

Nominal Anchors and Real Consequences: Inflation Targeting, Debt, and Investment

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secular trends in macro-finance since the 1980s

1. decline in long-term real interest rates on nominal bonds
2. increase in private (nominal) debt relative to GDP
3. investment 'drought' (declining I/Y)
4. stability of risky real returns to capital
5. strengthening of inflation targeting since the 1980s

trend often explained by real factors (demography, productivity, capital risk)

our question: can the *monetary policy regime* (5) be a unified explanation of (1)–(4)?

develop GE connections between inflation targeting and wider historical trends

credible inflation targeting $\implies$ lower inflation volatility

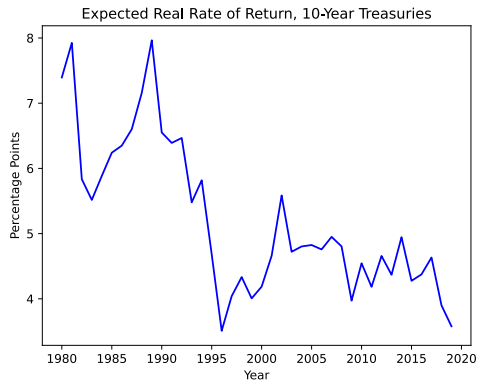
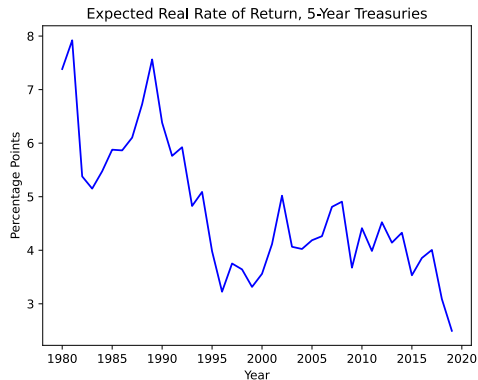
- nominal bonds become *safer* in real terms
- $\implies$ inflation risk premium declines $\implies R_0^* \downarrow$
- $\implies$ savers supply more savings in nominal assets $\implies$ debt $\uparrow$
- $\implies$ capital becomes relatively *more* risky $\implies K \downarrow, \mathbb{E}_0[R_0^K] \uparrow$

successful nominal anchoring transforms the *risk characteristics* of nominal assets, triggering portfolio reallocation away from risky capital toward safer nominal bonds

1. Stylized facts since the 1980s
2. A three-period macro-finance model
3. Analytical results: zero-debt equilibrium and asset prices
4. Analytical results: first-order approx. w/positive (nominal) debt and the crowding out of capital
5. Conclusion

Fact 1: Decline in long-term rates

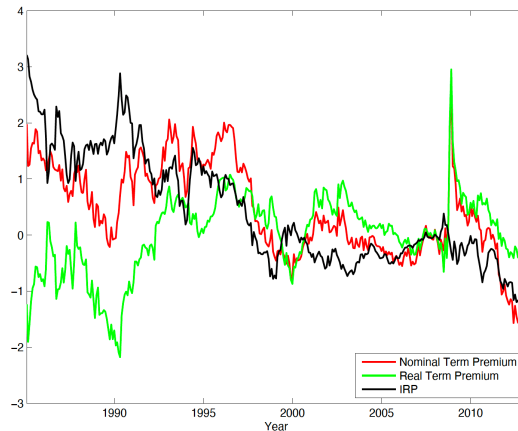
expected real yields on US nominal bonds



