Back to the 1980s or Not? The Drivers of Inflation and Real Risks in Treasury Bonds

Carolin Pflueger

Chicago Harris, NBER, and CEPR

March 2023

What Drives Risky Treasury Bonds?

- Bond-stock betas changed 1980s vs. 2000s, may change again
- Risky nominal bonds price **stagflation** risk or **“bad” inflation** in reduced-form models of inflation (Baele, Bekaert, and Inghelbrecht (2010), David and Veronesi (2013), Campbell, Pflueger, Viceira (2020),...)

What Drives Risky Treasury Bonds?

- Bond-stock betas changed 1980s vs. 2000s, may change again
- Risky nominal bonds price **stagflation** risk or **"bad" inflation** in reduced-form models of inflation (Baele, Bekaert, and Inghelbrecht (2010), David and Veronesi (2013), Campbell, Pflueger, Viceira (2020),...)
- What do bond risks teach us about **fundamental drivers** of inflation?
- Could supply shocks and/or monetary policy flip the sign of bond betas back to 1980s?

This Paper

1. **Calibrate New Keynesian model with endogenous risk premia to 1980s vs. 2000s:**
   - Risky nominal bonds 1980s explained from supply shocks and fast, anti-inflationary monetary policy rule
   - Safe nominal bonds in 2000s explained from demand shocks and more inertial, output-focused monetary policy rule
   - Endogenous "flight-to-safety" $\Rightarrow$ bond betas depend crucially on which shocks are priced in equilibrium
2. **Counterfactuals:** Supply shocks turn nominal bonds risky with 1980s-style monetary policy, but not with 2000s-style monetary policy

Risky nominal bonds as real-time indicator of "hard landing"

Drivers Are Again Relevant

DE Shaw &Co (2021)

Bloomberg

9/14/2022

In short, the safe haven status of Treasury securities was put to a major test, and it passed. (...) As argued in that paper, we believe that the stock-bond correlation depends critically on the type of shocks hitting the economic system.

With yesterday's inflation shock in the US and its implications for the Federal Reserve again raising stress levels in markets, the hot debate is whether we're headed for soft or hard landings in 2023.

ECONOMIC
REPORT
OF THE
PRESIDENT

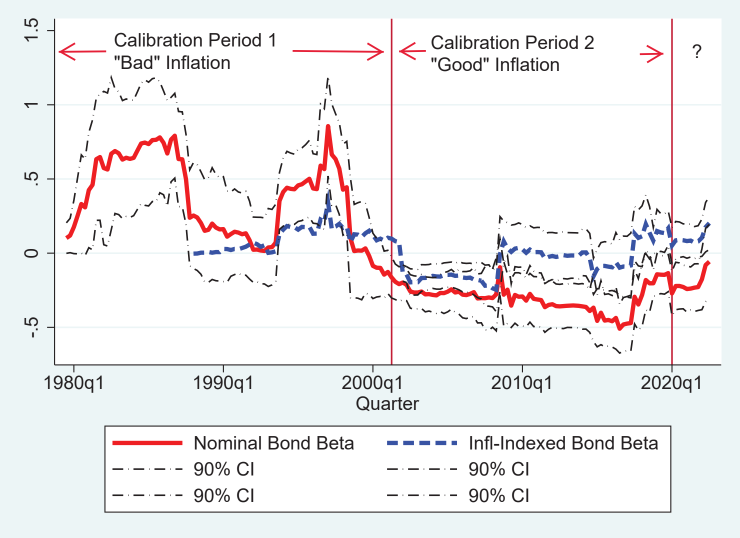
TRANSMITTED TO CONGRESS | MARCH 2023

Economic Report of the President (March 2023)

(...) in 2022 inflation led the Federal Reserve to raise the Federal Funds Rate, causing both stock and bond prices to decline. This relationship can be seen (...) starting slightly before the tightening cycle began, possibly due to markets anticipating monetary actions. The sign of this correlation suggests that negative supply shocks were important for U.S. financial markets in 2022.

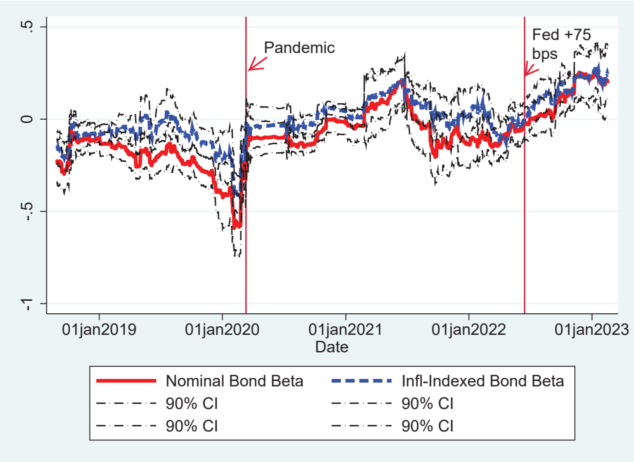
Economic shocks? Changing monetary policy? "Flight-to-safety"?

Historical Nominal and Real Bond Risks



$xr_{n,t+1} = \alpha + \beta xr^{eq}_{t+1} + \varepsilon_{t+1}$, quarterly returns, 5-year rolling windows

Recent Changes: Back to the 1980s?



