Assessing the ex ante uncertainty in the US SPF*

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2023 Conference on Real-Time Data Analysis, Methods, and Applications at Banco de España, Madrid

*The views expressed in this presentation are those of the authors and do not necessarily reflect those of the Deutsche Bundesbank or the Eurosystem

Introduction

- Economic uncertainty has received increasing attention in recent years
- Measuring uncertainty is important, but not straightforward. Surveys can provide measures of ex ante uncertainty of economic agents
- Quarterly US Survey of Professional Forecasters (SPF) and ECB SPF contain questions about probabilities of future macroeconomic developments (growth, inflation,...), yield histogram forecasts containing information about uncertainty
- Questions concern developments in
  - current calendar year (fixed-event forecast)
  - next calendar year (fixed-event forecast)
  - a fixed number of quarters (fixed-horizon forecast, only ECB SPF)
- Our aims:
  - Derive useful uncertainty measure from US SPF
  - Explore properties of US SPF uncertainty measure

Histograms (US GDP deflator)

	Survey Dates
Variable Number ↓	**2014:Q1 to Present**
	Ranges (Annual-Average over Annual-Average Percent Changes, Percentage Points)
1	4.0 or more
2	3.5 to 3.9
3	3.0 to 3.4
4	2.5 to 2.9
5	2.0 to 2.4
6	1.5 to 1.9
7	1.0 to 1.4
8	0.5 to 0.9
9	0.0 to 0.4
10	Will decline
11	Same as 1 – 10 for next year
12	
13	
14	
15	
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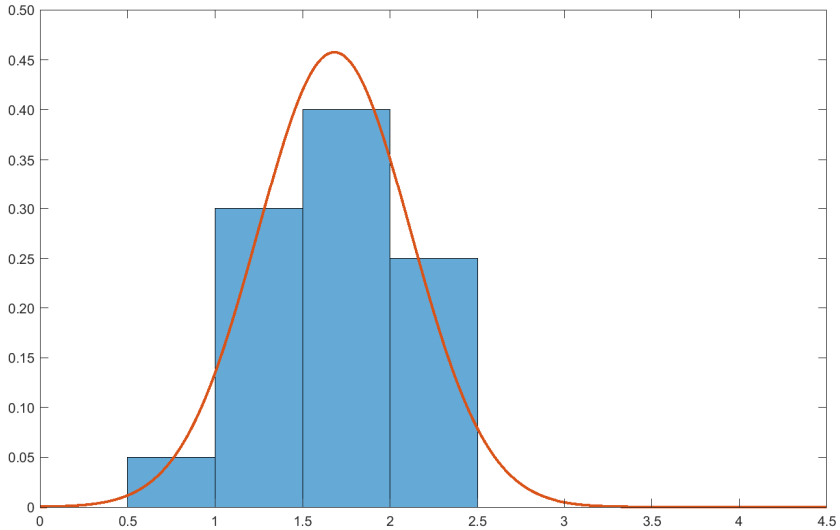
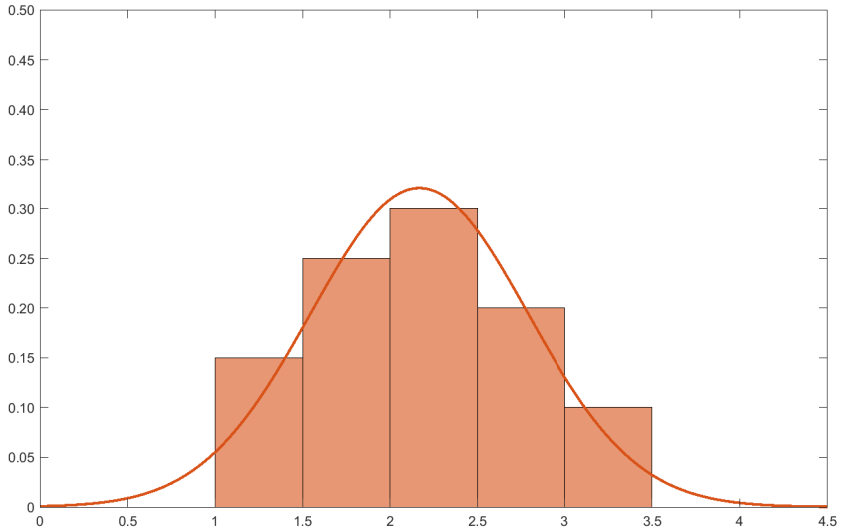
20	

