



Implications of climate for macro-financial imbalances in CESEE countries

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Outline

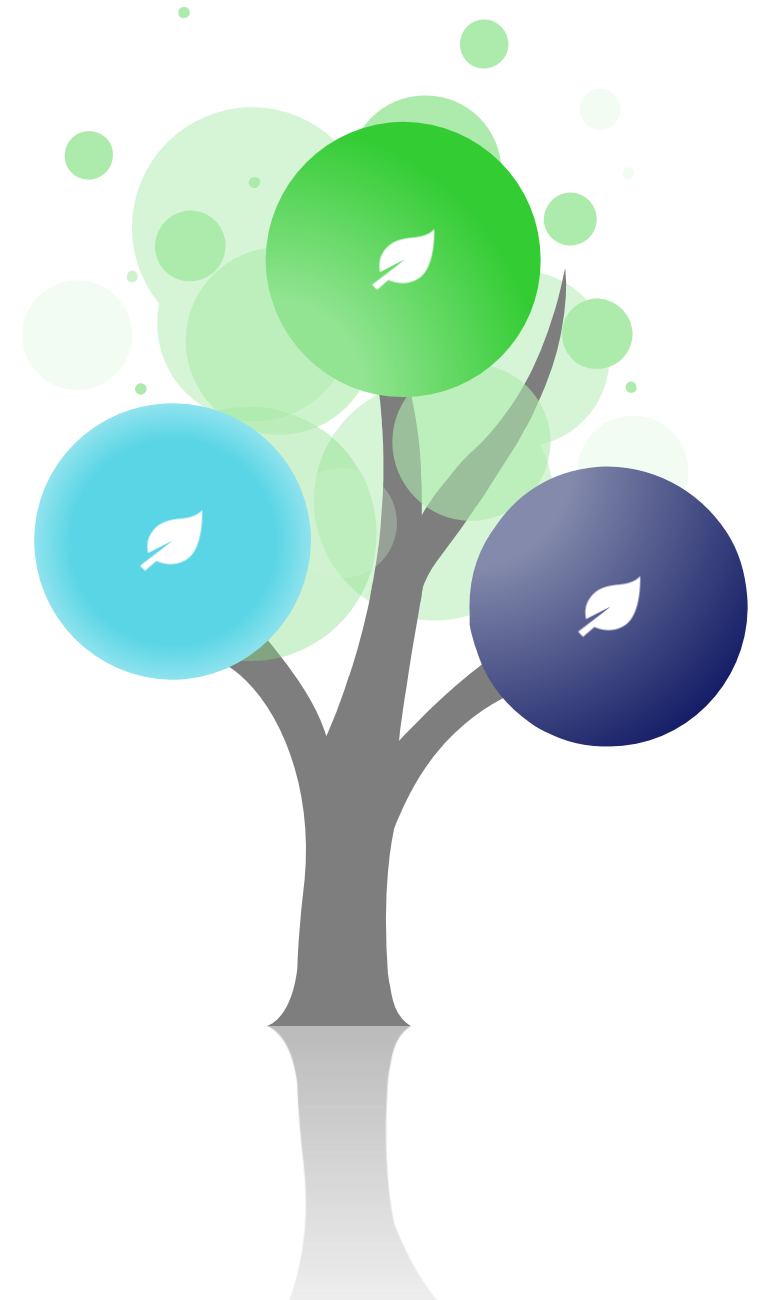
Introduction

Literature review

Methodology

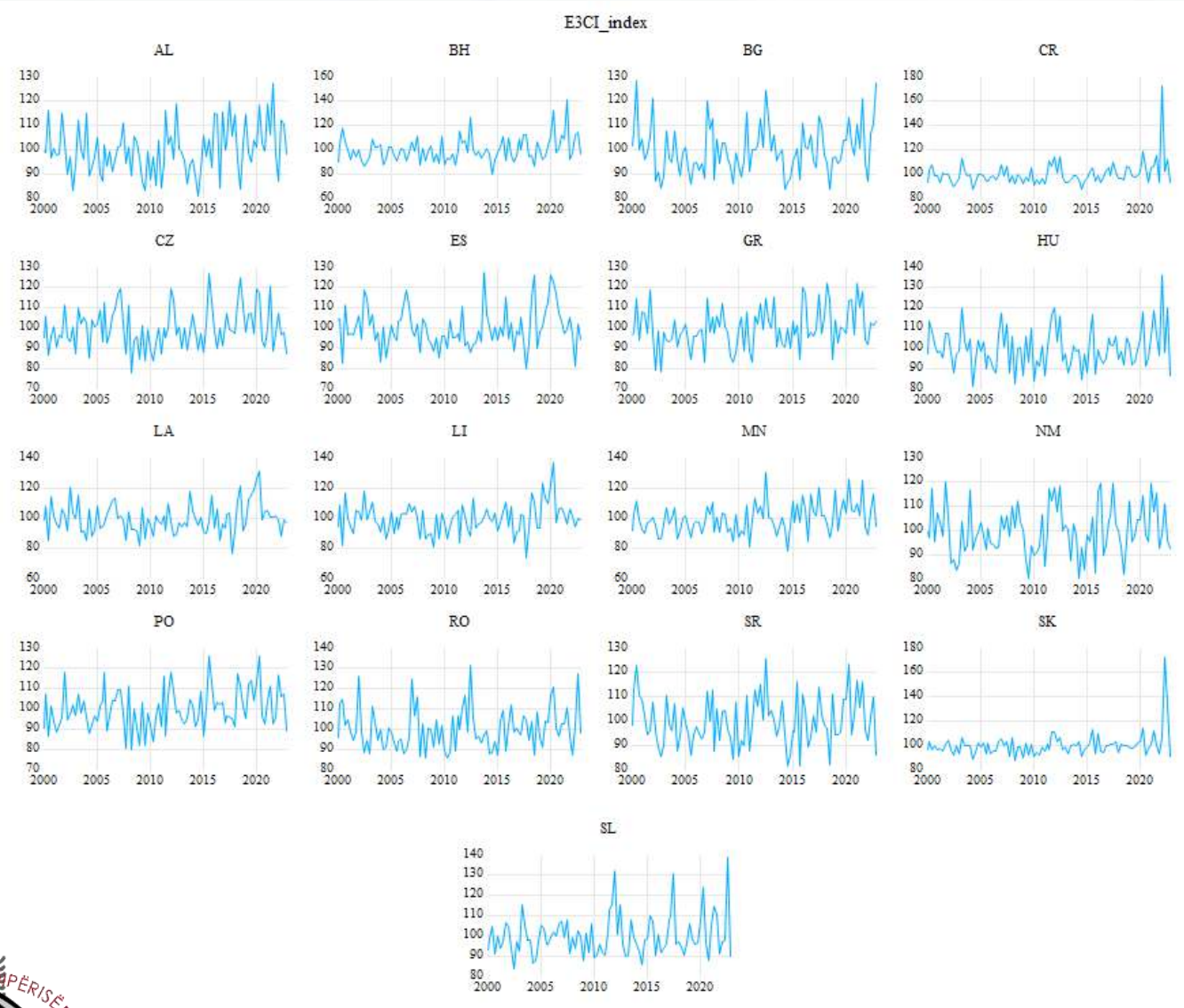
Empirical results

Final remarks



- Extreme weather events, driven by human-induced climate change, are becoming **more frequent** and **intense** (NASA, 2024), with significant implications for the economy and financial sector.
- CESEE countries are among the most vulnerable, facing **challenges** due to transitional economies, energy dependencies, and geographical exposure to climate risks.
- These weather events may **exacerbate vulnerabilities**, posing additional risks for **macroeconomic** and **financial stability**.
- **Understanding** these effects is critical for **enhancing resilience**, improving **policy responses**, and **managing** climate-related risks.

