Norges Bank

Finansdepartementet

Challenges posed by Climate Change to Inflation Targeting MP Regime

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The case for adaptive inflation targeting: monetary policy in a hot and volatile world

David Barmes, Irene Claeys, Simon Dikau and Luiz Awazu Pereira da Silva

Policy report
December 2024

THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE

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The green swan

Central banking and financial stability in the age of climate change

Patrick BOLTON - Morgan DESPRES - Luiz Awazu PEREIRA DA SILVA
Frédéric SAMAMA - Romain SVARTZMAN

January 2020

Source BIS: [The green swan - Central banking and financial stability in the age of climate change (bis.org)]

EUROPEAN CENTRAL BANK

EUROSYSTEM

Working Paper Series

Maximilian Kotz, Friderike Kuik, Eliza Lis, Christiane Nickel

The impact of global warming on inflation: averages, seasonality and extremes

European Central Bank Working Paper No. 2821, May 24, 2023

BIS

BIS Papers

No 160

Monetary policy for the green transition

by Luca Fornaro, Veronica Guerrieri and Lucrezia Reichlin

Monetary and Economic Department

September 2025

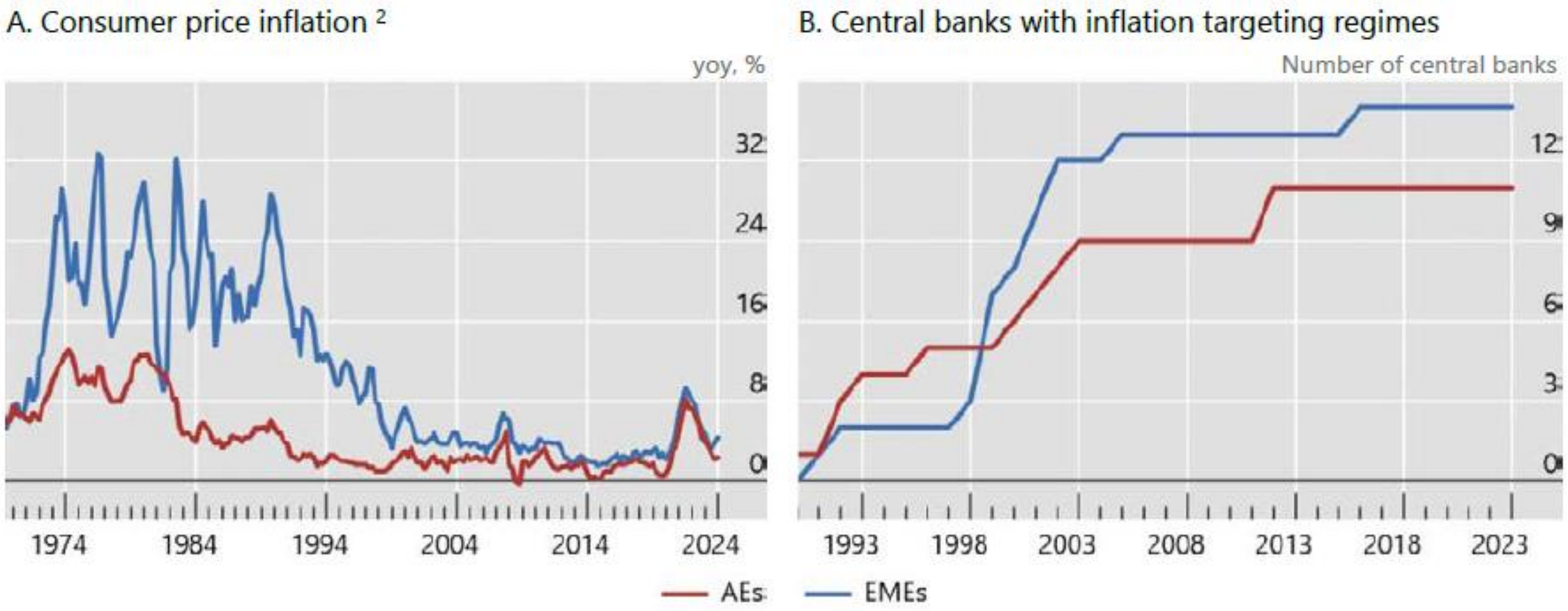
Inflation Targeting a very successful monetary policy regime (don’t change it!!!)

- Rules-based, forward-looking, communication-intensive monetary regime
- Clear numerical inflation objective, institutional independence, and expectation management
- Accountability, credibility
- Provided a stable nominal anchor during the Great Moderation

But limitations:

- To address financial exuberance → MAPs
- To operate at ZLB → UMP
- To deal with large supply shocks

