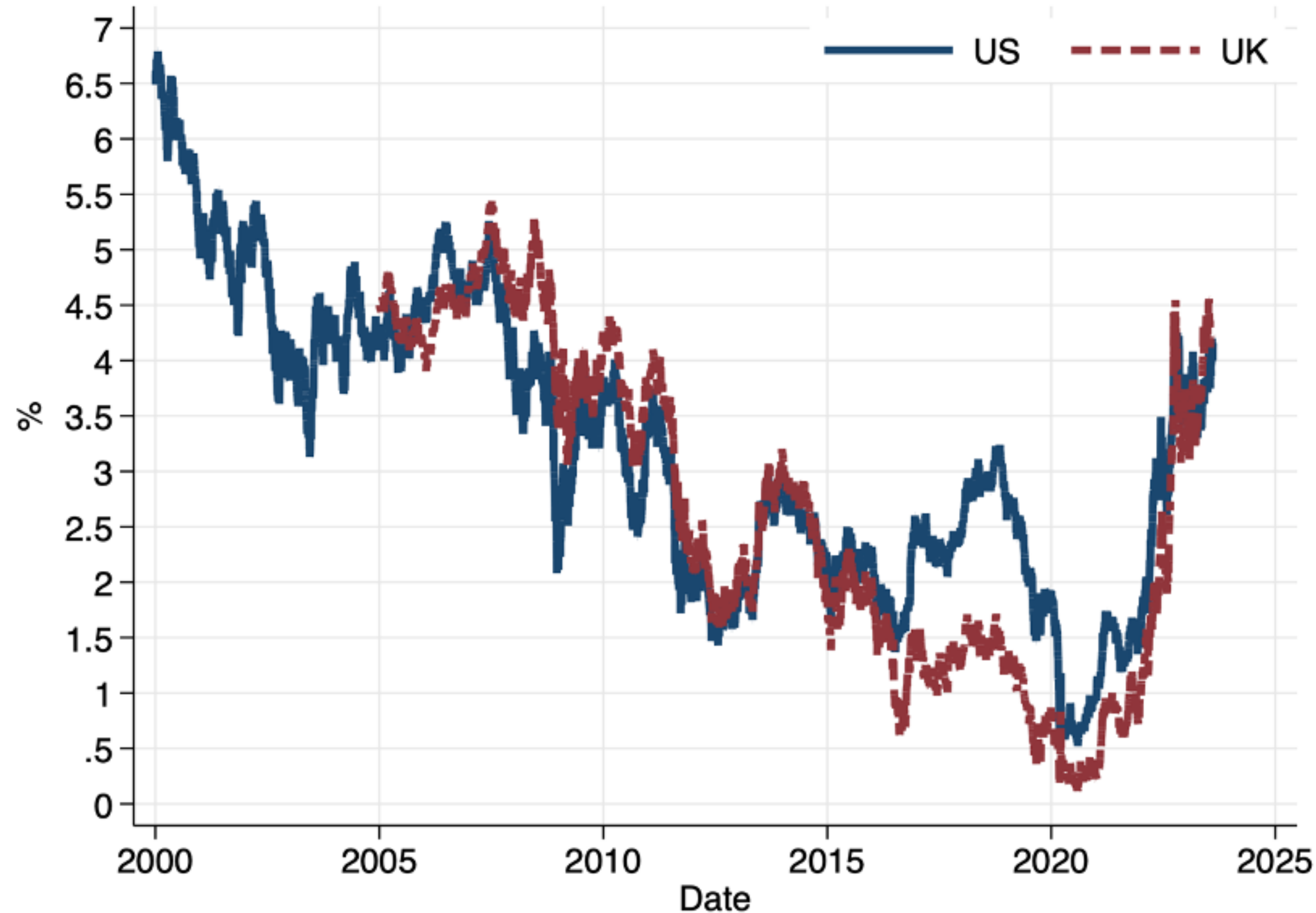


THE FUTURE LONG-RUN LEVEL OF INTEREST RATES

Ricardo Reis
LSE

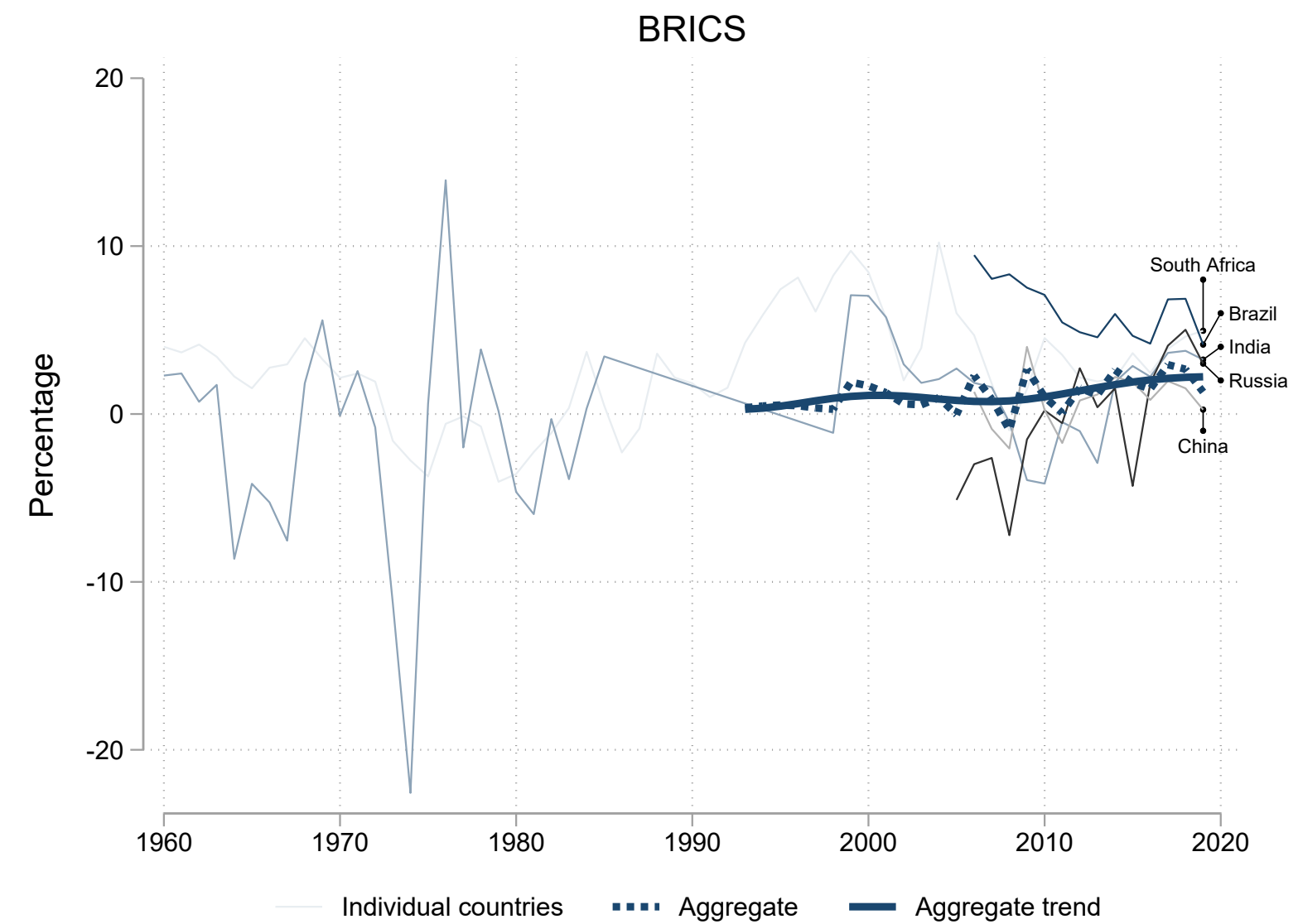
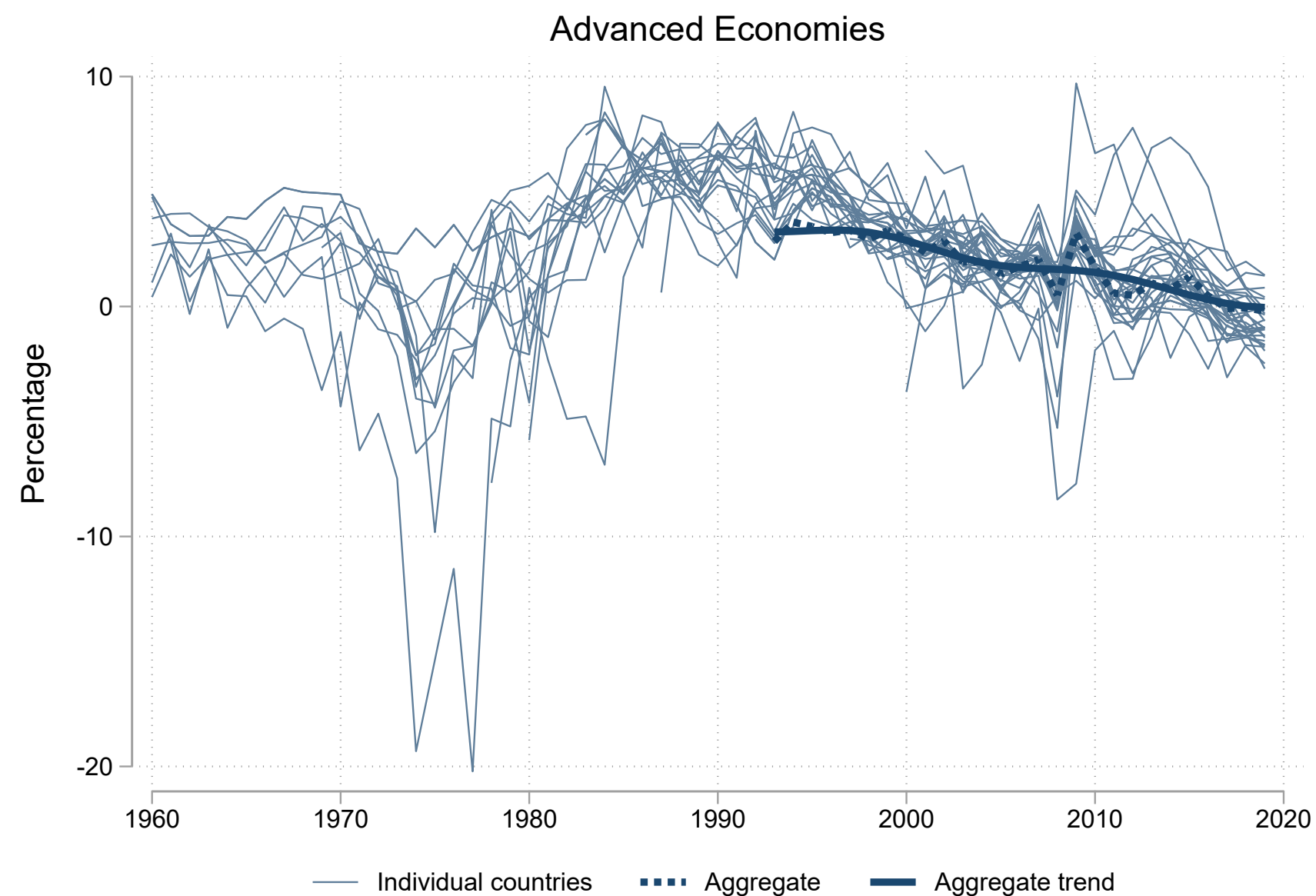
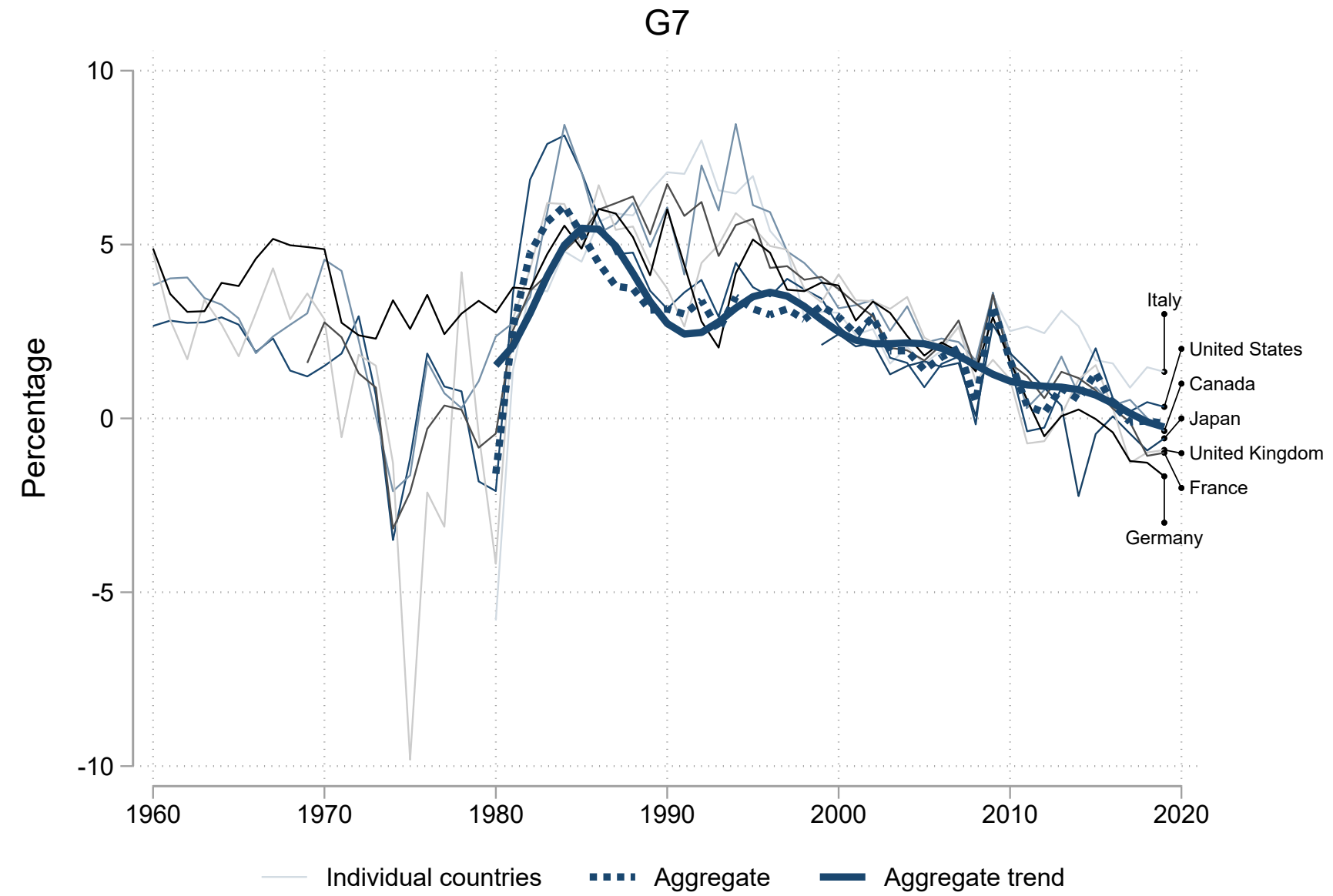
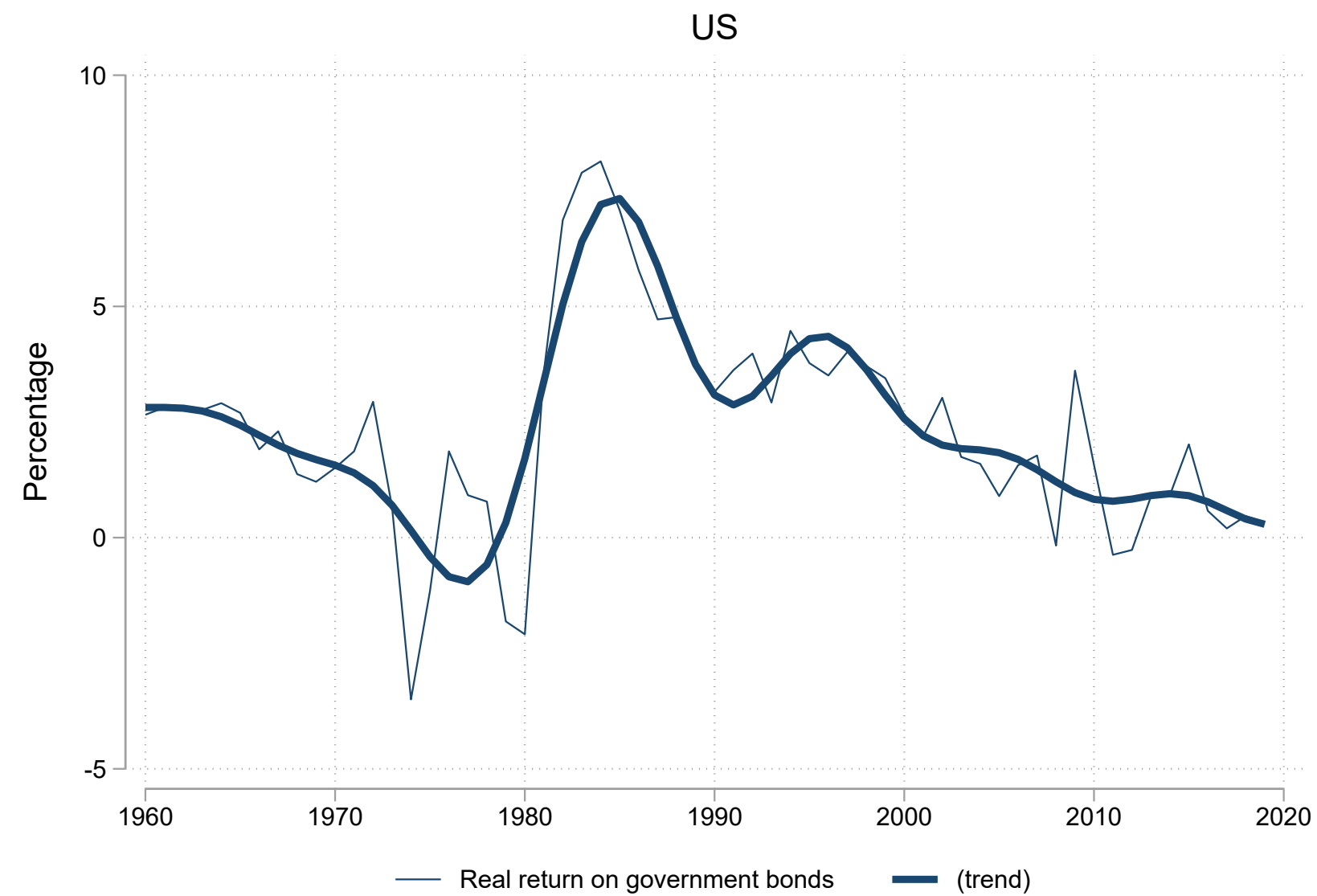
*December 2023
SUEF conference
Vienna, Austria*

