Now and then: a term structure perspective on twenty years of unconventional monetary policy

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Beatles references? Not too much

The last single from 2023 ...

... "it was 20 years ago today ..."

Roadmap for presentation

Outline & background

- overview, theme, and open questions
- COVID-period monetary policy cycle

Monetary policy measures

- Shadow Short Rates & complementary indicators
- the real long perspective on short rates

Yield curve decompositions

- expected policy rates & risk/term premiums
- long perspective for the US

Conclusion

1. Outline & background

Roadmap of presentation

I present **long-term perspectives on monetary policy** and the yield curve based on my regular updates of shadow/lower-bound term structure models

- Shadow Short Rate estimates, and two complementary indicators
- Yield curve decompositions into expected policy rate path and risk premiums, and a proxy for the natural rate

United States is the main focus

- also G4 (Euro Area, Japan, United Kingdom) & dollar bloc (Canada, Australia, and New Zealand)
- my results free on LJKmfa.com (Dec-2024 used here)

Focus on outputs and commentary, so not at all taxing ...

- .. but model aspects for term structure enthusiasts

Theme and questions to bear in mind

Unprecedented monetary policy stimulus from conventional & unconventional actions over past 20 years

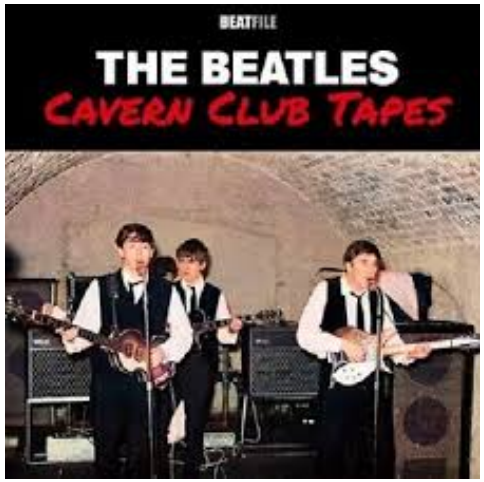
Justifiable then, given events during Global Financial Crisis/Great Recession (GFC/GR) and COVID pandemic, but latter policy contributed to recent elevated inflation.

Open questions now:

- Is current monetary policy in the right ballpark to bring inflation back to targets?
- Not explicitly addressed in this presentation ...
- ... but not helpful when markets, and even central banks, anticipate quick reversal to "**yesterday**" ...
- ... when a "**get back**" strategy, closer to historical norms, might be more appropriate
- And all of the above even before any "Trump changes"
- Rising risk premium rescue? (If tighter conditions needed.)

"Unprecedented?" Relative to ...?

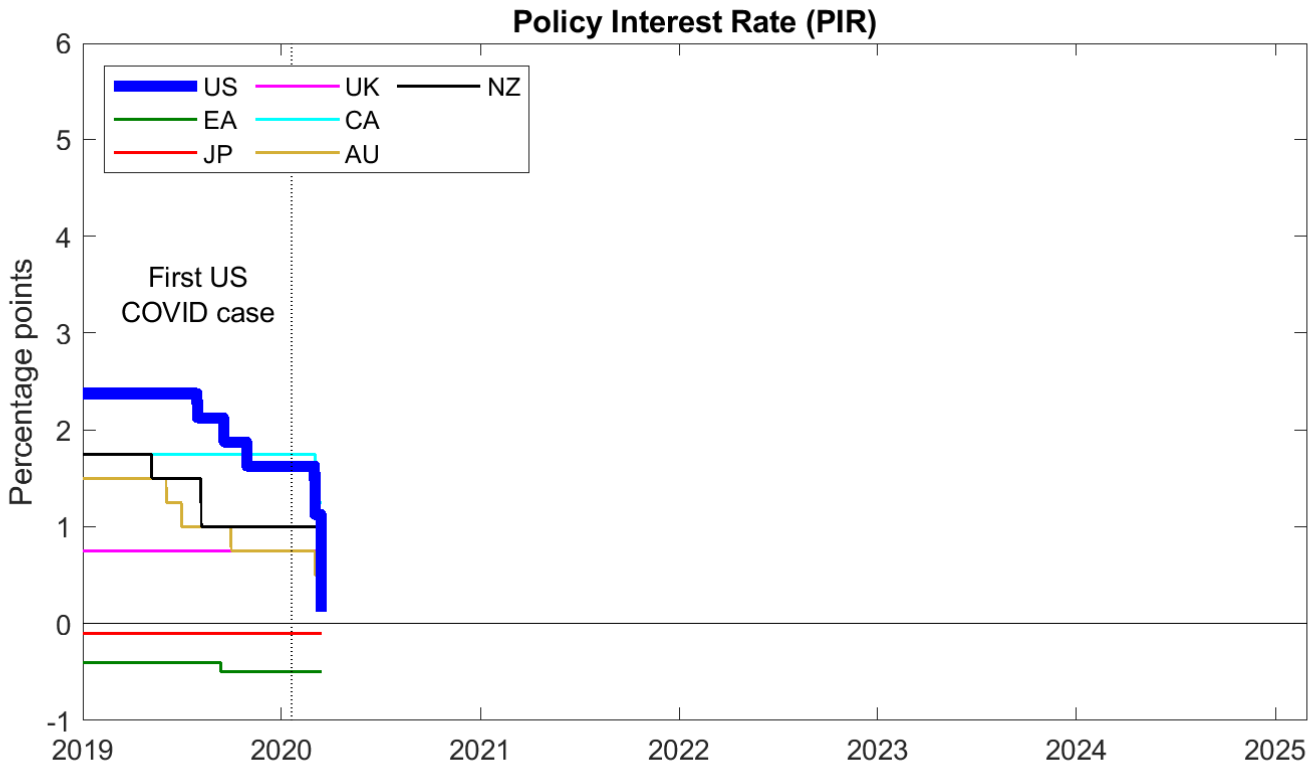
From around when these guys were getting started ...



... which, from observation alone, is some time back

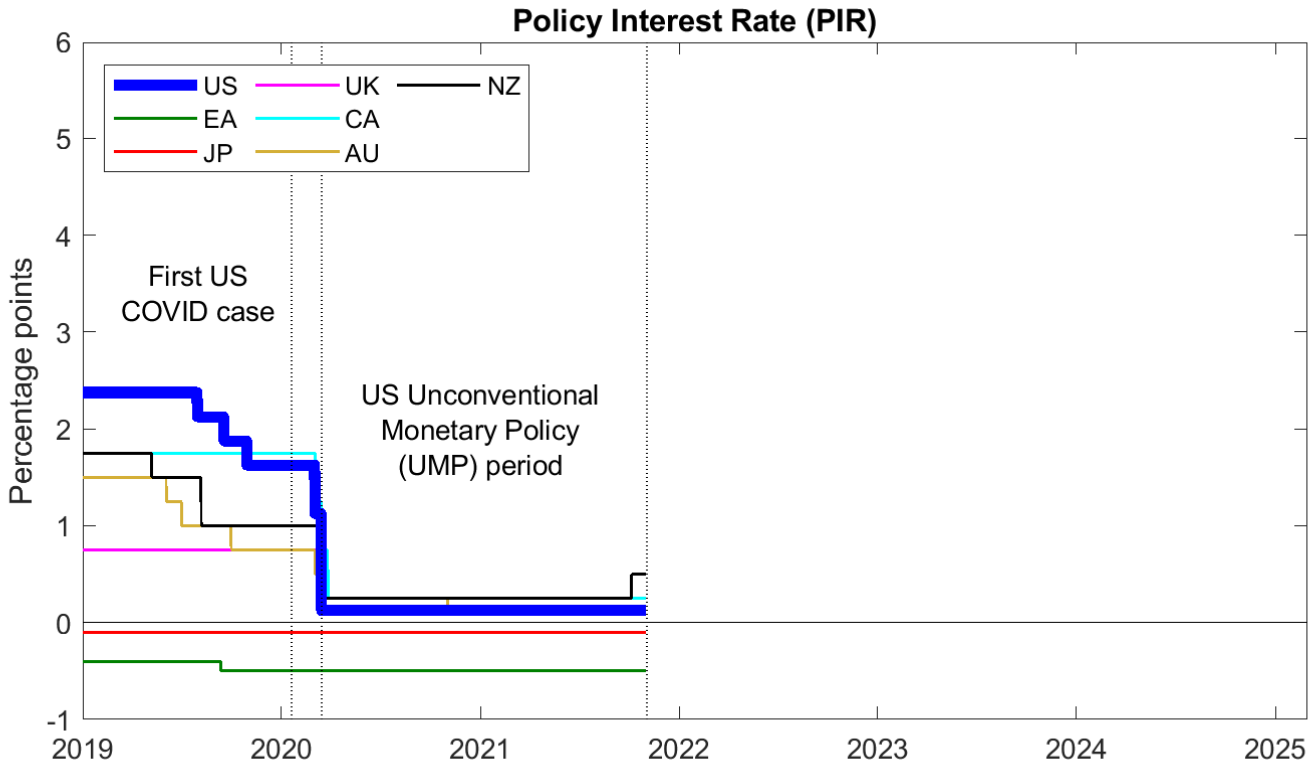
Conventional Monetary Policy (CMP) easing

"Help": On COVID onset, Central Banks (CBs) with positive Policy Interest Rates (PIRs) cut them to near-zero. EA and JP left their near-zero PIRs in place



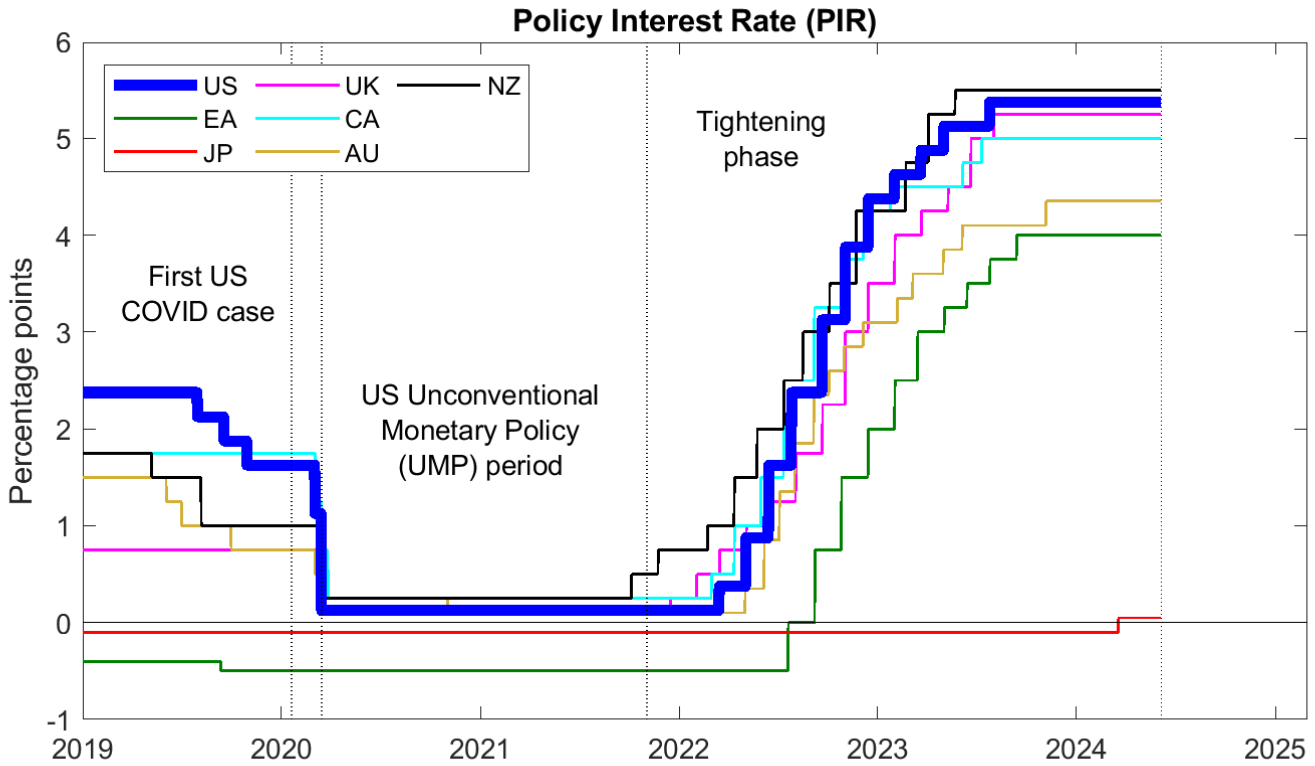
Unconventional Monetary Policy (UMP) easing

"**All you need is love**": CBs provided additional stimulus unconventionally, broadly via Quantitative Easing (QE), Credit Easing (CE), and Forward Guidance (FG) on those aspects



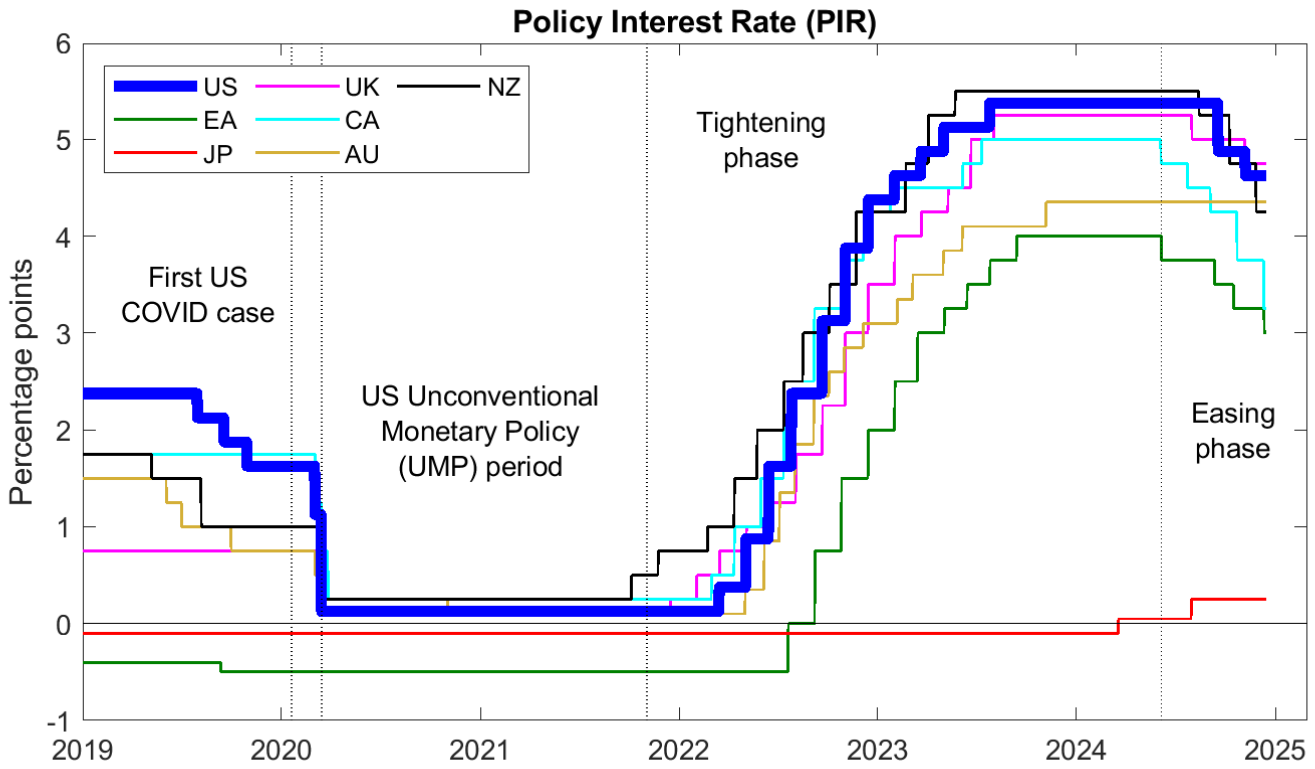
CMP and UMP tightening

"**Helter skelter**": As COVID and its economic disruption diminished, and inflation had increased and remained persistent, CBs raised their PIRs and ceased then reversed UMP actions



CMP easing

"**Here comes the sun**": CBs lowered PIRs in 2024H2 after inflation reversal. Open question on next steps; real economies slowing, but core inflation above targets



How stimulatory was UMP? And why is it important?

