The Political Economy of Green Stimulus Spending: Evidence from the Global Financial Crisis and the Covid-19 Crisis

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Abstract

The 2008 Global Financial Crisis and the 2020 Covid-19 pandemic triggered large economic stimulus packages in most countries. While aimed primarily at saving the domestic economy from widespread bankruptcies and mass unemployment, these stimulus packages also offered governments windows of opportunity for pivoting towards decarbonization. Drawing on a new dataset covering 40 of the world's largest economies' stimulus spending during the two crises, this article addresses two questions: 1) Did the allocation towards green investments increase in government stimulus packages from the Global Financial Crisis to the Covid-19 downturn? 2) What country characteristics are associated with green stimulus spending in each crisis? Grounded in distributive-conflict theory, we hypothesize that the relative strength of green and fossil stakeholders in the economy is decisive in shaping climate policy outcomes. Consistent with this theory, our empirical analysis reveals (1) a (small) uptick in net green spending from 2008 to 2020 and (2) that robust green economic interests are a significant predictor of green stimulus spending. However, fossil fuel interests did not exert a proportional influence on stimulus allocations. Notably, our research uncovers a pattern of path dependency, with countries leading in green stimulus spending during the Global Financial Crisis maintaining this position also through the Covid-19 pandemic. Overall, this article contributes a new comprehensive assessment of environmental policy outcomes during economic crises.

1. Introduction

The economic downturns brought about by the 2008 Global Financial Crisis and the 2020 Covid-19 pandemic triggered governments worldwide to adopt large stimulus packages. While aimed primarily at saving the domestic economy from widespread bankruptcies and mass unemployment, these stimulus packages also presented governments with unique opportunities to instigate structural changes in their countries' economies by investing in decarbonization.

A growing body of political science literature views economic crises as potential catalysts for climate action (Aklin & Urpelainen 2018; Barbier 2010; Blazquez, Galeotti, & Martin-Moreno 2021; Gawel & Lehmann 2020; Geels 2013; Gusheva & de Gooyert 2021). Stimulus spending during economic crises offers governments a chance to enhance decarbonization through investments that can sustainably shift their economies away from fossil fuels and thereby reduce greenhouse gas emissions (Tienhaara 2014; Burns and Tobin 2016).

We contribute to this literature by examining variation in green and fossil stimulus spending across 40 of the largest economies in the world, spanning two economic crises. Our analysis draws on a new dataset that covers the stimulus packages of 39 countries and the EU in response to the 2008 Global Financial Crisis and to the economic downturn following the 2020 Covid-19 pandemic.

Based on the distributive-conflict perspective in the climate politics literature, we theorize that the emissions profiles of economic stimulus packages depend on the relative political influence of green and fossil economic stakeholders (Aklin & Mildenberger 2020, 2022; Colgan, Green & Hale 2020; Hughes and Urpelainen 2015). Between the two crises, the relative prowess of green economic stakeholders surged globally, whereas that of their fossil counterparts declined. Thus, we expect an overall rise in the share of green spending in governmental stimulus packages from 2008 to 2020. We also anticipate that countries with more influential green economic sectors allocate a higher proportion of their stimulus budgets to green initiatives than those that are more strongly dominated by fossil fuel interests.

We thus aim to answer two research questions: First, did the share of green spending in governments' stimulus packages increase from the Global Financial Crisis to the Covid-19 economic downturn? And second, which country characteristics are associated with green stimulus spending across these two economic crises?

Our empirical analysis renders three main findings. First, in line with the distributive-conflict perspective, net green spending in economic stimulus packages increased from 2008 to 2020; however, this increment was rather modest. Overall, very few countries in our sample devoted substantial shares of stimulus spending to advance a climate agenda in either crisis, challenging the idea that economic crises are critical junctures for the advancement of climate policy (e.g., Bowen and Stern 2010; Tienhaara 2014; Burns and Tobin 2016; Aklin & Urpelainen 2018).

Second, countries with strong green industrial interests adopt more emissions-decreasing measures in their economic stimulus packages. This finding, too, aligns with distributive-conflict theory. More surprisingly, countries with strong fossil-fuel interests do not allocate a greater share of their stimulus spending to emissions-increasing purposes than other countries do. Contrary to the notion that fossil-fuels interest groups capture the policymaking process through lobbying, our analysis reveals no clear association between a country's fossil fuels production and its levels of fossil stimulus spending.

Finally, our analysis indicates that the frontrunners of green stimulus spending remained largely consistent between the Covid-19 crisis and the Global Financial Crisis. This finding suggests the presence of significant path dependencies in countries' stimulus spending. Even when controlling for a range of country characteristics, the emission profiles of stimulus packages during the Global Financial Crisis explain a substantial amount of cross-country variation in the emission profiles of countries' Covid-19 packages.

This article provides a novel evaluation of climate policy outcomes amid economic crises, complementing existing literature in at least two main ways. First, our article offers a new empirical test of the theorized link between exogenous shocks to the economy and the advancement of climate policy (Aklin & Urpelainen 2018; Barbier 2010; Blazquez, Galeotti, and Martin-Moreno 2021; Gawel and Lehmann 2020; Geels 2013; Seto et al. 2016; Hepburn et al. 2020; Gusheva and de Gooyert 2021), using more comprehensive and systematic data than existing studies do. Notably, we leverage a novel dataset that covers stimulus spending in 40 of the world's largest economies during both the 2008 Global Financial Crisis and the Covid-19 crisis, which facilitates an in-depth investigation into how the determinants of green stimulus spending evolved between these two major crises. Furthermore, it enables us to extend the analysis beyond the scope of the G20 nations, which is typically the focus of previous studies (e.g., Quitzow et al. 2021; Nahm et al. 2022).

Second, our article contributes a systematic evaluation of the widely held assertion that governments' climate policy preferences are shaped by conflicts between pro- and anti-climate reform interests (Aklin & Mildenberger 2020). While recent research has convincingly traced this mechanism in case studies of climate policy regulation (e.g, Breetz et al. 2018; Mildenberger 2020), we conduct a macro-level evaluation of the overarching patterns between countries' economic structure and their stimulus spending choices. By focusing on how distributive conflict shapes climate spending decisions rather than regulation, this article offers insights for the burgeoning literature on investment-based climate politics (Armitage et al. 2023; Darvass and Wolf 2023) and green industrial policy (Allan et al. 2021).

The remainder of this article is organized as follows. In section 2, we explain the general theory behind crises as opportunities for decarbonization, including how green stimulus spending differs from regular climate policy. Based on the distributive-conflict perspective, we also develop two hypotheses about green stimulus spending. In section 3, we describe our data and methods. In section 4, we report our empirical results. Finally, in section 5 we discuss our findings and conclude.

