Disciplining conjectures about 'eco-welfare states'
a multi-method approach

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draft 1.0 — comments welcome

Abstract

The literature on 'eco-welfare states' contends that social protection helps to mitigate climate change by smoothing labour redeployment amid technological transitions. However, few studies have employed rigorous methods to support these conjectures. This paper leverages a multi-method approach that combines quantitative analysis of aggregate-level indicators with case study analyses of causal mechanisms. We begin by articulating a behavioural model whereby compensatory policies shift stakeholder preferences in favour of restructuring toward a low-carbon economy. We then develop a novel time-variant measure of 'flexicurity' that accounts for the intersection of active labour market policy and the social safety net. Using hierarchical mixed-effects modelling, we find that countries with robust welfare states emit significantly less CO_2, on average, than countries with weak welfare states. Welfare state entrenchment is not a significant predictor of emissions trends. Case study analysis finds that emissions reductions stem from two non-mutually-exclusive causal pathways: compensation and executive action that imposes transition costs. The executive action route is unstable, however, due to electoral incentives to capture votes of policy losers by reversing course. Implications for governance of 'just transitions' are discussed.

Keywords: climate change; eco-welfare states; flexicurity; just transitions; mixed-methods

JEL classification: D63, H23, I38, J48, N5, P51, Q5

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1 Introduction

In the wake of COP26, many analysts have offered recommendations on how to meaningfully reduce global CO_2 emissions (Eckersley 2022; Harris 2022; Heffron 2021). In this spirit, there have been several calls for states to absorb or otherwise manage transition costs (Kaplinsky 2021; Mazzucato 2013; Trebilcock 2014). Emerging theory on 'eco-welfare states' is arguably poised to guide the policy discourse, the basic premise being that a robust social safety net complements environmental sustainability (García-García et al. 2022; Gough 2016; Koch 2020). Yet, theory on eco-welfare states has not been rigorously tested.[1]

This paper contributes to the scholarship on eco-welfare states by employing a step-by-step nested analysis that links a micro-level behavioral theory to macro-level aggregate indicators of environmental performance. We begin by articulating a compensation-based model of preference formation and juxtapose it against alternative explanations in the literature. Next, we use factor analysis to distill indicators of welfare state generosity, wage coordination and active labour market policy into a single time-variant, country-level measure of 'flexicurity' (cf. Viebrock & Clasen 2009). We then run a hierarchical mixed-effects model that regresses annual national CO_2 emissions on our flexicurity measure over a thirty-year period (1990–2019). Finally, to test for the operation of causal mechanisms, we conduct two case studies to explain CO_2 reductions in Denmark and the United Kingdom.

The overall findings are as follows. First, countries with stronger welfare regimes emit significantly less CO_2, on average, than countries with weak welfare regimes. Second, welfare state entrenchment within countries is not a significant predictor of emissions trends. Third, emission reductions stem from two causal pathways: compensation via flexicurity and executive action, the former of which compensates affected interests for transition costs, while the latter simply imposes transition costs. Lastly, whereas progress via the compensation pathway appears to be durable, progress via executive action may be fragile due to electoral incentives to capture votes of policy losers by reversing course on prior commitments.

The findings have implications for 'just transitions' policies which seek to fairly and equitably manage technological change and related social dislocations (García-García et al. 2022; Heffron 2021; Swilling 2020). Although uncompensated transition costs may be justified on the basis that the right to emit is not a recognized positive freedom, the fact that some high-emitting activities are permitted (e.g., in the transportation sector) while others are phased out raises concerns about fairness. Moreover, blue-collar workers in high-emitting industries tend to have comparatively modest incomes and therefore

[1] As discussed in Section 2, most existing research has used clustering methods to assess correspondence between welfare state robustness and environmental policy or public opinion in support of it (Cahen-Fourot 2020; Koch & Fritz 2014). The most rigorous analysis of which we are aware is Lim and Duit's (2018) paper on the adjacent question of the correspondence between government ideology and environmental policy.

lower average individual emissions from consumption than white-collar professionals (Oswald et al. 2020). For the sake of both durability and fairness, compensation via flexicurity seems like the preferable route.

2 Behavioural foundations

Although not explicitly articulated or formalized, several behavioural assumptions may be deduced from the literature on eco-welfare states. Incidentally, three of the most active commentators —John Dryzek, Ian Gough and James Meadowcroft— agree that social policy can be used as insurance against risk of dislocations caused by environmental regulation (Gough et al. 2008). The implication, long appreciated by economists in the context of moral hazard, is that insured individuals behave differently than their uninsured counterparts because the former expect to be compensated for negative consequences arising from risky behaviour (Varian 1980). Seen in a positive light, it has been argued that diffusion of risk may alter behaviour so profoundly that it makes possible societal feats that would otherwise be impossible (Esping-Andersen 1999). Indeed, public absorption of transition costs may render progressive policy change politically palatable to constituents who might otherwise resist it (Trebilcock 2014; Walter 2010). Along these lines, Mazzucato (2013) argues that 'socialization of risk' in the form of corporate welfare is responsible for observed incidence of innovation, even in nominally market-oriented economies, owing to its effect on the risk calculus of corporate executives.

Based on the preceding summary, individual preferences for sustainability may be modelled as a function of the utility an actor receives from environmental protection minus uncompensated losses incurred from policy change. Formally,

$$u_i(s) = [u_i(e)p_i(e)]\delta_i + u_i(c)p_i(c) - u_i(a) \tag{1}$$

where $u_i(e)p_i(e)$ is the i^{th} individual's expected utility from environmental protection (read: the individual's utility from environmental improvement multiplied by probability assigned by the individual to environmental improvement being forthcoming), δ_i is a discount rate, $u_i(c)p_i(c)$ is expected utility from compensation, and $u_i(a)$ is the reservation utility from current activities (e.g., wages, profit) that will be displaced by policy change. Preferences for sustainability are assumed to obtain when expected utility from policy change is positive, i.e., when $u_i(s) > 0$.