Not an easy question to answer, but influences economic outcomes (eventually and imprecisely: it's "**the long and winding road**")

near-zero PIR	$\Rightarrow$	overall	$\Rightarrow$	financial markets,
QE & CE	$\Rightarrow$	monetary		economic activity,
Forward Guidance	$\Rightarrow$	policy		and inflation

One approach: **quantify CMP + UMP with yield curve data**

- yield curve: interest rates for different times to maturity
- principle is yield curve embeds current CMP & UMP settings, and guidance/expectations of their evolution

One example: Shadow Short Rates (e.g. Krippner 2011-15)
Complementary perspectives: two other UMP indicators and yield curve decompositions into $\mathbb{E}$(PIR) & risk premium

2. Monetary policy measures

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Monetary policy measures

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Yield curve decompositions

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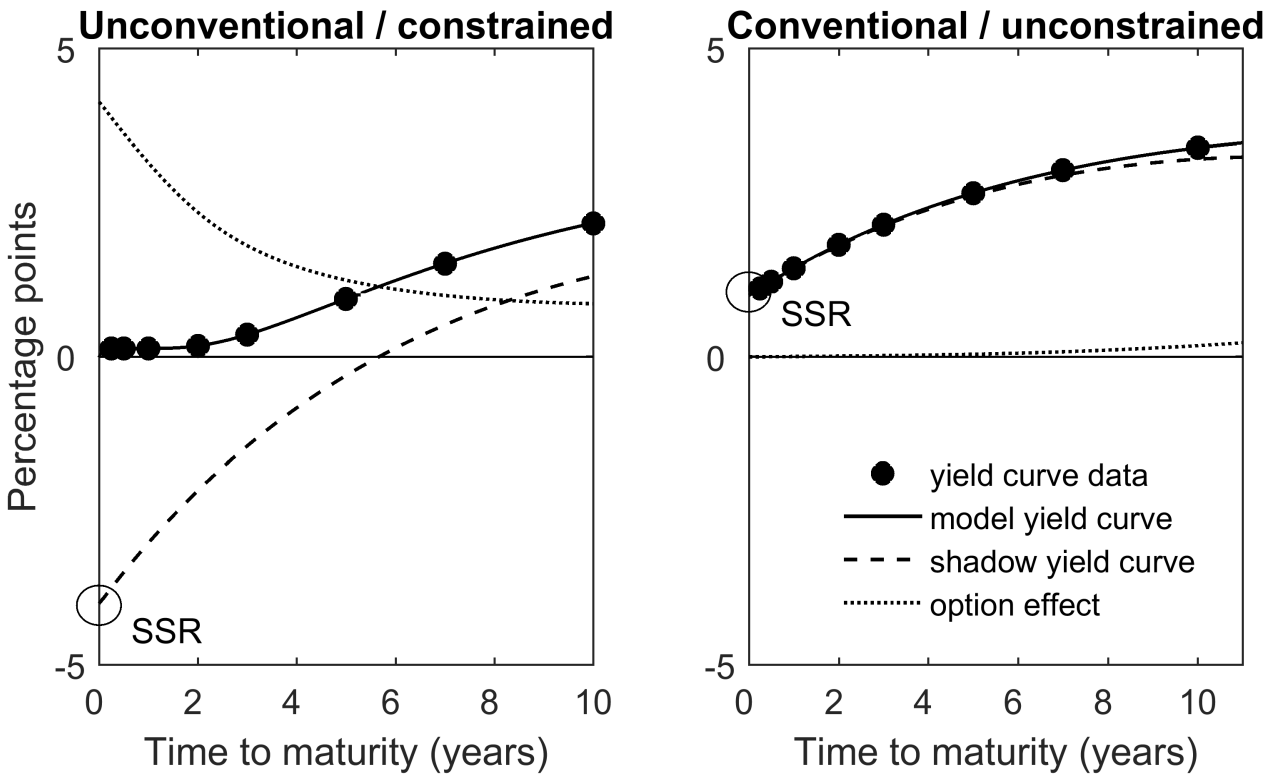
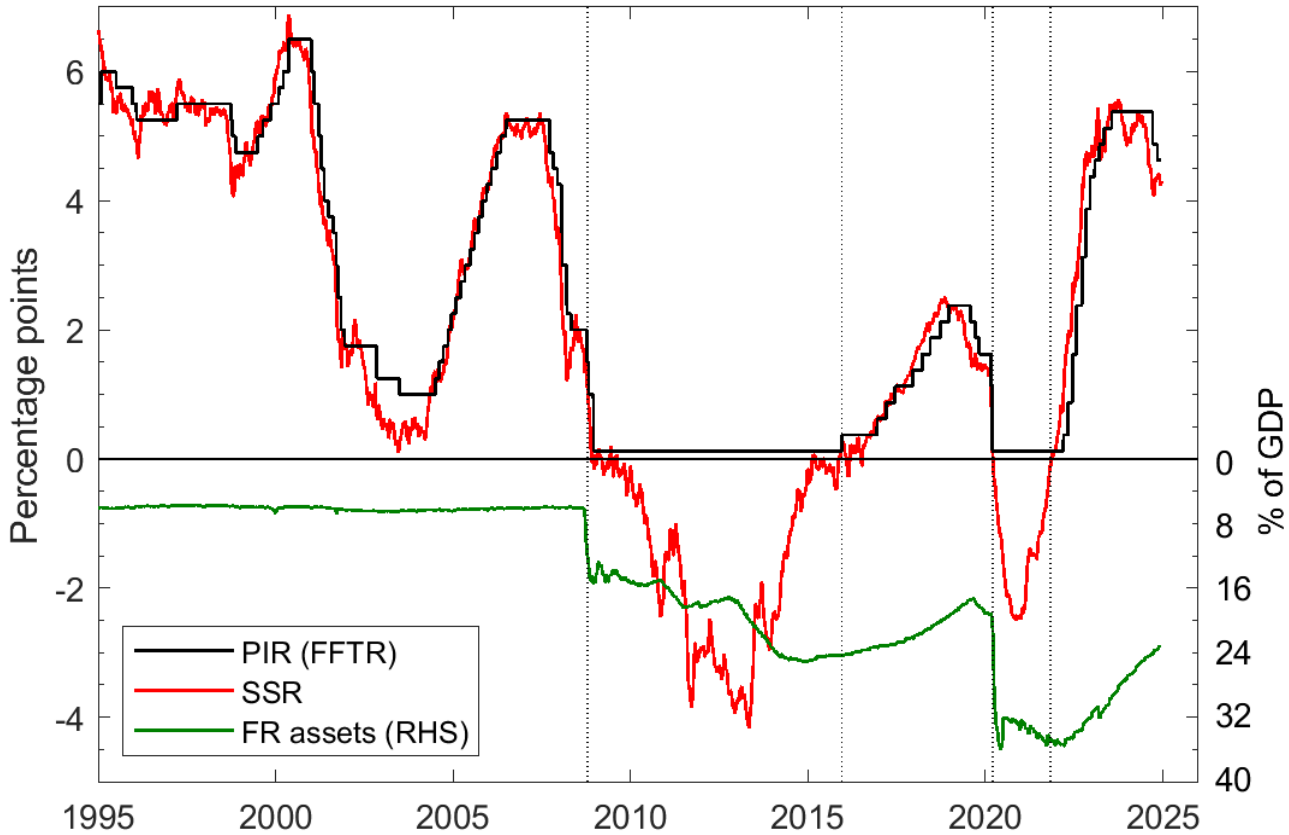
Shadow/LB term structure framework overview

- ZLB short rate = Shadow Short Rate + currency option
  - $\underline{r}(t) = r(t) + \max\left[-r\left(t\right), 0\right]$, (re-arranged from Black 1995)
- $\Rightarrow$ **ZLB yields = shadow yields + option effect**



US example: SSR as an indicator for UMP



Balance sheet approx. (no FG) from Gagnon and Sack (2018):
1.5% of GDP $\simeq$ 0.25% PIR. So 19% $\Rightarrow$ 3.1%, and 16% $\Rightarrow$ 2.7%.

Shadow/LB model: shadow specification is GATSM

1. **Specify & solve Gaussian diffusion for "short rate"**:
   - **state variables under physical measure $\mathbb{P}$**:
     $\mathrm{d}x(t) = \kappa[x(t) - \theta]\mathrm{d}t + \sigma \mathrm{d}W(t)$
   - **short rate**: $\mathrm{r}(t) = a_0 + b_0' x(t)$
2. **Specify risk adjustment**: $\Pi(t) = \sigma^{-1}[\gamma + \Gamma x(t)]$
3. **Solve for interest rates by maturity**:
   - **state variables under risk-adjusted measure $\mathbb{Q}$**:
     $\mathrm{d}x(t) = \tilde{\kappa}\left[x(t) - \tilde{\theta}\right]\mathrm{d}t + \sigma \mathrm{d}\tilde{W}(t)$
   - **forward rates**: $\mathrm{f}(t,\tau) = b_0' \exp(-\tilde{\kappa}\tau) x(t) + \mathrm{VE}(\tau)$
   - $\mathrm{VE}(\tau) = \frac{1}{2}\left[\int_0^\tau b_0' \exp(-\tilde{\kappa}u)\,\mathrm{d}u\right]\sigma\sigma'\left[\int_0^\tau \exp(-\tilde{\kappa}'u)\, b_0\,\mathrm{d}u\right]$
   - **interest rates**: $\mathrm{R}(t,\tau) = \frac{1}{\tau}\int_0^\tau \mathrm{f}(t,u)\mathrm{d}u$ (linear closed form)
4. **If no LB, estimate parameters and state variables:**
   - standard linear Kalman filter to best fit yield curve data
   - state equation $x(t)$, measurement equation $\mathrm{R}(t,\tau)$

GATSM shadow/lower-bound models

Krippner (2011-15): GATSM used for shadow term structure to price bonds plus "option of physical currency"

LB forward rates are (closed form):

$$\underline{\mathrm{f}}(t,\tau) = \mathrm{f}(t,\tau) \cdot \Phi\left[\frac{\mathrm{f}(t,\tau)}{\omega(\tau)}\right] + \omega(\tau) \cdot \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{1}{2}\left[\frac{\mathrm{f}(t,\tau)}{\omega(\tau)}\right]^2\right)$$

$\mathrm{f}(t,\tau)$ is shadow forward rate, $\Phi[\cdot]$ is cumulative normal function, and $[\omega(\tau)]^2 = \int_0^\tau b_0' \exp(-\tilde{\kappa}u)\,\sigma\sigma'\exp(-\tilde{\kappa}'u)\,b_0\,\mathrm{d}u$

LB interest rates by univariate numerical integration:

$$\underline{\mathrm{R}}(t,\tau) = \frac{1}{\tau}\int_0^\tau \underline{\mathrm{f}}(t,u)\,\mathrm{d}u$$

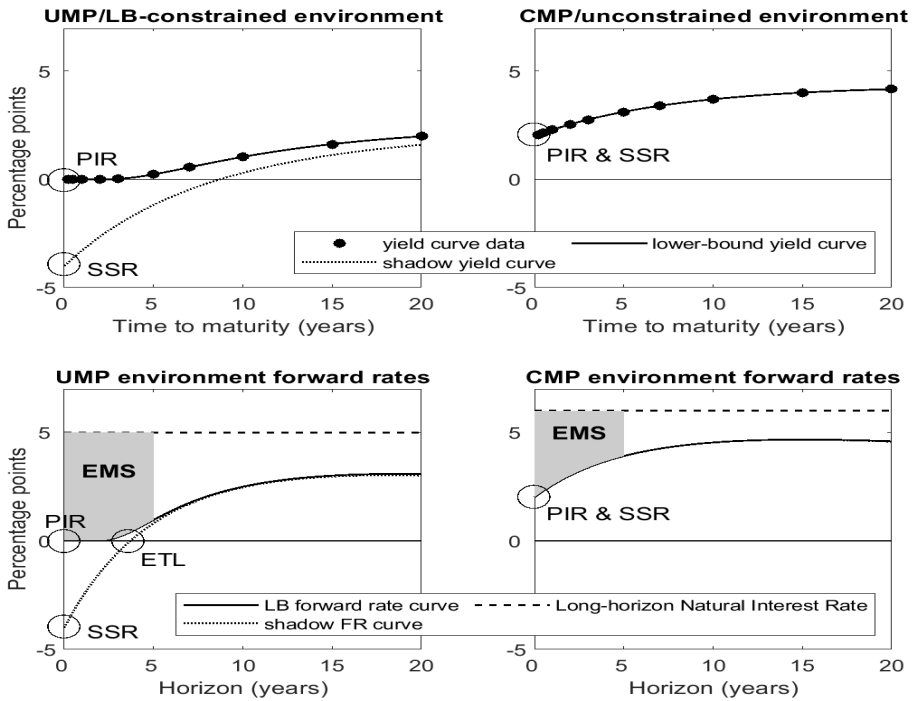
4. Estimate model parameters and state variables

- non-linear (iterated extended) Kalman filter
- non-linear state equation, linear measurement eq. for $\underline{\mathrm{R}}(t,\tau)$

Two other monetary policy metrics (SSR cross-check)

Expected Time to Lift-off (ETL): if SSR –ve, years until expected SSR path reaches zero (under $\mathbb{P}$-measure; later ...)

