Rethinking Short-Term Real Interest Rates and Term Spreads using very Long-Run Data.

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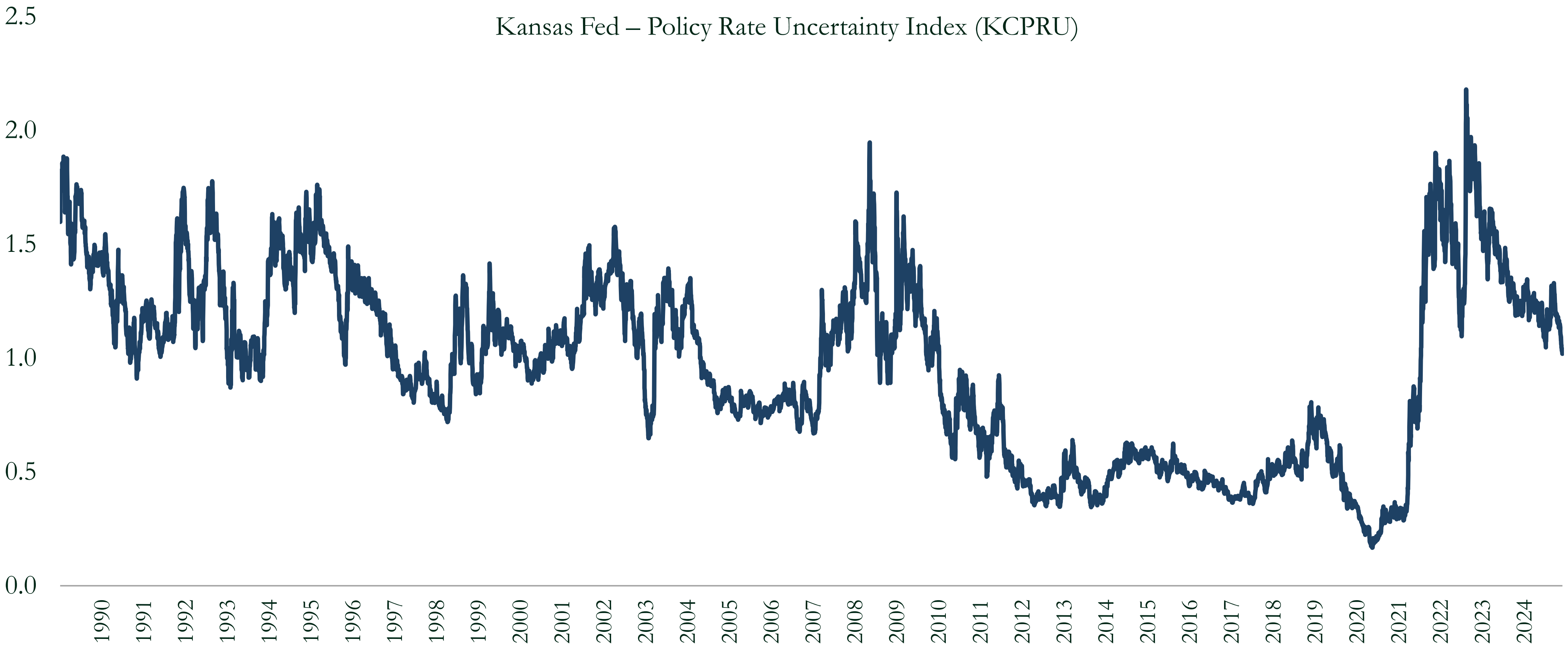
Motivation: R* and the "end of an era" (Sintra 2022)?

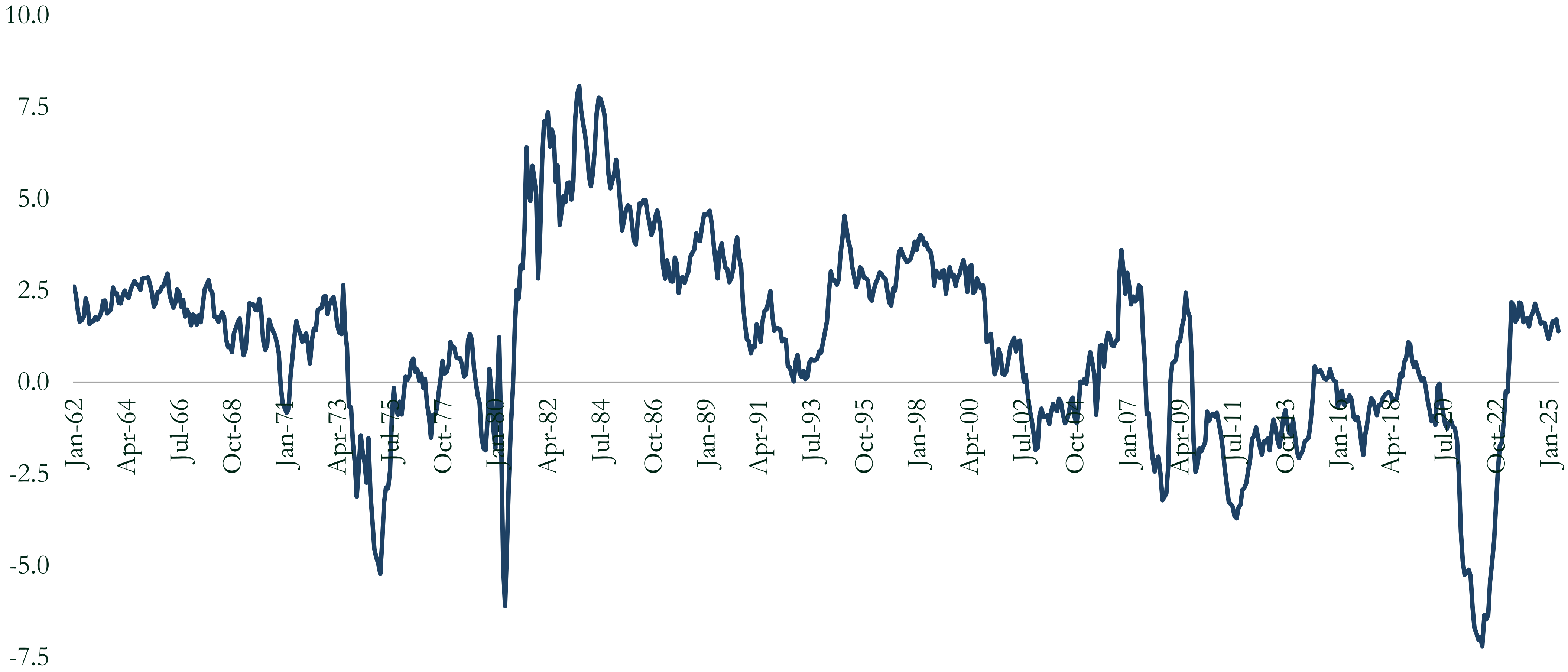
- Policy rate uncertainty is historically elevated post-COVID – what is the forward path of short-maturity interest rates?
- Are we amid early innings of a "new era" in policy rates (Lagarde at Sintra 2022)?



Notes: daily U.S. policy rate uncertainty index (KCPRU), via Kansas Fed and Bundick et al. (2024), as of July 15, 2025.

MOTIVATION: "END OF AN ERA" (SINTRA 2022)?