Large decline in long-term yields



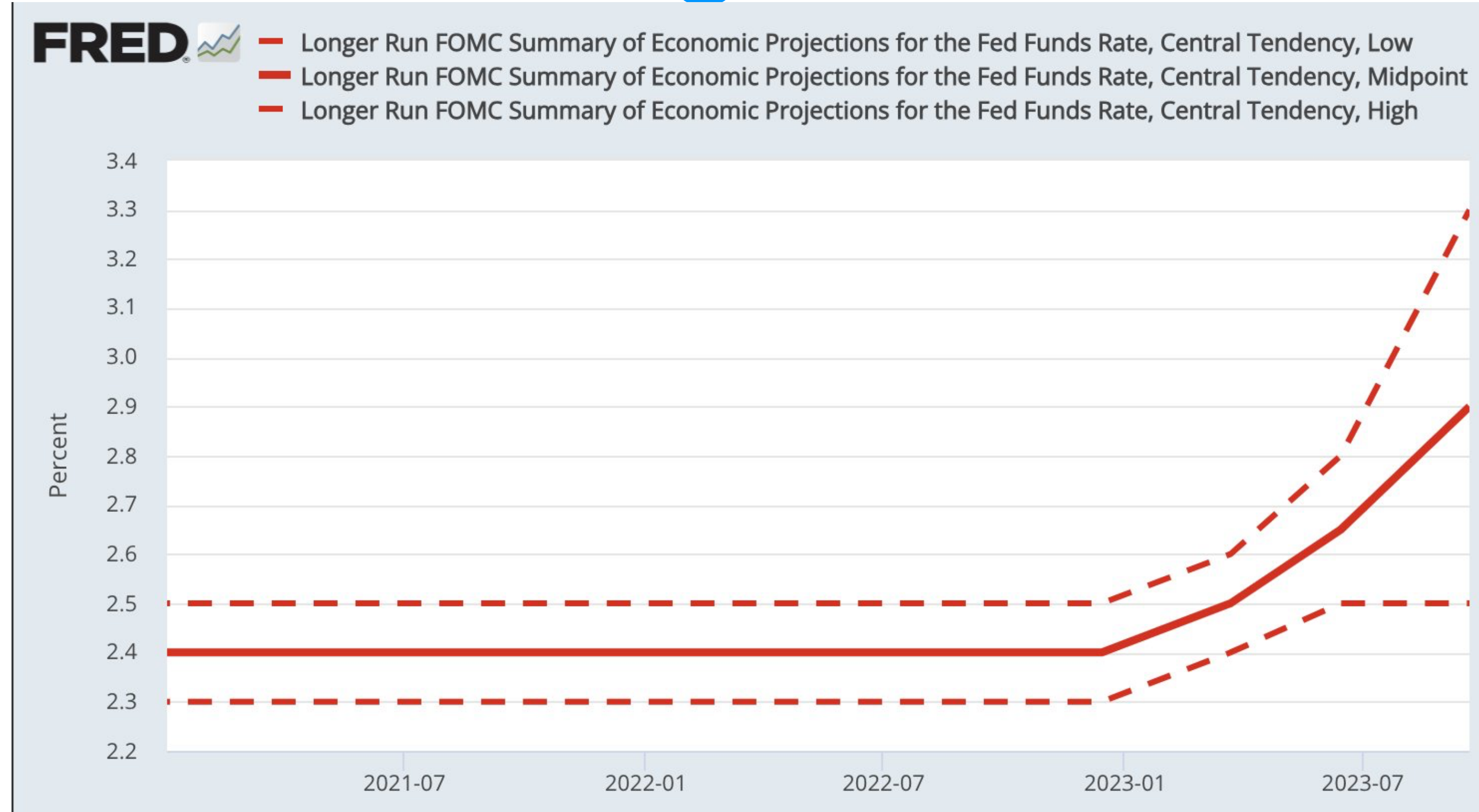
- Big fall starting in 1980s by 3 - 4%
- Some say even earlier, but doubtful
- And coincides with fall in inflation, so returns fall even more

Robust decline in real interest rate: r^*



- Trends using Mueller-Watson filter.
- National accounts

What is the new long run i^* ?



Three components of i^* : $r^* + \pi^* + r_p = i^*$

Pre-pandemic US estimates: $0.5 + 2 + 0 = 2.5$

Pre-pandemic EZ estimates: $-0.5 + 2 + 0 = 1.5$

Measurement: r^* on private investment

First approach: demand

Profits / CapitalStock

$$NOS = py - wl - \delta p^k k$$

$$r^* = \frac{NOS}{p^k k} = \frac{1 - \theta}{p^k k / py}$$

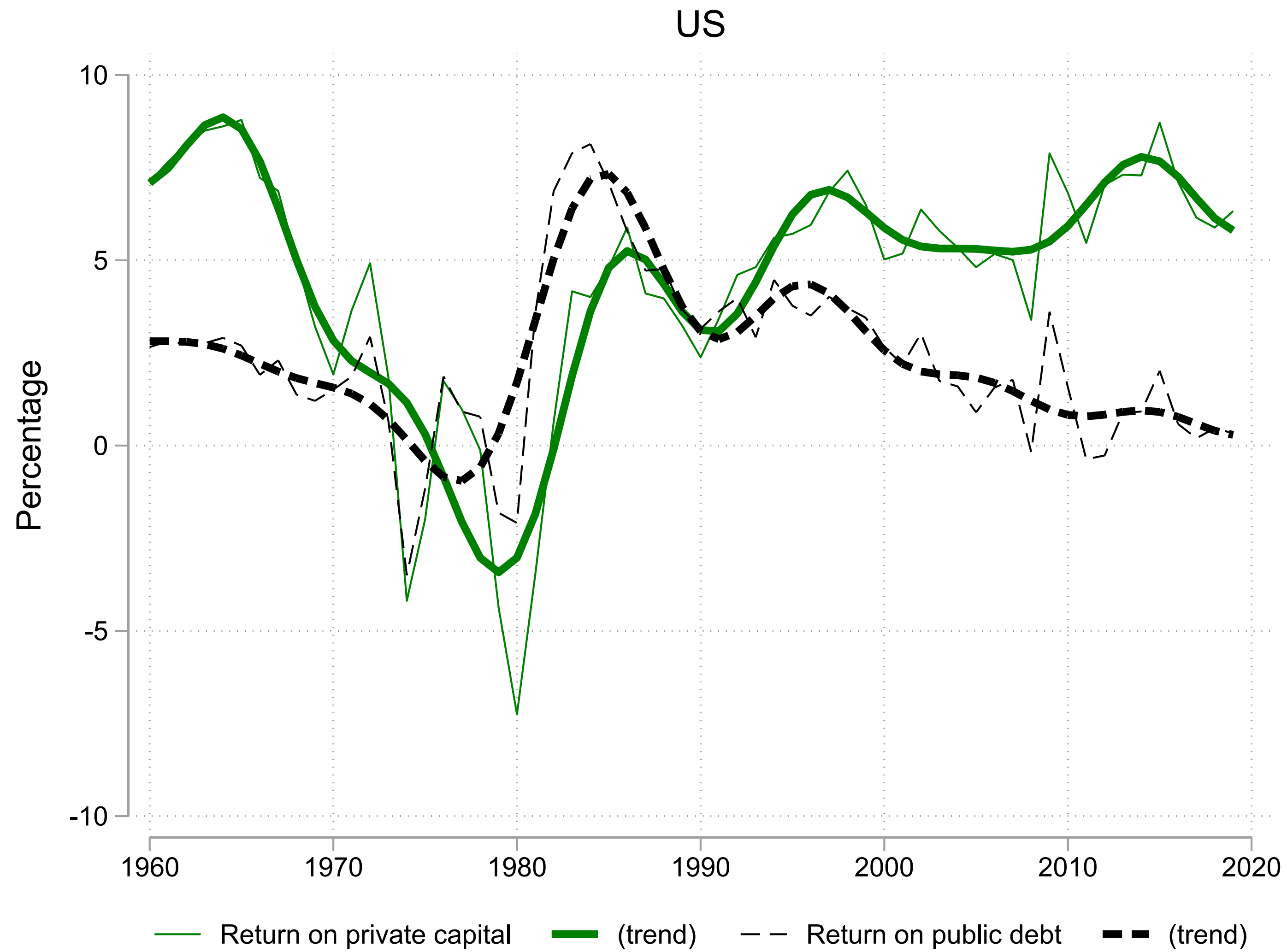
- NOS: operating surplus net of depreciation

