

Bank of England

Climate change, the macroeconomy and monetary policy

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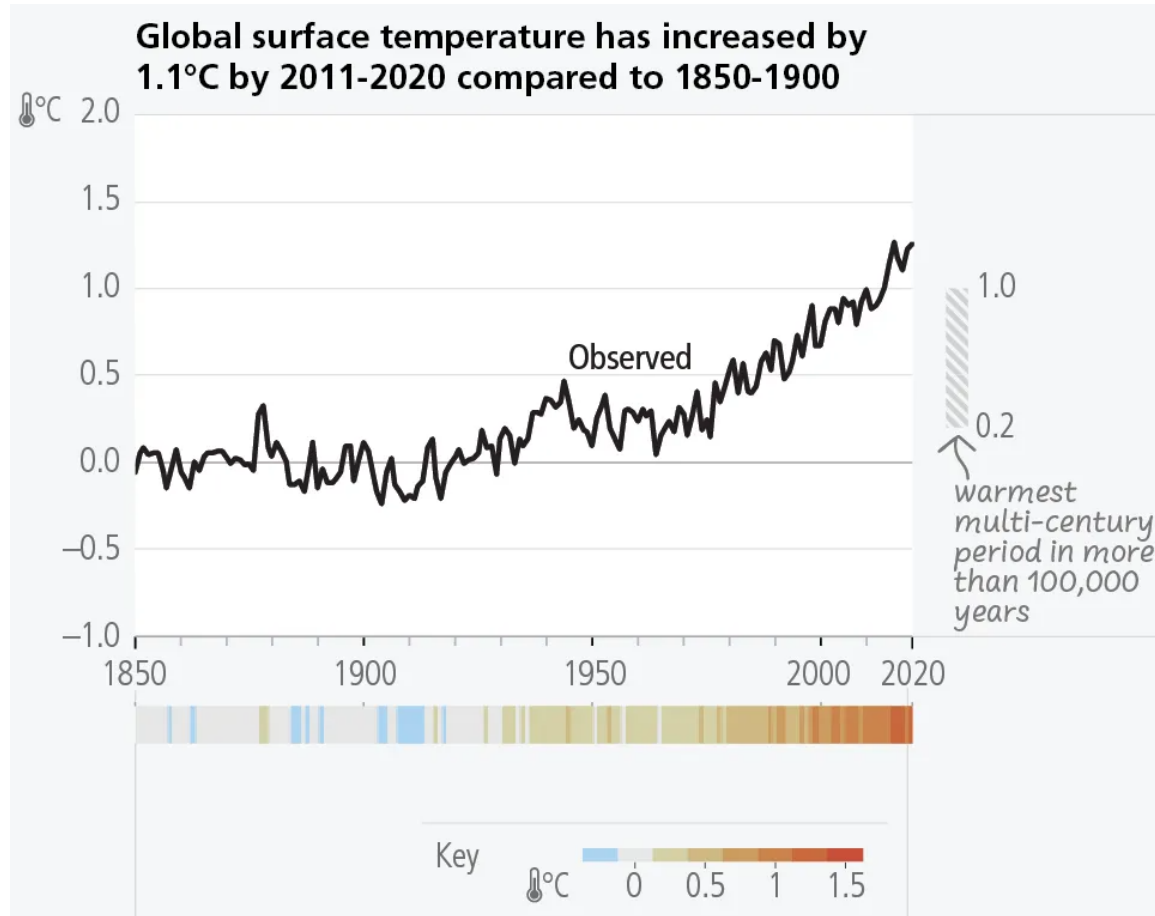
Chair of the Workstream on Monetary Policy,
Network for Greening the Financial System



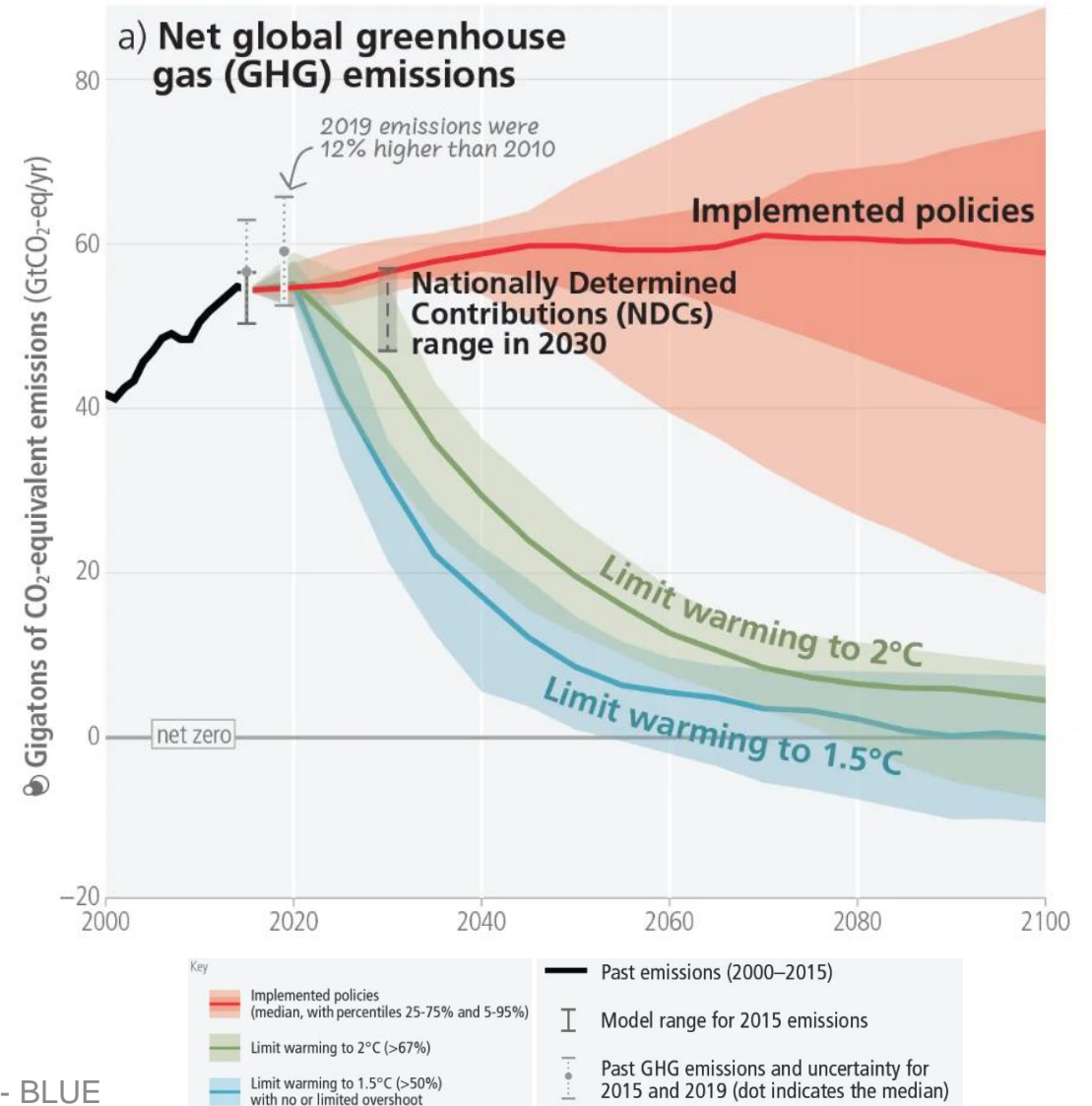
When central banks think about the impact of climate, we take as given....

- **The science**
 - We are interested in how it affects the economy and financial system and therefore the achievement of our statutory objectives.
- **That governments, not central banks, are responsible for mitigation policies**
 - But these policies – or uncertainty around them will have economic impacts.
- **Our mandate for price stability**
 - If climate change and the transition to net zero affect economic outcomes, then like other shocks, it can be a relevant consideration for monetary policy makers.