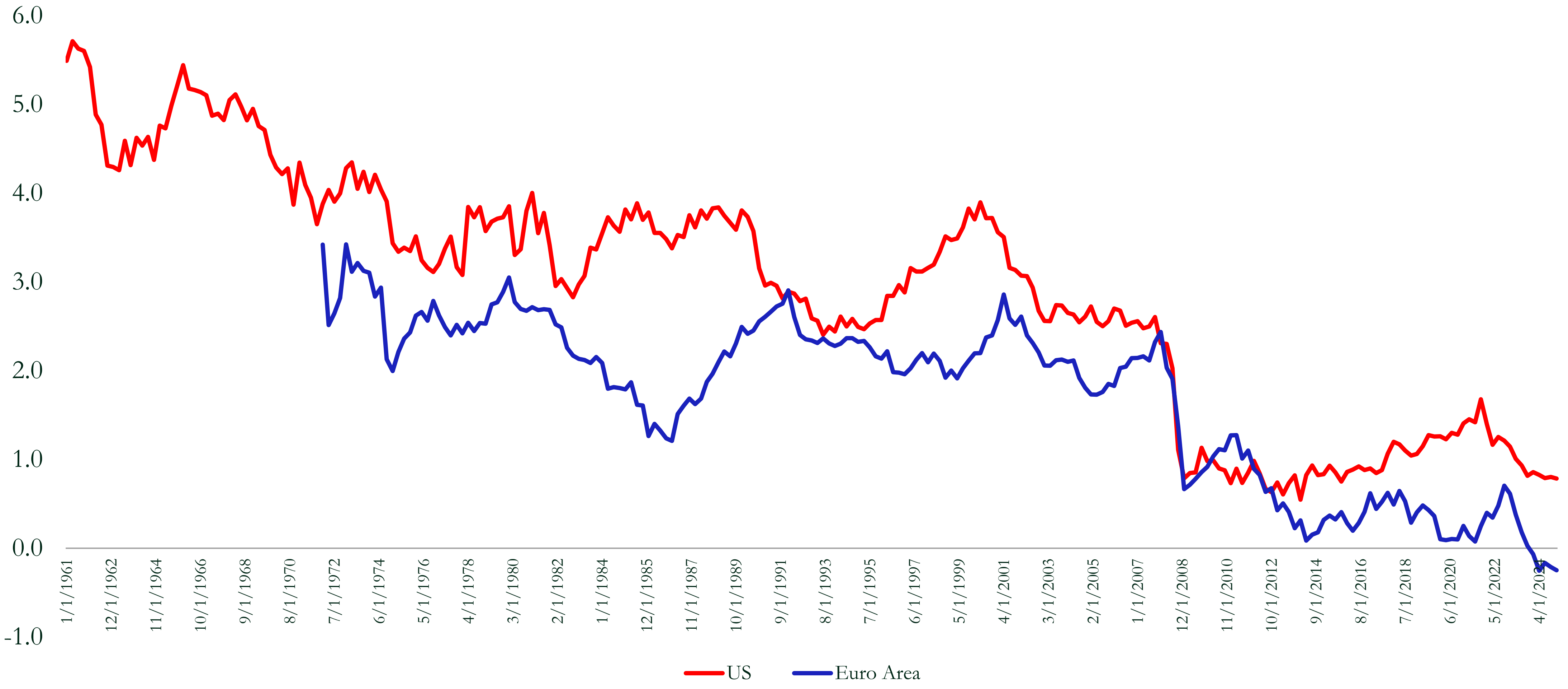
- Models of real rates and terms spreads highly influential for ongoing fiscal/monetary debates – but they abstract from post-1945 short-rate patterns.
- Typically, underlying literature assumes unit root or random walk behavior of policy / short-maturity rates, including HLW models.



Notes: U.S. real 1-year rate, constructed by taking 1-year nominal Treasury bill rate time *t*, adjusted by realized monthly y-o-y CPI at month *t*. Data via BLS and FRED.

MOTIVATION: "END OF AN ERA" (SINTRA 2022)?

- Models of "neutral rates" remain highly influential for monetary policy debates – but they abstract from post-1945 short-rate patterns.
- Typically, underlying literature assumes unit root or random walk behavior of policy / short-maturity rates, including HLW models.



Notes: U.S. and Euro Area "neutral rates" (r*) as defined by Holston-Laubach-Williams (2023), as of 1Q:2025. Retrieved July 2025 via FRBNY.

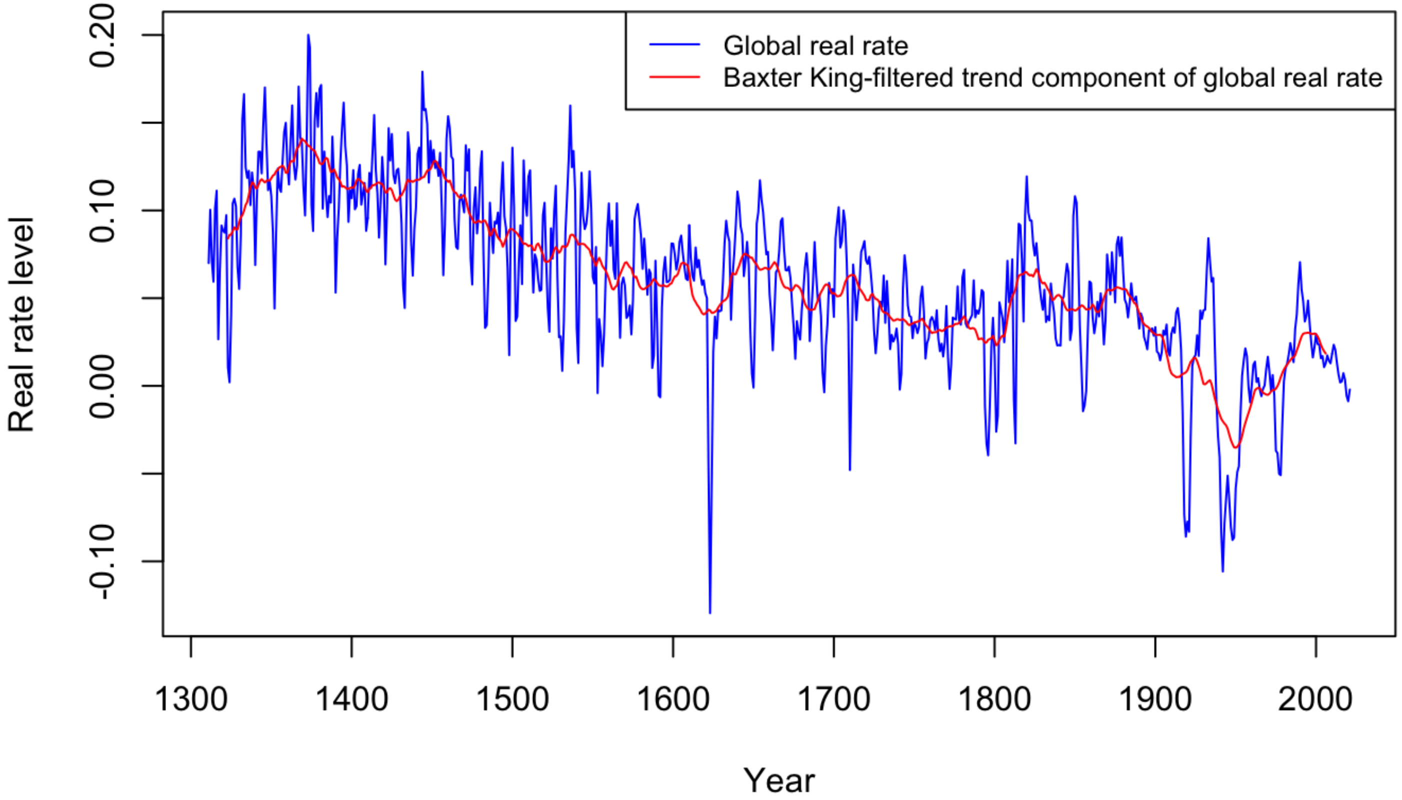
Approach, results

- In Rogoff Rossi and Schmelzing (2024), and Rogoff, Rossi, and Schmelzing (2025), we…
  - Construct a conceptually consistent, high-frequency (quarterly) short-maturity real rate and term spread dataset tracing leading economies over centuries (public or private).
  - Revisit real rate properties given significant data advances, fuse ST-LT data, exploit far greater statistical power.
  - Assess critically previous short-sample (1870-), short-maturity literature (Hamilton et al. 2016; JST 2020).
  - Ask if real rates / term spreads feature a unit root over the long-run. When did structural breaks occur? Are recent shocks permanent?
  - Assess global term spreads vs. rare disaster trends over time. Highlight apparent macro/public finance contradictions.

- …and find
  - Global short-maturity real rates are clearly trend stationary – which resolves important contradictions in literature.
  - Results survive out-of-sample tests – though we take NO particular stance on term structure or r* models.
  - Remarkable absence of structural breaks using conventional (open ended and alternative) tests.
  - Real rate shocks (2008, 2020) appear temporary, not secular.
  - Negative relationship of term spread trends (upwards sloping) and inflation volatility (downwards sloping).
    - Short-maturity debt in fact may not represent the historically "safe debt", or evidence of rising default risk expectations.

TREND COMPONENT GLOBAL REAL RATES.

