Fiscal policy and ecological sustainability: a post-Keynesian perspective

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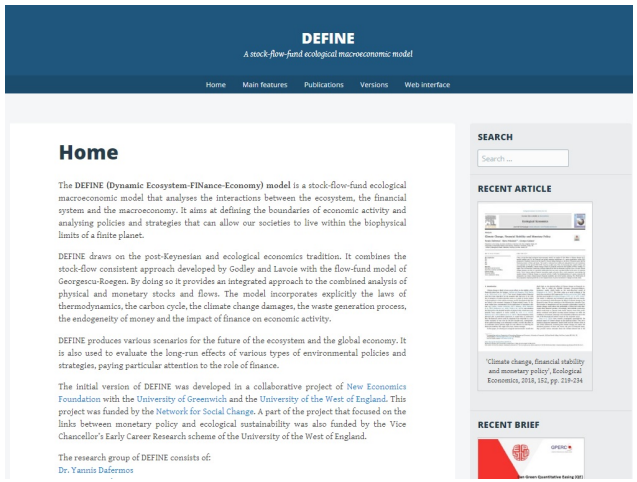
29th PKES Annual Workshop, 29 May 2019, Goldsmiths

- In post-Keynesian economics, fiscal policy plays a key role (e.g. Arestis and Sawyer, 2010; Hein and Stockhammer, 2010). However, fiscal policy for ecological sustainability has only recently received some attention.
- There are various forms of **green fiscal policies**:
  1. Environmental taxes (e.g. carbon taxes)
  2. Green subsidies(e.g. feed-in tariffs)
  3. Green public investment
  4. Research and development in green technologies
  5. Green job guarantee programmes

- **Environmental taxes**: Bovari et al (2018), D'Alessandro et al (2018), Mercure et al (2018)
- **Green subsidies**: Bovari et al (2018), Mercure et al (2018), Monasterolo and Raberto (2018, 2019)
- **Research and development in green technologies**: Deleidi et al (2019)
- **Green job guarantee programmes**: Godin (2012), D'Alessandro et al (2018)

- The existing studies have not systematically compared carbon taxes with other types of green fiscal policies with an explicit reference to their combined effects on economic, financial and environmental variables.
- We provide such a comparative evaluation using the **DEFINE** model (see Dafermos, et al, 2017, 2018). For more information, see: www.define-model.org
- This model combines a detailed financial system with environmental modules on climate change and the use of matter and energy.



Outline

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Key differences between IAMs/CGEs and PK ecological models

IAMs/CGE models	Post-Keynesian ecological models
Supply-determined output	Demand-determined output (with supply-side constraints)
Mitigation represents only a cost	Mitigation is both a cost and a source of income
Banks are financial intermediaries	Money is endogenous
Utility and profit maximisation	Fundamental uncertainty/bounded rationality
Environmental problems as externalities	Systems approach to the environmental issues

Outline

The model consists of two big blocks and various sub-blocks.

Ecosystem

- Matter, waste and recycling
- Energy
- Emissions and climate change
- Ecological efficiency and technology

Macroeconomy and financial system

- Output determination
- Firms
- Households
- Banks
- Government sector
- Central banks

Physical flow matrix

	Material balance	Energy balance
Inputs		
Extracted matter	$+M$	
Renewable energy		$+ER$
Non-renewable energy	$+CEN$	$+EN$
Oxygen used for fossil fuel combustion	$+O2$	
Outputs		
Industrial CO_2 emissions	$-EMIS_{IN}$	
Waste	$-W$	
Dissipated energy		$-ED$
Change in socio-economic stock	$-\Delta SES$	
Total	0	0

Physical stock-flow matrix

	Material reserves	Non-renewable energy reserves	Atmospheric CO_2 concentration	Socio-economic stock	Hazardous waste
Opening stock	REV_{M-1}	REV_{E-1}	$CO2_{AT-1}$	SES_{-1}	HWS_{-1}
Additions to stock					
Resources converted into reserves	$+CON_M$	$+CON_E$			
CO_2 emissions			$+EMIS$		
Production of material goods				$+MY$	
Non-recycled hazardous waste					$+haz\tilde{W}$
Reductions of stock					
Extraction/use of matter or energy	$-M$	$-EN$			
Net transfer of CO_2 to oceans/biosphere			$+(\phi_{11}-1)CO2_{AT-1}+\phi_{21}CO2_{UP-1}$		
Demolished/disposed socio-economic stock				$-DEM$	
Closing stock	REV_M	REV_E	$CO2_{AT}$	SES	HWS