Example histogram forecasts and fitted distributions

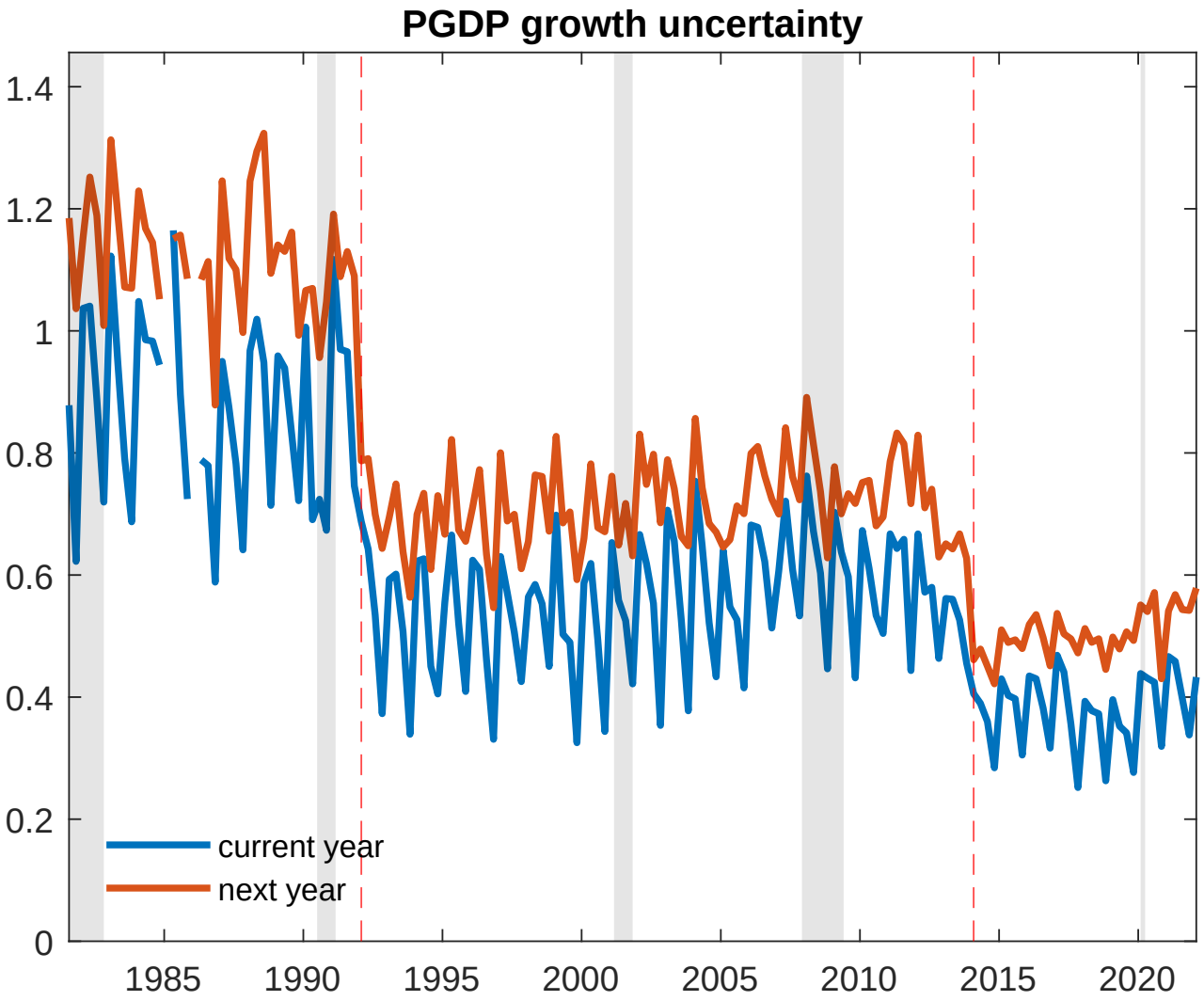




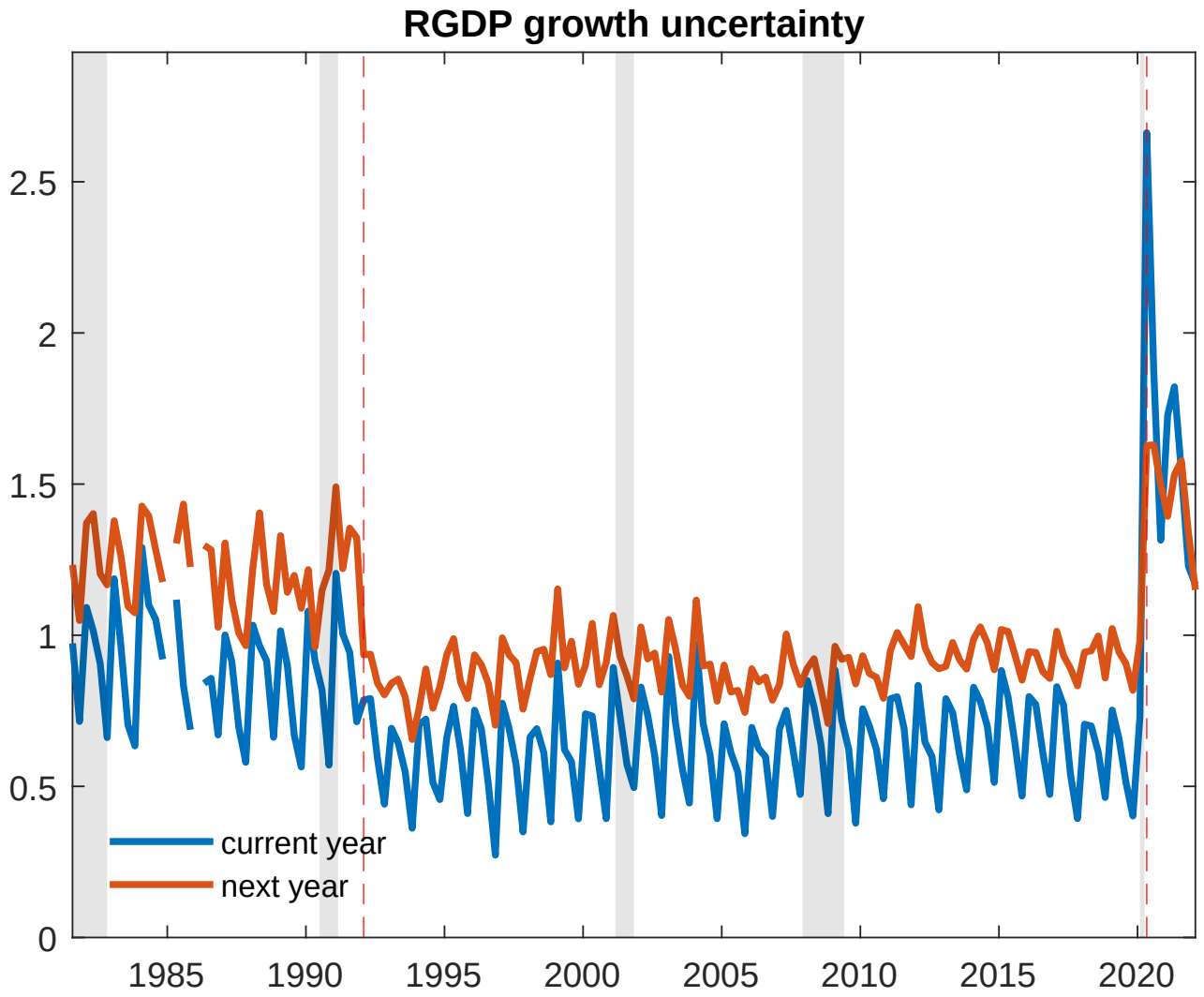
Histograms and corresponding fitted normal distributions for current year (left panel) and next year (right panel) GDP deflator growth from 2021q2, forecaster-ID 426

- To arrive at measure of aggregate uncertainty in a certain quarter
  1. calculate standard deviation for each forecaster
  2. average over all forecasters

