C3A Annual Symposium
December 2-6, 2024
World Bank Paris

Research Segment

Session 11: Fiscal Policy in the Transition Period

Chaired by María José Martínez (Ministry of Finance, Dominican Republic) & Francisco Amsler (WB-C3A)

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Mainstreaming Climate Action into the Budget Policies of Developing Economies

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Introduction

This Policy Brief focuses on **mainstreaming climate action** into budget policies in low-income and lower-middle-income countries:

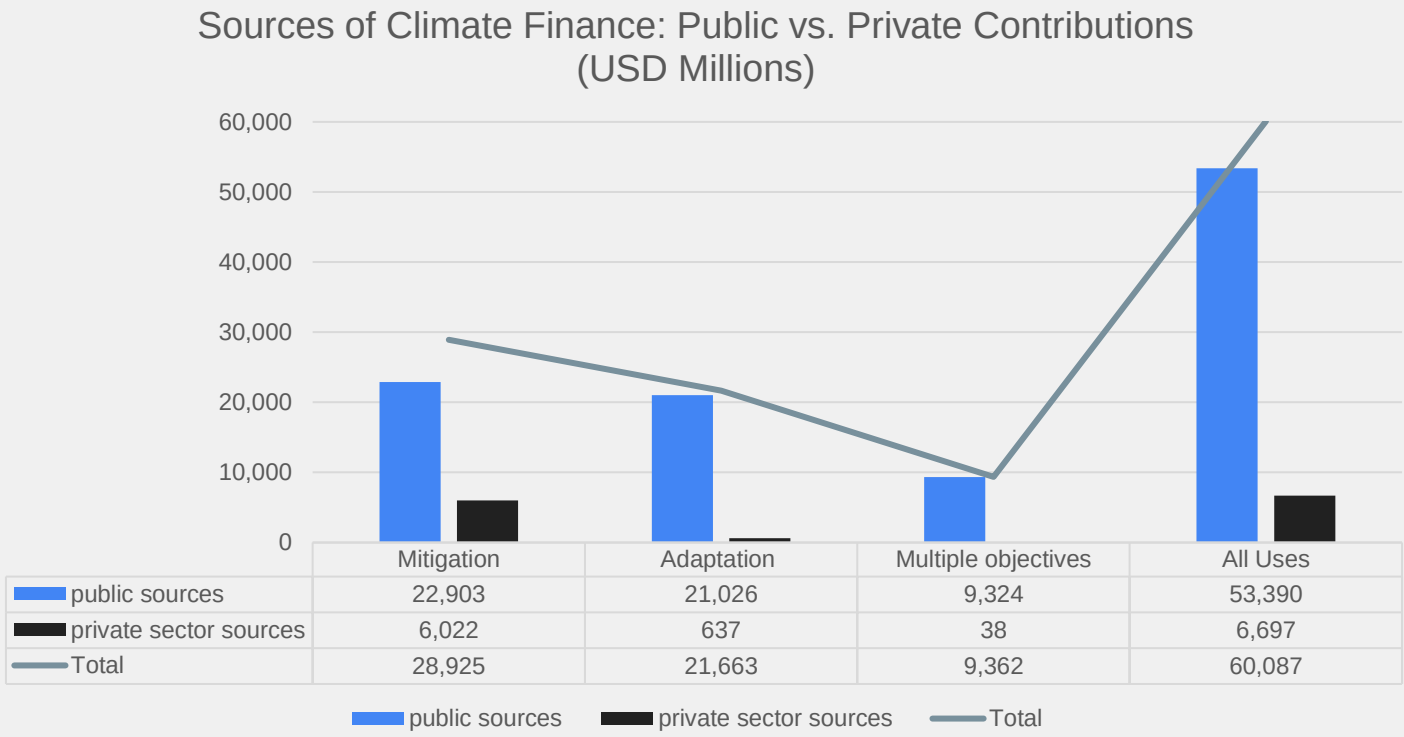
Key Points:

- **Mainstreaming** integrates climate action into national development strategies to **complement** other priorities and minimize trade offs.
- The government budget plays a key role, as most **climate finance in these economies is mobilized from public resources.**
- Climate action can be mainstreamed into budgets using Medium-Term Budget Frameworks (MTBFs).
- Spending on climate action and its financing must be compatible with medium-long term macro-fiscal sustainability.

Climate Action Landscape

- **Why Public Policy:** Mitigation and adaptation require major public policy interventions.
- Many adaptation investments are pure public goods. Mitigation has both private and (global) public good components.
- The high cost of private capital limits feasibility of private investment in mitigation in developing economies.
- **Dominance of public finance**: Government budgets are integral: public finance accounts for 79% of mitigation and 97% of adaptation finance in sub-Saharan Africa in 2021-2022.

Public and Private Climate Finance in Sub-Saharan Africa (2021-2022)



The data include finance from both external and domestic sources.
Source: Climate Policy Initiative Website

Principles for Mainstreaming Climate Action

- **Prioritizing climate action:** National development plans should incorporate climate priorities, guiding NDC commitments and shaping LTS and NAP strategies.
- **Ensuring macro-fiscal sustainability:** Climate investments must avoid unsustainable borrowing and contingent fiscal liabilities.
- **Integrating into budget processes**: Climate action should be incorporated into standard budget planning procedures.
- **Managing fiscal risks:** Fiscal policies must address climate-related risks through cost-effective and proactive strategies.

Ensuring Fiscal Sustainability for Climate Action: Medium Term Fiscal Framework (MTFF)

- **Fiscal sustainability:** MTFFs provide a framework to make realistic projections of aggregate budget resources consistent with fiscal sustainability over the medium to long term.

- **Maximizing fiscal resources for priority expenditures:** Fiscal space analysis can complement the MTFF by identifying the public resources available for climate action and other priorities within budgetary constraints.

- **Aligning climate commitments:** Nationally Determined Contributions (NDCs) must be realistically costed and consistent with available budget resource projections.

- **Creating fiscal space:** Options include implementing carbon taxes and/or reducing fuel subsidies.

Budget Expenditure Plans for Climate Action: LTS and NAP

- **Harmonizing budgets with public policy priorities:** MTBF combines the top down aggregate budget envelope with bottom up sector development plans.

- The LTS and NAP have similarities with sector development plans, but involve multiple sectors, and hence require cross-sector collaboration.

- LTS and NAP should identify and cost climate action priorities.

- **Sectoral implementation:** Line ministries should incorporate relevant climate action priorities from the LTS and NAP into their own sector development plans (e.g. agriculture, water).

Evaluation of Climate Action Proposals

Evaluation methodologies:

- Social Cost Benefit Analysis (CBA)
- Cost Effectiveness Analysis (CEA)
- Multi-criteria analysis (MCA)

Key Challenge: Uncertainty of long-term adaptation benefits due to (Knightian) uncertain future climate outcomes.

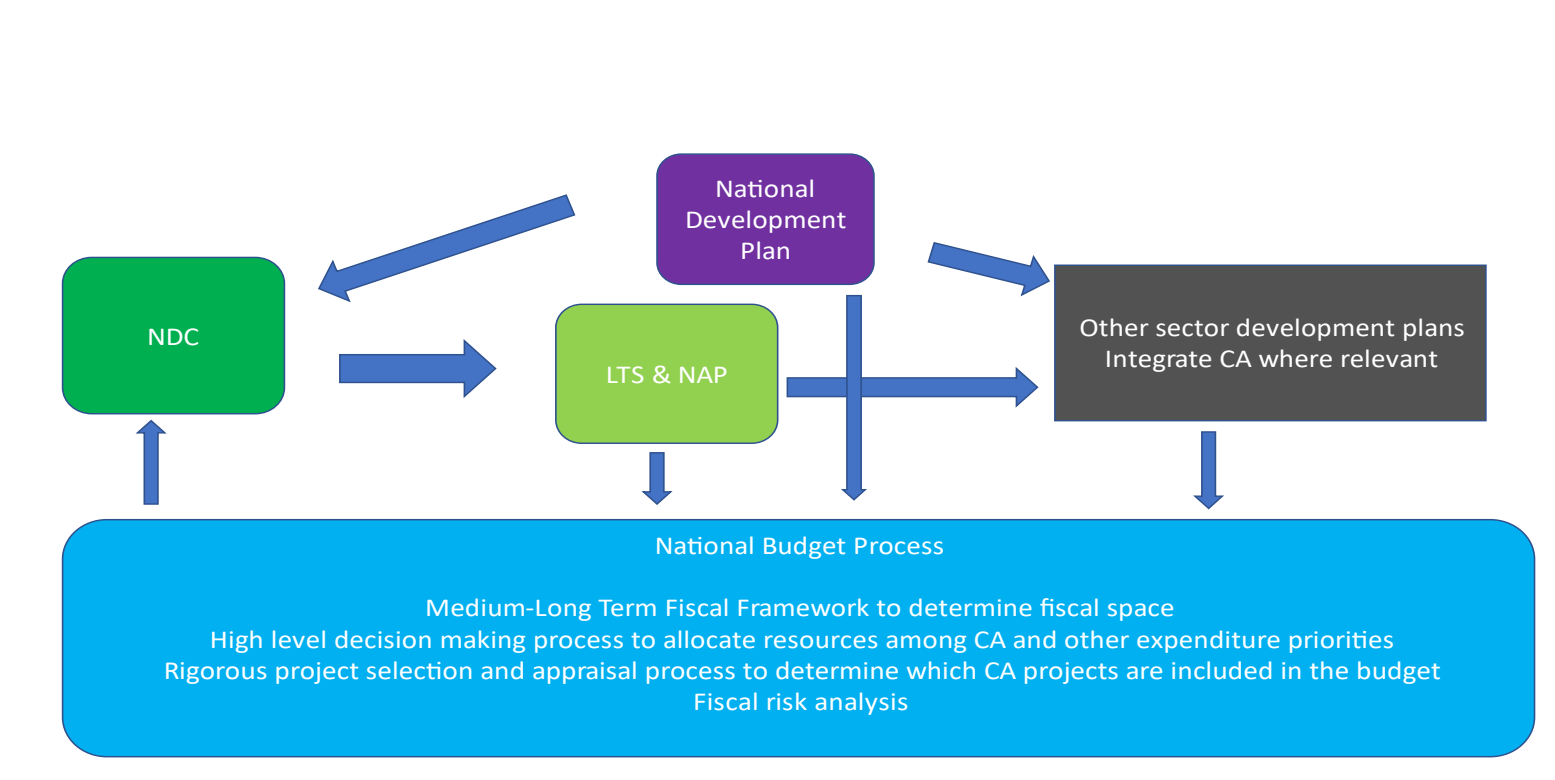
Strategic approaches to investment in the face of uncertainty:

- Focus on “no-regret” projects that deliver benefits under various outcomes.
- Incorporate flexibility and safety margins into project designs.

Determining Medium-term Expenditure Ceilings

- **Integrating priorities: MTBF c**ombine top-down fiscal projections from the MTFF with sectoral spending priorities.
- Requires allocating aggregate budget resources between priority sectors of the budget.
- **Sectoral allocations require high level** decision-making early in the budget process with strong political support.
- High-quality documents (e.g. LTS, NAP) are essential for policy based budgeting.

Key components for mainstreaming climate action into the MTBF



Managing Fiscal Risks of Climate Change

Transition Risks: Commitments to renewable energy producers could entail contingent fiscal liabilities.

Physical Risks: Costs from natural disasters.

Mitigation Strategies:

- Transition risks: necessary to fully understand and monitor explicit and implicit contingent fiscal liabilities.
- Adaptation investments to reduce physical risks where these are cost effective.
- Use sovereign insurance for climate disasters where adaptation is not cost effective; buffer funds for small scale frequent shocks; external insurance for large scale infrequent shocks.