Figure 1. Extreme weather events index



Legend:

- AL - Albania,
- BH - Bosnia and Herzegovina,
- BG - Bulgaria,
- CR - Croatia,
- CZ - Czech Republic,
- ES - Estonia,
- HU - Hungary,
- LA - Latvia,
- LI - Lithuania,
- MN - Montenegro,
- NM - North Macedonia,
- PO - Poland,
- RO - Romania,
- SR - Serbia,
- SK - Slovak Republic,
- SL - Slovenia

Source: International Foundation Big Data and Artificial Intelligence for Human Development (IFAB)



How do the extreme weather events affect macroeconomic and financial imbalances in CESEE countries, and how do these effects differ for varying degrees of macro-financial vulnerabilities?

- **Internal imbalances: Output gap, inflation**
- **External imbalances: Current Account gap, Real Effective Exchange Rate (REER) gap**
- **Financial imbalances: Financial Soundness Index (FSI)**

The literature on extreme weather events mainly focuses on advanced economies and GHG emissions & temperature rises, revealing a significant gap in research on acute weather risks in emerging economies.

Ciccarelli and Marotta (2024): Analyzed climate change's economic impacts across 24 countries (1990-2019).

- Identified four climate shocks with medium-term influence.

Pisa et al. (2022): Focused on European countries (2000-2022) and temperature shocks.

- Uncover non-linear effects across nations, emphasizing energy prices and ECB policy.

Faccia et al. (2021): Examined temperature effects on prices and GDP deflator across 48 countries (1990-2018).

- Seasonal temperature shocks, food price sensitivity, and non-linear effects highlighted.
- Stressed central banks' need to consider weather shocks on prices.

Bernie et al. (2021): Analyzed disaster events' effects on euro area countries (1996-2021).

- Heterogeneous inflation responses due to supply-demand disparities.

Kim et al. (2021): Studied ACI effects on the U.S. economy (1961-2019).

- Found negative impacts on industrial growth, inflation, and unemployment.

Acevedo et al. (2020): Assessed annual data across 180 economies (1950-2015) focusing on temperature and precipitation.

- Introduced non-linear model specifications, showing negative growth impact in high-temperature economies.

Mukherjee and Ouattara (2021): Used panel data (1961-2014) for developing and developed economies.

- Persistent weather effects on inflation, emphasizing central banks' attention to shocks.

➤ **Panel quantile regression analysis (PQREG)**

➤ **Countries:** Albania (AL), Bosnia-Herzegovina (BH), Bulgaria (BG), Czech Republic (CZ), Croatia (CR), Estonia (ES), Greece (GR), Hungary (HU), Latvia(LA), Lithuania (LI), Montenegro (MN), North Macedonia (NM), Poland (PO), Romania (RO), Serbia (SR), Slovak Republic (SK), Slovenia (SL)

➤ **Variables:** output gap (y_gap), inflation (π), current account to GDP gap (CA_gap), real effective exchange rate (REER) gap, financial soundness index (FSI), and extreme weather conditions index E3CI (European Extreme Events Climate Index)

➤ **Data sources:** IMF, World Bank, Eurostat, National Statistical Offices, and IFAB

➤ **Frequency:** quarterly data for 2000-2022

The **PQREG** is expressed in its reduced form as follows:

$$Q_{\pi}(\tau|X_{it}) = \alpha_i + \beta(\tau)*\chi_{it} + u_{it} \quad (1)$$

where $Q_{\pi}(\tau|X_{it})$ represents the τ -quantile of each of the measures of macroeconomic and financial imbalances, used as dependent variable Y_{it} ;

α_i is the country-specific fixed effect, capturing unobserved heterogeneity across countries;

$\beta(\tau)$ is the vector of coefficients associated with the independent variables χ_{it} which can vary depending on the quantile τ ;

u_{it} is the error term, which captures unobserved factors affecting Y_{it} .

$$Y_{i,t} = (y_gap, \pi, CA_gap, REER_gap, FSI, E3CI)'$$

The **current account gap**, denoted as CA_{gap} , is defined as follows:

$$CA_{i,t}^{gap} = CA_{i,t} - \widehat{CA}_{i,t}$$

Where $CA_{i,t}$ represents the observed current account (in percentage of GDP) and $\widehat{CA}_{i,t}$ the estimated equilibrium value. The latter is given by the estimation of the following specification:

$$CA_{i,t} = \alpha_i + \sum_{j=1}^n b_j Z_{i,t} + \mu_{i,t}$$

where n denotes the number of explanatory variables $Z_{i,t}$, $\mu_{i,t}$ is an *i.i.d.* error term, and α_i captures the country-fixed effects.