Inflation dynamics and inflation targeting adoption[1] Graph 1

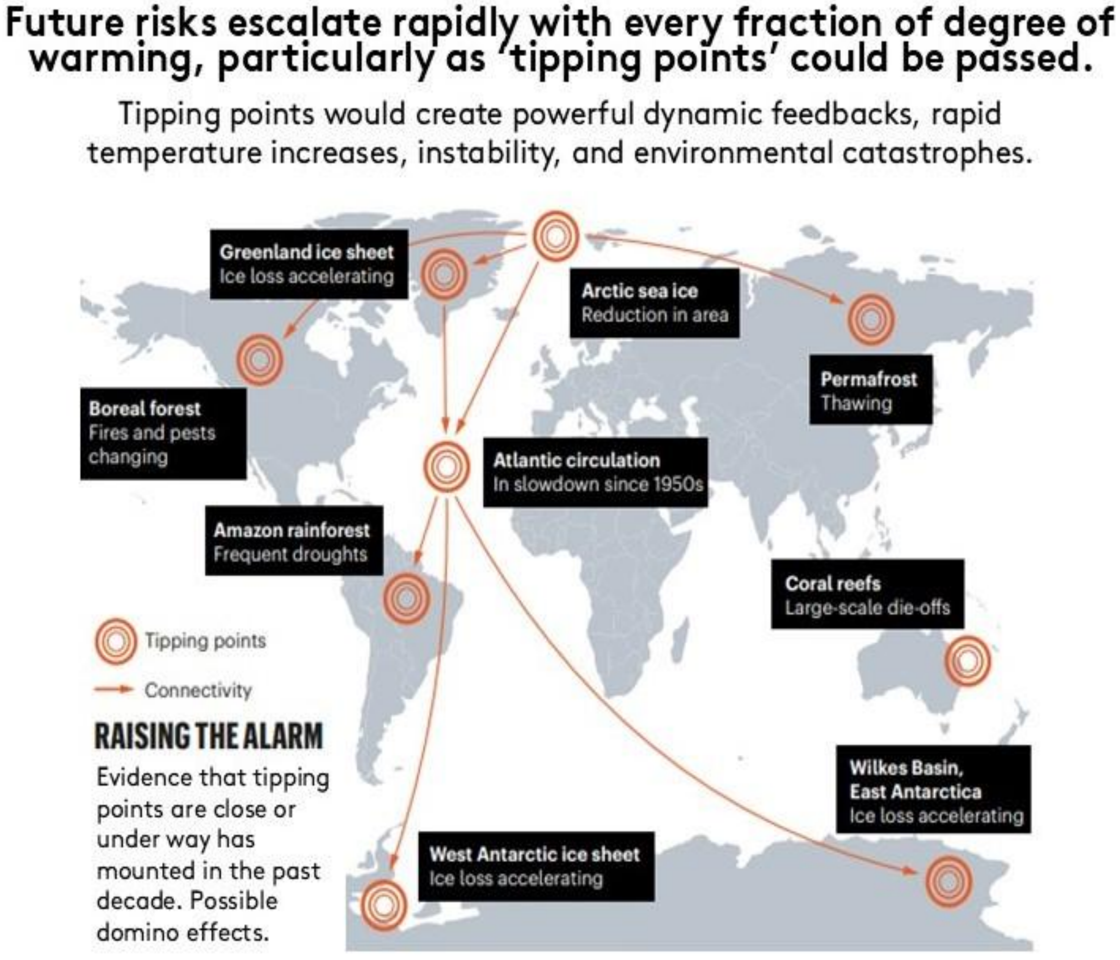


[1] Eleven AEs and 14 EMEs; euro area countries count a single jurisdiction. [2] Median.

Sources: Borio and Chavaz (forthcoming); national data; BIS.

What kind of Shock is Climate Change? A Green Swan

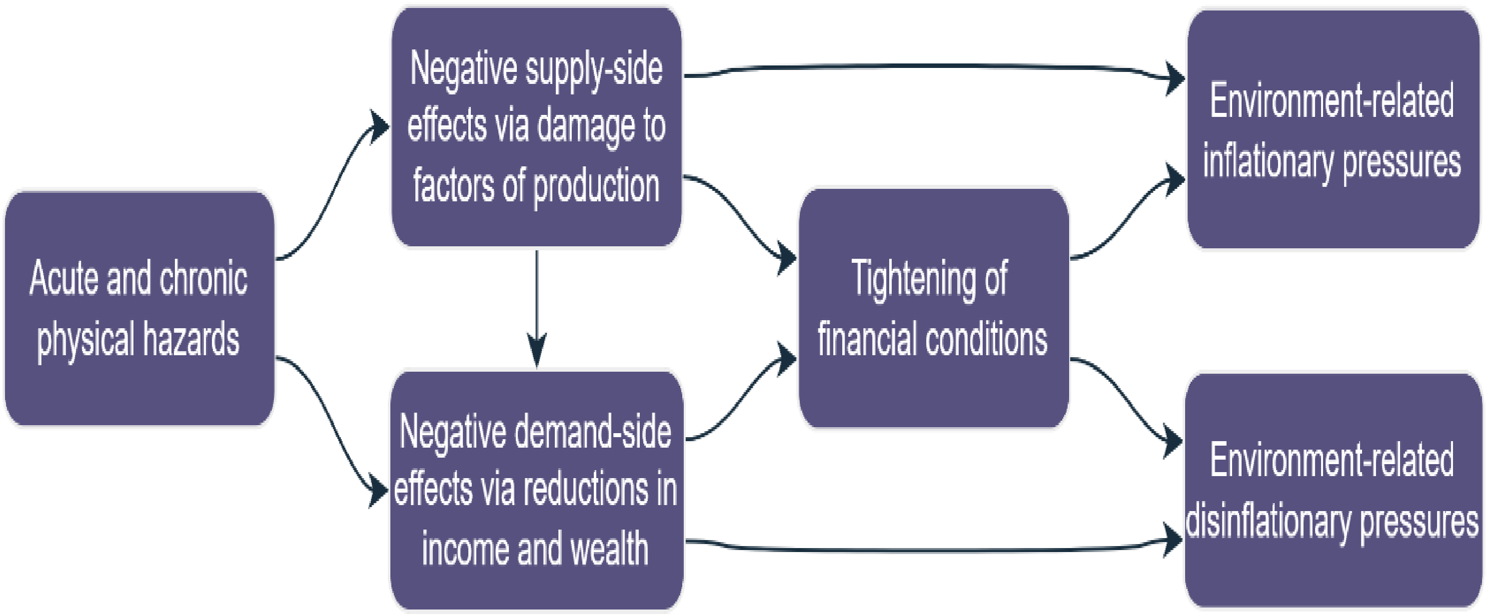
- Climate Green Swan complex supply / demand shock. Short-term and long-term ill-mapped effects (**tipping points**)
- Inflation targeting designed mostly during demand-dominant shocks. Globalization reduced cost pressures. Energy prices stable. Well-anchored expectations. Stable Phillips curve. Predictable transmission.
- With Climate, central bank faces more complex trade-off:
    - Tighten policy reacting to a temporary relative price shift → reduce inflation but worsen recession.
    - Ease policy or accommodate to avoid amplifying outp loss→ support activity but validate inflation.
- IT frameworks struggle with: Distinguishing temporary vs persistent shocks. Managing second-round effects. Preventing de-anchoring of expectations.
- Financial stability interaction: Supply shocks can increase sovereign spreads. Stress banking systems. Tighten financ conditions beyond policy intent. IT originally assumed: Pr stability was sufficient for financial stability. That proved incomplete post-2008 and again after 2022.



Source: Stern (2025)

Climate change is already producing ST supply shocks

- More frequent, persistent supply shocks: large body of literature pointing to risks of inflationary pressure coming from physical risks of climate change
- These supply risks are dominating risks of negative demand shocks
- IT regimes know well treatment of ST supply shocks (“look trough”) and negative demand shocks (accommodate);
- But what about frequent, large, cumulative, persistent, MLT supply shocks (reversal of China effect during Great Moderation)?