With the behavioural assumptions of Equation 1 specified, we may trace the linkages between welfare state generosity and sustainable development according to the causal process outlined in Figure 1. Specifically, welfare state generosity is assumed to alter utility functions in favour of sustainability by increasing the value of $u_i(c)p_i(c)$ in Equation 1, which is interpreted as a complement to 'post-material' incentives e and a

substitute for 'material' incentives *a*. We hasten to note, however, that we consider the conventional material/post-material terminology to be misleading in this context, as the distinction lies in the fact that environmental incentives are time-discounted and uncertain whereas productive incentives yield immediate and certain returns.[2]

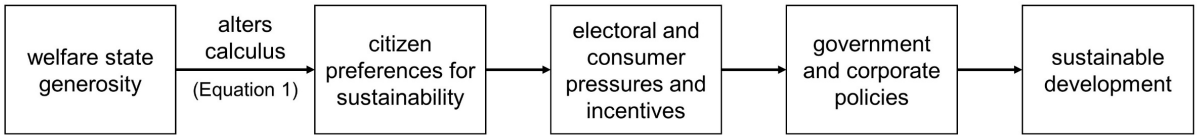

Figure 1: Hypothesized causal pathway

Alternative explanations floated in the literature include international agreements, EU membership, population density, environmental threats, government ideology, corporatism, political feasibility, social movements, regulatory competition, and economic contraction (Beeson 2010; Dryzek et al. 2003; Holzinger et al. 2008; Jackson 2016; Jahn 1998; Liefferink et al. 2009; Lim & Duit 2018; Scruggs 1999). Insofar as behavioral hypotheses differ, it is with respect to whether transitions are negotiated on a voluntary basis or imposed by authoritative actors. Of course, there may be several routes to a singular outcome; both mechanisms may be at work in a single case (Bennett & Checkel 2015). Moreover, because authoritative actors are typically beholden to voters, they have incentive to respond to constituent preferences (Cox 1990). Accordingly, we expect policy durability to be a function of welfare state robustness, as disaffected interests may mobilize against sustainability in the absence of compensation (Mokyr 1994).

By way of initial assessment, clustering methods have revealed that citizen preferences for sustainability are indeed stronger in countries with more robust welfare states (Cahen-Fourot 2020). However, cluster analysis has also found that environmental sustainability does not map neatly to conventional welfare state typologies (Koch & Fritz 2014). These findings may stem from the fact that conventional measures of welfare state robustness do not capture the full suite of compensatory instruments available to policymakers. As a corrective, the following section uses factor analysis to devise a new measure of welfare state robustness that accounts for a broad slate of compensatory policies.

[2] Whether environmental concerns constitute materialist or post-materialist (altruistic) values depends on individual tastes. Although unimportant for our purposes, it is typically inappropriate to assume environmental values are non-material. Rather, environmental concerns are often best described as material but time discounted, hence the inclusion of the discount term in Equation 1.

3 Aggregate-level indicators

For our dependent variable, we collected OECD data on CO_2 emissions per capita for 21 countries from 1990–2019 (OECD 2021a). Because we are most interested in environmental performance, we opted for an outcome measure over a measure of policy output (but see Lim and Duit [2018] for an excellent study using environmental policy outputs). We also chose CO_2 emissions per capita over more general measures of environmental protection since the former is non-ambiguous and less affected by local idiosyncrasies (e.g., vulnerability of biodiversity). Models featuring alternative dependent variables will be included in a subsequent draft of this paper.

For our independent variable, we operationalized a measure of flexicurity according to the following procedure. We began by running exploratory factor analysis on variables contained in the Comparative Welfare States Dataset in order to confirm a positive relationship between the many manifest variables contained therein and a limited set of latent variables representative of welfare state robustness (Brady et al. 2020).[3] We then conducted confirmatory factor analysis and found suitable model fit and strong loadings for a four-factor model with a single latent variable. As depicted in Figure 2, manifest variables include unemployment benefits, sickness benefits, wage coordination and active labour market policy. Per the intuition of factor analysis, these manifest variables are assumed to be caused by the latent variable, which we interpret as a measure of a country's level of flexicurity (cf. Viebrock & Clasen 2009).

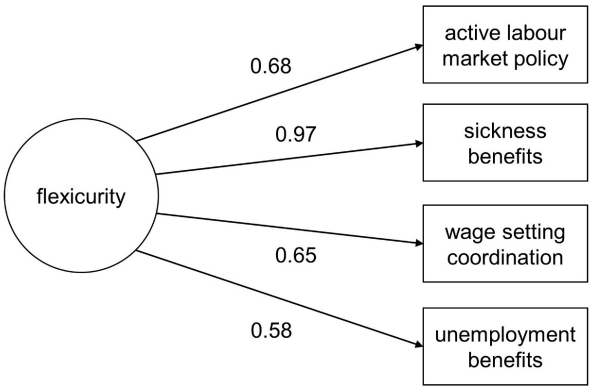

Figure 2: Factor loadings on latent measure of 'flexicurity'

Source: Comparative Welfare States Dataset variables *almp_pmp* (i.e., public and private expenditure on active labour market policy as a percentage of GDP), *sickgen*, *pengen*, *wcoord* (Brady et al 2021). Standardized loadings reported. Tucker-Lewis Index (TLI) goodness of fit statistic: 0.96. Root mean squared error of approximation (RMSEA) badness of fit statistic: 0.10.

[3] Our initial (exploratory) factor analysis included the following variables, all of which are positively correlated: public and private expenditure on active labour market policy (*almp_pmp*), sickness benefits (*sickgen*), unemployment benefits (*uegen*), pension benefits (*pengen*), works council status (*wc*), works council structure (*wc_struct*), works council rights (*wc_rights*), works council involvement in wage negotiations (*wc_negot*), union density (*ud*), union centralization (*unioncent*), and wage coordination (*wcoord*) (Brady et al. 2020).

Substantively, sickness benefits compensate workers to the extent that benefits are universal (i.e., not tied to employment). In countries where sickness benefits are disproportionately tied to employment (as has historically been the case in the United States), workers are expected to be more reluctant to support sustainability initiatives that are occupationally threatening than workers in countries where benefits are universal and generous. Similar logic applies to unemployment benefits: workers are expected to put up less resistance to job losses where benefits are generous and universal. Wage coordination captures the extent to which institutions exist to promote negotiated flexicurity across the economy. Arguably, wage coordination encourages positive sum solutions to technological transitions by maximizing the stratum of 'policy winners' and minimizing the number of 'policy losers' (Esping-Andersen 1999). Finally, active labour market policy compensates displaced workers through retraining and job placement programs.

Figure 3 reports descriptive statistics for CO_2 emissions and flexicurity from 1990 to 2019 for twenty-one OECD countries. Grey points on the flexicurity series represent years for which missing data necessitated estimation based on prevailing trends.[4] Notably, some countries have undergone welfare state entrenchment on the flexicurity measure while others have experienced retrenchment (cf. Thelen 2014). Regarding CO_2 output, although some countries increased emissions in the 1990s, all countries have since witnessed reductions, albeit to different degrees.

Although illuminating, the trends reported in Figure 3 provide few clues as to whether flexicurity, international agreements, EU membership, welfare state entrenchment, or some combination thereof, is decisive. The next section assesses the statistical relationship between flexicurity and CO_2 emissions, both between countries and within countries, controlling for international agreements, EU governance, post-materialist values, economic growth, taxes on emissions, political institutions, environmental risks and government expenditure on research and development.