US GDP deflator growth uncertainty



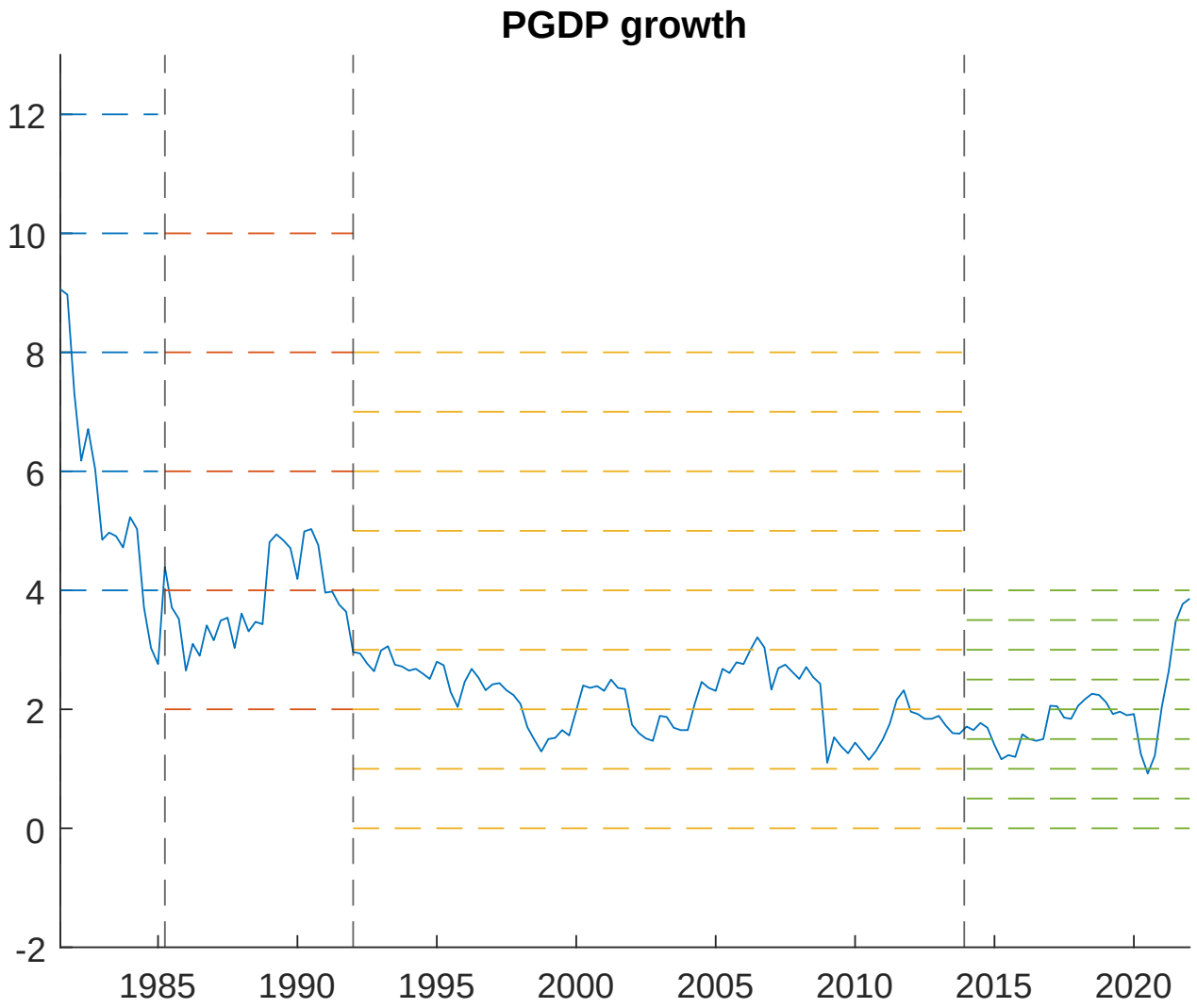
US real GDP growth uncertainty



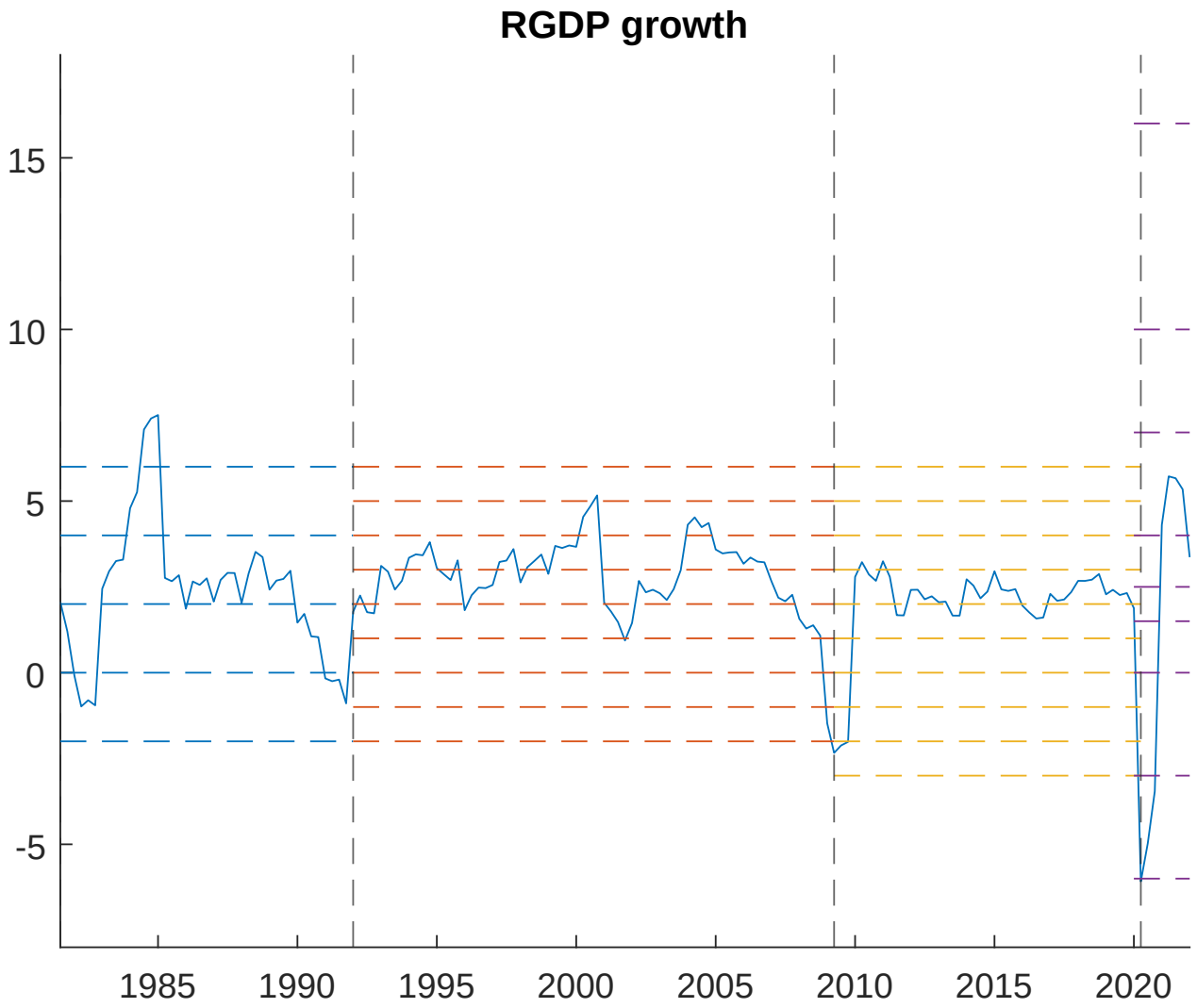
What we do

- We try to derive fixed-horizon uncertainty forecasts from fixed-event uncertainty forecasts for the US SPF
- Approach: linear combination of both fixed-event uncertainty forecasts from period t, which yields fixed-horizon uncertainty forecast from t
- Two major challenges
  - Understand structural breaks (largely ignored by literature until now)
  - Remove seasonality (coefficients of linear combination depend on quarter of forecast)
- Note: Our approach is related to Gánics, Rossi&Sekhposyan (forthcoming), who construct fixed-horizon density forecasts for the US SPF

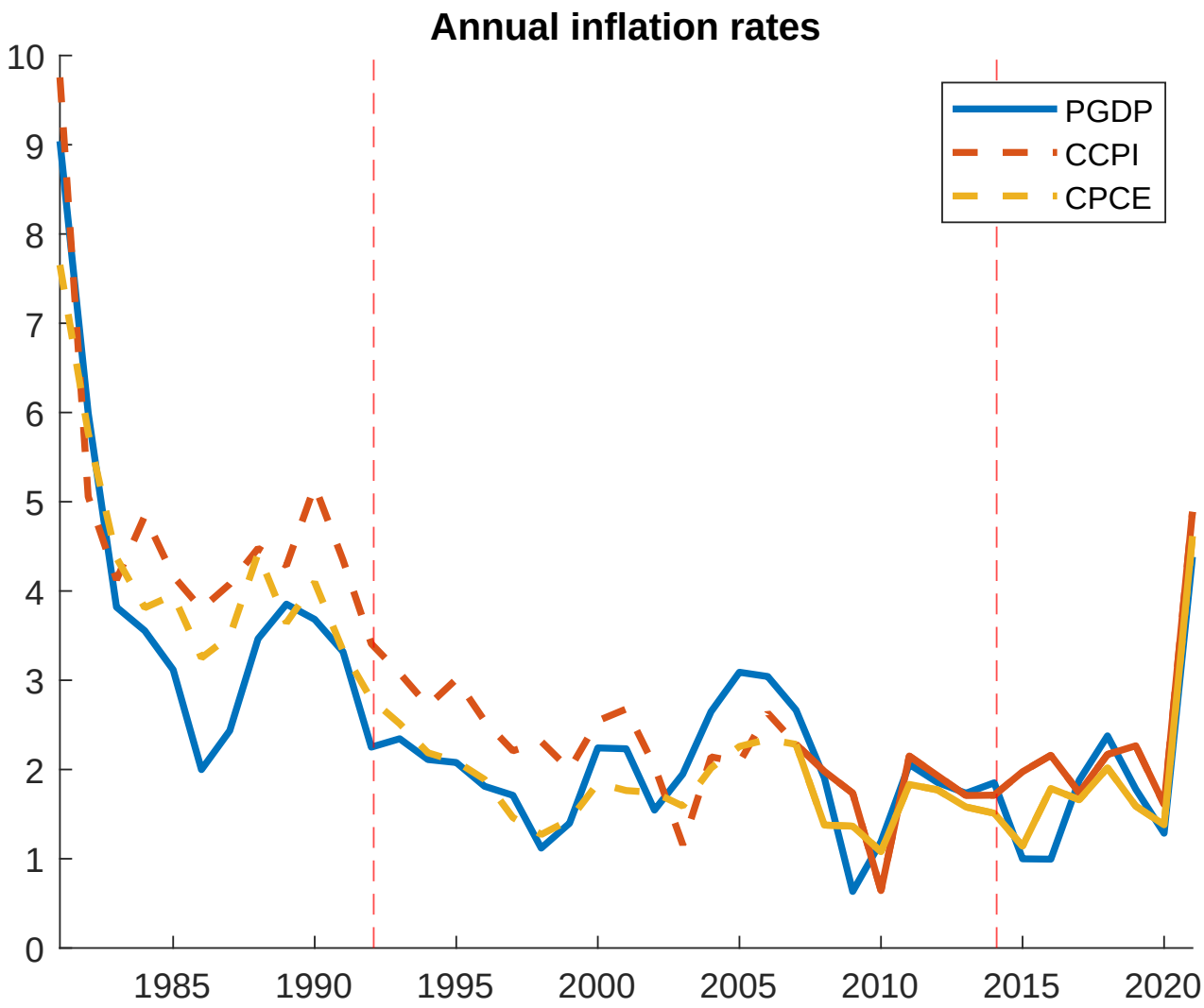
Structural breaks in US SPF - bin changes GDP deflator



