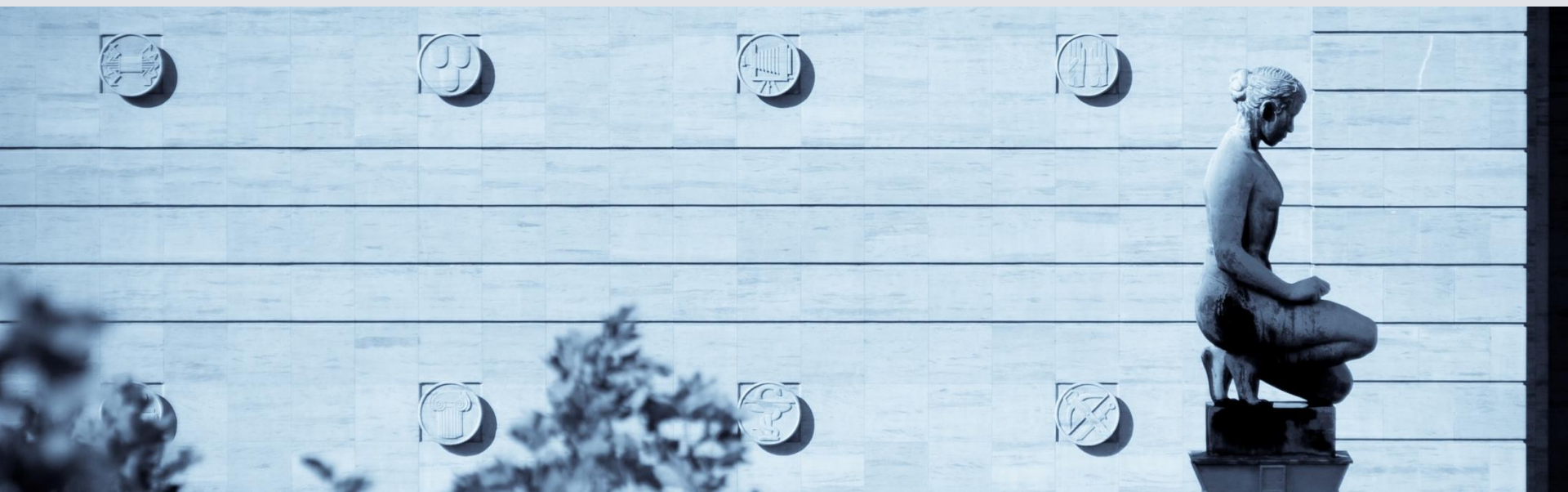# Is euro area lowflation here to stay?
# Insights from a time-varying parameter model with survey data *

2018 NBB International Conference on "Understanding inflation dynamics"

Brussels, October 25-26, 2018

Arnoud Stevens and Joris Wauters

# Do we still understand inflation dynamics?



The Big Read Central banks — + Add to myFT

**Central bankers face a crisis of confidence as models fail**

"*The root of the current insecurity around monetary policy is that in advanced economies — from Japan to the US — inflation is not behaving in the way economic models predicted*" (FT - Oct 11th, 2017)

**Janet Yellen:** (Speech - Sep 26th, 2017)
"*Our framework for understanding inflation dynamics could be mis-specified in some fundamental way*"

**Mario Draghi:** (Sept 2017 policy meeting)
"*the ongoing economic expansion . . . has yet to translate sufficiently into stronger inflation dynamics*"

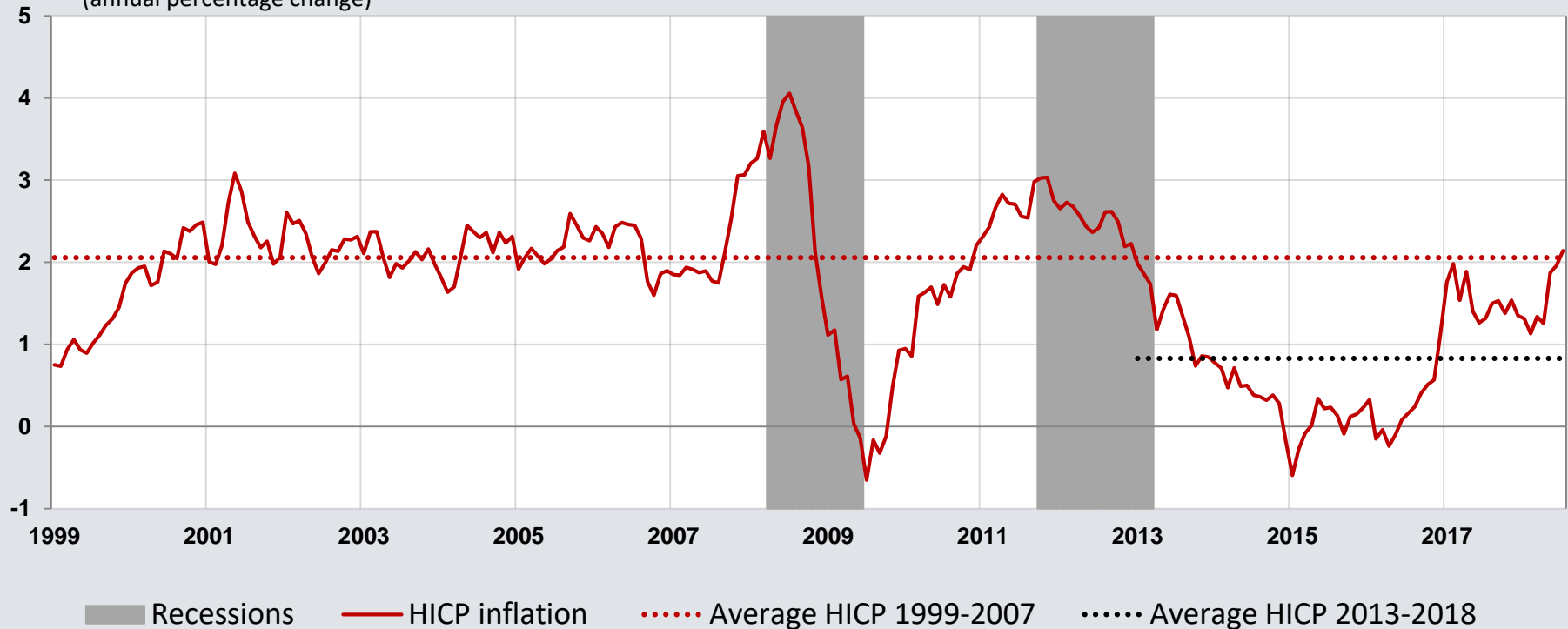# Motivation: euro area inflation is undershooting its target

