Greening the COVID-19 Economic Recovery: Lessons from the Financial Crisis

Karol Kempa[a] and Ashish Tyagi[a]

a: Frankfurt School of Finance and Management

IAEE Online Conference 2021
The Cyberspace, 7 June 2021

COVID19 Pandemic and Fiscal Spending

- The global economic downturn caused by the COVID-19 pandemic is the worst since the Great Depression.
- Gloabl economy shrank by 3.5%; losses particularly high in advanced economics with 4.9% (IMF, 2021).
- Massive fiscal spending as a reaction: USD 16.58 Trillion in 50 leading economics according to the Oxford University Economic Recovery Project (OUERP, 2021).
- In the short run, Corona dominated political and administrative action with environmental priroties fading into the background (Helm, 2020).
- Main focus: immediate health and economic crises caused by the pandemic and the required lockdown measures.
- Little of the fiscal spending was directed at green investments such as clean energy or pollution abatement (Barbier, 2020).

Greening the Recovery

- During the crisis, the focus shifted towards challenge of a long-term recovery; so far, USD 2.16 Trillion (OUERP, 2021).
- Increasing number of calls from economists, climate activists, journalists, etc. for an economic recovery is in line with the transition towards sustainable low-carbon economy (Hepburn et al., 2020).
- Emission reductions during the crisis, around 4% in 2020 compared to 2019 (Le Quéré et al. 2020), very likely only temporary.
- Around 19% of recovery spending, or 2.5% of total spending, is expected to enhance sustainability (green spending) (O'Callaghan & Murdock, 2021).

$\Rightarrow$ How important is a green economic recovery for the transition towards sustainable low-carbon economy?

Lessons from the Financial Crisis

This paper analyses the environmental impacts of green stimulus measures based on the experience from the Financial Crisis:

- Between 2008 and 2010, major economies spend more than USD 3.3 Trillion on stimulus packages with 16% devoted to green measures such as low-carbon energy, energy efficiency, recycling, and pollution abatement (Barbier, 2016).
- In contrast to COVID-19 recovery, long term effects can be analysed.
- Several studies have analyzed or discussed the impacts of these measures in order to derive lessons learned for the post-pandemic recovery (e.g., Barbier, 2020; Jäger et al., 2020; Kröger et al., 2020).
- However, systematic empirical analyses of the impacts of economic stimulus packages on investments or environment are lacking.

This paper uses a panel of OECD countries to answer:

$\Rightarrow$ What is the impact of green recovery spending the environment?

$\Rightarrow$ Is there an impact of recovery spending dedicated to renewable energy on RE investments?

Green Stimulus Spending after Financial Crisis

- Our main data source is Barbier (2016):
  - Total recovery spending and its timing in G20 countries.
  - Green stimulus differentiated into several sub-categories, e.g. low-carbon energy, energy efficiency, or water, waste, and pollution management and control.
- Extension the dataset based on data from other studies (e.g. Pollitt, 2011, Strand & Toman, 2010) and various government reports and documents.

$\Rightarrow$ Sample of 27 OECD countries.

