SIZING THE RISKS AND RAISING AWARENESS:
THE BANQUE DE FRANCE / ACPR EXPERIENCE IN DESIGNING CLIMATE STRESS-TESTING EXERCISES

Supervisory challenges and green transition in post-pandemic environment
FinSAC ANNUAL INTERNATIONAL CONFERENCE
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STÉPHANE DEES

BANQUE DE FRANCE

*The views expressed in this presentation are those of the authors and do not necessarily reflect the views of the Banque de France or the ACPR . Any errors and omissions are the sole responsibility of the authors.

BACKGROUND AND OBJECTIVES

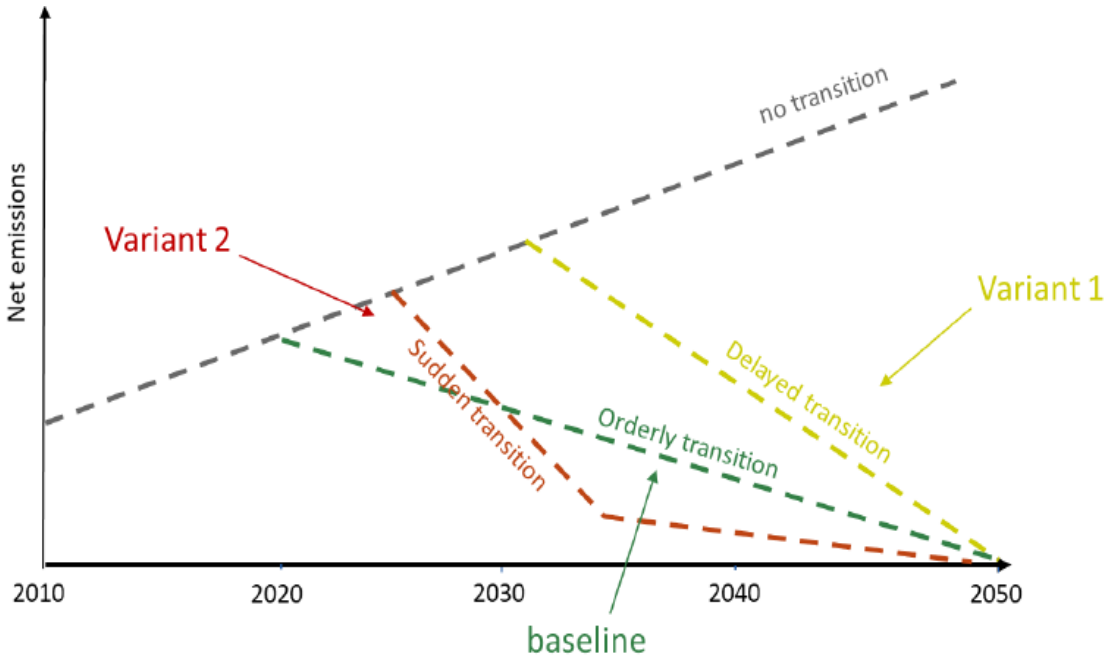
- Background:
  - 2015: French Act on Energy Transition and Green Growth includes an innovative extra-financial reporting framework and requires the implementation of a regular stress test scenario representative of climate change-related risks
  - 2018: ACPR survey aiming at monitoring climate-related exposures and gauging the progresses accomplished by firms
- Objectives:
  - For the Banque de France/ACPR:
    - Sizing the vulnerabilities and the risks, including possible mispricing
    - Raising awareness: assessing and making sure firms are equipped with or will adopt or develop appropriate methodologies and data to manage climate-change risks
  - For the financial industry:
    - Developing a better understanding of the transmission channels
    - Relying on a common set of assumptions and scenarios for comparability

MAIN FEATURES

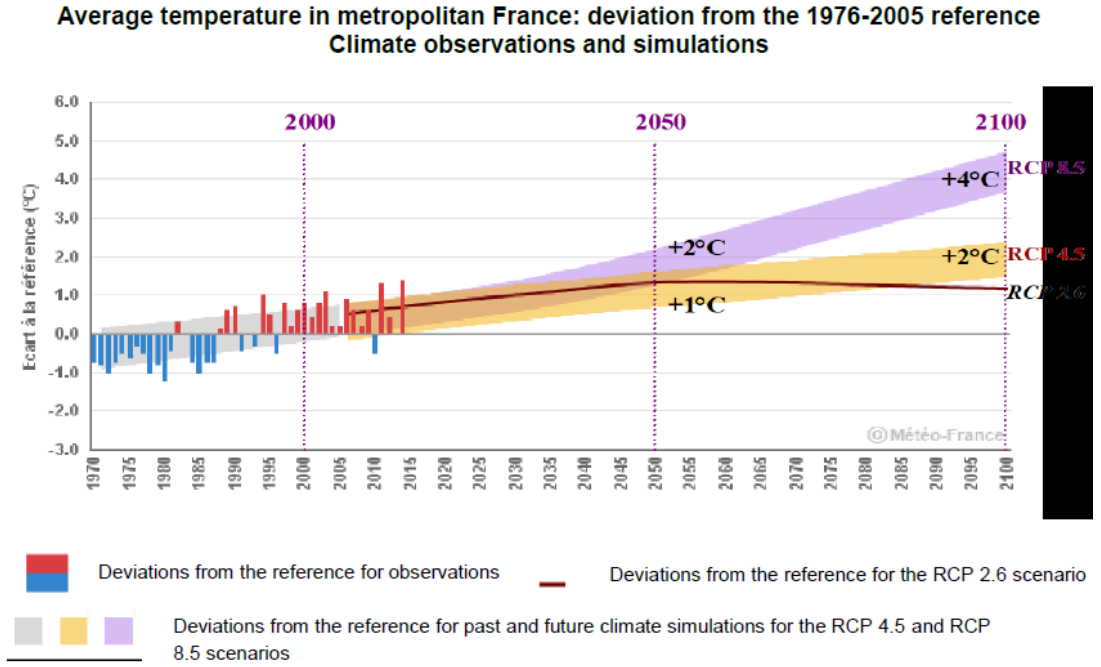
- Time period: **2020 – 2050**
- A **bottom-up** approach
- Both **banks** and **insurance companies**
- International: France + EU + US + Rest of the World (material exposures)
  - 80-85% of exposures for banks and insurances
- A **granular sectoral approach** with 55 sectors
- Transition risks and physical risks
- Combines **static** (2020-2025) and **dynamic balance-sheet** assumptions (2025-2050)
- Consistency checks and second round effects
- Voluntary « pilot » exercise : <u>not</u> a capital exercise

ASSESSING NGFS HIGH LEVEL SCENARIOS

- Transition risk
  - Based on carbon price policy
  - Baseline and Variant 1 from the NGFS
  - Variant 2 from ACPR
  - “BaU” backing physical risk scenario



- Physical risk
  - Assessed with the support of CCR and based on granular projections by Météo-France
  - Includes also health risks (pandemics and urban pollution due to increased frequency and length of heatwaves, developed with AON)



