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**Green Governments**

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## Green Governments

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# Green Governments

## Abstract

We examine how Green governments influence macroeconomic, education, and environmental outcomes. Our empirical strategy exploits that the Fukushima nuclear disaster in Japan gave rise to an unanticipated change in government in the German state Baden-Wuerttemberg in 2011. The incumbent rightwing government was replaced by a leftwing government led by the Green party. We use the synthetic control method to select control states against which Baden-Wuerttemberg's outcomes can be compared. The results do not suggest that the Green government influenced macroeconomic outcomes. The Green government implemented education policies that caused comprehensive schools to become larger. We find no evidence that the Green government influenced CO2 emissions, particulate matter emissions, or increased energy usage from renewable energies overall. An intriguing result is that the share of wind power usage decreased relative to the estimated counterfactual. Intra-ecological conflicts and realities in public office are likely to have prevented the Green government from implementing drastic policy changes.

JEL-Codes: C330, D720, E650, H700, I210, Q480, Q580.

Keywords: Green governments, partisan politics, synthetic control method, causal effects, Fukushima nuclear disaster, environmental policies, energy policies, renewable energies, comprehensive schools.

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# 1 Introduction

In many industrialized countries, Green parties have enjoyed tremendous electoral success over the last decade as climate change and environmental issues have become more salient. Since 2018, the “Fridays for Future” movements have captured young citizens. Many voters seem to wish for Green parties to be in office and Green governments to change environmental and energy outcomes. A major question is what Green parties do when they are in office. We examine how Green governments influence macroeconomic, education, and environmental outcomes.

We exploit that the Fukushima nuclear disaster in Japan gave rise to an unanticipated change in government in the German state Baden-Wuerttemberg (BW). On March 11, 2011, a tsunami following an earthquake destroyed the Fukushima Daiichi Nuclear Power Plant in Okuma (Japan), Fukushima Prefecture. The Fukushima nuclear accident influenced the state elections in BW on March 27, 2011. For the first time in history, a Green politician became the prime minister of a German state: Winfried Kretschmann became prime minister of the traditionally conservative state BW that had been governed by prime ministers from the conservative Christian Democratic Union (CDU) for 58 years until 2011.

The Green party formed a Green-led coalition with the Social Democratic Party (SPD), which we refer to as Green government for short. Importantly for our empirical strategy, the Fukushima natural disaster hardly changed election outcomes and coalition formation in other German states in 2011, and there has been no other Green prime minister.

The unanticipated change of government provides a unique setting for estimating the causal effect of a Green government on macroeconomic, education, and environmental outcomes. We use the synthetic control (SC) method ([Abadie and Gardeazabal, 2003](#)) to construct a weighted average of other German states (referred to as “synthetic” BW), which measures how outcomes would have evolved in the absence of a Green government. The SC method is well-suited for our purposes. It provides a transparent data-driven approach for selecting control units and safeguards against specification searches. The key insight of the SC method is that a weighted average of controls yields a better approximation of the counterfactual than an individual control unit or an unweighted average of controls as used in classical difference-in-difference (DID) analyses. What is more, unlike DID and other regression-based methods, SC precludes extrapolation beyond the support

of the data by restricting the weights to be non-negative and sum to one.

We investigate three types of outcomes. First, we consider key macroeconomic outcomes such as GDP per capita and unemployment rates. On the one hand, classical partisan theories provide testable hypotheses about how government ideology is expected to influence macroeconomic outcomes. In particular, leftwing governments are expected to increase short-run GDP growth and employment.<sup>1</sup> On the other hand, because there had not been a Green government before the Green government in BW took office, policy uncertainty was pronounced and larger than for many other changes of government. Therefore, the expected effect of a Green government on macroeconomic outcomes is ambiguous. Second, we examine education outcomes and cultural affairs because they have been contested policy fields in the German states for a long time (e.g., Potrafke, 2011). Finally, we investigate environmental and energy outcomes because they are the showcases of Green parties.

Our results do not suggest that the Green government in BW influenced macroeconomic outcomes. The Green government implemented education policies promoting a more integrative school system. We find that these policies drastically increased the number of students in comprehensive schools (*Gesamtschulen*) (including community schools (*Gemeinschaftschulen*) in which students with varying abilities attend the same school). We find no evidence that the Green government influenced CO2 emissions or increased energy usage from renewable energies overall. We find a significant negative effect on the share of brown coal and a positive effect on the share of water energy usage. By contrast, the share of wind power usage decreased relative to the estimated counterfactual.

Intra-ecological conflicts and realities in public office are likely to have prevented the Green government from implementing drastic policy changes. Wind turbines are an important case in point to portray how environmental protection and animal protection conflict. The Green government also needed to handle “not in my backyard” movements, especially since it encouraged direct democracy. Moreover, the Greens in BW did not enjoy broad political majorities in the counties and municipalities. Some political projects, such as expanding wind energy, benefit from support at the local level. Finally, public office requires making compromises. Citizens want to be employed, and an election-motivated

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<sup>1</sup>Green governments have traditionally belonged to the leftwing political camp. However, the partisan theories were developed for traditional party systems in the 1970s and 1980s, mostly ignoring Green governments.

Green government is unlikely to dispel, for example, the car industry that provides many jobs in BW (Mercedes Benz and Porsche are headquartered in BW).

**Contribution to the literature.** We present some of the first causal evidence on how Green governments perform in office. Our study relates to the traditional partisan theories predicting that leftwing governments implement more expansionary economic policies than rightwing governments (Hibbs, 1977; Chappell and Keech, 1986; Alesina, 1987); see Schmidt (1996) and Potrafke (2017, 2018) for surveys. Party-systems have changed drastically over the last decades. The platforms of established conservative and social-democratic parties have converged. As a consequence, new political parties have entered the political arena. Green parties have been represented in parliaments since the 1980s. Traditionally, Green parties have offered leftwing policy positions and belonged to the leftwing political camp.

Identifying causal effects of government ideology on policy outcomes is complicated by reverse causality issues and omitted variables biases (e.g., Potrafke, 2017, 2018). To overcome these challenges, studies since the late 2000s frequently use regression discontinuity designs focusing on close vote margins (e.g., Ferreira and Gyourko, 2009; Gerber and Hopkins, 2011; Fredriksson et al., 2011; Beland, 2015). Alternatively, where available, scholars use instrumental variables strategies (e.g., Lind, 2020). To estimate causal effects, we exploit that the an exogenous shock — the Fukushima nuclear accident — gave rise to an unexpected change in government and use the SC method to estimate causal effects.

Other related studies deal with outcomes of Green parties in government. The previous studies use panel data and report correlations between variables considering Green parties in government or environmental policy positions and outcome variables such as environment protection or CO2-emissions (e.g., Neumayer, 2003; Knill et al., 2010; Cheon and Urpelainen, 2013; Garmann, 2014). We exploit the unexpected change in government in BW to identify the causal effect of a Green government on macroeconomic, education, and environmental outcomes.

Our paper is also related to the fast growing literature that uses SC to estimate causal effects. Examples include: Abadie and Gardeazabal (2003), Kleven et al. (2013), Bohn et al. (2014), Pinotti (2015), Acemoglu et al. (2016), Eliason and Lutz (2018), Cunningham and Shah (2018), Andersson (2019), Peri and Yassenov (2019), and Potrafke et al. (2020).

## 2 The Fukushima disaster and the 2011 election

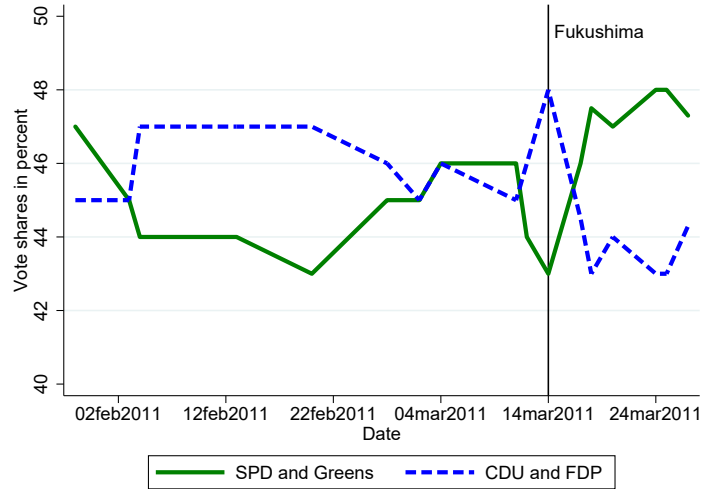
The 2011 state election in BW was historic. The conservative CDU set the prime minister for 58 years. The CDU had absolute majorities and formed single-party governments from 1972 to 1992. Before 1972 and after 1992, the CDU formed coalition governments either with the social-democratic SPD or the market-oriented FDP. The CDU had been the predominant party in BW for decades and enjoyed very comfortable political majorities. State elections take place every five years. The party vote shares of the state election on March 26, 2006 were: CDU 44.2%, FDP 10.7%, SPD 25.2%, and Greens 11.7%. The CDU and the FDP formed a rightwing coalition government since June 14, 2006. Even a year before the 2011 state election, which we examine, the CDU and FDP had a comfortable majority. Polls from February 18, 2010 were: CDU 43%, FDP 11%, SPD 20% and Greens 17% (infratest dimap). We return to an important event in February 2010 below.

The conservative CDU lost the election in 2011 against the Greens and the social-democratic SPD. What was more, for the first time in history, a green politician — Winfried Kretschmann — became prime minister of a German state. There were many reasons for the outcome of the 2011 election but, importantly for our research design, the Fukushima accident tipped the scales. The electorates of the catch-all parties CDU and SPD eroded. The established parties CDU, SPD, and FDP lost votes, and the Green party drastically increased its vote share. Voter turnout increased from 55.5% in 2006 to 66.8% in 2011. In particular, the Green party attracted votes from citizens who did not participate in previous elections (Haas, 2013).

