Coal, Early Industrialization, and the Persistence of Left-Wing Support

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Abstract

We show that much of the variation in contemporary patterns of European political geography is the consequence of early access to cheap energy at the height of the industrial revolution. Using data on the presence of historical coal mines, we find that the contemporary concentration of left voters is caused by the presence of nineteenth-century coal mines. Because the choice to mine coal is non-random, we exploit the underlying presence of carboniferous geological strata to instrument for the presence of historical coal mines and estimate between a 3-7% advantage for mainstream left parties in these regions. Using aggregate votes and individual-level survey responses we rule out mechanisms associated with sorting due to class, income, redistributive preferences, migration patterns, cosmopolitanism, and contemporary employment in manufacturing and mining. Instead, we provide evidence that the persistent strength of the left is the consequence of partisan attachments formed during the initial period of industrialization.

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The economic facts, which have so far played no role or only a contemptible one in the writing of history, are, at least in the modern world, a decisive historical force; that they form the basis of the origination of the present-day class antagonisms; that these class antagonisms, in the countries where they have become fully developed, thanks to large-scale industry, hence especially in England, are in their turn the basis of the formation of political parties and of party struggles, and thus of all political history.

- Friedrich Engels (1885)

Party identification is a durable attachment, not readily disturbed by passing events and personalities

- Campbell, Converse, Miller, & Stokes (1960)

1 Introduction

In most democratic settings, political parties' electoral support varies across space. But what explains the uneven distribution of partisanship and why is it that co-partisans tend to cluster geographically? The answers to these questions matter because the consequences of partisan spatial clustering are potentially large. Mechanically, the geographic concentration of co-partisans can create "unintentional gerrymandering," where support for some parties is derived from relatively few electoral districts (Rodden 2010, Chen, Rodden et al. 2013, Calvo and Rodden 2015). In a more behavioral sense, the isolation of co-partisans may exacerbate social and political divisions by limiting individuals' interaction with those who adhere to alternative viewpoints (Klar 2014, Sunstein 2009).

Broadly, explanations for partisan geographic clustering can be divided in two. On the one hand, it could be that people with similar politics choose to live near each other. On the other hand, it could be that features of voters' locations affect their partisan attachments. In this paper we provide evidence in favor of the latter explanation, showing that up to 70% of the within-country regional variation in the mainstream left's vote can be explained by a fundamental cause of early industrialization: access to cheap energy in the form of coal. Using both aggregate vote shares and individual-level survey responses, we are able to show that this result is not driven by mechanisms associated with class, preferences for redistribution, patterns of migration, cosmopolitan attitudes,

or contemporary economic conditions, including present-day patterns of employment in manufacturing and mining. Instead, we provide evidence that the persistent strength of the left is the consequence of strong partisan attachments formed at the height of industrialization and transmitted across generations of voters.

Access to energy, in particular coal, drove spatial patterns of industrialization in nineteenth and early twentieth century Europe. Because coal is heavy and difficult to transport over land, industrial production in the pre-railway era was precluded from areas that lacked coal or that were far from water transportation routes (Mathias 2013, Turnbull 1987). Pollard (1981)[p.4], for example, is explicit with this argument, noting the near one-to-one correspondence of coalfields and centers of industrialization in Britain and the proximity of major centers of heavy industry to coal fields in Belgium, Northern France, and the Ruhr Valley.

The immediate political consequences of industrialization are well understood. From the onset of the Industrial Revolution, organized movements of the European working classes served as the backbone of left-wing support. In one view, socialist and working class parties served as "torchbearers of democracy" (Eley 2002). Here, absent the franchise, the organizational capacity and power of industrial workers were crucial determinants of democratization (Rueschemeyer, Stephens and Stephens 1992, Collier 1999, Bermeo 1997). When they partook in electoral politics, left-wing parties found industrial labour to be a natural and organized constituency (Przeworski and Wallerstein 1982, Przeworski 1985, Bartolini 2000). Marx, for example, viewed this as an "organic relationship" in which workers were to be first organized "into a class, and consequently a political party" (Marx and Engels 1967; p. 144). This perspective is supported by a wide-ranging academic literature wherein occupation-based social class is viewed as a crucial, if not decisive, determinant of party system cleavages (Lipset and Rokkan 1967, Mair 1990).

In short, the distribution of energy determined where industrialization occurred. This, in turn, created dense concentrations of workers who served as the base of left-wing parties. We combine these features of early capitalist development to evaluate the persistent

effects of early industrialization on contemporary political preferences and outcomes. Using regional level vote shares and individual survey responses, we show that the location of coal in nineteenth century Europe (the crucial energy input determining where industrialization occurred) has had a strong and persistent effect on the spatial distribution of mainstream left-party support between 1990 and the present.

Of course, the location of coal mines was not randomly determined. Given that the presence of active mines at the height of the Industrial Revolution may have been at least partially related to a region's underlying social or economic dynamism, we cannot be certain that the association between the presence of historical coal mines and contemporary partisanship is causal. To identify the effect of historical coal mining we adopt two strategies. To start, we collect and condition on a host of potentially confounding "pre-treatment" covariates that may plausibly impact both the choice to mine and contemporary political attitudes. However, since it is unlikely we have collected the entire universe of measured or unmeasured confounders, we take an instrumental variables approach similar to that of Fernihough and O'Rourke (2014) and exploit an underlying geological cause of coal as an instrument. Here, we use the presence of carboniferous geological strata, the geology from which coal is mainly derived, as an encouragement for the presence of coal mines.

Our results speak to an open debate on the nature of European party systems. While in the short run industrialization produced a natural constituency for the left, political scientists are of two minds with respect to the consequences over the longer span. One group views national party systems as having been essentially "frozen" early in the twentieth century around a left-right cleavage (Mair 2001, Bartolini and Mair 2007, Bartolini 2000, Caramani 2004).[1] The other group views party-systems as having undergone a dramatic transformation beginning in the late twentieth century. With de-industrialization, additional "post-materialist" dimensions of party competition, unrelated to a left-right

[1]Caramani describes, "The long-term historical perspective since the mid-nineteenth century indicates that the electoral support for parties of the left-right cleavage spread and homogenized rapidly after the Industrial Revolution and remained stable with the 'freezing' of party systems in the 1920s." (Caramani 2004, p 5).

class-based division, became increasingly important (Kitschelt 1994, Inglehart 1997).

We find that, indeed, the deep past continues to impact the left's support in the present. However, we show that it has little to do with present-day class cleavages. Instead, we argue our result is the consequence of a direct persistence of partisanship. Theoretically, we build off a substantial literature in the study of political behavior that finds that partisan attitudes are inherited across generations, transmitted from parents to children through a process of Bayesian learning (Achen 2002, Gerber and Green 1998). We argue that the persistence of left-wing support is the consequence of intergenerationally transmitted political attitudes.

We investigate a wide range of alternative potential channels of persistence and then successively rule them out. We exclude mechanisms associated with differences in incomes, redistributive preferences, and the transmission of social class. We extensively explore the role of current and past migration as potential mechanisms, finding no support for this as a channel of persistence. Furthermore, we consider potential mechanisms associated with differences in cosmopolitanism and other post-modern values, again finding no evidence in their favor.