2. Theory

2.1 Economic crises as windows of opportunity for the green transformation

Historically, economic downturns have primarily been seen as obstacles to environmental policy progress. Indeed, ever since the Industrial Revolution, economic growth has been associated with an increase in emissions of greenhouse gases. Thus, before the turn of the century, climate policy debates typically stressed the presence of a conflict between climate and environmental policy on one hand and economic growth on the other (see Meckling and Allan 2020).

However, technological developments combined with replacing fossil fuels with clean energy can make high growth rates more sustainable (Fouquet 2019). In recent decades, several high-income countries have proved able to reduce their greenhouse-gas emissions while upholding high growth rates. This development shows that a decoupling of emissions from growth might in fact be possible, for example through transitioning away from coal,

adopting clean energy, imposing climate policies, and restructuring towards a more service-based economy.[1]

In parallel with these developments, a new narrative emerged in the mid-2000s, centering around the concept of green growth. Highlighting the possibility of *complementarity* between climate policy and economic progress (Meckling and Allan 2020), this perspective depicts economic downturns as potential catalysts for redirecting economic development in a more sustainable direction (Aklin & Urpelainen 2018; Barbier 2010; Blazquez, Galeotti, and Martin-Moreno 2021; Gawel and Lehmann 2020; Geels 2013; Hepburn et al. 2020; Gusheva and de Gooyert 2021; Seto et al. 2016). According to this more recent narrative, events like the Global Financial Crisis and the Covid-19 crisis function as external shocks to the economy that create windows of opportunity for setting off – or accelerating – the green transformation (Aklin & Urpelainen 2018).

This change in narrative became evident during the 2008–2009 Global Financial Crisis, which saw a new focus on the implementation of green industrial policy and green Keynesianism in economic stimulus packages (Hepburn et al. 2020; Meckling and Allan 2020). Although primarily aimed at saving the domestic economy from widespread bankruptcies and mass unemployment, economic stimulus packages also offer governments an opportunity to invest in decarbonization through structural changes in the economy – changes that can help reduce emissions and sustainably shift the global economy away from fossil fuels (Bowen and Stern 2010; Tienhaara 2014; Burns and Tobin 2016).

Traditional regulatory mitigation policies tend to impose concentrated costs on industries and businesses (e.g., renewable energy standards) or on consumers (e.g., gas taxes) (see, e.g., Mildenberger 2020). In contrast, green stimulus spending typically provides concentrated benefits to at least one and sometimes both types of actors in the form of subsidies, investments, or tax relief. A potential upside of relying on positive rather than negative incentives is that the former will more likely garner political support. While businesses face incentives to lobby against cost-inducing climate policies, and disadvantaged consumers might express disapproval of negative incentives at the ballot box, green stimulus spending will more likely mobilize political support from specific economic groups (Meckling 2021; Meckling et al. 2022).

[1] https://www.lse.ac.uk/granthaminstitute/explainers/can-we-have-economic-growth-and-tackle-climate-change-at-the-same-time/

In the green industrial policy literature, a key idea holds that it is better to start climate action with green spending initiatives that help build supportive coalitions than to start with market-based policies that could create political backlash. Moreover, empirical research has shown that green industrial policy can facilitate environmental goals, such as GHG emissions reductions, as well as the adoption of environmental policies, such as carbon pricing (Meckling et al. 2015; Meckling 2021).

Beyond case studies, prior efforts to elucidate cross-country disparities in green spending during economic crises have been scant. An important exception is Quitzow et al. (2021), who analyze green stimulus spending directed towards the energy supply sector in G20 countries during the Covid-19 crisis. They identify an institutional lock-in effect whereby existing trends are reinforced, leading to a widening gap between leaders and laggards in the energy transition. Renewable energy leaders continue the deployment of green energy and divest from coal, whereas countries with a strong lock-in in fossil-fuel industries direct stimulus spending at propping up those industries.

Andrew et al. (2022) also analyzed Covid-19-related stimulus spending in the G20 but with a broader lens. Their findings highlight a relationship between a country's green spending and various factors, such as GDP per capita and the severity of the pandemic's impact. They also find some evidence that green spending is positively related to renewable-energy consumption (as a share of total energy consumption) and negatively related to emissions intensity.

2.2 GFC vs COVID stimulus packages: expectations for overall spending

Shortly after it became clear that the COVID-19 crisis would entail adverse consequences for the global economy, policymakers around the world began designing Keynesian stimulus packages, seemingly drawing inspiration from strategies deployed to mitigate the Global Financial Crisis of 2008-09. The interim decade between the two crises witnessed major shifts in the global climate policy landscape: the nearly universal ratification of the Paris Agreement, the growing recognition of climate change as a pressing issue, plummeting renewable energy costs, and a significant surge in global renewable energy production.[2]

[2] Global renewable energy production had almost doubled in absolute terms (https://www.statista.com/statistics/1029063/renewable-energy-production-globally/) increasing its share of total energy production from 8.7% to 11.2% (see: https://www.c2es.org/cleaontent/renewable-energy/)

Consequently, the 2020 discourse around green stimulus was more pronounced in 2020 than in 2008–2009.

Apart from the changed climate policy landscape, the nature and economic implications of the Global Financial Crisis and the Covid-19 were also distinct. First, the Global Financial Crisis originated in financial markets and erupted in the United States as the value of mortgage-based securities tied to American real estate collapsed. In the first phase of the economic rescue efforts, many governments were compelled to bail out financial institutions that were "too big to fail", rather than to help consumers directly. In contrast, the economic downturn from Covid-19 was a direct consequence of a public health crisis, causing widespread disruptions in the real economy. It was spurred by governmental responses to a public health emergency, including lockdowns that prohibited consumers from conducting regular activities that contribute to economic activity.

Second, the pandemic's impact was more uniformly felt across countries, with more severe effects on unemployment levels and GDP growth. In contrast, countries varied significantly regarding how hard the Global Financial Crisis struck. Third, central banks played a more pronounced role in mitigating the Global Financial Crisis than they did under Covid-19. With already low interest rates at the onset of Covid-19, central banks had limited tools at their disposal, putting the onus on governments to adopt substantial fiscal spending packages. Finally, and related to the previous point, the Covid-19 stimulus packages were generally around four times bigger in real terms than the corresponding packages under the Global Financial Crisis, allowing for more discretion in spending allocations under Covid-19. Overall, these differences between the two crises lead us to expect that countries allocated a greater share of their stimulus spending to green objectives during the Covid-19 crisis than during the Global Financial Crisis.

2.3 Distributive conflict and cross-country variation in green crisis spending

Theoretically, our work leverages green spending during economic crises to assess whether and how investments in climate mitigation can be explained by the relative strength of green and fossil economic stakeholders in society (Aklin & Mildenberger 2020, 2022; Colgan, Green & Hale 2020; Hughes and Urpelainen 2015). The recent 'distributive conflict' perspective in climate policy research argues that divisions in the material interests of political and economic stakeholders trigger distributive conflict over climate policymaking (Aklin & Mildenberger 2020). The essence of the distributive-conflict perspective is succinctly

summarized by Aklin & Mildenberger (2020: 5), who postulate that "governments' preferences are shaped by conflicts between pro- and anti-climate reform interests" and that "climate policies create new economic winners and losers". Moreover, "sharp divisions in the material interests of political and economic stake-holders trigger subsequent distributive conflict over climate policy making." In line with this perspective, the gist of our theoretical argument is that the relative strength of different domestic economic interests shapes governments' ability to combine economic recovery and decarbonization efforts.