Transactions flow matrix

	Households		Firms		Commercial banks		Government sector		Central banks		Total
	Current	Capital	Current	Capital	Current	Capital	Current	Capital	Current	Capital	
Private consumption expenditures		$-C_{(PRI)}$	$+C_{(PRI)}$								0
Government consumption expenditures			$+C_{(GOV)}$				$-C_{(GOV)}$				0
Conventional investment			$+\Sigma I_{C(PRI)i} + I_{C(GOV)}$	$-\Sigma I_{C(PRI)i}$				$-I_{C(GOV)}$			0
Green investment			$+\Sigma I_{G(PRI)i} + I_{G(GOV)}$	$-\Sigma I_{G(PRI)i}$				$-I_{G(GOV)}$			0
Green subsidies			$+SUB$				$-SUB$				0
Household disposable income net of depreciation	$-Y_{HD}$	$+Y_{HD}$									0
Wages	$+wN$		$-wN$								0
Government balance							$-GB$	$+GB$			0
Taxes	$-T_H$		$-T_F - T_C$				$+T$				0
Firms' profits	$+DP$		$-TP$	$+RP$							0
Commercial banks' profits	$+BP_D$				$-BP$	$+BP_U$					0
Interest on deposits	$+int_D D_{-1}$				$-int_D D_{-1}$						0
Depreciation of green capital			$-\delta \Sigma K_{G(PRI)i-1}$	$+\delta \Sigma K_{G(PRI)i-1}$			$-\delta K_{G(GOV)-1}$	$+\delta K_{G(GOV)-1}$			0
Depreciation of conventional capital			$-\delta \Sigma K_{C(PRI)i-1}$	$+\delta \Sigma K_{C(PRI)i-1}$			$-\delta K_{C(GOV)-1}$	$+\delta K_{C(GOV)-1}$			0
Interest on conventional loans			$-\Sigma int_{Ci} L_{Ci-1}$		$+\Sigma int_{Ci} L_{Ci-1}$						0
Interest on green loans			$-\Sigma int_G L_{Gi-1}$		$+\Sigma int_G L_{Gi-1}$						0
Interest on conventional bonds	$+coupon_C b_{CH-1}$		$-coupon_C b_{C-1}$						$+coupon_C b_{CCB-1}$		0
Interest on green bonds	$+coupon_G b_{GH-1}$		$-coupon_G b_{G-1}$						$+coupon_G b_{GCB-1}$		0
Interest on government securities	$+int_S SEC_{H-1}$				$+int_S SEC_{B-1}$		$-int_S SEC_{-1}$		$+int_S SEC_{CB-1}$		0
Interest on advances					$-int_A A_{-1}$				$+int_A A_{-1}$		0
Depreciation of durable consumption goods	$-\xi DC_{-1}$	$+\xi DC_{-1}$									0
Central bank's profits							$+CBP$		$-CBP$		0
Bailout of banks						$+BAILOUT$	$-BAILOUT$				0
Δdeposits		$-\Delta D$				$+\Delta D$					0
Δconventional loans				$+\Sigma \Delta L_{Ci}$		$-\Sigma \Delta L_{Ci}$					0
Δgreen loans				$+\Sigma \Delta L_{Gi}$		$-\Sigma \Delta L_{Gi}$					0
Δconventional bonds		$\bar{p}_C \Delta b_{CH}$		$+\bar{p}_C \Delta b_C$						$\bar{p}_C \Delta b_{CCB}$	0
Δgreen bonds		$\bar{p}_G \Delta b_{GH}$		$+\bar{p}_G \Delta b_G$						$\bar{p}_G \Delta b_{GCB}$	0
Δgovernment securities		$-\Delta SEC_H$				$-\Delta SEC_B$		$+\Delta SEC$		$-\Delta SEC_{CB}$	0
Δadvances						$+\Delta A$				$-\Delta A$	0
Δhigh-powered money						$-\Delta HPM$				$+\Delta HPM$	0
Defaulted loans				$+DL$		$-DL$					0
Total	0	0	0	0	0	0	0	0	0	0	0

Balance sheet matrix

	Households	Firms	Commercial banks	Government sector	Central banks	Total
Conventional capital		$+\Sigma K_{C(PRI)i}$		$+K_{C(GOV)}$		$+K_C$
Green capital		$+\Sigma K_{G(PRI)i}$		$+K_{G(GOV)}$		$+K_G$
Durable consumption goods	$+DC$					$+DC$
Deposits	$+D$		$-D$			0
Conventional loans		$-\Sigma L_{Ci}$	$+\Sigma L_{Ci}$			0
Green loans		$-\Sigma L_{Gi}$	$+\Sigma L_{Gi}$			0
Conventional bonds	$+\overline{p}_C b_{CH}$	$-\overline{p}_C b_C$			$+\overline{p}_C b_{CCB}$	0
Green bonds	$+\overline{p}_G b_{GH}$	$-\overline{p}_G b_G$			$+\overline{p}_G b_{GCB}$	0
Government securities	$+SEC_H$		$+SEC_B$	$-SEC$	$+SEC_{CB}$	0
High-powered money			$+HPM$		$-HPM$	0
Advances			$-A$		$+A$	0
Total (net worth)	$+V_H$	$+V_F$	$+CAP$	$-SEC+K_{C(GOV)}+K_{G(GOV)}$	$+V_{CB}$	$+K_C+K_G+DC$

Investment and finance

- Firms have a desired overall **investment** which depends, amongst other factors, on the profit rate and the rate of capacity utilisation.
- Part of their investment is green. The proportion of green investment depends, amongst others, on carbon taxes and green subsidies.
- Firms **finance** desired green investment via (1) retained profits; (2) bonds; (3) bank loans.
- There is **credit rationing**: only a proportion of the demanded loans are provided by banks. Interest rate is also endogenous.