Fact 1: Decline in the inflation risk premium

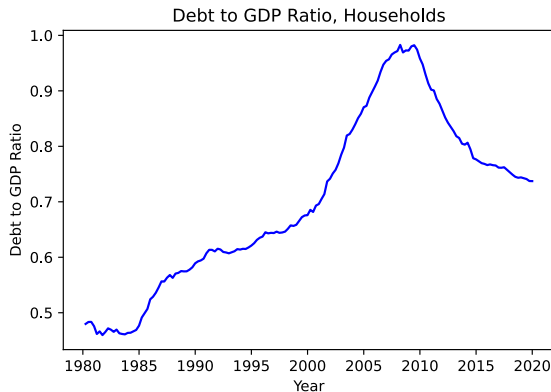
Inflation Risk Premium for the UK

10-year Term Premium Comparison



Fact 2: Rise in private (nominal) debt

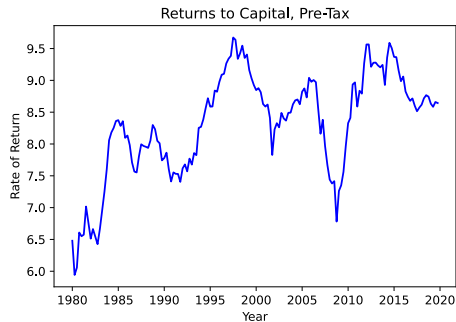
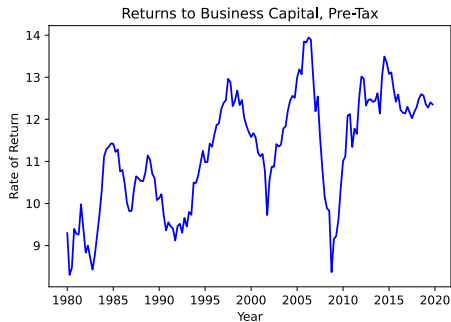
household debt relative to GDP in the US increased since 1980



Source: Our calculations based on Mian Straub & Sufi (2023)

Fact 3: Returns to capital stable or rising

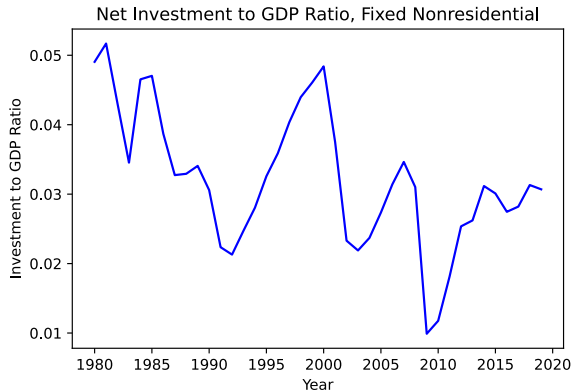
real return to capital, US data



Source: based on Gomme, Ravikumar, & Rupert (2019)

Fact 4: Investment drought

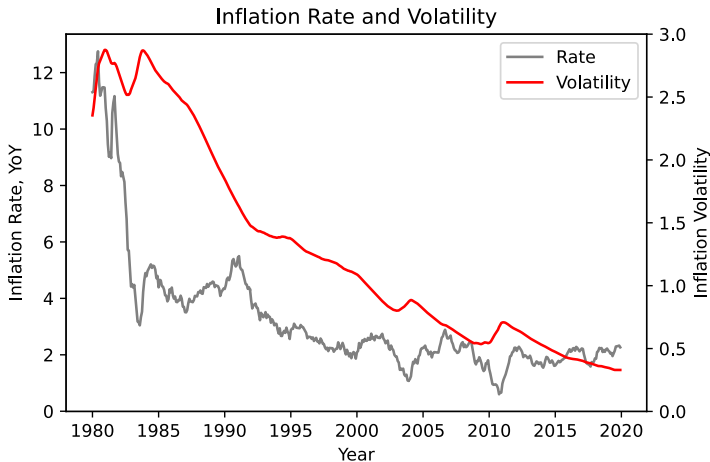
investment to GDP declined



Source: our calculations

Fact 5: Strengthening of inflation targeting

post Volcker, central banks adopt inflation targeting. US data (π , level and rolling sd)



Three Periods: ($t = 0, 1, 2$), flexible price economy

Agents

- Borrower and savers
- Central bank (Taylor rule)

Assets

- Short-term nominal bond (zero supply)
- Long-term nominal bond
- Capital: illiquid, cannot sell at date 1