$xr_{n,t+1} = \alpha + \beta xr^{eq}_{t+1} + \varepsilon_{t+1}$, daily returns, 6-month rolling windows

- Nominal bond betas below real bond betas, different from 1980s
- Uptick when Fed surprised with 75 bps interest rate hike

Literature

- **Macroeconomics of stagflation:** Cogley and Sargent (2001), Primiceri (2006), Sims and Zha (2006), Justiniano and Primiceri (2008), Clarida, Gali, and Gertler (2000), Bernanke et al. (1997), Drechsler, Savov, and Schnabl (2022)
- **Changing risks of Treasury bonds:** Campbell, Sunderam, and Viceira (2017), Campbell, Pflueger, and Viceira (2020), David and Veronesi (2013), Gourio and Ng (2020), Li et al. (2022), Hall, Sargent, Payne, Szoke (2022)
- **New Keynesian asset pricing models:** Rudebusch and Swanson (2008, 2012), Uhlig (2007), Kung (2015), Cabellero and Simsek (2022), Kekre and Lenel (2022), Pflueger and Rinaldi (2022)
- **Drivers of post-pandemic inflation:** Rubbo (2022), Di Giovanni, Kalemli-Özcan, Silva, Yildirim (2022), Harding, Linde, Trabandt (2022), Bianchi and Melosi (2022), Bianchi et al. (2022a), Bianchi et al. (2022b), Blinder (2023), ...

Fundamental shocks & policy propagation ⇒ Bond risks

MODEL

Work-Horse New Keynesian Model

- Euler equation: $x_t = f^x E_t x_{t+1} + \rho^x x_{t-1} - \psi r_t + v_{x,t}$
- Phillips curve: $\pi_t^w = f^\pi E_t \pi_{t+1}^w + \rho^\pi \pi_{t-1}^w + \kappa x_t + v_{\pi,t}$
- Interest rate rule: $i_t = \rho^i i_{t-1} + \left(1 - \rho^i\right)\left(\gamma^x x_t + \gamma^\pi \pi_t\right) + v_{i,t}$

$x_t =$ output gap, $\pi_t =$ inflation, $i_t = r_t + E_t \pi_{t+1}$ nominal rate

Work-Horse New Keynesian Model

- Euler equation: $x_t = f^x E_t x_{t+1} + \rho^x x_{t-1} - \psi r_t + v_{x,t}$
- Phillips curve: $\pi^w_t = f^\pi E_t \pi^w_{t+1} + \rho^\pi \pi^w_{t-1} + \kappa x_t + v_{\pi,t}$
- Interest rate rule: $i_t = \rho^i i_{t-1} + \left(1 - \rho^i\right)\left(\gamma^x x_t + \gamma^\pi \pi_t\right) + v_{i,t}$

$x_t =$ output gap, $\pi_t =$ inflation, $i_t = r_t + E_t \pi_{t+1}$ nominal rate

- **Key deviation:** Campbell, Pflueger, and Viceira (2020, JPE) habit formation preferences $\Rightarrow$ exactly log-linear macro Euler equation and non-linear risk premia in bonds and stocks

SUPPLY SIDE

Consumption, Output and Output Gap

- No investment: $C_t = Y_t$
- Equilibrium output gap-consumption relationship (up to constant)

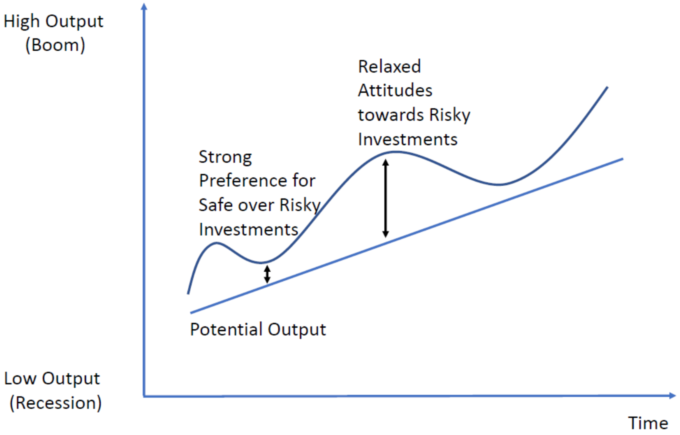
$$x_t \;\; = \;\; c_t - (1-\phi)\sum_{j=0}^{\infty} \phi^j c_{t-1-j}$$

- Labor disutility via home production (GHH (1988)), leisure habit exactly offsets aggregate effects
- Adaptive inflation expectations: $\tilde{E}_t \pi^w_{t+1} = (1-\zeta) E_t \pi^w_{t+1} + \zeta \pi^w_{t-1}$
- Standard log-linearized wage **Phillips curve**:

$$\pi^w_t \;\; = \;\; (1-\rho^\pi) E_t \pi^w_{t+1} + \underbrace{\rho^\pi}_{\rho^{\pi,0}+\zeta-\rho^{\pi,0}\zeta} \pi^w_{t-1} + \kappa x_t + v_{\pi,t}$$

CONSUMPTION AND PREFERENCES

Countercyclical Risk Aversion via Habits



Equity volatility, stock return predictability, endogenous "flight-to-safety" to bonds via one single mechanism