The IPCC view on climate change and climate policies



Source: IPCC, 2023

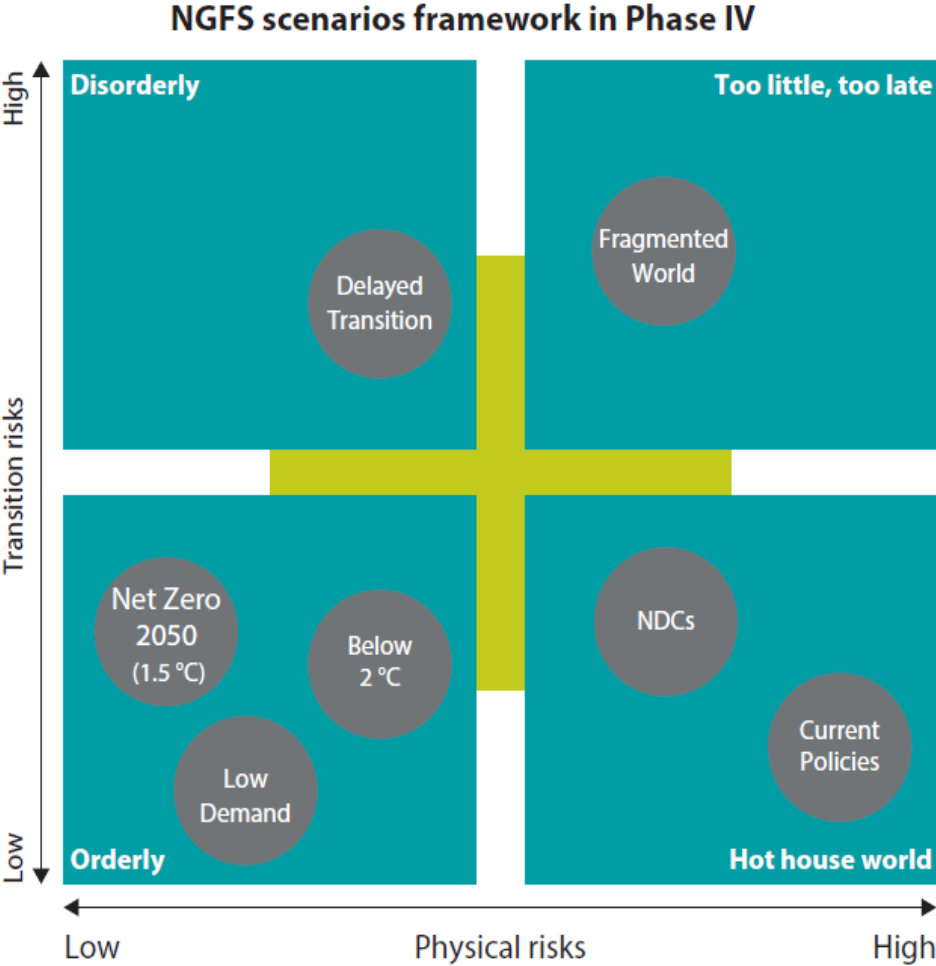


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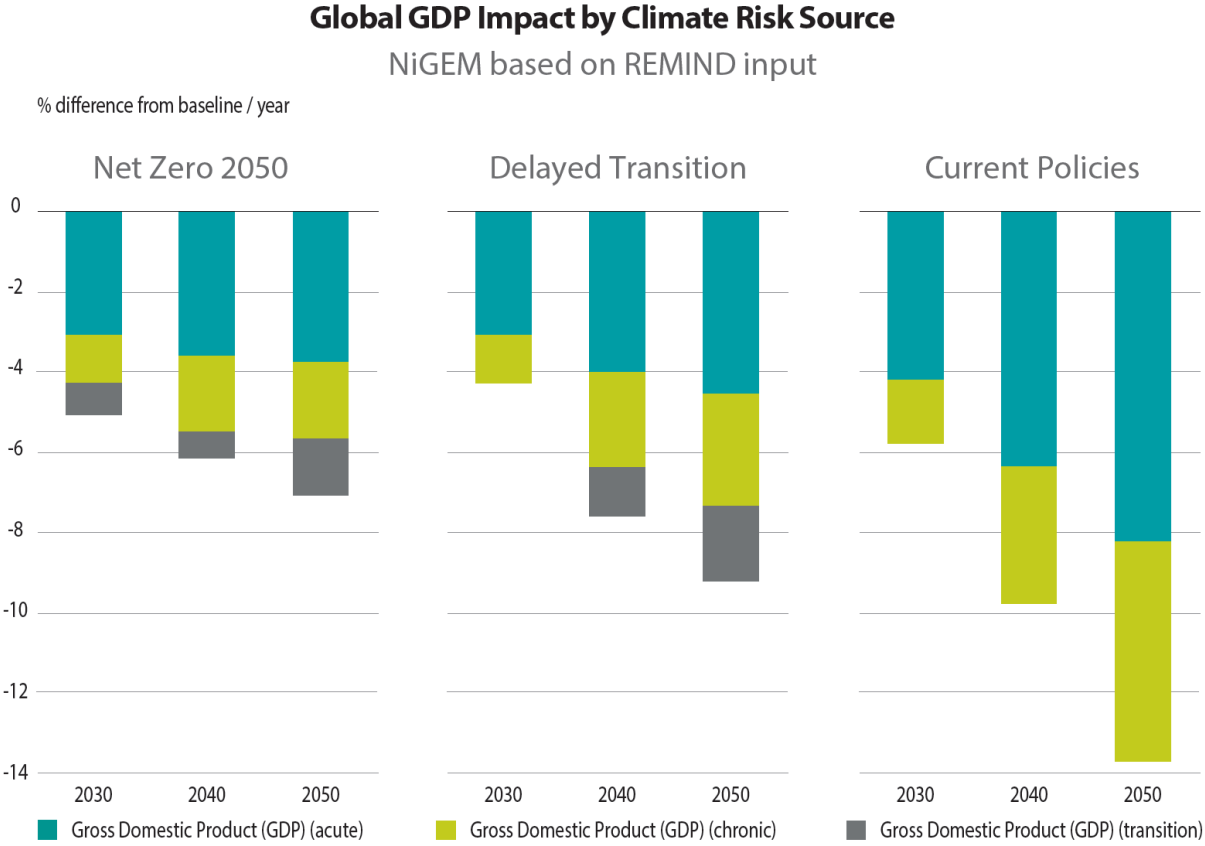
How do central banks think about climate?

- Central banks need to understand current and expected economic developments to be able to achieve their price stability mandates.
- If climate change and the transition have an economic impact then that is relevant for monetary policy decisions, like any other economic shock.
- In relation to their financial stability objectives, central banks also have a role in enhancing the resilience of individual firms and the wider financial system to climate-related risks.

Economic Impacts of climate in the NGFS long-term scenarios



Positioning of scenarios is approximate, based on an assessment of physical and transition risks out to 2100.



Note: The above figure shows how GDP is impacted across scenarios compared with a hypothetical (and impossible) baseline scenario in which no transition or physical risks occur. This baseline scenario represents a world in which climate change does not occur. Thus, climate change has a negative impact on GDP in every plausible scenario, but the magnitude of the losses differs across them.

Source: [NGFS \(2023\)](#)

How do central banks think about this issue?

- Central banks need to understand current and expected economic developments to be able to achieve their price stability mandates.
- If climate change and the transition has an economic impact then it is relevant for monetary policy decisions, like any other economic shock.
- Monetary policy makers are focused on shorter horizons, typically 2-3 years ahead, so focus has turned to what the shorter-term impacts might be and how we model them.
- In addition, central banks also need to understand the impacts on supply and the natural rate of interest.
- Macroeconomic impacts will vary across economies – and our framework will need to be flexible enough to allow for that.

Why is focus increasing?

- NGFS Workstream Monetary Policy has been developing a common analytical foundation to understand the macro impacts of climate over the past two years.
- The increased frequency and severity of shocks may make the impacts of extreme weather events harder to look through.
 - More frequent shocks may give rise to trade-offs between economic activity and inflation
 - Trade linkages also create a source of indirect exposure for economies via the impacts these events have on their major trading partners.
- Climate policies may give rise to large, prolonged, partly anticipated relative price changes in the economy.
 - Policies may give rise to potential trade-offs in the short-run.
 - Clarity and certainty on these policies affect behaviour → impacts macroeconomic outcomes.
 - Asymmetric policy mixes can give rise to international spillovers and cross-border impacts.

