Outline/Motivation
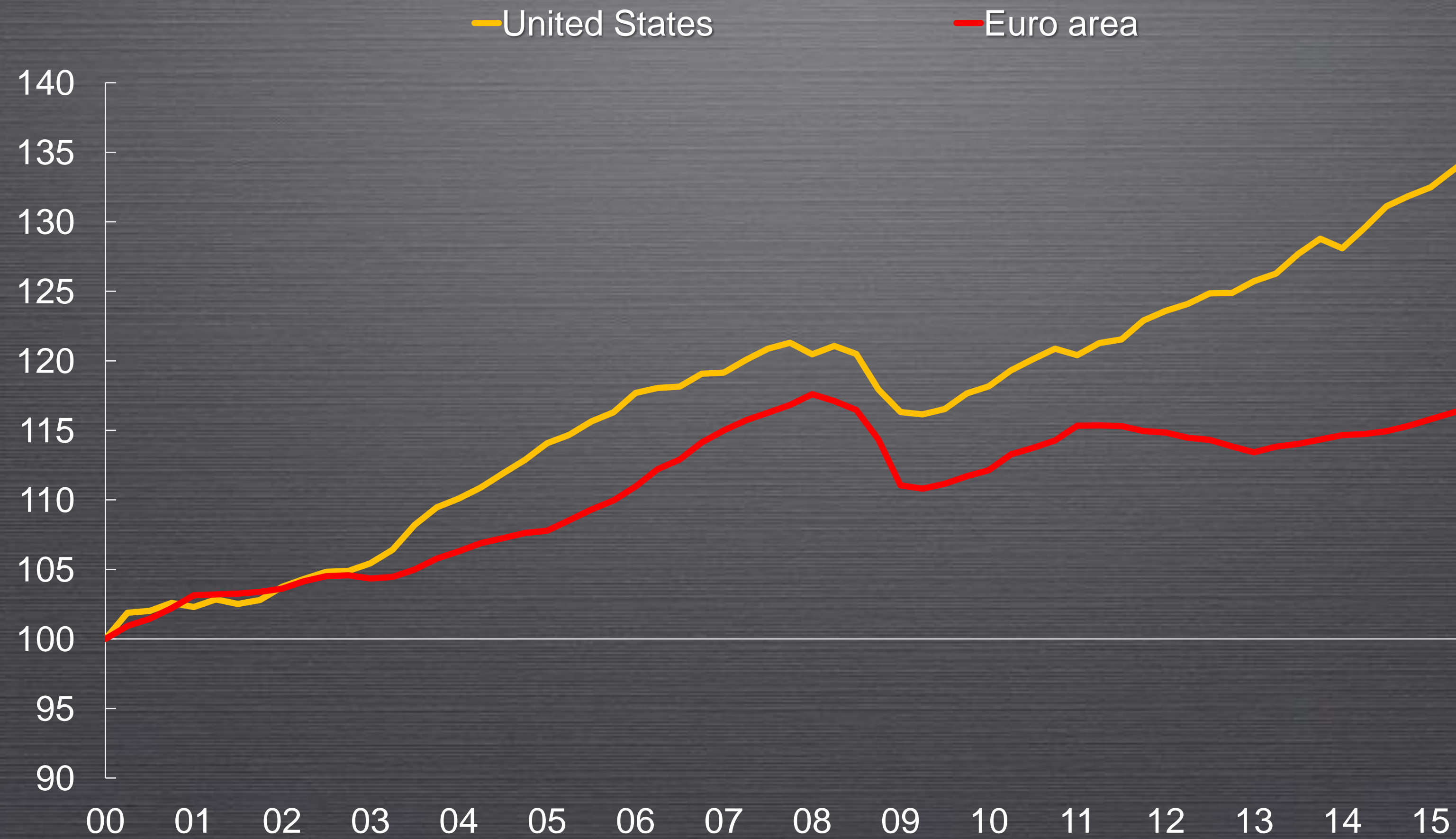
- Two striking facts :

  -Output remains far below the pre-recession trend

  -Inflation decreased less than was anticipated

- Two explorations:

  - Revisit the hysteresis hypothesis

  - Revisit relation between unemployment and inflation

- Draw monetary policy implications

- Caveat: Explorations.

Recessions and Subsequent Output - Methodology

Non-parametric method, focused on recessions. 23 countries, 50 years

- Defining Recessions: Harding and Pagan (2002)

  - By identifying peaks and troughs as local maxima and minima in the log level real GDP series. About 120 recessions.

- Estimating pre-recession trends (Position and Slope):

  - Position (Alt A: two year before recession; Alt B: two or more if credit boom)

  - Slope   (Alt A: 4 year window; Alt B: 10 year window)

- Using two GDP series:
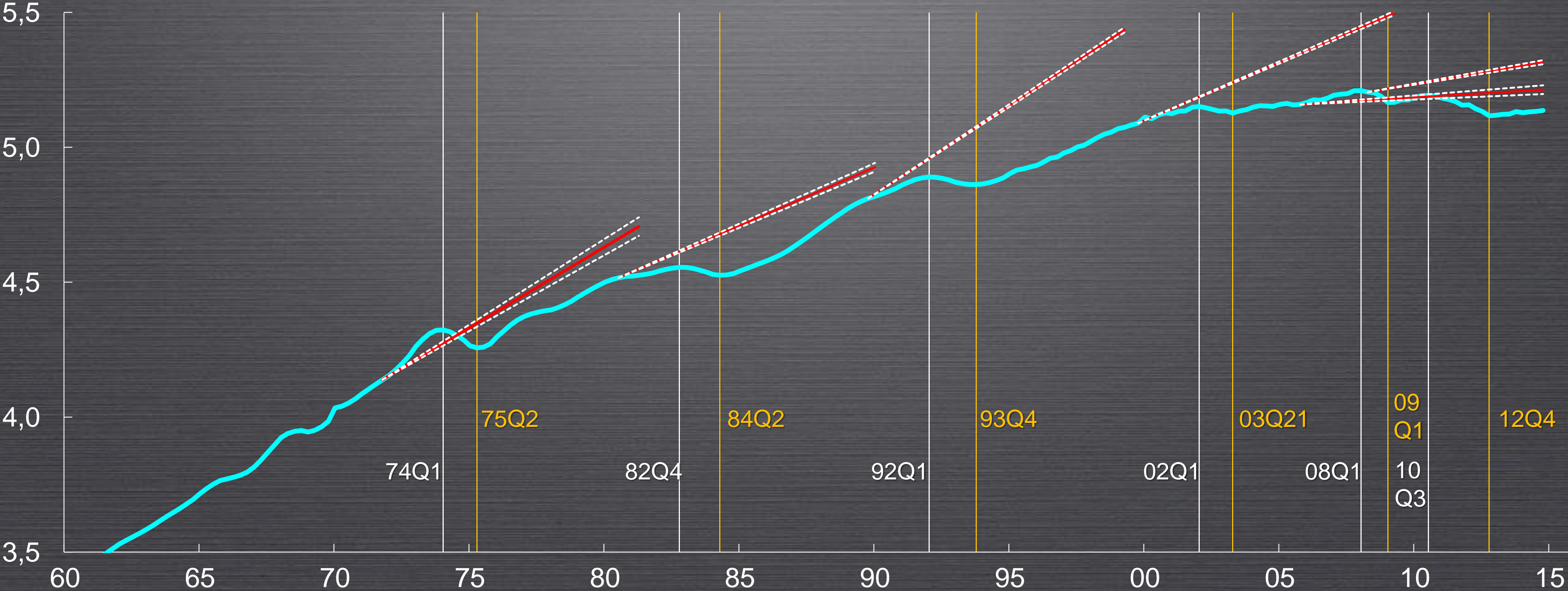 - Log Real GDP
  - Log Real GDP per working age population

