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Domestic Politics in the European Union's Emissions Trading System: Evidence from Free Allowance Allocation

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ABSTRACT

How do leaders determine to whom to target the benefits of new environmental policies? When the European Union first rolled out its Emissions Trading System in 2005, a cap-and-trade system that is the world's largest carbon market regulating 40% of EU emissions, national governments commanded significant leeway in determining the distribution of pollution permits to emitters. The allocation of "free allowances" represented a choice to distribute a sizable economic asset, along with the ability to pollute for free under the new system. This paper describes the provision of free allowances over time and examines whether leaders provided greater free allowances to emitting installations located in politically consequential places. I find that, in the United Kingdom, installations located in more marginal electoral constituencies received more free allowances on average than installations located in less marginal districts. While consistent with theoretical expectations, the effect is not statistically significant.

Keywords: EU ETS; carbon pricing; free allowances; electoral politics

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1 Introduction

The European Union's Emissions Trading System (EU ETS) constitutes the world's largest attempt to mitigate the effects of climate change. The EU ETS is a cap-and-trade system established in 2005 that regulates approximately 40% of the European Union's (EU) emissions, and places a price on carbon such that emissions reductions are undertaken in an economically efficient manner. In the initial policy rollout, national governments commanded significant leeway in determining key institutional design features, which had distributional consequences for actors who now required permits to pollute. This paper explores governments' incentives to target redistributive benefits of environmental policy and how politicians determine the recipients of these benefits.

The implementation of new environmental policies generates winners and losers (Aklin and Mildenberger, 2020; Colgan *et al.*, 2021). In the context of the EU ETS, EU member state governments could determine how permits were allocated across emitters within their countries between 2005 and 2012; a vast majority of permits were given out free of charge. The allocation of "free allowances" therefore represented a choice to distribute a sizable economic asset, along with the ability to pollute for free under the new system. For example, windfall profits associated with the allocation of free permits have been estimated at €19 million per year between 2005 and 2007 for electricity producers (Sijm *et al.*, 2006; Keppler and Cruciani, 2010) and €3.5 billion for the cement industry between 2005 and 2012 (Branger and Quirion, 2015). So how do governments choose to whom to target these benefits?

This paper explores how leaders' electoral incentives affect the disbursement of redistributive benefits. I argue that free allowances may be used as a targeted benefit to enhance politicians' electoral prospects (Golden and Min, 2013). In particular, I consider how the electoral geography of regulated plants affects their allocation of free allowances (Cox, 2010). The conventional economic wisdom explains patterns of free allocation based on sectoral demand, the risk of carbon leakage, and the threat of international competition. I contend that, even given the emissions intensity that a particular industry demands, leaders may on the margin provide greater free allowances to plants located in politically consequential places.

The analysis in this paper is descriptive (Gerring, 2012; Munger *et al.*, 2021). I examine the disbursement of free allowances in 31 countries (EU member states along with Iceland, Liechtenstein, Norway, and the United Kingdom until 2020) between 2005 and 2022. I document substantial heterogeneity over time, across sectors, and within countries as to how free allowances are allocated. While the EU ETS was a common policy with an EU-wide framework, its implementation varied domestically. To investigate the potential electoral dynamics involved in EU ETS implementation, I consider the case of the United Kingdom. The UK serves as a useful test of whether electoral incentives determined the provision of free permits because its electoral rule produces a clear prediction: policy benefits should be targeted at marginal seats (McGillivray, 2004; Finnegan, 2022). Consistent with this theoretical prediction, I find that, when comparing installations that are located in electoral constituencies that have a one percentage point difference in marginality, the installation in the more marginal district received on average 2.6% more free allowances. Moreover, I find that, when comparing two installations, one located in a constituency held by the government and one that is not, the installation in the constituency held by the government received on average 16.8% more free allowances. While these findings are consistent with theoretical expectations, they fail to reach conventional levels of statistical significance.

This paper's contribution is threefold. Primarily, I consider the electoral incentives that leaders face when implementing mitigation policies. An emerging literature investigates the effects of mitigation policy on electoral outcomes (e.g., Stokes, 2016; Urpelainen and Zhang, 2022; Bolet *et al.*, 2023; Voeten, 2024). While the evidence is mixed on whether climate policy improves upon or detracts from politician support, these studies make clear that politicians' anticipation of winners and losers is paramount to policy design and implementation. Other work within this literature investigates how other actors profit from politicians' desires to remain in office, namely how special interest groups can stymie policy implementation (Mildenberger, 2020; Stokes, 2020) or extract more favorable regulatory outcomes (Bayer, 2023).

Second, I contribute to the literature examining the allocation of targeted benefits. Classical theories consider whether benefits should be targeted at core supporters (Cox and McCubbins, 1986) or swing voters (Dixit and Londregan, 1996; Dixit and Londregan, 1998). Studies of international trade have argued that concentrated interests in electorally marginal districts within majoritarian electoral systems receive the most protection (e.g., McGillivray, 2004; Rickard, 2018). On climate policy in particular, Finnegan (2022) argues that leaders in majoritarian systems are less electorally insulated than leaders in proportional representation systems, and thus are less likely to impose short-term costs on voters required to invest in mitigation strategies. Similarly, other studies in this literature have examined whether the government's copartisan districts receive more benefits (e.g., Dynes and Huber, 2015; Fouirnaies and Mutlu-Eren, 2015).

Finally, this project joins literature in economics on the effects of the EU ETS. Scholars have primarily focused on whether or not the EU ETS has been successful in reducing emissions; evidence to support this claim has been mixed (Martin *et al.*, 2016).[1] Some scholars observe reductions at the installation level (Dechezleprêtre *et al.*, 2023; Colmer *et al.*, 2024) and the sectoral level

[1] Causal identification in this setting is difficult because installation-level data on emissions prior to the implementation of the EU ETS do not exist. The literature therefore relies on methods like matched difference-in-differences or synthetic control approaches in order to construct a relevant comparison group.

(Bayer and Aklin, 2020), while others have found negligible effects of the EU ETS (Jaraitė and Di Maria, 2016). I supplement this literature by examining the political considerations that impact the EU ETS's effectiveness, namely the politics of its institutional design and implementation.

This paper proceeds by reviewing relevant background on the EU ETS and then introduces the data on free allowances and verified emissions provided by the EU Transaction Log. This data is available for 31 countries between 2005 and 2022; I briefly describe trends in the data across countries, paying particular attention to the role of allocation by sector. I then use this data to examine the politics of free allowance allocation in the United Kingdom.

2 Background on the EU ETS

First launched in 2005, the EU ETS is a cap-and-trade system that regulates approximately 40% of the EU's emissions. As of 2023, the system regulates firms in sectors such as electricity and heat production, oil refineries, producers of ferrous and non-ferrous metals, cement, glass, ceramics, lime, pulp, paper, cardboard, chemical producers, and commercial aviation (from 2012) at approximately 18,000 installations/plants.