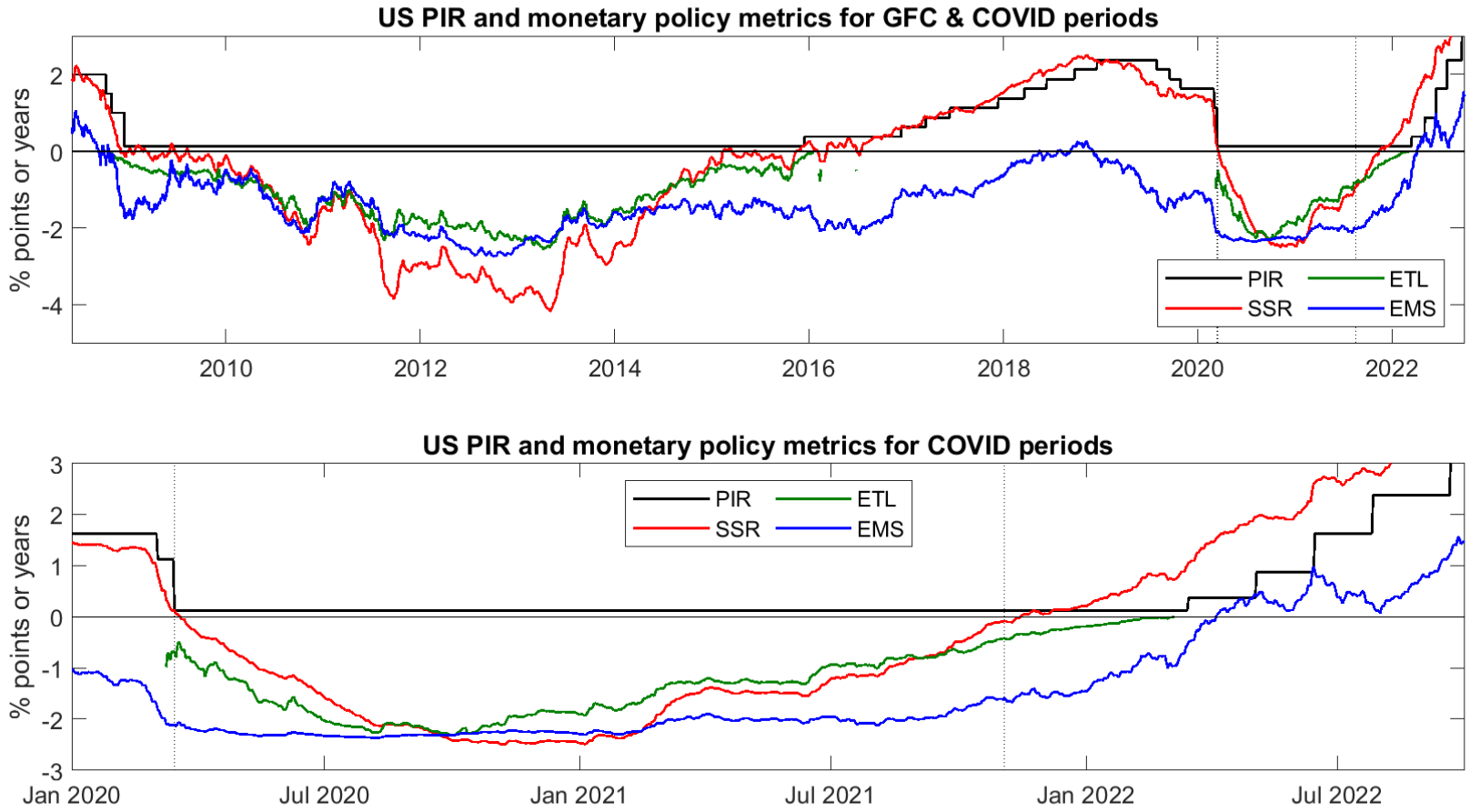
Effective Monetary Stimulus (EMS): $\mathbb{E}$(PIR) area relative to Long-horizon Natural Interest Rate (survey-based; later ...)



Calculate each day to assess evolution of CMP & UMP over time

The three monetary policy metrics for the US

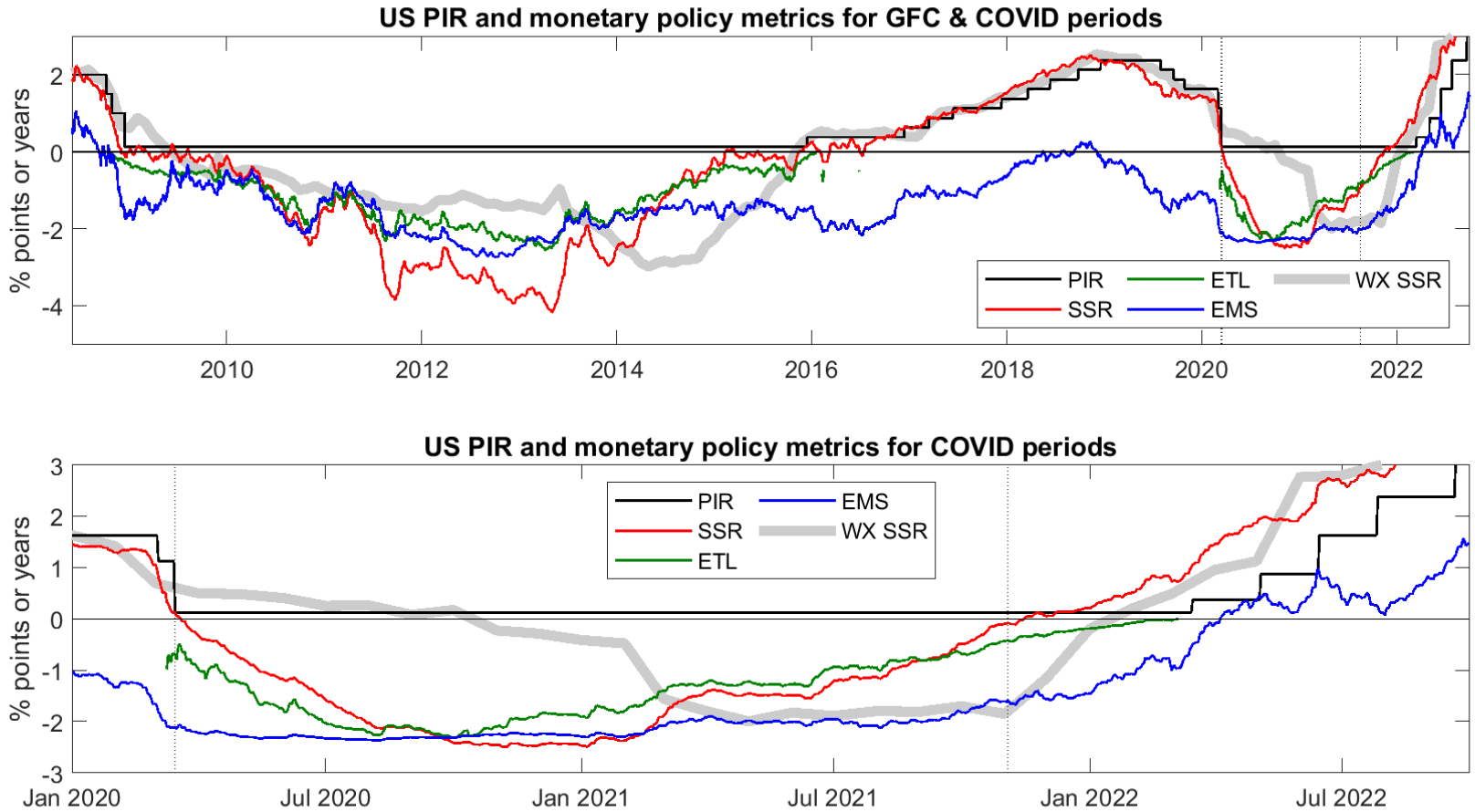
Note: ETL is negated to align with SSR and EMS metrics



SSR generally eases/tightens with ETL&EMS (and UMP events)

We appreciate you had a choice ...

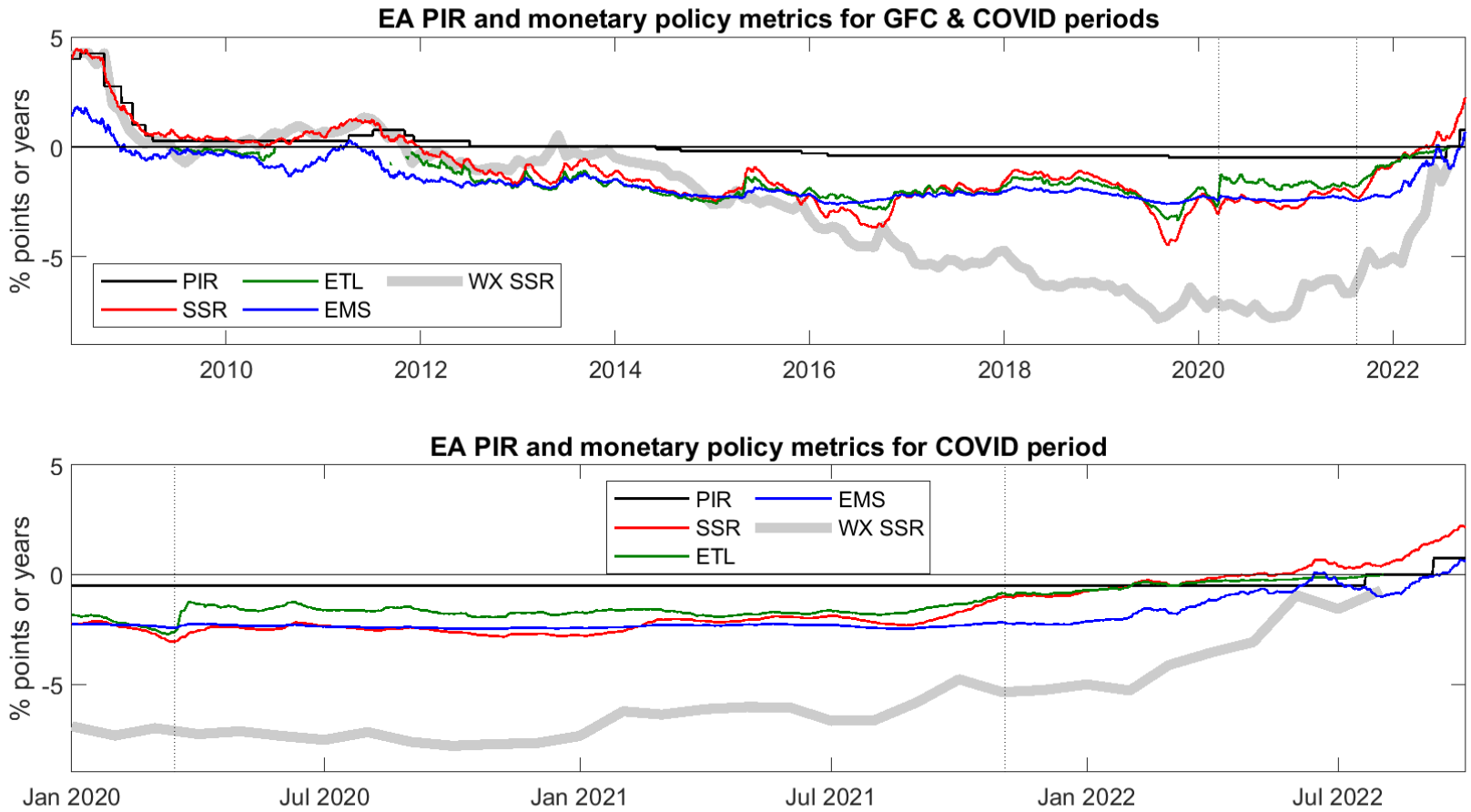
Wu-Xia SSRs kick in late, ease after tightening events, ...



... and less consistent with ETL&EMS (and UMP events; articles)

The three monetary policy metrics for the Euro Area

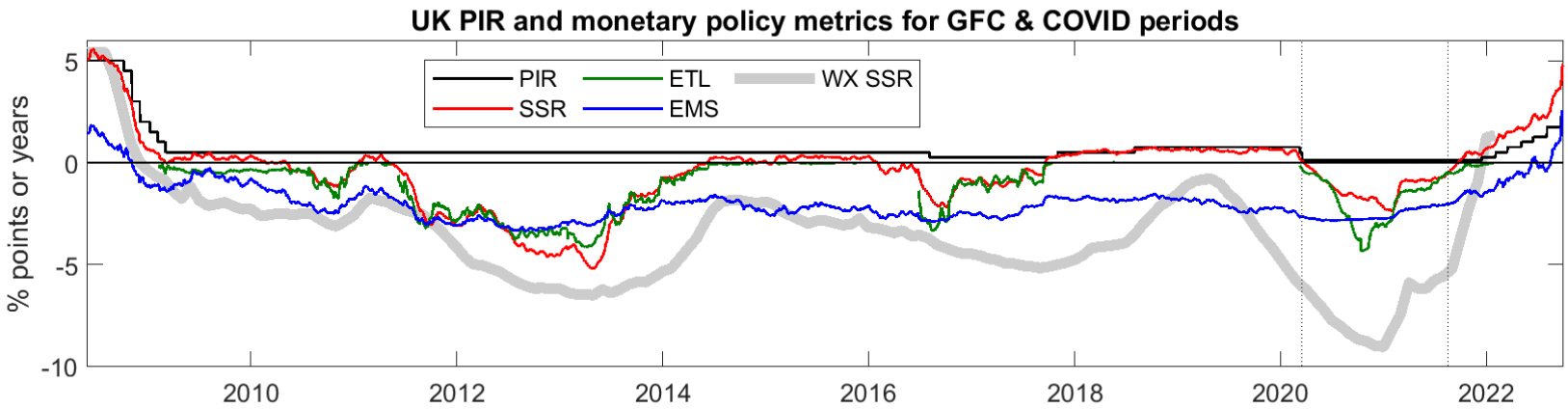
Material UMP easing was long delayed, then long in place