United States: Log real GDP and Extrapolated Trends

Source: IMF, *World Economic Outlook.*

4
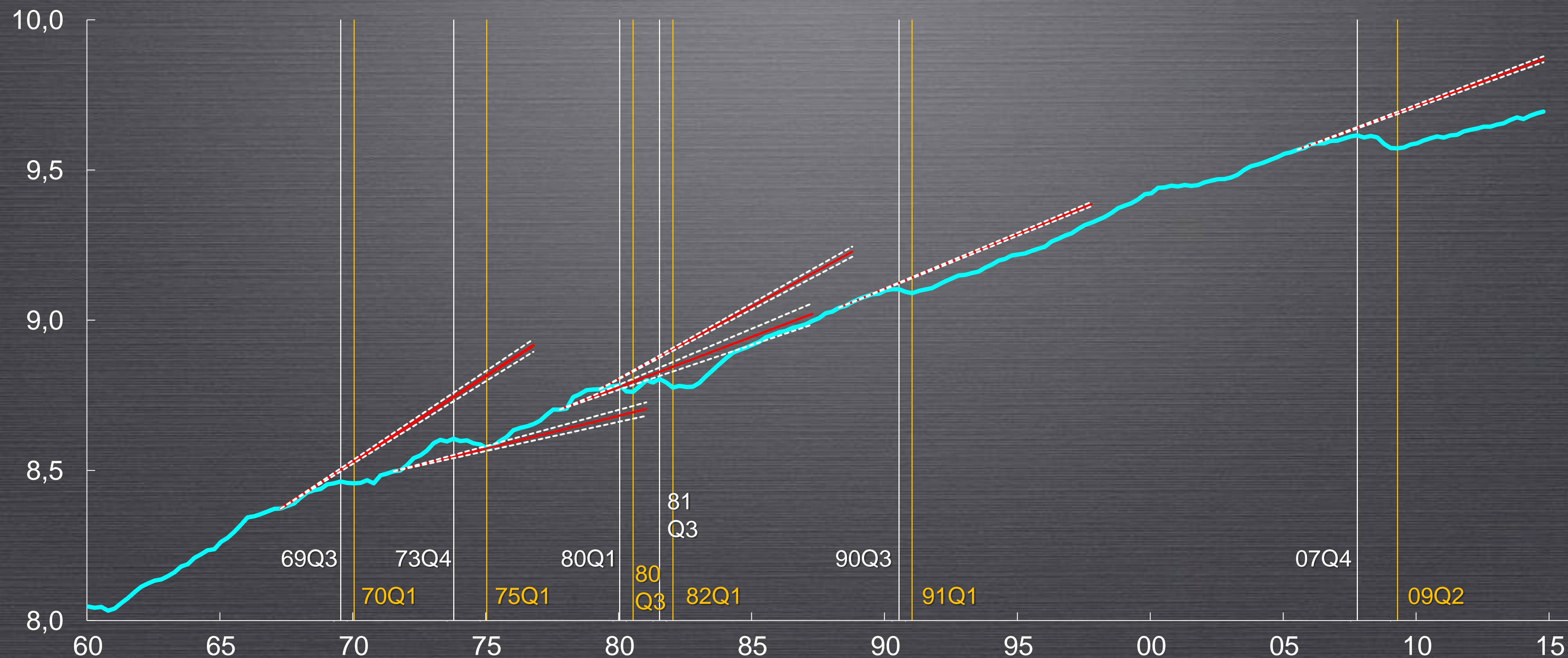
Portugal: Log real GDP and Extrapolated Trends

Source: IMF, *World Economic Outlook.*

Recessions, Output Level and Trend

GDP series used	Trend Extrapolation Starting Point	Trend Calculation: 4 year window			Trend Calculation: 10 year window		
		Episodes with NO sustained gap	Episodes with sustained gap	of which: Increasing over time	Episodes with NO sustained gap	Episodes with sustained gap	of which: Increasing over time
Log Real GDP	Benchmark: 2 Years Before	36%	64%	46%	39%	61%	40%
Log Real per capita GDP	Benchmark: 2 Years Before	43%	57%	40%	43%	57%	36%

- Recessions have been followed by a sustained gap between the actual series and the estimated trend in 2/3 of recessions.
- In 2/3 of those recessions, recessions have been followed by an increasing output gap (i.e. growth lower than pre-recession trend)

From Correlation to Causality?

Fact: Many recessions followed by lower output, even lower output growth

1. Recessions lead to lower output (hysteresis), or even to lower output growth (``super hysteresis'')

    Hysteresis: Through changes in behavior, skills, regulation, institutions.
    Super hysteresis: Less reallocation, less R&D spending?

2.Adverse shocks with acute and then chronic effects: Higher oil prices, Financial crises.

3. Reverse causality. Decreases in underlying growth, leading to decrease in spending and a recession.

Log GDP per Capita: Recessions and Supply Shocks

Scenario	Trend Calculation: 4 year window			Trend Calculation: 10 year window		
	Episodes with NO sustained gap	Episodes with sustained gap	of which: Increasing over time	Episodes with NO sustained gap	Episodes with sustained gap	of which: Increasing over time
With financial crisis	39%	61%	48%	22%	78%	61%
Without financial crisis	43%	57%	38%	48%	52%	30%
With oil price increases	28%	72%	67%	6%	94%	72%
Without oil price increases	45%	55%	36%	50%	50%	30%

- Larger output gaps in recessions associated with supply shocks
- But not always by a lot

Log GDP per Capita: Recessions and "Demand" Shocks

Scenario	Trend Calculation: 4 year window			Trend Calculation: 10 year window		
	Episodes with NO sustained gap	Episodes with sustained gap	of which: Increasing over time	Episodes with NO sustained gap	Episodes with sustained gap	of which: Increasing over time
With increasing inflation	38%	62%	44%	38%	62%	43%
With declining inflation	33%	67%	49%	42%	58%	36%
With intentional disinflation	61%	39%	21%	64%	36%	14%
Without intentional disinflation	37%	63%	46%	37%	63%	43%

- Even for recessions associated with intentional disinflations, the proportion followed by an output gap remains high (about 1/3).
- Still 14-21% of the cases with increasing gaps over time.

2: "The Missing Disinflation"

Advanced Economies CPI Headline Inflation
(percent; year over year)
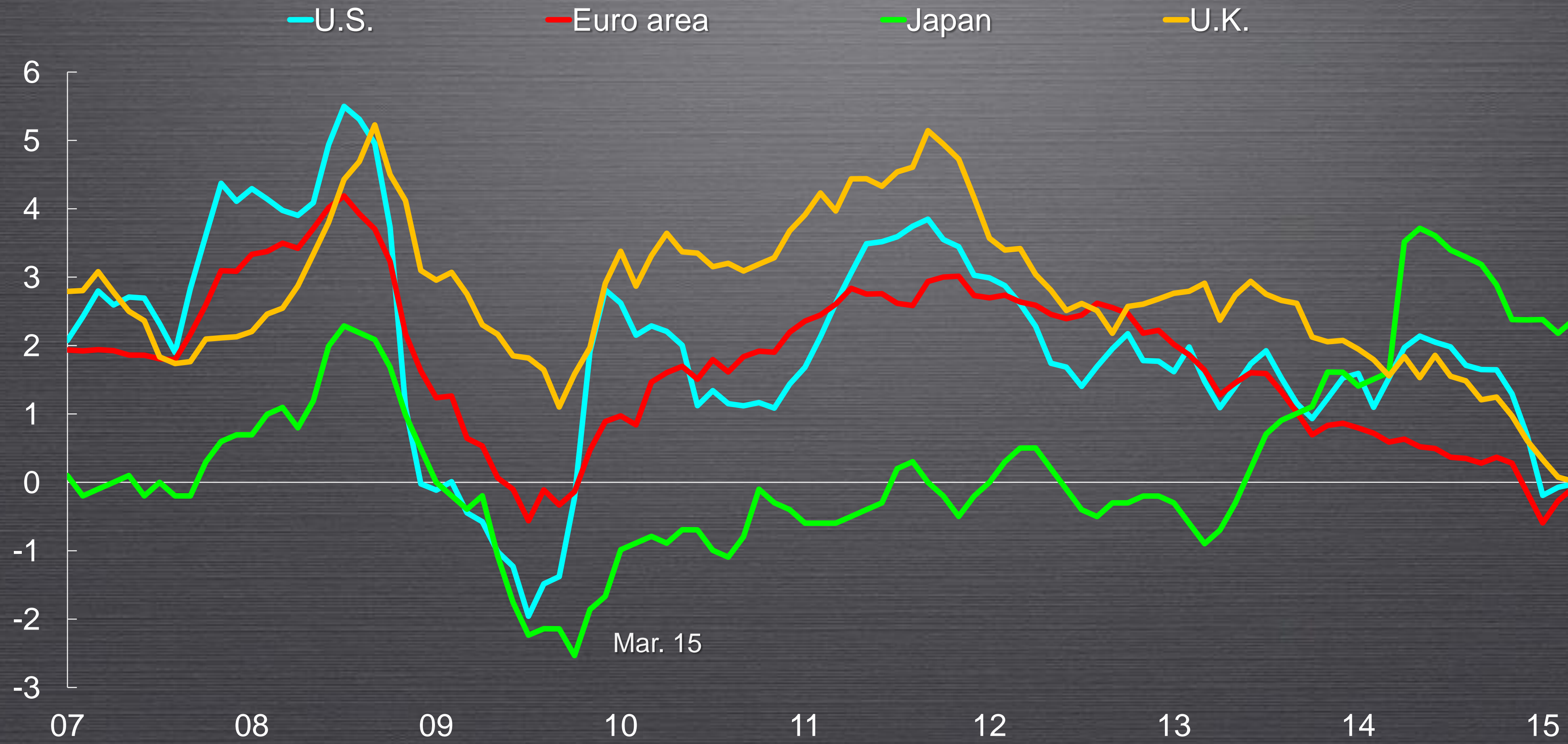
Estimating Phillips Curves

