The Political Economy of Green Industrial Policy: An Exploratory Analysis

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Abstract

This study explores the intricate relationship between the relative bargaining power of distributional coalitions and the number of green industrial policies implemented. Assuming a many-to-one mapping of the preferences of individuals in society to the preferences of political parties (i.e., assuming a perfect functioning democracy), we proxy the relative bargaining power of distributional coalitions by the relative political bargaining power of political parties in the government. We then investigate whether political parties that advocate for an active green industrial policy and possess a significant degree of political bargaining power in a government are more likely to lead to the implementation of green industrial subsidy programs during a specific election period in that country. Leveraging a distinctive dataset and index, our analysis reveals a robust and persistent positive correlation between the relative political bargaining power of distributional coalitions and the implementation of green industrial subsidy programs. Even after controlling for GDP per capita, the correlation remains, hinting at the complex interplay between political and economic factors in shaping green industrial policy. The results underscore the importance of aligning societal preferences toward green industrial policy and economic considerations for a sustainable future in the face of climate change challenges.

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1 Introduction

In the relentless pursuit of sustainable development and environmental stewardship, the foundational significance of green industrial policy becomes evident, steering societies toward a more eco-friendly and resilient future [38, 28]. Primarily, green industrial policies[1] act as catalysts for innovation and technological advancement in the pursuit of sustainable solutions. By establishing frameworks that incentivize and prioritize environmentally friendly practices, these policies cultivate fertile ground for the development and adoption of new green technologies. The adoption of these technologies leads to lower aggregate energy intensity given the composition of the economy and supports the transition to a lower-carbon economy due to improved energy efficiency [36, 24].

If green industrial policy can contribute to a wider spread of green technologies, then why are some countries failing to implement efficient industrial policies? While there may be multiple factors at play, political dynamics are certainly one of them, often overlooked in the literature [51]. Implementing any industrial policy affects different groups in a heterogeneous way, generating supporters and opponents of the proposed changes [51, 12, 23]. This, in turn, impacts the choices made by governments regarding whether or not to undertake the reforms and how to execute them. As governments have electoral motives, they will implement policies only when such policies do not cause substantial losses to a significant portion of the electorate or create a clash with powerful interest groups [51, 37, 40, 20]. Green technology adoption exhibits a strong temporal component as the benefits are accrued in the future while the costs associated with them are often immediate [51]. Additionally, those who ultimately benefit from these transformations may not be the same as those who make sacrifices in the short term. Thus, examining the preferences of relevant distributional coalitions, defined by specific groups in society who aim to maintain and strengthen their position, and understanding the resulting clashes within the socioeconomic systems are crucial for a better understanding of the obstacles to the adoption of green technologies.

The primary question addressed in this paper is the following: What is the impact of the relative political bargaining power of distributional coalitions on the nature and existence of industrial policy aimed at improving energy efficiency? To answer this question, this paper relies on political economy and technology diffusion theory to better understand the barriers to the implementation of domestic green industrial policies. Previous studies on the adoption of green technologies in the political economy [5, 6, 15, 18, 29, 41, 49] as well as the diffusion literature [10, 11, 13, 21], have produced valuable insights, but we need to consider them simultaneously to better understand the variation in the success of the green industrial policy, and thus the widespread adoption of green technologies[2].

Firstly, we employ a dual strategy: introducing a basic demand model of technology adoption and incorporating insights from political economy theory to derive conceptual predictions. This

[1] Green industrial policies can be defined as industrial policies with an environmental goal—or more precisely, as sector-targeted policies that affect the economic production structure with the aim of generating environmental benefits.

[2] This rest on the assumption that more efficient industrial policies aimed at improving energy efficiency in industry result in a greater incorporation of green technologies within industry, all else equal.

approach enhances our understanding of the significance of industrial policy in steering the adoption of green technologies and elucidates how governments make policy decisions influenced by the relative bargaining power of distributional coalitions. Thirdly, we collect and utilize data to construct a unique dataset, from which we derive an index measuring governments' progressiveness in intervening in their domestic economy to enhance energy efficiency in the industry. Subsequently, we test the prediction that our index is significantly positively correlated with the number of implemented climate policies using an ordered probit model. The concluding sections present and discuss our results, reflecting on their implications.

