Inflation and Treasury Convenience

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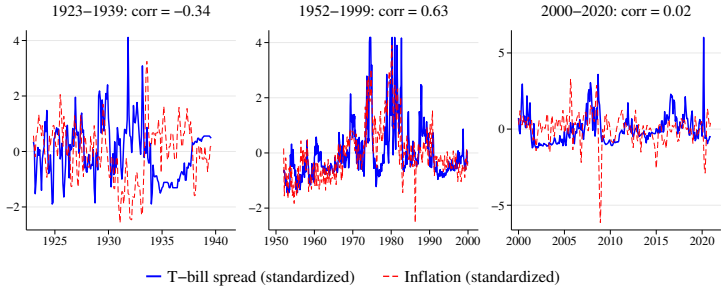
Inflation, money, and the Treasury market

- **How is Treasury convenience linked to inflation over past century?**
- Treasury bonds earn substantial premium for their convenience
  (Longstaff 2004; Krishnamurthy and Vissing-Jorgensen, 2012; Nagel 2016)
  - Source of fiscal capacity; channel for monetary policy transmission; US global status
- **Keynes (1937)**: "... as happens in a crisis, liquidity-preferences are sharply raised. The rate of interest is the factor which adjusts (...) the demand for hoards to the supply of hoards."
- **Friedman (1969)**: "Inflation... raises the cost of holding money and assets that are close substitutes for money."

Changing dominance of channels explains switches in convenience-inflation relationship

Convenience yield and inflation: Three distinct periods



Macroeconomic drivers?

1. 1923:01–1939:08
   - Excluding WWI/WWII
   - Great depression, banking panics
2. 1952:01–1999:12
   - High, volatile inflation
   - Counter-cyclical inflation
   - Oil shocks
3. 2000:01–2020:07
   - Stable inflation
   - Pro-cyclical inflation
   - LTCM, Asian crisis, GFC

What we do

Two main contributions:

1. **Empirical Fact:** Convenience–inflation relationship was strongly *positive* during second half of the 20th century (1952–1999), but negative both pre-WWII and post-2000

2. **Estimated macro-finance model with liquid Treasuries:**
   - Log-linear three-equation New Keynesian model of monetary policy + consumption-habit preferences (Campbell, Pflueger and Viceira(2020))
   - Demand for liquid assets with deposits and Treasuries substitutes (Krishnamurthy and Vissing-Jorgensen (2012))
   - **New:** Shocks to demand for liquid bonds vs. traditional macroeconomic demand shocks

3. **Results:** Convenience-inflation comovement diagnostic of macroeconomic drivers
   - Inflation shocks driving convenience 1952-1999
   - Liquidity demand as negative macroeconomic demand shock post-2000
   - Implications for hedging properties of long-term Treasury bonds

Literature

- **Treasury convenience yields:** Krishnamurthy and Vissing-Jorgensen (2012), Du, Tepper, Verdelhan (2020), Nagel (2016), Diamond and van Tassel (2024), Krishnamurthy and Li (2023), Fu, Li, Xie (2022), He, Nagel, and Song (2022), Acharya and Laarits (2024), Di Tella, Hebert, Kurlat, and Wang (2024)
- **Safe asset determination:** Duffie, Garleanu, and Pedersen (2007), He, Krishnamurthy and Milbradt (2019), Gorton and Ordonez (2022), Brunnermeier, Merkel, Sannikov (2022), Coppola, Krishnamurthy, and Xu (2023), Chen, Jiang, Lustig, van Nieuwerburgh, and Xiaolan (2023)
- **Changing inflation drivers and bond-stock correlation:** Campbell, Sunderam, and Viceira (2017), Campbell, Pflueger, and Viceira (2020), David and Veronesi (2013), Pflueger (2023)
- **New Keynesian models with liquidity/safety:** Piazzesi, Rogers, and Schneider (2019), Engel and Wu (2022), Anzaotegui, Comin, Gertler and Martinez (2019), Caballero and Simsek (2020), Kekre and Lenel (2021), Jiang, Krishnamurthy, and Lustig (2022), Brunnermeier, Merkel, and Sannikov (2023)