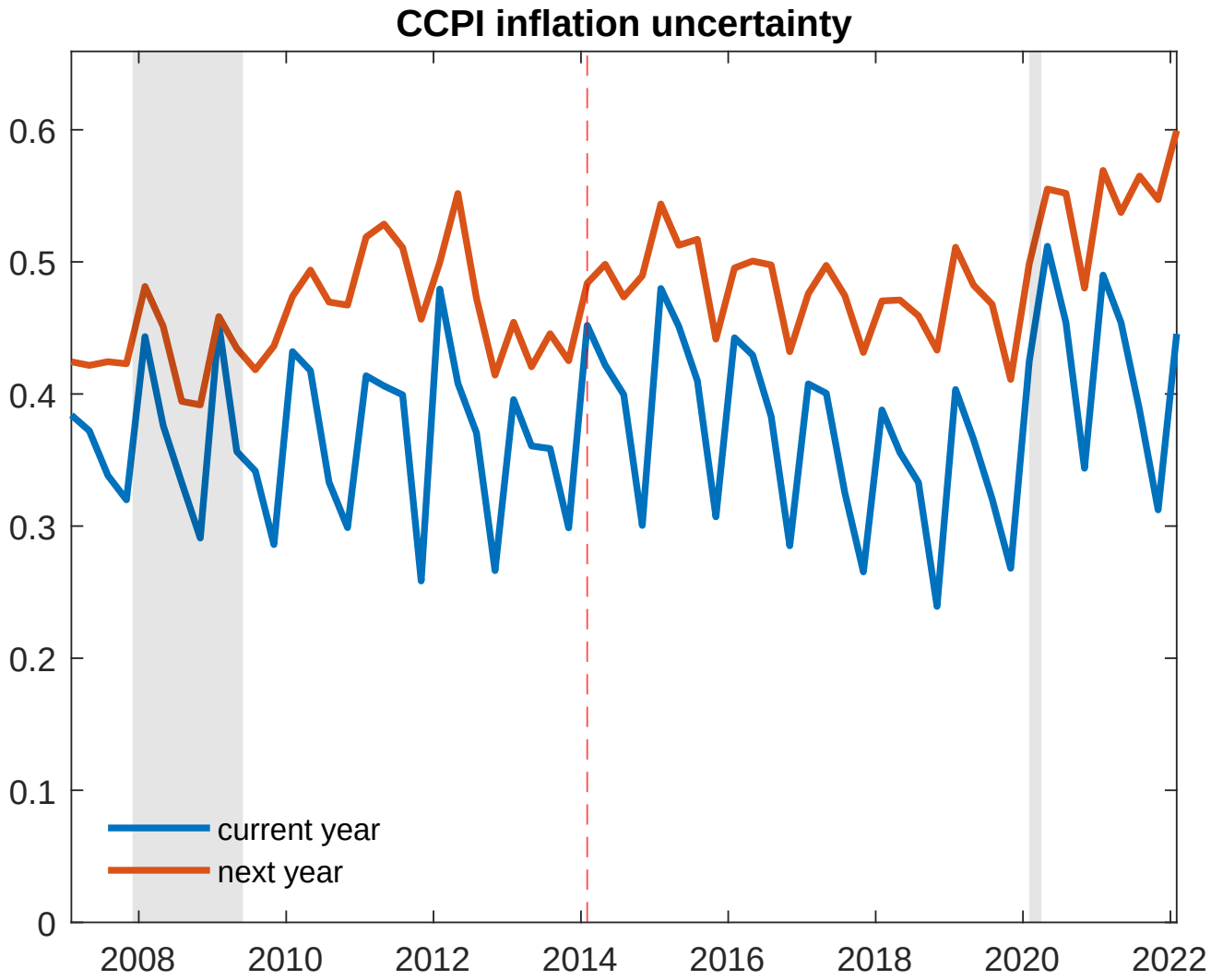
Structural breaks in US SPF - bin changes GDP deflator



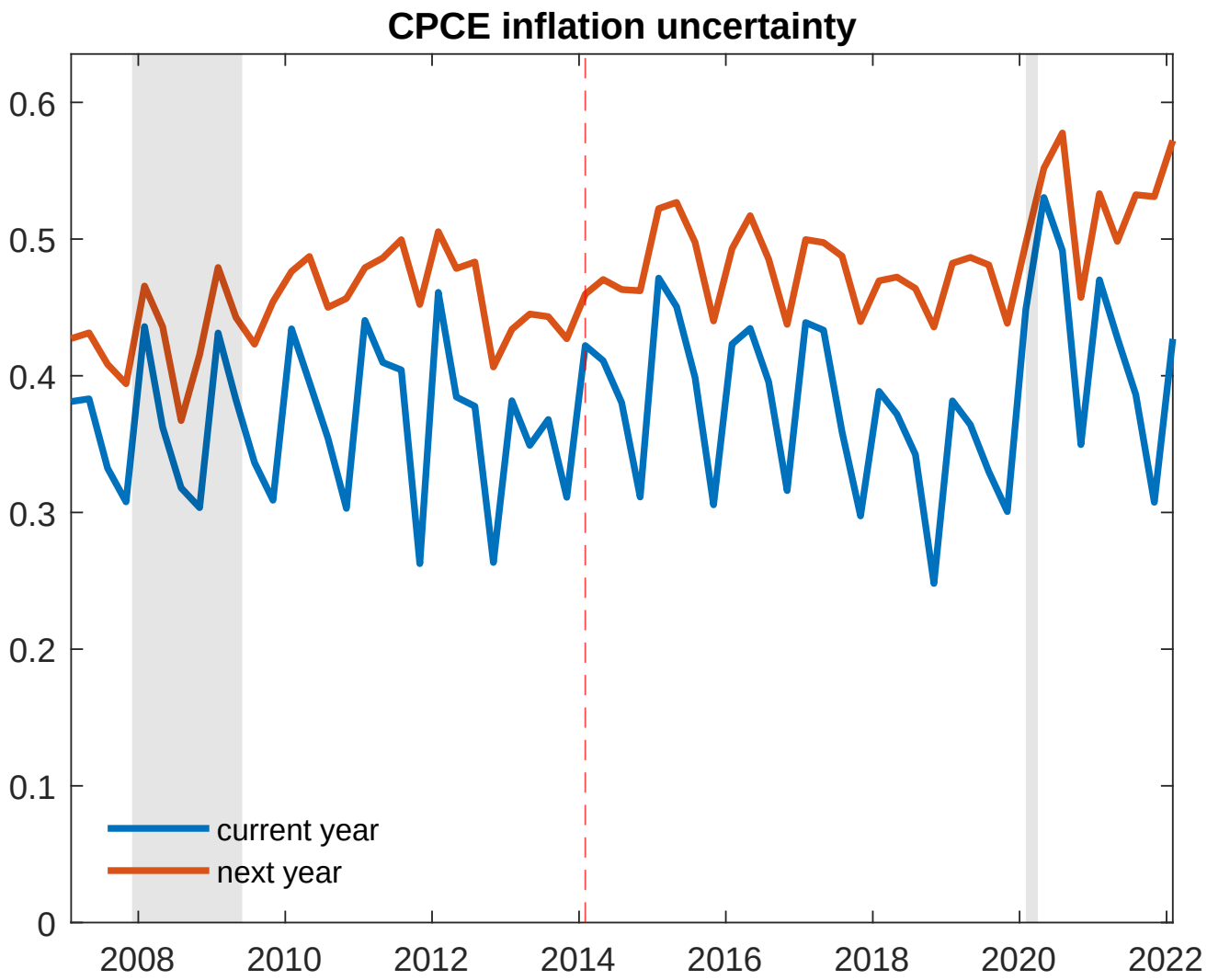
Structural breaks? Measures of annual US inflation



Structural break? US SPF core CPI inflation uncertainty



Structural break? US SPF core PCE inflation uncertainty



Structural break in inflation uncertainty in 2014?

- No evidence for structural break in US SPF ex ante core CPI and core PCE inflation uncertainty in 2014 based on sample 2009-2018
- No evidence for structural break in 2014 in (absolute values of) residuals 2009-2018 of autoregressive process for GDP deflator growth

$\rightarrow$ *No evidence against no structural break in inflation uncertainty in 2014*

- How does *measured* uncertainty depend on bin width?
  - Assumption: measured uncertainty given by

$$\sigma_{meas} = c \times x^{\gamma},$$

where c is some value and x denotes pp per bin

- Changes in x change measured uncertainty by

$$\Delta \ln \sigma_{meas} = \gamma \times \Delta \ln x$$

Estimating the effect of bin width change

- For

$$\Delta \ln \sigma_{meas} = \gamma \times \Delta \ln x$$

special cases are

  - $\gamma = 0$: bin width does not affect measured uncertainty (assumption in virtually entire literature)
  - $\gamma = 1$: forecasters ignore bin width; use same number of bins, assign same probabilities regardless of width (assumption of Glas and Hartmann, 2022)

