

Macro-Financial Scenario Analysis under Climate Risk: “Evidence from Tunisia using Conditional BVAR and Local Projections”

**14th Conference BCC:
« Resilience of the financial system: Where do we stand »
10-11 September 2025**

MOTIVATION

Tunisia faces compounding macro-financial and climate-related risks

1

Sovereign-bank linkages

Persistent fiscal deficits and rising public debt have deepened banks' exposure to sovereign risk, raising the odds of adverse feedback loops.

2

Rising physical climate exposure

Recurrent droughts, water scarcity and temperature shocks weigh on agriculture, food prices, growth and, ultimately, repayment capacity.

3

Limits of traditional stress tests

Static balance-sheet assumptions and linear models struggle to capture uncertainty, nonlinearities and bank-level heterogeneity.

RESEARCH QUESTION & CONTRIBUTION

A hybrid framework to trace climate and macro shocks into bank-level credit risk

Research question

How do macroeconomic and physical climate shocks propagate through the Tunisian economy to affect bank-level non-performing loans — and how does this transmission differ across banks?

Sample: 11 largest banks · 88.5% of system credit · quarterly, 2012–2024

● Hybrid BVAR–LP framework

Internally consistent macro scenarios (conditional BVAR) mapped to granular bank-level risk (Local Projections).

● Climate risk, explicitly modelled

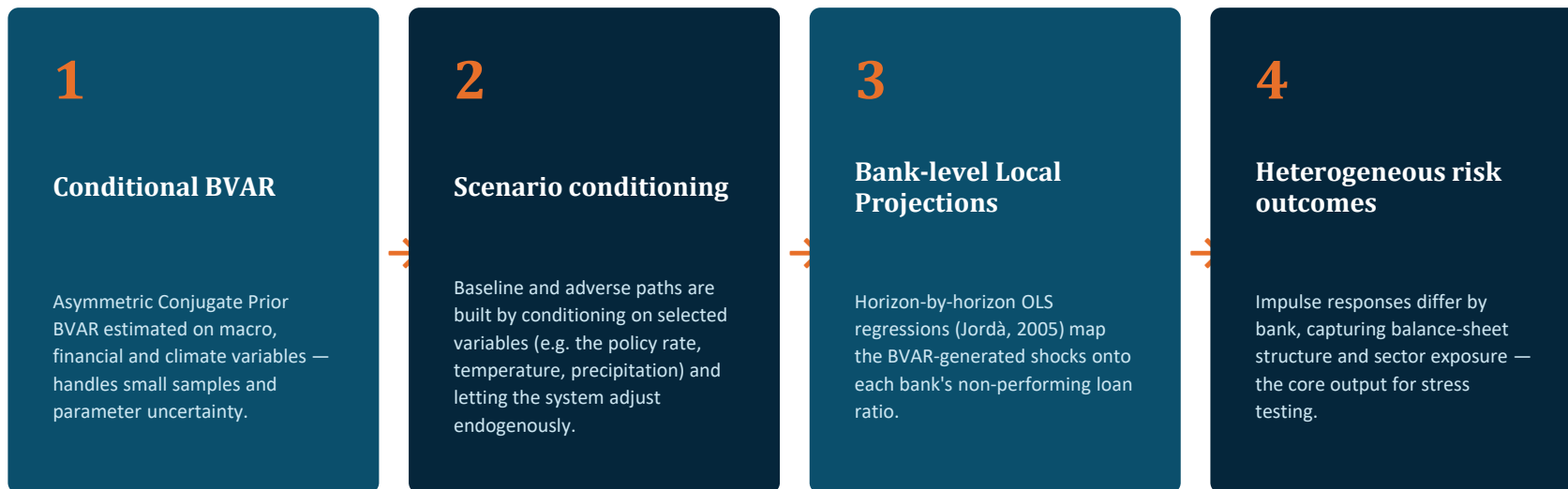
Physical shocks — temperature and precipitation anomalies — embedded directly in the macro-financial scenario design.

● New evidence for an emerging market

First systematic evidence on heterogeneous climate-risk transmission across Tunisian banks using supervisory data.

METHODOLOGY

Conditional BVAR generates the macro scenario; Local Projections translate it into bank risk



Both equality constraints (target paths) and inequality constraints (admissible bounds) can be imposed jointly on the forecast distribution, following Chan et al. (2025).