Government

- Firms have to pay **taxes** based on the carbon emissions that they generate.
- The government covers a proportion of green private investment spending via **green subsidies**.
- The government undertakes both green and conventional investment.
- **Public investment** increases public capital. As green capital becomes higher (compared to conventional capital), energy efficiency and the share of renewables increases.

Outline

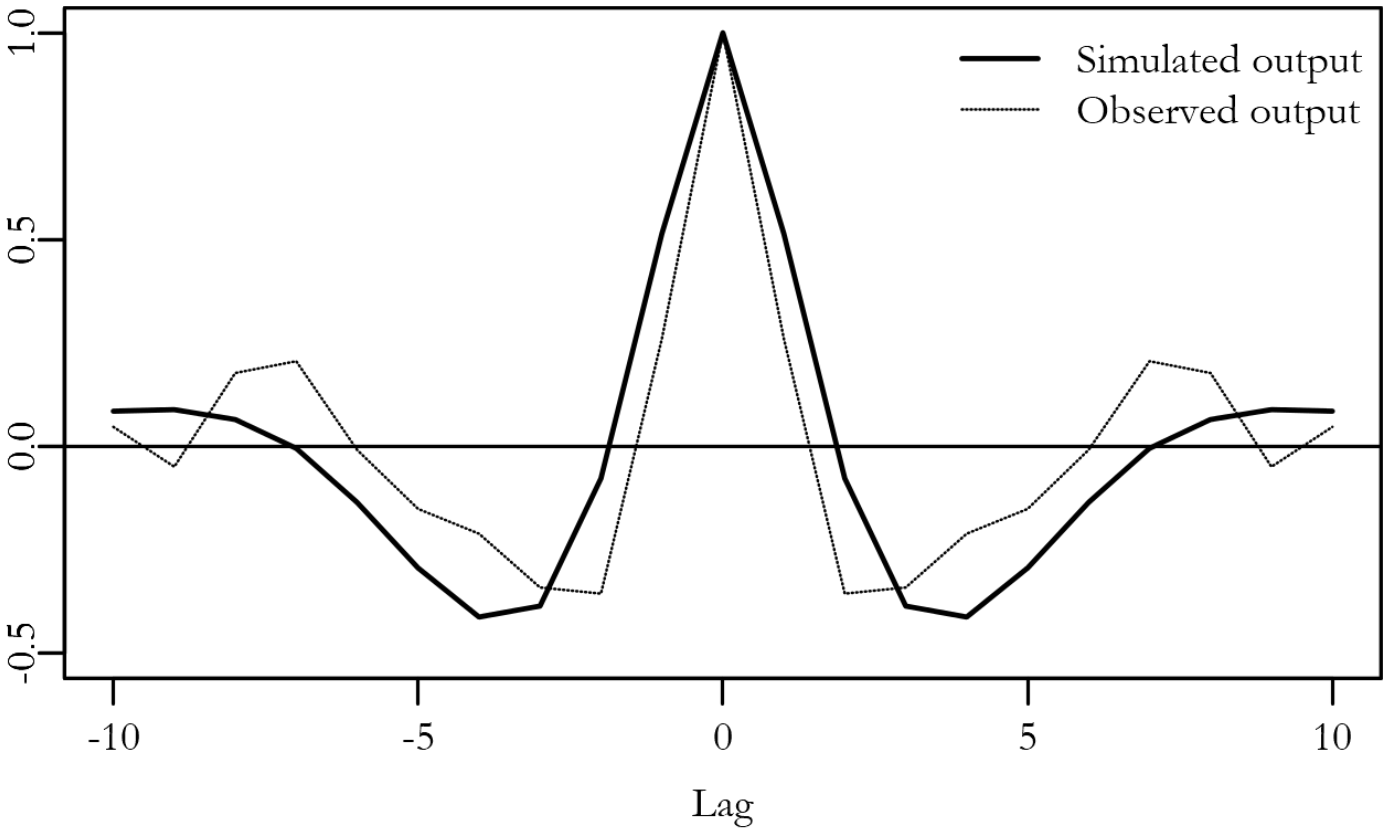
Calibration/estimation of the model:

- We use a mix of calibration and estimation techniques.
- We estimate some functions (such as investment, consumption and credit provision) using panel data for the global economy.
- We calibrate some parameter values using data or other studies.
- We develop a baseline scenario and then conduct sensitivity and policy analysis.

Baseline scenario:

- Economic growth is, on average, slightly lower than 2.5% till 2050.
- Population becomes 9.77bn people in 2050.
- Very slow transition to a low-carbon economy.
- Share of renewable energy increases (from 14% in 2017) to 25% in 2050.
- Energy intensity improves by 30% till 2050.
- The default rate on corporate loans is around 4% till 2050.