The incumbent CDU/FDP-government lost support in the polls in the year 2010 for two important reasons. First, the then CDU/FDP-governments initiated the reconstruction of the main station in the state’s capital Stuttgart (Stuttgart 21). The electorate was quite divided regarding the reconstruction of the main station. Rightwing voters were in favor of converting the terminal into an underground through station. Plans on how to reconstruct the main station have been discussed since 1985 (Wagschal and Wehner, 2013). The state parliament approved the plan for Stuttgart 21 in 2006, a referendum against the plans was denied in 2007, and constructions started in 2010. The expected costs for the project were around 2.5 billion Euros in 1995 and more than 4 billion Euros in 2010 (some 7.7 billion Euros in the year 2018). Citizens protested against the constructions. Violence escalated at the protests on September 30, 2010. There were conciliations in fall 2010,



Figure 1: Election polls



*Sources:* infratest dimap, emnid, Forsa, Forschungsgruppe Wahlen, and own calculations. The latest poll that was started before the Fukushima disaster predicted: CDU 42%, FDP 6%, SPD 22% and the Greens 21% (infratest dimap, published on March 14, polled March 10-12). The rightwing camp was in front by 48% to 43% (blue-dashed line in the figure). The Fukushima nuclear disaster in Japan occurred on March 11. Things changed in the next poll that was also conducted by infratest dimap, published on March 17, polled March 14-17: CDU 39%, FDP 5.5%, SPD 22% and the Greens 24%.

including temporary building freezes. Stuttgart 21 influenced the 2011 state election — the CDU lost popularity and the Greens benefited. In November 2011, a referendum on whether the state government should withdraw from the project did, however, not receive a majority.

Second, the CDU replaced the prime minister in February 2010. Stefan Mappus succeeded Günther Oettinger. Stefan Mappus was an unpopular incumbent (e.g., [Wehner, 2013](#)). His platforms on energy policy helped to make the Fukushima accident a game-changer. In September 2010, the federal government decided to extend the run-time of Germany’s nuclear power plants. The decision of the conservative/market-oriented CDU/CSU/FDP government was made against the votes of the leftwing opposition in the German parliament. A prominent proponent was Stefan Mappus, who was in favor of nuclear energy and advocated the “out of the nuclear phase-out”. However, after the Fukushima accident, the federal government changed its position on nuclear energy and promoted nuclear phase-outs. Stefan Mappus faced a dilemma. German citizens and the federal government turned away from nuclear energy, the type of energy he had been supporting for a long time. He eventually gave in and advocated the phase-out of nuclear energy, losing credibility.

Figure 1 shows polls for the four major political parties before the 2011 state elec-

tion. We use data from the four leading pollsters: infratest dimap, emnid, Forsa, and Forschungsgruppe Wahlen. The polls differ by some percentage points across the individual pollsters, even when citizens have been polled in very similar time intervals. It is conceivable that pollsters have some political alignments. Therefore, Figure 1 shows all polls from the four leading pollsters in chronological order. In January 2011, the vote share of the Greens was predicted to be 27%. The Greens and the SPD had a majority in the polls in January 2011. Clearly, the Greens and the SPD would have taken any opportunity to form a coalition. The conservative CDU was the predominant party and governed BW for 58 years. A change of government — a leftwing coalition removing the conservative CDU from office — would have been a historic event.

The popularity of the Greens declined in February 2011. Support for the reconstruction of the main station in the state’s capital Stuttgart (Stuttgart 21) increased and was now supported by 43% of the respondents of a representative survey (40% in November 2010) and not supported by 35% (39% in November 2010) (*SWR Aktuell*, 2011). The conciliations that took place in the late fall and the arbitration award by Heiner Geissler (a retired CDU politician) in December 2010 influenced parties’ popularity. The CDU managed to portray the Greens as a destructive party that is opposing everything (*Zeit Online*, 2011). Representative surveys showed, for example, that Stuttgart 21 was perceived as being less important than education policies (*SWR Aktuell*, 2011). The CDU was also perceived as being by far the most competent party regarding economic policies. In a representative survey, citizens were asked which party is the most competent one regarding economic policies. The results were: CDU 42%, SPD 11%, Greens 6%, FDP 3%, no party 20%, do not know 18% (*Forschungsgruppe Wahlen*, 2011). The overwhelming success of the Greens in the polls and the surprisingly poor performance of the CDU in the fall/winter 2010 seemed to be exaggerated. When it got serious before the election in 2011, the traditionally conservative electorate in BW returned to support the conservative incumbent government.

The predicted vote share of the Greens decreased to 19% at the beginning of March 2011; the polls were published on March 2 and related to surveys conducted during February 21–25. The latest poll that was started before the Fukushima disaster predicted: CDU 42%, FDP 6%, SPD 22%, and the Greens 21% (infratest dimap, published on March 14, polled March 10–12). The rightwing camp was in front by 48% to 43%. The Fukushima

nuclear disaster in Japan occurred on March 11. Things changed in the next poll that was also conducted by infratest dimap, published on March 17 (polled March 14–17): CDU 39%, FDP 5.5%, SPD 22%, and the Greens 24%. The vote share of the CDU decreased by three percentage points, the vote share of the Greens increased by three percentage points. The two latest polls before the elections polled by Forsa and emnid reported that the vote shares of the leftwing camp were five percentage points higher than the vote shares of the rightwing camp (48% to 43%). The CDU received 38%, the Greens 24% and 25%. The predicted vote shares of the SPD hardly changed. The Fukushima disaster gave rise to decreasing predicted vote shares of the conservative CDU and increasing predicted vote shares of the Greens. After the Fukushima disaster, the vote shares of the Greens and the SPD were on average 5 percentage points higher than the vote shares of the CDU and FDP. The state election took place on March 27. The change of power was sealed. Vote shares were: CDU 39%, FDP 5.3%, SPD 23.1%, and the Greens 24.2%.

The Green party formed a coalition with the SPD. The coalition agreement was entitled “The change begins”.<sup>2</sup> Winfried Kretschmann became prime minister on May 12, 2011. The cabinet included the prime minister Kretschmann and twelve ministers: seven SPD ministers and five Green ministers (see Table 6 for details). The SPD had more ministers than the Greens because Kretschmann became prime minister. In any event, two Green secretaries of state were also members of the government and were entitled to vote in the government. The Greens therefore had a majority in the government (eight Greens against seven SPD politicians). They also had one more seat than the SPD in the state parliament. Thus, the Greens were the dominant force in the state government. Kretschmann was Germany’s first-ever Green prime minister — a major achievement for the Green party. Nils Schmidt, the chairman of the SPD, became the deputy prime minister and was heading a new “super-ministry” for public finance and economic affairs. The SPD minister Gabriele Warminski-Leitheusser was heading the ministry for education, youth, and sports; she was replaced by the SPD minister Andreas Stoch in January 2013. The Green minister Franz Untersteller was heading the ministry for the environment, climate protection, and energy — a key ministry for the Green party.

International media reported on how Fukushima tipped the scales. For example, the New York Times and the British Guardian headlined “Merkel loses key German state on

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<sup>2</sup>On party platforms, see Appendix A.

nuclear fears” (Dempsey, 2011) and “German Greens hail state victory in vote overshadowed by Fukushima” (Pidd, 2011). The Australian Sydney Morning Herald headlined “German Greens on Fukushima high” and explained “A Green-led alliance with the Social Democrats won a four-seat majority in the state parliament of the southern state of Baden-Wurttemberg in a direct response to the Fukushima nuclear crisis” (Totaro, 2011).

### 3 Empirical strategy

#### 3.1 The synthetic control method

We use the SC method (Abadie and Gardeazabal, 2003; Abadie et al., 2010, 2015; Abadie, 2019) to estimate the causal effect of the change in government in BW on economic outcomes.

Let  $j$  index German states and  $t$  index time periods. The value  $j = 1$  corresponds to BW and  $j = 2, \dots, J + 1$  index  $J$  other German states that serve as controls. Let  $Y_{jt}$  be the observed outcome of state  $j$  in period  $t$ ; see Section 3.3 for a description of the outcomes of interest. We adopt the potential outcomes framework (Neyman, 1923; Rubin, 1974). Let  $Y_{jt}^N$  and  $Y_{jt}^I$  denote the potential outcomes without and with the treatment.<sup>3</sup> In our context, the “treatment” is having a Green government. BW is untreated for  $t \leq T_0$  and treated for  $t > T_0$ . The control states remain untreated for all periods. Thus, observed outcomes are related to potential outcomes as  $Y_{jt} = D_{jt}Y_{jt}^I + (1 - D_{jt})Y_{jt}^N$ , where  $D_{jt} = 1\{j = 1, t > T_0\}$ . The new Green government took office on May 12, 2011. We therefore consider the year 2011 as the first treatment period such that  $T_0 = 2010$ . Doing so follows studies on partisan politics which assign a year in which a government changes to the government that was in power for at least six months (Potrafke, 2017). We examine data until 2015 because the next state election took place in March 2016. The Greens won the 2016 state elections and formed a coalition government with the conservative CDU.

