Is a €10 Trillion European Climate Investment Initiative Fiscally Sustainable?

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Background

- Third report of research project with Foundation of European Progressive Studies and Karl Renner Institut:
  - Study 1: How to Boost the European Green Deal's Scale and Ambition? (Wildauer et al. 2020)
  - Study 2: A European Wealth Tax for a Fair and Green Recovery (Kapeller et al. 2021)
  - Study 3: Is a €10 Trillion European Climate Investment Initiative Fiscally Sustainable? (Wildauer et al. 2021)
- Joint work with Stuart Leitch (University of Greenwich) and Jakob Kapeller (Universität Duisburg-Essen und Universität Linz)

Outline

Motivation and Research Question

Motivation

- The threat of climate change is massive:
  1. There is not much time left at the current speed of action
  2. The cost of inaction or too little action will be substantial
  3. There is significant uncertainty about all of this (tendency for humans to be overly optimistic)
- Fiscal policies vital for fast, targeted and large-scale interventions
- In contrast neoclassical economic theory slow in recognizing this (from RANK to HANK)
  1. monetary policy primary and preferential policy tool
  2. small multipliers (in RANK models): fiscal expansions result in rising gov. debt ratios
- Policy debate in state of scepticism towards large scale fiscal policy intervention ...
- Prejudice robs us of an important policy tool!

Research Question

"What are the effects on growth and public deficits of a large-scale European public investment initiative, targeted at providing critical green infrastructure?"

Our approach to answering this question contributes fourfold to the literature:

1. First attempt to model large-scale fiscal policy intervention (€ 850 bn annually over 12 years) in EU27
2. Study semi-permanent (5 year) intervention in contras to one-off vs permanent shocks
3. Non-linearities in the form of mean shifts allow large sample period of >100 quarters including 2009 crisis
4. Compare effectiveness of coordinate vs uncoordinated fiscal efforts in EU27

Findings

1. Sizeable effects of permanent expansion of public investment: Long run multiplier ≈ 5 (**output and employment dividend**)
2. Public investment to address climate change likely to lower debt to GDP ratios (**public finance dividend**)
3. Between €1.1 and €1.5 additional output per €1 investment with fiscal coordination (**coordination dividend**)

Methodology and Data

Identification

- We estimate recursively identified, semi-structural VAR models
- Main assumption: government investment does not react within quarter to GDP or GDEBT
- Which means our data vector y_t is ordered in the following way:

$$y_t = \begin{bmatrix} GINV_t \\ y_{2,t} \\ y_{3,t} \end{bmatrix} \tag{1}$$

A simple approach to nonlinearities: Step indicator saturation (SIS)

- The 2009 financial crisis + weak recovery poses significant challenge to linear time series analysis
- We model it as exogenous event of historical proportion by means of step indicator saturation (SIS) Castle et al. (2015)
- SIS: saturate the model with step indicators S_i for each quarter t where S_t is equal to 1 from the first quarter up to quarter t and zero afterwards:

$$S_t = (\underbrace{1, \ldots, 1}_{\text{t times}}, \underbrace{0, \ldots, 0}_{\text{T-t times}}) \tag{2}$$

A simple approach to nonlinearities: Step indicator saturation (SIS)

- Thus the system we estimate becomes:

$$B_0 y_t = B_1 y_{t-1} + \cdots + B_p y_{t-p} + m_0 + m_1 t + \sum_{i=1}^{s} m_{2,i} S_i + \omega_t \tag{3}$$

where y_t is a vector of K endogenous variables of the dimensions $K \times 1$, p is the lag length, the B matrices are $K \times K$ coefficient matrics, m_0 is a $K \times 1$ vector of intercepts, m_1 is a $K \times 1$ vector of time trends and $m_{2,i}$ are a $K \times K$ coefficient matrices for s step indicators represented by the $K \times 1$ vectors S_i.

- In model A: $K = 2$ and $y_t = [GINV_t,\ GDP_t]'$
- In model B: $K = 3$ and $y_t = [GINV_t,\ GDP_t,\ GDEBT_t]'$