Changing inflation-convenience relationship, informative about inflation fundamentals

Data and measurement

1. Monthly data from 1923 to 2020 (start post-WWI inflation)
2. Convenience yield
   - Primary measure: GC repo-T-bill spread (Nagel (2016), extended with CP-Tbill spread)
   - AAA-Treasury spread (Krishnamurthy and Vissing-Jorgensen (2012), Payne et al. (2025))
3. Inflation
   - 3-month change in seasonally adjusted headline CPI
4. Controls: FFR, VIX (fitted prior to 1990), BAA-AAA spread, debt/GDP, rolling bond-stock beta (Acharya and Laarits (2025))

Changing convenience-inflation relationship 1923-2020

	T-bill spread				
	(1)	(2)	(3)	(4)	(5)
Inflation	-0.015***	-0.015***	-0.013***	-0.010***	-0.010***
	(-3.87)	(-4.62)	(-3.53)	(-4.10)	(-3.75)
Inflation x $I_{1952-1999}$	0.12***	0.059***	0.11***	0.053***	0.054***
	(7.93)	(3.71)	(7.73)	(3.74)	(3.52)
Inflation x $I_{\geq 2000}$	0.016**	-0.00064	0.0097	0.0095	0.0096
	(2.29)	(-0.11)	(1.41)	(1.33)	(1.33)
FFR		0.081***		0.083***	0.083***
		(8.11)		(8.16)	(8.06)
Debt/GDP			-0.35	0.21	0.21
			(-1.61)	(0.98)	(0.98)
VIX				0.011***	0.011***
				(4.63)	(3.35)
Baa spread					-0.0077
					(-0.17)
$\bar{R}^2$	0.43	0.56	0.43	0.59	0.59
N	1028	1028	1028	1028	1028

- 1952–1999: 1pp increase in inflation associated with 12 bps higher convenience spread
  (Convenience spread: avg = 43 bps; sd = 46 bps)

Changing convenience-inflation relationship 1952-2020

	T-bill spread			
Inflation	0.10***	0.043***	0.044***	0.049***
	(7.20)	(2.73)	(3.02)	(2.82)
Inflation x $I_{\geq 2000}$	-0.10***	-0.059***	-0.043**	-0.048**
	(-6.62)	(-3.74)	(-2.53)	(-2.51)
FFR		0.083***	0.082***	0.082***
		(7.86)	(7.13)	(7.02)
Debt/GDP			0.24	0.25
			(1.10)	(1.16)
VIX			0.011**	0.011**
			(2.45)	(2.50)
Baa spread			0.00024	0.0019
			(0.00)	(0.02)
$I_{1979-80}$				-0.18
				(-0.89)
$\bar{R}^2$	0.43	0.57	0.59	0.59
N	828	828	828	828

- 2000-2020: 1pp increase in inflation associated with 10 bps lower convenience spread

Alternative convenience measures (1961-2020)

	Tbill spr	Aaa-Tsy	Aaa-GSW (ca)
Inflation	0.037***	0.061***	0.020
	(2.59)	(3.62)	(1.24)
Inflation x $I_{\geq 2000}$	-0.058***	-0.070***	-0.028*
	(-3.95)	(-3.71)	(-1.72)
FFR	0.11***	-0.023	0.0061
	(8.71)	(-1.22)	(0.34)
Debt/GDP		-0.35	-0.036
		(-0.94)	(-0.12)
VIX		0.0044	0.0079*
		(0.90)	(1.79)
Baa spread		0.43***	0.17*
		(4.37)	(1.87)
$I_{1979-80}$		-0.44***	-0.41***
		(-3.40)	(-3.06)
Stock-bond beta	-0.42***		
	(-3.09)		
$\bar{R}^2$	0.62	0.41	0.23
N	710	710	710

- Switch in convenience-inflation relationship carries over to long-term Treasuries.

