What next for r^*: business as usual or a turning point?

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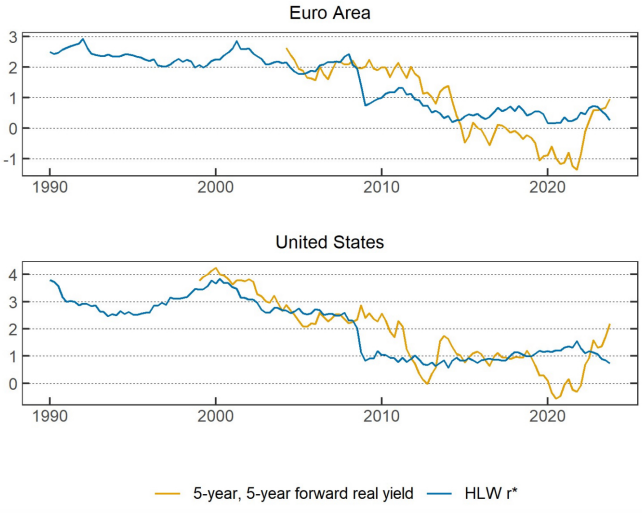
r^* – business as usual or a turning point?



From: John C. Williams (2024): R-Star: A Global Perspective

Organizing framework

- Risky (ν) capital K, safe bonds B, importance of bonds indexed by $\psi \in [0,1], \approx \frac{B}{B+K}$
- Investors (share χ, can invest in K and B) and households (share $1-\chi$, can invest in B only)
- Effective time preference ρ, risk aversion γ, inverse IES σ
- Imperfectly-elastic long-run asset supply (life-cycle, idiosyncratic income risk): $p > 0$
- Capital share in production α, gross markup φ, growth g, capital taxes τ_k

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- Equilibrium returns, approximately:

$$r_b \approx \underbrace{\rho}_{\text{patience}} + \underbrace{\sigma g}_{\text{optimism}} + \underbrace{p\sigma \cdot (\psi + (1-\psi)\alpha^*)}_{\text{firm and govt asset demand}} - \underbrace{(1-\psi)^2 \frac{\gamma(1+\gamma)\nu^2}{2}}_{\text{convenience, safety}}$$

$$r_k \approx r_b + \underbrace{(1-\psi)\frac{\gamma\nu^2}{\chi}\alpha^*}_{\text{compensation for risk}}$$

where α^* is the *after tax share of capital inclusive of profits*:

$$\alpha^* \approx (1-\tau_k)\left(\frac{\varphi-1}{\varphi} + \frac{\alpha}{\varphi}\right)$$

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1. Life cycle model – builds on Rachel and Summers (2020), Gertler (1999)
   - shut down risk ($\nu = 0$), but add richer demographic structure and gov policy (retirement, social security)
   - study business-as-usual and 4 forces in AEs as a (closed) block

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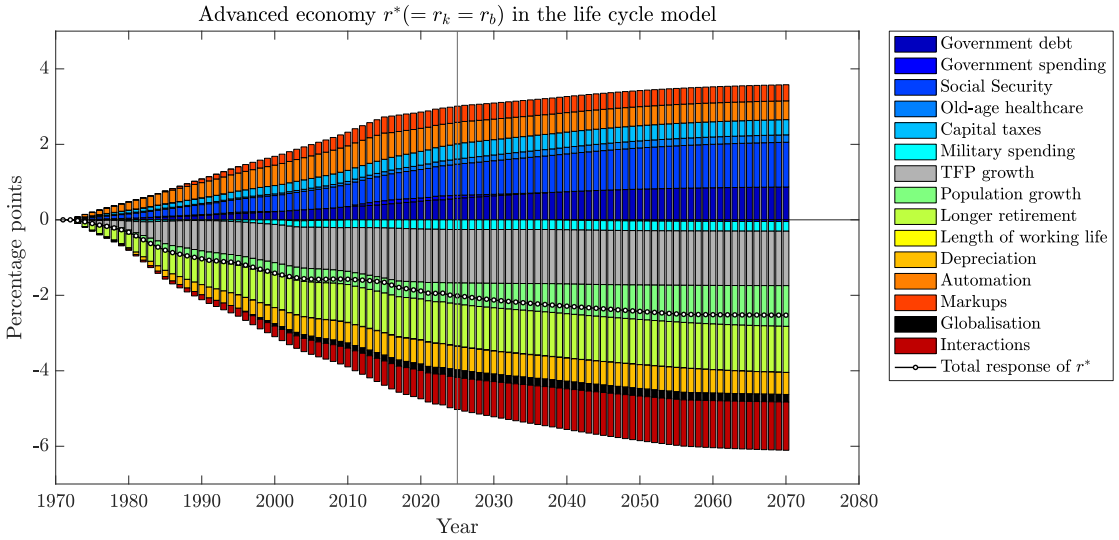
2. Two asset model – builds on Moll, Rachel and Restrepo (2022):
   - Additional insights: risk, concentration, convenience yields – qualitatively today