Using both regional and survey data from across Europe, along with more micro-level constituency and individual data from Britain, we provide direct support for a simple mechanism of intergenerational political preference transmission. Dating to the very earliest behavioral studies in political science (Campbell et al. 1960), scholars have pointed to the strong stability of partisan identification (Achen 1975, Green and Palmquist 1990; 1994). Partisanship is seen to be affective and as stable in survey responses as other similar slow moving, nearly immutable, attributes like ethnicity or religion (Green, Palmquist and Schickler 2004). Moreover, like ethnicity or religion, partisan attitudes are inherited across generations (Niemi and Jennings 1991, Jennings, Stoker and Bowers 2009, Jennings and Niemi 2015, Prior 2010). Here, parental socialization coupled with learning in young adulthood has been shown to explain a large portion of variation in

adult partisanship.[2]

The coevolution of European industrialization and party systems gives us empirical leverage on the question of persistent partisanship. The location of energy during the early phase of the Industrial Revolution (in the form of coal deposits) corresponds geographically with the greatest concentration of left-wing support at precisely the time most West-European party systems took shape – at the same point in time when initial beliefs about partisanship were formed. That is, the Industrial Revolution, fueled by coal, created identities wherein individuals came to see themselves as members of a social group defined by the support of political parties. Like these other identities, partisanship was – and is – transmitted across generations, persisting even when the economic conditions that created these initial identities ceased to operate.

To pin down our proposed mechanism of persistence we provide evidence from both a cross-European sample of survey respondents and an empirical case study of Great Britain. In the European sample we conduct two analyses. First, we conduct a matching exercise where we compare pairs of similar people currently living in the same regions, one of whom grew up in a coal-mining region the other who did not. In this matched sample, we find an effect, roughly identical to that in our baseline analysis, of having been raised in a coal mining region. That is, even when comparing pairs of individuals currently living in the same location, exposure to a history of coal mining in childhood explains almost all of our main result. Second, we explore the impact of a history of coal mining on a sample of second-generation immigrants. Because their parents immigrated well after the Industrial Revolution, this sample of survey respondents could not have been exposed to the history of preference formation and transmission that we conjecture is driving our main result. In line with our hypothesis, we find no evidence of an effect of historical coal-mining among the children of immigrants.

[2]In the appendix we show that our results are consistent with a simple model wherein voters assess their own party identification using information about government performance and their own prior beliefs about parties' relative benefits. These prior beliefs are, in turn, derived from their parents' partisanship. As a result, party attachment evolves over generations as individuals weigh information gleaned from observed government performance, parental identification, and the initial conditions that described relative benefits of parties.

In our British case study we exploit fine-grained data that allows us to uncover the relationship between early industrialization, the formation of partisan ties, and their transmission across generations. First, we assemble data on historical voting behavior across constituencies and census data on industrial workers. We show that coal mining constituencies: i) voted more for Labour already in 1931 and ii) had a sizably larger share of industrial workers. Then, in a mediation analysis framework, we show that the impact of coal on Labour support operates almost entirely through its effect on the presence of industrial workers. Second, we exploit surveys of voting behavior covering the last two decades of the twentieth century that contain information on the voting behavior of respondents' parents. Our findings suggest that about half of the total effect of living in a formerly coal mining constituency on left party support is driven by the intergenerational transmission of partisan attitudes.

2 Data and Identifying Assumptions

2.1 Data Sources

We construct a dataset measuring outcomes at both the NUTS2 European region and individual level.[3] We have collected data on five topics: i.) electoral returns for 29 European countries from 1990-2016; ii.) survey data describing individual political, social, and economic attitudes; iii.) data on contemporary incomes, economic activity, and education; iv.) the presence of nineteenth and early twentieth century coal mines and the underlying geological conditions that cause coal to form; v.) pre-1800 measures of economic activity, including the size of urban population within a given region and the historical presence of iron mines and forges; and lastly vi.) a set of geographical "control" variables. For summary statistics, see Table B2 in the appendix.

[3]NUTS2 stands for *Nomenclature des unités territoriales statistiques*. These are geographic subdivisions of countries constructed for statistical purposes by the European Union.

2.1.1 Outcome Variables

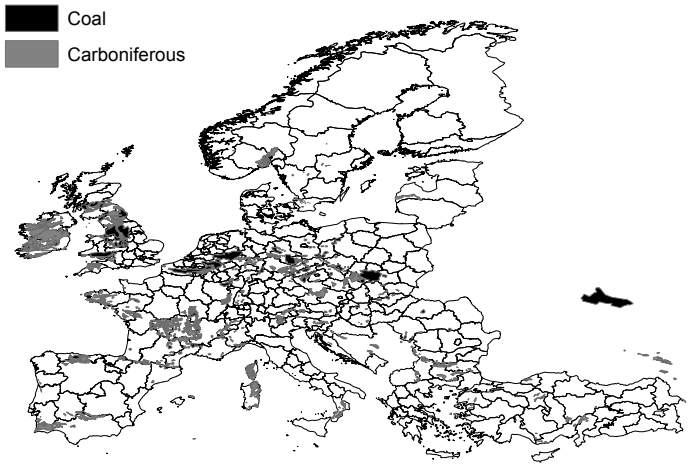
Our primary result shows that past experience with coal mining explains a sizable share of the current distribution of the left's vote and left-wing preferences amongst voters across European regions. In order to make proper comparisons across countries with electoral districts of various magnitudes, we aggregate each democratic election for 29 European states to the NUTS2 regional level and focus upon the vote share of mainstream social democratic and labour parties received in national parliamentary elections. In political systems with two rounds of voting, we focus on the first round; for bicameral legislatures, we only consider the lower body. Table B1 in the appendix gives a full list of parties we have coded as members of the mainstream left. Similarly, we exploit survey data from rounds 5-7 of the European Social Survey that has been geo-referenced to the NUTS2 region to obtain individual party identification.

To evaluate competing mechanisms associated with differences in social class, we construct from the ESS several measures that exploit fine-grained data on the occupational sector of each survey respondent. Though we have less finely grained data, we construct similar measures based on each respondent's father's occupation. Relatedly, from survey data we exploit direct measures of household incomes, educational attainment, and union membership. In addition, using data from the ESS and ESPON 2016 project, we construct several proxies of past and current migration. Finally, we evaluate potential alternative mechanisms that operate through variation in post-materialist preferences, examining individual attitudes towards tradition, religion, homosexuality, and the environment.

2.1.2 Historical Coal Mines and Geological Strata

The main independent variable of interest in our analysis is the historical presence of coal mines in the region. To do this we use a map of nineteenth century coal mines, the *Les Houilléres Européennes* map from Chatel and Dollfus (1931), which records the location of 124 major coalfields within Europe open at the time of publication. We geo-

Figure 1



Note: The Location of Carboniferous Geological Strata and Coal Mines. Data from International Geological Map of Europe (2013) & Chatel and Dollfus (1931)

reference the location of these historical mines to modern NUTS2 borders. Our baseline measure of historical mining is an indicator variable taking a value of one if at least one historical mine was located within the boundaries of a NUTS2 region and zero otherwise. Since mines can extend along several kilometers, as an alternative, we employ a variable measuring the share of the region historically occupied by mines.

These data are, to our knowledge, the most precise description of the distribution of coalfields at the start of the twentieth century. Still, given that these maps provide only aggregate information, we cannot link these data to individual coal mines over time. In the appendix we describe and analyze data collected through an internet-based data search on coal mines across Europe, providing an alternative method of mapping historical coal mining.

Given that the presence of active mines at the height of the Industrial Revolution may be related to the economic, cultural, or political features of regions, we exploit a specific geographical characteristic of the region to predict the historical presence of coal mines. Following Fernihough and O'Rourke (2014), we collect data on the presence of

carboniferous strata in each NUTS2 region. Coal beds are mainly located in geological strata originating in the Carboniferous period, the era between 354 and 290 million years ago. Since coal is more likely to appear in areas with carboniferous geological strata, we treat it as an encouragement for the presence of coal mines. We digitize carboniferous strata maps retrieved from the International Geological Map of Europe and reference it to modern NUTS2 borders. Again, the baseline variable is an indicator variable taking a value of one if a carboniferous strata is found within the region borders and zero otherwise.