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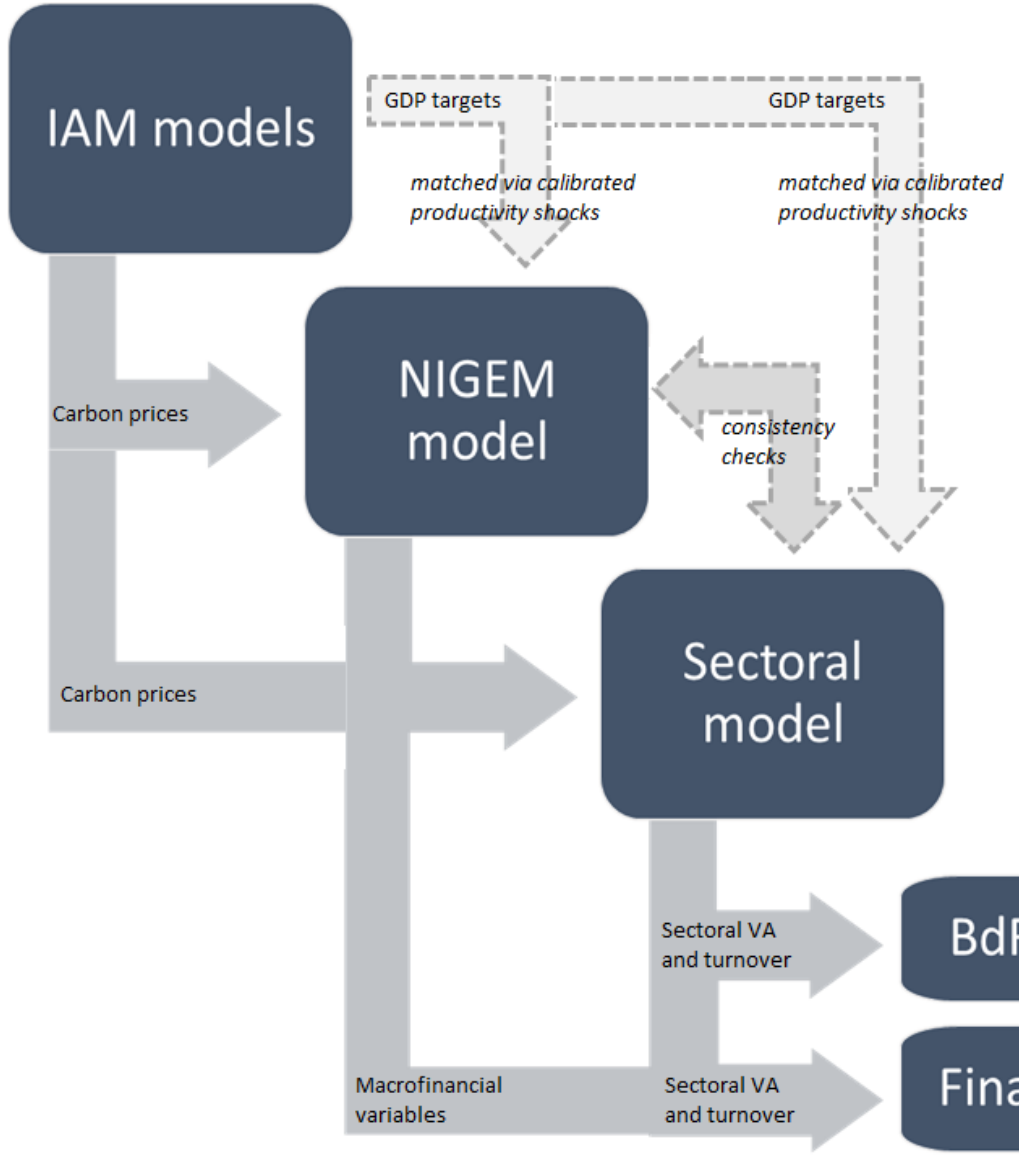
MODELING ARCHITECTURE



- **NGFS *high-level* Reference scenarios**
- Outputs: carbon prices, GHG emissions

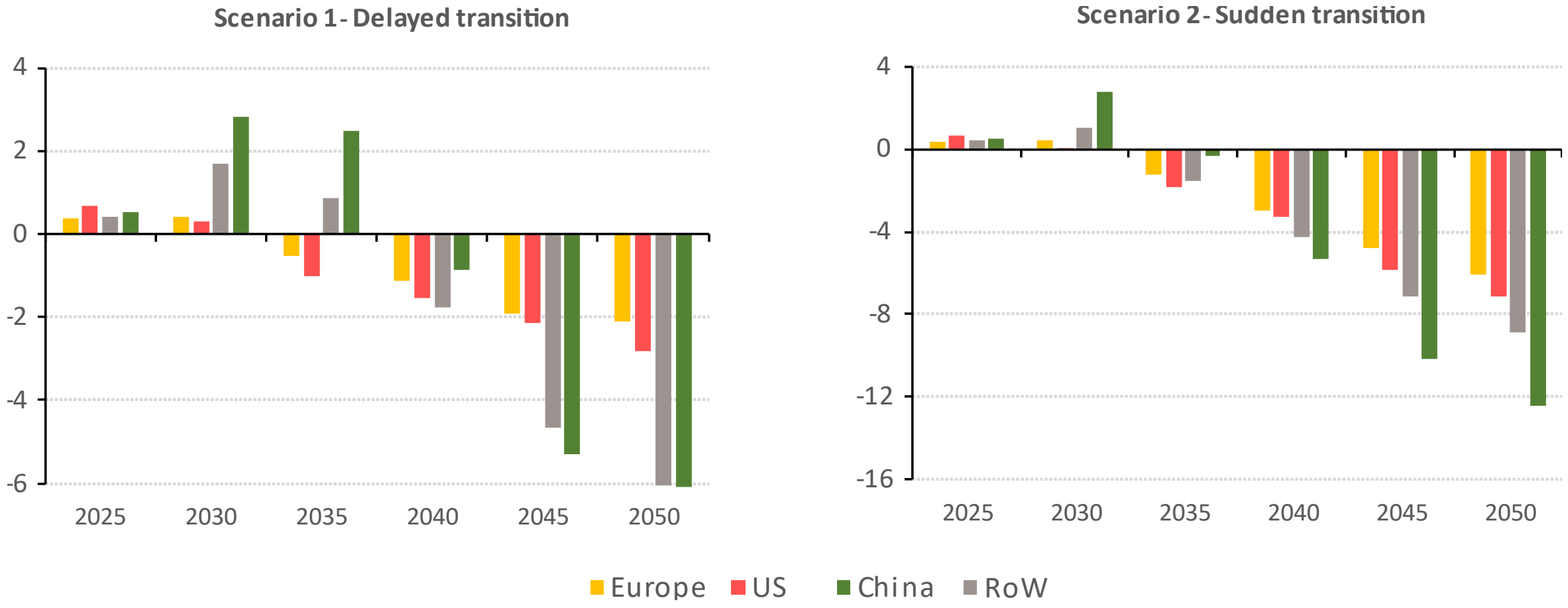
- **Country-level macroeconomic model**
- Outputs : Macrofinancial variables (inflation, employment, etc.)