Under distributive politics, the structural composition of the domestic economy constitutes an important factor for explaining when interest groups favoring investments in clean-energy industries (and climate policy more broadly) are likely to prevail. The relative balance of fossil-fuel versus green-technology interests determines the size and political clout of vested-interest opposition to green measures (Meckling et al. 2015; Stefes 2020). A domestic economy dominated by actors invested in fossil fuels will likely generate substantial opposition against green stimulus packages and strong demands for using economic stimulus funds to bolster the competitiveness of incumbents in high-emitting industries (Aklin and Urpelainen 2013; Tvinnereim and Ivarsflaten 2016). Conversely, economies in which sizeable industries likely to benefit from green stimulus measures have already been developed, for instance as a result of previous industrial policies, will likely face less interest-group opposition against – and more interest-group support for – investments in green sources of economic growth (Meckling et al. 2017).

The distributive-conflict perspective also emphasizes that we should expect cross-country variation concerning how climate politics develops over time. Such variation is partly driven by differences in economic interests – differences that to a large extent are determined by the strength of fossil-fuel asset holders relative to climate-vulnerable and clean-energy asset holders in the various countries (Aklin & Mildenberger 2020; Colgan et al. 2021). We hence hypothesize that the relative centrality of green and fossil industries in a country's economy influences the degree to which the country concerned devotes stimulus spending toward green or fossil measures during the two economic crises. More specifically, we expect countries with strong green industrial interests to adopt a higher share of emissions-reducing measures in their stimulus spending packages. Conversely, we expect countries with strong fossil interests to devote a higher share of stimulus packages toward emissions-increasing causes.

3. Data and method

Our analysis is based on a novel dataset covering stimulus spending efforts in 40 economies (39 countries + the EU) during the Global Financial Crisis and the COVID-19 crisis. Our dataset provides comprehensive information on (announced) stimulus spending in the world's 40 largest economies, including the likely greenhouse gas emissions impact of all spending measures passed during the two recessions. We label spending measures that likely generated decreased greenhouse gas emissions as 'green' spending and measures that likely increased greenhouse gas emissions as 'fossil' spending. Our measure of green spending is focused on climate impacts rather than broader environmental impacts. We limit our analysis to governments' announced spending amounts: We neither evaluate the actual implementation trajectories of spending measures nor attempt to quantify the amount of greenhouse gases these spending measures led to.

Our dataset builds on the data collection efforts of Nahm et al. (2022) and applies the same methodology and coding schemes. The details of the GFC and Covid-19 related fiscal stimulus spending measures included in the database were primarily sourced directly from the text of the appropriate legislation or from government websites, white papers, press releases, et cetera. In some cases, information pertaining to spending measures was also drawn from other reliable sources, such as academic papers, news reports, and policy trackers. Supplementary Material I offers more information about our procedure for evaluating the greenhouse gas impact of the spending measures.

We first provide a descriptive overview of cross-country variation in the emissions profiles of economic stimulus packages. Next, we fit a series of regressions to test which country characteristics are associated with the share of green and fossil measures in the stimulus packages. We analyze the relationship between proxies for the relative importance of green and fossil industries in the domestic economy on the one hand and green stimulus spending on the other.

In our regressions, we employ two different dependent variables as measures of green stimulus spending: gross green spending and net green spending. Gross green spending is defined as the share of a country's total stimulus spending devoted to emissions-reducing measures. Net green spending is defined as the difference between the share of a country's total spending that is allocated to emissions-reducing measures and the share of its total spending that is allocated to emissions-increasing measures.

Our main independent variables are based on the distributive-conflict perspective and include variables that capture the centrality of fossil and green industries, respectively, in the economies of our observational units. To capture the centrality of fossil industries, we measure the share of gas, oil, and coal production in countries' GDP. These data are drawn from the Global Fossil Fuels Registry (2023). To capture the centrality of green industries, we use the Green Industrial Performance (GIP) Index developed by Moll de Alba and Todorov (2022). The GIP index is constructed by ranking countries on six factors that jointly capture their amounts of green exports, green domestic production, and green employment.[3] The index provides a measure of how climate-friendly a country's domestic production of goods and its international trade of such goods are, based on the World Bank's list of climate-friendly products. Its methodology is similar to the competitive manufacturing performance index developed by the United Nations Industrial Development Organization.

Finally, we include a set of controls that are theoretically linked to climate policy adoption either directly or through moderating the effects of our independent variables: GDP/capita (World Bank 2023a), state capacity (Hanson and Sigman (2015), GHG emissions/capita (World Bank 2023b), and EU membership. We control for GDP/Capita because existing research has shown that GDP/Capita is associated with both the deployment of new technologies (Pianta & Brutschin 2022) and with climate policy ambition (Tørstad et al. 2020). In line with Pianta & Brutschin (2022), we include GHG emissions/capita as a proxy for the level of carbon 'lock-in' across countries (see also Seto et al. 2016). Countries with high levels of GHG emissions/capita will likely exhibit higher resistance toward the adoption of green stimulus policies from both producers and consumers (Pianta & Brutschin 2022). State capacity is also an important theorized factor driving both different types of climate policy adoption (Aklin & Urpelainen 2013; Jewell et al., 2019) and the extent to which green and fossil interest groups can easily lobby climate politics (Meckling and Nahm 2022). Finally, we control for EU membership because the EU has developed common climate policy targets for EU member countries. Although the EU adopted economic stimulus packages of its own during the two crises, we exclude it as from our statistical analyses since it is not a nation state like our other observational units.

[3] The six factors are: green manufacturing value added per capita, green manufactured exports per capita, share of green manufacturing value added in total manufacturing value added, share of green manufactured exports in total manufactured exports, share of green manufacturing employment in total manufacturing employment, and co2 emissions from manufacturing per unit of manufacturing value added.

We perform several robustness checks on our results. The results are robust to the inclusion of countries' renewable energy consumption as share of total final energy consumption (World Bank 2023); the size of countries' real GDP and their total stimulus spending; and to using a different measure of state capacity (tax revenue as % of GDP). The results also hold when we exclude all the control variables outlined above. Finally, four countries (China, Russia, Taiwan, and Nigeria) have missing values on the GIP score values in the GFC analysis. The results are substantively unchanged when we impute missing values for these countries instead of dropping them from the analysis.