Conclusions

Key Takeaways for Mainstreaming Climate Action into Budgets:

- **Central role of budgets:** Government budgets are pivotal for climate action in LICs and LMICs.
- **Framework for integration:** MTBFs offer a structured approach to embedding climate action in budget processes.
- Climate action must be consistent with macro-fiscal sustainability.
- **Strategic guidance:** Documents like LTS and NAP ensure practical prioritization and feasibility of climate initiatives.
- **Managing climate risks:** Fiscal risk management must account for the impacts of climate change.

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

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

SESSION 11: Fiscal policy in the transition

Maria José Martinez & Francisco Amsler

Friday 6 December, 4:00pm-5:30pm, Conference Room C

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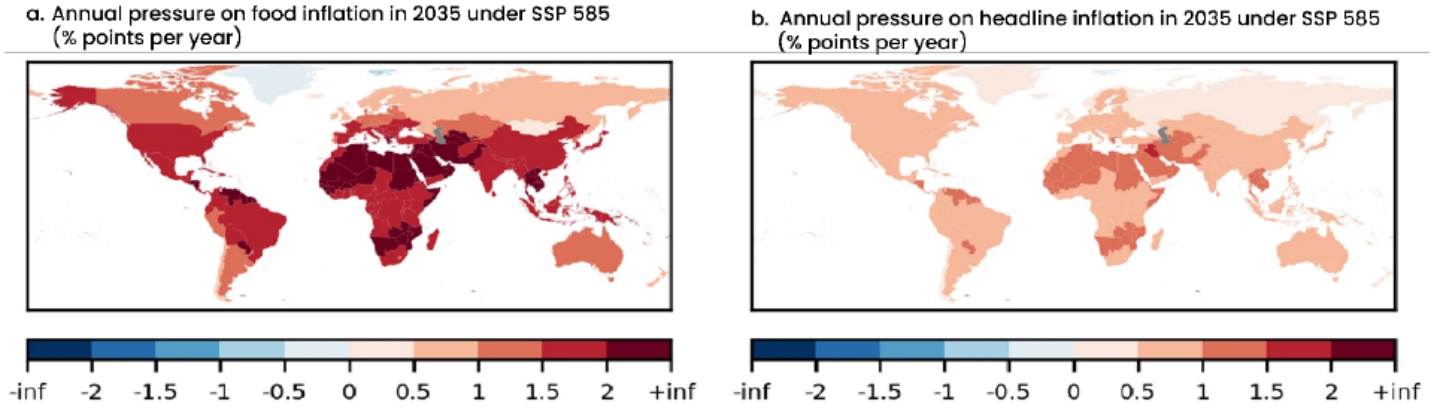
Inflationary risks in a hot and volatile world

Climate change

- Already generating short-term inflationary pressures due to negative supply side impacts
- Supply shocks likely to become more severe, frequent, and persistent as climate change intensifies
- By 2035, higher average temperatures could contribute up to 1.18 percentage points per year to headline inflation (Kotz et al., 2024)

Figure S1. Pressure on headline and food inflation rates due to higher average temperatures

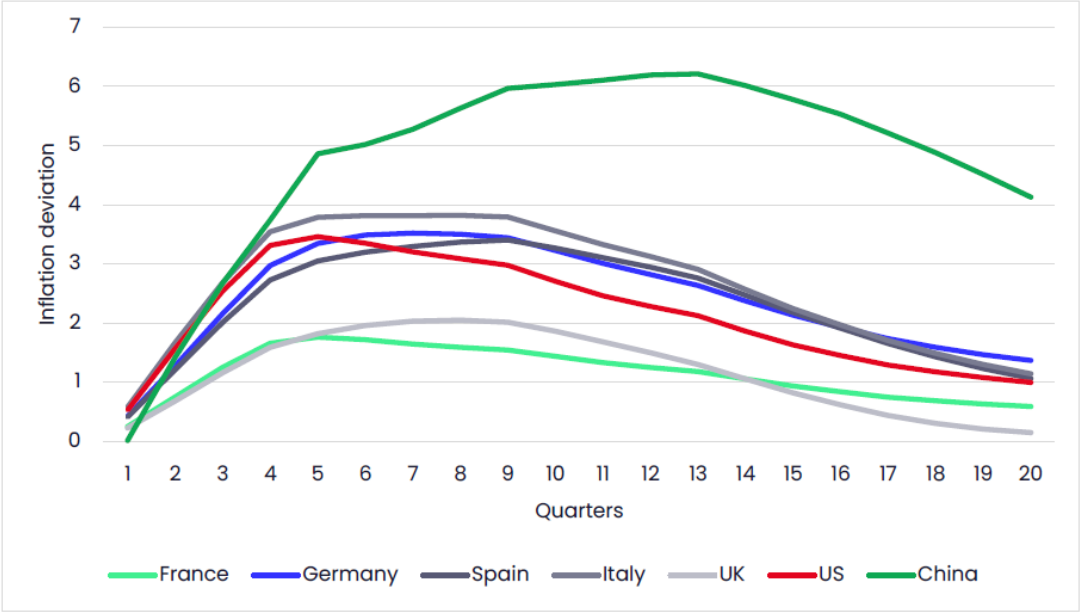


Note: SSP 585 is a high-emissions scenario. Source: Kotz et al. (2024)

Disorderly transitions

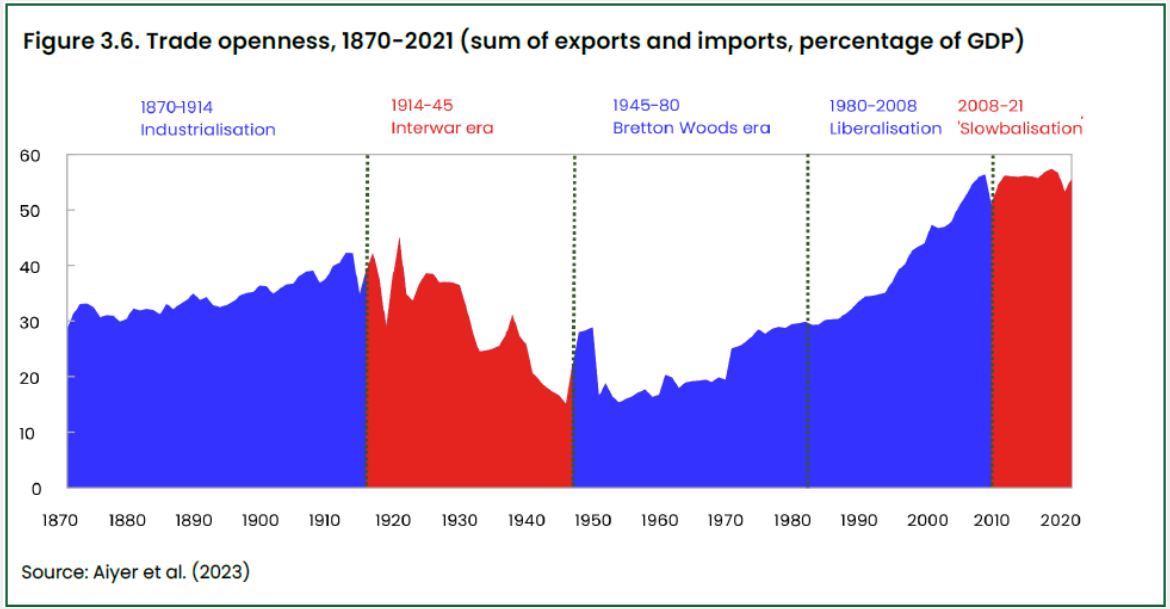
- In the long-term, given the volatility associated with climate change, a green transition is a necessary precondition for price stability
- But disorderly carbon taxation and sudden environmental regulations could represent another source of negative supply shock
- Modelling by Allen et al. (2023) 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)

Geoeconomic Fragmentation



- Rising geopolitical tensions and geoeconomic fragmentation may act as another source of negative supply shocks
- A 1-standard-deviation shock in geopolitical risk increases inflation by about 2 percentage points (Iacoviello et al., 2024)
- On the brink of a "Great Reversal" of the favourable supply side conditions that characterised the "Great Moderation"?

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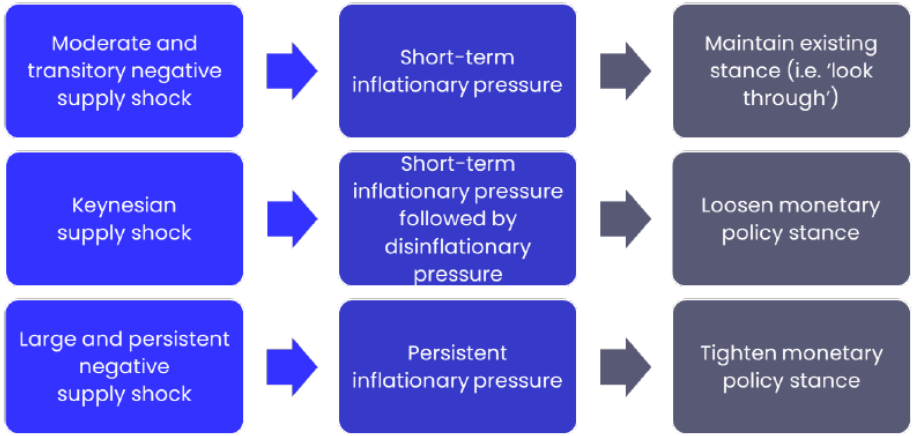
Challenges and trade-offs for monetary policy

How does monetary policy respond to supply shocks?

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



Source: Authors

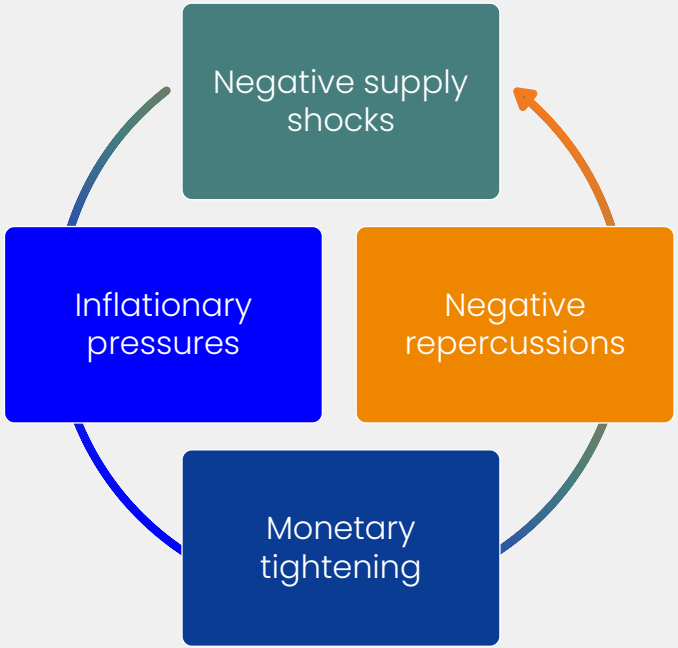
- Negative supply shocks are not new to flexible inflation-targeting regimes: if transitory, 'looking through' the shock is the standard response
- However, trade-offs resulting from supply shocks can produce disagreement on monetary policy committees between 'doves' v 'hawks' (Madeira et al., 2023) 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 "excessive"

The costs of "excessive" monetary tightening

Tightening monetary policy in response to negative supply shocks entails trade-offs related to:

- Economic output:
- Financial stability
- Fiscal space
- Income inequality
- Green transition

Negative effects on productive capacity increase likelihood of/exposure to future negative supply shocks, implying a trade-off between short/medium- and longer-term price stability



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An adaptive inflation targeting framework

Key features of flexible vs adaptive inflation targeting

Table 5.1. Key differences between flexible and adaptive inflation targeting

Framework	Target	Horizon	Toolkit
Flexible inflation targeting	Usually a point target (typically 2%), sometimes with small accommodation bands	Medium term, typically two years	Policy rate, collateral policy and post-Global Financial Crisis unconventional monetary policies, all focused on managing aggregate demand
Adaptive inflation targeting	(a) Point target of same 2% but with bigger accommodation bands (b) Targeting explicitly a range around 2% (c) A higher point target[1] (3%) with smaller accommodation bands	Same as FIT, with a longer horizon (three or more years)[2] when supply-side disruptions are pervasive	Same as FIT, with additional targeted instruments focused on supply-side resilience, macroprudential policy that adequately prices climate risk, and forecasting frameworks featuring climate and supply-side risks

Notes: 1. For a discussion of a higher target for different reasons, see Blanchard (2022). 2. For a discussion of longer periods for convergence for different reasons (actual inflation below the 2% target), see the discussions at the US Federal Reserve and European Central Bank on AIT (Clarida, 2020)
Source: Authors

- Builds on principles of 'flexible', 'average', and 'integrated' IT, while enabling central banks to adapt their approach when inflation is driven primarily by adverse supply conditions.
- Prevents excessive tightening of monetary policy in response to negative supply shocks, balancing short/medium-term price stability and longer-term macroeconomic stability
- Provides fiscal policymakers with more room to take a more active stance in preventing and mitigating negative supply shocks with strategic investment, price caps, subsidies, etc.

