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Ecological Preferences and the Carbon Intensity of Corporate Investment*

Abstract

Lowering carbon intensity in manufacturing is necessary to transform current production technologies. We test if local agents' preferences, revealed by vote shares for the Green party during local elections in Germany, relate to the carbon intensity of investments in production technologies. Our sample comprises all investment choices made by manufacturing establishments from 2005-2017. Our results suggest that ecological preferences correlate with significantly fewer carbon-intensive investment projects while investments stimulating growth and reducing carbon emissions increase by 14 percentage points. Both results are more distinct in federal states where the Green Party enjoys political power and local ecological preferences are high.

Keywords: ecological preferences, elections, establishments' energy usage, investments

JEL classification: D72, G31, G38, O13

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1 Introduction

Achieving sustainable economic growth hinges on a swift and substantial reduction of greenhouse gas (GHG) emissions. Against the backdrop that the manufacturing and production sectors account for 20% of carbon emissions worldwide (World Economic Forum, 2023), we study the transformation of contemporary production technologies towards an ecologically sustainable employment of resources to produce goods and services. Specifically, we ask whether and how ecological preferences revealed during local election cycles affect the energy intensity of corporate investment choices.

The textbook solution to how investors would internalize the cost associated with GHG emissions would be a Pigouvian carbon tax. Consequently, the higher operating cost of energy-intensive production technologies induces entrepreneurs to choose either less energy-intensive machines when making capital investment decisions or production technologies using less GHG-intensive energy sources. Alas, this policy is infeasible in the presence of electoral cycles, which generate time-inconsistent behavior by elected politicians (Hassler et al., 2021). The alternative trivial solution is voluntary abstinence by agents from economic growth as any increase in economic activity given contemporary technology inevitably increases GHG emission volumes (see, for example, Buch-Hansen and Carstensen, 2021). This approach is infeasible, too, as long as the preferences of both consumers (Besley and Persson, 2019, 2023) as well as investors (Oehmke and Opp, 2024) do not change such that agents are willing to trade-off consumption and returns, respectively.

This paper takes a canonical corporate finance angle to tackle the nexus between investment choices, local agents' preferences, and political agendas. Using the population of manufacturing plants in Germany between 2005 and 2017, we investigate whether and how investment decisions regarding the carbon intensity of a project interact with agents' ecological preferences revealed during local elections and the ecological agenda pursued by state governments.

Our first results indicate that investing establishments consume relatively more energy across all investment groups. However, comparing establishments that grow after an investment, energy consumption is significantly higher for establishments that also increase carbon intensity.

Our headline result highlights the importance of voters' ecological preferences to nudge investing entrepreneurs. Larger vote shares for the Green Party in county elections are associated with a reduced likelihood of observing technology adoption that increases carbon emissions while reducing output. Instead, those investments that lead to an expansion of output while decreasing carbon emissions become 14 percentage points more likely when the Green Party receives five percentage points more votes in county elections.

Finally, we suggest two facilitators for these headline results. First, the estimated effects are more pronounced when considering only federal states where the Green Party is part of the government. That means that substituting low output-high carbon for high output-low carbon investments is more prevalent in a political environment where ecological policies are more accessible to implement because of more political backup. Alternatively, the fact that the Green Party is in power on the federal level may only reflect stronger ecological preferences. We test this notion explicitly and find that the interplay of 'green states' and ecological preferences correspond to the most distinct reduction of low output-high carbon investment in favor of investment choices that are associated with a lower carbon intensity.

We are not the first to investigate the interplay between political cycles and the sustainability choices of firms. However, our unique institutional and empirical setting allows us to overcome three crucial limitations in the existing literature.

First, corporate investment is conventionally only observable for large, listed firms that have to comply with more stringent financial publication requirements. Moreover, the emission intensity of existing and new capital is typically only observed for a subset of very large firms that participate in carbon cap and trade systems, such as in Sweden (Martinsson et al., 2024), California (Ivanov et al., 2023), or the European Union (Verde, 2020). In contrast, we can provide evidence on the *population* of manufacturing plants in a large, industrialized economy for a long time horizon spanning multiple business cycles, namely Germany between 2005 and 2017.

Second, even when we observe GHG emissions at the firm or plant level, we rarely obtain information about the technological traits of newly acquired production technology, particularly their energy intensity. Our access to detailed administrative data comprises investment decisions at the establishment level and the resulting output and energy usage. Notably, we can differentiate the latter into energy usage from carbon-intensive sources (coal, oil, and gas) versus sustainable, low-carbon sources (renewable and district energy). With the benefit of hindsight, we can thus classify each investment event ex-post into sustainable versus non-sustainable technology choices regarding carbon intensity and output.

Third, while numerous studies demonstrate theoretically the importance of both agents' preferences (Besley and Persson, 2023) as well as choices by the central planner on taxes, subsidies, and other forms of transfer payments (for example, Acemoglu et al., 2016; Aghion et al., 2023) it is hard to elicit especially the former over longer time horizons. Whereas surveys can provide meaningful and detailed insights on the cross-section of ecological preferences (such as in Dechezleprêtre et al., 2022), it is challenging to obtain robust approximations over an entire, let alone multiple business and election cycles. Our unique setting leverages the distinct federalist political decision-making processes in Germany. We argue that local agents' preferences are revealed during local elections (*"Kommunalwahlen"*). In contrast, state-level electoral cycles (*"Landtagswahlen"*) gauge the central planners' inclinedness, or resistance, towards re-distributional policies to compensate for costly climate protection policies. We use *county-level* vote shares of the Green party as preference proxies that have been manually collected and used before (Dam and Koetter, 2012; Koetter and Popov, 2021), exploiting the fact that Germany is home to a party founded already decades ago on the premise of an ecological political agenda. We thereby also relate to the literature about the economic effects of local elections. However, as opposed to studies by, for example, Englmaier and Stowasser (2017); Englmaier et al. (2017); Koetter and Popov (2021), we employ the outcome of county elections in Germany as the revelation of ecological preferences.

