or bond supply shock) mapped into de-trended idiosyncratic excess return volatility, as one possible driver of corporate defaults.
  - Asset preference shocks (or bond demand shock) allow for independent (residual) variation of demand for debt.

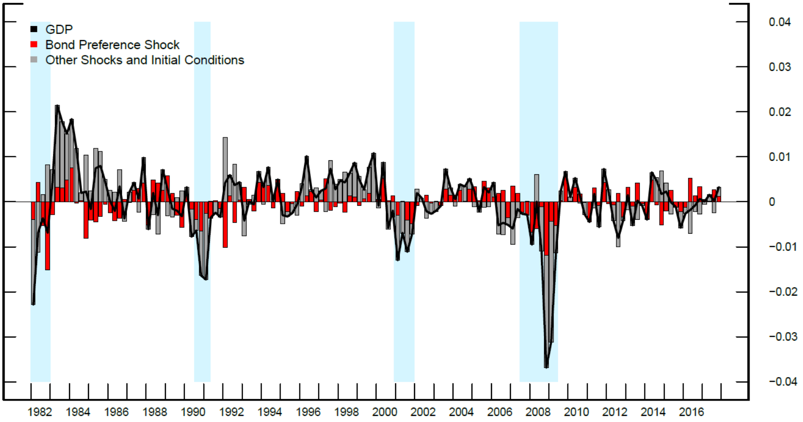
Variance Decomposition

Variance Decomposition

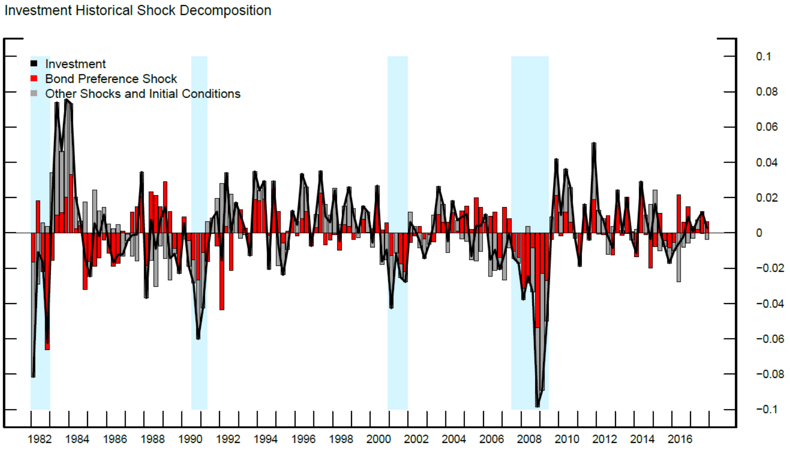
	mp	gam	p	w	bet	g	tp	b	sigma
GDP	9	21	25	5	9	9	3	17	1
Investment	10	10	31	6	1	0	6	35	2
Consumption	1	30	2	1	56	0	1	9	0
Hours	4	3	35	6	6	3	4	39	1
Inflation	3	5	7	5	4	2	7	67	0
Fed Funds Rate	4	7	6	2	3	2	6	70	0
Corporate Bond Spread	0	0	0	0	0	0	1	99	0
Term Premium	5	2	3	1	2	1	62	23	0
Idiosyncratic Stock Return Vol	0	0	0	0	0	0	0	0	44
Excess Stock Returns	4	5	1	1	2	1	15	63	8
Excess Bond Returns	3	2	1	2	1	1	43	22	25
Equity Payouts	0	10	1	2	1	0	1	42	44
Default Rate	0	0	0	0	0	0	4	79	16
Debt Repurchases	1	29	2	1	1	1	3	21	0

Historical Shock Decomposition: GDP

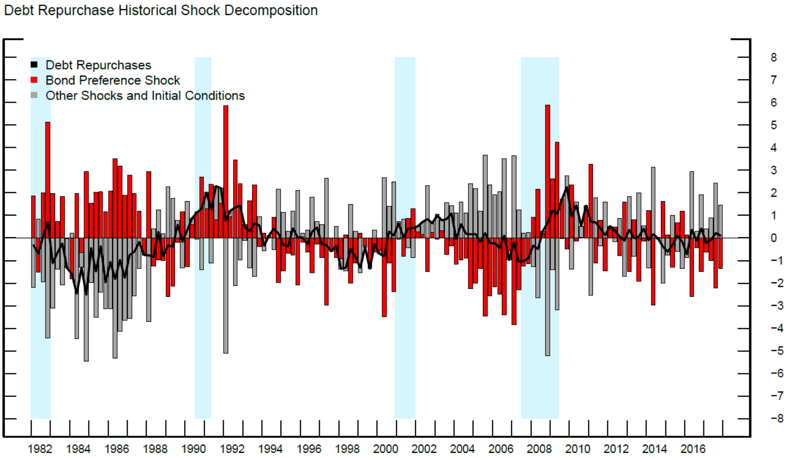
GDP Growth Historical Shock Decomposition