We are interested in the causal effect of the change in government in BW after 2010:

$$\alpha_t = Y_{1t}^I - Y_{1t}^N, \quad t \in \{2011, 2012, 2013, 2014, 2015\}$$

Note that  $Y_{1t}^I$  (the potential outcome with a Green government) is observed in the post treatment period, whereas  $Y_{1t}^N$  (the potential outcome without a Green government) is

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<sup>3</sup>The superscript  $N$  stands for “no intervention”; the superscript  $I$  stands for “intervention”.

fundamentally unobserved. In other words,

$$\alpha_t = Y_{1t}^I - Y_{1t}^N = Y_{1t} - Y_{1t}^N.$$

To estimate  $\alpha_t$ , we need to estimate  $Y_{1t}^N$ . We consider the following SC estimator:

$$\hat{Y}_{1t}^N = \sum_{j=2}^{J+1} \hat{w}_j Y_{jt}^N = \sum_{j=2}^{J+1} \hat{w}_j Y_{jt}, \quad (1)$$

where the second equality follows because  $Y_{jt}^N = Y_{jt}$  for  $j \geq 2$  and all  $t$  since the control states are untreated. In equation (1), we approximate the potential outcome of BW using a weighted combination of the contemporaneous (potential) outcomes of the other German states. We refer to this weighted combination as “synthetic BW”.

We estimate the weights based on the pre-treatment data. Let  $X_1, \dots, X_{J+1}$  denote vectors of predictors and define  $X_0 \equiv [X_2, \dots, X_{J+1}]$ . The weights are obtained as

$$\hat{w} \equiv (\hat{w}_2, \dots, \hat{w}_{J+1}) = \arg \min_w \sqrt{(X_1 - X_0 w)' \Omega (X_1 - X_0 w)} \quad \text{s.t. } w \geq 0 \text{ and } \sum_{j=2}^{J+1} w_j = 1.$$

Here  $\Omega$  is a diagonal matrix of weights. We implement SC using the Stata package `synth`, which computes  $\Omega$  using a data-driven regression-based method. Due to the constraints imposed on the estimation problem,  $\hat{w}$  will typically be a sparse vector (i.e., only contain few non-zero weights), which facilitates the interpretation of the synthetic BW. Moreover, the constraints preclude extrapolation beyond the support of the control data. Different choices of predictors  $X_j$  are possible. To mitigate concerns of specification searching, we follow the recent literature (e.g., [Doudchenko and Imbens, 2016](#)) and use all pre-treatment outcomes and no additional covariates.<sup>4</sup>

To make inferences on  $(\alpha_{2011}, \dots, \alpha_{2015})$ , we use the permutation method proposed of [Abadie et al. \(2010\)](#); see also [Firpo and Possebom \(2018\)](#).<sup>5</sup> The basic idea of this approach is to permute the treatment assignment and to estimate effects for all the control states. We then compare the effects for BW to the distribution of these placebo estimates and deem them significant when they are large relative to the placebo effects. As discussed

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<sup>4</sup>We refer to [Botosaru and Ferman \(2019\)](#) and [Kaul et al. \(2017\)](#) for a discussion on the role of additional covariates in SC settings.

<sup>5</sup>The permutation inference procedure is a finite sample inference approach, conditions on the data, and exploits the randomness in the treatment assignment mechanism; see, for example, [Chernozhukov et al. \(2019a\)](#), [Chernozhukov et al. \(2019b\)](#), and [Li \(2019\)](#) for sampling-based inference approaches.

in [Abadie et al. \(2010\)](#), this method reduces to classical randomization inference if the treatment is randomly assigned. When random assignment fails, it can be interpreted as evaluating significance relative to a benchmark distribution of the assignment process ([Abadie, 2019](#)).

### 3.2 Choice of donor pool

We use other German states to construct the control group (referred to as “donor pool”). BW has been ruled by the conservative CDU for 58 years before treatment. The synthetic BW should thus be based on German states that also had a conservative government for a long time before the change of government in BW. Bavaria is the only state ruled by the conservative CSU (the CDU’s sister party that is only running in Bavaria) before and after treatment in BW. One may, therefore, want to compare BW with Bavaria only. However, for several of our outcomes of interest, the trends between BW and Bavaria are not parallel before treatment such that a simple DID approach using Bavaria as the control group is not suitable (see, for example, [Appendix B](#)). This motivates the use of the SC method based on an extended donor pool. SC exploits that a weighted combination of control units often provides a better approximation to the counterfactual than one single control unit. The SC method is adaptive: whenever Bavaria helps to provide a good approximation to the counterfactual, it will be assigned positive weight and included in the synthetic BW, which is the case for several outcomes of interest. We choose as our donor pool all German states that had the conservative CDU in government, at least for some years during our pre-treatment period based on which we estimate synthetic BW. Our final donor pool includes all other German states except Rhineland-Palatinate.<sup>6</sup>

It is important to ensure that none of the control units is treated. There has been no other Green prime minister in Germany until now, except for Winfried Kretschmann in BW. The Greens do not have as much executive power in any German state as they have in BW.<sup>7</sup> The Fukushima disaster is very likely to have influenced parties’ platforms

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<sup>6</sup>The CDU was ruling in Rhineland-Palatinate until spring 1991, just before our pre-treatment period begins. The SPD won the state elections in spring 1991 and has been ruling in coalitions with the market-oriented FDP and the Greens since 1991.

<sup>7</sup>The Greens have been a junior coalition partner since the 1980s in many German states, but they have never been leading a state government. They were also a junior coalition partner at the national level (e.g., [Zohlnhöfer, 2004](#)).

and governments’ policies in the other German states as well. Only in BW, however, the Fukushima disaster gave rise to a Green government. Consequently, our results should be interpreted as lower bounds on the causal effects measuring how Green governments (our “treatment”) influence outcomes since the synthetic BW also likely became “greener”.<sup>8</sup>

### 3.3 Data and institutional background

Germany has 16 states: ten West German states and six East German states (including Berlin). The German Unification occurred in October 1990. Consequently, data for the East German states are available since the early 1990s.

Macroeconomic variables such as GDP and the number of employees are available since the 1990s for all 16 German states. We use data by the German Statistical Office and its working group Regional Accounts. We use data going back to 1992 and do not consider the year 1991 because data in the year 1991 were heavily influenced by the German unification.

One may also want to examine more fine-grained economic policies that are likely to be directly influenced by government ideology. In particular, the reform of the fiscal constitution in 2006 re-assigned rights and duties between the state governments and the national government. Since 2006, for example, the state governments set the real estate transfer tax rates and design salaries of civil servants. What is more, the German Supreme Court permitted the state governments to charge tuition fees in January 2005. Scholars have examined the correlation between government ideology and the individual policies measures state government have been allowed to design since the mid/late 2000s (e.g., Krause and Potrafke, 2020). SC methods require enough pre-treatment data (e.g., Abadie et al., 2010; Abadie, 2019) and are thus not suitable for investigating these policies for which the pre-treatment period encompasses only four or five years.

German state governments have leeway in designing education outcomes and cultural affairs. Important outcomes are the numbers of students at different types of secondary schools: lower secondary schools, secondary schools, high schools, and comprehensive

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<sup>8</sup>The Fukushima disaster likely affected our outcomes of interest directly. Our application of the SC method requires that this direct effect is the same for BW and synthetic BW. For instance, Ferman (2019) provides conditions under which SC is asymptotically unbiased when the potential outcomes follow a factor model and the treatment assignment is correlated with the factor structure.

schools (including community schools). Leftwing governments such as the Green government in BW tend to favor more inclusivity than rightwing governments and often argue that high ability students should be taught together with lower ability students. Comprehensive schools implement these ideas. Social-democratic parties have advocated such education policies in many countries, and also in BW before the 2011 election. The SPD held the ministry for education after the 2011 election. Before the 2011 election, the Greens in BW advocated collective studying for ten years in an elementary or comprehensive school. They emphasized that communities and society in general should have more power in designing school structures (Busemeyer and Haastert, 2017). We use the number of students in the individual school type. The data are provided by the Standing Conference of the Ministers of Education and Cultural Affairs of the Laender (CMC). Our sample covers the period 1992–2015.

Green governments are especially concerned about environmental outcomes. We therefore employ outcome variables that are related to environmental policies such as CO2 emissions and energy sources such as renewable energies. The data are provided by the State Working Committee for Energy Balances — the agency of the German states that compiles and provides the data of energy balances in the German states. Data are available since the 1990s.

We disentangle primary energy usage by the individual energy sources (each measured as a share of primary energy usage): renewable energies (e.g., wind and solar energy), mineral oil, gas, brown coal, stone coal.<sup>9</sup> We do not consider nuclear energy because the federal government decided to abolish nuclear energy after the Fukushima disaster (cf. Section 2).

We also use data on nature reserves and landscape conservation areas. The data are provided by the Federal Agency for Nature Conservation and available since 2003. We measure the individual variables as a share of a state’s overall area.

Table 7 lists all dependent variables, data sources, and the time period considered based on data availability. The time period considered before treatment thus depends on data availability for the different outcome variables.

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<sup>9</sup>We use temperature adjusted data where available; see Table 7 for more details.