Surplus Consumption in Habit Preferences

- Difference habit utility (Campbell and Cochrane, 1999)

$$U_t = \frac{(C_t - H_t)^{1-\gamma} - 1}{1-\gamma}$$

- Relative risk aversion: $\frac{\gamma}{S_t}$, where *surplus consumption* ratio

$$S_t = \frac{C_t - H_t}{C_t}$$

- Stochastic discount factor (SDF):

$$M_{t+1} = \beta exp\left(-\gamma\left(\Delta c_{t+1} + \Delta s_{t+1}\right)\right)$$

- Homoskedastic shocks; time-varying risk premia only from preferences

Habit Dynamics via Surplus Consumption

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

- Highly non-linear $\lambda(s_t)$ decreases with surplus consumption (Campbell and Cochrane, 1999)
- $\theta_1 < 0$ and $\theta_2 > 0$: Increased habit dependence on most recent consumption (Campbell, Pflueger, and Viceira, 2020, Christiano, Eichenbaum, and Evans, 2005)
- Consumption-based interpretation through equilibrium output gap-consumption link

Pricing Bonds and Stocks

- Bond preference shock ξ_t enters bond asset pricing equations like "standard" discount rate shock

$$P^{\$}_{n,t} = exp(-\xi_t) E_t \left[M_{t+1} exp(-\pi_{t+1}) P^{\$}_{n-1,t+1} \right]$$

- Asset pricing recursions for zero-coupon consumption claims

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

Pricing Bonds and Stocks

- Bond preference shock ξ_t enters bond asset pricing equations like "standard" discount rate shock

$$P^{\$}_{n,t} \quad = \quad exp(-\xi_t) E_t \left[M_{t+1} exp(-\pi_{t+1}) P^{\$}_{n-1,t+1} \right]$$

- Asset pricing recursions for zero-coupon consumption claims

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

- Fits neatly into two most common models of asset price-driven demand shocks (Bernanke and Gertler (2000), Gilchrist and Leahy (2002))
  - Optimism about future growth (e.g. "new economy") (Beaudry and Portier (2006), Bordalo et al. (2022)...)
  - External finance premium (Gertler and Karadi (2011), Gilchrist and Zakrajsek (2012)...)

▸ Excess Bond Premium

Macro Euler Equation from Pricing Risk-Free Rate

$$1 \quad = \quad exp\left(-\xi_t\right) E_t\left[M_{t+1} exp(r_t)\right]$$

- Substitute for SDF $M_{t+1} = exp\left(-\gamma(\Delta c_{t+1} + \Delta s_{t+1})\right)$:
- Rearranging gives exactly log-linear consumption **Euler equation**:

$$x_t = \underbrace{f^x}_{\frac{1}{\phi-\theta_1}} E_t x_{t+1} + \underbrace{\rho^x}_{\frac{\theta_2}{\phi-\theta_1}} x_{t-1} - \underbrace{\psi}_{\frac{1}{\gamma(\phi-\theta_1)}} r_t + \underbrace{\psi\xi_t}_{\text{Demand Shock } v_{x,t}}$$

Two-Step Solution

1. Macro equilibrium: Loglinear macroeconomic dynamics

$$\begin{aligned} Y_t &= BY_{t-1} + \Sigma v_t, \\ Y_t &= \left[x_t, \pi_t^w, i_t\right]', \\ v_t &= \left[v_{x,t}, v_{\pi,t}, v_{i,t}\right]' \end{aligned}$$

Two-Step Solution

1. Macro equilibrium: Loglinear macroeconomic dynamics

$$\begin{aligned} Y_t &= BY_{t-1} + \Sigma v_t, \\ Y_t &= \left[x_t, \pi_t^w, i_t\right]', \\ v_t &= \left[v_{x,t}, v_{\pi,t}, v_{i,t}\right]' \end{aligned}$$

2. Asset prices: Real cash flow cyclicality depends on macroeconomic equilibrium, solve with value function iteration (programming package coming soon....)

Two-Step Solution

1. Macro equilibrium: Loglinear macroeconomic dynamics

$$\begin{aligned} Y_t &= BY_{t-1} + \Sigma v_t, \\ Y_t &= \left[x_t, \pi_t^w, i_t\right]', \\ v_t &= \left[v_{x,t}, v_{\pi,t}, v_{i,t}\right]' \end{aligned}$$

2. Asset prices: Real cash flow cyclicality depends on macroeconomic equilibrium, solve with value function iteration (programming package coming soon....)

- Illustrative asset paying αc_{t+1}:

$$E_t \left[xr_{t+1}^{c,\alpha}\right] + \frac{1}{2} Var\left(r_{t+1}^{c,\alpha}\right) = \alpha \mathrm{Cov}_t\left(-m_{t+1}, c_{t+1}\right) = \alpha\gamma\left(1 + \lambda\left(s_t\right)\right)\sigma_c^2$$

  - If $\alpha > 0$ risk premium falls with surplus consumption (recall $\lambda'(s_t) < 0$) and vice versa