➢ ECB target: inflation below, but close to, 2% in the medium term

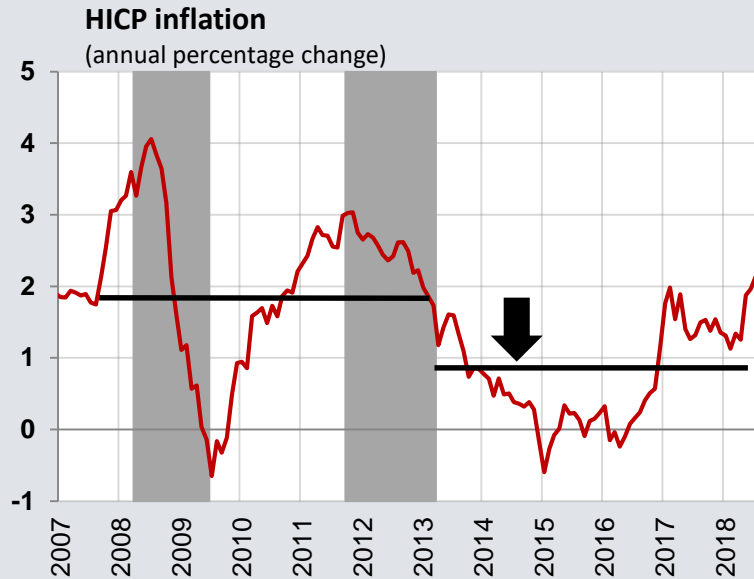➢ Persistent low inflation since 2013, despite the economic recovery

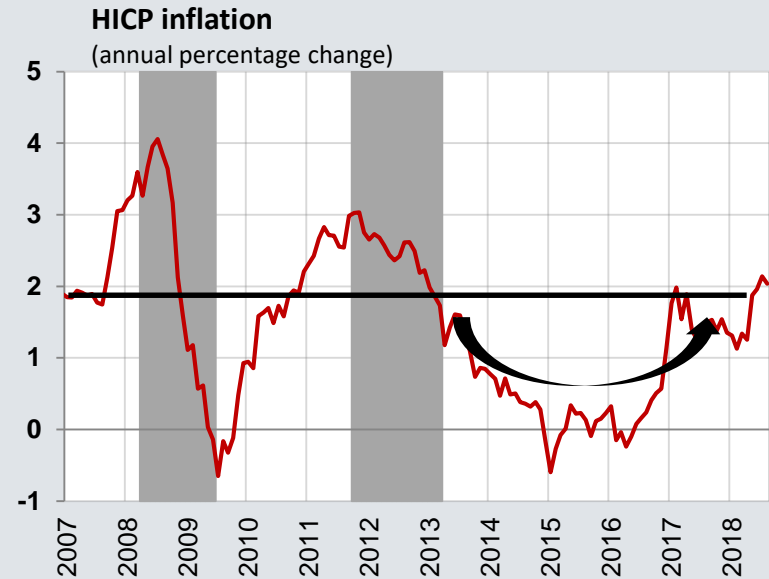**HICP inflation**
(annual percentage change)



Recessions — HICP inflation ····· Average HICP 1999-2007 ····· Average HICP 2013-2018

# What explains this so-called *lowflation* period?

| Permanent effects… | …or cyclical effects ? |
|---|---|



**HICP inflation**
(annual percentage change)

Permanent decline in inflation's
long-run trend

Inflation expected to return to target,
but adjustment might take longer

# Diagnosis is important for monetary policy making

| → additional stimulus warranted | → remaining '*patient, persistent and prudent*' should be sufficient |
|---|---|

# This paper

➤ *Trend vs cycle: what do survey inflation expectations tell?*

↳ Survey forecasts typically…

…*(a)* incorporate new information regarding structural changes

…*(b)* perform well in forecast comparisons
(e.g., Ang et al, 2007, and Faust and Wright, 2013)

➤ *To this end:*
a) Estimate a time-varying parameter Phillips curve model

a) Investigate whether adding survey expectations changes the results

# Relation to the literature

1. Literature on understanding euro area *lowflation*

   ➢ Only few studies analyse the role of survey forecasts; the ones that do, focus on long-term inflation expectations only
   (e.g., Garcia and Poon, 2018; Banbura and van Vlodrop, 2018)

   > The short end of the expectations curve might convey additional valuable information

2. Approach: model-consistent treatments of the term structure of inflation expectations…

   ➢ …Typically adopt a constant parameter set-up
   (e.g., Kozicki and Tinsley, 2012; Crump et al., 2016; Winkelried, 2017)

   > TVP allows for measuring structural changes

   ➢ …or model inflation dynamics in a univariate fashion
   (e.g., Mertens and Nason, 2018)

   > PC approach: allows to zoom in on several cyclical drivers (economic slack and import prices)

# Main Findings

➤ The *lowflation* is mainly due to **cyclical drivers**

- The model with survey expectations finds a more muted decline in trend inflation in recent years and a larger degree of economic slack
- The impact of economic slack and import prices on inflation increased in recent years

➤ Including survey data improves the model's out-of-sample forecasting performance

➤ Forecasters updated their predictions more actively during crisis period

➤ Short and medium term expectations convey useful information about inflation's trend and cyclical factors

**Outline**

# I.  Model

# II.  Data and Estimation

# III.  Results

**Outline**

# I. Model

## II. Data and Estimation

## III. Results

# Baseline model: time-varying parameter Phillips curve

➢ **Key ingredients** (based on Chan, Koop and Potter, 2016):

$$\underbrace{\pi_t - \tau_t^{\pi}}_{} = \rho_t^{\pi}(\pi_{t-1} - \tau_{t-1}^{\pi}) + \lambda_t \underbrace{(u_t - \tau_t^u)}_{} + \gamma_t \underbrace{(\pi_t^m - \tau_t^m)}_{} + \epsilon_t^{\pi}$$

Inflation gap

Unemployment gap (slack)

Import price inflation gap

$$u_t - \tau_t^u = \rho_1^u(u_{t-1} - \tau_{t-1}^u) + \rho_2^u(u_{t-2} - \tau_{t-2}^u) + \epsilon_t^u$$
$$\pi_t^m - \tau_t^m = \epsilon_t^m$$

- Stochastic volatility in $\epsilon_t^{\pi}$
- Trends $(\tau_t^i)$ and time-varying parameters $(\rho_t^{\pi}, \lambda_t, \gamma_t)$ evolve as random walks

➢ **Intuition:**

Shifts in trend inflation $\tau_t^{\pi}$ ➡ permanent effects on inflation.

Shocks $(\epsilon_t^{\pi}, \epsilon_t^u, \epsilon_t^m)$ and changes in their transmission $(\rho_t^{\pi}, \lambda_t, \gamma_t)$ ➡ transitory effects.