4 Hierarchical mixed-effects

Hierarchical mixed-effects modelling is appropriate for our purposes given that we are interested in the determinants of CO_2 emissions both between and within countries. At the first level, between-effects estimation permits comparisons across countries based on group averages (i.e., country means). At the second level, random-effects estimation permits within-country comparisons based on unique intercepts and slopes for each country. Random effects estimation is useful for evaluating whether welfare state entrenchment leads to more substantial CO_2 reductions than retrenchment.

[4] Data for sickness benefits and unemployment benefits are only currently available to 2010. Data for active labour market policy and wage coordination are available to 2017. Data and replication code used to forecast estimates can be found at https://matt-wilder.github.io/. Subsequent drafts of this paper will experiment with alternative means of operationalizing welfare state robustness.

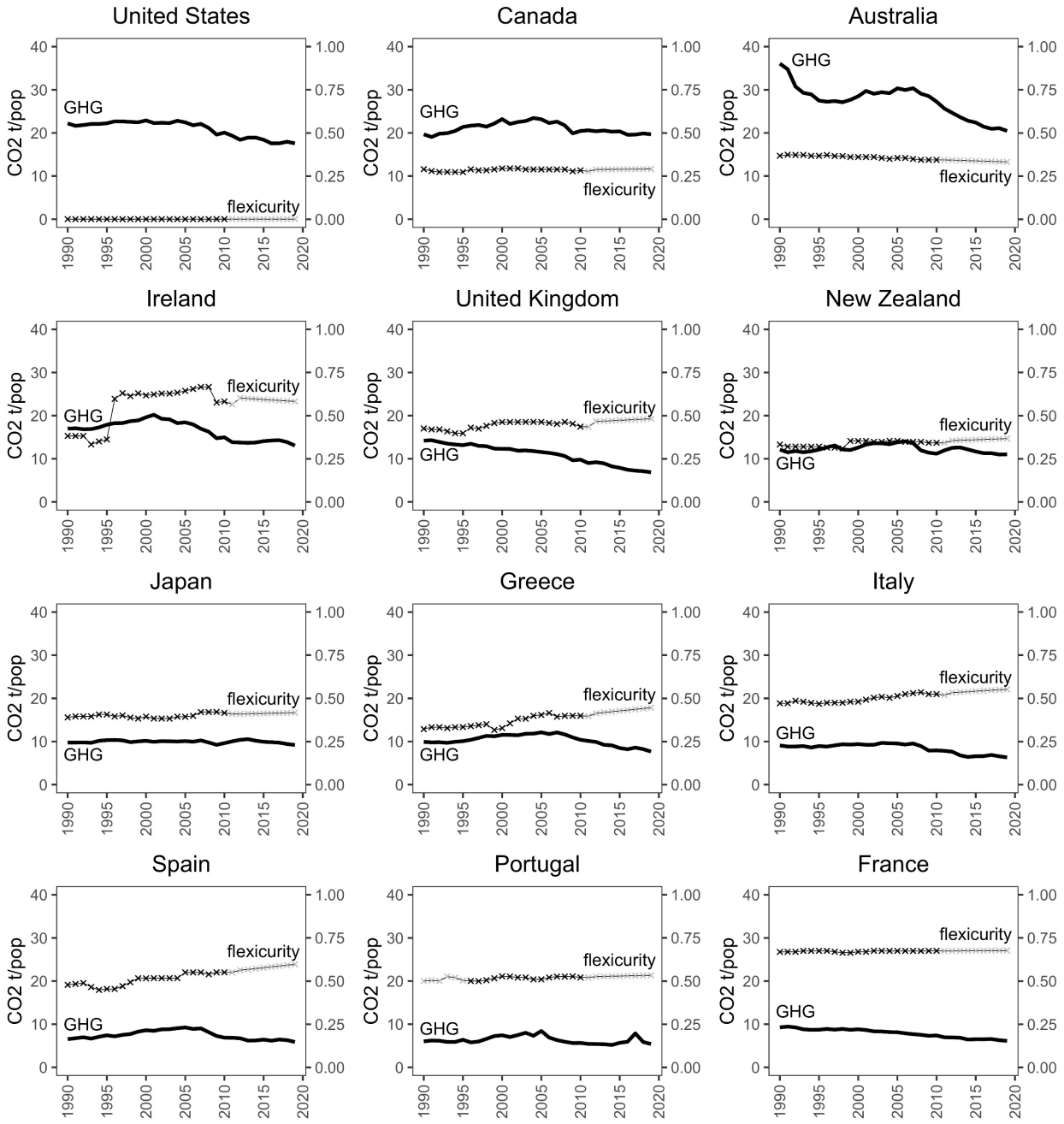

Figure 3: CO_2 emissions and flexicurity by country, 1990–2019

GHG series refers to annual CO_2 tons per capita, including land use, land use change and forestry (LULUCF) (source: OECD 2021a). The flexicurity series was generated via factor analysis from Comparative Welfare States Dataset variables *almp_pmp*, *wcoord*, *uegen*, *sickgen* (Brady et al. 2020). Shaded points based partly on estimated values.