- θ : net labor share

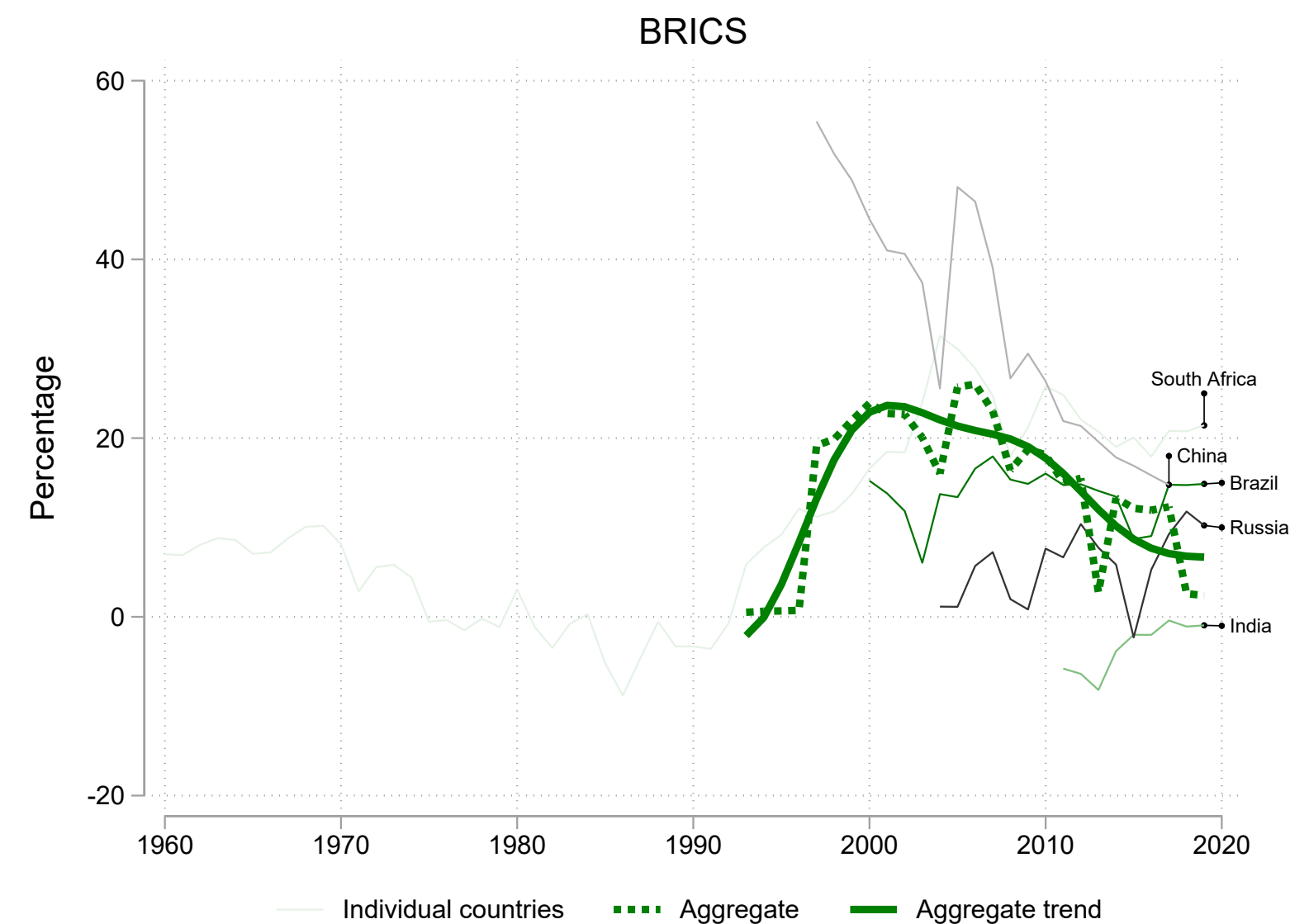
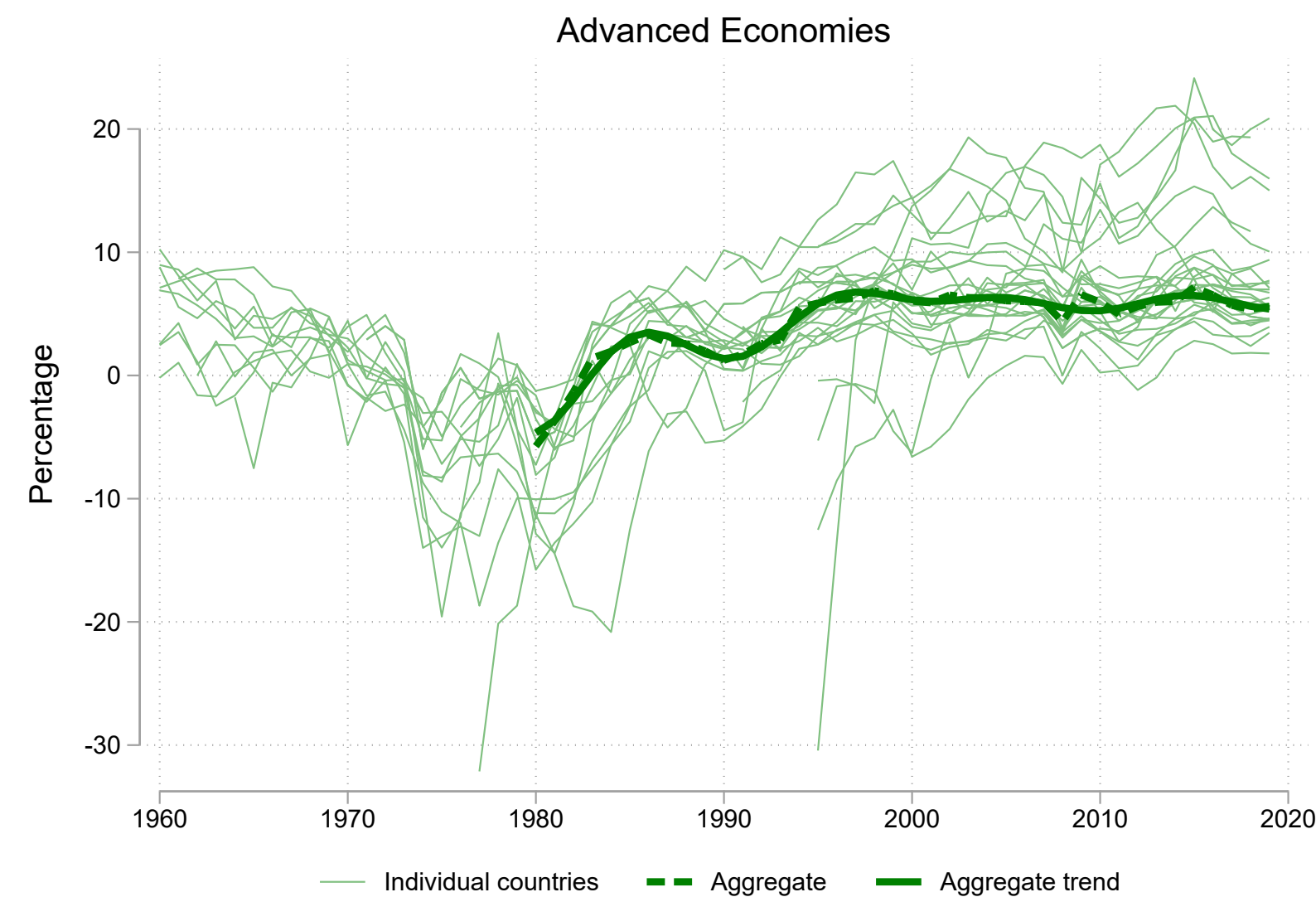
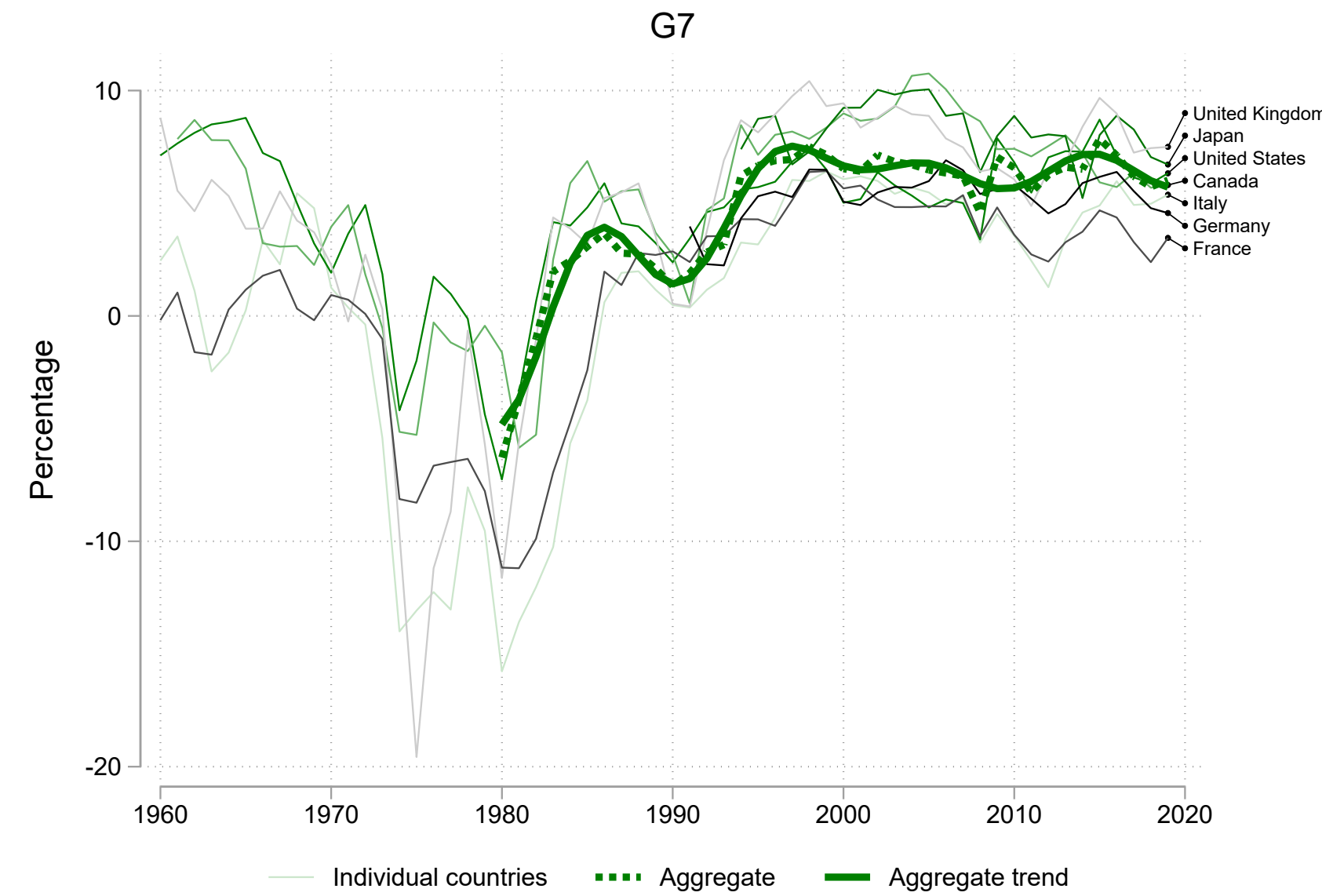
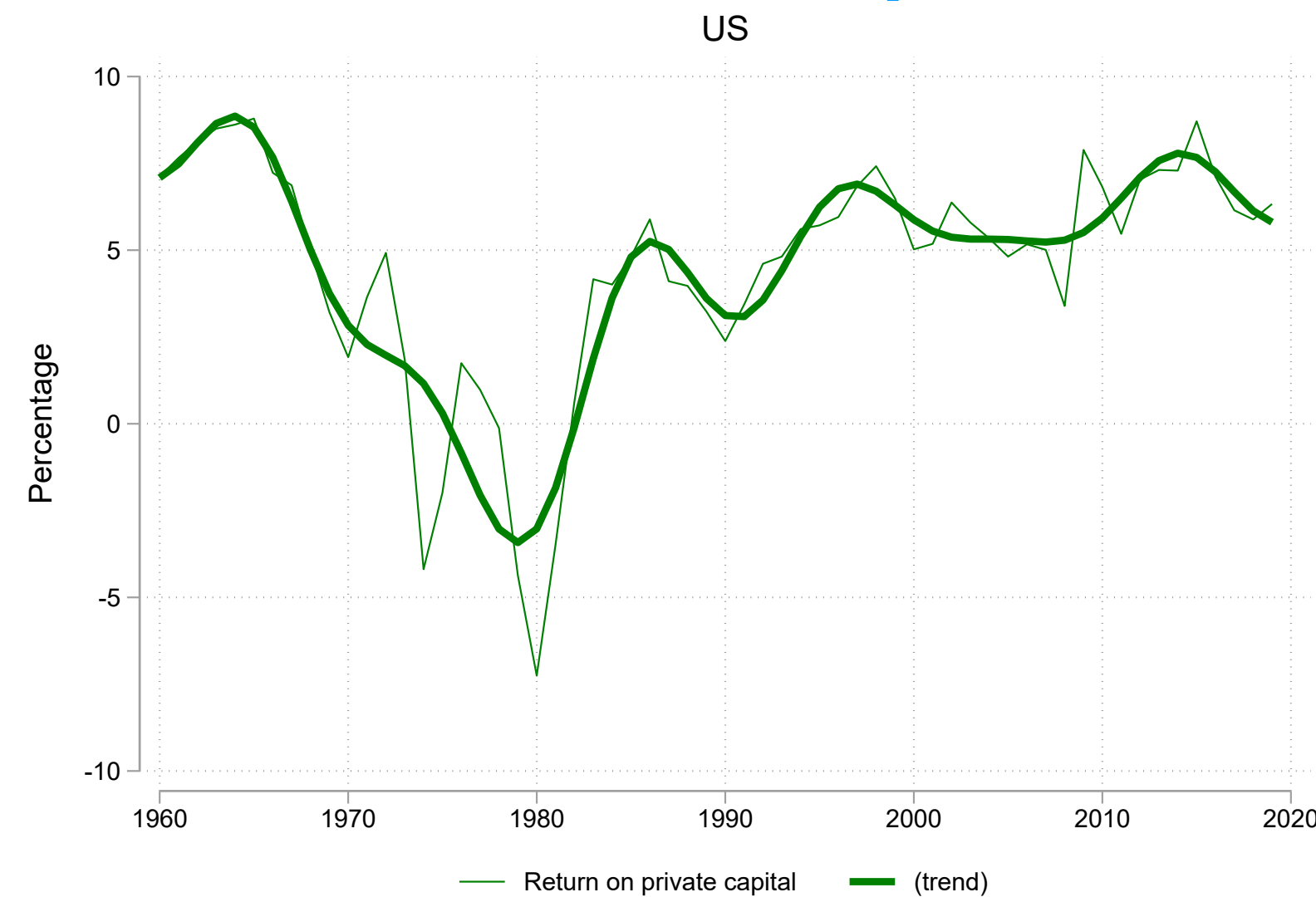
But have to be careful with:

- I) nominal capital to output ratio, otherwise trend in relative price of investment.
- II) labor share net of measured depreciation, otherwise trend in depreciation rates and intangibles
- III) net operating surplus adjusted for self-employment, otherwise trend in move from informal to formal economy.

Estimates of private r^* with 3 adjustments



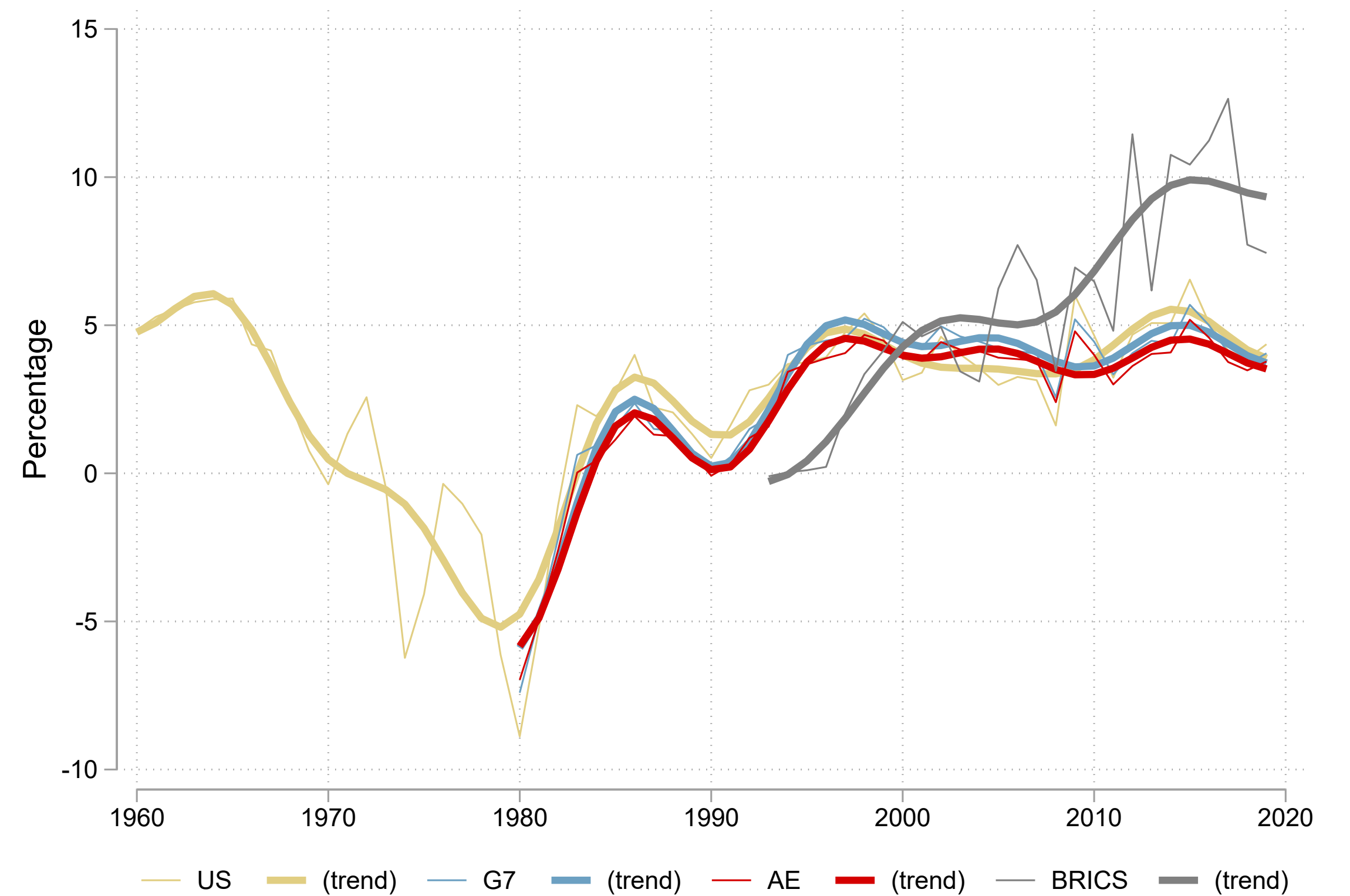
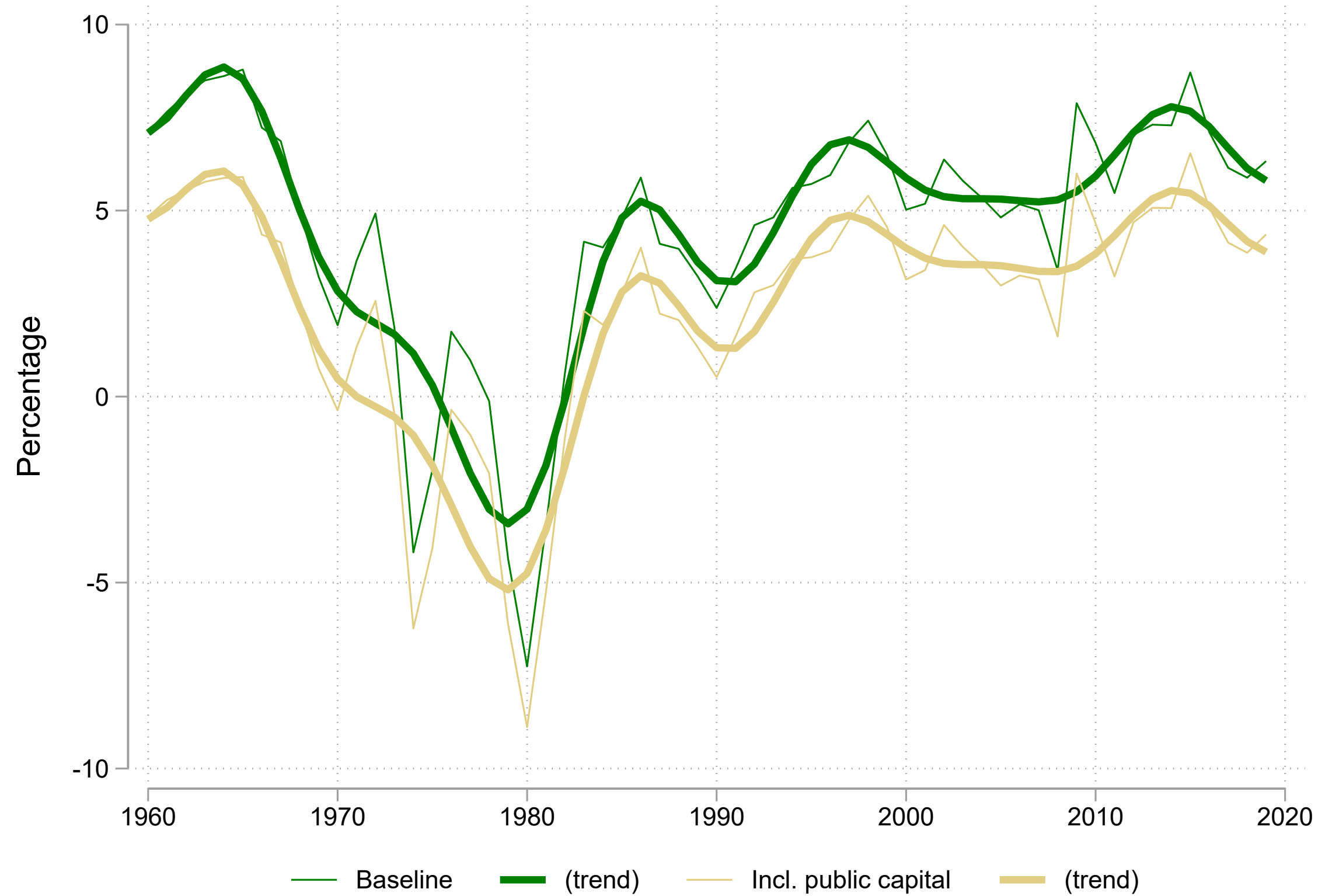
Concern iv) true across countries?