# Extended model with survey inflation expectations

➢ **Measurement equation** for the survey forecast for inflation at horizon *t+h* given the information *at the start of period t*

$$\underbrace{\pi^e_{t+h_n|t}}_{\substack{\text{Period } t\text{'s} \\ \text{survey forecast}}} = (1 - \xi_{t-1}) \underbrace{f_{h_n}(\theta_{t-1}, Y^{t-1})}_{\text{Model forecast}} + \xi_{t-1} \underbrace{\pi^e_{t-1+h_n|t-1}}_{\substack{\text{Previous period's} \\ \text{survey forecast}}} + \epsilon^{h_n}_t$$

➡ The weighting coefficient $\xi_{t-1}$ induces forecast smoothing

➢ **Intuition behind the degree of forecast smoothing** $\xi_t$

- $\xi_t = 0$ → survey expectations = model forecast (*SPF no smoothing model*)
- $\xi_t = 1$ → full decoupling (*baseline model*)
- $0 < \xi_t < 1$ → partial adjustment (*SPF model*)

  ↳ • Motivation: informational rigidities / strategic behaviour

  - Consistent with EA evidence pointing to slow updating of professional forecasters (e.g., Andrade and le Bihan, 2013)

**Outline**

I.   **Model**

II.  **Data and Estimation**

III. **Results**

# Data details

➢ **Sample:** 1990Q1 - 2017Q4

➢ **Macroeconomic data:**
- $\pi_t$ : HICP inflation (annualised percentage quarterly changes)
- $u_t$ : civilian unemployment rate
- $\pi_t^m$: annualized quarterly change in the import-price relative to the GDP deflator
  (Matheson and Stavrev, 2013)

➢ **Inflation expectations data:** ECB's Survey of Professional Forecasters (SPF):
- Available on a quarterly basis since 1999Q1
- Contains rolling horizon…

*One-year[1] and two-year[2] ahead forecasts*

... and calendar horizon forecast for year-on-year inflation

*Current calendar year*
*Next calendar year*
*Five calendar years ahead[3]*

- In our empirical set-up: *(1)*, *(2)* & *(5)* = noisy indicators of the model forecast of *yoy* inflation 3,7 and 19 quarters ahead (cfr., Smets, Warne and Wouters, 2014).
- Issue: SPF data is collected at the start of each quarter, and is based on macro data from the previous quarter:

$$\pi_{t+h_n|t}^e \text{ is therefore based on } f_{h_n}(\theta_{t-1}, Y^{t-1})$$

# Estimation

➤ All latent states (i.e., time varying trends and coefficients ) and static coefficients are jointly estimated …

➤ **…**applying Bayesian Gibbs sampling techniques

➤ **Issue:** the model forecast function $f_{h_n}(\theta_{t-1}, Y^{t-1})$ is nonlinear in the parameters $\theta_{t-1}$

E.g., consider the simplified model:
$$\pi_t = \rho_t \pi_{t-1} + error,$$

then the 2 period ahead model forecast reads:
$$\hat{\pi}_t^{t+1} = (\rho_{t-1})^2 \pi_{t-1}$$

➡ implement a single-move Gibbs sampler to draw from the parameters which enter nonlinearly in the model forecast equations (based on Cogley, 2005; Koop and Potter, 2011)

**Outline**

# Permanent or cyclical forces? Using survey data leads to different conclusions

### Trend inflation $(\tau_t^\pi)$



—— baseline  —— SPF model  —— Inflation

### Natural rate of unemployment $(\tau_t^u)$



—— baseline  —— SPF model  —— Unemployment
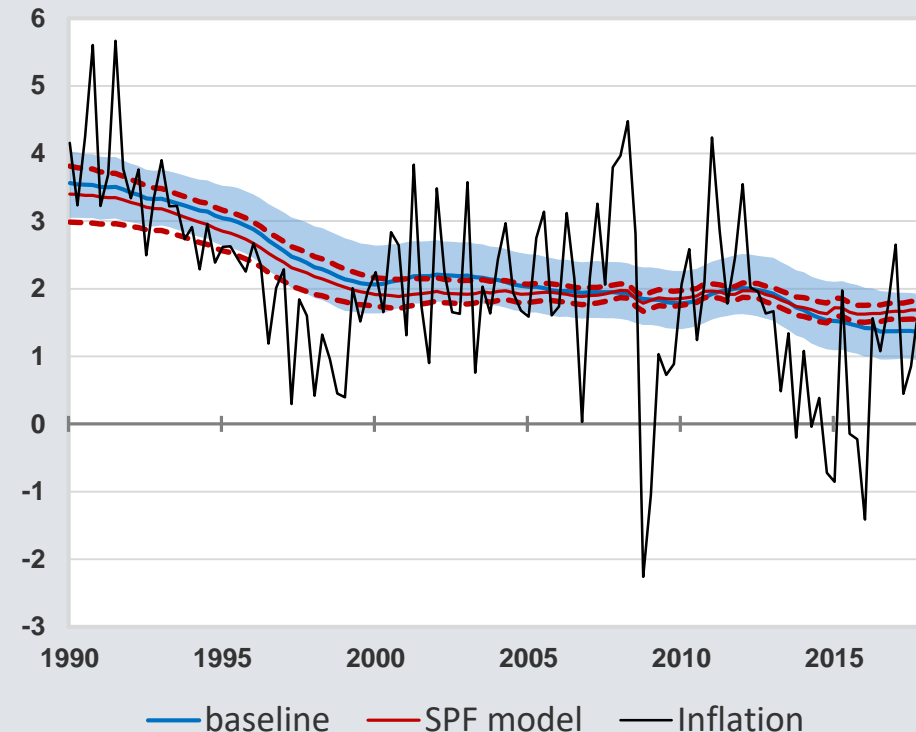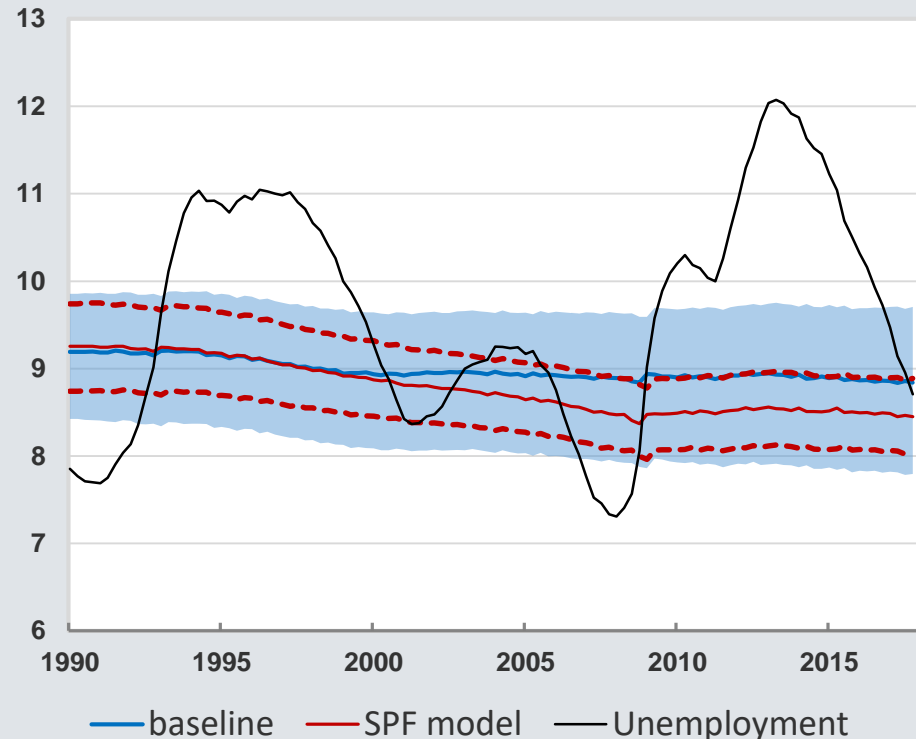
➢ Excluding SPF data: trend inflation dropped significantly below 2% (median value of 1.4%)
➢ Including SPF data: significant but less pronounced fall in trend inflation (1.7% at median); instead higher economic slack during the *lowflation* period.

