Building Back Better: How Big Are Green Spending Multipliers?

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Nicoletta Batini (IEO, IMF); Mario Di Serio (U. Salerno); Matteo Fragetta (U. Salerno); Giovanni Melina (RES, IMF); Anthony Waldron (U. Cambridge)

Outline

1. **Motivation**
2. Data on green and non-eco-friendly spending
3. Econometric methodology and specification
4. Results
5. Conclusions and policy implications

Can a green recovery be a strong recovery?

- 2020 saw **dramatic cuts in emissions** and **increase in public sensitivity** to climate and biodiversity crises.
- But **climate agenda was derailed**: largest share of fiscal stimuli went to non-eco-friendly industries and habitat encroachments (that triggered COVID) left unaddressed.
- In the post-emergency phase, calls to **build back better,** stewarding the global economy within limits set by nature (Attenborough, 2020; Georgieva, 2020; Guterres, 2020; Stiglitz, 2020; Gates, 2021; Carney, 2021).
- Is there a **tradeoff** for the recovery **between green and strong**?
- **Multiplier analysis** can help us get a handle.

Big gulf

- Global carbon emissions dropped by **6.4% in 2020.**
- To keep global warming well below 1.5C, emissions need to fall **by 7.6 % year-on-year, over the next decade.**
- Energy consumption contributes to around ¾ of all anthropogenic greenhouse gas emissions. We need **double the clean energy investment** of what pledged to stay within 2C.
- In parallel, we are degrading fast all carbon sinks—ocean, forests, mangroves etc. For Paris we need to preserve 30% of our ecosystems but conservation spending is minuscular (0.1-0.2% GWP) and totally incapable at present of inverting this trend. We need **7-10 times more spending on conservation.**

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Unique dataset

- **Variety of green expenditure typologies**—the most impactful:
  - Energy 2/3 total emissions (IEA, OECD-WNA, Lovering et al, 2016);
  - Land use 1/3 total emissions (Waldron et al, 2018; OECD; Searchinger et al., 2020).

(So, both *carbon-neutral* or *carbon-sink* activities)

- **Green spending:**
  - Clean energy (solar, wind—on/offshore, hydro, geothermal, biomass, nuclear);
  - Ecosystem conservation.

- **Non-eco-friendly spending:**
  - Fossil fuels (oil, gas, coal);
  - Subsidies to industrial crop and animal agriculture (ex green shares).

Energy data

- Data on greenhouse gas *emissions* and *climate change* (installed renewable energy plants *capacity*, levelized *cost* of energy (LCOE), and levelized cost of electricity) have become widely available through open sources.

- Data on *investment in green or non-eco-friendly energy* not easy to find (much of it relates to private finance).

- Data used here: **assembled specifically** thanks to the help of various international energy agencies:
  - Clean **renewable energy data**: from the IEA. It consists of estimates of capital spending on power generation using renewable sources for 11 countries or groups.
  - **Non-eco-friendly energy data**: same source and fully comparable. Data cover 2003-2019.
  - Clean **non-renewable energy data**: historical reactor-specific overnight construction cost (OCC) data covering the full cost history for existing nuclear reactors in Canada, France, Germany, Japan, India, South Korea and the United States, i.e., about two-thirds of all reactors globally (Lovering, Yip and Nordhaus, 2016). Extended for this project to include China. Data cover 1971-2017.

Land use data

- Ideally green spending for land use relates to spending on eco-friendly agriculture but this now is only 2-3% of total and no long series available.

- Focus on **spending on biodiversity conservation**.
  - No standardized definition of what constitutes "biodiversity spending", a situation that has led countries to report, a heterogeneous mix of items, under the "biodiversity' flag".

- Use Miller et al. (2012) and Waldron et al (2013, 2017) who define a subset of **"strict" spending that directly conserves biodiversity** (e.g., funding for a nature reserve).
  - 4 sources: domestic governments, international aid (including donations from private foundations), long-term endowment-based systems such as conservation trust funds, and self-funding arrangements (16 countries, 1994-2008).