Concluding remarks

- 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 applicable

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

- Because IT regime entails using communication, guidance with credibility.: the best is to (1) discuss challenges now in coordinated policy circles for central banks (when inflation and expectations are relatively anchored), (2) 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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Report available at: The case for adaptive inflation targeting: monetary policy in a hot and volatile world - CETEx

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Discussion and Q&A

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Adaptation and Mitigation Options to the Economy-wide Effects of Climate Change in Uganda

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1. Introduction

Background

Although Uganda's emissions are relatively low compared to industrialized economies;

—However, the country is among the most vulnerable to extreme climate change events like floods and droughts.

—The effects of these events have immediate impacts on economic growth given that;

- the economy's agriculture is rain-fed
- and contributes about a quarter of economic activity (GDP) and employs more than half of the population.

Research Questions

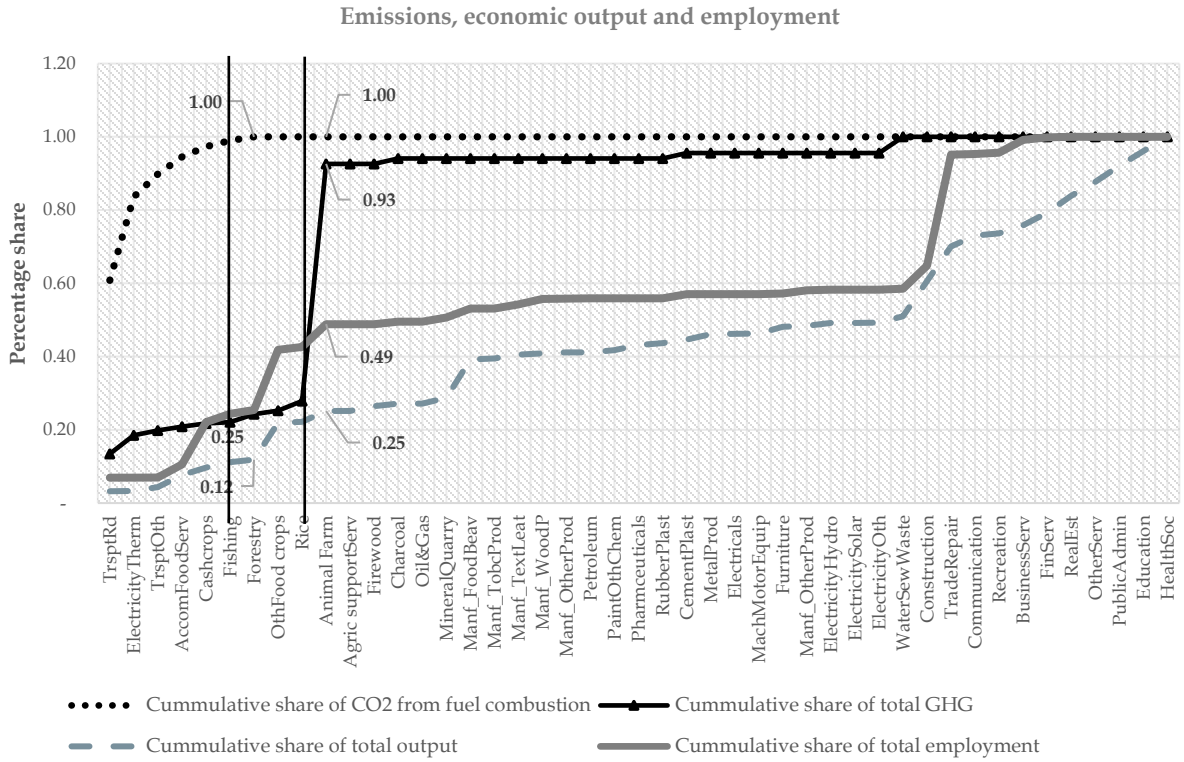
i. What are the economy-wide impacts of climate change related hazards like floods on the Ugandan economy?

ii. Using the damage function, what is the contribution of climate-resilient infrastructure in reducing the damaging effects of the adverse climate change events like floods?

iii. How effective is carbon tax as a mitigation of climate change in terms of emission reduction? Are there feedback effects of such policies?

2. Background

GHG Emissions by sector in comparison to economic output and employment

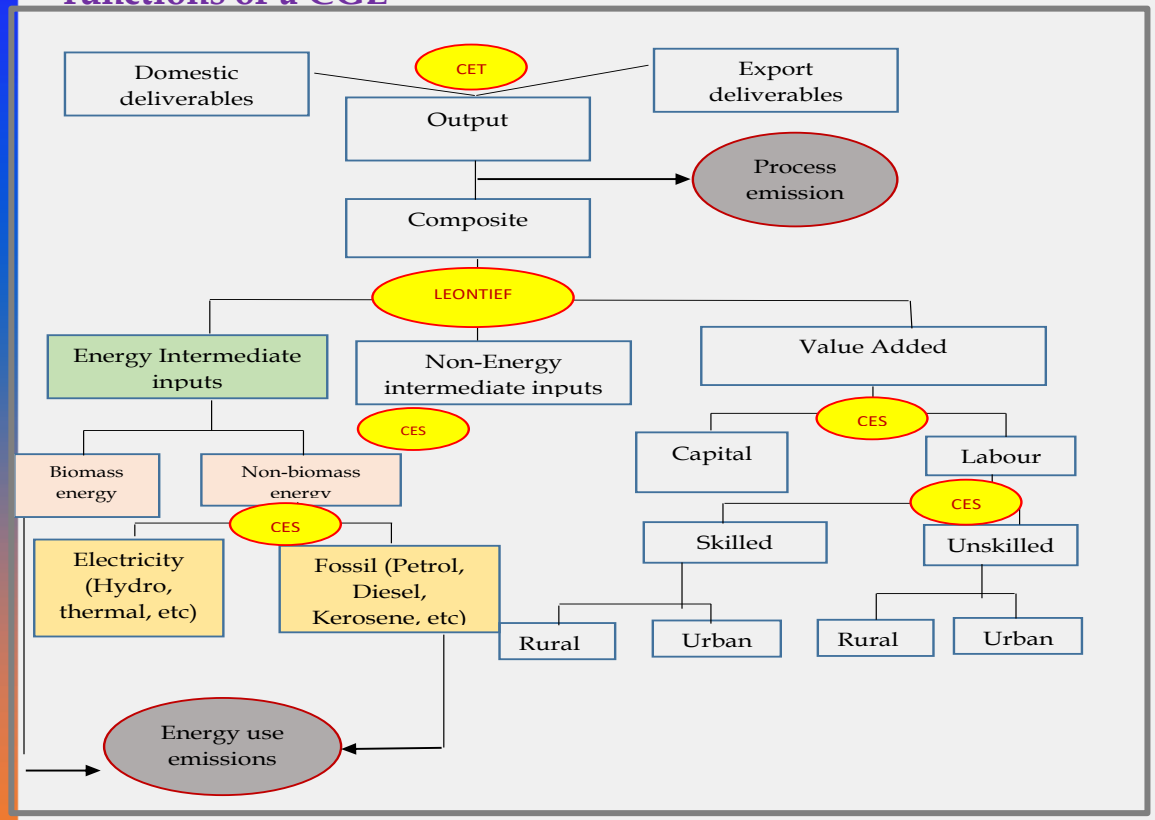


Background emission stock analysis

- Emissions in Uganda are largely derived from activities that contribute 1/4 of the national output.
  - These include transport, thermal electricity, hotel and accommodation, cash crops, fishing and forestry.
  - These account for 93% of Total GHG
  - Account for 25% of economic output
  - Employ about ½ of the population
- Sectors engaged in the combustion of fossil fuel as a source of energy;
  - Account for only 12% of economic output
  - 1/4 (25%) of total GHG
- At the national level, sectors responsible for 3/4 of economic output do not have a significant contribution to the accumulation of emissions in Uganda.

3. Method

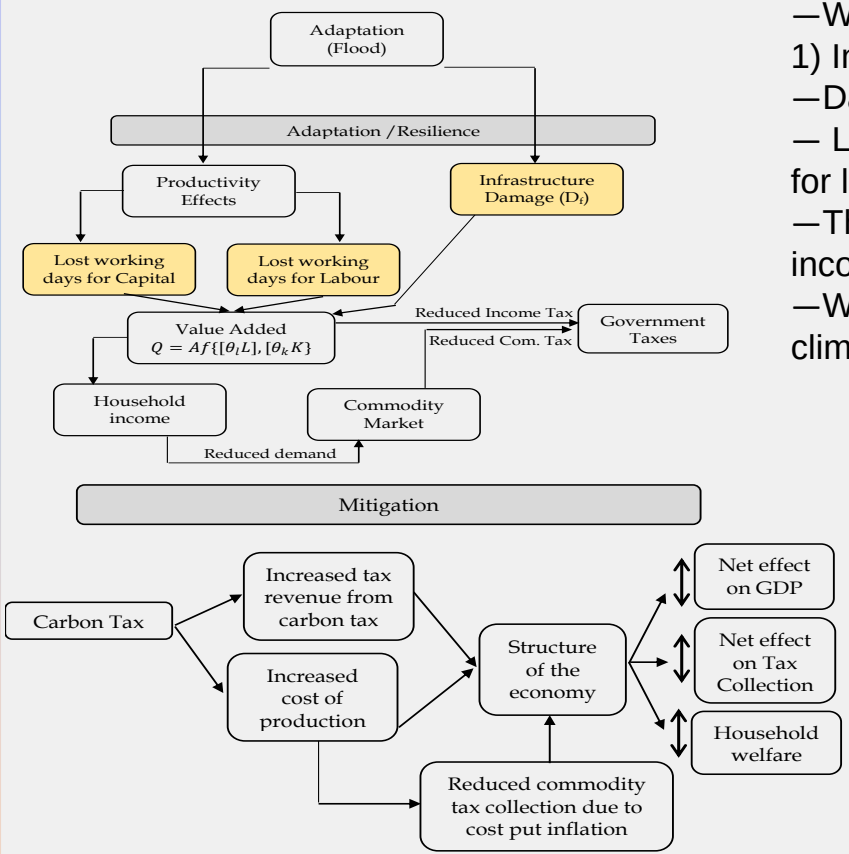
1. Nesting of climate variables in the production and supply functions of a CGE



- ✓ We used the Computable General Equilibrium (CGE) model to assess the impact channels of climate change-related hazards like floods.
- ✓ The blocks of this model were developed following Sadoulet and de Janvry (1995).
- ✓ The diagram shows the nesting of climate variables in the production and supply functions of a CGE
- ✓ We customise the standard CGE model to incorporate Greenhouse Gas Emissions (carbon dioxide equivalent) from the intermediate use of energy goods.