2.1.3 Geographical and Historical Controls

Furthermore, to exclude the possibility that the geographic characteristics of carboniferous areas are different from those of non-carboniferous areas, we include a rich set of covariates describing these characteristics. Our geographical measures include average temperature, precipitation, mean elevation, terrain ruggedness, and average soil suitability. Moreover, to account for the possibility that carboniferous strata happen to be located in particularly remote areas, we construct a set of location controls that include distance to the sea, to the country borders, to inland water bodies, latitudes, longitude and an interaction term between latitude and longitude.

Finally, to account for the possibility that areas with carboniferous strata had different patterns of urbanization prior to the Industrial Revolution, we control for urban population in 1800, exploiting data from Bairoch *et al.* (1988). Similarly, to proxy for potential technological differences across carboniferous and non-carboniferous regions that may predict an ability to mine, we control for the historical presence of iron mines and forges as recorded in Sprandel (1968; p. 93-220).

2.2 Identification Strategy

Our empirical analysis exploits cross-regional variation in historical coal extraction. Since we aim to net out the role of characteristics operating at the country level, our baseline specification exploits only within-country variation. More formally, we will estimate vari-

ants of the following equation:

$$Outcome_{i,c,t} = \rho_0 + \rho_1 CoalMining_{i,c} + \rho_2 \mathbf{X}_{i,c} + \rho_3 \mathbf{Z}_{i,c} + \mu_c + \eta_t + \epsilon_{i,c,t} \quad (1)$$

Where i stands for the NUTS2 European region and c stands for country and t for the particular election year. Our baseline specification includes a full set of country fixed effects, μ_c. When we have electoral outcomes we include the full set of election year effects, η_t, and when we focus on survey-based outcomes we instead include a set of survey-wave fixed effects. This framework allows us to account for confounding factors that operate at the national level and to rule out country-specific characteristics, for example the particular national electoral rules or a history of democracy, which might be related to both historical coal mining and contemporary political attitudes. From another perspective, this empirical framework allows us to focus on the subset of political and economic channels most closely related to the regional unit.

The main parameter of interest, ρ_1, measures the average difference between regions that had coal mines in the nineteenth century and regions that did not. We have two reasons to expect a naive comparison derived from OLS estimates to be biased. First, if the most dynamic regions, those which would be wealthiest regardless of access to coal, were more likely to adopt coal mining, and if economic dynamism – wealth – is negatively correlated with preferences for the left, then our estimates would be biased downward. Moreover, since we are using a reconstruction of the spatial location of nineteenth century coal mines, there is likely measurement error in our independent variable of interest. Because of this, we should expect standard OLS estimates to be biased toward zero.

As a first strategy for comparing more homogenous regions, we control for a set of exogenous geographic controls, $\mathbf{X}_{i,c}$, which include climatic, geographic, and locational characteristics of the region. We further add a set of controls, $\mathbf{Z}_{i,c}$, that are potentially endogenous but measured prior to treatment. These include urban population in 1800 and the historical presence of iron mines and forges. Our second strategy exploits the

fact that coal was not present everywhere in Europe but was concentrated in areas with specific geological characteristics. We exploit the presence of geological strata from the carboniferous period as an instrument for the presence of nineteenth century coal mining, estimating the effect of coal mining on our outcomes of interest via two-stage least squares estimation of the following system.

$$\begin{aligned} CoalMining_{i,c,t} &= \pi_0 + \pi_1 Carboniferous_{i,c} + \pi_2 \mathbf{X}_{i,c} + \pi_3 \mathbf{Z}_{i,c} + \delta_c + \psi_t + \upsilon_{i,c,t} \\ Outcome_{i,c,t} &= \rho_0 + \rho_1 CoalMining_{i,c} + \rho_2 \mathbf{X}_{i,c} + \rho_3 \mathbf{Z}_{i,c} + \mu_c + \eta_t + \epsilon_{i,c,t} \end{aligned} \tag{2}$$

To obtain consistent estimates of ρ_1, we need to exclude the possibility that carboniferous geology has a direct effect on contemporary left-party support or, similarly, that carboniferous geology is associated with features that have a direct effect on contemporary partisanship. That is, we need $\upsilon_{i,c,t}$ to be uncorrelated with $\epsilon_{i,c,t}$. For this reason, we verify the robustness of our instrumental variables estimates to the inclusion of climatic, geographic, and locational characteristics of the region by including the vector of controls $\mathbf{X_{i,c}}$ and characteristics of the region measured before the nineteenth century, $\mathbf{Z_{i,c}}$. Finally, we investigate a number of plausible violations of the exclusion restriction and conduct a series of exercises to validate our necessary identifying assumption.

3 Main Results

3.1 Electoral Support

We begin by establishing a statistical association between past coal mining and contemporary left-party voteshares. The outcome is the mainstream left's vote share at the regional level in a given election. These results are presented in the first four columns of Table 1. In the baseline model (column 1) we pool all elections and include only the full set of country and year fixed effects, estimating the relationship between the presence of

historical coal mines and left-party support via ordinary least squares. Next, in columns 2-4 we successively introduce a set of geographic covariates, distance measures, and "pre-treatment" covariates related to each region's economic history. Across specification, we find evidence of between a 4 and 4.5 percentage point increase in the mainstream left's vote share associated with the presence of a historical coal mine. This reflects between 13.8 and 15.5% of the average regional left-party vote share (.29) or between 36 and 41% of the average within country variation in the mainstream left's vote share (.11). In the next four columns we reproduce the same set of models, now estimating the reduced form relationship between our instrument – the presence of carboniferous geology – and left support, yielding the intention-treat-effect (ITT) of coal mining. We reproduce the same qualitative results as before, estimating an approximate 3 percentage point increase in the left's vote in regions with carboniferous geology.

Since we expect there to be selection of the sort where those regions that already had some underlying technical knowledge, surplus labour force, or other advantage were also those that were most likely to take advantage of energy from coal, we believe OLS estimates to be biased downward.[4] To obtain more credible estimates, we exploit variation in the presence of coal mines induced by the existence of carboniferous geology. These instrumental variables results are given in the last four columns of Table 1. Across every statistical model where we instrument for coal mines, carboniferous geology is a very strong predictor of the presence of mines and satisfies rule-of-thumb levels of statistical strength. As before, in column 9, we include as covariates the full set of year and country fixed effects. This yields an effect of historical coal mining on left-party support of 5.5 percentage points. As we successively add control variables (columns 10-12), this effect increases in magnitude to just over 8 percentage points, or around 75% of the average within-country variation in left electoral support and one-quarter the average regional vote share.

[4]Note that despite this downward bias, the magnitude of these results represents roughly 30% of the within-country standard deviation in left-party vote share.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Historical Mine	0.040	0.045	0.044	0.044					0.055	0.077	0.080	0.083
	(0.007)	(0.007)	(0.007)	(0.007)					(0.015)	(0.014)	(0.015)	(0.016)
Carboniferous Strata					0.021	0.030	0.029	0.029				
					(0.005)	(0.005)	(0.005)	(0.006)				
									First Stage			
Carboniferous Strata									0.373	0.383	0.366	0.352
									(0.039)	(0.040)	(0.038)	(0.033)
F-Stat on Instrument									426.166	415.232	373.556	345.538
Controls												
Geographic	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Distance	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Economic	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Model:	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	2SLS	2SLS	2SLS	2SLS
R^2	0.409	0.454	0.461	0.462	0.400	0.446	0.454	0.456	0.407	0.445	0.451	0.450
N	1916	1916	1916	1916	1916	1916	1916	1916	1916	1916	1916	1916

Notes: The unit of observation is the NUTS2 European region. The dependent variable is left party vote share. Moran's I test for spatial correlation in model errors and associated p-value are given in the lower panel. The null hypothesis in this test is of no spatial correlation. Standard errors are clustered at the country level.

Table 1

3.1.1 Robustness Checks

Our baseline results are robust to various re-operationalizations of both the independent and the dependent variables. First, our findings remain substantively unchanged when we use several alternative measures of historical coal mining. Our results remain qualitatively and quantitatively unchanged when we treat the independent variable as the percentage of territory in each region comprised of a coal mine (Table C2), considering only large mines (Table C3), and restricting the analysis to currently closed mines and mines opened before 1900, respectively (Table C4).