Clearly: Stronger anchoring of expectations. But appears to be more.

So estimate time varying Phillips curves (using non linear Kalman filter)

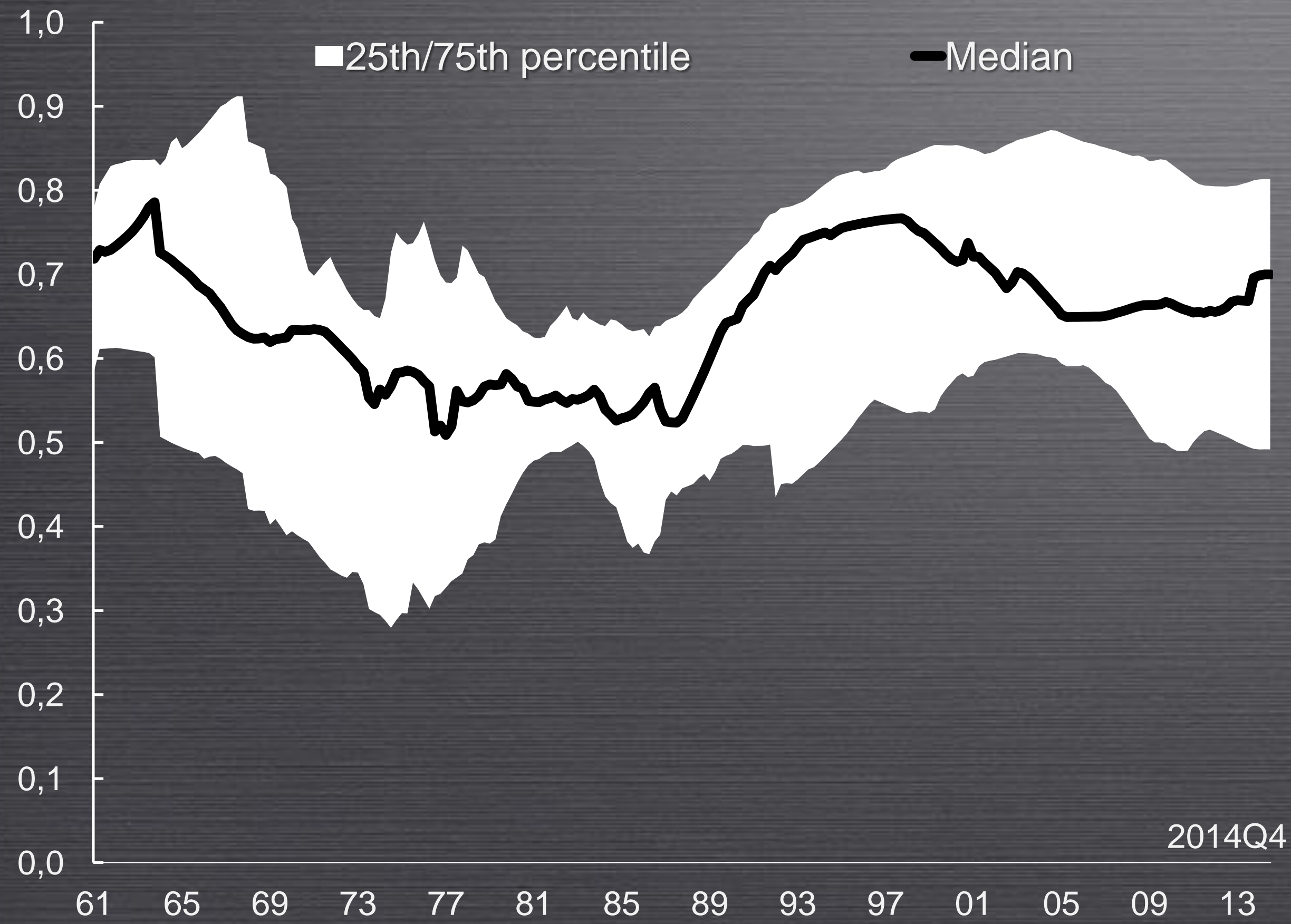$$\pi_t = \theta_t(u_t - u_t^*) + \lambda_t \pi^e_{\ t} + (1-\lambda_t)\pi_{t-1} + \mu_t \pi_{mt} + \varepsilon_{\ t}$$

The parameters: λ_t, θ_t, μ_t, and the natural rate, which is unobservable, are assumed to follow constrained random walks (θ_t and $\mu_t \geq 0$, and $0 \leq \lambda_t \leq 1$)

Estimated over 50 years, 20 countries. Country specific coefficients.

Phillips Curve Estimates - Benchmark

Anchoring of Inflation to Long Term Expectations (λ)
(median all countries)