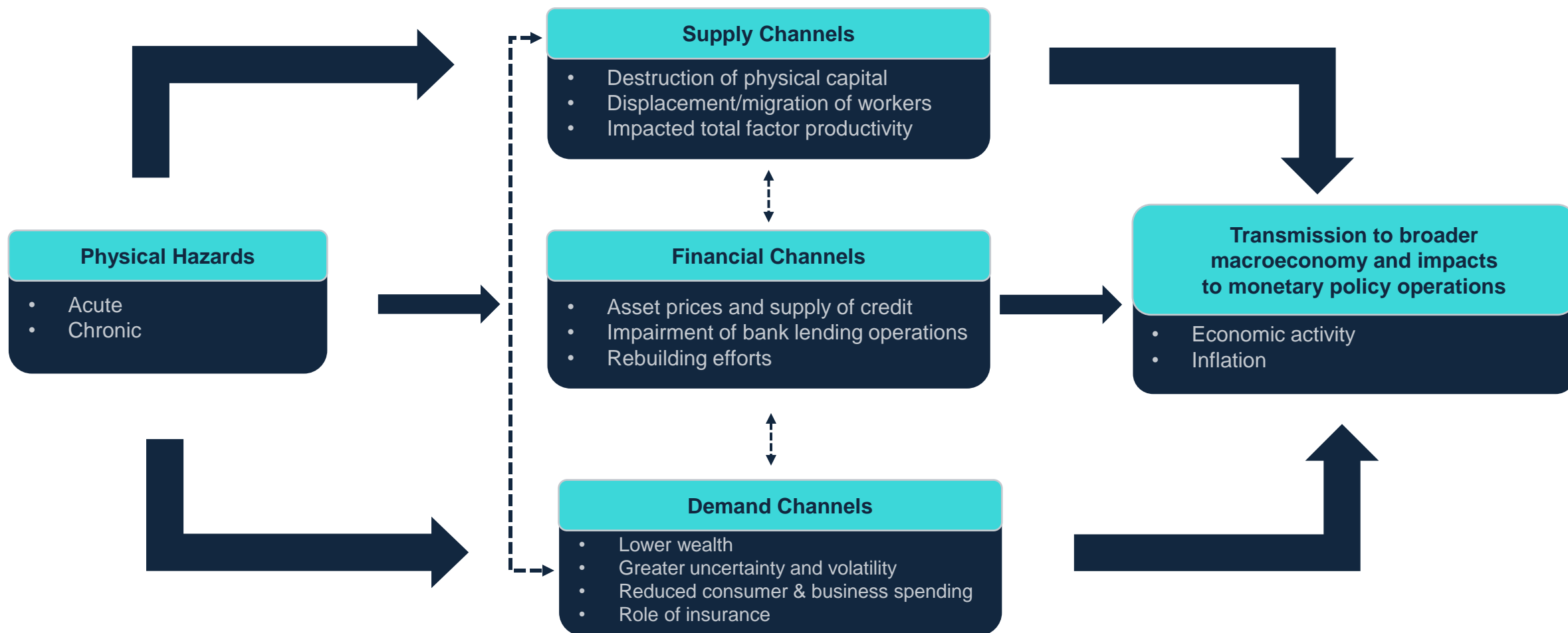


Physical impacts

Framework for understanding physical impacts

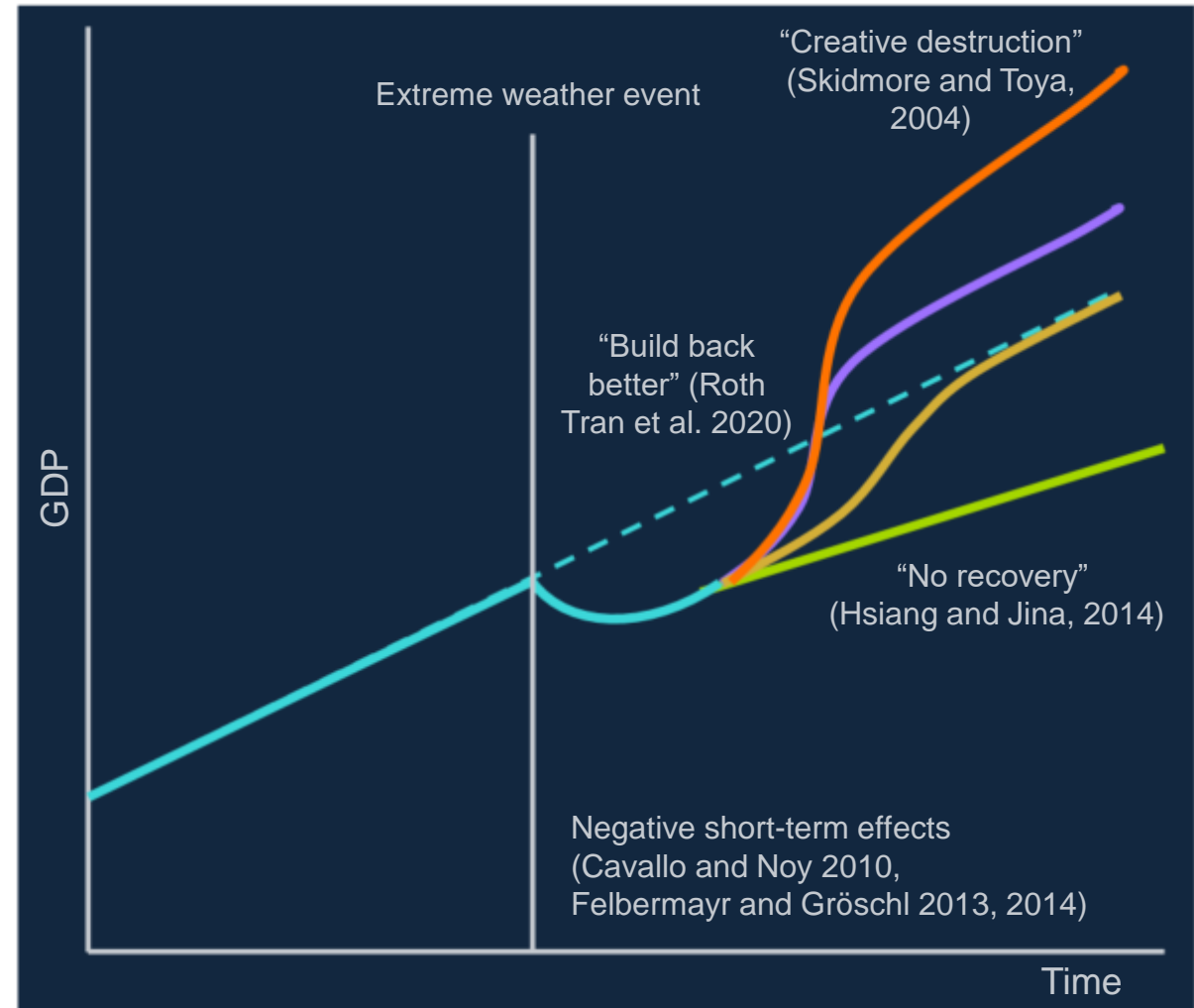
- The type of event matters: no two events have the same macroeconomic effect. It will depend on:
 - **Physical hazard type:** e.g., heatwaves, floods, wildfires, and storms
 - **Exposure:** does the event affect a location with economic activity? What is the value of affected assets?
 - **Vulnerability:** reflecting issues such as construction quality, disaster preparedness and response capacity.
- Also important to consider a country's **resilience threshold**, which depends on structural factors as well as wealth, fiscal capacity, and insurance mechanisms.

Transmission of physical hazards to the macroeconomy



GDP Impacts – range of estimates (so far) from the literature

- The level and growth rate of GDP drops in the short-run.
- Over time, GDP growth recovers, but for severe disasters, GDP can remain significantly below its pre-shock level.
- A climate disaster results in a cumulative per-capita output loss of 0.25%, 0.5% and 1% for high, middle and low-income countries respectively (Raddatz, 2009).
- International spillovers from severe weather events can be of considerable magnitude, including through commodity prices.



Inflation Impacts – what does the literature say?

- Evidence is mixed because there are a range of determinants, but in the very short-term a spike in inflation typically follows an extreme weather event. (Keen and Pakko (2011), Gallic and Vermandel (2020), Evgenidis et al (2021), Cantelmo et al (2023))
- Storms increase food price inflation, floods increase headline inflation (Parker (2018))
- Developing economies can experience elevated inflation for several years after a disaster. (Parker (2018))
- Evidence that international food price shocks spill over into domestic inflation. Peersman (2022)
- Evidence of non-linear impacts from heatwaves and higher temperatures, which may add to inflation volatility (Kotz et al. (2023)).