- G7: use national accounts
- AEs: use AMECO, OECD, concern ii)
- BRICS national accounts for NOS, IMF for K, concerns ii) and iii)
- Averages by GDP weighting.

Concern v) public capital stock?

- If it is a productive input that generates the NOS, should include it, lower returns.
- Trend in public investment over last ten years (austerity)



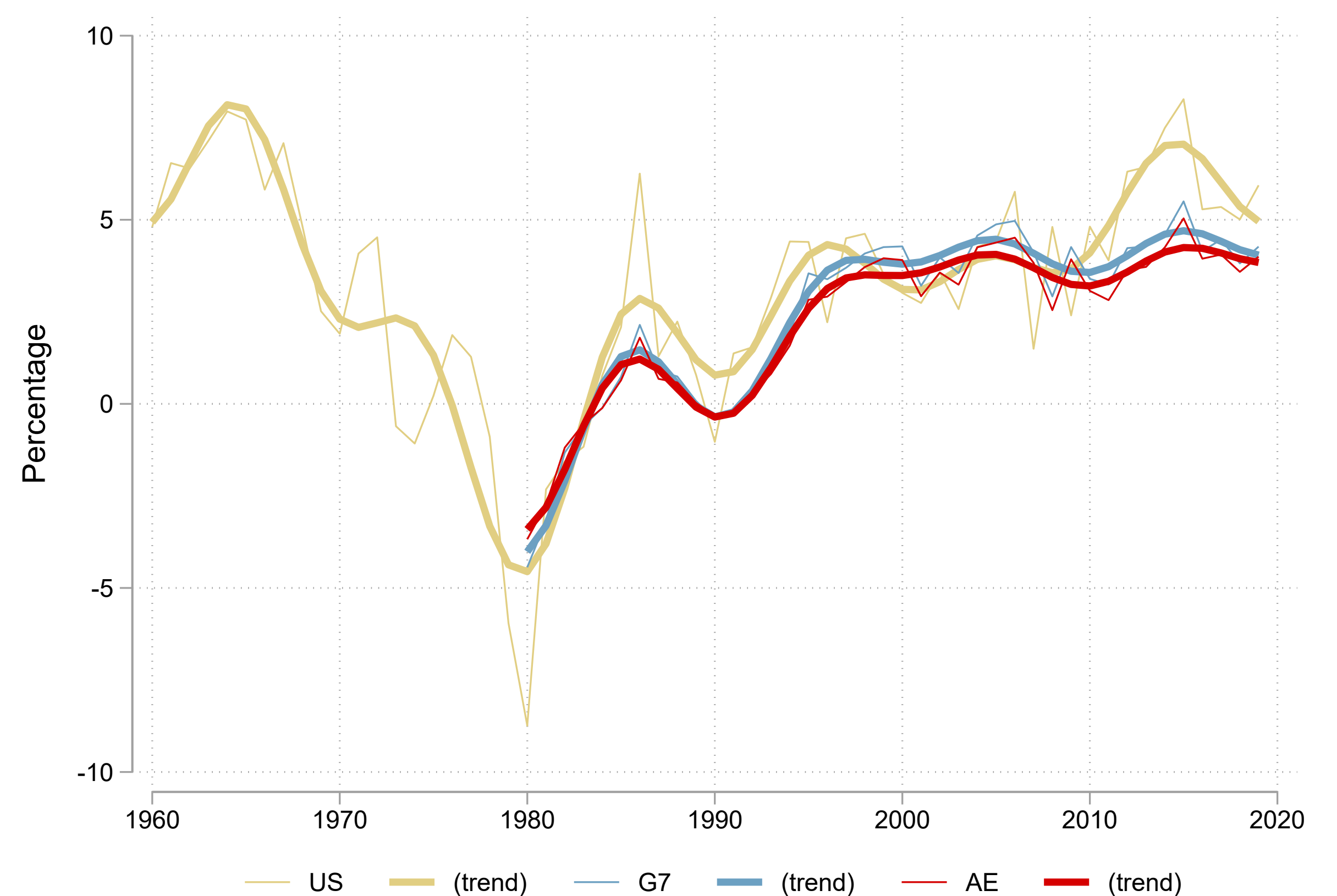
Concern vi) include capital gains?

- From increase in capital good prices.

$$\frac{p_{t+1}^k / p_t^k}{p_{t+1} / p_t}$$

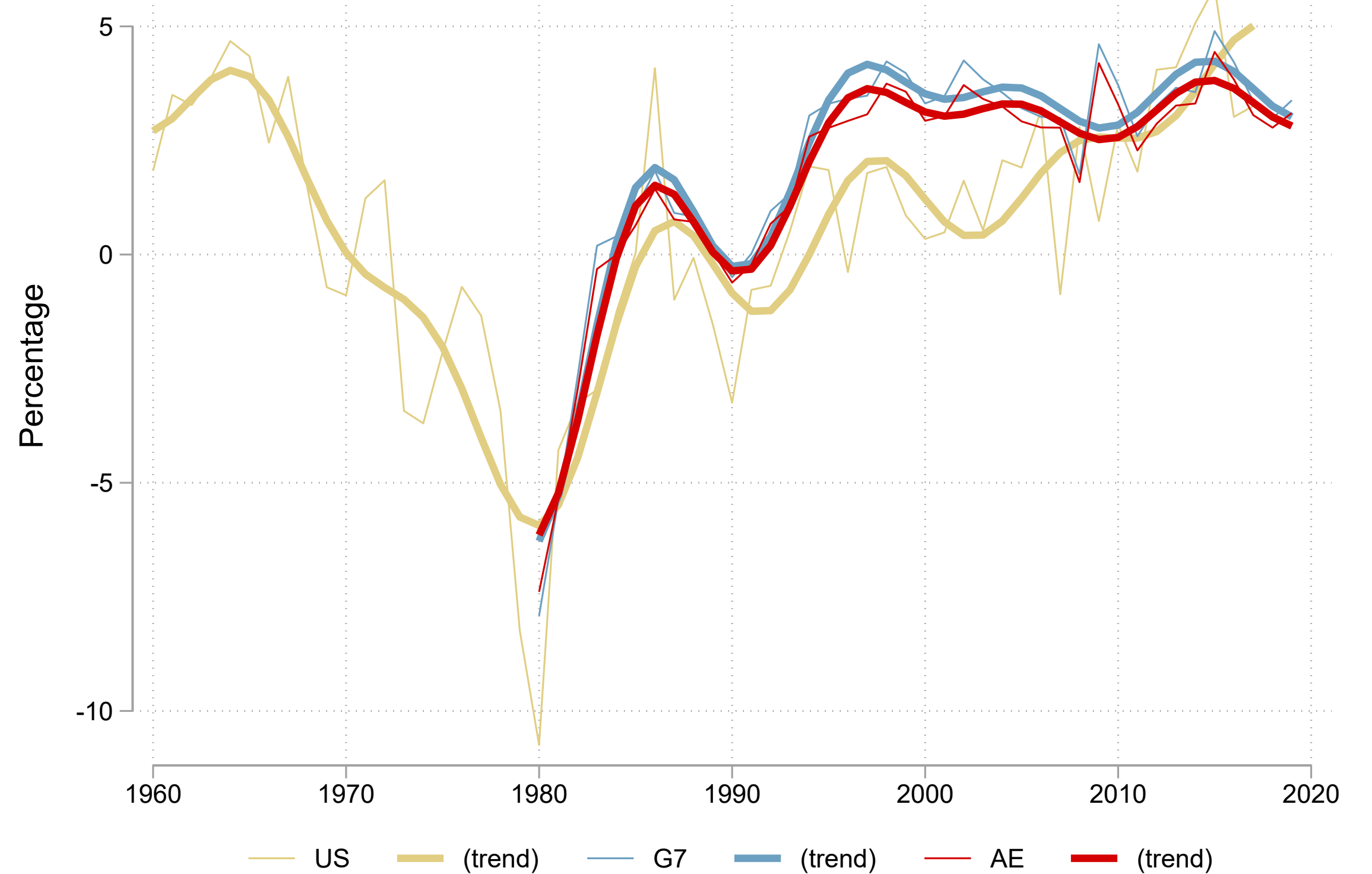
- If capital is reversible on aggregate, should include it

$$p_{t+1} / p_t$$



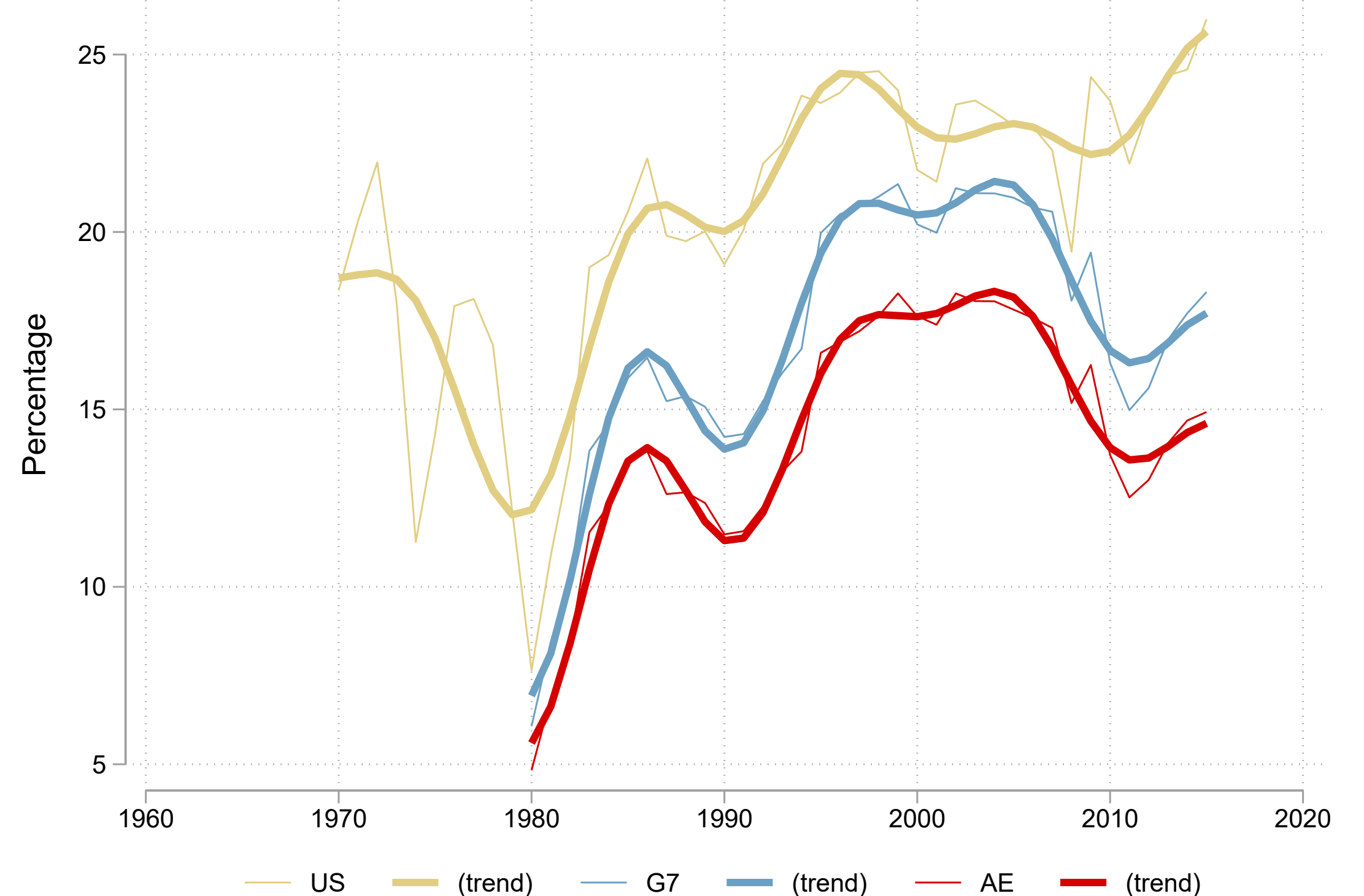
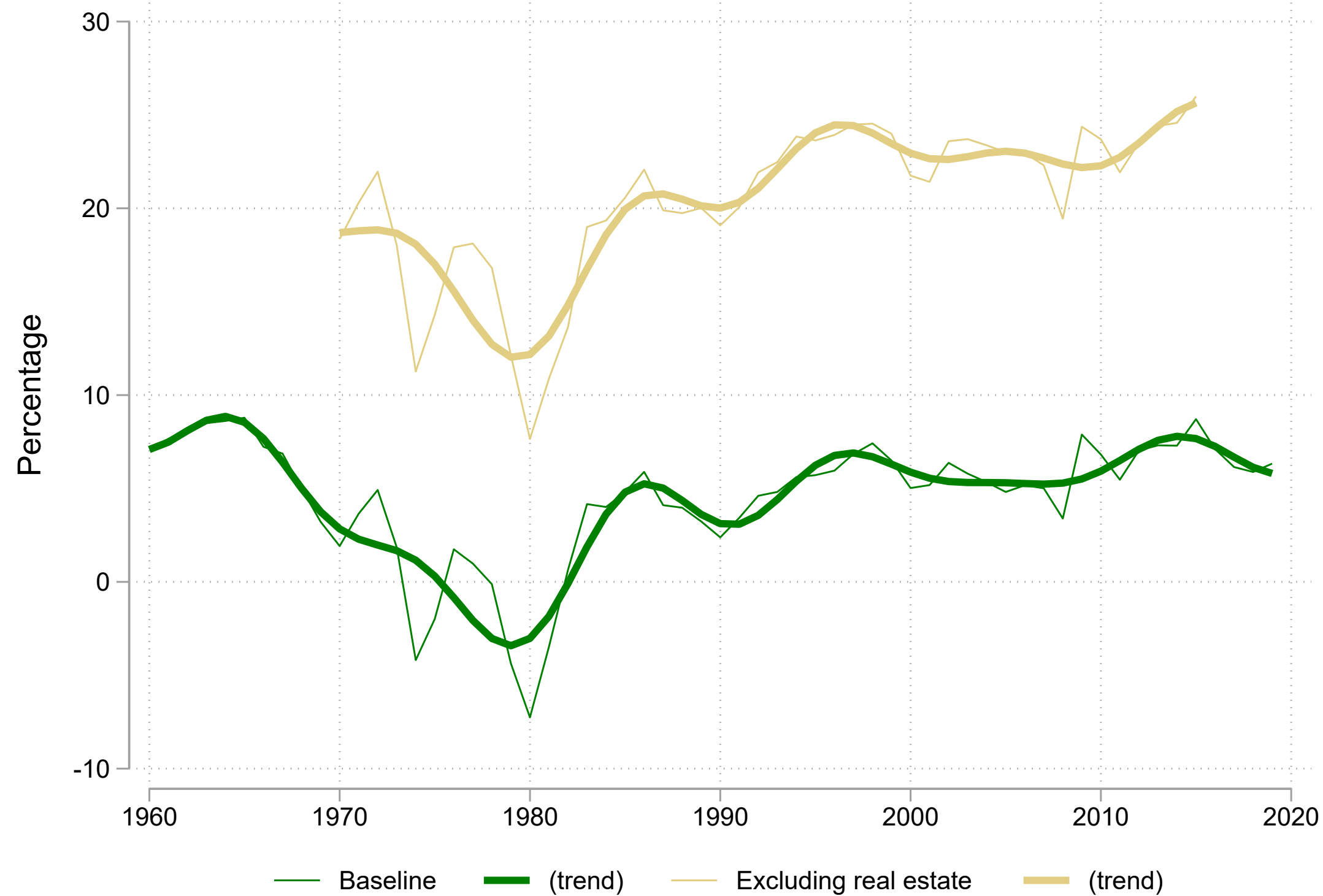
Concern vii) take out taxes on investment