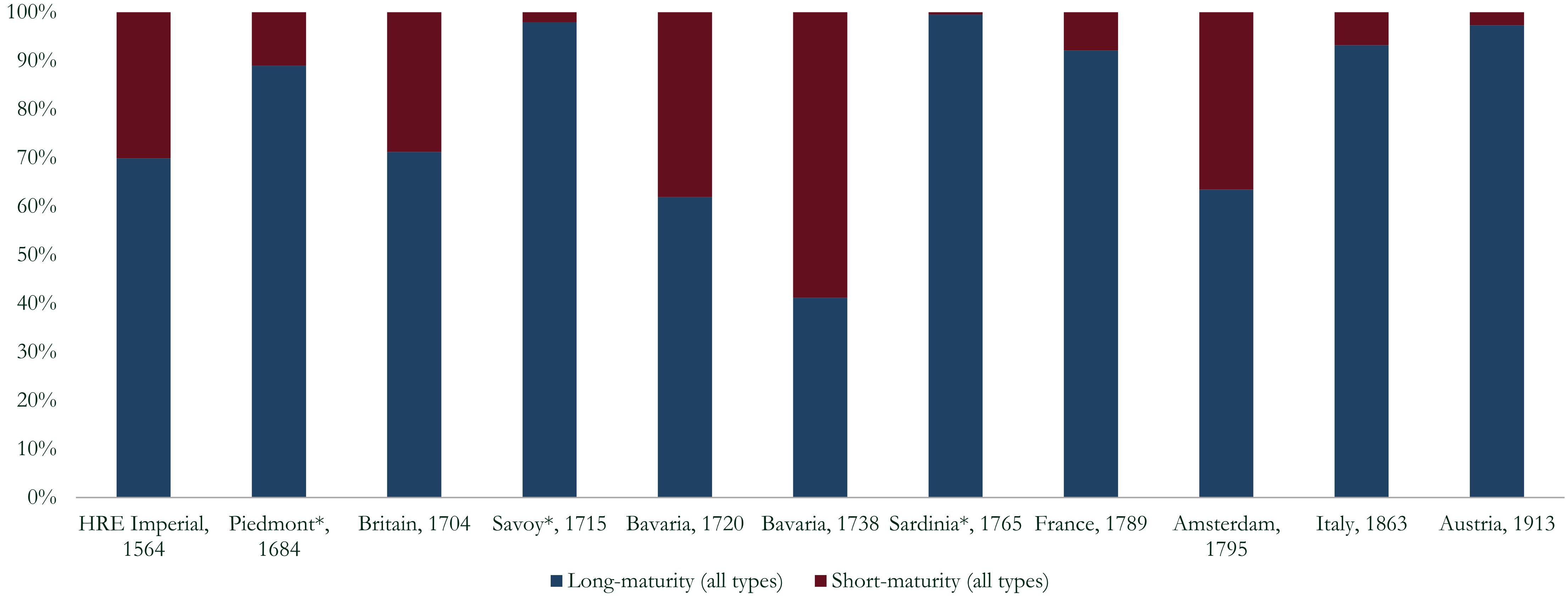
- Rogoff, Rossi, Schmelzing (2024) demonstrated trend stationarity in global long-maturity rates, 1311-2022, on basis of Schmelzing (2026).
- Long-maturity debt constitutes the "original" sovereign debt – but raises questions on short-maturity dynamics, policy rates, r* of past 150 years.
- Term structure dynamics are not conclusive about implications across maturities regarding econometric properties (e.g. historical "preferred habitats").



Notes: Figure displays "Global GW basis" (blue), weighting the eight country series according to their respective rolling GDP shares over time. These GDP shares are obtained using the consistent definitions of population and per capita real GDP figures in Maddison (2010): the sum of the eight country-level aggregate GDP figures (population x per capita GDP, for each country, linearly interpolating between Maddison's benchmark years) represents the "global GDP" figure, with the U.S. and Japan entering the sample in 1790 and 1870, respectively. Red line displays Baxter King-filtered version of global GW real rate series, with Baxter and King's bandpass filtered long-run component of the global real rate, together with its 95 percent coverage confidence interval (CI). The bandpass filter is tailored to retain fluctuations larger than 100 years. The t-statistic is obtained using Newey and West (1987) standard errors with a maximum of 4 lags..

Why short-maturity? Early sovereign debt equals long-maturity sovereign debt.

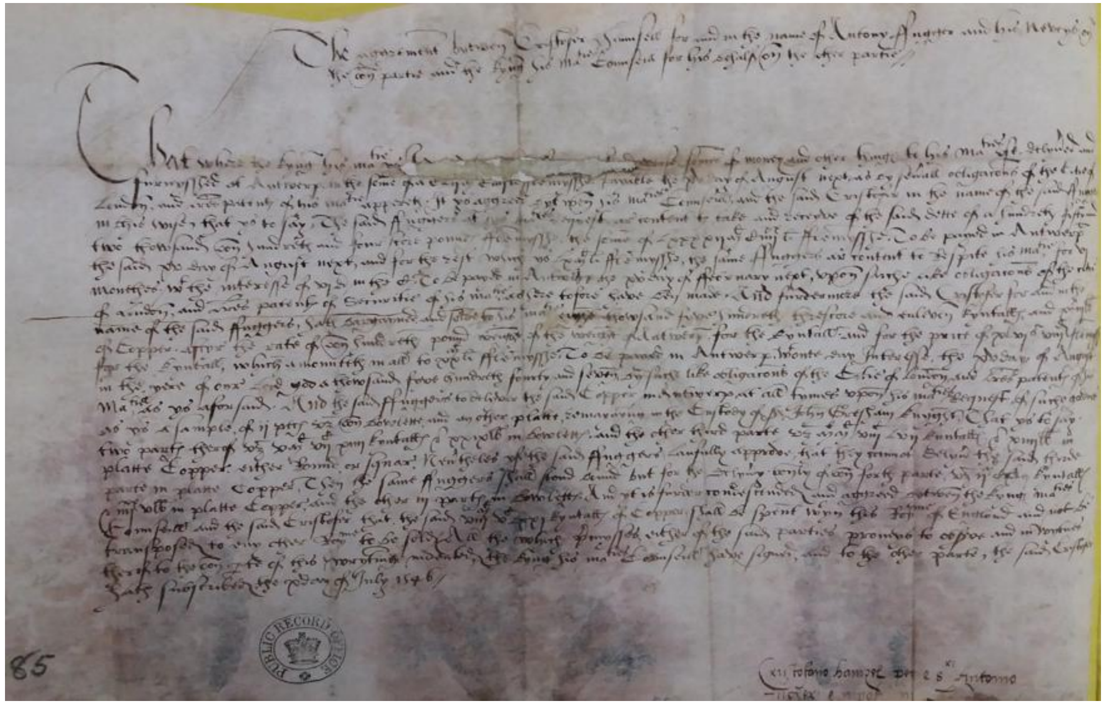
- U.S. typical in beginning regular bills issuance only by 1929. U.K. 1877 "Treasury Bills Act" (issuance: WWI).