- For **non-eco-friendly spending** we use the relevant **categories of OECD PSE** from Searchinger et al (2020) (20 countries)—responsible for 2/3 of global agricultural production—for 1997-2016.

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We use panel vector-autoregressive (VAR) models to estimate cumulated spending multipliers.

$$y_{i,t} = \rho_i + \gamma_t + A^1 y_{i,t-1} + \cdots + A^p y_{i,t-p} + B_i x_{i,t} + \varepsilon_{i,t}$$

- To estimate coefficients and residual variance covariance matrix, use Bayesian approach utilizing a traditional Normal-Wishart strategy.

- Cholesky identification: spending variable ordered first.

- For each of 10,000 draws from the posterior distribution, derive IRFs and save median response and the 16th and 84th percentile of distribution.

- Use IRFs to compute *cumulated spending multipliers:* the cumulative change in GDP divided by the cumulative change in spending on energy or land use, at various time horizons (as, e.g., in Gordon and Krenn, 2010; Ramey and Zubairy, 2018).

Availability of green and non-eco-friendly spending data, and macroeconomic data dictates coverage.

Spending Type	Time period	# of countries	Country list	Data sources
Renewable energy	2003-2019	9 + 2 groups	China, Japan, Korea, Canada, United States, Brazil, Indonesia, Mexico, Russia, Oceania group [Australia and New Zeland], EA group [France Germany and Italy]	IEA, IMF's WEO, Thomson Reuters Datastream
Nuclear energy	1991-2017	6	China, France, Japan, Korea, Canada, Usa	OECD-NEA, IMF's WEO, Thomson Reuters Datastream
Fossil fuel energy	2003-2019	9 + 2 groups	China, Japan, Korea, Canada, United States, Brazil, Indonesia, Mexico, Russia, Oceania group [Australia and New Zeland], EA group [France Germany and Italy]	IEA, IMF's WEO, Thomson Reuters Datastream
Green land use	1994-2008	16	BurkinaFaso, Burundi, Cambodia, Cameroon, Central African Republic, Chad, Ghana, Guatemala, Malawi, Mozambique, Niger, Senegal, Sierra Leone, Madagascar, Tanzania, Uganda	Waldron et al. 2018, IMF's WEO, Thomson Reuters Datastream
Non-eco-friendly land use	1997-2016	20	China, Japan, Korea, Canada, United States, Australia, Chile, Indonesia, Mexico, New Zealand, Russia, South Africa, Colombia, Iceland, Israel, Kazakhstan, Norway, Switzerland, Turkey, Ukraine	Searchinger et al. 2020, IMF's WEO, Thomson Reuters Datastream

The specification controls for common factors and expected investment spending.

- For **green and non-eco-friendly energy spending** multipliers:
  - *endogenous variables*: energy investments variable; total investments net of energy investments, real GDP, and common factors from large set of macro variables
  - *exogenous variable:* forecast of time-*t* total investment (gross capital formation), made by the IMF's WEO at time *t-1*.

