GENEVA GRADUATE INSTITUTE

INTERNATIONAL ECONOMICS

What Drives Long Term Interest Rates? Evidence from the Entire Swiss Franc History (1852-2022)

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A long view on fundamental interest rates

- Downtrend in nominal and real interest rates since the 1980's entails challenges (conduct of monetary policy, risks on financial stability).
  - Interest rates aren't low any longer since 2021 (e.g. TIPS)...
  - …but forces that drove them low remain (e.g. demographics) and could reassert themselves.
- Research tends to focus on large economies in recent decades. How about smaller countries, on a very long sample?
  - Switzerland, as a «safe haven». But was not always so.
- Research on real factors (savings rate, ageing). How about nominal factors (inflation volatility)?
- Taking a long view is challenging.
  - Scarce historical data are for Switzerland, especially before 1900.
  - Measurement errors, especially in inflation.
  - Structural shifts (such as change in FX regime).

What we do and find

- Theoretical contribution: do countries with more stable nominal variables (inflation) have lower interest rate?
  - Yes, but under specific conditions (less general than term premium).
- Construct data of short- and long-term interest rates, and exchange rate for Switzerland since 1852, using novel archival data.
  - Long-term rates and exchange rate previously unavailable.
- Extract trend components using time-varying parameters VAR.
  - TVP-VAR-SV flexibly allows for parameters changes, including sudden ones.
- Cross-country perspective on real interest rates.
  - Term premium appears when inflation becomes positive.
  - UIP deviations (low Swiss rates) in the last third of the 20th century.
- Connect term and UIP premia to inflation volatility.
  - Evidence for the link, but heterogenous across time for UIP.

Connection to the literature (1)

- Trend decrease in natural real interest rate (r*).
  - Reliance on DSGE model (Laubach and Williams 2003, 2016).
  - Sensitivity to expectations (Lopez-Salido, Sanz-Maldonado, Schippits, and Wei 2020)
  - Long perspective (Del Negro et al. 2019, Fiorentini et al. 2018).
  - Application to Switzerland (Bacchetta et al. 2022).

- Historical analysis of Switzerland.
  - Challenges from mismeasurements (Kaufmann 2020).
  - Swiss «low interest rate island» since WW1 (Kugler and Weder di Mauro 2002,4,5, Cunat 2003, Baltensperger and Kugler 2016).

Connection to the literature (2)

- Methodological literature.
  - Earlier studies (Primiceri, 2005, Del Negro et al., 2019) impose gradual changes of parameters and trends.
  - Time-varying VAR, allowing for rapid changes in parameters (Huber et al. 2019).
  - Use of mixture models (Gerlach et al. 2000, Giordani and Kohn 2008).
- Sources of UIP deviations (Bacchetta 2013).
  - Deviations after shocks due to limited participation (Bacchetta and van Wincoop 2010), varying risk aversio (Verdlehan 2010), frictions in financial markets (Itskhoki and Mukhin 2021).
  - «Steady state» deviation, of second order (Bengui and Sander 2023, for real bonds).
  - Relevance of inflation risk (Kalemli-Ozcan 2022).

Outline

- Theory of link between UIP deviation and inflation volatility.
- New historical data.
- Long-run values from TVP-VAR-SV.
    - Swiss variables in international perspective.
- Econometric assessment of the role of inflation volatility (in progress).

A simple theory

- Inflation volatility affects the term premium between short and long bonds (Bauer and Rudebusch 2020, Bianchi et al. 2022, Tristani and Hördahl 2010, Söderlind 2011).
  - So should we have the same thing in cross-country terms (UIP)?
- Two periods, two countries, investing in risk-free nominal bonds in the two currencies, and complete assets.
- Euler conditions and full risk sharing (CRRA utility):

$$1 = \frac{1+i_{t+1}}{1+\delta} E_t \frac{P_t}{P_{t+1}} \left(\frac{C_{t+1}}{C_t}\right)^{-\gamma}$$

$$1 = \frac{1+i^*_{t+1}}{1+\delta} E_t \frac{S_{t+1} P_t}{S_t P_{t+1}} \left(\frac{C_{t+1}}{C_t}\right)^{-\gamma}$$

$$\frac{S_{t+1} P^*_{t+1}}{P_{t+1}} \left(\frac{C_{t+1}}{C^*_{t+1}}\right)^{-\gamma} = \frac{S_t P^*_t}{P_t} \left(\frac{C_t}{C^*_t}\right)^{-\gamma}$$

UIP deviation

- UIP gap (2nd order) reflects relative volatility of marginal utility:

$$i_{t+1} - i^*_{t+1} - E_t(s_{t+1} - s_t)$$

$$= -\frac{1}{2}[Var_t(\gamma c_{t+1} + p_{t+1}) - Var_t(\gamma c^*_{t+1} + p^*_{t+1})]$$

$$= -\frac{1}{2}[Var_t(m_{t+1}) - Var_t(m^*_{t+1})]$$

  using the money demand $M_{t+1} = P_{t+1}(C_{t+1})^{-\gamma}$

- The country with the more volatile money supply has the lower interest rate (lower than UIP), reflecting hedging properties of bonds.

- If monetary policy is random, then high monetary volatility is association with low interest rate and high inflation volatility.

(In)efficient monetary policy

- Linear production function in labor with productivity shocks.
  - Firms' desired price reflects money (flexible wage) net of productivity: $m_{t+1} - a_{t+1}$.
- Inflation volatility driven by:
  - Volatility of money net of productivity.
  - Volatility of exchange rate (money in both countries), depending on home bias and invoicing.
- Compute the optimal monetary stances (Nash equilibrium) as functions of productivity, depending on invoicing: m_{t+1}^{eff} and m_{t+1}^{*eff}.
- Central banks' reactivity may be insufficient:

