The macroeconomic effects of climate shocks in Europe

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Outline

Motivation

- Increasing climatic variability (temperatures and precipitations) due to global warming; expected divergent changes across EZ's climatic areas (IPCC, 2019)
- How this affects macroeconomic dynamics? Are policy-relevant variables involved in the changes? Need to get some info from recent hystorical data
- With a centralized MP that targets aggregate EZ inflation, asymmetric (idiosyncratic) shocks do matter $\rightarrow$ Further source of price dispersion
- Evaluate the effects of climate shocks for EZ's MP-relevant target variables - prices in the first place

Related literature

- Schlenker and Roberts (2009) $\rightarrow$ Nonlinear and asymmetric relationship between temperatures and yields
- Dell et al. (2012) $\rightarrow$ Rising temperatures negatively affect economic growth
- Donadelli et al. (2017) $\rightarrow$ Significant impact of temperature shock on TFP, output, and labour productivity (standard VAR)
- Donadelli et al. (2020) $\rightarrow$ Temperature volatility shocks

This paper

- What we DO:
  - Temperature shocks in EZ countries
  - Non-linear effects
- What we DO NOT do:
  - Extreme-weather events
  - Heterogeneity within countries (only average data)

Variables

Climatic variable

Temperature (Temp, CRU)

- T_t: Average monthly temperature
- $\overline{T}$: Historical sample monthly average temperature

$$Temp_t = T_t - \overline{T}$$

Macroeconomic variables

Gross value-added of agriculture (VAA, Eurostat)

Energy production (EnProd, Eurostat)

CPI of food (CPF, FAOSTAT)

CPI of energy (CPEn, OECD)

Harmonized CPI - all items (CPI, Eurostat)

EZ Harmonized CPI - core (EZCPI, FRED Economic Data)

The empirical model

- Structural Vector Auto-regressive model (SVAR):