Model overview

New Keynesian core (IS, Phillips, Taylor rule) + convenience/liquidity block

- Households derive utility from consumption and **liquidity aggregate** combining deposits and Treasuries
- Consumption habits $\Rightarrow$ volatile and **endogenous risk premia** in stocks and bonds
- Deposit rate stickiness + policy inertia $\Rightarrow$ **convenience-inflation link**

Preferences over consumption and liquidity

$$U(C_t, H_t, Q_t) = \underbrace{\frac{(C_t - H_t)^{1-\gamma}}{1-\gamma}}_{\text{Consumption utility}} + \underbrace{\alpha \log Q_t}_{\text{Liquidity}}$$

- Preference for liquidity akin to money in the utility (Sidrauski (1967))
- Liquid bonds and deposits are substitutes (Friedman and Schwartz (1982), KVJ (2012), Nagel (2016); Krishnamurthy and Li (2023)))

$$Q_t = (D_t) + \frac{\lambda_t}{1-\lambda_t}(B_t)$$

  D_t and B_t denote real quantities of deposits and Treasuries
- λ_t = liquidity demand for bonds; source of liquidity demand shocks

Three short-term interest rates

- I_t^l: Illiquid loan rate
  - HH and firms cannot directly borrow and lend at T-bill rates
- I_t^b: Liquid T-bill rate
  - Fed sets i_t^b according to an inertial Taylor rule (below)
- I_t^d: Liquid deposit rate
  - HH earn interest by depositing money at bank

- Assume: Deposit rate adjusts partially and slowly (Nagel, 2016)

$$I_t^d = \delta I_t^l + \rho^d I_{t-1}^d,$$

  - If $\delta = 0$, deposits collapse to cash
  - Reflects deposit franchise and market power of deposit-taking institutions (e.g. Drechsler, Savov, and Schnabel (2023))

Production and prices

- Sticky prices (Calvo, 1983) with optimizing firms gives log-linearized Phillips curve

$$\pi_t = \rho_\pi \pi_{t-1} + (1 - \rho_\pi) E_t \pi_{t+1} + \kappa x_t + v_{\pi,t}$$

- Phillips curve (supply) shock $v_{\pi,t}$ raises inflation while lowering output gap x_t, provided that monetary policy reacts strongly (Pflueger (2025))

Monetary policy

- Monetary policy rule described by log-linear rule in liquid rate

$$i_t^b = (1 - \rho_i)(\gamma_x x_t + \gamma_\pi \pi_t) + \rho_i i_{t-1}^b + v_{i,t}$$

- Adjust towards policy rate target: $\gamma_x x_t + \gamma_\pi \pi_t$

- Monetary policy shock $v_{i,t}$ reflects deviation from rule, followed by mean-reversion

Log-linear model: Convenience spread

- Log-linear approximate short-term convenience spread:

$$\ell_t \equiv i_t^\ell - i_t^b = \rho_\ell \ell_{t-1} + \underbrace{g_i i_t^b}_{\text{policy rate}} + \underbrace{g_x x_t + g_\pi \pi_t + g_v v_t^i}_{\text{target rate}} + \underbrace{v_t^\ell}_{\text{liquidity shock}}$$

- Long-term convenience spread increases with policy rate and inflation (Money channel)
  - Policy rule enters separately if deposit rates adjust gradually
- Convenience spread increases with liquidity demand shock λ_t (NK demand channel)