In line with the most prominent literature (Lane and Milesi-Ferretti, 2012), $Z_{i,t}$ includes:

- fiscal balance (fisc_gdp)
- lagged net foreign asset position (nfa_gdp)
- relative level of PPP-adjusted GDP per capita
- relative GDP growth rate
- aging rate
- old-age dependency ratio
- population growth rate
- M2 to GDP ratio
- degree of openness
- terms of trade
- oil balance

Capitalization

CAR; ROE; Core capital/Total assets
Equity/Total assets
Asset growth
Equity growth
Fixed assets/ Regulatory capital
Non-performing loans (NPL)/ Regulatory Capital

Liquidity

Loans/ Deposits
Liquid assets/ Total assets
Assets-Liabilities
Interest income/Total income (%)
Net interest margin
Net interest income/ Gross operating income
Net interest income growth (%)

Asset quality

NPL ratio
Total loans/ Total assets
Loans growth (%)
Loss from loans/Total loans (%)
Provisions/NPL (%)

Sensitivity to market risk

Net open position in foreign exchange (%)
Net open position in foreign exchange/Regulatory capital (%)

Earnings

ROA
Interest income growth (%)
Interest income/Total income (%)
Net interest margin
Net interest income/ Gross operating income
Net interest income growth (%)

Management

Income/cost
Personnel expenses/Total expenditure
Personnel expenses/Non-interest income
Interest Expenditure / Total
Deposits
(Rev Interest - Exp Interest) / PE
Net Interest Profit / Total Assets
Non-Interest Income / Total Income



We follow the Uniform Financial Rating System approach:

Principal Component Analysis: Normalize correlated indicators into distinct uncorrelated indices. Standardize using the normalization formula

Exponential Transformation: Adjust normalized values to range between [0, 1]

Construction of the FSI:

$$FSI_t = \varpi_1 \sum_1^n Z_{t,C}^* + \varpi_1 \sum_1^n Z_{t,A}^* + \varpi_1 \sum_1^n Z_{t,M}^* + \varpi_1 \sum_1^n Z_{t,E}^* + \varpi_1 \sum_1^n Z_{t,L}^* \\ + \varpi_1 \sum_1^n Z_{t,S}^*$$