2 Conceptual Framework

Given the presence of greener technologies on the global market and the necessity to transfer these technologies from advanced to developing economies, we must understand why some countries are more successful in adopting these technologies than others. The exploration of the variance in the adoption of (green) technology is frequently conducted through the lens of technological diffusion theory, with a comparatively lesser emphasis on political economy theory. Although these studies have produced valuable insights, it is necessary to incorporate political, social, and technological aspects as explanatory components when analyzing why certain countries have successfully implemented green technologies on their path to diversifying their economies while others have not.

2.1 Technological Diffusion Theory

Technology diffusion refers to the process by which innovations spread within and across economies [54]. Thus, the analysis does not try to analyze the generation of innovations but rather where, how and when these new innovations are diffused and then adopted. We will discuss the case of the international transfer of (green) technology where green technology is invented in a technology-leading country and then analyze the adoption of this new technology in a developing economy trying to green their production structures along the path of diversifying their economies. Some understanding of the classic technology diffusion theory is essential if we are to gain insights into the processes of green technology adoption in developing economies. Since the classical work of Reinganum [50] who used a game theoretical approach to model technology diffusion based on the processes described by Schumpeter, the literature has grown significantly, drawing on insights from economics [11], sociology [19], political science [45], and management studies [21]. A comprehensive review of the literature is beyond the scope of this paper. Instead, the insights obtained from a basic demand-side model developed by Reinganum [50] will be sufficient for our analysis. As the presentation of the model in the original paper is highly mathematical, we follow the conceptual illustration of Stoneman [54] without losing much of the insights and adjust the model slightly to fit our analysis better.

2.1.1 A basic demand-model of technology adoption

There is a new green technology available on the global market. Let there be n firms in the domestic economy, potentially adopting a new green technology developed by a technology-leading country in which firms are heterogeneous with respect to their profits. Firm $i's$ profits when m other firms are adopting the new technology at time t is $\pi_{it,1}(m,n)$ if it adopts the new technology and $\pi_{it,0}(m,n)$ if it does not. Let the costs of adopting the new green technology in period t be $C_{t,1}$. Then a firm that only considers the short-term and is only focused on maximizing profits will adopt the new technology in time t if

$$\pi_{it,1}(m,n) - \pi_{it,0}(m,n) > C_{t,1} \tag{1}$$

As firms are heterogeneous, some firms might adopt the new technology while others may not. If for firm i we have $\pi_{it,1}(m,n) - \pi_{it,0}(m,n) > \pi_{jt,1}(m,n) - \pi_{jt,0}(m,n)$ for every $j \neq i$, but still $\pi_{it,1}(m,n) - \pi_{it,0}(m,n) < C_{t,1}$, the green technology is not adopted in the domestic economy without any government intervention. There is potential scope for the government to reduce $C_{t,1}$ to encourage the wider spread of the new green technology. Let $S_{t,1}$ be a general subsidy received by the firm in period t. Then the new decision rule becomes

$$\pi_{it,1}(m,n) - \pi_{it,0}(m,n) > C_{t,1} - S_{t,1} \tag{2}$$

Models similar to the one presented above normally assume that $C_{t,1}$ falls over time, and as it does so, adoption of the technology increases, leading to a diffusion path. Although Schumpeter's $C_{t,1}$ would be more endogenously determined compared to our version, it is still clear why this basic model has a Schumpeterian flavor. This basic model is particularly relevant in highlighting a central assumption in classical diffusion theory on which we will build our argument later, namely: firms in the domestic industry will only adopt the new green technology when they can receive market benefits (i.e. increased profits) or when governments incentives industries financially (e.g., through subsidies).

2.1.2 Uncertainty and Expectations

The static model presented above ignores two important aspects of the diffusion process. First, the industry does not only care about current profits but also about future profits, potentially at a discount rate. Hence, they would be willing to adopt the new green technology even if $\pi_{it,1}(m,n) - \pi_{it,0}(m,n) < C_{t,1}$, under certain conditions. Second, the diffusion process and the associated outcomes involve a large degree of uncertainty as the process takes place in an environment where information is imperfect. Hence, under certain conditions, firms should be willing to allocate some of their current resources towards securing greater profitability in the future. For example, companies may make investments if they anticipate reduced expenses as a result of increased efficiency or improved adherence to government regulations. The willingness of industries to invest