Our results further speak to the literature at the intersection of ecological preferences, climate-related policies, and firms' choices for investments in technologies aiming to reduce emissions. Acemoglu et al. (2016), for example, more generally stress that carbon taxes and subsidies into research may foster the development of low-carbon technologies. However, the associated transition turns out to be slow. Additionally, alternative ways that rely only on carbon pricing come with sufficient welfare cost, as pointed out by Gillingham and Stock (2018), who revisit several static and dynamic costs of climate policies. Regarding individual preferences, Dechezleprêtre et al. (2022) ran a large-scale international survey and found that people's support for climate policies hinges on the perceived effectiveness of the policies, their distributional consequences, and their impact on people's daily lives. They also highlight that informing people about policies only generates support by explaining the implications along those lines. Furthermore, Aghion et al. (2023) use data for 42 countries and show that if firms are more exposed to environmental attitudes, their likelihood of innovating in low-carbon technologies is significantly impacted. In terms of impact on green innovation, they show that an interplay of product market competition and green attitudes resemble effects from instruments like sharp fuel price increases.

Regarding the reaction of firms to climate policies, Bartram et al. (2022) highlight the importance of financial frictions. They show that constrained establishments shift their production and emissions out of California in response to cape-and-trade policies, while unconstrained entities stay put. De Haas and Popov (2023) also highlight the role of finance for emission reduction. They show that deeper stock markets help to reduce emissions by supporting green innovations in carbon-intensive industries. Gormsen et al. (2023) further emphasize that a cost of capital channel can serve as a key mechanism for incentivizing the reallocation of capital both across firms and within firms, encouraging a shift toward greener investments. Brown et al. (2022) point to a similar channel by showing that firms' expenditure in research and development (R&D) respond to pollution taxes, especially for high-polluting firms most impacted by those taxes. The results from Aghion et al. (2016) point in a similar direction. They show that higher fuel prices lead car producers to turn from carbon-intensive to low-carbon technologies.

2 Data Sources and Methodology

2.1 Data Sources

We explain the data sets we use in the following and provide descriptive statistics and more details about how we calculate each variable in table 1.

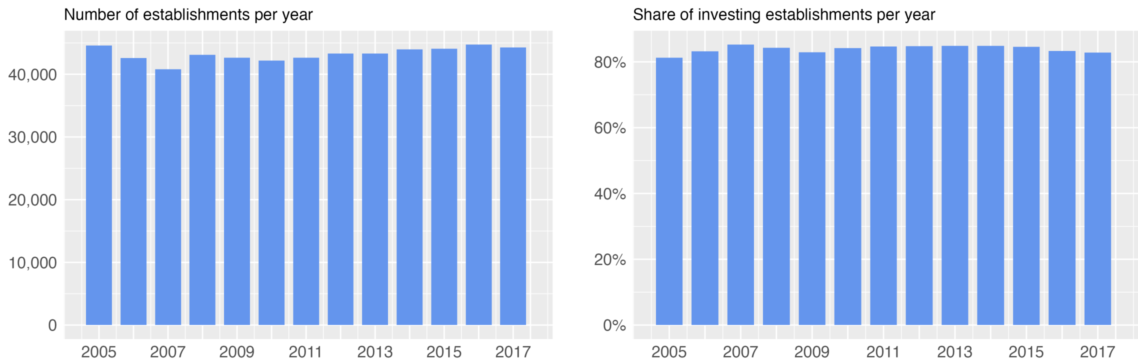
Table 1: Descriptive Statistics and Variable Description

Mean	Sd	Description
1.21	13.6	**Investment:** the amount of gross investments in million Euros.
83.91	36.75	**Investment Dummy:** Percentage share of establishments with gross investments unequal to zero.
41.75	49.31	**Investment group 0:** The percentage share of observations for which establishments report no investment.
13.36	34.02	**Investment group 1:** The percentage share of observations for which establishments report increased carbon-intensive energy and decreased revenues after an investment.
9.75	29.67	**Investment group 2:** The percentage share of observations for which establishments report a decrease in carbon-intensive energy and a decrease in revenues after an investment.
16.13	36.78	**Investment group 3:** The percentage share of observations for which establishments report an increase in carbon-intensive energy and an increase of revenues in the investment.
19.01	39.24	**Investment group 4:** The percentage share of observations for which establishments report a decrease in carbon-intensive energy and an increase in revenues after an investment.
37.6	431	**Output:** the amount of gross revenues in million Euros.
29.2	878	**Energy usage:** the amount of energy usage in a million kilowatts per hour.
43.35	28.41	**Carbon-intensive energy:** the share of dirty energy usage in percent.
52.13	26.86	**Electricity:** the share of electricity usage in percent.
4.52	15.95	**Low-carbon energy:** the share of clean energy usage in percent.
9.13	4.47	**Green preference:** the average voting share in percent per county for the sample period.
0.04	5.54	**Green share:** the change in percentage points of voting share of the Green party in the county elections.
42.31	49.52	**Green state:** the percentage share of federal states in which the Green party is part of the governing coalition.

Notes: This table presents mean values and standard deviations for the variables we use in this paper. Details about how we measure and calculate variables are in the last column.

Establishment-level data for German manufacturing We use establishment-level data of the universe of German manufacturing firms from the the Research Data Center of the Federal Statistical Office and Statistical Offices of the Federal States in Germany (RDC, 2023a,b).[1] For our analysis, we use the sample period 2005 to 2017.

Figure 1: Establishments per year and share of investing establishments



Notes: The subfigure on the left shows the number of establishments per year. The subfigure on the right displays the share (in percent) of establishments with positive gross investments for each year.

The left bar chart of figure 1 shows the number of establishments per year in our sample. We start with 44,570 establishments in 2005 while 44,267 exist in 2017. Overall, our sample covers 562,160 observations.