3. Method … cont

2. Climate Change - Adaptation



Conceptual - Adaptation

—We hypothesize two transmission channels 1) Infrastructure damage and, 2) Productivity slowdown.

—Damages to the infrastructure reduce productive capital stock.

— Lost working hours due to extreme weather reduces productivity for labour and capital.

—This leads to a contraction in value-added, household factor incomes, and demand. Consequently, tax collections are reduced.

—We hypothesise that adaptation reduces the adverse effects of climate events on the economy.

Conceptual - Mitigation

—We introduce a carbon tax which increases production costs and generates some additional tax revenue.

—The effects (tax, growth and welfare) depend on the structure of the economy.

—E.g. If an economy's demand is price inelastic, the tax would be inflationary thus increasing govt revenues and reducing real wages & real govt incomes.

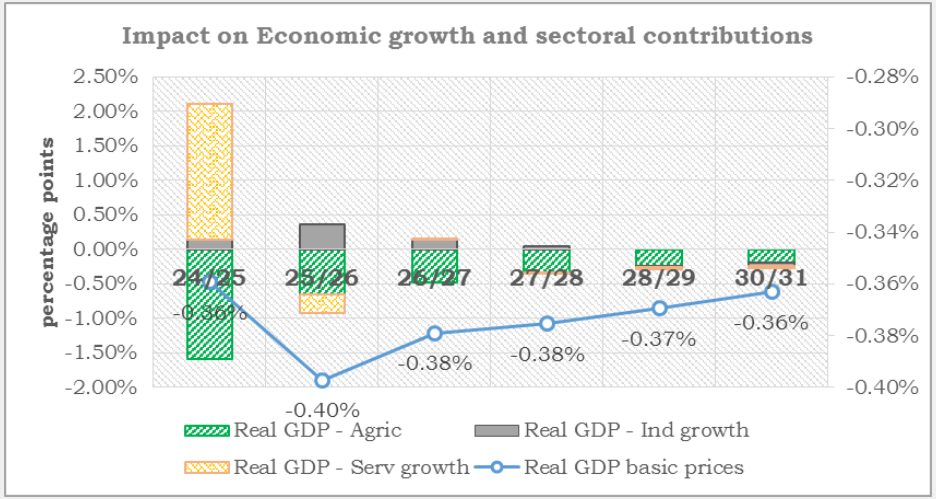
—The impact on GDP would depend on how the carbon tax receipts are used by govt.

4. Method – Simulation Design

	Climate change hazard and government response	Simulation description
	Adaptation scenario	
No.1	Flood	4 weeks of lost time for labour and capital in the agriculture sector 0.5 percent damage to the infrastructure for all sectors of the economy
No. 2	Adaptation measure	Increase the economy's resilience to climate change effects by 20 percent
	Mitigation scenario	
No. 3	Mitigation measure	Increase the carbon tax by a half-fold and observe the effect on the carbon emissions and costs to the economy

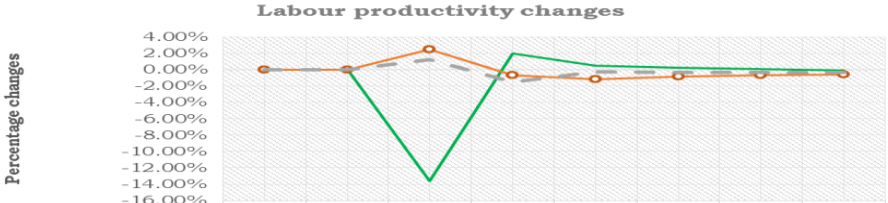
5. Results – Economic impacts

1. Economic growth response to floods and adaptation



- ✓ Due to reduced activity and growth in agriculture, factors of production move to the service and industry sector thus increasing their respective outputs in the initial year.
- ✓ The increase in the service sector output is short-lived as the sector faces a reduction in economic growth in the second period thus forcing a reduction in economic growth further by 0.4 percentage points in FY 2025/26.
- ✓ For the rest of the years, the impact on service and industry subsides as that on agriculture declines slowly in the medium term; thus keeping economic growth below the baseline scenario as the economy recovers in the medium term.

2. Labour productivity



	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
Impact - Agriculture	0.00%	0.00%	-13.63%	2.00%	0.49%	0.27%	0.05%	-0.08%
Impact - Industry	0.00%	0.00%	2.46%	-0.64%	-1.16%	-0.86%	-0.70%	-0.59%
Impact - Service	0.00%	0.00%	1.19%	-1.47%	-0.27%	-0.38%	-0.34%	-0.32%

Analysis of impact on productivity

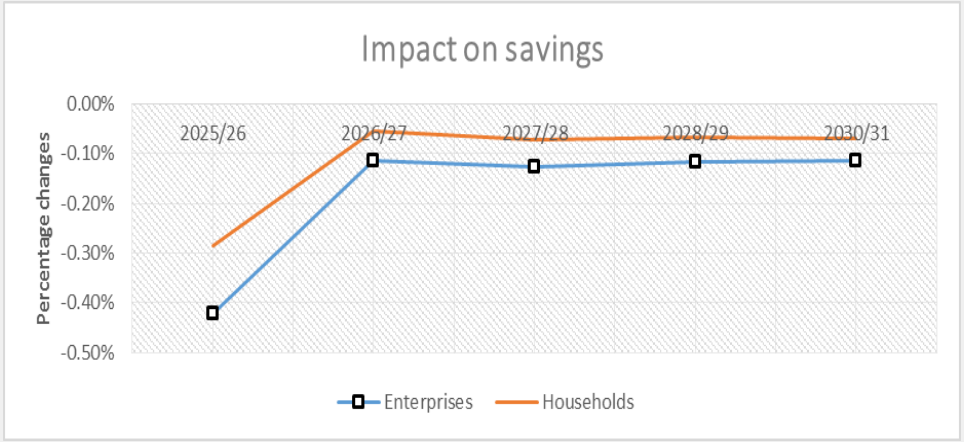
—Floods destroy the infrastructure and creat redundancy of factors hence deteriorating labour productivity.

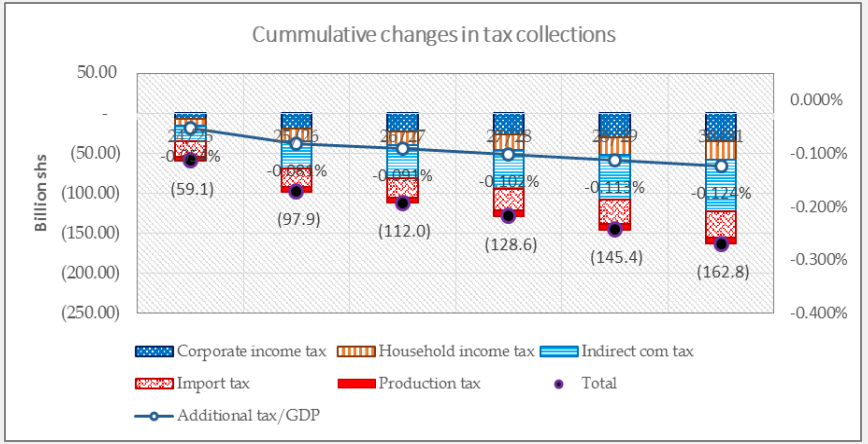
—Productivity of agriculture deteriorates to a tune of 13.6 percent; however, productivity for industry and service improve due to reduced factor prices and thereafter deteriorates in the medium term as that for agriculture recovers back to the steady state.

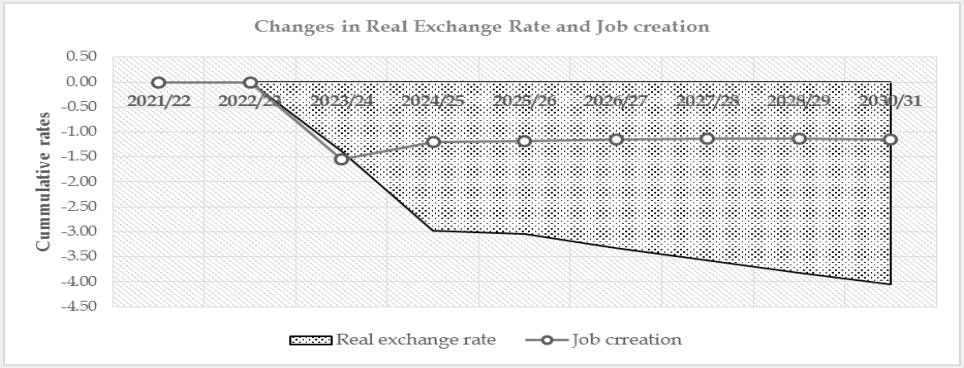
—Although productivity recovers in the medium term, it should be noted it remains below the baseline scenario in the medium term.

5. Results – Economic impacts

3. Impact on savings, real exchange rate, and tax collections



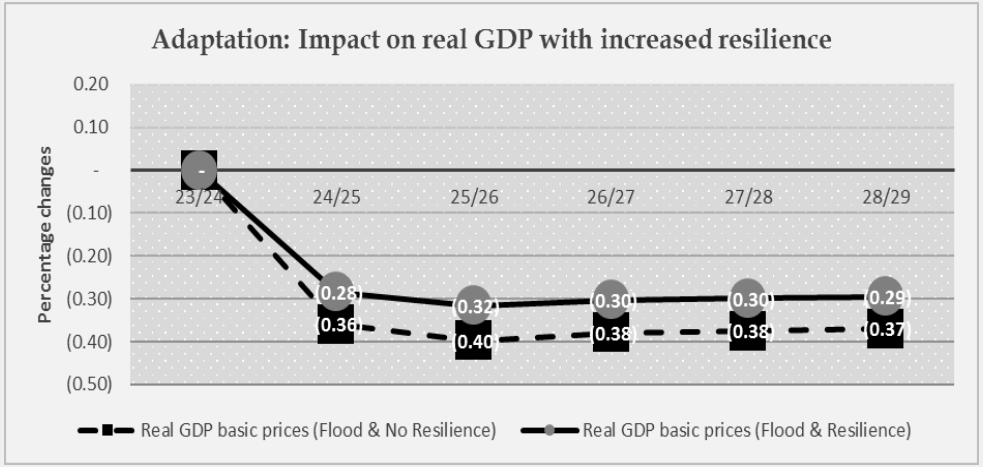




- ✓ An annual average of four weeks flood in Uganda would reduce tax collections by about UGX 59 billion in the first year (FY 2024/25) which would accumulate to UGX 163 billion by FY 2030/31.
- ✓ The main affected tax heads are indirect commodity tax, income taxes and import duties.
- ✓ Tax damaging effects of floods confirms the link between adverse climate change weather events and fiscal policy outcome.

6. Results – Impacts of Adaptation

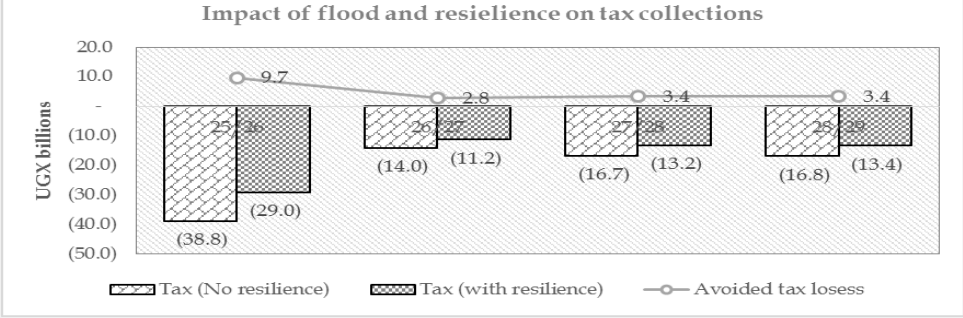
1. Economic growth response to floods and adaptation



Analysis of impact on growth

- floods constrain economic growth through their effects on labour and capital productivity in agriculture and also the damages made to the productive infrastructure.
- Economic growth effect is persistent for some periods in the outlook mainly because the damage on infrastructure drags capital stock below the baseline for longer periods if rehabilitation of the lost capital is not implemented.
- However, when government adopts measures that improve the economy's resilience by 20 percent; the loss in economic growth is reduced to about 0.3 percentage points annually.