VAR model

$$Y_t = a + A_1 Y_{t-1} + \dots + A_p Y_{t-p} + \varepsilon_t, \quad \varepsilon_t \sim N(0, \Sigma)$$

estimates **fixed parameters** using traditional frequentist methods

BVAR model

$$A_0 Y_t = a + A_1 Y_{t-1} + \dots + A_p Y_{t-p} + \varepsilon_t, \quad \varepsilon_t \sim N(0_n, I_n)$$

treats parameters as random variables and applies **prior beliefs** (shrinkage) to handle overparameterization and improve forecasts

Conditional Forecasting

imposing **restrictions** on the future paths of the variables in the BVAR

Equality constraints

$$y_{T+1, T+h} | R, r, \Omega \sim N(\mu_y, \Sigma_y)$$

- specific target value

Inequality constraints

$$\underline{c} < S y_{T+1, T+h} < \bar{c}$$

- within certain bounds

Asymmetric Conjugate Prior

$$y_{it} = w_{it} \alpha_i + z_{it} \beta_i + \varepsilon_{it}$$

- flexible Bayesian regularization scheme

Local Projections (LPs)

$$y_{t+h} = \alpha_h + \sum_{j=0}^{p-1} \beta_{h,j} y_{t-j} + \sum_{j=0}^{p-1} \gamma_{h,j} x_{t-j} + u_{t+h}$$

Computes impulse responses directly at each horizon

Empirical Results

1- Monetary Policy Stress Test

A banking system with important structural vulnerabilities

Scenario

+100 basis points policy-rate shock

Main findings

NPLs increase gradually

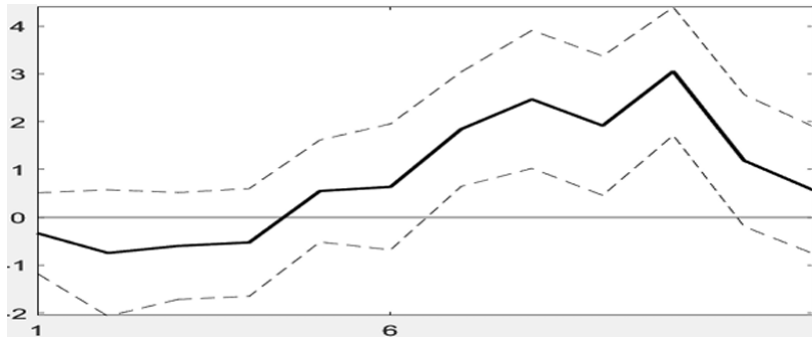
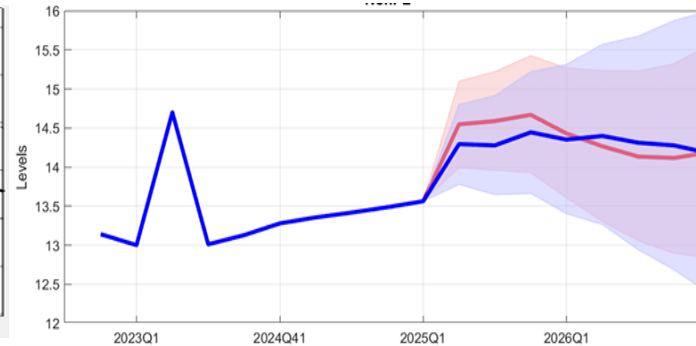
Peak impact after 4–8 quarters

Median increase:

0.6–1.4 percentage points

Weaker banks experience substantially larger deteriorations

Aggregate NPL due to monetary shock



Interpretation

Monetary tightening weakens borrowers' repayment capacity through slower economic activity.