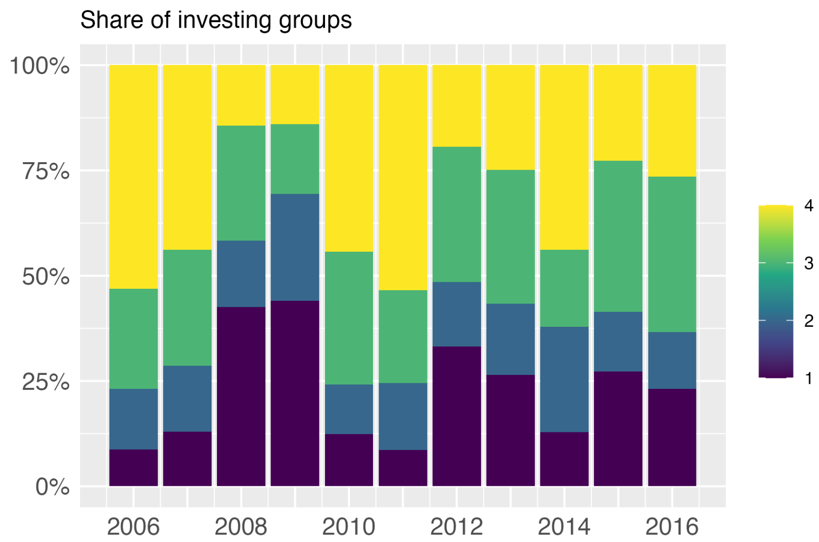
We exploit two critical features of the establishment-level data for our analysis. First, establishments must provide detailed information about the amount of energy they use and the type of energy sources. That means we can differentiate for every establishment between the following resources: oil, gas, coal, district heat, renewables, electricity, and others. Overall, the establishments in our sample used 1,039.43 billion kilowatts per hour in 2005, which covers roughly the sum of all energy used by manufacturing Germany report by the the German Statistical Office. Data from the Bundesverband der Energie- und Wasserwirtschaft e.V. report that the industry, business, and trade, households, and traffic in Germany used up to 2,500 terawatt hours in 2005. Thereby, the establishments in our sample cover about 41% of all energy usage in Germany in 2005 and about 52% in 2017.

Our descriptive statistics from table 1 show that carbon-intensive energy sources like

[1](DOI(s): 10.21242/43531.2018.00.03.1.1.0 and 10.21242/42111.2021.00.01.1.1.0)

coal, oil, and gas make up around 52% of energy usage in our sample. Low-carbon energy sources like renewable and district heat (and others) account for about 4.5%. The remainder comes from electricity.

Figure 2: Investment groups over time



Notes: This figure displays the share of investment groups 1 (dark blue) to 4 (yellow) per year. Establishments in group 1 see a decrease in output and an increase in carbon intensity after investment. Group 2 comprises establishments with lower output and lower carbon intensity after an investment. Group 3 (4) has higher output and higher (lower) carbon intensity after an investment.

Second, we use detailed information about establishments' investments to identify when they invest. Throughout our analysis, we use the sum of gross investment per year. The bar chart on the right of figure 1 shows the share of establishments with gross investments unequal to zero. We find that, on average, more than 80% of the establishments in our sample saw positive gross investment every year during our sample period. The mean investment is about 1.2 million Euros. However, our sample also comprises establishments with investment volumes up to 1.7 billion Euros. Regarding total investments, the establishments in our sample invested 43.6 billion Euros in 2005 and 60.3 billion Euros in 2017. Compared to overall national accounts figures for Germany from the German Statistical Office, we cover around 10% of total investment in fixed assets in Germany.

In our analysis, we use the information on whether establishments invest for two purposes. First, we regard the 'investment event' as an opportunity to employ new machinery and technologies that alter the type and volume of energy used. We use these occasions to investigate whether energy usage and its source change. Second and critically, the combination of investment and energy usage data allows us to guess ex-post about the type of investment. We thereby can differentiate between four types of investing establishments. 1) establishments for which the investment leads to a decrease in output[2] and an increase in the share of carbon-intensive energy in the two years after an investment (group 1). 2) establishments for which the investment leads to a decrease in output and a decrease in the share of carbon-intensive energy in the two years after an investment (group 2). 3) establishments for which the investment leads to an increase in output and an increase in the share of carbon-intensive energy in the two years after an investment (group 3). Moreover, 4) establishments for which the investment leads to an increase in output and a decrease in the share of carbon-intensive energy in the two years after an investment (group 4). For all groups, we require no investment in the year prior and past the 'investment event.'

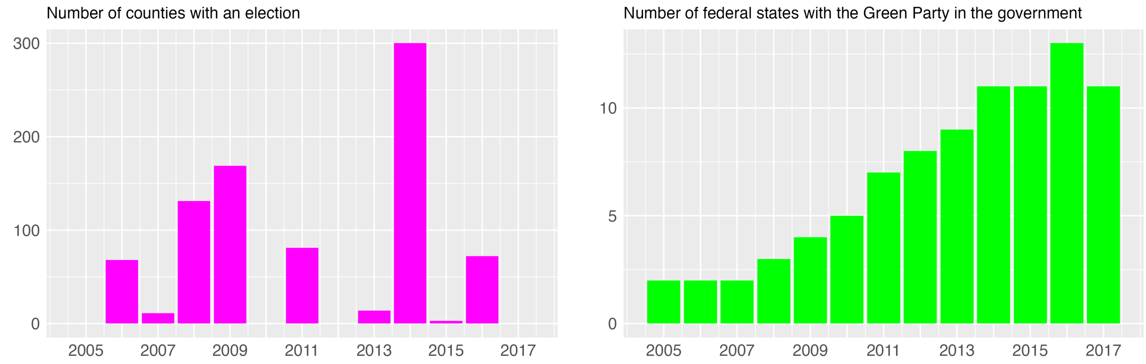
Figure 2 plots the share of groups per year. We find that, at the beginning of our sample period in 2006, the low output-high carbon outcome group 1 makes the lowest share of all groups (below 10%) while the high output-low carbon group 4 comprises the major share. This distribution reverted quite a bit during the financial crisis of 2008 and 2009. In 2016, however, we observe lower shares of around 25% for both groups. In comparison, the lowest share comes from the low output-low carbon group 2. In contrast, group 3, characterized by an increase in output and carbon-intensive energy share, makes the major share at the end of our sample period.