# Important changes in the transmission of cyclical factors:



**Intrinsic persistence** $(\rho_t^\pi)$     **Phillips curve slope** $(-\lambda_t)$     **Import price coefficient** $(\gamma_t)$

baseline    SPF model
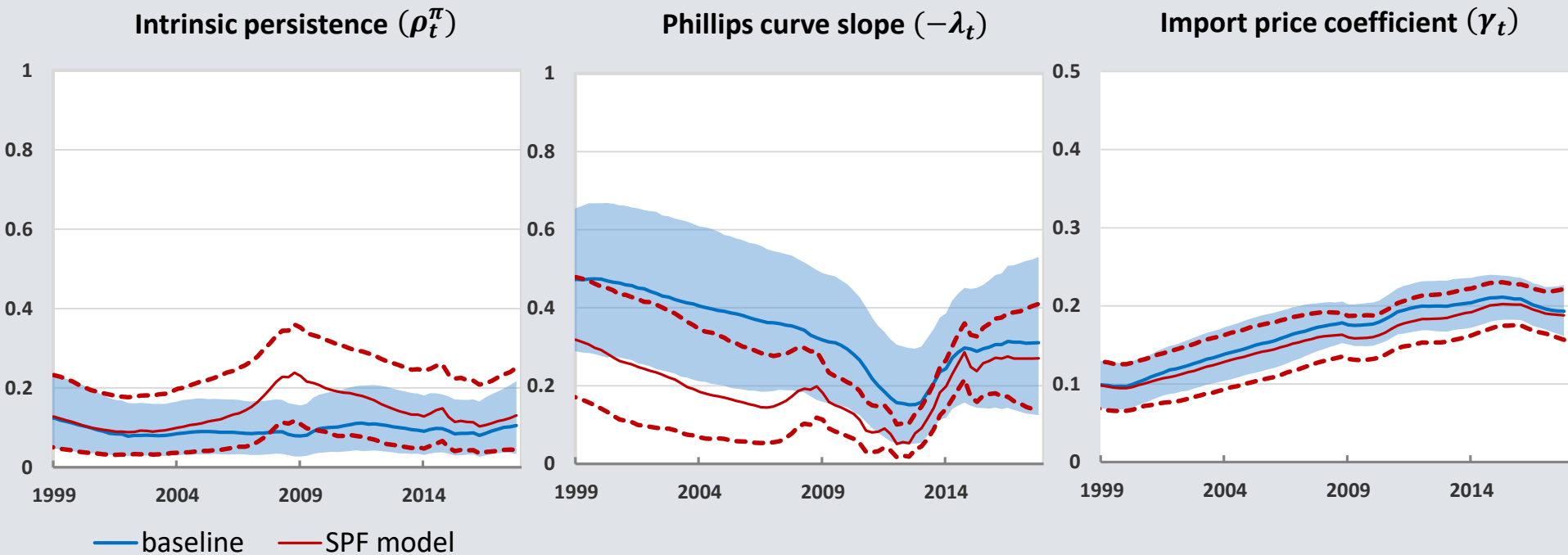
- Inflation has become more sensitive to both domestic cyclical fluctuations and foreign price pressures in recent years.
    - Importance of import price inflation continuously increased since 2000 (significant at the 95 % level in both models)
    - After a general flattening, the Phillips curve steepened over the course of the Great Recession (significant at 68% level in the SPF model)
- Intrinsic persistence temporarily peaked in 2008Q4-2009Q1, but remained overall low

# Forecasters updated their projections more frequently during the financial crisis period



Forecast smoothing $\xi_t$
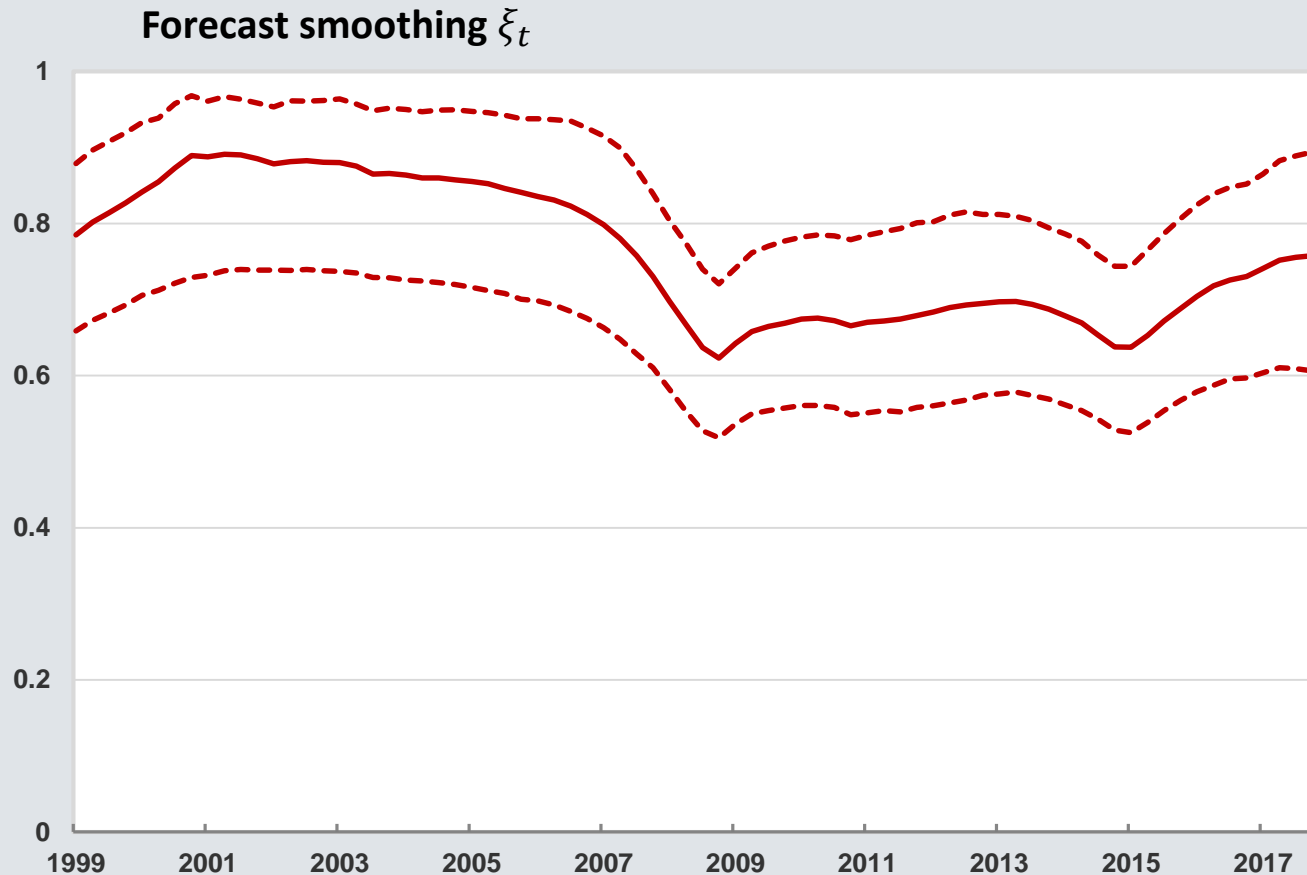
# SPF improves the forecast accuracy of our model in predicting future inflation…