Model summary: Macroeconomics

$$
\begin{aligned}
\text{Euler equation:} \quad & x_t &=& \rho_x x_{t-1} + (1-\rho_x) E_t x_{t+1} - \psi(i_t^b - E_t \pi_{t+1}) - \psi \ell_t + v_{x,t} \\
\text{Phillips curve:} \quad & \pi_t &=& \rho_\pi \pi_{t-1} + (1-\rho_\pi) E_t \pi_{t+1} + \kappa x_t + v_{\pi,t} \\
\text{Monetary policy rule:} \quad & i_t^b &=& (1-\rho_i)(\gamma_x x_t + \gamma_\pi \pi_t) + \rho_i i_{t-1}^b + v_{i,t} \\
\text{Convenience spread:} \quad & \ell_t &=& = \rho_\ell \ell_{t-1} + g_i i_t^b + g_x x_t + g_\pi \pi_t + g_v v_t^i + v_t^\ell
\end{aligned}
$$

- Liquidity demand shock (v_t^ℓ) acts like a negative demand shock in IS via $-\psi \ell_t$.
- Four shocks: liquidity demand, non-liquidity demand, supply (cost-push), monetary policy.

- Surplus consumption $S_t = \frac{C_t - H_t}{C_t}$, risk aversion γ / S_t (Campbell, Pflueger, Viceira (2020))

$$
s_{t+1} = (1-\theta_0)\bar{s} + \theta_0 s_t + \theta_1 x_t + \theta_2 x_{t-1} + \psi^{-1} v_{x,t} + \lambda(s_t)\varepsilon_{c,t+1}
$$

- **New:** Demand shock $v_{x,t}$ equivalent to change in discount factor, i.e. patience shock (to first order)

Model summary: Stocks and Bonds

- Liquid Treasury bond price recursion

$$\begin{aligned} E_t\left[M_{t+1}\frac{P^{\$}_{n-1,t+1}exp(-\pi_{t+1})}{P^{\$}_{n,t}}\right] &= E_t\left[M_{t+1}\exp(i^b_t)exp(-\pi_{t+1})\right], \\ M_{t+1} &= \beta exp(-\gamma(\Delta c_{t+1}+\Delta s_{t+1})) \end{aligned}$$

- Consumption claims do not provide liquidity services, following recursion

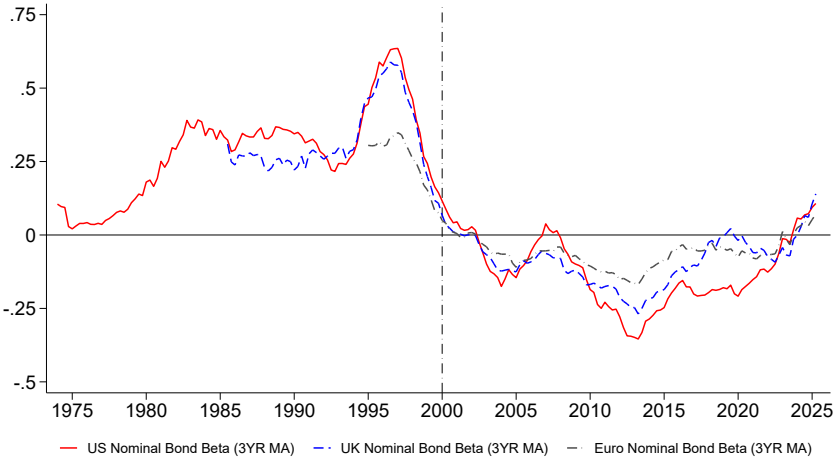
$$\frac{P^c_{n,t}}{C_t} = E_t\left[M_{t+1}\frac{C_{t+1}}{C_t}\frac{P^c_{n-1,t+1}}{C_{t+1}}\right]$$

- Stocks represent levered claim to all future consumption (Abel 1990, Campbell 1986)
- Solution strategy: Linear minimum state variable solution for $(x_t, \pi_t, i^b_t, \ell_t)$, numerical asset prices highly nonlinear in add'l state variable s_t

