



EUROPEAN CENTRAL BANK

EUROSYSTEM

# Understanding inflation dynamics and monetary policy

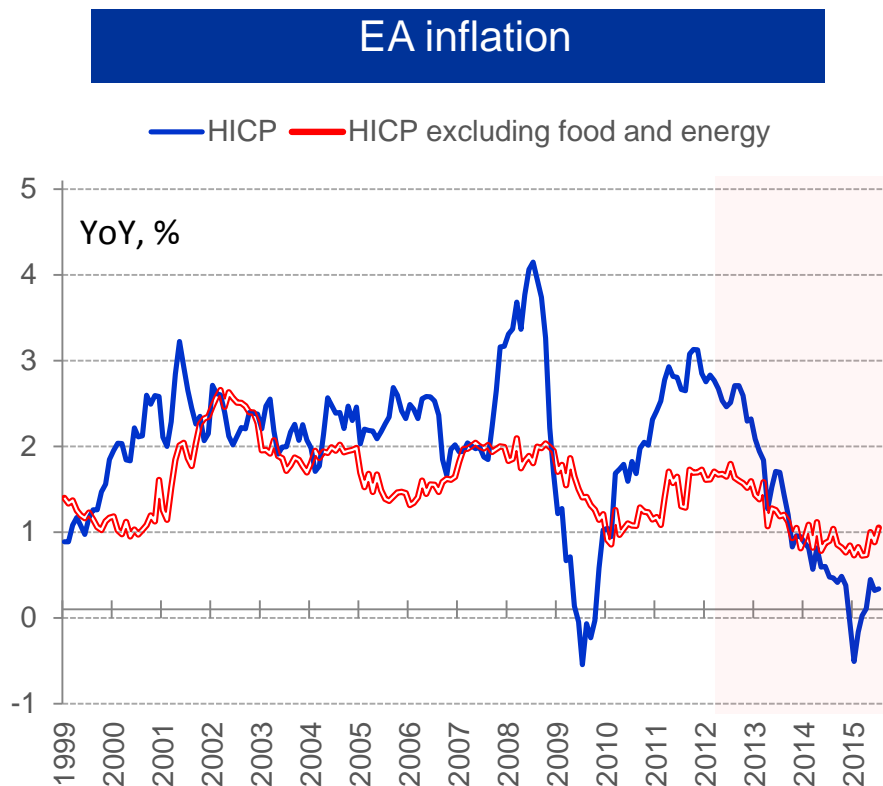
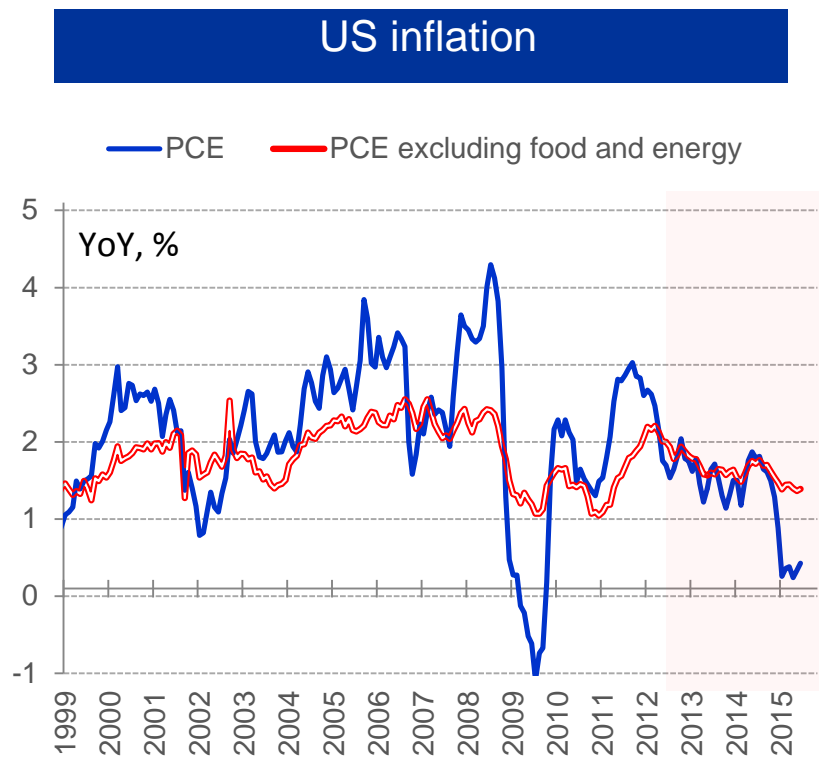
**Vítor Constâncio**  
*ECB Vice-President*

Intervention at the Kansas FED  
Jackson Hole Economic Policy Symposium  
29 August 2015

1. Low inflation regime: puzzles and forecasting errors
2. Drivers of low inflation in the EA: domestic or external?
3. Forecasting errors
4. The Phillips curve as a vehicle to discuss inflation dynamics:
  - 4.1. Measuring the economic slack, the slope and its stability
  - 4.2. Are hybrid NKPC or TPC good predictors of Inflation?
  - 4.3. Stability of the coefficients and time-varying coefficients: persistence, response to economic activity, to inflation expectations, to external prices and other supply shocks; limitations of the Phillips curve and the need to use several different models
5. Lessons for monetary policy: the use of models and judgment to understand, forecast and design policies to influence medium term inflation; achieving the inflation target in the EA

# Low inflation regime and some puzzles ...

Inflation in advanced economies has been low for a prolonged period...



Source: Eurostat, Haver Analytics.