2. Tax collections response to floods and adaptation

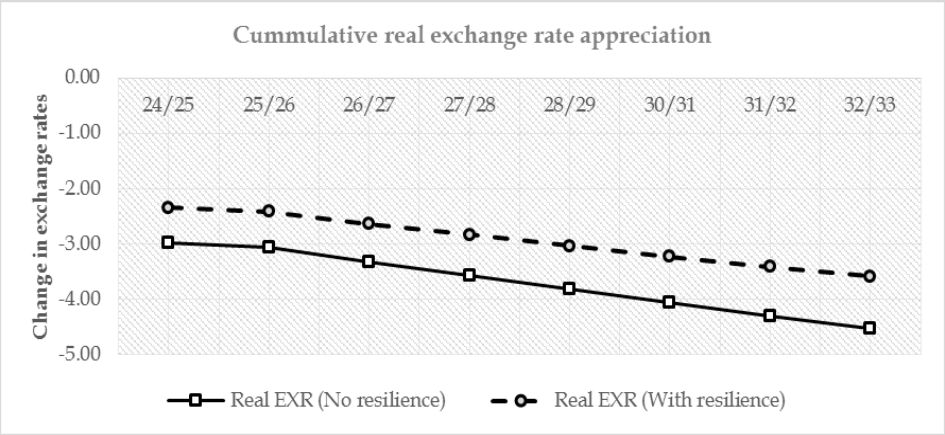


Analysis of impact on tax collections

- Direct effects of floods on agriculture and indirect effects on other sectors of the economy reducing tax collections by the government.
- improving the economic resilience of the economy would reduce tax loses by UGX 9.7 billion in the first period and an average of UGX 3.2 billion for the rest of the periods in the medium term.

6. Results – Impacts of Adaptation

3. Export competitiveness and job creation response to floods and adaptation



Analysis of impact on competitiveness

—We use the adjustments of the posterior real exchange rate as a proxy for the competitiveness of Uganda's exports

—flood shock cumulatively appreciates the real exchange rate to a tune of 4.5 percentage points between FY 2024/25 and FY 2032/33. This has a reducing effect on Uganda's exports as they become more expensive to the international markets.

—a 20 percent improvement in economic resilience, would reduce the appreciation effect from an accumulation of 4.5 percent to 3.6 percent

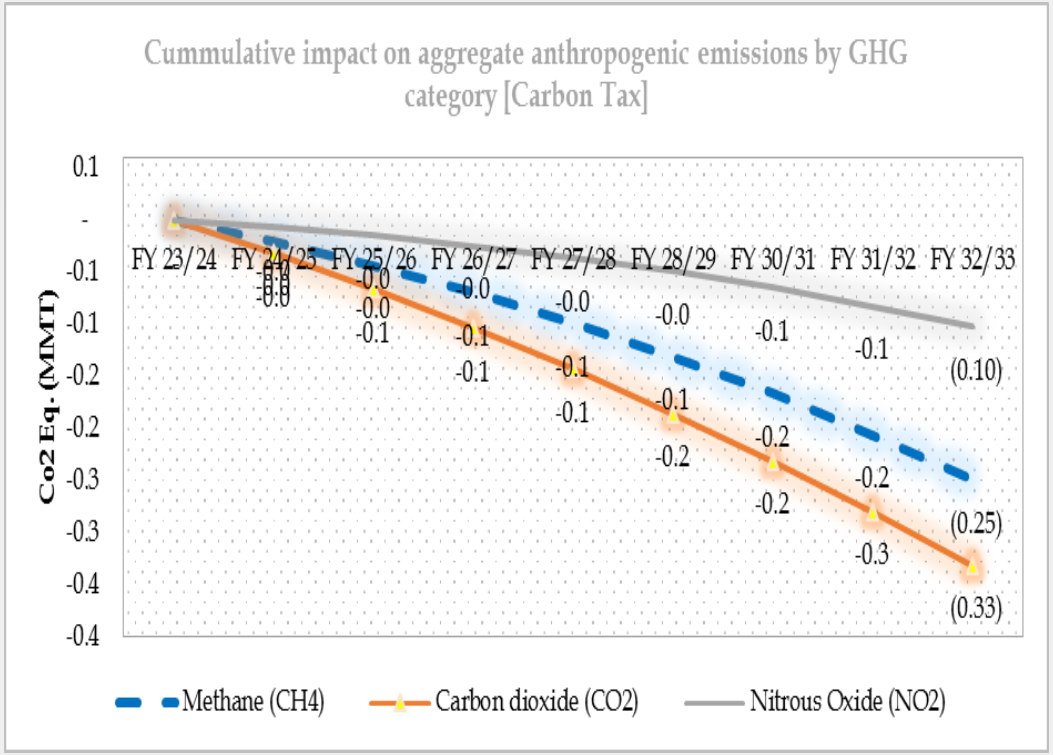
Analysis of impact on employment

— Exchange rate appreciation combined with contraction in output shrinks employment

— improvement in economic resilience, it would reduce the number of jobs lost in the medium term

7. Results – Mitigation (Carbon Tax)

4. Emissions (CO2e) response to carbon tax as a mitigation measure

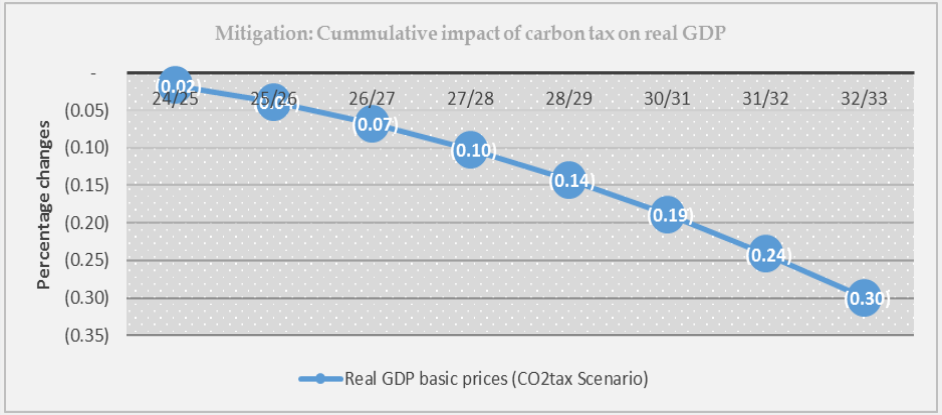


Analysis of impact of carbon tax on emissions

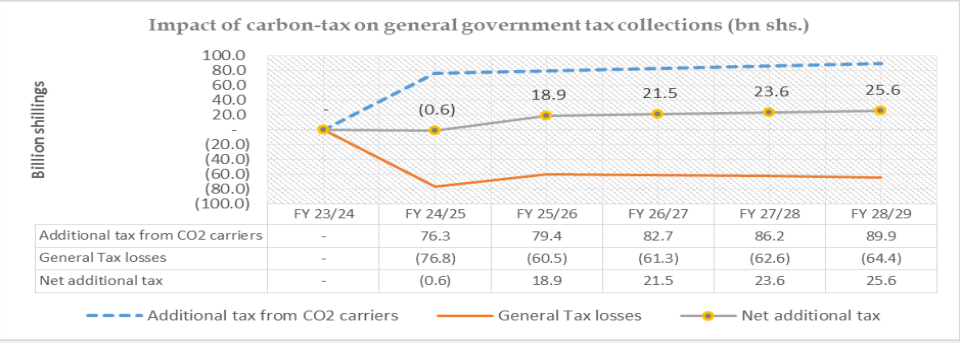
- Increase of carbon tax rate by half, the anthropogenic GHG emissions reduce by 0.68 MMT CO2e cumulatively by FY 2032/33; which amounts to an average of 0.086 MMT CO2e annual reduction.
- This confirms that carbon tax would contribute to the reduction of emissions in Uganda, and consistent to the path set in the Nationally Determined Contributions (MoWE, 2022).

7. Results – Mitigation (Carbon Tax)

5. Carbon tax effects on GDP



6. Carbon tax effects on tax collections



	FY 23/24	FY 24/25	FY 25/26	FY 26/27	FY 27/28	FY 28/29
Additional tax from CO2 carriers	-	76.3	79.4	82.7	86.2	89.9
General Tax losses	-	(76.8)	(60.5)	(61.3)	(62.6)	(64.4)
Net additional tax	-	(0.6)	18.9	21.5	23.6	25.6

Analysis of impact of carbon tax on Economic Growth

—that carbon tax would discount the economic growth returns by an annual average of 0.04 percentage points which accumulates to 0.3 percent of GDP lost by 2032/33.

—The reduction in growth is caused by a contraction in economic activity driven by higher costs of energy inputs among the productive sectors.

Analysis of impact of carbon tax on Tax collections

—The effect on net tax is two-fold.

- First, the reduction in economic output reduces taxable commodities and profits; thus a decline in indirect and direct taxes.
- On the other hand, the increase in the carbon tax increases tax revenues to the government.

—Thus, the net of these tax-head flows dictates final tax collections.

—About **UGX 76.8 bn** is lost in tax due to the effects of a carbon tax on output in the first period. The carbon tax itself brings in **UGX 76.3 bn**, leading to a net tax loss of UGX **0.6 bn** in the first period.

—In the rest of the simulation period, carbon tax gains surpass the general tax losses leading to net tax gains

8. Conclusion & Recommendations

Conclusions

- GHG emissions in Uganda are generated by sectors accounting for a 1/4 of economic output.
- Climate-resilient infrastructure reduces the effect of climate change hazards on macroeconomic outcomes
- Mitigation measures like carbon tax reduces GHG emissions with a cost on economic growth.
- Proceeds from carbon tax should be invested in climate-resilient infrastructure to cushion the effects of carbon tax on growth.

Recommendations

- Government should design enforceable national climate policies, like carbon pricing mechanisms and emissions reduction targets especially for the key emitting sectors like energy, transport, and agriculture.
- Studies could explore the option of combining carbon tax with transition to renewable energy sources such as solar, wind, and hydroelectric power. This contributes to attainment of NDCs.
- There is a need for the government to increase investment in climate-resilient infrastructure.
- There is a need for investment in research and development for new climate technologies and practices, including carbon capture and storage and sustainable agriculture.

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Discussion and Q&A

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Green fiscal policy in an empirical UK E-SFC model

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Background

Green fiscal policies in the UK

There are currently several green fiscal policies active in the UK. Some examples:

- **UK ETS**: Replacing the EU ETS in 2021, this is the UK's current carbon pricing scheme.
- **Great British Energy**: A publicly-owned energy company that is planning invest £8.3bn over the next 5 years while encouraging private investment in renewable energy.
- **Boiler Upgrade Scheme**: An application-based grant scheme providing up to £7,500 per household upgrading from a gas boiler to a heat pump.

The Climate Change Committee recommends strengthening existing policies, such as the UK emissions trading scheme, but also advocates for wider ranges of policies to achieve UK climate goals.

UK macro models of green fiscal policies

There is a range of models developed for the UK context to explore the role of a green policies. Some examples:

- The **National Institute of Economic and Social Research (NiESR) model** has been used for exploring climate fiscal policy scenarios (Hantzsche et al. 2018; NGFS 2024).
- A few **DSGE models** have been developed to analyse the impacts of a introducing a carbon tax and a ban on petrol or gas (e.g. Batten and Millard, 2024).
- The macro-econometric model **E3ME** has been used to explore several decarbonisation scenarios about housing, transport and power (Hayward et al., 2023).

However, in these modelling approaches finance is not explicitly modelled and, therefore, it is not possible to assess the financial impacts and macrofinancial feedback loops generated by green policies.