Historical Shock Decomposition: Investment

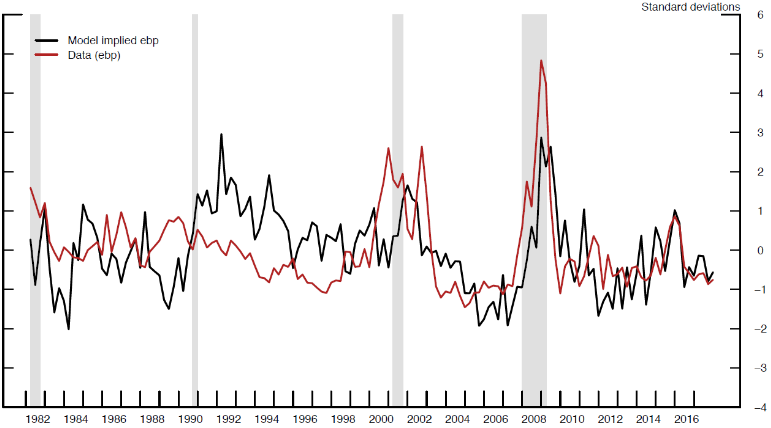


Historical Shock Decomposition: Debt Flows



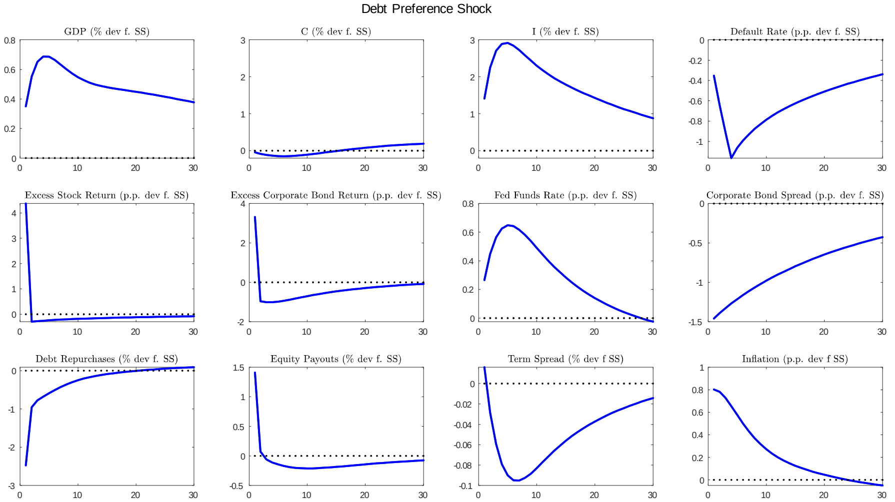
Model Implied EBP vs Data

Model implied ebp

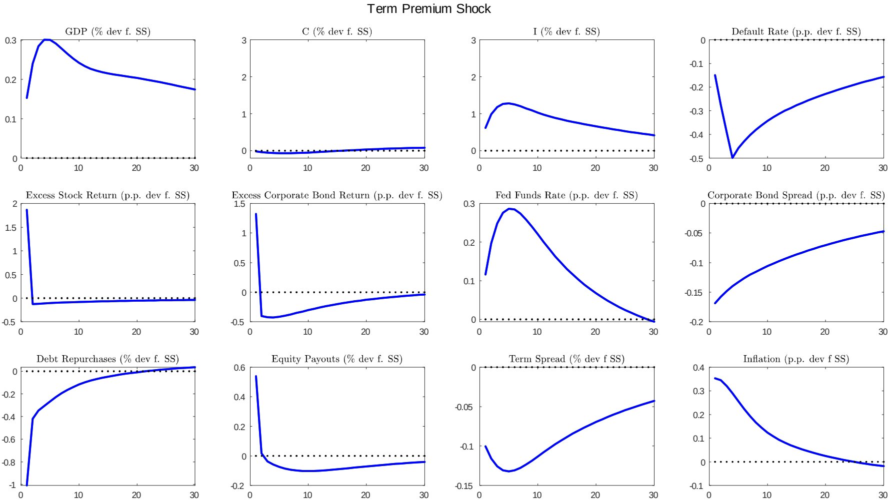


Note: The Data (ebp) series is the standardized Ex 267% ted recessions.