How to keep benefits of IT regime without credibility loss?

- Mission creep, loss of independence / credibility
- Look at evidence, trade-offs and adapt IT

SSPs are climate scenarios i.e **Shared Socioeconomic Pathways (SSPs)** framework, refining the older **Representative Concentration Pathways (RCPs)** used in previous IPCC reports

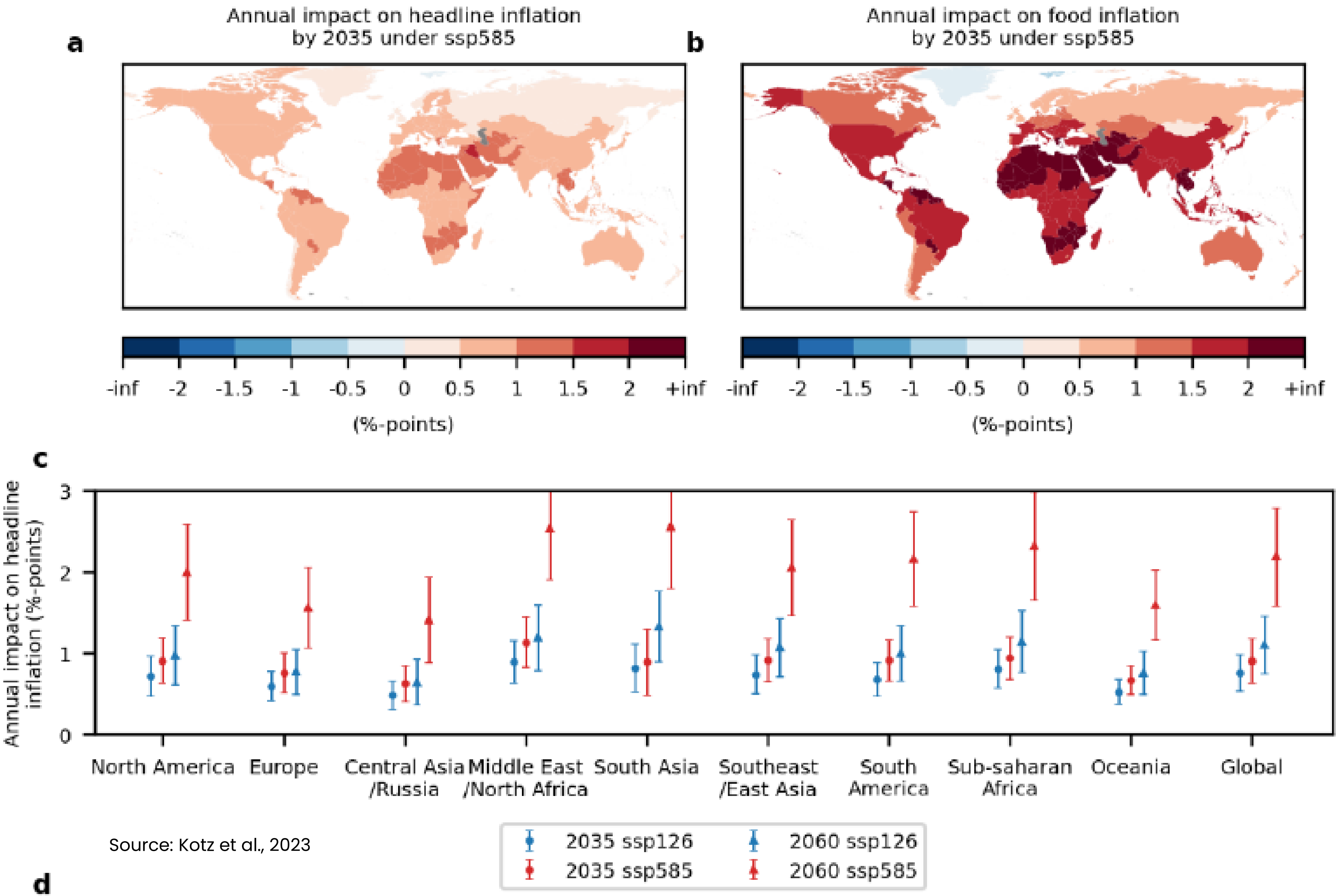
SSP1-2.6 is a **low-emission** climate scenario: Global temperature increase ~1.8°C above pre-industrial levels by 2100 (range: 1.3–2.4°C)

SSP5-8.5 is a high-emission, worst-case climate scenario: Global temperature increase: ~4.3°C above pre-industrial levels by 2100 (range: 3.3–5.7°C

Analytical Approach: Using fixed-effects panel regression models, the team estimated the causal effects of these climatic variables on month-on-month inflation rates

Integration with Climate Models: The empirical findings were combined with projections from the Coupled Model Intercomparison Project Phase 6 (CMIP6) ensemble, which includes multiple state-of-the-art climate models.