- **Sector-level disaggregation**
- Outputs: VA and turnover for 55 sectors

- **Firm-level disaggregation**
- Outputs: PDs

- Outputs: Market valuation, etc.

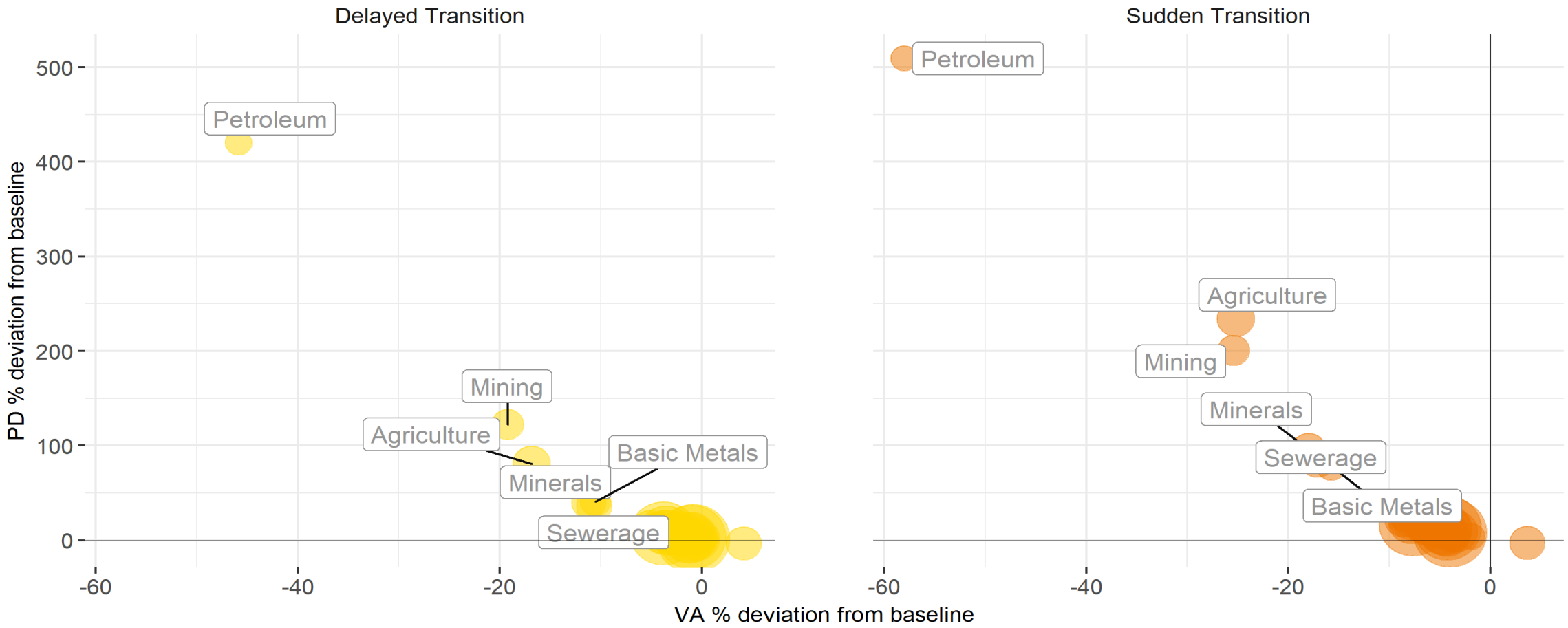
MACROECONOMIC IMPACTS



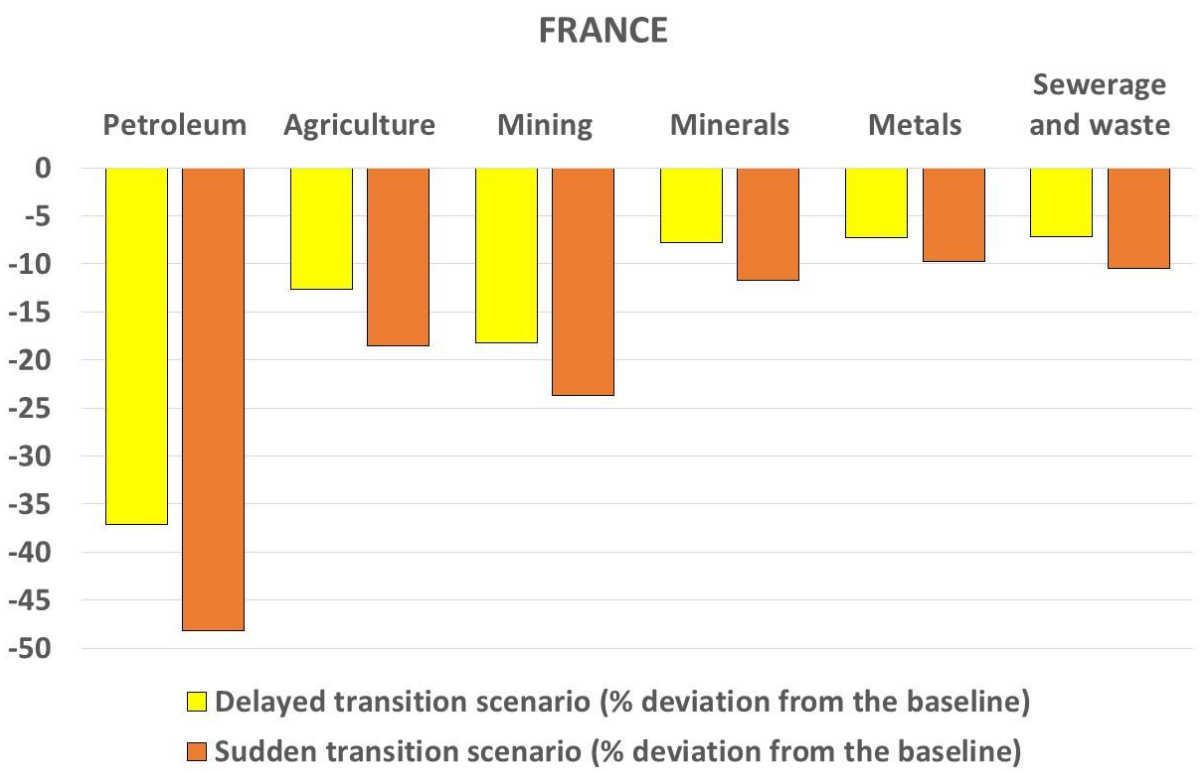
Real GDP levels (% deviation from baseline)