The EU ETS requires that polluters acquire permits to emit. Permits can be acquired through auctions and secondary market purchases, or through handouts known as free allowances. The system operates on the "polluter pays principle," which stipulates that firms who are most willing to pollute should incur the greatest costs to do so; the EU ETS therefore seeks to affect firm behavior by requiring emitters to either purchase permits, thereby incurring financial costs for polluting, or reduce their emissions.

The EU ETS operates on an annual compliance cycle. Each year, installations must report their emissions which are verified by an accredited monitor. Upon verification, installations must surrender one permit per ton of carbon dioxide equivalent emitted. Failure to comply with this protocol results in a fine of €100 per ton of outstanding carbon.

The EU ETS emerged as Europe's response to implementing the emissions reduction target mandated in the Kyoto Protocol. The Kyoto Protocol required that the EU reduce emissions by 8% relative to 1990 levels – an EU-wide target – and had three noteworthy impacts on EU climate policy. First, the EU-15, a core group of European countries, developed a burden-sharing agreement which stipulated whether countries needed to cut their emissions by a certain percentage, or simply limit their increase relative to 1990 levels.[2] This burden-sharing agreement laid the foundations for the initial implementation of the EU

[2] See COM(1999)230 final, "Preparing for the Implementation of the Kyoto Protocol," Annex I for burden sharing percentages across member states.

ETS in many countries because it informed how national policymakers would set their caps. Second, the EU's deliberations surrounding the ratification of the Kyoto Protocol, particularly with the United States, centered primarily around market-based mechanisms for emissions reductions (Schreurs, 2004); the 2000 Green Paper outlining the creation of the EU ETS encourages other industrialized nations to partake in emissions trading markets in order to induce abatement in the most cost effective way possible (European Commission 2000). Third, in implementing the EU's Kyoto target, the EU ETS linked with the Kyoto Protocol's flexibility mechanisms. This meant that between 2008 and 2012 firms could use international credits in addition to EU ETS permits to offset their emissions.

The EU ETS has adopted a "learning by doing approach" and its structure has evolved numerous times. Two central features are the determination of the cap and the allocation rule (Skjærseth and Wettestad, 2008). The cap sets the overall limit of allowances to be circulated in a given year, and the allocation rule determines how these allowances are to be divided across installations. In the pilot phase (2005-2007) and initial trading phase (2008-2012), caps were decentralized and national governments were able to provide allowances to installations at their discretion without centralized rules. This gave member states considerable leeway in sorting out appropriate internal allocation (van Zeben, 2014), resulting in heterogeneity across countries in determining allocation (Kettner *et al.*, 2008). Each member state drew up a "National Allocation Plan" (NAP), a document stating the total quantity of allowances that it intended to allocate for the phase and how it proposed to allocate them. National caps were to be "consistent with" the burden-sharing agreement and Kyoto targets in the pilot phase, and to be further tightened for compliance if needed in the initial trading phase (Skjærseth and Wettestad, 2008).

NAPs determined a member state's overall cap on emissions for a trading period, to be divided evenly across years, and the allocation of allowances to installations.[3] Notably, the ETS Directive (2003) stated that at least 95% and 90% of allowances shall be allocated free of charge in Phases I and II, respectively. This rule served as a political subsidy to ensure the participation of member states (Skjærseth and Wettestad, 2008). Some countries decided not to auction allowances at all and provided them all for free. By allowing national governments to determine these free allowances, allocation was effectively conducted via grandfathering as initial allocations were often computed using historical emissions data (Zaklan, 2016; De Vivo and Marin, 2018; Sato *et al.*, 2022). In general, free allowances for an installation were determined for the duration of a trading phase prior to the initiation of that phase, and were

[3]NAPs were due on December 31, 2003 for Phase I, and June 30, 2006 for Phase II. NAPs had to be accepted by the European Commission; the EC could (and often did, particularly in the run up to Phase II) reject NAPs to request more ambitious revisions.

distributed symmetrically or in some deterministically decreasing way across years within the trading period (Zaklan, 2016).

As an example, consider the NAP of the United Kingdom for the pilot phase of the EU ETS. The UK was the first EU member state to publish a NAP in January 2004. To determine its national cap, the UK factored in its reduction target as per the burden-sharing agreement, which was to reduce emissions by 12.5% relative to 1990 levels, equal to 653 million tons of CO_2eq, and its own domestic target of reducing emissions by 20% by 2010. The cap was set at 736.3 million tons, to be divided equally across the three years of Phase I, or an annual cap of 245.4 million tons. Allowances were allocated in a two-stage approach that first apportioned a fraction of the cap to each sector, and then allocated to installations within each sector. Sector-wide allocations were made on the basis of the sector's projected emissions between 2005 and 2007. Allocations at the installation level were issued in three equal annual installments and were determined on the basis of each installation's share of "relevant emissions." Relevant emissions were generally the average emissions during the period 1998-2003. The extensive stakeholder consultation involved in this process led to the creation of policies, like the two-stage allocation from sector to installation, that ultimately became the basis for many NAPs (Ellerman *et al.*, 2007; Meckling, 2011).

Initial NAPs were relatively generous in their allocation (Betz *et al.*, 2004), with larger installations often receiving substantially more allowances than surrendered (Kettner *et al.*, 2008). This "overallocation" relative to installations' verified emissions is often credited as the cause of the price of allowances falling to zero on the secondary market by the end of the pilot phase (Metcalf, 2009; Bayer and Aklin, 2020).

Phase III began in 2013 and the EU reformed several aspects of the EU ETS. Rather than rely on national caps, the EU set a Europe-wide cap, which decreases at a linear rate each year. In Phase III, the linear reduction factor was 1.74% compared to 2010 (the midpoint of 2008–2012), reaching in 2020 a level 21% below 2005 emissions (Verde *et al.*, 2019, p. 441). In Phase IV, the EU set a more ambitious linear reduction factor of 2.2%. Moreover, the primary method of allocation transitioned from free allowances to auctioning. Member states are allocated a share of the cap to auction off proportional to their verified emissions in the first phase of the EU ETS. In practice, however member states have centralized auctioning through the European Energy Exchange, pooling their allowances together to be auctioned jointly. Approximately 57% of allowances in circulation in Phase III were auctioned.