4. Empirical analysis

4.1 Overall stimulus spending patterns

Our first expectation was that countries would allocate a larger share of their economic stimulus packages toward emissions-decreasing measures during the Covid-19 crisis compared to the preceding Global Financial Crisis. Table 1 shows an overview of countries' share of gross green, gross fossil, and net green spending in their economic stimulus packages during the two crises. On average, gross green spending declined from the Global Financial Crisis to the Covid-19 downturn: the countries in our sample devoted 12% of their stimulus packages during the Global Financial Crisis and 9% of their Covid-19 stimulus packages to green objectives. Nevertheless, the net difference between green and fossil spending suggests that the Covid-19 packages were slightly more climate-friendly than the Global Financial Crisis packages. On average, net green spending (the difference between gross green and gross fossil spending) was around 5 percentage points in countries' Covid-19 stimulus packages, compared to around 0 for the stimulus packages under the Global Financial Crisis. Thus, net green spending increased from the Global Financial Crisis to the Covid-19 crisis; however, worth noting is that this increase was due to a substantial decline in gross fossil spending, rather than an increase in gross green spending.

Table 1. Average share of green and fossil spending in GFC and COVID-19 economic stimulus packages.

Economic stimulus package	**Gross green spending**	**Gross fossil spending**	**Net green spending**
GFC	12 %	11.9 %	0.1 pp
COVID	8.9 %	3.9 %	5 pp
GFC-COVID change	-3.1 pp	-8.0 pp	4.9 pp

Figure 1 displays cross-country variation in *gross* green stimulus spending both under the Global Financial crisis and under the Covid-19 crisis, ranked according to their average value for the two crises. The figure shows that South Korea, Denmark, and the EU stand out as consistent green spenders during both crises. Other countries that consistently do reasonably well in terms of gross green spending include Germany, Italy, China, and Mexico. Yet other countries had high gross green spending only under the Global Financial Crisis (e.g., Israel and Nigeria) or only under the Covid-19 crisis (e.g., Poland, France, and Belgium). The horizontal blue and yellow lines show countries' average share of gross green spending for each crisis.

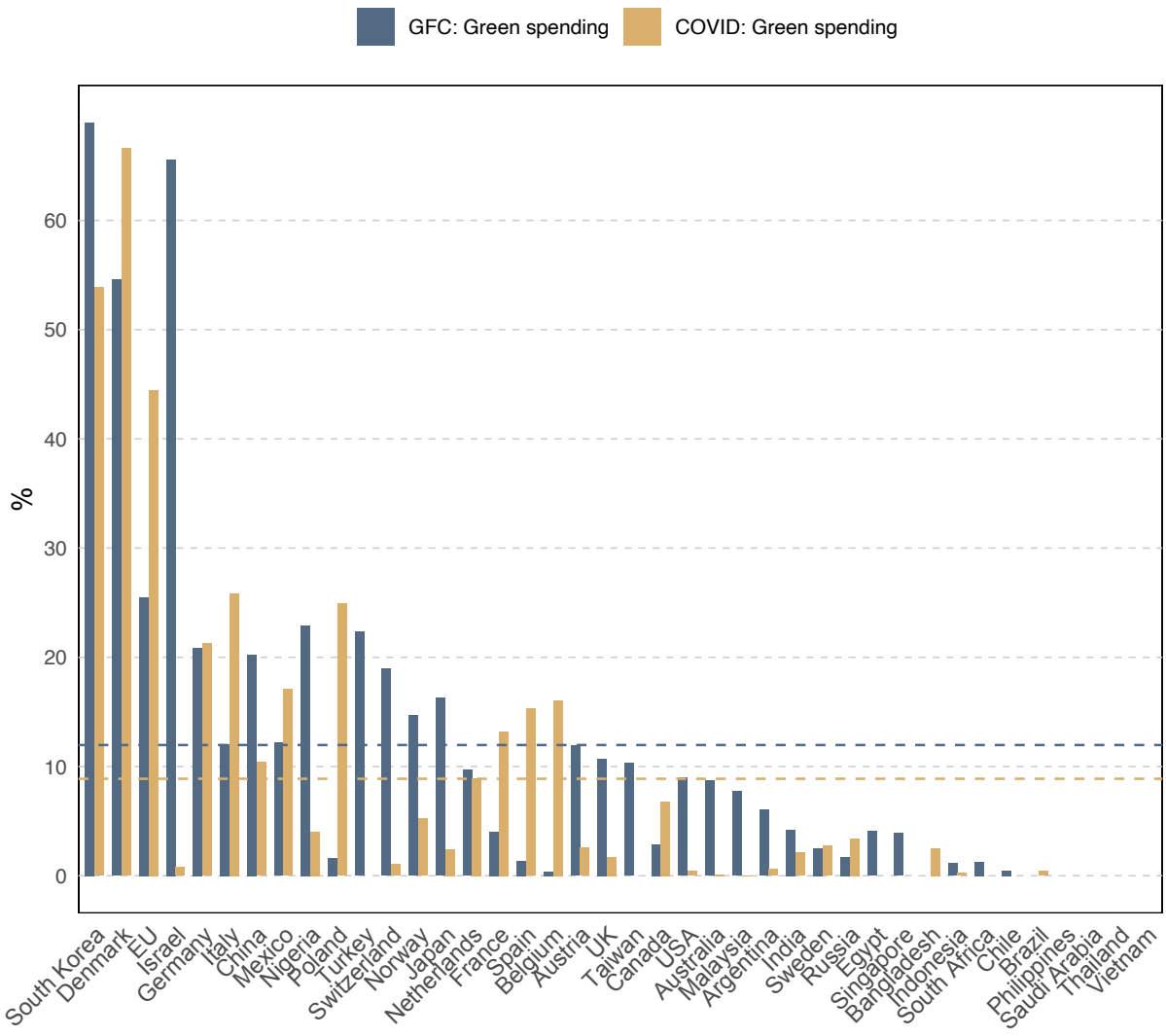

Figure 1. Overview of gross green spending (as share of total stimulus). Dashed lines represent averages across all countries. Countries are sorted by highest to lowest average values across the two crises.

Figure 2 shows cross-country variation in *net* green spending in countries' stimulus packages during the two crises. The number of countries in which net green spending was positive increased slightly from the Global Financial Crisis to the Covid-19 crisis. 19 countries (and the EU) increased their net green stimulus spending from the Global Financial Crisis to the Covid-19 crisis, while 18 countries reduced their net green stimulus spending. The ranking of countries in Figure 2 is relatively similar to that in Figure 1, with the top six countries unchanged. Further down the list, there are some changes. For example, countries such as Switzerland, Norway, and Nigeria rank considerably lower on net green spending than

on gross green spending, while the opposite is true for Saudi Arabia, Singapore, and Brazil. Thailand and Vietnam did not devote any stimulus funds toward either fossil or green objectives in either crisis; hence their balance in net green spending was the same (0) in both crises. In summary, the figures show substantial variation in green and fossil spending both across countries and across the two crises.