**RMSE relative to baseline model**
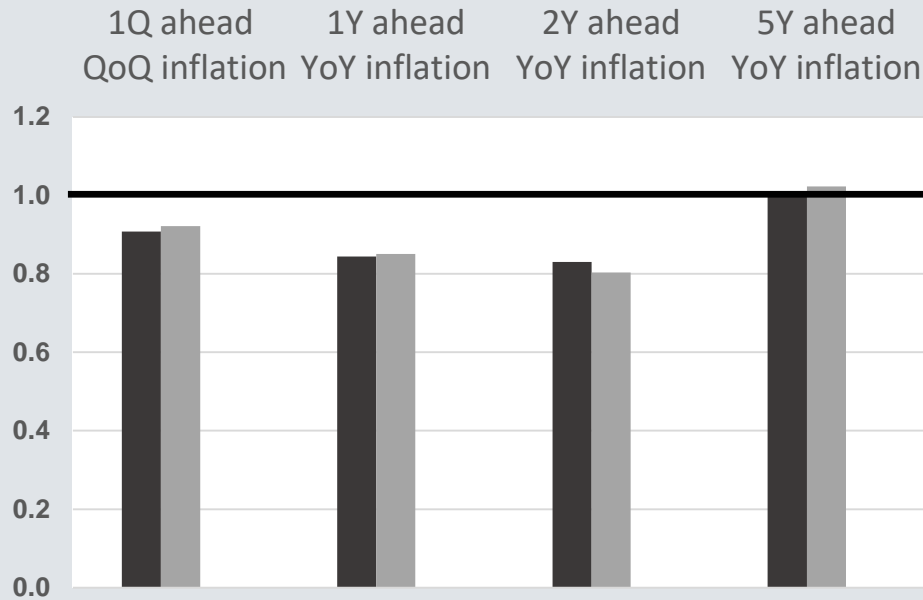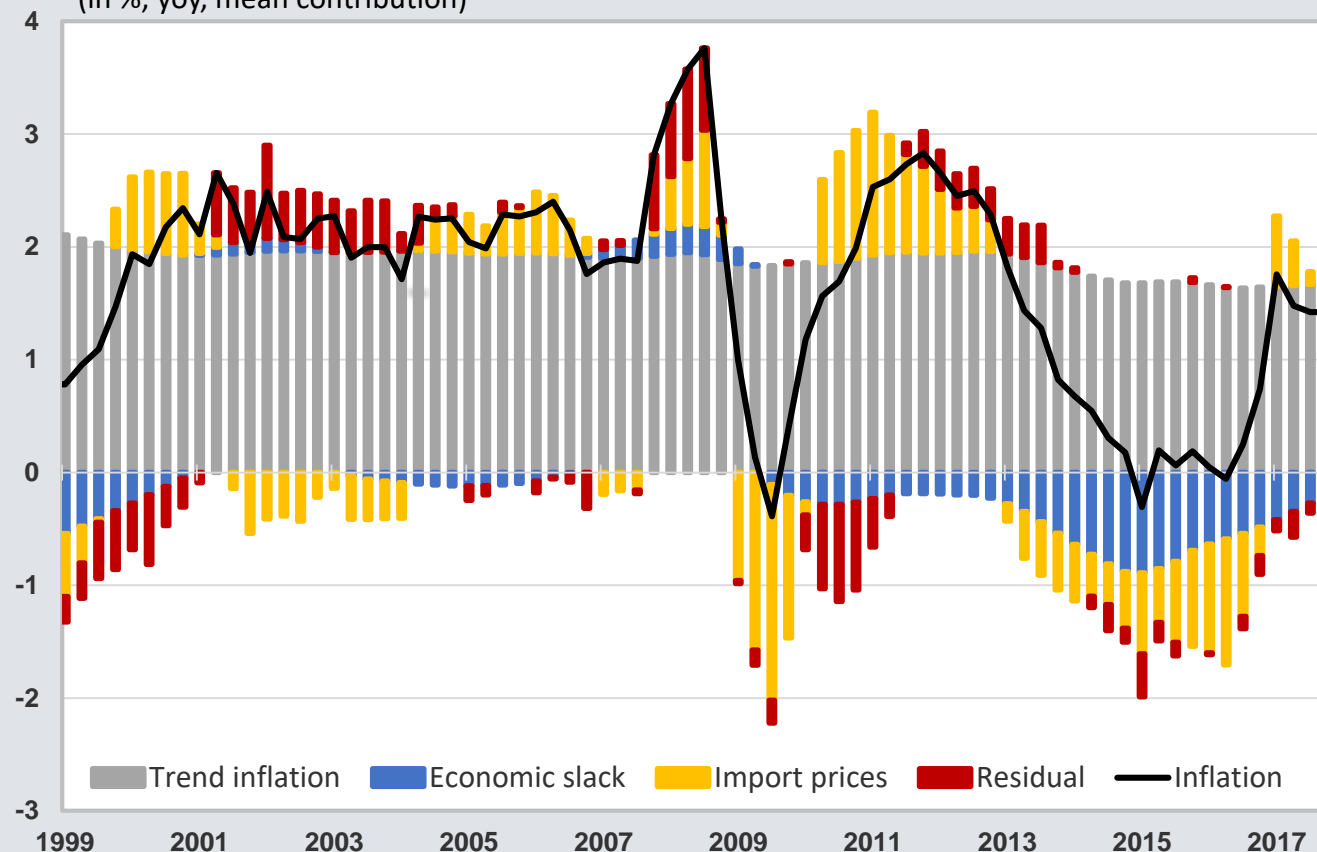
**CLPD relative to baseline model**
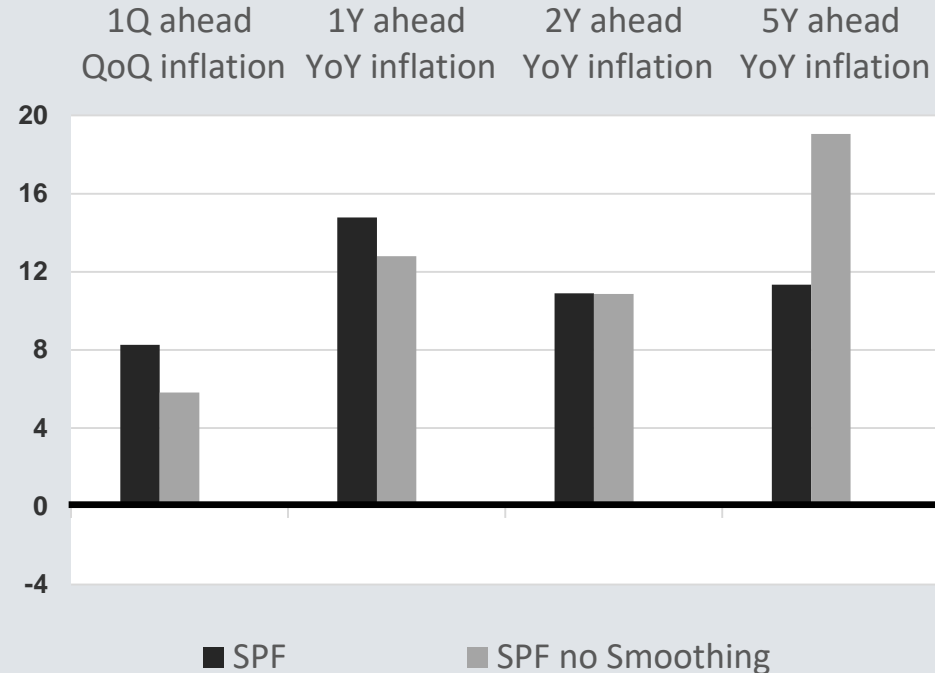