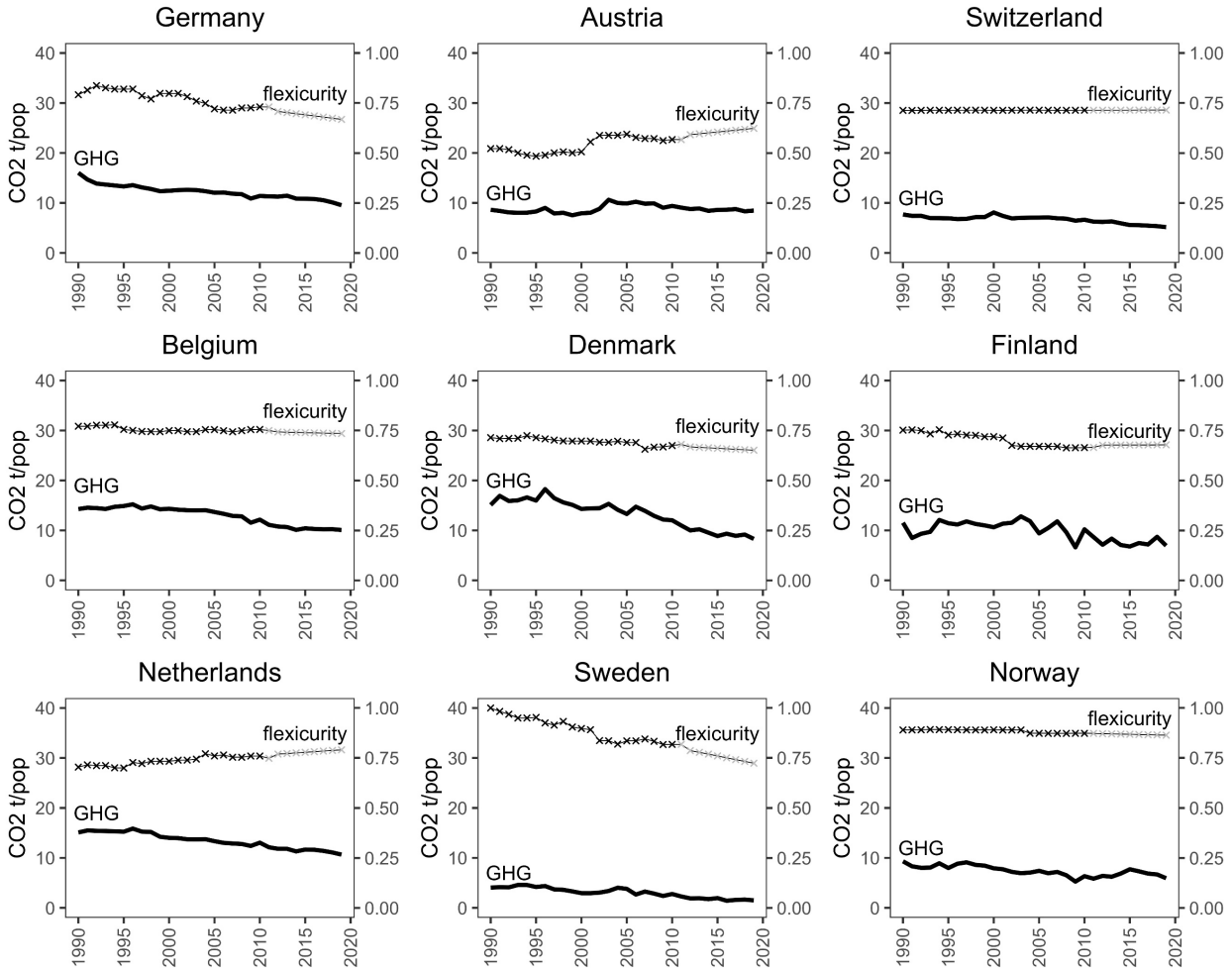

Figure 3 (continued): CO_2 emissions and flexicurity by country, 1990–2019

GHG series refers to annual CO_2 tons per capita, including land use, land use change and forestry (LULUCF) (source: OECD 2021a). The flexicurity series was generated via factor analysis from Comparative Welfare States Dataset variables *almp_pmp, wcoord, uegen, sickgen* (Brady et al. 2020). Shaded points based partly on estimated values.

Figure 4 conveys the logic of hierarchical mixed-effects in the context of the bivariate relationship between flexicurity and CO_2 emissions per capita. The between effects estimator is represented by the long grey regression line, while the random effects estimator is generated from the manifold colored, country-specific regression lines. The bivariate relationship suggests a strong negative between-country effect that is consistent with our hypothesis, while the varying slopes at the within-country level cast doubt over whether welfare state entrenchment systematically affects CO_2 output.

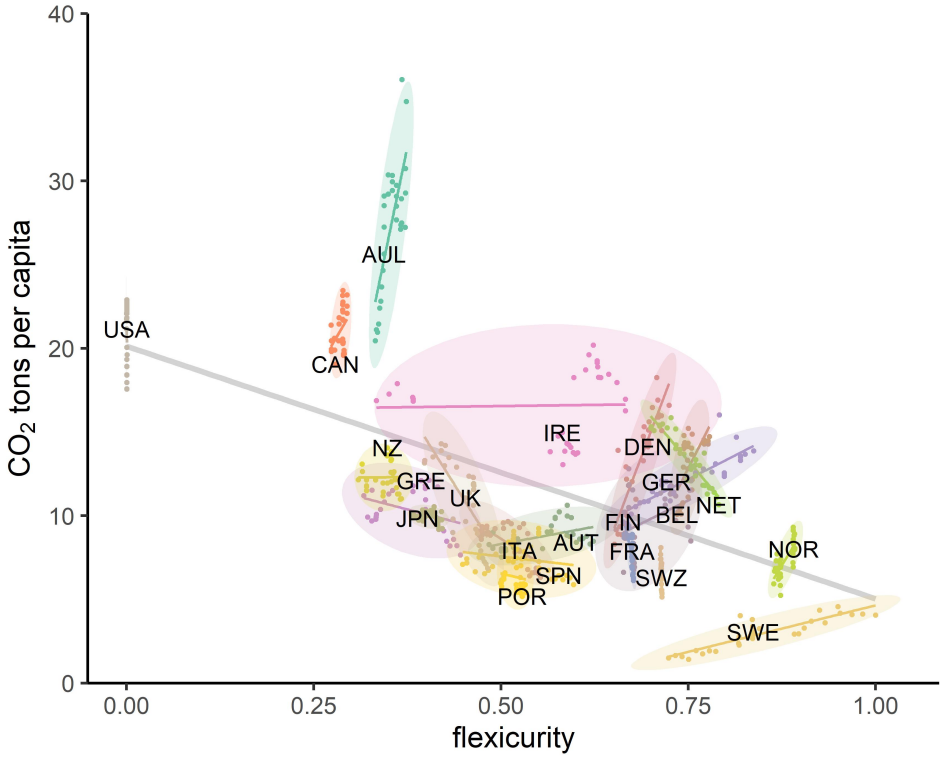

Figure 4: Relationship between flexicurity and CO_2 emissions

Source: OECD (2021a): CO_2 tons per capita including land use, land use change and forestry (LULUCF). Flexicurity index generated by factor analysis from Comparative Welfare States Dataset variables *almp_pmp, wcoord, uegen, sickgen* (Brady et al. 2020). AUL = Australia; AUT = Austria; BEL = Belgium; CAN = Canada; DEN = Denmark; FIN = Finland; FRA = France; GER = Germany; GRE = Greece; ITA = Italy; IRE = Ireland; JPN = Japan; NET = Netherlands; NOR = Norway; NZ = New Zealand; POR = Portugal; SPN = Spain; SWE = Sweden; SWZ = Switzerland; UK = United Kingdom; USA = United States.