Endowments

- exogenous endowment at all dates

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Shocks

All uncertainty resolves at date 1

Aggregate Risk

- Preference shock ξ_1
- Source of inflation volatility
- inflation risk premium

Idiosyncratic Liquidity Risk on Savers

- Prob. λ : forced to liquidate at date 1
- Low income y_L in liquidity state
- interest rate risk on long-term bond

Two types $j \in \{b, s\}$: borrowers and savers, each mass one

- Borrowers: discount factor β_b^t , with β_b small (always constrained)
- Savers: discount factor $\beta^t \xi_t$, where ξ_t is a stochastic preference shock

Preference shock ξ_1 :

- $\xi_0 = 1$, $\xi_1 \sim [\xi_L, \xi_H]$ with $\mathbb{E}[\xi_1] = 1$, $\text{Var}(\xi_1) > 0$
- Date-2 persistence: $\xi_2 = \xi_1^\rho$ with $\rho \in (0, 1)$
- All uncertainty resolves at date 1

Idiosyncratic Liquidity Shock

Each saver draws $\eta \in \{0, 1\}$ (wt on date 2 utility) at beginning of date 1, i.i.d., independent of ξ_1 :

	Impatient ($\eta = 0$)	Patient ($\eta = 1$)
Probability	λ	$1 - \lambda$
Date-1 endowment	y_L	$y_H \geq y_L$
Long bonds at date 1	Sells at Q_1^L	Holds to maturity

$\omega \equiv (y_H/y_L)^\gamma \geq 1$: the impatient type's marginal utility relative to the patient's

Saver's date-0 utility:

$$U_s = u(C_{s,0}) + \beta \mathbb{E} \left[\xi_1 \left(\lambda u(C'_{s,1}) + (1 - \lambda) \left[u(C^P_{s,1}) + \beta \xi_1^{\rho-1} u(C^P_{s,2}) \right] \right) \right]$$

$$u(C) = C^{1-\gamma}/(1-\gamma)$$

1. **Short-term nominal bond:** issued at date 0, pays $(1 + i_0^S)$ at date 1
 - Zero supply: pins short-term real interest rate
 - Real return $(1 + i_0^S)/\Pi_1$, exposed to date-1 inflation
2. **Long-term nominal bond:** issued at date 0 at price Q_0^L , pays 1 at date 2
 - Liquid: can be resold at date 1 at price $Q_1^L = \frac{1}{1+i_1^S}$
 - Impatient type sells at $Q_1^L \Rightarrow$ exposed to both inflation risk and interest rate risk
3. **Real capital K :** invested at date 0, produces $\bar{A}K^\alpha$ at date 2
 - Illiquid: cannot be sold or pledged at date 1
 - No inflation exposure

Saver's Budget Constraints

Date 0 (before learning η):

$$P_0 C_{s,0} + P_0 K + Q_0^L B_s^L + B_s^S = P_0 Y_0$$

Date 1, Impatient type (λ): sells all long bonds, consumes everything

$$P_1 C_{s,1}^I = P_1 y_L + Q_1^L B_s^L + (1 + i_0^S) B_s^S$$

Date 1 and 2, Patient type ($1 - \lambda$): receives y_H , holds bonds to maturity, saves S_1

$$\begin{aligned} P_1 C_{s,1}^P + S_1 &= P_1 y_H + (1 + i_0^S) B_s^S \\ P_2 C_{s,2}^P &= P_2 \bar{A} K^\alpha + P_2 Y_2 + B_s^L + (1 + i_1^S) S_1 \end{aligned}$$

Market clearing: $B_s^S = 0$ (zero supply), $(1 - \lambda) S_1 = \lambda Q_1^L B_s^L$

