Inflation and the Economic Activity Variables' Steeplechase

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Motivation

- Ongoing controversy about the relationship between price inflation and domestic economic activity. Albeit the concept of the Phillips curve as a long-term and stable link between inflation and cyclical conditions is deeply rooted in macroeconomics, its empirical evidence has been ambiguous.

- The Great Recession: further doubts on validity of the Phillips curve. Sharp increase of unemployment is accompanied by relatively muted response of inflation.

- This paper aims to show, to what extent the uncertainty about the choice of proper forcing variable contributes to ambiguity of the evidence on the Phillips curve in the United States and other G7 countries, while the focus of most of the current literature is on time variance of parameters and other nonlinearities.

- Variables included in our steeplechase: output gap, rulc, unemployment-based indicators and variables representing external inflationary pressures.

Introduction

- The dynamic model averaging in this paper marries both, model selection and time variance and in fact, while considering broad set of variables at once, the DMA approach is more closer to actual decision making of monetary authorities than the simple, one equation models.

- Variables included in our steeplechase: output gap, rulc, unemployment-based indicators and variables representing external inflationary pressures.

- Our results show that inflation seems to respond to different measures of economic activity across time and space to a varying extent and no measure of economic activity clearly dominates in all countries or over the whole sample.

- The output gap is often outperformed by unemployment-related variables such as the short-term unemployment rate, unemployment expansion gap or the unemployment recession gap.

- We document weakening of the inflation-activity relationship (i.e. flattening of the Phillips curve) in the recent decade that is robust both across activity measures and across countries.

Outline

- The inflation – economic activity nexus: which variables drive inflation?

- Methodology. The Dynamic Model Averaging and Dynamic Model Selection

- Results 1 – UC-SV model and inflation trend

- Results 2 – The U.S. inflation gap

- Results 3 – International evidence

- Conclusions and policy implications

Inflation – economic activity nexus

- Output gap: aggregate measure, uncertainty related to data revisions and reliability of estimates. Trend-cycle decomposition particularly uncertain in the real time (Kocherlakota, 2010, among others, link the decrease in economic activity in the Great Recession to the decrease of potential output).

- Unemployment rate, since 1980's focus on short-term unemployment or deviations from the NAIRU (Ball and Mazumder, 2011, Simon et al., IMF WEO 2013/4). Growth of employment.

- Unemployment recession gap – difference between actual unemployment and minimum unemployment over the last three years (Stock and Watson, 2010). We include also the counterpart, unemployment expansion gap.

- NKPC literature – Galí-Gertler (1999) use real unit labor costs (proxy to marginal costs).

- External inflationary pressures: oil prices, nominal effective exchange rate.

Methodology

- We follow Stock and Watson (2010) and consider model with inflation and inflation trend implying focus on the inflation gap.

- Time-variance of parameters and stochastic volatility is considered.

$$\pi_{t+h} = \tau_{t|t} + \gamma_t x_t + e_{t+h}, \quad \mathrm{var}(e_{t+h}) = \sigma^2_{e,t+h}$$

$$\gamma_t = \gamma_{t-1} + \xi_t, \quad \mathrm{var}(\xi_t) = \sigma^2_{\xi,t}, \mathrm{cov}(e_{t+h}, \xi_t) = 0$$

- The inflation trend is derived from unobserved-component stochastic volatility model. in which the rate of inflation is represented as a sum of trend and transitory component.

$$\pi_t = \tau_t + \eta_t, \quad E\eta_t = 0, \mathrm{var}(\eta_t) = \sigma^2_{\eta,t}$$

$$\tau_t = \tau_{t-1} + \varepsilon_t, \quad E\varepsilon_t = 0, \mathrm{var}(\varepsilon_t) = \sigma^2_{\varepsilon,t}, \mathrm{cov}(\eta_t, \varepsilon_t) = 0$$

- It can be shown that the model is richly parametrized backward-looking Phillips curve (with potentially long lags). To the extent to which the trend mimics inflationary expectations it can also be thought of as a NKPC model.

Methodology

- The dynamic model averaging marries both, model selection and parameter variation.

- We assume that a reaction of inflation to the signal contained in the economic activity variables may have changed over time. To account for this uncertainty we make a use of Dynamic Model Averaging (Raftery et al., 2010). It uses time-varying parameter model framework and dynamic model switching.

- The outcome of the DMA is derivation of probability $\pi_{t|t,k}$ of each model k being "true" at time t. These probabilities drive model switching.

- Raftery et al. (2010) and Koop and Korobilis (2010) show that posterior model are related to the weighted product of predictive densities $p_k(y_t|y^{t-1})$:

$$\pi_{t|t-1,k} \propto \prod_{i=1}^{t-1} [p_k(y_{t-i}|y^{t-i-1})]^{\alpha^i}$$

- It means that model k will receive higher probability at time t if it has exhibited good forecast performance in the recent past where the performance is measured by the predictive density.

Methodology

- Time-varying parameter models as well as UC-SV model are estimated by traditional (but fairly simplified) Kalman filter in spirit of Raftery et al. (2010) and Koop and Korobilis (2012).

- We avoid the need to specify uknown variances by employing forgetting factor (transition equation) and EWMA estimate (observation equation).

- This leads to computationally simple but effective estimation strategy.

- Value of forgetting factor is controlled by two parameters (minimum value and the speed of adjustment) which must be specified prior to the analysis. Conditional on their value, forgetting factor at time t is set in data-driven manner.

Methodology: Models in DMA

Model	Trend	Output gap	RULC	Growth in employment	Short-term unemployment	Unemployment recession gap	Unemployment expansion gap	Oil price	Effective Exchange rate
1	●	●							
2	●		●						
3	●			●					
4	●				●				
5	●					●			
6	●						●		
7	●	●						●	●
8	●		●					●	●
9	●			●				●	●
10	●				●			●	●
11	●					●		●	●
12	●						●	●	●
13	●							●	●