Moreover, we show that our measure of support for left-wing parties does not rest on our choices in the coding of the left. In Table C5, we include green and far-left parties in the outcome measure. Similarly in Table C6, we replicate our main results treating the outcome as the mainstream left's vote share in European Parliament elections. As an alternative, we verify our results using as a dependent variable self-reported placement on a left-right scale from the European Social Survey (Table C7).

We provide several additional results supporting our main findings. In Table C8 we show that the effect is stable over time. In Table C9 we summarize results of specifications accounting for spatial spillovers across regions. Finally, in Table C10 we explore more explicitly the role of canals and waterways and how they interact with historical coal mining.

3.2 Individual Support

In order to more directly measure individual attitudes, we exploit data from waves 5-7 of the European Social Survey (ESS) to evaluate the impact of historical coal mining on respondents' partisan preferences.[5] The survey asks respondents what party they most closely identify with. Here, we construct a dummy variable that takes on a value of one if the survey respondent identifies most with one of the left-wing parties in Table B1.

[5]We focus on individuals because of the ecological problem induced by aggregation. As such, our findings at the regional level may not reflect the true underlying political preferences and ideological positions of voters.

Only about half of those surveyed respond that they are close to any party. Following convention we exclude those who have no party identification from the analysis.

In Table 2 we replicate Table 1, now presenting estimates of the relationship between historical coal mines, carboniferous geology, and individual-level support for left parties. The outcome is measured at the individual level while the interventions of interest, the presence of historical coal mines and carboniferous strata, are given at the regional level. Our results are consistent with our analysis of aggregate voteshares.

Across specification we estimate an increase in left support associated with historical coal mines of between 3.3 and 3.8 percentage points (columns 1-4). The presence of carboniferous strata yields qualitatively similar results, with estimated increases in left-party support of between 3.7 and 5 percentage points (columns 5-8). In the final four columns (9-12) of Table 2, where we exploit our instrumental variables setup to account for potential bias in our baseline least-squares results, we find individual support for the left increases by between 11.2 and 16.2 percentage points in the presence of a historical mine.[6]

3.3 Evaluating our Identifying Assumptions

In all, we find strong empirical support that the presence of coal mines in the 19th century, the locations that fueled the industrial revolution, had a lasting impact on partisan preferences and voting today. Still, in order for our estimates to be consistently identified we either need to have controlled for all possible confounders or we need our instrument, the presence of carboniferous geological strata, to have no direct effect on political attitudes and behavior in the present day other than through the economic choice to mine. First off, it is implausible that we can control for all unobserved confounders. What is more, the crucial assumption needed to identify our instrumental variables estimates is largely untestable. Nevertheless, we provide a series of corroborative results which lend

[6]In the appendix (Table C7) we replicate Table 2 using an alternative measure of left support based upon individual placement on an eleven-point left-right scale.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Historical Mine	0.033	0.038	0.037	0.036					0.112	0.147	0.162	0.156
	(0.012)	(0.013)	(0.013)	(0.013)					(0.056)	(0.056)	(0.064)	(0.068)
Carboniferous Strata					0.037	0.050	0.049	0.048				
					(0.016)	(0.016)	(0.016)	(0.018)				
									First Stage			
Carboniferous Strata									0.333	0.340	0.307	0.307
									(0.070)	(0.076)	(0.074)	(0.079)
F-Stat on Instrument									5458.675	4821.571	3660.604	3114.64
Model:	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	2SLS	2SLS	2SLS	2SLS
Controls												
Individual	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographic	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Distance	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Economic	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.063	0.065	0.065	0.065	0.063	0.065	0.065	0.065	0.060	0.059	0.058	0.059
N	39710	39710	39710	39710	39710	39710	39710	39710	39710	39710	39710	39710

$p < 0.01$, $p < 0.05$, $^{p} < 0.1$

Notes: The unit of observation is the individual survey respondent. The dependent variable is a dummy variable taking a value of 1 if the individual responds that the mainstream left party is that which they feel most close to. Standard errors are clustered by the NUTS2 Region. All models include design-based weights.

Table 2

credibility to our findings.

As a sort of placebo exercise we regress our political outcomes, the left's vote share and individual identification on a left-right spectrum and party identification, on the presence of Permian geology, the geologic period immediately following the carboniferous era. As in our main analysis, we construct a dummy variable that takes on a value of 1 when the Permian strata are present in a given region and zero when it is not. Because of the temporal proximity of these geological periods, these strata share similar bio-geographic features but are, nevertheless, considerably different with respect to coal richness. In fact, there is no experience of European coal extraction from Permian sediments.[7] This exercise is insightful because if coal-extraction - and not other bio-geographic features of Carboniferous areas - drives the relationship between Carboniferous strata and present-day income, we should observe no effect for Permian strata. We present these results in the first three columns of Table 3. Across each of these political outcomes, we find no statistical evidence of a relationship between Permian geology and present day political outcomes.

Another potential violation of the exclusion restriction would occur if the underlying geological propensity for coal had direct effects on political behavior through contemporary mining activity. To evaluate this, we regress three outcomes related to present day mining on the existence of carboniferous geology and show that there is no statistical association between them. In the last three columns of Table 3, we successively evaluate the correlation between carboniferous strata on the number of mining firms, the fraction of people employed in mines, and the total number of individuals employed in mining, each measured at the NUTS2 region. In each model, we estimate a null relationship.[8]

[7]For an overview of the geological science see Speight (2012).

[8]All data in these regressions come from the Eurostat statistical service

The Null Relationship Between Permian Strata & Contemporary Partisanship and Carboniferous Strata & Contemporary Mining

	1.	2.	3.	4.	5.	6.
	Left Vote Share	*Close to Left Party*	*Left Right Scale*	*# Mining Firms*	*% Employed in Mining*	*# Employed in Mining*
Permian Strata	0.003	0.008	−0.022			
	(0.009)	(0.020)	(0.081)			
Carboniferous Strata				−3.526	−0.001	1184.668
				(11.774)	(0.003)	(1685.823)
Individual	No	Yes	Yes	No	No	No
Geographic	Yes	Yes	Yes	Yes	Yes	Yes
Distance	Yes	Yes	Yes	Yes	Yes	Yes
Economic	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	No	No	Yes	Yes	Yes
Wave FE	No	Yes	Yes	No	No	No
R^2	0.447	0.065	0.025	0.351	0.174	0.184
N	1916	39710	79181	278	278	278

Notes: In columns 1 & 4-6 the unit of observation is the NUTS2 European region. In columns 2-3 the unit of observation is the individual survey respondent. All models include country and year or survey wave fixed effects. In column 1 standard errors are clustered at the country-year level. In columns 2-3 standard errors are clustered at the NUTS2 region level. In columns 4-6 standard errors are clustered by country.

Table 3

4 Mechanisms of Persistence

In this section we characterize results describing potential mechanisms linking the existence of coal mining in Europe's past to present-day differences in political attitudes. In the main text we examine a set of mechanisms related to economic conditions, focusing on measures of social class and income. In the appendix we include a battery of tests to evaluate a large number of additional potential mechanisms, including proximate causes like the voters' evaluation of the current state of the economy and government performance, the role of contemporary and historical migration patterns, and differences in attitudes related to post-materialist beliefs. All sets of results indicate these potential channels cannot explain the relationship between historical coal mining and contemporary support for the left.