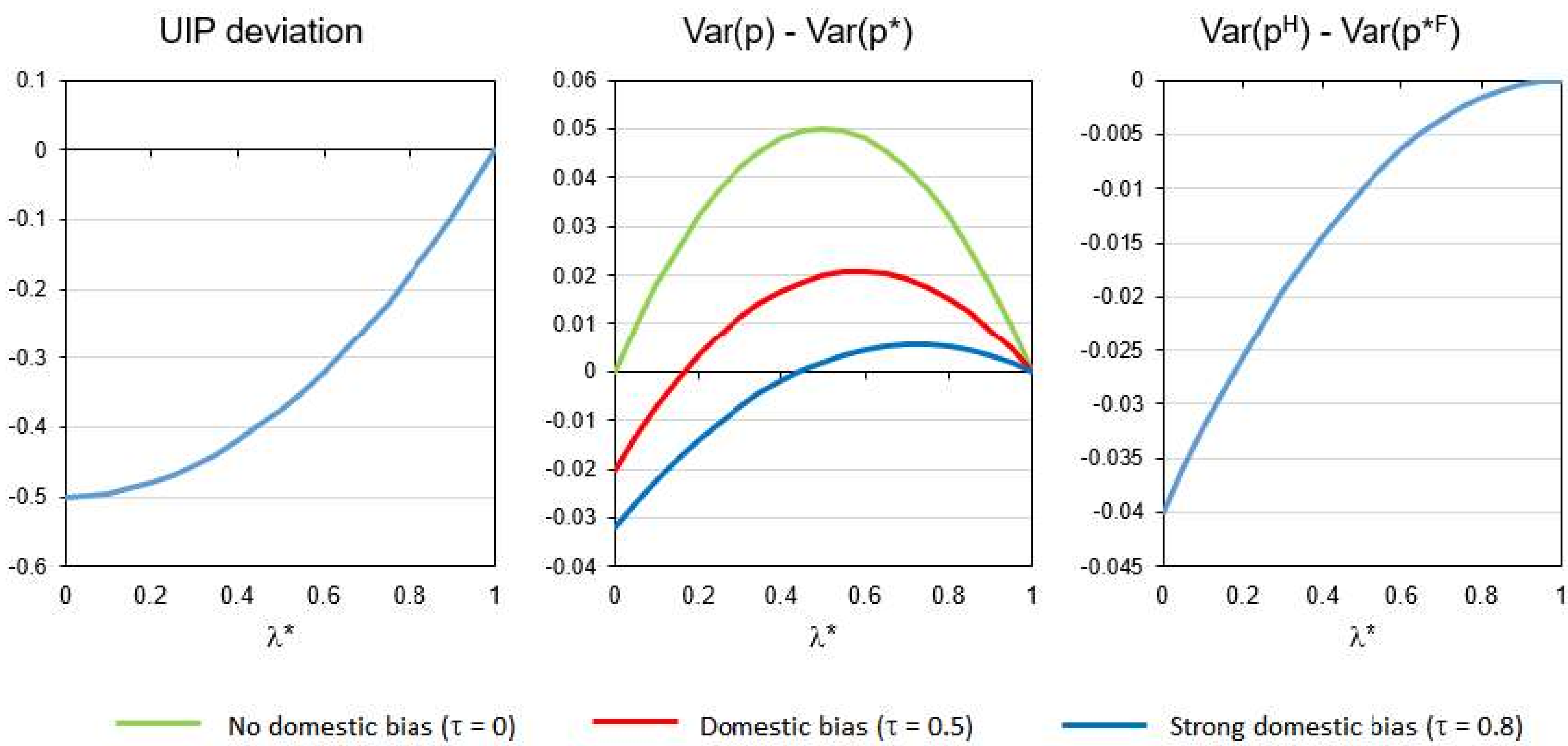
$$m_{t+1} = \lambda m_{t+1}^{eff} \quad , \quad m_{t+1}^{*} = \lambda^{*} m_{t+1}^{*eff} \qquad \lambda, \lambda^{*} \leq 1$$

- Good monetary policy is effective reaction to shocks, not absence of policy shocks. Numerical illustration with $\lambda = 1$ and $\lambda^{*} \leq 1$.

Full exchange rate pass-through

- Home has a low interest rate and less volatile domestic inflation.
  - Overall inflation also lower if not too exposed to the exchange rate (domestic bias).

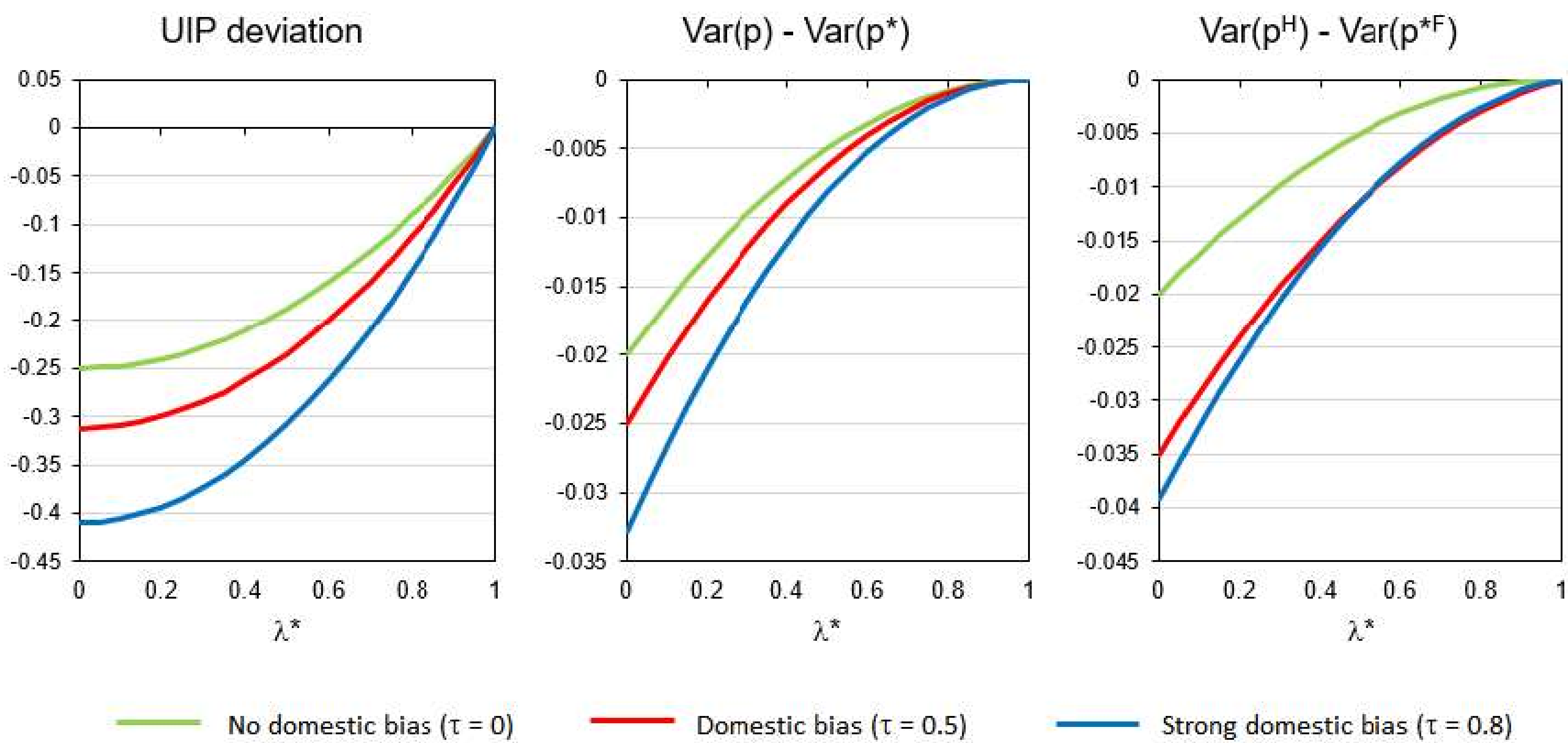
Fig. 1: Symmetric full pass-through ($\eta = \eta^* = 1$)



Zero exchange rate pass-through

- Home has a low interest rate and less volatile inflation (both domestic and overall, as import prices are shielded from the exchange rate).