Issue long-term nominal bonds, face a limit on expected real repayment:

$$\mathbb{E}_0 \left[\frac{B_b^L}{P_2} \right] \geq -d^L \quad \Longleftrightarrow \quad b^L \leq \frac{d^L}{(R_0^{L*})^2}$$

where $b^L \equiv -Q_0^L B_b^L / P_0$ is the market value of debt and $(R_0^{L*})^2 \equiv \mathbb{E}_0[(\Pi_1 \Pi_2)^{-1}] / Q_0^L$ is the expected real long yield (annualized)

- Consume at dates 0 and 2 only:

$$P_0 C_{b,0} = P_0 Y_{b,0} + Q_0^L B_b^L, \quad P_2 C_{b,2} = P_2 Y_{b,2} - B_b^L$$

- Always constrained (β_b small)

Taylor rule:

$$1 + i_1^S = \frac{1}{\beta} \Pi_1^{\phi_\pi}, \quad \phi_\pi > 1$$

- normalize $P_0 = 1$
- Assume $\Pi_2 = 1$ (Krugman 1998)

Date-1 long bond price:

$$Q_1^L = \frac{1}{1 + i_1^S} = \beta \Pi_1^{-\phi_\pi}$$

⇒ resale price moves with the real rate: interest rate risk for savers who sell at date 1

Three pricing equations:

- **Short bond** (no supply):

$$1 = \mathbb{E} \left[\left(\lambda M'_{01} + (1 - \lambda) M^P_{01} \right) \frac{1 + i_0^S}{\Pi_1} \right]$$

- **Long bond** (hybrid: impatient sells at date 1, patient holds to date 2):

$$Q_0^L = \mathbb{E} \left[\lambda M'_{01} \frac{Q_1^L}{\Pi_1} + (1 - \lambda) M^P_{02} \frac{1}{\Pi_1 \Pi_2} \right]$$

- **Capital** (only patient types benefit, illiquidity wedge $(1 - \lambda)$):

$$1 = (1 - \lambda) \mathbb{E} \left[M^P_{02} R_K \right], \quad R_K = \alpha \bar{A} K^{\alpha-1}$$

$$\text{real SDFs: } M_{01}^j \equiv \beta \xi_1 \frac{u'(C_{s,1}^j)}{u'(C_{s,0})} \text{ for } j \in \{I, P\}, \quad M_{02}^P \equiv \beta^2 \xi_1^\rho \frac{u'(C_{s,2}^P)}{u'(C_{s,0})}$$

Zero-debt benchmark

Set $d^L = 0$: no borrowing or lending. savers only save in capital.

from patient type's date-1 Euler + Taylor rule, solve for equilibrium inflation:

$$\bar{\Pi}_1 = \bar{D} \xi_1^a, \quad \text{where } a \equiv \frac{1-\rho}{\phi_\pi}, \quad \bar{D} \equiv \left(\frac{Y_2 + \bar{A}\bar{K}^\alpha}{y_H} \right)^{\gamma/\phi_\pi}$$

inflation variance:

$$\text{Var}(\log \bar{\Pi}_1) = \left(\frac{1-\rho}{\phi_\pi} \right)^2 \text{Var}(\log \xi_1) \quad \implies \quad \text{strictly decreasing in } \phi_\pi$$

Zero-debt: inflation risk premia

expected real return on the short nominal bond:

$$\bar{R}_0^{S*} = \bar{R}_1^f \cdot \underbrace{\frac{\mathbb{E}[\xi_1^{-a}]}{\mathbb{E}[\xi_1^{1-a}]}}_{\text{IRP}^S > 1}$$

- $\uparrow \phi_\pi \implies \downarrow \bar{R}_0^{S*}$ (lower compensation for inflation risk)
- as $\phi_\pi \rightarrow \infty$: $\text{IRP}^S \rightarrow 1$. Perfect IT eliminates inflation risk premium
- IRP^S independent of γ , λ , or ω
- nominal bonds remain bad hedges ($\log M_{01}$ and $\log \bar{\Pi}_1^{-1}$ perfectly negatively correlated); inflation targeting shrinks their exposure, $\text{sd}(\log \bar{\Pi}_1^{-1}) = a \text{sd}(\log \xi_1)$
- **long bond**, same convexity argument: $(\bar{R}_0^{L*})^2 \propto \mathbb{E}[\xi_1^{-a}]/\mathbb{E}[\xi_1^{\rho-a}]$, also **strictly decreasing in ϕ_π**