4.1 Economic Mechanisms

To evaluate potential economic channels we rely upon the following measures, each taken or derived from the ESS:

First, we consider two measures of occupation-based social class. If historical coal mining affects political attitudes through its impact on social class we would expect an association between the two. First, we code survey respondents' position on the International Socio-Economic Index of Occupational Status (ISEI). This is derived from the `ISCO08` coding of survey respondents' occupations to produce a comparable cross-national measure of occupational status. High levels correspond with high social class and low the converse (Ganzeboom and Treiman 1996). Second, we construct the Erikson–Goldthorpe-Portocarero measure of social class from the `ISCO88` coding of respondents' occupations (Erikson and Goldthorpe 1992). These two measures of class correlate highly (ρ = -0.80) in our data. Next, since class is sticky we use a nine-point scale from the ESS based on each respondent's father's occupation.[9] In addition, as a proxy of membership in the

[9]This places professional and technical occupations at one extreme and unskilled/farm workers at the other.

working class, we consider an indicator that takes on a value of one if the respondent is or has ever been a member of a union.[10]

A related economic channel through which coal might affect preferences for the left is via its impact on individuals' incomes and, consequently, through their preferences for redistribution. To capture this, first we measure survey respondents' incomes, operationalized as their household income decile relative to the distribution of their country of residence. Then, we capture survey respondents' preferences for redistribution, which is measured with a five-point scale where low values indicate a greater preference for redistribution.[11]

In Table 4 we regress each of these measures on the presence of a historical mine, estimating the effect of historical coal mining via OLS and 2SLS, instrumenting for the presence of coal mines with the presence of carboniferous strata. In each model we present estimates controlling for all of our observable covariates. Models without these controls yield qualitatively similar results. Across outcomes we obtain estimates that are indistinguishable from zero, indicating no difference in terms of these potential channels between coal mining and non-coal mining regions. The exception to this is the model where we instrument for the presence of mines and treat preferences for redistribution as the outcome (column 12). Here, our estimate indicates a small but positive and statistically significant relationship between historical mining and preferences for government intervention. Nevertheless, the magnitude of this effect (-.19) reflects just under 20% of the within-country standard deviation in preferences for redistribution.[12]

[10] In appendix Tables D2 and D3 we explore various measure of human capital as potential mechanism, again finding null results.

[11] In appendix Table D4 we explore in detail the role of income per capita, measured at the level of region. Although we uncover an association between historical coal mining and lower incomes per capita, we show through a causal mediation framework that the direct effect of coal is unchanged after accounting the mediating impact of regional GDP per capita.

[12] In appendix Table D1 we explore redistributive preferences through a causal mediation framework and find no evidence in support of it as a channel of persistence.

The Effect of Historical Mining Coal Mining on Social Class and Income Measures

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
	ISEI-Class		*EGP-Class*		*Father Occupation*		*Union Member*		*Income Decile*		*Redistribution*	
Historical Mine	−0.259	−2.322	0.012	0.316	−0.045	0.427	0.005	0.020	0.108	−0.565	−0.025	−0.191
	(0.503)	(2.043)	(0.051)	(0.197)	(0.086)	(0.349)	(0.008)	(0.023)	(0.131)	(0.331)	(0.023)	(0.095)
	First Stage											
Carboniferous Strata		0.353		0.354		0.364		0.334		0.386		0.362
		(0.083)		(0.084)		(0.083)		(0.085)		(0.083)		(0.084)
F-Stat on Instrument		7797.505		7790.275		8000.235		7352.922		8160.268		8973.38
Controls												
Individual	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographic	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Distance	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Model	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
R^2	0.033	0.032	0.071	0.067	0.125	0.121	0.212	0.212	0.119	0.113	0.119	0.117
N	80402	80402	79430	79430	77557	77557	86678	86678	70449	70449	88787	88787

Notes: The unit of observation is the individual survey respondent. The dependent variable is given in the header of each column. Standard errors are clustered by the NUTS2 Region. All models include design-based weights.

Table 4

4.2 Additional Mechanisms

In addition to the economic channels explored above, we investigate a number of potential mechanisms that might explain the link between coal mining regions and left support. An extended description of our data sources, empirical approach, and complete results from the analysis described in this section is given in appendix section D4.2.

First, we explore the role of current and past migration, considering the possibility that historical coal mining led to different patterns of migration and potentially to sorting by partisan attitudes. In Table D5 we find no evidence of a relationship between being a former coal mining region and a higher density of external and internal migrants today. Additionally, we attempt to reconstruct several measures of past migration, looking at the share of people born abroad in older generations. Results, summarized in Table D6, indicate that there is no significant difference between coal mining and other regions in terms of this migrant population.

In Table D7 we investigate whether coal mining regions were more exposed to conflict. Using localized data from the Militarized Interstate Disputes database (Palmer et al. 2015), we find that historical mining regions were no more the focus of military disputes between 1816 and 2000 than were non-mining regions. In Table D12, we examine the possibility that differences in partisan attitudes occur because those in historical coal mining regions appraise the state of the economy or the performance of government differently than those in non-coal mining regions. Again, we find no evidence of this.

In Table D8 we consider the possibility that early industrialization led to dense urban clusters where left supporters might tend to live. However, we find little evidence of a statistically significant relationship between the presence of historical coal mines and population density. In Table D9 we explore the relationship between historical coal mining, welfare dependency, and public employment. Here, the evidence is mixed. In OLS estimates we find no evidence that living in a historical coal mining region increases the likelihood of being dependent on welfare. However, when we instrument for historical coal mines we find some evidence of a small effect of living in a historical mining region

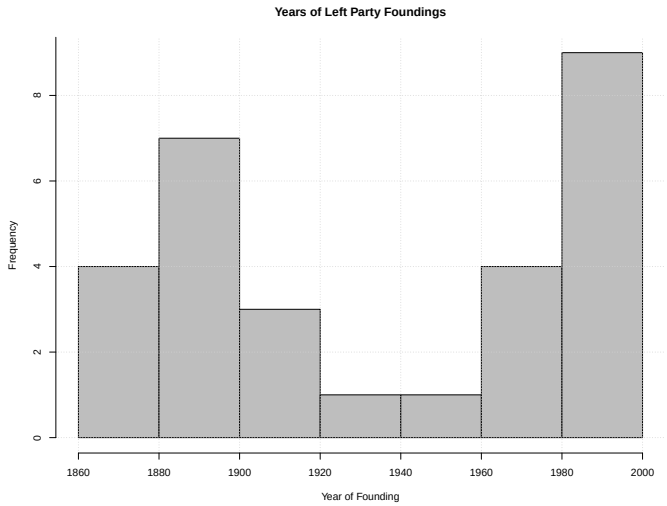
on depending on government benefits. We find no evidence of a relationship between a history of coal mining and individuals' likelihood of being employed in the public sector. Finally, in Table D10 we explore the relationship between historical coal mining and attitudes on four related post-materialist issues: attitudes toward tradition; attitudes toward homosexuality; environmentalism; and attitudes toward religion. We find no evidence that a history of coal mining is associated with any measure of post-materialism.

5 Early Industrialization and Parental Transmission

In this section we provide evidence that a history of coal mining impacts present-day partisan preferences through initial partisan preferences formed at the height of industrialization. Furthermore, we show that these partisan attachments were then passed down through a process of inter-generational socialization. To start, we show that the entirety of our main result is explained by the set of countries where present-day left parties were formed before the Second World War. That is, our baseline result is wholly driven by countries where party systems formation and industrialization broadly overlapped.

Second, we provide evidence that coal's effect on preferences is the consequence of socialization that takes place relatively early on in life. Here, we compare pairs of similar individual survey respondents who currently live in the same region, one of whom lived in a mining region at an early age and the other who did not. We show that despite living alongside each other, individuals who grew up in coal mining regions are more likely to support the left. Then, we describe results where we focus on the attitudes held by the children of immigrants whose parents could not have been exposed to a history of coal. Here, we find no difference in left support between the children of immigrants living in regions with a history of coal mining and the children of immigrants who live in non-mining regions.

Finally, we conduct a short statistical case study using historical micro-data from Great Britain. This allows us to highlight the underlying mechanism of preference for-



Notes: The distribution of founding dates for all left parties in our sample.