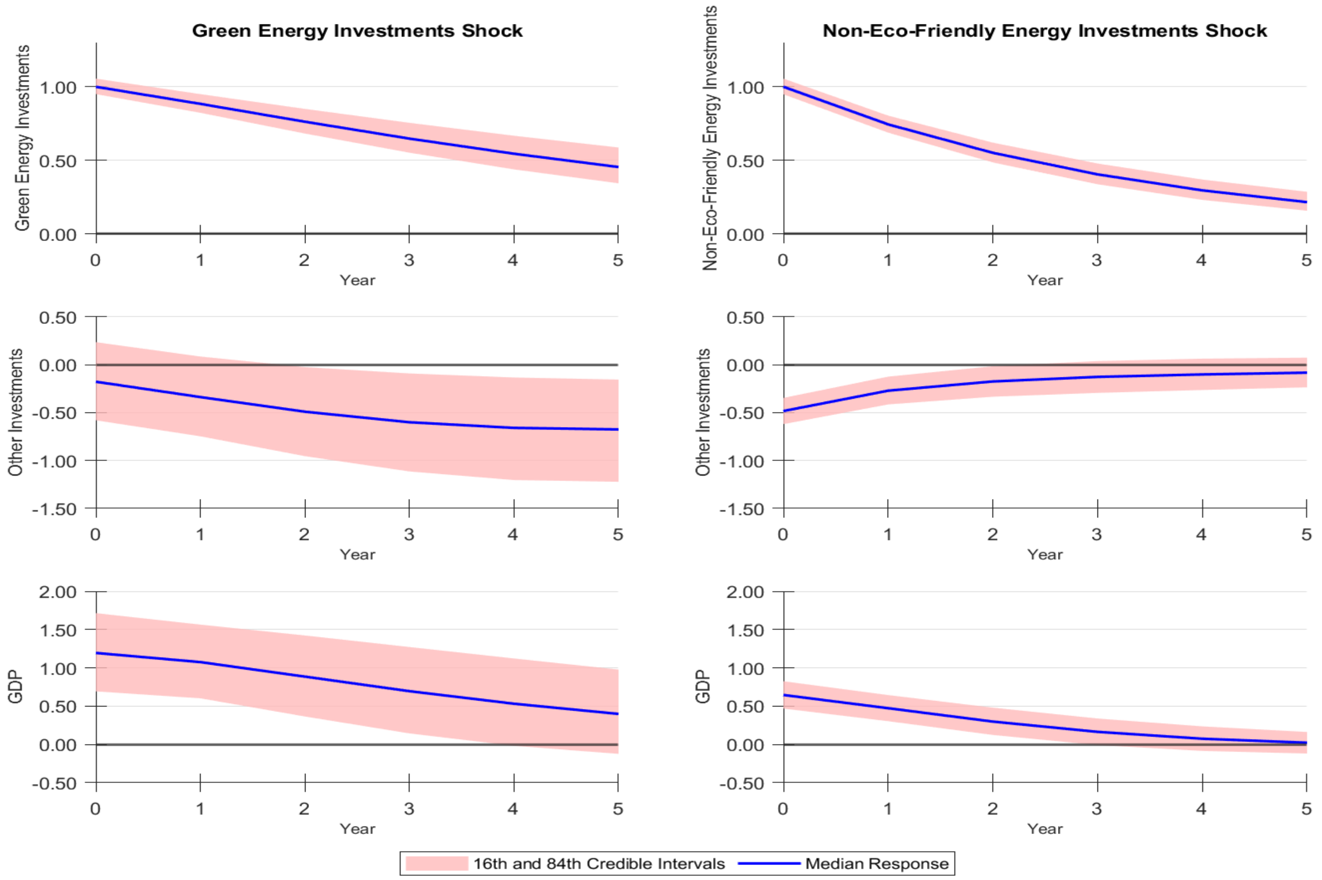
- For **green and non-eco-friendly land-use spending** multipliers:
  - *endogenous variables*: land-use variable spending; real GDP, and common factors from large set of macro variables

- To avoid ex-post conversion of estimated elasticities to dollar equivalents and potential biases in the cumulated spending multipliers: real GPD and spending variables are divided by the real potential GDP of the corresponding countries (as in recent literature on fiscal multipliers).

Outline

The green renewable energy investment multiplier is systematically higher than the non-eco-friendly energy spending multiplier.

Impulse Responses to Green (Renewable) and Non-Eco-Friendly (Non-Renewable) Energy Investment Spending



Note: Blue bold lines represent median responses. Shaded areas represent credible intervals delimited by the 16th and the 84th percentiles.