Fig. 2: Symmetric zero pass-through ($\eta = \eta^* = 0$)



Message from theory

- Asymmetric invoicing (DCP of foreign currency) leads to lower Home interest rate and domestic inflation even when both banks react efficiently.
- Stabilisation of the exchange rate by the Home country reduces the range of parameters where is has a lower interest rate and less volatile inflation.

- Pattern of relative interest rate and relative inflation volatility is subtle.
  - High rate and low volatility if monetary policy is random.
  - Low rate and low volatility for the country with more efficient reaction, especially if limited impact of exchange rate.
  - Low rate and low volatility should be seen in times of flexible exchange rate and different reactivity of central banks.

Novel data set

Data on interest rates

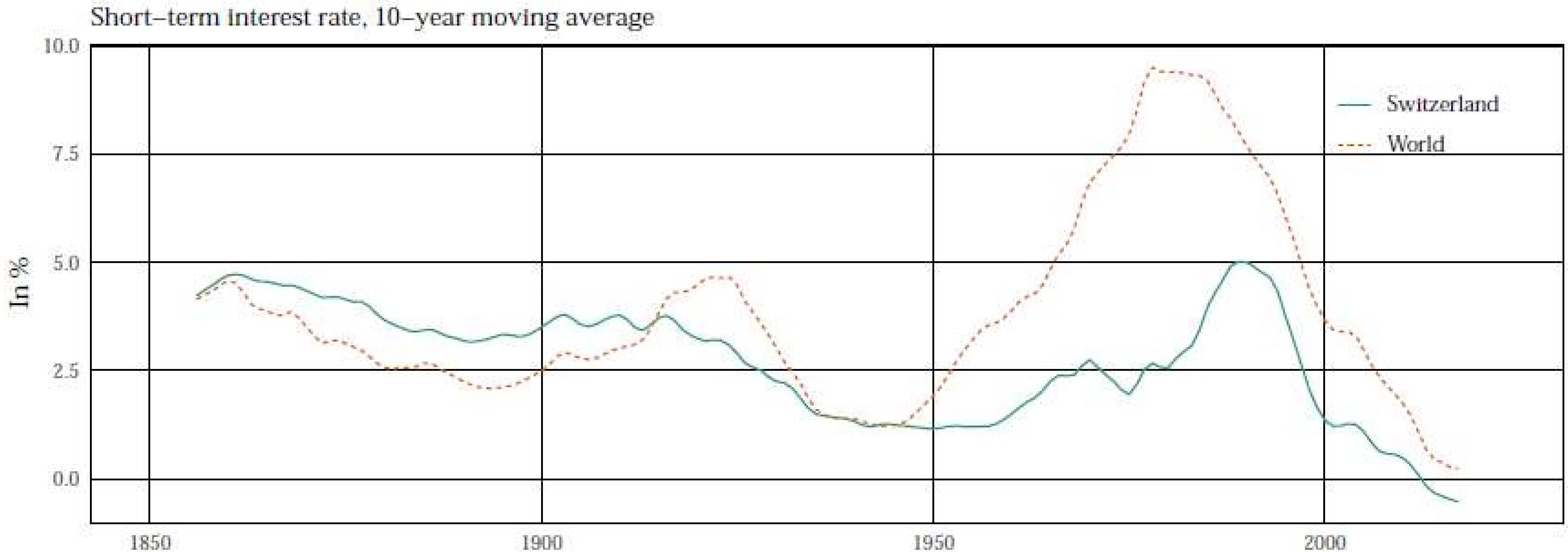
- Collection of high frequency data from archive on short and long interest rates, and exchange rates.
- Short interest rates.
  - Daily private and cantonal banks discount rates (ZH, SG, BS, BE, LS, GE) until 1890.
  - Market rates of emission banks and money market rate in Zurich, 1890-1930, Money market rate in Zurich from SNB statistical bulletin until 1999. SARON since.
- Long interest rates (10 years).
  - Quotation lists of Federal and Cantonal bonds (ZH, SG, BS, GE, VD, BE, FR) until 1899, with sample broadening with time.
  - Confederation, cantonal, and railway bonds 1899-1923.
  - SNB data on Federal and railways bonds 1924-1988, Federal bonds since.

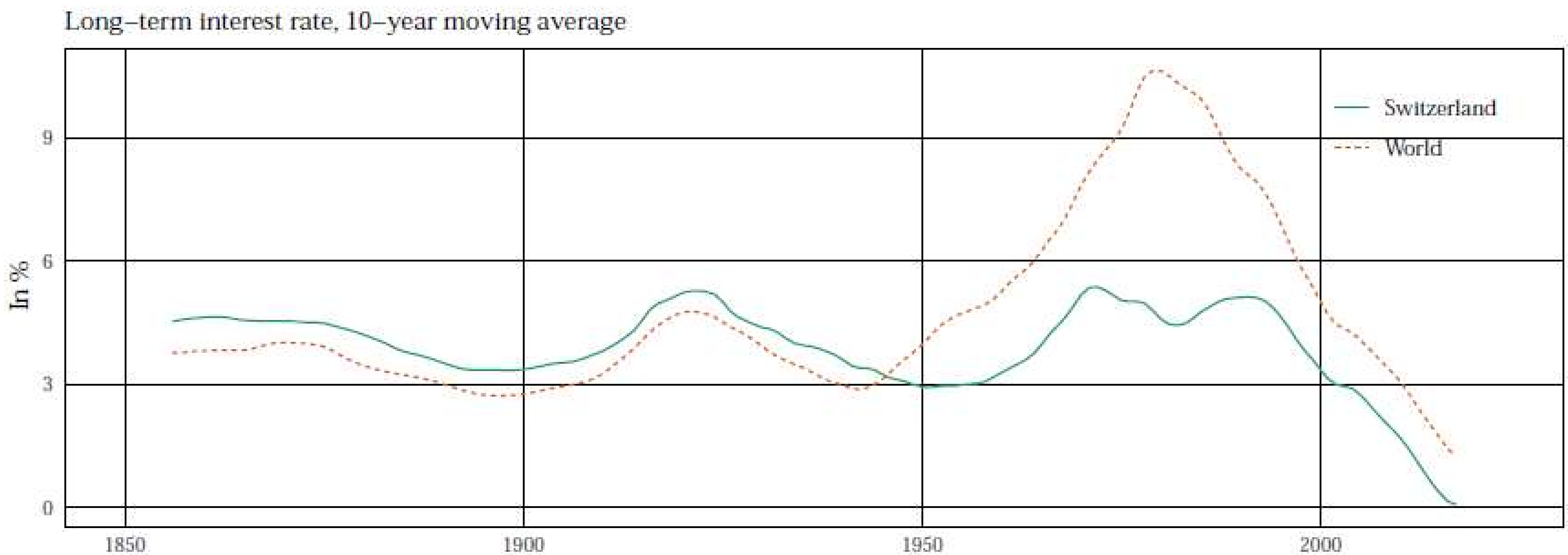
Data on exchange rates and inflation

- Exchange rates.
  - Newspapers (ZH until 1890) and quotations sheets (BS until 1914) agains major European financial centers.
  - Official data since 1914.
- Inflation.
  - HSSO data for wholesale prices until 1913, CPI since.