Ecological preferences Our second main data set comprises details about any election on the county and federal state level in Germany from 1990 onwards. Although information about voter turnout and the shares of all parties are available on many different (official) websites, the federalist structure of the German electoral system has made it tough to collect a consistent database for all German counties and federal states over

[2]Since we do not have output for the establishments, we use revenues as a proxy.

time.[3]

Figure 3: Elections and the Green Party



Notes: The subfigure on the left shows the number of counties with an election per year. The subfigure on the right displays the number of federal states where the Green Party is part of the government.

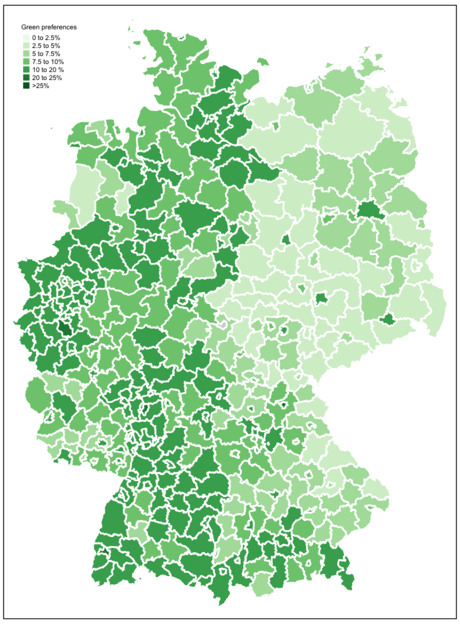
For our analysis, we take three critical information from this data set. First, we know the exact date of any election on the county- or federal-state level, which we will exploit in investigating establishment behavior around county-level elections. We plot the number of counties with an election on the left of figure 3. For any of those elections, we know the exact change of the Green Party. We regard this information as the revelation of ecological preferences through elections in German counties.

On top of this 'shock-like' measure of ecological preferences, we secondly calculate the average voting shares for the Green Party for our sample period per county. We view this average as informative about long-term differences in 'ecological preferences' between counties. Figure 4 plots these long-term preferences across counties for our sample period.

Third, the federal state-level election results inform us about the parties that form the governing coalition per federal state. For our analysis, we view this information as an additional proxy that the 'green politics' are more accessible to implement on a regional level. The right panel of figure 3 shows that only a few states had the Green party as part of the government at the beginning of the sample period. At the end of our sample period, however, the Green Party is part of the governing coalition in eleven federal states in Germany.

[3]On top, many county reforms make it hard to map past elections to the current set of counties. We deal with this issue by allocating the information to the original set of counties from 1990 and adjusting our data according to any country reform.

Figure 4: Long-term Ecological Preferences



Notes: This map displays the average voting shares for the Green party across counties for our sample period 2005-2017. Lighter (darker) green colors indicate lower (higher) average shares per county.

2.2 Methodology

We exploit two types of events: i) *investments* by establishments, which indicate establishments' possibility to change production technology, and ii) *county elections*, which reveal ecological preferences in the locality. Since both events occur at different points in time and more than once for the establishments in our sample, we employ the event-study methodology put forward in De Chaisemartin and D'haultfœuille (2023) and De Chaisemartin and d'Haultfoeuille (2024).

Investment events We use regressions based on equation (1) to examine whether and how investments at the establishment level influence establishment-level outcomes.

$$Y_{i,t} = \gamma_i + \gamma_t + \bar{\gamma}^I I_{i,\tau} + \epsilon_{i,t} \tag{1}$$

Y is a short-hand for outcomes that vary at the establishment level i and between years t in the sample period. γ_i and γ_t are fixed effects on the establishment and year level. I is a dummy that is one if an establishment has non-zero gross investments at event year $\tau = 0$. The coefficient $\bar{\gamma}^I$ thereby measures the average effect of this event for investing establishments relative to establishments without an investment. This average effect relates to three post-event ($\tau = 1, 2, 3$) periods relative to two placebo periods ($\tau = -2, -1$).

We consider four dependent variable Y for analyzing equation (1). First, we use the natural logarithm of the total energy usage per establishment and year (Energy (ln)). Second, we calculate the three parts that make up total energy usage for each establishment: Electricity (ln) is the natural logarithm of the total usage of electricity; Carbon-intensive energy (ln) which is the sum of energy that comes from coal, oil, and gas; Low-carbon energy (ln) which is the natural logarithm of the remaining sources which are district heat, renewables, and other sources.

Regional elections To estimate the effects of the regional elections, we employ equation (2)

$$Y_{i,r,t} = \gamma_i + \gamma_t + \bar{\gamma}^G G_{r,\tau} + \epsilon_{i,r,t} \tag{2}$$

Again, Y is a short-hand for outcomes varying at the establishment level i and year t. Each establishment resides in county r on which level the elections take place. γ_t and γ_i introduce fixed effects on the year and establishment level, subsuming county-fixed effects. Similar to the investments from equation (1), we estimate average effects $\bar{\gamma}^G$ for two placebo and three post-election periods. $G_{r,\tau}$ measures the percentage points change of the voting shares for the Green Party at those elections.

We use various dependent variables in our regressions of equation (2). First, we use a dummy variable on the establishment level, indicating whether establishments have positive gross investments in a particular year. We further differentiate within the investment events and use the separation through dummy variables into the four types of investment from above: (1) investments that lead to lower output and higher carbon intensity; (2) lower output and lower carbon intensity; (3) higher output and higher carbon intensity; and (4) higher output and lower carbon intensity.