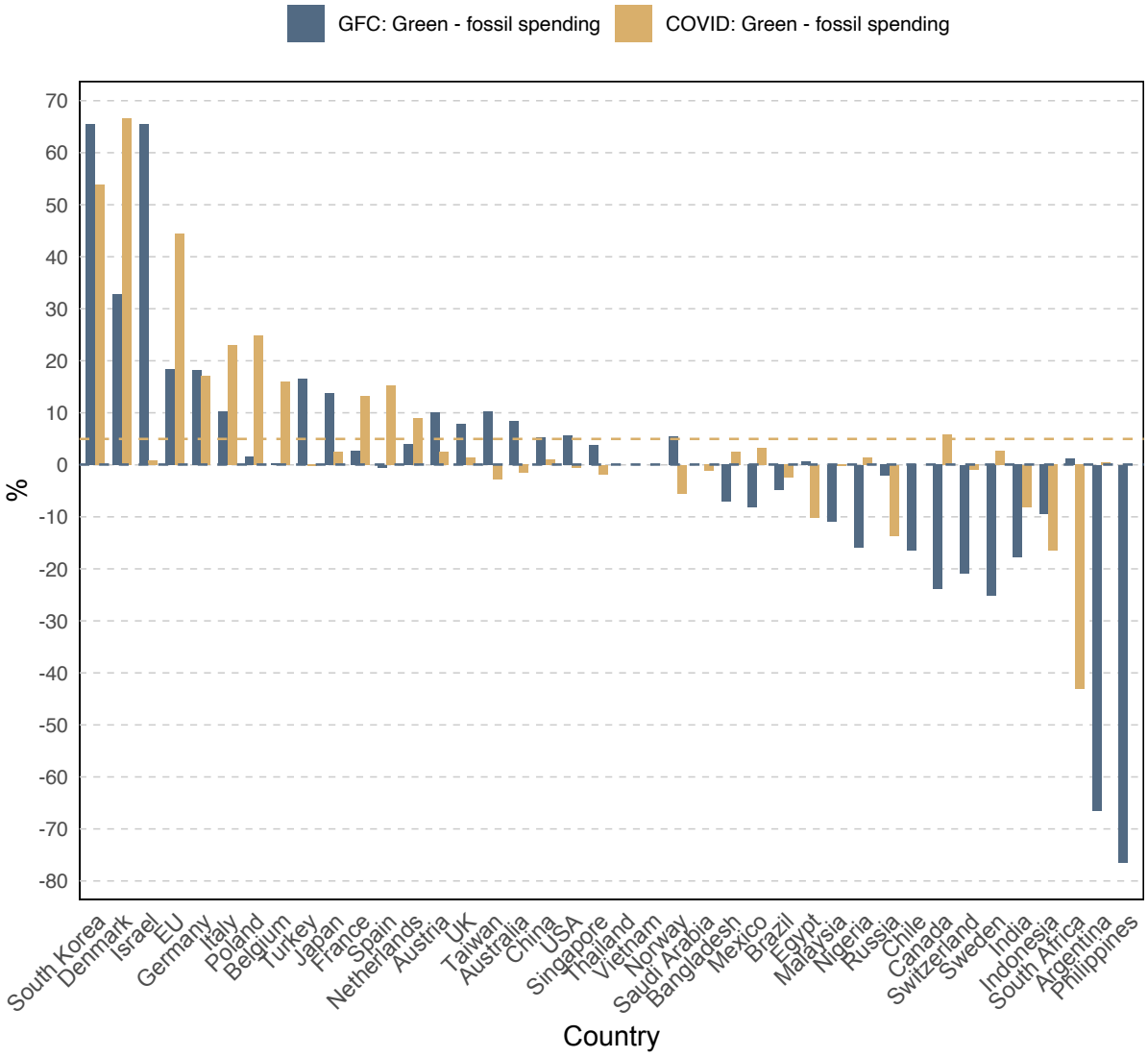

Figure 2. Overview of net green spending (measured as share of total stimulus). Dashed lines represent averages across all countries. Countries are sorted by highest to lowest average values across the two crises.

4.2 Cross-country variation

We now proceed to assessing cross-country variation in green spending. Our second theoretical expectation was that the relative strength of countries' green and fossil-fuel-based industries would affect the level of green crisis spending. To test this expectation, we fit Ordinary Least Squares (OLS) regressions. We present separate models for gross and green stimulus spending in each of the two crises. Table 2 reports models for the Global Financial Crisis, while Table 3 reports models for the Covid-19 crisis.

Table 2 displays two multivariate OLS regression models with gross and net green spending in stimulus packages under the Global Financial Crisis as dependent variables. Consistent with our theoretical expectation that the relative clout of domestic green and fossil economic interests affects countries' stimulus spending, the coefficient for the green industrial performance index is positive and statistically significant in the regression with gross green spending as dependent variable. Moreover, and again in line with our expectations, the coefficients for domestic oil and coal production are also positive and statistically significant in the model with gross green spending as dependent variable.

More surprising is that the coefficient for natural gas production is also positive in this model. The explanation might be that in many countries (including the US), emissions reductions result from coal being replaced by natural gas. Hence, both increased natural gas production and green stimulus spending might serve as co-elements in climate policies. We also note that in the model with gross green spending as dependent variable, the coefficient for EU membership is negative. The explanation for this finding might be that during the Global Financial Crisis, the EU adopted a separate institution-wide stimulus package that contained a substantial amount of green stimulus measures (see Figures 1 and 2). Finally, while the coefficients for some of our independent variables are statistically significant in the model with gross green spending as dependent variable, none of the corresponding coefficients are statistically significant in the model with net green spending as dependent variable. In other words, while the models in Table 2 predict cross-country variations in green spending rather well, the same thing cannot be said for variations in fossil spending.

Table 2. OLS regressions. Dependent variables: Gross and net green spending in GFC stimulus packages.

	Dependent variable:	
	Gross green spending (GFC)	Net green spending (GFC)
	(1)	(2)
Constant	189.163	324.623
	(139.861)	(256.942)
Green Industrial Performance index	74.114**	53.074
	(28.154)	(51.723)
Coal production / GDP	-21.136**	-20.619
	(10.236)	(18.804)
Gas production / GDP	24.156**	29.765
	(10.049)	(18.460)
Oil production / GDP	-94.433**	-127.593
	(45.214)	(83.063)
EU membership	-18.306**	-4.423
	(6.758)	(12.415)
GDP / capita (log)	-11.856	-17.472
	(10.113)	(18.580)
GHG emissions / capita (log)	11.572	26.762
	(8.951)	(16.445)
State capacity	6.707	3.632
	(7.125)	(13.090)
Observations	34	34
R^2	0.531	0.318
Adjusted R^2	0.380	0.100
F Statistic (df = 8; 25)	3.533***	1.459
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 3 displays four OLS regression models with gross and net green spending in Covid-19 stimulus packages as dependent variables. The two first models include the same covariates as the regressions in table 2. In contrast, the two last models also include variables capturing

countries' levels of green spending during the Global Financial Crisis. Evincing the relationship between green economic interests and green spending, the coefficient for countries' green industrial performance score again has the expected sign and is statistically significant. The only other independent variable for which the coefficient is statistically significant during the Covid-19 crisis is the level of gross green spending during the Global Financial Crisis. The coefficients for fossil-fuel production all have the expected sign, yet are not statistically significant in any of the four models in Table 3.

