Asset safety and liquidity over the business cycle

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Motivation I

The market for treasuries is one of the largest financial markets:

- \$27,000 bn of securities outstanding end of 2Q2024;
- \$880 bn average daily trading volume in 2Q2024.

Treasuries play a pivotal role for U.S. monetary policy implementation:

- used in open market operations, i.e., reverse repo;
- at the center of CB balance-sheet policies like QE and QT.

Also the corporate-bonds market is important and growing.

Motivation II

Treasuries are valued not only for their pecuniary return:

- they bear a liquidity premium;
- they bear a safety premium.

In the data, both components are counter-cyclical, even after controlling for:

- fiscal policy (supply of treasuries);
- monetary policy (effective federal funds rate);
- economic uncertainty (VIX index).

To explain the data, we develop a real business cycle model with:

- labor-search frictions;
- corporate bonds and corporate default;
- a transactions-based role for assets.

Related literature

Treasury premium: Krishnamurthy and Vissing-Jorgensen (2012); Nagel (2016); Caramp and Singh (2023); Bayer et al. (2023); Ferrero and Haas (2023).

Corporate default: Gourio (2013); Gomes et al. (2016); Bai (2021).

Labor search and liquidity: Berentsen et al. (2011), Ait Lahcen et al. (2022).

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Stylized facts I

	Total premium (Baa - TB20Y)	Safety premium (Baa - Aaa)	Liquidity premium (Aaa - TB20Y)
Average	1.99 pp	1.18 pp	0.81 pp
Average during recessions	2.62 pp	1.65 pp	0.97 pp
Average outside of recessions	1.80 pp	1.04 pp	0.76 pp

Cyclical components:	Total premium (Baa - TB20Y)	Safety premium (Baa - Aaa)	Liquidity premium (Aaa - TB20Y)
STD	0.45 pp	0.34 pp	0.17 pp
STD during recessions	0.68 pp	0.55 pp	0.20 pp
STD outside of recessions	0.31 pp	0.21 pp	0.16 pp

Notes: Data covers the period 1919Q1-2019Q4. Cyclical series are computed using the HP filter with $\lambda = 1,600$.

Stylized facts II

	Dep. var.: yield difference (HP filtered)		
	Baa-TB20Y	Baa-Aaa	Aaa-TB20Y
	(1)	(2)	(3)
Unemployment	0.317***	0.187***	0.129***
	(0.042)	(0.029)	(0.018)
Debt-to-GDP	-7.534***	-3.378***	-4.157***
	(1.472)	(0.994)	(0.749)
Federal Funds Rate	0.011	0.006	0.005
	(0.020)	(0.015)	(0.009)
VIX	0.055***	0.033***	0.022***
	(0.013)	(0.010)	(0.009)
Observations	262	262	262
R^2	0.500	0.430	0.392
Adjusted R^2	0.493	0.421	0.383
Residual Std. Error	0.305	0.207	0.158
F Statistic	27.300***	18.956***	33.462***
Note:	*p<0.1; **p<0.05; ***p<0.01		

Table: Regressions of yield differences on unemployment (HP filtered).

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Overview

Real business cycle model with frictions in goods, labor, and financial markets.

Unit mass of large firms:

- match with workers in a labor market (Pissarides, 2000);
- sell output in a frictional goods market (Kiyotaki and Wright, 1993);
- face aggregate and idiosyncratic shocks;
- issue defaultable bonds (Bai, 2021).

Unit mass of households:

- supply labor to firms in the labor market;
- buy goods from firms in the frictional goods market;
- need liquid assets to pay for goods (Lagos and Wright, 2005).

Environment

Time $t = 0, 1, 2, ...$ is discrete and continues forever.

Trade takes place in alternating markets:

- decentralized goods market (DM);
- centralized goods and asset market (CM);
- decentralized labor market (LM).

Two perishable goods:

- DM good x;
- CM good y (numéraire).