The EU also sought to initiate the phasing out of free allowances by standardizing criteria for eligibility through benchmarking. The use of benchmarking was intended to reduce free allowances to each installation (Lecourt *et al.*, 2013). In 2011 the EU released product-specific benchmarks based on the emissions intensity of the most efficient installations producing a given product, as well as a list of products deemed as risk of carbon leakage.[4] Free allowances were determined based on the product benchmarks for each installation, an installation's production performance, and whether the installation produced goods at risk of carbon leakage. This calculation was conducted at the EU level and no longer gave national governments the discretion of provide free allowances.[5]

As the EU ETS transitions away from free allocation – with the goal of phasing free allowances out entirely by 2028 – its market mechanisms become increasingly important. Reforms to the institution seek to ensure market stability, hoping to avoid another crash in the price of permits on the secondary market. As such, the European Commission introduced the Market Stability Reserve in 2019, which controls allowances in circulation by sucking out excess supply in periods of high supply or low demand into a reserve to be reintroduced later in trading phases. This has led to a steady increase in the price of permits, breaking €100 in February 2023.[6]

Figure 1 summarizes the key flows of the EU ETS over time. I plot the cap, disbursement of free allowances, verified emissions, and emissions "net" of international credits for all stationary installations (excluding aviation) for 2005-2022. The solid black line represents the cap, the maximum possible quantity of emissions allowed in the system. Between 2005 and 2012, this is the sum of caps set by each member state; from 2013 the cap was centralized by the EU and declines linearly each year. The dashed dark purple line displays free allowances. In the first two phases, the share of free allowances is approximately 90-95% of the cap, but drops off steadily beginning in Phase III. Notably, installations in the electricity and power generation sector were no longer eligible to receive free allowances. By 2022, the share of free allowances had fallen to 35% of the cap.

The dotted light purple line tracks verified emissions across regulated installations. The overallocation of free allowances relative to emissions can

[4]Sectors are deemed to be at risk at the EU level based on two criteria. Carbon intensity measures the potential significance of carbon costs as in the maximum impact that carbon prices could have on the sector. Trade intensity measures the openness of the sector to international competition. If deemed at risk based on these criteria by the European Commission, then an installation within an at risk sector can receive up to 100% of their benchmarked emissions in free allowances (Verde *et al.*, 2019).

[5]The following formula operationalizes free allocation in Phase III for installation i in year t (European Commission 2011):

$$\text{Free Allowances}_{it} = \text{Benchmark}_i \times \text{HAL}_i \times \text{CLCF}_{it} \times \text{CSCF}_t,$$

which is the product of the product-specific benchmark, the installation's historical annual production performance, a linearly decreasing factor based on risk for carbon leakage, and a cross-sectional correction factor applied to all installations. When the EU instituted its benchmarks and determined free allowances for all installations in Phase III, its calculations exceeded the cap. Thus, a cross-sectional correction factor was applied to all installations.

[6]https://www.reuters.com/markets/carbon/europes-carbon-price-hits-record-high-100-euros-2023-02-21/.

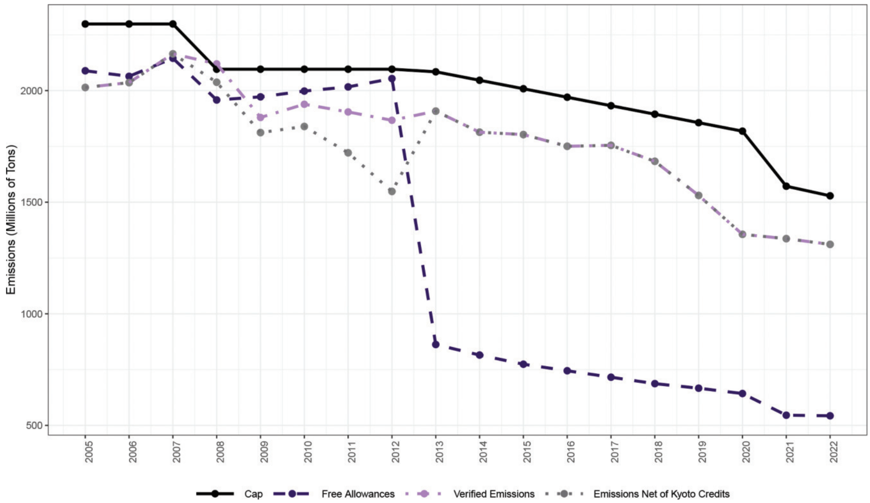

Figure 1: Cap, free allowances, and verified emissions for stationary installations.

be seen based on the discrepancy between the dashed line and the dotted line, particularly in Phase II, where the total number of verified emissions is below the total quantity of free allowances. However, at the start of Phase II in 2008, verified emissions actually exceeded the cap. This was allowed to happen based on the EU ETS's link with the Clean Development Mechanism/Joint Implementation procedures of the Kyoto Protocol; this scheme allowed firms to engage in offset activities or emissions reductions outside the EU. Subtracting the number of international credits surrendered from verified emissions yields the grey dot-dashed line, the "net" emissions from the EU ETS.

3 Political Allocation of Free Allowances?

How do governments determine to whom to provide free allowances and to what extent do domestic electoral considerations play a role? Conventional wisdom claims that the provision of free allowances is chiefly economic: by subsidizing firms' emissions, governments could safeguard the competitiveness of regulated industry and attempt to avoid carbon leakage. Since governments had few rules constraining their choice of allocation rule in the first two trading phases, their decisions represented a "complex tug-of-war between environmental ambition, principles of aggregate economic efficiency, and the politics of distribution" (Sato *et al.*, 2022, p. 3).

Several scholars have documented the influence of firms and other lobbying groups on free allocation. Since some of the largest polluters ended up profiting the most, selling their allowances and generating substantial windfall profits (Cludius, 2018), some industries lobbied to support the EU ETS and hoped to continue the practice of grandfathered free allocation (Fuchs and Feldhoff, 2016). These studies center upon the demand-side of the political economy of allocation, or actors' incentives to interact with the government in order to receive free allowances.

Along these lines, Bayer (2023) finds that governments provided greater free allowances to firms that could credibly threaten to relocate business, which is measured by having a foreign headquarters. Firm relocation and the risk of carbon leakage were seen as the largest potential drawbacks to the EU ETS (Dechezleprêtre *et al.*, 2023); this threat enabled firms to receive more lenient regulation in form of greater subsidized emissions. Theoretically, Lai (2007) and Lai (2008) demonstrates how lobbying by special interest groups affects a government's incentives to set an emissions cap as well as the allocation rule. In a framework similar to Grossman and Helpman (1994), these papers characterize optimal allocation under the pressures of political interests. When governments maximize both a weighted sum of social welfare and campaign contributions, Lai (2007) shows that the optimal allocation rule is free allocation by grandfathering.

In addition to these demand-side political forces shaping the provision of free allowances, I argue that there may also be political motivations on the supply side. That is, governments may also have strategic incentives to provide free allowances to particular installations over others. I contend that these considerations can stem from electoral politics, and the disbursement of free allowances is then akin to the provision of distributive benefits or targeted spending (Cox, 2010; Golden and Min, 2013). Certainly, free allowances provide localized benefits to firms and their employees by creating laxer regulatory environments, and the costs of free allocation – namely greater emissions as a larger endowment of allowances means firms have to incur fewer costs to emit – are diffuse across the public (Weingast *et al.*, 1981).

I therefore test whether the anticipated electoral effects of environmental policy were pertinent to leaders when initially designing allocation schemes. While the effects of the EU ETS and other environmental policy may not be the most salient or visible policy to the public (Crawley *et al.*, 2022) – which may also vary across EU member states as different national governments sought to be "policy entrepreneurs" on climate change issues (Wurzel, 2008) – there were certainly large distributional concerns about how the value of this new economic asset would accrue to firms (Sato *et al.*, 2022), which has downstream consequences for individuals as workers, consumers, and voters. Such consequences could then lead politician to target the benefits of the policy toward electorally important constituencies.