Results 1
UC-SV trend inflation and inflation expectations
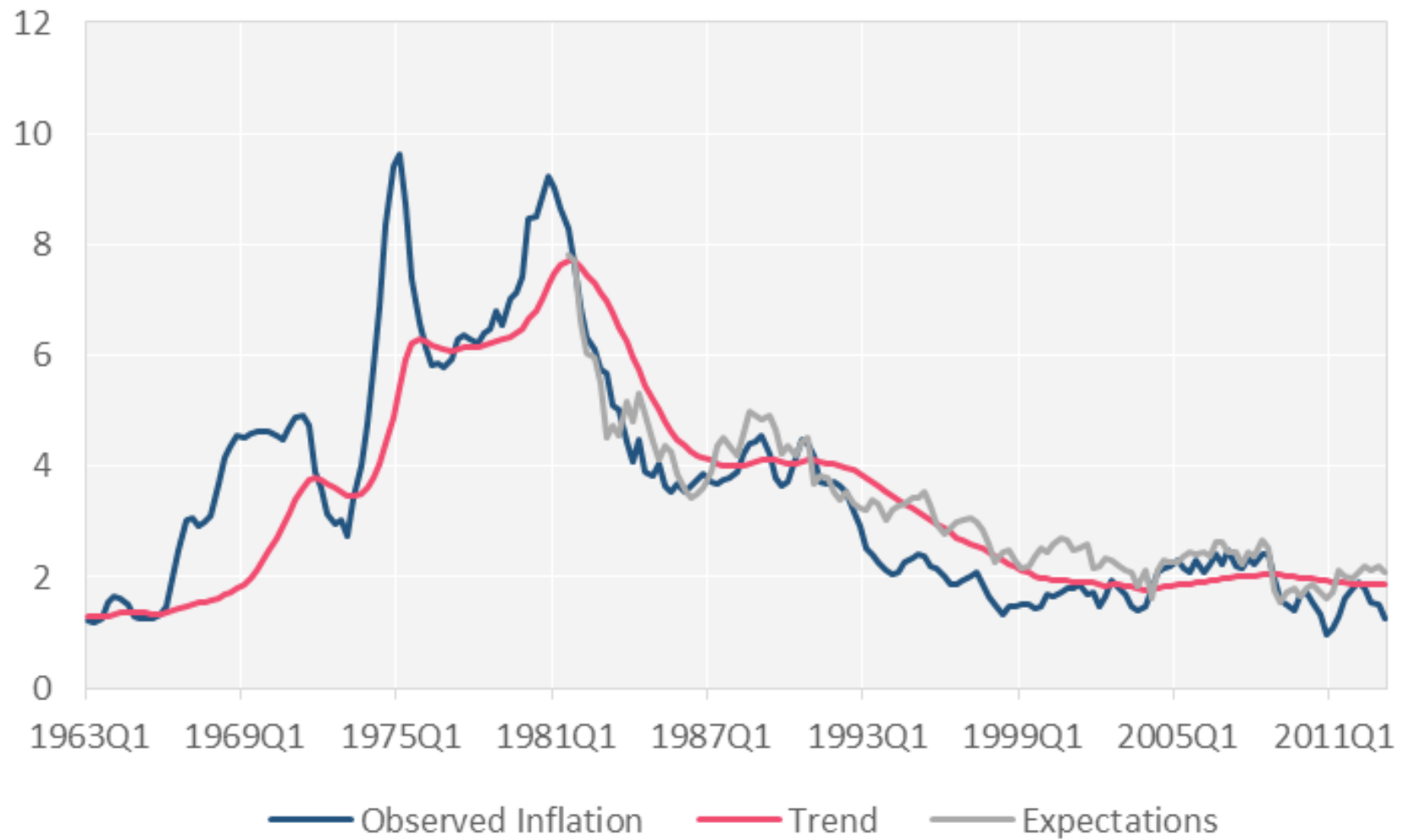
Results 1
UC-SV trend inflation: Estimated value of forgetting factor
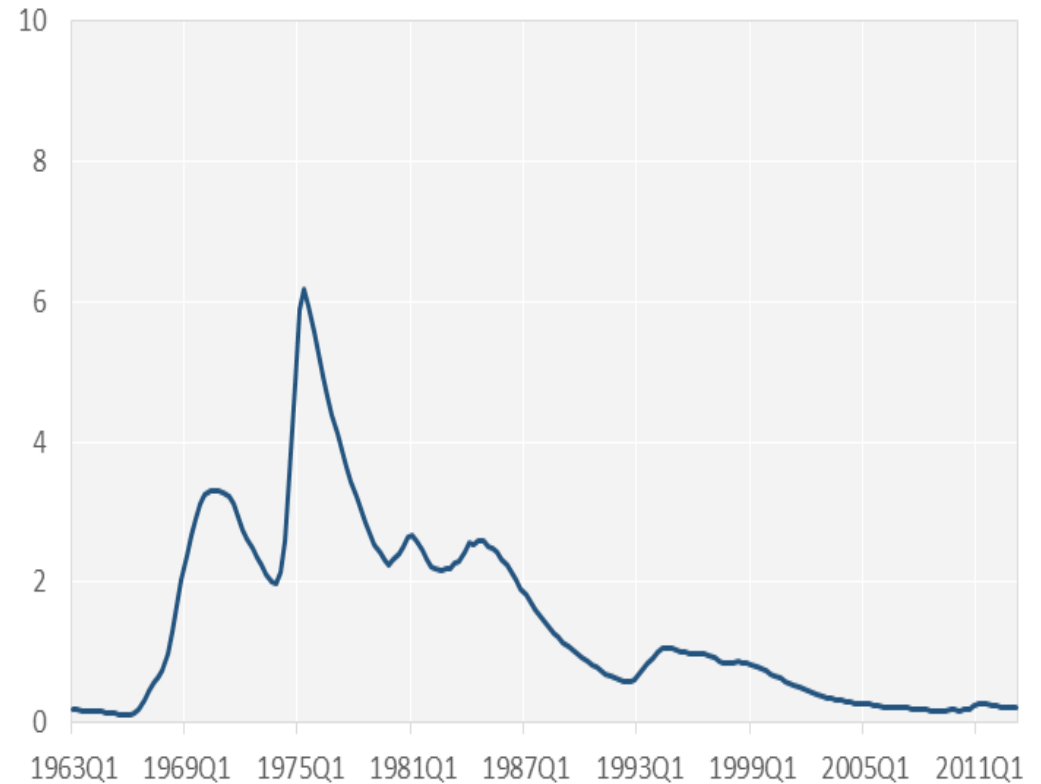