## 4 Results

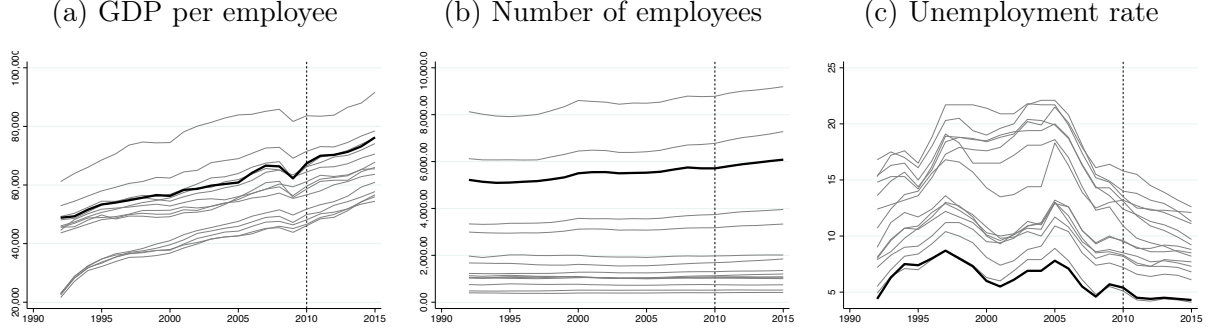
### 4.1 Macroeconomic outcomes

We investigate how the Green government influenced macroeconomic outcomes. Ex ante, the effect of a Green government on macroeconomic outcomes is unclear. On the one hand, the partisan theories suggest that short-run GDP and employment increase when leftwing governments enter office. An important reason is that leftwing governments implement expansionary policies such as increasing public expenditure. The new Green government was advocating a larger size and scope of government than the previous CDU-led governments (Hörisch and Wurster, 2017). One might therefore expect that short-run GDP and employment should increase. On the other hand, the new leftwing government was led by the Greens, and there had not been any other Green state (or national) government before. As a result, political uncertainty was pronounced — citizens and entrepreneurs could only guess what a Green government would do and might have been hesitant in consuming and investing (e.g., Julio and Yook, 2012), which would decrease short-run GDP and employment.

We examine three macroeconomic outcomes as baselines: GDP per employee in Euros, the number of employees, and the unemployment rate. The data are provided by the Research Group on Regional Accounts from the Federal Statistical Office and the Federal Agency of Work. We use data from 1992 to 2015 (treatment occurred in 2011). Appendix C.1 also includes results for compensation per employees (often used as a proxy for labor costs) and gross investments (as a share of GDP).

We first investigate how the macroeconomic outcomes developed in BW compared to the other German states. Figure 2 shows that the levels of macroeconomic outcomes in BW (thick line) are different from the other German states. GDP per employee and employment are higher in BW than in most other German states. BW is a large German state: BW has around 11 million inhabitants and ranks third in population size. North Rhine-Westphalia has around 18 million, Bavaria has around 13 million, and Lower-Saxony has around 8 million inhabitants. Figure 2 further shows that there is some heterogeneity in the time trends before 2011, and that the degree of trend heterogeneity varies across outcomes.

Figure 2: Spaghetti graph: Macro outcomes



Sources: Regional Accounts VGRdL and Federal Agency of Work

Table 1 shows the estimated SC weights for the three macroeconomic outcomes. Bavaria is quite important. It receives weight for two of the three individual dependent variables: 32.1% for GDP per employee and 100% for the unemployment rate.

Table 1: Weights to measure the synthetic BW - Macroeconomic outcomes

	GDP per employee	Number of employees	Unemployment rate
Brandenburg	0	0	0
Berlin	0	0	0
Bavaria	0.321	0	1
Bremen	0	0	0
Hesse	0.356	0	0
Hamburg	0	0	0
Mecklenburg-Pomerania	0	0	0
Lower-Saxony	0.176	0.575	0
North Rhine-Westphalia	0.051	0.404	0
Schlewig-Holstein	0	0	0
Saarland	0.096	0.020	0
Saxony	0	0	0
Saxony-Anhalt	0	0	0
Thuringia	0	0	0

Figures 3–5 present the results of our SC analysis. The left panels show how the individual macroeconomic outcomes developed in BW and synthetic BW. The SC method delivers a high quality of pre-treatment fits between BW and synthetic BW when the gaps between the individual macroeconomic outcomes in BW and the synthetic BW are small before 2011.

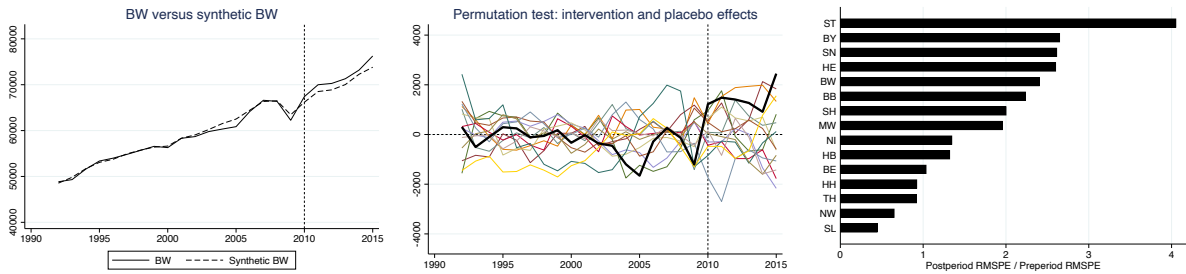
How the Green government influenced the individual macroeconomic outcomes is measured by the gap between the individual macroeconomic outcomes in BW and the synthetic BW after treatment. The left panels of Figures 3–5 suggest that GDP per employee

and the number of employees were somewhat higher in BW than in synthetic BW after treatment. The unemployment rate was hardly higher in BW than in synthetic BW after treatment.

To assess the statistical significance of the results, we rely on the permutation inference approach outlined in Section 3.1. We assign the treatment iteratively to every state in the donor pool. For some control states, the SC method does not deliver good pre-treatment fits. Therefore, we exclude states for which the pre-treatment MSPE (mean squared prediction error) is at least 10 times larger than BW's pre-treatment MSPE. The center panels of Figures 3–5 present the results, allowing for a visual comparison of the gap in BW and the permutation distribution of placebo gaps.

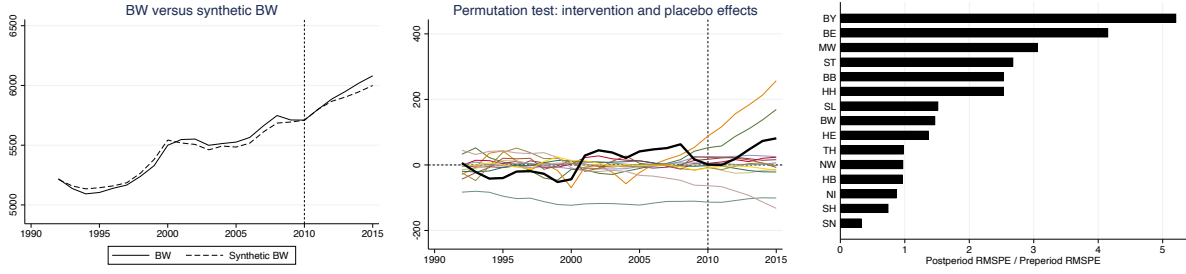
Clearly, the choice of the MSPE cutoff of 10 is arbitrary and one could, for example, also choose 5 or 20 as in [Abadie et al. \(2010\)](#). Therefore, in the right panels of Figures 3–5, we report the ratio of post-treatment root MSPE (RMSPE) to pre-treatment RMSPE, following [Abadie et al. \(2015\)](#). A large ratio of post- and pre-treatment RMSPE is indicative of a true effect. For GDP per capita, the ratio for BW is the fifth highest among all states. The implied permutation  $p$ -value is  $p = (J + 1)^{-1} \sum_{j=1}^{J+1} 1 \{r_j \geq r_1\} = 5/15 = 1/3$ , where  $r_j$  is the ratio of post and pre-treatment RMSPEs for unit  $j$ , and  $j = 1$  indexes BW. Under random assignment of the treatment, this is a valid  $p$ -value for testing the null hypothesis of no effect whatsoever (e.g., [Firpo and Possebom, 2018](#)). For the other outcomes, we also find that the ratio for BW is not among the two largest ratios of the control states such that all permutation  $p$ -values are larger than 0.13. Overall, our results do not suggest that the Green government significantly influenced macroeconomic outcomes.

Figure 3: GDP per employee



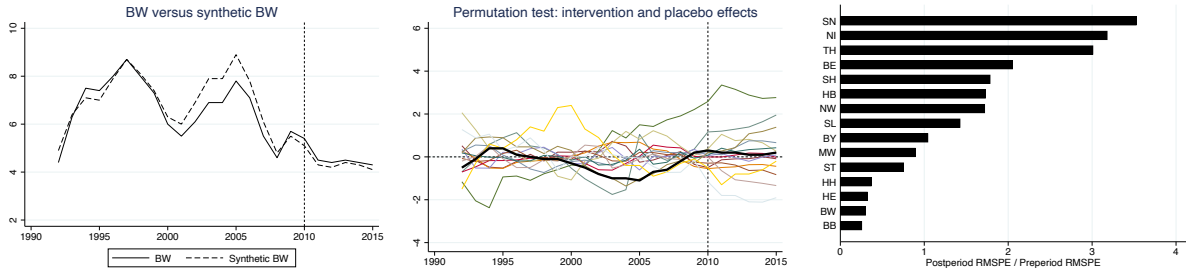
Source: Regional Accounts VGRdL. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

Figure 4: Number of employees



Source: Regional Accounts VGRdL. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

Figure 5: Unemployment rate



Source: Federal Agency of Work. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

German state governments have limited leeway in designing fiscal policies. A great deal of public expenditure is determined by national law. It is still an open question how much of the overall states' budget is discretionary (e.g., [Potrafke, 2011](#)). State governments influence, for example, spending on education, cultural affairs, and inner security (e.g., police forces). The panel data on budget composition provided by the Federal Statistical Office ends in the year 2011, and no suitable expenditure data are currently available (we return to expenditure on cultural affairs in the next section). The national government is in charge of setting major taxes such as the income tax, corporate taxes, and the value added tax. The state governments set real estate transfer tax rates since the year 2006. We do not investigate real estate transfer taxes because the pre-treatment period is too short for applying the SC method.