Zero-debt: capital is independent of ϕ_π

capital Euler (only patient types benefit; illiquidity wedge $1 - \lambda$):

$$1 = (1 - \lambda) \mathbb{E} \left[M_{02}^P R_K \right], \quad R_K = \alpha \bar{A} K^{\alpha-1}$$

at $b^L = 0$: $M_{02}^P = \beta^2 \xi_1^\rho \left(\frac{Y_2 + \bar{A} K^\alpha}{C_{s,0}} \right)^{-\gamma}$

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Capital–bond spread: $\sqrt{R_K} - \bar{R}_0^{L*}$

- R_K invariant to ϕ_π , while $\bar{R}_0^{L*}$ strictly decreasing
- $\implies$ **spread rises** as inflation targeting becomes more aggressive
- spread > 0 iff $\lambda > \lambda^*$, and $\lambda^* \downarrow$ **as** $\phi_\pi \uparrow$ ($\lambda^* \rightarrow 0$ as $\phi_\pi \rightarrow \infty$)

Inflation persistence and the term premium

both yields fall with ϕ_π . does the **spread**?

Term premium: expected excess return of the long over the short bond, date 0 to 1,
 $TP \equiv \log \mathbb{E}_0[R_{01}^L] - \log \mathbb{E}_0[R_{01}^S] > 0$ for any distribution of ξ_1

with $\Pi_2 = 1$: $\theta = 1 - \rho$ is **independent of** ϕ_π , since the resale price moves with the real rate

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persistence: $\Pi_2 = \Pi_1^\delta$, $0 \leq \delta < \phi_\pi \implies$ pass-through $a = \frac{1 - \rho}{\phi_\pi - \delta}$

resale price: $Q_1^L \propto \xi_1^{-\theta}$, $\theta \equiv \underbrace{(1 - \rho)}_{\text{real rate}} + \underbrace{a \delta}_{\text{expected inflation}}$

now targeting stabilizes the resale price ($\theta \downarrow$) $\implies \phi_\pi \uparrow \implies$ **TP $\downarrow$**

At zero debt, more aggressive inflation targeting ($\uparrow \phi_\pi$):

1. $\bar{R}_0^{S*} \downarrow$: short-bond IRP falls (lower inflation risk)
2. $\bar{R}_0^{L*} \downarrow$: long-bond IRP falls (lower inflation *and* interest rate risk)
3. **term premium compresses**, with persistent inflation ($\delta > 0$)
4. R_K unchanged: capital return pinned by real fundamentals
5. **capital-bond spread $\sqrt{R_K} - \bar{R}_0^{L*}$ rises**

Next: what happens when we turn on debt ($b^L > 0$)?

A First-Order Approximation

equilibrium $\mathbb{E}[F(x(\xi), \xi; \theta)] = 0$, $\theta = (\sigma, d^L)$

where $\xi = \mathbb{E}\xi + \sigma\varepsilon$ and d^L is the borrowing limit

(a) linearize in σ at $\theta = (0, d^L)$: the equilibrium x^* is **deterministic**

$$0 = \underbrace{\mathbb{E}[\partial_x F(x^*, \mathbb{E}\xi) \partial_\sigma x]}_{= \partial_x F \mathbb{E}[\partial_\sigma x]} + \underbrace{\mathbb{E}[\partial_\xi F(x^*, \mathbb{E}\xi) \varepsilon]}_{= 0}$$

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(b) linearize in d^L at $\theta = (\sigma, 0)$: the equilibrium $\bar{x}(\xi)$ is still **stochastic**

$$0 = \underbrace{\mathbb{E}[\partial_x F(\bar{x}(\xi), \xi) \partial_d x(\xi)]}_{\neq \mathbb{E}[\partial_x F] \mathbb{E}[\partial_d x]} + \mathbb{E}[\partial_d F(\bar{x}(\xi), \xi)]$$