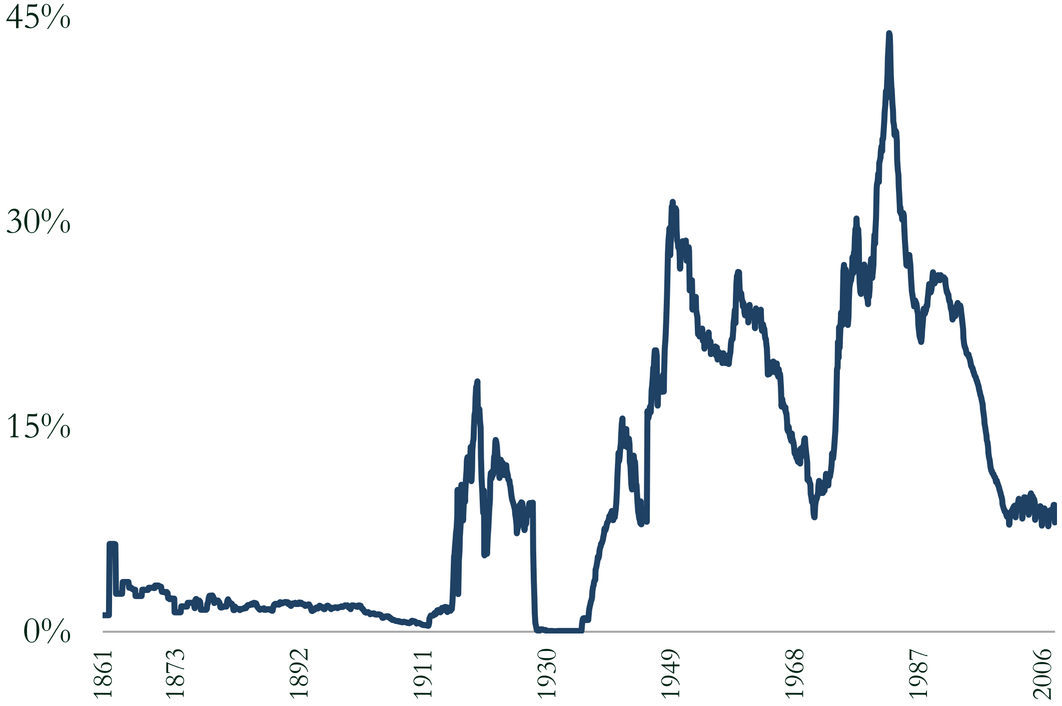
Notes: via Schmelzing (2026); basis is both consolidated and unconsolidated central government debt stock in respective polities, including personal loans where applicable. Sources include Necco (1915), Dickson (1967) and Dimsdale and Thomas (2016) for U.K. 1706, Legay (2011) for France 1789 (here excluding offices), Fritschy (2003) for Amsterdam 1795, Schmelzle (1900) for Bavaria, Huber (1893) for Ferdinand I.'s HRE debts in 1564, and Patzauer (1916) for Austria 1913.

NEW DATA – SECONDARY VOLUNTARY ST RATES.

- Historically, short-maturity sovereign debt is OTC – not least given usury laws. Analogues are Spanish Asientos, U.S. *Certificates of Indebtedness*, U.K. *Exchequer Bills*.
- U.S. typical in regular bills issuance only by 1929. U.K. 1877 “Treasury Bills Act” (issuance: WWI). DM ST issuance may have peaked late 1980s.

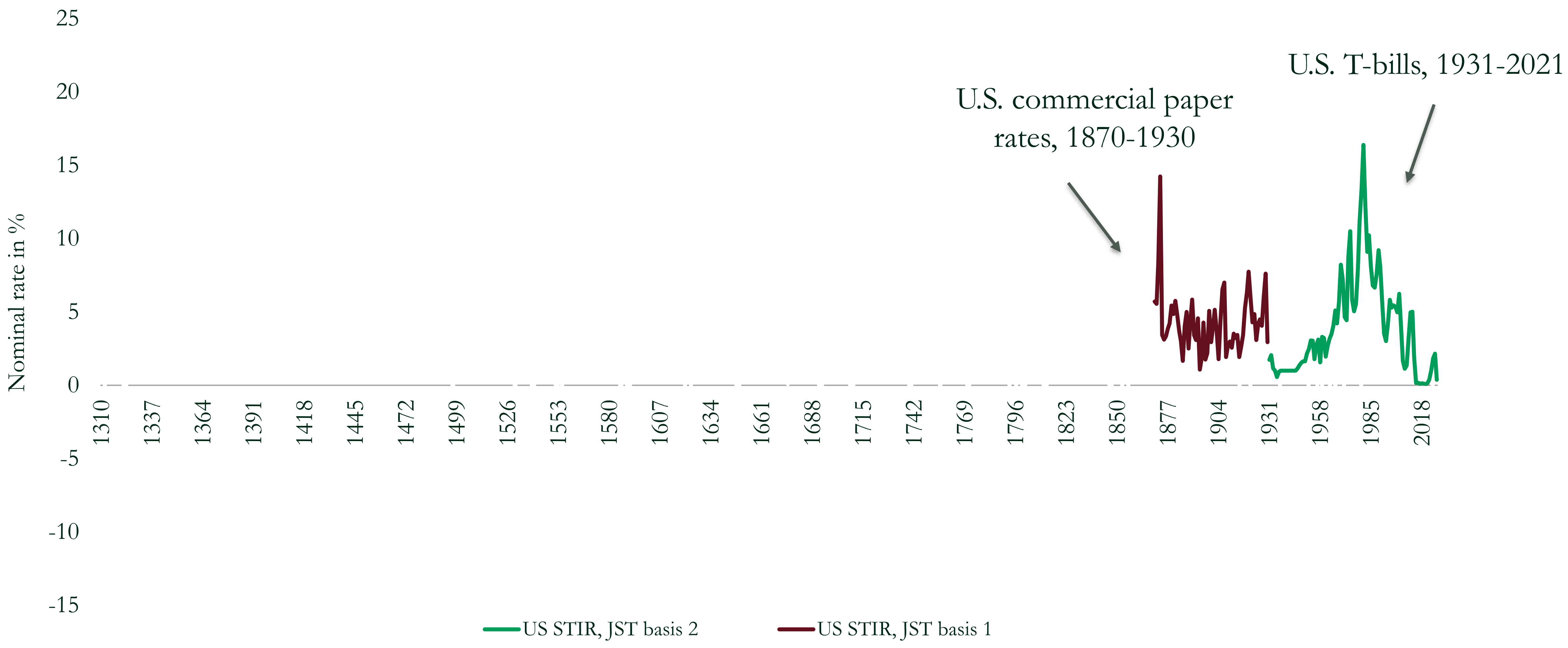


Short-maturity OTC contract, English Crown-Fugger, July 1546.
Source: TNA, E101/601.



Share of short-maturity debt in Italian public debt, 1861-2007
Source: Francese and Pace (2008).

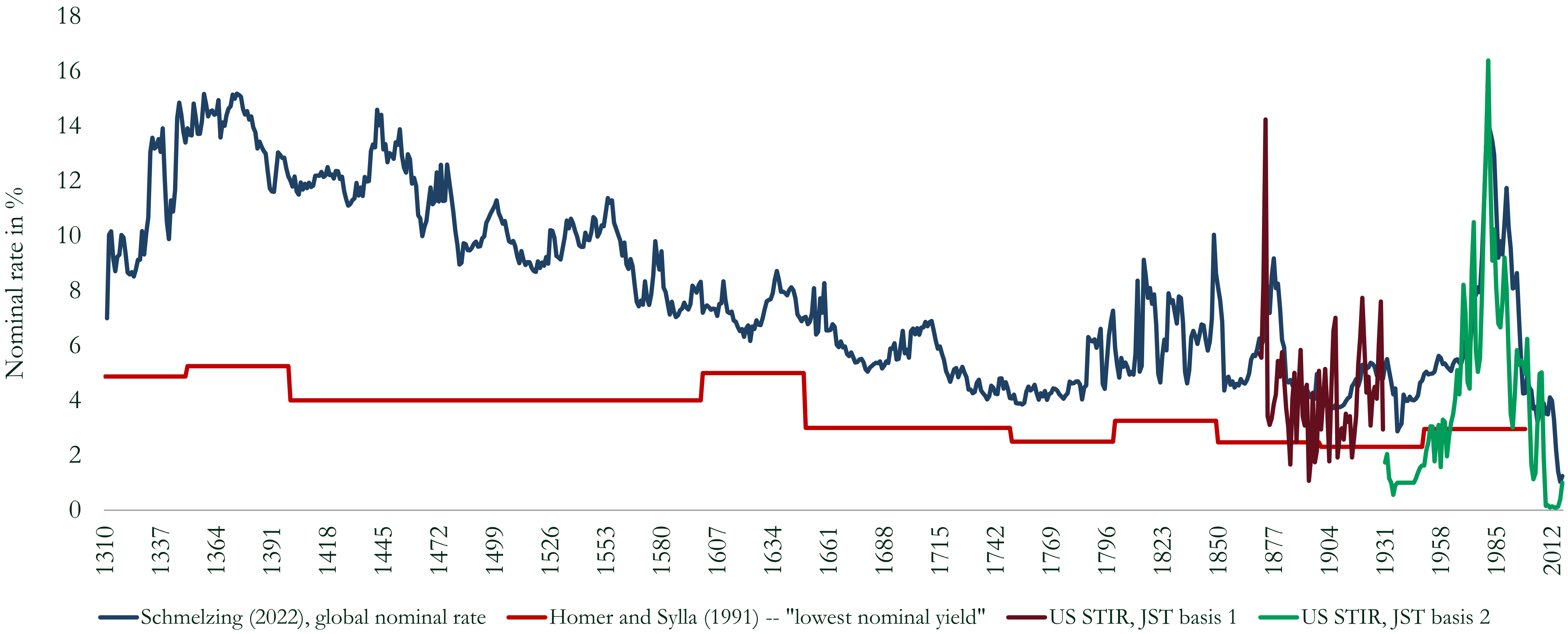
Existing discussions fail to detect trend, use spliced data.