Perhaps the most striking feature of Table 3 is that the inclusion of levels of green spending during the Global Financial Crisis more than doubles the adjusted R^2 of the model with gross green spending as dependent variable. Such inclusion also increases the adjusted R^2 of the model with net green spending as dependent variable; however, in this model the increase is more modest. We interpret the increase in the model's explained variation as an indication of path dependency: The explanation for the cross-country variations in green spending during both crises seems rooted in factors existing already prior to the two crises.

In summary, the coefficients of our main independent variables, as well as those of the control variables, largely have the expected sign. However, the models vary regarding the extent to which the coefficients are statistically significant, which is unsurprising given the relatively low number of observations in our regressions.

Table 3. OLS regressions. Dependent variables: Gross and net green spending in COVID-19 stimulus packages, with and without control for GFC green spending.

	Dependent variable:			
	Gross green spending (COVID)	Net green spending (COVID	Gross green spending (COVID)	Net green spending (COVID)
	(1)	(2)	(3)	(4)
Constant	217.066 (131.965)	84.442 (164.055)	138.886 (94.513)	49.918 (158.576)
Green Industrial Performance index	72.941*** (25.740)	61.575* (32.000)	42.819** (19.058)	52.124 (31.140)
Coal production / GDP	-5.991 (10.027)	-8.264 (12.465)	2.743 (7.279)	-5.586 (12.053)
Gas production / GDP	3.744 (6.403)	8.327 (7.960)	8.175* (4.606)	8.864 (7.646)
Oil production / GDP	-2.208 (30.132)	-14.465 (37.460)	-7.400 (21.346)	-10.142 (36.031)
EU membership	9.671 (6.511)	9.189 (8.094)	17.764*** (4.847)	10.096 (7.785)
GHG / Capita (log)	10.134 (7.055)	3.357 (8.770)	6.657 (5.034)	-0.230 (8.640)
GDP / Capita (log)	-17.687* (10.223)	-7.745 (12.709)	-11.868 (7.315)	-6.209 (12.227)
State capacity	1.834 (6.390)	1.521 (7.944)	-1.215 (4.558)	1.433 (7.625)
GFC gross green spending			0.551*** (0.103)	
GFC net green spending				0.201* (0.109)
Observations	37	37	37	37
R^2	0.432	0.406	0.726	0.472
Adjusted R^2	0.270	0.236	0.635	0.296
F Statistic	2.666** (df = 8; 28)	2.388** (df = 8; 28)	7.944*** (df = 9; 27)	2.681** (df = 9; 27)
Note:				*p<0.1; **p<0.05; ***p<0.01

5. Discussion and Conclusion

Using a novel dataset on 39 countries and the EU, this paper analyzes green stimulus spending during the 2008 Global Financial Crisis and the 2020 Covid-19 crisis. Based on the distributive-conflict theory on climate policymaking, we expected that the green share of total stimulus spending would have increased from 2008 to 2020 and that the relative clout of green and fossil industries would be associated with the emissions profile of countries' stimulus packages.

Our results offer mixed support for these expectations. First, the average share of net green spending did increase from 2008 to 2020, but only marginally and primarily due to decreased gross fossil spending rather than increased gross green spending. Overall, our analysis paints a rather dismal picture of countries' willingness to use economic stimulus to advance ambitious climate policies. While economic crises in principle offer a political window of opportunity to advance climate goals, very few countries exploited this opportunity extensively in any of the two crises we examine. Hence, our findings provide sobering empirical evidence regarding the theoretical literature arguing that economic crises can serve as effective catalysts for path-breaking climate policy change (e.g., Seto et al. 2016; Aklin & Urpelainen 2018).

Second, our statistical tests suggest that a higher relative strength of green industrial interests in their domestic economy consistently leads countries to adopt greener stimulus packages on average. Hence, countries such as South Korea, Denmark, and Germany – as well as the EU – are among those that adopted a high share of green stimulus measures during both crises. Conversely, none of the major carbon-exporting countries engage in any significant green stimulus spending. Indeed, countries such as Australia, China, Russia, and Saudi Arabia come across as consistent laggards on our green stimulus spending indicators. Our analysis suggests that countries with high fossil-fuels production were more unlikely to adopt green stimulus spending during the Global Financial Crisis. Yet, on average countries with high levels of fossil-fuel production did not adopt more fossil-fuel-supportive economic stimulus according to our analysis.

Our finding that the magnitude of fossil-fuel production is not associated with increased fossil spending suggests that many governments are able to bypass distributive conflict and lobbying from vested interests during economic crises. In line with this argument, Tørstad et al. (2023) find that (liberal) governments in Canada and the US are surprisingly

capable of overcoming resistance from fossil-fuel-based interests against green stimulus spending. At least part of the explanation might be that green spending does not produce negative incentives (like regular climate policy such as carbon pricing does); instead, it offers positive incentives to achieve climate outcomes. Whereas climate policy instruments that impose concentrated costs have often seen intense lobbying from affected industries, the allocation of concentrated benefits through stimulus spending may reduce the incentives for green and fossil industries alike to invest heavily in lobbying. Moreover, economic stimulus packages are often negotiated within a short span of time, which leaves only limited room for lobbying before political compromises are made. Yet, most of the countries in our sample ultimately failed to use stimulus spending to sufficiently advance a climate agenda, which is puzzling if fossil-fuel lobbies were indeed unable to sway the policymaking process. A possible interpretation of the negative association between oil and coal production on one hand and green spending on the other during the Global Financial Crisis is that anti-climate interest groups successfully retained the status quo and undermined transformative green spending efforts (if any).

Finally, we find that overall, the countries engaging the most in green stimulus spending during the Covid-19 crisis were largely the same as those engaging the most in such spending during the Global Financial Crisis. Indeed, the stimulus spending of the countries included in our database are strikingly similar across the two crises despite these crises' vastly different nature and context. Based on this consistency within countries across time, we conclude that the two economic downturns have largely mirrored governments' climate political priorities prevailing prior to the downturns. This conclusion aligns with those of Quitzow et al. (2021). Analyzing green stimulus spending directed towards the energy supply sector in G20 countries, they found an institutional lock-in effect suggesting that the Covid-19 crisis exacerbated existing inequalities in the energy transition landscape across countries. Our results point in the same direction.