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the equilibrium we expand around inherits whatever we switch off:

$\sigma = 0$ removes the risk, $d^L = 0$ removes only the **portfolio**

$\implies$ risk premia survive at **first order**

Computing the First-Order Term

from (b), the first-order term needs exactly two:

$$\mathbb{E}[\partial_x F(\bar{x}(\xi), \xi) \partial_d x(\xi)] \quad \text{and} \quad \mathbb{E}[\partial_d F(\bar{x}(\xi), \xi)]$$

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in our model $\bar{x}(\xi)$ is a **power** of the shock:

$$\bar{\Pi}_1 = \bar{D} \xi_1^a, \quad a = \frac{1 - \rho}{\phi_\pi}$$

products of powers are powers, so everything inside those expectations is a combination of powers of ξ_1

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both expectations therefore reduce to sums of $\mathbb{E}[\xi_1^s]$, and ϕ_π enters **only through the exponent a**

closed form throughout: the risky equilibrium is never solved numerically

Two reinforcing channels

now turn on debt. the impatient type's date-1 consumption becomes state contingent:

$$C'_{s,1} = y_L + \frac{Q_1^L}{P_1} B_s^L = y_L + \beta \Pi_1^{-(1+\phi_\pi)} \frac{b^L}{Q_0^L}$$

savers now bear resale-price risk in consumption, amplified by $\omega = (y_H/y_L)^\gamma$

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Proposition. At $b^L > 0$, $\partial R_0^{L*}/\partial \phi_\pi < 0$: savers demand less compensation for holding debt, through two channels

(i) Hold-to-maturity risk (all savers):

- $\uparrow \phi_\pi$ reduces $\text{Var}(\log \Pi_1) \implies$ compresses IRP
- same mechanism as zero-debt benchmark

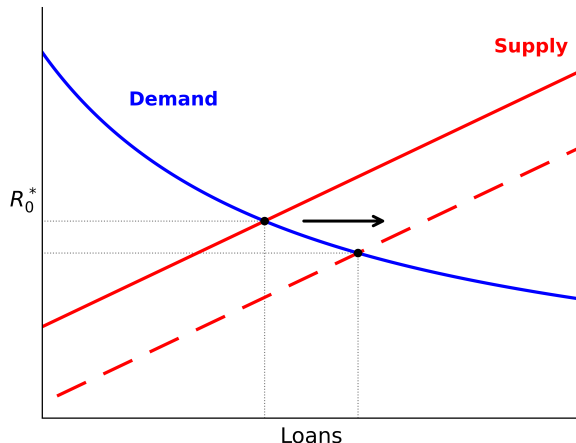
(ii) Liquidation risk ($\propto \lambda$, amplified by ω):

- sellers' payoff exposed to inflation risk and interest rate risk
- $\uparrow \phi_\pi$ shrinks the inflation part; interest rate risk makes this channel more sensitive to ϕ_π

Intuition: supply and demand for credit

more aggressive inflation targeting $\implies$ lower R_0^{L*}

$\implies$ more nominal debt supplied by savers $\implies$ lower R_0^L , more credit in equilibrium



[binding debt limit: demand curve $(R_0^{L*})^2 = d^L/b^L$, with b^L the market value of loans]

Crowd-out: the question

when bonds become safer, do savers **displace capital** or just **save more**?

write total savings as $S_0 \equiv Y_0 - C_{s,0} = K + b^L$

differentiate with respect to bond holdings b :

$$\left. \frac{dK}{db} \right|_{b=0} = \underbrace{sl - 1}_{\text{portfolio margin}} + \underbrace{\left. \frac{dS_0}{db} \right|_{b=0}}_{\text{savings margin}}$$

- **portfolio margin** = -1 : holding S_0 fixed, each dollar of bonds displaces a dollar of capital
- **savings margin** = $1 + k$: when bonds are more attractive, saver may cut $C_{s,0}$ and save more
- $k \equiv dK/db$ is the **crowd-out coefficient**