Slope of the Phillips Curve (θ)
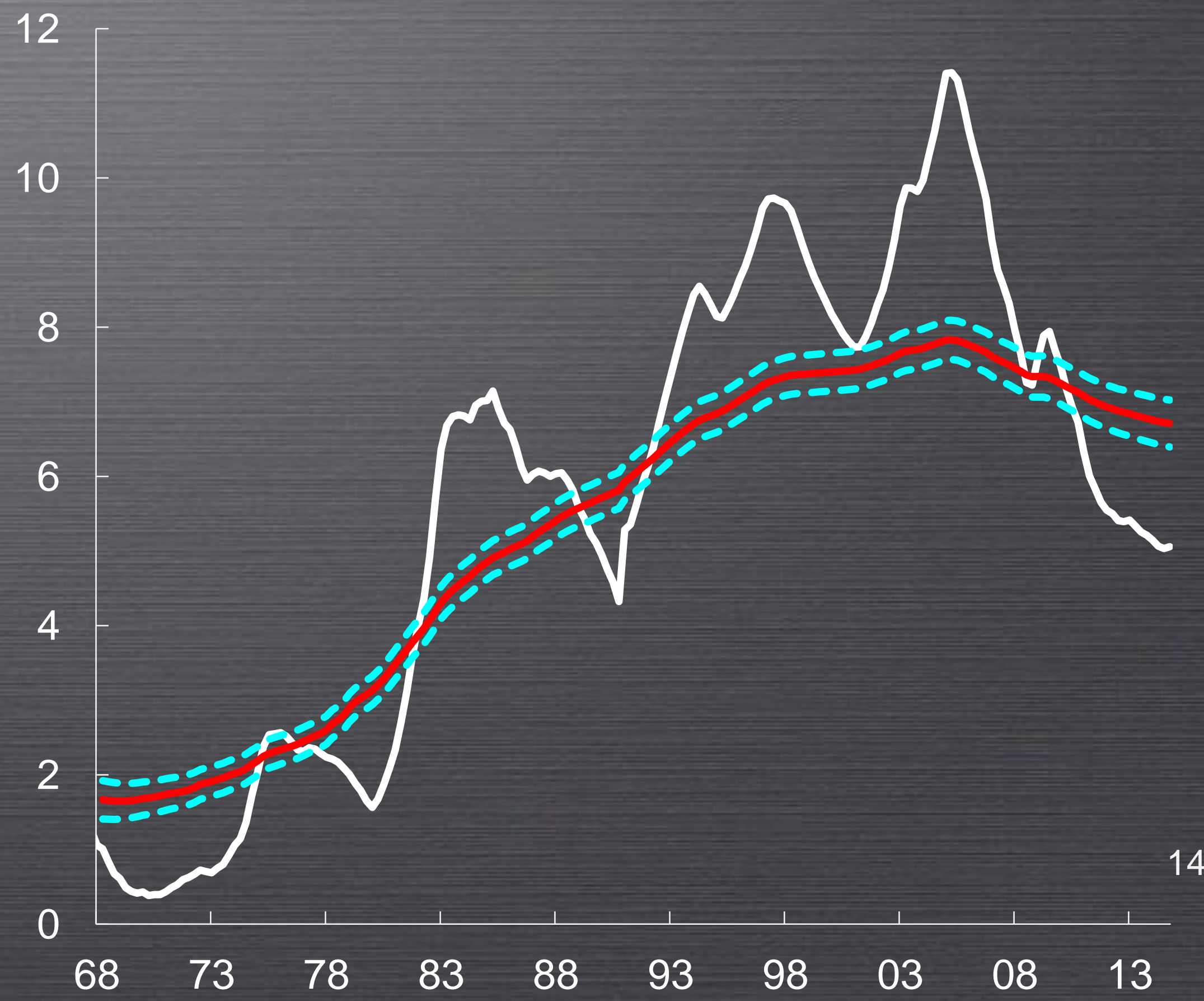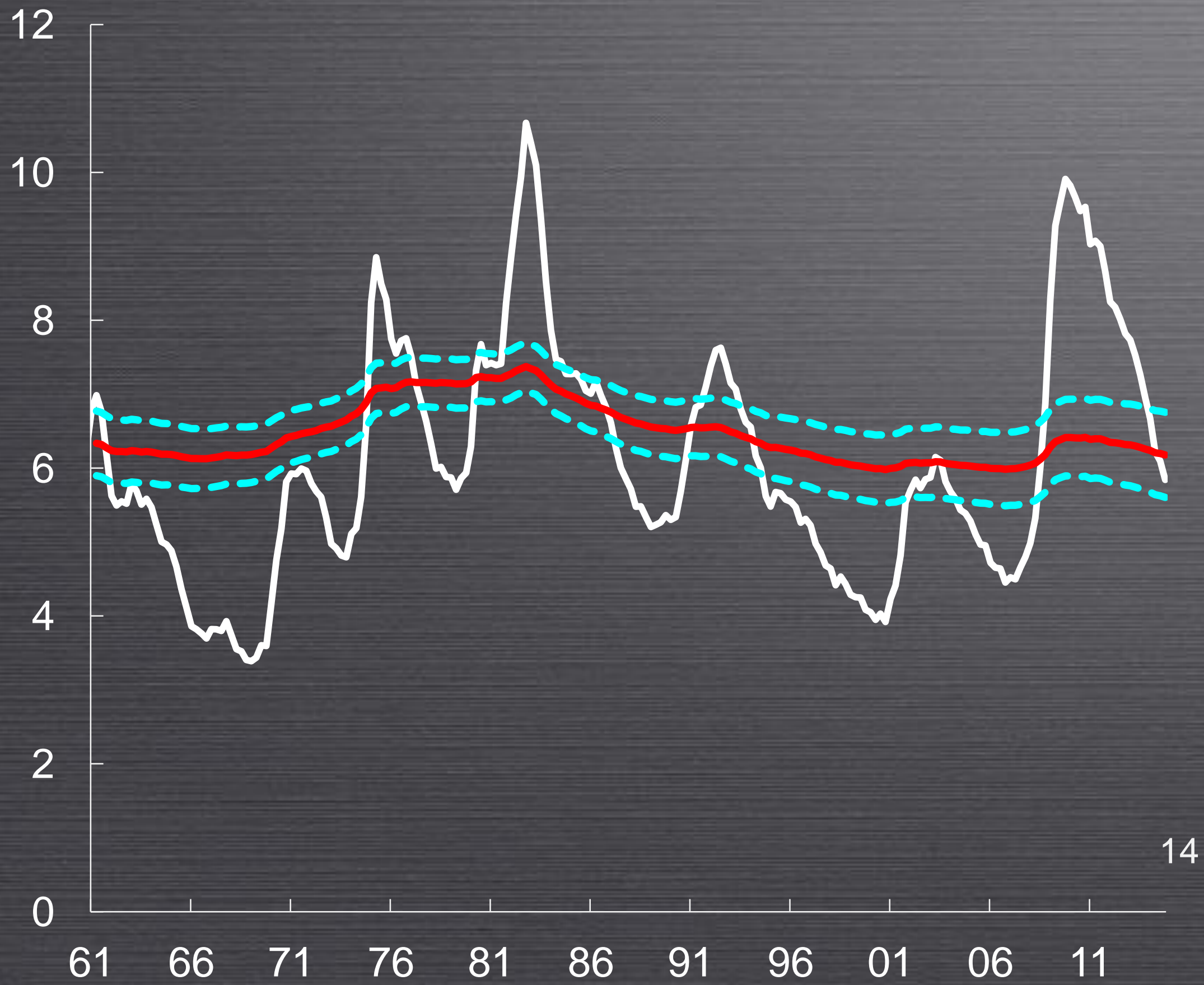*(median all countries)*

Source: Staff calculations.