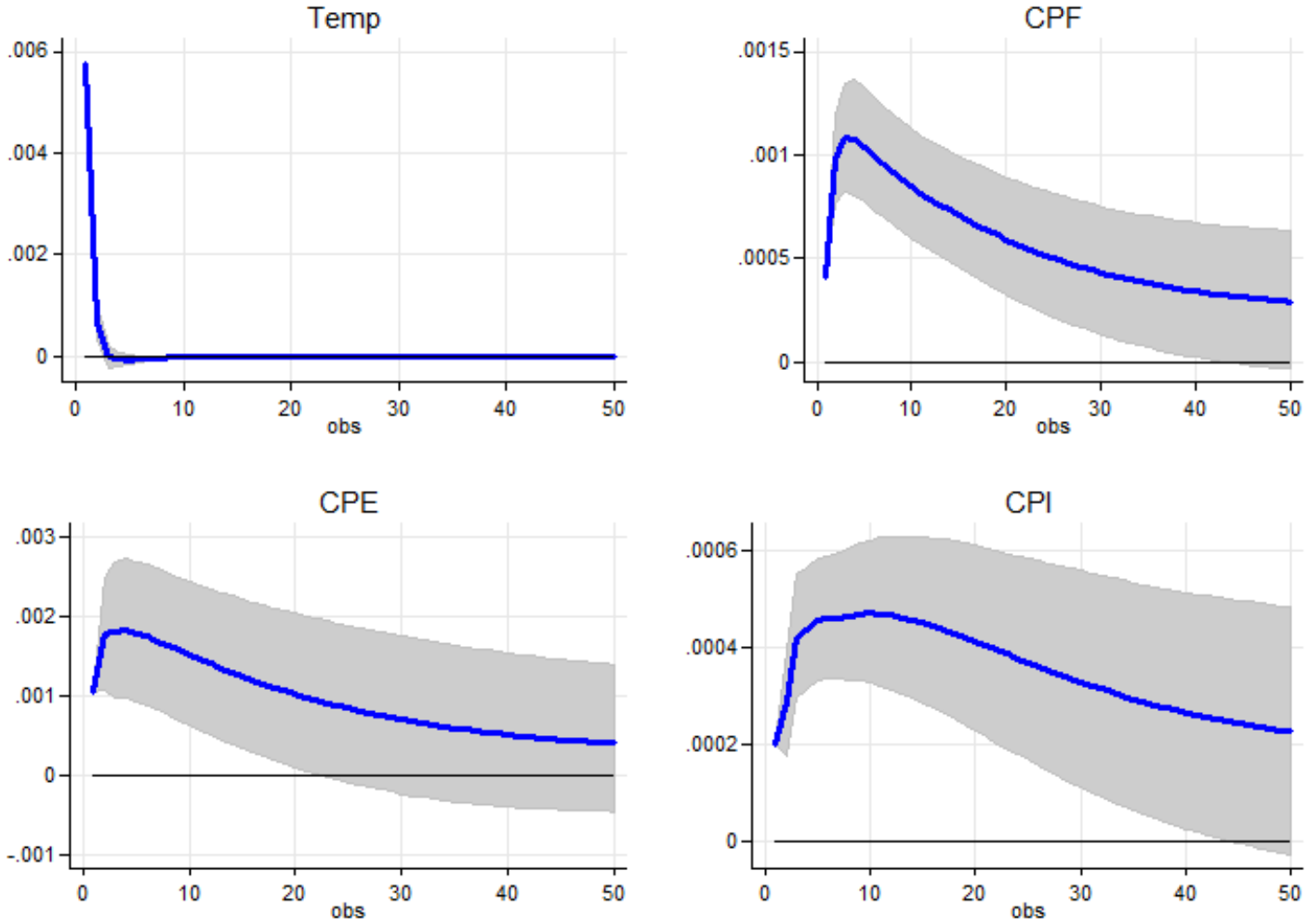
$$A(L)Y_t = \epsilon_t \tag{1}$$

$$A(L) = A_0 - A_1 - ... - A_p \tag{2}$$

$$Y_t' = [\text{Temp}_t \quad \text{VAA}_t \quad \text{EnP}_t \quad \text{CPF}_t \quad \text{CPE}_t \quad \text{CPI}_t \quad \text{EZCPI}_t] \tag{3}$$