Two particularly puzzling episodes:

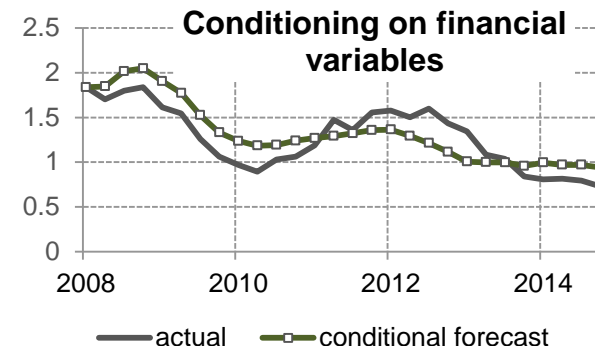
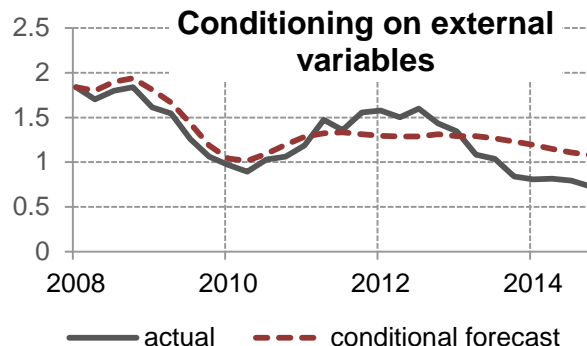
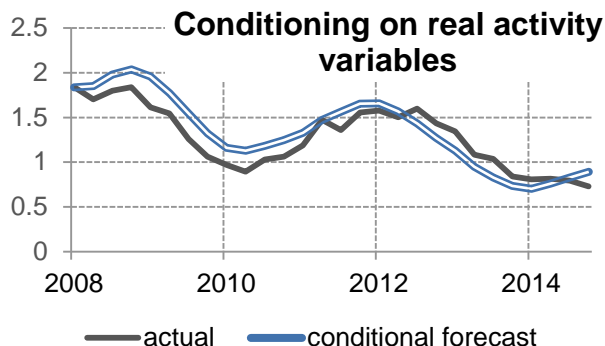
- the **missing disinflation** in the wake of the Great Recession;
- the **excessive disinflation** after 2012, especially in the euro area

# ... ex-post explanations for the euro area ...

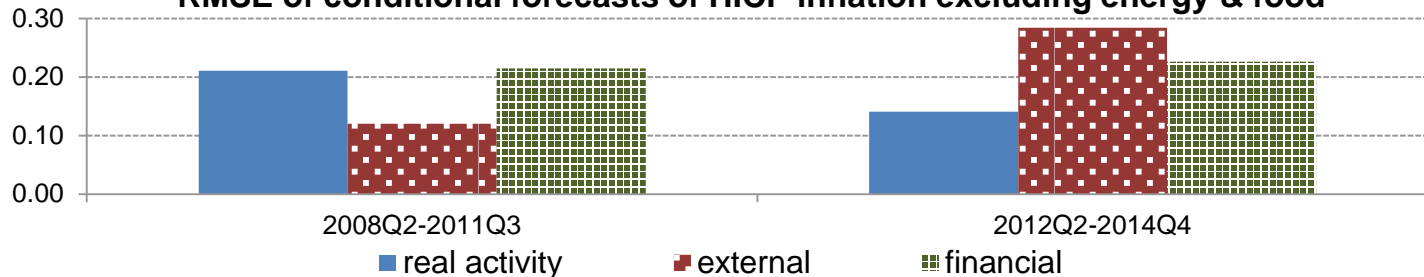
First recessionary period → mainly due to external factors

The second episode of disinflation → more domestically driven

## Euro area HICP excluding energy & food (YoY, %)



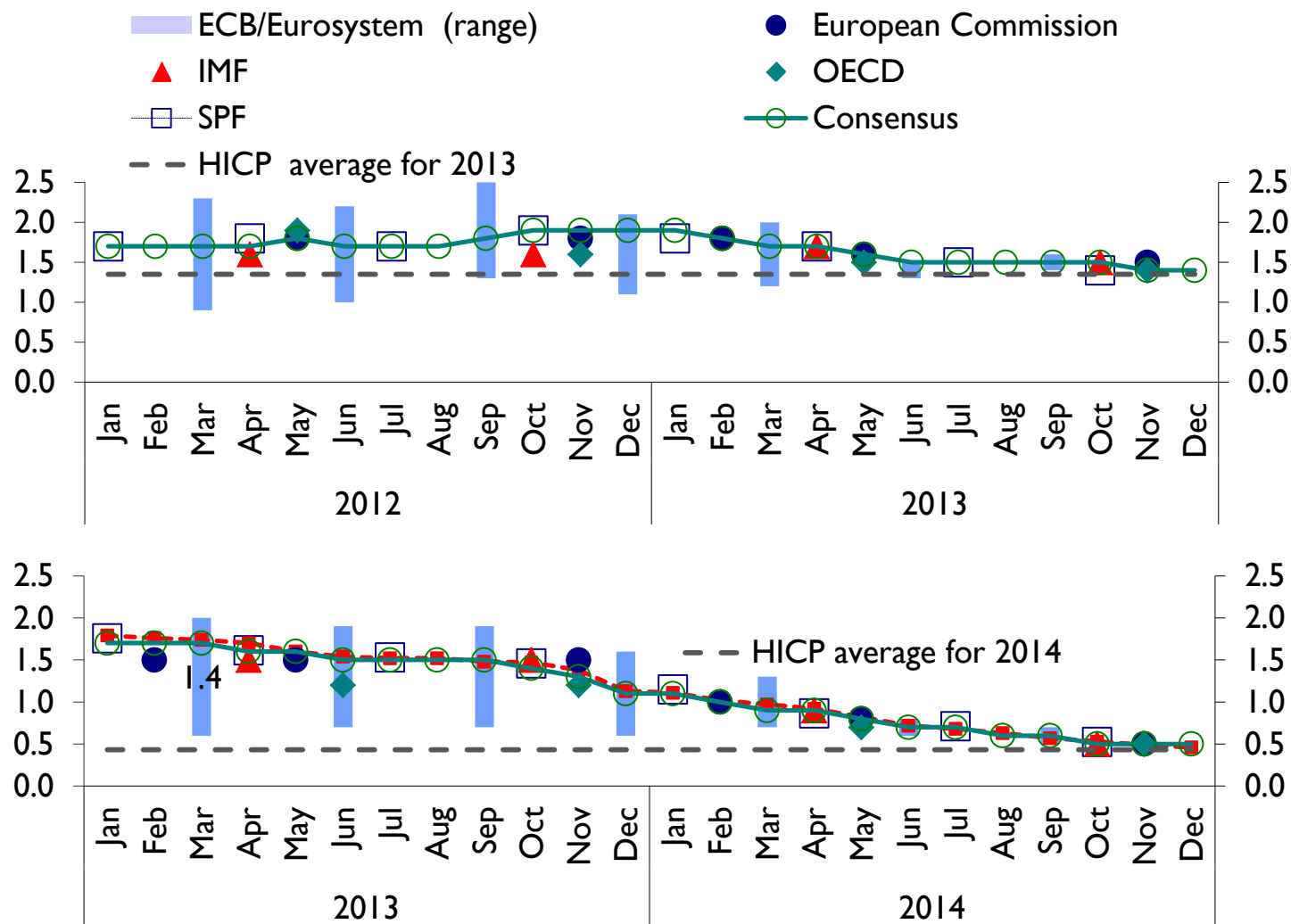
## RMSE of conditional forecasts of HICP inflation excluding energy & food