Classic accounts of the provision of targeted benefits then adjudicate whether leaders allocate benefits to core supporters (Cox and McCubbins,

1986) or to swing voters (Dixit and Londregan, 1996; Dixit and Londregan, 1998). Applied work has argued that the electoral rule plays a role, with leaders in majoritarian systems targeting benefits toward concentrated interests in marginal districts, while leaders of proportional systems are expected to allocate benefits toward their electoral base, which is often more geographically diffuse (McGillivray, 2004; Rickard, 2018; Finnegan, 2022).

To formalize these theoretical arguments, I develop a simple formal model in the Online Appendix combining the development of an optimal cap (cf. Phaneuf and Requate, 2016, ch. 3, 8) and probabilistic voting (Lindbeck and Weibull, 1987) to consider how a politician can strategically allocate free allowances to firms in the shadow of electoral support. Firms produce goods that generate emissions, and individuals located in different electoral districts both consume these goods and express political support for the politician, but suffer disutility from greater amounts of pollution. The tradeoff between stimulating production and getting elected – balancing social welfare and political support – drives the derivation of an emissions cap which is divvied into free allowances. Similar to the canonical accounts, the politician targets swing voters in each district, the voter who is exactly indifferent between their utility from consumption and damages and the value of the politician on all other electorally salient dimensions. However, in contrast to other models of redistributive politics in which a politician designs a scheme of targeting spending (e.g., a vector of transfers to each electoral district), the politician here chooses only one cap, which is divided among the firms, and this policy choice affects voter welfare downstream through production and emissions. In equilibrium, the optimal cap is a weighted average of the politician's concerns for social welfare and for her electoral support, where the latter is represented by the preferences of the swing voter within each electoral district. Swing voters in larger districts and in districts with low electoral uncertainty receive the most weight.

In what follows, I focus on the case of the United Kingdom; since the UK is a majoritarian system, the canonical expectation is that the government would provide more free allowances to installations located in marginal districts. In the United Kingdom, the responsibility of developing and implementing the NAP fell on several government departments and bureaucratic agencies. The lead government department responsible for the development of the NAP was the Department for Environment, Food and Rural Affairs (DEFRA), which had primary responsibility for the development of UK environmental policy. The Department of Trade and Industry also played an important role by providing energy use forecasts and serving as a liaison with industry (Ellerman *et al.*, 2007, pp. 44–45). As these government departments were run by ministers who were also elected representatives, it could be the case that the developers of the UK's NAP sought to provide additional allowances to installations in politically consequential locations. In addition to these departments, the UK's Environment Agency was responsible for issuing permits to sites and therefore ultimately for the determination of which sites would be eligible for coverage. This agency, while sponsored by DEFRA, is a non-departmental public body, meaning its executives are not a part of the government.

4 Data

The primary data source is the European Union Transaction Log (EUTL) as compiled by Abrell, 2023. This database contains information on installation locations, emissions, compliance, and freely allocated and surrendered allowances across Europe from 2005 to 2022. This includes emissions data for installations in regulated sectors for the 27 EU countries, as well as Iceland, Liechtenstein, Norway, and the United Kingdom until 2020.[7] Figure 2 displays a map of these installations across Europe. The color of each dot demarcates the installation's sector. Of the nearly 18,000 installations regulated by the EU ETS, the lion's share are energy-generating plants (61.3%), followed by installations that handle minerals such as cement, lime, and glass (16.5%), aircrafts (9.1%), installations that produce paper (5.7%), metals (4.2%), chemicals (2.9%), and installations engaged in other activities (0.34%).

Table 1 displays summary statistics at the installation and sector level for free allowances and verified emissions between 2005 and 2022.[8] On average, an installation received 1.3 million allowances over the course of study, with average emissions totaling 1.8 million tons. The distributions of free allowances and emissions are both highly skewed as the average installation receives over ten times the free allowances as the median installation and the average installation emits over twenty times the median installation.

Turning to sector-level statistics, installations in the energy sector make up the lion's share of installations regulated by the EU ETS at 61.3%, and over three quarters of total emissions. Other sectors such as minerals and metals make up substantial shares of regulated installations and contribute approximately 17% of total emissions together. On average, installations in the metals sector pollute the most, and also receive the greatest amount of free allowances, likely due to the carbon intensity of these activities. Furthermore, in all sectors besides energy and aircrafts, installations are on average allocated more free allowances than they ultimately pollute. This is true for the median installation in every sector as well.

The EU ETS has undergone several institutional revisions, so I consider how the disbursement of free allowances has changed over time. Conventional

[7]The EUTL no longer maintains data on installations in the United Kingdom after its exit from the EU. The UK has its own emissions trading system (UK ETS) which continues to regulate installations and maintains data on free allocation, verified emissions, and surrendered allowances.

[8]Sectoral classifications are based on Bayer and Aklin, 2020.

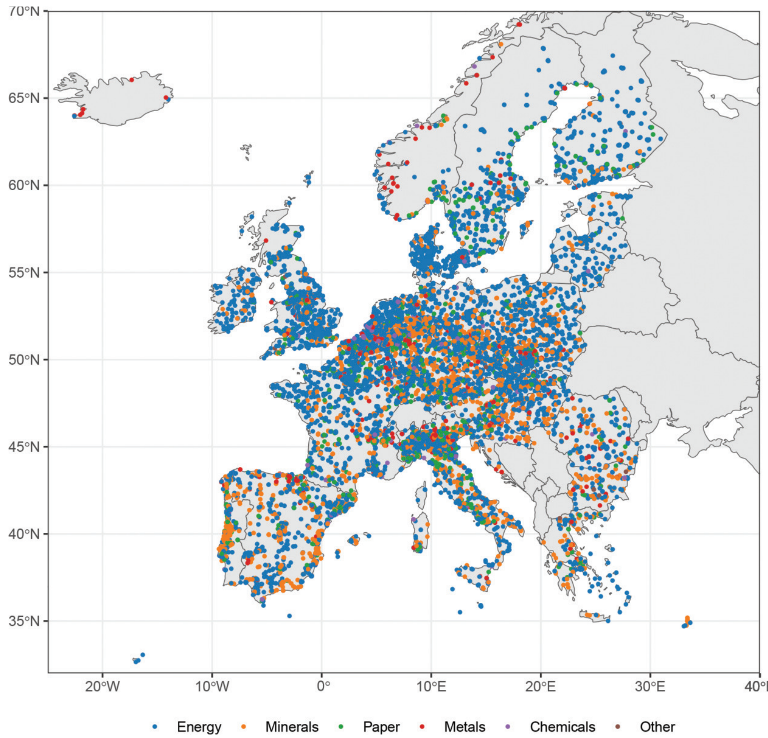

Figure 2: Map of stationary installations regulated by the EU ETS.