- Estimating equation

$$\ln\left(\sigma^{\pi}_{t+j|t,i}\right) = c_{\pi,i,j} + \gamma \ln\left(x^{\pi}_{t,i}\right) + \varepsilon_t$$

with t year of forecast, i quarter of forecast, $j = 0, 1$ forecast target (current year, next year), sample 2009-2018, gives

$$\hat{\gamma} = 0.598 \text{ (std.err.: } 0.023)$$

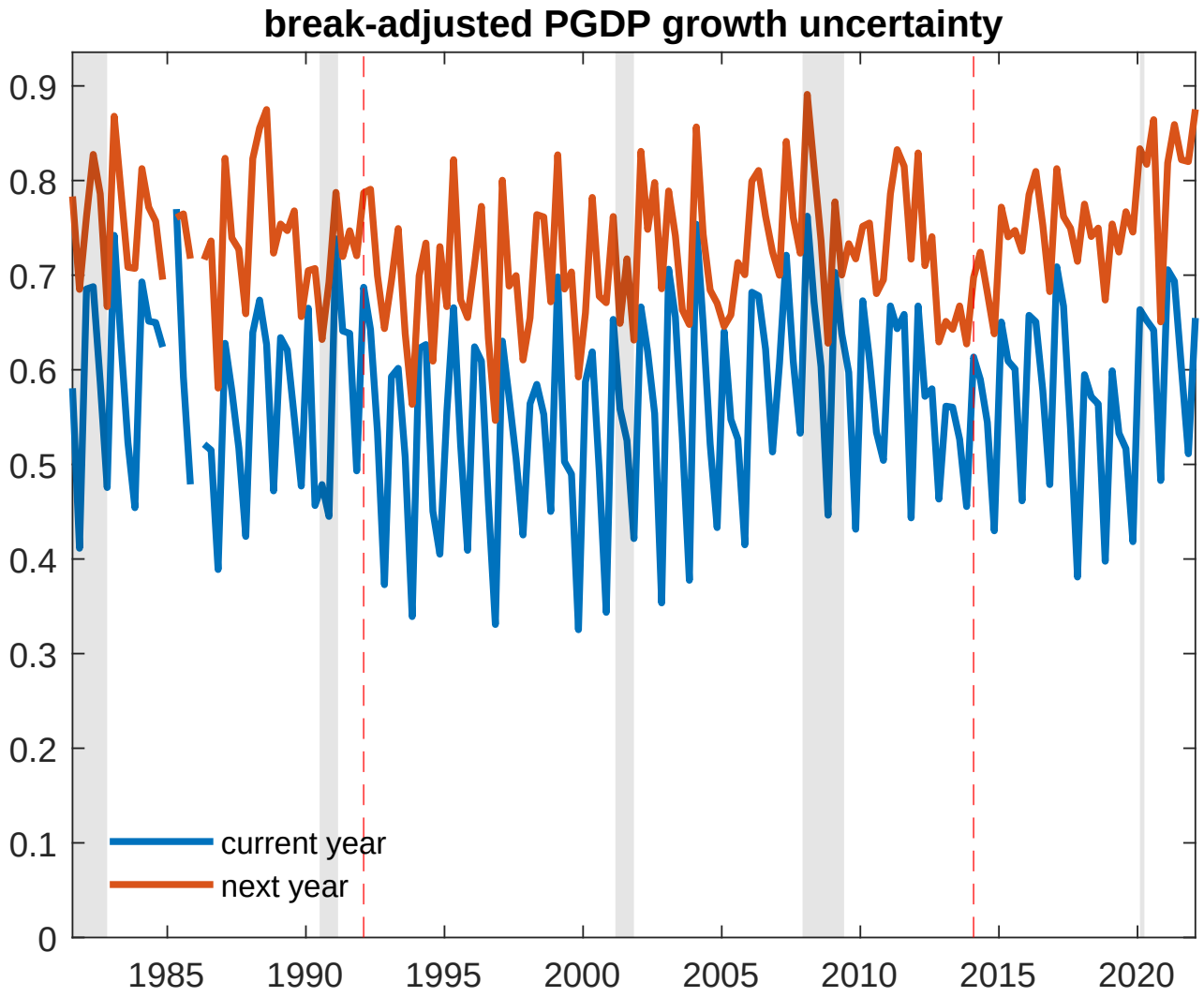
Break adjustment for histogram-based uncertainty

- $\gamma = 0.6$ implies that halving bin width reduces measured standard deviation by $1/3$
- Determine break-adjusted uncertainty as

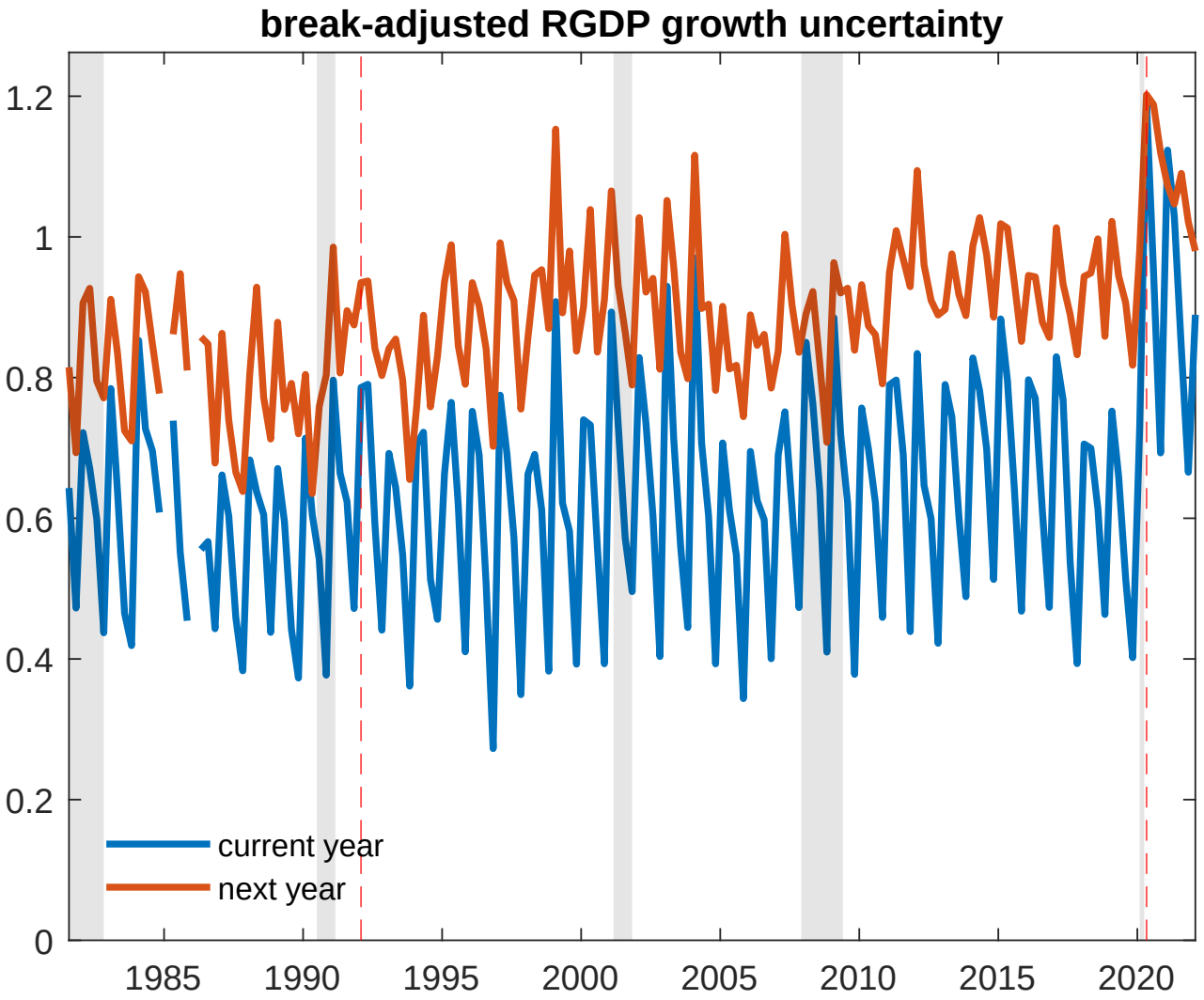
$$\tilde{\sigma}_{t+j|t,i} = \sigma_{t+j|t,i} \left(x_{t,i}\right)^{0.598}$$

  for each period t, i and both fixed-event forecasts $j = 0, 1$
- $x^{\pi}_{t,i} = x^{y}_{t,i} = 1$ from 1992q1 to 2013q4($x^{\pi}_{t,i}$)/2020q1($x^{y}_{t,i}$)
  $\rightarrow$ break-adjusted uncertainty coincides with original uncertainty
- $x^{\pi}_{t,i} = x^{y}_{t,i} = 2$ from 1981q3 until 1991q4
- Since 2014q1, $x^{\pi}_{t,i} = 0.5$
- Since 2020q2, $x^{y}_{t,i}$ time-varying and dependent on j due to use of different widths

Break-adjusted US GDP deflator growth uncertainty



Break-adjusted US real GDP growth uncertainty



Seasonal adjustment

- Fixed-horizon (3-q-ahead) uncertainty $\hat{\sigma}_{(t,i)+3|t,i}$ determined by