*Note: evidence from the ESCB Task Force on Low Inflation. Results based on a Bayesian VAR including: HICP excluding energy and food, real activity indicators (real GDP, the unemployment rate, real investment), external variables (NEER, non-energy commodity prices, oil price in USD, foreign demand), financial variables (short term interest rate, lending rate to NFCs, real loans to NFCs). Estimation sample: 1995 – 2014, conditional forecasts starts in 2008Q2.*

# ... and over-prediction since 2012Q2

## Evolution of projections of average euro area HICP inflation for 2013 (top) and 2014 (bottom)



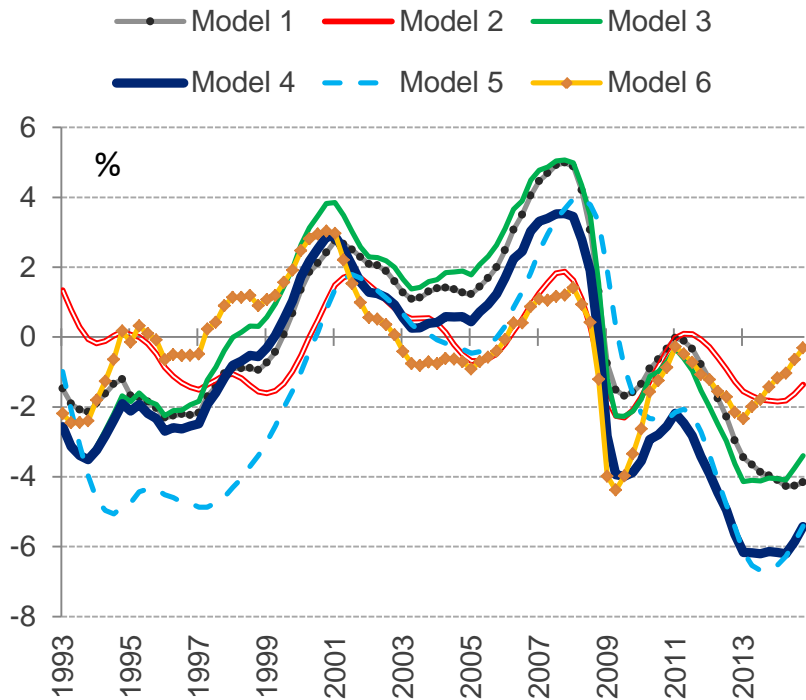
Sources: IMF, ECB, Consensus Economics, OECD and European Commission.

Note: The dates on the x-axis indicate the publication dates of each projection. The time span between the cutoff date for the information used and the actual publication date varies across projections.

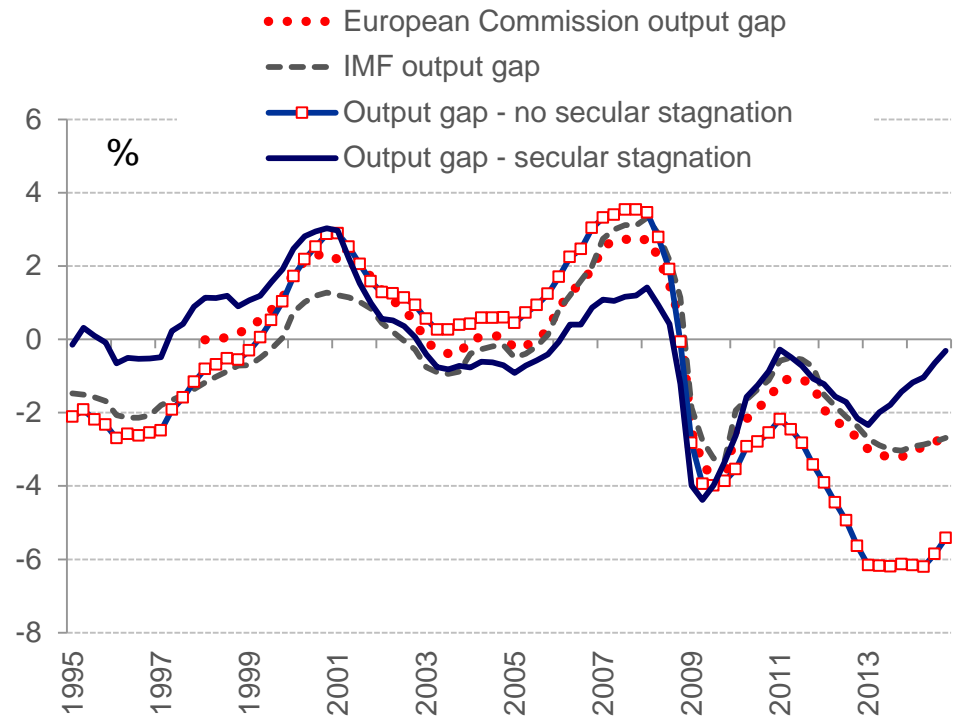
# Usual measures of slack can vary substantially