State governments have had leeway to influence deficits and public debt for a long time. In 2009, the national government introduced a debt brake into the national constitution. The national government's budget needed to be balanced by 2016. The state

governments' budgets needed to be balanced by 2020. The Green government thus had the opportunity to issue new debt, but less so than previous state governments. Neither the CDU-led government until May 2011 nor the Green governments from 2011 to 2020 introduced the debt brake into BW's state constitution.<sup>10</sup> We examine the debt-to-GDP ratio as dependent variable. Data are available since 1992 and are provided by the Federal Statistical Office.

Figure 6 shows that, compared with other German states, BW had quite small debt-to-GDP ratios. Only Bavaria had a smaller debt-to-GDP ratio for most of the pre-treatment period. Trends in debt-to-GDP ratios varied across countries before treatment. The results do not suggest, however, that the Green government influenced the debt-to-GDP ratio (Figure 7).

Figure 6: Spaghetti graph: Public debt (as a share of GDP)

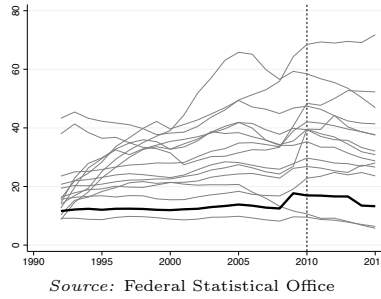
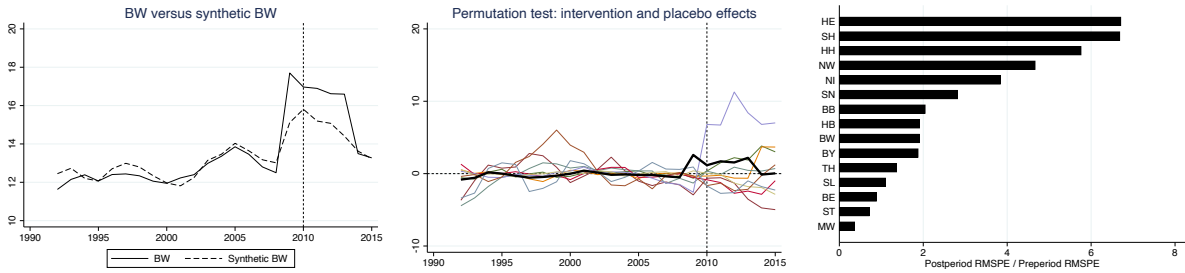


Figure 7: Public debt-to-GDP ratio



Source: Federal Statistical Office Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

<sup>10</sup>By introducing the debt brake into the state's constitution, state governments influence, for example, shadow budgets and exception clauses when natural disasters and extraordinary recessions occur.

## 4.2 Education and spending on cultural affairs

German state governments enjoy quite some leeway in designing education policies and cultural affairs. We examine how the Green government influenced education outcomes and spending on cultural affairs when coming into power.

A major issue is how state governments organize the school system. Ten years of school are mandatory in Germany. Students attend primary school for four years in BW, and must attend secondary school at least for another six years. There were four types of secondary schools: lower secondary school (*Hauptschule*), secondary school (*Realschule*), high school (*Gymnasium*), and comprehensive schools (*Gesamtschule*). Students attend high school for eight or nine years (instead of six years in lower secondary and secondary schools) and receive their high school diploma (*Abitur*) when they graduate. In comprehensive schools, students with varying abilities attend the same school, but are taught in individual classes based on their cognitive abilities and capacities. There are usually three performance levels in comprehensive schools, relating to the performance levels in lower secondary school, secondary school, and high school.

Primary schools gave parents obligatory advice on which type of secondary school parents had to send their children. This advice was based on students' performance in primary school. The Green government abolished the obligatory advice of primary schools for the students' type of secondary school. Doing so was an important education reform that the new Green government implemented (Busemeyer and Haastert, 2017). The Green government was also not comfortable with distinguishing school types based on students' performance and introduced so called community schools (*Gemeinschaftsschulen*). Community schools are attended by students who are advised by primary schools to attend lower secondary school, secondary school, and high school. In community schools, students with varying abilities are taught in the same class. The Standing Conference of the Ministers of Education and Cultural Affairs of the Laender (CMC) subsumes the community schools to be comprehensive schools.

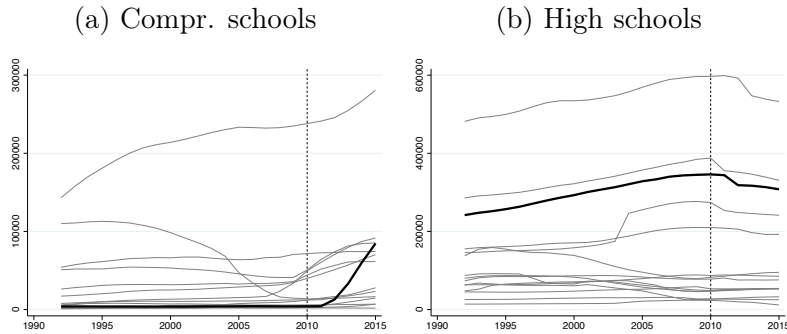
Secondary schools were free to choose whether they wanted to become a community school. The state government provided financial incentives to become a community school. In the school year 2012/2013, there were 42 community schools (starting group). Secondary schools that wanted to become community schools needed to succeed in a two-stage competition. During the two-stage competition, they were evaluated based on

their (1) pedagogical concept, (2) experience in being a full-time school and work with parents, and (3) a letter of intent by the school board. The number of community schools drastically increased. In the school year 2013/2014, for example, there were 89 community schools. Many lower secondary schools and secondary schools became community schools, much less high schools were interested in becoming a community school ([“FAQ zur Gemeinschaftsschule”, 2020](#)).<sup>11</sup>

We examine how the Green government influenced the organization of secondary schools by using the number of students in each individual school type as the dependent variables: lower secondary schools, secondary schools, high schools, and comprehensive schools (including community schools). The data and classification are provided by the CMC.

We discuss results for high schools and comprehensive schools. Results for lower secondary schools and secondary schools are presented in the Appendix C.2. Figure 8 shows that the pre-treatment trends of the outcome variables differed quite a bit across the German states. Therefore, using the SC method as compared to DID is helpful here. Full data over the period 1992–2015 is available for all 14 control states for high schools and 13 control states for comprehensive schools.

Figure 8: Spaghetti graph: Number of students



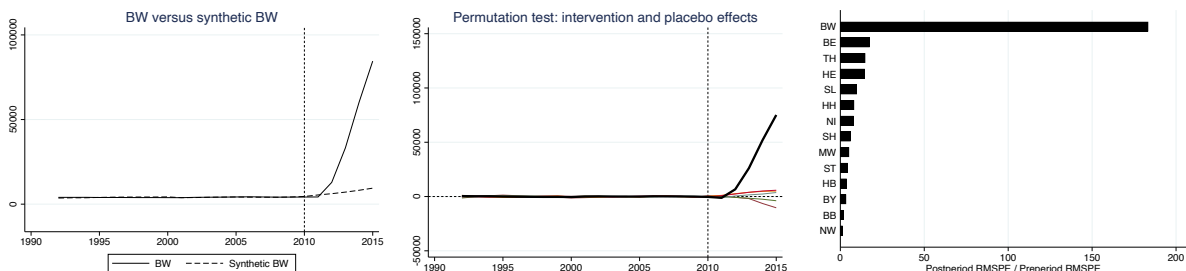
Source: Standing Conference of the Ministers of Education and Cultural Affairs of the Laender

Figure 9 shows that the SC method delivers an excellent quality of pre-treatment

<sup>11</sup>Community schools were also introduced in other German states. Saxony had community schools from the school year 2006/2007 until 2010/2011. Saxony-Anhalt decided in 2012 to introduce community schools beginning with the school year 2013/2014, Berlin had the first pilot phase over the period 2008–2011, Saarland introduced them in 2012/2013, and Schleswig-Holstein converted comprehensive schools to community schools until 2010.

fits between BW and synthetic BW for students at comprehensive schools. The gaps between students in BW and the synthetic BW after treatment are huge. The permutation inference procedure suggests that the gaps between students at comprehensive schools in BW and synthetic BW was the largest among the German states (center panel). The ratio of the post-intervention and the pre-intervention RMSPE is by far the largest in BW compared to the other German states (right panels). The permutation  $p$ -value is  $1/14 = 0.07$  (the smallest possible  $p$ -value). These results suggest that the change of government caused a substantial extension of comprehensive schools, an effect based on introducing community schools.<sup>12</sup>

Figure 9: Number of students in comprehensive schools



Source: Standing Conference of the Ministers of Education and Cultural Affairs of the Laender. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

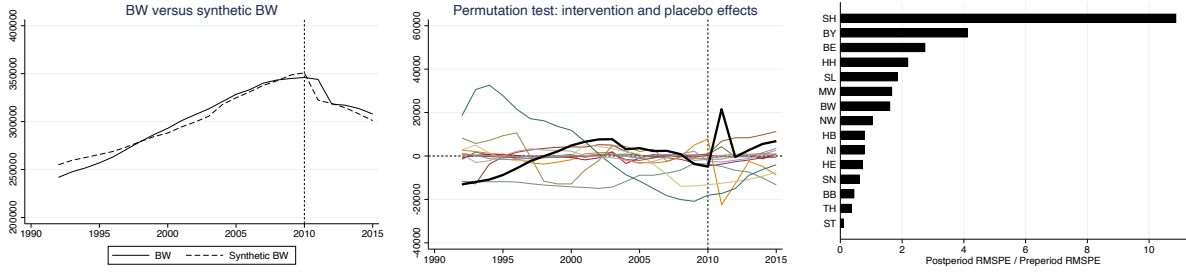
The quality of the pre-treatment fit for students at high schools is somewhat worse than the quality of the pre-treatment fit for students at comprehensive schools (see the left panel in Figure 10). The results suggest that the Green government did not influence the number of students in high schools.<sup>13</sup>

<sup>12</sup>The results for comprehensive schools are robust to standardizing the number of students by the overall population and by the total number of students in each state. Standardizing by the total number of students in each state is problematic because lower secondary and secondary schools have been reformed in some states; students attend primary school in Berlin and Brandenburg for six years, but for four years in the other German states.