in green technologies can be hindered by significant risks associated with the expected returns on such investments. Industries must also consider the likelihood of experiencing exogenous shocks, such as changes in market conditions or government policies [41]. For instance, sudden drops in energy prices or the adoption of stringent emissions standards by governments can serve as exogenous shocks. Industries may have varying approaches to dealing with these two types of risks. Specifically, technology-specific risks can be reduced by initiating pilot projects, which enable companies to test technology and identify problems before full-scale implementation. Other types of investment risks, such as shifting market or policy conditions, are harder to control. As a result, decision-makers in industries evaluate the available evidence to estimate the ease of adoption and use of the new technology, its impact on profitability, and the success of other companies in developing and deploying the technology to increase competitiveness. As a result, the decision rule presented above is too simplistic to capture real-world decision-making. Therefore, we present the following decision rule

$$\mathbb{E}\sum_{t=0}^{\infty}\beta^t\left[\pi_{it,1}(m,n)-\pi_{it,0}(m,n)\right]>\mathbb{E}\sum_{t=0}^{\infty}\beta^t C_{t,1} \tag{3}$$

where E is the expectations operator, and β is a discount factor between 0 and 1. The decision rule above applies to the scenario without government support. If the government contributes to the industry's innovative efforts by providing a general subsidy, green technology is adopted when the sum of expected discounted lifetime profits exceeds the sum of the expected discounted lifetime costs associated with the adoption corrected for a general subsidy, leading to the following decision rule

$$\mathbb{E}\sum_{t=0}^{\infty}\beta^t\left[\pi_{it,1}(m,n)-\pi_{it,0}(m,n)\right]>\mathbb{E}\sum_{t=0}^{\infty}\beta^t\left[C_{t,1}-S_{t,1}\right] \tag{4}$$

We have now presented the final decision rule of the domestic firm that is considering adopting a new green technology available on the global market. As the simple rule shows, the role of the government can be highly influential in the widespread adoption of green technologies in the domestic economy. The technology diffusion literature mostly tries to understand the determinants of the size of the cost of adoption (C_t) and identify which barriers exist that prevent the adoption of a new green technology [10, 52, 49, 13]. However, the endogeneity of the presence of the general subsidy (S_t) to the social and political dynamics is much less studied, although potentially serving a crucial role in the adoption of green technologies, as argued above.

2.2 Political Economy Theory

We now examine the dynamics present in the political landscape that determine the presence and size of the general subsidy. It is as if we are making the general subsidy endogenous to the underlying social and political systems where welfare-maximizing groups interact with each other to protect their interests. Instead of formally modeling the endogeneity of the general subsidy, we will take a

more qualitative approach, which is more commonly employed in political science literature [12]. A complicating factor in the implementation of green industrial policy is the presence of rent-dependent actors, making a political economy perspective necessary [44, 18, 9, 5]. The political economy perspective acknowledges the ongoing historical process that interweaves political, economic, and social factors of change. For example, Ake [3] argues that the political economy approach considers the relatedness of social life and material existence. Marchak [39] defines the political economy perspective as the examination of power relationships that stem from or rely on a property rights system, the historical progression of such relationships, and their cultural and social manifestations. Onimode [48], in the tradition of Marx, emphasized that political factors significantly influence the forces and relations of production that compromise the modes of production where the pursuit of profit and the exploitation of resources can lead to unsustainable practices and the degradation of the natural environment. Building on these insights, the analysis employed in this paper aims to gain valuable insights for understanding the adoption of green practices in a relatively low level of abstraction.

2.2.1 Distributional Coalitions

A green growth approach generates substantial domestic resistance as these strategies create domestic winners and losers [51]. Groups in society form distributional coalitions to protect their interests and gain more power [47, 14]. Olson [47] and Cameron [14] define distributional coalitions as specific groups in society who aim to maintain and strengthen their position. The government's choice of promoting the adoption of green technology can be explained by the relative power of these distributional coalitions [22]. The bargaining power of these coalitions is influenced by several factors, including resource ownership, organizational capacity, networks and alliances, and access to information. The specific strategies adopted then lead to distributional consequences, which refers to the way in which political decisions create winners or losers [12]. These distributional coalitions involve a wide range of stakeholders, including governments, local communities, suppliers, industry associations, consumers, non-governmental organizations, environmental organizations, civil society, academia, and (foreign) investors.

To operationalize the analysis, the classification of stakeholders will be limited to domestic industry, local communities, and government agencies. These groups are responsible for representing other stakeholders' interests to varying degrees. For instance, environmental agency members frequently belong to the local communities, work in academia, or are farmers. Importantly, following the literature, the classification problem regards those who possess tangible, fixed assets as part of the industry since their income is reliant on the profitability of their organization. On the other hand, members of local communities do not have ownership of any assets, and thus they are forced to sell their labor [16]. This is based on the assumption that these laborers do not hold any stocks in the manufacturing company. It is important to note that salaried government workers are constituents of the local communities, as their primary source of income is their wages [56, 12]. However, the analysis still considers them separately since they have varied interests and perform a specific role

in the processes that lead to the successful adoption of green technology.