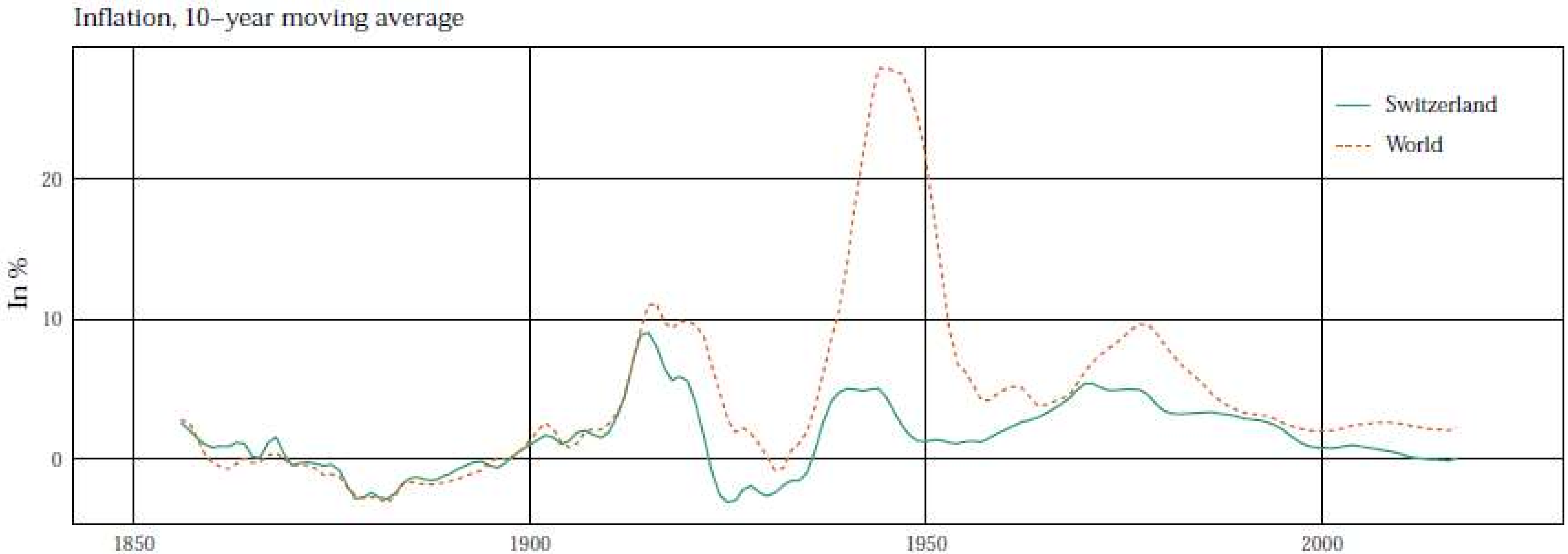
- Usual data available for «rest of the world».
  - United Kingdom and France until 1914.
  - UK, France, and United states from 1914 to 1963.
  - Trade-weighted measures across Switzerland’s partners since 1964 (OECD, SNB).

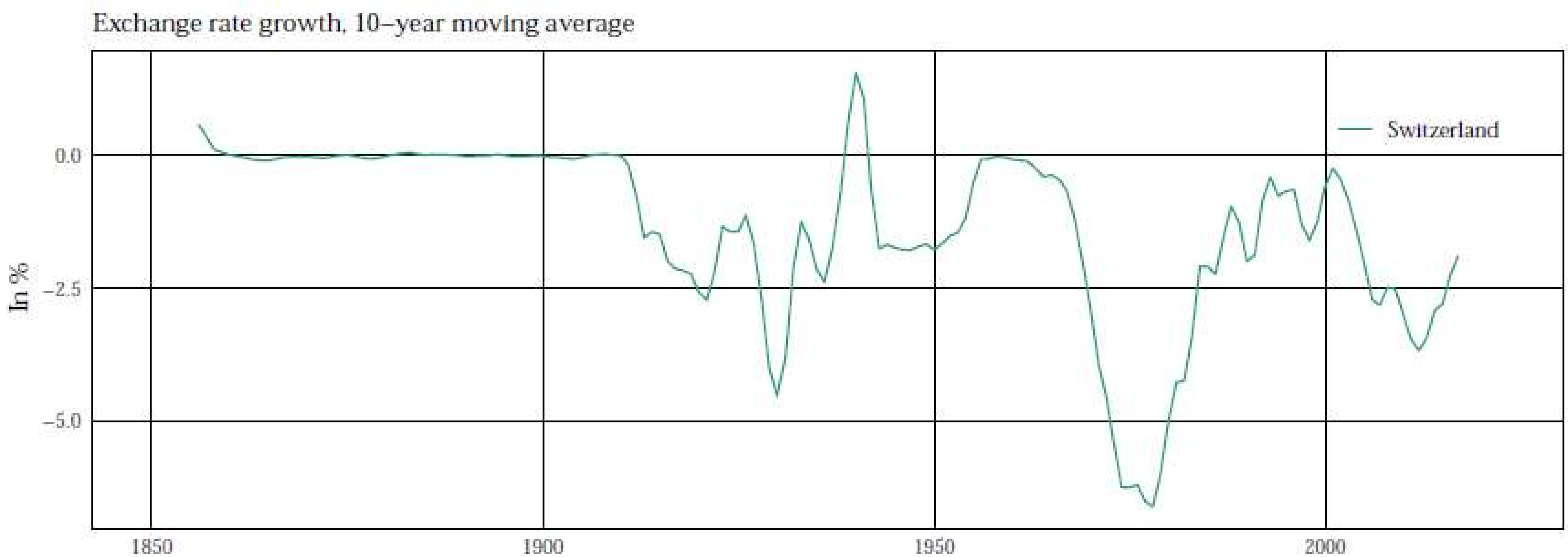
Interest rates





Inflation and exchange rate





Extracting trends

Allowing for regime changes

- Usual theory-based approach based on general equilibrium model.
  - Challenging with historical data: several regime changes (Bretton Woods, floating exchange rates).