3 Results

Investments and energy usage The graphs from figure 5 show regression results for equation (1). In the top left graph, we estimate the effect using the natural logarithm of total energy usage as the dependent variable. On the left of this subfigure, we start by using all observations across all investment events irrespective of their type (412,000 observations). We find a positive coefficient (blue point), which is significant at the 95% level indicated by the confidence bands (blue lines). Our average effects stem from comparing the three years after to the two years before an investment. The resulting coefficient size is 0.06, which indicates that, on average, establishments with an investment event increase their energy usage by about 6 percentage points after investing compared to establishments without investments.

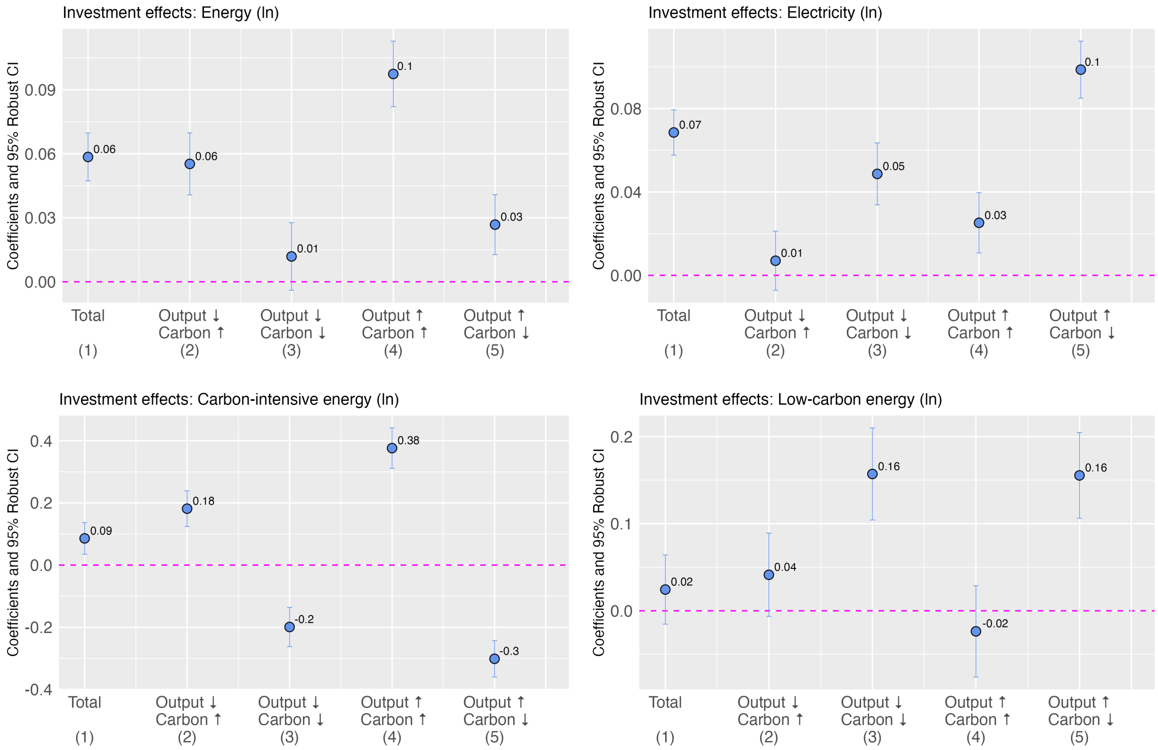
Next, we investigate the differential effects of energy usage on the subsample of establishments in investment group 1 against those without an investment, resulting in 153,000 observations. We find very similar results as in column (1). Compared to the establishments in the control group, establishments with investments that lead to lower output and higher carbon shares increase their energy usage significantly by around 6 percentage points during the post-investment period.

In column (3), we consider the subsample of establishments with lower output and lower share of carbon-intensive energy, which amounts to 134,000 observations, including the establishment considered for the control group. We find a much lower size of the coefficients, which turns out to be insignificant. Instead, we find the highest increase in energy usage after investment for the sample, where investments lead to higher outputs and usage of carbon-intensive energy (167,000 observations). The significant coefficient is 0.1, which suggests a relative increase in energy usage of about 10 percentage points in the post-investment period.

Last, the high output-low carbon subsample of 185,000 observations also has a positive and significant differential effect. We find that establishment that falls under this investment category increase their energy usage by about 3 percentage points.

A first takeaway from our investigation in the top-left subfigure is that establishments

Figure 5: Investment effects



Notes: Each subfigure shows the average treatment effect (blue points) of a regression of equation (1). We define the treatment by the year an establishment has positive gross investments, and we use two placebo and three treatment periods. We estimate robust standard errors clustered at the establishment level and provide respective 95% confidence bands in blue. The dependent variable Y is total energy usage (top left), total electricity usage (top right), total carbon-intensive energy resources (oil, gas, coal; bottom left), and total low-carbon energy resources (district heat, renewables, other; bottom right) all transformed into their natural logarithm. Each subfigure follows the same structure. In (1), on the very left, we provide average treatment effects for all establishments. (2), (3), (4), and (5) show the effects of the subsamples of investment events in which output either declines or increases and carbon-intensive energy usage goes up or falls (the four investment groups we defined above).

from the manufacturing sector in Germany do not show signs of lowering total energy usage in their production. This pattern persists even when we break down investments by type. Instead, our findings indicate that adopting new technologies increases energy consumption.

The subfigure on the top right of 5 investigates the amount of electricity as the dependent variable. Across all investments, we find that establishments relatively increase their electricity usage significantly in the three years after an investment by seven percentage points. Focusing on the different investment groups, we find positive and significant effects between 3 to 10 percentage points for groups 2 to 4. A significant effect on electricity is only absent for group 1, for which output declines and carbon intensity increases after the investment. Notably, both groups for which carbon intensity declined after the investment show the highest increase in electricity, which is not surprising given that the supply of energy in Germany from low-carbon resources has increased from around 20% in 2011 to 33% in 2017 (Destatis, 2012, 2018).