Model of the life-cycle

Key properties:

- Households save for retirement
- Ricardian Equivalence doesn't hold
- Upward sloping long-run asset supply – shifts in both capital supply (HH) and demand (firms) drive r^*
- No risk or convenience – one rate of return, $r^* = r_k = r_b$

Drivers of r^* – the past, and "business as usual" projection



- Strong forces in either direction. Growth and demographic drag offset to some extent by fiscal policy.
- Shifts in capital demand – depreciation, automation, markups – have large effects on r^*

Business as usual – underlying trends and assumptions

1. **TFP growth:** 1.5%pa in 1970 to around 0.5%pa today and going forward
2. **Fiscal / social ratios** mirror data for the OECD. Going forward, debt: IMF forecast + slow stabilization, social security spending continues to rise, but slightly less rapidly than in the past, military spending stable at around 2.5% of GDP on average
3. **Demographic** variables calibrated to match longevity, population growth, length of retirement using UN data and projections
4. Half of the rise in gross **mark-up** that Farhi and Gourio (2018) found for the US
5. A fall in effective **tax on capital** across advanced economies as in Zucman et al (2022)
6. **Automation** – the rise in α – fills in the remainder of the fall in the labor share (Gutierrez and Piton (2019))
7. **Depreciation rate** rises by 1 percentage point (Dalgaard and Olsen (2021)) since the 90s and continues going up steadily
8. **Globalization:** 3% of capital stock migrated outside AEs, boosting productivity
9. **Interactions:** $A^s(r)$ is increasing and concave; $A^d(r)$ is decreasing and convex

4 forces outside of the “business as usual” baseline

1. De-globalization and re-shoring
2. The end of the peace dividend
3. AI
4. Green transition

- Must move away from perfect foresight: in the model, agents only just now realize these forces are there (expectational shocks)