Crowd-out: why it is incomplete

buy one more unit of bonds, adjust capital by k : the capital Euler
 $(1 - \lambda) \mathbb{E}[M_{02}^P R_K] = 1$ must still hold

$$0 = \underbrace{(1+k) \frac{\gamma}{\bar{C}_0}}_{\text{(a) more saving: date-0 MU}\uparrow} + \underbrace{k \frac{1-\alpha}{\bar{K}}}_{\text{(b) less capital: } R_K \uparrow} + \underbrace{\left(k + \frac{1}{\chi}\right) \frac{\gamma R_K}{\bar{C}_2}}_{\text{(c) date-2 consumption: lost capital income } kR_K, \text{ bond payoff } R_K/\chi}, \quad \chi \equiv 1 + \lambda(\omega - 1)$$

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- **benchmark** ($\alpha = 1, \chi = 1$): bonds and capital are perfect substitutes for the patient saver $\implies$ pure portfolio swap, $k = -1$
- **diminishing returns** ($\alpha < 1$): displacing capital raises $R_K \implies$ saver keeps some capital and saves more
- **liquidity value** ($\chi > 1$): per unit, the bond delivers only $1/\chi$ of capital's date-2 payoff $\implies$ a one-for-one swap would cut $C_{s,2}^P \implies$ saver saves more

Proposition. The crowd-out coefficient is

$$k = -\frac{\gamma/\bar{C}_0 + \gamma R_K/(\chi\bar{C}_2)}{\gamma/\bar{C}_0 + (1-\alpha)/\bar{K} + \gamma R_K/\bar{C}_2} \in [-1, 0)$$

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- $k < 0$: bond purchases always crowd out capital
- one-for-one ($k = -1$) iff $\alpha = 1$ and $\chi = 1$
- incomplete otherwise: diminishing returns ($\alpha < 1$) or the liquidity value of long bonds ($\chi > 1$) lead savers to finance part of the bond purchase by saving more

Conclusion

$\uparrow \phi_\pi \implies$ safer nominal bonds $\implies b \uparrow \implies K \downarrow \implies \mathbb{E}_0[R_0^K] \uparrow$

aggressive inflation targeting regime:

- reduces inflation volatility $\implies$ lowers R_0^*
- low inflation volatility $\implies$ nominal bonds safer $\implies$ supply of savings in nominal assets goes up
- capital becomes relatively *more* risky $\implies$ supply of savings in real assets falls
- equilibrium: $\uparrow$ private credit, $\downarrow$ natural rate on nominal bonds, $\downarrow$ investment

a unified account of macro-finance trends since the 1980s:

declining real rates, rising debt, investment drought, stable returns on capital
all as equilibrium responses to a single shift in monetary policy regime

What next

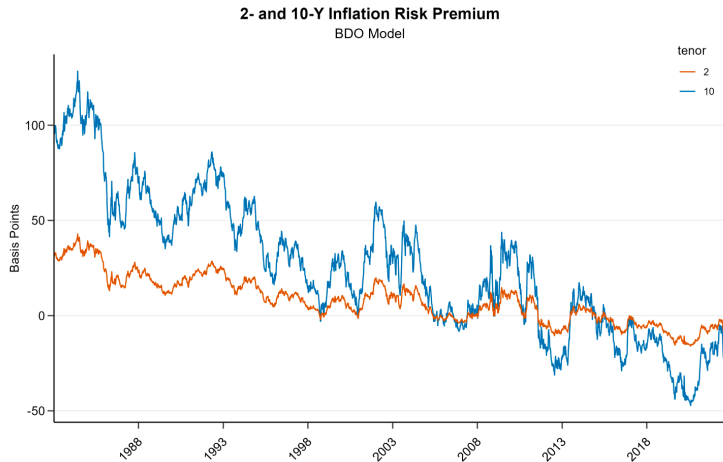
quantitative exercise:

- infinite horizon model with aggregate uncertainty
- decompose the contribution to decline in r^* from ϕ_π vs other forces (demography, productivity, capital risk)

THANK YOU!