Two assets:

- safe government bonds (fixed supply);
- defaultable corporate bonds (endogenous supply).

Preferences and technologies

Household has preferences described by

$$\mathcal{U} = \sum_{t=0}^{\infty} \beta^t \left[u(x_t) + h_t\right];$$

- x_t consumption of DM$_t$ goods;
- h_t net consumption of CM$_t$ goods.

A firm with n workers produces $(y - z)n$ CM goods:

- economy-wide productivity y;
- idiosyncratic i.i.d. cost shock z.

Firm can produce x units of DM good on-demand from $c(x)$ units of CM goods.

Timeline

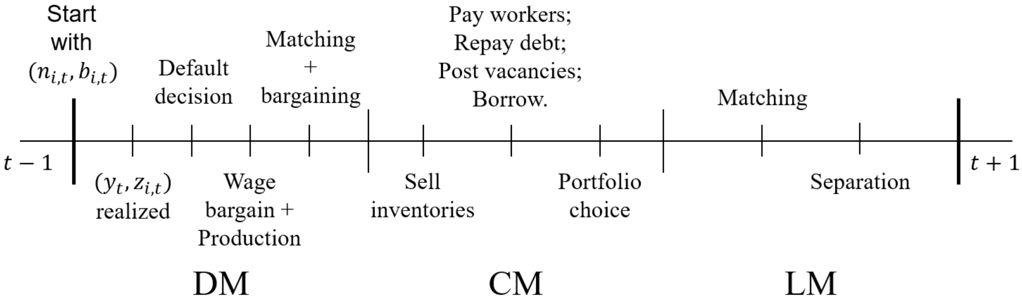

Figure: Timeline of events.

Households: employed at firm with shock z

$$
\begin{aligned}
V^1(b_g, b_c, z) = {} & \alpha(n) \max_{\mathrm{v}(x) \le a(b_g, b_c)} \{u(x) - \mathrm{v}(x)\} \\
& + b_g + b_c \int r(b, n, z)\Phi(\mathrm{d}z') + \mathrm{w}(z) + T \\
& + \max_{b_{g,+1}, b_{+1} \ge 0} \left\{ \begin{aligned} & - b_{g,+1} p_g - b_{c,+1} p(b_{+1}, n_{+1}) + \beta\delta\mathbb{E}V^0_{+1}(b_{g,+1}, b_{c,+1}) \\ & \quad + \beta(1-\delta)\mathbb{E}\int V^1_{+1}(b_{g,+1}, b_{c,+1}, z')\Phi(\mathrm{d}z') \end{aligned} \right\}.
\end{aligned}
$$

Collateral value of the asset portfolio is

$$
a(b_g, b_c) \equiv \chi_g b_g + \chi_c b_c \int r(b, n, z')\Phi(\mathrm{d}z')
$$

Households: unemployed

$$
\begin{aligned}
V^0(b_g, b_c) = \alpha(n) & \max_{\mathrm{v}(x) \leq a(b_g, b_c)} \{u(x) - \mathrm{v}(x)\} \\
& + b_g + b_c \int r(b, n, z')\Phi(\mathrm{d}z') + \ell + T \\
& + \max_{b_{g,+1}, b_{+1} \geq 0} \left\{ \begin{aligned} & - b_{g,+1} p_g - b_{c,+1} p(b_{+1}, n_{+1}) + \beta[1 - f(\theta)]\mathbb{E}V^0_{+1}(b_{g,+1}, b_{+1}) \\ & \quad + \beta f(\theta)\mathbb{E} \int V^1_{+1}(b_{g,+1}, b_{+1}, z')\Phi(\mathrm{d}z') \end{aligned} \right\}.
\end{aligned}
$$

The term ℓ is the flow value of being unemployed.