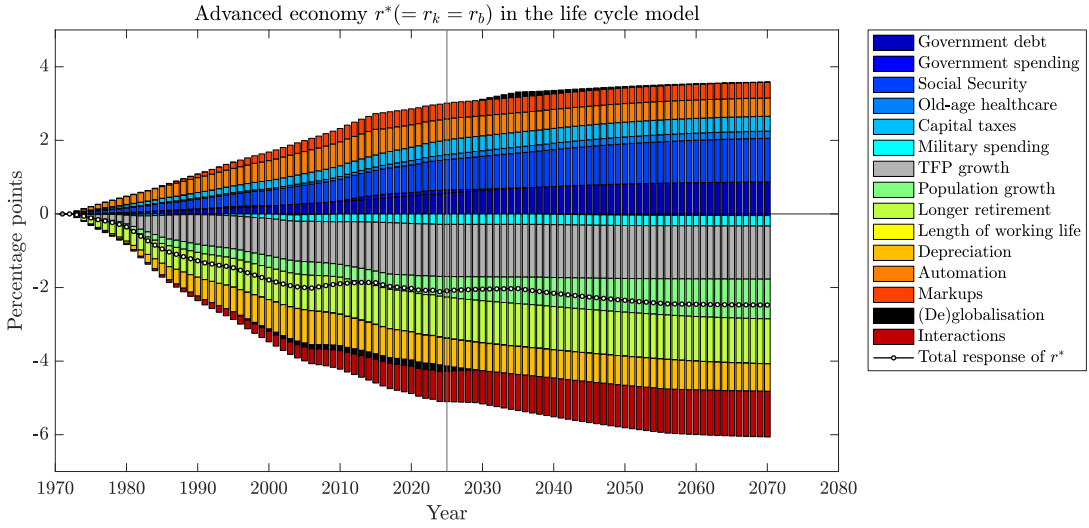
Deglobalization and re-shoring

- In 1990, roughly 80% of global capital stock was estimated to be in advanced economies.
- By 2020, this fell to 60-65%
- Much of that is convergence. But some of it is capital offshoring.

Assumptions over the past / in the “business as usual”’ projection:

- Since the late 1990s, roughly 3% of AEs’ capital stock migrated outside
- This persists (in levels)

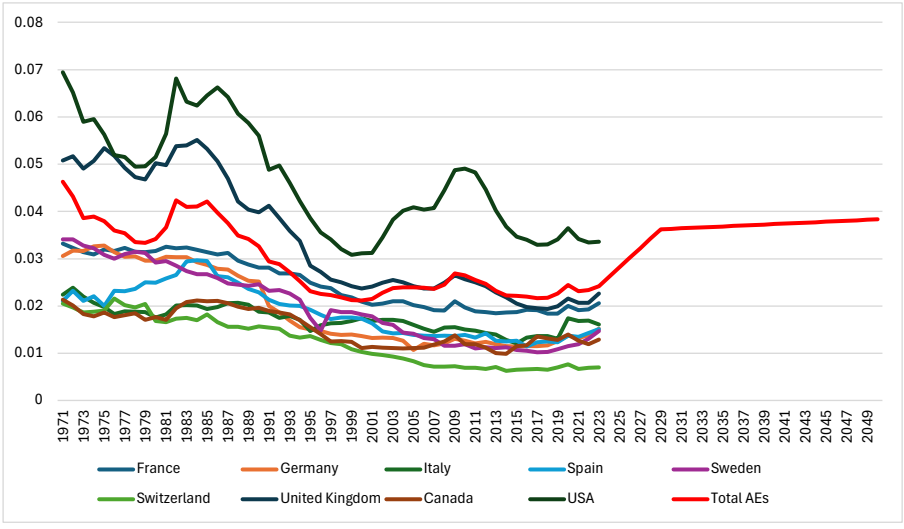
Force 1: De-globalization and re-shoring



- Assume around a third of it will be re-shored – greater capital demand in AEs, and higher r^*
- Off-shoring provided a small boost to productivity, that is unwound here

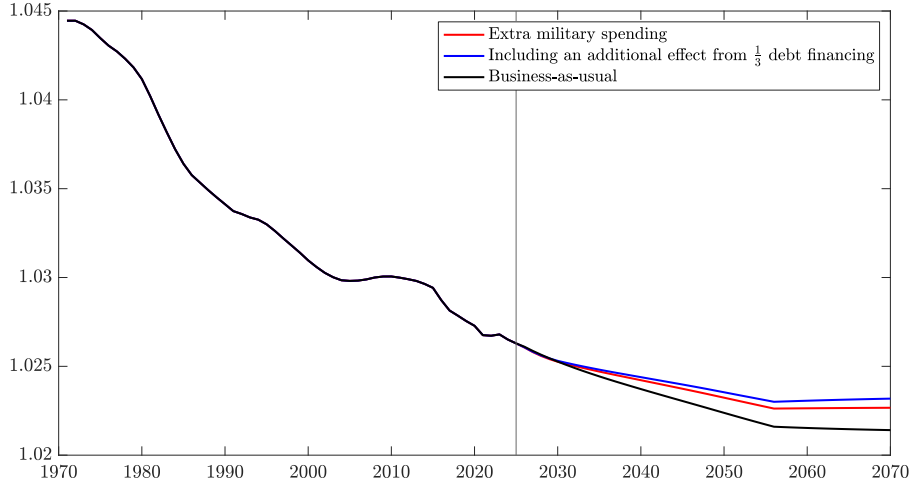
Humans used to spend a large fraction of income on defense