2- Climate Shock Transmission: Macroeconomic Fundamentals

Physical climate shocks generate persistent macroeconomic deterioration

IRF's due to a precipitation shock

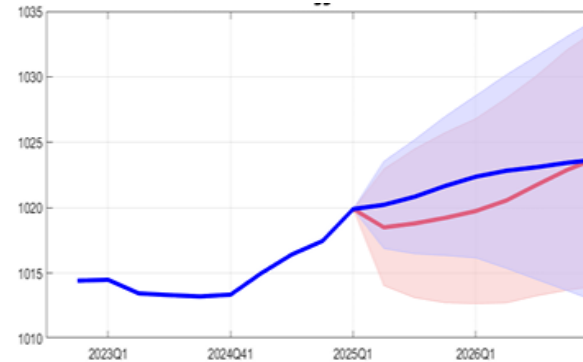
Main effects

- Aggregate demand falls
- Net exports decline
- Exchange rate depreciates
- Unemployment increases

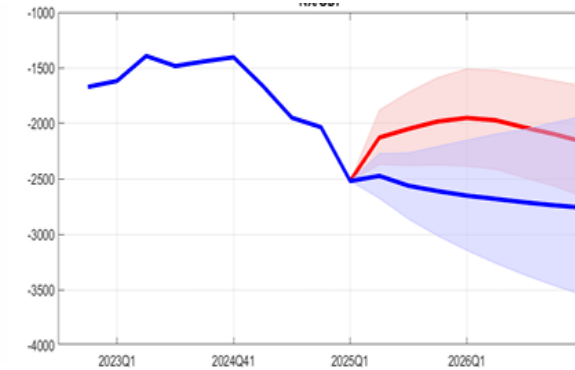
The effects are:

- persistent
- medium-term
- economically significant

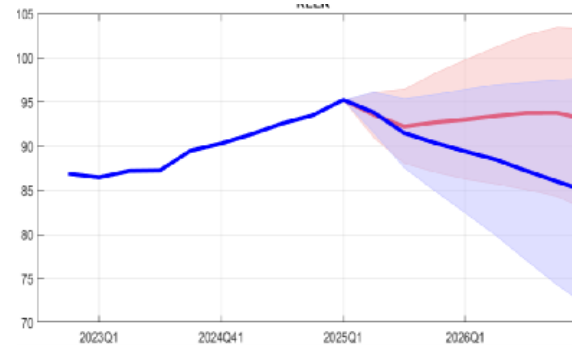
Aggregate demand



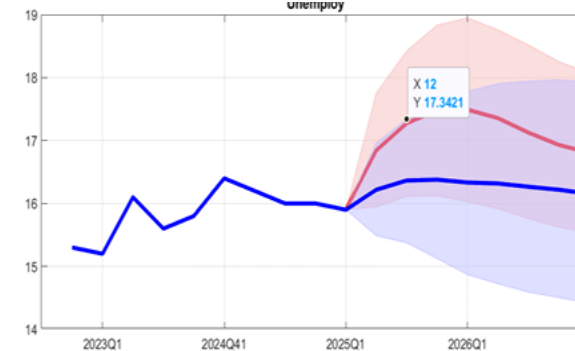
Net exports



REER



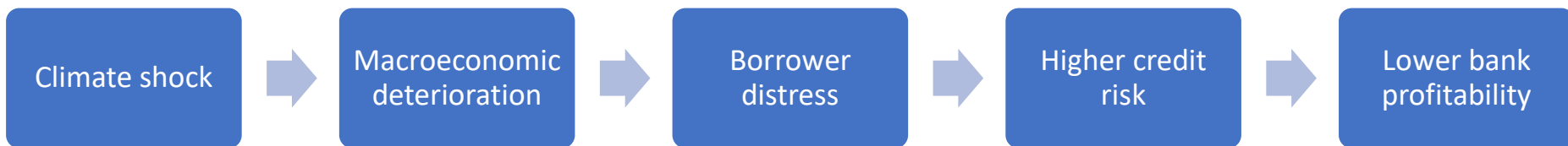
Unemployment rate



Climate shocks therefore behave like adverse supply shocks with broad macro-financial consequences.

3- Climate Shocks, Banking Sector Resilience

The transmission occurs through:



IRF's due to a precipitation shock

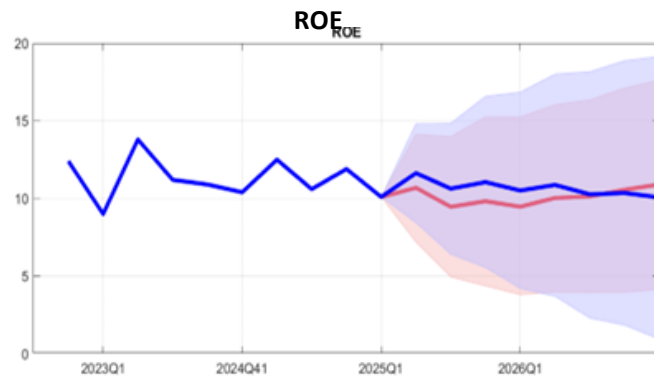
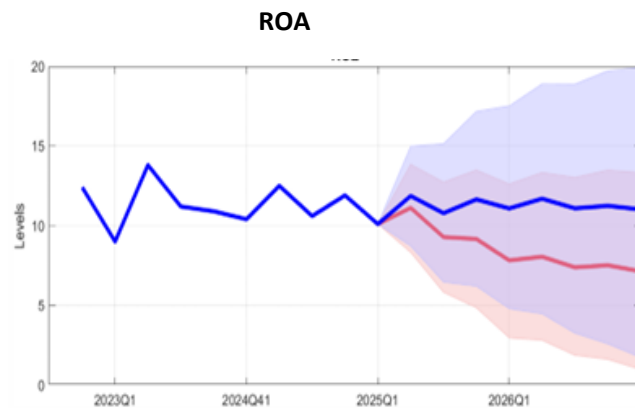
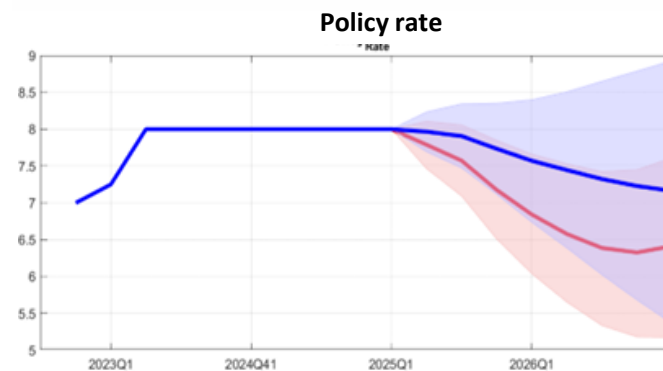
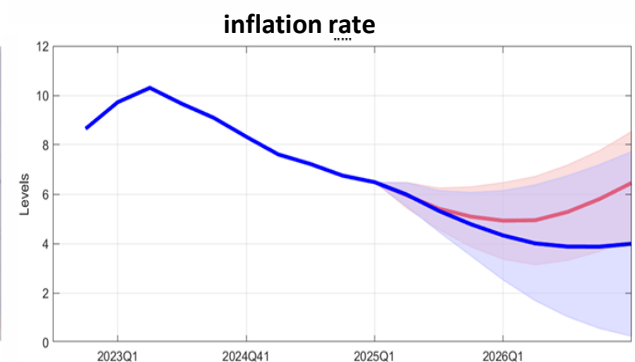
Climate shocks weaken banking performance

Results show

- Higher NPLs
- Lower ROA
- Lower ROE
- Significant heterogeneity across banks

Monetary policy reaction

- Decreasing policy rate
- Amplifying inflationary pressures



POLICY IMPLICATIONS

Toward climate-aware, bank-sensitive macroprudential surveillance

1

Forward-looking PDs

Integrate both monetary and climate shocks into IFRS 9-compliant, forward-looking probability-of-default models.

2

Climate stress testing

Embed physical climate risk directly into scenario design, rather than treating it as a separate add-on exercise.

3

Monetary-macroprudential coordination

Tightening cycles raise credit risk with a lag — macroprudential buffers should be built ahead of, not during, stress.

4

Sectoral instruments

Target structurally vulnerable, climate-sensitive segments — agriculture, tourism, construction — rather than relying on aggregate tools alone.

CONCLUSION

Climate risk is a systemic, not a peripheral, macro-financial risk for Tunisia's banking sector

0.6–1.4pp

median NPL increase after a 100bp
monetary tightening

1.8–3.2%

peak contraction in aggregate demand
after a climate shock

0.8–1.7pp

rise in inflation despite weaker output
— a stagflationary signature

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- Monetary policy and climate shocks both raise bank credit risk, through distinct but reinforcing channels.
 - Climate risk transmits first through agriculture, then spills over into the broader banking system.
 - Bank-level heterogeneity is substantial — aggregate stress tests risk underestimating vulnerabilities.
 - The combined BVAR–LP framework offers a transparent, operational tool for climate stress testing.