➤ Except at the LT 5y ahead forecast horizon using the RMSE as the forecast metric

# … which provides confidence that the low inflation is mainly due to cyclical factors

Gradual declining slack with increasing Phillips curve slope
Downward import price pressures

**Historical decomposition of inflation with the SPF smoothing model**
(in %, yoy, mean contribution)



Legend: Trend inflation, Economic slack, Import prices, Residual, Inflation

**Relative contribution to inflation variation since 2007**

| Variation in | |
|---|---|
| Trend | 8% |
| Slack | 21% |
| Import prices | 55% |
| Residual | 16% |

# Relative forecast performance (CLPD) over time
## (relative to baseline)



**1Q ahead QoQ inflation**

**1Y ahead YoY inflation**

**2Y ahead YoY inflation**

**5Y ahead YoY inflation**

——— SPF model   - - - - SPF no smoothing
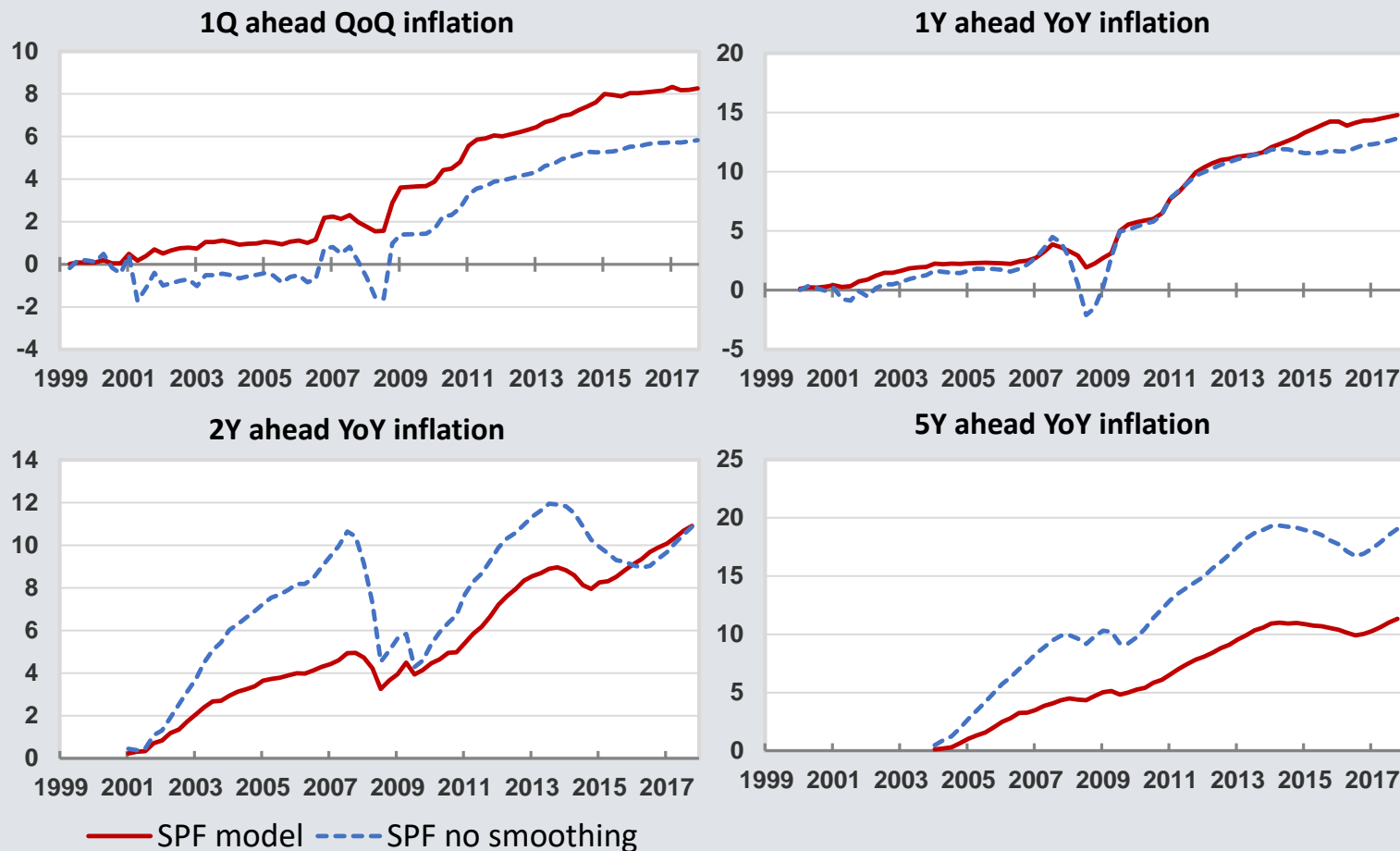
➢ Better forecast accuracy of SPF models: mainly after outbreak of the financial crisis in 2007
➢ Temporarily better performance of baseline model during the two most recent bouts of falling inflation → coincident link with forecast smoothing dynamics?

# Robustness: Relevance short-term forecast data & TVP ?

Two robustness checks:
  a) Long-term survey forecasts only
  b) Constant parameters

➢ These two alternative model variants attribute less weight to domestic slack in explaining the *lowflation* ▶

  ▪ Excluding short-term forecast data: stronger weakening in trend inflation

  ▪ Constant parameters:
    ○ stronger contribution from negative inflation shocks
    ○ lower upward price pressures coming from foreign factors

➢ Including information from short-term survey forecasts and adding time-variation in parameters is useful in predicting future inflation ▶

➡ **TVP and short-term inflation expectations are important traits to consider in the analysis of inflation dynamics**

# Conclusions

➢ The model with survey expectations finds a more muted decline in trend inflation in recent years and a larger degree of economic slack

➢ The inclusion of survey data improves the forecast performance of the model in predicting inflation

➡ From the perspective of a practitioner, interested in inflation predictability, our results support the view that the *lowflation* is mainly driven by cyclical, and thus temporary forces, rather than by downward revisions in long-term inflation expectations

➢ Forecasters updated their beliefs more frequently during the financial crisis period; but overall survey expectations remained very persistent

➢ Short and medium term expectations bring useful information for detecting changes in the dynamics of the inflation gap