Force 2: Military spending as a share of GDP, and a rearmament scenario



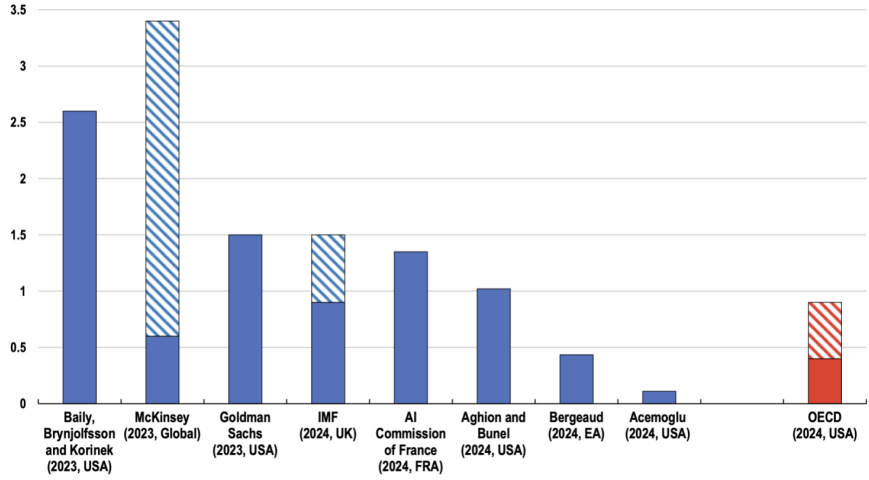
- Assume a third of the spending is funded by additional debt issuance.

Force 2: The end of the peace dividend: r^* (gross)



- Short-run response is small: the shock makes households poorer. Saving increases in anticipation of tough times ahead, providing an offset for r^*

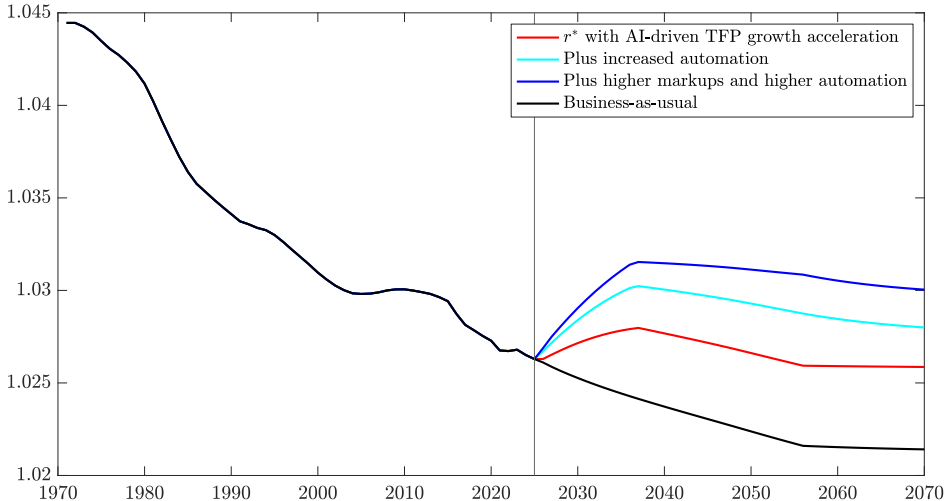
Force 3: AI. Predicted boost to annual productivity growth this decade



Source: Fillipucci et al (2024)

- Numbers are huge and hugely heterogenous. Long-run effects on r^* easy: $\Delta r^* \approx \frac{1}{TES} \times \Delta g$
- Here: transition, and other channels (market power and capital share ↑)

Force 3: AI and r^*



- Assume TFP growth 0.5pp higher for a decade, and steady state growth boost of 0.25pp. Plus higher mark-ups (2pp) and α (1pp).
- All three raise r^*. These effects are large. Missing: effects through heightened uncertainty + inequality.