Auto-correlation: output



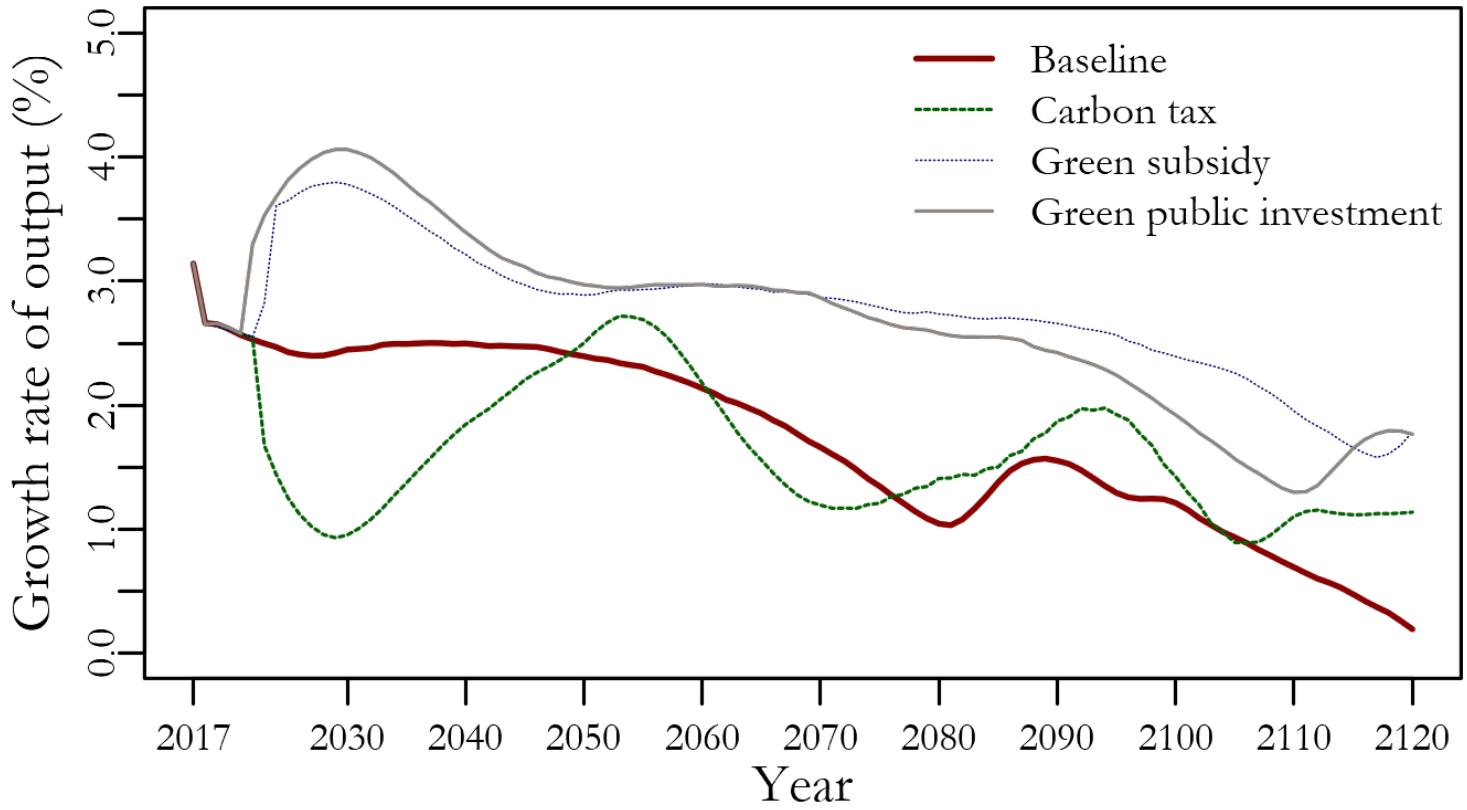
Outline

- We assume that in 2022 green fiscal policies are introduced in the following ways:
  1. Carbon tax: The carbon tax increases to 16 US dollars per tonne of CO_2 (this corresponds to 80 US dollars for the emissions currently covered by a carbon pricing scheme).
  2. Green public subsidies: The green public subsidies provided by the government increases from 28% to 60% (as a proportion of green investment)
  3. Green public investment: The green investment of the government increases from 0.25% to 1% (as a proportion of GDP)

Key similarities and differences between the three green fiscal policies

	Increase in carbon tax	Increase in green subsidy rate	Increase in public green investment
Economic growth	Declines	Increases	Increases
Transition financial risks	Yes	No	No
Physical financial risks	Decline moderately	Decline	Decline
Public indebtedness	Increases	Declines moderately	Declines moderately
Global warming	Declines moderately	Declines	Declines