Figure 2

mation and intergenerational transmission. First, we show that the impact of coal on left-party voting in the early twentieth century operated largely through the number of industrial workers present in a given electoral constituency. Second, we use survey data describing the preferences of both parents and children to provide evidence that the long-run impact of coal operates through the intergenerational transmission of preferences.

5.1 The Timing of Left Party Foundation

In this section we document that historical coal mining led to support for left-wing parties only in those countries where present-day left parties formed before the Second World War. To do so, we estimate the following model:

$$Voteshare_{i,c,t} = \rho_0 + \rho_1 CoalMining_{i,c} + \rho_2 CoalMining_{i,c} \times PostWar_c + \rho_3 PostWar_c + \rho_4 \mathbf{X}_{i,c} + \rho_5 \mathbf{Z}_{i,c} + \mu_c + \eta_t + \epsilon_{i,c,t} \tag{3}$$

where $PostWar_c$ takes a value of one if the country's main left party was founded after the Second World War and zero otherwise.

Table 2 gives the histogram of founding dates of the left parties in our sample. It is clear that there are two clusters: those that formed before the Second World War and those that formed after. We discretize parties along these lines so that ρ_1 gives the impact of coal mining conditional upon the left party having formed before the war and $\rho_1 + \rho_2$ gives the impact of coal mining conditional upon the party having formed after.[13]

Estimates of these effects are given in Table 5. Columns 1-2 present OLS estimates, columns 3-4 reduced form ITT estimates, and columns 5-6 2SLS estimates. Across specification the impact of coal is almost wholly concentrated in the set of parties that formed before the Second World War. These results indicate that the impact of historical mining on support for pre-war left parties' vote share ranges from between just over 6 to 10.7 percentage points. By contrast, in only one of the six models is our estimate of the effect of mining for post-war parties positive and statistically significant (model 2) and in half of our models our point estimate for post-war parties is negative, though statistically indistinguishable from zero (columns 1,3,5).

These results suggest that historical access to energy only impacts present-day political outcomes in cases where partisan identities were formed in the period when coal served as the main source of energy. In cases where mainstream left parties only formed late, we find no evidence of a persistent effect of access to coal on any of our political outcomes. In these places where the industrial working class were not organized into a (democratic) mass party, there is no evidence of partisan persistence. Yet, where industrial workers served as the backbone of the left, their early organizational impact persists.

5.2 Socialization Not Location

Next, we exploit data from the fourth wave of the European Values Study that describes both the region respondents lived in when they were fourteen years old and the region they currently live in. We use these data to highlight the fact that exposure to coal

[13]In appendix Table E1 we interact our measures of historical coal mining with the founding date of each left party and obtain qualitatively similar results.

	1.	2.	3.	4.	5.	6.
Historical Mine | *Pre-War Party* - [ρ_1]	0.062	0.062			0.093	0.107
	(0.009)	(0.010)			(0.020)	(0.021)
Historical Mine | *Post-War Party* - [ρ_1+ρ_2]	-0.001	0.019			-0.020	0.023
	(0.009)	(0.008)			(0.024)	(0.023)
Carboniferous Strata | *Pre-War Party* - [ρ_1]			0.036	0.040		
			(0.005)	(0.007)		
Carboniferous Strata | *Post-War Party* - [ρ_1+ρ_2]			-0.007	0.010		
			(0.008)	(0.008)		
Controls						
Individual	No	Yes	No	Yes	No	Yes
Geographic	No	Yes	No	Yes	No	Yes
Distance	No	Yes	No	Yes	No	Yes
Economic	No	Yes	No	Yes	No	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Model	OLS	OLS	OLS	OLS	2SLS	2SLS
R^2	0.417	0.464	0.405	0.458	0.410	0.452
N	1916	1916	1916	1916	1916	1916

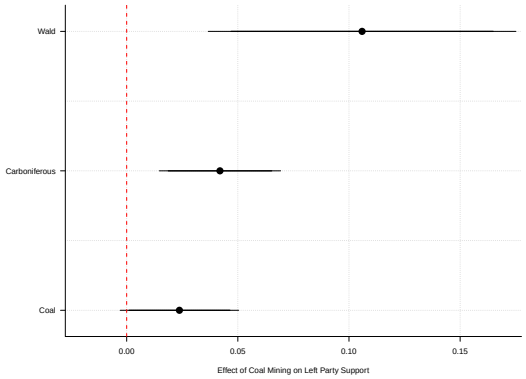
Notes: The unit of observation is the NUTS2 European region. The dependent variable is left party vote share. First stage regressions for 2SLS estimates (columns 5-6) are given in Table E2 in the appendix. Standard errors are clustered at the country level.

Table 5

mining operates through a process of socialization. We compare pairs of similar people living in the identical present-day region, one of whom grew up in a coal mining region and the other who did not. To accomplish this, we conduct an exact match of individuals based upon their current region as well as their, age, religion, and gender.

After the construction of our matched sample, we identify the impact of historical coal mining non-parametrically, first via a simple difference in means. Then, we estimate the effect of having historically mined via the Wald estimator, where we treat our dummy for carboniferous geology as an instrument for our coal mine indicator. Results from this exercise are presented in Figure 3. Using our dummy indicators for the presence of

Figure 3: Coal and Political Socialization



Notes: This figure gives the effect of historical coal mining in the region a survey respondent lived in when they were fourteen in a sample where we exact match on the region respondents currently live in as well as their age, religion, and gender. The matched sample size is 4,396 survey respondents. The bottom two rows give simple difference-in-means. The top row gives the Wald-IV estimate, treating carboniferous geology as an instrument for the presence of coal mines.

a historical coal mine and carboniferous strata we estimate a 2.4 and 4.2% increase in left support among those who at age fourteen lived in a coal mining region, respectively. When we instrument for the presence of coal, this estimate increases to 10.6%.[14] Note that these estimates are very close to our baseline results, suggesting that our findings are driven by experiences early in life.

In appendix Table E4 and Figure E1 we provide further corroboration of our proposed mechanism. There, we restrict our analysis to second generation immigrant voters, e.g. those who have immigrant parents.[15] We examine the relationship between a history of coal mining in a sub-sample of survey respondents who could not have experienced the intergenerational transmission of preferences formed at the height of the Industrial Revolution. In this sub-sample of second-generation immigrants we find no evidence that coal mining has an impact on partisan support.

[14]In appendix Table E3 we demonstrate that these results are robust to the inclusion of the full set of controls.

[15]From the ESS data, we obtain a sample of 3,050 second-generation immigrants.

5.3 Great Britain: Micro-Evidence of Intergenerational Preference Transmission

Finally, we provide evidence from Britain that a history of coal mining continues to impact support for the left through partisan identities constructed at the height of the Industrial Revolution that were then transmitted across generations. As a first step we couple constituency-level data describing Labour's vote share with census data describing the distribution of industrial workers. We use these data to show that nearly all of the impact of our measure of historical coal extraction on Labour's support at the height of British coal consumption was driven by the presence of industrial workers. In our second step we exploit British Election Survey data to show that the impact of historical coal mining on individual support for Labour operates largely through the impact of parents' partisan attachments on children's support.

5.3.1 Industrialization and Labour's Vote Share

To start, we show that historical coal mining is associated with both Labour's vote share in the election of 1931 and the presence of industrial workers in the same year. This is the earliest election for which we obtain both electoral data at the constituency level and roughly contemporaneous data on the industrial composition of constituencies, derived from the census of 1931.[16]

In the first six columns of Table 6 the outcome variable is Labour's vote share in 1931. The first finding is that the presence of a historical coal mine is positive and statistically significantly correlated with Labour's support already in 1931.[17] The magnitude of our OLS estimates of the reduced form impact of coal and the ITT effect of carboniferous strata are roughly in line with those in our main analysis, ranging between 4.1 and 10.5 percentage points (columns 2-3). However, our 2SLS estimates are considerably larger,

[16]We obtain these data from Smith and Ball (2016). In appendix Table E5 we provide substantively identical results using data aggregated at the county level from the elections of 1924 and 1961 coupled with census data from 1921.