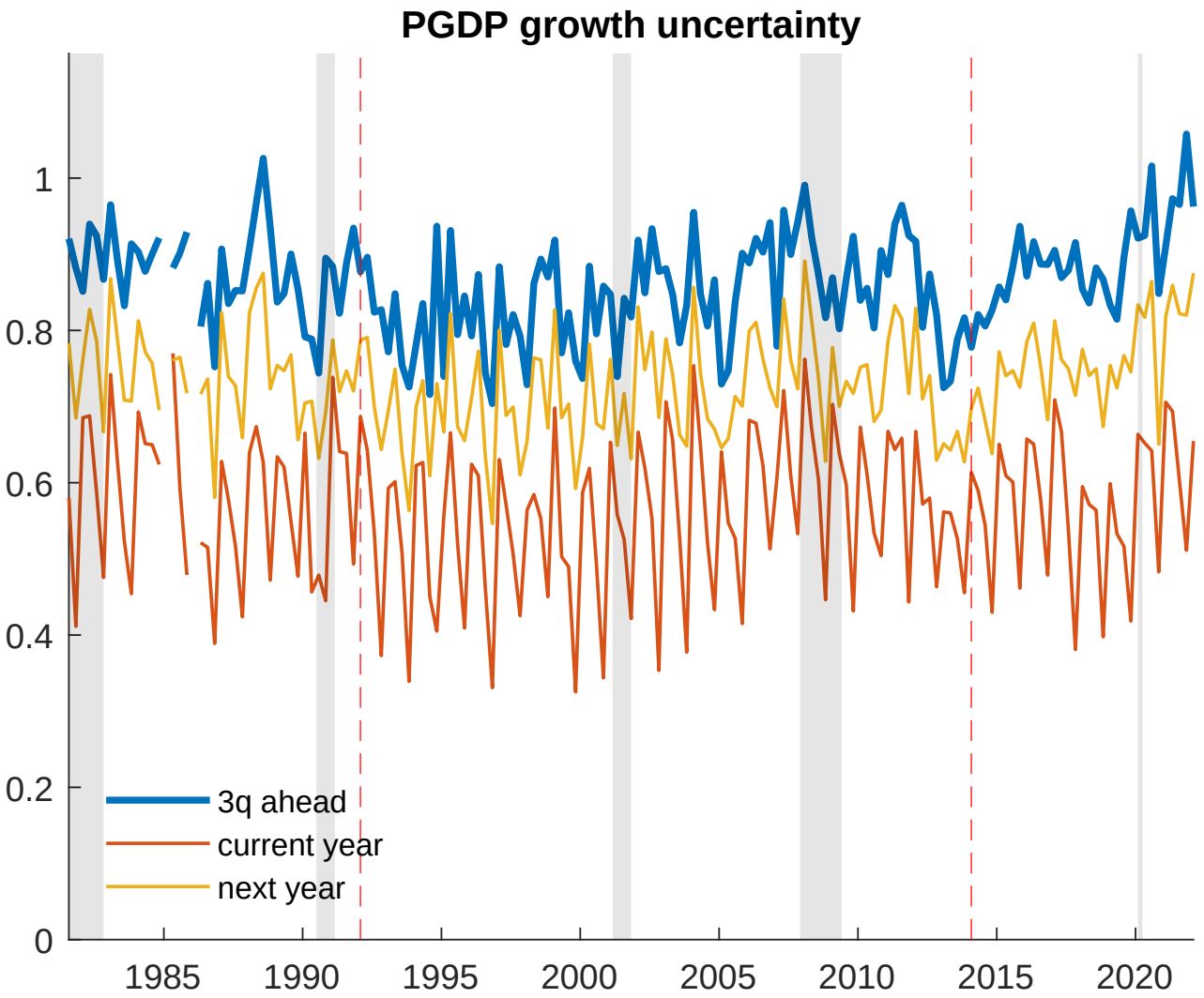
$$\left(\hat{\sigma}_{(t,i)+3|t,i}\right)^2 = b_{1,i}\left(\tilde{\sigma}_{t|t,i}\right)^2 + b_{2,i}\left(\tilde{\sigma}_{t+1|t,i}\right)^2$$

  with $b_{1,i} = \lambda \times b_{2,i}$, $\lambda \geq 0$

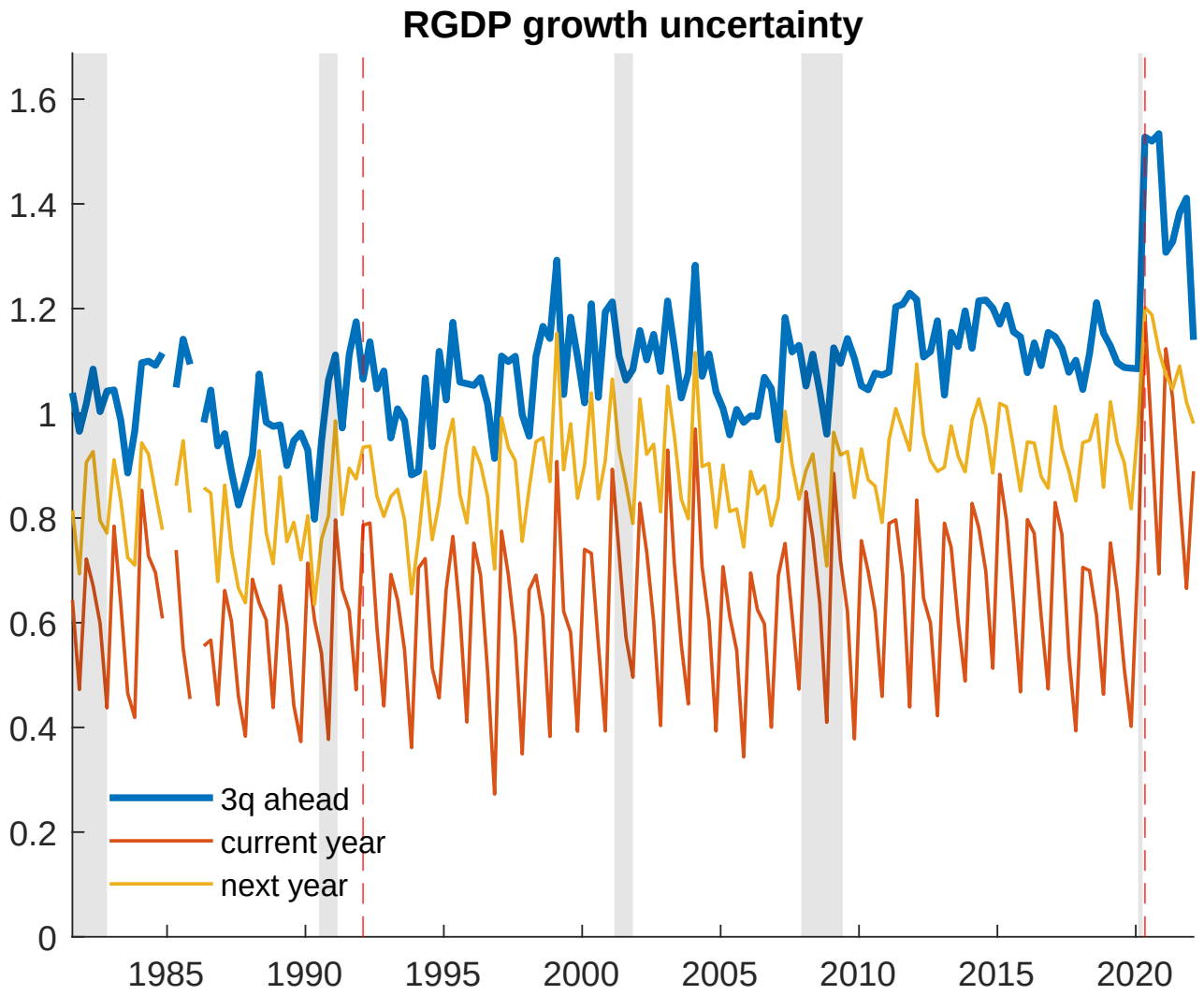
- $b_{1,i}, b_{2,i}$ based on MSEs of monthly AR(1)-process with coef. ρ
- ρ, λ chosen such that a seasonality test statistic is minimized

	GDP deflator growth		real GDP growth	
ρ^*	0.00		0.19	
λ^*	0.14		0.50	
	$b^*_{1,i}$ (cur.)	$b^*_{2,i}$ (next)	$b^*_{1,i}$ (cur.)	$b^*_{2,i}$ (next)
$i = q1$	0.16	1.12	0.48	0.96
$i = q2$	0.16	1.18	0.54	1.08
$i = q3$	0.18	1.28	0.62	1.24
$i = q4$	0.22	1.58	0.79	1.57