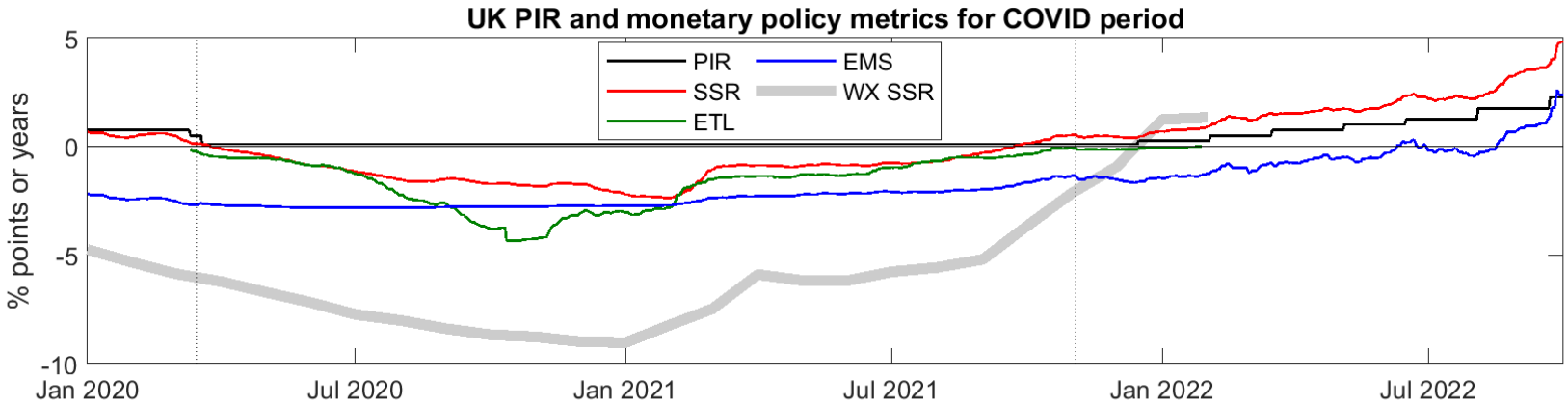


WX SSRs very –ve & less consistent with ETL&EMS movements

The three monetary policy metrics for the UK

SSRs –ve for GFC/GR, Brexit, and COVID

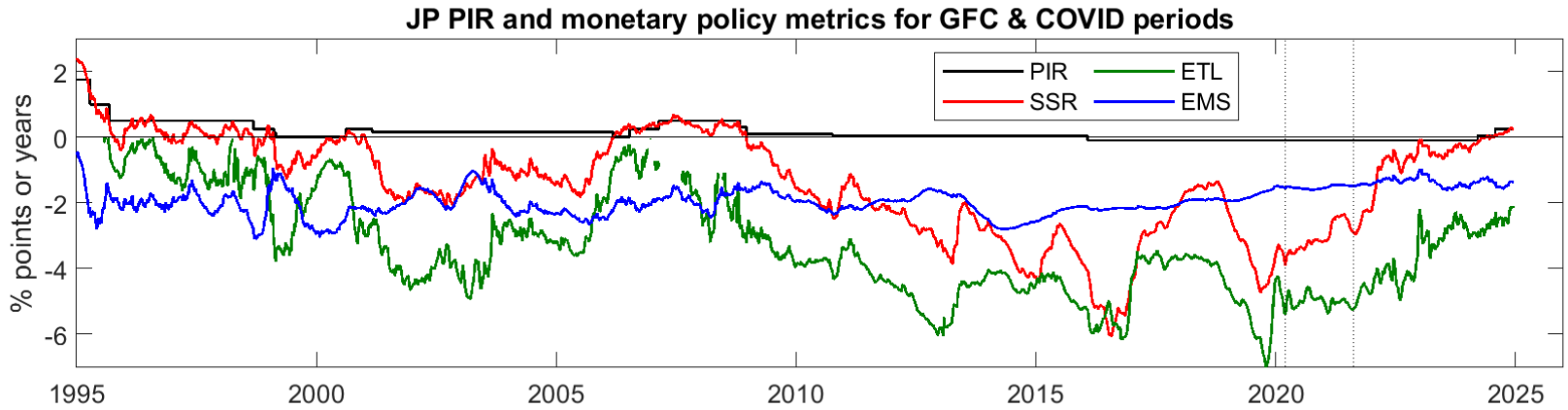


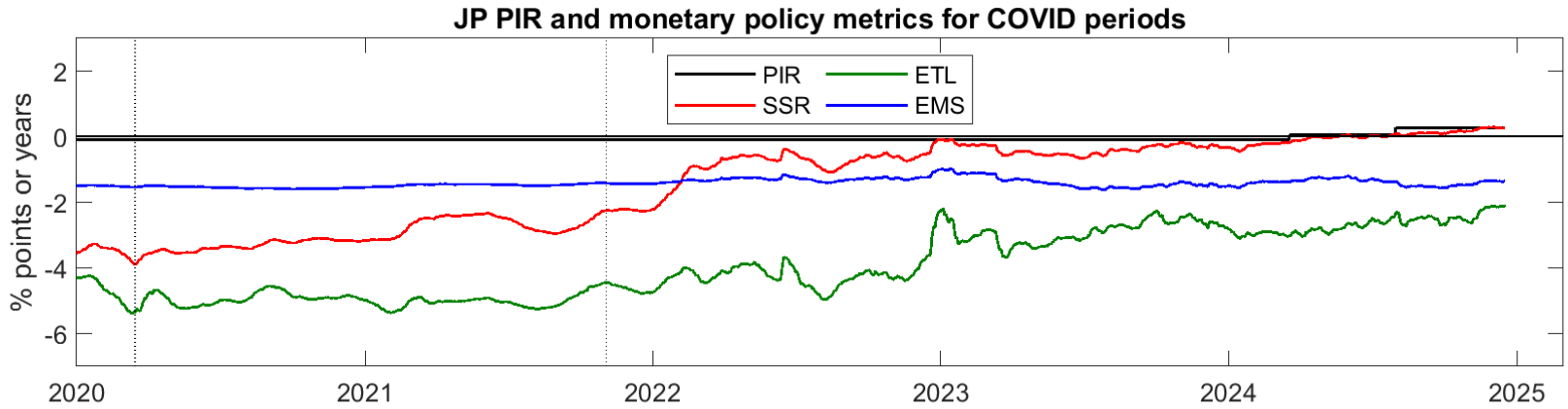


WX SSRs very –ve & misses Nov-17 to Mar-20 "lifted-off" PIR

The three monetary policy metrics for Japan

Nearly full-sample UMP, slow recent lift-off (ETL lagging)

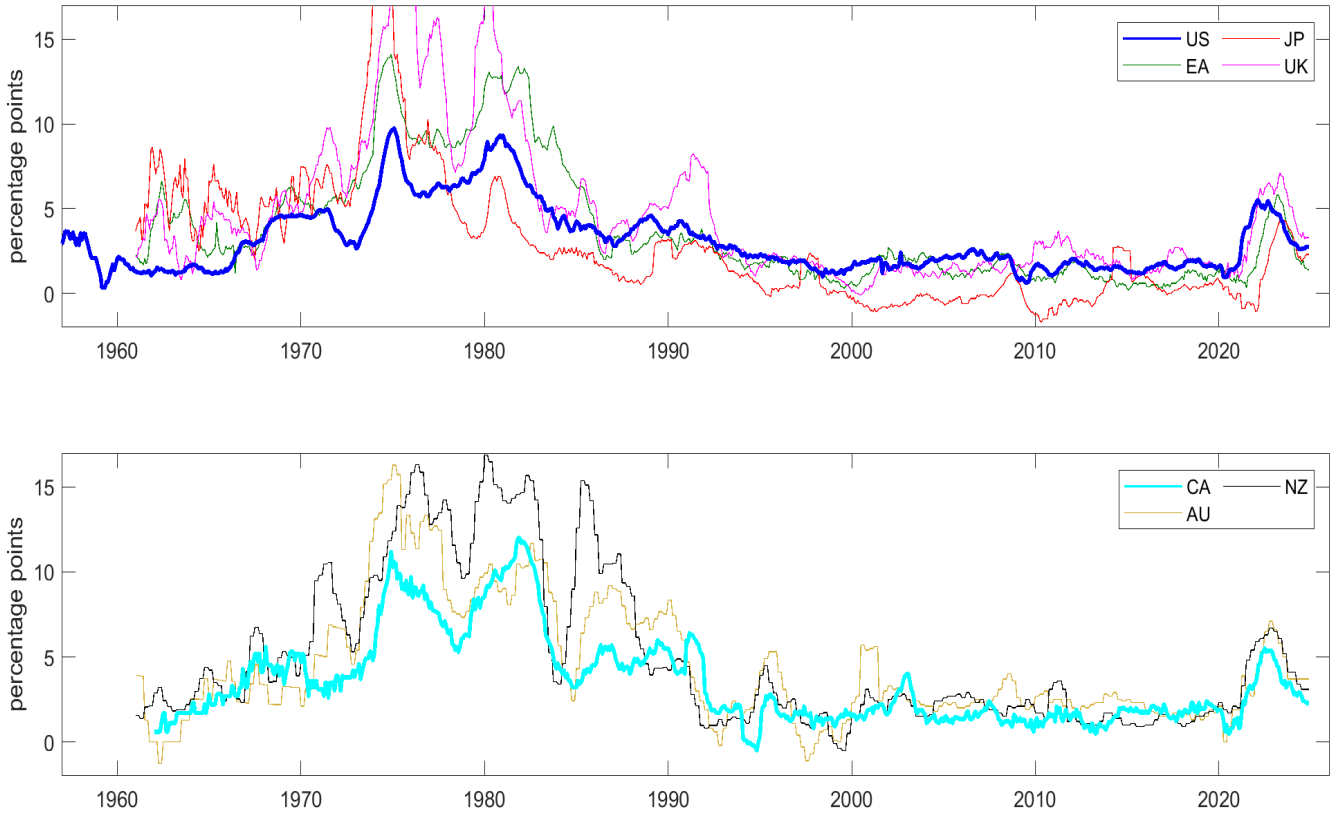




WX SSRs not estimated for Japan

Recent inflation has been elevated

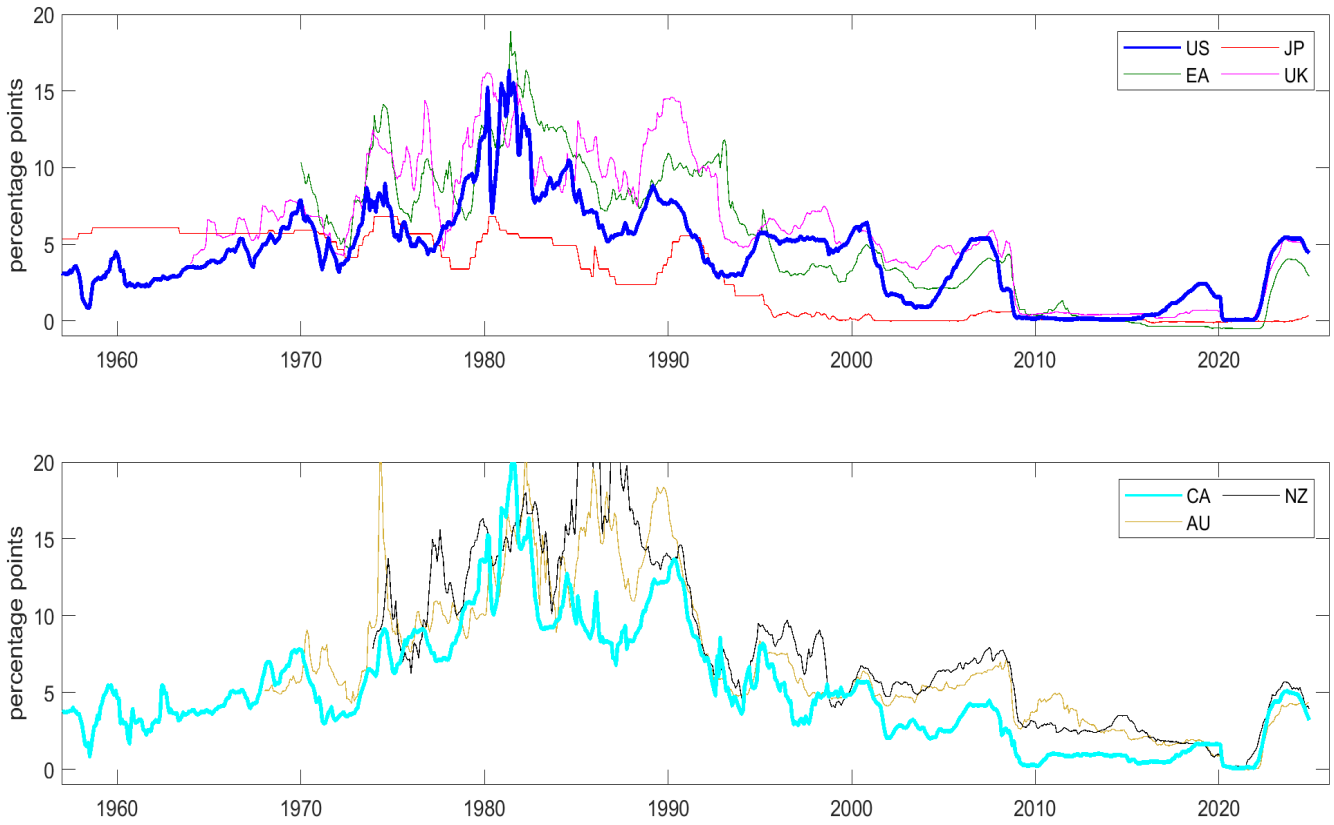
PCE/CPI inflation was at levels last seen in 1970-80s



Note: annual % change, ex-Food&Energy as available

Recent 3m rates moved quickly from trough to peak

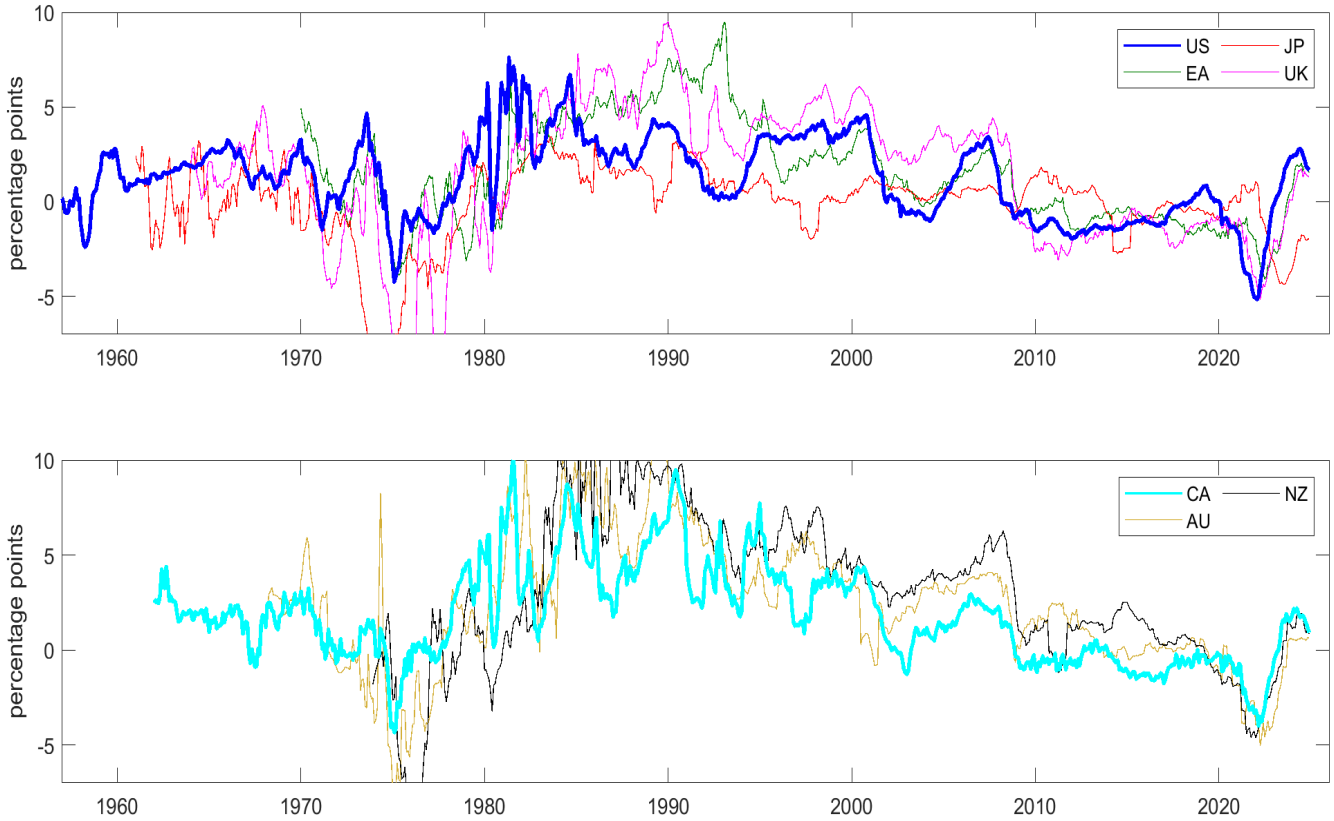
Reflects COVID stimulus, then PIR increases to quell inflation



Note: data compiled from IMF, FRED, and Bloomberg

Recent real 3m interest rates were sample lows

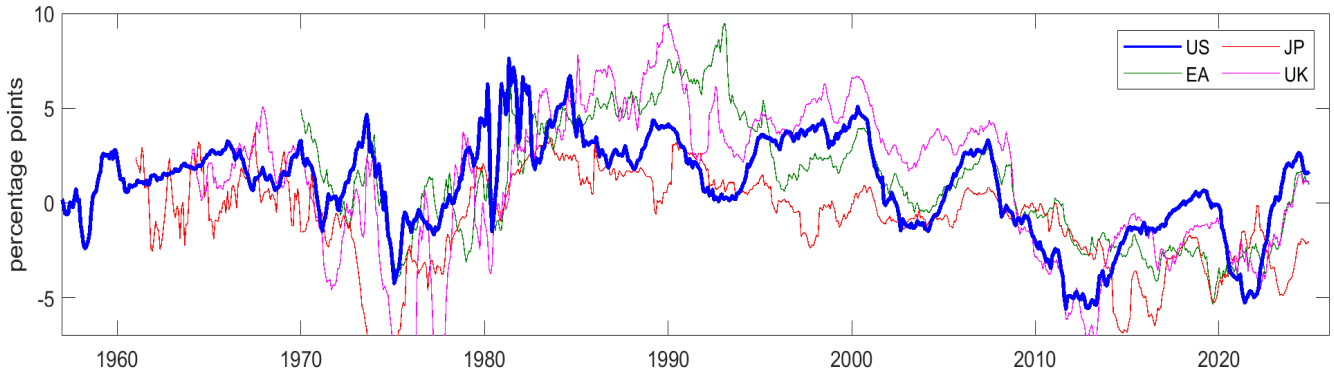
Reached levels lower than 1970-80s ...