Benefits of the E-SFC modelling framework

- Ecological stock flow-consistent (E-SFC) models are well placed to analyse the role of finance in the economy since the financial sector and the interactions between **assets/liabilities** and **sectoral financial balances** are explicitly formulated.
- SFC models can easily capture **disequilibrium** and **path dependency** processes, allowing trade-offs of policies to be analysed within a dynamic setting.
- Country-specific ecological stock-flow consistent models, in particular, can accurately reflect the **economic structure of a specific country** using national accounting data.

The model that we develop is called **DEFINE-UK** since it applies the DEFINE framework (Dafermos and Nikolaidi 2022) to the UK economy drawing on the empirical SFC literature (e.g. Zezza and Zezza 2019; Byrialsen and Raza, 2020; Valdecantos, 2020)

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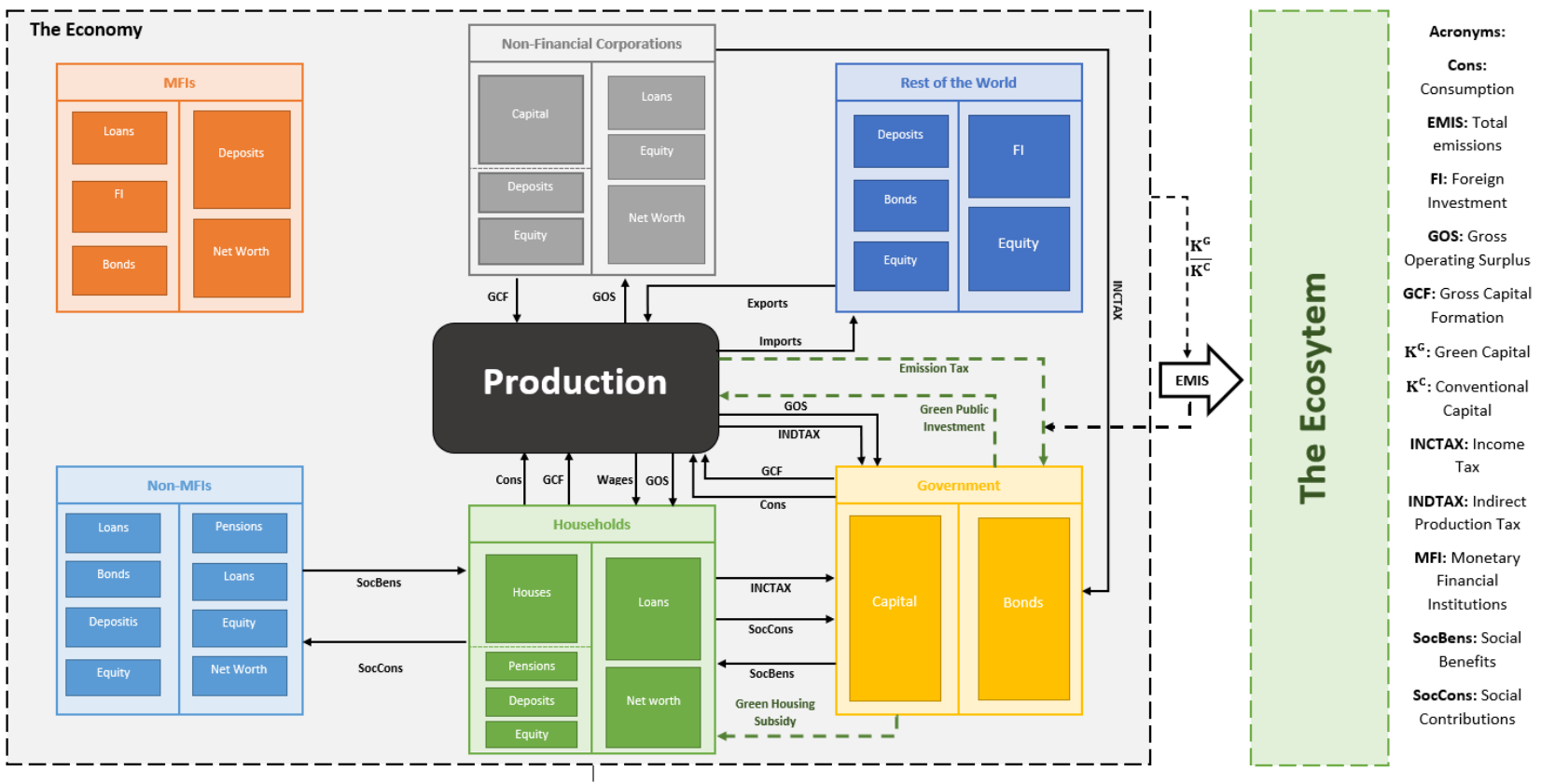
Model structure



Notes: This diagram presents a simplified version of the model. In particular, interest and dividend flows are not included as they flow between most sectors. In addition, stocks are presented as balance sheets with assets on the left and liabilities on the right but this daigram does not show the correspondence between different assets and liabilities.

Balance Sheet Matrix

UK data in percent (%) of total economy financial assets, 1997-2021 average

Balance Sheet							
Assets/liabilities	Sector						
	NFC	**MFI**	**Non-MFI**	**GVT**	**HH**	**RoW**	**Total**
Real assets							
Capital (firms)	+9.4%						+9.4%
Capital (public)				+2.8%			+2.8%
Housing					+16.8%[1]		+16.8%
Financial Assets							
Household Deposits		-4.5%			+4.5%		0
Household Loans		+3.9%			-3.9%		0
Household Pensions			-10.4%		+10.4%		0
Foreign Investment		+14.6%				-14.6%	0
NFC Deposits	+2.8%	-2.8%					0
NFC Loans	-3.8%	+3.8%					0
GVT Borrowing		+1.7%	+1.7%	-5.2%		+1.7%	0
NMFI Deposits		-8.7%	+8.7%				0
NMFI LOANS		+5.9%	-5.9%				0
RoW Deposits		-13.9%				+13.9%	0
Equity Assets	+2.8%		-11.0%		+3.1%	+5.1%	0
Equity Liabilities	-9.1%		+15.2%			-6.1%	0
Residual Instrument	-3.0%	+0.8%	+1.1%	+1.9%	-1.0%	+0.3%	0
Net Worth	-0.6%	+0.8%	-0.7%	-0.4%	+29.9%	+0.4%	+29.0%

Types of equations

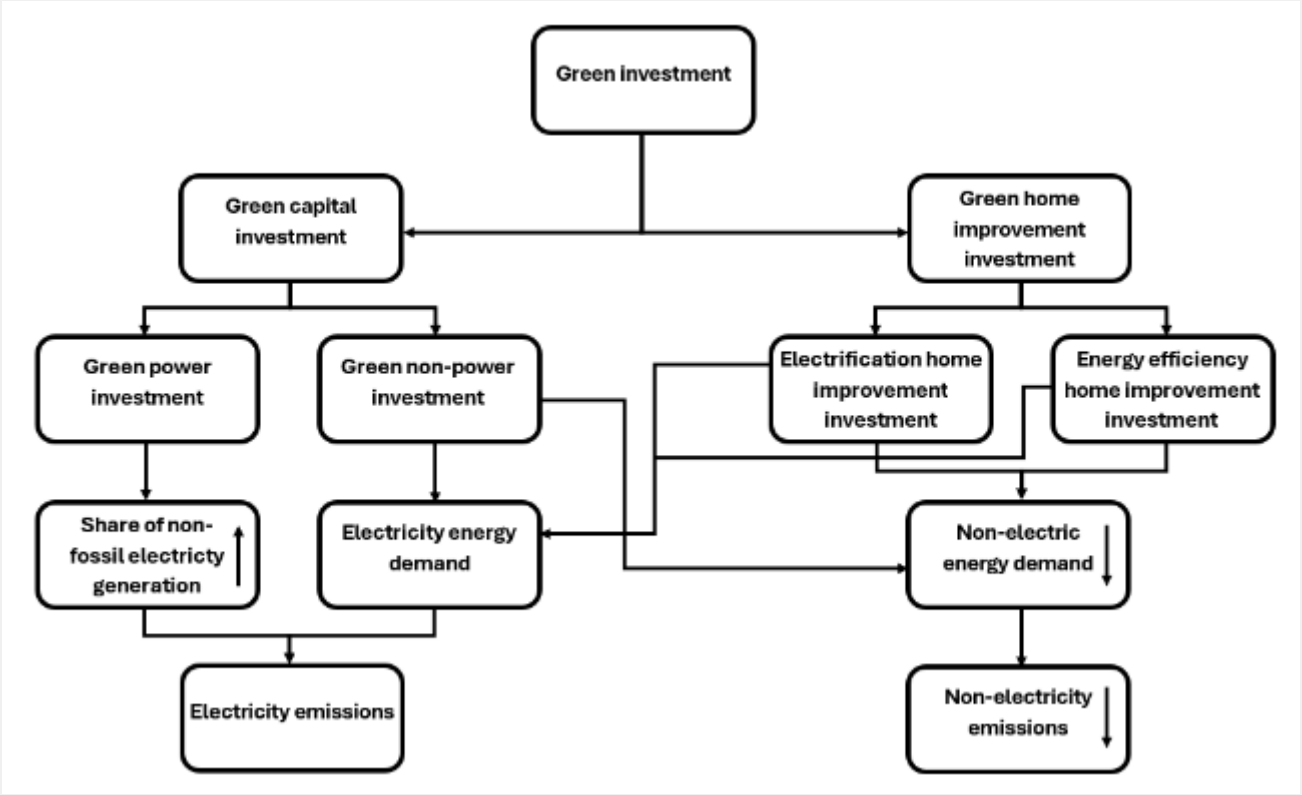
- **Identities**: Equations that are directly derived from the transactions and balance sheet matrices.
- **Behavioural equations**: Equations that are econometrically estimated (inflation, productivity, consumption, investment etc.)
- **Technical relationships**: These are calibrated equations that are neither identities nor behavioural equations. Examples include the definition of the wage share, the definition of the unemployment rate and variables that are projected to fit a baseline scenario (such as government consumption).

Green capital

In the model, achieving environmental targets requires the growth of several green capital stocks, with the investment in said capital requiring both time and financing. We distinguish between different real assets:

- General **green capital**, held by firms and the government, where more green capital leads to higher energy efficiency and electricity use.
- Separate **capital for the power generation sector**, which can be either fossil fuel-based or non-fossil fuel based.
- **Housing stock** with different energy efficiencies, using UK energy performance certificate (EPC) data.

Green investment channels



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Scenario analysis

Baseline scenario: key features

Variable	2022	2035	Mean	St. deviation
Real GDP growth (%)	2.48	1.16	0.84	0.81
Unemployment (%)	3.52	5.23	4.89	1.30
Population (millions)	67.81	73.11	70.65	1.63
Non-fossil electricity generation (%)	61.47	100	82.39	12.61
Total emissions ($MTCO_{2e}$/year)	400	230	299	51.49
Emission price (£/TCO_{2e})	2.50	21.27	17.63	4.78
Non-fossil power investment/GDP (%)	0.24	0.33	0.28	0.03

Notes: All quarterly values are annualised and the mean and standard deviation are calculated from 2022-2035.