Notes: Homer and Sylla (2005) splices authors' "lowest nominal yield" series in (ibid., 1991, 554f.), interpolating missing values. Schmelzing real unfiltered uses the seven-year progressively-lagged inflation-adjusted nominal rates, weighted by running GDP shares based on Maddison (2010) for an eight-country DM sample over time. Both series refer to long-maturity public voluntary debt contracts, with Schmelzing (2022) average maturity over time standing at an estimated 13.2 years. The approximation of inflation expectations in Schmelzing (2022) follows the approach in Homer and Sylla (1991; 2005), but is robust to alternative methodologies.

Long samples strongly suggest time trend may exist.

- Reconstruction of ST maturity leg enables us to fuse with LT data in Schmelzing (2022) and elsewhere.



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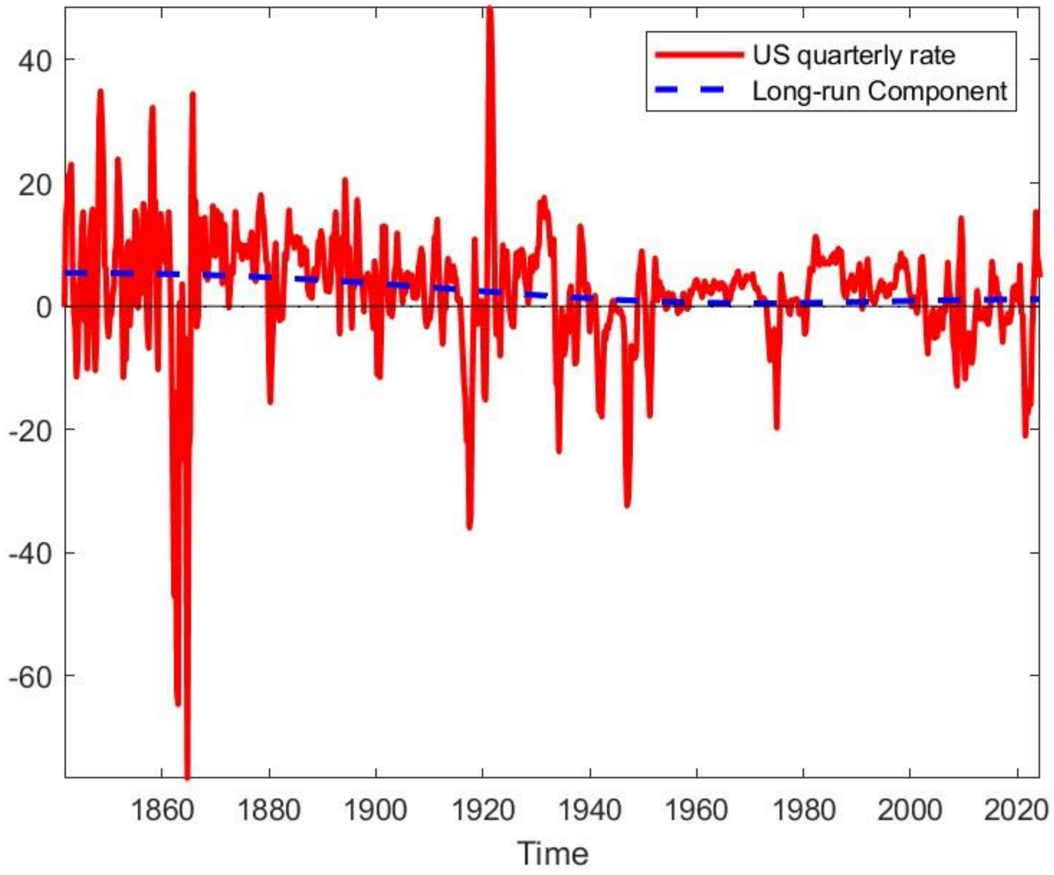
HEADLINE U.S. RATES – ARE TREND STATIONARY – 1831-2025.

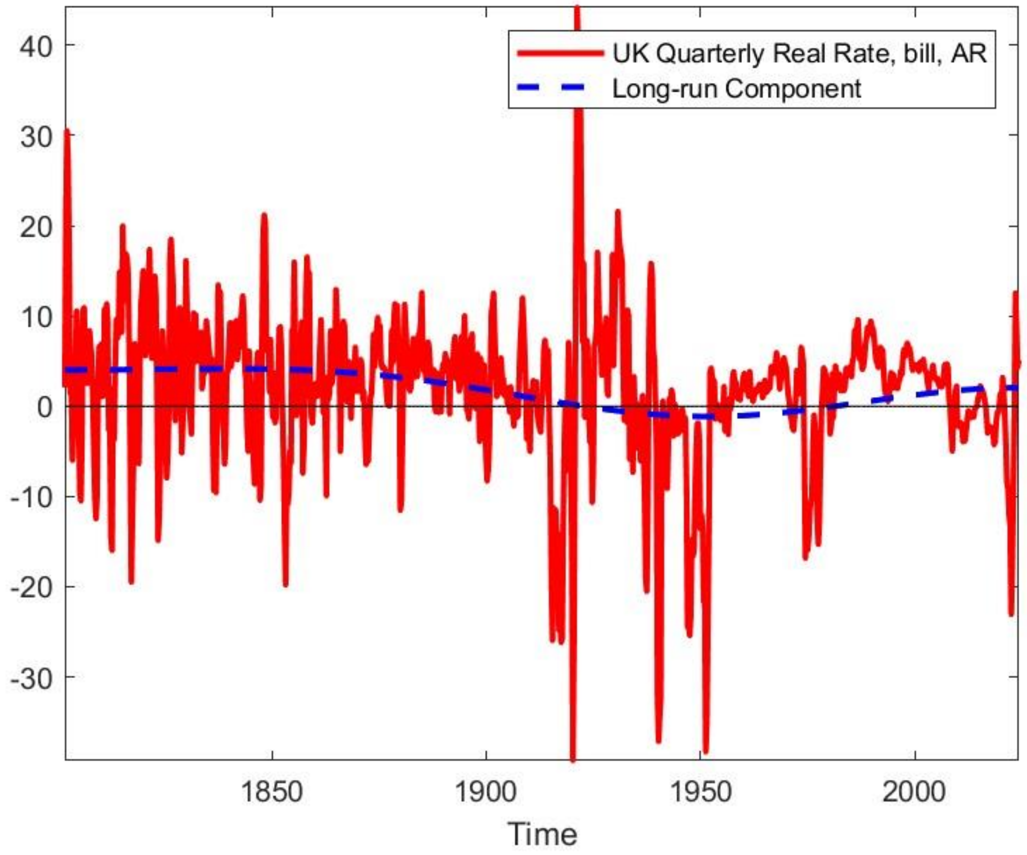
- Safe asset provider ex ante short-maturity rates, robust to multiple inflation (expectation) approaches (AR, progressive lags; annualized / yoy).
- Ability to reject null hypothesis of unit root at 1% level, using ADF-GLS and Zivot-Andrews – whether allowing for time-trend or not.



Notes: Red line displays U.S. quarterly data based on nominal prime commercial paper rates, 60-90 day maturity. We form inflation expectations via an autoregressive procedure as in Hamilton et al. (2016) using quarterly U.S. wholesale inflation rate, with sources including Bigelow (1862), Macaulay (1938), and Board (2024) for rates, and Smith (1935) for wholesale inflation. The blue line displays the underlying trend component using the methodology of Mueller-Watson (2018), selecting fluctuations with periodicity of 100 years or more.

HEADLINE U.K. RATES – ARE TREND STATIONARY – 1801-2025.