Growth rate of output



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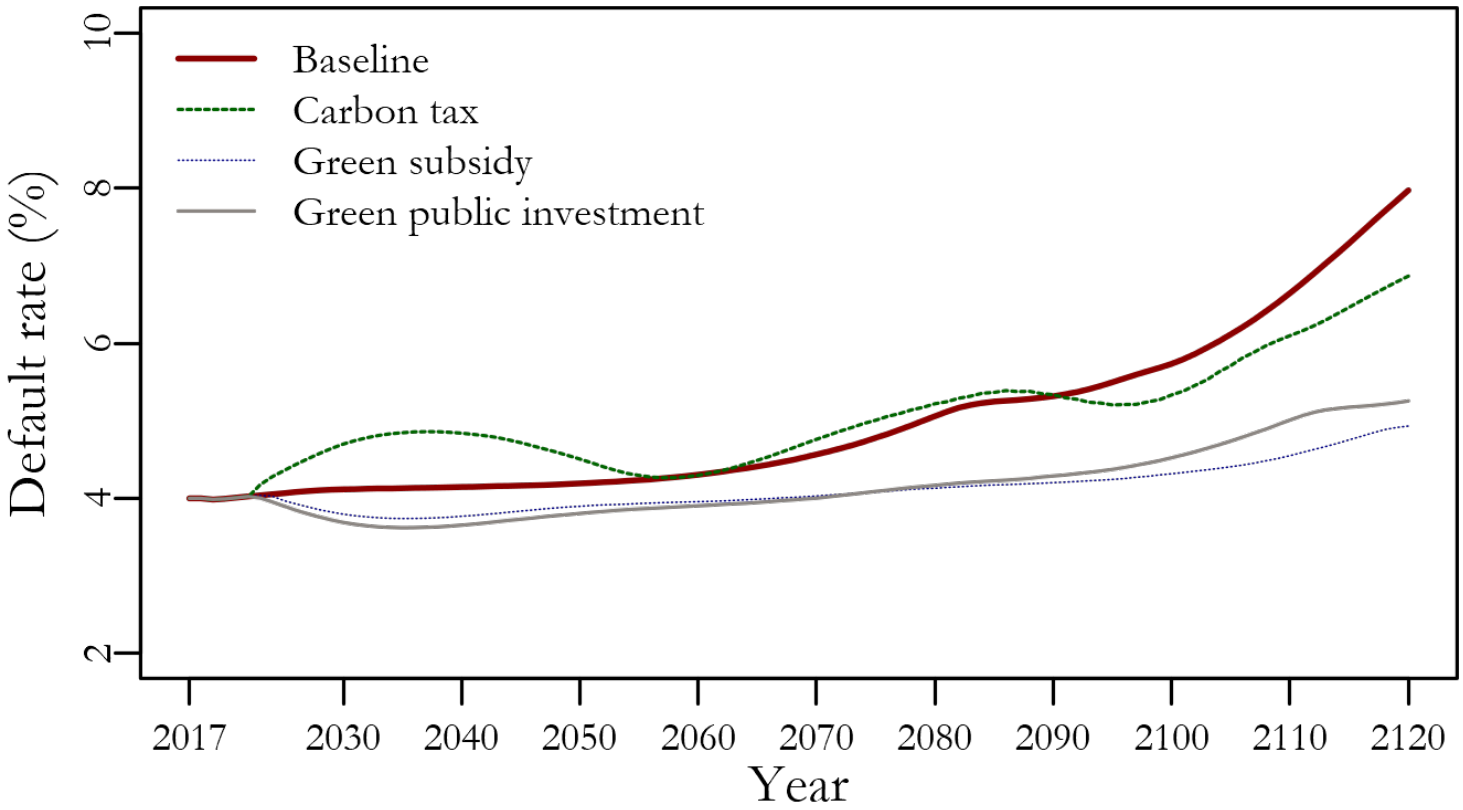
Default rate