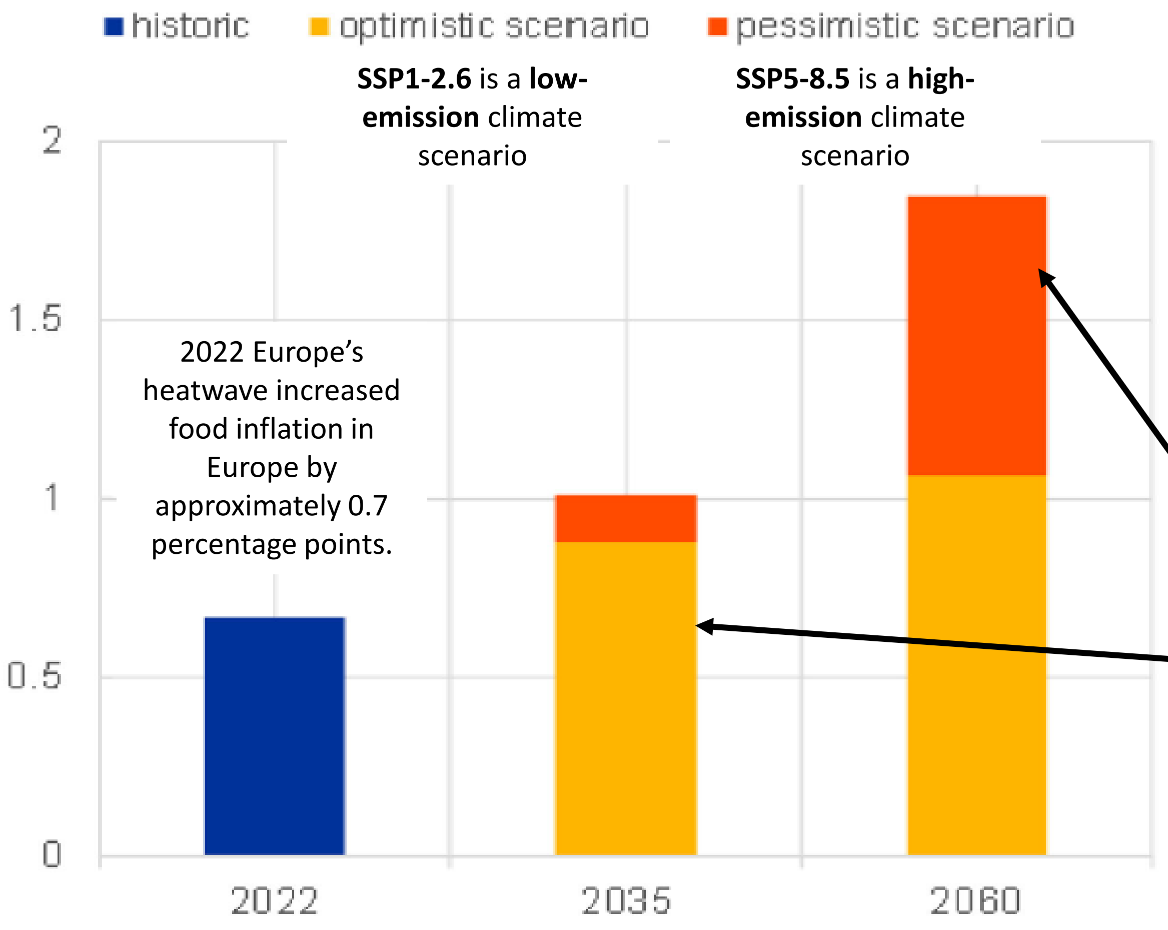
Case Study – 2022 European Heatwave



Source: Kotz et al., 2023

Estimated impacts of summer heat on food price inflation

(percentage points)



- <u>Impact on Price Stability Europe</u> – CC increases probability of lower yields in agriculture; higher food prices; transmit into higher cost of production and end up in (range of optimistic-pessimistic scenarios):
  - 1% higher food inflation (2035) and
  - 2% higher food inflation (2060)

Sources: Kotz et al. (2023).

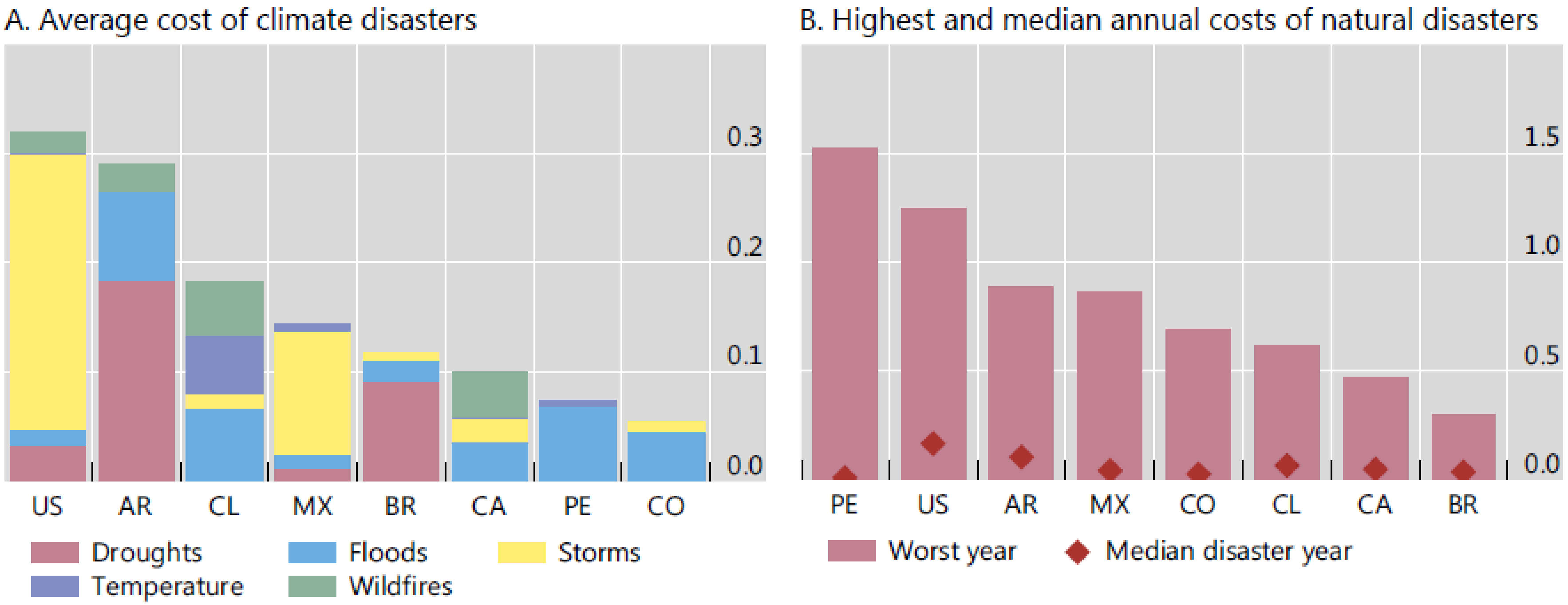
Source: Kuik Friderike, Christiane Nickel, Miles Parker and Wolfgang Modery" The price of inaction: what a hotter climate means for monetary policy" ECB Blog, 18 December 2023

Estimated with a global panel regression approach, using monthly prices and high-resolution climate data. Cumulative deviation of food inflation from baseline after 12 months due to extreme June/July/August temperatures are shown. Projected temperatures of a 2022-like summer in future climate models.