Fit to Target Moments

		1952–1999		2000–2020	
		Data	Model	Data	Model
Volatilities	Vol(T-bill spread)	0.579	0.476	0.219	0.291
		(0.030)		(0.017)	
	Vol(Inflation)	3.277	2.374	2.665	0.679
		(0.168)		(0.207)	
	Vol(Output gap)	2.287	2.665	1.955	1.606
		(0.117)		(0.152)	
Correlations	Corr(Inflation, output Gap)	-0.119	-0.312	0.292	0.427
		(0.072)		(0.102)	
Bond-Stock Beta	Bond return $\sim \beta \cdot$ Stock return	0.215	0.157	-0.288	-0.049
		(0.071)		(0.054)	
Reg Coefs	T-bill spread $\sim b \cdot$ Inflation	0.109	0.091	-0.003	-0.010
		(0.010)		(0.009)	

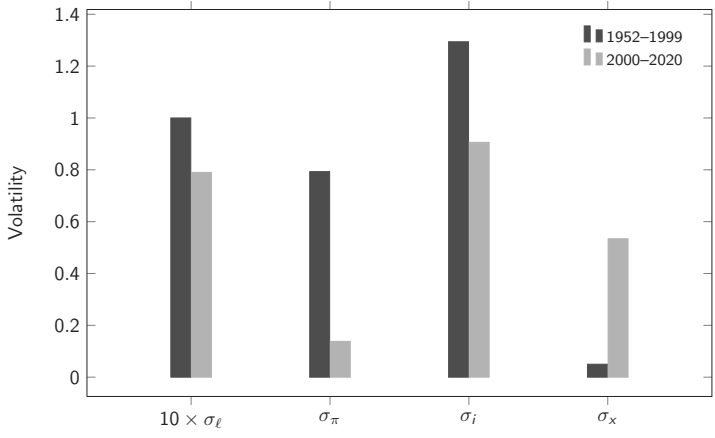
Changing Bond-Stock Betas in the Data



Campbell, Pflueger, and Viceira (2025)

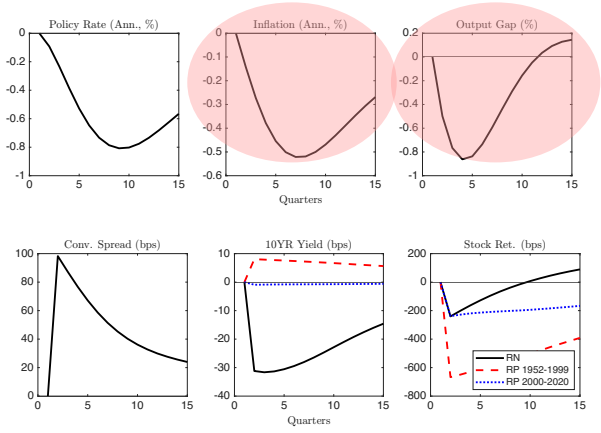
Estimated Shock Volatilities

- 1952–1999: Dominant **supply** shocks
- 2000–2020: Dominant **liquidity** and non-liquidity demand shocks



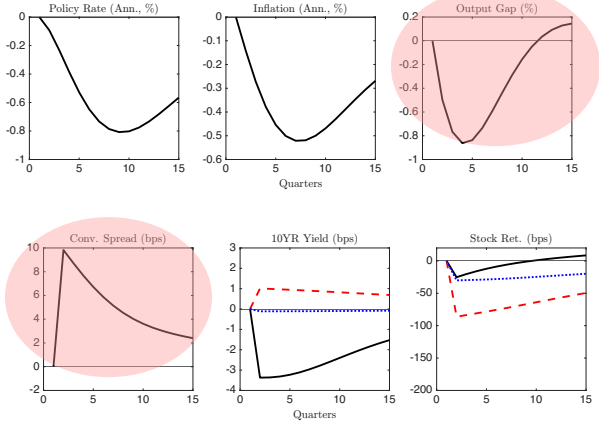
Liquidity shock vol scaled to reflect persistence.