Force 4: Green transition – or lack thereof

Green transition:

- Conceptually, achieving green transition is costly – akin to a composite anticipated negative capital and technology shocks (Mehrotra (2025))
- This *lowers* r^* along the transition (while consumption is lower, investment is higher)
- How costly? Estimates vary widely, but plausibly small (e.g. b/c investment in electricity generation is a small share of GDP; and b/c of green technological progress)

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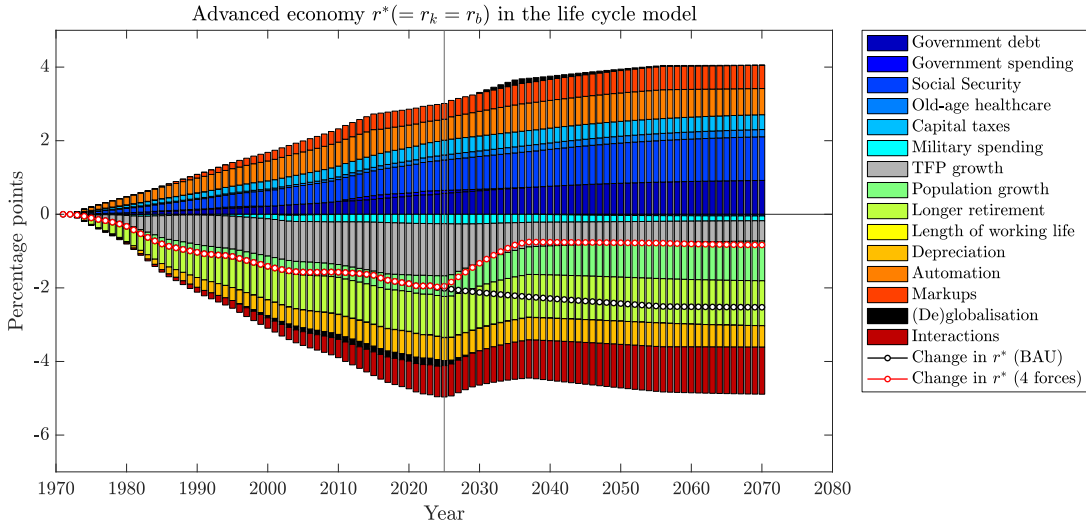
Climate damages:

- Climate change damages not only the planet, but also the economy
- Recent estimates suggest climate effects on AEs GDP are large:

$$\text{1 degree C } \rightarrow 10\% \text{ hit to GDP (Bilal and Kanzig (2024))}$$

  - See also Rachel and De Ridder, *Emissions-Adjusted Total Factor Productivity* (2025)
- As this gets embedded in pessimistic, fossil-fuelled expectations, lack of action may be a drag on r^* in AEs

The 4 (or 3, rather) forces together



- It's possible that we're at the turning point, but much hinges on the AI boost to growth

AI in a model with capital risk

$$r_b \approx \rho + \sigma g + p\sigma \cdot (\psi + (1-\psi)\alpha^*) - (1-\psi)^2 \frac{\gamma(1+\gamma)\nu^2}{2}$$

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- Recall: ν is capital income risk, χ is share of investor households
- AI: higher risk $\nu \uparrow$ and more concentrated $\chi \downarrow$?
- If so, these forces can provide some offset to the AI boost to r_b and might keep the $r_k - r_b$ spread high
- Quantification: work in progress...

Summary and ongoing and future directions

- Several forces driving r^* are persistent and here to stay
- But are these models capable of predicting a turnaround? Yes, with previously unexpected shifts.
- I analyzed and provided a first-pass quantification of the forces that came into view recently
  - de-globalization
  - rearmament
  - AI
  - Green transition
- While not a forecast, a useful sensitivity and scenario exercise.
- Others – geopolitical re-alignment and fragmentation, for example – must be on our watch list.