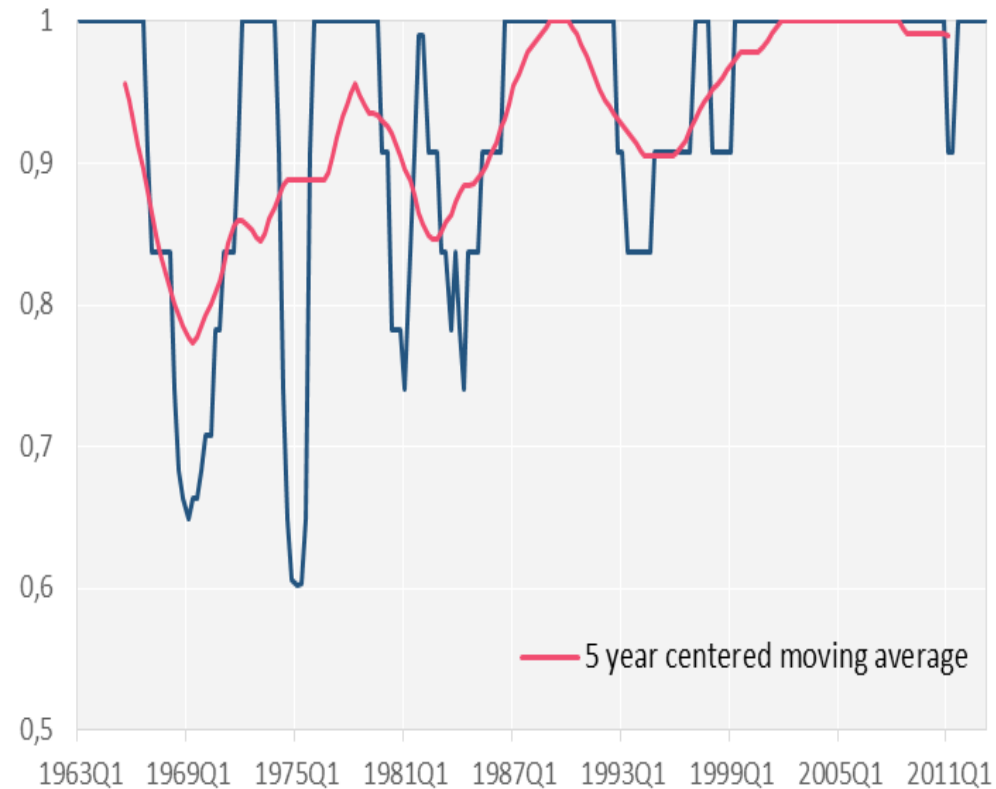
Results 2
U.S. Inflation gap – Inclusion probabilities
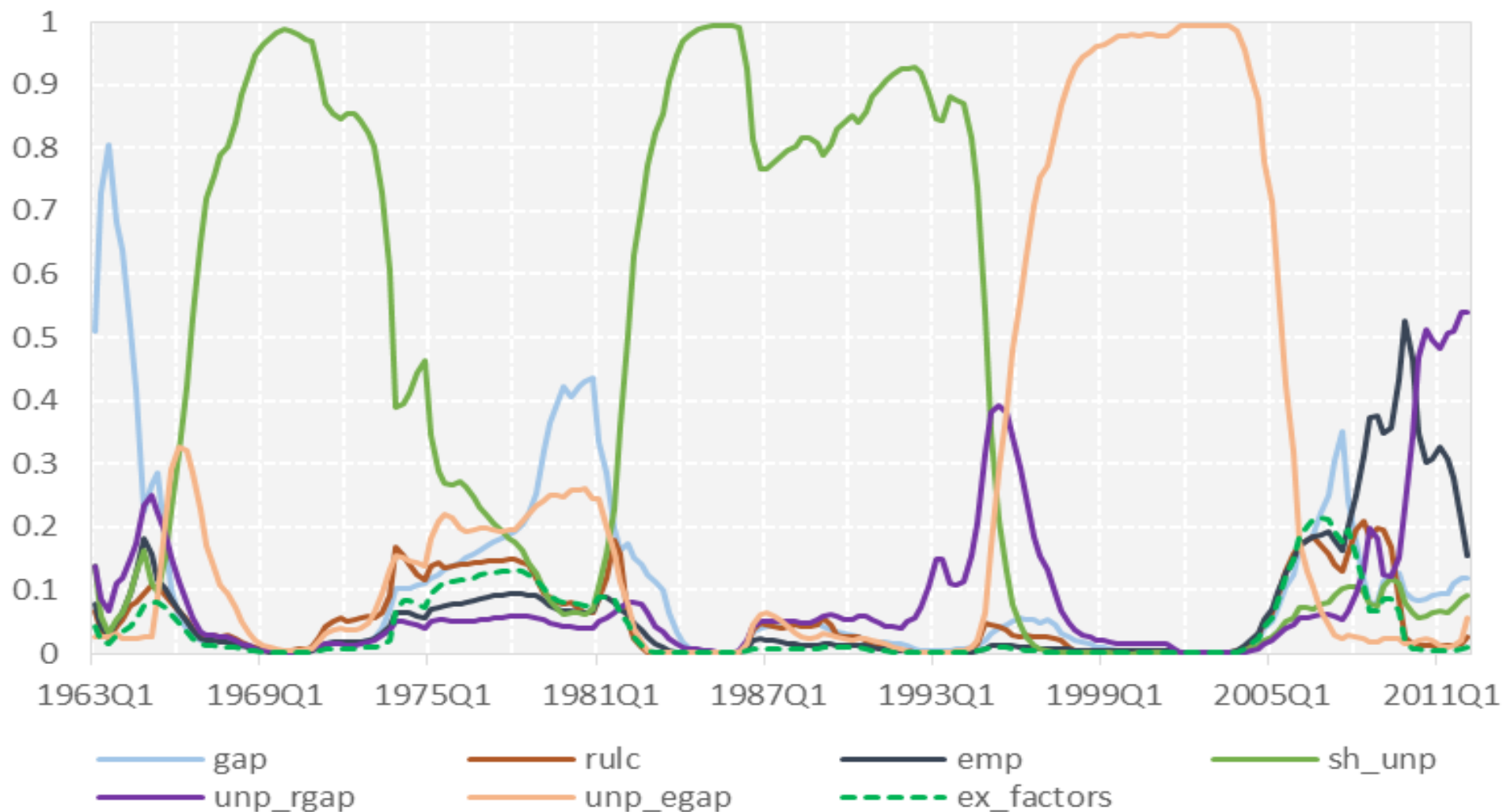
Results 2
U.S. Inflation gap – Time varying coefficients
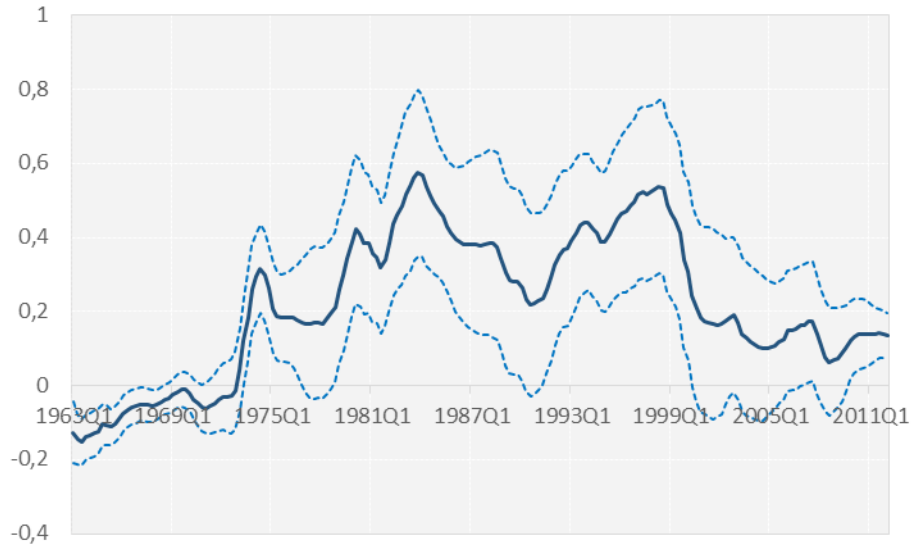