Impulse responses: Liquidity demand shock



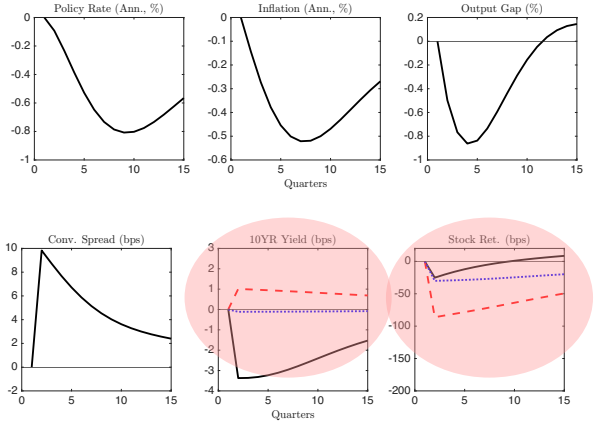
- **Inflation and output fall together**

Impulse responses: Liquidity demand shock



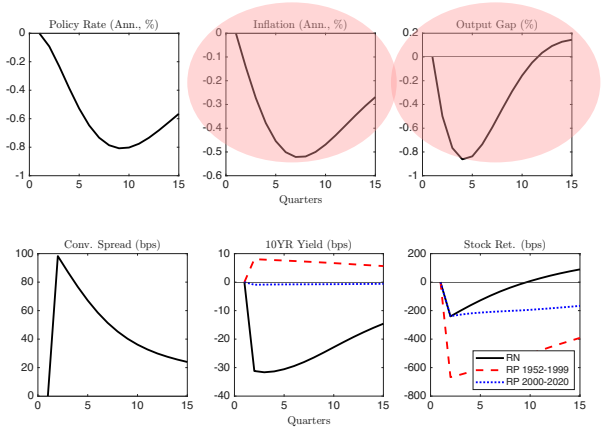
- Inflation and output fall together like macroeconomic demand shock
- **Convenience spread and inflation move opposite like pre-WWII and 2000s**

Impulse responses: Liquidity demand shock



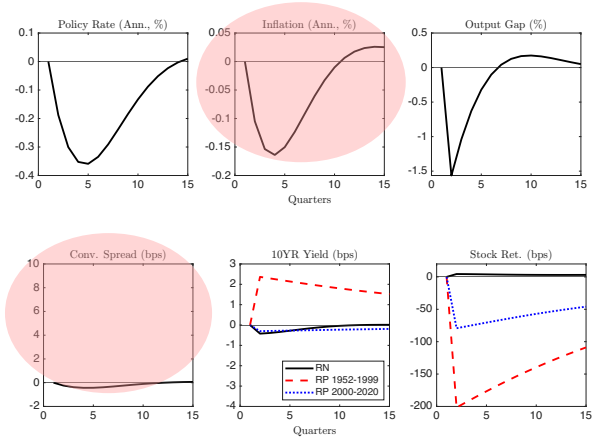
- Inflation and output fall together like macroeconomic demand shock
- Convenience spread and inflation move opposite like pre-WWII and 2000s
- **Bond yields fall/prices rise as stocks fall $\Rightarrow$ negative bond-stock beta**

Impulse responses: Non-liquidity demand shock



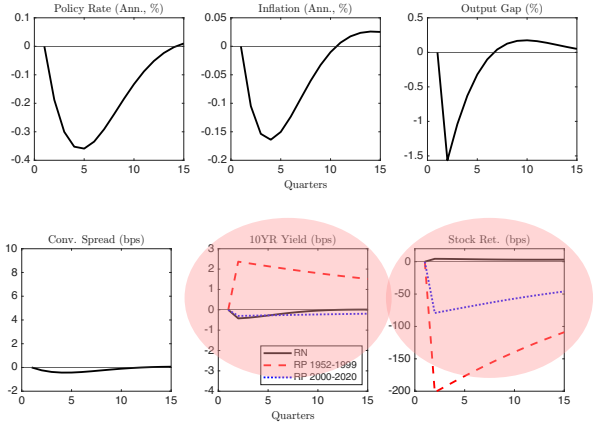
- **Similar output and inflation dynamics as liquidity demand shock**