## Slack measures based on GDP

### Six variants of a Bayesian dynamic factor model



### Comparison with traditional measures of the output gap



Source: IMF WEO, AMECO, Eurostat, ECB staff calculation

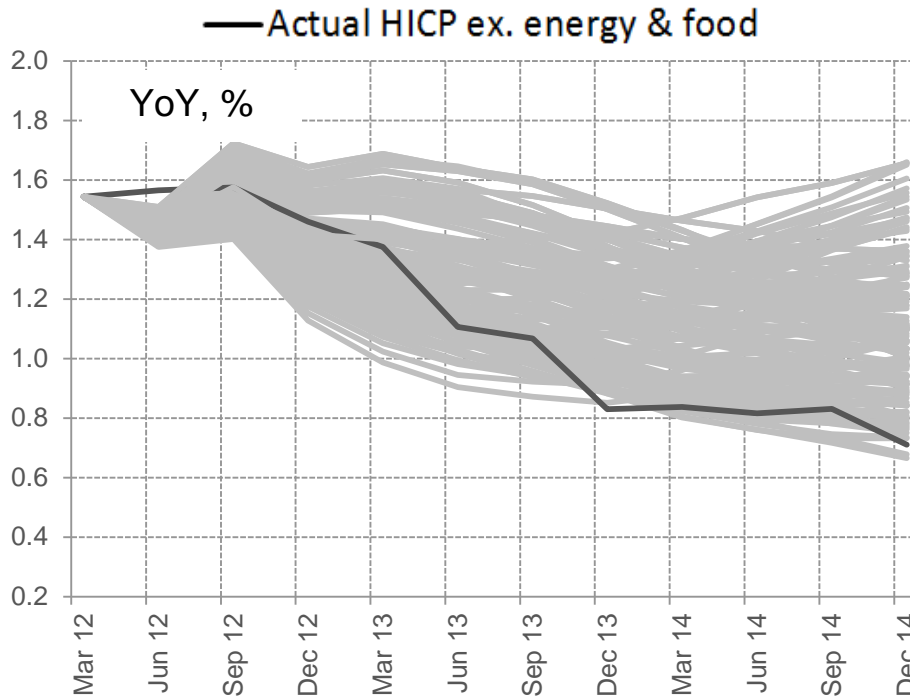
Notes: 2 measures of slack: Output gap - no secular stagnation and Output gap - secular stagnation are derived in "Inflation forecasts in a Bayesian dynamic factor model of the euro area", M. Jarocinski and M. Lenza, 2015, mimeo;

- Assumption 1: no secular stagnation → continuing trend growth, large output gap. Good inflation forecasts.
  - Assumption 2: secular stagnation → slow trend growth, closing output gap. Less good at forecasting inflation.
- The IMF and European Commission output gap measures are interpolated.

# Explaining inflation through the lens of the Phillips curve

$$\pi_t = \alpha + \rho\pi_{t-1} + \beta\text{Slack}_{t-1} + \delta\pi_{t-2}^{imp} + \gamma\pi_t^e + \varepsilon_t$$

Conditional out-of-sample projection of HICP  
excl. energy & food 2012Q2: 2014Q4



Source: ECB staff calculations

Note: The estimation starting date is 1995Q1 depending on data availability.

**Specification search of a hybrid NKPC with variants across:**

**Slack measures:**

- Output gap (OG)
- GDP growth
- Unemployment rate
- Unemployment gap
- Unemployment gap (Kalman filter)
- Short term (ST) unemployment
- ST unemployment gap (Kalman filter)
- IMF output gap
- European Commission OG
- Unemployment recession gap
- OG – no secular stagnation
- OG – secular stagnation

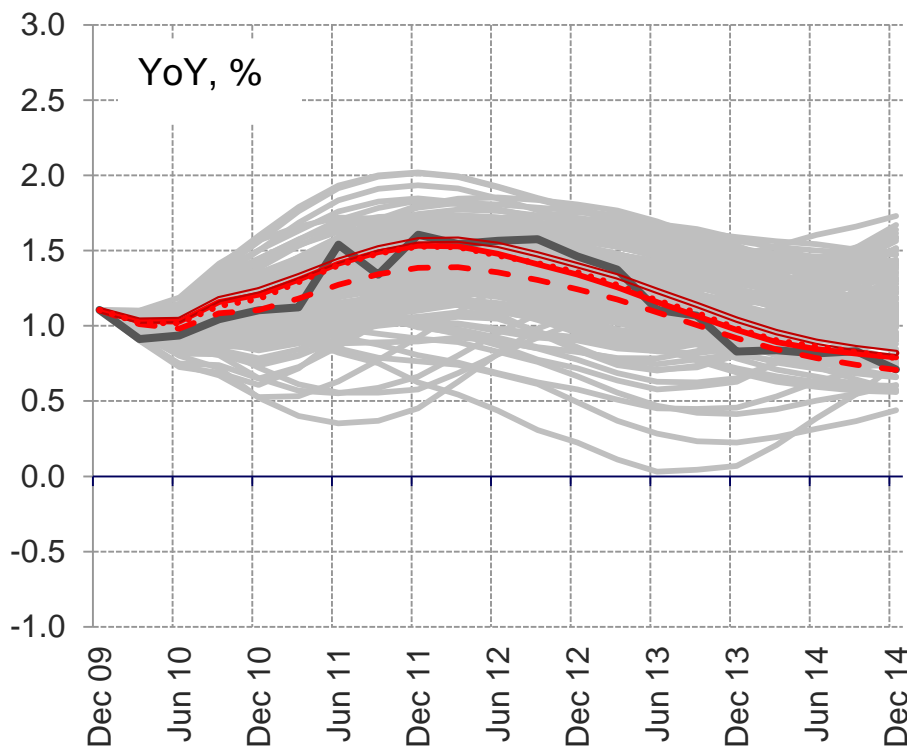
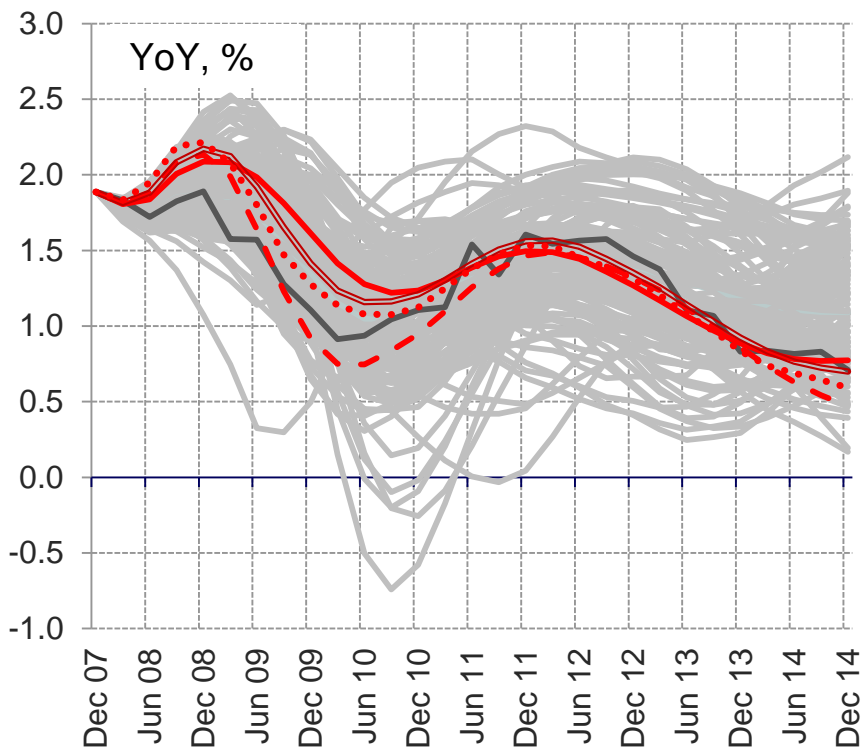
**Expectations measures:**