The two subfigures at the bottom of 5 show the change in carbon-intensive energy and low-carbon energy for investing establishment. Across all investments, we find a significant relative increase in the volume of carbon-intensive energy by 9 percentage points, while the volume of low-carbon energy does not change significantly. The remaining columns in both subfigures show coefficients across investment groups. This is an important exercise because it shows whether or not the volume of carbon-intensive and low-carbon energy changes for investment groups is characterized by a change in shares of these energy sources. We find that carbon-intensive volumes are increasing for groups 2 and 3 while low-carbon energy volumes are increasing for groups 2 and 4. Our results thereby indicate that the change in energy shares that we use to define the investment groups comes from volume changes in energy sources relative to output.

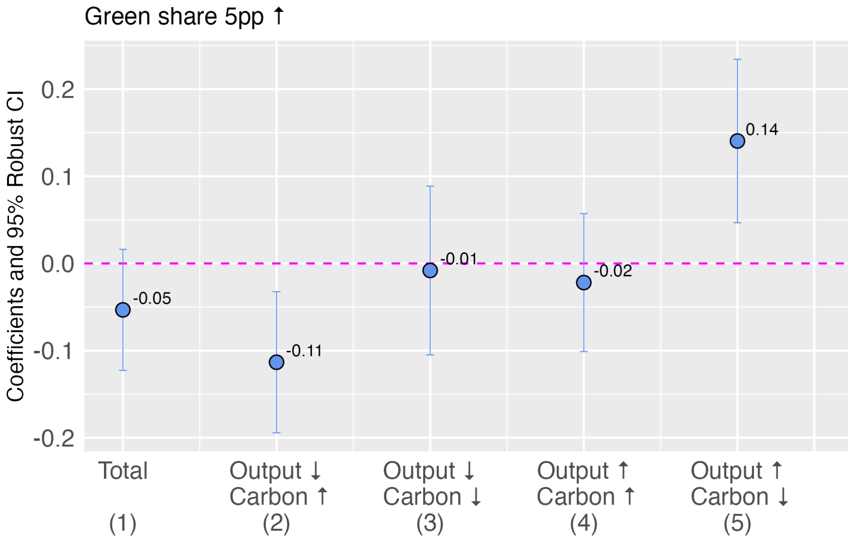
Ecological preferences and types of investments We provide regression results for equation (2) in figure 6, considering different investment types again as dependent variables. Here, we use county elections and explicitly the percentage point change of the Green party as our proxy for the revealed ecological preferences. In the remainder, we present the coefficients for the change in election outcome for the Green party as a change of about five percentage points, which mirrors an increase from the 25th to the 75th percentile of the distribution.

We start on the left with a dummy as the dependent variable, which indicates positive gross investment per establishment. We again consider two pre- and three post-election periods, resulting in both subfigures of figure 6 in a sample of 252,000 observations.

Using the investment dummy, regardless of the type of investment, we find a negative coefficient of about 0.05. However, our results suggest that an increase in the Green Party's share does not significantly change the likelihood of an investment overall.

The remaining columns of figure 6 consider dummies for the respective investment

Figure 6: Ecological preferences through county elections



Notes: This figure shows the average treatment effect (blue points) of a regression of equation (2). We define the treatment by the increase in the Green Party's vote share in a regional election. For both, we use two placebo and three treatment periods. We estimate robust standard errors clustered at the establishment level and provide respective 95% confidence bands in blue. The dependent variable Y is (1) a dummy if an establishment has positive gross investments; (2) a dummy if the investment leads to lower output and higher usage of carbon-intensive energy; (3) a dummy if the investment leads to lower output and lower usage of carbon-intensive energy; (4) a dummy if the investment leads to higher output and higher usage of carbon-intensive energy; (5) a dummy if the investment leads to higher output and lower usage of carbon-intensive energy (the four investment groups we defined above).

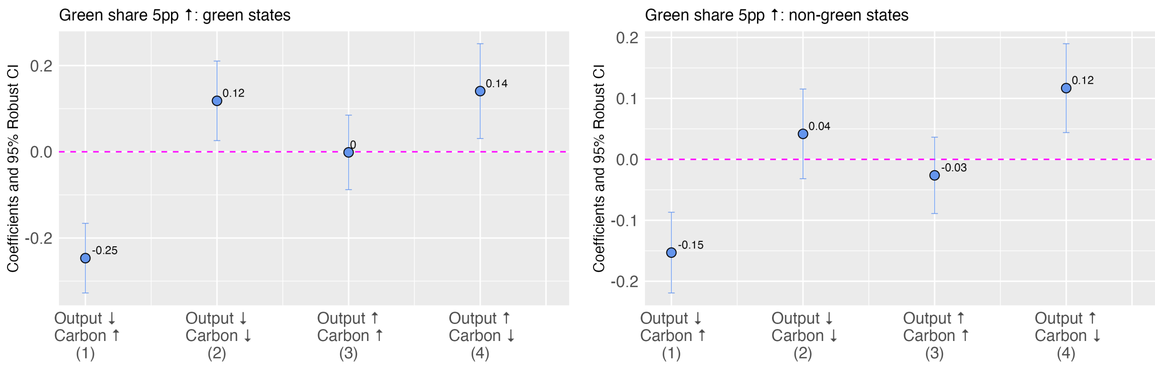
groups in terms of output and carbon-intensive energy use that we defined above. An increase in the voting shares for the Green party in a county election correlates with a significantly lower likelihood of investment events that decrease output and increase the carbon intensity of establishments. This effect is also sizeable as it states that those investments relatively decrease by 11 percentage points. For investments with lower output and lower carbon intensity, we have a slight negative coefficient, which is insignificant. Similarly, investments that lead to higher out and higher carbon intensity see a non-significant decrease.

Last, investments leading to higher output with lower carbon intensity significantly go up by 14 percentage points if the voting shares of the Green party increase by five percentage points.

Overall, results from figure 6 indicate in the vein of Besley and Persson (2019, 2023) that the formation of ecological preferences correlates with the decision of establishments into technologies supporting green transitioning.