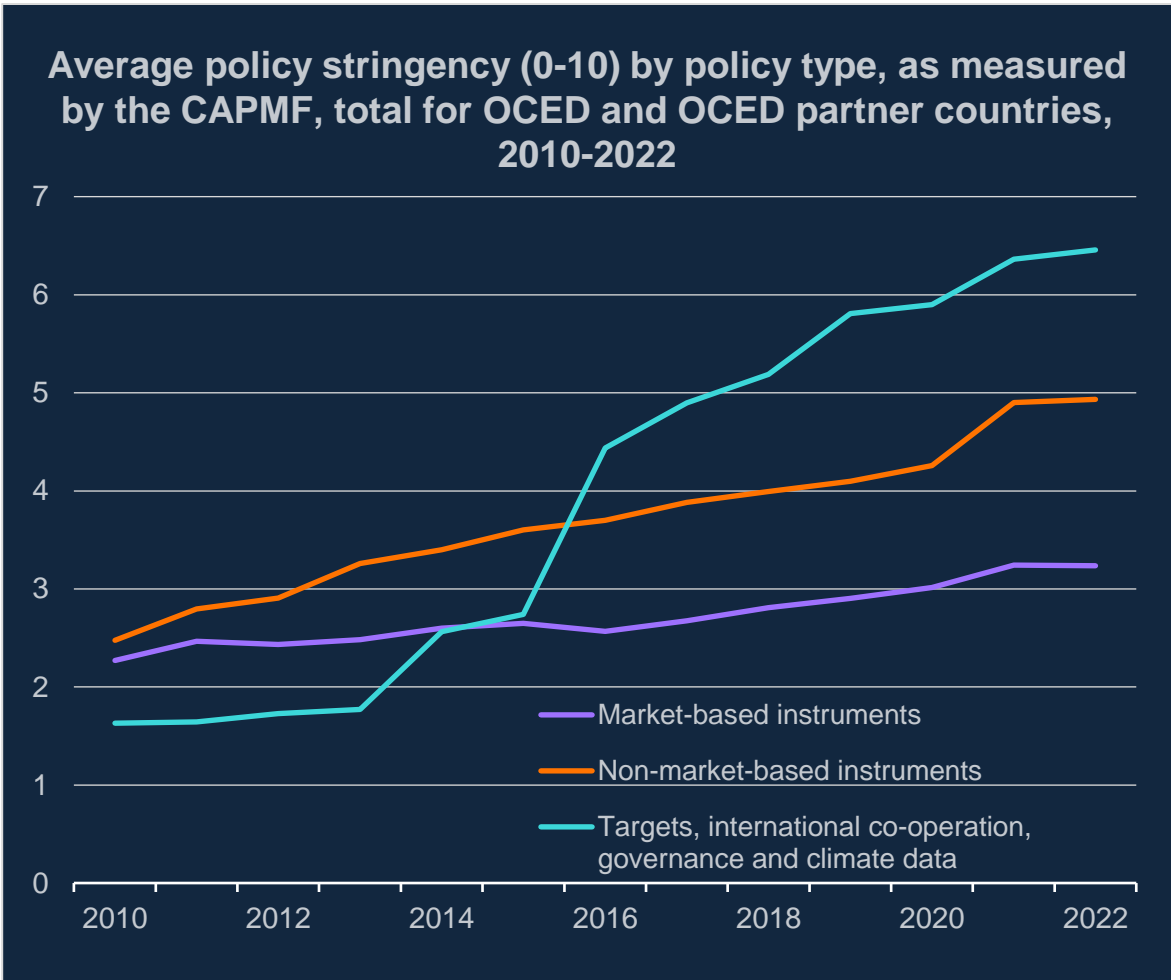
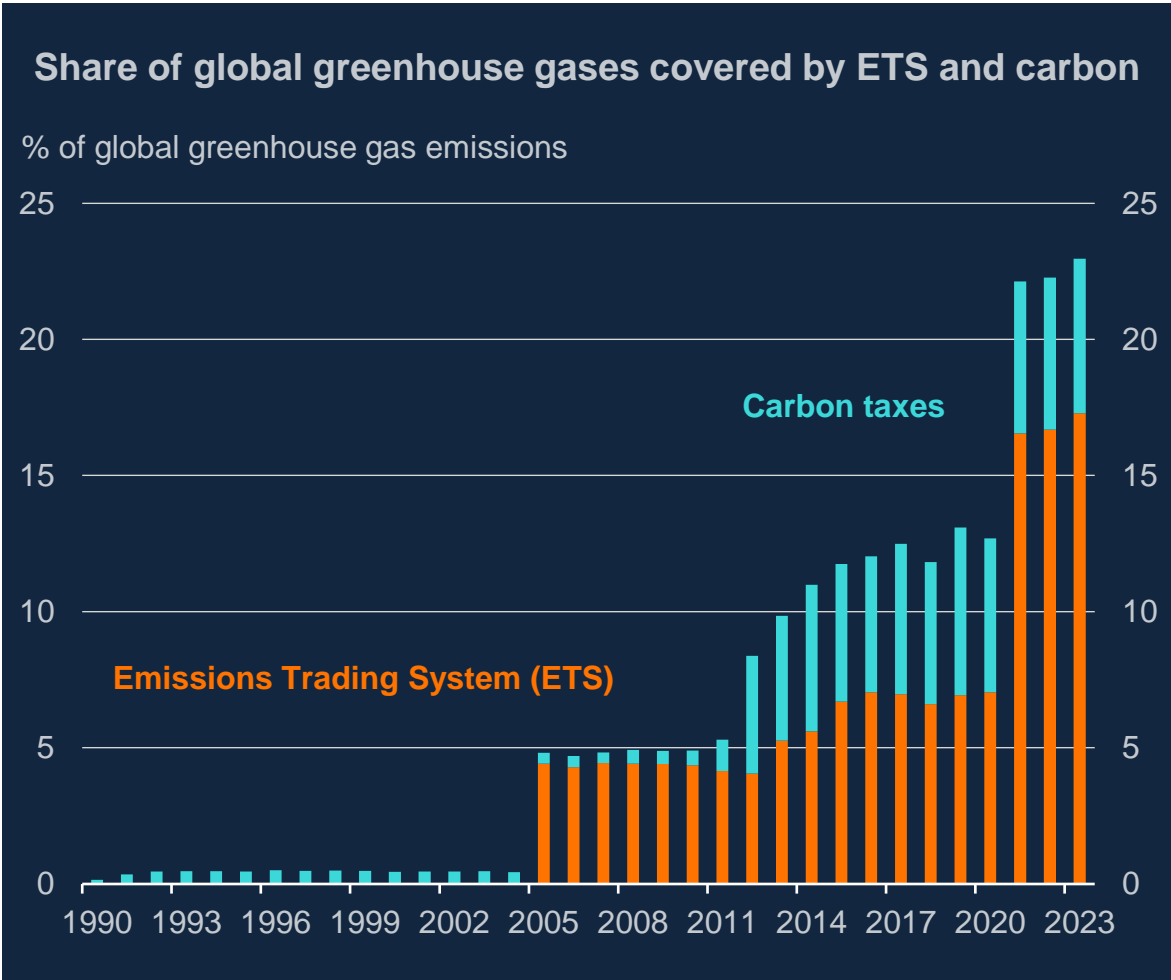


Transition impacts

Types of climate mitigation policies

- **Carbon pricing**
 - EU and UK Emissions Trading System
 - Canadian carbon tax (provincial and federal)
- **Government subsidies**
 - US Inflation Reduction Act
 - EU Green Deal Industrial Plan
- **Non-market-based regulatory instruments**
 - EU Fit for 55
 - UK Zero Emission Vehicle (ZEV) mandate
 - India's energy efficiency programme