Climate change is already producing fiscal – financial impact

Average and worst annual impact of climate disasters in the Americas over 2000–23

As a percentage of GDP | Graph 3

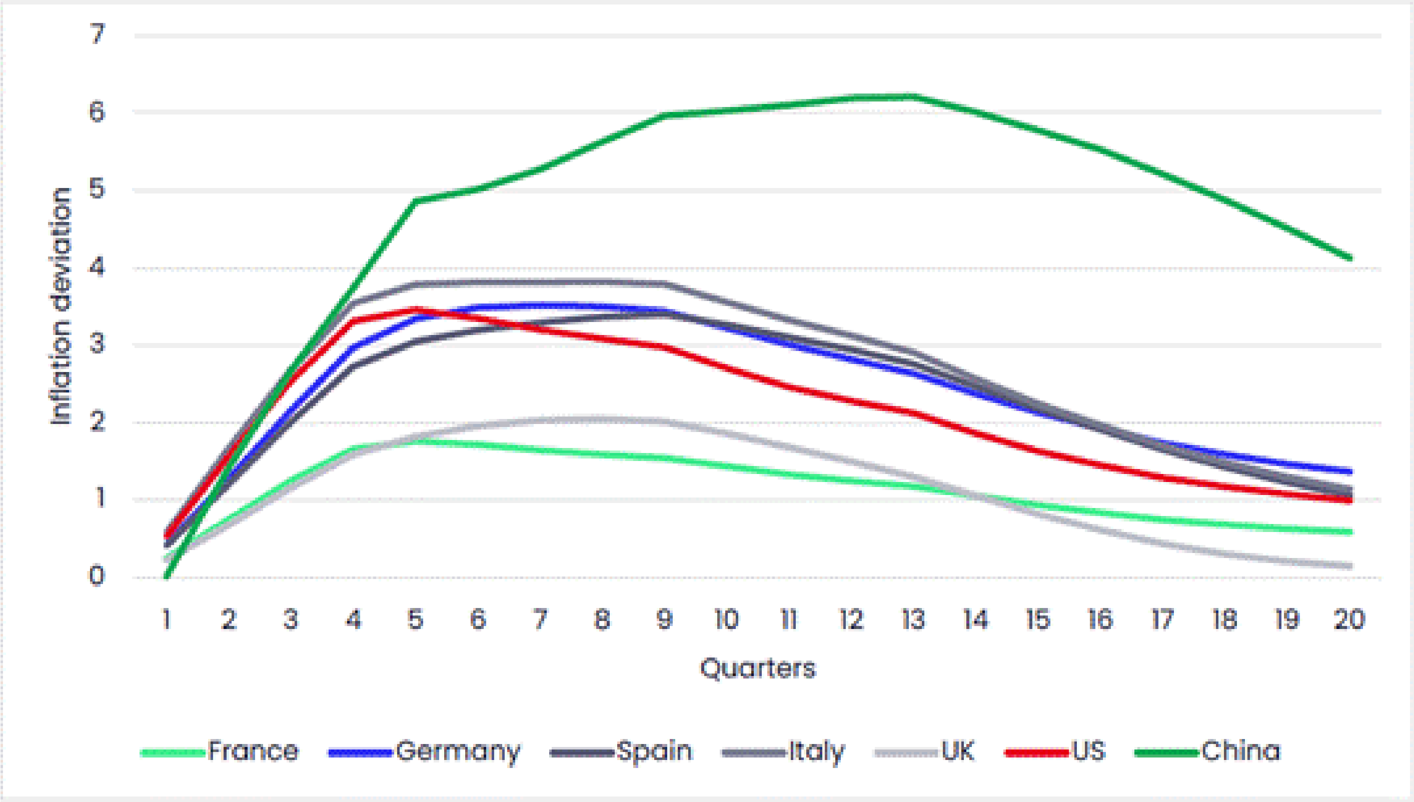


Sources: EM-DAT International Disaster Database; authors' calculations.

Climate change policies will produce inflation impact

- Carbon tax for green transition is a necessary instrument for reaching NZ
- But disorderly carbon taxation and sudden environmental regulations could represent another source of negative supply shock
- Modelling by Allen et al. (2023) suggests that a disorderly carbon taxation scenario could see central banks overshooting their targets

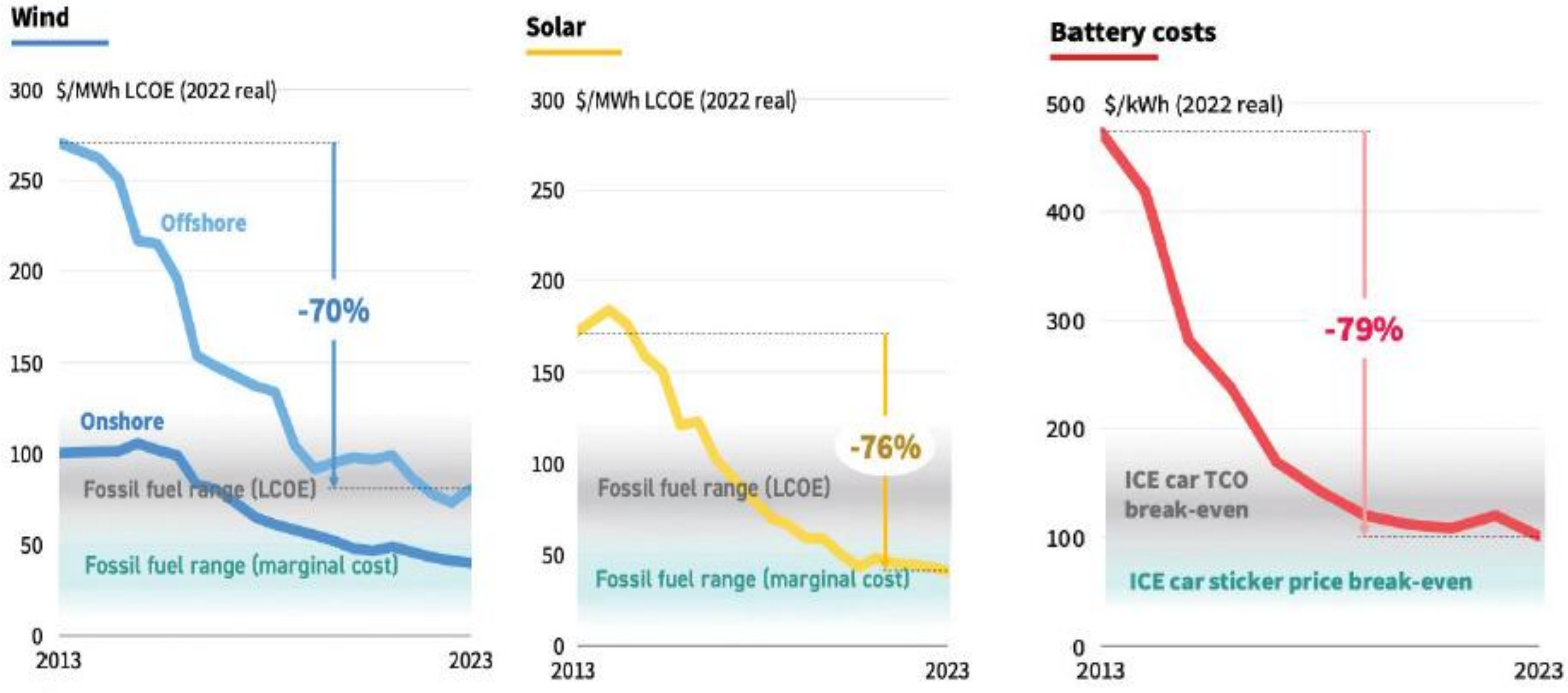
Figure 3.5. Estimates of the inflationary effects of disorderly carbon taxation (% point deviation from baseline year-over-year growth rate)