To control for potential confounders, and to assess our hypothesis against rival explanations, we include several additional variables in the regression output reported in Table 1. Specifically, we are interested in whether flexicurity better accounts for CO_2 emissions than international agreements (i.e., the Kyoto Protocol), EU membership, post-materialist values, economic growth rate, taxes on emissions, political veto players, air pollution, and government spending on research and development related to climate change. The column labelled 'model 1' reports the bivariate between-effects relationship represented by the grey line in Figure 4. The 'model 2' column reports between-effects estimates with controls. Because 'model 2' is estimated from a relatively low number of group means (n = 21), we include an alternative, non-heteroskedastic 'pooled' model generated from N = 50 random draws from the full N = 630 panel, which was necessary to avoid bias due to autocorrelation. The 'baseline' random effects column reports the panel average CO_2 output (11.76 tons per capita). The 'model 3' column reports a bivariate random-effects model. The 'model 4' column reports a random-effects model with control variables.

	between-effects			random-effects		
	model 1	model 2	pooled	baseline	model 3	model 4
(intercept)	20.50*** (2.94)	13.09* (6.77)	13.79*** (3.21)	11.76 (1.22)	4.09 (6.93)	6.34 (2.19)
flexicurity	–15.74*** (4.97)	–33.82*** (7.85)	–29.58*** (4.84)	-	13.31 (13.67)	7.36 (2.75)
Kyoto	-	7.79 (5.96)	5.58* (2.26)	-	-	0.73 (0.34)
EU membership	-	–2.89 (3.13)	–3.65** (1.36)	-	-	–6.80 (2.33)
post-materialist values	-	–0.07 (8.25)	0.47 (3.01)	-	-	5.05 (0.49)
growth	-	1.03 (2.76)	0.80*** (0.26)	-	-	0.16 (0.04)
carbon taxes	-	1.75 (2.70)	1.86 (1.11)	-	-	0.15 (0.47)
veto players	-	19.84** (7.13)	15.11*** (3.51)	-	-	–0.54 (0.73)
air pollution	-	–0.07 (8.25)	0.00 (0.00)	-	-	0.01 (0.00)
government R&D	-	0.00 (0.00)	0.00 (0.00)	-	-	0.00 (0.00)
adjusted R^2	0.30	0.48	0.68	ICC	0.92	0.31	0.57
N	630	154	50	*N*	630	630	154
periods *t*	30	4–12	1–6	*n*	21	21	21
groups *n*	21	21	21	ΔR^2	-	0.42	0.74
* $p < 0.10$	** $p < 0.05$		*** $p < 0.01$			

Table 1: Hierarchical mixed-effects results, CO_2 emissions per capita

ICC intra-class correlation coefficient. Standard errors in parentheses (heteroskedasticity and autocorrelation corrected in pooled model). Pooled model Lagrange multiplier test for autocorrelation insignificant at $p = 0.18$. Fixed-effects estimates reported for mixed-effects models. Kyoto, EU membership and post-materialist values included only as fixed effects in mixed-effects models; all other variables computed as random and fixed-effects. Flexicurity index generated by factor analysis from Comparative Welfare States Dataset variables *almp_pmp, wcoord, uegen, sickgen* (Brady et al. 2020). Kyoto = 1 for parties to the Doha Amendment after 2015, 0 otherwise. EU membership = 1 for EU countries, 0 otherwise. Post-materialist values = average weighted country-wave responses to 3-point question in Integrated Values Surveys (IVS 2021). Growth = growth rate (output approach) (OECD, 2021b). Carbon taxes = tax revenue/GDP in climate change domain (OECD 2022a). Veto players = Political Constraints Dataset variable *polconiii* (Henisz 2017). Air pollution = premature deaths per million due to ambient particulate matter (OECD 2020b). Government R&D = government expenditure on research and development related to environment, energy and industrial processes (millions, 2015 USD) (OECD 2022b).

The intercept values reported in Table 1 represent estimated annual CO_2 tons per capita when variables are at their zero values. Coefficients represent estimated change in annual CO_2 tons per capita for each one unit increase on the respective variable. Because flexicurity ranges from 0 to 1, its coefficient represents the estimated difference in emissions between the lowest and highest values for flexicurity in the sample. Substantively, model 1 estimates that the average Swede in 1990 emitted 15.74 fewer tons of CO_2 than the average American in 2008.

The *p*-values in model 1 confirm that the between-effects relationship conveyed in Figure 4 is statistically significant, while the results for model 2 and our pooled model confirm that the effect is robust to the addition of control variables. In fact, the strength of the relationship between CO_2 emissions and flexicurity increases with the addition of controls.[5] However, the random-effects models also confirm that the effect is almost entirely between countries. Indeed, the intra-class correlation criterion (ICC) estimates that 92% of variance is attributable to cluster effects, while the sign on the flexicurity variables switches from negative to positive in the random-effects models. However, the large standard errors in models 3 and 4 suggest that the within-country effect is insignificant, despite substantial improvement in the R^2 value from the baseline model. The inference to be drawn is that welfare state entrenchment does not affect CO_2 emissions; if anything, welfare state retrenchment yields lower emissions.

The pooled model returns the most significant coefficients. Kyoto and EU membership are estimated to have positive and negative effects on emissions, respectively. Kyoto is coded 1 from 2005 onward for all countries that signed on to the Doha Amendment, and 0 otherwise.[6] Growth represents annual growth rate in percent, which is significant only in the pooled model, with a one percentage point increase in economic growth corresponding to an estimated 0.80 ton per capita increase in CO_2 emissions. The veto players variable has a strong and significant positive effect in the between-effects and pooled models, and a null effect in the random-effects model (as indicated by the standard error). Veto players measures 'political constraints' and therefore captures institutional features related to both 'cooperative veto points' (e.g., corporatism) and 'competitive veto points' that make policy change more difficult to achieve (cf. Birchfield & Crepaz 1998; Henisz 2000; Tsebelis 2002). Like flexicurity, the veto players variable is indexed to a range between 0 and 1, with the minimum value representing Portugal 2011 and the maximum Belgium 2003. Notably, bivariate analysis of the relationship between veto players and CO_2 emissions returns a null result.

With respect to non-significant control variables, the post-materialist values variable is based on country averages to survey responses on a three-point scale, whereby 1 represents 'materialist' and 3 represents 'post-materialist.' Incidentally, Germany

[5] To assess the robustness of our pooled coefficient, we generated 10,000 random samples of $N = 50$ from the full panel and calculated an average coefficient of –24.16 for flexicurity.

[6] The Kyoto variable is coded 1 for all countries from 2005 to 2019, aside from Canada, Japan, New Zealand and the United States, as these countries did not ratify the Doha Amendment.

2019–19 scores highest at 2.32, while Australia 2010–14 scores lowest at 1.63. Contrary to expectations, bivariate analyses of the relationship between post-materialist values and CO_2 emissions return positive and statistically-insignificant coefficients, suggesting that, if anything, post-materialist values correspond with higher, not lower, emissions. Carbon taxes measure revenue from taxes related to climate change as a percentage of GDP, the coefficients for which are positively signed (counter-intuitively) and statistically insignificant across all models. Air pollution measures premature deaths per million attributable to ambient particulate matter, which may not be significant due to the fact that policy responses to air pollution may take years to manifest as CO_2 reductions. Finally, government R&D measures real government expenditure related to environment, energy and industrial processes in millions of US dollars. Interestingly, the highest spender was Japan in 2019, while the lowest was Switzerland in 2000.