Output gap
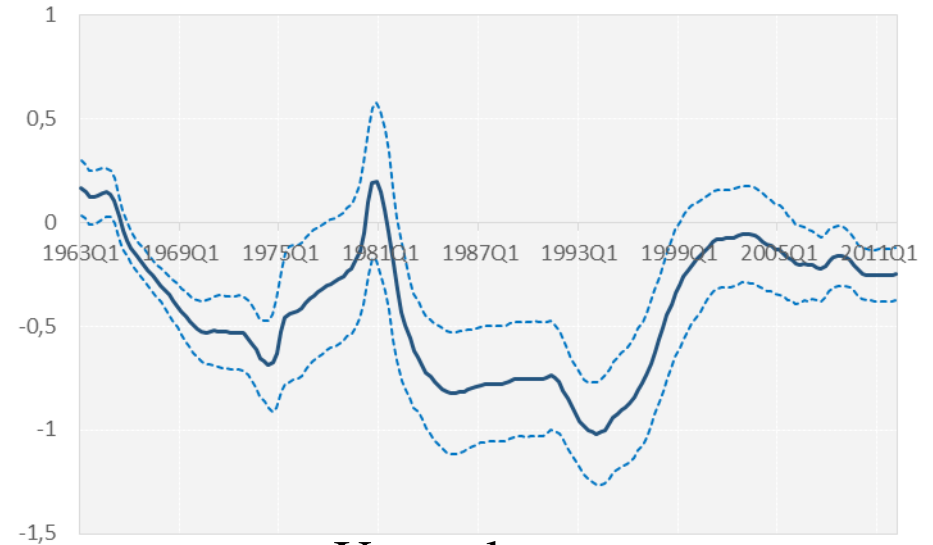
Unemployment
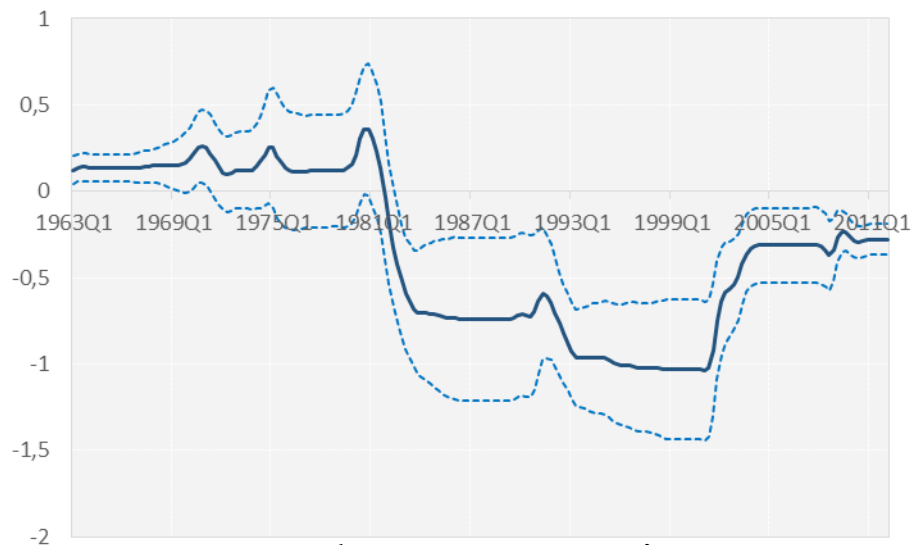
Unemployment recession gap
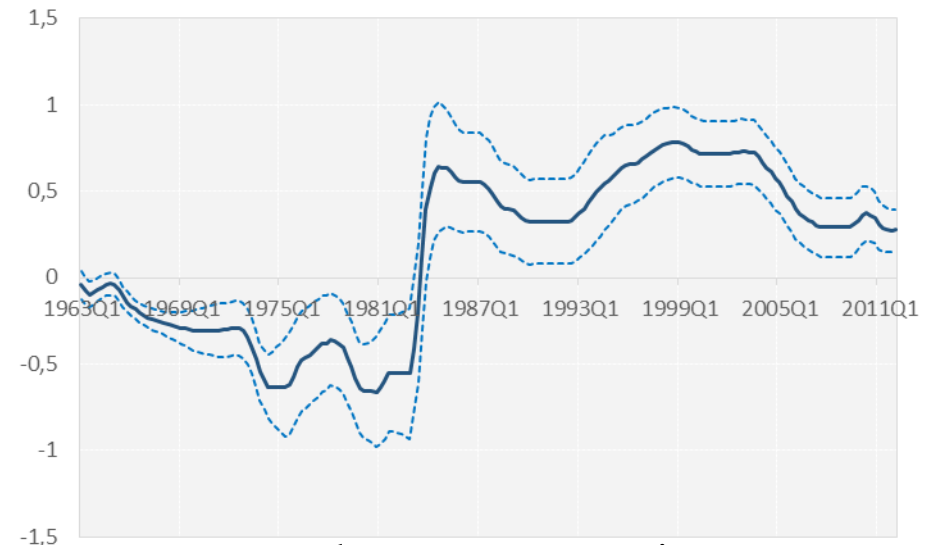
Unemployment expansion gap