Climate mitigation policies are increasing



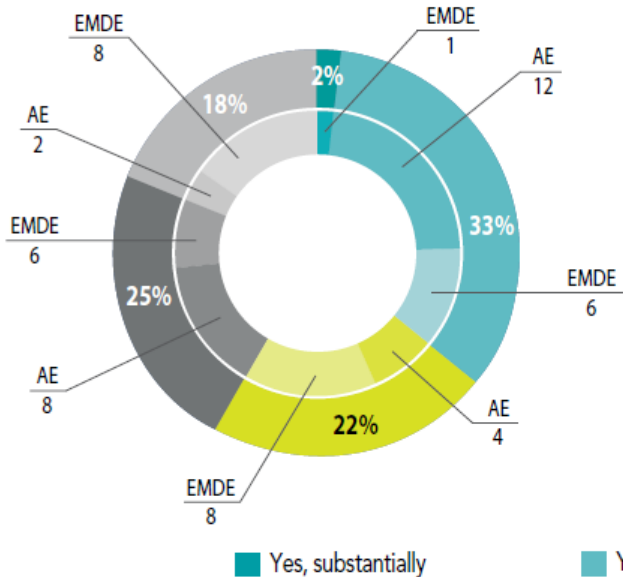
Source: World Bank (2023) and Bank calculations

Source: OECD Climate Action Monitor 2023

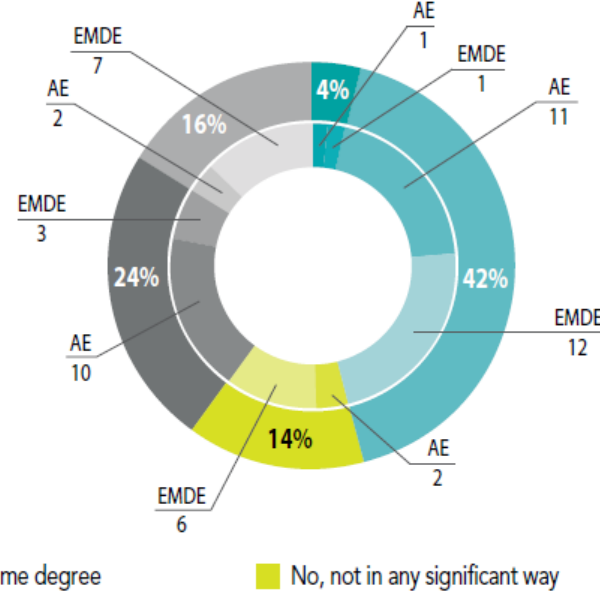
NGFS Workstream Monetary Policy Membership Survey

Chart 3 **Macroeconomic impacts of the net zero transition**

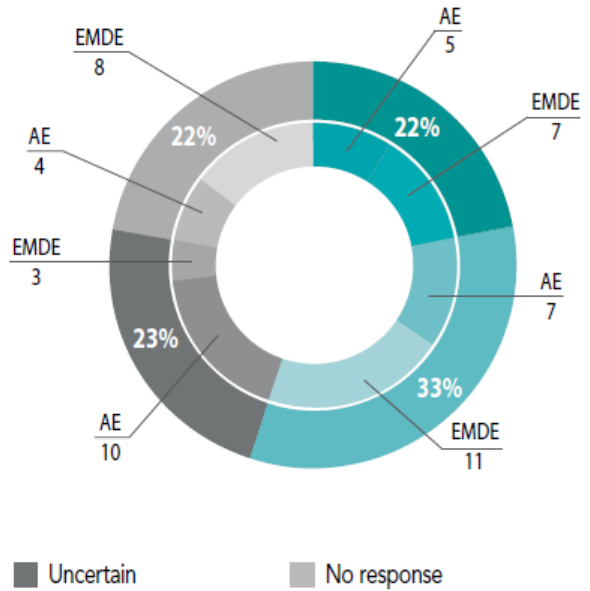
a) Has your macroeconomy been affected by the consequences of the low carbon/net zero transition over the past five years (including spillover impacts)?



b) How do you expect your macroeconomy to be affected by the consequences of the low carbon/net zero transition over the monetary policy horizon (including spillover impacts)?

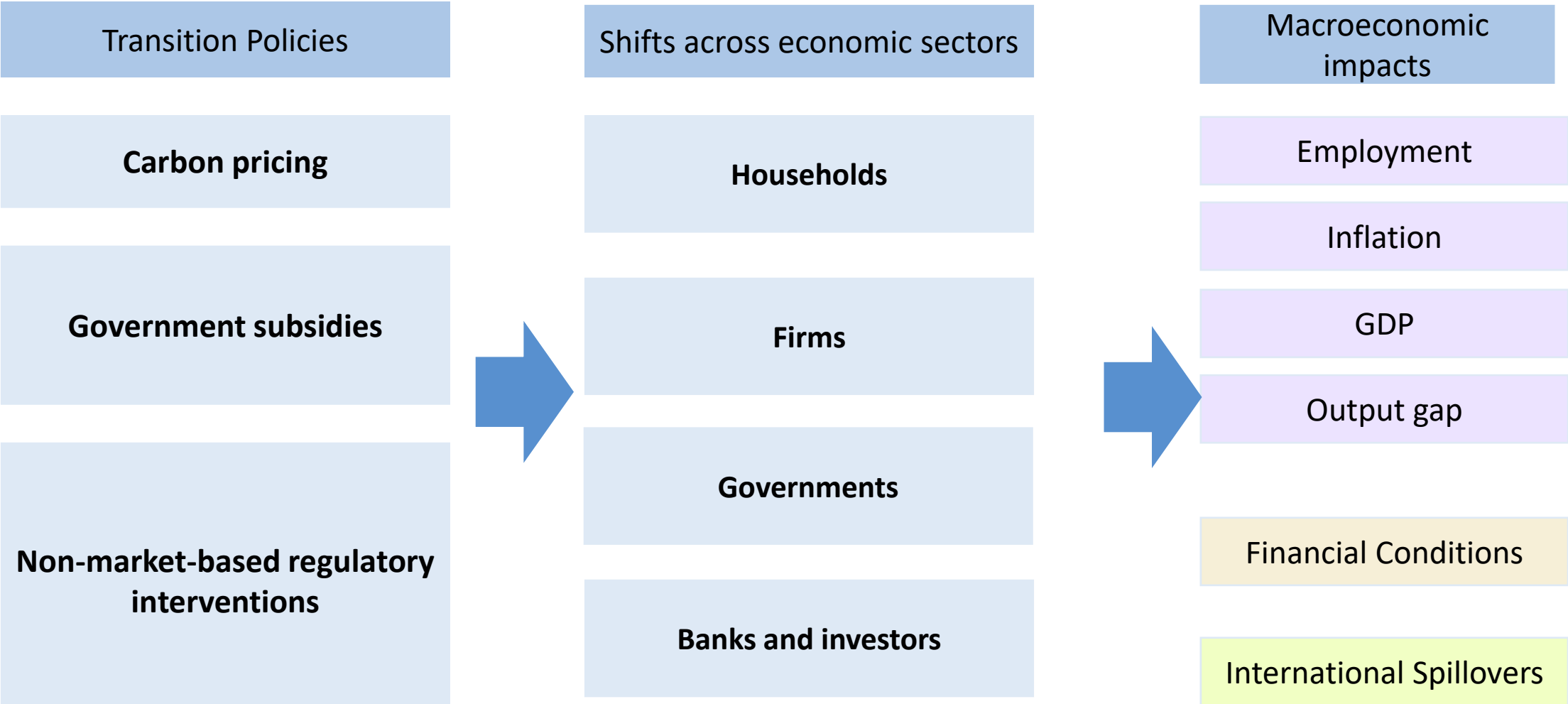


c) How do you expect your macroeconomy to be affected by the consequences of the low carbon/net zero transition over the medium-longer term (including spillover impacts)?



Note: Outer ring shows total replies to each question (as a percentage of all replies given). Inner ring shows breakdown of the replies by economy type (with the number of replies given for AEs and EMDEs).