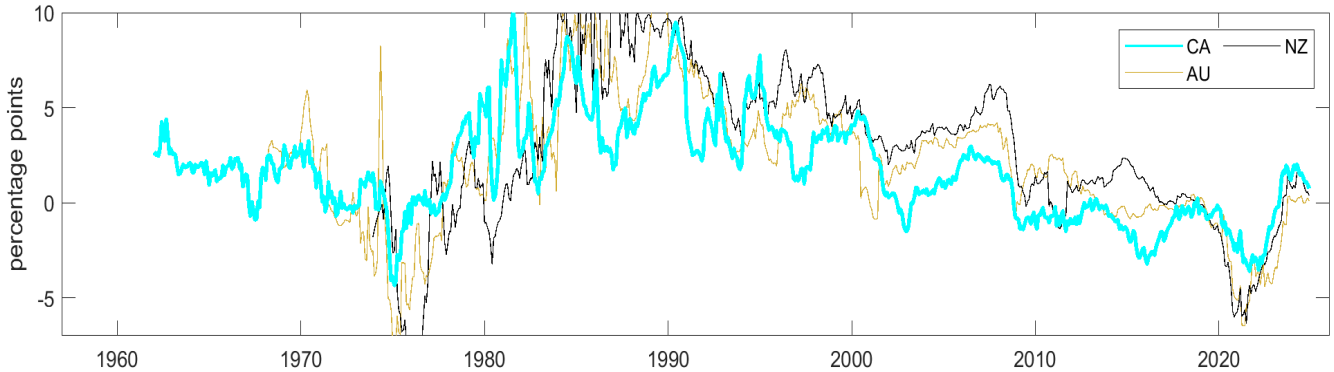


... albeit quick reversal with inflation decline & PIR hikes

Real 3m/SSR series very low for past 15 years

SSR estimates used from 1995 to account for UMP

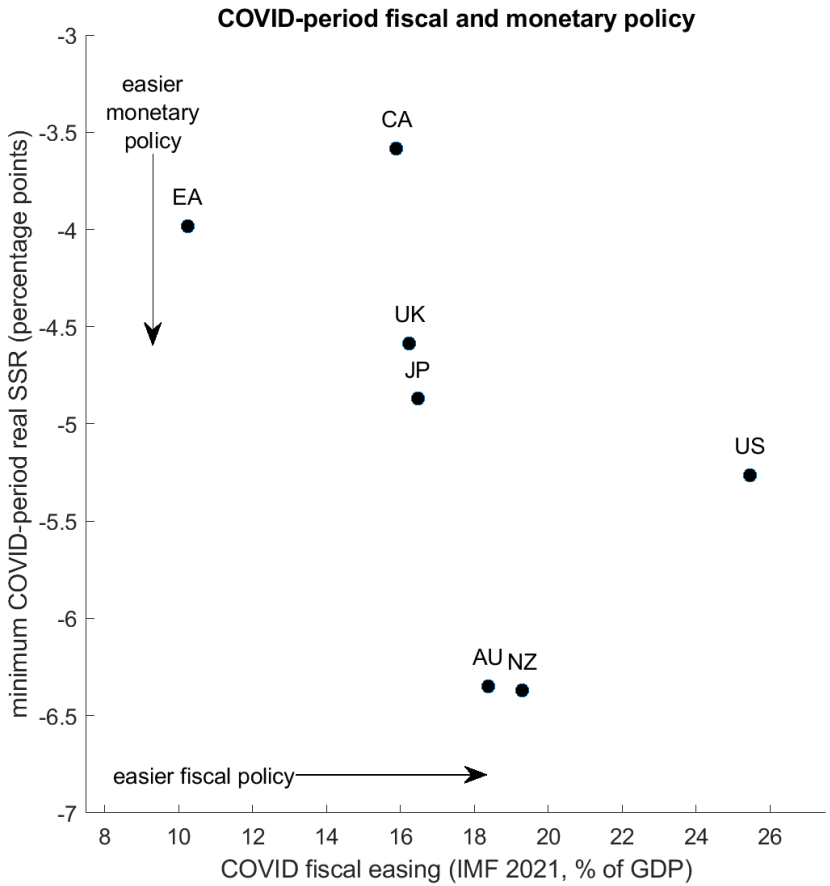




Note: doesn't account for changes in r^*/real neutral rates

Fiscal policy then: "a little help from my friends"

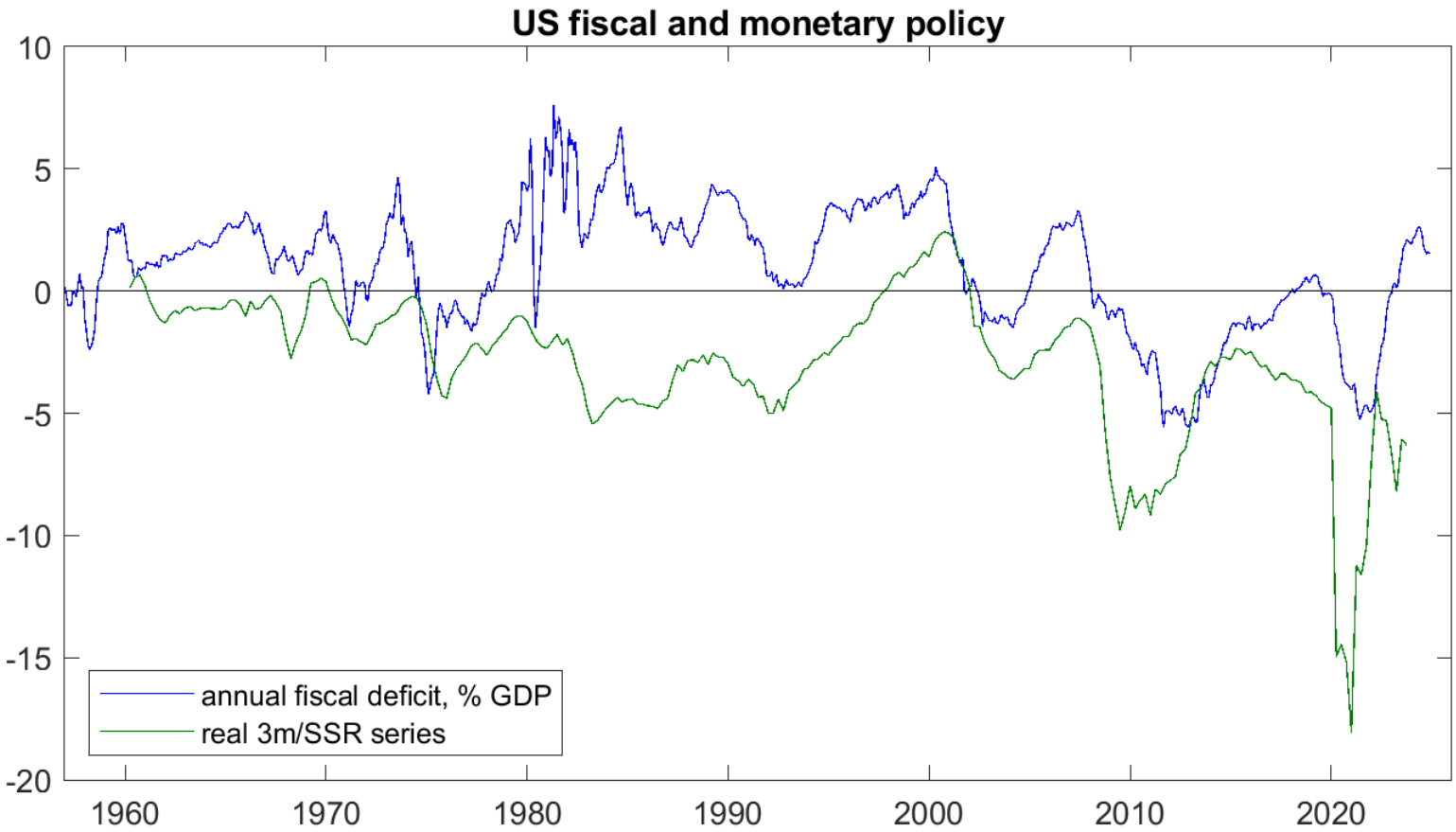
COVID fiscal policy was very stimulatory. Justifiable then ...



Note: fiscal data is from the IMF ("Fiscal Monitor: Database of Country Fiscal Measures in Response to the COVID-19 Pandemic") and is the additional spending and forgone revenue from Jan-2020 to Jun-2021

But now, "come together" would be more helpful

US fiscal policy remains easy, monetary policy restrictive



Anecdotally, same fiscal/monetary mix in other economies

3. Yield curve decompositions

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Decomposition of a bond yield

Bond yield for a given maturity contains two components:

- **EPIR**: Expected Policy Interest Rate component
- **BYRP**: Bond Yield Risk Premium component

EPIR reflects rolling investment in PIR path to bond maturity

BYRP reflects "**everything but EPIR**":

- fundamental risk/return characteristics of bonds
  - how bonds hedge consumption path under uncertainty
  - tangible proxy is diversification benefits from bonds within a portfolio, e.g. correlation of bond/equity returns
- non-fundamental but important non-EPIR influences, e.g.:
  - liquidity/safety benefits during financial market stress
  - effects of QE/QT, bond issuance trends
  - potential loss/recovery on default

Model-based estimates: recall GATSM outline

EPIR component comes from this part of GATSM:

- **state variables & $\mathsf{r}(t)$ under physical measure $\mathbb{P}$:**
- $\mathrm{d}x(t) = \kappa[x(t) - \theta]\mathrm{d}t + \sigma \mathrm{d}W(t)$
- solve for $\mathbb{E}_t^{\mathbb{P}}[\mathsf{r}(t+\tau)] = a_0 + b_0' \mathbb{E}_t^{\mathbb{P}}[x(t)]$

BYRP component comes from this part of GATSM:

- **Specify risk adjustment**: $\Pi(t) = \sigma^{-1}[\gamma + \Gamma x(t)]$

Combining the two parts above gives the yield curve:

- **state variables & $\mathsf{r}(t)$ under risk-adjusted measure $\mathbb{Q}$**
- $\mathrm{d}x(t) = \tilde{\kappa}\left[x(t) - \tilde{\theta}\right]\mathrm{d}t + \sigma \mathrm{d}\tilde{W}(t)$
- solve for $\mathbb{E}_t^{\mathbb{Q}}[\mathsf{r}(t+\tau)] = a_0 + b_0' \mathbb{E}_t^{\mathbb{Q}}[x(t)] = \mathsf{f}(t,\tau)$
- **interest rates**: $\mathsf{R}(t,\tau) = \frac{1}{\tau}\int_0^\tau \mathsf{f}(t,u)\mathrm{d}u$

But all within shadow/LB framework
to account for UMP/LB periods over sample

Main features of the model

	Journal	Survey data (1)	TV nom. r^* (2)	LB (3)	P Q UR (4)	Econ.
KT 2001	JME	-	✓	-	✓	-
KO 2005/12	JFQA	✓	·	·	·	US
KW 2005/??	?	✓	·	·	·	US
ACM 2011/13	JFE	·	·	·	·	US
CR 2012/12	EJ	·	·	·	·	US
K 2017/–	[LSWIP]	✓	✓	✓	✓	G4/db
BR 2017/20	AER	·	✓	·/✓	·	US
KP 2020/23	JFQA	✓	·	✓	·	US

(1) survey information used for $\mathbb{P}$-measure

(2) time-varying nominal natural rate ("shifting endpoints")

(3) allows for lower-bound constraint

(4) unit roots under $\mathbb{P}$ and $\mathbb{Q}$ allows persistent risk premiums

And I use yield curve data to 30-y maturity; others to 10-y

From shadow/LB model estimation

R data, observed yield curve, is composed of:

- **EPIR**: Expected Policy Interest Rate component
- **BYRP**: Bond Yield Risk Premium component
- negligible residuals, i.e. **R model** $\simeq$ **R data**, so ...

$$\textbf{R model/data} = \textbf{EPIR} + \textbf{BYRP}$$

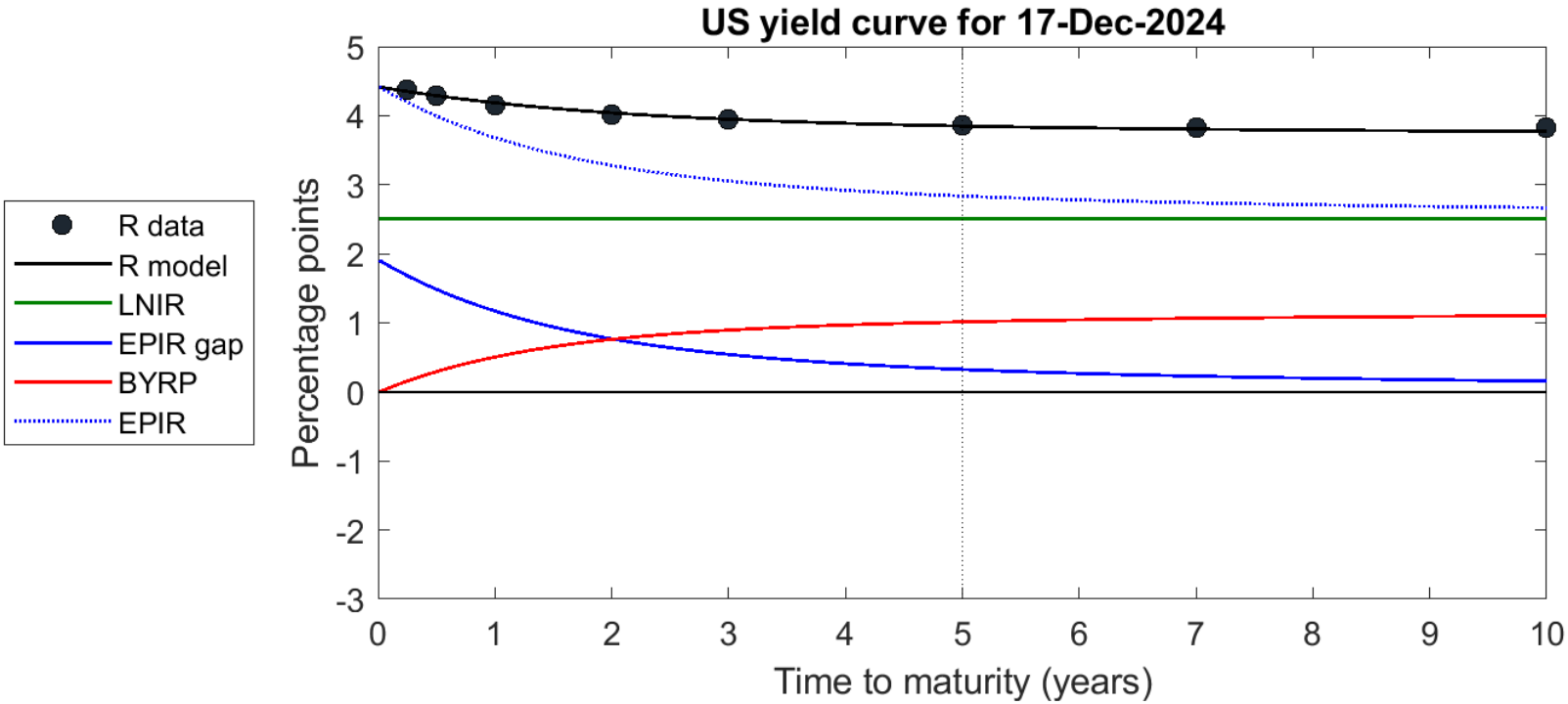
Estimation includes survey data specific to EPIR:

- expectations of 3-month & 10-year rate for range of horizons
- expectations of long-horizon GDP growth and inflation
  - long-horizon nominal GDP growth is a proxy for steady state PIR, i.e. nominal natural interest rate
  - **LNIR**: Long-horizon Natural Interest Rate (nominal)

Useful to use **EPIR gap** = **EPIR** – **LNIR**, so:

$$\textbf{R model/data} = \textbf{LNIR} + \textbf{EPIR gap} + \textbf{BYRP}$$

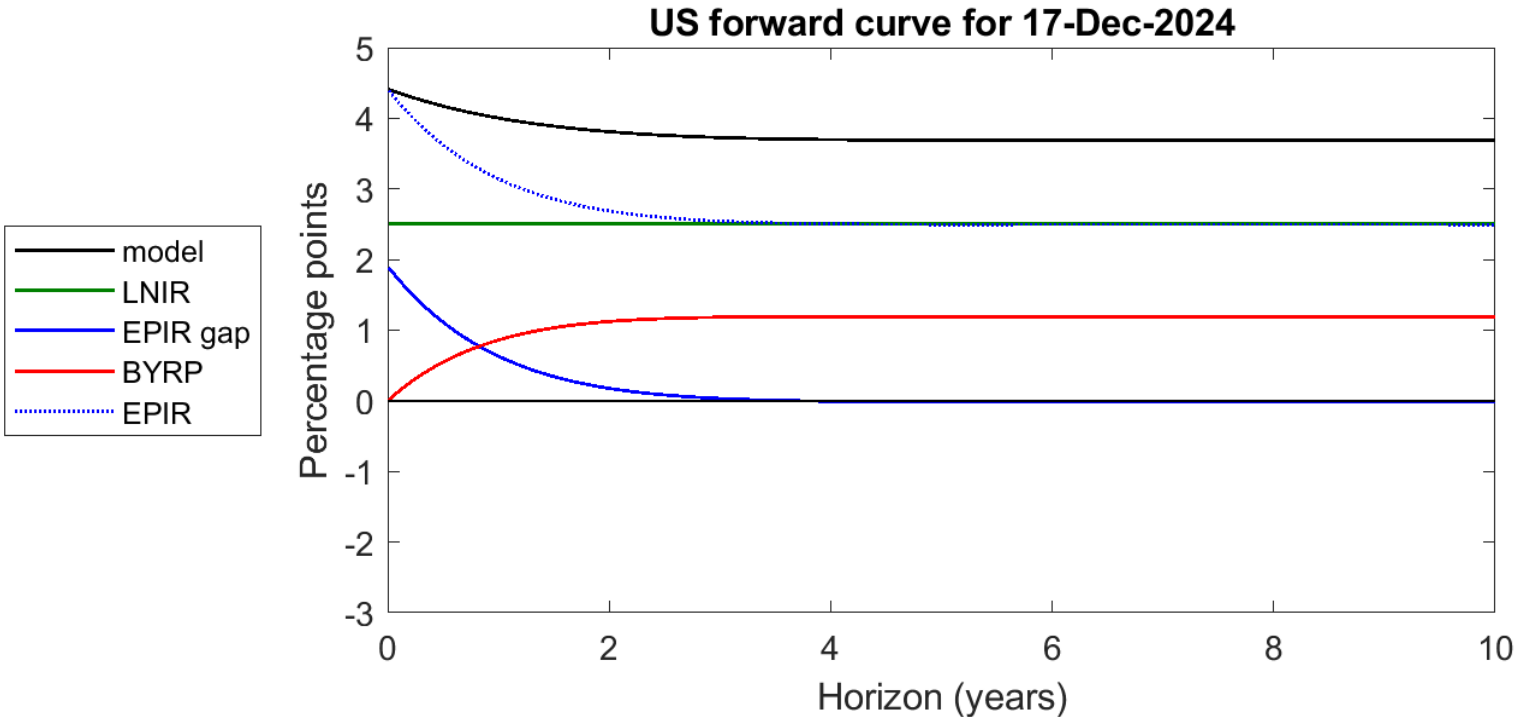
Most recent yield curve decomposition for US



Yield curve perspective for EPIR gives mean of path to each maturity

Forward rate perspective gives the path itself

Forward rate curve for the yield curve decomposition



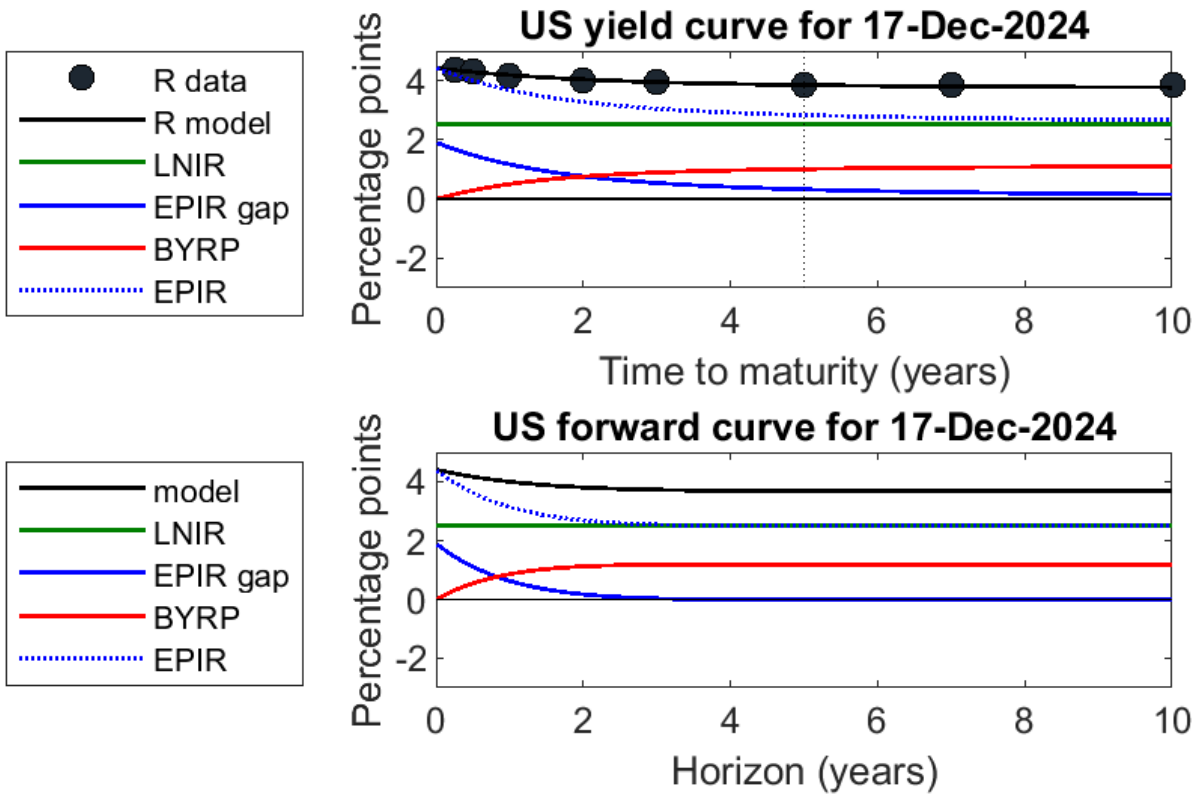
EPIR $>$ **LNIR**: **+ve EPIR gap, with expected decline**

$\Rightarrow$ **restrictive monetary policy stance, with gradual easing**

+ve risk premium component (QT)

$\Rightarrow$ longer-maturity yields $>$ mean of expected PIR path

Same figures on single slide ...



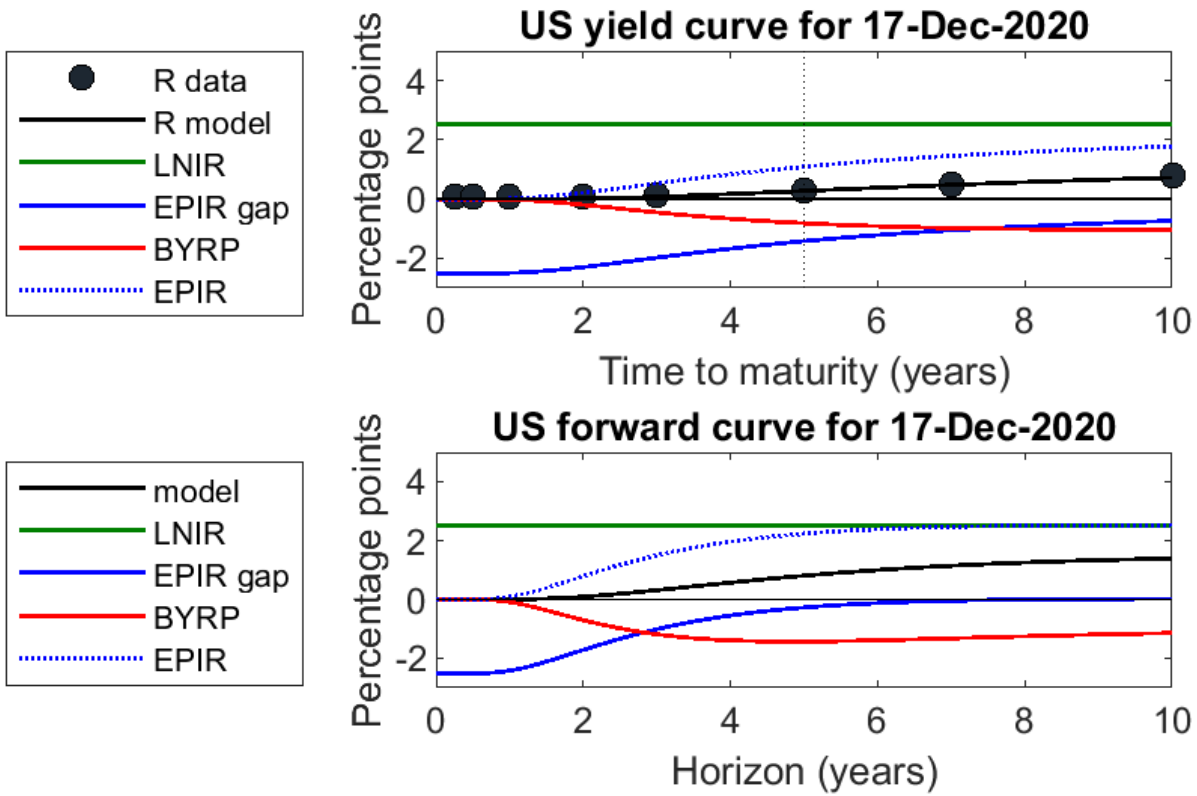
EPIR $>$ **LNIR**: **+ve EPIR gap, with expected decline**

$\Rightarrow$ restrictive monetary policy stance, with gradual easing

+ve risk premium component (QT)

$\Rightarrow$ longer-maturity yields $>$ average of expected PIR path

... to compare to results four years earlier



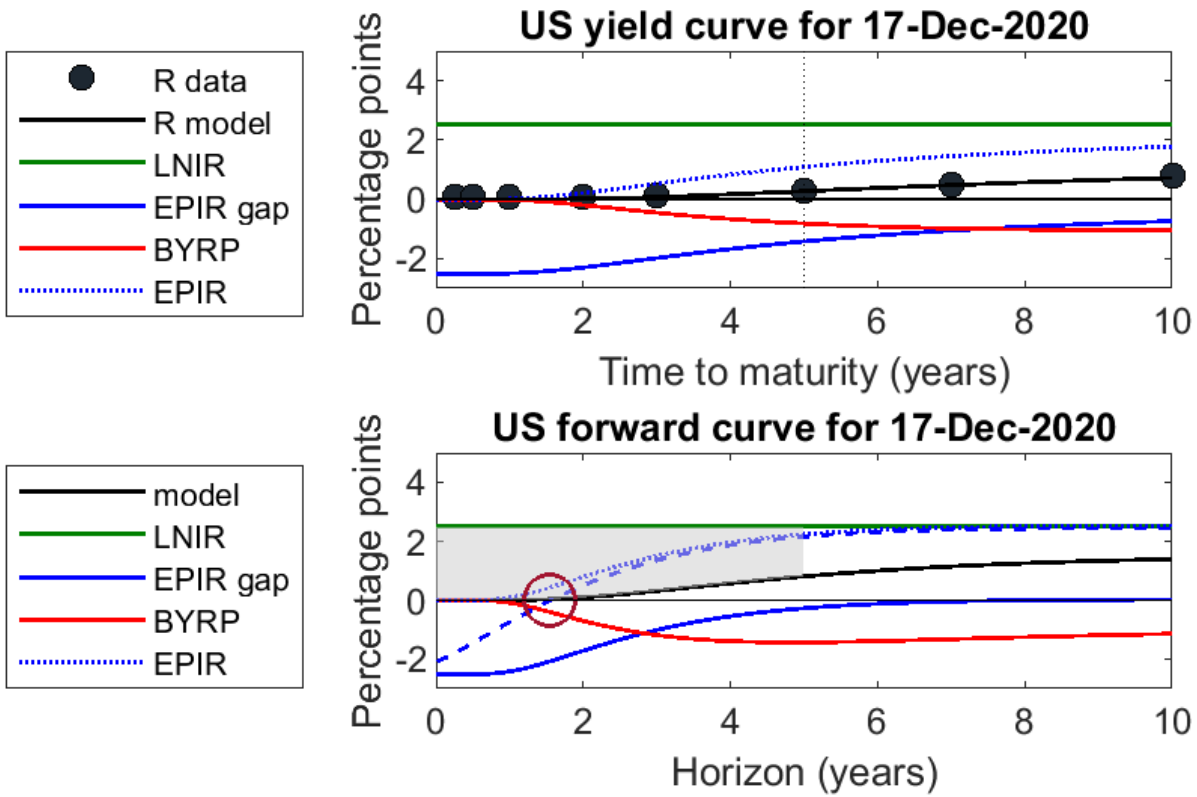
EPIR $<$ **LNIR**: **–ve EPIR gap, with expected increase**

$\Rightarrow$ stimulatory monetary policy stance, with eventual tightening

–ve risk premium component (QE)