Green Stimulus Spending: COVID-19 Crisis

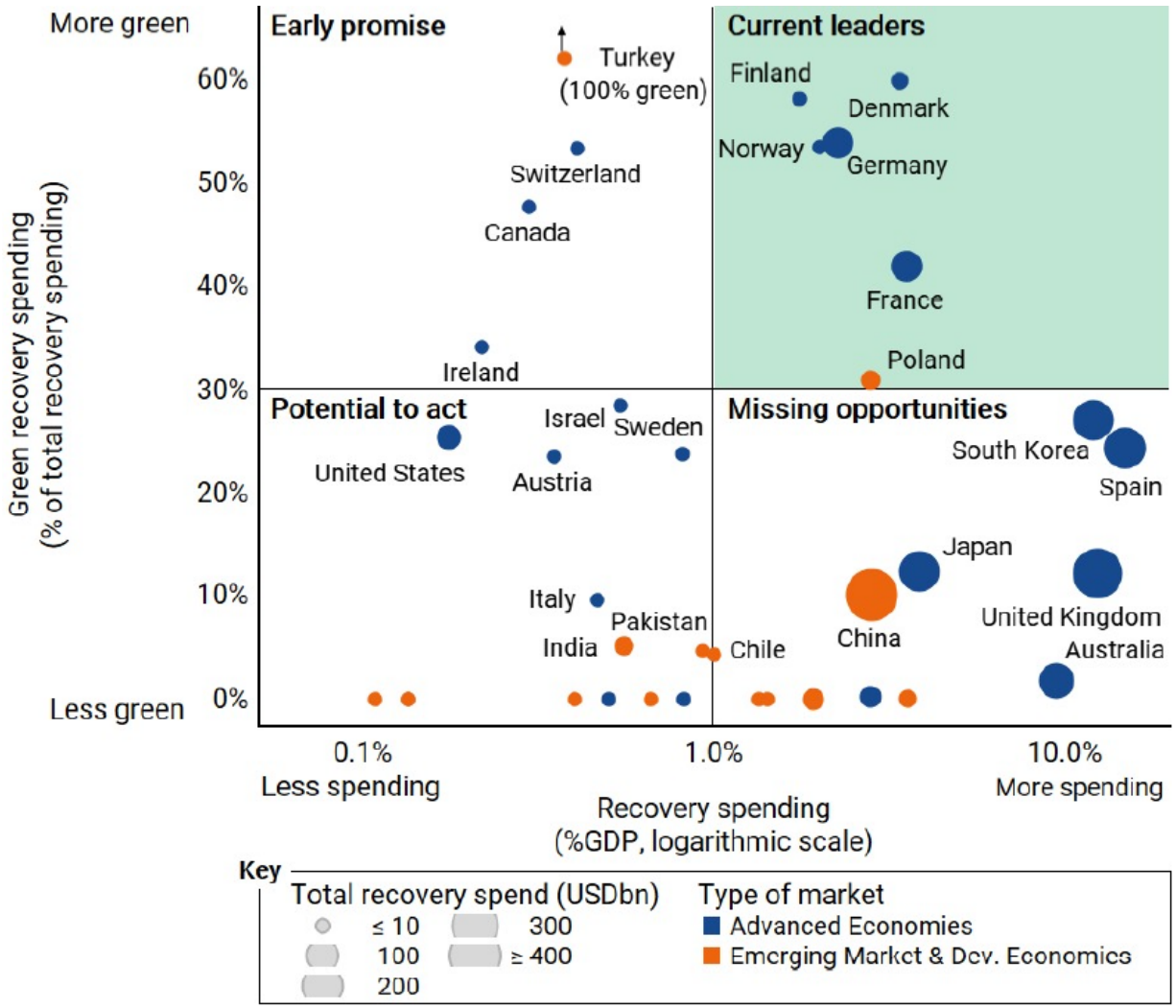

Figure 1: COVID-19 crisis green recovery spending as a percentage of total recovery spending versus recovery spending as percentage of GDP.