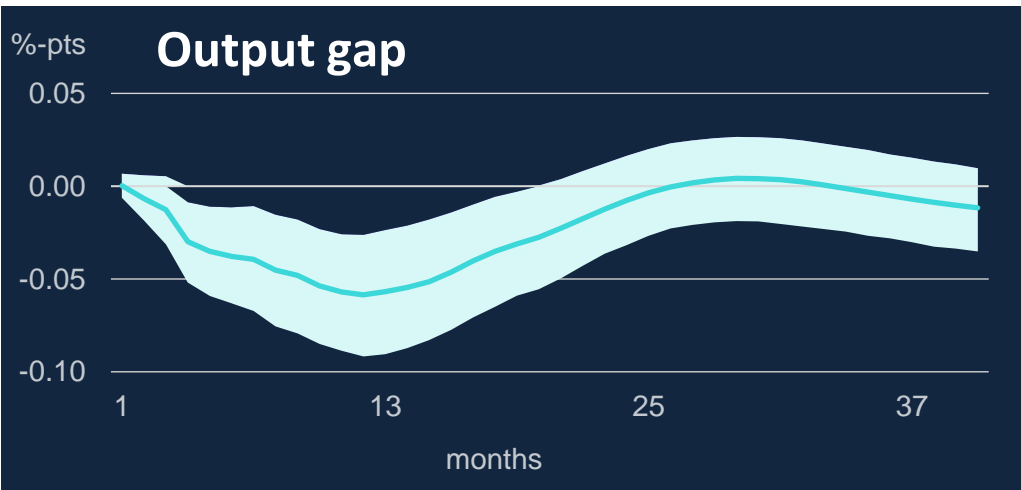
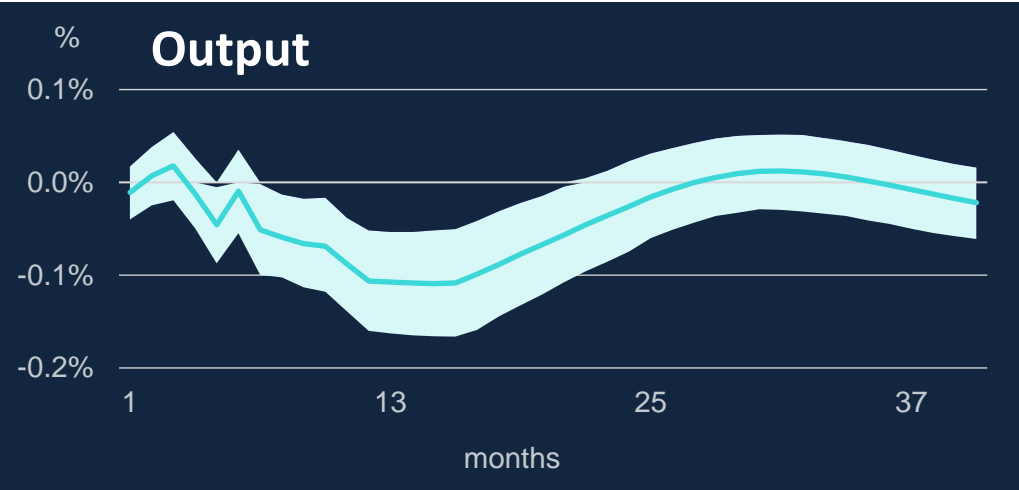
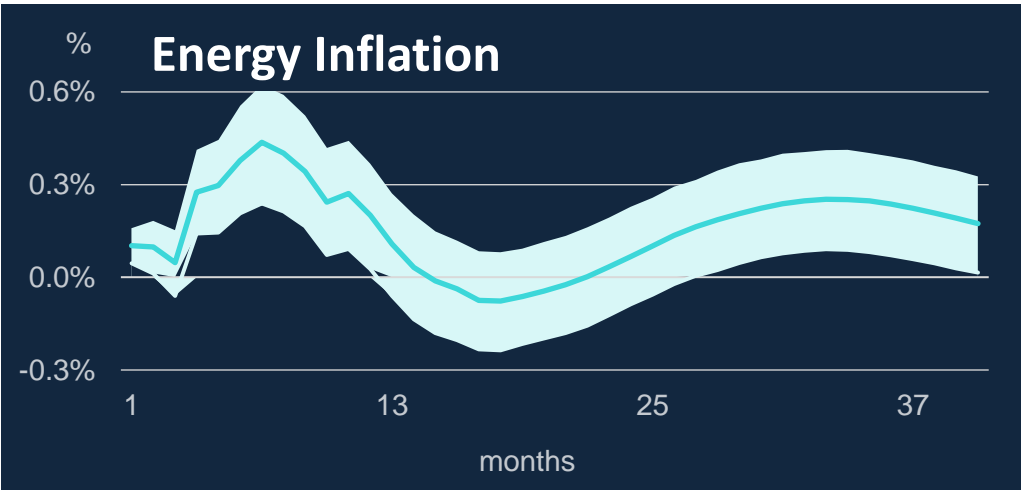
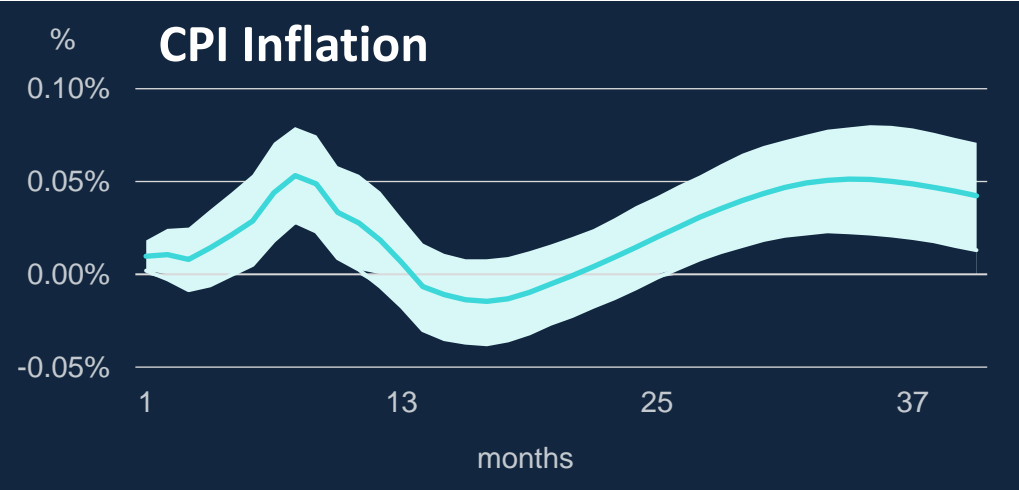
Propagation of effects from transition drivers to the macroeconomy