CALIBRATION

Calibration 1980s vs. 2000s

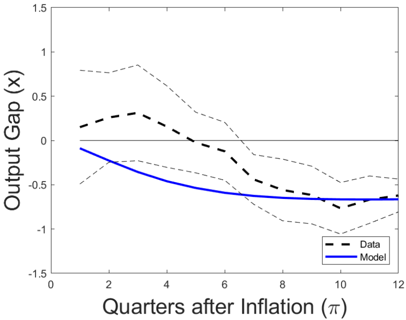
		1979.Q4–2001.Q1	2001.Q2-2022.Q2
Monetary Policy Rule			
Inflation weight	γ^{π}	1.35	1.10
		(0.32)	(0.06)
Output gap weight	γ^{x}	0.50	1.00
		(0.42)	(0.17)
Inertia	ρ^{i}	0.54	0.80
		(0.13)	(0.03)
Shock Volatilities			
Vol. demand shock	σ_x	0.01	0.59
		(0.08)	(0.02)
Vol. PC shock	σ_π	0.58	0.07
		(0.06)	(0.00)
Vol. MP shock	σ_i	0.55	0.07
		(0.11)	(0.02)
Expectations			
Adaptive Inflation Expectations	ζ	0.6	0.0
		(0.51)	(2.67)

MODEL/DATA 1980s vs. 2000s

Target Output-Inflation Comovement

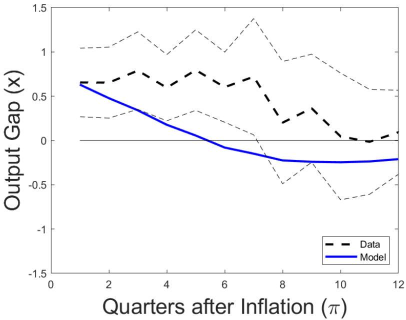
$$x_{t+h} = a_{0,h} + a_{1,h}\pi_t + a_{2,h}\pi_{t-1} + \varepsilon_{t+h}$$

1979.Q4–2001.Q1



Large supply shocks ($\sigma_\pi \gg 0$)

2001.Q2–2019.Q4

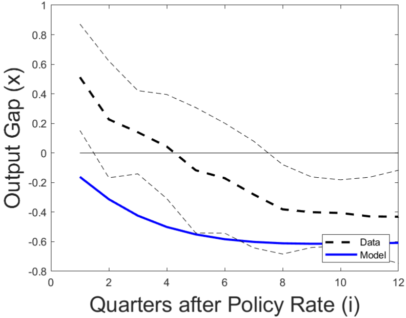


Small supply shocks ($\sigma_\pi \approx 0$)

Target Output-Fed Funds Rate Comovement

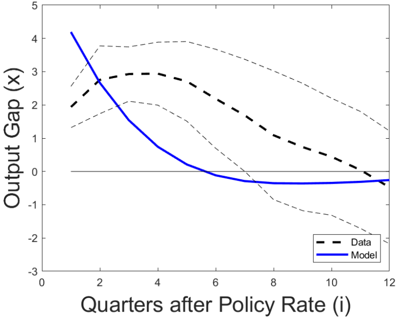
$$x_{t+h} = a_{0,h} + a_{1,h} i_t + a_{2,h} i_{t-1} + \varepsilon_{t+h}$$

1979.Q4–2001.Q1



Large MP shocks ($\sigma_i \gg 0$)

2001.Q2–2019.Q4

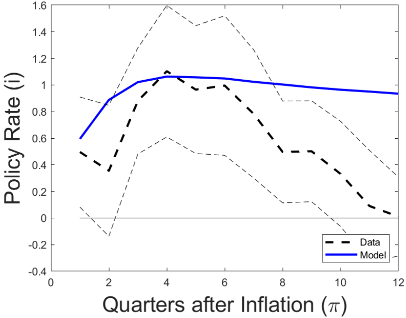


Large demand shocks ($\sigma_x \gg 0$)

Target Fed Funds Rate-Inflation Comovement

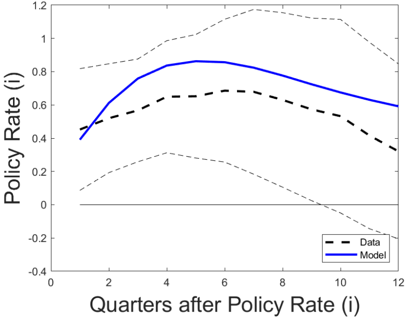
$$i_{t+h} = a_{0,h} + a_{1,h}\pi_t + a_{2,h}\pi_{t-1} + \varepsilon_{t+h}$$

1979.Q4–2001.Q1



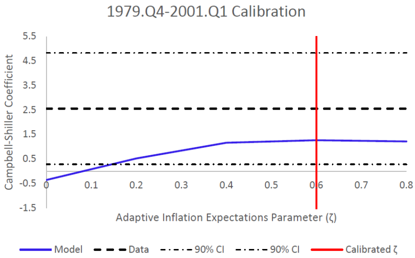
High γ^{π}, low ρ^{i}

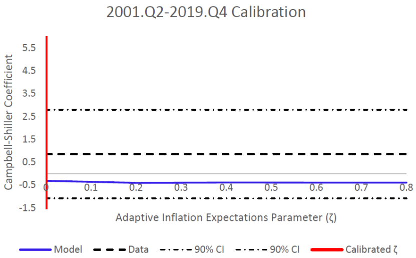
2001.Q2–2019.Q4



High γ^{x}, high ρ^{i}

Calibrate Inflation Expectations to Bond Predictability





- 1980s Calibration: Persistent inflation from supply shocks and backward-looking inflation expectations
  - Expectations hypothesis term roughly cancels so slope of yield curve dominated by risk premium
  - Echoes older empirical literature linking less persistent interest rates to expectations hypothesis (Mankiw, Miron, and Weil (1987), Hardouvelis (1994))