The quantitative results suggest that welfare state robustness (operationalized as flexicurity) is the most significant predictor of differences in CO_2 emissions between countries. However, welfare state entrenchment within countries does not lead to significantly lower emissions, as countries that have undergone welfare state retrenchment have made greater progress, on average, than countries that have undergone entrenchment. The other notable between-country finding is that political veto players are associated with higher emissions when controlling for flexicurity. One interpretation is that flexicurity accounts for the compensatory aspects of corporatism, leaving the variance associated with protectionist institutions to be explained by the veto players variable. In other words, flexicurity captures negotiated compensation associated with 'cooperative veto points' but not protectionist tendencies associated with 'competitive veto points' (Birchfield & Crepaz 1998). It must be stressed, however, that the effect is present only at the between-country level, not at the within-country level. EU membership also seems to have a negative effect on emissions, although the relationship is not significant in the between-effects model. Culture (post-materialist values), economic performance (growth), regulation (carbon taxes), environmental hazards (air pollution), public goods and corporate welfare (government R&D) are insignificant across all models. International agreements (Kyoto) are insignificant in all but the pooled model, in which the coefficient is positive and weakly significant.

5 Case studies

Conventional practice in mixed-methods research is to investigate cases both 'on' and 'off' the regression line (Lieberman 2005). Yet, as critics have convincingly pointed out, 'it is important to cast the net broadly for alternative explanations' when conducting case research because linear statistical models may suffer from poor quality data, spuriousness, and misspecification due to non-linear relationships (Bennett & Checkel 2015: 23; Rohlfing 2008).

According to the quantitative data, Denmark had unusually high CO_2 emissions for its level of flexicurity at the beginning of the period, but drastically reduced its emissions over time. As shown in Figure 4, Denmark moved from a position 'off the line' to a position 'on the line.' The inverse occurred in the United Kingdom. The UK started off with relatively high CO_2 emissions, as predicted based on its relatively meager welfare state, then proceeded to reduce its emissions to an extent not predicted by the statistical model. The UK moved from a position 'on the line' to a position 'off the line.' Notably, as shown in Figure 3, Denmark underwent welfare state retrenchment over the study period, while the UK experienced welfare state entrenchment.

More granular quantitative data may assist in discerning the source of emissions reductions. Figure 5 displays CO_2 emissions for each country by source. These statistics indicate that both countries made substantial progress in the energy sector, while the UK also reduced emissions from industry. For its part, industrial emissions in Denmark were was always comparatively low. Of course, the quantitative data do not provide any information about *how* these countries reduced emissions. For that, case study analysis of causal mechanisms is required.

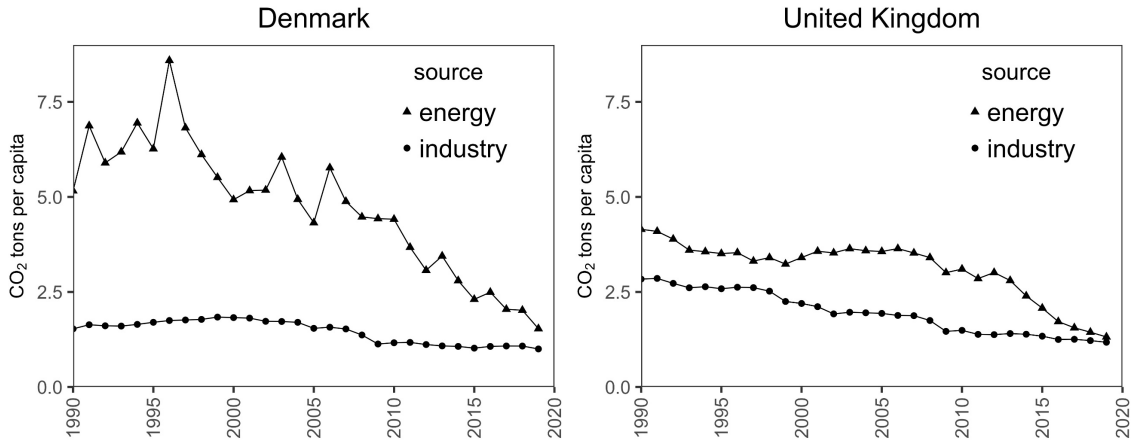

Figure 5: CO_2 emissions by source in Denmark and the United Kingdom, 1990–2019

Source: OECD (2021a). Energy series based on '1A1 energy industries'; industry series based on '1A2 manufacturing industries and construction' and '2 industrial production and product use'.

5.1 Denmark

Compared to many other industrialized countries, Denmark was historically poor with respect to accessible fossil fuel deposits. In the wake of the 1973 OPEC oil crisis, Denmark's apparent energy insecurity became the impetus for both offshore oil drilling in the North Sea and aggressive investment in wind power generation. Yet, Denmark

remained dependent on imported fossil fuels for heat, electricity and transport until the late 1990s, and imported coal continues to be part of Denmark's energy mix. Given that investment in wind power would take decades to pay dividends, political institutions that facilitate multi-partisan agreements were crucial for sustaining political commitment to creating comparative advantage in renewables (OECD 2021c). To that end, Denmark's proportional representation system has produced a durable multi-party coalition committed to renewable energy.

Incidentally, the term 'flexicurity' was coined to describe Danish welfare state reform in the 1990s (Viebrock & Clasen 2009). Although unions were active supporters of green growth in the 1990s, Danish corporatism has since been criticized for excluding unions in the policymaking process (Rathgeb 2017; Tapper & Shovelton 2009). Instead, Danish energy policy is based predominantly on feed-in tariff subsidies and carbon taxes negotiated with considerable input from industry, revenues from which are channeled into incentives for further sustainable development and retraining in low-emitting occupations (OECD 2021d). Although lamented in some quarters for promoting 'workfare' over welfare (and therefore welfare state retrenchment), the Danish flexicurity model boasts an impressive record of labour market activation, a low Gini coefficient and high average income (Rosholm & Svarer 2008).

As shown in Figure 5, Danish industry has few significant emitters. Rather, it is dominated by major wind energy manufacturers, such as Vestas and its suppliers. Notably, industry associations were not always supportive of carbon taxes, as evidenced by opposition on the part of Dansk Industri to the 1995 carbon tax. Arguably, a tipping point was reached at which the majority of influential Danish companies stood to benefit from the country's green growth trajectory. Moreover, although carbon taxes and above-average electricity rates have been found to be regressive for both households and small businesses, policy losers are largely powerless to oppose the status quo (Wier et al. 2005).