<sup>13</sup>The Green government also implemented policies affecting tertiary education, and it would be interesting to examine outcomes such as expenditure for tertiary education (Bartscherer, 2017). However, data on expenditure for tertiary education are currently only available until 2011.



Figure 10: Number of students in high schools

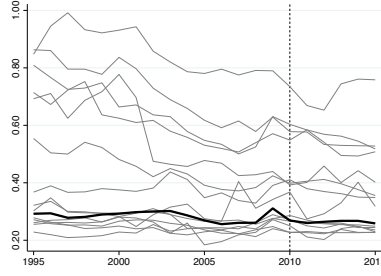


Source: Standing Conference of the Ministers of Education and Cultural Affairs of the Laender. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

German state governments enjoy cultural sovereignty and design cultural policies. The German constitution describes the allocation of rights and duties between the national, state, and local level. Article 30 of the German Constitution describes that the German states are responsible for all issues that are not designed by the national government. Cultural policies are a prime example. The German state governments are in charge of, for example, broadcasting services and the arts (including theatres, operas, exhibitions, etc.).

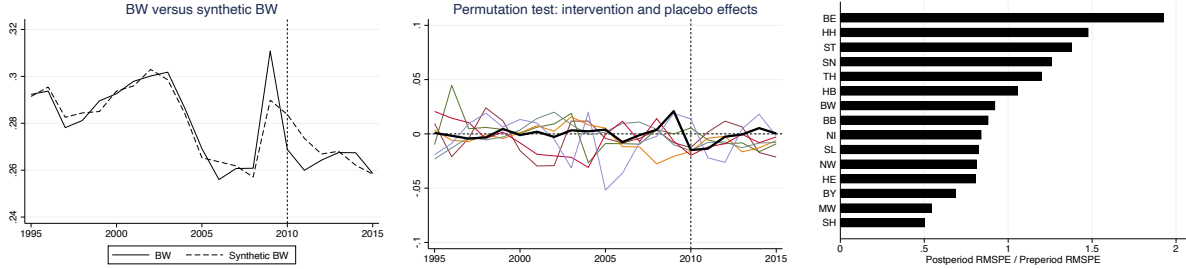
We examine public expenditure on cultural affairs. The data on public expenditure on cultural affairs is compiled by the Federal Statistical Office supported by the national government and the CMC. It is published annually in the fiscal report on cultural affairs (*Kulturfinanzbericht*). We use public expenditure on cultural affairs as a share of states' GDP. The amounts of public expenditure on cultural affairs differ quite a bit across the German states. In 2010, public expenditure on cultural affairs as a share of states' GDP was 0.38% on average, it was just 0.27% in BW and much higher in states such as Berlin (0.58%) and Saxony (0.73%) (see Figure 11). The trends in public expenditure on cultural affairs also differ across the German states before treatment in 2011. The quality of the pre-treatment fit between BW and synthetic BW is good, the year 2009 being an exception (see Figure 12). The results do not suggest that the Green government influenced public expenditure on cultural affairs.

Figure 11: Spaghetti graph: Public expenditure on cultural affairs (share of GDP)



Source: Standing Conference of the Ministers of Education and Cultural Affairs of the Laender

Figure 12: Public expenditure on cultural affairs (share of GDP)



Source: Standing Conference of the Ministers of Education and Cultural Affairs of the Laender. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

### 4.3 Energy and environmental outcomes

German state governments can influence energy and environmental outcomes, for example, by promoting and regulating energy technologies (Wurster, 2017). Promoting includes subsidizing individual energy technologies. The state government subsidizes thermal but not electrical energy. It regulates energy technologies and advertises areas to build wind turbines. State governments also influence the construction of power plants as well as power and gas lines.<sup>14</sup> In BW, the previous CDU-led government landed a political coup in 2010 that helped influencing energy policies a great deal. The CDU-led government repurchased stocks (45.01%) of the major energy provider in BW from the French energy provider Electricite de France. The state government thus possessed opportunities to directly influence energy outcomes (Wurster, 2017). In particular, the Greens held the

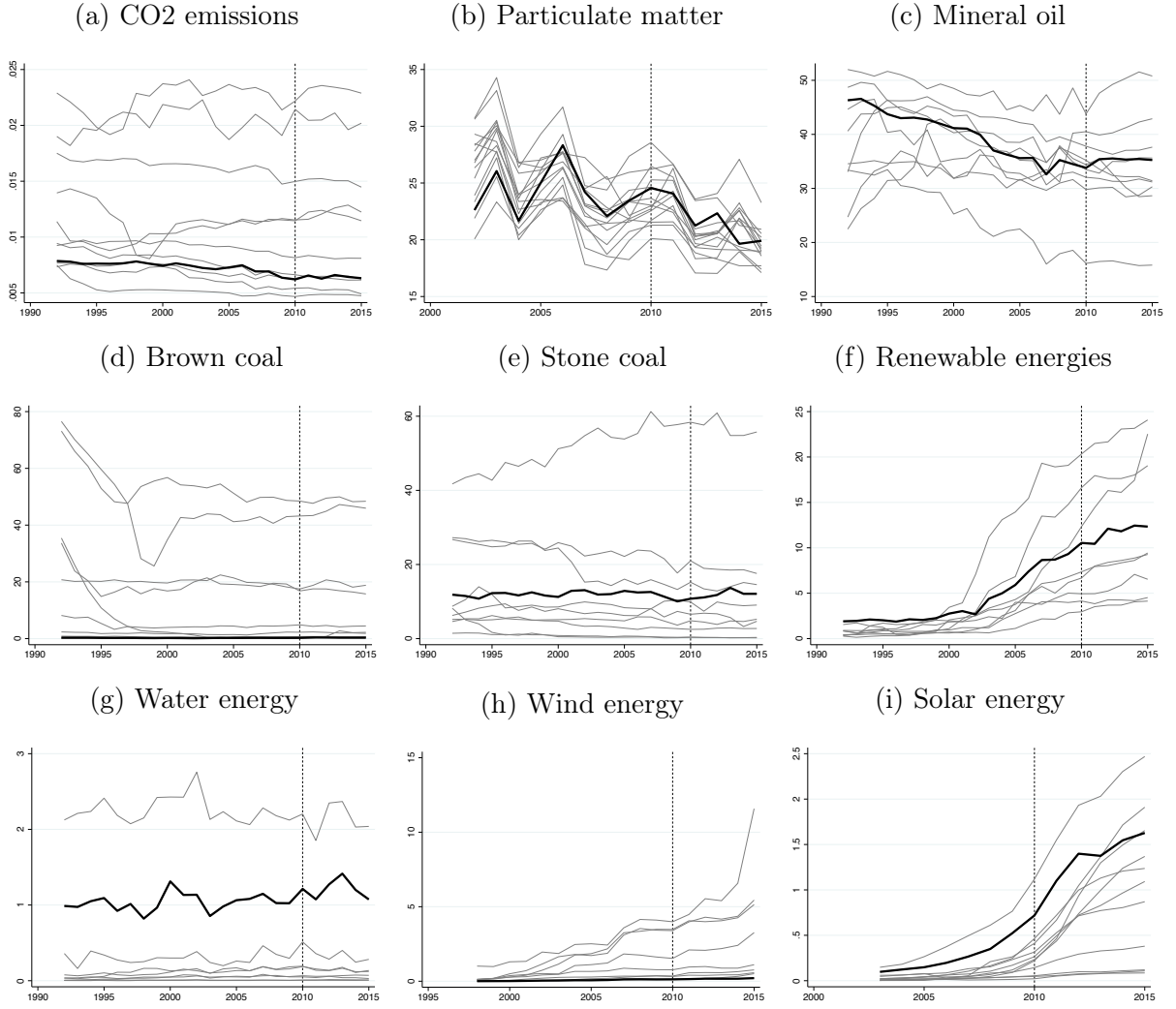
<sup>14</sup>However, these are typically long-term projects, the effects of which are unlikely to materialize within the five-year post-treatment period that we consider.

ministry for Environment, Climate Protection and Energy (cf. Table 6).

Important measures for energy and environmental outcomes include primary energy usage and, of course, by which energy carrier energy is produced. We expect Green governments to use renewable energy carriers to decrease CO2 emissions such as wind energy. Primary energy usage covers the energy content of all energy carriers within a state (industry, traffic, energy consumption of households, etc.) including mineral oil, brown and stone coal, natural gas, nuclear energy, as well as renewable energies such as wind and solar energy.

Figure 13 shows that the pre-treatment trends differ drastically between the states for several key outcomes (e.g., CO2 emissions, particulate matter, mineral oil, water energy, wind energy, and solar energy). The SC method is particularly useful in this context. It allows for choosing a suitable synthetic control unit, which combines information from multiple control states in a transparent and data-driven way.