Power and preferences So far, our results suggest that voting outcomes on the county level favoring the Green party reduce unwanted low output-high carbon investment but increase the likelihood of investment resulting in higher output with lower shares of carbon-intensive energy. In this paragraph, we will investigate whether and how two additional aspects of green politics influence our results.

Figure 7: Green states



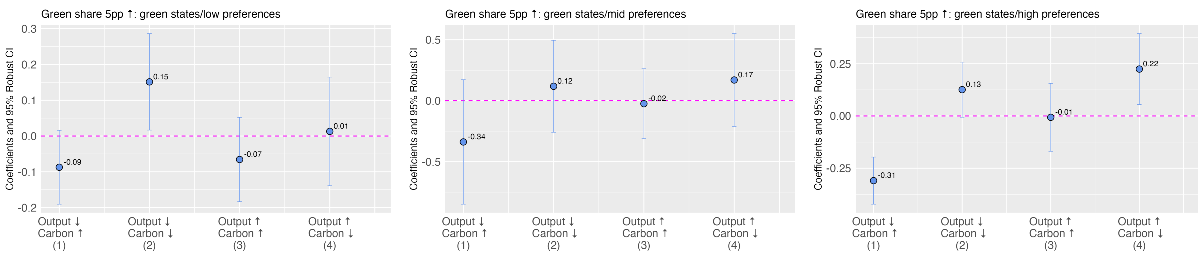
Notes: The subfigures show the average treatment effect (blue points) of a regression of equation (2). We define the treatment by the increase in the Green Party's vote share in a regional election. We use two placebo and three treatment periods. We estimate robust standard errors clustered at the establishment level and provide respective 95% confidence bands in blue. The dependent variable Y is (1) a dummy if an investment leads to lower output and higher usage of carbon-intensive energy; (2) a dummy if an investment leads to lower output and lower usage of carbon-intensive energy; (3) a dummy if an investment lead to higher output and higher usage of carbon-intensive energy; (4) a dummy if an investment leads to higher output and lower usage of carbon-intensive energy. We employ different subsamples in each subfigure. The one on the left shows regressions for establishments in states where the Green Party is part of the government. The subfigure on the right samples only establishments in states where the Green Party is not part of the government.

Federal state-level We start by investigating whether our results on how voting shares for the Green party affect investment types differ for federal states in Germany in which the Green party is part of the governing coalition. Thereby, we rerun our regression for equation (2) for the two subsamples and present our results in two subfigures of figure 7.

We start on the left, considering investment events around county elections in federal states with the Green party being part of the coalition (green states). We find that an increase in the Green Party voting shares leads to a significantly lower likelihood of investment, leading to lower output and higher carbon intensity. Compared to the coefficient size from above, this effect is much more pronounced and indicates a decrease in this investment type by around 25 percentage points. In comparison to the right of figure 7, the same investigation in non-green states (the Green party is not part of the governing coalition) still produces significant effects; however, it is less pronounced in terms of size (15 percentage points). In terms of stipulating high output-low carbon investments, we find no difference between green and non-green states. In both subsamples, an increase in the Green party's voting shares of about five percentage points increases the likelihood of these kinds of technology by 12 to 14 percentage points.

Unlike the overall effect presented above, the Green party's election outcome significantly affects investment group 2 (investments with lower output and lower carbon intensity). Since we are not able to detect significant effects for high output-high carbon investment in both types of states, political power on the state level seems to matter for reducing unwanted investment that leads to low outputs and high carbon and, at the same time, stipulating both investment types that come with lower shares of carbon-intensive energy.

Figure 8: Green States and Ecological Preferences



Notes: The subfigures show the average treatment effect (blue points) of a regression of equation (2) for which we only use establishment residing in states in which the Green party is part of the government. We define the treatment by the increase in the Green Party's vote share in a regional election. We use two placebo and three treatment periods. We estimate robust standard errors clustered at the establishment level and provide respective 95% confidence bands in blue. The dependent variable Y is (1) a dummy if an investment leads to lower output and higher usage of carbon-intensive energy; (2) a dummy if an investment leads to lower output and lower usage of carbon-intensive energy; (3) a dummy if an investment lead to higher output and higher usage of carbon-intensive energy; (4) a dummy if an investment leads to higher output and lower usage of carbon-intensive energy. Each subfigure represents different subsamples within green states. The left subfigure sample establishments residing in counties where ecological preferences measured by the average regional vote share for the Green party are below the 25th percentile. The subfigures in the middle and on the right show the same effects but for counties in which ecological preferences are between the 25th and 75th percentile (middle) or above the 75th percentile (right).

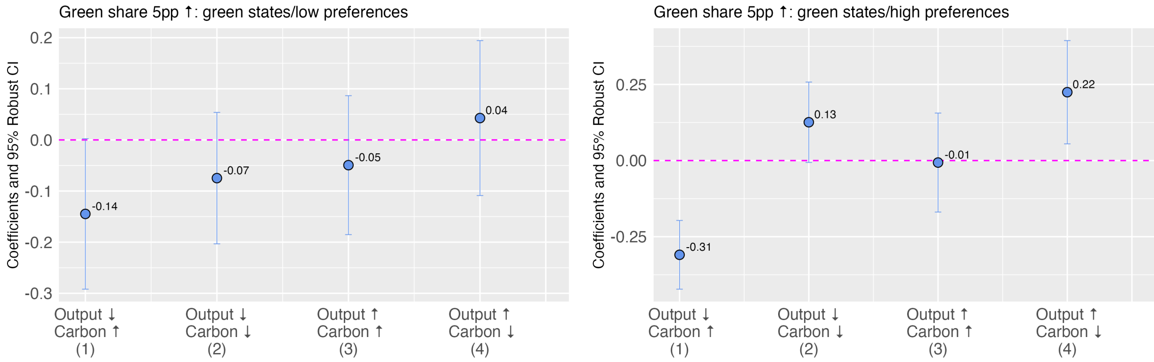
County level Last, we investigate the role of long-term green preference at the county level. Different from changes in voting shares through elections, we take the average of Green party voting shares for our entire sample period and differentiate our regression into three additional subgroups. Counties with low ecological preferences comprise all counties with average green voting shares below the 25th percentile. We consider counties with mid preferences in the range between the 25th and 75th percentile. Last, we consider counties with high preference in the top quartile.