- Past inflation
- Consumers (DG ECFIN)
- Consensus (2 to 7Q ahead)
- SPF (1, 2 and 5Y ahead)

**Several estimates perform well**

# Conditional forecast starting in 2008q1 and 2010q1

- Actual HICP ex. energy & food
- Unemployment rate / Consensus 3Q ahead
- - - OG - no secular stagnation / Consensus 2Q ahead
- Unemployment rate / Consensus 2Q ahead
- ..... Unemployment gap / Consensus 4Q ahead

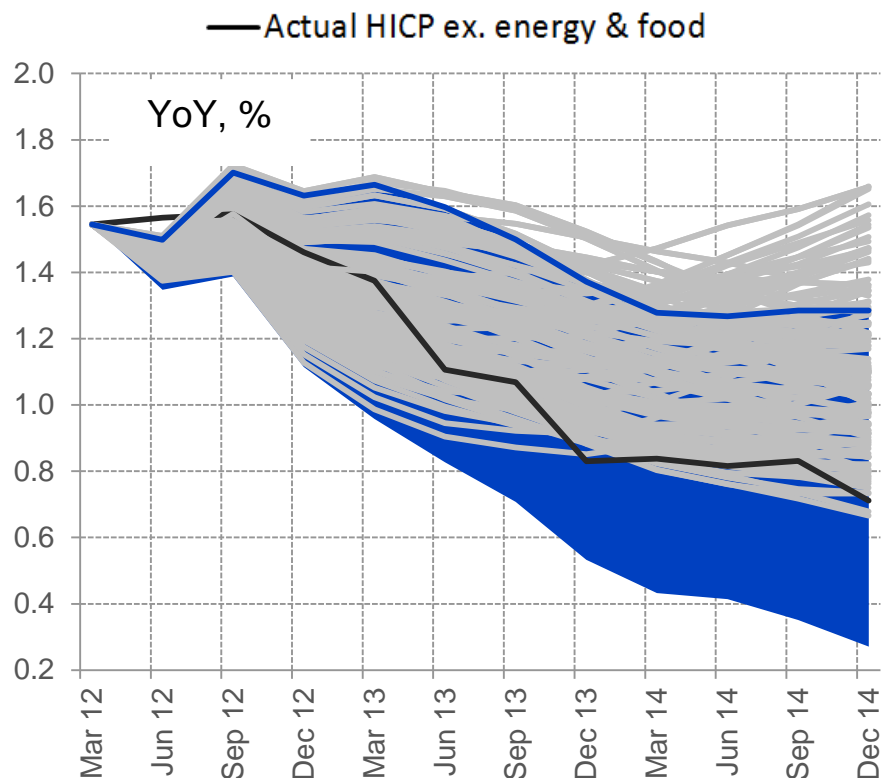


Source: ECB staff calculations.

The Phillips curve is alive in the euro area: some specifications are able to explain the recent 'excessive disinflation'



## Conditional out-of-sample projection of HICP excl. energy & food 2012Q2: 2014Q4



**Light grey estimates:** linear models, fixed coefficients (as on previous slide)

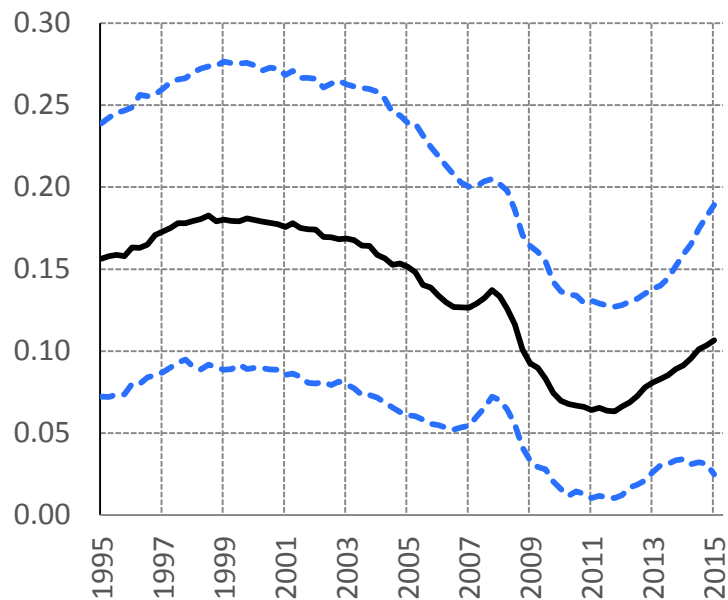
**Blue:** nonlinear models with explicit state dependence of all model coefficients on slack measures

Source: ECB staff calculations.