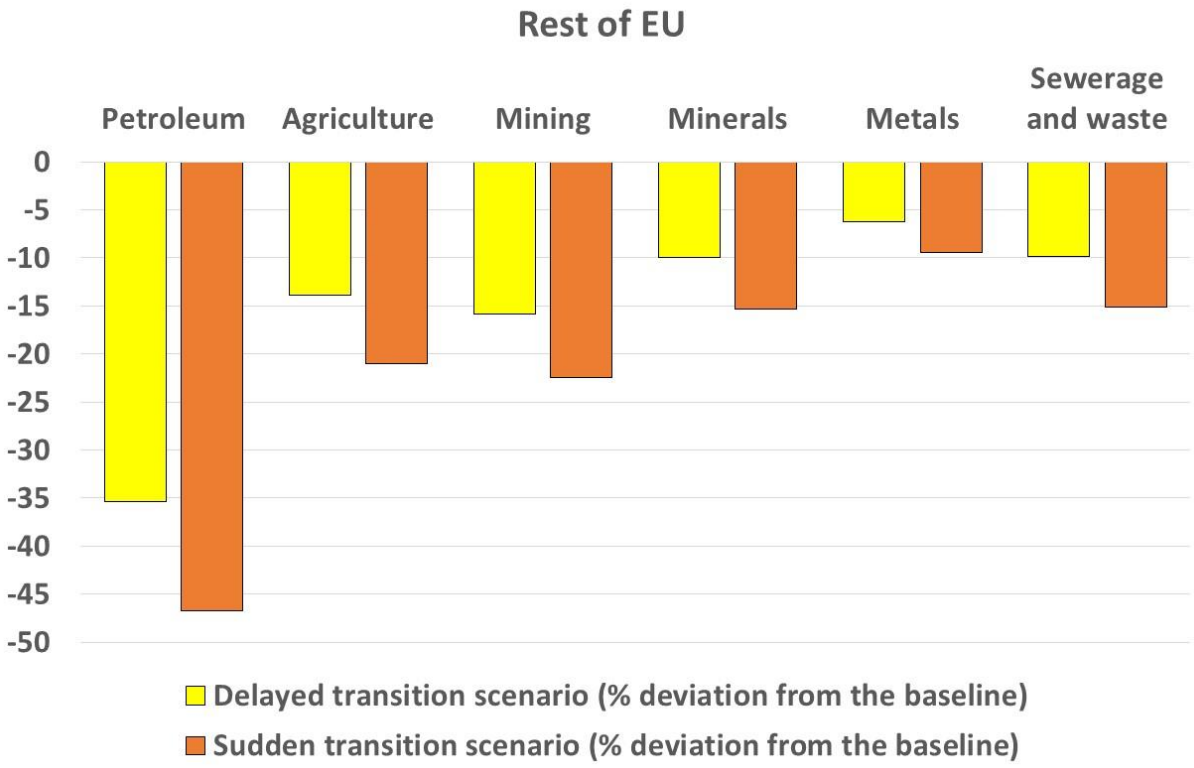
SECTORAL AND INFRA-SECTORAL IMPACTS

Differentiated impacts on Probabilities of Default as of 2050



ASSET PRICE SHOCKS





Stock price shocks by sector (% deviation from baseline)

ACPR PILOT EXERCISE

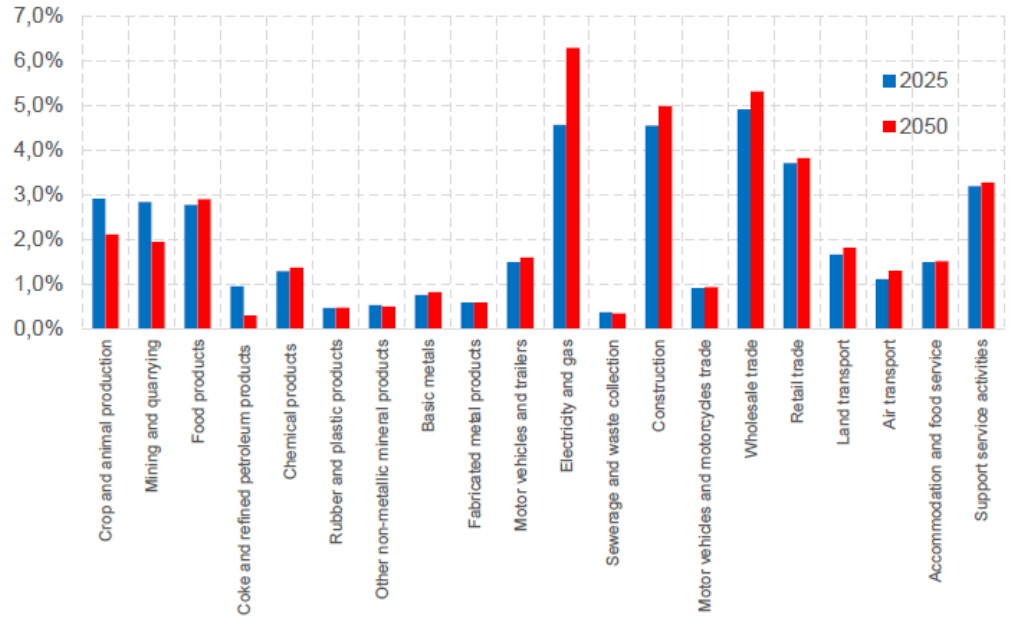
- A very **strong participation**: 9 banking groups (accounting for 85% of total banking assets) and 14 groups of insurers (20 insurance companies - covering 76% of the sector's technical provisions);

- The methodological notices provided by the financial institutions show **in-depth analyses of the climate-change risks** developed in the context of this exercise; include qualitative assessments.

- Banking institutions appreciated the provision of **granular sectoral and geographical data**. They also recognized the usefulness of climate-related variables.

INSIGHTS FROM THE DYNAMIC BALANCE SHEET ASSUMPTION

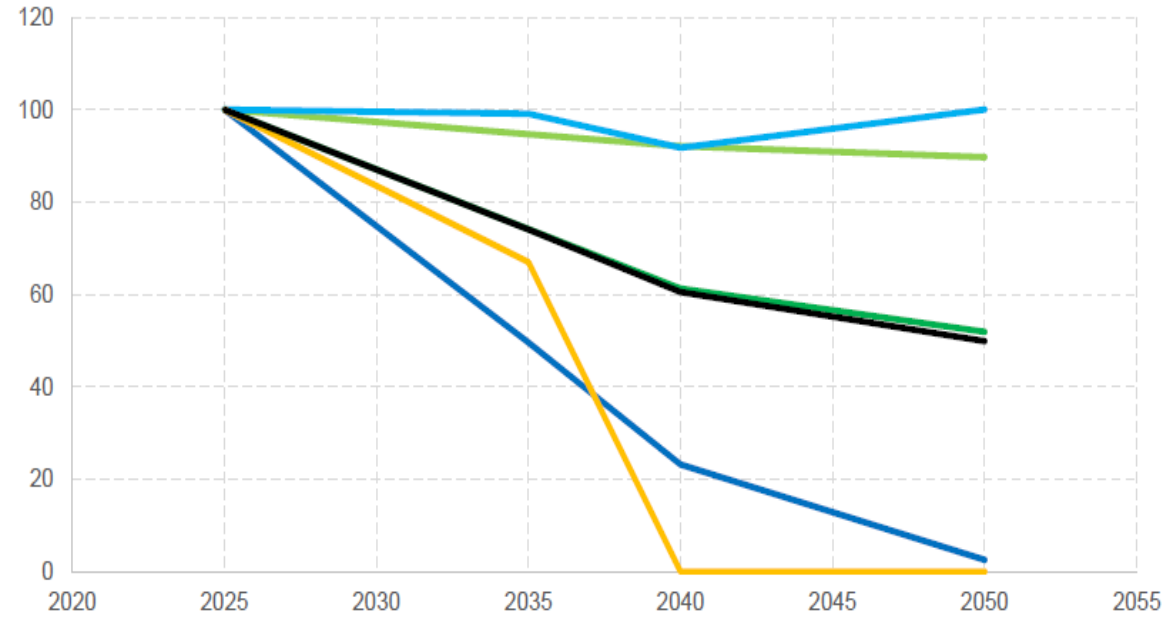
Chart 2 - Sectoral structure of credit exposures