Our work suggests at least three avenues for future research. First, it should look further into why only some countries seized the opportunities offered by the Global Financial Crises and the Covid-19 crisis for accelerating the green transformation. Why is it that countries such as different as South Korea and Denmark were able to exploit both economic downturns to make headway in their green transformation, while many other countries were not? Our study only establishes overarching associations; hence, more is needed to unpack in more detail *how* green and fossil interest groups affect policy outcomes. Second, while our

analysis has focused on political economy factors, alternative explanations such as the role of elite political ideology (Aklin & Urpelainen 2018) and political competition (Aklin & Urpelainen 2018) may hold promise in explaining diverging green spending outcomes. Finally, our analysis is limited to assessing governments' announced spending amounts and does not establish whether and if so, how green stimulus spending has been effective in reducing greenhouse gas emissions. With the global rise of investment-based climate politics (Armitage et al. 2023; Darvass and Wolf 2023) and green industrial policy (Allan et al. 2021), spearheaded by the massive US Inflation Reduction Act, future research should more systematically examine the emissions effects of economic spending packages to draw lessons about how to channel green funding effectively.

References

Aklin, Michaël & Matto Mildenberger 2020. "Prisoners of the Wrong Dilemma: Why Distributive Conflict, Not Collective Action, Characterizes the Politics of Climate Change", *Global Environmental Politics* 20(4):4–27.

Aklin, Michaël & Matto Mildenberger 2022. "Reply: The Persistent Absence of Empirical Evidence for Free-Riding in Global Climate Politics", *Global Environmental Politics* (early access article).

Aklin, Michaël, and Johannes Urpelainen. 2018. *Renewables: The Politics of a Global Energy Transition*. Cambridge, MA: MIT Press.

Allan, Bentley, Joanna I. Lewis, and Thomas Oatley. 2021. "Green Industrial Policy and the Global Transformation of Climate Politics." *Global Environmental Politics*, October, 1–19. https://doi.org/10.1162/glep_a_00640.

Andrew, Kevin, Basma Majerbi & Ekaterina Rhodes 2022. «Sluching or speeding toward net zero? Evidence from COVID-19 energy-related stimulus policies in the G20", *Ecological Economics* 201.

Armitage, Sarah C., Noël Bakhtian, and Adam B. Jaffe. 2023. "Innovation Market Failures and the Design of New Climate Policy Instruments." Working Paper. Working Paper Series. National Bureau of Economic Research. https://doi.org/10.3386/w31622.

Barbier, Edward. 2010. *A Global Green New Deal*. Cambridge: Cambridge University Press.

Blazquez, Jorge, Marzio Galeotti, and Jose M. Martin-Moreno. 2021. "Green Recovery Packages for a Post-Covid-19 World: A Lesson from the Collapse of Spanish Wind Farms in the Past Financial Crisis." Renewable & Sustainable Energy Reviews 151 (November): 111570. https://doi.org/10.1016/j.rser.2021.111570.

Bowen, Alex, and Nicholas Stern. 2010. "Environmental Policy and the Economic Downturn." *Oxford Review of Economic Policy* 26 (2): 137–63.

Breetz, Hanna, Matto Mildenberger, and Leah Stokes. 2018. "The Political Logics of Clean Energy Transitions." *Business and Politics* 20 (4): 492–522. https://doi.org/10.1017/bap.2018.14.

Burns, Charlotte, and Paul Tobin. 2016. "The Impact of the Economic Crisis on European Union Environmental Policy." *JCMS: Journal of Common Market Studies* 54 (6): 1485–94. https://doi.org/10.1111/jcms.12396.

Colgan, Jeff D., Jessica F. Green, and Thomas N. Hale 2020. "Asset Revaluation and the Existential Politics of Climate Change", *International Organization* 75(3): 586–610.

Darvas, Zsolt, and Guntram B. Wolff. 2023. "A Green Fiscal Pact for the EU: Increasing Climate Investments While Consolidating Budgets." *Climate Policy* 23 (4): 409–17. https://doi.org/10.1080/14693062.2022.2147893.

Fouquet, Roger (ed.) 2019. *Handbook on Green Growth.* London: Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science.

Gawel, Erik, and Paul Lehmann. 2020. "Killing Two Birds with One Stone? Green Dead Ends and Ways Out of the COVID-19 Crisis." *Environmental & Resource Economics*, July, 1–5. https://doi.org/10.1007/s10640-020-00443-y.

Geels, Frank W. 2013. "The Impact of the Financial–Economic Crisis on Sustainability Transitions: Financial Investment, Governance and Public Discourse." *Environmental Innovation and Societal Transitions*, Economic-financial crisis and sustainability transition, 6 (March): 67–95. https://doi.org/10.1016/j.eist.2012.11.004.

Global Fossil Fuels Registry. 2023. Registry Emissions Model. Link: https://fossilfuelregistry.org/datasets

Gusheva, Ema, and Vincent de Gooyert. 2021. "Can We Have Our Cake and Eat It? A Review of the Debate on Green Recovery from the COVID-19 Crisis." *Sustainability* 13 (2): 874. https://doi.org/10.3390/su13020874.

Han, Heejin, and Taedong Lee. 2022. "Varieties of Green Stimulus Policies: Comparative Analysis of the Green Growth and Green New Deal Policies in South Korea." *The Journal of Environment & Development*, November, 10704965221139304. https://doi.org/10.1177/10704965221139303.

Hughes, Llewelyn, and Johannes Urpelainen. 2015. "Interests, Institutions, and Climate Policy: Explaining the Choice of Policy Instruments for the Energy Sector." *Environmental Science & Policy* 54 (December): 52–63. https://doi.org/10.1016/j.envsci.2015.06.014.

International Energy Agency. 2023. Government Energy Spending Tracker. Link: https://www.iea.org/reports/government-energy-spending-tracker-2

Kennard, Amanda & Keith E. Schnakenberg 2022. "Comment: Global Climate Policy and Collective Action", *Global Environmental Politics* (early access article).

Klenert, David, Franziska Funke, Linus Mattauch, and Brian O'Callaghan. 2020. "Five Lessons from COVID-19 for Advancing Climate Change Mitigation." *Environmental and Resource Economics* 76 (4): 751–78. https://doi.org/10.1007/s10640-020-00453-w.

Lockwood, Matthew. 2018. "Right-Wing Populism and the Climate Change Agenda: Exploring the Linkages." *Environmental Politics* 27 (4): 712–32.

Meckling, Jonas, Nina Kelsey, Eric Biber, and John Zysman. 2015. "Winning Coalitions for Climate Policy." *Science* 349 (6253): 1170–71. https://doi.org/10.1126/science.aab1336.

Meckling, Jonas. 2021. "Making Industrial Policy Work for Decarbonization." *Global Environmental Politics* 21 (4): 134–47. https://doi.org/10.1162/glep_a_00624.

Meckling, Jonas, and Bentley B. Allan. 2020. "The Evolution of Ideas in Global Climate Policy." *Nature Climate Change* 10 (5): 434–38. https://doi.org/10.1038/s41558-020-0739-7.

Meckling, Jonas, Nina Kelsey, Eric Biber, and John Zysman. 2015. "Winning Coalitions for Climate Policy." *Science* 349 (6253): 1170–71. https://doi.org/10.1126/science.aab1336.