US GDP deflator growth fixed-horizon uncertainty



US real GDP growth fixed-horizon uncertainty

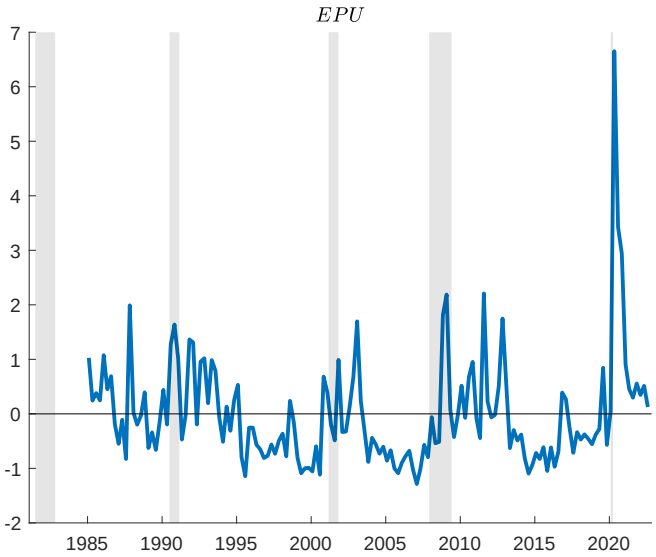


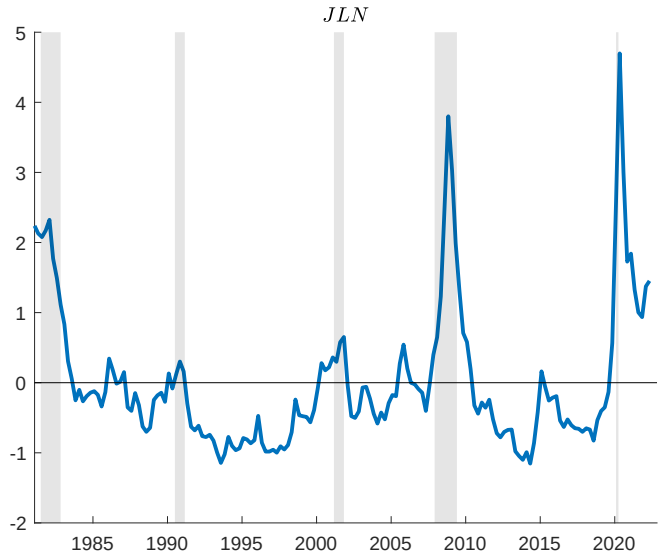
Properties of break- and seasonally adjusted uncertainty

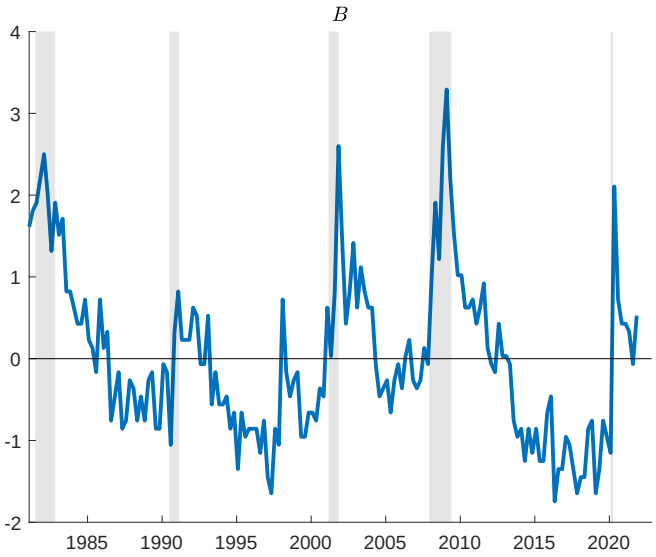
- US SPF fixed-horizon uncertainties hardly related to business cycle except for growth in pandemic recession
- Other uncertainty measures like
  - Economic Policy Uncertainty (Baker, Bloom, and Davis, 2016)
  - Macro Uncertainty (Jurado, Ludvigson, and Ng, 2015)
  - Rounding-Based Inflation Uncertainty (Binder, 2017)
  - Growth Disagreement (US SPF point forecast dispersion)

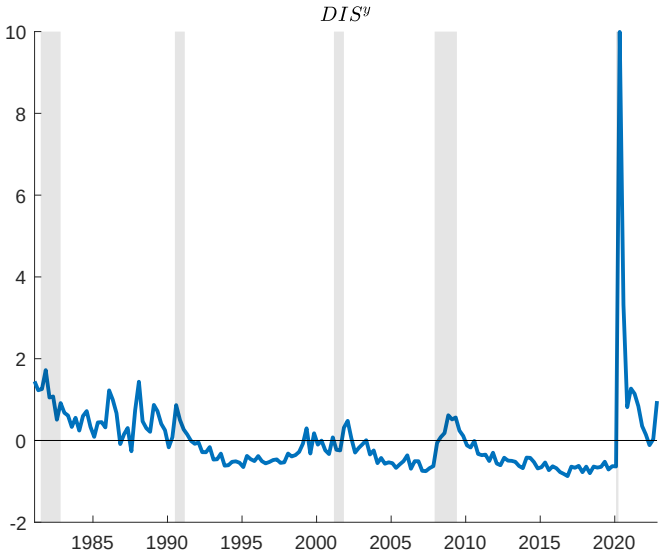
  typically attain large values during each recession
- How are US SPF fixed-horizon uncertainties related to established uncertainty measures?

Other uncertainty measures









Correlations

	$\hat{\sigma}_y^*$	DIS^y	EPU	JLN	B
$\hat{\sigma}_\pi^*$	0.41^{***}	0.22^{*}	0.18^{*}	0.31^{**}	0.22^{***}
$\hat{\sigma}_\pi^*$	0.33^{***}	0.17^{*}	0.08	0.20^{**}	0.21^{***}
$\hat{\sigma}_\pi^*$	0.50^{***}	-0.02	0.07	0.19^{**}	0.15^{*}
$\hat{\sigma}_y^*$		0.27	0.37	0.25	0.07
$\hat{\sigma}_y^*$		-0.32^{**}	0.00	-0.12	-0.04
$\hat{\sigma}_y^*$		0.02	0.05	-0.05	-0.03
DIS^y			0.70	0.65^{*}	0.46^{***}
DIS^y			0.39^{***}	0.56^{**}	0.57^{**}
DIS^y			0.33^{*}	0.62	0.74^{**}

Note: The first of the three rows of correlations always refers to the sample 1981q3 to 2022q1, the second row to 1981q3 to 2019q4, and the third row to 1992q1 to 2019q4.

Correlations and uncertainty shocks

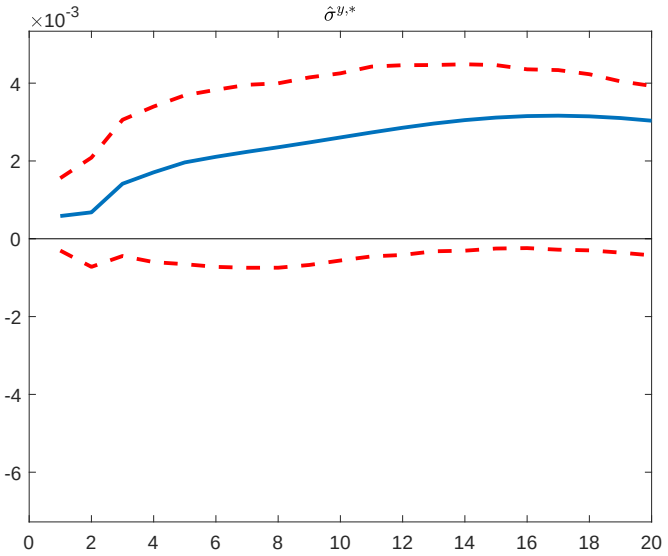
- US SPF fixed-horizon...
  - growth uncertainty virtually uncorrelated...
  - inflation uncertainty weakly correlated...
  - growth disagreement at least moderately correlated...