# Thank you for your attention

# -

# Questions?

# Backup slides

# SPF no smoothing model:
# Trend inflation and the natural rate of unemployment

### Trend inflation $(\tau_t^\pi)$
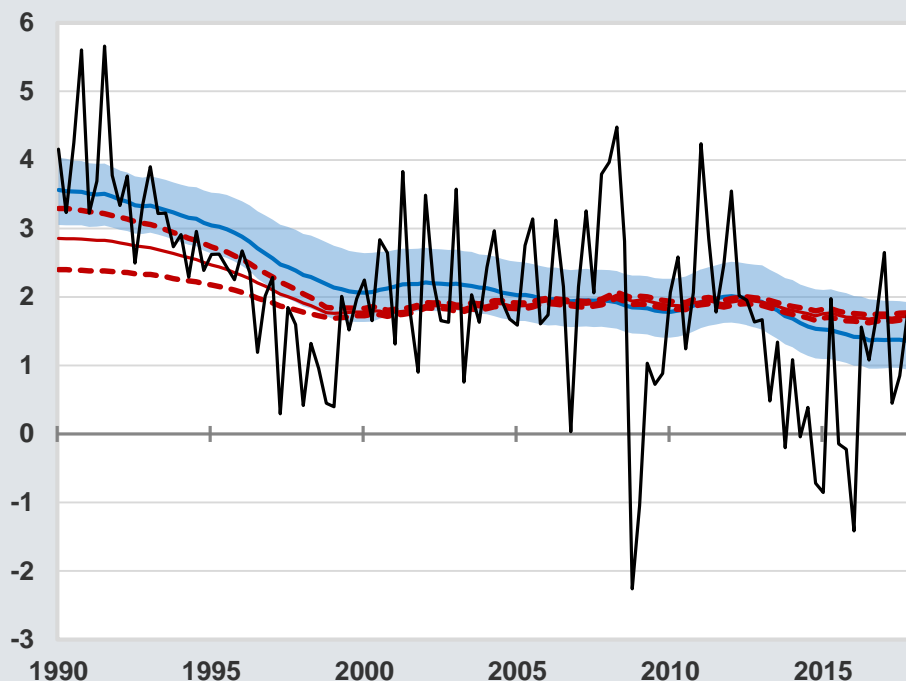


### Natural rate of unemployment $(\tau_t^u)$
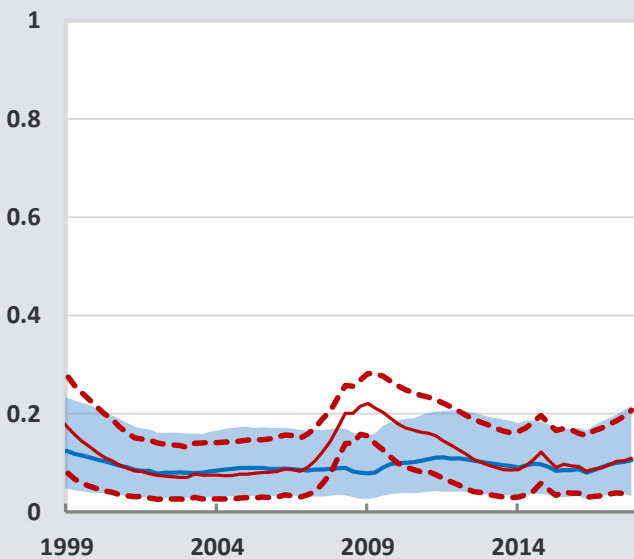


—— baseline

—— SPF no smoothing model
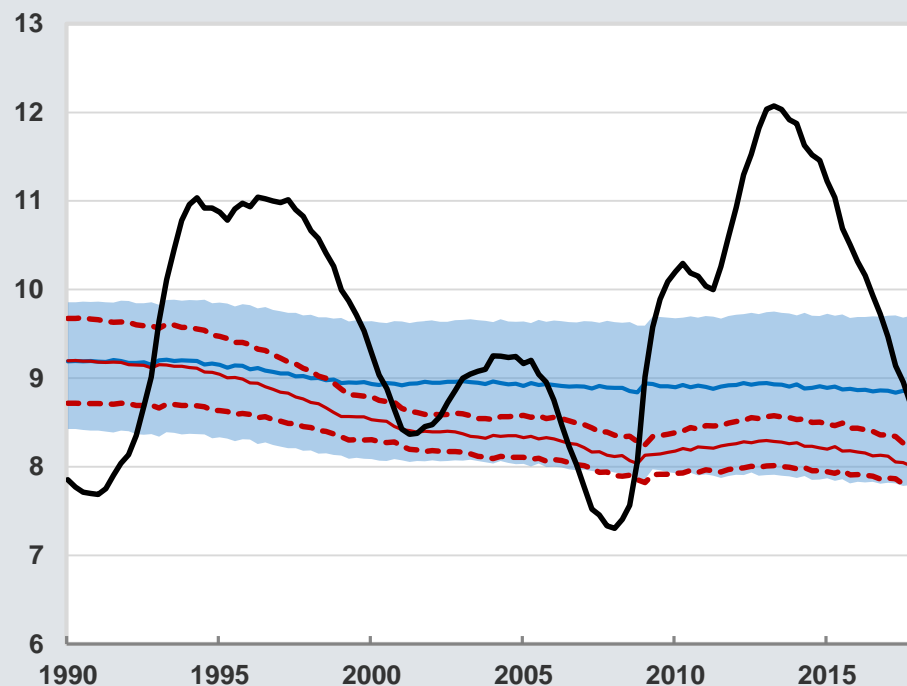
—— baseline

—— SPF no smoothing model

# SPF no smoothing model:
# Time varying Phillips curve parameters

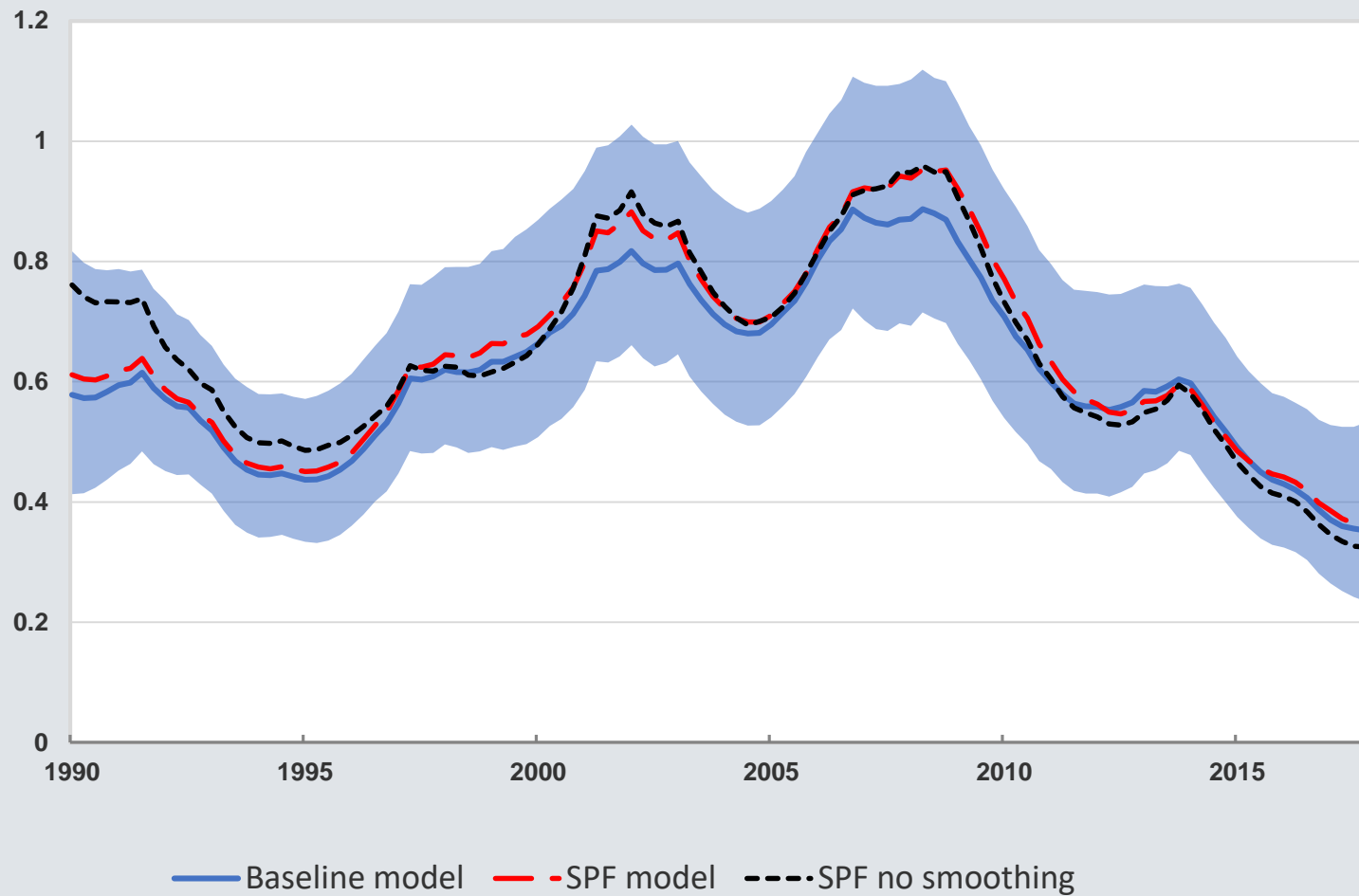**Intrinsic persistence** $(\rho_t^\pi)$