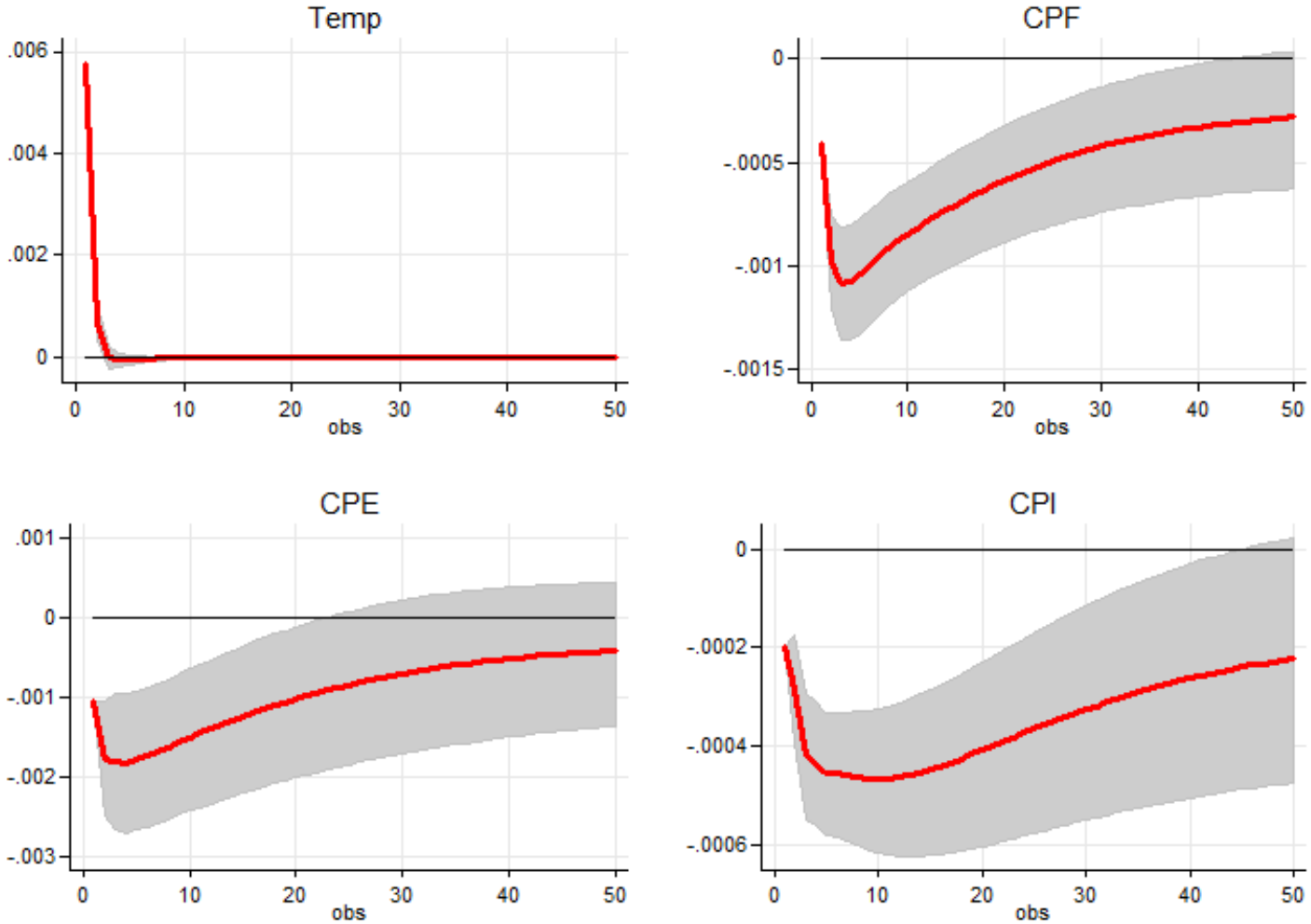
- Estimation method: Bayesian (Minnesota Prior - Full BSVAR)
- Sample: 2000m1 - 2016m12

IRFs to COLD shock in northen countries



[1] Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands

IRFs to HOT shock in northen countries



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Identification issues

- Cholesky:
  - Symmetric and linear response of macro-variables to negative and positive temperature shocks
  - Has a positive temperature shock the same impact of a negative one in abs. value? If not, does the country weather-structure matter?
- $\Rightarrow$ Recursive structure (as in Cholesky) + sign restrictions:
  - Allows to differentiate + and - temperature shocks
  - How? One more variable and some theory...

Variable: variance of vapour pressure

- **Gay-Lussac's law**: The *pressure* of a fixed mass of gas held at constant volume is *directionally proportional* to its Kelvin *temperature* $\rightarrow$ VP increases, Temp increases and vice versa

1. VP_t[1]: average daily vapour pressure
2. $VPvar_t$: monthly variance of the vapour pressure (from daily observations):

$$VPvar_t = \frac{\sum_{d=1}^{n}(VP_d - \overline{VP})^2}{n-1} \tag{4}$$

$$Y_t' = [\text{Temp}_t \quad \text{VPvar}_t \quad \text{VAA}_t \quad \text{EnP}_t \quad \text{CPF}_t \quad \text{CPE}_t \quad \text{CPI}_t \quad \text{EZCPI}_t] \tag{5}$$

[1] Data of the daily vapour pressure (VP_t) - defined in Hp - retrieved by www.ogimet.com

Identification

- Mixed set-point near-Cholesky on A_0:

$$A_0 = \begin{bmatrix} + & - & 0 & 0 & 0 & 0 & 0 & 0 \\ + & + & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & 0 & 0 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & 0 & 0 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} & 0 & 0 \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & a_{77} & 0 \\ a_{81} & a_{82} & a_{83} & a_{84} & a_{85} & a_{86} & a_{87} & a_{88} \end{bmatrix}$$