Green Stimulus Spending: Financial Crisis

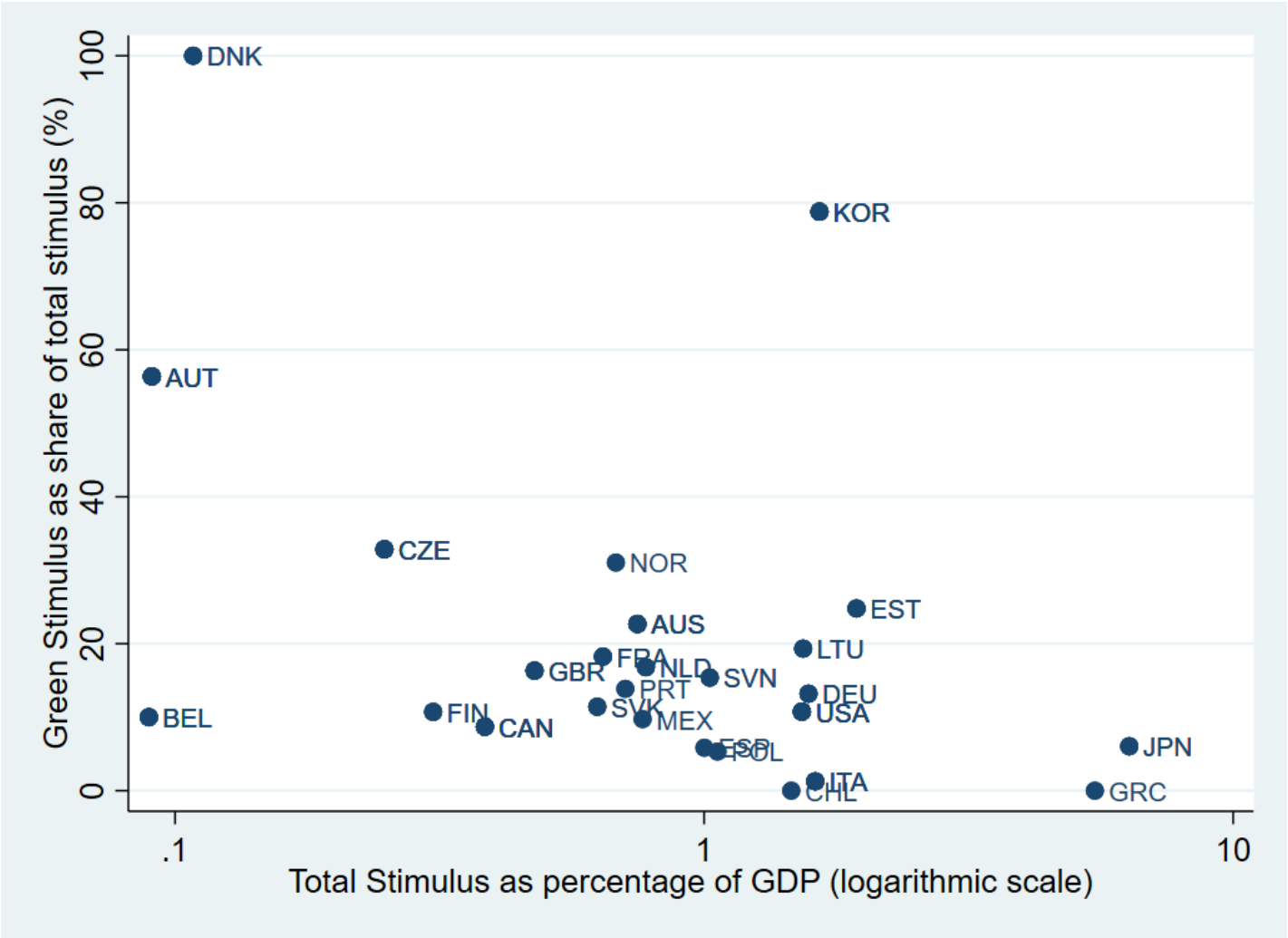

Figure 2: Financial Crisis green recovery spending as a percentage of total recovery spending versus recovery spending as percentage of GDP.

RE Investment, Environmental Impact, and Controls

Renewable energy (RE) investment (2000-2019):

- Data source: Bloomberg New Energy Finance (BNEF).
- BNEF contains project-level data on investments in utility-scale renewable energy plants that we aggregate to annual national investments.
- Investment deal recorded at financial close, i.e. closer to investment decision than other measures of RE deployment (e.g. $\triangle$ capacity).

Environmental impacts (2000-2016):

- World Bank data on CO2 emissions per capita.
- Ecological footprint of production per capita form the Global Footprint Network.

Control variables:

- Data for controls, such as GDP, energy use, and manufacturing/services value added, are obtained from World Bank.

Descriptive Statistics

Table 1: Descriptive Statistics

	Obs.	Mean	SD	Min	Max
CO2 Emissions p.c. (Metric tons)	455	8.90	3.83	2.68	20.2
Ecol. Footprint of Prod. p.c. (gha)	459	5.93	3.04	2.09	14.2
GDP p.c. (constant 2010 USD)	540	34129.2	18526.8	6928.3	92556.3
Energy Use p.c. (kg of oil equiv.)	430	3971.9	1656.2	1516.6	8455.5
Manufacturing VA (share of GDP)	534	14.9	4.79	5.65	28.2
Services VA (share of GDP)	534	62.3	5.90	47.2	77.6
Urban population share	540	75.4	11.1	50.8	98.0
Green Stimulus Share	520	0.21	0.23	0	1
RE Stimulus (Dummy)	540	0.44	0.50	0	1

Empirical Approach

- Almost all countries in the sample have some green recovery spending.
- We analyse the impact of the share of green stimulus on CO2 per capita the ecological footprint of production per capita.

- **Model 1: Are there any lasting environmental impacts of green recovery spending?**

$$\begin{aligned} ENV_{it} = \beta_0 + \beta_1 STIM_{it} + \beta_2 POST_{it} + \beta_3 STIM_{it} \times GREEN_i \\ + \beta_4 POST_{it} \times GREEN_i + \beta_5 X_{it} + \mu_i + \varphi_t + \varepsilon_{it}, \end{aligned} \tag{1}$$

  - ENV_{it} : CO2 emissions / Ecological footprint in country i at time t,
  - $GREEN_i$: green stimulus as a share of total stimulus spending,
  - $STIM_{it}$: dummy equal to one for stimulus period,
  - $POST_{it}$: dummy equal to one for post stimulus period,
  - X_{it} : control variables.