Semi-permanent IRFs

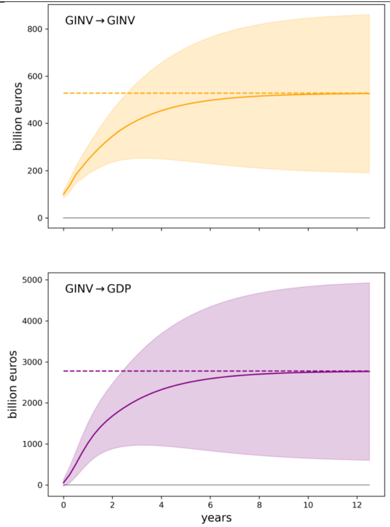
- we distinguish different types of impulse response functions (IRFs):
- In addition to structural (S-IRF) and cumulative structural (CS-IRFs) which represent the response of the system to one-off and permanent shocks respectively ...
- we trace the response of transitory but persistent increase in GINV.
- Specifically an exogenous expansion over 5 years (20 quarters), leading to a total expansion of GINV of €10 trillion over 12 years.
- We can calculate such a **semi-permanent structural IRF** (SPS-IRF) for a period of l quarters as:

$$Y_t - Y_t^p = \sum_{j=0}^{t} \theta_{Y,G,j} - \sum_{j=0}^{t-l-1} \theta_{Y,G,j} = \text{CS-IRF}_{Y,G,t} - \text{CS-IRF}_{Y,G,t-l-1} = \text{SPS-IRF}_{Y,G,t} \quad (4)$$

Results

Cumulative IRFs: Solid lines represent CS-IRFS to a €100 billion increase in GINV in year 0. Dashed lines represent the long-run effect, and shaded areas represent 90% confidence intervals. Responses are depicted as deviations from the baseline trajectories.

model A



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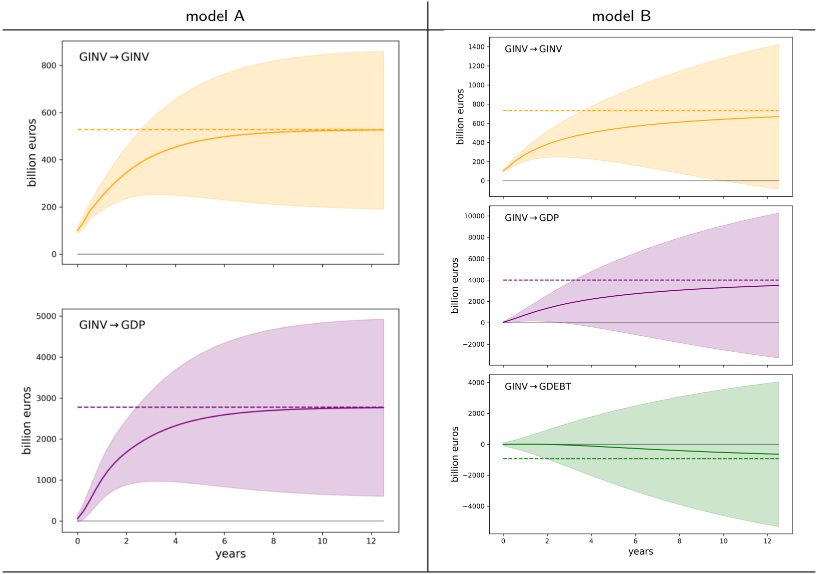


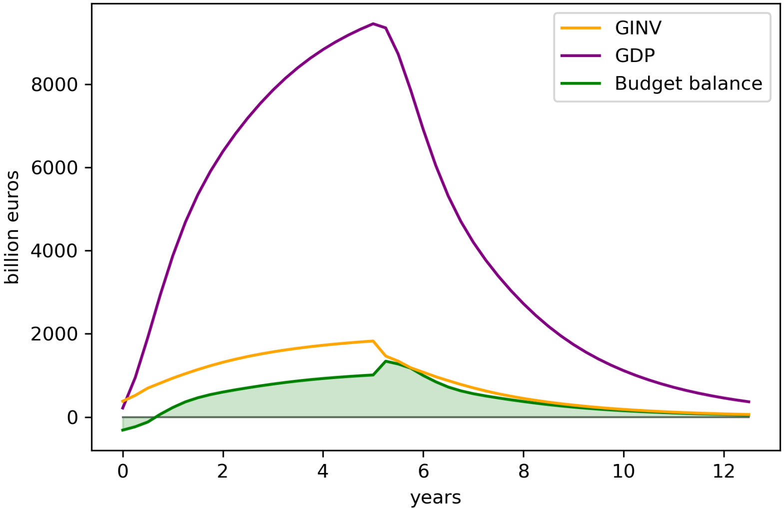
Long run public investment multipliers (LRMs)

Horizon	model A	model B
Impact	0.57	0.56
1 year	4.15	2.70
5 years	5.18	4.62
10 years	5.25	5.12

LRMs are calculated as the ratio of the GDP deviation t years after the investment impulse, relative to the GINV deviation t years after the impulse