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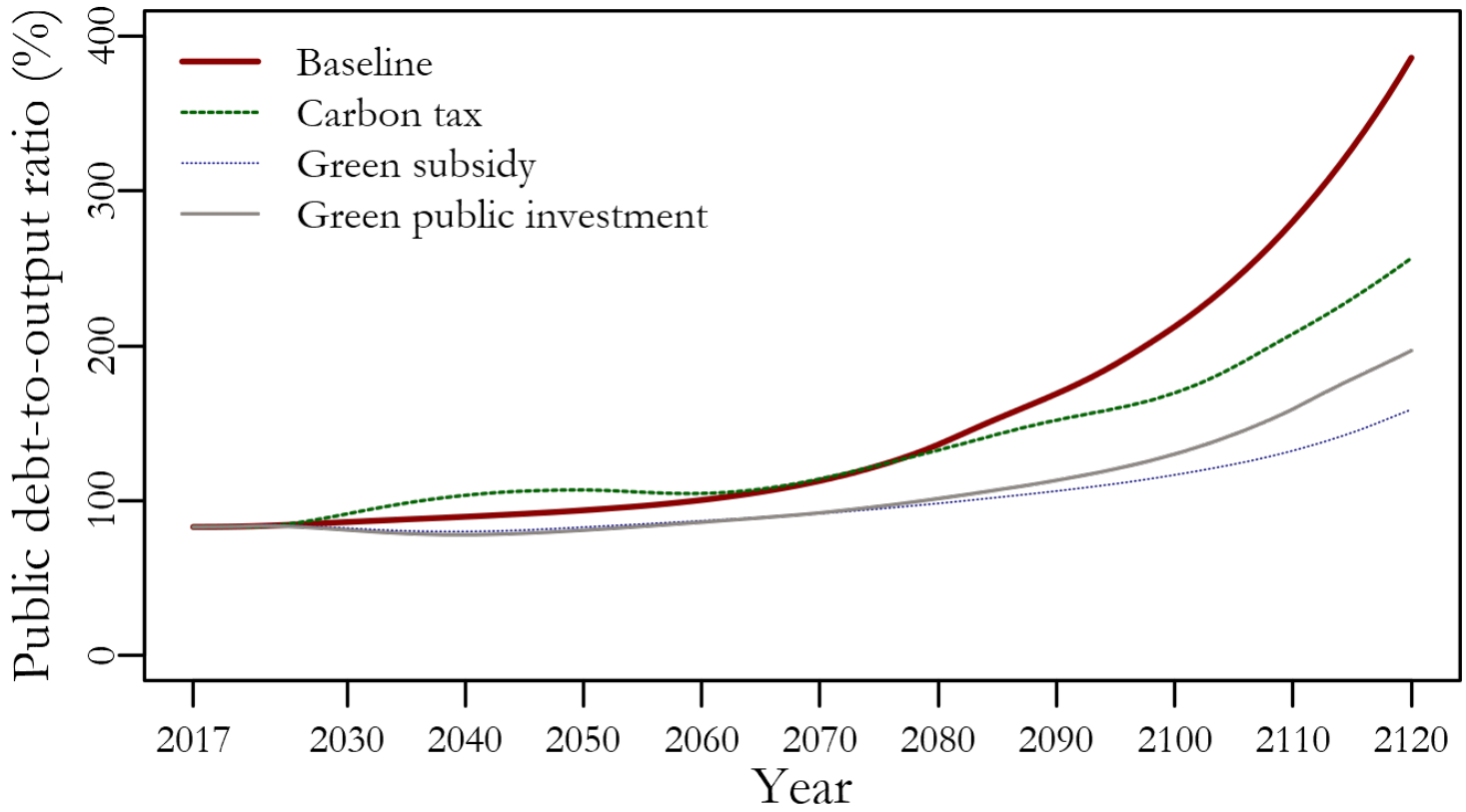
Public debt-to-output ratio