2.2.2 Interests and Motivations

We need to understand the economic goals and the environmental and social considerations of these distributional coalitions. The decision-making process of industry is more complex than the decision rule above illustrates. Still, industry is primarily concerned about profit maximization, market expansion and resource access are prioritized [34, 53, 27]. Apart from economic interests, industry may also engage in social responsibility, adopting sustainable practices, addressing environmental concerns, and enhancing public and environmental well-being [2]. However, this social and environmental ethical behaviour may be motivated by the need to reduce societal unrest and sustain unsustainable production activities. Thus, industry is interested in political decisions that provide them with favourable conditions for production, reduced regulations, tax incentives to maximize profitability (e.g. in the form of a general subsidy), and access to global market chains [35].

The economic goals of local communities are focused on job creation, poverty alleviation and improving infrastructure, which directly impacts their prosperity and quality of life [58, 1]. Diversifying the economy by building new industries is seen as a way to increase living standards and provide financial stability for families [4, 60]. Local communities are also interested in preserving the social and environmental environment and often advocate for political decisions that limit unsustainable production activities as they may significantly harm the local ecosystems [8, 58, 30]. Therefore, these communities prioritize political decisions that promote job creation, fair compensation for local resource use, and investments in local infrastructure [57].

Governments in countries with a large extractive and industry can earn significant revenues from these sectors [42]. However, these sectors are also fraught with several challenges, such as environmental degradation, social inequality, and potential political instability [8]. Government agencies have a critical role to play in managing these challenges and ensuring that the benefits of extractive activities are equitably distributed [42]. These agencies are often faced with competing objectives, such as maximizing the revenues from resource extraction and industry exports, fostering economic development and employment opportunities, guaranteeing national resource security, financing public services and infrastructure projects, and safeguarding the welfare and interests of local communities [26]. Hence, although they favor sustainable over unsustainable production practices, the presence of general subsidies are often limited to constraints along various dimensions. Obviously, the government should remain uninvolved in the adoption of green technology by domestic industry when the costs are low enough for the industry to adopt the technology without support. If this is the case, $\pi_{it,1}(m,n) - \pi_{it,0}(m,n) > C_{t,1}$ for every i, and consequently $S_{t,1} = 0$. However, if there exists i such that $\pi_{it,1}(m,n) - \pi_{it,0}(m,n) < C_{t,1}$, government assistance can influence the adoption of the new green technology in the domestic economy and $S_{t,1} \geq 0$. In this case, the government will contribute when the benefits of the adoption of the new green technology outweigh the cost of support.

These costs and benefits are not merely monetary amounts but also involve electoral costs and

benefits. Importantly, local communities are important voting groups, and governments often rely on the support of these communities to secure votes during elections. Therefore, prioritizing policies that cater to the welfare and interests of these communities can increase the chances of re-election, as well as promote social stability by addressing their concerns and avoiding protests or social disruption that could lead to political instability [12]. However, governments may also be motivated to maximize revenues from export revenues to support economic development, create employment opportunities, and maintain national resource security [17]. This could be especially essential in developing economies, where governments rely on the revenue generated by extractive activities to fund public services and infrastructure projects [59]. Thus, providing support to the industry and thereby influencing the adoption of green technology and eco-friendly policies can be seen as partly motivated by political economy dynamics.

2.2.3 Policy preferences toward green industrial policy

Having defined the relevant distributional coalitions and described their objectives, we may ask how these interests affect the political decisions made by government agencies. We recognize the duality of the objectives of the government and assume that government officials want to remain in office while trying to maximize government revenues simultaneously. Contrary to the assumption that governments inherently prioritise sustainable practices, we argue that political decisions are predominantly driven by short-term electoral motives. Governments strategically respond to the perceived electoral preferences of local communities concerned about the enduring impact of unsustainable activities. This rests on the assumption that the ideological beliefs of policymakers do not directly influence their political decisions. Some empirical papers suggest the opposite [33, 43]. However, Bunte [12] argues that despite politicians having personal ideological beliefs, they are often elected because their views align with those of influential interest groups. The electoral process ensures that politicians' preferences match those of the dominant interest groups. Conversely, politicians whose views diverge from these powerful groups are likely to lose their positions. In this way, the trade-off between short-term economic gains and long-term sustainability can be reframed as a distinctly short-term dilemma[3]. Leaders aiming to retain their positions tend to implement policies that key distributional coalitions prefer [37, 40], which allows distributional coalitions to influence government decisions [46]. In line with the works of Frieden [23] and Bunte [12], the approach employed in this paper assumes that the primary role of the government is to consolidate the preferences of distributional coalitions, considering their respective impact and subsequently cater to the politically most powerful groups.