Note: across geographical areas for all banks participating in the exercise under the sudden transition scenario

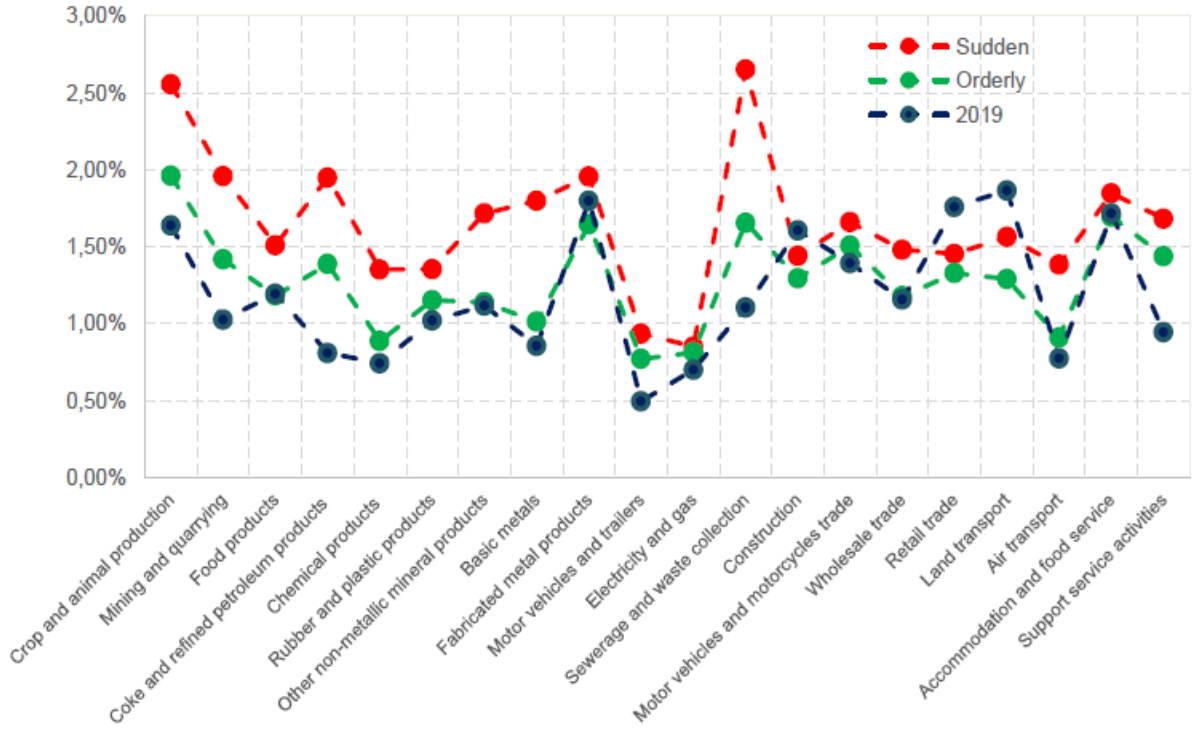
Source: ACPR

Chart 3 - Evolution of credit exposures in the sector of manufacture of coke and refined petroleum products



IMPACT ON CREDIT RISK

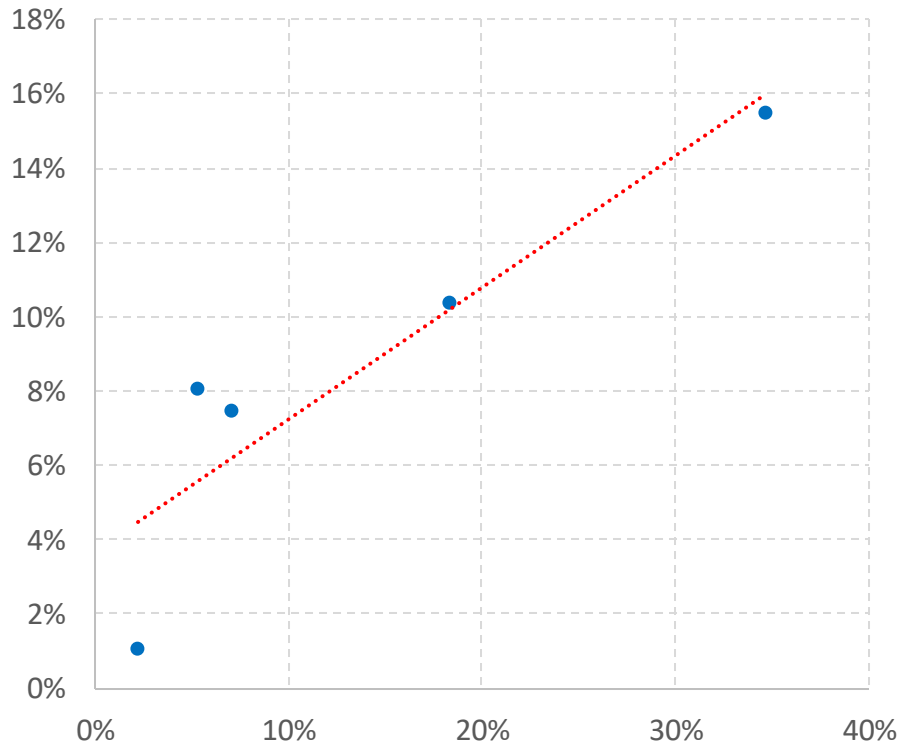
Chart 7 - Evolution of the probability of default broken down by sector



Note: the graph below represents the weighted average (weighted using total corporate exposures) of the one-year probabilities of default by sector of the 6 main French banking groups. The levels shown for the orderly and sudden transition scenarios correspond to those observed in 2050.