▸ Inflation forecast errors by subperiod ▸ Term spread impulse responses

ASSET PRICING IMPLICATIONS

Match Changing Bond Risks from 1980s to 2000s

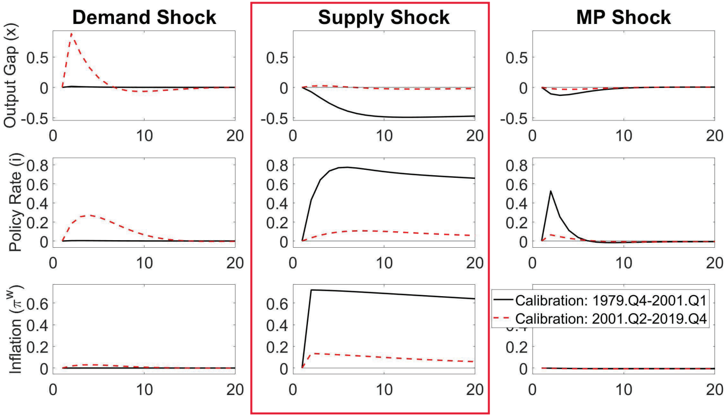
	1979.Q4–2001.Q1		2001.Q2–2019.Q4	
	Model	Data	Model	Data
Yield Spread	2.28	1.53	-0.58	2.06
Return Vol.	15.82	14.81	2.12	9.28
Nominal Bond-Stock Beta	0.86	0.24	-0.09	-0.31
Real Bond-Stock Beta	0.05	0.08	-0.08	-0.06
1 YR Excess Return on slope*	1.26	2.55	-0.31	0.86
1 YR Excess Return on slope (R^2)	0.01	0.07	0.01	0.02

* = targeted

- Bond betas not explicitly targeted in calibration
- **What mechanism generates changing bond betas?**

IMPULSE RESPONSES

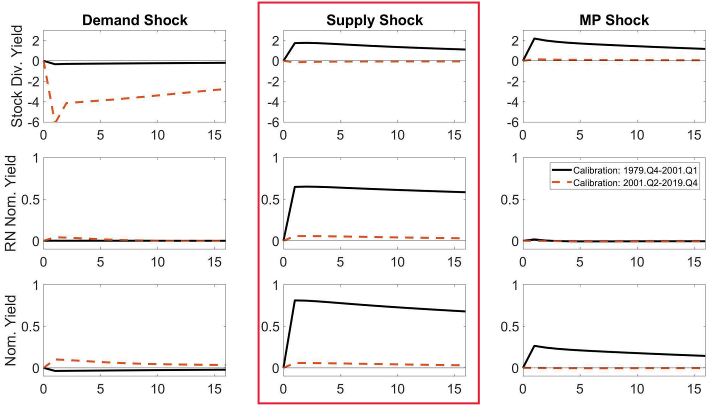
Macro Impulse Responses to Supply Shock...



1 std surprises ▸ Constant Size Shock

- 2000s Calibration: Monetary policy rule leads to “soft landing”

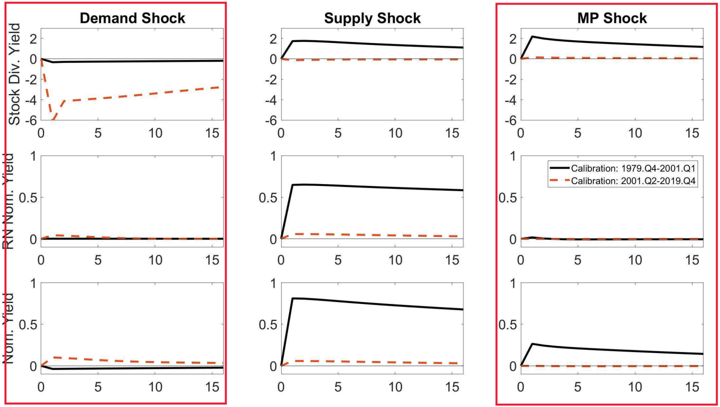
Translate into Bond-Stock Comovement...



1 std surprises

- Bond prices fall with bond yield, stock prices fall with dividend yield
- **1980s Calibration: Positive bond-stock comovement**
- **2000s Calibration: Negative bond-stock comovement**

...and Risk Premia after Non-Supply Shocks



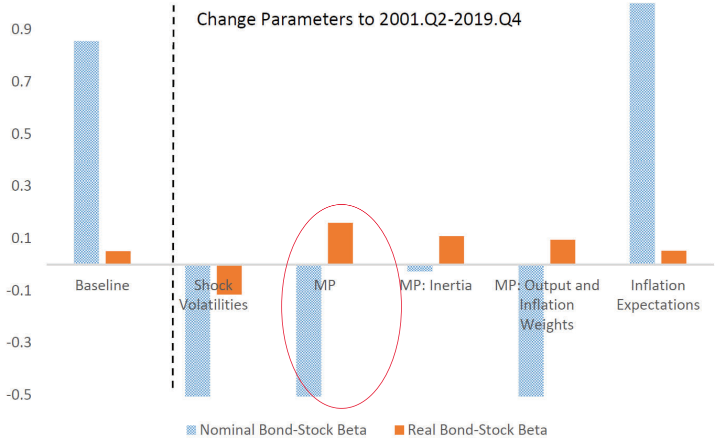
1 std surprises

- Overall and risk-neutral yield responses differ, sometimes markedly
- Bonds benefit from "flight-to-safety" in 2000s, but suffer in 1980s