13

Phillips Curve Estimates - Benchmark

United States

Germany

Unemployment Rate (white line) and Natural Rate (red line, dotted blue line +/- 1 standard deviation)
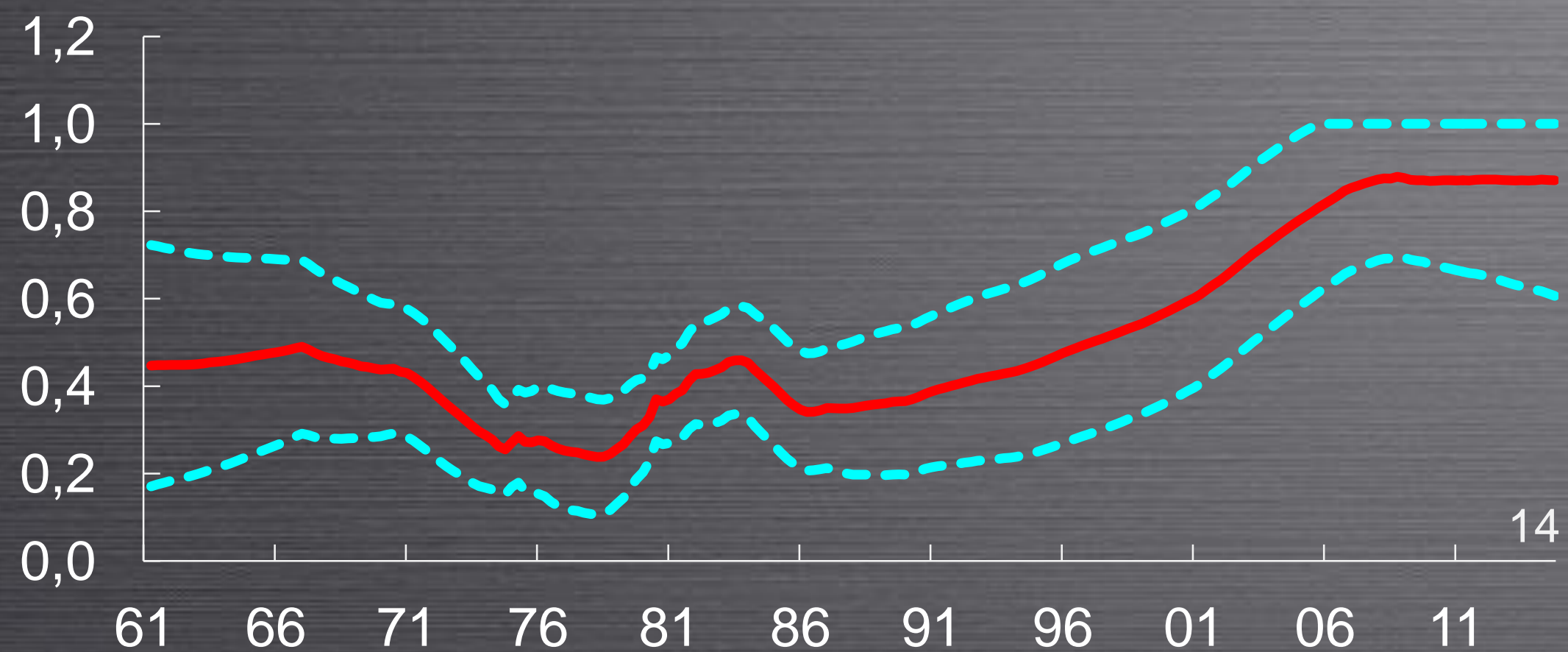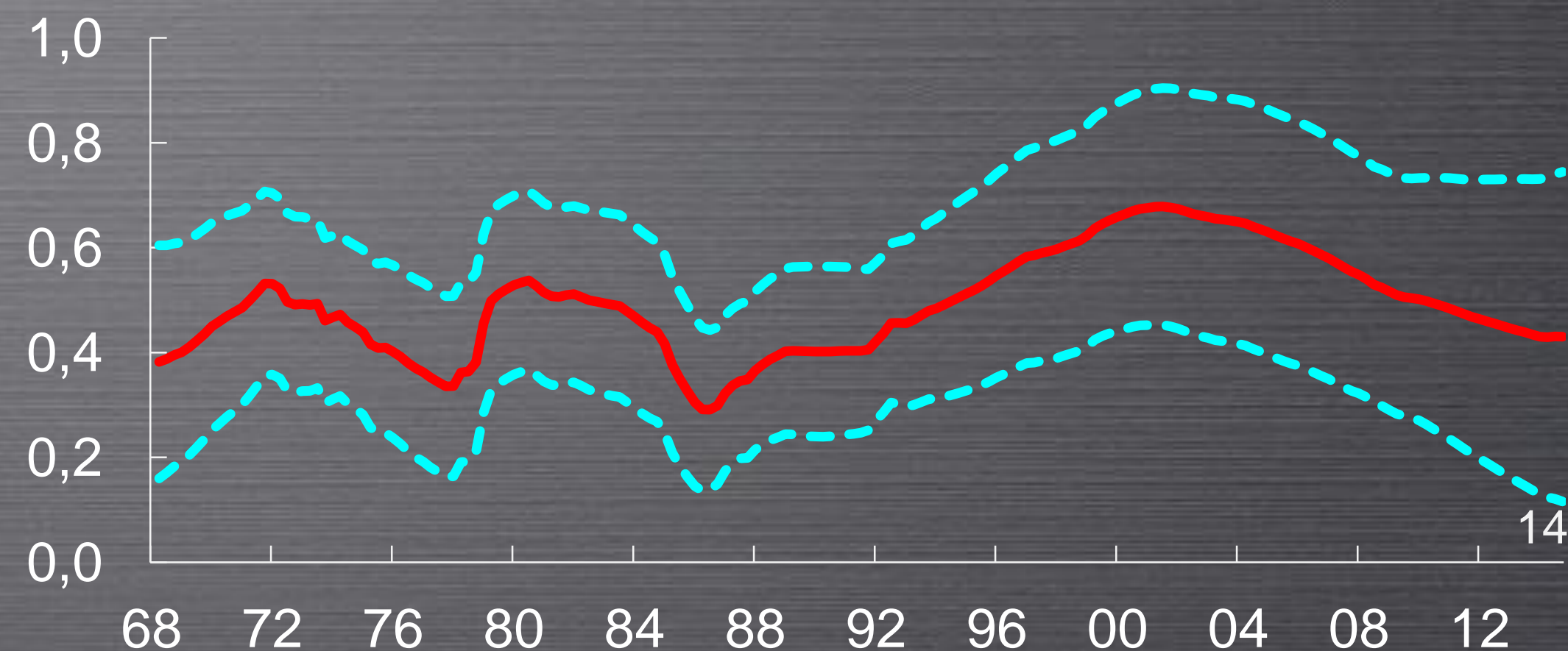
Source: IMF staff calculations.