The dynamics between distributional coalitions and government decision-making, as previously outlined, have significant implications for political parties within democratic systems. The power and influence of relevant distributional coalitions play an important role in determining the political strength and decision-making authority of conservative and progressive parties [29, 41]. On the one

[3]For instance, Garri [25] demonstrated in a two-period model that politicians, driven by different motivations, might provide a public good for immediate payoff to avoid being perceived as ineffective even if this is suboptimal.

hand, labor might vote for progressive parties as they often champion social and environmental justice and advocate for government intervention to create jobs and reduce poverty. On the other hand, the industry might vote for conservative parties as they often prioritize traditional values, limited government involvement, and pro-business measures. Specifically, the role of conservative and progressive parties in influencing policies, such as providing subsidies for eco-friendly production methods, is of great importance. Progressive parties exercise considerable influence in promoting government involvement in key areas such as environmental protection, social welfare initiatives, and labor rights. Their public policies often revolve around promoting the adoption of environmentally friendly production techniques through subsidies and other incentives, reflecting their strong dedication to sustainability [6, 15]. On the other hand, conservative parties typically prioritize reducing government regulations, reducing taxes, and developing policies to protect the competitiveness of the domestic industry, which can lead to a preference for market-driven solutions that prioritize profits rather than direct subsidies to green the production practices [6, 15]. Creating a functional government within a democratic system characterized by an abundance of political parties necessitates the formation of political coalitions. These coalitions, which align to a lesser or greater degree with each party's agenda, play a pivotal role in influencing the type of policies implemented. Balancing the interests of the local communities and industry within these political coalitions determines the eventual policies implemented by the government.

2.2.4 Dynamics and Expected Outcomes

Based on our observations, we can make some general predictions. The predictions will be presented in their most general form, which then can be translated to predictions for specific cases (i.e., the adoption of a specific green technology at a specific location and time). Based on the final decision rule, providing more and higher general subsidies to potential adopters of new green technologies is likely to enhance the likelihood of widespread adoption among domestic firms. Then based on our political economy theory of technology adoption, we can make the following predictions. Firstly, government policies are significantly influenced by key distributional coalitions that exert their power via the democratic voting system. Secondly, conservative parties lean towards reduced regulations and therefore reduce the number of subsidy programs to support firms in reducing energy intensity. Thirdly, progressive parties focus on environmental protection and government intervention, and therefore increase the number of those subsidy programs. Finally, if a political coalition is formed with a conservative and progressive party, policy outcomes are likely to be shaped by a nuanced negotiation of preferences influenced by the relative political bargaining power of each party.

Thus, the conceptual framework presented above integrates basic insights from the technological diffusion literature and builds a political economy theory of green technology adoption to better understand the success of green technology adoption in some developing countries. By examining the decision-making processes of firms, the role of government subsidies, and the dynamics among distributional coalitions and the government, this framework offers a perspective that goes beyond economic considerations.

3 Empirical Evidence

The remainder of the paper aims to test whether countries with a progressive stance towards government intervention in industry to green productive practices are more likely to implement such policies than more conservative governments. We aim to test the predictions by constructing a unique index of the progressiveness of the government and then test whether it is a significant predictor for the number of climate policies implemented aiming to reduce energy intensity in the industry. The goal is not to establish causal relationships but rather to discover some interesting tendencies that require further exploration.