COUNTERFACTUALS

Starting from 1980s

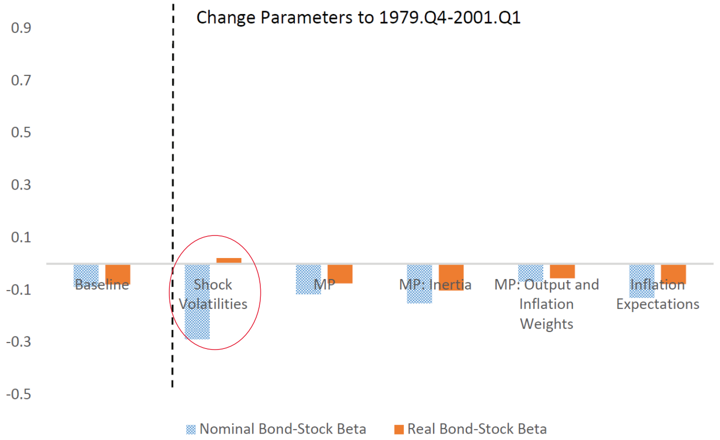
Shocks OR monetary policy flip bond risks



- Volatile supply shocks and 2000s-style monetary policy lead to negative bond-stock betas and de-coupling of real and nominal bonds

Starting from 2000s

Neither shocks NOR monetary policy flip bond risks

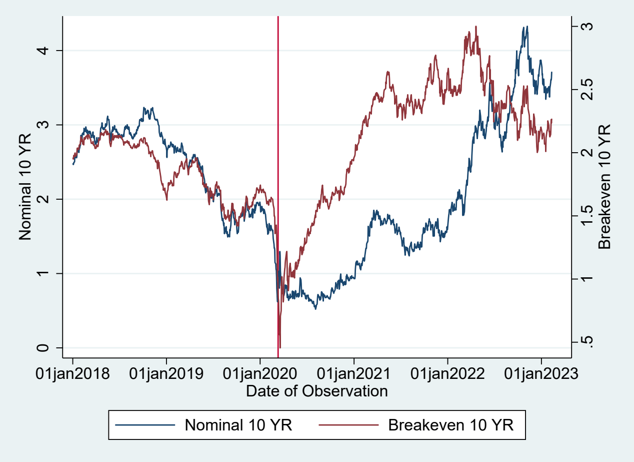


- Volatile supply shocks and 2000s-style monetary policy again lead to negative bond-stock betas and de-coupling of real and nominal bonds