$\Rightarrow$ longer-maturity yields $<$ average of expected PIR path

And here's the ETL & EMS introduced previously



EPIR $<$ **LNIR**: **–ve EPIR gap, with expected increase**

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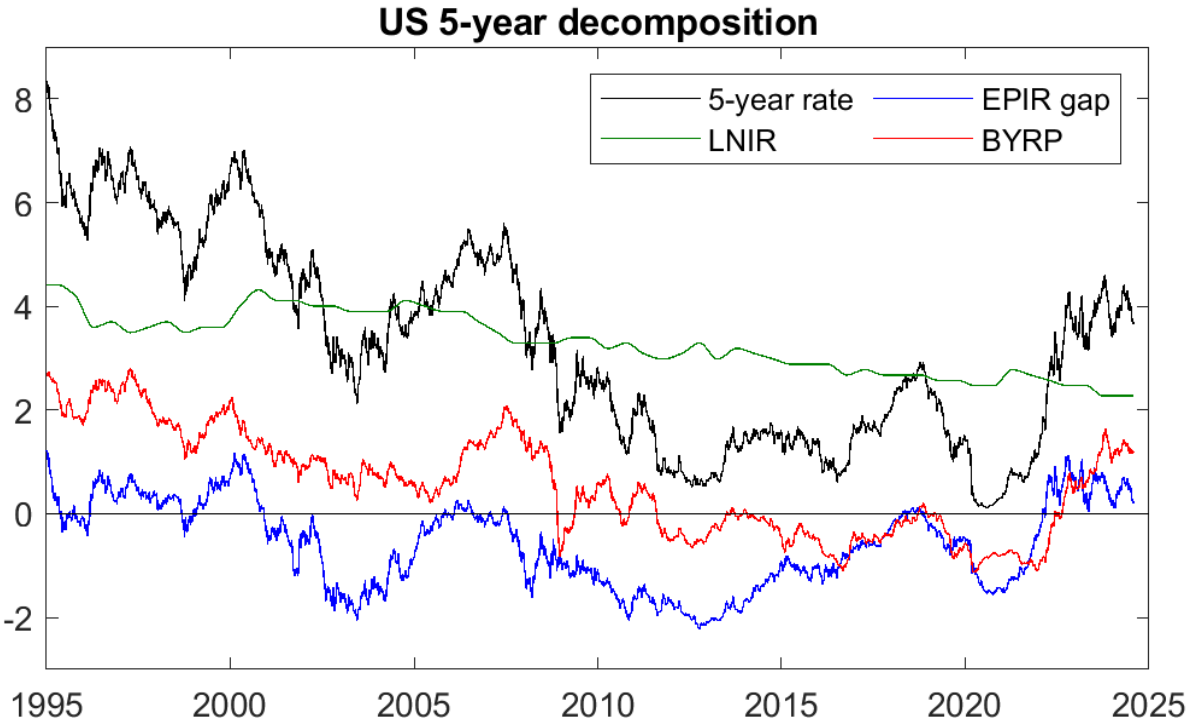
$\Rightarrow$ longer-maturity yields $<$ average of expected PIR path

Time series of 5-year yield decomposition for US

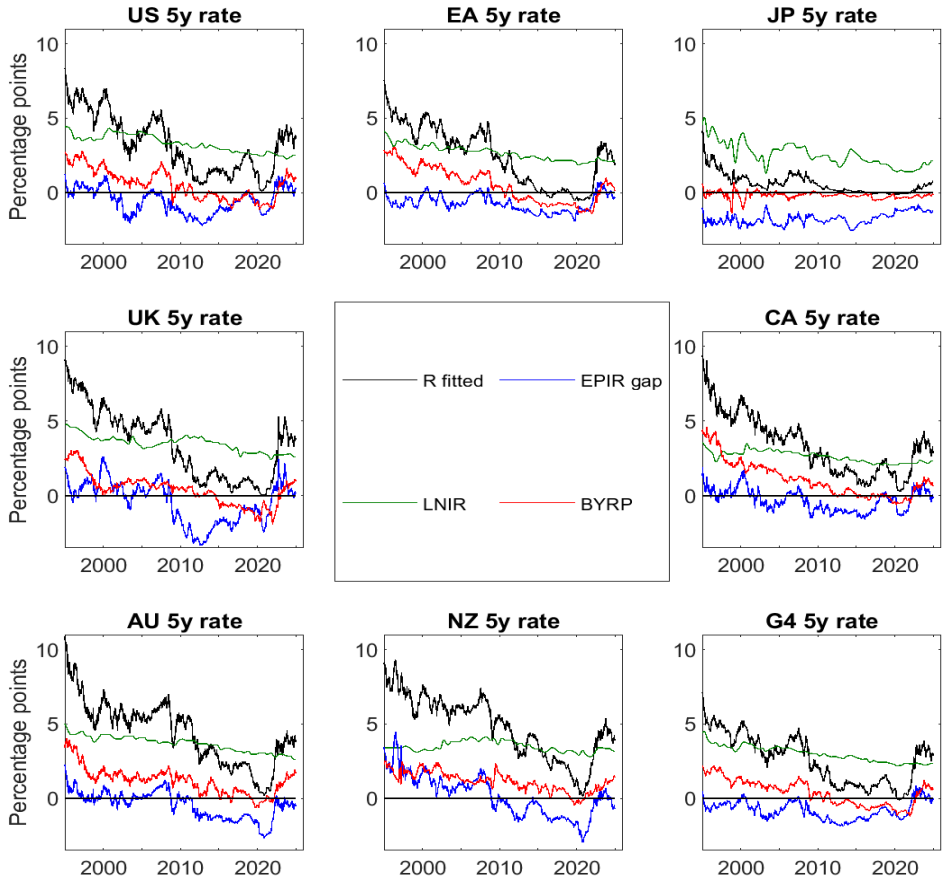


LNIR: mild decline over time, mainly $\mathbb{E}(Y)$ & $\mathbb{E}(\pi)$

EPIR gap: mainly stimulatory monetary policy since GFC

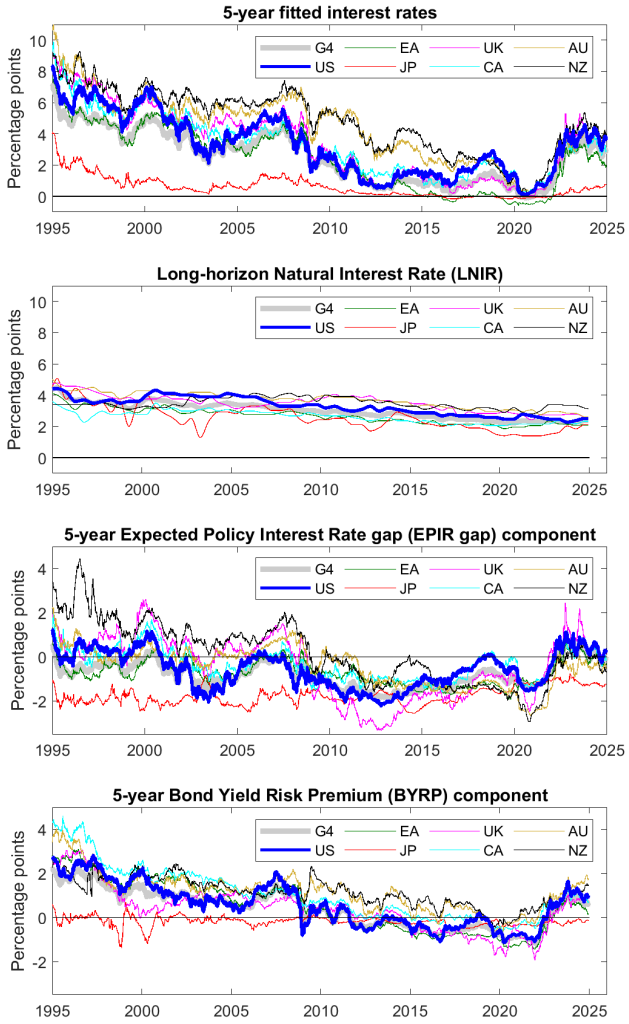
risk premium: large decline over time, mainly π risk & QE since GFC, then material reversal

Yield curve decomposition results by economy



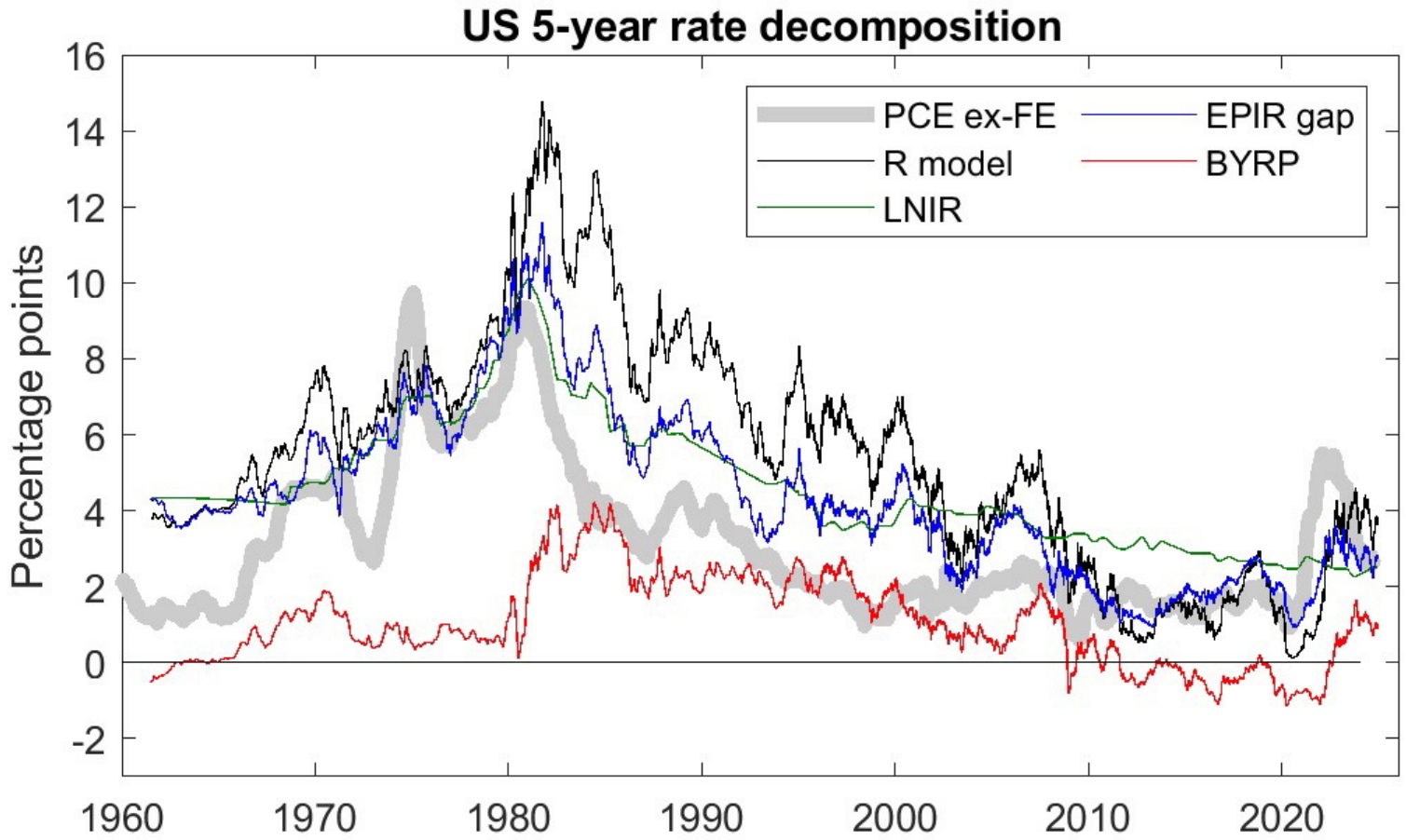
all have similar themes to US, except Japan

Yield curve decomposition results by category



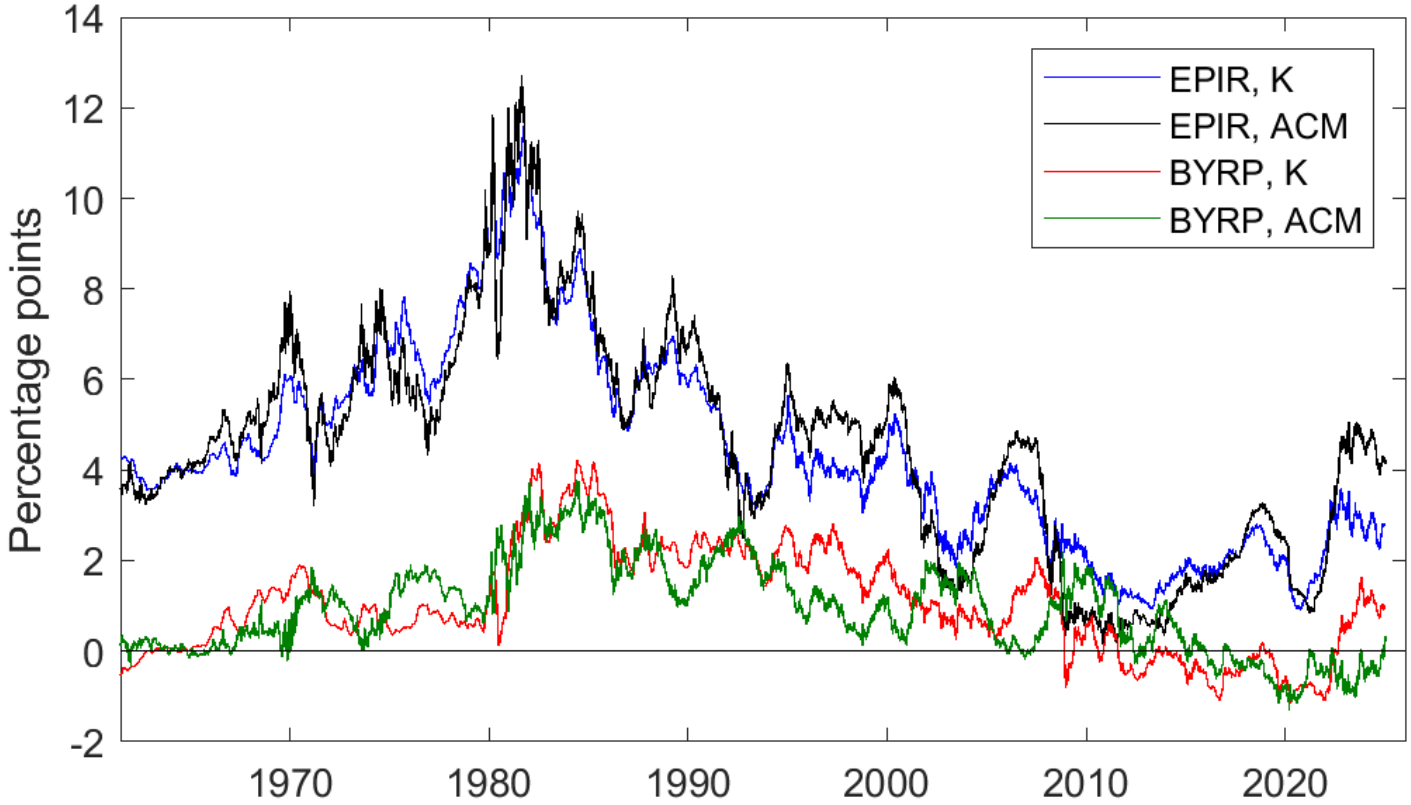
exceptions for Japan very evident in each category