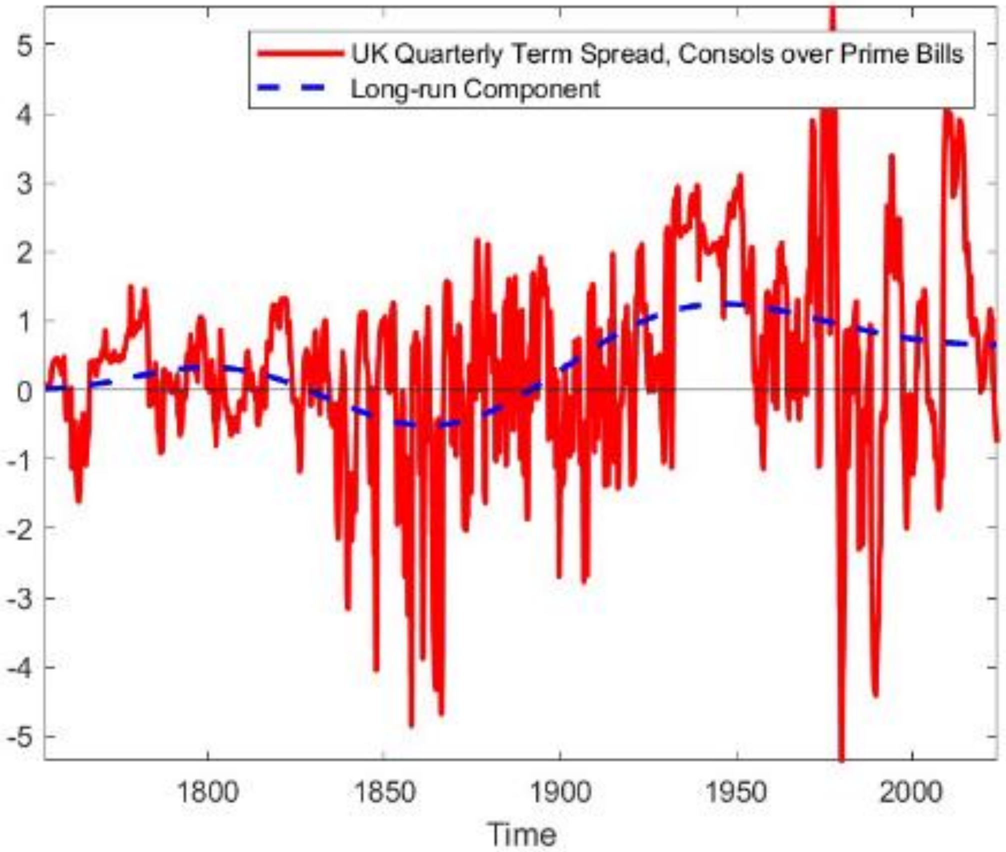
- Safe asset provider ex ante short-maturity rates, robust to multiple inflation (expectation) approaches (AR, progressive lags; annualized / yoy).
- Ability to reject null hypothesis of unit root at 1% level, using ADF-GLS and Zivot-Andrews – whether allowing for time-trend or not.



Notes: Red line displays U.K. quarterly data based on nominal bill rates, 60-90 day maturity. We form inflation expectations via an autoregressive procedure as in Hamilton et al. (2016) using quarterly U.K. wholesale inflation rate, with sources including Dimsdale and Thomas (2016) and BoE (2025), also for wholesale inflation. The blue line displays the underlying trend component using the methodology of Mueller-Watson (2018), selecting fluctuations with periodicity of 100 years or more.

HEADLINE U.K. TERM SPREADS – TREND STATIONARY – 1753-2025.

- Safe asset provider nom. term spreads (quarterly/annual), robust to multiple constructions (public /private sector), depending on literature.
- Ability to reject null hypothesis of unit root at 1% level, using ADF-GLS and Zivot-Andrews – whether allowing for time-trend or not.
- Upwards trend, with "Great Moderation" phase evidently not the norm. Short-maturity decline historically steeper.



Notes: Red line displays U.K. quarterly term spread data based on nominal bill rates on the short end, 60-90 day maturity, and consol rates on the long end. All in nominal terms, with sources including Dimsdale and Thomas (2016) and BoE (2025), also for wholesale inflation. The blue line displays the underlying trend component using the methodology of Mueller-Watson (2018), selecting fluctuations with periodicity of 100 years or more.

HEADLINE GLOBAL RATES – ARE TREND STATIONARY – 1704-2022.

- Stationarity results also hold at 1% level for 1704/1831-2024 sample (with and without time trends). Echoing results from related new long-horizon lit.
- Zivot-Andrews test allows for presence of breaks, but rejects unit root, too.

ADF-GLS TEST (WITH TIME TREND) RESULTS		
U.S. short-maturity real (quarterly)	1	-10.636
	2	-11.255
	3	-11.582
U.S. short-maturity real, AR (quarterly)	1	-11.639
	2	-11.007
	3	-10.631
U.S. t-spreads (annual)	1	-3.244
	2	-3.771
	3	-4.090
U.K. short-maturity real	1	-5.160
	2	-6.790
	3	-7.963

Notes: The table reports ADF-GLS test statistics for several choices of the number of lags (with a maximum of 3 lags). The regression includes a constant and a deterministic time trend. The critical values at the 1, 5 and 10 percent significance levels are the following for all observations: -3.480 (1%); -2.890 (5%); -2.570 (10%). "Optimal lag" indicates the optimal number of lags according to the sequential procedure ("Seq"), the Bayesian Information Criterion (SIC), or the Modified Information Criterion (MAIC). The test rejects when the test statistic is negative and larger (in absolute value) than the critical value. For the real rate series, nominal rates in quarter t are matched to inflation expectations that are constructed either based on Hamilton et al.'s (2016) autoregressive approach with four lags, labeled 'AR', or the current-quarter (t) year-on-year change in the wholesale/PPI price index. "T-spread" denotes nominal spread between long-maturity U.S. sovereign bond yields, and short-maturity 60-90 day prime commercial paper rates.

HEADLINE RATES AND TERM SPREADS – STRUCTURAL BREAKS – 1704-2022.

- Shortage of short-maturity structural breaks – including weakness of 1914, 1980s, and 2008 break results.
- Conventional Bai-Perron (1998) approach (open-ended, up to five breaks). Alternative: Chow (1960), which tests specified break dates.
- Exception: U.K. public term spread, 2007 break.

series		Break dates
U.S. short-maturity real		none
U.S. term spread nominal		none
U.K. short-maturity real 1		none
U.K. short-maturity real 2		none
U.K. public term spread (ann)		2007
U.K. private term spread		none
U.K. public term spread (qrt)		none

Notes: The table reports the results of the sequential Bai and Perron's test for the U.K. and U.S. real short-maturity rate data which is combined with long-maturity data for the U.S. as based on Schmelzing (2025) for the term spread series. U.K. data per text. The test is implemented in Matlab. The model includes a constant and a deterministic trend (as a fraction of the total sample size) and we test for breaks in both the constant as well as the slope of the deterministic trend. The test is implemented using a HAC variance estimator, the trimming parameter is 15 percent and the maximum number of break points is 5 for all series. All dates refer to significance at the 1% level. Real rates, unless otherwise stated, uses current year inflation adjustment.

HEADLINE RATES AND TERM SPREADS – HALF-LIVES – 1791-2024.

- Economically meaningful and rising long-horizon adjustment speeds, across short-maturity and term spread data, annual and quarterly.
- Half-life evidence for SM mirroring new LM evidence: early modern comparable adjustment speeds.