Results 2
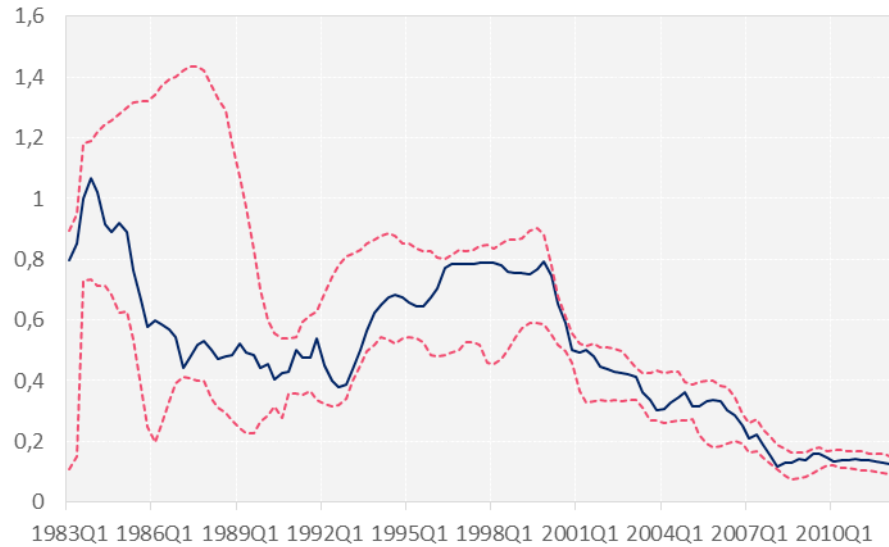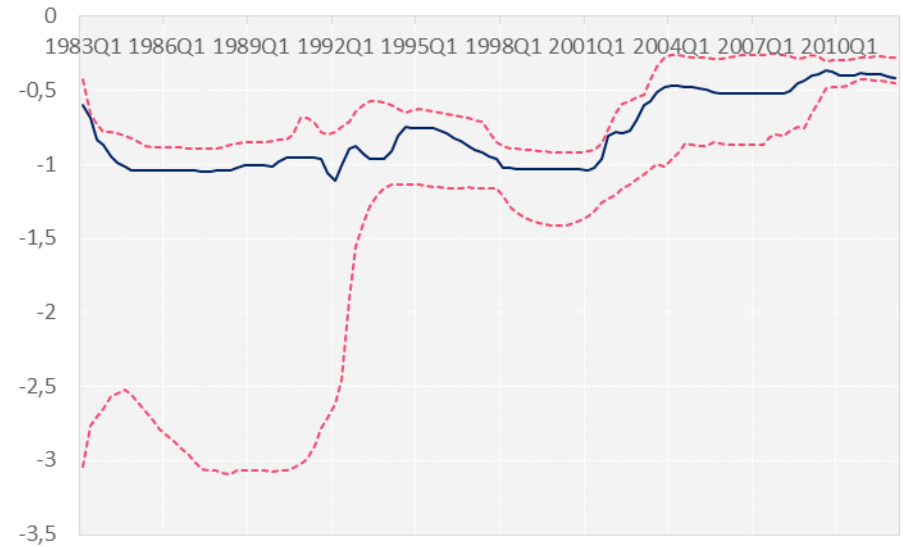## U.S. Inflation gap – External and domestic factors
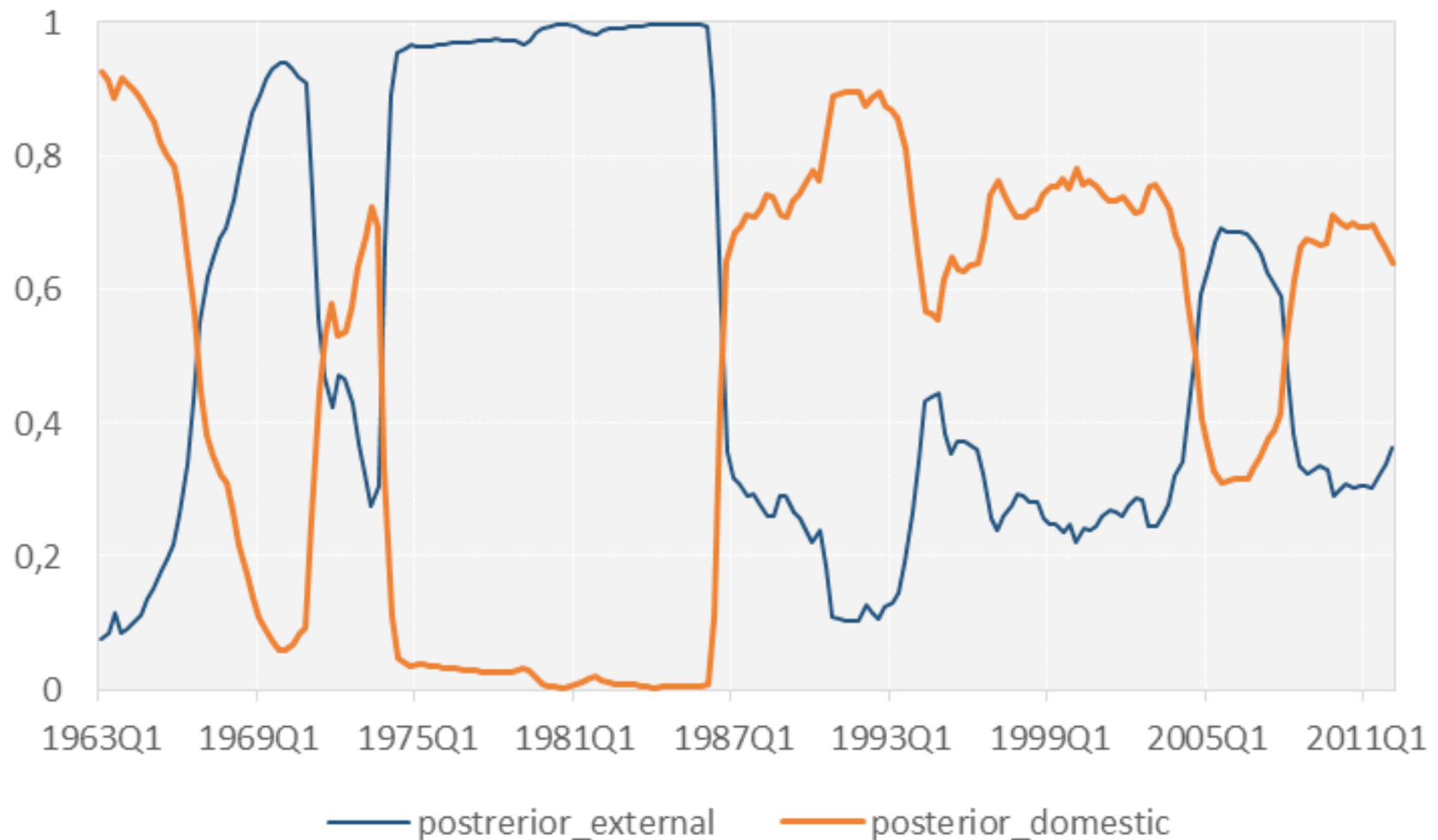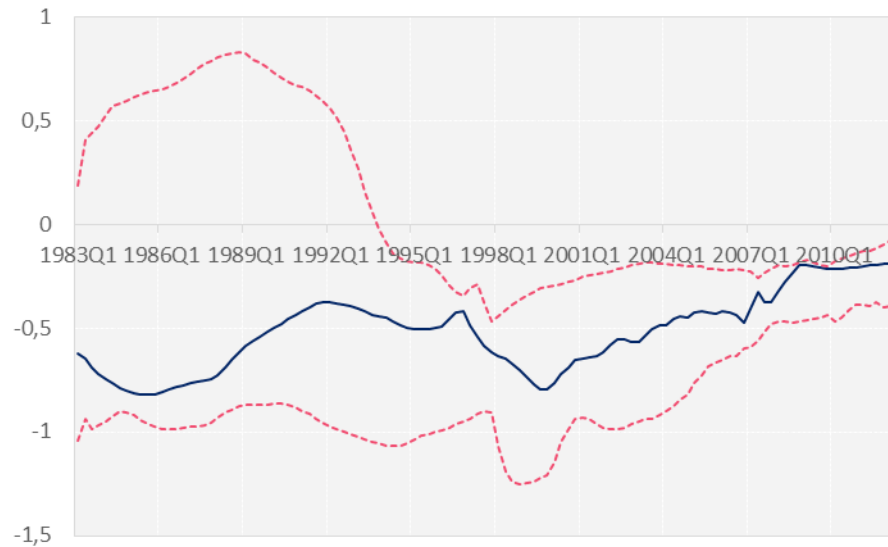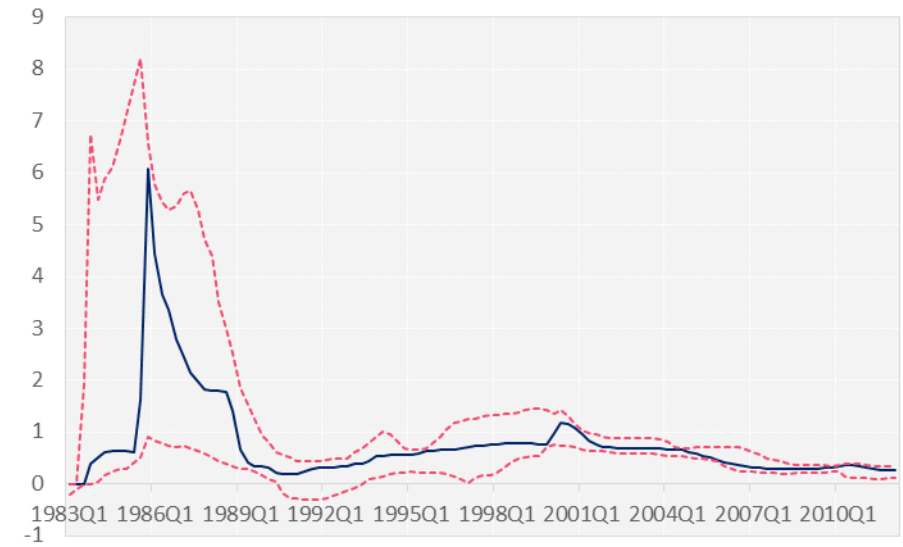
Results 3 International Evidence
Time varying coefficients (medians, G7)