For their part, politically-influential agricultural interests have benefitted from investment in wind power generation, as many farmers own turbines and are organized into wind cooperatives. Moreover, Danish agricultural interests have hitherto faced few policies targeting agricultural emissions, which now outrank emissions from energy and industry (OECD 2021a). Yet, for the time being, emphasis appears to be on limiting emissions from transportation and residential heating via gasoline taxes, electrification, bicycle infrastructure and district heating.

The case evidence adds nuance to our understanding of the processes by which CO_2 reductions may be achieved. Specifically, corporatist systems of interest intermediation may take many forms that differentially privilege labour and business. While it is true that Denmark's flexicurity regime has been instrumental for redeploying labour across sectors of the economy, corporate welfare has arguably played an even larger role in Denmark's green energy revolution. Political institutions have also facilitated the energy transition, namely the system of proportional representation and coalition government, which necessitates cooperation across partisan lines. Although regressive carbon taxes and high

electricity prices impose costs on households and businesses, policy losers stand little chance of reversing policy given the foothold enjoyed by the green growth coalition. While Denmark is vulnerable to environmental risks associated with sea rise, the explanation appears to be primarily economic. It made good business sense for the Denmark to promote itself as a model of sustainable growth —not least because it has helped position Vestas as a major exporter of wind turbines for the world market.

5.2 United Kingdom

The UK is the mirror image of Denmark in the sense that the UK is a modest but entrenching welfare state that has historically benefited from ample deposits of fossil fuels. As shown in Figure 5, progress is largely attributable to industrial restructuring. Specifically, emissions reductions have followed from restructuring in five high-emitting industries: coal, petroleum refining, chemicals, steel and cement.

The decline of the domestic coal industry and concomitant phase-out of coal-fired electricity generation has been particularly significant, as other high-emitting industries historically depended on coal as a low-cost input to remain competitive. According to Glyn and Machin, the UK coal industry experienced 'a rate of decline that is probably unparalleled in any major industry in any advanced capitalist country' (1997: 197). While industrial adjustment in the UK can be attributed to lack of competitiveness, political and policy-related questions remain as to how closures occurred at the rate they did. Indeed, other jurisdictions sustained domestic coal output, even in the face of low-productivity, through the use of government subsidies (Storchmann 2005). How did the UK manage the transition?

Theory on eco-welfare states posits that restructuring toward a low-emission economy follows from policies that mitigate the sting of adjustment. Several such policies can be identified in the UK, which correspond to upticks on the flexicurity measure in Figure 3. However, as to whether compensatory policies were responsible for emissions reductions, it must be emphasized that industrial decline was catalyzed foremost by policies that created painful dislocations: the privatization of state-owned enterprises following election of the Thatcher Conservatives in 1979 (Henderson & Shutt 2004).

Nevertheless, government did implement active labour market policy during the Conservative long reign (1979–1997). Examples include the Job and Career Change Scheme (1985–1995) and green jobs training through the Energy Action Grants Agency (1990–2011). Following the 1997 election of the Blair Labour government, 'new deal' policies bolstered flexicurity for purposes of transitioning to a low-carbon 'knowledge-driven economy' (Exchequer 1999; Thursfield & Henderson 2004). Incidentally, high-emitting industries were concentrated in poorer regions with comparatively few alternative options for employment. Labour's 'welfare to work' policy therefore gave unemployment insurance recipients the option of free full-time education or working for

an environmental task force when no other suitable opportunities could be found (Zaidi 2009). In 1999, the Department of Communities and Local Government also established the Coalfields Regeneration Trust, which continues to fund social and economic development in former coal communities.

Flexicurity notwithstanding, Labour's 'green levy' on business is widely regarded as the primary policy instrument responsible for curbing industrial emissions at the turn of the millennium (Richardson & Chanwai 2003). Premised on the 'polluter pays' principle, the levy combined environmental impact audits with an emissions tax, whereby revenues were used to finance reductions to employers' national insurance contributions so that major employers were less affected than high-emitting capital-intensive firms (Exchequer 1999). Although concerns over urban air quality induced widespread public support for the green levy, it is noteworthy that steel and chemical lobbies successfully mobilized to scale back the levy on the basis that it would move jobs overseas (Pearce 2006).

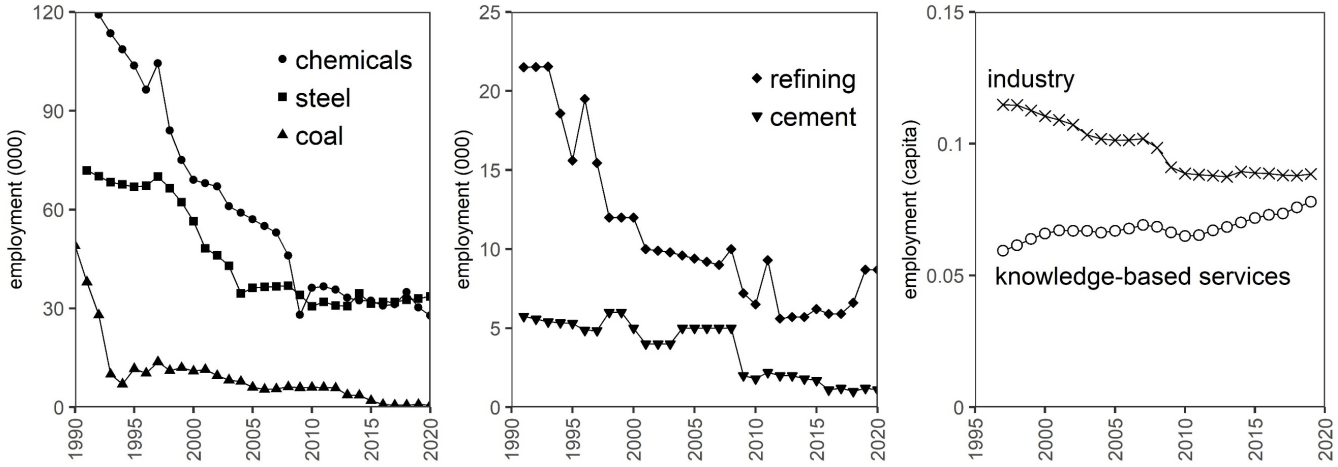

Figure 6: Employment in the United Kingdom over time

Source: OECD (2020b); United Kingdom (2020; 2008; 1998). 'Knowledge-based services' is an aggregate of three service sub-sectors: information and communication; financial and insurance activities; and professional, scientific and technical activities (OECD 2020b).

