The macroeconomic effects of climate shocks in Europe

F.S. Lucidi, M.M. Pisa, M. Tancioni

Sapienza University of Rome

IAEE Conference
June 9, 2021
Outline

1 Motivation and related literature

2 Model: identification and estimation

3 Results

4 Discussion
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 → 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) → Nonlinear and asymmetric relationship between temperatures and yields
- Dell et al. (2012) → Rising temperatures negatively affect economic growth
- Donadelli et al. (2017) → Significant impact of temperature shock on TFP, output, and labour productivity (standard VAR)
- Donadelli et al. (2020) → 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):

\[ A(L) Y_t = \epsilon_t \]  \hspace{1cm} (1)

\[ A(L) = A_0 - A_1 - ... - A_p \]  \hspace{1cm} (2)

\[ Y'_t = [\text{Temp}_t \hspace{0.5cm} \text{VAA}_t \hspace{0.5cm} \text{EnP}_t \hspace{0.5cm} \text{CPF}_t \hspace{0.5cm} \text{CPE}_t \hspace{0.5cm} \text{CPI}_t \hspace{0.5cm} \text{EZCPI}_t] \]  \hspace{1cm} (3)

- Estimation method: Bayesian (Minnesota Prior - Full BSVAR)

- Sample: 2000m1 - 2016m12
IRFs to COLD shock in northern countries

1 Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands
IRFs to **HOT** shock in northern countries

1 Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands
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?

  ⇒ 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* → VP increases, Temp increases and vice versa

1. $VP_t^1$: average daily vapour pressure
2. $VP_{var_t}$: monthly variance of the vapour pressure (from daily observations):

$$VP_{var_t} = \frac{\sum_{d=1}^{n}(VP_d - VP)^2}{n-1}$$  \hspace{1cm} (4)

$$Y_t' = \begin{bmatrix} Temp_t & VP_{var_t} & VAA_t & EnP_t & CPF_t & CPE_t & CPI_t & EZCPI_t \end{bmatrix}$$  \hspace{1cm} (5)

---

$^1$Data of the daily vapour pressure ($VP_t$) - defined in Hp - retrieved by www.ogimet.com
Mixed set-point near-Cholesky on $A_0$:

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