Two policy examples – carbon pricing and subsidies

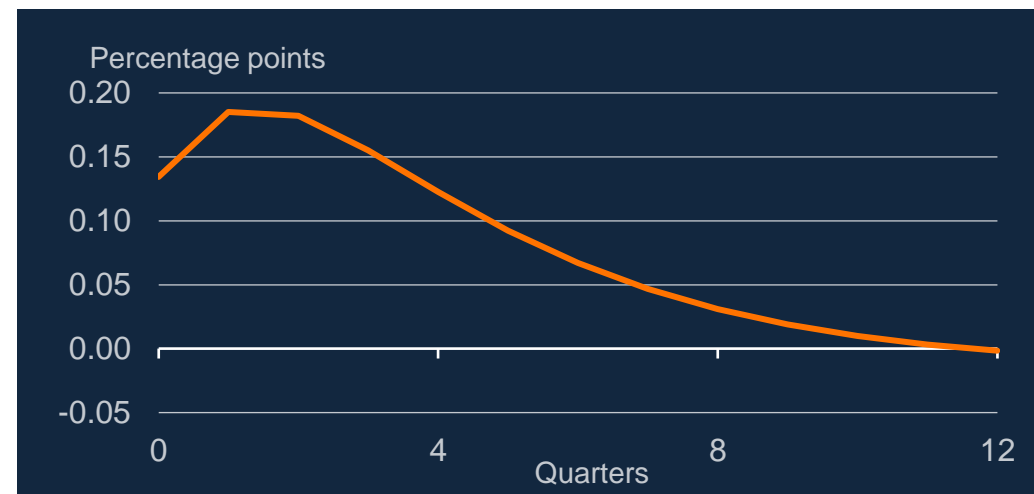
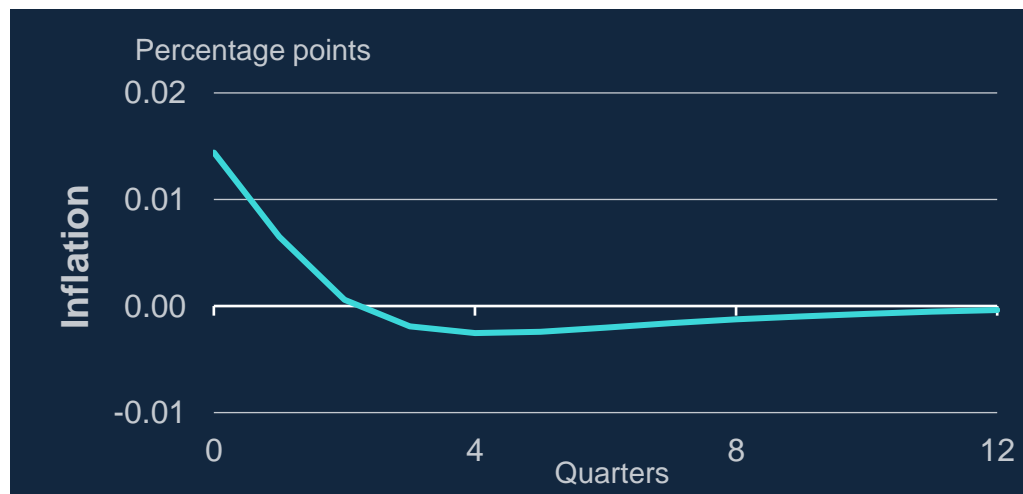
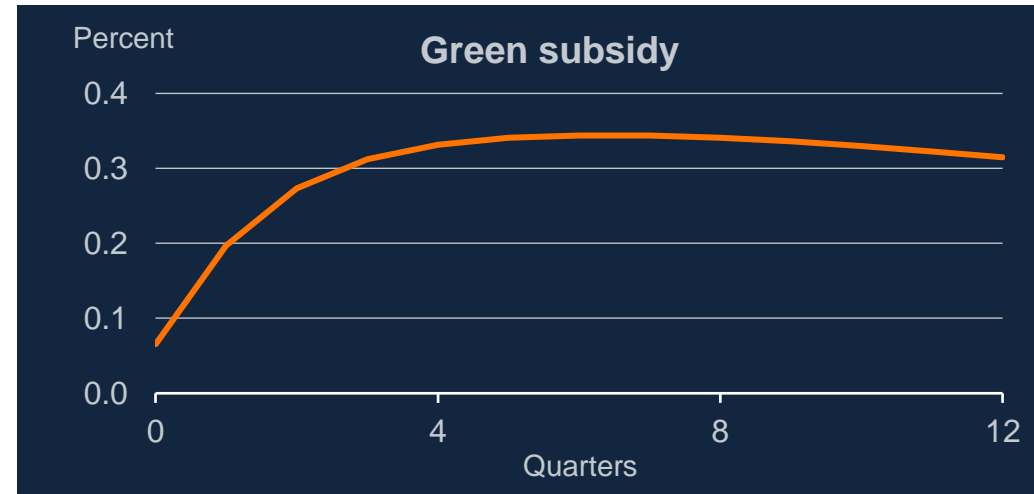
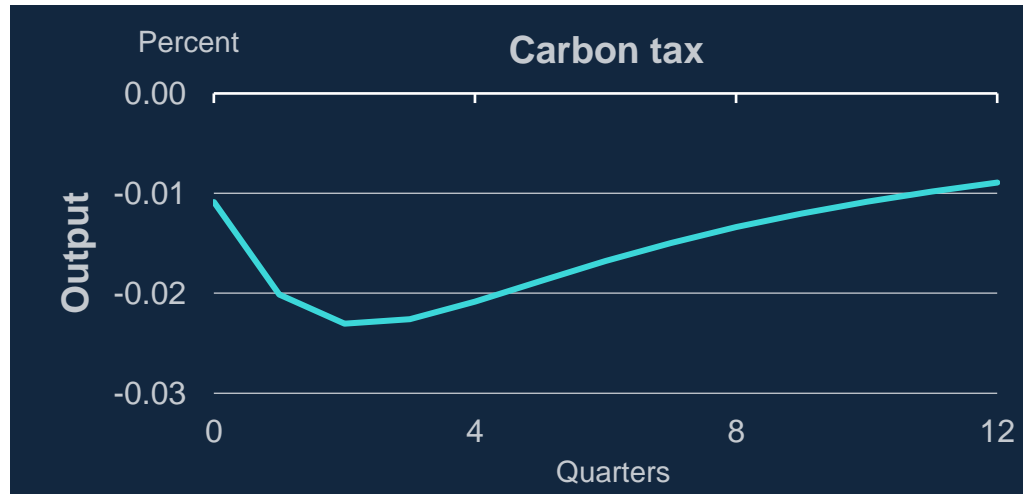
- Carbon pricing
 - Directly internalises the externality
 - Uses market forces to reduce emissions
 - Cost effective and efficient
 - Revenue can be recycled
- Subsidies
 - Costs less visible to economic agents → easier politically to implement?
 - Less efficient than carbon pricing
 - Need to be funded somehow → other taxes need to rise?

ETS carbon price shocks appear to be stagflationary for the UK



Source: Bank calculations

The effects of carbon taxes and subsidies on GDP and inflation



International Spillovers from overseas policies

Bank analysis uses a two-country, two-sector (green and emissions intensive) DSGE model to explore the international spillovers of a foreign carbon tax and green subsidy:

- Both carbon taxes and green subsidies result in a reallocation of resources from emission intensive sectors to green ones in the economy imposing the policy.
- While the country imposing the policy becomes greener, resources are reallocated towards more emission intensive sectors in the trading partner.
- Green capital flows are generated towards countries implementing the policy.
- Real exchange rate: Carbon tax abroad (depreciation) vs green subsidy abroad (appreciation)
- Overseas carbon tax = output down (eventually)/inflation up for the UK
- Overseas green subsidy = output up (eventually)/inflation down for the UK

What are the impacts of transition policies?

- The transition is likely to increase inflation and its volatility in the short term. The short-term impacts on output are more ambiguous.
- Carbon pricing and subsidies may have opposite impacts on inflation and output in the short-run, but their medium-term effects will largely depend on the policy design.
- The impact of higher green investment on inflation and output will depend on the interplay of supply and demand across various markets, including the extent of capital deepening or crowding out effects.
- Credible and predictable climate policy at the national level can reduce uncertainty and minimise any macroeconomic frictions associated with the transition.
- Spillovers from asymmetric policies to trade, capital flows and exchange rates are likely.



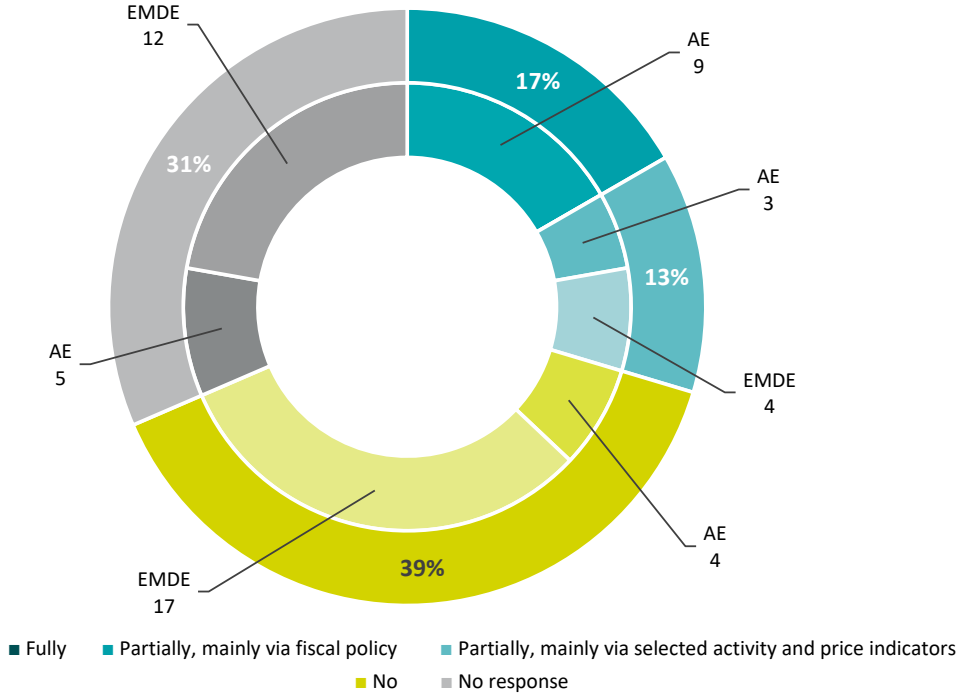
Macroeconomic modelling issues

What are the issues for central banks to resolve?