wisdom suggests that since the EU centralized allocation and standardized the eligibility for free allowances in 2013, this year should be an inflection point in how permits were disbursed (Lecourt *et al.*, 2013). Figure A.1 in the Online Appendix plots the cumulative total of free allowances and verified emissions within all EU ETS countries over time. In almost all countries, there is a kink in the disbursement of free allowances around 2013, indicating that free permits were provided as a lesser rate compared to the first two phases. Figure A.2 disaggregates further to consider the average amount of free allowances received annually by an installation within each EU ETS country. It is clear that after the EU's harmonization of the free allowance eligibility criteria in 2013, installations received fewer free allowances on average in virtually all countries. On average, installations received approximately 200,000 free allowances in 2005, dropping down to about 70,000 by 2022.[9]

[9]This sharp discontinuity in average free allowances disbursed around 2013 is present in large emitters like France, Germany, and the United Kingdom, but is less pronounced in smaller countries like Denmark, Latvia, or Lithuania. Strikingly, free allowances increased on average in Norway and Sweden after 2013.

Table 1: Summary statistics for free allowances and verified emissions in millions of tons, 2005–2022.

	Free Allowances	Verified Emissions	Share of Installations
Installation-level			
Mean	1.324	1.827	
Median	0.109	0.092	
Shares by Sector			
Energy	0.619	0.758	0.613
Minerals	0.157	0.104	0.165
Paper	0.024	0.015	0.057
Metals	0.139	0.077	0.042
Chemicals	0.041	0.028	0.029
Aircrafts	0.020	0.019	0.091
Other	0.000	0.000	0.003
Mean by Sector			
Energy	1.338	2.258	
Minerals	1.259	1.151	
Paper	0.566	0.473	
Metals	4.407	3.372	
Chemicals	1.875	1.753	
Aircrafts	0.291	0.375	
Other	0.020	0.021	
Median by Sector			
Energy	0.100	0.090	
Minerals	0.165	0.133	
Paper	0.230	0.162	
Metals	0.416	0.407	
Chemicals	0.497	0.308	
Aircrafts	0.000	0.000	
Other	0.000	0.000	

Moreover, extant scholarship has documented sectoral variation in EU ETS regulation (Genovese and Tvinnereim, 2019; Bayer and Aklin, 2020). The left panel of Figure 3 disaggregates annual disbursement of free allowances by sector. In the first two trading phases, a vast majority of free allowances were provided to the energy industry, primarily subsidizing the costs of power generation. The level of free allowances is relatively constant within each of the first two phases, but there is a noticeable increase in free allowances in 2012 with the introduction of the aviation sector into the EU ETS. As has been well-documented, there is a substantial decrease in the provision of free allowances beginning in 2013: the figure illustrates that this is almost exclusively driven by the reduction in free permits provided to the energy industry (Fabra and Reguant, 2014). Indeed, beginning in 2013, installations engaged in power generation were obliged to acquire allowances via auctioning. Since the initiation of Phase III in 2013, free allowances have only been provided to power generation installations in select countries in order to ensure continued modernization of the sector, but the EU maintains that electricity generators in principle must purchase all of their allowances.[10]

The figure also demonstrates that the amount of free allowances to other sectors has not experienced the same precipitous decrease as in the energy sector, even after 2013 when the EU instituted allocation via benchmarking. In general, annual sectoral totals increase across the first two phases of emissions trading, reaching a peak in 2012, and then decrease through the third phase. For example, installations in the metals industry were allocated 176 million allowances in total in 2005, received their highest annual sum in 2012 at 214 million allowances, yet allowances to this industry still totaled 160 million in 2020. Trends in the paper and pulp industries and minerals industries are similar. In fact, installations producing chemicals saw their allocation of free allowances increase after 2013.

The right panel of Figure 3 illustrates verified emissions by sector. The figure makes clear that there has been a decrease in annual emissions over time among regulated installations, but the reduction is not as dramatic as the decrease in free allowances. Furthermore, the decrease in emissions appears to be concentrated among energy-producing installations, which corroborates extant literature that the EU ETS's effect of reducing emissions has been primarily realized in the electricity sector (Bayer and Aklin, 2020; Colmer *et al.*, 2024). Dechezleprêtre *et al.* (2023) provide suggestive evidence that the EU ETS's effects of reducing emissions are stronger for installations with less generous free allocation, which corresponds to the drop in free allowances allocated to the electricity sector after 2013.

In other sectors, verified emissions appear relatively constant over the course of the EU ETS: in 2005, the metals industry produced 139 million tons of CO_2eq and produced 131 million tons in 2020. In the minerals industry, there were 212 million tons of verified emissions in 2005, falling slightly to 175 million tons by 2020. To the extent that there have been reductions in sectors like manufacturing, previous studies have attributed these cuts to greater energy efficiency rather than as a result of the EU ETS (Petrick and Wagner, 2014). This is relatively unsurprising given that EU's free allowance benchmarks continue to subsidize about 90–95% of heavy industry's emissions.

[10] https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/free-allocation/allocation-modernise-energy-sector_en.

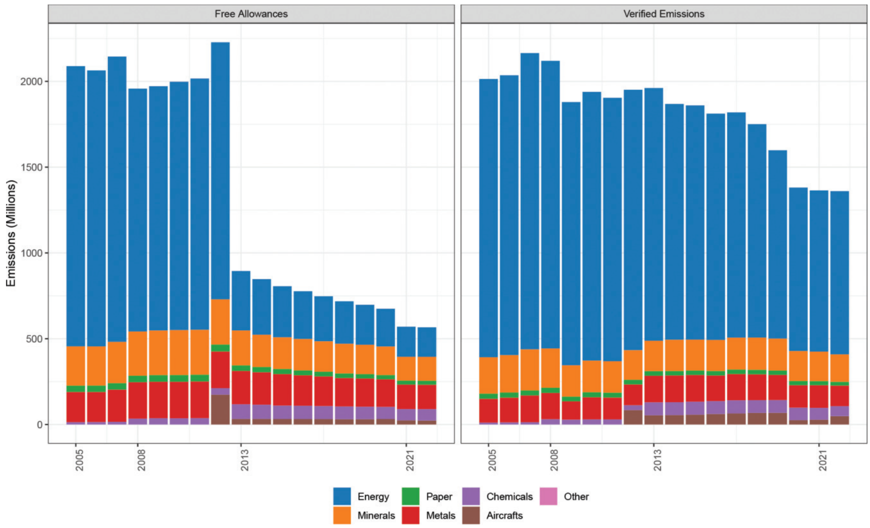

Figure 3: Free allowances and verified emissions by sector, 2005–2022.