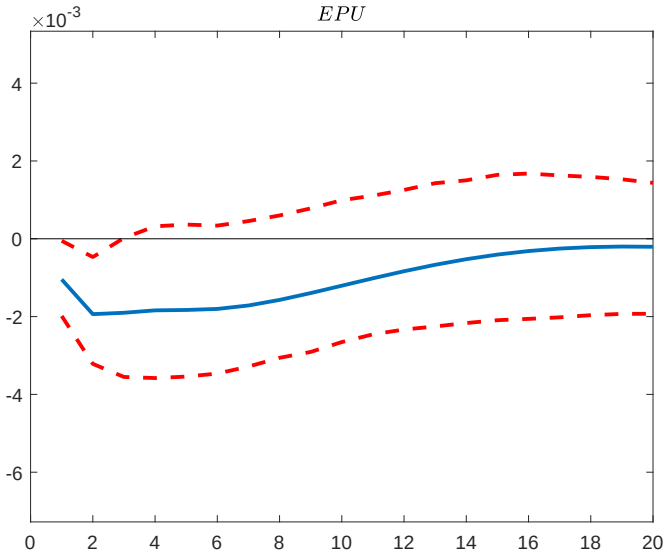
  with common uncertainty indices

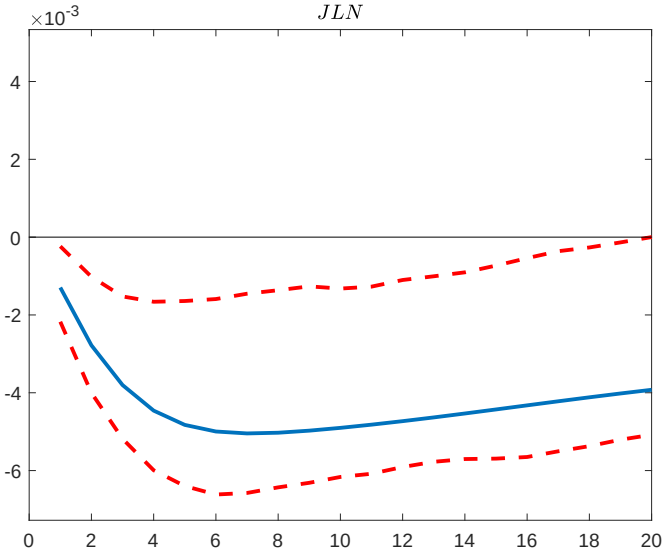
- Stylized fact about uncertainty: Positive uncertainty shocks reduce economic activity
- What about US SPF fixed-horizon uncertainty shocks?
- Estimate 5-variable quarterly VAR from Rossi&Sekhposyan (2015)
  - standardized uncertainty measure
  - log of S&P 500
  - Federal Funds rate
  - log of employment
  - log of real GDP

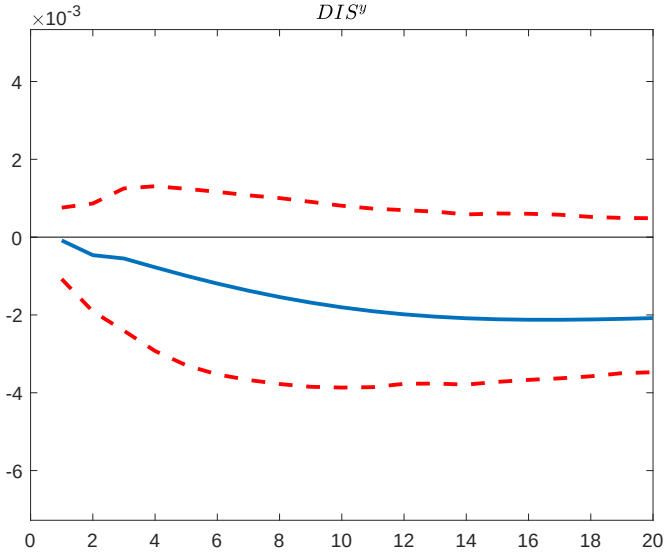
  and calculate response of real GDP to uncertainty shock
- Estimation sample is 1985q1 to 2019q4

Real GDP response to uncertainty shock





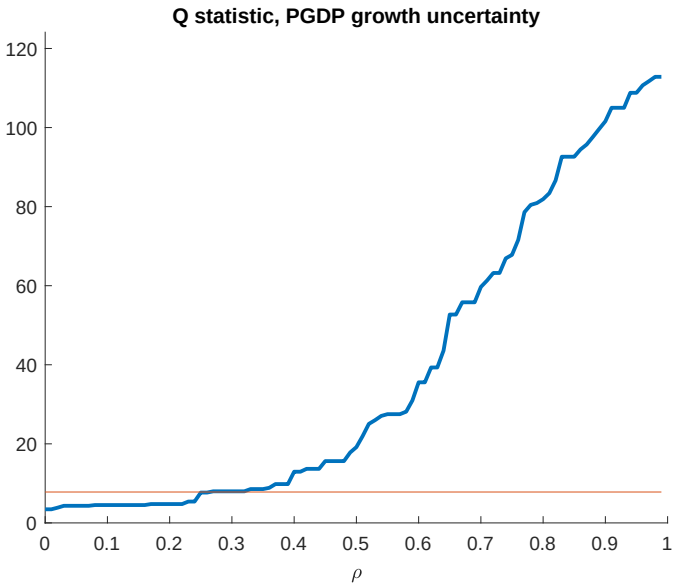


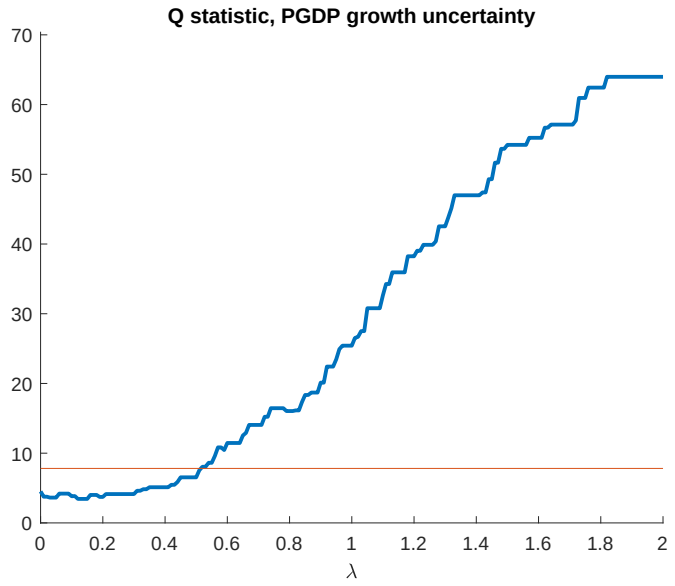


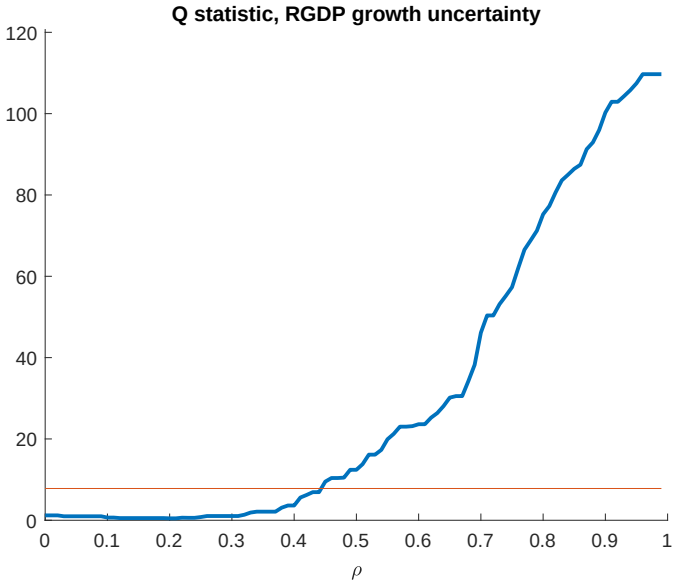
Conclusion

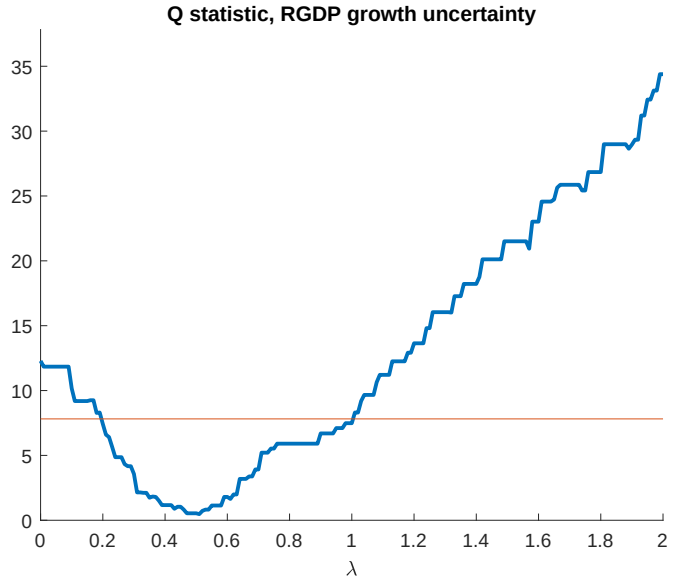
- Deriving useful ex ante uncertainty from US SPF is challenging
  - Underlying histogram forecasts are subject to large structural breaks
  - We propose approach for break adjustment, which requires potentially strong assumptions
  - Fixed-event uncertainties have seasonal pattern
  - Seasonal adjustment based on properties of forecast uncertainty seems feasible
- Properties of derived ex ante uncertainty at least partly at odds with conventional wisdom about evolution and effects of economic uncertainty
- Better understanding of effects of histogram definitions needed
- Disagreement appears to be a more recommendable measure of ex ante uncertainty from US SPF
- Other survey design required to obtain robust information about expected distributional features?

Q statistics for inflation, growth depending on ρ, λ









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