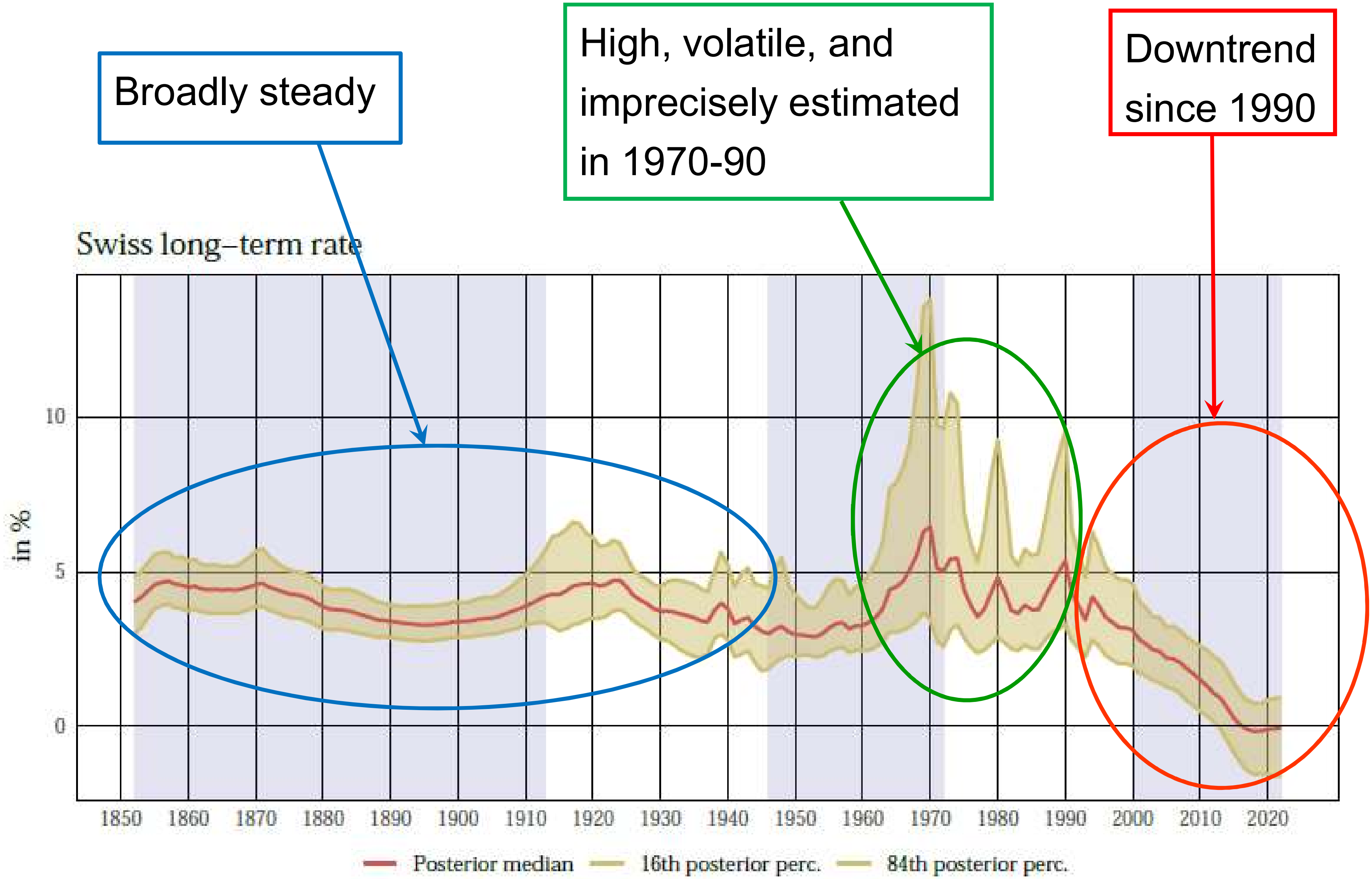
- Statistically-based approach using reduced form time-varying parameters VAR with stochastic volatility.
  - Multivariate time series model allows to estimate dynamically evolving long-term Beveridge and Nelson (1981)-type trends.
  - Best long-term forecast, long run values from the VAR, once the dynamics given parameter values have played out.
  - Inflation, short and long interest rates, exchange rate (Swiss and RoW series).

Flexible approach

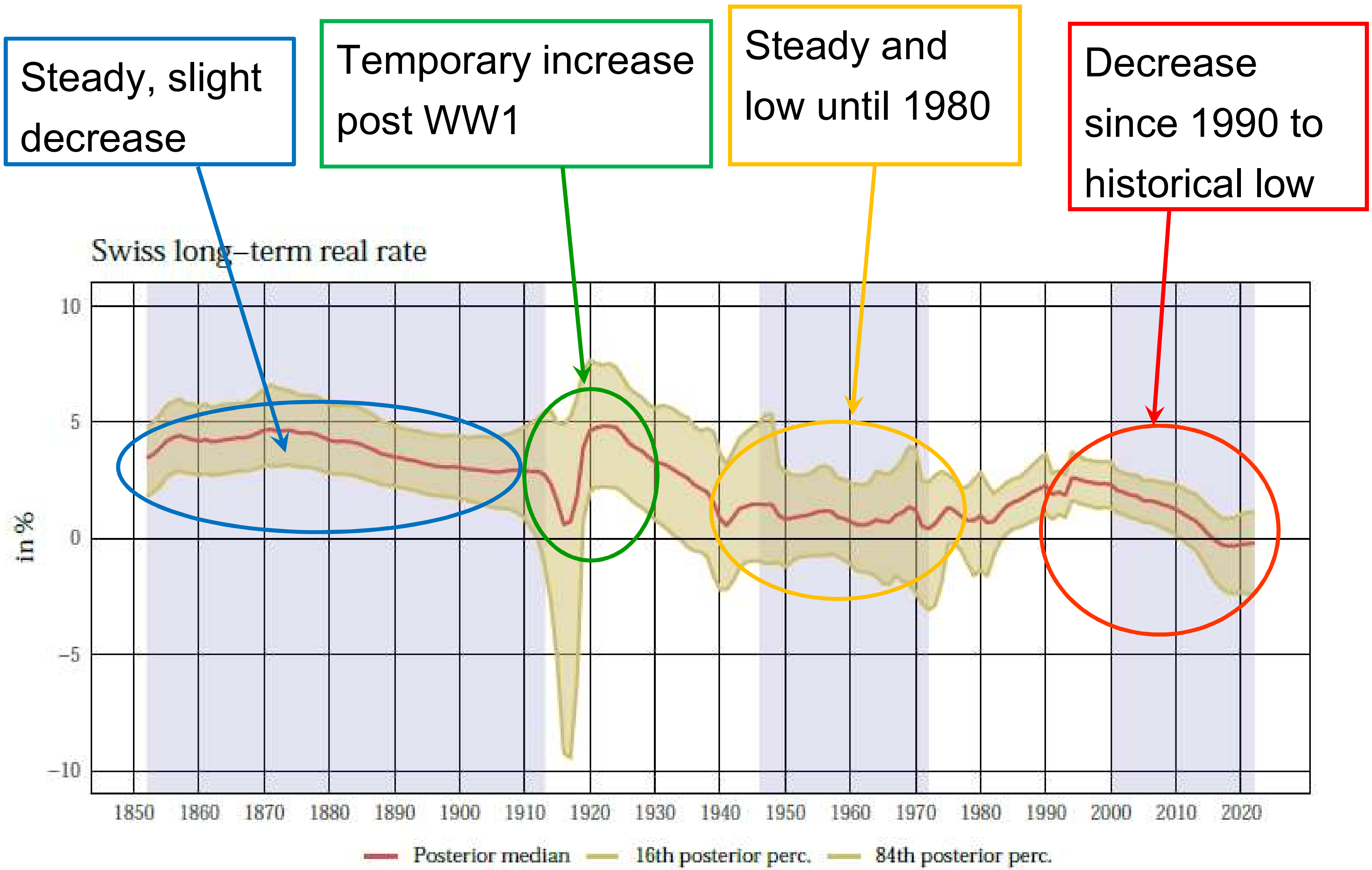
- Existing studies (e.g., Primiceri, 2005, Del Negro et al., 2019) restrict parameters (and the trends) to evolve gradually over time.
  - Problematic in the presence of regime shifts (e.g. collapse of Bretton Woods system, World Wars).