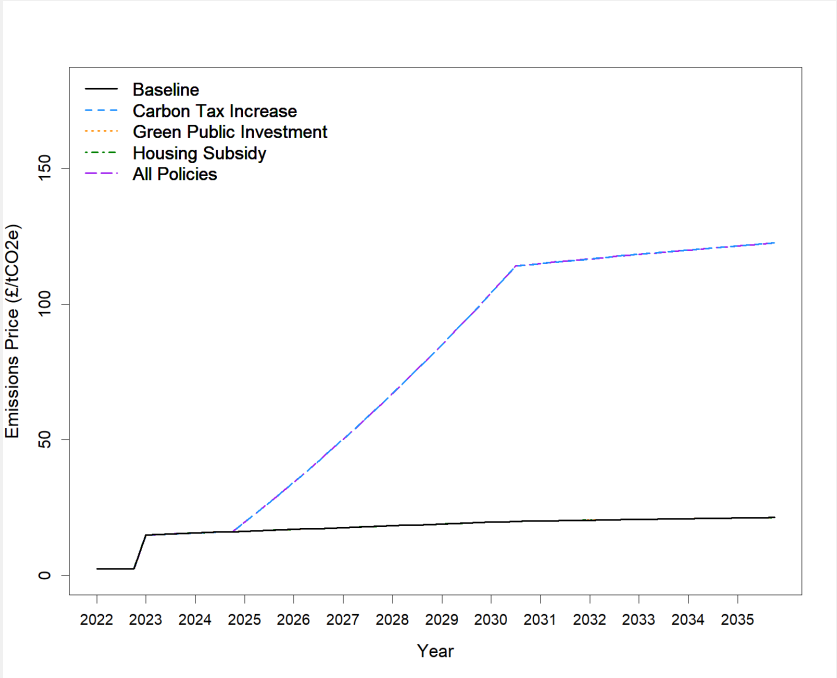
Green Fiscal Policies

We run four green fiscal policy scenarios. All are implemented in 2025 Q1.

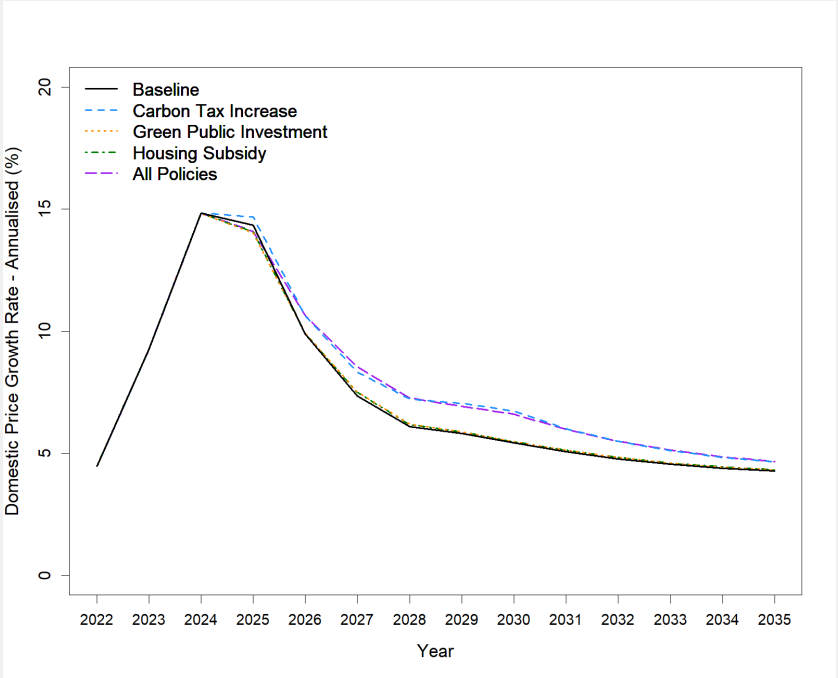
- **Carbon Tax Increase:** The tax on emissions is increased steadily from around £15/MTCO2e to over £120/MTCO2e by 2030. Beyond 2030 the emission price grows in line with the overall price level.
- **Green Public Investment:** The government increases its public investment from £8.3 bn to £50 bn over 5 years and continues with this level of real investment for the rest of the simulation.
- **Housing Subsidy:** The government provides subsidies to households for green home improvements reducing the cost of energy efficiency and electrification improvements by 40%.
- **Combined Scenario:** All above policies are run simultaneously.