Firms: equity value

Equity value for a firm with n workers, b bonds, and shock z:

$$J(n,b,z) = \max\left\{0, \left[\mathcal{O} - \mathrm{w}(z) - z\right] n - b + V(n)\right\}$$

$$V(n) \equiv \max_{v,b_{+1}} \left\{-\kappa v + (1+\tau) p\left(b_{+1}, n_{+1}\right) b_{+1} + \beta \mathbb{E} \int J_{+1}(n_{+1}, b_{+1}, z') \Phi(\mathrm{d}z')\right\}$$

- revenue per worker is $\mathcal{O} = y + \frac{\alpha(N)}{N}[\mathrm{v}(x) - c(x)]$;
- firm's employment develops as $n_{+1} = (1-\delta)n + q(\theta)v$;

The actual CM repayment bondholders receive per bond is:

$$\overline{r}(b,n,z) = \begin{cases} 1 & \text{if } z \leq z^*(b,n), \\ \frac{\zeta[(\mathcal{O} - \mathrm{w}(z) - z)n + V(n)]}{b} & \text{if } z > z^*(b,n). \end{cases}$$

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Equilibrium

We solve for a recursive equilibrium with as relevant aggregate state

$$\Omega = \{y, n, b\},$$

where b are corporate bonds and $\{n_{+1}, b_{+1}\}$ is perfectly predictable from Ω.

In equilibrium:

- bargained wages depend only on Ω and shock z;
- all households hold the same asset portfolio;
- the value of a firm is linear in employment, i.e, $V(n) = nV(1)$;
- collateral supply is $a = \chi_g b_g + \chi_c b \underbrace{\int r(b, n, z')\Phi(\mathrm{d}z')}_{\equiv \mathcal{R}}$

Asset pricing I

Collateral scarcity is

$$\mathcal{L} = \alpha(n) \max \left\{ \left(\frac{u' - \mathrm{v}'}{\mathrm{v}'} \right) \circ \mathrm{v}^{-1}(a), 0 \right\}.$$

Euler equations imply bond prices

$$\begin{aligned} p_g &= \beta \mathbb{E} \left\{ 1 + \chi_g \mathcal{L}_{+1} \right\}, \\ p_c &= \beta \mathbb{E} \left\{ \mathcal{R}_{+1} [1 + \chi_c \mathcal{L}_{+1}] \right\}. \end{aligned}$$

A safe corporate bond ($r_+ = 1$ almost surely) would be priced at:

$$p_{c,s} = \beta \mathbb{E} \left\{ 1 + \chi_c \mathcal{L}_{+1} \right\}.$$

Asset pricing II

Following Krishnamurthy and Vissing-Jorgensen (2012):

$$\underbrace{\log p_g - \log p_c}_{\equiv \text{ treasury premium}} = \underbrace{\log p_g - \log p_{c,s}}_{\equiv \text{ liquidity premium}} + \underbrace{\log p_{c,s} - \log p_c}_{\equiv \text{ safety premium}}.$$

This implies

$$\text{LP} \approx (\chi_g - \chi_c)\mathbb{E}\mathcal{L}_{+1},$$

$$\text{SP} \approx 1 - \mathbb{E}\mathcal{R}_{+1} - \frac{\chi_c \mathbb{COV}\{\mathcal{R}_{+1}, \mathcal{L}_{+1}\}}{1 + \chi_c \mathbb{E}\mathcal{L}_{+1}}.$$

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Calibration: functional forms

We match the model at a monthly frequency:

- $\log y = (1-\rho_y)\log \bar{y} + \rho_y \log y_{-1} + \varepsilon_y, \quad \varepsilon_y \sim N(0, \sigma_y)$;
- $z \sim N(0, \sigma_z)$;
- LM matching as in Den Haan et al. (2000)

$$\mathcal{M}(v,u) = \frac{v(1-n)}{[v^\mu + (1-n)^\mu]^{1/\mu}};$$

- CRRA utility and linear cost in the DM as in Lagos and Wright (2005)

$$u(x) = A\frac{x^{1-\gamma}}{1-\gamma} \quad \text{and} \quad c(x) = x;$$

- DM matching as in Kiyotaki and Wright (1993)

$$\alpha(n) = \frac{n}{1+n}.$$

Calibration: direct

We can calibrate some parameters directly from the data:

Table: Directly calibrated parameters

Parameter	Description	Value
β	Discount factor	0.9986
δ	Job separation rate	0.0250
ζ	Restructuring recovery.	0.4200
χ_g	Government-bond pledgeability	1.0000

Calibration: indirect

We calibrate the remaining parameters jointly with SMM:

Table: SMM calibrated parameters

Parameter	Description	Value	Moment	Frequency	Data	Model
κ	Vacancy cost	0.749	Average labor market tightness	Monthly	0.655	0.655
ℓ	Flow value of unemployment	1.008	Unemployment volatility	Quarterly	0.138	0.139
μ	Parameter of the LM matching fun.	1.195	Average job finding probability	Monthly	0.430	0.430
ξ	Worker bargaining weight	0.057	Elast. of wage to labor prod.	Quarterly	0.481	0.477
ρ_y	Persistence parameter of y process	0.941	Autocorr. of labor productivity	Quarterly	0.735	0.729
σ_y	Volatility parameter of y process	0.006	SD of labor productivity	Quarterly	0.013	0.013
A	Level parameter of DM utility	0.851	Average safety premium (annualized)	Monthly	1.179pp	0.557pp
γ	Curvature parameter of DM utility	0.226	Volatility of the treasury premium	Monthly	0.446	0.439
χ_c	Pledgeability of corporate bonds	0.565	Average liquidity premium (annualized)	Monthly	0.810pp	0.808pp
φ	Buyer bargaining weight	0.057	Average DM price markup	Monthly	0.360	0.350
b_g	Real supply of government bonds	0.266	Average treasuries/NGDP	Monthly	0.262	0.264
σ_z	SD of the idiosyncratic cost shock z_i	0.209	Quarterly average default rate on Baa-rated bonds	Monthly	0.059%	0.071%

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Model validation

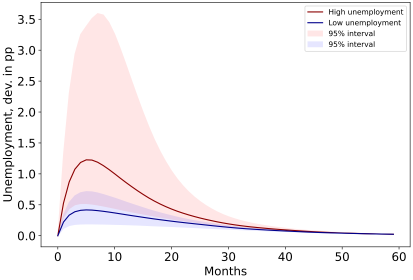
	Treasury premium	*Safety premium*	*Liquidity premium*
	(1)	(2)	(3)
Data coeff. on u	0.317***	0.187***	0.129***
	(0.042)	(0.029)	(0.018)
Model coeff. on u	0.459***	0.176***	0.283***
	(0.012)	(0.009)	(0.005)
Observations	288	288	288
Data R^2	0.500	0.430	0.392
Model R^2	0.986	0.988	0.784

*p<0.1; **p<0.05; ***p<0.01

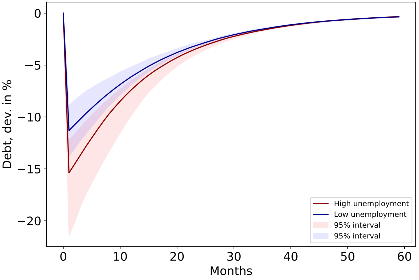
Notes: The model is simulated for 1,000 runs each of length 1,000 months with a burn-in period of 136 months to obtain the same length as the data. All variables are quarterly averages of monthly simulated data detrended using the HP filter with $\lambda = 1600$. Regression statistics are averaged over all simulations. Standard errors are in parentheses.

Table: Regression of treasury, safety, and liquidity premia on unemployment.

Model dynamics: conditional impulse responses I



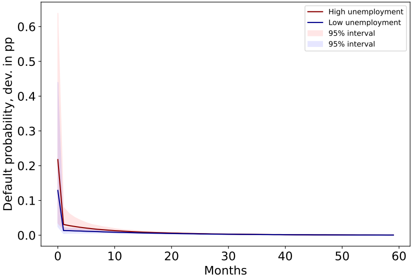
(a) Unemployment, $1 - n$.