- Flexible TVP-VAR also allows for rapid changes in the underlying parameters (Huber et al. 2019).
  - Allows for gradual changes as well as sudden regime shifts.
  - Additional flexibility achieved through mixture innovations in the state equations of the parameter.

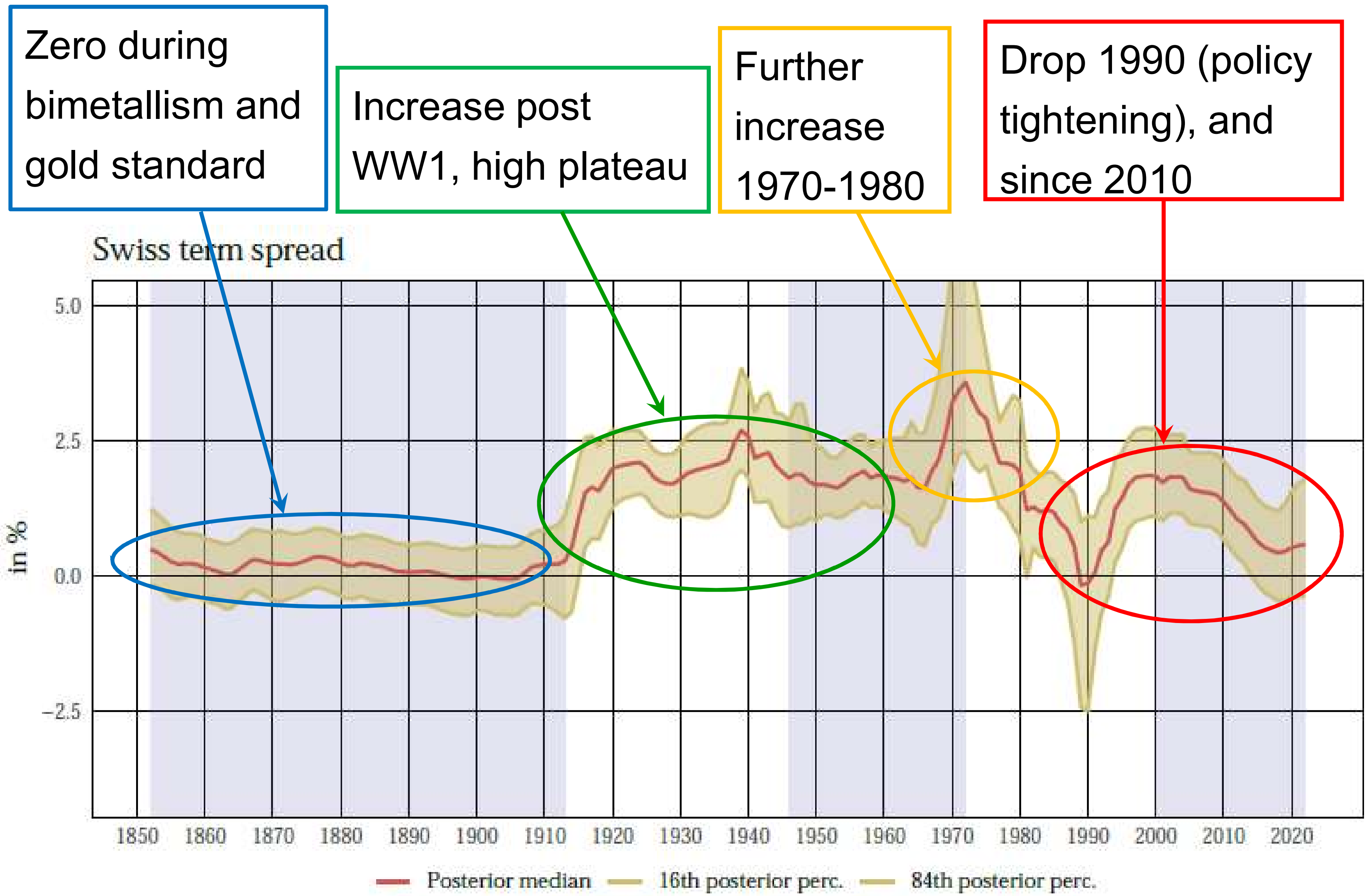
Nominal long-term rate trend



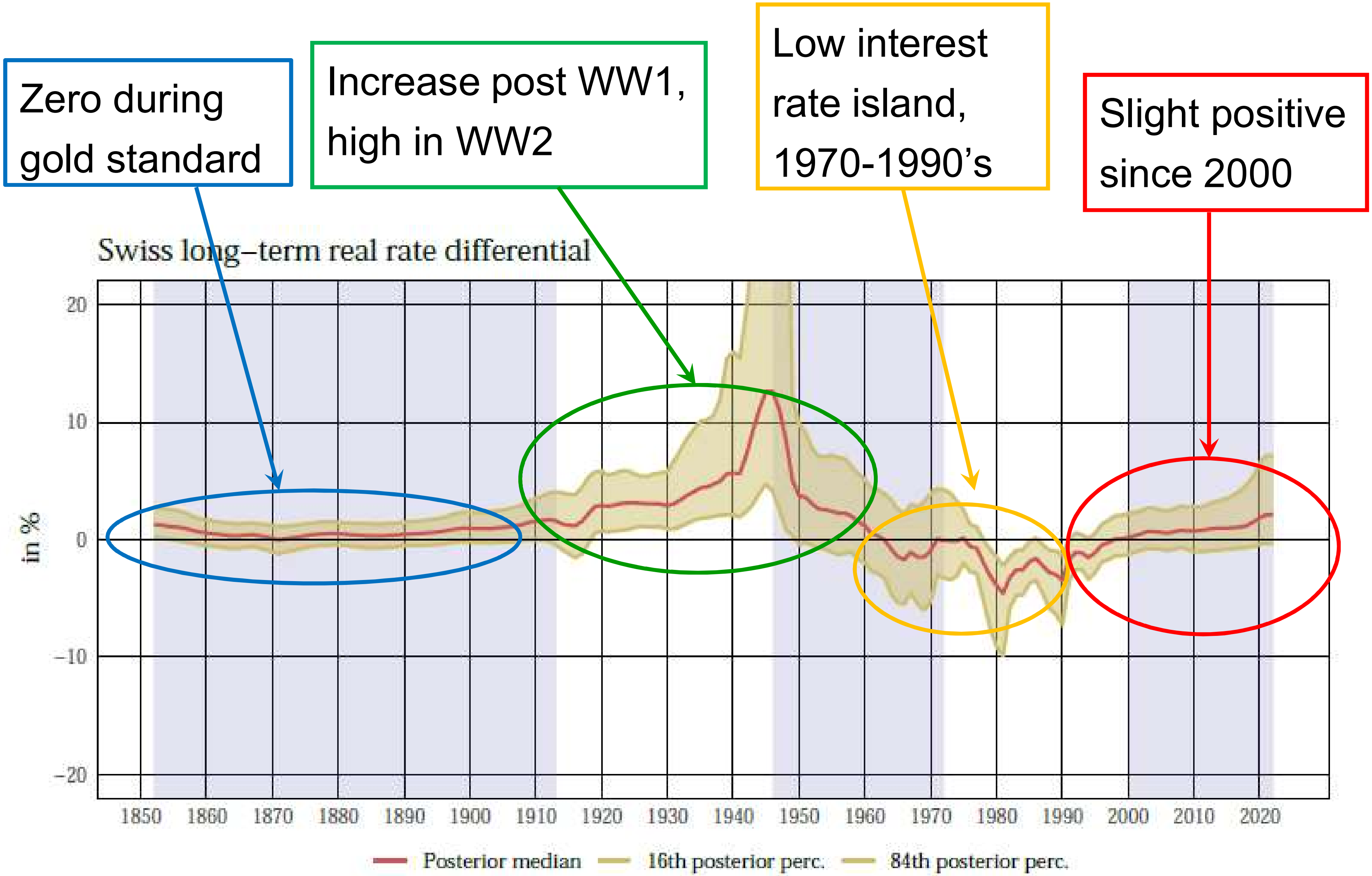
Real long-term rate trend



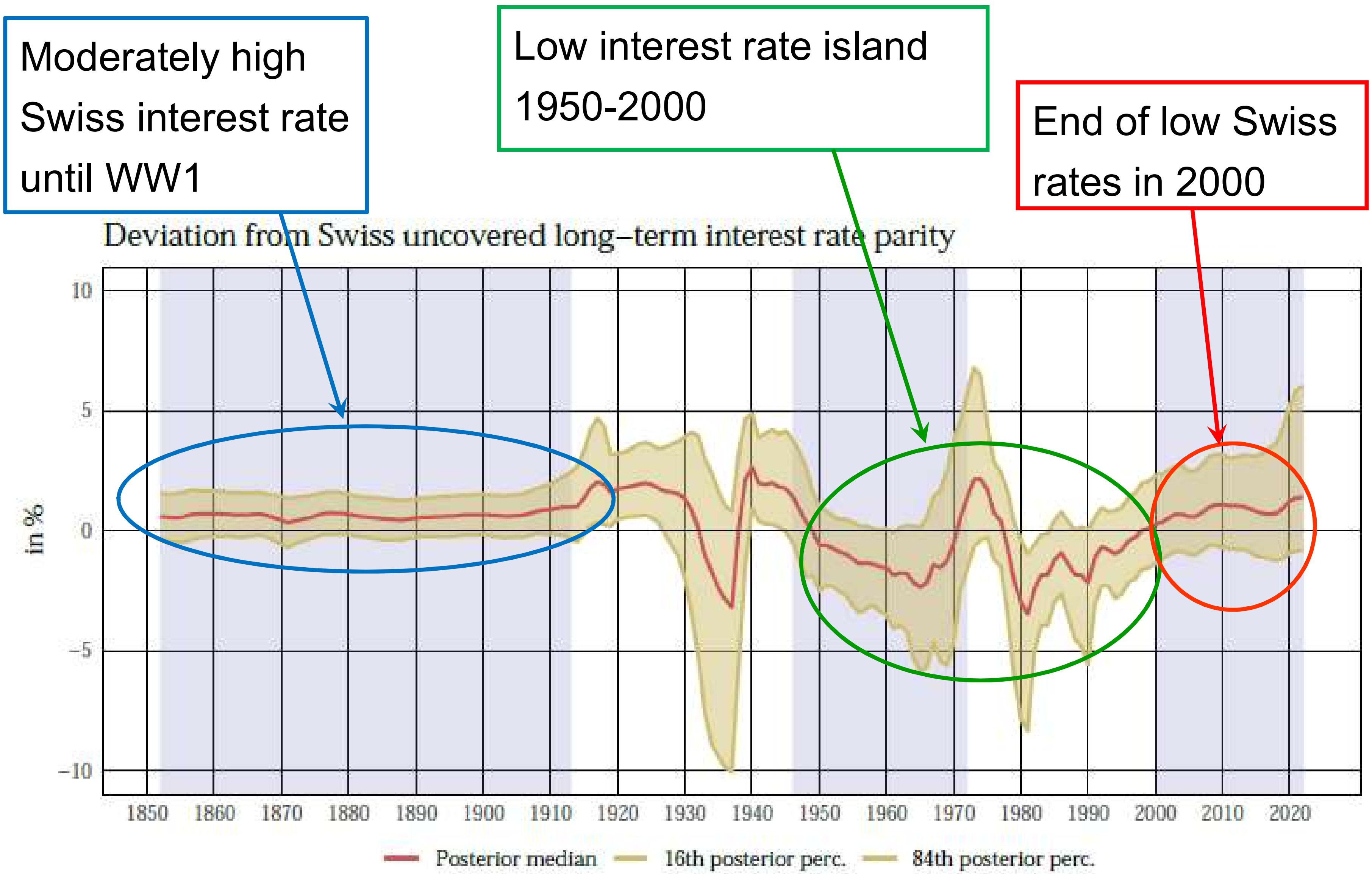
Term spread


Zero during bimetallism and gold standard
Increase post WW1, high plateau
Further increase 1970-1980
Drop 1990 (policy tightening), and since 2010
Swiss term spread
in %
5.0
2.5
0.0
−2.5
1850
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
Posterior median
16th posterior perc.
84th posterior perc.

Real long-term rate: CH - RoW



UIP deviation



Econometric assessment

Inflation volatility and term spread

- Three measures of volatility:
  - Level of inflation (higher is more uncertain).
  - Interquartile range of TVP-VAR posterior distribution.
  - Standard deviation of trend inflation.
- Swiss term spread positively associated with volatility.