Preliminary results

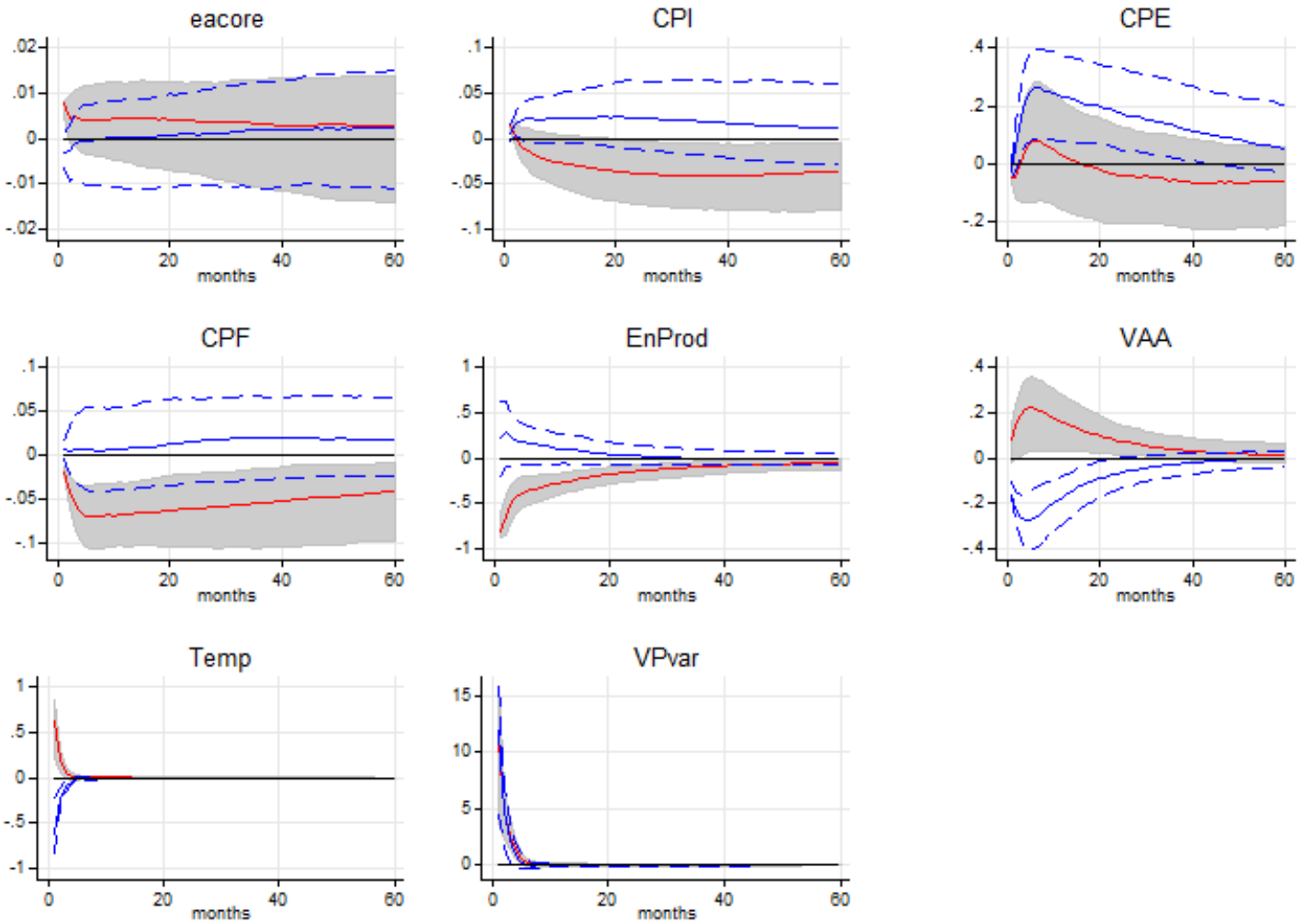

Figure: Spain. IRFs to a positive and negative Temp shocks

Preliminary results

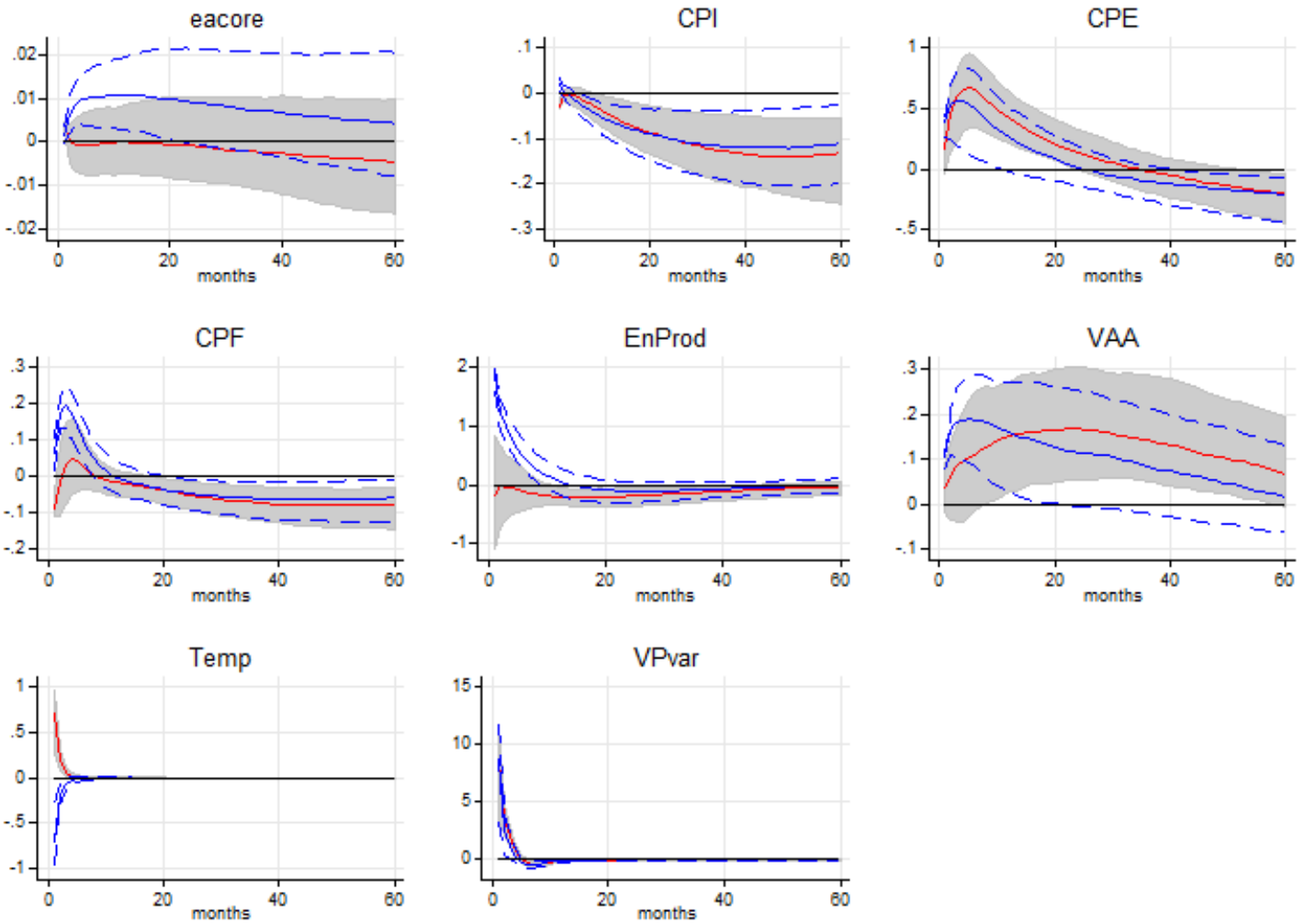

Figure: Greece. IRFs to a positive and negative Temp shocks

Preliminary results

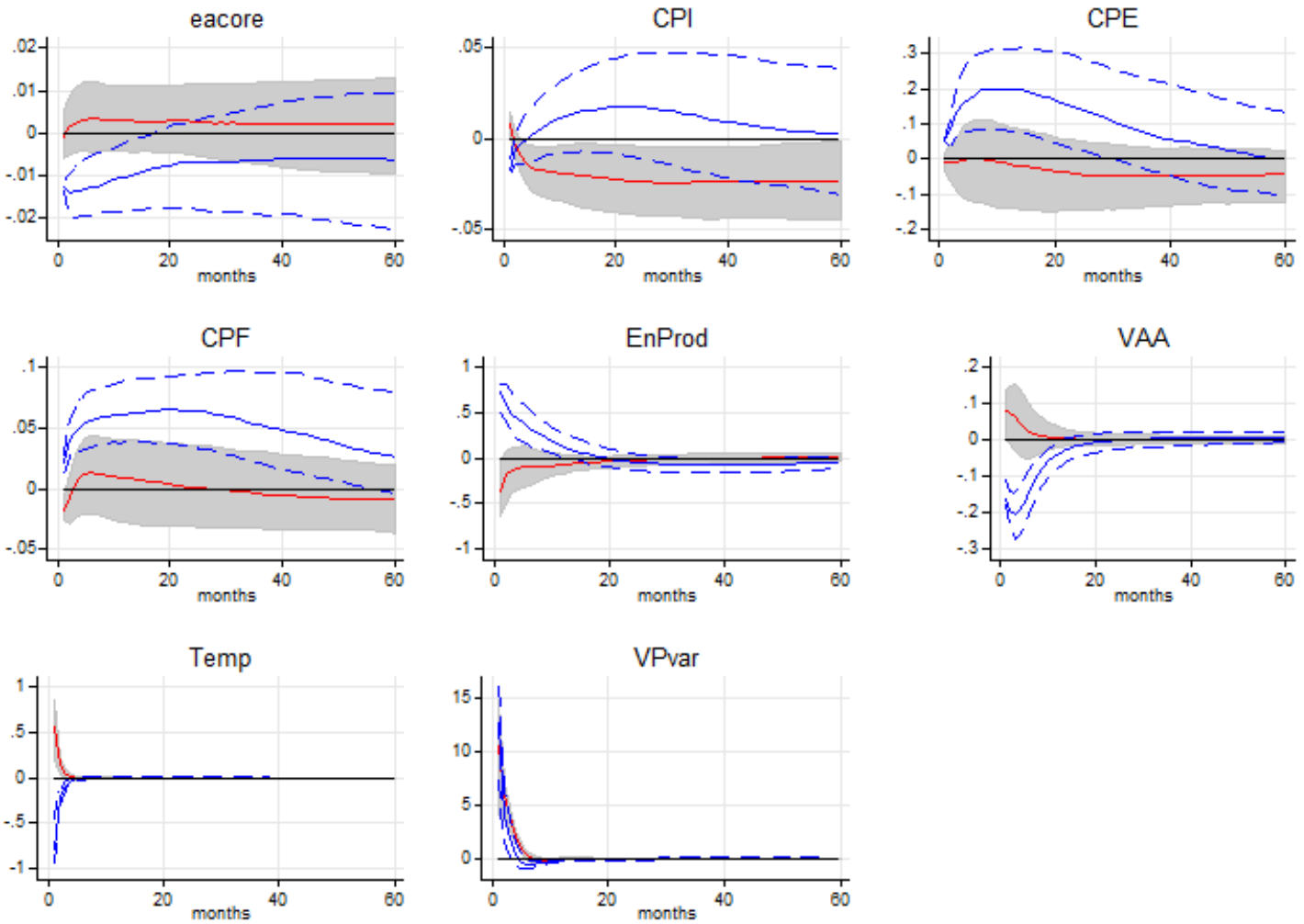

Figure: Italy. IRFs to a positive and negative Temp shocks

Discussion

- Responses to temperature shocks are generally relevant for macroeconomy. The issue may be relevant for policy-makers
- Temperature shocks have significantly nonlinear (differential) effect for positive and negative deviations from historical values
- Evidence of significant heterogeneity in the cross-country responses
- Additional source of heterogeneity for EZ countries. Should the CB target variations in inflation triggered by climate shocks?
- Further research needed to focus on extreme climatic events, long-term change, trasmission channels.

Thanks for your attention