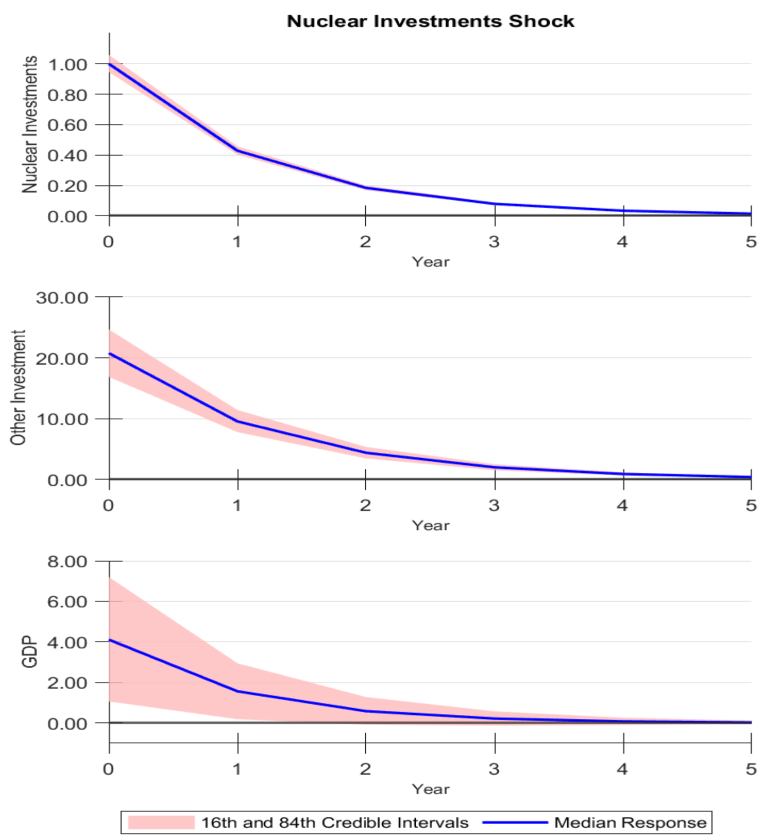
Cumulated Multipliers

Hori-zon	Green Energy Investments Multiplier	Non-Eco-Friendly Energy Investments Multiplier
Im-pact	1.19*	0.65*
1 Year	1.20*	0.64*
2 Years	1.19*	0.62*
3 Years	1.17*	0.59*
4 Years	1.14*	0.55
5 Years	1.11	0.52

Note: * denotes multipliers with credible intervals, delimited by the 16th and the 84th percentiles, that exclude zero.

Nuclear energy investment spending has a large output multiplier, significant in the short run.

Impulse Responses to Nuclear Energy Investment Spending



Note: Blue bold lines represent median responses. Shaded areas represent credible intervals delimited by the 16th and the 84th percentiles.