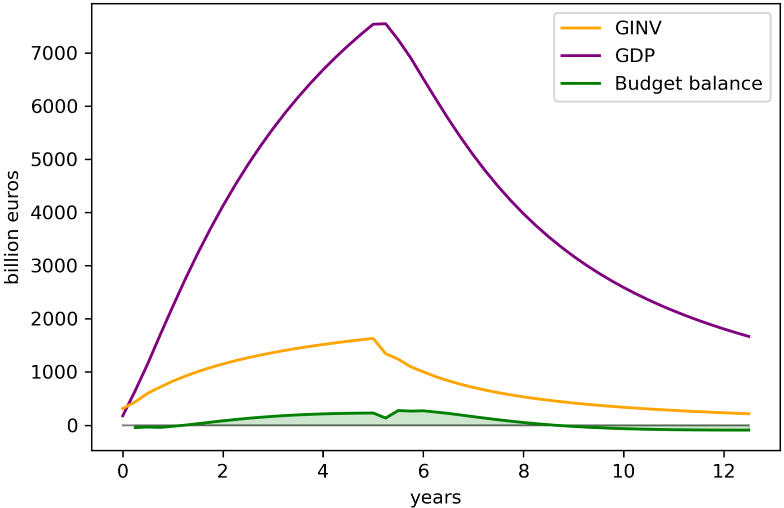
5 year fiscal expansion in model A: $[GINV_t, \ GDP_t]'$

$$\text{Budget balance}_t = 0.3GDP_t - GINV_t$$



5 year fiscal expansion in model B: $[GINV_t,\ GDP_t,\ GDEBT_t]'$

$$\text{Budget balance}_t = GDEBT_{t-1} - GDEBT_t$$



Coordinated vs uncoordinated fiscal policy (model A)

Horizon	(1) EU27 GINV impulse (EU27 data)	(2) country GINV impulse (GDP-weighted)	(3) country GINV impulse (aggregated marg. eff.)
Impact	0.57	1.13	0.51
1 year	4.15	2.99	2.37
5 years	5.18	3.64	3.90
10 years	5.25	3.71	4.14

Conclusion

Conclusion

1. Fiscal policy can be highly effective policy to fight climate change
2. In addition:
    - Macroeconomic impulse of public investment is larger: **output and employment dividend**
    - Long term impact on public finances is positive: **public finance dividend**
    - Coordinating fiscal policy in EU27 makes it more effective: **coordination dividend**

Thank you!

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References I

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Kapeller, J., Leitch, S. & Wildauer, R. (2021), 'A european wealth tax for a fair and green recovery', *Greenwich Papers in Political Economy* (81).

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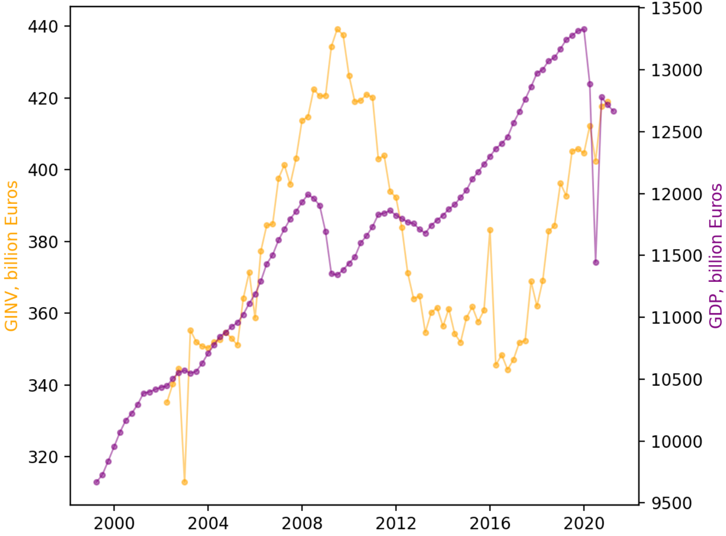
Appendix