To put some structure on this relationship, I examine the amount of free allowances that installations received as a function of sector and location. Pooling across time, I estimate the following regression equation using ordinary least squares where the unit of analysis is installation i in sector s and country c:

$$\log\Big(\text{Free Allowances} + 1\Big)_{isc} = \beta_1 \text{Sector}_s + \beta_2 \text{Country}_c + \beta_3 \text{Sector}_s * \text{Country}_c + \varepsilon_{isc}.$$

This regression models the disbursement of free allowances to a particular installation based on its sector and country of origin. I allow these effects to vary by country-sector by including their interaction term. Therefore, the model accounts for any sector-specific factors that would predict free allowances such as heterogeneity in emissions intensity across different carbon-producing activities, as well as country-specific factors. It does not, however, account for installation-specific factors or any within-country variation in the provision of free allowances.

Figure 4 illustrates the results by plotting the predicted value of free allowances by country and sector with 95% confidence intervals.[11] The figure demonstrates that there is substantial heterogeneity within and across sectors. The metals sector is predicted to receive the greatest amount of free allowances

[11] I generate confidence intervals from standard errors simulated via nonparametric bootstrap with $n = 10000$ iterations. The precision of each estimate is a function of the number of installations in each sector within countries.

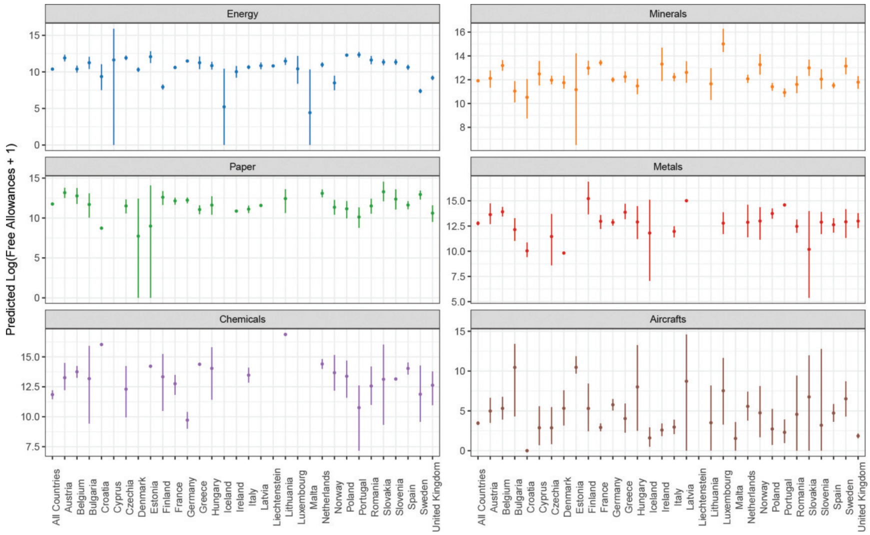

Figure 4: Predicted free allowances by country within sectors.

in total, which corroborates the finding in Figure 3 that these installations have received a relatively large and constant level of free allowances each year. Installations in the chemical sector vary greatly in the free allowances they receive across countries, with Lithuania being a noticeable outlier. Interestingly, there is less variation in the predicted free allowances across countries within the paper sector, meaning an installation in this sector is predicted to receive a similar level of free allowances regardless of the country.

There is also heterogeneity within and across countries in terms of the free allowances provided to a particular installation. In Romania and Bulgaria, for example, stationary installations (excluding aircrafts) are predicted to receive similar amounts of free allowances regardless of the sector, while there is greater variance in predicted free allowances in countries like the Netherlands and Spain.

To characterize this heterogeneity further, I perform pairwise significance tests and examine the density of the residuals from this predictive model. The results are shown in Figures A.3 and A.4. Many of these estimates are statistically significant from one another, meaning that installations are predicted to receive meaningfully different amounts based on their sector across countries. In addition, the residual plots illustrate “prediction errors” and indicate large variance in the ability of the model to predict free allowances received by each installation solely by country and sector.

The description in this section has uncovered several empirical regularities. First, the disbursement of free allowances over time reflects institutional changes set forth by the EU in 2013. Figure A.1 demonstrates that the rate of allocation free allowances decreased beginning in the third trading phase. The average number of free allowances also decreases over time, shown in Figure A.2. These figures also demonstrate widespread overallocation of free allowances relative to eventual emissions, which continues to persist in many countries. However, this aggregate analysis masks important sectoral heterogeneity. As Figure 3 makes clear, the decrease in the provision of free allowances after 2013 has been driven almost exclusively by the energy sector. Even after the institution of EU benchmarks, sectors received similar numbers of free allowances as in the first two trading periods.

Figure 4 predicts the provision of free allowances by country and sector. The figure documents considerable variance in how free allowances are distributed across countries, even in the same sector. This finding is interesting in light of the conventional wisdom, which is that the disbursement of free allowances is predicated upon sectoral factors (Verde *et al.*, 2019). However, the analysis thus far has yet to examine within-country factors or installation-specific elements that may explain the disbursement of free allowances, which I turn to now.

5 Analysis of Free Allowances in the United Kingdom

To investigate the potential role of politics, I zoom into the United Kingdom. The United Kingdom presents as an optimal case to test the argument that free allowances may have been strategically allocated on a political basis for several reasons. First, extant scholarship has documented that local benefits in the UK have been strategically allocated on the basis of district marginality (Ward and John, 1999) and copartisan bias (Fouirnaies and Mutlu-Eren, 2015). Indeed, theoretical accounts of distributive politics imply that the incentives for politicians within the UK's majoritarian electoral system skew toward the provision of targeted benefits in order to further electoral prospects (McGillivray, 2004), including in the realm of climate policy (Finnegan, 2022).

Moreover, the British political environment during this time was relatively stable. Tony Blair and the Labour Party defeated incumbent Prime Minister John Major in 1997 in a landslide victory, and Labour remained in power until 2010. In what follows, I study the allocation of free allowances over the first two phases of the EU ETS using the United Kingdom's National Allocation Plans, written in 2003 and 2006 respectively. This means that the ruling party from the signing of the Kyoto Protocol at the end of 1997 to the determination of Phase II free allowances remained constant. It is therefore easy to identify the expected direction of targeting and whether free allowances accrued to installations located in districts that were more consequential to the Labour Party's hold on government.

Finally, carbon trading was a relatively visible policy in the UK, as the country hosted one of two pilot schemes that predated the EU ETS. Upon the formation of the new Labour government, a group of business organizations led by BP and Shell lobbied the government to implement an emissions trading system (Meckling, 2011, p. 104). The government was receptive, hoping the creation of this market would allow London to rival other potential financial hubs (Meckling, 2011, p. 109). The UK subsequently developed a pilot UK ETS, which ran from 2002 to 2007. The scheme pioneered the use of emissions trading by placing pressure on Europe to adopt the policy as an EU-wide response to complying with the Kyoto Protocol. The turn toward emissions trading is particularly surprising given the widespread resistance to market-based mechanisms on continental Europe (Skjærseth and Wettestad, 2008).