[17]Going so far back in time is particularly important for our analysis, as it permits us to exclude the role of deindustrialization as a potential confounding factor.

ranging from 16.3 in the model with no covariates (column 5) to 32.3 percentage points in the model with the full set of controls (column 6).

Our second finding, in the next six columns, shows that historical mining is a strong predictor of the share of individuals employed in manufacturing and mining, again measured at the parliamentary constituency. We estimate that the presence of a historical coal mine increased the proportion of workers employed in industry by between 8.3 (column 8) and 36.6%.

Third, we then estimate the proportion of coal's impact on Labour's early support that was caused by the clustering of industrial workers. To conduct this exercise we follow the approach proposed by Imai et al. (2010), which allows us to decompose the total effect of coal mining into its direct effect and the proportion of the effect mediated by the proportion of workers employed in industry. In other words, this method allows us to quantify the proportion of coal's impact on the left's support that operates through regional the proportion of employed persons in industry.

Results from this exercise are presented in the first 4 columns of Table 8. These findings indicate that the entirety of coal's impact on Labour's constituency-level vote share is driven by the proportion of workers employed in mining and manufacturing. We present results from this exercise in Table 8. In the first two rows are estimates of the average causal mediation effect for non-mining (row a.) and mining (row b.) regions. That is, these quantities hold fixed the treatment status of each group and isolate the indirect effect of coal mines that operates through the proportion of persons employed in industry. Similarly, in rows c.) and d.) we present estimates of the direct effect of coal mines for non-mining and mining regions, respectively. Here, we hold fixed mines' impact as it operates through the mediator, and construct estimates of the direct effect of coal. Finally, in row e.) we present the average total effect, which is the total impact of coal mines that operates through both direct and indirect channels.

Substantively, we focus upon the "total indirect effect" for coal mining regions given in row b.). In columns 1-2 we present the baseline set of indirect and direct effects using

our dummy for the presence of carboniferous strata as our treatment variable. In columns 3-4 we follow the method proposed by Yamamoto (2013), which allows for the estimation of mediation and direct effects in an instrumental variables framework. As before, we use the presence of carboniferous geology as an instrument for the presence of historical coal mines. These results are presented in the last four columns and give qualitatively similar point estimates.

In each specification, the point estimate of the direct effect for mining regions (row d.) is negative, though statistically insignificant. By contrast, across models the effect of coal that operates through industrial employment is statistically significant and positive, indicating between a 19.5 and 50% absolute increase in Labour's vote in mining regions. Moreover, in each specification the effect of coal that is mediated by the presence of industrial workers equals or exceeds the total effect (row e.) of mining, indicating that the effect of coal on Labour's support in 1931 was entirely driven by its impact on an industrial base of support.

Of course, this result relies upon the strong assumption of sequential ignorability. To evaluate the robustness of our results to violations of this assumption we conduct the sensitivity analysis proposed by Imai et al. (2011). In the left-hand panel of Figure 4 we plot potential violations of sequential ignorability (parameterized as the correlation between the error terms of the mediator and outcome models) on the x-axis against the mediating effect under such a violation on the y-axis. We see that it would take a substantively large violation to make our findings null.

5.3.2 Intergenerational Transmission of Political Preferences

As a next step toward evaluating the intergenerational transmission of preferences caused by a history of coal, we exploit data from the four British Election Survey waves from 1983-1997. First, we show that coal mining is still associated with individual preferences for Labour in the late 1980s, more than half a century after 1931. Then, we show that coal mining is similarly associated with individual survey respondents' parents support

The Effect of Historical Mining Coal Mining on Constituency Level Labour Support and Manufacturing in 1931

Outcome:	*Constituency Labour Voteshare 1931*						*% Employed in Manufacturing & Mining 1931*					
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Historical Mine	0.096	0.041			0.163	0.323	0.188	0.083			0.306	0.366
	(0.017)	(0.025)			(0.026)	(0.102)	(0.014)	(0.020)			(0.023)	(0.085)
Carboniferous Strata			0.105	0.091					0.203	0.125		
			(0.017)	(0.022)					(0.013)	(0.017)		
	First Stage											
Carboniferous Strata					0.645	0.281					0.663	0.341
					(0.035)	(0.049)					(0.041)	(0.064)
F-Stat on Instrument					351.403	52.927					269.472	44.258
Controls												
Geographic	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Distance	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Economic	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Model:	OLS	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	OLS	2SLS	2SLS
R^2	0.079	0.186	0.067	0.165	0.035	-0.038	0.415	0.582	0.354	0.545	0.213	0.225
N	508	507	508	507	508	507	341	340	341	340	341	340

$^{p} < 0.01$, $^{p} < 0.05$, $^{p} < 0.1$

Notes: The unit of observation is the English Parliamentary Constituency. The dependent variable in columns 1-6 is Labour's vote share. The dependent variable in columns 7-12 is the percentage of employed individuals in mining or manufacturing. Robust Standard errors in parentheses.

Table 6

The Effect of Historical Mining Coal Mining on Individual and Parental Support For Labour

Outcome:	*Individual Support for Labour*						*Parents Supported Labour*					
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Historical Mine	0.102	0.060			0.142	0.113	0.096	0.068			0.137	0.144
	(0.012)	(0.014)			(0.016)	(0.024)	(0.012)	(0.015)			(0.014)	(0.023)
Carboniferous Strata			0.110	0.074					0.107	0.094		
			(0.013)	(0.016)					(0.011)	(0.015)		
	First Stage											
					0.776	0.653					0.776	0.653
					(0.036)	(0.055)					(0.036)	(0.055)
F-Stat on Instrument					14668.589	6427.845					14668.589	6427.845
Controls												
Individual	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographic	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Distance	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Economic	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Model:	OLS	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	OLS	2SLS	2SLS
R^2	0.017	0.047	0.018	0.047	0.015	0.044	0.016	0.025	0.016	0.023	0.013	0.017
N	14864	14864	14864	14864	14864	14864	14864	14864	14864	14864	14864	14864

$p < 0.01$, $p < 0.05$, $^{p} < 0.1$

Notes: The unit of observation is the individual survey respondent. The dependent variable in columns 1-6 is an indicator taking on 1 if the respondent supports Labour. The dependent variable in columns 7-12 is an indicator taking on a value of 1 if the both of the respondent's parents supported Labour. Robust Standard errors clustered by constituency in parentheses.

Table 7

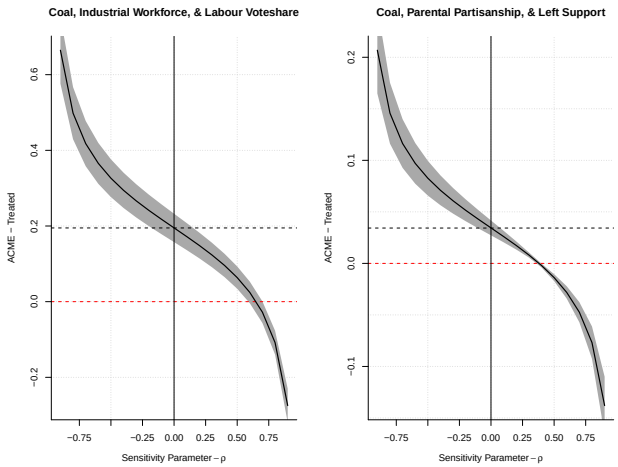
for Labour. Finally, we show that over half of coal's long-run effect on contemporary attitudes operates through parents' partisan attachments.