- Corporate income taxes put wedge in relative returns.
- GRR (I I): take out personal income taxes, but they fall on government bond holdings too

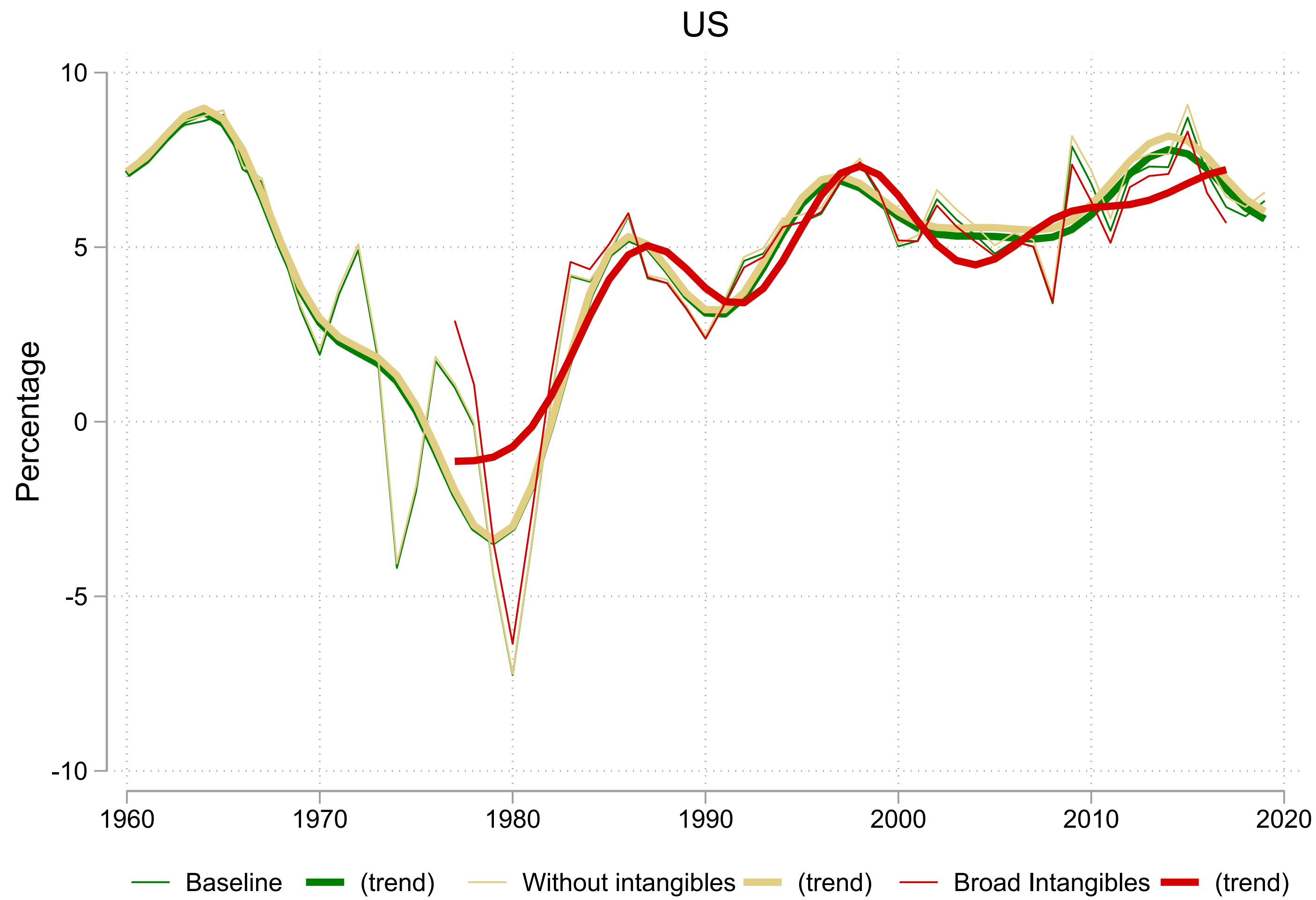


Concern viii) exclude real estate?

- If land is not accumulated, may give returns, but not relevant for aggregate investment
- Previous literature estimates (Gutierrez Piton following Rognlie), but gross



Concern ix) intangibles



- Raises capital stock but also raises NOS

$$r_t^{k,new} = \frac{NOS_t + Inv_t^I - Dep_t^I}{K_t + K_t^I}$$

- At first, raises r^k because higher numerator. In steady state lowers r^k because higher denominator.
- Three measures:
 1. Old NIPA, no intangibles
 2. NIPA, narrow intangibles
 3. Corrado et al: broader int.
- Indeed from 1 to 3, get more of a trend down in returns. But too small to matter for $r^k - r^b$ wedge

Second approach: supply of capital

$$g(c) = (1 - \chi)\beta[\alpha \times lev \times m + (1 - \alpha)r]^\nu + \chi g(wl)$$

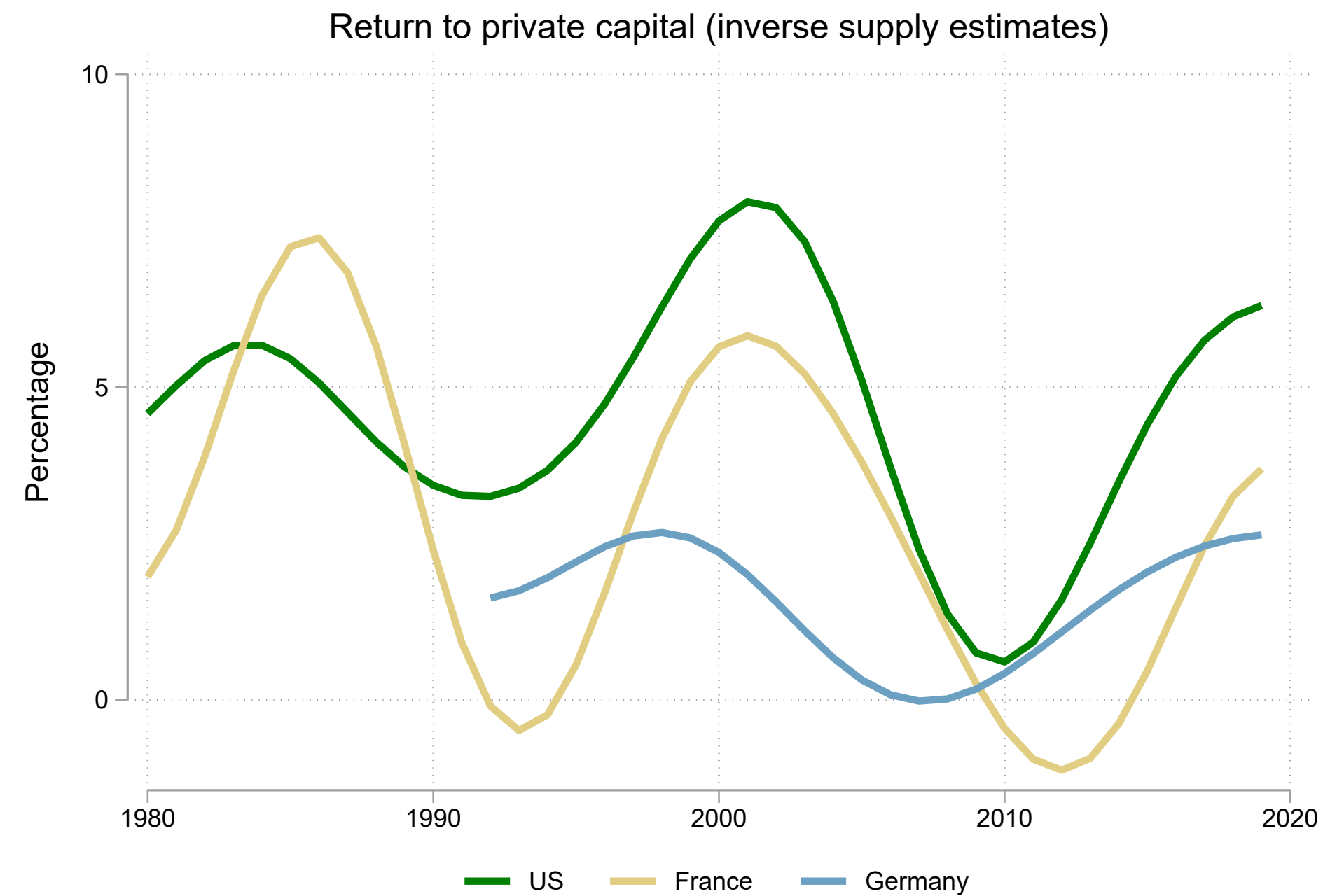
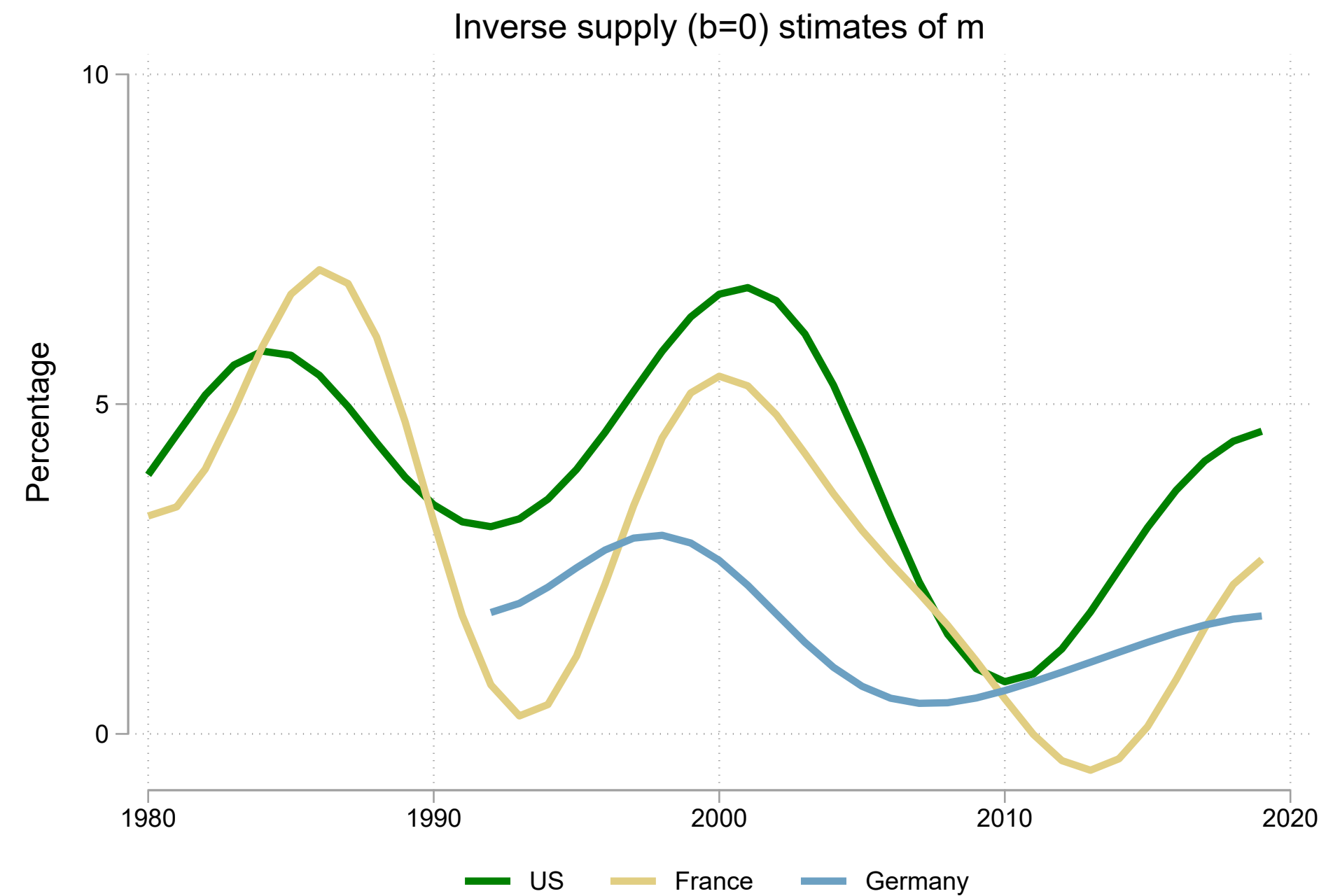
$$x = \log \left(\frac{g(1 - s) - \chi g(1 - \theta)}{1 - \chi} \right) + \log(g(y))$$

$$p_t^k k_{t+1} + p_t^c c_t = m_t p_t^k k_t + w_t l_t$$

$$\hat{C}\hat{W}_t = \mathbb{E}_t \left[\sum_{s=1}^{\infty} \rho^s \left(\hat{m}_{t+s} - \Delta(\hat{p}_{t+s}^c + \hat{c}_{t+s}) \right) \right]$$