Environmental Impacts of Green Stimulus

Table 2: Environmental Impacts of Green Stimulus: Fixed Effects Estimates

	(1) CO2 Emissions		(2) Ecol. Footprint of Prod.	
GDP p.c. (constant 2010 USD)	0.0001**	(0.0000)	-0.0000	(0.0000)
Energy Use p.c. (kg of oil equiv.)	0.0026***	(0.0002)	0.0008***	(0.0003)
Manufacturing VA (share of GDP)	0.0542	(0.0516)	0.1382**	(0.0576)
Services VA (share of GDP)	-0.0312	(0.0271)	0.0040	(0.0377)
Urban population share	0.0844***	(0.0290)	-0.0015	(0.0265)
Stimulus Period	-1.1030***	(0.3461)	-0.0153	(0.2972)
Post Stimulus Period	-0.8542**	(0.3065)	0.1690	(0.2982)
Stimulus Period × Green Stimulus Share	-0.5569**	(0.2172)	-0.3798**	(0.1714)
Post Stimulus Period × Green Stimulus Share	-1.3286***	(0.2060)	-0.9136***	(0.1966)
Observations	413		415	
R^2	0.855		0.517	

Estimates include year-fixed effects.
Robust standard errors clustered at firm level in parentheses.
* $p < .1$, ** $p < .05$, *** $p < .01$.

Empirical Approach

- Green stimulus data contains the information how much stimulus was allocated to renewable energy.
- Less than half of the countries in the sample had spending on low-carbon power, such that the other countries can be used as a control group.

Empirical Approach

- Green stimulus data contains the information how much stimulus was allocated to renewable energy.
- Less than half of the countries in the sample had spending on low-carbon power, such that the other countries can be used as a control group.

- **Model 2: Does RE recovery spending impact RE investment?**

$$REINV_{it} = \beta_0 + \beta_1 STIM_{it} + \beta_2 POST_{it} + \beta_3 STIM_{it} \times RE_i + \beta_4 POST_{it} \times RE_i + \beta_5 X_{it} + \mu_i + \varphi_t + \varepsilon_{it}, \quad (2)$$

  - $REINV_{it}$: Renewable energy investment in country i at time t,
  - RE_i : dummy equal to one for countries with RE stimulus spending,
  - $STIM_{it}$: dummy equal to one for stimulus period,
  - $POST_{it}$: dummy equal to one for post stimulus period,
  - X_{it} : control variables.

The Impact of Renewable Energy Stimulus on Investments

Table 3: The Impact of Renewable Energy Stimulus on Renewable Investments: Fixed Effects Estimates

	(1) Renewables	(2) Wind	(3) Solar	(4) Biomass
GDP p.c. (constant 2010 USD)	0.0025	0.0016	0.0009*	-0.0001
	(0.0021)	(0.0017)	(0.0005)	(0.0005)
Manufacturing VA (share of GDP)	-5.8780**	-4.8020**	-0.9465	0.1245
	(2.3129)	(2.1773)	(1.1873)	(0.8040)
Services VA (share of GDP)	1.3705	0.9238	1.4136	-0.8546
	(3.9313)	(3.6682)	(1.1884)	(0.7658)
Stimulus Period	13.8668	-1.9023	20.0437	-2.4549
	(30.4762)	(26.0163)	(12.4483)	(6.2632)
Post Stimulus Period	-16.4697	-7.5371	-5.9895	-1.1761
	(21.7369)	(19.1052)	(5.8031)	(4.3788)
RE Stimulus × Stimulus Period	-18.5615	7.6217	-24.2806**	-1.4958
	(15.6092)	(10.3760)	(10.6219)	(4.3068)
RE Stimulus × Post Stimulus Period	43.7633**	27.5154*	8.8832	6.5406
	(18.6632)	(14.3462)	(6.2237)	(4.4504)
Observations	534	534	534	534
R^2	0.234	0.178	0.151	0.075

Estimates include year-fixed effects.
Robust standard errors clustered at firm level in parentheses.
* $p < .1$, ** $p < .05$, *** $p < .01$.

Preliminary Conclusions

- Overall, CO2 emissions per capita decreased after the financial crisis; the ecological footprint of production did not.
- Higher green stimulus spending yields:
  1. additional CO2 emission reductions and
  2. a lower ecological footprint of production in the post stimulus period.
- RE Investments recovered relatively quickly after the Financial Crisis.
- Dedicated stimulus packages, however, resulted in higher renewable energy investments in the post stimulus period.
- Overall, the findings seem to indicate that type of stimulus spending has persistent impacts, which stresses the importance of greening the post-COVID19 recovery to enable the transition towards sustainable low-carbon economy.

Thank you for your attention!

k.kempa@fs.de