Source: ACPR

Correlation of the rate of change of the CoR *corporate* between baseline and adverse and share of corporate exposures to sensitive sectors



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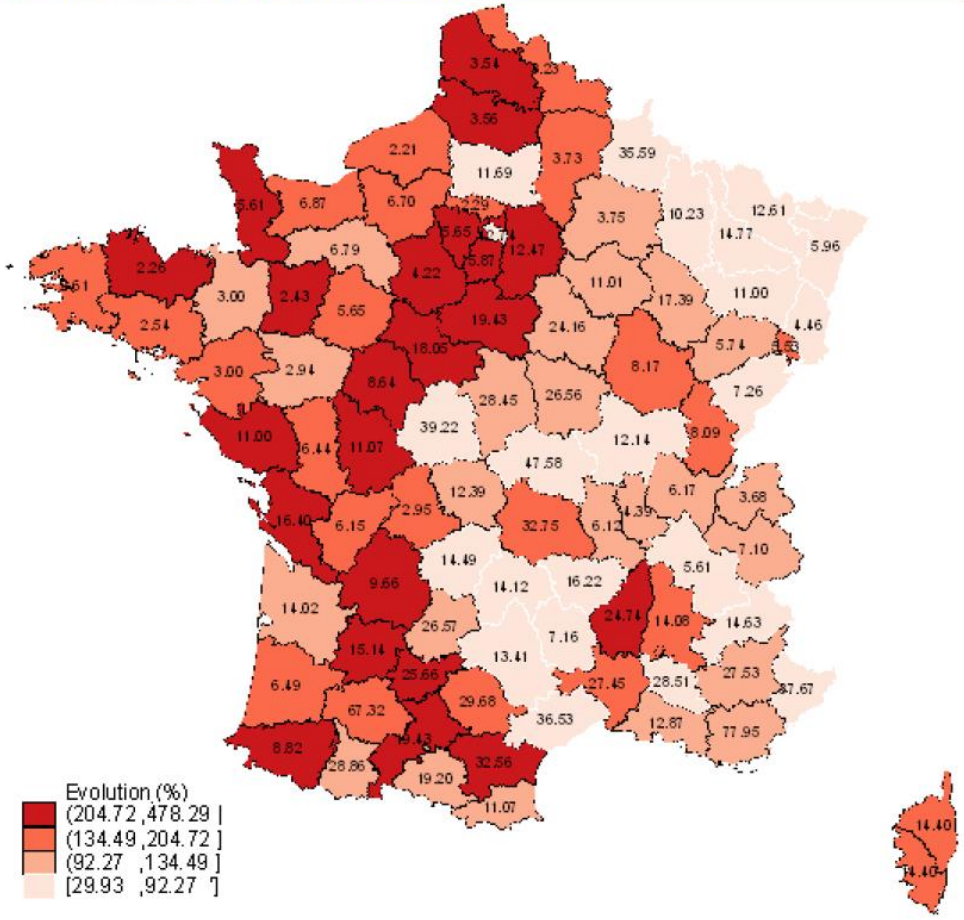
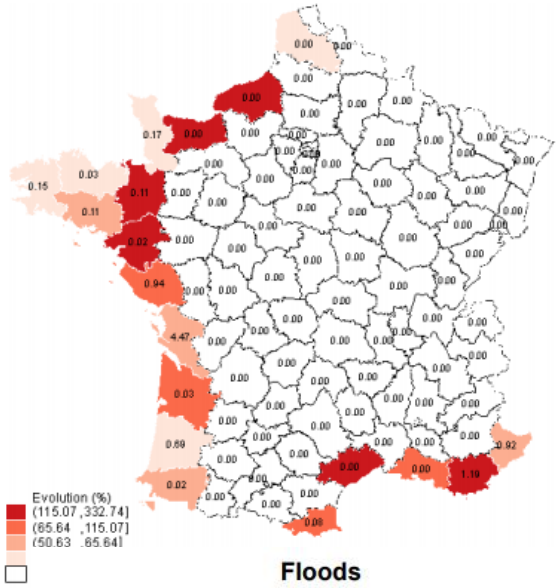
PHYSICAL RISKS: 3 PERILS IN MAINLAND FRANCE & CYCLONES OVERSEAS

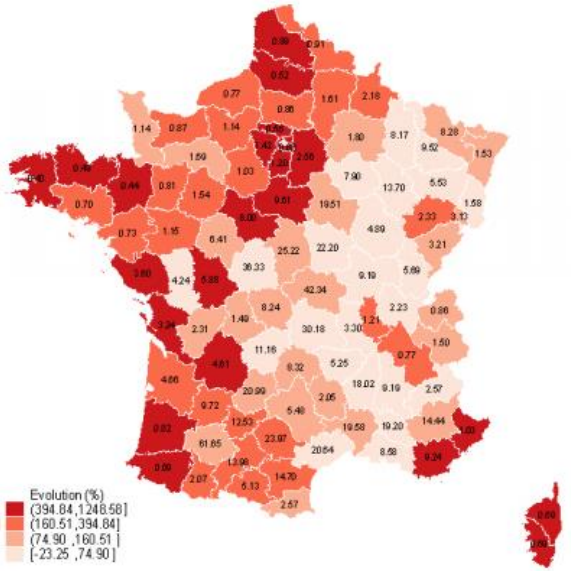
Chart 17 – Claims for all perils (2019 - 2050)



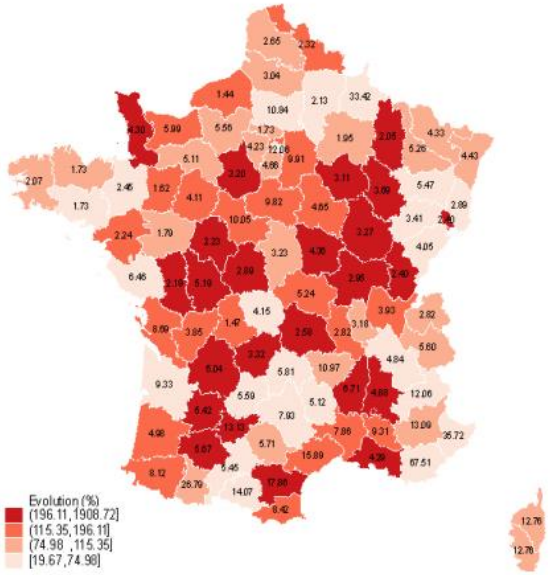
Marine Submersions



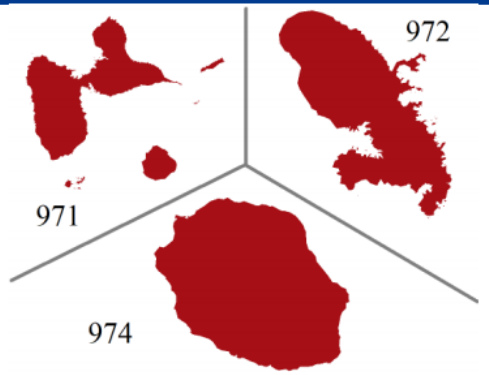
Droughts



Floods



All perils - Martinique, Guadeloupe, Reunion islands



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CONCLUSIONS

- Strong engagement from participants and significant methodological developments despite challenges; this exercise was considered as a catalyst
- Identified challenges:
  - Scenarios: not enough variability across NGFS scenarios; issue of the identification of sensitive sectors and granularity
  - Methodological issues: handling long-term horizons, sectoral differentiation and integration into internal models…
- Basis for future work :
  - Identifying best practices regarding the different methodological approaches
  - Improving the analysis on certain segments (market risk, households…)
  - Physical risk remains a challenge: inability to precisely locate exposures for banks; sizing insurance protection gap