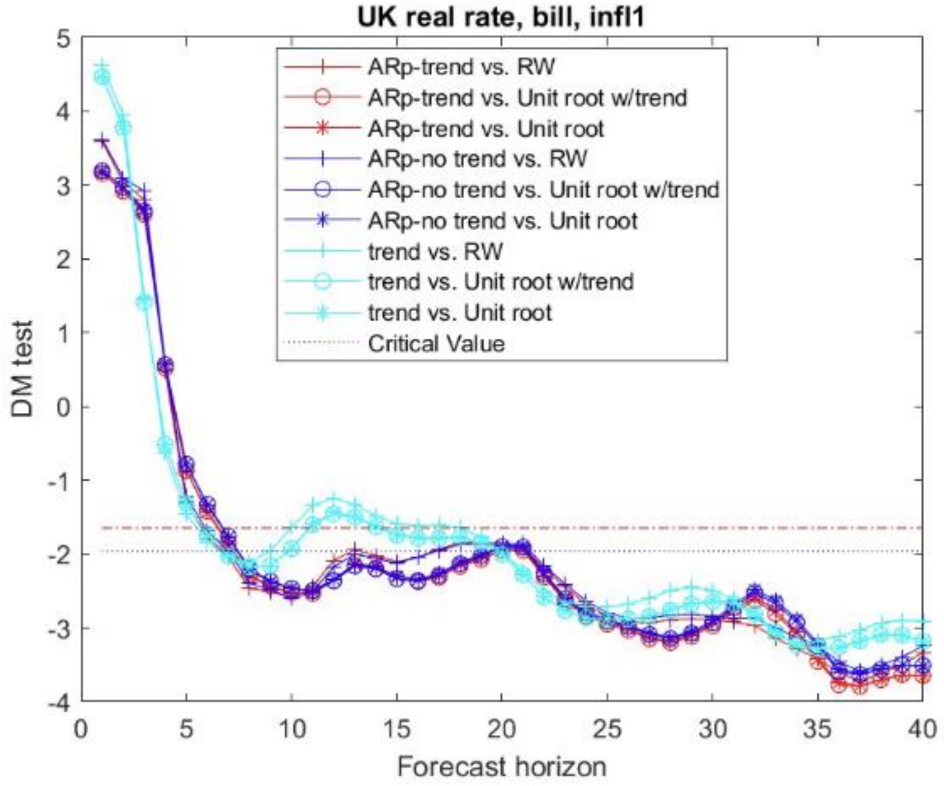
HALF-LIFE RESULTS

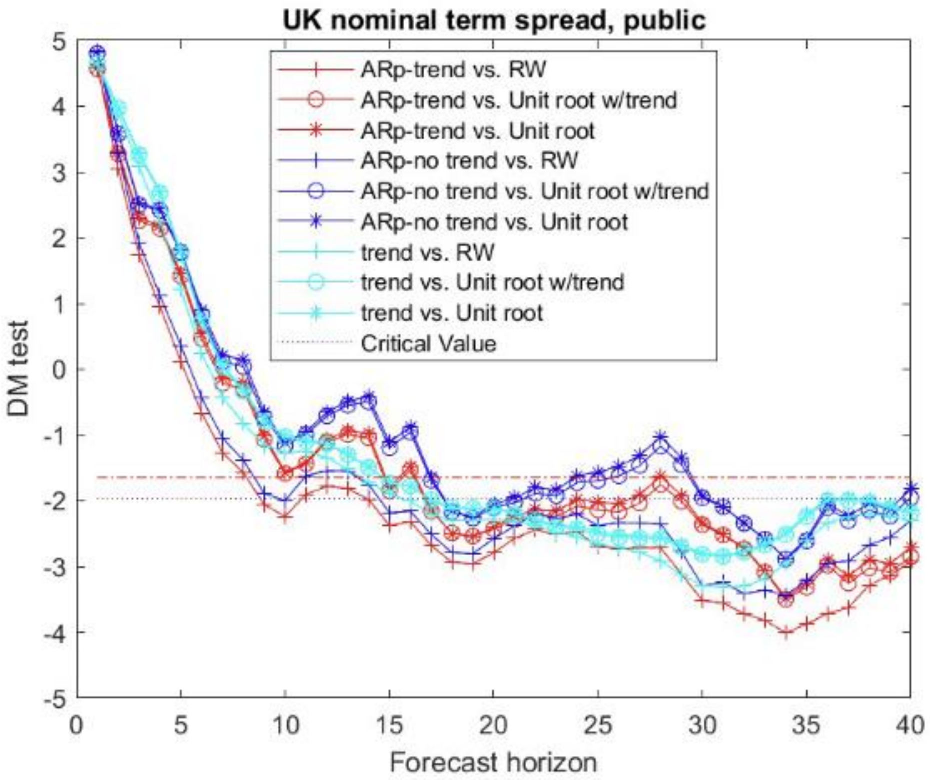
	Period	Half-life	3/4	7/8
U.S. annual real	1831-2024	0.77	2.10	3.28
	1831-1914	0.57	0.85	2.45
	1915-2024	2.06	2.94	3.68
U.S. annual term spread	1831-2024	0.85	3.04	5.20
	1831-1914	0.68	2.64	4.70
	1915-2024	2.49	4.20	6.20
U.K. real rate bill (quarterly)	1791-2024	1.15	1.50	1.73
	1791-1914	0.83	1.10	1.24
	1915-2024	1.58	1.90	2.21

Notes: The table reports median unbiased estimates and 90% confidence intervals of alpha based on Hansen (1999)'s grid-bootstrap as well as median unbiased estimates and 90\% confidence intervals of: the half-life (column labeled 1/2-life), the 3/4-life (column labeled 3/4-life) and the (7/8)-life (column labeled 7/8-life) based on Steinsson (2008). The table reports both the full sample as well as sub-sample estimates. The median unbiased estimates of gamma in the full sample are: US nominal: (-0.269,-0.100); U.S. real: -0.14076; U.S term spread: -0.21222, -0.02931. The half-life is estimated as the first horizon at which the impulse response equals one-half of the initial impact effect (similarly, the 3/4- and 7/8-lives are estimated as the first horizon at which the impulse response equals one-quarter and one-eight of the initial impact effect, respectively). The half-life can be a non-integer number (similarly for the 3/4- and 7/8-lives). For annual data 1-H values are used for the 2024 value.

Results survive out-of-sample tests.

- Horse race between stationary models vs. random walk / unit root / unit root with trend.
- At all forecasting frequencies from 8 quarters onwards, stationary models beat alternatives, for short-term rates and term spreads.