14

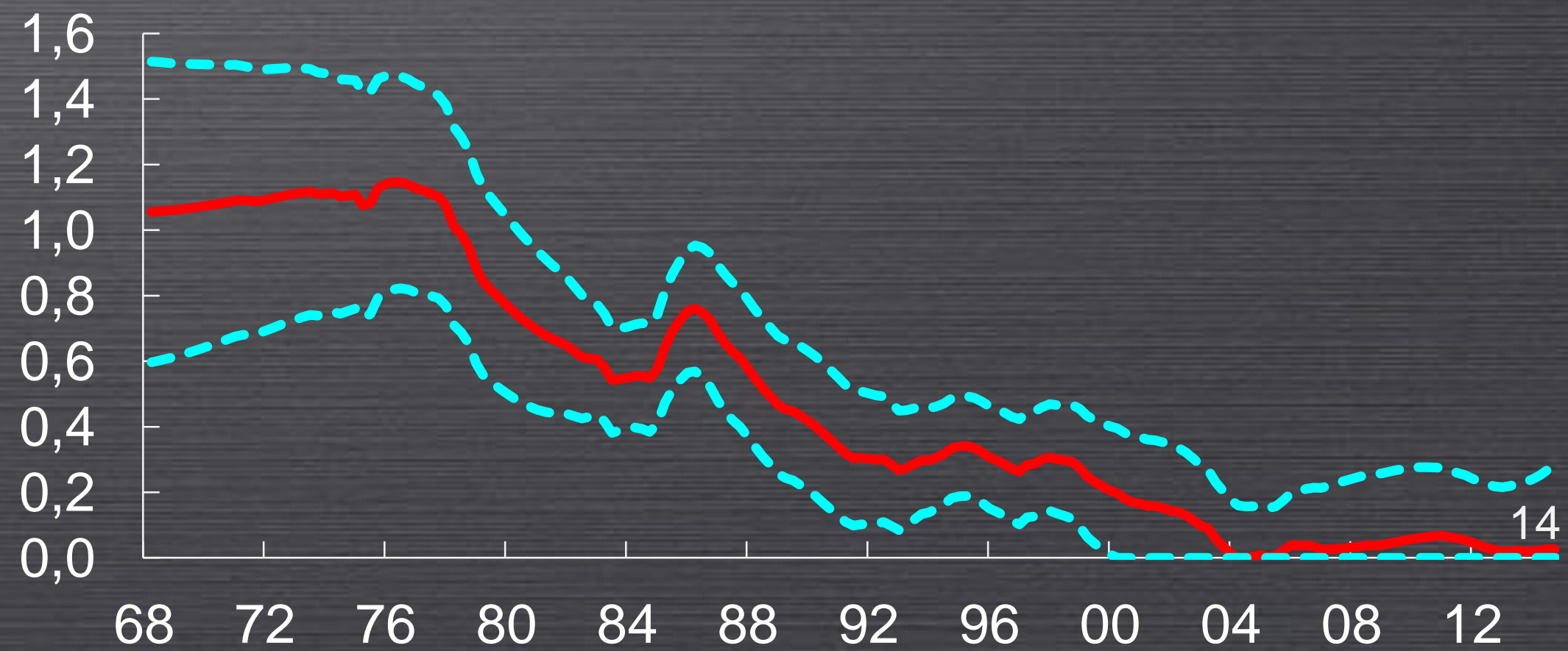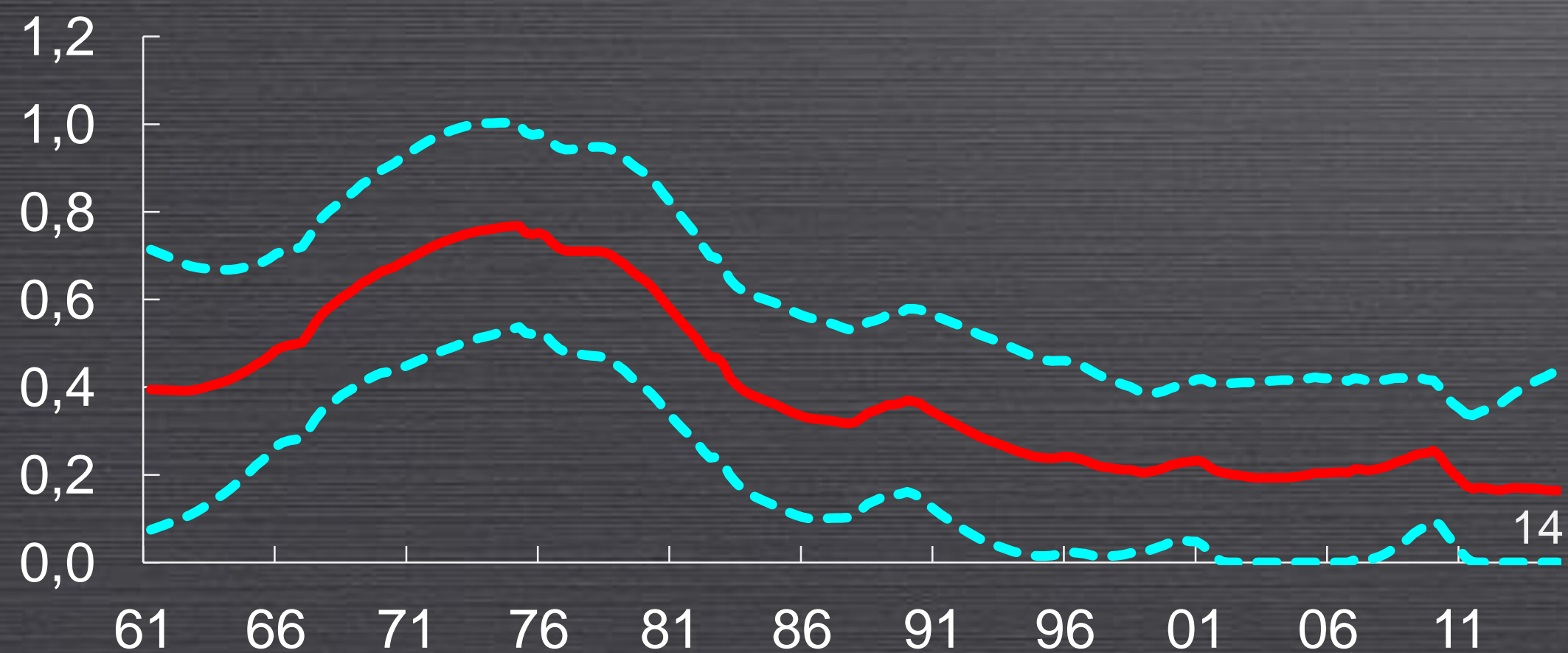# Phillips Curve Estimates - Benchmark

United States   **Germany**

Anchoring of Inflation to Long Term Expectations (λ) (dotted blue line +/- 1 standard deviation)