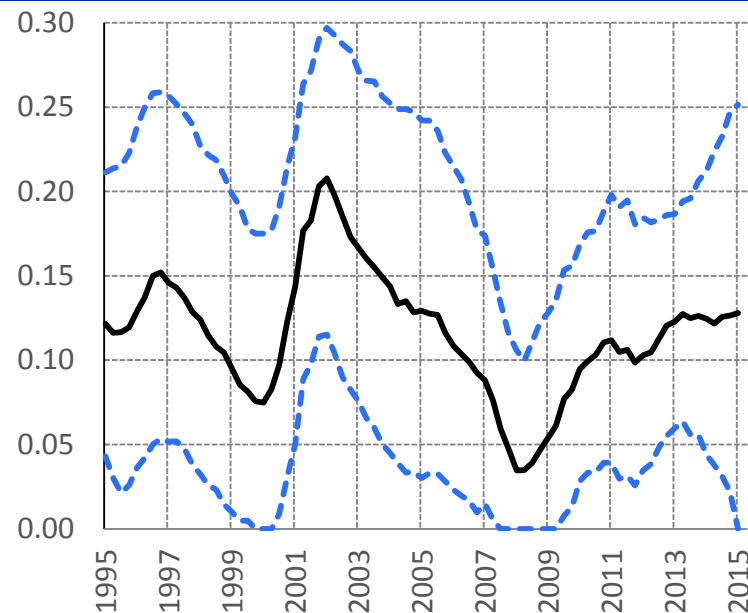
$$\pi_t = \alpha + \rho\pi_{t-1} + \beta\text{Slack}_{t-1} + \delta\pi_{t-2}^{\text{imp}} + \gamma\pi_t^e + \varepsilon_t$$

# Time-varying Phillips curves for the euro area

## Time-varying slope headline inflation



## Time-varying slope for inflation ex energy and food



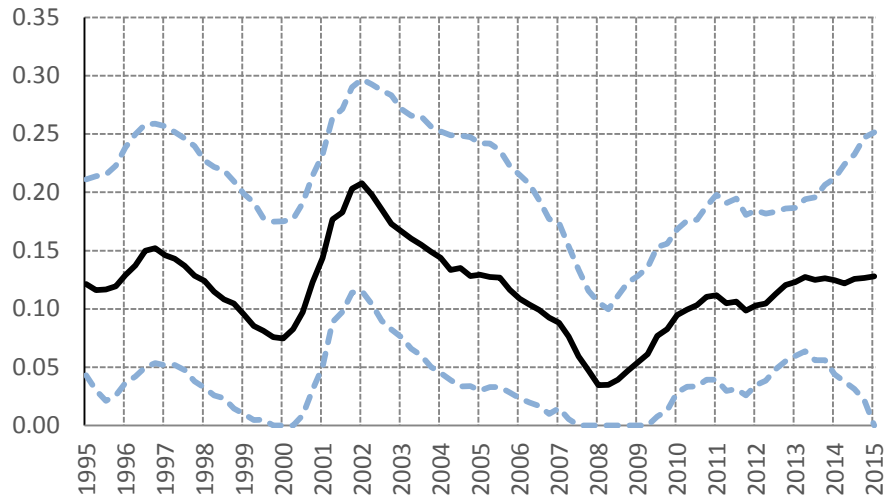
Source: ECB staff calculations.

Note: Annual inflation regressed against its first lag, unemployment gap, imported inflation and survey inflation expectations.

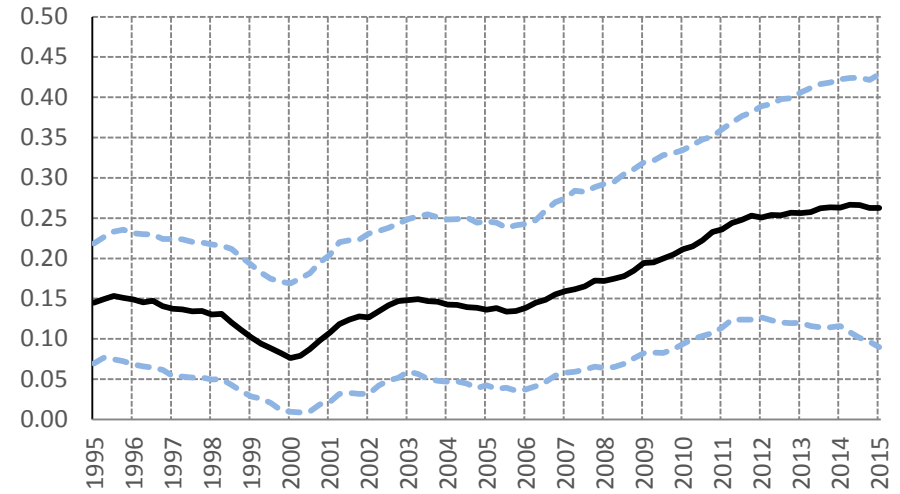
$$\pi_t = \theta_{1t}(u_{t-1} - u_{t-1}^*) + \theta_{2t}\pi_t^e + (1 - \theta_{2t})\pi_{t-1} + \theta_{3t}\pi_{t-1}^{imp} + \varepsilon_t$$