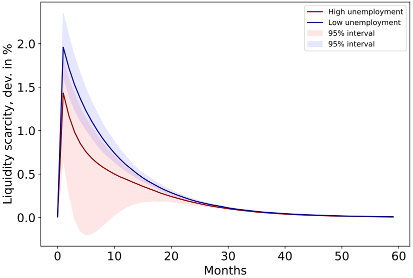
(b) Corporate debt, $\bar{b}$.

Figure: Reaction to a negative productivity shock.

Model dynamics: conditional impulse responses II



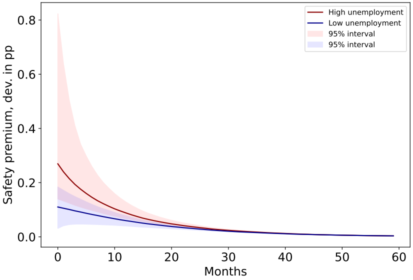
(a) Default probability., $1 - \Phi \circ z^*(d)$.



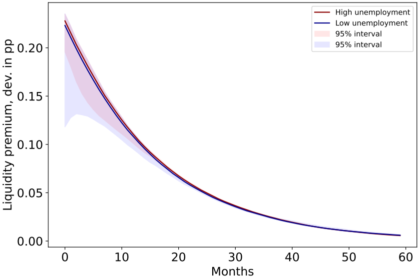
(b) Collateral scarcity, $\mathcal{L}$.

Figure: Reaction to a negative productivity shock.

Model dynamics: conditional impulse responses III



(a) Safety premium.



(b) Liquidity premium.

Figure: Reaction to a negative productivity shock.

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Conclusion

We constructed a real business cycle model with:

- equilibrium unemployment;
- endogenous corporate default;
- an explicit notion of liquidity.

Next steps:

- match average safety premium better, e.g., with large risk-averse families;
- look at higher order moments, e.g., distribution of the treasury premium.

References I

Ait Lahcen, M., Baughman, G., Rabinovich, S., and van Buggenum, H. (2022). Nonlinear unemployment effects of the inflation tax. European Economic Review, 148:104247.

Bai, H. (2021). Unemployment and credit risk. Journal of Financial Economics, 142(1):127–145.

Bayer, C., Born, B., and Luetticke, R. (2023). The liquidity channel of fiscal policy. Journal of Monetary Economics, 134:86–117.

Berentsen, A., Menzio, G., and Wright, R. (2011). Inflation and unemployment in the long run. American Economic Review, 101(1):371–98.

Caramp, N. and Singh, S. R. (2023). Bond premium cyclicality and liquidity traps. Review of Economic Studies, page rdad003.

Den Haan, W. J., Ramey, G., and Watson, J. (2000). Job destruction and propagation of shocks. American economic review, 90(3):482–498.

Ferrero, A. and Haas, A. (2023). Liquidity and safety over the business cycle.

Gomes, J., Jermann, U., and Schmid, L. (2016). Sticky leverage. American Economic Review, 106(12):3800–3828.

Gourio, F. (2013). Credit risk and disaster risk. American Economic Journal: Macroeconomics, 5(3):1–34.

Kiyotaki, N. and Wright, R. (1993). A search-theoretic approach to monetary economics. The American Economic Review, pages 63–77.

Krishnamurthy, A. and Vissing-Jorgensen, A. (2012). The aggregate demand for treasury debt. Journal of Political Economy, 120(2):233–267.

Lagos, R. and Wright, R. (2005). A unified framework for monetary theory and policy analysis. Journal of Political Economy, 113(3):463–484.

Nagel, S. (2016). The liquidity premium of near-money assets. The Quarterly Journal of Economics, 131(4):1927–1971.

Pissarides, C. A. (2000). Equilibrium Unemployment Theory, volume 1. The MIT Press.