3.1 Data

To test the conceptual predictions presented in the previous section, a unique dataset was created by combining information from various sources. First, we collected data on all climate policies implemented worldwide via the IEA's Policies and Measures Database[4] [31], which provides data on existing or planned government policies and measures to reduce greenhouse gas emissions, improve energy efficiency, and support the development and deployment of renewables and other clean energy technologies. Specifically, we include those policies pertaining to payments, finance, and grants with the objective of advancing energy efficiency and encouraging the use of renewable energy in industry. For example, it includes government-sponsored grants for solar panel installations, financial incentives for energy-efficient infrastructure projects, and industry-led investigations into cutting-edge carbon capture technologies. We collapsed the data based on country and year to get the total number of climate policies implemented for an individual country in a given year. Second, we collected election data from The Manifesto Project[5][55], which documents political parties' election manifestos in order to study their policy preferences. The dataset covers over 1,000 parties globally since 1945, with regular biannual updates. The Manifesto Corpus, which is a digitalized and multilingual collection, consists of machine-readable electoral programs that have been quasi-sentence unitized and coded using the Manifesto Coding scheme, with metadata such as party and election date. With coverage of over 60 countries and nearly 40 languages, the corpus comprises more than 3,000 machine-readable programs and over 1.8 million coded quasi-sentences. The ultimate goal of The Manifesto Project is to conduct substantive analyses of parties' roles in the political process, with an emphasis on programmatic representation quality. Finally, macroeconomic data was collected from the World Economic Outlook Database[6] [32].

3.2 The Progress Index

From the data provided by The Manifesto Project, we created a unique index that measures the government's position on government intervention in the domestic industry to foster environmentally

[4]The database is available at https://www.iea.org/policies.
[5]The database is avaiable at https://manifesto-project.wzb.eu/.
[6]The dataset is available at https://www.imf.org/en/Publications/WEO/weo-database/2023/April.

sustainable production practices. The dataset includes all election results for political parties that have secured at least one seat in the parliamentary elections of Australia, Japan, New Zealand, North America, South Korea, and Western Europe, as well as those that have won two or more seats in Central and Eastern Europe and South America. Each observation details a country, political party, their party family (e.g. Ecological, Socialist, Conservative, etc), and the percentage of votes gained by each party. The study evaluates measurable aspects of quasi-sentences[7] found in the agendas of each political party, organized by various categories. By applying codes, these policy agendas are analyzed to assign numerical values to multiple dimensions based on the occurrence of specific words or sentences related to particular subjects outlined in the parties' formal policy documents. For example, if a party dedicates a substantial amount of quasi-sentences to the 'economy' category, it is likely placing a significant emphasis on economic policies within its agenda. Similarly, if a party allocates a significant portion to 'welfare and quality of life' it indicates a prioritization of social welfare policies. After establishing the total number of quasi-sentences related to various topics in the party's manifesto, this number was subsequently transformed into a proportion of all the quasi-sentences in the manifesto. This conversion was achieved by dividing the count of quasi-sentences related to specific topics by the total number of quasi-sentences present in the entire manifesto. By comparing the quasi-sentences per topic among different parties, we can better understand their policy focuses and how they position themselves within the political landscape.

We created an index for each individual party that reflected their stance towards government intervention in the domestic industry to help them green their productive activities. Essentially, we calculated a weighted average of the relative number of quasi-sentences per relevant topic. This weighted average takes into account various topics, each assigned positive or negative weight, reflecting the government's inclination towards specific economic policies and interventions. Topics where the relative number of quasi-sentences contributed positively to the index, include support for supply-side-oriented economic policies that prioritize businesses over consumers, initiatives promoting a fair and open economic market, a commitment to modernizing industries, and advocating for direct government control of the economy. Positive attitudes towards all labor groups, the working class, and unemployed workers, as well as prioritizing sustainable economic development while opposing growth that harms the environment or society, were also positively weighed. On the other hand, topics with negative weights include favoring the free market and free-market capitalism as preferred economic models, negative references to labor groups and trade unions, and opposing the need for direct governmental control of the economy.

Hence, we developed a measure of progressiveness towards climate action for each political party in our dataset. Utilizing this party-specific metric as the foundation, we have established an election-country-specific index by calculating a weighted average across individual party indices. The weights were determined based on the percentage of votes received by each respective party. As a result, a party that demonstrates a significant level of progressiveness in favor of government

[7]In the context of the coding unit, a quasi-sentence is defined as a single statement, and while a grammatical sentence can encompass multiple quasi-sentences, it should not extend beyond the boundaries of one grammatical sentence, with the exception of the preamble and headlines.

intervention and secures a substantial vote share will result in a high election-country-specific index. Conversely, a party that exhibits a similar inclination towards government intervention but receives only a modest fraction of votes will result in a lower index, all else equal. In the subsequent analysis, we refer to the index we have generated as the Progress Index.

