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

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Chicago Harris, NBER, and CEPR

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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),...).
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- 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?
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)

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.

Bloomberg

9/14/2022

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 (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.

Historical Nominal and Real Bond Risks

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

Pflueger (2023)  
Back to the 1980s or Not?  
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Recent Changes: Back to the 1980s?

<table>
<thead>
<tr>
<th>Date</th>
<th>Nominal Bond Beta</th>
<th>Infl-Indexed Bond Beta</th>
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<tbody>
<tr>
<td>Pandemic</td>
<td>Fed +75 bps</td>
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Nominal bond betas below real bond betas, different from 1980s

Uptick when Fed surprised with 75 bps interest rate hike

\[ x_{r_{n,t+1}} = \alpha + \beta x_{r_{eq,t+1}} + \varepsilon_{t+1}, \text{ daily returns, 6-month rolling windows} \]


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:** \( x_t = f^x E_t x_{t+1} + \rho^x x_{t-1} - \psi r_t + \nu_{x,t} \)

- **Phillips curve:** \( \pi^w_t = f^\pi E_t \pi^w_{t+1} + \rho^\pi \pi^w_{t-1} + \kappa x_t + \nu_{\pi,t} \)

- **Interest rate rule:** \( i_t = \rho^i i_{t-1} + (1 - \rho^i) (\gamma^x x_t + \gamma^\pi \pi_t) + \nu_{i,t} \)

\( x_t = \) output gap, \( \pi_t = \) inflation, \( i_t = r_t + E_t \pi_{t+1} \) nominal rate
Work-Horse New Keynesian Model

- Euler equation: \( x_t = f^x E_t x_{t+1} + \rho^x x_{t-1} - \psi r_t + \nu_{x,t} \)

- Phillips curve: \( \pi_t^w = f^\pi E_t \pi_{t+1}^w + \rho^\pi \pi_{t-1}^w + \kappa x_t + \nu_{\pi,t} \)

- Interest rate rule: \( i_t = \rho^i i_{t-1} + (1 - \rho^i) (\gamma^x x_t + \gamma^\pi \pi_t) + \nu_{i,t} \)

\( x_t = \) 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
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: $\tilde{E}_t \pi_{t+1}^w = (1 - \zeta) E_t \pi_{t+1}^w + \zeta \pi_{t-1}^w$

- Standard log-linearized wage **Phillips curve**:

$$\pi_t^w = (1 - \rho^\pi) E_t \pi_{t+1}^w + \rho^\pi \pi_{t-1}^w + \kappa x_t + \nu_{\pi,t}$$
CONSUMPTION AND PREFERENCES
Countercyclical Risk Aversion via Habits

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

Pflueger (2023)
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):
  \[ M_{t+1} = \beta \exp(-\gamma (\Delta c_{t+1} + \Delta s_{t+1})) \]

- Homoskedastic shocks; time-varying risk premia only from preferences
\[ s_{t+1} = (1 - \theta_0)\bar{s} + \theta_0 s_t + \theta_1 x_t + \theta_2 x_{t-1} + \lambda(s_t)\epsilon_{c,t+1} \]

- 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
Bond preference shock $\xi_t$ enters bond asset pricing equations like “standard” discount rate shock

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

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 $\xi_t$ enters bond asset pricing equations like “standard” discount rate shock

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

- Asset pricing recursions for zero-coupon consumption claims

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

- 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)...)
1 = \exp(-\xi_t) E_t [M_{t+1}\exp(r_t)]

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

\[
x_t = \left( f^x E_t x_{t+1} + \rho^x x_{t-1} - \psi r_t + \psi \xi_t \right) \frac{1}{\phi - \theta_1} + \frac{\theta_2}{\phi - \theta_1} + \frac{1}{\gamma(\phi - \theta_1)} Demand Shock \; v_{x,t}
\]
Macro equilibrium: Loglinear macroeconomic dynamics

\[ Y_t = B Y_{t-1} + \Sigma v_t, \]
\[ Y_t = [x_t, \pi_t, i_t]', \]
\[ v_t = [v_{x,t}, v_{\pi,t}, v_{i,t}]'. \]
Two-Step Solution

1. Macro equilibrium: Loglinear macroeconomic dynamics

\[ Y_t = BY_{t-1} + \Sigma v_t, \]
\[ Y_t = [x_t, \pi_t^w, i_t]', \]
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2. Asset prices: Real cash flow cyclicality depends on macroeconomic equilibrium, solve with value function iteration (programming package coming soon....)
Two-Step Solution

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

- Illustrative asset paying \( \alpha c_{t+1} \):

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

- If \( \alpha > 0 \) risk premium falls with surplus consumption (recall \( \lambda' (s_t) < 0 \)) and vice versa
CALIBRATION
# Calibration 1980s vs. 2000s

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Monetary Policy Rule</strong></td>
<td></td>
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<tr>
<td>Inflation weight $\gamma^\pi$</td>
<td>1.35</td>
<td>1.10</td>
</tr>
<tr>
<td></td>
<td>(0.32)</td>
<td>(0.06)</td>
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<tr>
<td>Output gap weight $\gamma^x$</td>
<td>0.50</td>
<td>1.00</td>
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<tr>
<td></td>
<td>(0.42)</td>
<td>(0.17)</td>
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<tr>
<td>Inertia $\rho^i$</td>
<td>0.54</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td>(0.13)</td>
<td>(0.03)</td>
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<tr>
<td><strong>Shock Volatilities</strong></td>
<td></td>
<td></td>
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<tr>
<td>Vol. demand shock $\sigma_x$</td>
<td>0.01</td>
<td>0.59</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.02)</td>
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<tr>
<td>Vol. PC shock $\sigma_\pi$</td>
<td>0.58</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.00)</td>
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<tr>
<td>Vol. MP shock $\sigma_i$</td>
<td>0.55</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(0.02)</td>
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<tr>
<td><strong>Expectations</strong></td>
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<tr>
<td>Adaptive Inflation Expectations $\zeta$</td>
<td>0.6</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>(0.51)</td>
<td>(2.67)</td>
</tr>
</tbody>
</table>