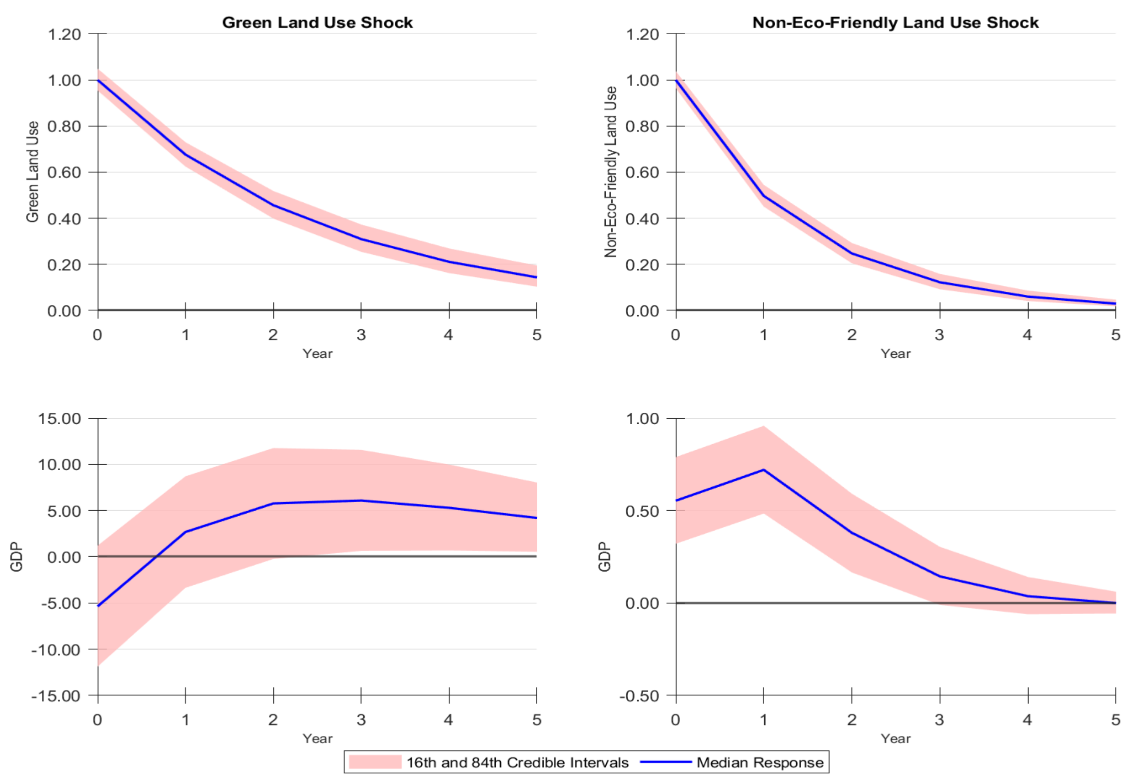
Cumulated Multipliers

Horizon	Nuclear Energy Investments Multiplier
Impact	4.11*
1 Year	3.97*
2 Years	3.88
3 Years	3.83
4 Years	3.80
5 Years	3.78

Note: * denotes multipliers with credible intervals, delimited by the 16th and the 84th percentiles, that exclude zero.

Green land-use spending multipliers are very large and outperform non-eco-friendly land-use multipliers in the medium term.

Impulse Responses to Green (Renewable) and Non-Eco-Friendly (Non-Renewable) Energy Investment Spending



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Cumulated Multipliers

Hori-zon	Green Land-Use Spending Multiplier	Non-Eco-Friendly Land-Use Spending Multiplier
Im-pact	-5.36	0.55*
1 Year	-1.60	0.85*
2 Years	1.45*	0.95*
3 Years	3.75*	0.96*
4 Years	5.45*	0.95
5 Years	6.67*	0.94

Note: * denotes multipliers with credible intervals, delimited by the 16th and the 84th percentiles, that exclude zero.

Existing bottom-up and input-output analyses confirm significant economic benefits of green spending.

- **Renewable energy:**
  - spending in clean energy may beat job creations from spending on fossil fuels by a ratio of 3:1 (Pollin et al., 2009; Garrett-Peltier, 2017; WRI, 2020b);
  - doubling the share of renewables by 2030 would increase global GDP by up to US$ 1.3 trillion compared to business as usual (IRENA, 2016);
  - in Europe, every €1 spent in clean energy could generate some €2 to €3 of GVA (McKinsey, 2020b).

- **Nuclear energy**
  - 1$ spent by the average reactor results in the creation of US$1.04 in the local community, US$1.18 in the state economy and US$1.87 in the U.S. economy NEI (2014);
  - nuclear spending has added more value in GVA terms than the value associated by similar expenditure in non-eco-friendly energy (IEAE, 2009).

- **Green land use**
  - protecting 30 percent of the world's land and ocean provides greater benefits than the *status quo*, both for economies and ecosystems; revenues associated with protected areas outweigh costs by a factor of at least 5:1 (Waldron et al., 2020).

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Conclusions and policy implications

- Post-COVID-19 economic recovery stimulus packages provide a unique opportunity to build back better and shape a more resilient and sustainable future.

- Strong empirical evidence that **spending on measures targeting good environmental outcomes** (clean energy and ecosystem conservation):
  1. can produce **more growth** than environmentally-detrimental measures, *and*
  2. are **economically sustainable** because they end up producing more GDP than they initially demand.

- Investments that favor decarbonization and carbon-capture through nature-based solutions is good for the planet *and* promises to be the cheapest and shortest route back to a prosperous global economy.

Thank you!