Impulse responses: Non-liquidity demand shock



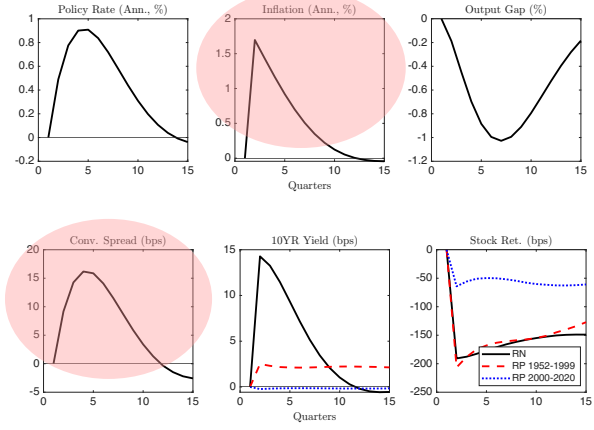
- Similar output and inflation dynamics as liquidity demand shocks
- **Little effect on convenience-inflation relationship**

Impulse responses: Non-liquidity demand shock



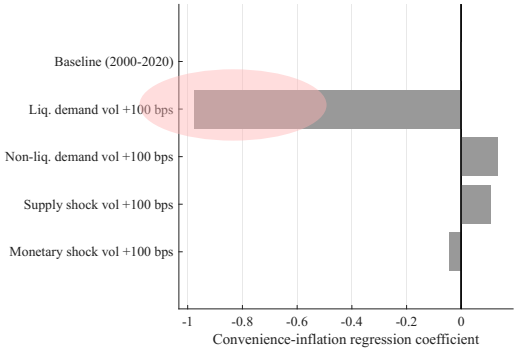
- Similar output and inflation dynamics as liquidity demand shocks
- Little effect on convenience-inflation relationship
- **Bonds and stocks: Common risk premium pre-2000 vs. hedging risk premium**

Impulse responses: Supply shock



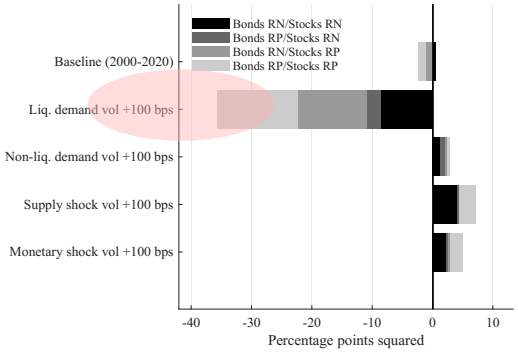
- Inflation and policy rate rise while output gap falls: Stagflation
- Convenience spread rises with inflation (money channel)
- Bond yields rise/prices fall as stocks fall $\Rightarrow$ positive bond-stock beta

Counterfactual convenience-inflation coefficient



- Liquidity demand shocks generate strongly **negative convenience–inflation coefficient**
- Supply and non-liquidity demand shocks generate positive comovement (money channel)
- Monetary policy shocks less important

Counterfactual nominal bond–stock comovements



- Liquidity demand shocks generate a negative bond–stock covariance in equilibrium
- Other shocks produce positive bond-stock comovement if dominant in equilibrium