Slope of Phillips Curve (Θ) (dotted blue line +/-1 standard deviation)

Source: IMF staff calculations.

15

Two alternative specifications:

1) Hysteresis:

$$u_t^* = b\,u_{t-1}^* + (1-b)\,u_{t-1} + \eta_t$$
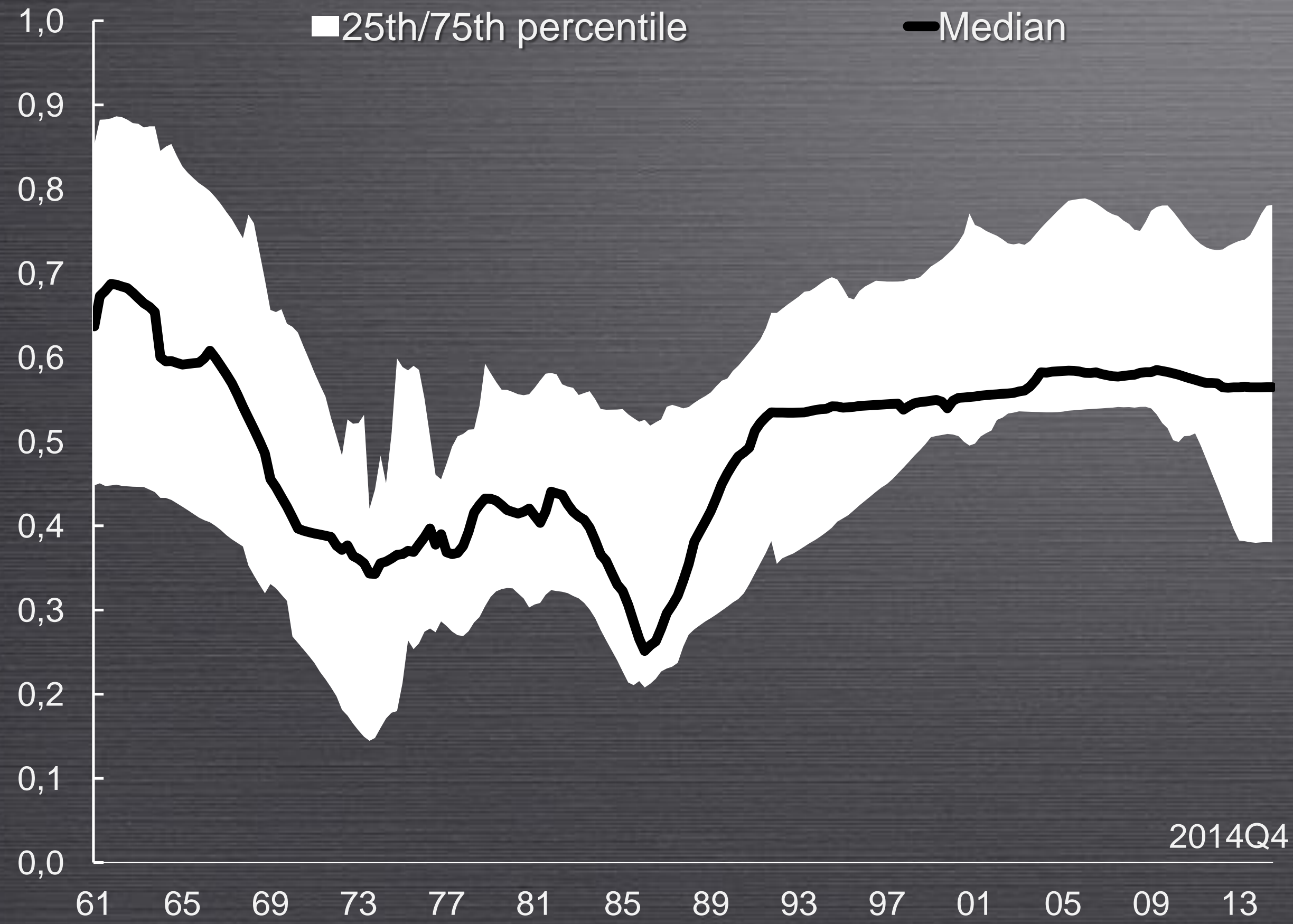
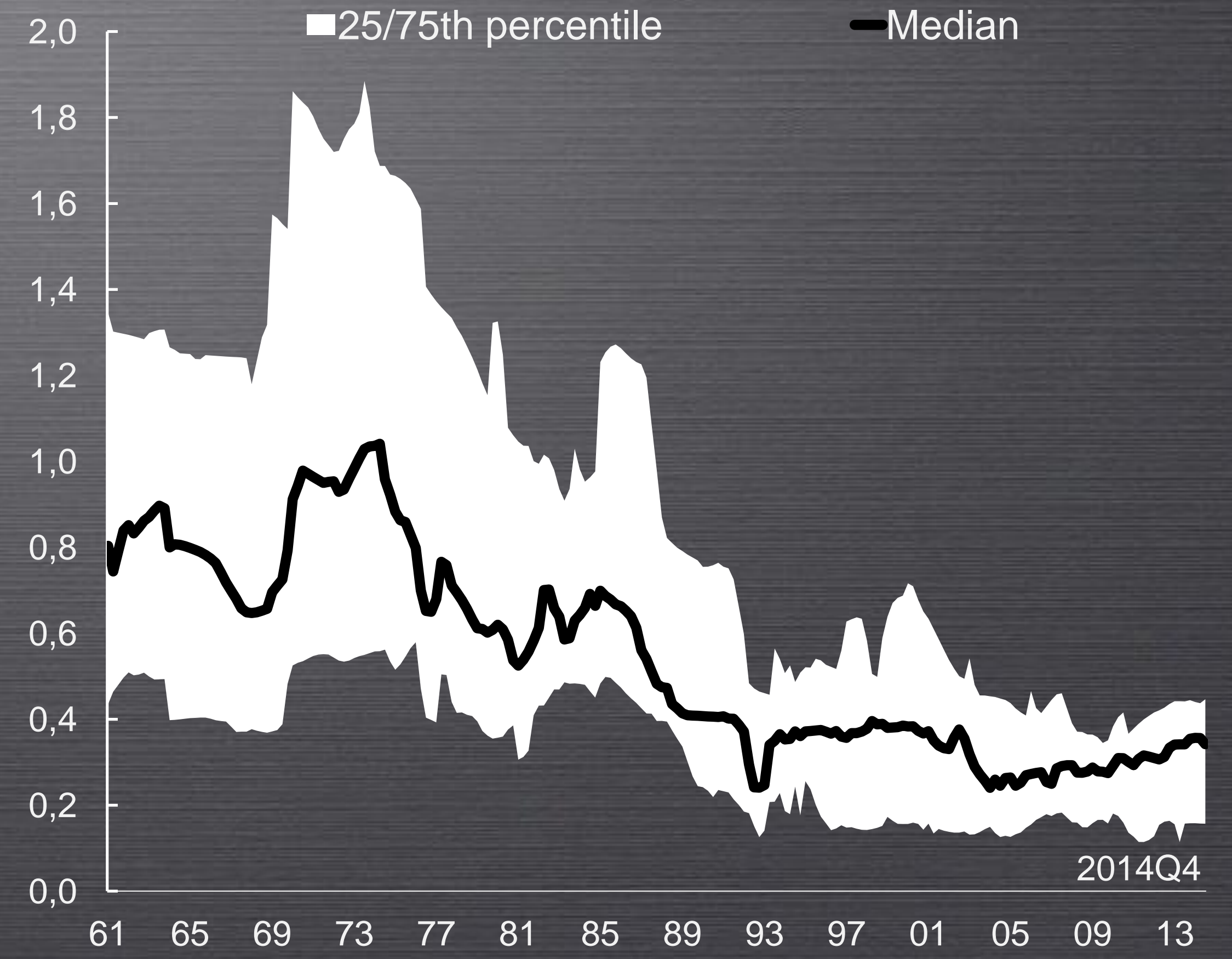where $0.9 \leq b \leq 1$.