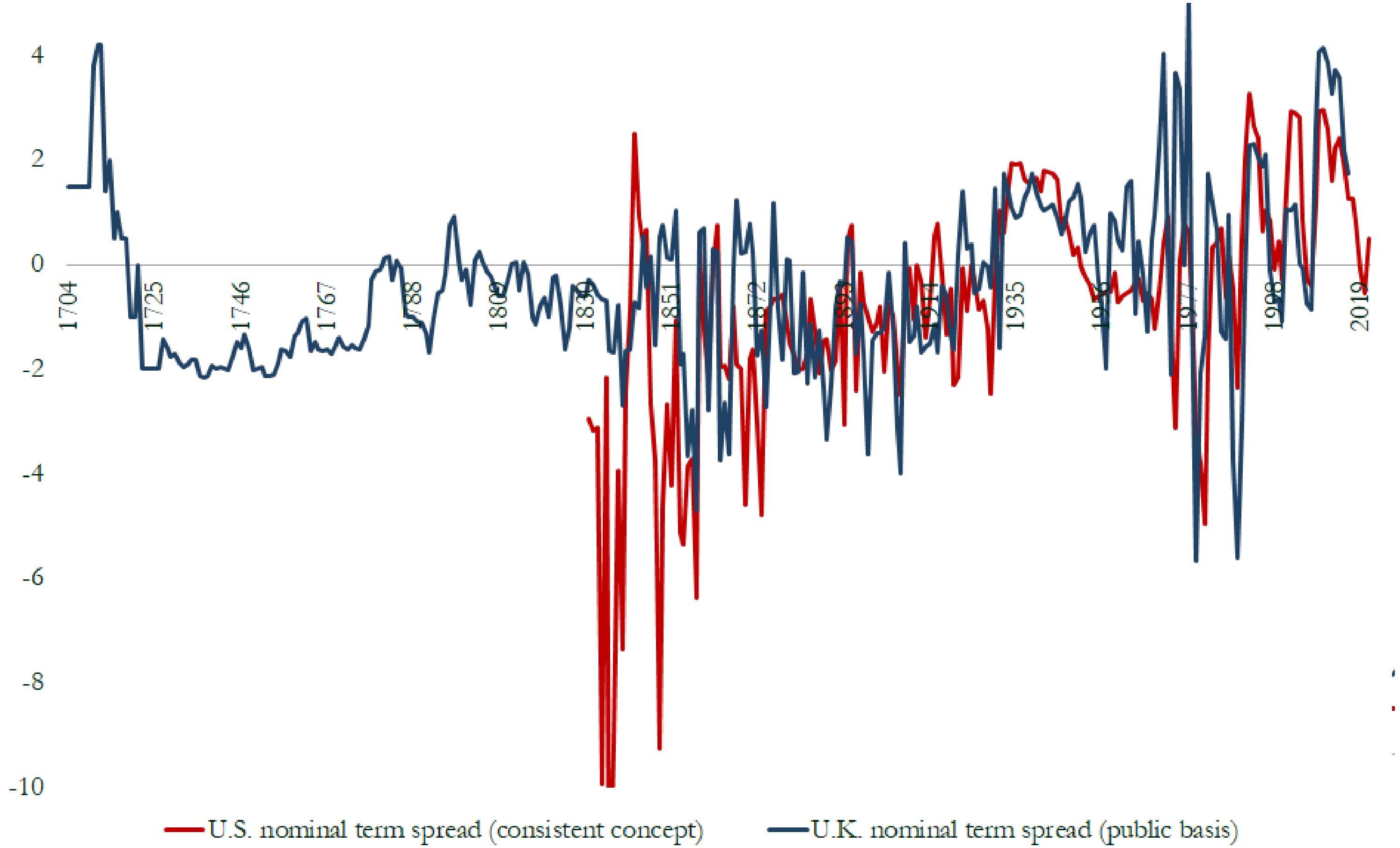




Notes: The pictures report the Diebold and Mariano (1995) test for equal predictive ability for stationary vs. non-stationary models, as described in the legend. Negative values indicate that the stationary model has a lower mean squared forecast error than the non-stationary model. The pictures also report the critical value based on the Giacomini and White (2006) approximation (one-sided is -1.645 (dotted line) and two-sided is -1.96 (dashed-dotted line)). Forecasts are obtained in rolling windows with size equal to half of the total sample size.

Allows comprehensive reconstruction of term spreads.

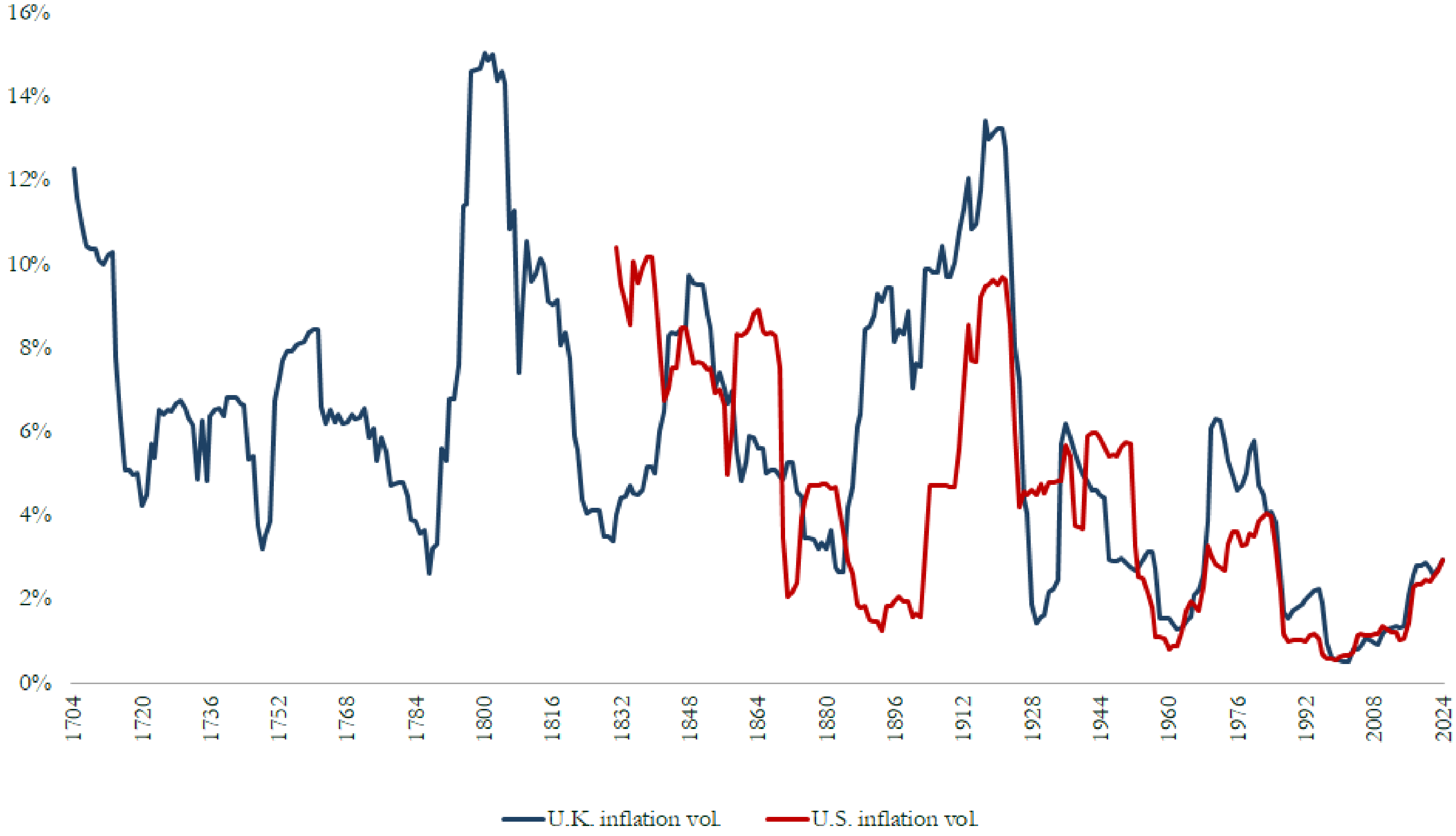
- U.S., and U.K. term spreads confirm trend stationarity at 1% levels via ADF-GLS (with or without time trend).
- Clear upwards slope – with historically permanent inversion.
- Questions "Great Moderation" assumptions on falling term spreads (inflation vol.) – Wright (2011) and others.



Notes: Figure displays U.K. ex ante real rates using progressively-lagged (seven-year) inflation excluding current year. Inflation to 1914 sourced via Allen's (2001) London CPI, and afterwards, via Dimsdale and Thomas (2016). Nominal rates via Schmelzing (2020; 2022) and documentation there. Alternative inflation expectation approaches to be found in Schmelzing (2022 – using local currency year-on-year changes and others), and in Rogoff, Rossi, and Schmelzing (2022), using equal-lagged inflation including current year following Eichengreen (2015), and autoregressive inflation model following Hamilton et al. (2016).

WHICH RUN COUNTER TO INFLATION VOLATILITY (DEFAULT) DATA.

- Literature assumes inflation volatility proxies default risk over time (e.g. Wachter et al. 2022).
- Inflation volatility (rare disasters) disproportionately affects long-maturity part of term structure (Barro, Nakamura, Steinsson 2013).
- However, we uncover secular discrepancies in term spreads vs. inflation vol – correlation clearly appears negative.
- We do not definitively "solve" contradiction, but: rising default risk from sources unrelated to inflation (financial repression)? R-G over time rising (RS 2025).



Notes: The figure displays the standard deviation of the realized annual year-on-year inflation rate, as a 13-year centered average standard deviation. The U.K. series starts in 1704, the U.S. series starts in 1831, the Austrian in 1807, equivalent to the inception dates for the term spread series. Sources for U.S. inflation data is David and Solar (1977) and FRED (2023); for U.K. data Dimsdale and Thomas (2016) and IMF IFS (2023), and for Austria Hubmann, Jobst, and Maier (2020) and IMF IFS (2023).

Conclusions

- Strong evidence of trend stationarity of real rates and term spreads once short-maturity, long samples and high frequency are examined:
  - Real interest rate shocks are temporary, not permanent. Key implications for 2008, 2020.
  - This resolves important contradictions in literature (theory assumes stationarity, empirics to date unable to confirm).

- Strong implications for r* analyses (HLW 2023): all plausible proxies now point towards trend stationarity results.

- Therefore, not evident that international financial system experienced the "end of an era" (Lagarde) with COVID.
- Whatever plausible term spread or r* model one adopts – and we do not take particular stances –, it needs to conform to econometric properties highlighted here.

- How can we reconcile *rising* term spread evidence, with falling rare disaster (inflation volatility) evidence?
  - Perhaps short-maturity debt is and was not actually the prime "safe" asset.
  - Alternatively, markets secularly reflect rising default risks from sources other than inflation risk (financial repression)?