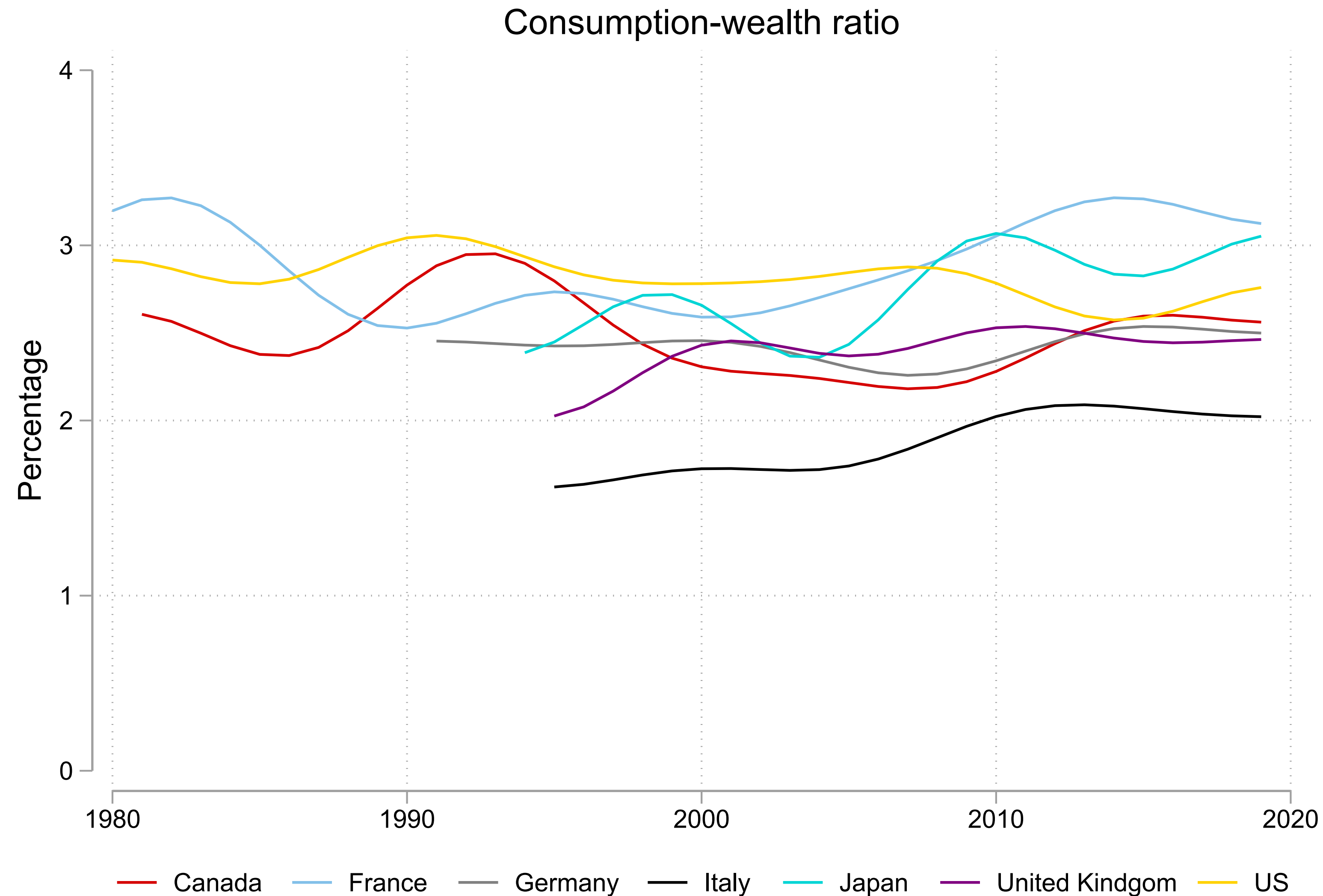
- Modern Euler equation: hand to mouth (χ) and heterogeneous returns (α)
- If $b=0$, then $m=x/v$, just as in classic case, but adjusted for χ in consumption instead of income. Otherwise average two returns
- Consumption function and resource constraint
- Consumption-wealth ratio, with wealth $CW = p^c c / p^k r^k k$

Inverse supply of savings



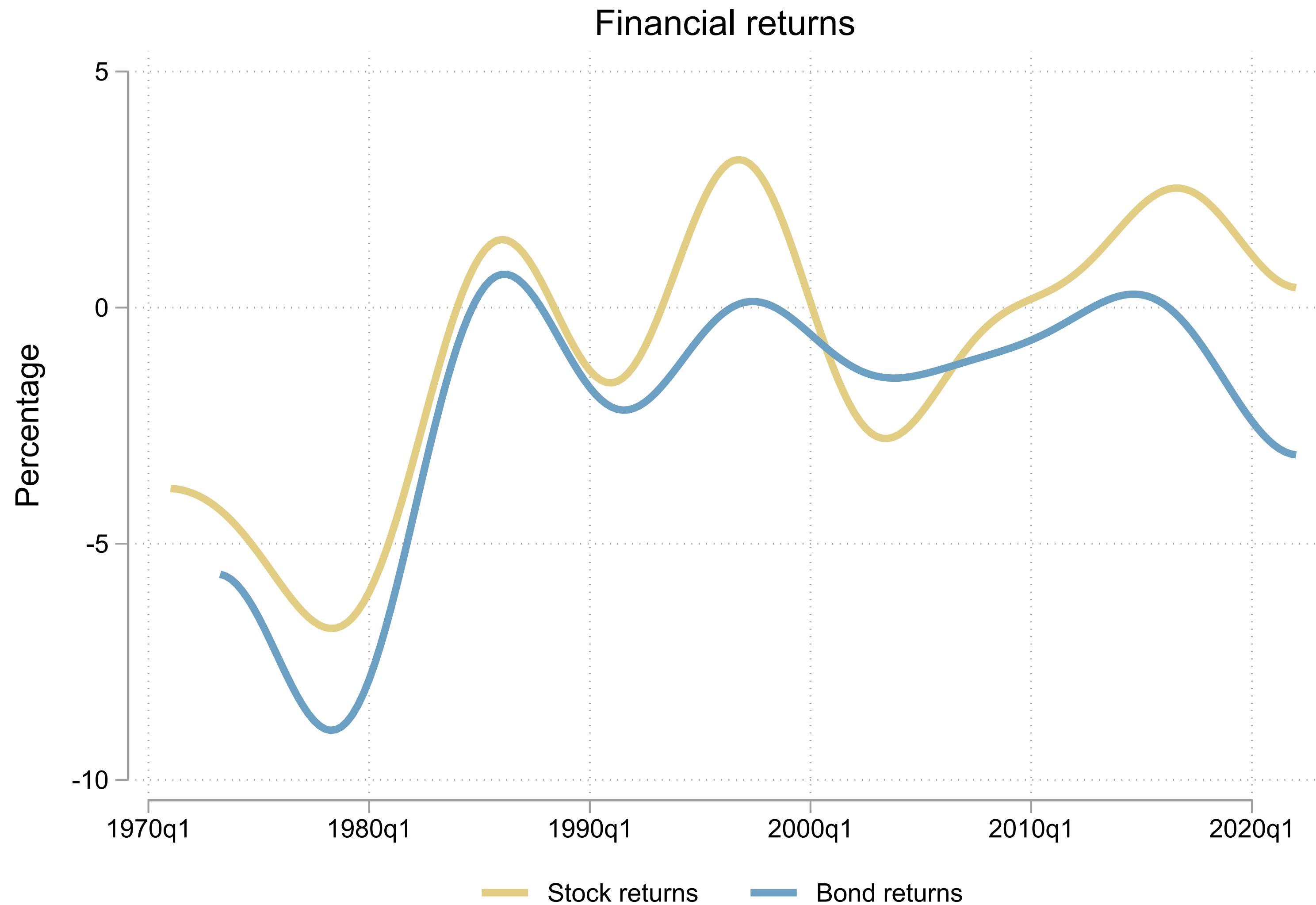
- No clear trend
- Fall in first decade, increase in second decade
- Because:
 - (i) savings rate trend down,
 - (ii) labor income trend down
 - (iii) credit trend up

Consumption-wealth in the data



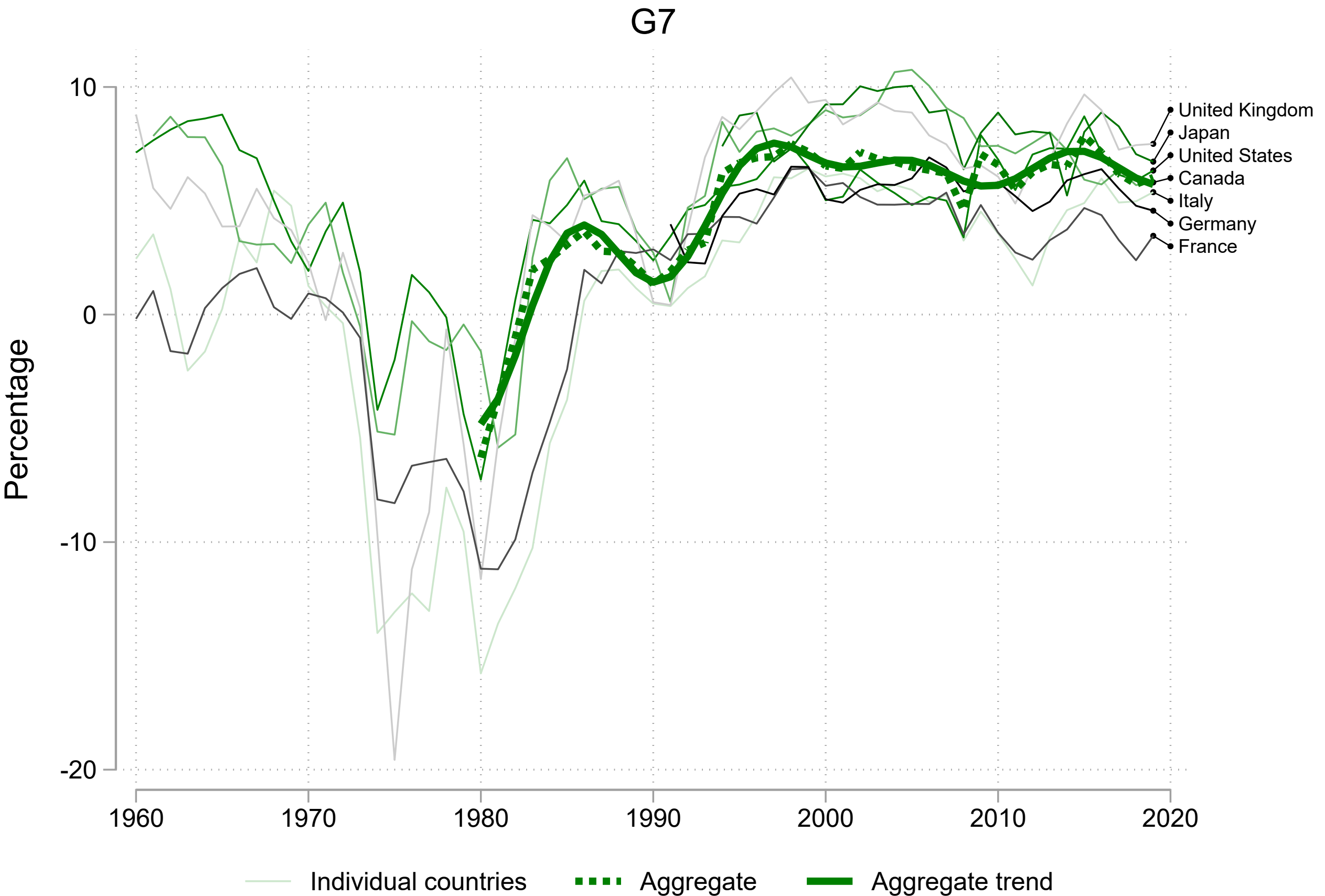
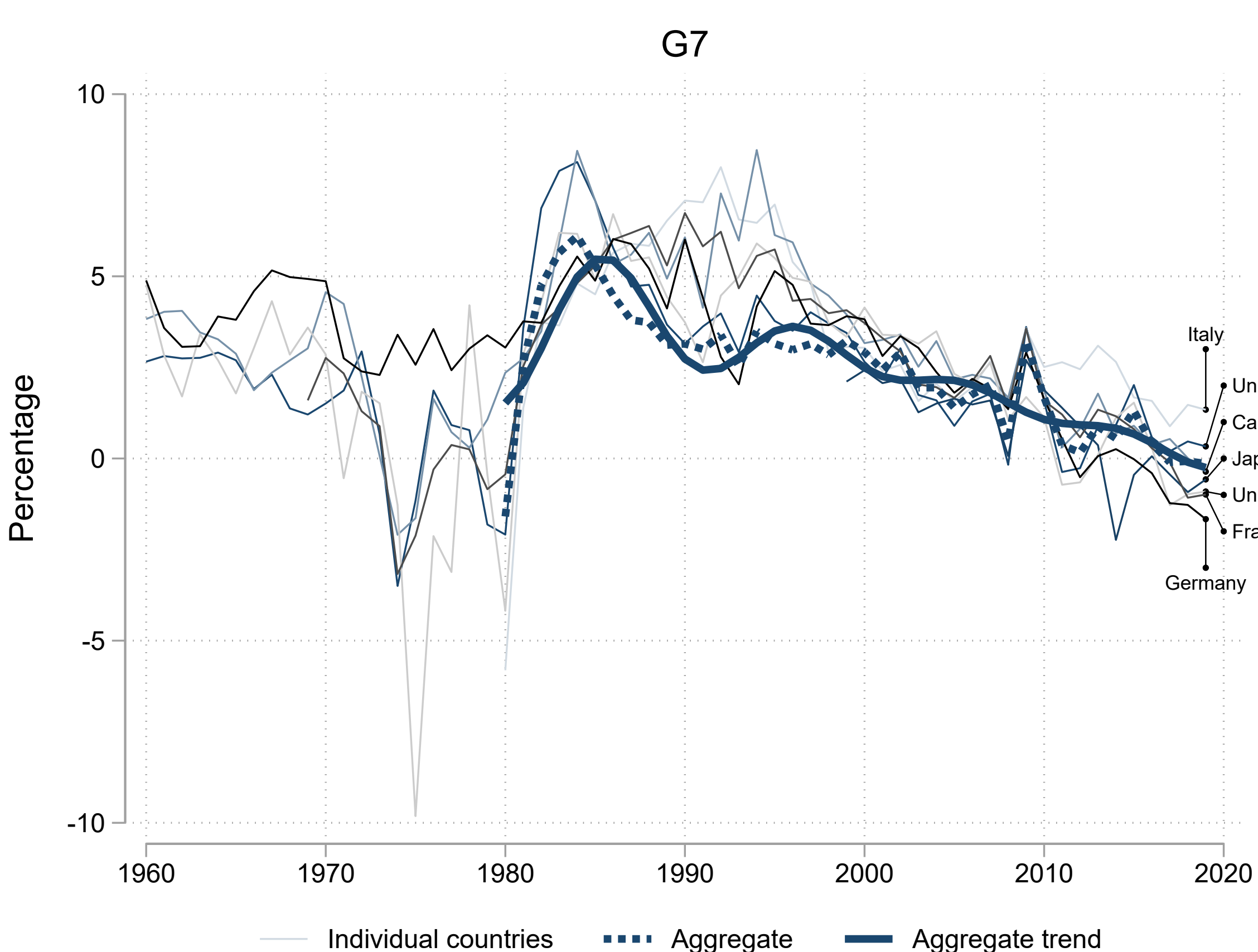
- Null hypothesis: no change in forward-looking expected m
- Implies there would be no downward trend in the consumption-wealth ratio.
- Plot in the data confirms it

Approach 3: Financial returns



- Broad stock index
- Broad corporate bond index
- But Modigliani-Miller says you should not trust this
- Further evidence: hurdle rates and internal rates of return.

Conclusion: the trend in r^* was a trend in m^*-r^*



Any explanation for the fall in r^* on government bonds has to account for the increase in the wedge between the two r^* 's

What are those theories?

(i) The savings glut: geopolitics and China

Mercantilists current account surpluses and fast-growing economies with shallow financial markets

(ii) The safety and liquidity of government bonds,

GFC and the desire for safety, financial regulation, QE and its scarcity

(iii) The great stagnation and austerity

No investment demand for abundant supply of savings.