The three subfigures of figure 8 present regression results for the sample of green states differentiating into subsamples of low, mid, and high ecological preferences. Overall, we find no statistically significant effects for the groups of counties with low and mid preferences. Importantly, however, the subfigure on the right indicates our previous results: a significant reduction of investments leading to lower output and higher carbon intensity and a significant increase in investment types that come with higher output and lower carbon intensity. For this sample, where ecological preferences and power seem to be most pronounced, we also see the most substantial effect in terms of size. We find a reduction of about 31 percentage points of inefficient-carbon-intensive investments and an increase in efficient investment, reducing carbon emissions by 22 percentage points.

Checking on the control group and dynamics In this paragraph, we check our results in two ways. First, we scrutinize our results from figure 8 by checking their sensitivity to the control group. In our analysis so far, we investigate the results for a particular investment group against having all other establishments in the control group. In figure 9, we change that by only allowing non-investing establishments into the control group. Compared to figure 8, we find very similar results. For the low-preference counties in green states (left subfigure), we again find absent statistically significant effects for groups 1, 3, and 4. Similar to 8, only group 2 on the left shows positive and significant effects. Economic-wise, the effect of 15 percentage points turns out higher compared to 12 percentage points from before.

The same applies when comparing the green states-high preference sample from figures 8 and 9. Not surprisingly, when we chose only non-investing establishments for the control

Figure 9: Green States and Ecological Preferences with non-investing establishments as controls only

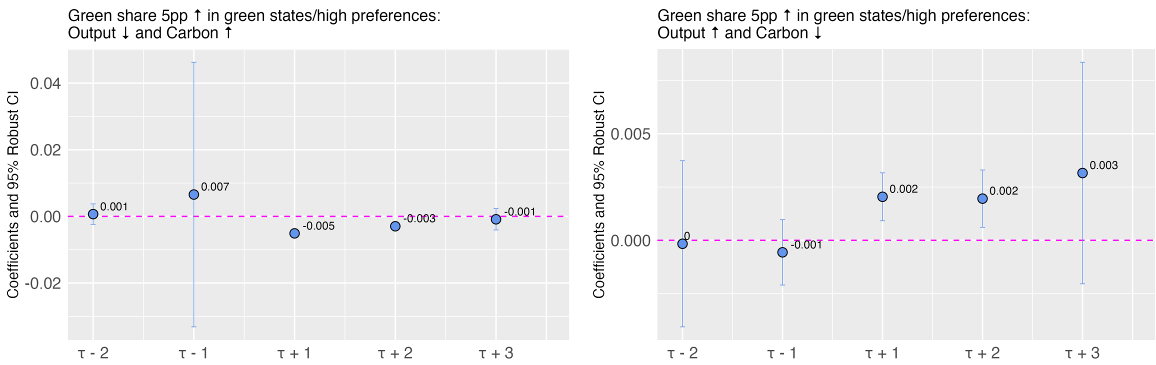


Notes: The subfigures show the average treatment effect (blue points) of a regression of equation (2) for which we only use establishment residing in states in which the Green party is part of the government. We define the treatment by the increase in the Green Party's vote share in a regional election. We use two placebo and three treatment periods. We estimate robust standard errors clustered at the establishment level and provide respective 95% confidence bands in blue. The dependent variable Y is (1) a dummy if an investment leads to lower output and higher usage of carbon-intensive energy; (2) a dummy if an investment leads to lower output and lower usage of carbon-intensive energy; (3) a dummy if an investment lead to higher output and higher usage of carbon-intensive energy; (4) a dummy if an investment leads to higher output and lower usage of carbon-intensive energy. The regression results in the subfigures only include the non-investing establishment in the control group. Both subfigures represent different subsamples within green states. The left subfigure sample establishments residing in counties where ecological preferences measured by the average regional vote share for the Green party are below the 25th percentile. The subfigures on the right show the same effects but for counties where ecological preferences are above the 75th percentile.

group, effects for groups 1 and 4 were more pronounced in economic terms. In figure 9, we find a decrease in the low output-high carbon outcome of 31 percentage points while high output-low carbon investment increases by 22 percentage points.

Second, instead of average effects, we investigate yearly effects around investments for groups 1 and 2 for the sample of green states with high preferences. We present the results in figure 10. We draw two conclusions from both subfigures of figure 10. First, we do not find significant pre-investment effects for both investment groups. On top of that, the developments of coefficients pre-investment do not indicate pre-trends. Second, we find that effects kick in significantly in the two years following the investment event for both investment groups. In year three, the effects were insignificant for both groups.

Figure 10: Green states and Ecological Preferences dynamically



Notes: The subfigures show yearly treatment effects (blue points) of regression of equation (2) for establishments residing in green states and counties with an average voting share for the Green party in the top quartile. We define the treatment by the increase in the Green Party's vote share in a regional election. We show yearly treatment effects for the two placebo and three treatment periods. We estimate robust standard errors clustered at the establishment level and provide respective 95% confidence bands in blue. The dependent variable Y is either a dummy if an investment leads to lower output and higher usage of carbon-intensive energy (left subfigure) or a dummy if an investment leads to higher output and lower usage of carbon-intensive energy (right subfigure).

4 Conclusion

There are many possibilities to incentivize economic players to shift to lower-carbon technologies. In the spirit of Besley and Persson (2019, 2023), we empirically test whether ecological preferences correlate with a green transition in manufacturing.

Our results indicate that the revelation of ecological preferences comes with significantly fewer investments in unwanted technologies that lower output while increasing emissions. At the same time, ecological preferences spur the development of investments that lower emissions and, at the same time, keep output up. The formation of ecological preferences is a critical factor in greening economies.

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