Output gap

Unemployment

Unemployment recession gap

Unemployment expansion gap

Results 3 International Evidence Proportions of time when variables dominate

Country	Output gap	RULC	Empl. growth	Short-term unemp.	Unemp. rec. gap	Unemp. exp. gap	External factors
United States	12.69	0.00	4.57	50.76	5.58	24.87	1.52
Canada	11.68	8.76	0.73	50.36	11.68	16.79	0.00
Germany	50.46	10.09	0.92	22.94	15.60	0.00	0.00
France	0.00	18.35	2.75	36.70	22.94	19.26	0.00
Italy	14.68	23.85	5.50	33.94	6.42	15.60	0.00
United Kingdom	40.37	0.00	13.76	1.83	17.43	26.60	0.00
Japan	0.00	0.00	6.02	31.58	62.40	0.00	0.00
Czech Republic t+4	0.00	28.07	0.00	7.02	21.05	43.86	0.00
Czech Republic t+1	28.33	0.00	0.00	0.00	53.33	13.33	5.00

# Results 3 International Evidence
Germany, France, Italy, the U.K.
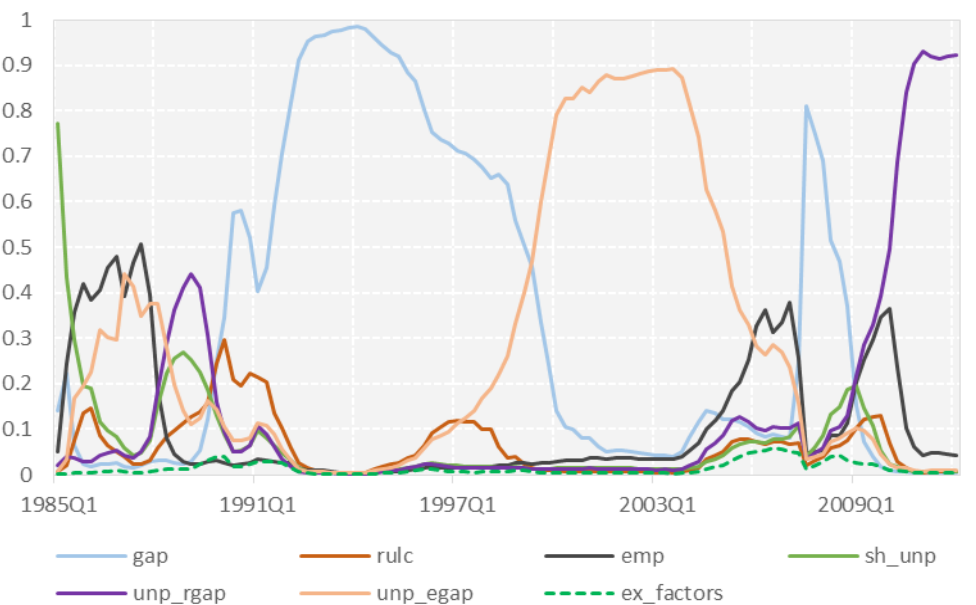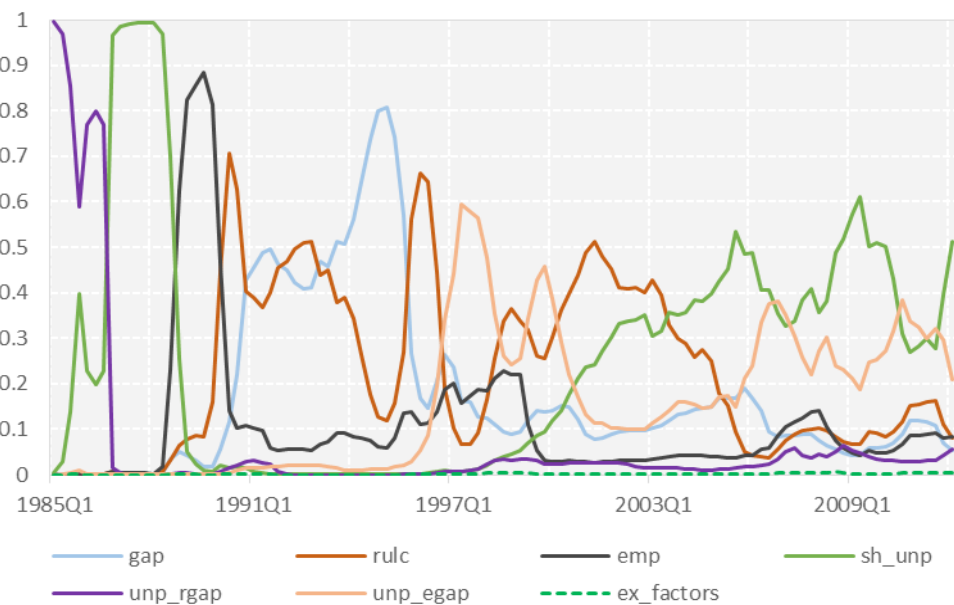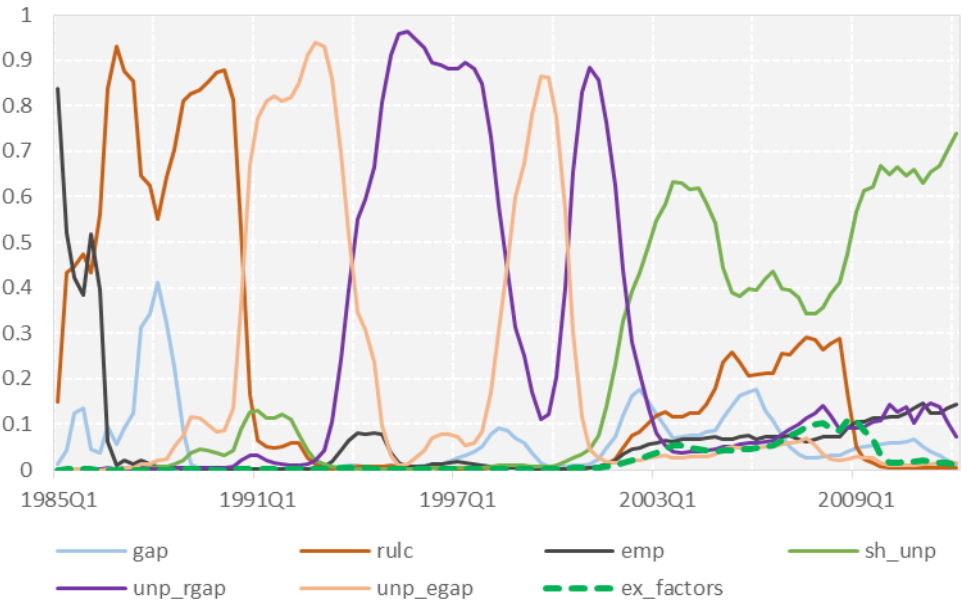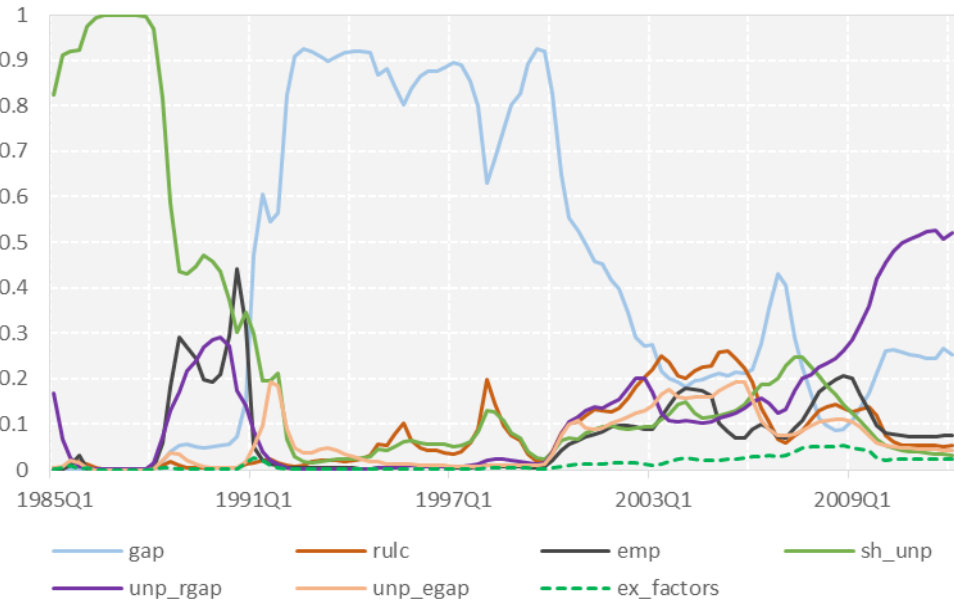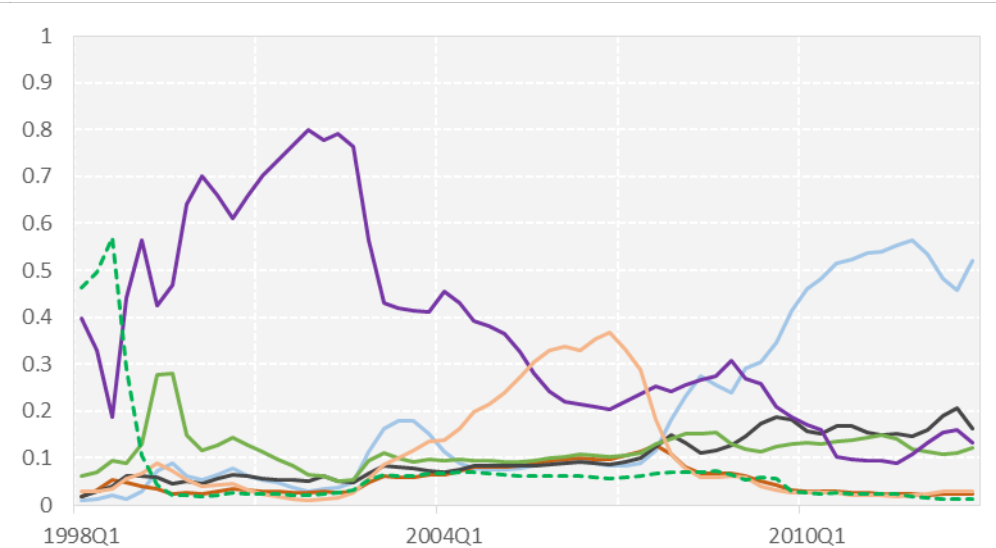
Results 3 International Evidence Model fit: R-squared