**Phillips curve slope** $(-\lambda_t)$
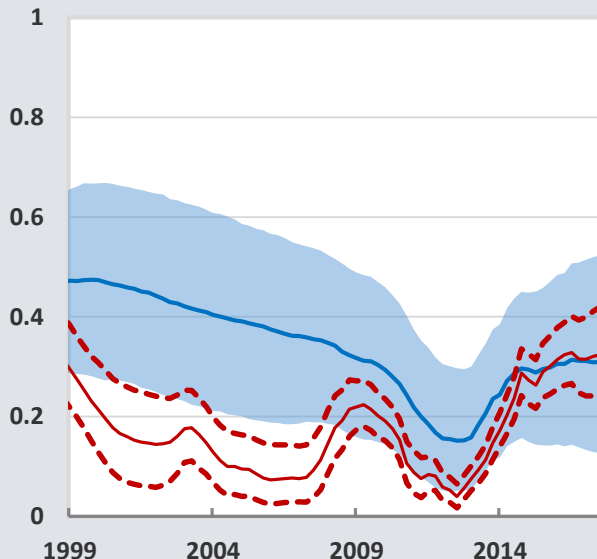
**Import price coefficient** $(\gamma_t)$
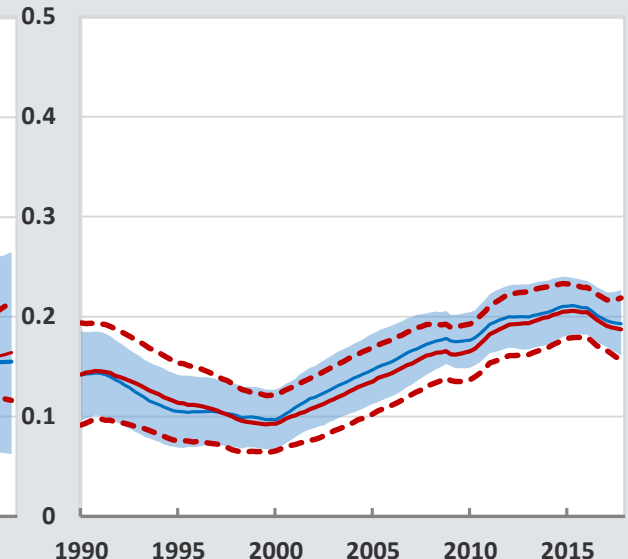
— baseline

— SPF no smoothing model

# Time varying stochastic volatility

**Trend inflation** $(\tau_t^\pi)$ — **Natural rate of unemployment** $(\tau_t^u)$
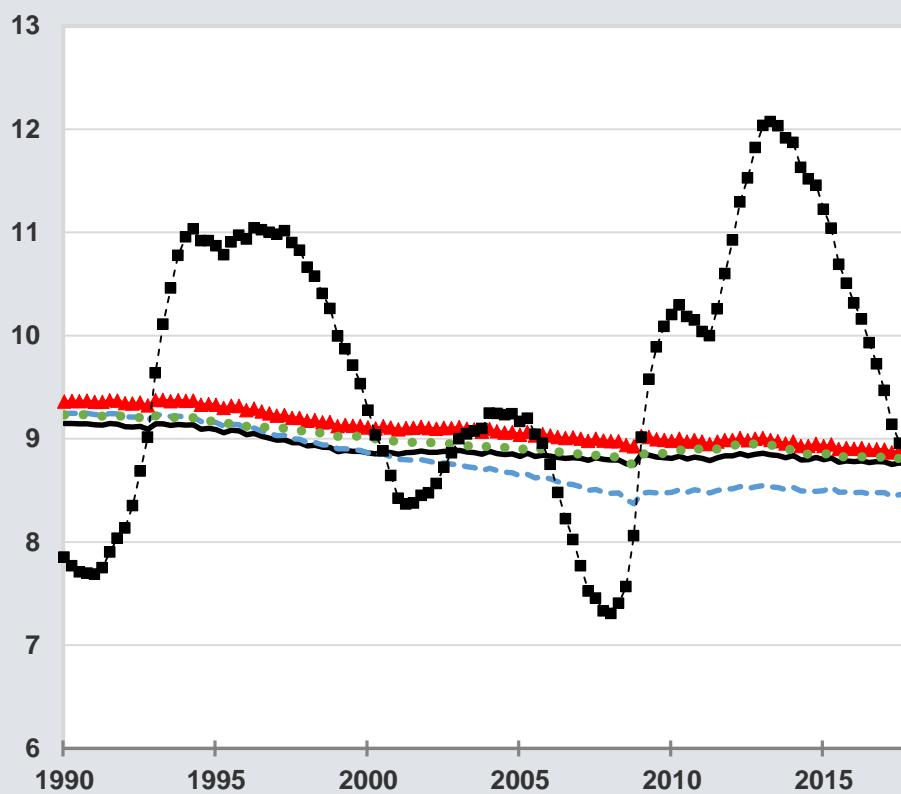
Legend: Baseline, SPF model, LT-exp model, CST model, Unemployment

**RMSE relative to baseline model**

**CLPD relative to baseline model**