2) Short term Unemployment

Phillips Curve Estimates - Allowing for Hysteresis

Anchoring of Inflation to Long Term Expectations (λ)
(median all countries)

Slope of the Phillips Curve (θ)
(median all countries)

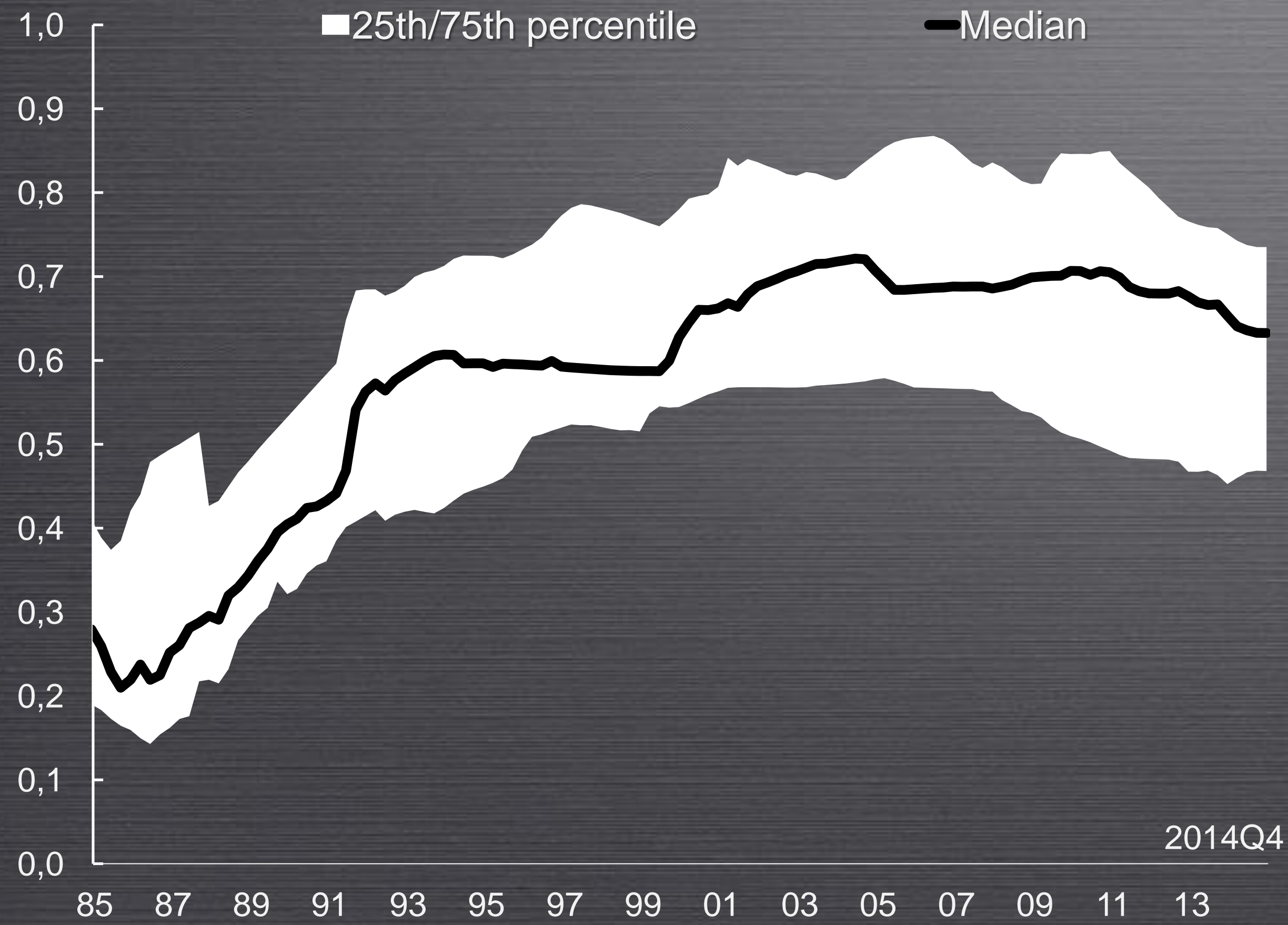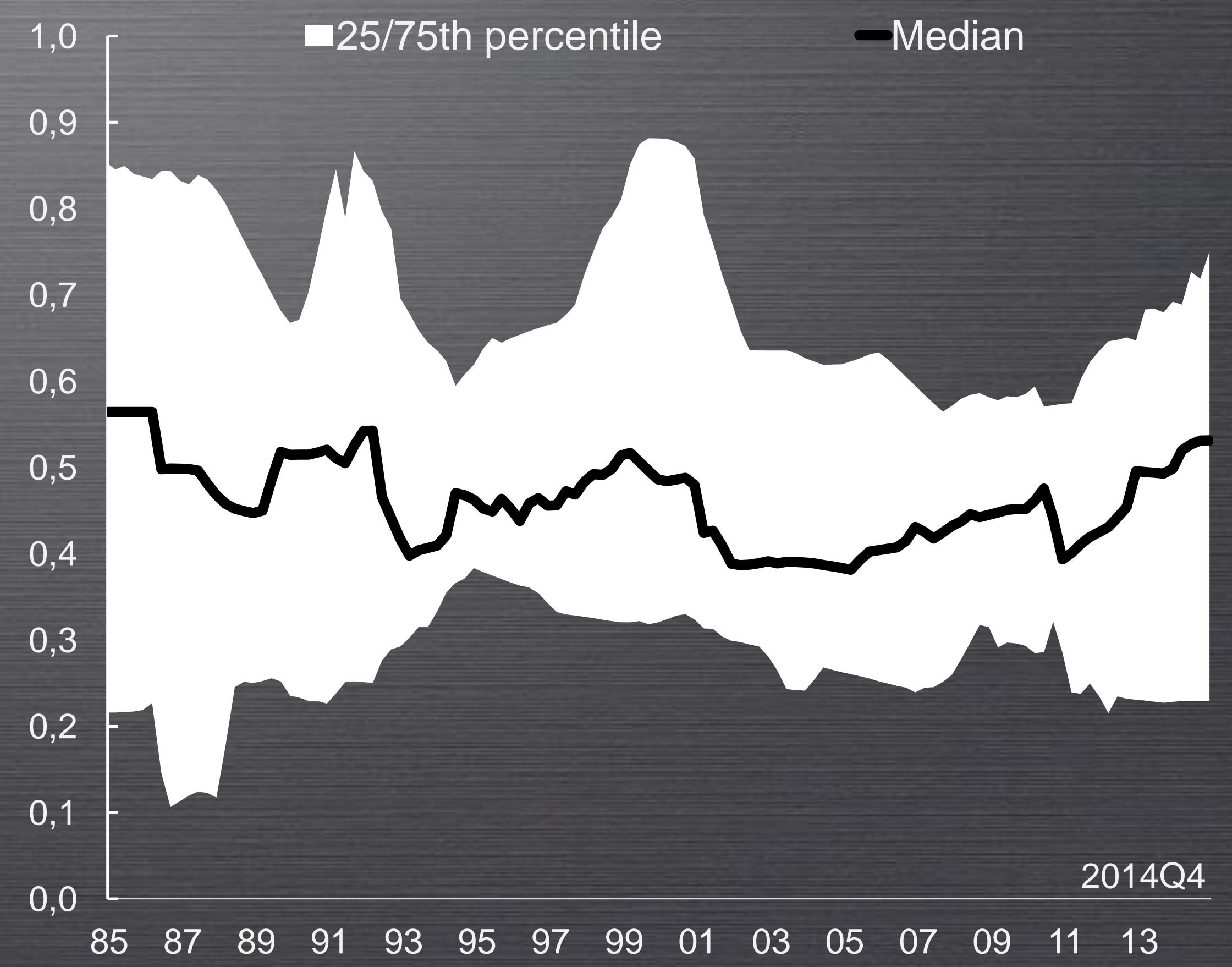

Source: Staff calculations.

Phillips Curve Estimates – with Short-Term Unemployment

Anchoring of Inflation to Long Term Expectations (λ)
(median all countries)

Slope of the Phillips Curve (θ)
(median all countries)

Source: Staff calculations.

Monetary Policy Implications. 1.

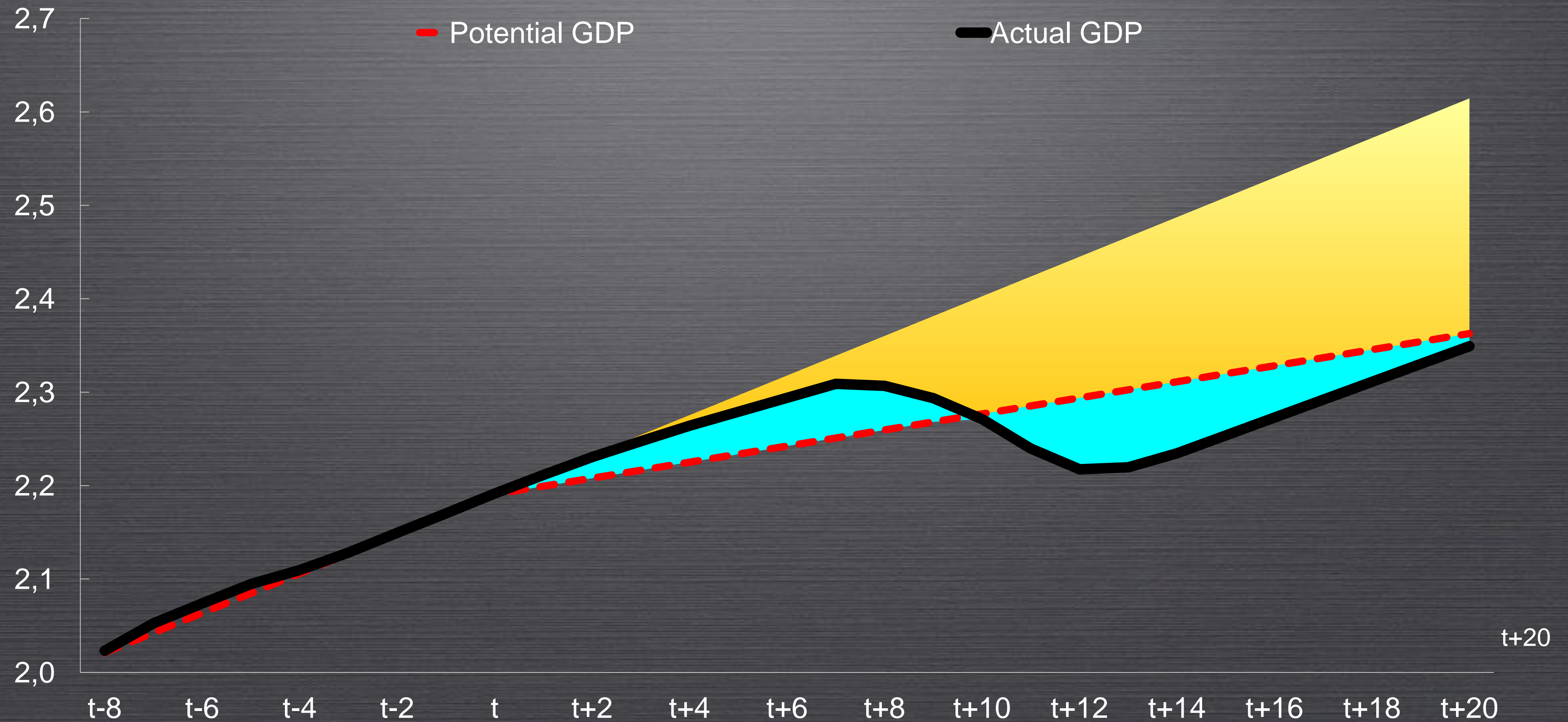Reverse causality or hysteresis/super hysteresis?

- To the extent that hysteresis is present, deviations of output from its optimal level are much longer lasting and thus more costly than usually assumed

- To the extent however that many recessions are caused by an underlying decrease in growth, risk of overestimating potential output during and after the recession (see next figure)

- Challenge: Identify relative importance of each.

Monetary Policy Implications. 2

- If the output gap only has a small and uncertain effect on inflation, stabilizing inflation may require very large movements in the output gap

- This suggests that monetary policy should focus on stabilizing the output gap rather than inflation . Reinforce the need for a dual mandate. (But challenge from part 1: size of the output/unemployment gap?)

- A puzzle and a challenge:

  Increased anchoring of expectations and increased confidence in central bank achieving its target.

  Decrease in the ability of central bank to achieve that target.