	Term spread Switzerland					
	(1)	(2)	(3)	(4)	(5)	(6)
Trend inflation	0.41***	0.43***				
	(0.12)	(0.12)				
Interq. range			0.36**	0.36***		
			(0.15)	(0.13)		
Uncond. std.					0.12*	0.12*
					(0.07)	(0.07)
Constant	0.64*	0.95***	0.23	0.31	0.34	0.42
	(0.33)	(0.37)	(0.47)	(0.45)	(0.58)	(0.78)
Controls	No	Yes	No	Yes	No	Yes
N	171	171	171	171	171	171
R^2	0.38	0.42	0.33	0.33	0.10	0.10
Adjusted R^2	0.38	0.41	0.33	0.32	0.10	0.09

Inflation volatility and UIP gap

- UIP gap and CG-RoW inflation volatility.

- Relation is heterogenous across monetary regimes.
- Present during Bretton Woods and monetary targeting.
- No longer after broad adoption of inflation targeting.

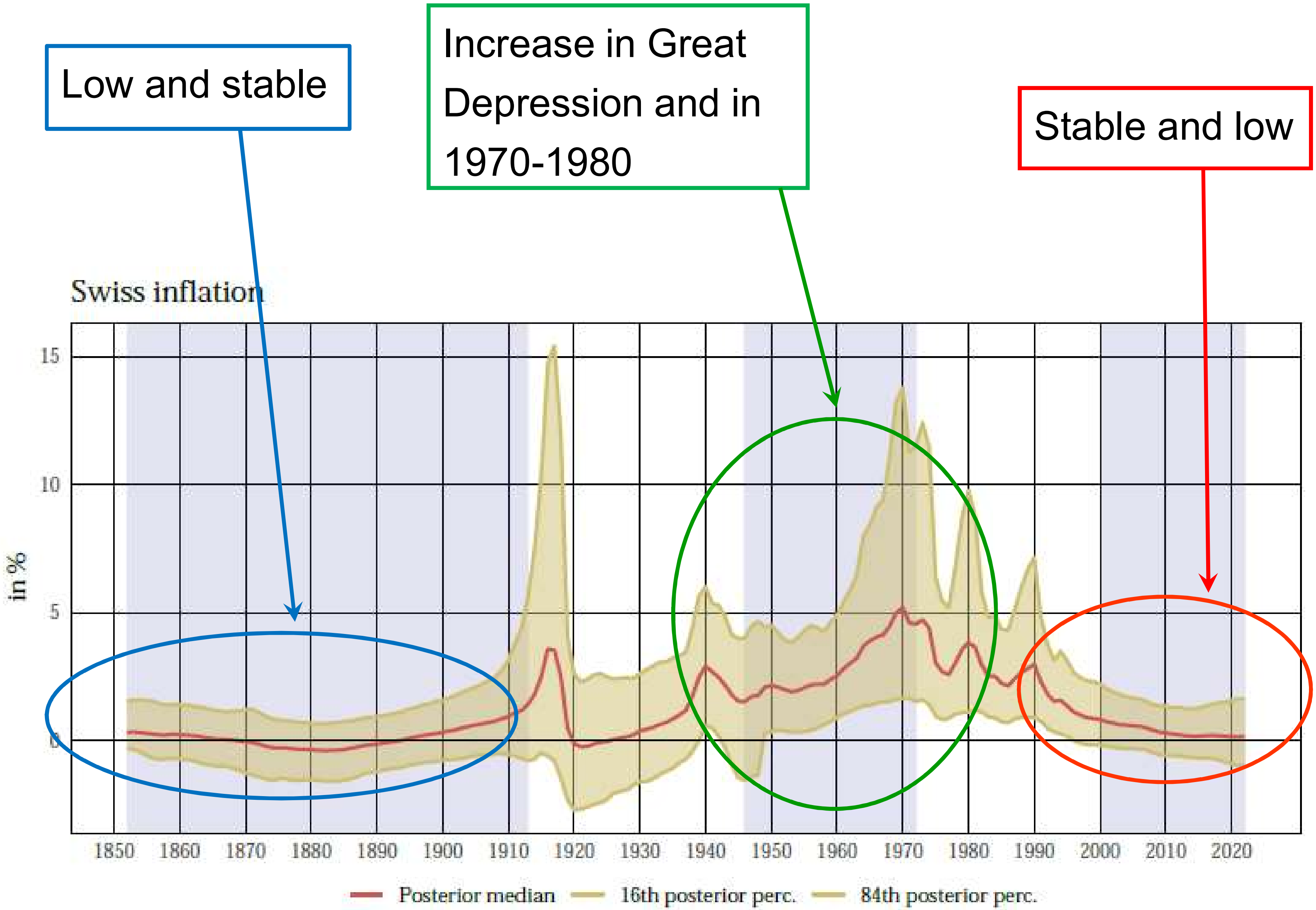
	Interest rate differential			Deviation from UIP		
	INF	IQR	SDT	INF	IQR	SDT
	(4)	(5)	(6)	(7)	(8)	(9)
Unc. x Metallic reg.	0.46	−2.94*	−0.10	1.33	−2.69*	0.08
	(1.50)	(1.59)	(0.61)	(1.31)	(1.54)	(0.70)
Unc. x World Wars	−1.10	0.56	0.12	−0.06	0.44	0.02
	(0.71)	(0.85)	(0.30)	(0.77)	(0.68)	(0.32)
Unc. x Bretton Woods	0.57	1.44*	0.97*	0.67	1.13***	0.86**
	(0.82)	(0.76)	(0.55)	(0.51)	(0.38)	(0.34)
Unc. x Monetary targ.	0.93***	1.27***	0.82***	0.71*	0.91*	0.60*
	(0.30)	(0.49)	(0.30)	(0.38)	(0.52)	(0.33)
Unc. x Inflation targ.	−0.19	−1.39	−0.23	−0.13	−1.28	−0.20
	(0.34)	(1.39)	(0.60)	(0.31)	(1.33)	(0.63)
Constant	0.15	−0.07	0.20	0.23	−0.04	0.22
	(0.47)	(0.48)	(0.57)	(0.44)	(0.50)	(0.66)
N	169	169	169	169	169	169
R^2	0.32	0.38	0.32	0.31	0.35	0.28
Adjusted R^2	0.30	0.36	0.30	0.29	0.33	0.26

Conclusion

- Long perspective using new dataset from archival sources.
- Nominal factors: countries with low inflation volatility can have lower rates if it reflects better targeted policy.
- Extraction of time-varying trends, and decomposition of drivers of interest rates.
  - Gold standard: Switzerland in line with rest of the world.
  - Interwar and 1970-1980's: higher trend inflation, decrease in real interest rate, positive term spreads, low interest rate island (since WW2).
  - Since 2000: normalisation, end of low interest island (other countries become more similar to Switzerland).
  - Evidence (in progress) of role of inflation volatility for UIP deviations during Bretton Woods and monetary targeting.

Extra slides

Inflation trend



Deviation from PPP