Source: Authors, based on Allen et al. (2023)

More inflationary pressure during the transition?

Figure 4.3: Renewable power technologies: decreases in LCOE, 2013–2023



Note: The costs are global averages, i.e., weighted averages of, for example, all solar projects.
Source: Adapted from Bond et al. (2024, p. 8). Copyright 2024 The Rocky Mountain Institute, CC BY-SA 4.0.

Source: Stern (2025)

- LCOE: Levelized Cost of Electricity, a metric to compare the average cost of producing electricity from different technologies over their entire lifetime.
- Cost of renewable energy production / storage is falling but transition to Net Zero could entail **<u>higher costs for a while, given network entrance – coupling costs of bringing new technologies</u>**

Monetary Tightening and the Green Transition

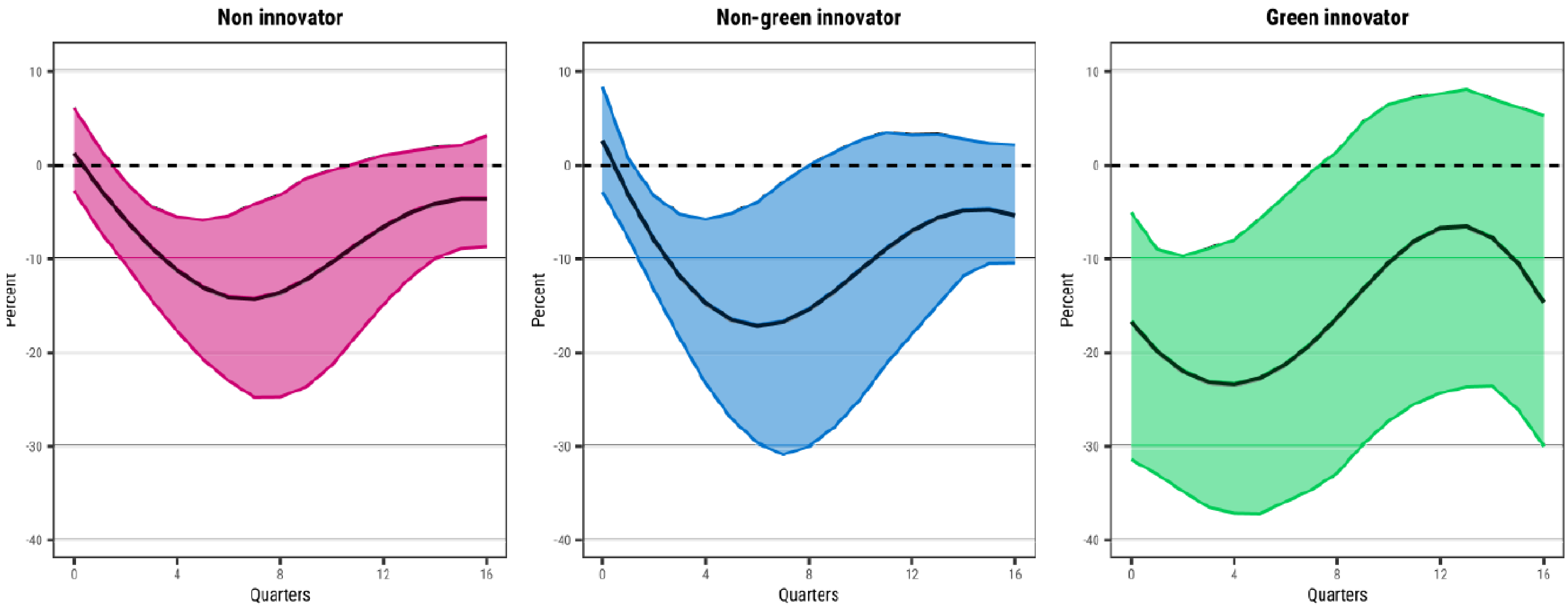
Climate transition requires sustained investment in clean technologies. Evidence (Fornaro et al., 2024):

- When financial or monetary conditions tighten
  → Investment falls for all firms
  → **Green investment falls more**
- Why?
  - Green firms face higher capital costs
  - More leverage and higher risk
  - R&D-intensive, long-horizon projects

Model results:

- **Strict inflation targeting** → Higher rates reduce green investment and slow productivity shift
- Allowing temporary inflation → Facilitates reallocation toward clean sector
- **Trade-off:**
  Aggressive inflation control may unintentionally delay the green transition.

Climate change, if Financial Conditions tightens, reduce green investment



Fornaro and al (2024): financial conditions and firm-level evidence. VAR-style identification within a local projection framework

Data Strategy. No long time-series data on green investment, use USPTO patent data. Match patents to Compustat firms.

Classify firms into: Non-innovators Non-green innovators Green innovators (>25% of patents green)

Then estimate local projections using the Chicago Fed NFCI (Financial Conditions Index).