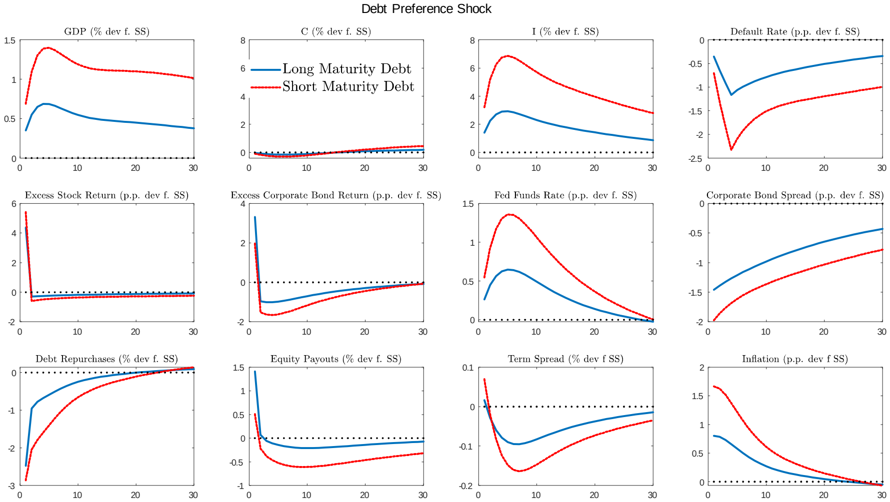
IRFs: Bond Preference Shock



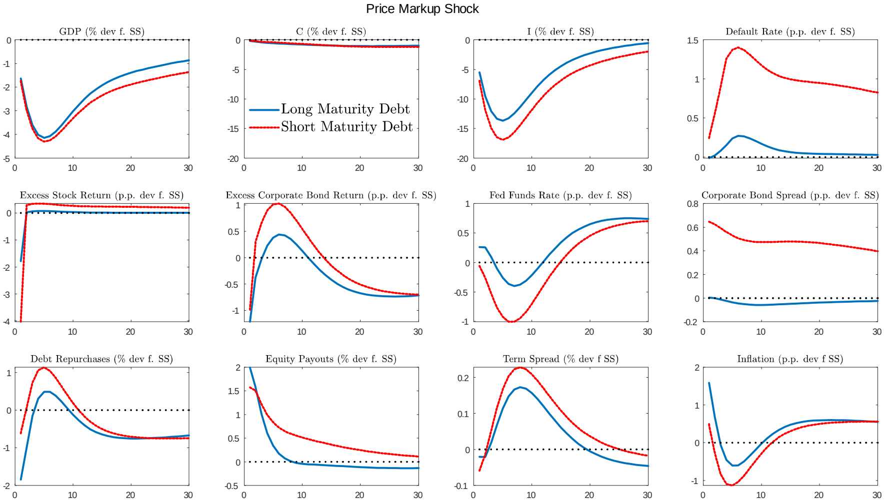
IRFs: Term Premium Shock



IRFs: Role of Debt Maturity



IRFs: Debt Deflation



Conclusion

- Propose framework for studying role of risk premia in macroeconomic dynamics.
- Framework addresses two key empirical findings
  - Credit spreads have substantial predictive power for business cycles, and predictive power comes from variation in premia not default losses; in contrast, stock prices do not have robust predictive power
  - Net debt issuance is cyclical and negatively correlated with net equity issuance
- Contribution
  - develop monetary dynamic general equilibrium model in which firms optimally choose investment, debt, equity issuance, taking into account expected default losses and fluctuations in risk premia
  - Estimate model to match asset prices, financing flows, and macro variables
- Next Steps
  - Explore implications of asset demand elasticity further.
  - Explore alternative shock structures (treasury preference shocks, equity preference shock?)

Model: Value of Corporate Debt

- Constraint to maximization problem – HH Euler equation for corporate debt:

$$
\begin{aligned}
Q_t^B B_t \quad = \quad & E_t \Bigg[\beta SDF^B_{t,t+1} \Bigg[(1 - \Phi(z^*_{t+1}))(c + \lambda + (1-\lambda) Q^B_{t+1}) \frac{B_t}{\pi_{t+1}} + \\
& \xi \left(\int_{z_{min}}^{z^*_{t+1}} \Pi^{pt}_{t+1}(z_{t+1}) d\Phi(z) \right. \\
& \left. + \Phi(z^*_{t+1}) (V(B_t / \pi_{t+1}, \mathbf{S}_{t+1}) + (1-\lambda) Q^B_{t+1} \frac{B_t}{\pi_{t+1}}) \right) \Bigg] \Bigg]
\end{aligned}
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& \xi \left(\int_{z_{min}}^{z_{t+1}^*} \Pi_{t+1}^{pt}(z_{t+1}) d\Phi(z) \right. \\
& \left. \left. \left. + \Phi(z_{t+1}^*)(V(B_t/\pi_{t+1}, \mathbf{S}_{t+1}) + (1-\lambda) Q_{t+1}^B \frac{B_t}{\pi_{t+1}}) \right) \right] \right]
\end{aligned}
$$

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Observation equation:

$$Y_t = C + BX_t + \eta_t^{meas}$$

- Y_t, vector of observables,
- C, constant terms
- B, loadings on state variables X_t

State-transition equation:

$$X_t = \mu_X + \Phi X_{t-1} + \Sigma \varepsilon_t$$

- X_t, vector of state variables,
- $[\mu, \Phi, \Sigma]$ solution to DSGE model
- ε_t, structural shocks to the economy.