# HICP excluding energy & food: Phillips curve parameters

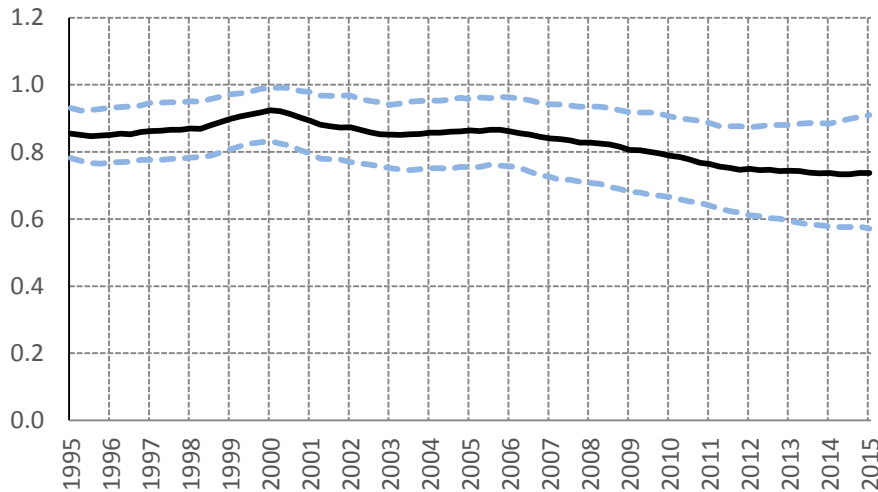
## Slack measure



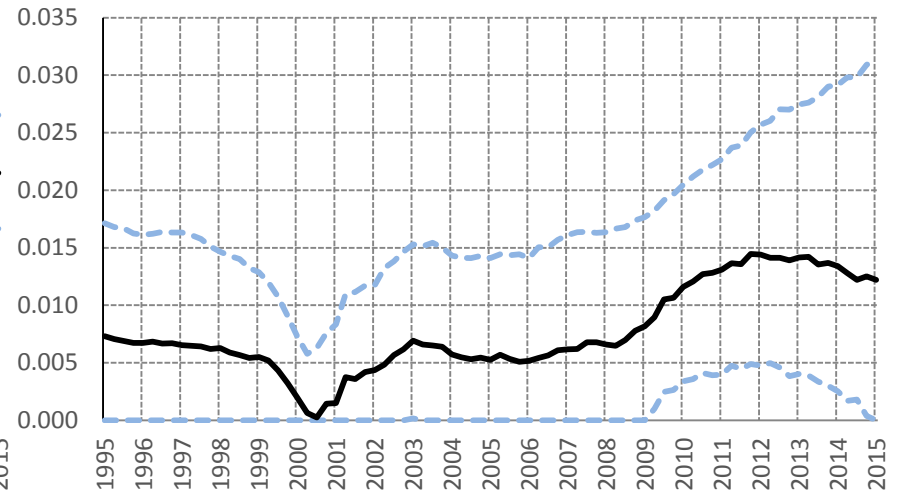
## Weight on Expectations



## Weight on Inflation Persistence



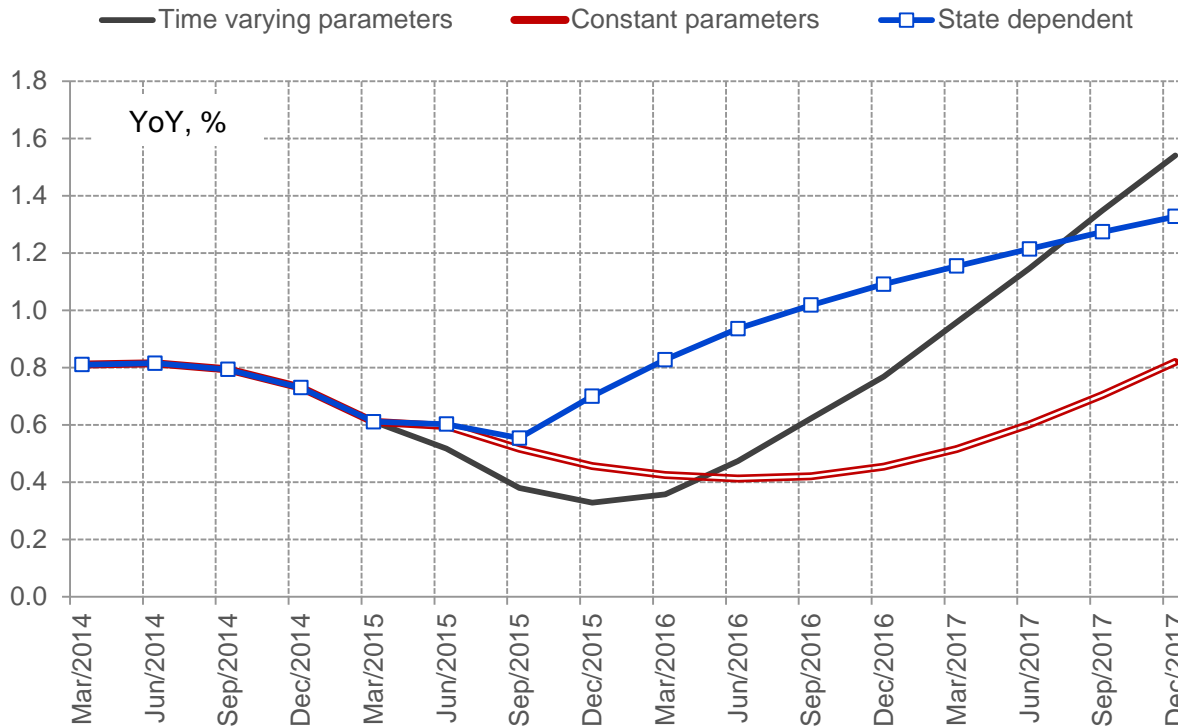
## Weight on Import Prices



Source: ECB staff calculations.

# Looking ahead – euro area forecast from June 2015

Conditional forecast of HICP inflation excluding energy and food: - constant vs. time-varying parameters (state-dependent and unrestricted approach)



The inflation/real activity link has strengthened in the euro area. Provided our policies will be able to significantly reduce the output gap, we can rely on a material effect to help the normalization of the inflation rate closer to target

Source: ECB staff calculations.

Note: Conditional on the expected path of the unemployment rate, import prices, exchange rate, and a proxy for medium term inflation expectations, for 2015 Q2 – 2017 Q4.