Table 1 provides a breakdown of the Progress Index across quantiles of the logarithm of GDP per capita[8]. The table includes key statistical measures for the Progress Index within these quantiles. For each quantile, the table displays the minimum value, the first quartile, the mean (average), the third quartile, and the maximum value of the Progress Index. These values offer insights into the distribution and variability of the Progress Index across different levels of economic development, as represented by GDP per capita quantiles. The results from t-tests indicate that there are statistically significant differences in means between the quantiles. The table also indicates trends such as the general increase in the mean Progress Index as GDP per capita quartiles ascend, suggesting a positive correlation between economic development and the political landscape's stance on government intervention and environmental sustainability. Indeed, the correlation coefficient between the log of GDP per capita and the progress index is approximately 0.31. Table 2 showcases the energy efficiency policies implemented by countries worldwide[9] between 2000 and 2022 to promote eco-friendly industrial activities. The table highlights the top and bottom 10 nations based on the total number of policies. The United States emerges as a frontrunner with 53 policies, followed closely by Germany with 44 policies. Australia and Canada exhibit comparable commitment with 38 policies each, while the United Kingdom completes the top five with 35 policies. These large and mostly advanced economies showcase a strong dedication to diverse energy policies, reflecting their advanced technology and strategic sustainability goals. On the other hand, the bottom 10 countries have a modest total of policies, indicating a limited spectrum of energy policies. These nations exhibit a more restrained approach, suggesting potential challenges or differing priorities in pursuing sustainable energy development. This variation in the subsidy programs provided to industry at the country level underscores the diversity in a country's willingness or capability to provide such subsidies.

Table 1: Progress Index for each 4-Quantile of log(GDP)

Quantile of log(**GDP**)	**Min.**	**Mean**	**Max.**
0.25	3.91	12.5	34.5
0.5	4.28	22.8	41.5
0.75	7.48	29.1	71.7
1	7.36	36.3	88.5

Source: The Manifesto Project and World Economic Outlook Database

[8]The quantiles in the table 1 are based on the distribution of the log(GDP) for all democratic countries worldwide, where the countries have been mapped to GDP per capita data from the World Bank.

[9]The data on these policies has been gathered since 1999 through contributions from governments and partner organizations by the IEA Agency.

Table 2: Number of Policies

Top 10		Bottom 10	
Country	**Total Policies**	**Country**	**Total Policies**
United States	53	Bangladesh	1
Germany	44	Chinese Taipei	1
Australia	38	Israel	1
Canada	38	Jordan	1
United Kingdom	35	Kenya	1
India	31	Myanmar	1
France	24	Romania	1
People's Republic of China	22	Saudi Arabia	1
Ireland	19	Thailand	1
Portugal	19	Azerbaijan	2

Source: International Energy Agency

3.3 Estimation Strategy

In order to evaluate our predictions, we tested whether the level of progressiveness demonstrated by political coalitions in promoting government intervention to improve industrial energy efficiency, as measured by our index, can be considered a significant indicator for the number of climate policies enacted in each country on a yearly basis. As our dependent variable, number of policies, is a discrete order variable, we employed an ordered probit model. The ordered probit model is particularly suited for situations where the dependent variable exhibits an ordinal nature, implying an inherent order or ranking of outcomes [7]. This is precisely the case with our discrete and ordered variable representing the count of climate policies. The model assumes a latent variable, Y_i, underlying the observed ordinal categories, and this latent variable follows a logistic, normal, extreme-value, or Cauchy distribution. For our specific analysis, we estimated the following ordered probit model:

$$\text{probit } P(\text{Number of Policies} \leq k|x) = \zeta_k - \eta$$

In this equation, ζ_k represents the breakpoints determining the thresholds between different ordinal categories, and η is the linear predictor—a linear function of the explanatory variables without an intercept term. The ordered probit model's statistical assumptions are well-suited to our research framework. By utilizing the probit link function, the model assumes a standard normal distribution for the latent variable that underpins the ordinal categories. This is especially useful in investigating issues like political stances or climate policies that may display discernible thresholds or degrees of intensity. Additionally, the ordered probit model is proficient at calculating threshold parameters, which indicate the points at which the likelihood of moving from one category to the next changes. This is valuable when analyzing political party positions that might exhibit clear thresholds or levels of intensity in their attitudes toward government intervention. Our first model focuses solely on our

index as the explanatory variable. However, we acknowledge the potential predictive power of GDP per capita regarding the number of implemented policies and its correlation with the progressiveness index. Thus, in Model 2, we introduce GDP per capita as a control variable to reduce endogeneity issues.