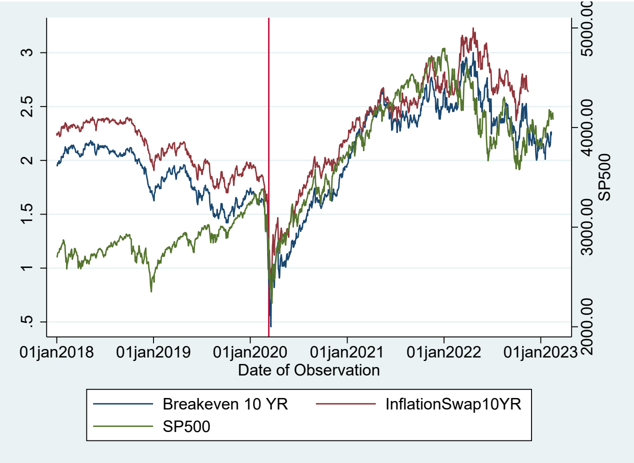
Adaptive Inflation Expectations

Post-Pandemic Treasury Bond Risks

Decoupling of Nominal and Real Yields

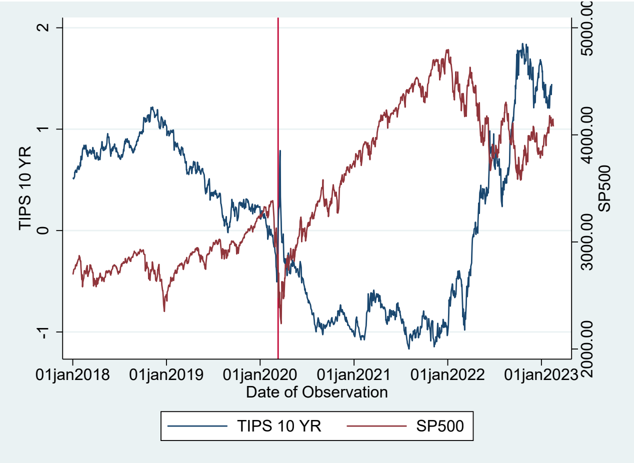


Breakeven Moves with Stock Market



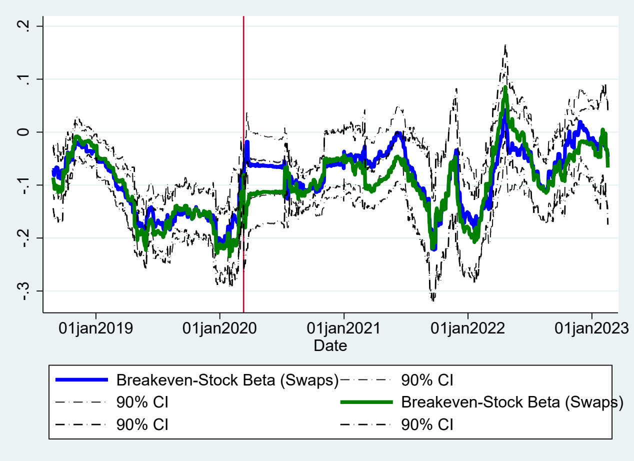
Negative nominal bond-stock return beta

Real Yields Move Against Stock Market



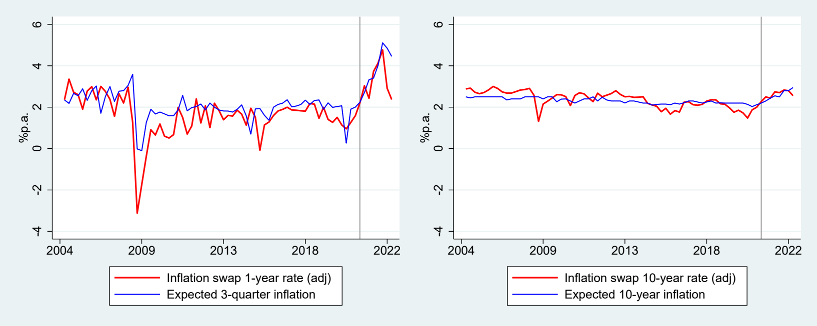
Positive real bond-stock return beta

Inflation Component of Bond-Stock Beta



$xr^{\$}_{n,t+1} - xr^{TIPS}_{n,t+1} = \alpha + \beta xr^{eq}_{t+1} + \varepsilon_{t+1}$, daily returns, 6-month rolling windows

Small Inflation Risk Premia in Swap Market



Cieslak and Pflueger (2023)

Inflation risk premium = Swap rate − expected inflation

Conclusion: Not (Yet) Back to Stagflationary 1980s

- New Keynesian asset pricing model: Interaction of supply shocks and fast, anti-inflationary monetary policy leads to risky nominal bonds
- Endogenously time-varying risk premia turn bond-stock betas into equilibrium indicator
- Nominal bond-stock betas priced stagflation risk in the 1980s due to supply shocks and reactive monetary policy
- Demand shocks and inertial monetary policy rule led to safe Treasury bonds in 2000s
- Small nominal bond risks still appear to indicate “soft(-ish) landing”

Consistent with Inflation Forecast Errors

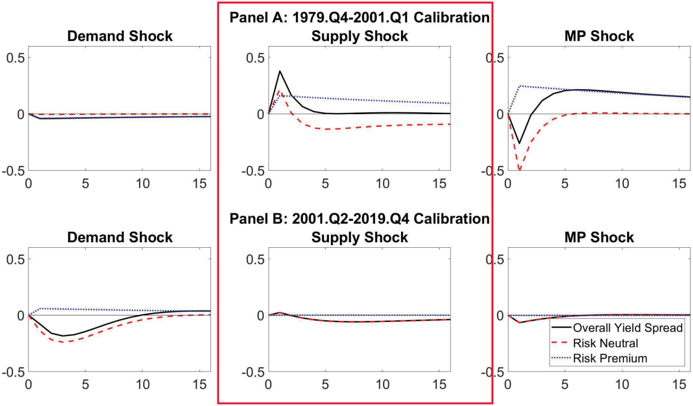
	Data			Model	
$\tilde{E}_t \pi_{t+3} - \tilde{E}_{t-1} \pi_{t+3}$	0.926***	0.433	-0.310	1.43	-0.01
	(0.34)	(0.32)	(0.43)		
Const.	-0.114	-0.795***	-0.046		
	(0.28)	(0.20)	(0.18)		
N	126	87	71		
R-sq	0.09	0.03	0.00		
Sample	1968.Q4-2001.Q1	1979.Q4–2001.Q1	2001.Q2–2019.Q4	1980s	2000s

$$\pi_{t+3} - \tilde{E}_t \pi_{t+3} = a_0 + a_1 \left(\tilde{E}_t \pi_{t+3} - \tilde{E}_{t-1} \pi_{t+3} \right) + \varepsilon_{t+3}$$

- Adaptive inflation expectations parameters consistent with (untargeted) Coibion-Gorodnichenko regressions
- Mindful of low precision for 2000s sample

back

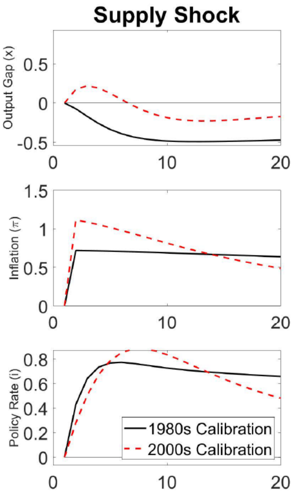
Yield Spread Response and Bond Excess Predictability



- **1980s Calibration**: Inflation persistence implies that yield spread dominated by time-varying risk premia
- **2000s Calibration**: Yield spread $\approx$ risk neutral $\Rightarrow$ No predictability

back

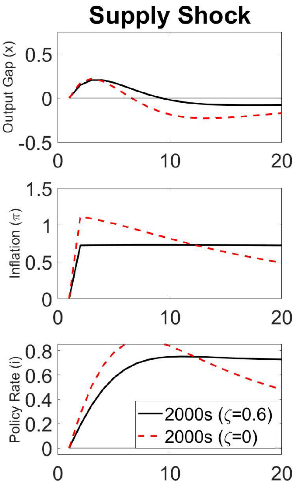
Supply Shock Responses for Equal-Size Shock