Extra: demographics

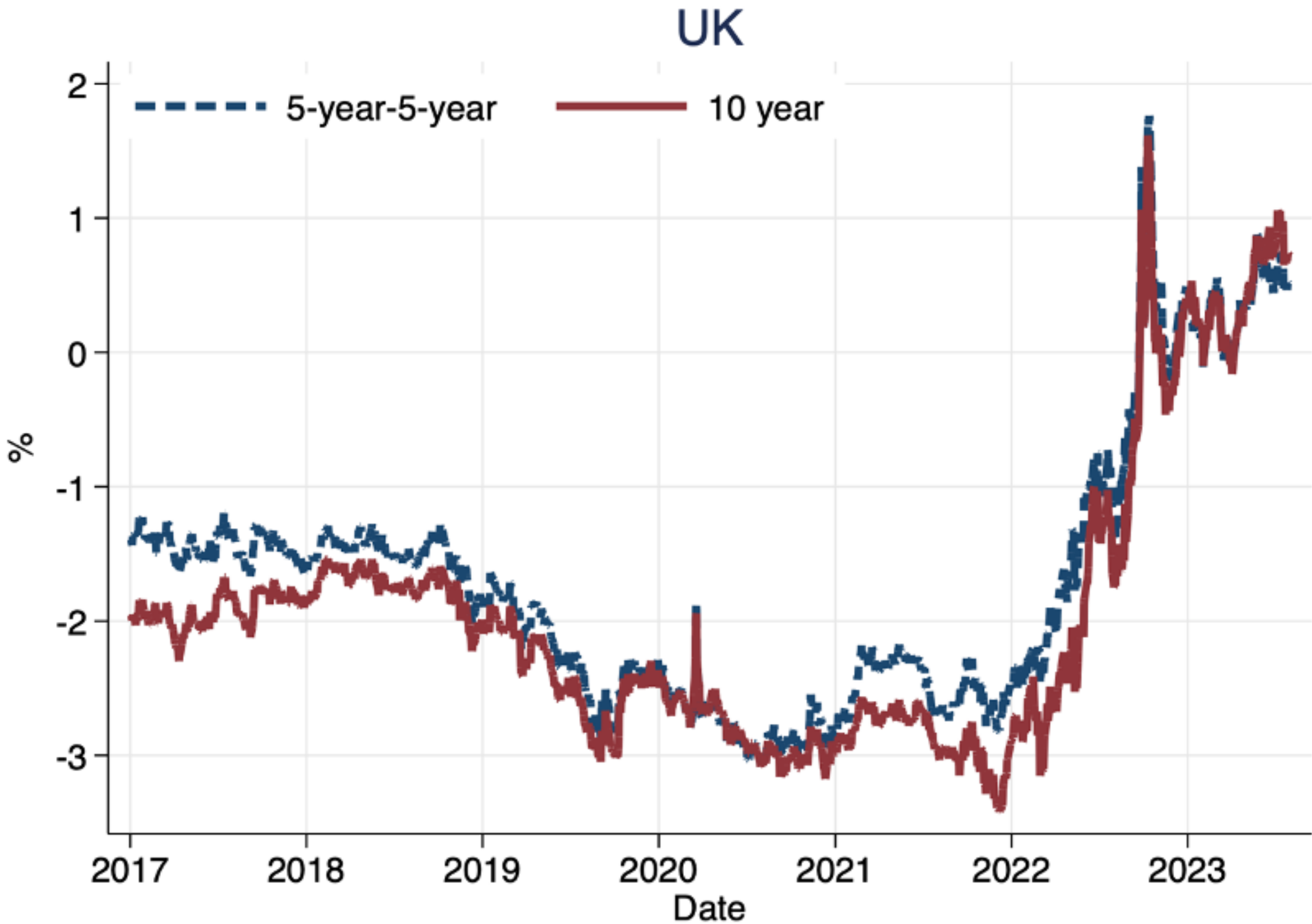
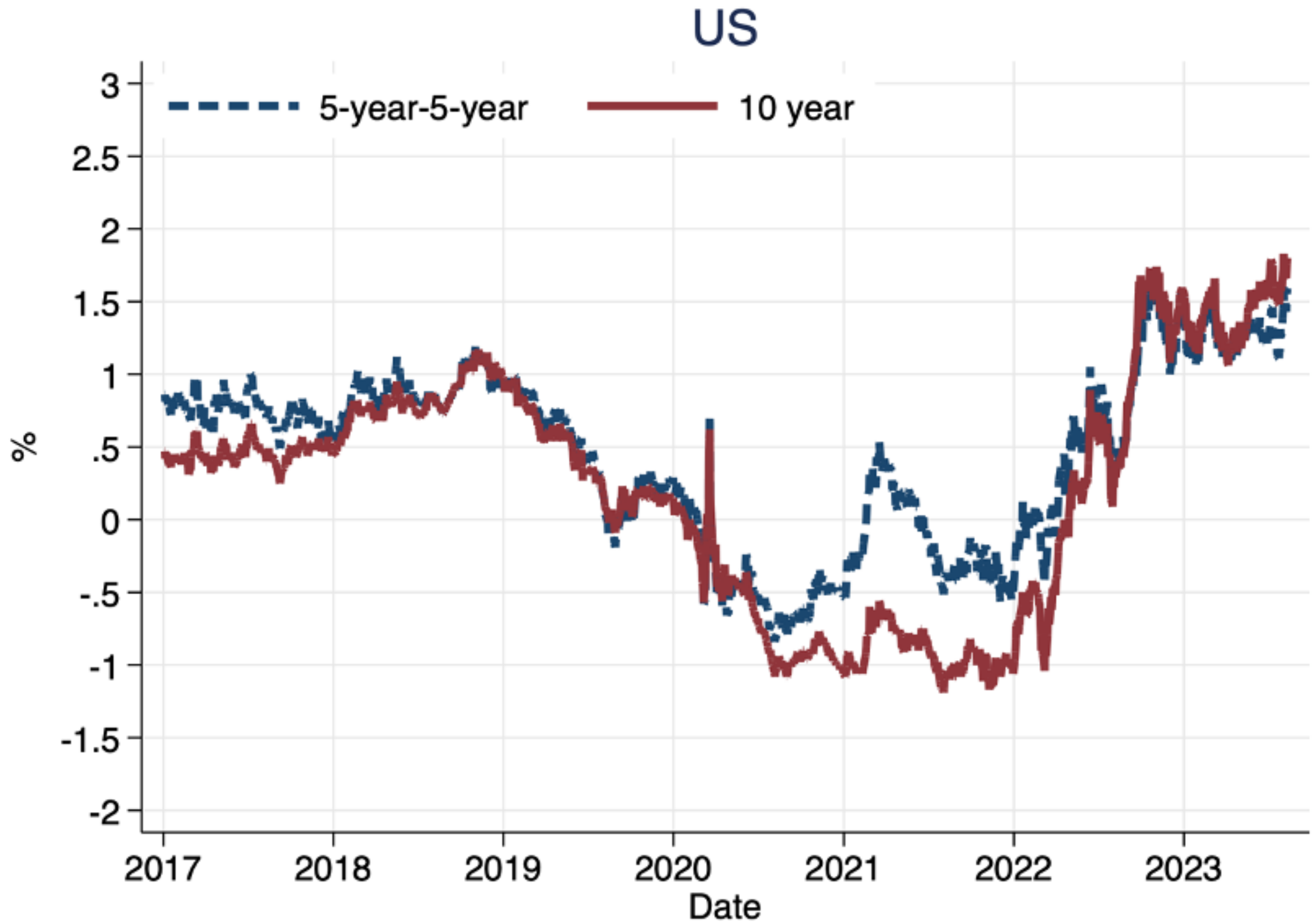
New trends point to rising r^* :

- (i) Geopolitics and the relative safety of government bonds,
Decline in savings from BRICS into Western government bonds
- (ii) The safety and liquidity of government bonds,
Quantitative tightening, debt ceilings
- (iii) Private investment and austerity in public investment
Large and ambitious programs on both sides of the Atlantic

Unknown: financial repression and debt revenues

Bottom line: higher real r^* by 1.0 - 1.5%

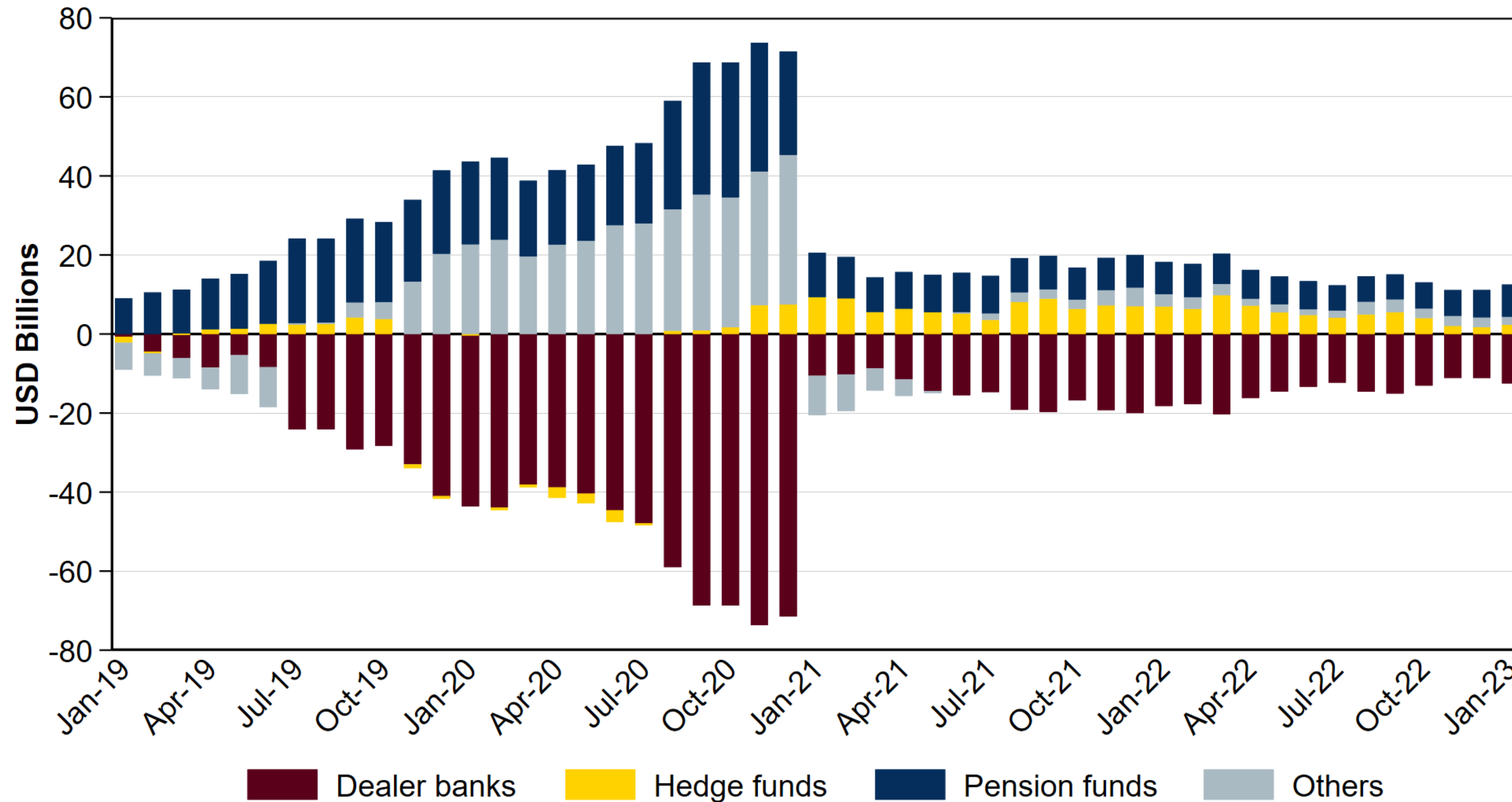
Figure 6. Real yields at 10-year and at the 5-year-5year horizons



Measurement: r_p and the market for inflation risk

Risk premium: who sells insurance?

Net notional position by investor type in EU-inflation swaps



Buy / sell an inflation swap contract if you want insurance

Dealer banks sold insurance, pensions funds bought it

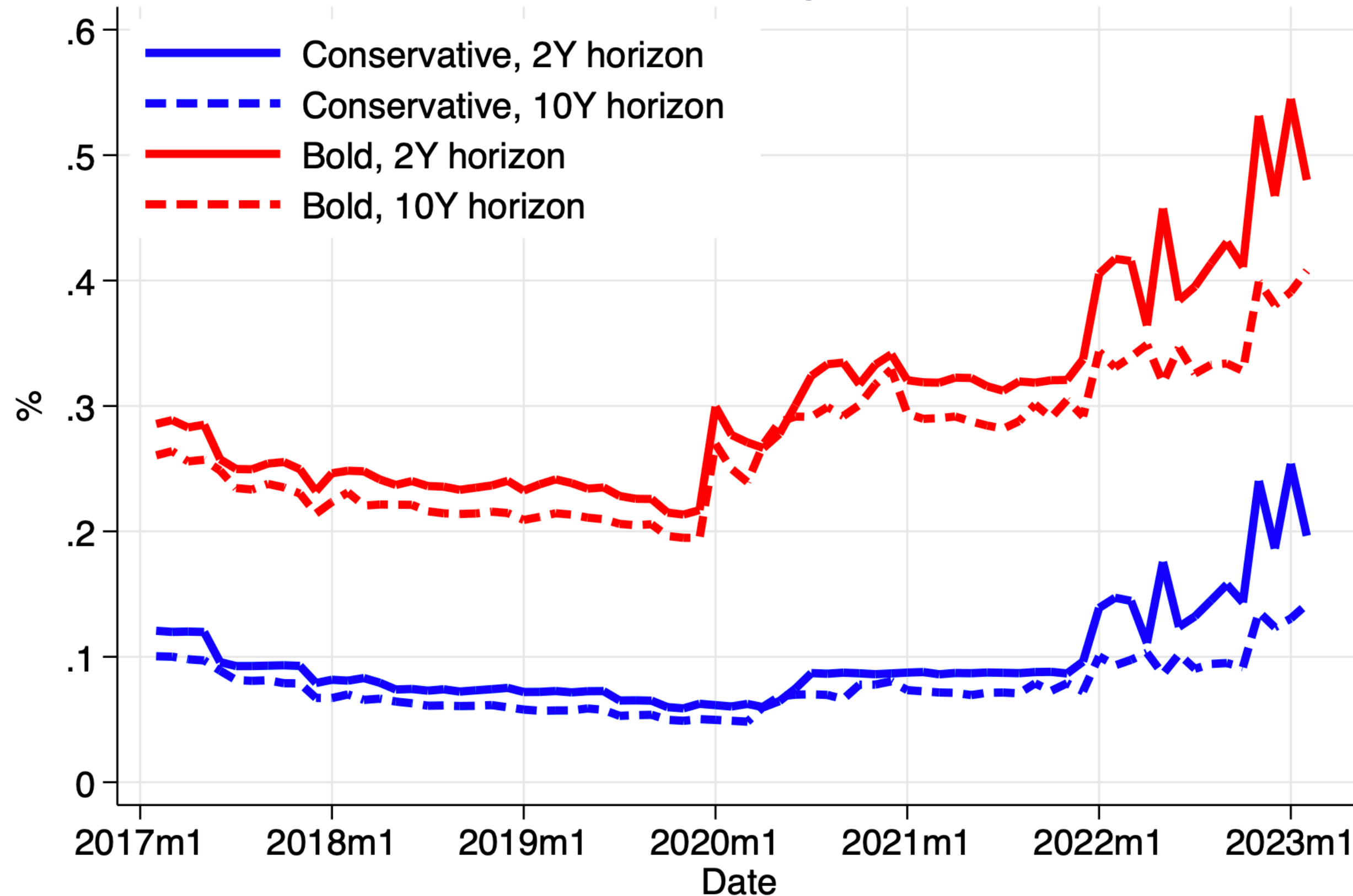
Dealers' capacity is shrinking, with it price of insurance is rising

Risk premia

$$\mathbb{E}_t \pi_{t+1} = \underbrace{\frac{R_{f,t}}{R_{real,t}}}_{\text{breakeven inflation}} + \text{COV}_t^* \left(\pi_{t+1}, \frac{R_{t+1}}{R_{f,t}} \right)$$

$$\text{COV}_t^* \left(\pi_{t+1}, R_{t+1}/R_{f,t} \right) = \text{corr}_t^* \left(\pi_{t+1}, R_{t+1}/R_{f,t} \right) \sqrt{\text{var}_t^* \pi_{t+1} \text{var}_t^* (R_{t+1}/R_{f,t})}$$

Inflation risk premia



Separating out the risk premia depends on your model of risk

But can bound it. Because from the options know prices of pure inflation risk and of risk aversion

Higher by 0.1% to 0.25%

Measurement: expected inflation

Expected inflation in EA: 5y5y

Markets price in higher long-term eurozone inflation

5y5y inflation swap rate (%)