Delta method standard errors in parentheses

Pflueger (2023)
MODEL/DATA 1980s vs. 2000s
Target Output-Inflation Comovement

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


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

Small supply shocks \((\sigma_\pi \approx 0)\)
Target Output–Fed Funds Rate Comovement

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


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

Large demand shocks \((\sigma_x \gg 0)\)
$$i_{t+h} = a_{0,h} + a_{1,h}\pi_t + a_{2,h}\pi_{t-1} + \varepsilon_{t+h}$$


High $\gamma^\pi$, low $\rho^i$


High $\gamma^x$, high $\rho^i$
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))
ASSET PRICING IMPLICATIONS
## Match Changing Bond Risks from 1980s to 2000s

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<tbody>
<tr>
<td></td>
<td>Model</td>
<td>Data</td>
<td>Model</td>
<td>Data</td>
</tr>
<tr>
<td>Yield Spread</td>
<td>2.28</td>
<td>1.53</td>
<td>-0.58</td>
<td>2.06</td>
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<tr>
<td>Return Vol.</td>
<td>15.82</td>
<td>14.81</td>
<td>2.12</td>
<td>9.28</td>
</tr>
<tr>
<td>Nominal Bond-Stock Beta</td>
<td>0.86</td>
<td>0.24</td>
<td>-0.09</td>
<td>-0.31</td>
</tr>
<tr>
<td>Real Bond-Stock Beta</td>
<td>0.05</td>
<td>0.08</td>
<td>-0.08</td>
<td>-0.06</td>
</tr>
<tr>
<td>1 YR Excess Return on slope*</td>
<td>1.26</td>
<td>2.55</td>
<td>-0.31</td>
<td>0.86</td>
</tr>
<tr>
<td>1 YR Excess Return on slope (R²)</td>
<td>0.01</td>
<td>0.07</td>
<td>0.01</td>
<td>0.02</td>
</tr>
</tbody>
</table>

* = 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

- 2000s Calibration: Monetary policy rule leads to “soft landing”
Translate into Bond-Stock Comovement...

- 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

Overall and risk-neutral yield responses differ, sometimes markedly.

- Bonds benefit from “flight-to-safety” in 2000s, but suffer in 1980s.
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
Post-Pandemic Treasury Bond Risks
Decoupling of Nominal and Real Yields

Nominal 10 YR vs Breakeven 10 YR over time from January 2018 to January 2023.
Breakeven Moves with Stock Market

Negative nominal bond-stock return beta

Pflueger (2023) Back to the 1980s or Not? March 2023
Real Yields Move Against Stock Market

Positive real bond-stock return beta
Inflation Component of Bond-Stock Beta

\[ \alpha_r n,t+1 - \alpha_r TIPS n,t+1 = \alpha + \beta \alpha r_{eq}, t+1 + \epsilon_{t+1}, \] 
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

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

- Adaptive inflation expectations parameters consistent with (untargeted) Coibion-Gorodnichenko regressions
- Mindful of low precision for 2000s sample
1980s Calibration: Inflation persistence implies that yield spread dominated by time-varying risk premia

2000s Calibration: Yield spread \( \approx \) risk neutral \( \Rightarrow \) No predictability
Supply Shock Responses for Equal-Size Shock

1980s size supply shock for both
Role of Inflation Expectations for Macro Dynamics

Supply Shock

1980s size supply shock for both

- Output Gap ($x$)
- Inflation ($\pi$)
- Policy Rate ($i$)

2000s ($\zeta=0.6$)
2000s ($\zeta=0$)
Panel B: Starting from 2001.Q2-2019.Q4 Calibration (zeta=0.6)

Change Parameters to 1979.Q4-2001.Q1
- Adaptive Inflation Expectations -

- Baseline (zeta=0.6)
- Shock Volatilities
- MP
- MP: Inertia
- MP: Output and Inflation Weights
- Inflation Expectations (zeta=0)

Nominal Bond-Stock Beta
Real Bond-Stock Beta
### Excess Bond Premium and Business Cycle

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<thead>
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<tbody>
<tr>
<td>Corr(EBP, F. Output Gap)</td>
<td>-0.23</td>
<td>-0.41</td>
</tr>
<tr>
<td>Corr(EBP, F. Inflation)</td>
<td>0.19</td>
<td>-0.56</td>
</tr>
<tr>
<td>Corr(ΔEBP, Bond Return)</td>
<td>0.14</td>
<td>0.51</td>
</tr>
<tr>
<td>Corr(ΔEBP, Stock Return)</td>
<td>-0.10</td>
<td>-0.68</td>
</tr>
</tbody>
</table>

- 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 monetary policy) shocks

**Bond preference shock resembles external finance premium in data**
Starting from 1980s: Change Individual Shock Volatilities


- 1980s Baseline
- Demand Shock $\uparrow$
- Supply Shock $\downarrow$
- MP Shock $\downarrow$

Nominal Bond-Stock Beta  Real Bond-Stock Beta
Starting from 2000s: Change Individual Shock Volatilities

Change Parameters to 1979.Q4-2001.Q1

- 2000s Baseline
- Demand Shock ↓
- Supply Shock ↑
- MP Shock ↑

Nominal Bond-Stock Beta  Real Bond-Stock Beta