3.4 Results

The findings of the ordered probit regression models, which aimed to investigate the correlation between the progressiveness of political coalitions, as measured by the Progress Index, and the number of climate policies implemented, are displayed in Table 3. The empirical strategy considered two models: Model 1 concentrated solely on the Progress Index as the explanatory variable, while Model 2 introduced GDP per capita as a control variable to address one of the most obvious sources of endogeneity. According to the findings of model 1, there exists a statistically significant and affirmative correlation between the progressiveness of political coalitions and the number of climate policies. Thus, an increase in the Progress Index is likely to lead to a corresponding rise in the enactment of more climate policies. When introducing GDP per capita as a control variable in Model 2, the coefficient for the Progress Index remains statistically significant but decreases. Additionally, GDP per capita has a statistically significant positive correlation with the number of climate policies, close to the correlation coefficient presented earlier. Based on minimizing the AIC information criteria, it can be inferred that Model 2, which incorporates GDP per capita as a control variable, is a better fit for the data. The study's results provide evidence that the degree of progressiveness towards providing subsidies to industry within political coalitions is a key factor in the number of climate policies that are implemented. Furthermore, the integration of GDP per capita as a control variable strengthens the model's explanatory capacity while also addressing potential endogeneity problems. It is noteworthy that the progressiveness of political coalitions continues to be a reliable predictor, even when accounting for GDP per capita. These findings expand our comprehension of the factors that influence the implementation of climate policies, emphasizing the significance of considering both political dynamics and economic indicators in such analyses.

Table 3: Ordered Probit Regression Results

	Model 1		Model 2	
	Coefficient	(Std. Error)	Coefficient	(Std. Error)
Progress Index	0.036***	(0.005)	0.011***	(0.004)
GDP per capita (logged)	-	-	0.335***	(0.051)
AIC	1616		879.8549	
df	1102		866	

*Note: *** indicates confidence at 1%, ** at 5% significance level.*

4 Conclusion

We conducted an analysis to examine the relationship between political coalition progressiveness and the implementation of climate policies, with a focus on government intervention to promote energy efficiency improvements in industry. Our analysis was based on a theoretical framework that drew from political economy and technological diffusion literature, providing a solid foundation for understanding the dynamics between government decision-making, distributional coalitions, and the impact of political parties on the adoption of green technologies. We used an ordered probit model to conduct an empirical analysis, relying on a unique dataset that combined information from the IEA's Policies and Measures Database, The Manifesto Project, and the World Economic Outlook Database. By creating a Progress Index, we were able to measure the stances of political parties toward government intervention in domestic industries to encourage sustainable practices. Our findings consistently demonstrated a statistically significant and positive correlation between the progressiveness of political coalitions and the number of climate policies implemented, highlighting the essential role of political dynamics in shaping climate policy. To enhance the explanatory power of our model and address potential endogeneity concerns, we included GDP per capita as a control variable. The correlation between the progressiveness of political coalitions and climate policy implementation persisted even after accounting for economic indicators, underscoring the complex interplay between political and economic factors.

The results have significant implications, emphasizing the critical role that political ideologies and coalitions play in shaping climate policies. As the world struggles to address environmental sustainability, our study provides valuable insights into the factors influencing policy outcomes. However, our study has limitations, and ongoing research is necessary to refine our models and explore the complex nature of political and economic interactions. For example, while our ordered probit model offers insights into correlations, it remains challenged by the inability to account for unobserved variables that may influence political stances and policy outcomes concurrently. Future research endeavors might explore more advanced econometric methods or leverage instrumental variables to mitigate endogeneity concerns further. The temporal dynamics of policy implementation pose another layer of complexity. Our study spans data from 2000 to 2022, during which political and economic landscapes have undoubtedly undergone significant transformations. Understanding the nuanced temporal dynamics of policy responses to evolving global challenges and technological advancements requires further investigation. Future studies should delve deeper into the temporal aspects of policy implementation, consider additional contextual variables, and expand the geographical scope to encompass diverse political and economic landscapes. Furthermore, it would be interesting to analyze how macroeconomic factors influence the preferences of the various distributional coalitions.

In summary, our research illuminates the complex interplay between preferences toward green industrial policy and the resulting outcomes of climate policy. Our findings highlight the critical need to synchronize political will and economic considerations in order to ensure a sustainable future in the face of the challenges presented by the energy transition.

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