Source: Bloomberg

© FT

From inflation swap contracts

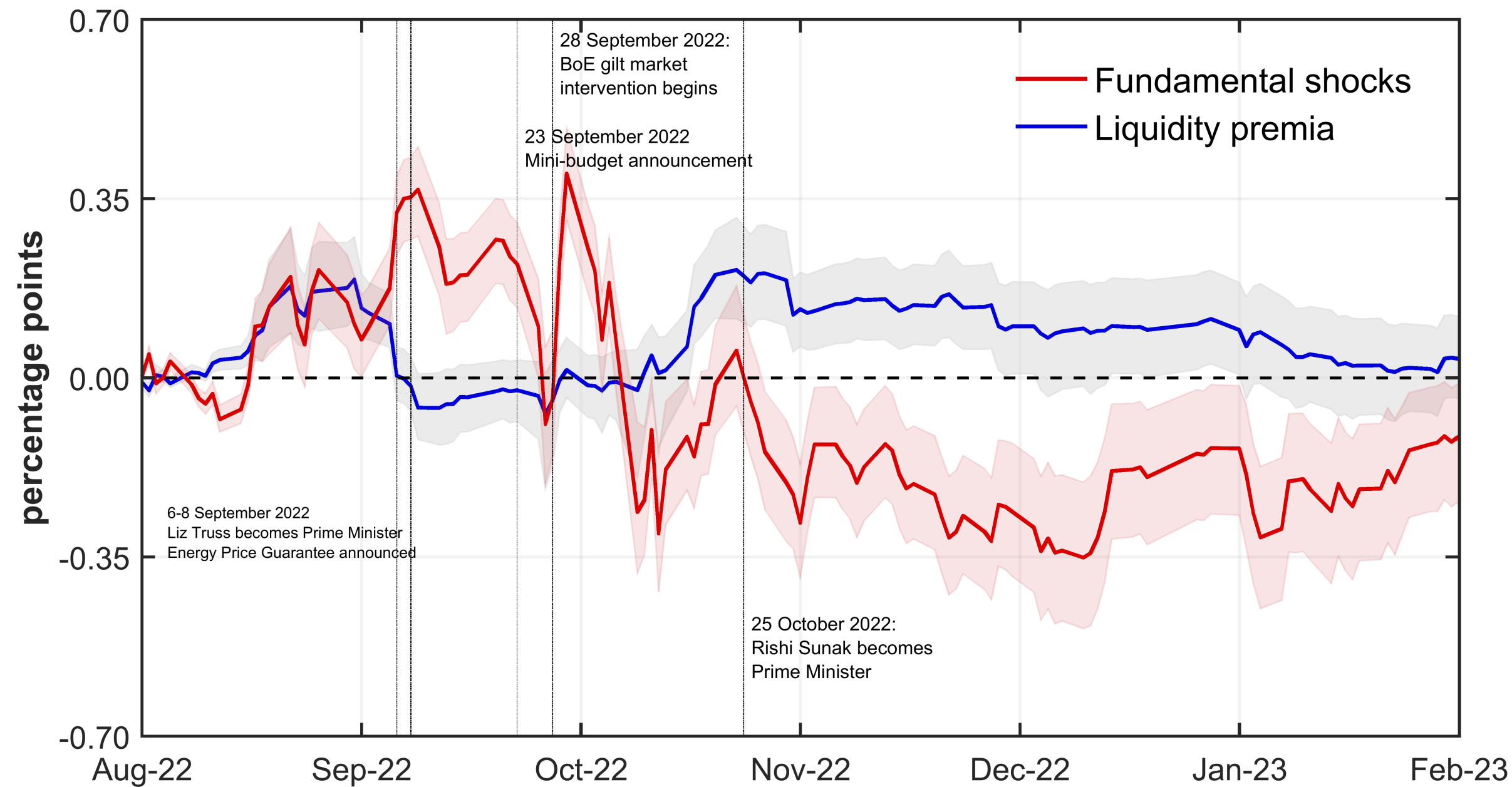
$$\pi^{10} - \pi^5 = \pi^{5-5}$$

Starting to approach 3%, above 2%

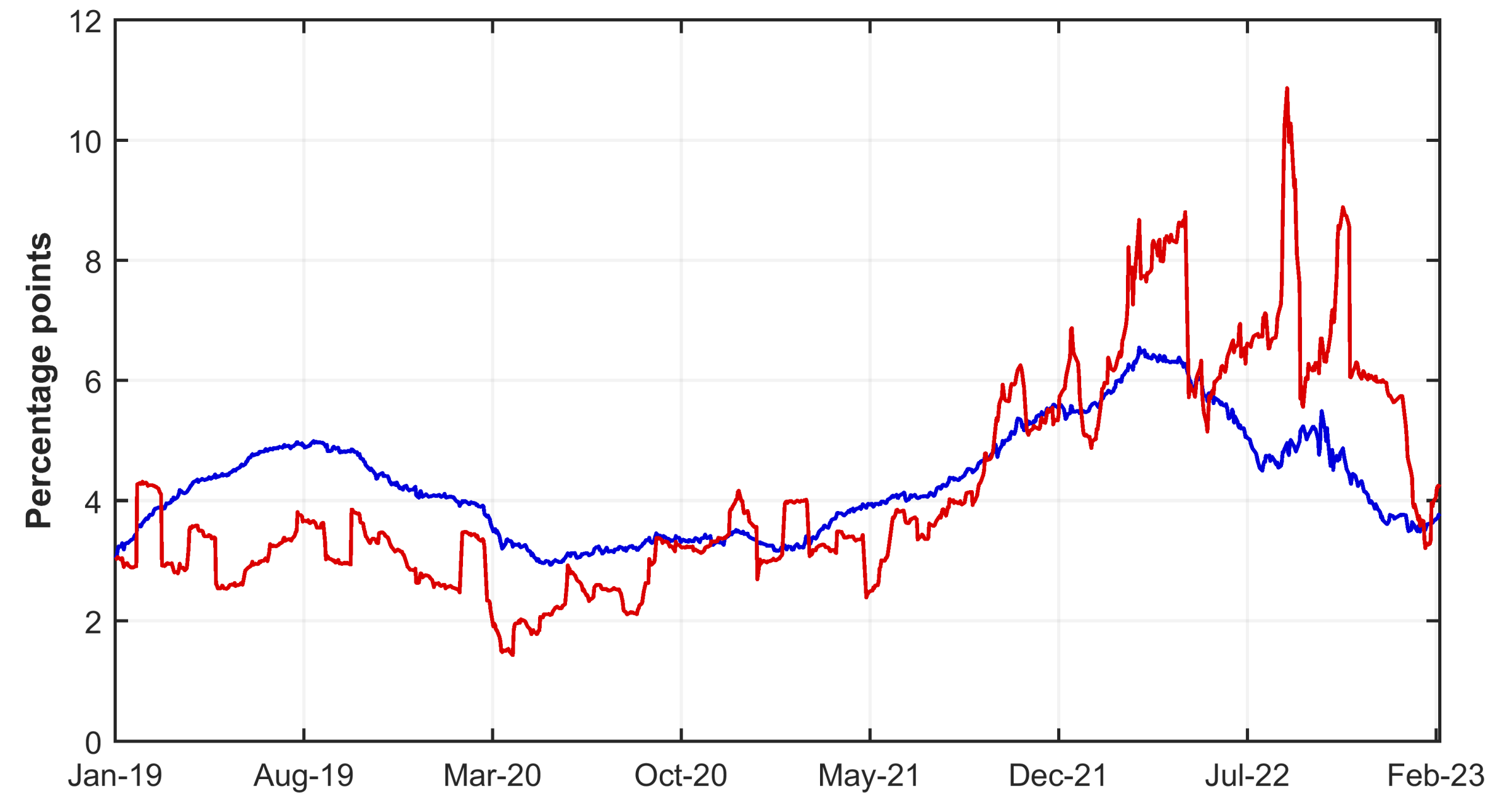
But cannot take these at face value, clean them of liquidity and risk premia.

Liquidity premia and overshooting

(a) Estimated liquidity premia and fundamental shocks



(b) Short horizon UK RPI inflation swap rates



Autumn crisis in UK is a good illustration as it put stress on dealers

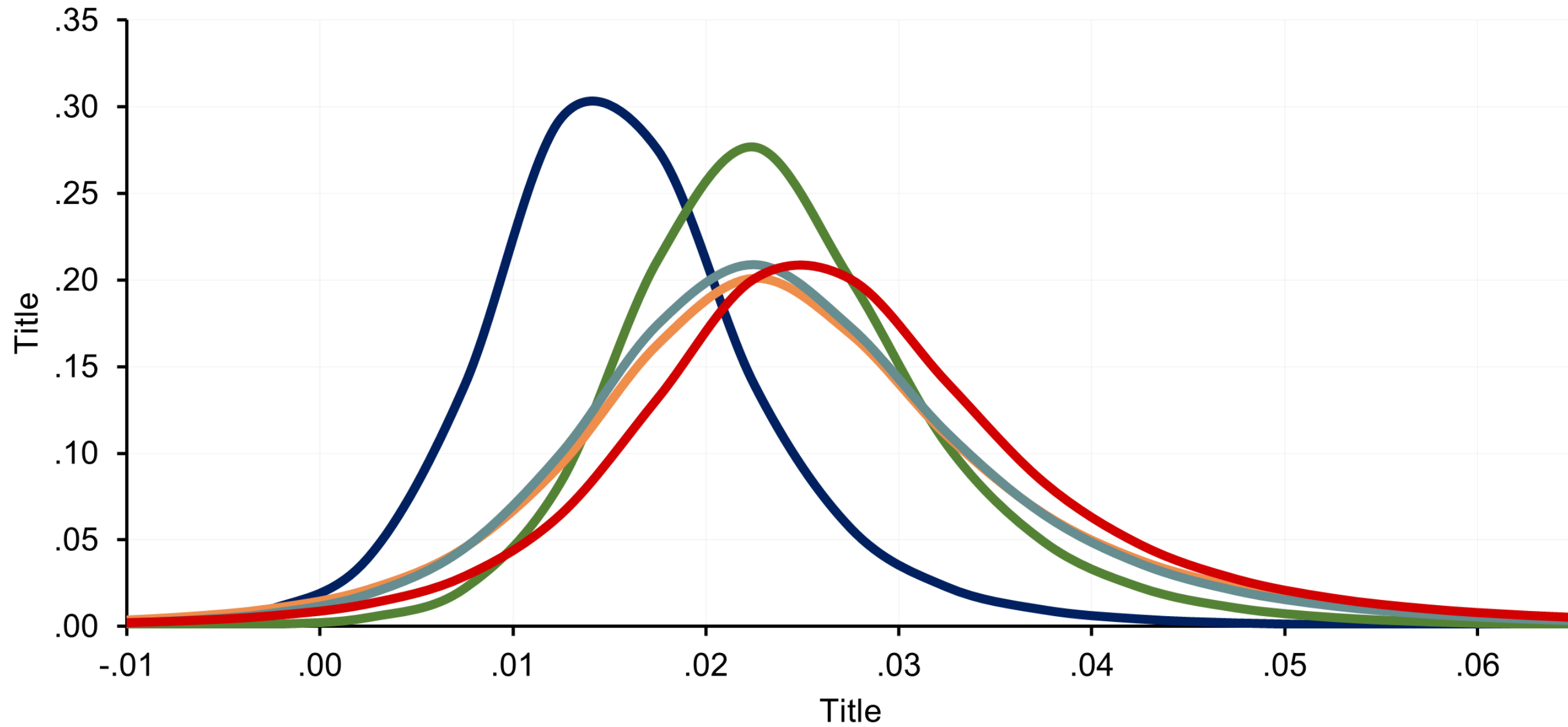
Identified using market segmentation between short and long horizon

So the current 2.5% expected inflation better understood as 2.1 - 2.2%.

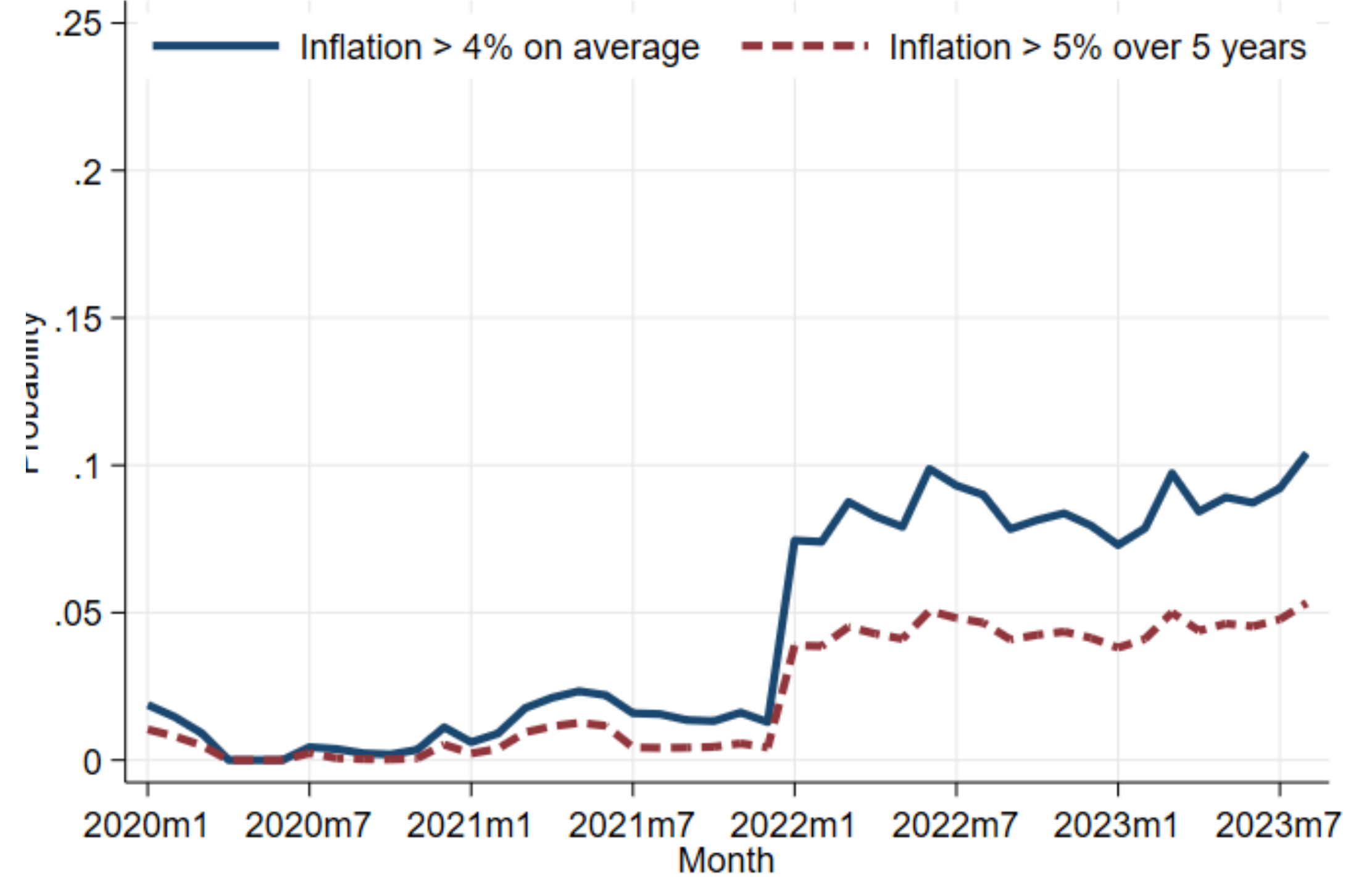
Expected inflation in EA: where are the tails?

EZ risk-adjusted probability densities for 10y inflation

— Jul2021 — Jul2022 — Jan2023 — Jun2023 — Aug2023



EZ probability of 5y5y high-inflation disaster



Use options on swap contracts, clear break after end of 2021

Right tail risk is the dominant force

And theory?

(i) Raising the inflation target

Economists talking about it for a while...

(ii) Government fiscal pressure

Impact of higher interest rates on budgets felt in 2024 and especially 2025

(iii) Opportunistic theory of disinflation

Upward bias moving forward

Increase by 10 - 25% the chances that inflation target gets revised upwards to 3% would give you a 0.1-0.25% increase in expected inflation

Conclusion: adding it all up

Conclusion on long-run yields

Decline of 3-4% between 2000-19 on i^* , but now:

- Expected inflation and risk premium up by 0.2 - 0.5%.
- Real return on government bonds up by 1.0 - 1.5% i^* is up by **1.2 - 2%**.
- In EZ up from 1.5% in 2019 to **2.7 - 3.5%**. Trading right now at 2.8%.
- in US: up from 2.5% to **3.7 - 4.5%**. Trading right now at 4.1%.

What does this tell us about current policy challenges?

- Tightness: once monetary policy starts cutting, only do so by 100bp.
- Fiscal policy: debt revenues permanently lower, less fiscal space.