Regarding effects of policy on employment by industry, Figure 6 indicates that the coal and cement industries in the UK have been almost entirely wiped out, while the chemical, steel and petroleum refining industries consolidated around 2010 and have remained stable since. The rightmost panel in Figure 6 also shows that diminished employment in conventional industry has been offset by increased employment in knowledge-based services. Yet, to the extent that policy succeeded in accommodating displaced workers, evaluations are mixed. Although retraining funneled many displaced

workers into new career paths, the fact that many ultimately found themselves in minimum wage occupations or on permanent disability has led commentators to conclude that a gulph exists between the rhetoric and reality of 'life-long learning' in the UK (Thursfield & Henderson 2004).

In terms of explanation, on one hand, emissions reductions in the UK are attributable to political institutions that permit the executive to impose costly policies with minimal interference from affected interests (Lijphart 2012; Tsebelis 2002). Specifically, executive dominance in the British political system allowed government to impose the green levy on business, privatize industries, and acquiesce to closures that displaced workers. On the other hand, because the executive is beholden to electoral pluralities at the district level, it has incentive to enact moderate policies in order to maximize vote share (Cox 1990). Political incentives may therefore explain why Conservative and Labour governments offered (counter-intuitive) concessions to workers and businesses in the form of retraining schemes and revisions to the green levy. By the same token, the moderate amount of eco-welfare policy observed at the aggregate level in the UK can attributed to the declining share of blue-collar voters vis-à-vis white collar voters in 'knowledge-based' sectors (cf. Scharpf 1987).

All in all, although transition to a low-emission economy in the UK may have been facilitated by compensatory policies (including corporate welfare), it was also motivated by environmental risks (i.e., air quality) and accomplished via the imposition of costs that were not fully compensated. Notably, however, political alienation that stoked the Brexit movement has not prompted major policy reversal on climate change mitigation in the UK. The story contrasts with developments in the United States and Canada, where carbon taxes and support for renewable energy have been resisted and reversed by conservative governments that galvanized political support of alienated constituents (cf. Bartels 2016). As discussed in the following section, whether differences in political responses are primarily an artefact of institutions or compensation remains a question for further research.

6 Discussion

To recap, our quantitative model produced four major findings. First, compensatory welfare policy is the strongest predictor of differences in CO_2 emissions between countries. Second, welfare state entrenchment within countries is not associated with emissions reduction (if anything, the opposite is true). Third, the number of political veto players in a country is a significant and positive predictor CO_2 emissions. Fourth, other explanations offered in the literature were found to be insignificant in our quantitative model.

Our case-level analysis of causal mechanisms confirmed that compensation via active labour market policy was a factor in how Denmark and the UK achieved emissions

reductions. The case evidence also suggested that political institutions matter in terms of the constituencies on to which transition costs may be imposed. Consistent with the thesis that negotiated compromise in corporatist systems facilitates positive-sum green energy transitions, we found evidence of a durable, cross-class coalition in favour of green growth in Denmark (cf. Dryzek et al. 2003). However, the green bargain in Denmark was apparently not negotiated in the traditional image of corporatist interest intermediation, as labour interests were marginal relative to business. Moreover, costs associated with carbon taxes and corporate welfare in the form of feed-in tariff subsidies for renewable energy producers have disproportionately been borne by low-income households and small businesses. Although outcomes were similar in the United Kingdom, the political calculus was different, as institutions do not encourage coalition building but rather moderate policies that appeal to the median voter on issues (Cox 1990).

Our case-level analysis also revealed that many of the other causes identified in the literature were at play, despite being insignificant in our quantitative model. Specifically, carbon taxes have loomed large in Denmark and the UK, as have environmental risks and corporate welfare in the form of tax concessions and feed-in tariff subsidies. Emission reductions have thus not followed exclusively from voluntary preference change envisioned by the behavioural model depicted in Figure 1. Rather, emissions reductions have also followed as a consequence of executive imposition of transition costs.

Although effective in the short-run, the executive action route is potentially unstable since it creates political incentives for policy losers to mobilize in support of policy reversal (Birchfield & Crepaz 1998; Mokyr 1994). The experience in Canada and the United States is consistent with the prediction, as high-emitting incumbents have exploited competitive political institutions to resist and reverse progress in the realm of carbon taxes, feed-in tariffs, green jobs training, coal mining and gas extraction.[7] The implication is that compensation for technological dislocations may be required to ensure durable commitment to sustainable development (Trebilcock 2014).

As discussed in Section 2, we understand the compensation mechanism to be the crux of emergent theory on eco-welfare states. Although compensation is not necessarily fair or equitable (especially when granted as ransom), there are obvious parallels between eco-welfare states and just transitions. The case evidence suggests that the transition toward a low-carbon economy has so far not been particularly fair or equitable. For reasons of both fairness and efficacy, there may be grounds for further investment in the compensatory instruments of eco-welfare states.

Skeptics may counter that positive inducements are insufficient, and that strong regulations devised by politically-insulated arms-length agencies are required to meaningfully confront the climate crisis (Beeson 2010). We concede that any conclusions drawn herein are tentative. In order to further discipline our conjectures regarding causal mechanisms, it will be necessary to systematically conduct additional case studies and

[7] The next draft of this paper will include a case study of climate change policy in the United States.

evaluate findings using tools of Bayesian analysis (Bennett 2015). For example, it would be possible to evaluate weights of evidence for and against the regulation and compensation hypotheses to discern the characteristics of the most effective and fair policies (cf. Fairfield & Charman 2017).

7 Conclusion

Despite much discussion of eco-welfare states, theory underlying the concept remains underdeveloped. Consequently, there has been little systematic analysis linking welfare state institutions to ecological performance via testable causal mechanisms. This paper has contributed to the literature on the institutional determinants of climate change mitigation by undertaking a multi-method analysis of the linkages between welfare state generosity and CO_2 emissions.

We began by articulating an insurance-based behavioural model whereby compensatory policies were assumed to alter stakeholder preferences in support of sustainability. We then developed a novel time-variant measure of 'flexicurity' that captures both passive social insurance and active labour market policy. Our quantitative analysis of twenty-one OECD countries over a thirty year period found that compensatory policies better account for differences in CO_2 emissions between countries than other explanations advanced in the literature. Yet, we also found that welfare state entrenchment does not account for CO_2 reductions within countries over time. Case study analysis of CO_2 reductions in Denmark and the United Kingdom revealed two non-mutually-exclusive pathways to sustainable development: compensation and executive action that imposes transition costs.

Although it is arguable that regulation is more effective than compensation in the short-run, the executive action pathway risks prompting political mobilization on the part of 'policy losers' intent on reversing course on prior commitments. Questions also arise regarding the fairness of uncompensated transition costs. A tentative argument can therefore be made that compensation is a preferable means of accomplishing sustainability goals. In that sense, theory and evidence on eco-welfare states is closely related to current discussions about 'just transitions.' Further systematic research is needed, however, regarding potential trade-offs between equity and efficiency in the sustainability domain.

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