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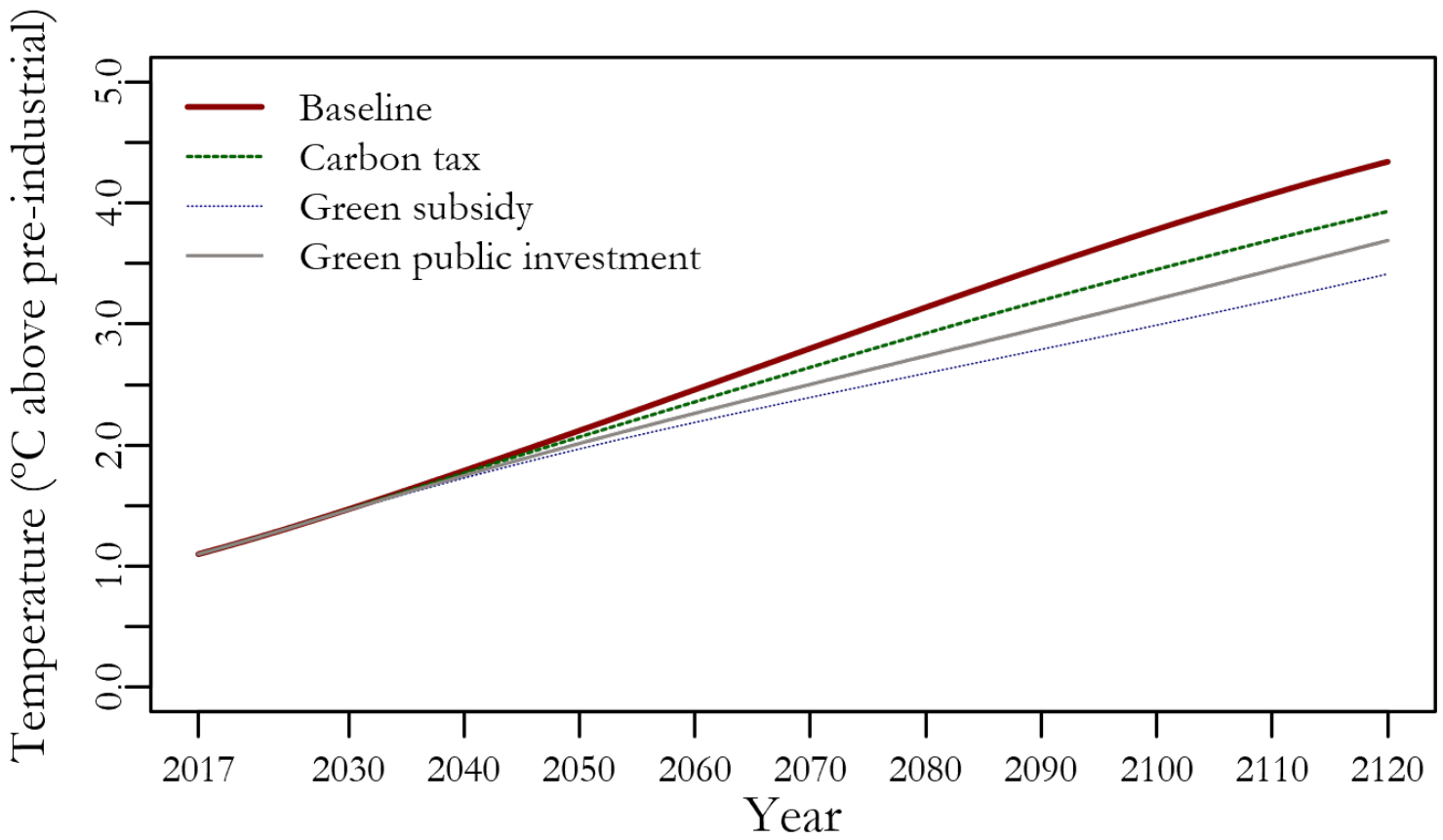
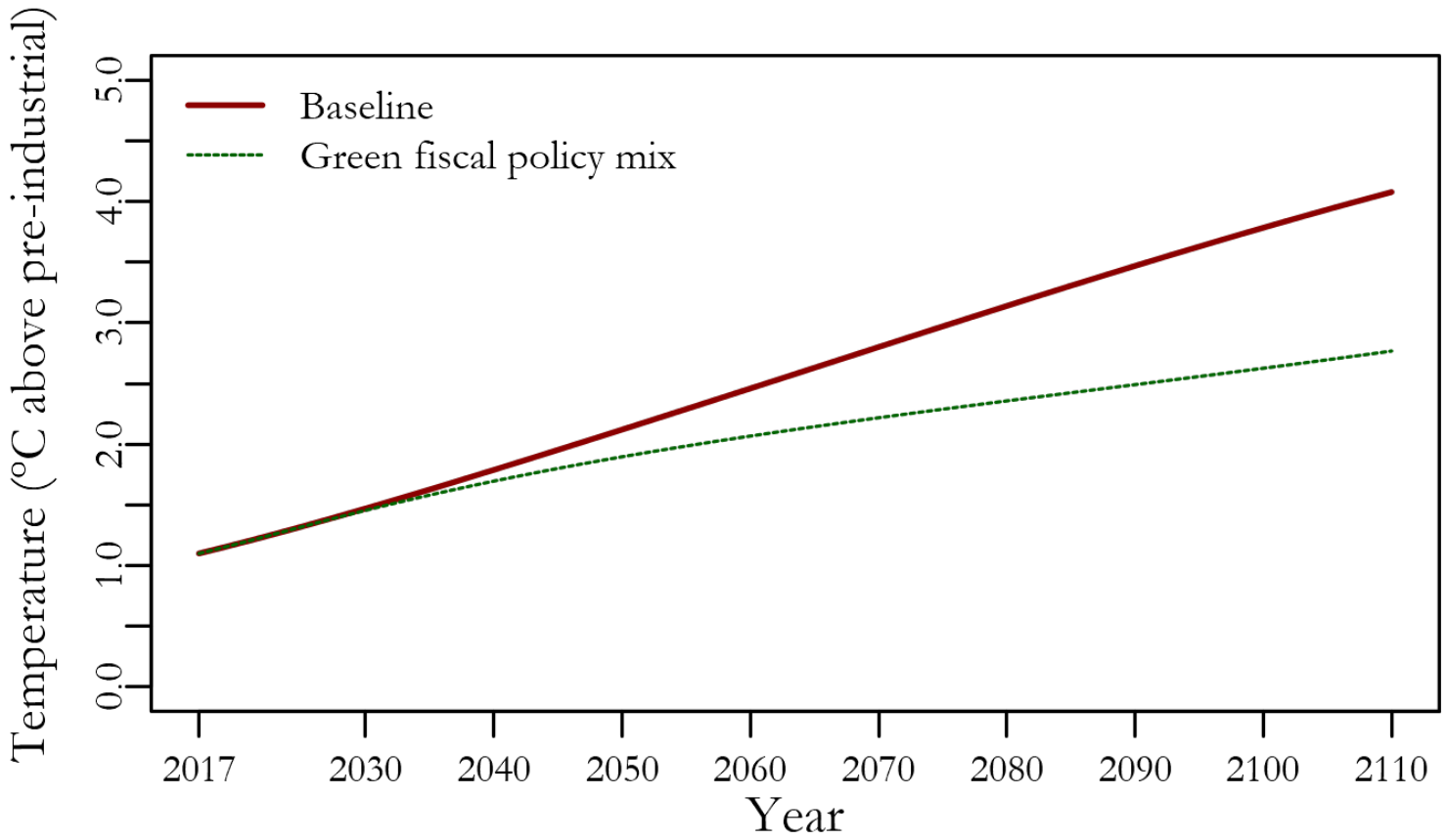
Atmospheric temperature