I hypothesize that leaders' electoral considerations affect the disbursement of free allowances. This means that the UK's political geography should, at the margin, play a role in determining how installations receive these permits. As is common in accounts of redistributive politics (Golden and Min, 2013), I consider how the government may have targeted free allowances at particular electoral districts in order to improve its political fortunes. Figure 5 plots the spatial distribution of free allowances within each electoral constituency. Each panel represents the total free allowances given to installations within constituencies for a particular trading phase. I restrict attention to the first two trading phases, 2005-2007 and 2008-2012, because it is during these periods in which national policymakers had discretion over developing National Allocation Plans and determined how permits were to be allocated.

The traditional hypothesis is that the UK's majoritarian electoral system pushes its leaders toward targeting benefits in electorally marginal districts (McGillivray, 2004; Finnegan, 2022). I operationalize a district's political importance in several ways. First, similar to McGillivray (2004), I use vote differentials by comparing the Labour Party's vote share in a given district relative to the vote share of its largest rival, minus an adjustment. If Labour won the seat by a large majority, the district has low marginality. Similarly, a district has low marginality if Labour lost by a large majority. The adjustment captures the district's "underlying marginality" that is not reflected in the observed vote shares. In both the 2001 and 2005 elections, the Labour Party won a substantial majority of seats, but seats that are truly marginal are only those that the government necessarily needs to stay in power. This means that Labour won several opposition districts that they may not have been expected to capture, and they may have won districts that were truly marginal by larger margins than expected. To identify these truly marginal seats, I rank order

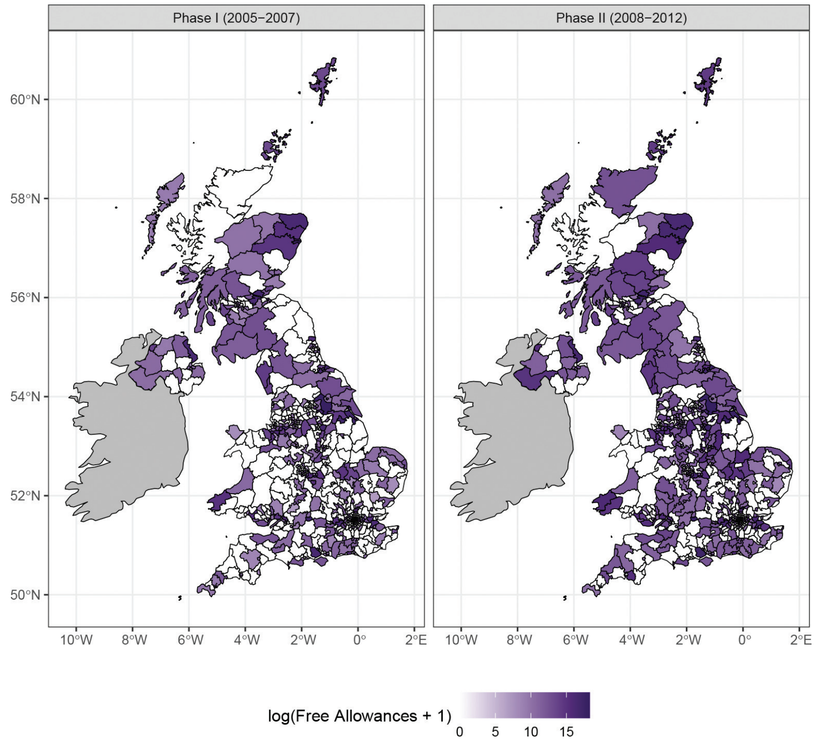

Figure 5: Disbursement of free allowances by electoral constituency in the UK.

constituencies based on the difference in Labour's vote share and the vote share of the largest rival party. I then subtract off the excess Labour vote share from the median constituency to find the adjustment. This represents the extra share by which Labour won in the "decisive" constituency in securing a Labour majority. In the 2001 election, Labour won the median constituency by 12.7 percentage points relative to the largest party. In 2005, this adjustment was 5 percentage points. Therefore, my first measure of marginality for constituency c from election t is

$$\text{Marginality}_{ct} = -|\text{Labour Share}_{ct} - \text{Largest Share}_{ct} - \text{Adjustment}_t|.$$

Greater values of this measure reflect greater underlying district marginality, with a maximum at zero. The theoretical expectation is that this measure should correlate positively with the disbursement of free allowances.

Second, following Fouirnaies and Mutlu-Eren (2015) and Dynes and Huber (2015), I consider simple measures of copartisanship. I define a district's

Labour "tendency" as the district's vote share for the Labour Party minus the average district vote share for Labour from a given election. Positive values of this measure indicate that constituents voted for Labour at a greater rate than average, while negative values of the measure reflect less Labour support than average. I define a district as being in the majority if Labour won the district. The theoretical expectation is that seats won by Labour should receive greater benefits – in this case, the installations located in seats by a Labour majority should receive more free allowances. I make use of British general election results at the constituency level as compiled by Norris (2005) and Norris (2019) to operationalize these marginality measures.

Given the total free allowances received by installation i located in constituency c over trading phase t, as well as the various measures of political importance defined for a constituency c in election t, I estimate the following regression equation using ordinary least squares:

$$\log\Big(\text{Free Allowances} + 1\Big)_{ict} = \beta \text{Political Importance}_{ct} + \alpha_c + \lambda_t + \varepsilon_{ict},$$

where α_c are constituency fixed effects and λ_t are trading phase/election fixed effects. Conveniently, the 2001 election precedes the writing of the UK's National Allocation Plan for Phase I of emissions trading in 2003, and the 2005 election precedes the writing of the Phase II NAP in 2006. The coefficient of interest is β, which captures the marginal effect of an electoral constitutency's political importance in the previous election on the allocation of free allowances to an installation within that constituency in ETS trading phase t. Standard errors are clustered at the constituency level.

While this analysis is certainly not causal, this estimation strategy relies on fixed effects to address some unobserved confounders that could hinder inference and may generate a spurious correlation between district marginality and the provision of free allowances. Installations are not randomly assigned across space, and electoral districts are not exogenously marginal. Indeed, it may be the case that the industrial contours of a particular constituency define its political environment, and subsequently its marginality. The inclusion of constituency fixed effects partially addresses this concern, but to the extent that this dynamic changes over time it may bias the results.

Table 2 displays the main results. As hypothesized, there is a positive relationship between a constituency's marginality and the free allowances received by an installation located in that constituency. Specifically, Model 1 shows that a one percentage point increase in a constituency's marginality increases the average logged free allowances provided to an installation within that constituency by 2.6%. While this difference is small, these are avoided regulatory costs for firms and their employees (cf. Bayer, 2023). Models 2 and 3 indicate that installations located in districts won by the Labour Party, and those that voted for Labour more than the average district, received more free

Table 2: Effects of marginality on disbursement of free allowances.