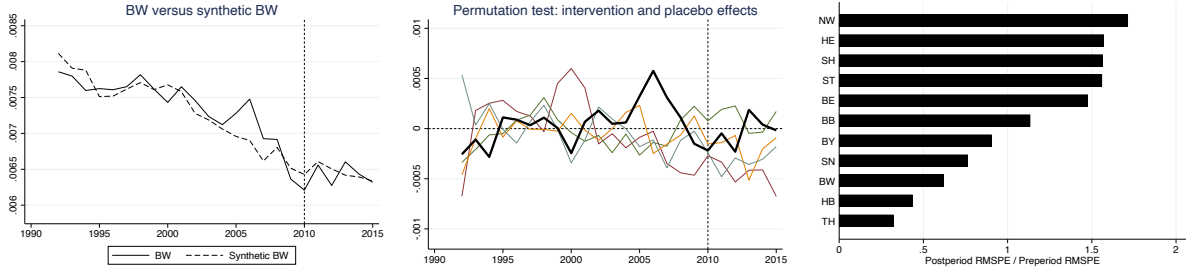
Figure 13: Spaghetti graph: Energy outcomes



Notes: CO2 emissions are measured in 1000t per inhabitant. Particulate matter is measured in micro grams per cubic meter. The energy outcomes are measured as a share of primary energy usage.

We first examine CO2 emissions (as measured in 1000 tons per inhabitant). Figure 14 presents the results. We do not find evidence that the Green government influenced CO2 emissions.

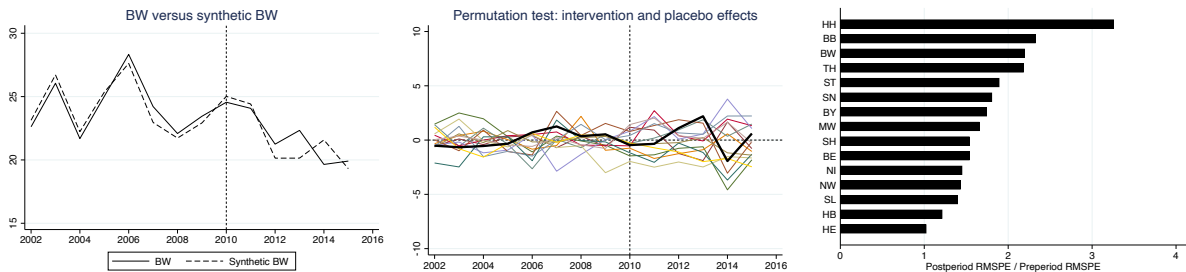
Figure 14: CO2 emissions in 1000 tons per inhabitant



Source: State Working Committee for Energy Balances. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

Particulate matter is another important environmental outcome. Particulate matter is an air pollutant. The main contributors are industries and traffic. Citizens also produce particulate matter by using, for example, wood heaters. Concentration of particulate matter is especially pronounced in agglomerations and cities. The German states run measurement stations for particulate matter.<sup>15</sup> Particulate matter is measured in micro grams per cubic meter. We use the yearly averages of particulate matter per state as the dependent variable. Data is provided by the Federal Environment Agency. The results in Figure 15 do not suggest that the Green government influenced particulate matter.

Figure 15: Particulate matter



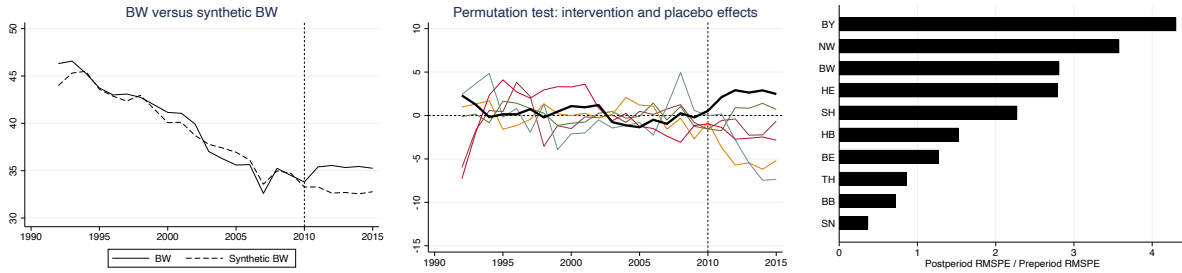
Source: Federal Environment Agency. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

Green governments are expected to decrease overall energy consumption and to resort to “clean” energy sources, i.e., energy sources that do not give rise to high CO2 emissions. We therefore examine whether the Green government increased the share of renewable energies such as wind energies (as a share of primary energy usage) and changed the

<sup>15</sup>The number of measurement stations varies across states and depends on the states' size. In 2015, for example, BW had 22 measurement stations, Berlin had five measurement stations.

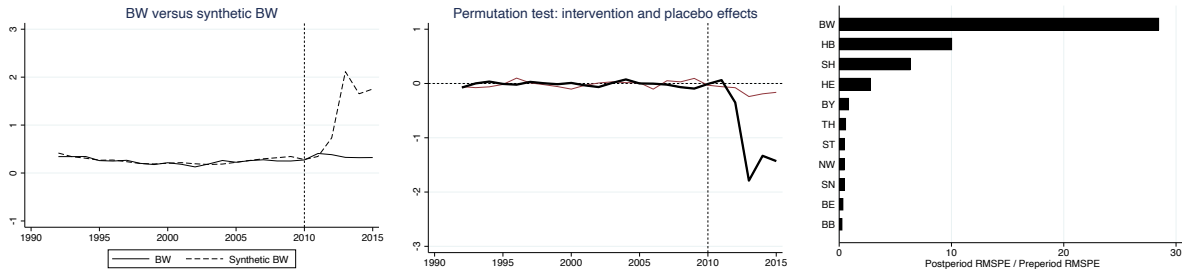
energy mix towards “cleaner” energy sources. In what follows, we examine the individual components of primary energy usage.

Figure 16: Share mineral oil



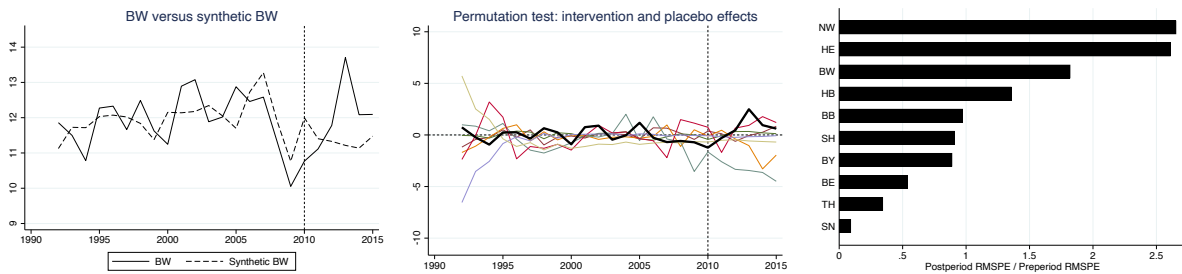
Source: State Working Committee for Energy Balances. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

Figure 17: Share brown coal



Source: State Working Committee for Energy Balances. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

Figure 18: Share stone coal



Source: State Working Committee for Energy Balances. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

Figure 16 shows that the share of mineral oil in BW was similar to the share of mineral oil in the synthetic BW. When the Green government was in office, the share of mineral

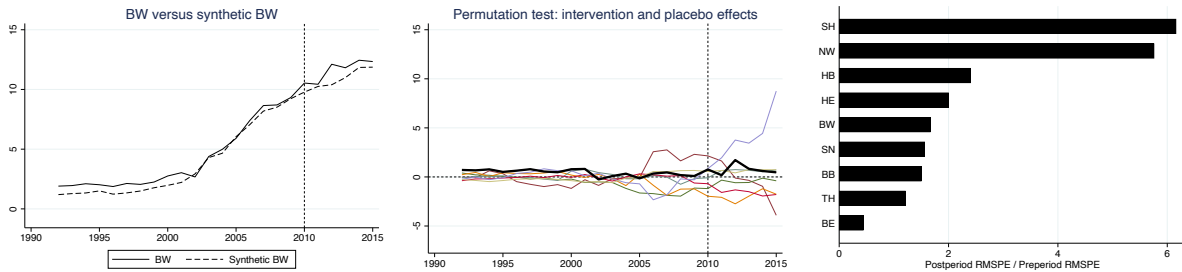
oil in BW increased in 2011 and remained quite constant over the period 2012–2015. The permutation test does not suggest that effect on mineral oil was significant.

The left panel in Figure 17 suggests that the Green government reduced brown coal usage as a share of primary energy usage. The left panel of Figure 17 shows that the share of brown coal in BW developed in a very similar manner as the share of brown coal in synthetic BW before treatment. After treatment the share of brown coal in BW was much smaller than in synthetic BW. The drastic increase in brown coal usage in synthetic BW gives rise to a negative effect since the brown coal usage in BW stayed roughly constant.

Stone coal usage as a share of primary energy usage is much larger (11.1% in 2011). Stone coal energy usage gives rise to high CO<sub>2</sub> emissions. Therefore, the Green government is expected to decrease stone coal usage. However, Figure 18 shows that the Green government even somewhat increased the share of stone coal. The permutation tests do not suggest any significant effect on stone coal.

Renewable energies, measured as a share of primary energy usage, were similar in BW and synthetic BW before treatment (left panel of Figure 19). The permutation inference procedure does not suggest that the Green government influenced the share of renewable energies.