Country	DMA model	DMS model
United States	0.514	0.480
Canada	0.661	0.611
Germany	0.424	0.378
France	0.493	0.174
Italy	0.354	0.232
United Kingdom	0.385	0.393
Japan	0.490	0.337
Czech Republic t+4	0.238	0.106
Czech Republic t+1	0.271	0.239

Results 4 The Czech Republic

(t+4 left, t+1 right)
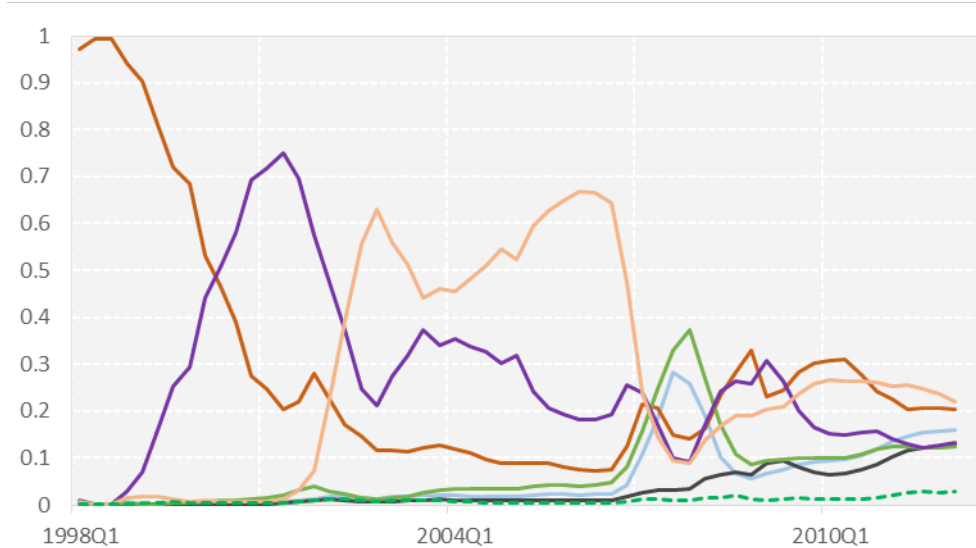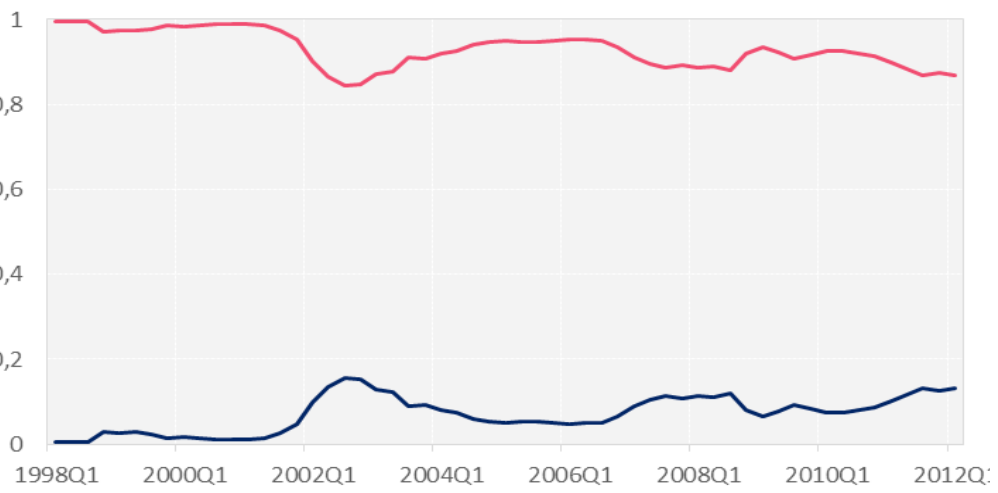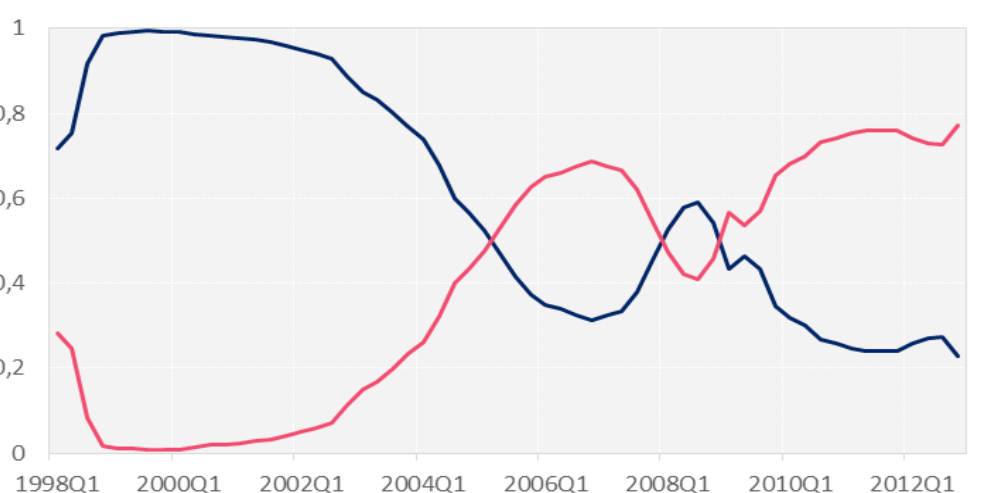
Conclusions

- Both of the features of our methodology, model switching and time variance of coefficients are relevant in the context of the inflation-activity relationship.

- Inflation seems to respond to different measures of economic slack across time and space and no measure of economic activity clearly dominates in all countries or over the whole sample.

- The output gap is often outperformed by unemployment-related variables such as the short-term unemployment rate, unemployment expansion gap or the unemployment recession gap.

- We document weakening of the inflation-activity relationship (i.e. flattening of the Phillips curve) in the recent decade that is robust both across activity measures and across countries.

- Nevertheless, the central banks should be still concerned about future inflation and should monitor inflationary pressure on disaggregated basis, since our results imply, that not any variable signals changes in inflation consistently over long periods.

Thank you for your attention!

Additional slides

Results 4 The Czech Republic
(coefficients, t+1)