Thank you

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Annexes

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CLIMATE SCENARIOS

Specificities of climate scenarios

	Standard scenarios	Climate change scenarios	
		Transition risks	Physical risks
Horizon	Short to medium run	Short, medium and **long run**	Short, medium and **long run**
Scenario drivers	Economic and financial	**Climate policy and technological change**	Conditional on outcomes of transition scenarios and/or **environmental dynamics**
Shock values	Guidance from historical data	Little to no guidance from history	Little to no guidance from history
Aggregation	National	**Sectoral**	Sectoral and **geographical**
Feedback loops	Work in progress (e.g. macro models with financial frictions)	Work in progress (e.g. interaction between policy and economy)	**Interaction climate - economy**

BdF/ACPR scenario narratives:

- **3 Transition risk scenarios:**
  - 1 **baseline** scenario and 2 **adverse variants**
  - 2 shock variables related to transition risks:
    - **carbon price**
    - **productivity**
  - Adverse variants depending on:
    - **Timing** of the shocks
    - **Size** of the shocks
    - Assumptions about technology – **productivity**
- **1 Physical risk scenario:** based on "RCP 8.5"

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Macro Model: NiGEM

- Multi country new keynesian general equilibrium model
- Carbon emissions not present => carbon tax implemented through calibrated increases in fossil fuel prices (inspired by work by DNB)

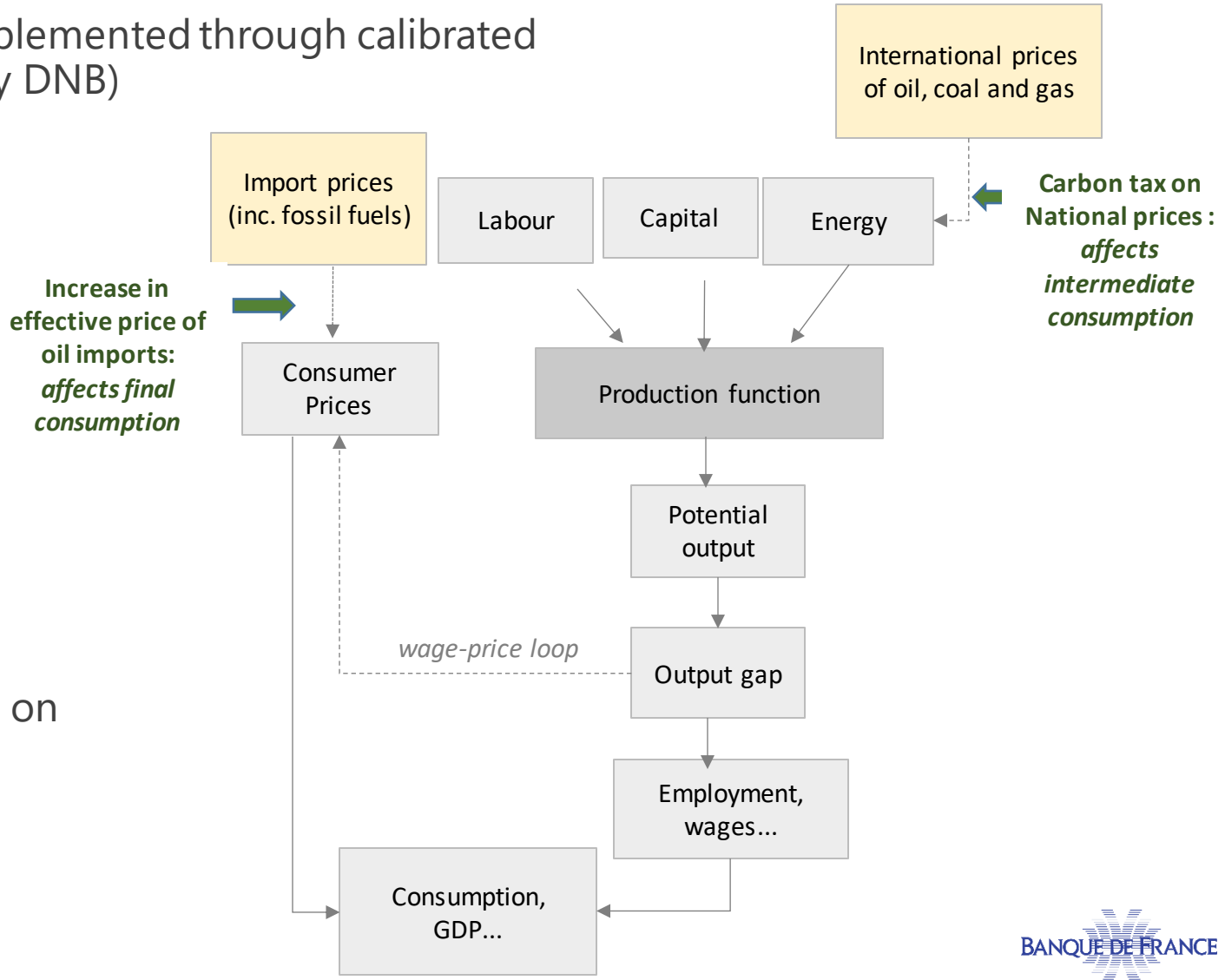
- 2 main transmission channels:
  - Energy prices as intermediate cost:
    intermediate input in production function; affects oil intensity

    'Effective' price of fossil fuel$_{country\ X}$ = *International price + Carbon tax*$_{country\ X}$

  - Energy prices for households:
    'effective' price of imported fossil fuels is included in consumption price index (excise tax on petroleum products in France)

    -> direct impact on consumer prices

- Impact on aggregate variables:
  GDP, consumption, wages, unemployment



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Sectoral Model: Production Network

- **Multi-country, multi-sector model** (Devulder & Lisack, 2020)
- Real, static, general equilibrium model
- **Substitution:**
  - Across sectoral goods, energy and labour for production
  - Across sectoral goods and energy for final consumption
- **Energy types:**
  - Coke and oil refining
  - Gas, electricity and air conditioning

Carbon price:

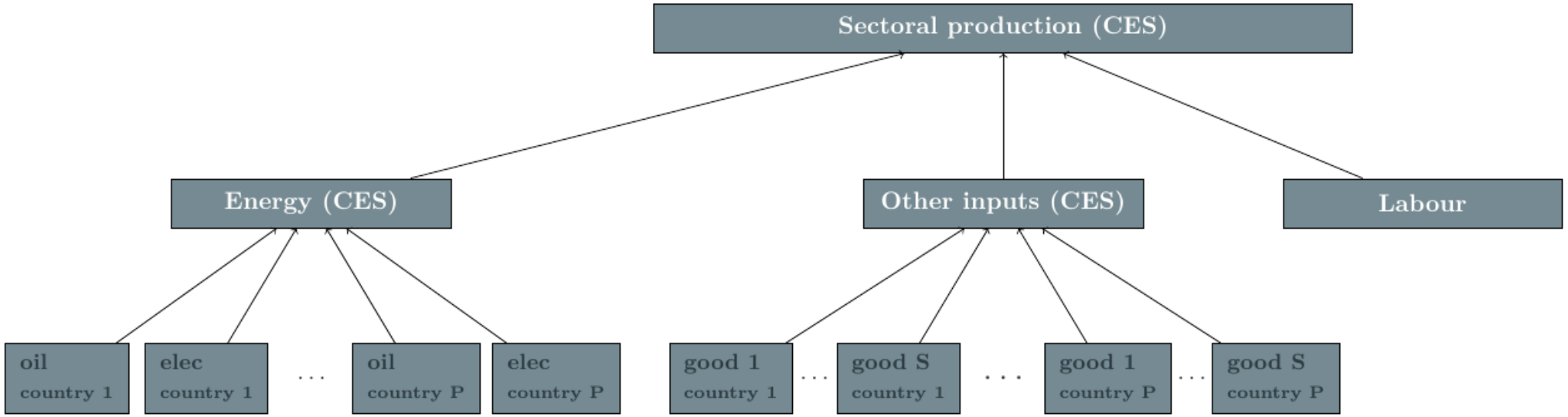
- On final purchase (oil & coke) by households
- On intermediate purchase (oil & coke) by producers

Labor productivity:

- One shock per country, homogeneous across sectors within each country

=> Impacts on:

- Real value added
- Real turnover for each sector



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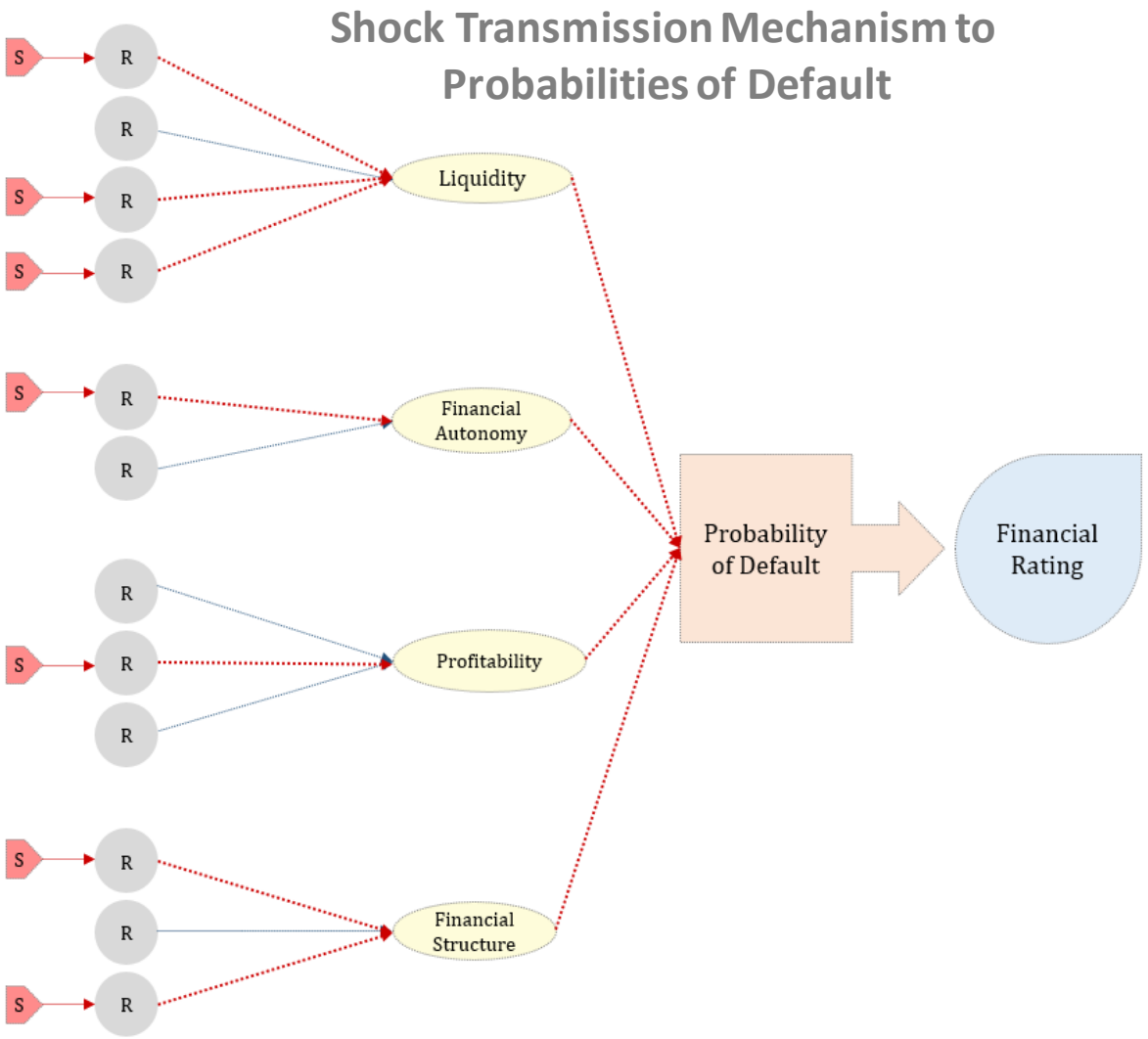
Infra-Sectoral Model

Using Credit Risk to disentangle between winners & losers



Model

- NFC Credit Risk rating
- 7 different macro-sector models

Data & Default Definition

- Around 270K firms per year.
- Yearly firm accounting data from FIBEN (2011-2017).
- Payment default data from the French national Central Credit Register (2012-2018).
- One-year horizon binary default complying with Eurosystem standards and Basel Committee definition.

Probabilities of default estimated using Financial Ratios and Theme based categorical variables

- Firth's Logistic Regression with Intercept Correction and prudential adjustments.
- Determination of final rating classes using a Smoothing Cubic Spline.

Shock Transmission Mechanism

- Impacts on real value added and real turn-over

⇒ firm-level financial aggregates

⇒ affect financial ratios and probabilities of default.

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HEALTH INSURANCE SCENARIOS

- **AON models evolution of health claims** due to:
  - Spread of vector-borne diseases
    - Climate-driven migration of mosquitos or other insects
    - Impacts given by *région* (13 in France)
    - Scenario based on report Drif, Roche & Valade (2020)
  - Increase in air pollution in major metropolitan areas (concentration + peak)
    - Ozone (03), Dioxide nitrogen (N02), fine particles PM 2.5 + PM 10
    - Impacts given for 10 largest French metropolitan areas
    - Scenario based on report Drif, Messina & Valade (2020)

- **Mortality and sinistrality tables are projected (from 2020 to 2050)** for:
  - Death benefit guarantees
  - Healthcare coverage (hospitalizations and consulations)
  - Work stoppage guarantees