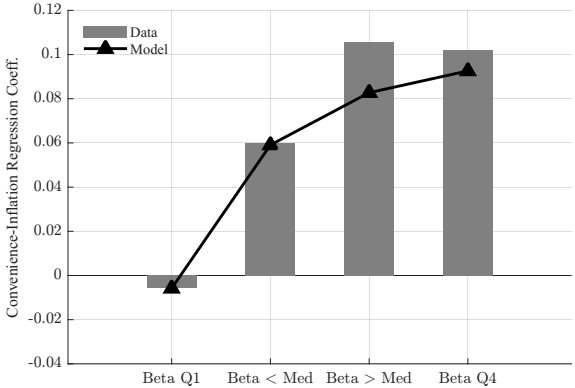
Discussion: Economic channels

Inflation $\leftrightarrows$ *convenience yield?*

- Changing dominance of two channels with different causal interpretation of shocks
  - New Keynesian demand channel (post-2000):
    Liquidity demand shock $\rightarrow$ higher convenience yield $\rightarrow$ lower aggregate demand $\rightarrow$ lower inflation
  - Money channel (second half of 20th century):
    Cost-push supply shock $\rightarrow$ higher inflation $\rightarrow$ higher opportunity cost of holding money/near money $\rightarrow$ higher convenience yield

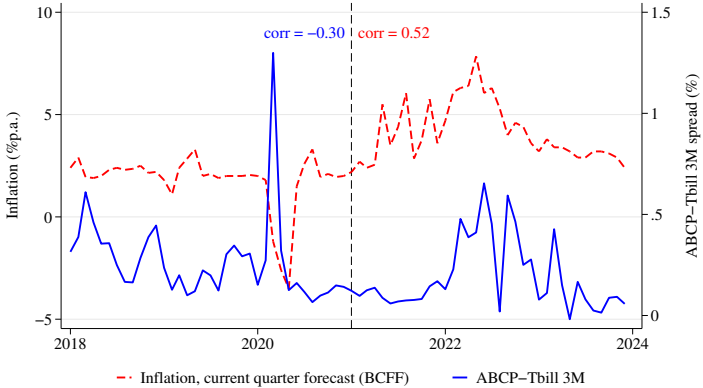
Convenience-inflation relationship by bond-stock beta

- Moving from 1952–1999 to 2000–2020 shock mix flips model convenience-inflation
- Convenience-inflation relationship similarly increases with bond-stock beta in data
- **Intuition:** Negative bond-stock beta proxies for dominant liquidity demand shocks



Discussion: COVID inflation

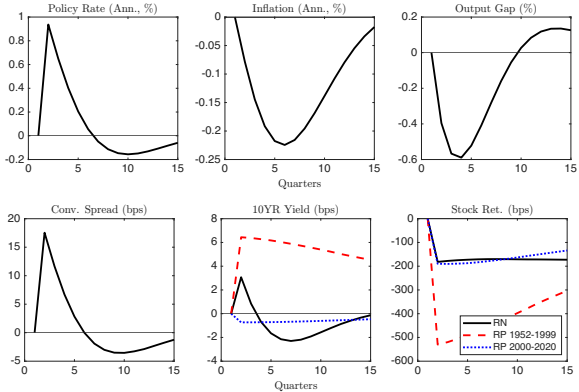
- Early 2020: convenience rises while inflation falls (liquidity stress).
- Mid-2021: supply/inflation shocks return; convenience–inflation comovement turns positive again.



Conclusion

- Low-frequency changes in inflation-convenience comovement
  - Pre-WWII: $(-)Cor$, high convenience $\leftrightarrow$ low inflation.
  - 1952-1999: $(+)Cor$, high inflation $\leftrightarrow$ high convenience.
  - 2000-2020: $(-)Cor$, high convenience $\leftrightarrow$ low inflation.
- Changing prevalence of money channel vs. liquidity demand channel
  - Inflation shocks raise interest rates and cost of convenience in 1952–1999
  - Demand for convenient Treasuries suppresses agg demand and lowers inflation in 2000s
- New Keynesian-liquidity model accounts for facts and links to asset pricing

Impulse responses: Monetary policy shock



- Policy rate and inflation move in opposite directions
- Bond yields rise as stocks fall $\Rightarrow$ positive bond-stock beta
- Small positive effect on convenience-inflation relationship