Long-term US 5-year yield decomposition



This perspective shows trends/cycles in 5-year rates & the components

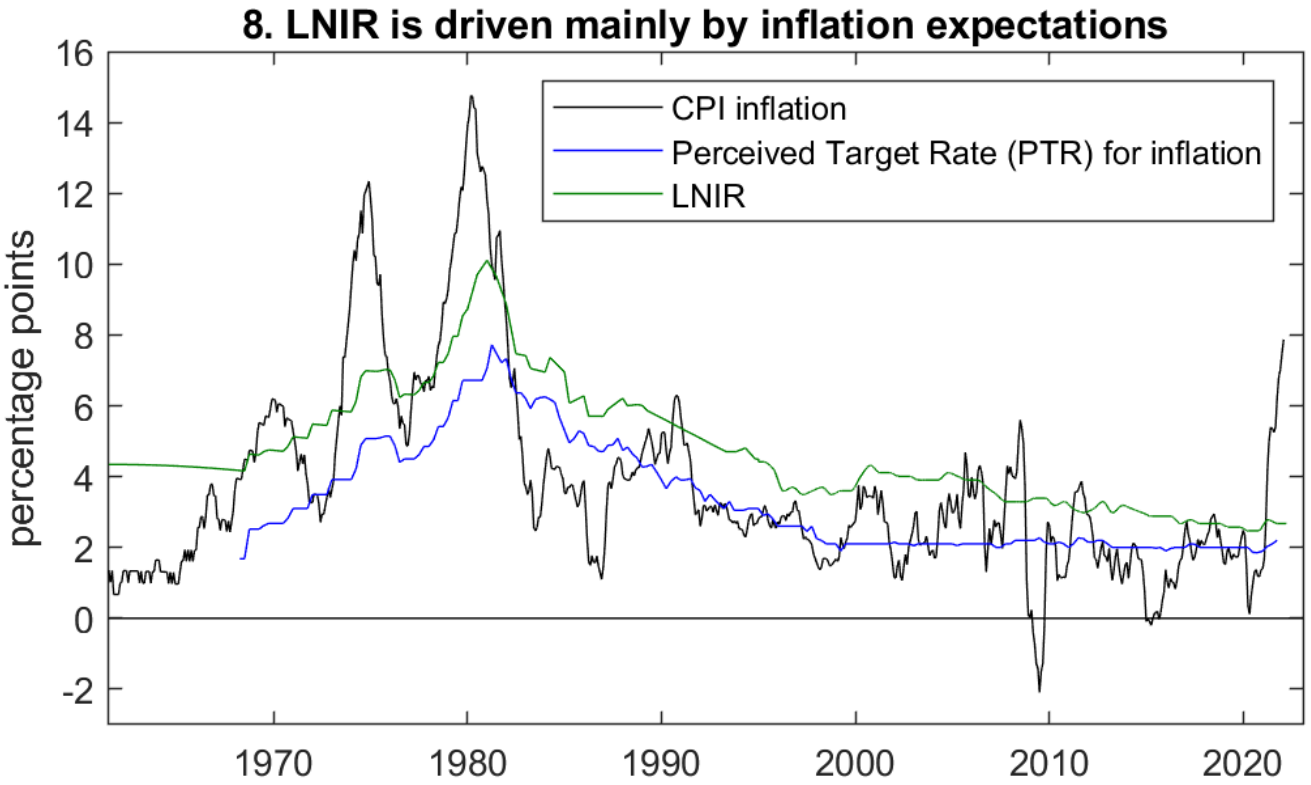
Results relative to ACM



Some distinct differences, more so from 1990 & quite wide recently (ACM EPIR higher & BYRP lower)

But long-term evolutions broadly similar

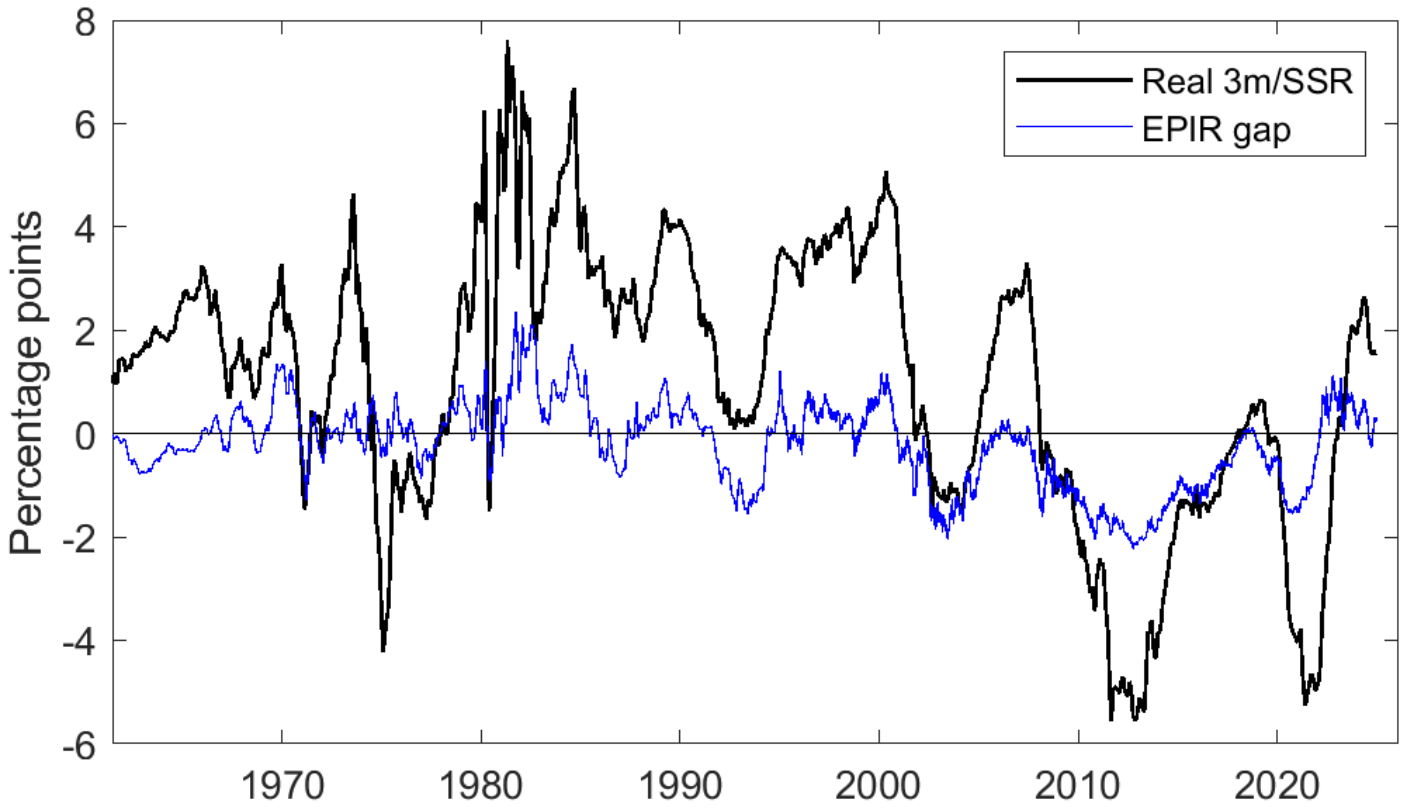
LNIR: Long Horizon (Nominal) Natural Interest Rate



PTR is FRB/US data, then long-horizon survey data

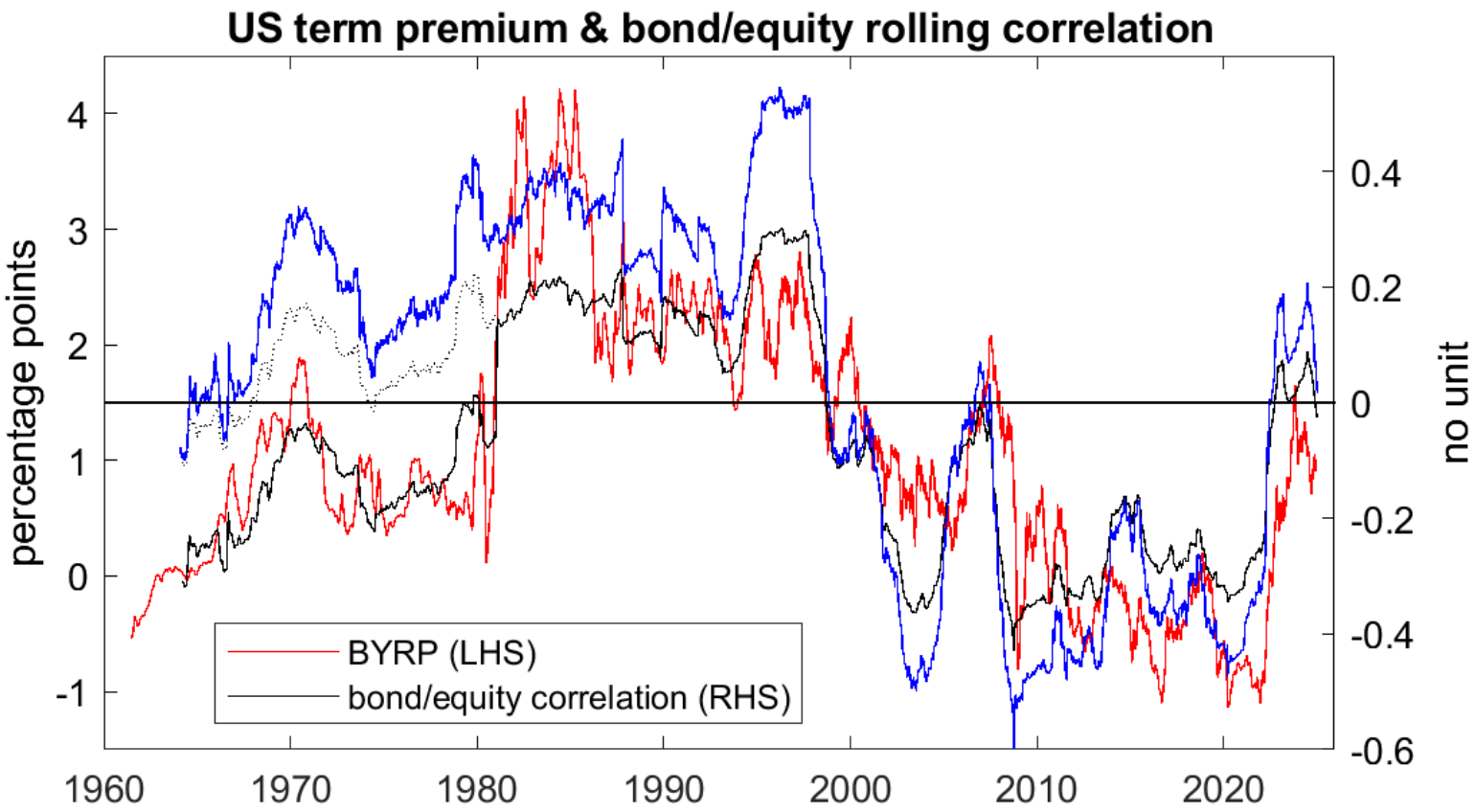
Real r^* is gap between LNIR & $\mathbb{E}(\pi)$. Based on historic GDP trends & long-horizon GDP survey data. Similar to HLW & LW, within their confidence intervals

EPIR gap very low for past 20 years



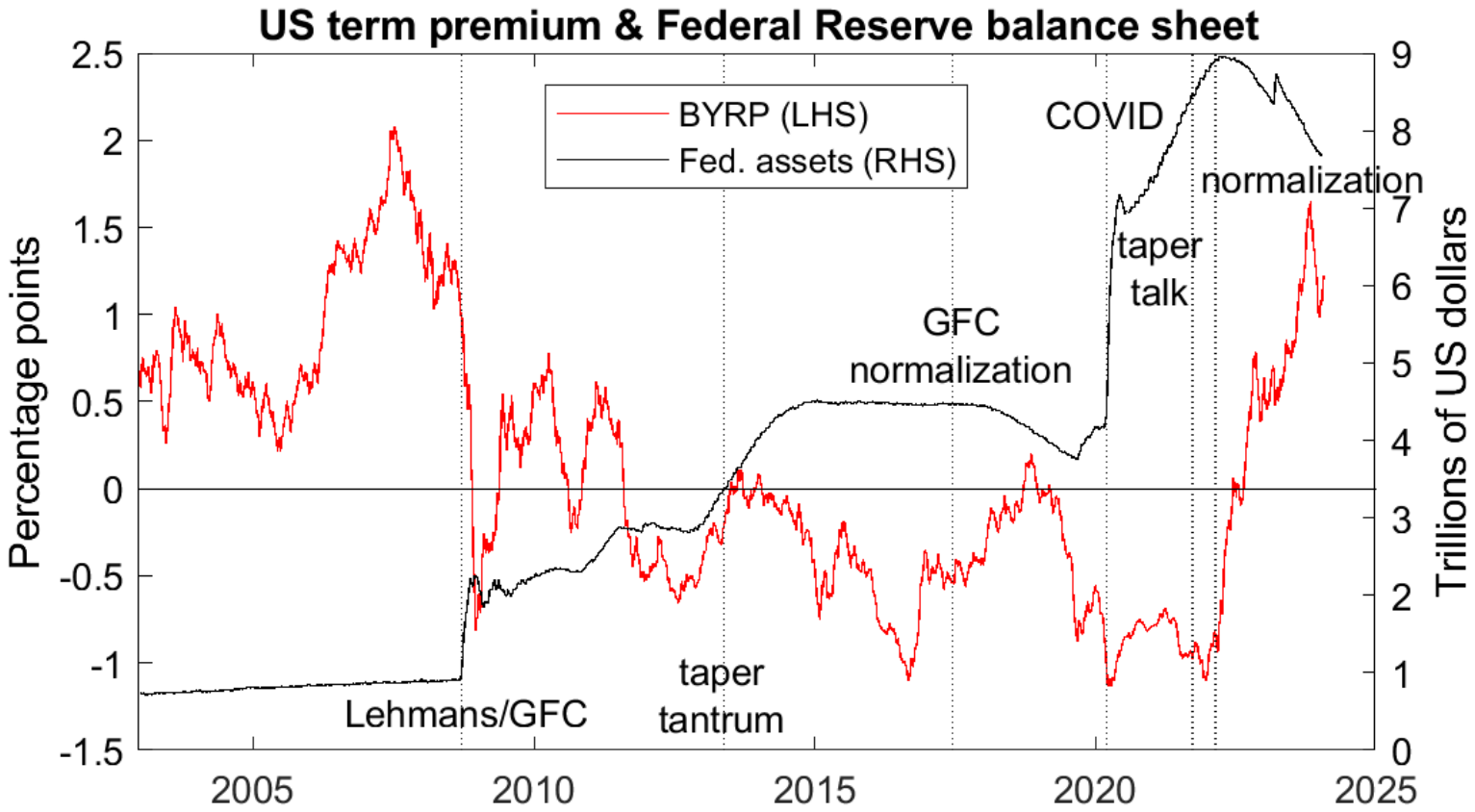
5-year EPIR gap is average expected PIR over following five years, **relative to LNIR**. So changes in both r^* & inflation regimes now accounted for (unlike real 3-m/SSR). **Early 2000s cycle now another unprecendented low with lower subsequent peak**

Bond/equity correlation influence for risk premium



BYRP is lower/–ve (i.e. bond prices higher)
when bonds offer better diversification for equities
BYRP higher/+ve when poor diversifier (e.g. inflation risk)

Central bank & safety/liquidity influences



Marked safety/liquidity declines at onset of GFC & COVID

Link to central bank balance sheet also apparent:

broadly, BYRP declines/increases with QE/QT

Current influences imply elevated/rising BYRP

Fundamental risk/return characteristics of bonds

- **bond/equity correlation elevated**

Non-fundamental influences:

- liquidity/safety benefits during financial market stress
  - not currently in effect
- effects of QE/QT, bond issuance trends
  - **QT ongoing in US and most other CBs**
  - **government bond issuance is high given fiscal deficits**
- potential loss/recovery on default
  - never say never !!

Risk premiums will likely contribute to restrictive monetary conditions, or offset accommodative monetary conditions

4. Conclusion

Then: unprecedented monetary policy stimulus from conventional & unconventional actions over past 20 years

- based on real series of 3-month interest rates/Policy Interest Rates augmented with Shadow Short Rate to approximately account for Global Financial Crisis/Great Recession and COVID Unconventional Monetary Policy periods
- **and yield curve decompositions**:
  - expected policy rate paths relative to survey-based proxies for the natural rate have been in ballpark lower than the prior sample period from around 1950/60s
  - likewise for risk premiums: mainly negative over past 20 years

Now: **current monetary policy is restrictive** (**moderately**)

- open question if/when current settings will bring inflation back to targets
- elevated/rising risk premium will likely contribute to tighter monetary conditions