To start, in columns 1-6 of Table 7, we present evidence that having lived in a constituency that historically mined coal increased individuals' likelihood of supporting Labour two generations later. Again, the magnitude of these results are in line with those from our baseline analysis, with effects ranging between a 6 and 14.2% increase in Labour support. Then, in columns 7-12, we treat an indicator taking on a value of one and zero otherwise if both of the respondents' parents supported Labour as our outcome variable. Across specification, the magnitude of coal's effect on respondent's parental support for the left is nearly identical to that when we estimate the effect of coal on individual's own support.

These findings suggest a strong persistence across generations of political preferences in coal mining areas. Again taking a causal mediation approach, we estimate the proportion of the long-term effect of coal on support for Labour that can be attributed to parents' partisanship. In the last four columns of Table 8 the outcome is the individual survey respondent's expressed support for Labour. Across specification, the mediating effect in coal mining regions is positive and statistically significant (row b.) and ranges in magnitude from a 3.4 to 6.6% increased probability of Labour support. These results indicate that between 40 and 53% of the total effect of coal mining regions is driven by parents' partisan attitudes. In the right-hand panel of Figure 4 we evaluate the robustness of our sequential ignorability assumption. Again, we see that it would take a large violation in order to obtain a null mediating effect.

In sum, the results of the case study on Great Britain presented in this section support our broader conjecture about the mechanisms of persistence driving our main results. These findings indicate that access to coal during the period of its dominance as an energy source created areas densely populated with industrial workers. These workers formed the base of support for the Labour party. Moreover, a large proportion of the persistent support for Labour over the next half century that was caused by coal was

Figure 4: The Sensitivity ACME Estimates to Violations of Sequential Ignorability



Notes: This figure presents the sensitivity analysis proposed by Imai et al. (2011). In the left hand panel we plot potential violations of sequential ignorability (parameterized as the correlation between the error terms of the mediator and outcome models) on the x-axis against the mediating effect under such a violation on the y-axis. The left-hand panel gives the results for model 2 and the right-hand panel gives results for model 6, both from Table 8.

transmitted intergenerationally from parents to children.

6 Conclusion

The spatial distribution of political preferences can dramatically impact the link between votes and seats in legislatures, particularly in majoritarian contexts. In this paper we provide evidence that contemporary patterns of support for mainstream left parties have deep-seated economic causes. We show that easy access to the main form of energy exploited during the period of European industrialization caused a geographic concentration of contemporary left-wing support on the continent. The geographic concentration of industrialization and, therefore, industrial labour, created natural constituencies for the left, constituencies which persist into the present day.

Furthermore, we investigated the channels of persistent partisanship and provided evidence against plausible alternative explanations of spatial variation in left-wing support. We find no support for channels associated with differences in class, income, redistribu-

Outcome:	*Constituency Labour Voteshare 1931*				*Individual Support for Labour 83-97*			
Mediator:	*% Employed in Manufacturing + Mining*				*Both Parents Voted Labour*			
	1.	2.	3.	4.	5.	6.	7.	8.
Mediating Effect (Control)	0.166 [0.1187 , 0.2237]	0.1659 [0.115 , 0.2173]	0.268 [0.1535 , 0.3921]	0.4638 [0.273 , 0.7397]	0.0321 [0.0279 , 0.0366]	0.0272 [0.0214 , 0.0329]	0.0396 [0.0342 , 0.0455]	0.0384 [0.0297 , 0.0465]
Mediating Effect (Treated)	0.195 [0.1591 , 0.2368]	0.1949 [0.1556 , 0.2324]	0.2831 [0.1417 , 0.3534]	0.4957 [0.322 , 0.7586]	0.04 [0.0346 , 0.0455]	0.0343 [0.0272 , 0.0411]	0.0527 [0.0459 , 0.0604]	0.0554 [0.0442 , 0.0674]
Direct Effect (Control)	-0.0396 [-0.0805 , -0.0016]	-0.0404 [-0.0816 , 9e-04]	-0.0437 [-0.1243 , 0.0925]	-0.027 [-0.6043 , 0.4192]	0.0617 [0.0483 , 0.075]	0.0348 [0.0173 , 0.052]	0.0784 [0.0638 , 0.096]	0.0491 [0.0211 , 0.0779]
Direct Effect (Treated)	-0.0107 [-0.0647 , 0.0393]	-0.0114 [-0.064 , 0.0449]	-0.0287 [-0.148 , 0.0829]	0.0053 [-0.8851 , 0.5495]	0.0696 [0.0569 , 0.0822]	0.0419 [0.0247 , 0.0586]	0.0915 [0.0774 , 0.108]	0.0661 [0.0385 , 0.0942]
Total Effect	0.1553 [0.1162 , 0.1885]	0.1545 [0.1205 , 0.1909]	0.2394 [0.1821 , 0.3053]	0.4687 [-0.1912 , 0.958]	0.1017 [0.0876 , 0.1152]	0.0691 [0.0512 , 0.0872]	0.1311 [0.116 , 0.1498]	0.1045 [0.077 , 0.1338]
Model:	ITT	ITT	IV	IV	ITT	ITT	IV	IV
Controls:								
Individual	No	No	No	No	Yes	Yes	Yes	Yes
Geographic	No	Yes	No	Yes	No	Yes	No	Yes
Distance	No	Yes	No	Yes	No	Yes	No	Yes
Economic	No	Yes	No	Yes	No	Yes	No	Yes
Wave FE	No	No	No	No	Yes	Yes	Yes	Yes

Notes: The unit of observation in columns 1-4 is English Parliamentary Constituency. In columns 5-8 it is the individual survey respondent. The dependent variable in columns 1-4 is Labour's vote share. The Dependent variable in columns 5-8 is individual's support for Labour. The mediating variable in columns 1-4 is the proportion of employed individuals working in mining and manufacturing. In columns 5-8 the mediating variable is whether an individual's parents both supported Labour. 95% confidence intervals derived from quasi-Bayesian simulation.

Table 8

tive preferences, migration patterns, cosmopolitanism, or contemporary employment in manufacturing and mining. In contrast, we provide evidence in support of a direct impact of partisanship over the long span. That is, in those places where party systems (and consequently, partisan attachments) and the Industrial Revolution occurred simultaneously, we observe a strong persistent effect of historical coal mining on left-wing support. However, in the absence of this concurrence (in places with long-lasting dictatorships like Spain, Portugal, and Greece or the formerly communist countries of Eastern Europe) we find no contemporary political effect of past access to coal.[18] In all, our results suggest there are deep roots of contemporary political cleavages and demonstrate how conditions at the formation of democratic party systems have substantial lasting influence.

These results have both normative and positive implications. From a normative standpoint the incentive of elected officials to exert effort or behave responsively may be vitiated if partisan identities persist even when the economic and political conditions that fostered them have ceased to be meaningful. That is, if elected officials can rely upon substantial electoral support simply because of partisan attachments and not their own performance whilst in office, it may place limits on the ability of elections to hold politicians accountable, potentially with serious welfare implications. Relatedly, because access to coal resulted in a concentration of left-wing voters, it may introduce normatively undesirable biases into voting systems that, to one degree or another, imperfectly translate individual votes into legislative seats. In first-past-the-post systems, this type of bias is potentially substantial when left parties obtain large "surplus" majorities in these concentrated districts and yet only obtain a single seat. Again, this may lead to a failure of democratic representation where large majorities of voters may prefer left candidates but because of this unintentional gerrymandering, they may be unable to secure legislative majorities.

In a positive sense, and related to this last point, our results help explain the empirical association between first-past-the-post electoral systems and right-wing governments at

[18]We might also add we do not expect our findings to hold as strongly in the United States where, because of a much more advanced rail system, the geography of coal and the geography of industrialization were less markedly coterminous. See O'Brien (1983).

the national level. As such, our findings call into question theoretical models that view voting rules as a fundamental cause of this electoral bias against the left. Instead, our results suggest that electoral systems simply moderate the impact of political geography.

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