- Modelling toolkits may need to be enhanced.
- But several challenges:
 - Data quality and availability
 - Linking climate and macro models
 - Modelling linkages
 - Improving supply-side modelling

Embedding of climate considerations into forecast models to support monetary policy decision-making

To what extent has your central bank more formally and systematically embedded climate considerations into the forecast models that support your monetary policy committee's decisions?



Note: Outer ring shows total replies (as a percentage of all replies given). Inner ring shows breakdown of the replies by economy type (with the number of replies given for AEs and EMDEs).
Source: NGFS (2023)

Current state of modelling efforts

- No such thing as the perfect model, but we can use existing models where appropriate to help us make an assessment.
- Transition impacts
 - Conventional models can be used to explore impacts of different policy levers.
- Physical impacts
 - Requires integration of science and economics: challenging with multiple layers of uncertainty.
 - Integrated assessment models have been the dominant modelling tool.
- Overall – no “silver bullet” so we may need multiple models or alternative approaches.



Monetary policy implications

Macro-relevant physical impacts

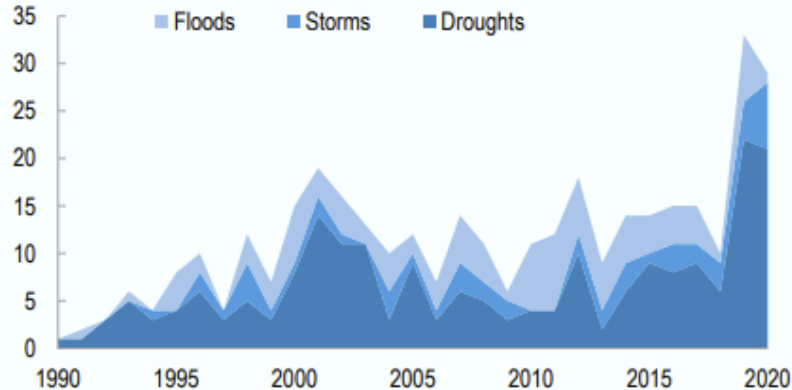
- Output lower in the short-run.
 - Impact on inflation will depend on how demand and supply affected
 - But likely that we can expect disruptions – via impacts on food production, goods trade and supply chains – to create short-term price pressures.
 - Spillovers play an important role given global interlinkages
- Can we just “look through” the direct effect of these shocks?

Climate shocks are increasing in frequency and potential impact

2.2. Descriptive Statistics

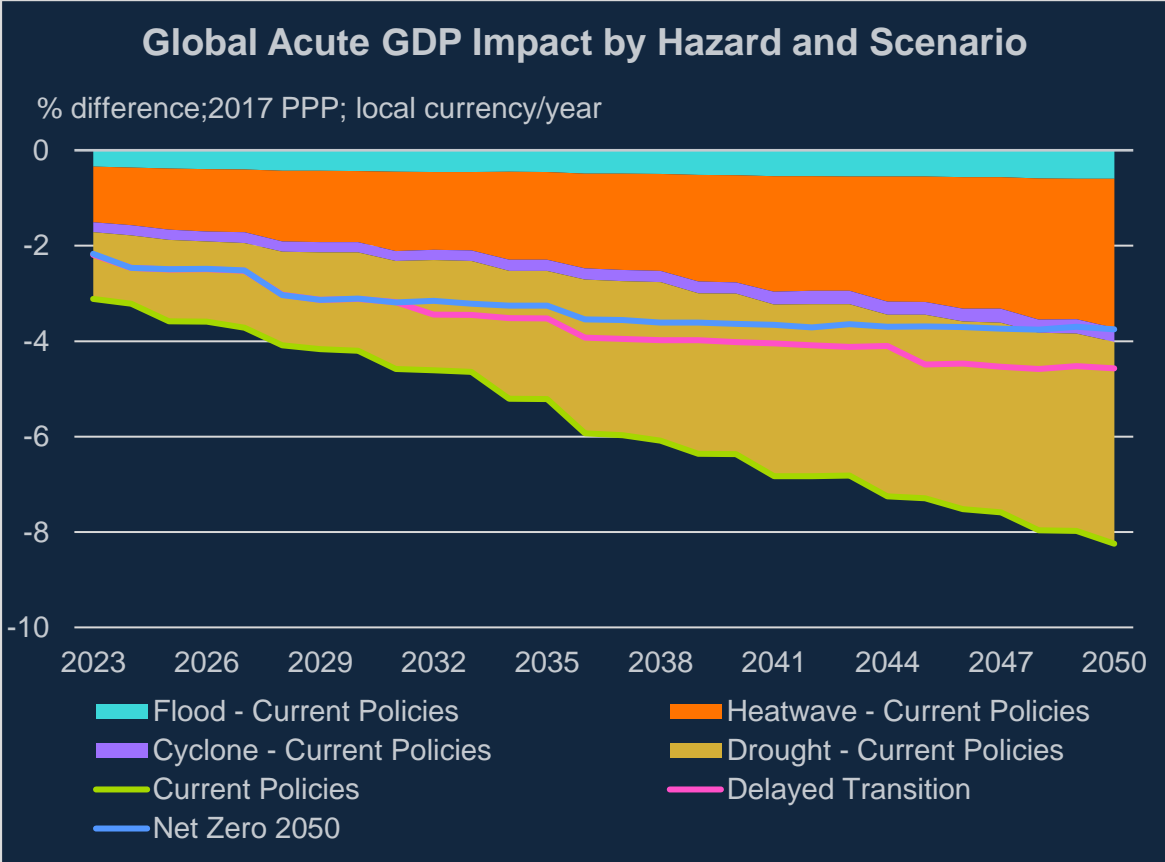
In this section, we briefly preview descriptive figures on disasters and macroeconomic indicators. Across the globe, extreme disasters are recorded every year. Droughts are more common than extreme storms and floods. The number of droughts has increased in recent years, topping the high drought incidence observed in the early 2000s (Figure 2).

Figure 2: Frequency of Extreme Natural Disasters (Global, Number of per year)



Sources: EM-DAT, the International Disaster Database; PDSI, National Oceanic and Atmospheric Administration (NOAA); and IMF staff calculations.

Source: *IMF (2023)*



Source: *NGFS Scenarios for Central Banks and Supervisors, November 2023*

Macro-relevant physical impacts

- Output lower in the short-run.
- Impact on inflation will depend on how demand and supply affected
- But likely that we can expect disruptions – via impacts on food production, goods trade and supply chains – to create short-term price pressures.
- Spillovers play an important role given global interlinkages

- Increased frequency and severity of shocks could make it harder for monetary policy to “look through”.

Macro-relevant transition impacts

- Carbon prices = supply shock, subsidies = demand shock.
- So far macroeconomic impacts of climate mitigation policies have been modest.
- But global carbon prices could rise substantially from current levels as governments seek to meet stated/legislated timelines for net zero.
- Range of potential paths that policy action could take (e.g. slow and orderly, delayed and fast)
- Regardless of path, monetary policy makers will have to understand and manage a prolonged relative price shift.

Impact on equilibrium interest rates

	Pushing up on R^*	Pushing down on R^*
Transition	Rise in green investment for decarbonising industries	Reduced investment in carbon intensive industries
	Increase in productivity growth from green innovation	Increased risk premium from higher macroeconomic volatility/uncertainty or riskiness of green investments
	Rise in government debt associated with green subsidies / public investments to decarbonise	Precautionary saving rises in response to increased risk
Physical	Rise in government debt associated with public investments in adaptations to physical impacts	The impact of climate shocks can destroy physical capital and reduce productivity
		Higher depreciation on capital from physical impacts

Key takeaways:

- Impact of climate shocks and mitigation policies on economies likely to increase
- Spillovers and cross-border impacts will have an important role to play
- Complex challenge bringing together climate science and macroeconomics
- Central bank toolkits are developing but can't let best be the enemy of the good.
- Not yet embedded effects into our main forecasting models – do we need to?
- NGFS Workstream Monetary Policy has been building an analytical framework to help central banks in these endeavours.
- The next phase of work will focus on how monetary policy makers might use it.
- Central banks have different mandates and responsibilities, but all central banks need to understand the shocks and forces shaping their economies.

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