Scenario results

Emission Price

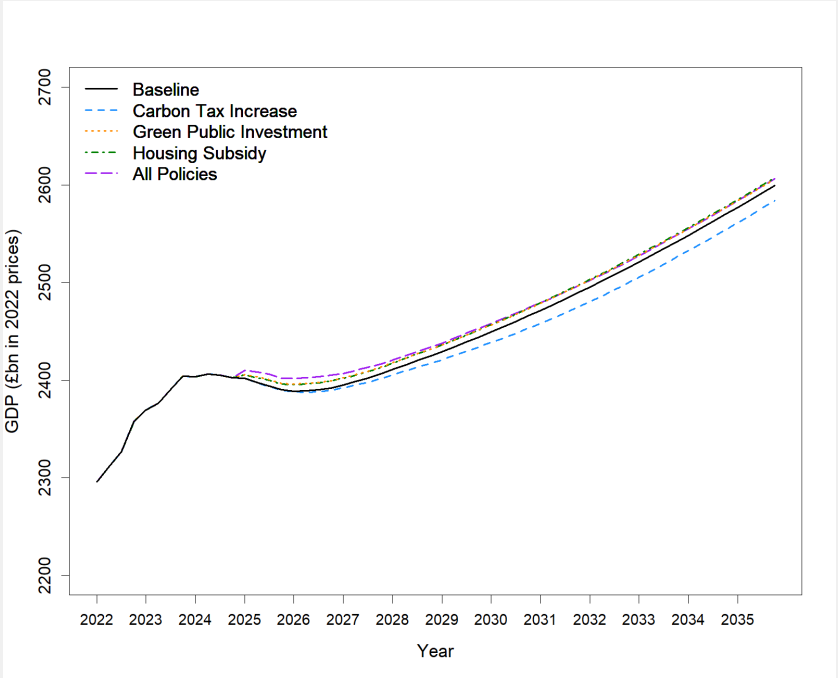


Domestic inflation

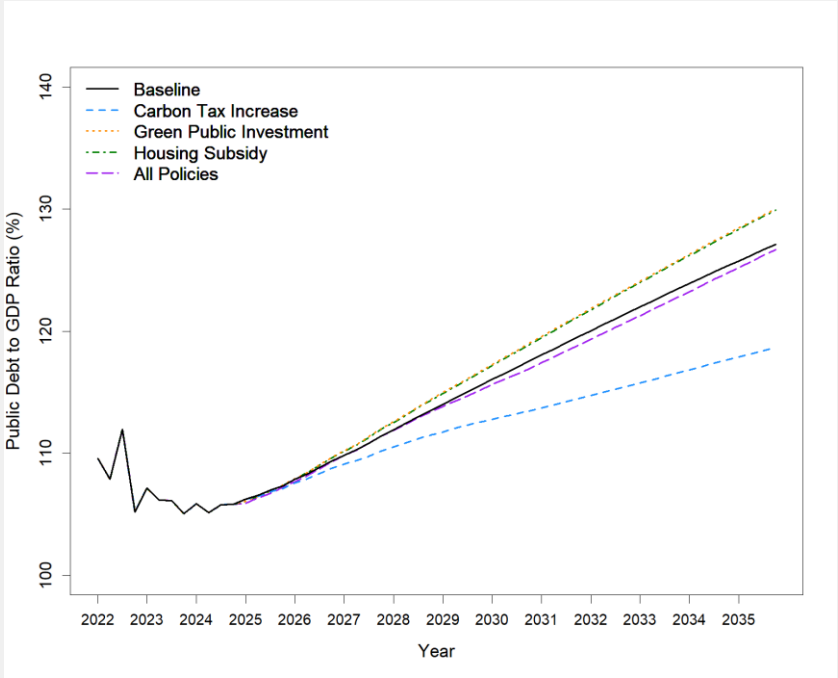


Scenario results

GDP

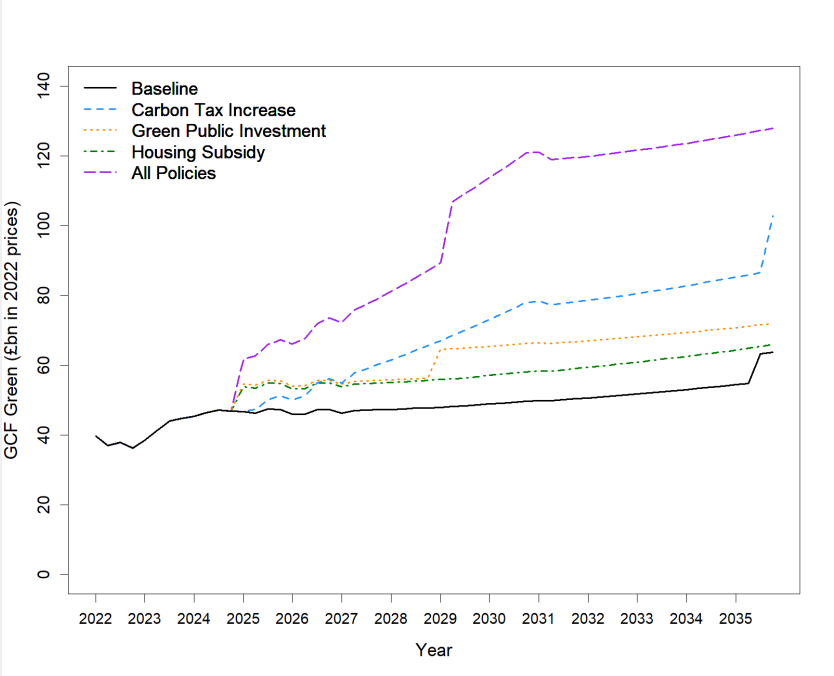


Public debt-to-GDP ratio

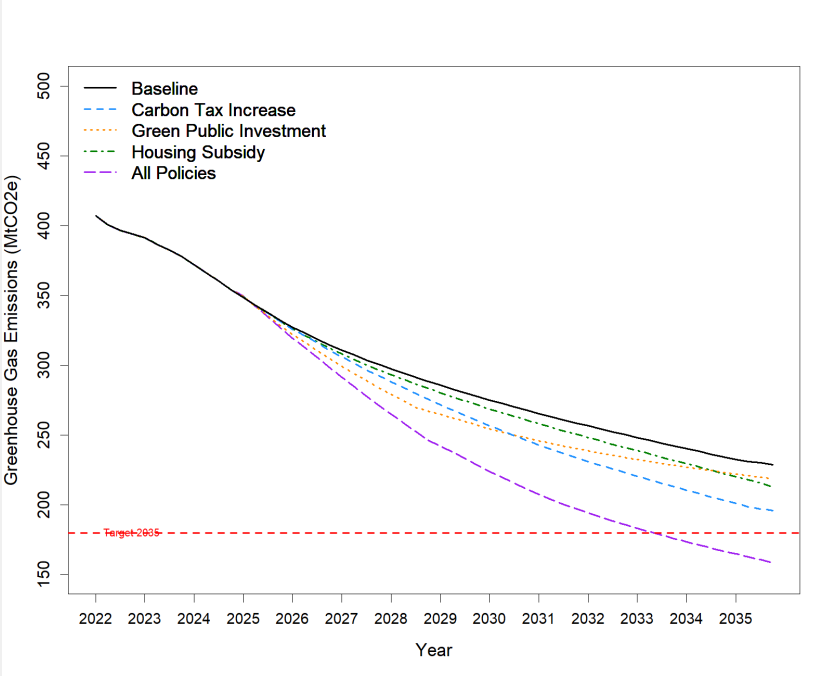


Scenario results

Total green investment

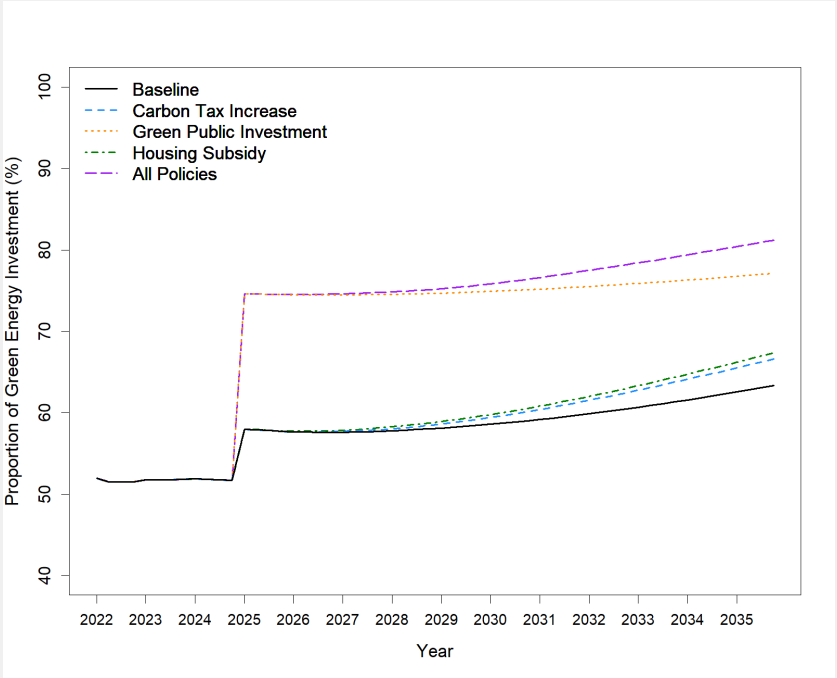


Total GHG emissions

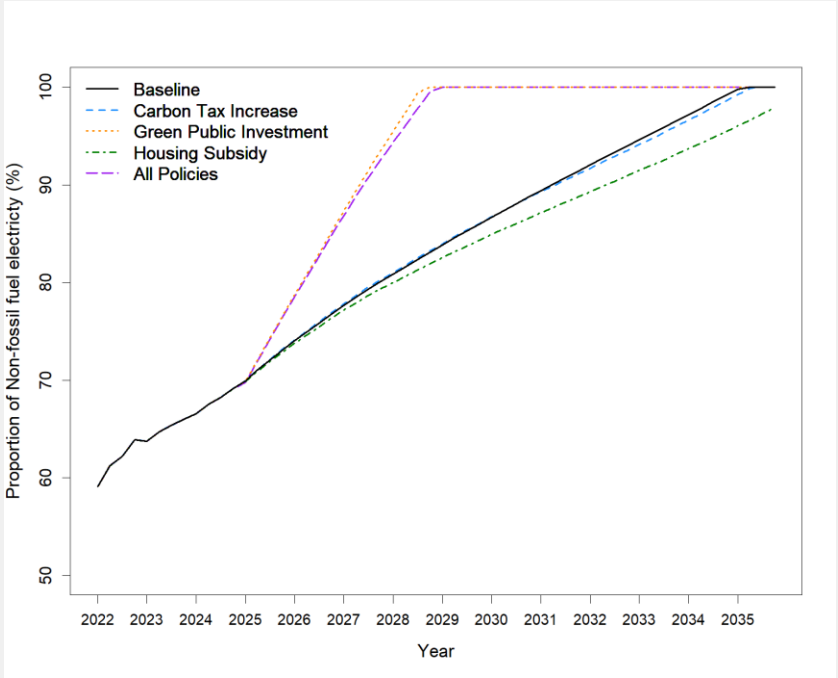


Scenario results

Green power investment

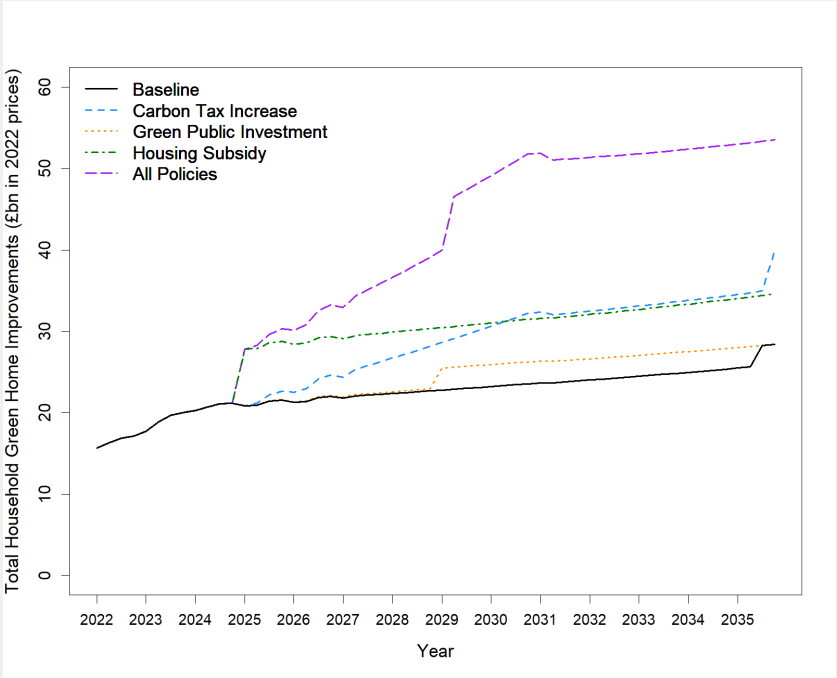


Proportion of non-fossil electricity

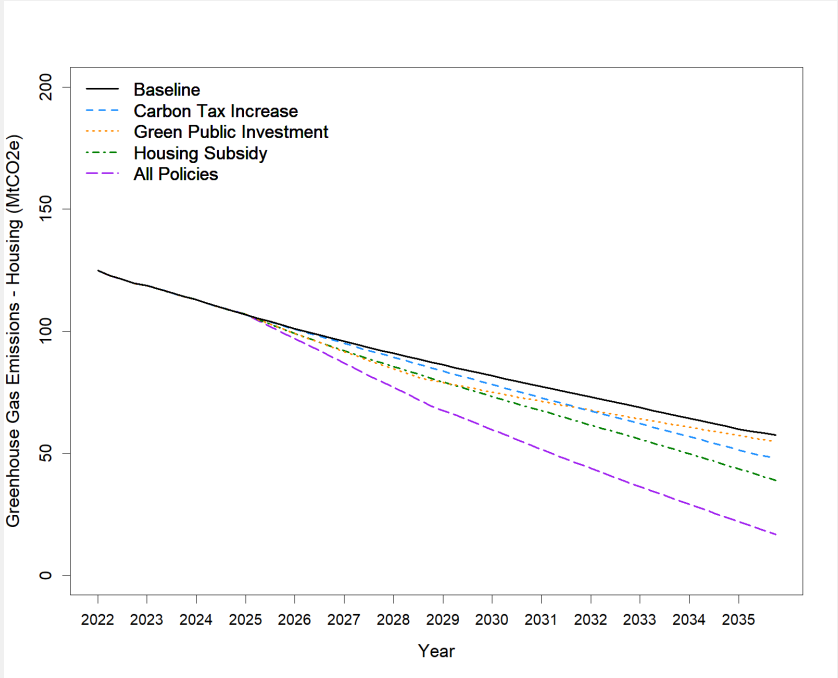


Scenario results

Green home improvements

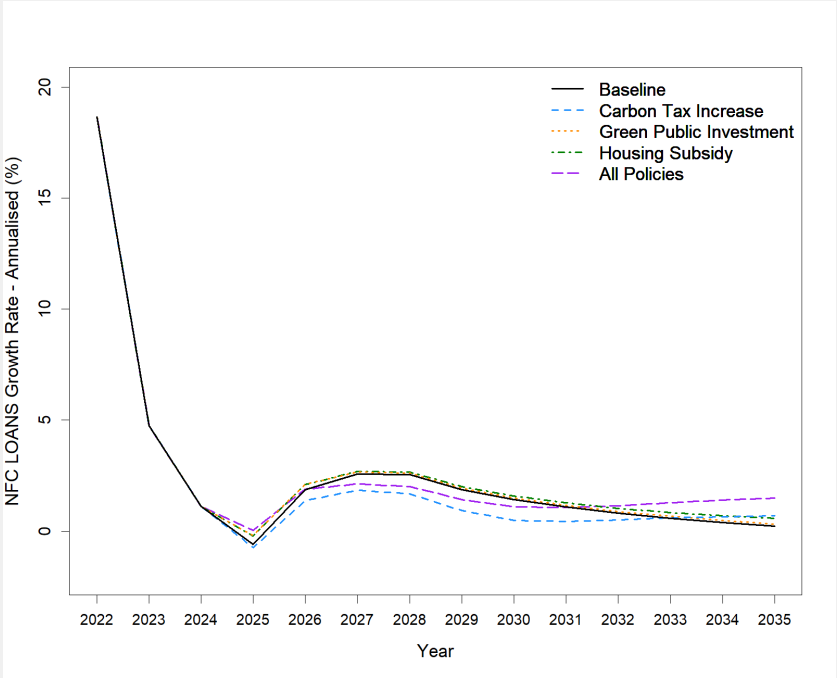


Housing emissions

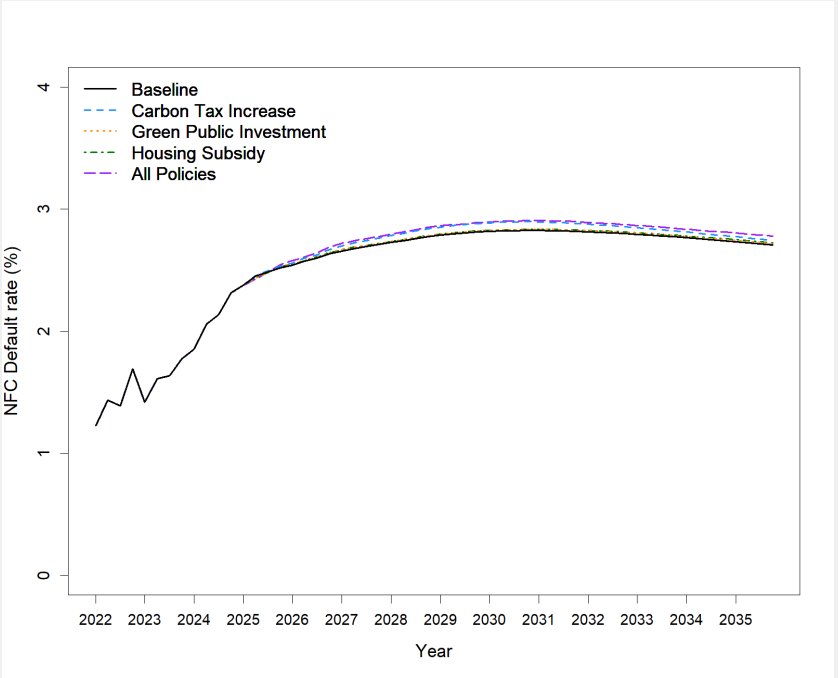


Scenario results

Growth of corporate loans



Corporate default rate



Scenario results: summary

Indicator	Carbon Tax		GPI	
	Short run	Long run	Short run	Long run
Emissions	↓	↓	↓↓	↓
Electricity Share	-	-	↑↑	-
GDP	↓	↓↓	↑	↑
Public debt-GDP	↓↓	↓↓	↑	↑
Firm defaults	↑	↑	-	-

Indicator	Housing Subsidy		All Policies	
	Short run	Long run	Short run	Long run
Emissions	↓	↓	↓↓	↓↓
Electricity Share	-	↓	↑↑	-
GDP	↑	↑	↑↑	↑
Public debt-GDP	↑	↑	-	-
Firm defaults	-	-	↑	↑

4

Conclusion

Key messages and future extensions

- Key messages:
  - ✓ Trade-offs arise when policies are applied in isolation, including the recessionary impacts of a carbon tax and the diminishing returns of green power investment.
  - ✓ Most of these trade-offs can be addressed or mitigated when policies are applied simultaneously.
  - ✓ For decarbonisation goals, the benefits of combined fiscal policies can be greater than the sum of the benefits of individual policies.
- Future extensions:
  - ✓ Sensitivity analysis and validation
  - ✓ Additional climate policy mixes including regulation and financial policies
  - ✓ Input-output analysis for the power sector
  - ✓ More ecological variables; sectoral heterogeneity.

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