1980s size supply shock for both

back

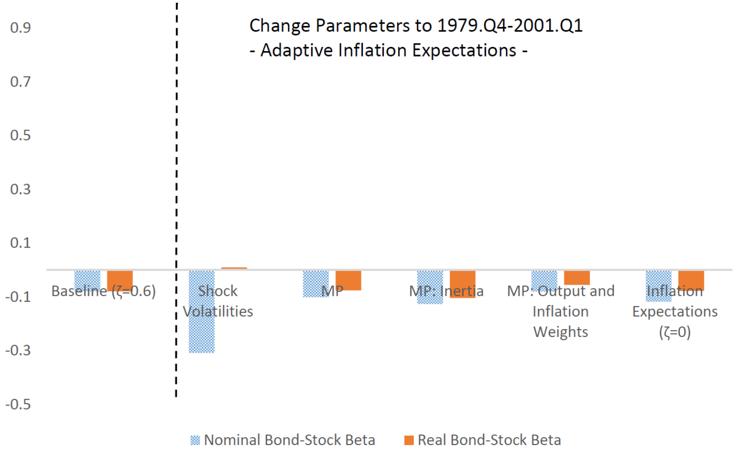
Role of Inflation Expectations for Macro Dynamics



1980s size supply shock for both

Bond Betas with Adaptive Inflation Expectations

Panel B: Starting from 2001.Q2-2019.Q4 Calibration (zeta=0.6)



back

Excess Bond Premium and Business Cycle

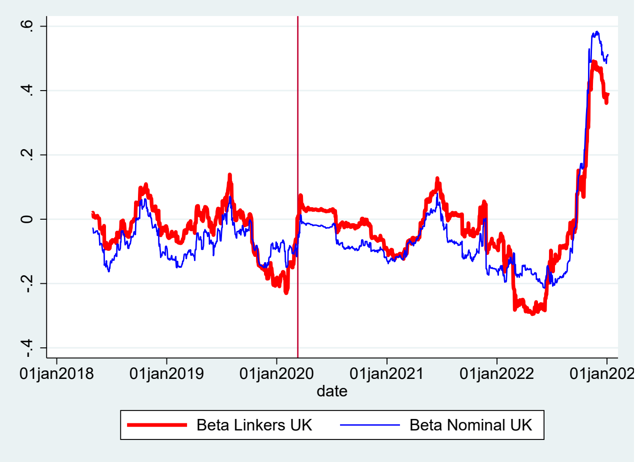
	1979.Q4-2001.Q1	2001.Q2-2019.Q4
Corr(EBP, F. Output Gap)	-0.23	-0.41
Corr(EBP, F. Inflation)	0.19	-0.56
Corr(ΔEBP, Bond Return)	0.14	0.51
Corr(ΔEBP, Stock Return)	-0.10	-0.68

- Excess bond premium from Gilchrist and Zakrajsek (2012)
- Correlations as for adverse demand shock in model
- Large magnitudes in second subperiod consistent with dominance of demand shocks
- Smaller correlations in first subperiod consistent with dominance of other (supply and and monetary policy) shocks

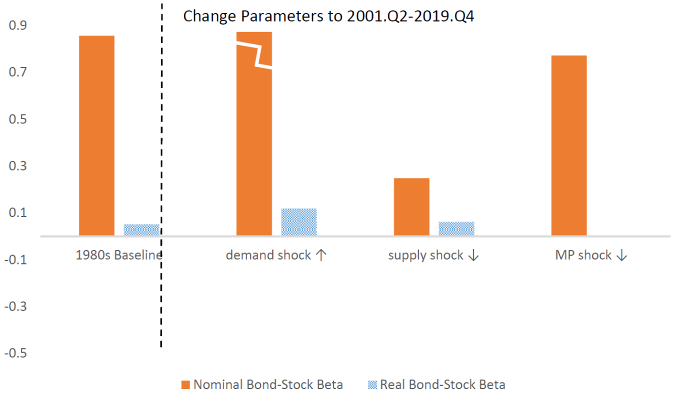
Bond preference shock resembles external finance premium in data

back

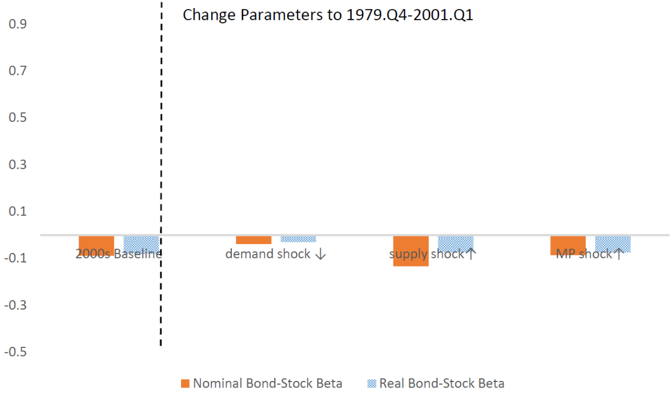
UK Bond Betas



Starting from 1980s: Change Individual Shock Volatilities



Starting fro 2000s: Change Individual Shock Volatilities



back