	(1)	(2)	(3)
Marginality	0.026		
	(0.033)		
Labour Tendency		0.035	
		(0.037)	
Labour Majority			0.160
			(1.40)
Observations	2,893	2,893	2,893
R^2	0.347	0.347	0.346
Within R^2	0.0003	0.0003	1.16×10^{-5}
Constituency fixed effects	✓	✓	✓
Trading Phase fixed effects	✓	✓	✓

Note: Standard errors clustered by electoral constituency.

allowances than those located in districts lost by the Labour Party or districts with less Labour support relative to the average district. These results appear to suggest positive policy benefits for installations in politically meaningful places.

The results corroborate theoretical expectations, but are not statistically significant. The data are over a fairly short time span relative to elections, given that there are only two phases of the institution under which leaders had discretion to allocate. Furthermore, one might expect a null result because the measures of marginality exhibit relatively little within-phase variation after accounting for the Labour adjustment factor described above (see Figure A.6). Pooling variation across phases produces positive and statistically significant results, as shown in Table A.1 in the Online Appendix, but this may also be explained by a secular increase in the disbursement of free allowances across trading phases (the second phase was longer, there may have been new entrants into the system, etc.).

Given these data limitations, I estimate the effect of district marginality on free allowances using different fixed effect specifications. Table 3 provides the results using the measure of marginality based on McGillivray, 2004. Beyond constituency fixed effects, I employ installation, sector, county, and region fixed effects. Even when accounting for variation across sectors or other cross-sectional units, district marginality retains a positive but not statistically significant relationship in their disbursement. I further disaggregate these results by phase in Table A.2 using sector, county, and region fixed effects. Estimates are robustly positive but statistically insignificant in both trading phases.

Table 3: Effects of marginality on disbursement of free allowances (Other fixed effects models).

	(1)	(2)	(3)	(4)
Marginality	0.026	0.021	0.007	0.013
	(0.033)	(0.018)	(0.013)	(0.014)
Observations	2,893	2,893	2,893	2,893
R^2	0.732	0.049	0.101	0.064
Within R^2	0.0006	0.003	0.0002	0.0010
Installation fixed effects	✓			
Sector fixed effects		✓		
County fixed effects			✓	
Region fixed effects				✓
Trading Phase fixed effects	✓	✓	✓	✓

Note: Standard errors clustered by electoral constituency.

6 Discussion

The politics of free allowance allocation are undoubtedly complex and will certainly vary given the domestic political context. The European Union represents an interesting case for several reasons. First, the EU's emissions trading system is the largest carbon market in the world, so understanding the politics that underpin it is central to further development of cap and trade institutions. Second, given the EU's supranational structure, examining the EU ETS provides an opportunity to investigate how a common policy may be implemented heterogeneously based on domestic conditions that vary across member states.

Central to the cap and trade system is the idea that while firms may receive initial endowments for free, they are able to exchange them in a market among other economic actors. There is thus strategic behavior between these actors after taking free allowances as given. Indeed, many firms amassed windfall profits by selling excess permits because their endowments ultimately exceeded demand (Cludius, 2018). Then, the null result described above may reflect the idea that, even though political leaders could set initial endowments which conform to expected demand for permits, the downstream strategic behavior of firms may have also affected their disbursement.

As the formal model in the Online Appendix demonstrates, political leaders setting optimal caps know how their choice of the cap induces production, emissions, and subsequent social welfare. Moreover, in the model, a politician setting the cap maximizes a weighted average between electoral support and social welfare. The empirical results are thus consistent with the idea that, while electoral motivations can push leaders to allocate allowances toward more marginal districts, initial allocation decisions are also affected by downstream economic interactions.

In addition, it is important not to understate the role of commitment that underlied the initial trading phases of the EU ETS. National Allocation Plans required political leaders to commit to distributions of allowances for installations ahead of time, and could not alter them *ex post* because doing so could distort the economic market (Verde *et al.*, 2019). Empirically, this commitment may have contributed to anticipatory effects on behalf of economic agents, which may have impacted the results above. Substantively, commitment may have also contributed to overallocation (Metcalf, 2009). Subsequent reforms of the EU ETS like the Market Stability Reserve, which seeks to modulate the supply of available permits, may play an instrumental role in the future efficacy of the EU's cap and trade program.

The primary empirical analysis presented in this paper examined the United Kingdom, whose majoritarian electoral system is often associated with the provision of targeted goods for electoral gain. However, with the exception of France, all other EU countries use some form of proportional representation as their electoral rule. Majoritarian systems clearly delineate why marginal districts may be recipients of redistributive goods, while scholars examining proportional systems have argued that leaders are incentivized to target benefits both to core supporters (Tavits, 2009; Rickard, 2018), as well as toward marginal districts, similar to majoritarian systems (Latner and McGann, 2005; Catalinac and Motolinia, 2021). Since votes to parties have equal weight regardless of their geographical concentration in proportional systems, the incentives to geographically target free allowances may be less clear in other member states. However, electoral incentives may play a role in these systems based on the nexus of other political and environmental factors that are geographically concentrated, like pollution damages. In the formal model in the Online Appendix, individuals experience disutility from the accumulation of pollution within their electoral districts which can be district-specific; leaders in proportional systems may wish to minimize these damages to maximize electoral support.

A final consideration in investigating the role of free allowances concerns the design of a cross-national carbon market. Zooming out of the domestic institutional context, free allowances may have been an important tool to ensure the participation of member states in the EU ETS (Skjærseth and Wettestad, 2008). Indeed, the use of free allowances may have come at the expense of efficacy of the institution in reducing emissions (Dechezleprêtre *et al.*, 2023), but they represented a form of flexibility (cf. Rosendorff and Milner, 2001) by which leaders could accommodate international demands into the behavior of domestic actors. While emissions trading systems exist subnationally in other countries like the United States and China, unifying

EU member states with heterogeneous political, economic, and environmental circumstances required mechanisms like free allocation to achieve Brussels' regulatory goals.

7 Conclusions

This paper considers the political determinants of the allocation of free allowances in the European Union's Emissions Trading System. Importantly, while the EU ETS was proposed by the EU as a common policy response to climate mitigation, its implementation was overseen by national policymakers. Member state governments had considerable leeway in how they chose to initially allocate permits to regulated plants. I find, consistent with canonical theories of distributive politics (e.g., McGillivray, 2004), installations located in electorally marginal districts on average received more free allowances than installations located in less marginal districts in the United Kingdom. Installations located in Labour-controlled constituencies were also more likely to receive more free allowances than installations in constituencies not won by the government. While the effects align directionally with theory, they are not statistically significant at conventional levels.

This paper zeroed in on the role and rationale of allocation in cap and trade systems, a central feature of carbon markets. Free allowances played an important role internationally and domestically in integrating member states to form a supranational emissions trading system. But the rules or practices of allocation may also affect decisionmaking within cap and trade systems. For example, leaders, firms, and voters may behave differently if allowances are allocated based on grandfathering or benchmarking; theoretical work suggests that if allowances are determined via grandfathering, then firms have perverse incentives to pollute heavily *ex ante* to receive favorable allocations *ex post* (Bohringer and Lange, 2005). Investigating how these rules map onto political processes is a fruitful avenue for research in furthering understanding of the institutional features of cap and trade systems.

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