where $\sum_{j=1}^6 \varpi_j = 1$

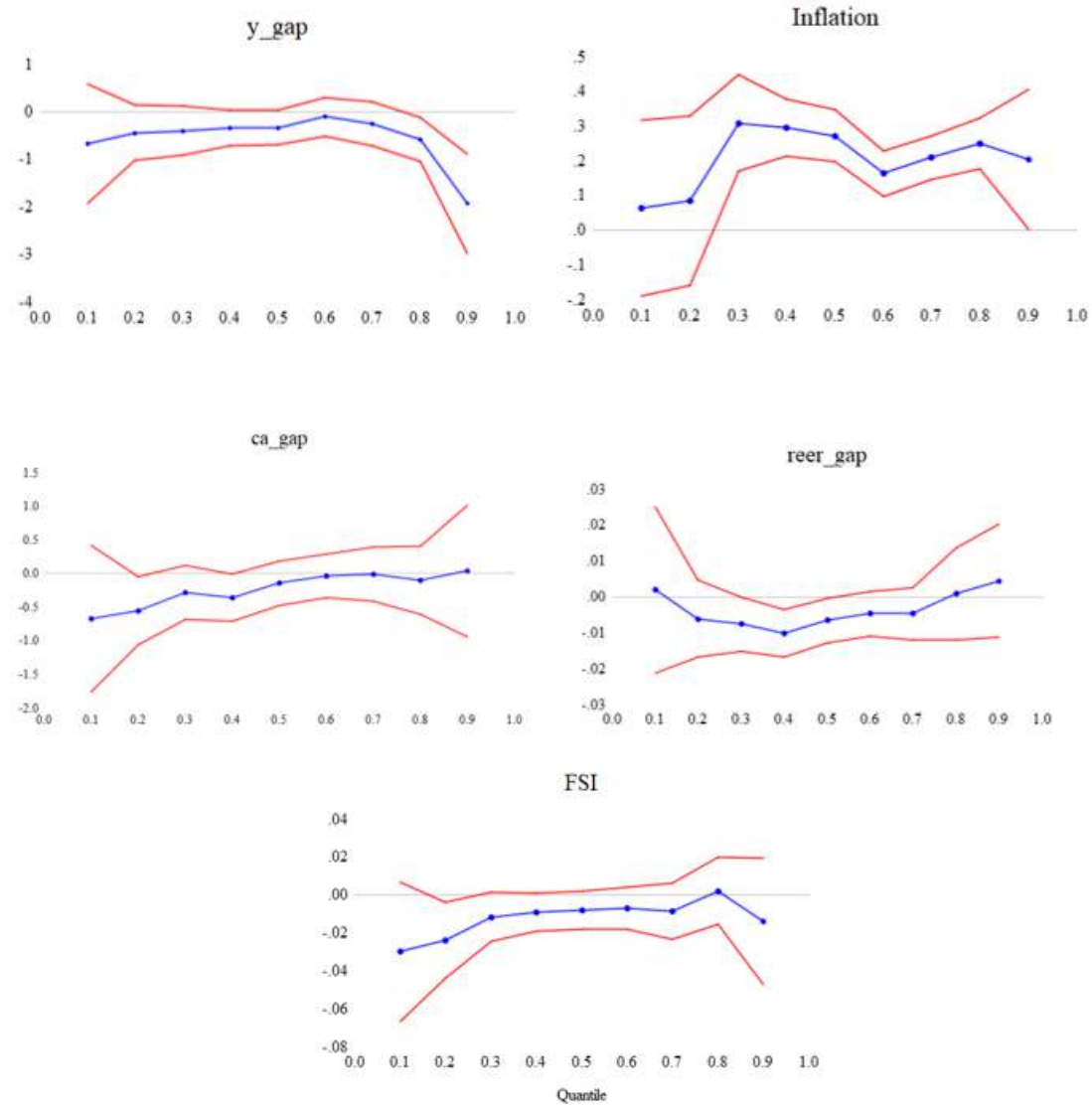


Figure 2. Estimates of macro-financial effects of climate change across different quantiles.
 Source: Authors' computations.

- The analysis reveals that countries with higher economic imbalances experience more severe output disruptions and heightened inflationary pressures following a climate shock.
- Climate shocks have a limited immediate impact on external imbalances, as evidenced by minimal shifts in the current account and REER gaps at lower and middle quantiles. However, countries with existing vulnerabilities may still face longer-term pressures on trade and investment patterns.
- Climate shocks may intensify financial vulnerabilities for countries already experiencing lower levels of financial resilience.

- This paper contributes to filling the gap in empirical literature regarding climate-related macroeconomic and financial implications.
- Climate change presents additional trade-offs for policymakers.
- Extreme weather events notably decrease the output gap and increase short-term inflation in CESEE region, highlighting economic vulnerability to weather disruptions.
- The effects seem to be less pronounced on external imbalances.
- Countries with pre-existing macroeconomic and financial vulnerabilities are significantly more susceptible to the adverse impacts of climate shocks.
- **Further Research:** climate policies, impacts of climate change on various economic sectors, technological innovation, distributional effects for different socio-economic groups etc.
- **Policy Implications:** Proactive measures to enhance resilience against climate-related risks and promote sustainable economic development.

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**Thank you
for
Your attention!**

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