Meckling, Jonas, Thomas Sterner, and Gernot Wagner. 2017. "Policy Sequencing toward Decarbonization." *Nature Energy* 2 (12): 918–22. https://doi.org/10.1038/s41560-017-0025-8.

Meckling, Jonas, and Jonas Nahm. 2022. "Strategic State Capacity: How States Counter Opposition to Climate Policy." *Comparative Political Studies* 55(3):493-523.

Meckling, Jonas, Phillip Y. Lipscy, Jared J. Finnegan, and Florence Metz. 2022. "Why Nations Lead or Lag in Energy Transitions." *Science* 378 (6615): 31–33. https://doi.org/10.1126/science.adc9973.

Mildenberger, Matto. 2020. *Carbon Captured: How Business and Labor Control Climate Politics*. MIT Press.

Moll de Alba, Jaime, and Valentin Todorov. 2022. "Measuring Green Industrial Performance: A Regional Outlook of Eastern Asia and Europe." *Economic Change and Restructuring*, August. https://doi.org/10.1007/s10644-022-09436-x.

Pianta, Silvia, and Elina Brutschin. 2022. "Emissions Lock-in, Capacity, and Public Opinion: How Insights From Political Science Can Inform Climate Modeling Efforts." *Politics and Governance* 10 (3): 186–99. https://doi.org/10.17645/pag.v10i3.5462.

Pollitt, Hector, Richard Lewney, Bence Kiss-Dobronyi, and Xinru Lin. 2021. "Modelling the Economic Effects of COVID-19 and Possible Green Recovery Plans: A Post-Keynesian Approach." *Climate Policy* 21 (10): 1257–71. https://doi.org/10.1080/14693062.2021.1965525.

Quitzow, Rainer, German Bersalli, Laima Eicke, Joschka Jahn, Johan Lilliestam, Flavio Lira, Adela Marian, et al. 2021. "The COVID-19 Crisis Deepens the Gulf between Leaders and Laggards in the Global Energy Transition." *Energy Research & Social Science* 74 (April): 101981. https://doi.org/10.1016/j.erss.2021.101981.

Seto, Karen C., Steven J. Davis, Ronald B. Mitchell, Eleanor C. Stokes, Gregory Unruh, and Diana Ürge-Vorsatz. 2016. "Carbon Lock-In: Types, Causes, and Policy Implications." *Annual Review of Environment and Resources* 41 (1): 425–52. https://doi.org/10.1146/annurev-environ-110615-085934.

Stefes, Christoph H. 2020. "Opposing Energy Transitions: Modeling the Contested Nature of Energy Transitions in the Electricity Sector." *Review of Policy Research* 37 (3): 292–312.

Strand, Jon, and Michael Toman. 2010. "'Green Stimulus,'Economic Recovery, and Long-Term Sustainable Development." World Bank Policy Research Working Paper 5163. Rochester, NY. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1533681.

Tienhaara, Kyla. 2014. "Varieties of Green Capitalism: Economy and Environment in the Wake of the Global Financial Crisis." *Environmental Politics* 23(2): 187–204.

Tørstad, Vegard, Jonas Nahm, Jon Hovi, Tora Skodvin and Gard Olav Dietrichson. Economic Recessions and Decarbonization: Analyzing Green Stimulus Spending in Canada and the US. Working paper.

Tørstad, Vegard, Håkon Sælen, and Live Standal Bøyum. 2020. "The Domestic Politics of International Climate Commitments: Which Factors Explain Cross-Country Variation in NDC Ambition?" *Environmental Research Letters* 15 (2): 024021. https://doi.org/10.1088/1748-9326/ab63e0.

Tvinnereim, Endre, and Elisabeth Ivarsflaten. 2016. "Fossil Fuels, Employment, and Support for Climate Policies." *Energy Policy* 96 (September): 364–71.

World Bank. 2023a. GDP (current US$). Link: https://data.worldbank.org/indicator/NY.GDP.MKTP.CD

World Bank. 2023b. CO2 emissions (metric tons per capita. Link: https://data.worldbank.org/indicator/EN.ATM.CO2E.PC

Zenghelis, Dimitri. 2014. "In Praise of a Green Stimulus." *WIREs Climate Change* 5 (1): 7–14. https://doi.org/10.1002/wcc.256.

Supplementary Material I: Measurement of green and fossil spending

Our definitions of green and fossil spending are based on the potential climate change (greenhouse gas emissions) impact of spending measures in stimulus packages. We label measures that likely generated decreased greenhouse gas emissions as green spending and measures that likely increased greenhouse gas emissions as fossil spending.

Granted that the overall policy goal of economic stimulus packages is to spur economic growth, the overall distinction between green and fossil spending in our framework is based on whether spending measures potentially reinforce or decouple greenhouse gas emissions and economic activity. "Green" spending measures are aimed at decoupling greenhouse gas emissions from economic activity, while "fossil" spending measures are those that reinforce the link between economic recovery and fossil fuels (Hepburn et al. 2020). We consider both consumption and production measures on the demand-side and supply-side of economic activity.

Our measure of green/fossil spending is relatively narrow in the sense that it is focused on climate impacts rather than the broader environmental footprint. Moreover, our analysis is

limited to governments' *announced* spending amounts: it does not evaluate the actual implementation trajectories of spending measures nor quantify the amount of greenhouse gases these eventually lead to.

We code a relatively narrow set of spending items as "green" or "fossil". While all economic sectors in a country generally emit greenhouse gases, we restrict our coding of industrial support measures to economic sectors that have a clear tie to the usage, production, or deployment of either fossil fuels or renewable energy. In cases where the climate impacts are highly complex or indirect, such as for spending directed toward the health sector, services, telecommunications, and education, we classify the emissions impact as "neutral".

The main categories for fossil and green spending, developed inductively based on which types of policies that are includes in recovery packages, include employment programs; energy infrastructure; housing; cross-cutting energy efficiency measures; research and development; transportation infrastructure; transport subsidies; direct industrial support; and tax incentives for individuals and companies. Within these categories, we classify spending measures that likely will likely help decoupling greenhouse gas emissions from economic activity as "green"; while we classify those that likely reinforce the link between economic recovery and fossil fuels as "fossil" (Hepburn et al. 2020). Some spending items, such as support for deployment of biofuels and R&D measures for carbon capture and storage, are not straightforward to classify. Biofuels may have emissions-reducing effects where consumed but emissions-increasing effects at the production stage; and the effectiveness of carbon capture and storage technology is disputed. In such cases of doubt, we qualitatively assess the stimulus measures' likely *national* greenhouse gas emissions effects compared to the counterfactual scenario under which a given measure was not enacted. We also cross-verify our coding choices with the Global Recovery Observatory (Global Recovery Observatory - Oxford University Economic Recovery Project) and the *International Energy Agency*'s *Government Energy Spending Tracker* (https://www.iea.org/reports/government-energy-spending-tracker-2).