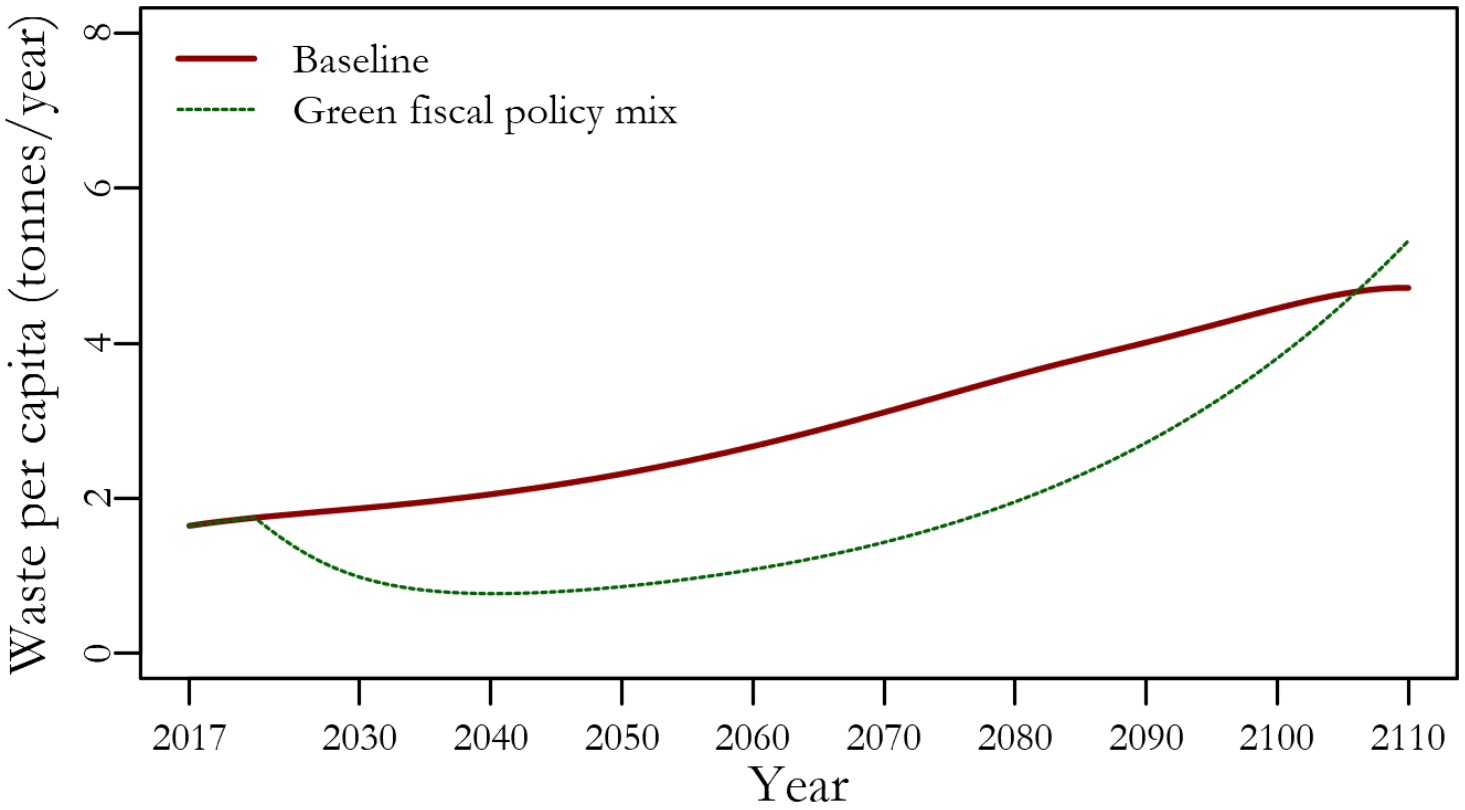


- We assume that in 2022 we combine all the above mentioned policies simultaneously
  1. The contractionary effects of a higher carbon tax are offset
  2. Green investment increases more
  3. Carbon emissions decline much more. As a result, physical climate-related financial risks are much less pronounced.

Atmospheric temperature



Waste per capita



Outline

- **Carbon taxes** can reduce global warming but at the same time they can give rise to a type of climate Minsky moment.
- **Green subsidies and green public investment** have positive environmental effects but with some macroeconomic rebound effects.
- A **green fiscal policy mix** is more effective from both an environmental and an economic/financial point view. However, there are some material depletion and waste generation problems in the very long run.
- A green fiscal policy mix might not be enough to achieve 2 degrees. Regulation, green finance policies and a change in consumption patterns need to accompany such a mix.