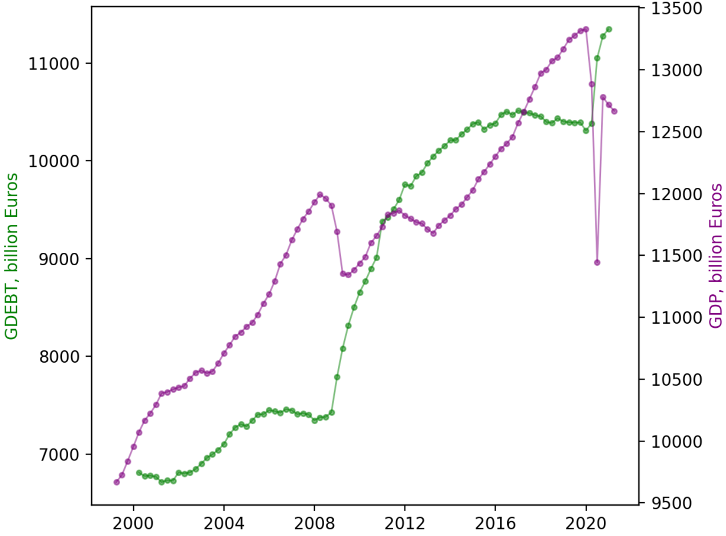
Data

- We use quarterly data from 2002Q1 to 2021Q4 (80 quarters) for GDP, gov. GFCF (GINV) and gov. debt (GDEBT)
- in real terms and logarithms
- from Eurostat tables *namq_10_gdp*, *gov_10q_ggnfa* and *gov_10q_ggdebt* respectively
- GINV and GDEBT: seasonally and calendar adjusted using Python's statsmodels x13 package
- quarterly GDP and GINV series are annualized

Real GDP and GINV



Real GDP and GDEBT



Cumulative IRFs and Permanent Shocks

- Starting from the structural impulse response function (S-IRF) of GDP (Y) in response to a shock to GINV (G) in period t, which yields the deviation from equilibrium of GDP, t periods after an exogenous increase in G occured in period 0 ($\omega_{G,0}$):

$$\text{S-IRF}_t = \frac{\partial Y_t}{\partial \omega_{G,0}} = \theta_{Y,G,t}$$

- We define the cumulative structural IRF as:

$$\text{CS-IRF}_t = \sum_{i=0}^{t} \theta_{Y,G,i}$$

- For an infinite horizon CS-IRF_∞ becomes the effect of a permanent change in G (intercept shift):

$$\text{CS-IRF}_\infty = \sum_{i=0}^{\infty} \theta_{Y,G,i} = \frac{\partial Y_t^*}{\partial m_G}$$

- We can think of cumulative IRFs as tracing a series of shocks through the system. Each of these shocks is identical to the previous one. For each of them we can use a structural IRF and thus summing all of these IRFs up yields a cumulative IRF.
- That provides a clear and intuitive interpretation of cumulative IRFs:

$$\text{S-IRF}_t = \frac{\partial Y_t}{\partial \omega_{G,0}} = \theta_{Y,G,t}$$

$$\text{CS-IRF}_t = \sum_{j=0}^{t} \theta_{Y,G,j}$$

- This also yields a more direct interpretation of the semi permanent IRFs. They are the result of simply tracing a certain number of reoccuring shocks, lets say 5 instead of infinitely many in the standard cumulative IRF.
- This means we can define them as:

$$\text{SPS-IRF}_{Y,G,t} = \sum_{j=t-l+1}^{t} \theta_{Y,G,j}$$

- Another way of looking at it is in a table with time and shocks on the axes:

	$t = 0$	$t = 1$	$t = 2$	$t = 3$
ω_0	θ_0	θ_1	θ_2	θ_3
ω_1		θ_0	θ_1	θ_2
ω_2			θ_0	θ_1
ω_3				θ_0

- Another way of looking at it is in a table with time and shocks on the axes:

	$t=0$	$t=1$	$t=2$	$t=3$	
ω_0	θ_0	θ_1	θ_2	θ_3	CS-IRF $= \sum_{j=0}^{3} \theta_j$

- This is the standard interpretation as summing up the response over time

- There is an equivalent way however which is to interpret cumulative IRFs as permanent shocks

	$t=0$	$t=1$	$t=2$	$t=3$
ω_0	θ_0	θ_1	θ_2	θ_3
ω_1		θ_0	θ_1	θ_2
ω_2			θ_0	θ_1
ω_3				θ_0
				CS-IRF $= \sum_{j=0}^{3} \theta_j$

- Mathematically they are equivalent

- The latter interpretation directly lends itself to the definition of semi-permanent structural IRFs (SPS-IRFs)
- Let's look at an example of a shock which lasts for 2 periods (it occurs in $t = 0$ and in $t = 1$):

	$t = 0$	$t = 1$	$t = 2$	$t = 3$
ω_0	θ_0	θ_1	θ_2	θ_3
ω_1		θ_0	θ_1	θ_2
				SPS-IRF $= \sum_{j=2}^{3} \theta_j$

Long Run Multiplier

- In order to obtain long run public investment multipliers (LRMs) we start by turning cumulative IRFs into marginal effects by multiplying them with the sample average of the response variable GDP (Y):

$$ME_{Y,G,t} = \bar{Y}\theta_{Y,G,t}$$

- We define the long run public investment multiplier (LRM) as the ratio of the GDP deviation t years after the investment impulse, relative to the GINV deviation t years after the impulse:

$$LRM_t = \frac{\sum_{i=0}^{t} ME_{Y,G,i}}{\sum_{i=0}^{t} ME_{G,G,i}}$$