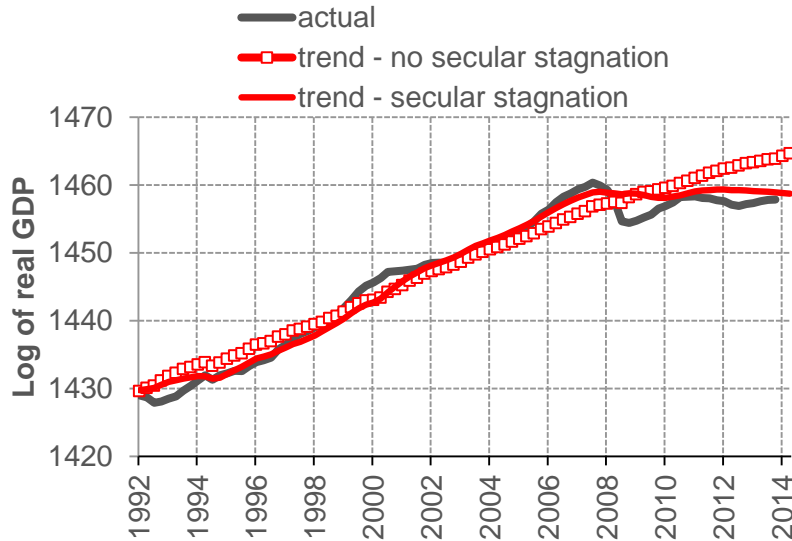
# CONCLUSION

1. Inflation dynamics since the Great Recession has shown signs of instability that led to many forecasting mistakes. Two main puzzles, of “missing disinflation” and “excessive disinflation “ triggered a surge of new research around the Phillips Curve and its possible demise that seems have been prematurely foreseen.
2. There is an important common factor in inflation in the advanced economies that helps to explain national inflation dynamics. The current phase of low inflation, aside from commodity price developments, is significantly influenced by negative demand shocks both at the global and national levels.
3. In particular, the recent low inflation in the euro area was largely triggered by domestic demand weakness, leading very likely to a degree of economic slack larger than the one predicted by the usual methods.
4. The Phillips Curve seems to survive the recent reassessment and is still a valid tool of analysis in the euro area, meaning that a sustained recovery in inflation is conditional to real activity and inflation expectations.
5. The inflation/real activity link has strengthened in the euro area. Provided our policies will be able to significantly reduce the output gap, we can rely on a material effect to help the normalization of the inflation rate closer to target.

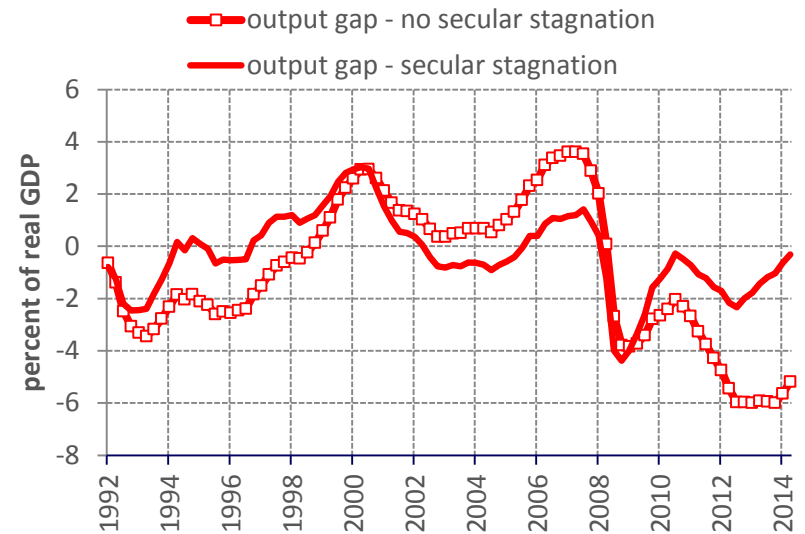
# BACKGROUND SLIDES

# Two extreme views of recent output gap from factor models

## Two estimates of potential output



## Corresponding output gaps



Source: M. Jarocinski and M. Lenza (ECB WP, forthcoming).

Note: Models include the same real activity indicators (real GDP and its components, unemployment rate, capacity utilization, consumer confidence) but differ in the econometric model of trends:

Model 1 (no secular stagnation) – restricts changes in trend output growth.

Model 2 (secular stagnation) – allows permanent changes in trend output growth.

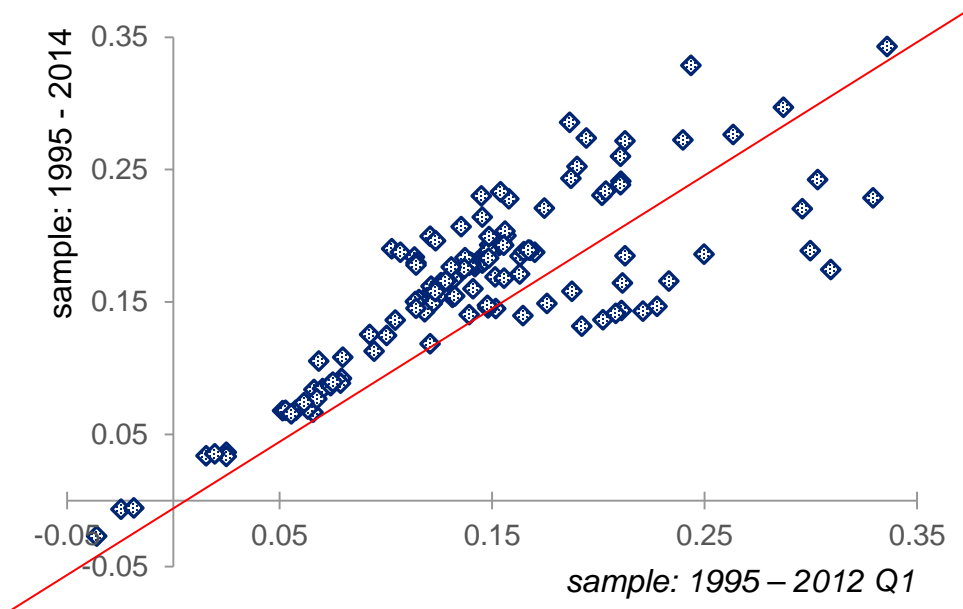
**Assumption 1:** no secular stagnation → large output gap. Good inflation forecasts.

**Assumption 2:** secular stagnation: slow trend growth, closing output gap. Less good at forecasting inflation.

# Most specifications point towards an increasing slope

$$\pi_t = \alpha + \rho\pi_{t-1} + \beta\text{Slack}_{t-1} + \delta\pi_{t-2}^{\text{imp}} + \gamma\pi_t^e + \varepsilon_t$$

## Euro area Phillips curve slope in two samples



Source: ECB staff calculations

Note: Annualized Q-o-Q growth rates of seasonally adjusted HICP excluding energy and food regressed against its first lag, lagged slack measure, lagged imported inflation and inflation expectations. Slack measures are standardized for comparability.

### Slack measures:

- Output gap (OG)
- GDP growth
- Unemployment rate
- Unemployment gap
- Unemployment gap (KF)
- Short term (ST) unemployment
- ST unemployment gap (KF)
- IMF output gap
- European Commission OG
- Unemployment recession gap
- OG – no secular stagnation
- OG – secular stagnation

### Expectations measures:

- Past inflation
- Consumers
- Consensus (1 to 6Q ahead)
- SPF (1, 2 and 5Y ahead)