Fact 1: Decline in long-term rates

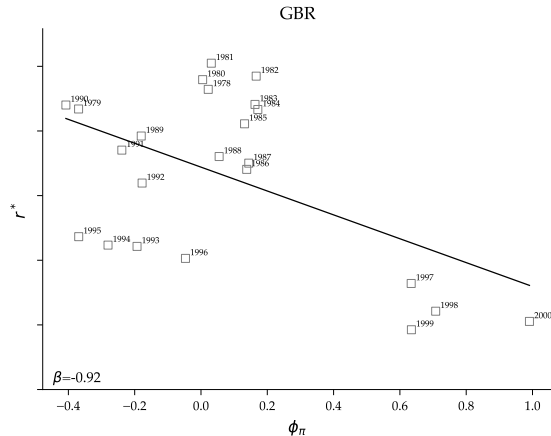
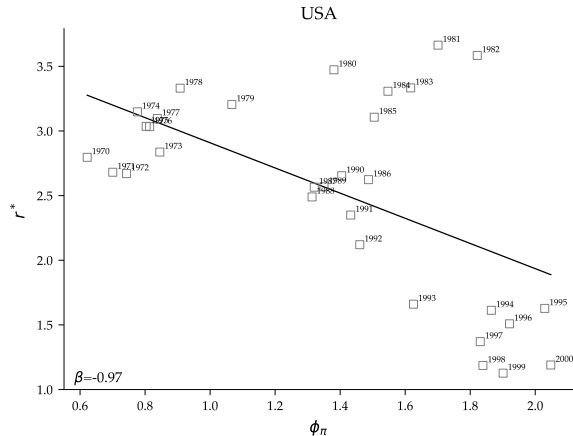
Inflation Risk Premium for the US



Breach, D'Amico, Orphanides (2020) for the US.

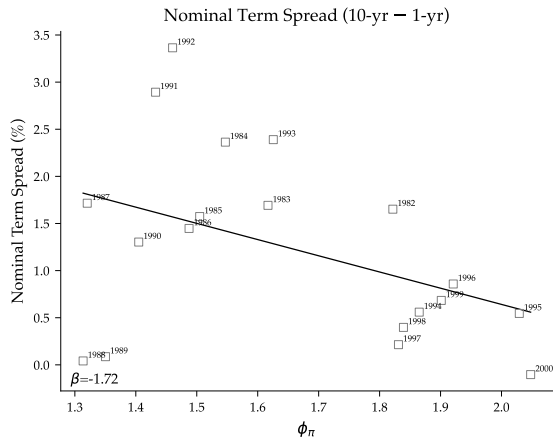
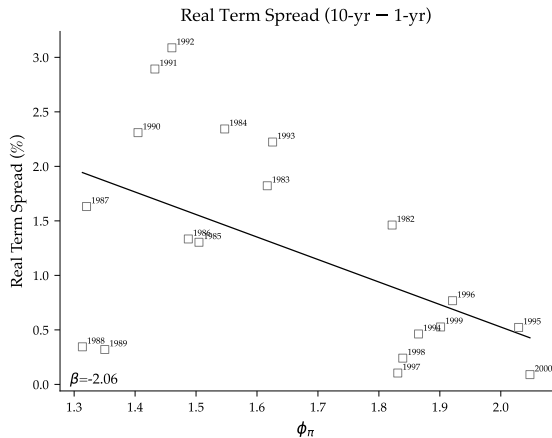
Monetary policy and r-star

HLW estimates of r^* and our estimates of ϕ_π based on Carvalho Nechio Tristao (2021)



Monetary policy and term spread

Term spread (10 y - 1 y) + our estimates of ϕ_π based on Carvalho Nechio Tristao (2021)



Monetary policy and DGGT r-star spread

DGGT term spread + our estimates of ϕ_π based on Carvalho Nechio Tristao (2021)