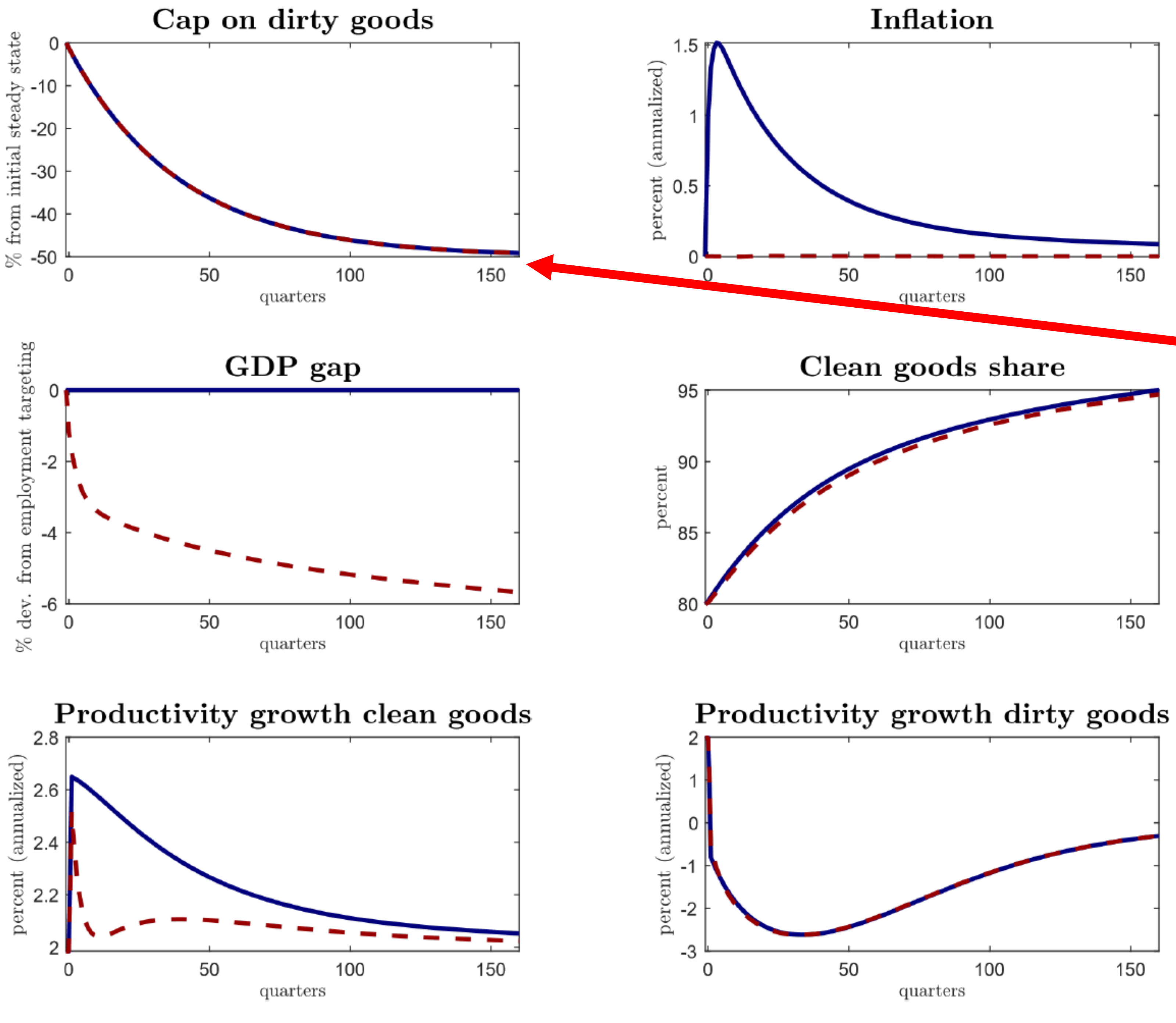
Key Firm-Level Findings: When financial conditions tighten:
Investment falls for all firms; but green innovators' investment falls more. R&D spending by green firms is especially depressed
Green firms have:

- Higher perceived cost of capital
- Higher leverage
- Higher business risk (asset beta)
- They are more sensitive to credit tightening.

Climate change, <u>if Monetary Conditions tightens</u>, reduce green investment

Fornaro et al. (2024): Monetary Policy and the Green Transition

- Develop a New Keynesian DSGE model with sticky prices and an interest-rate rule.
- Economy consists of clean and dirty sectors, with a regulatory cap on dirty production representing climate policy.
- Gradual tightening of this cap creates capacity constraints, producing a convex (non-linear) Phillips curve and a structurally worse inflation–output trade-off.
- The model includes endogenous technological change, allowing firms to invest in clean and dirty productivity.
- Green investment is more sensitive to interest rates (as before), as dirty firms face shorter horizons under regulation.
- Simulations compare monetary regimes (employment "**<u>adaptive</u>**" vs strict inflation targeting) and reveal a "green dilemma":
  - Fighting inflation aggressively increases output losses and slows the transition.
  - Allowing temporary inflation facilitates structural reallocation.
- Coordinated monetary and fiscal/credit support for green investment helps reconcile price stability, growth, and transition speed.



Solid lines: employment targeting. Dashed lines: inflation targeting.

Results of standard New-Keynesian DSGE model in Fornaro and al (2024)

- 2 Technologies, Dirty (Brown) and Clean (Green)
- Policy (Green Regulation) **cap Dirty (Brown) production** → binding → More Inflation pressure

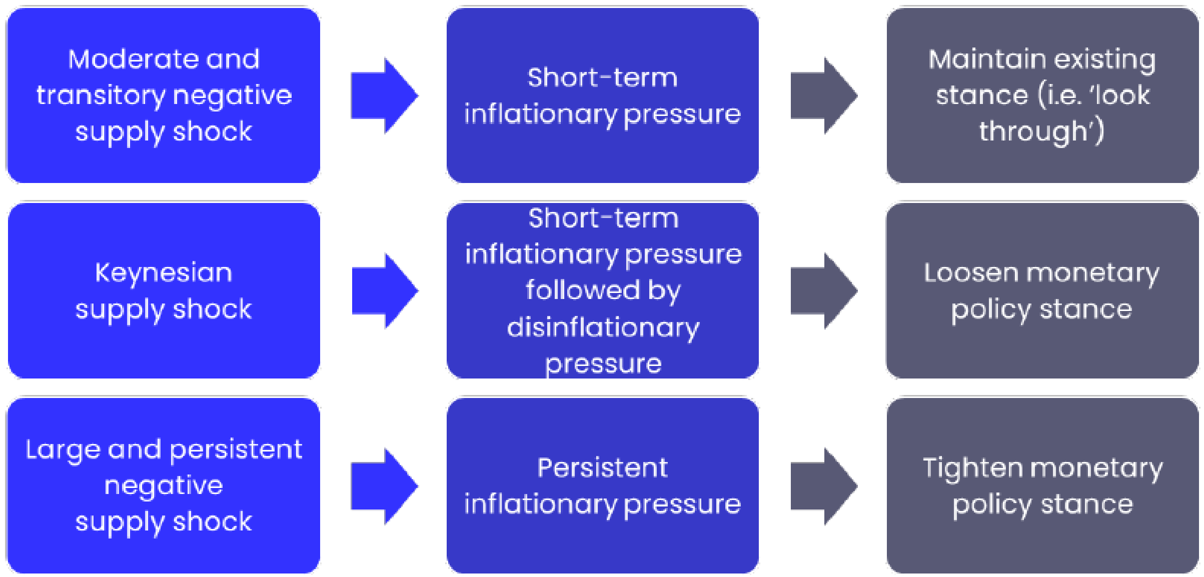
Comparing 2 CB MP regimes:

- Employment targeting (solid line)
- Standard Inflation targeting (dashed line)

Standard inflation targeting tight monetary stance reduces incentives to invest in Clean (Green) technologies, slowing down its productivity growth, but Dirty (Brown) investment not much change

- <u>Negative supply shocks are not new to standard flex inflation-targeting regimes</u>: if transitory, 'looking through' the shock is the standard response
- However, trade-offs resulting from supply shocks can produce disagreement on monetary policy committees between 'doves' v 'hawks' i.e. growth and sacrifice ratio
- The more severe, repeated, and persistent that negative supply shocks become, the more likely monetary tightening becomes - may be "**<u>excessive</u>**"

Figure 4.3. Typical monetary responses to different types of negative supply shock



Source: Authors

Climate Change Trade-Off for CBs operating an IT regime

- **Facing persistent negative supply (inflationary) shocks under IT regimes : CB should "look through" or "tighten" MP? Within existing mandate, with commitment to 2% target and same institutional arrangements:**

- **Risk (1):** "Look through" → "dovish" overshooting of the 2% target repeatedly → de-anchoring inflation expectations → loss of credibility → eventually more inflation?
- **Risk (2): "**Tighten" → sticking to current 2% target → maybe "hawkish" in "<u>excess</u>"(?) → hampering "green", transition investment → more sluggish growth → slower "green" transition, welfare loss?

Adaptive IT for CBs under an IT

- **Begin discussing IT regime to "adaptive" IT for a "hotter world"**

Framework	Target	Horizon	Toolkit
Flexible inflation targeting	Usually a point target (typically 2%), sometimes with small accommodation bands	Medium-term, typically 2 years	Policy rate, focused on managing aggregate demand
Adaptive inflation targeting	(a) Point target of same 2% but with larger accommodation bands for shocks; (b) targeting explicitly a range around 2%; or (c) higher point target (3%) with smaller accommodation bands	Medium term, 2 years, but with longer horizon (3+ years) applying when climate-related supply conditions are pervasive	• Policy rate, focused on managing aggregate demand • Macroprudential policy to adequately price climate risk and build supply side resilience • Forecasting models featuring climate risks

Adaptive IT for CBs under an IT

- **Why start discussion now?** Before impact of CC manifest into actual inflation and forecasts, triggering credibility issues, being "under pressure"
- **Who to discuss?** The CB community. Not a CB in isolation, as "opportunistic" individual choice
- **Where to discuss?** As a collective discussion about key components of IT regime → ideal place, the BIS and/or IMF and/or G20
- **What to discuss?** (1) options (target, band, horizon); (2) critical issue of communication with markets (timing/rationale), see Blanchard for challenges at ZLB, FED Clarida with AIT and combining policy rate + MAPs with Integrated Inflation Targeting for EMDEs

Other Policy Issues for CBs with Climate Change

- **CC-related Basel-type regulation on CC-risks**; CC-related disclosure on CC-risks (IFRS)
- CC-related **macro-prudential frameworks** and **standard** adoptions (IFRS);
- **Revisit CB MP operational framework** (eg., “greening”, including reserves, collaterals and APPs-QEs)
- **Support “green” finance directly or indirectly**: conditional / direct lending; Paris-2oC or NZ-compatible financial portfolio design; “green”-ESG bond issuances and guarantees

Beyond IT, more challenges and new macro-financial context with CC: "CC" negative supply shocks with impact on g(pot), r*, U*

- Rising risk premia. Fiscal responses to the GFC and Covid-19 has left us with high debt levels; for all → higher rollover costs of debt after CBs increased their policy rates → **how to boost green investment with a shrinking fiscal policy space?**
- New "neutral rate" or r* for CBs (equilibria savings=investment) and higher MLT inflation rate for some time during NZ transition. End of excess savings or "savings glut", demand for more investments for NZ→ **where is neutral policy rate?**
- New financial losses and excesses? Climate risks → financial (ins)stability of insurance and banks; non regulated non-bank financial activities. Many new financial markets risks are not covered by Basel → **higher odds of financial crises, potential "cost" for FP?**
- New equilibria in labor markets. New working arrangements (home office), AI-related technology changes, higher unemployment? Size of safety nets, transitional social transfers, etc; lower immigration for political reasons → **higher wage pressure? Higher service inflation then headline inflation?**
- New political economy context for fiscal, monetary policies and to implement structural reforms; "missing" social consensus; geopolitical fragmentation → **political paralysis & inaction?**

Conclusion

- **Climate change is already bringing more persistent and larger negative supply shocks** (challenging functioning of flexible inflation-targeting regimes) and exacerbating trade-offs because ‘looking through’ transitory shocks, as standard MP response, not anymore ideal response (trade-off with LT growth)

- **Discussing MP response under IT by central banks** is needed to avoid monetary tightening becoming “excessive” and exacerbating downturns

- **Caution: IT regime requires “credibility”** any change entails using communication, guidance, need to preserve benefits of IT while putting new trade-off for discussion:
    1) discuss these challenges (1.a.) when inflation and expectations are relatively anchored and on target; (1.b.) in coordinated policy circles for central banks where the whole community is represented like BIS, not isolated opportunistic position by one CB)
    2) analytical discussion then could propose triggers and process accordingly and
    3) define when and how implement “adaptive inflation targeting” for a hotter and more volatile world

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