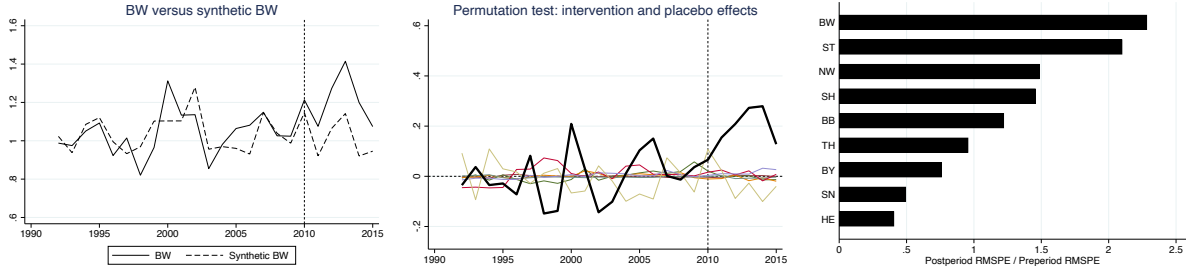
Figure 19: Share renewable energies



Source: State Working Committee for Energy Balances. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

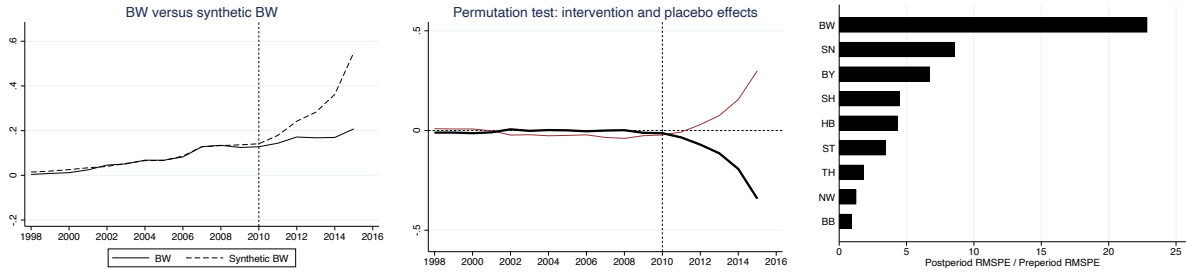
Figure 20 suggests that the Green government increased water power measured as a share of primary energy usage. The pre-treatment fit is, however, rather poor. BW and synthetic BW differ quite a bit before treatment. The ratio between the post-intervention RMSPE and the pre-intervention RMSPE is the largest for BW (2.33), but only a little larger than in Saxony-Anhalt (2.13). These results provide some weak evidence that the Green government increased water energy as a share of primary energy usage.

Figure 20: Share water energy



Source: State Working Committee for Energy Balances. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

Figure 21: Share wind energy



Source: State Working Committee for Energy Balances. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

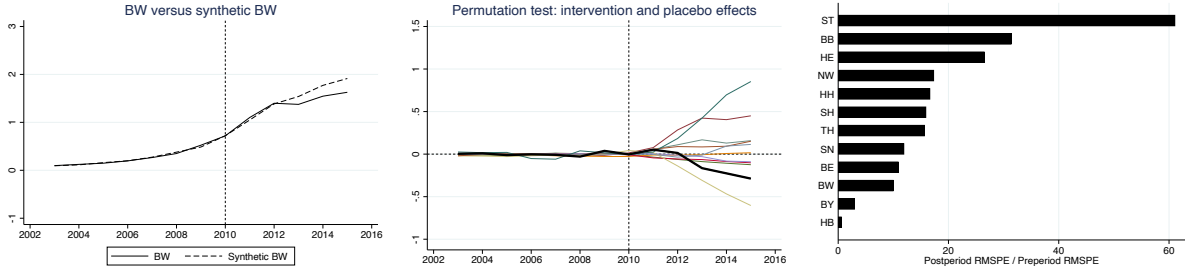
How the Green government influenced wind power is remarkable. The left panel of Figure 21 suggests that the Green government decreased wind power measured as a share of primary energy usage. The effect is based on a larger increase in wind energy usage in synthetic BW than in BW. The ratio between the post-intervention RMSPE and the pre-intervention RMSPE is the largest for BW. Bavaria receives 95% of the weight in designing the synthetic BW. Since the Second World War, Bavaria has been governed by the conservative CSU, which promoted wind power to a much larger extent than the Green government in BW after the Fukushima disaster.

The negative effect on wind energy usage contrasts with expectations one may well have about Green governments. It does corroborate, however, anecdotal evidence about how the Green government influenced wind power in BW (Goetz, 2019). During the election campaign before the elections in March 2011, the Green party promised to increase wind power and to promote direct democracy and public participation. For example, the Green government introduced a new Ministry of State for public participation. As a



result, the Green government needed to handle citizens' action committees (not-in-my-backyard) and trade offs between building wind turbines and preserving natural habitats for animals such as birds. Wind turbines curtail natural habitats for animals. First, they are life-threatening for (migrant) birds. In BW, nature conservation associations were opposing wind turbines because the wind turbines curtail the habitats of bats and red kites. Second, installing and maintaining wind turbines requires cutting down vegetation and curtailing habitats of animals that live on the ground. The Greens had to handle an inner ecological conflict: nature and animal protection versus climate protection (Wurster, 2017). Moreover, the Green state government did not enjoy encompassing political support at the local level and could not exploit local networks. Having Green political majorities in the local and city councils may have helped to expand wind power as well (should the Greens have liked to do so given the intra-ecological conflict).

Figure 22: Share solar energy



Source: State Working Committee for Energy Balances. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

We do not observe significant effects on the share of solar energy (see Figure 22). The left and center panel suggest that share of solar energy decreased under the Green government. The ratio of the post and pre-period RMSPE for BW is, however, not among the largest among all states.

Appendix C.3 presents results for additional energy and environmental outcomes. Our results suggest that the Green government did not significantly influence the usage of gas, biogas, and biomass as measured as a share of primary energy usage. Moreover, we find no evidence that the Green government expanded protected nature reserves and landscape conservation areas (measured as a share of the state's overall area).<sup>16</sup>

<sup>16</sup>The Green government introduced BW's first national park: the Northern Black Forest became a national park in 2014. Because the Northern Black Forest is BW's only national park and other German

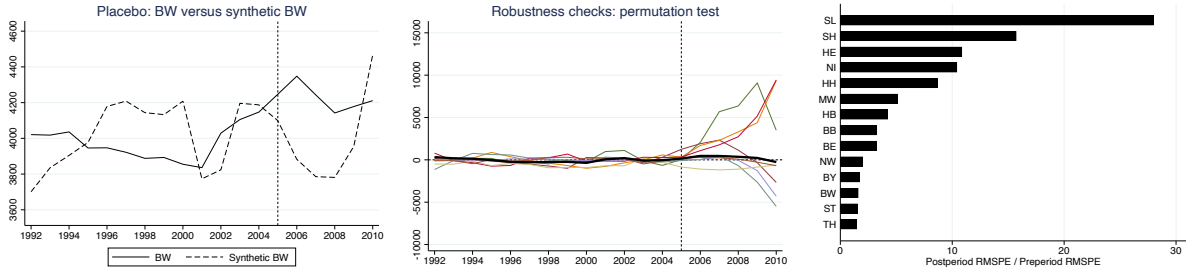
## 5 Robustness and sensitivity analyses

### 5.1 In-time placebo tests

We perform a series of “in-time” placebo tests (e.g., [Abadie et al., 2015](#)). In particular, we shift the treatment from 2011 to 2006 (the year when the last election took place). True effects of the Green government after treatment in the year 2011 would be corroborated by no effects of the placebo treatments in the pre-treatment period.

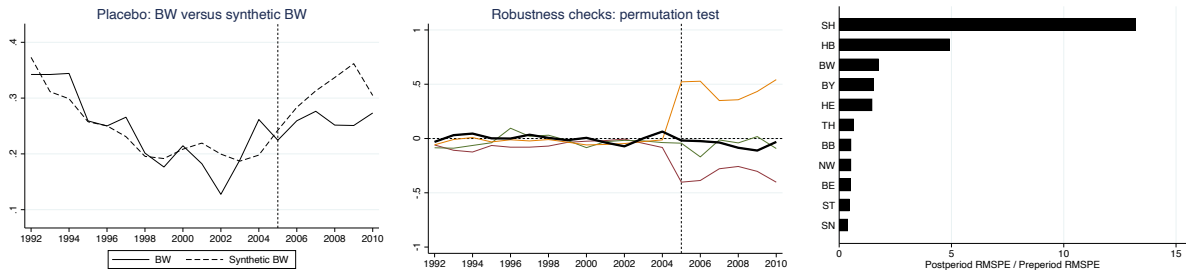
We focus on the four outcomes where the ratio of the post-treatment and the pre-treatment RMSPE for BW is the largest among all states. Figures 23 – 26 show that there is no significant placebo effect for any of the outcomes, which corroborates our main findings.

Figure 23: Students comprehensive schools: placebo treatment in 2006



Source: Standing Conference of the Ministers of Education and Cultural Affairs of the Laender. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW’s pre-treatment MSPE.

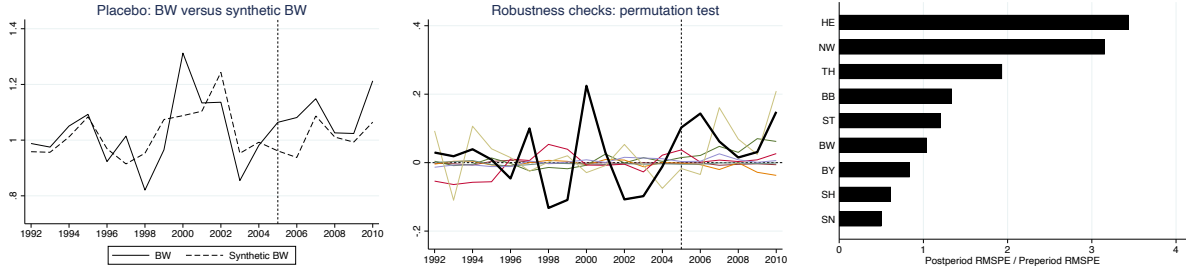
Figure 24: Share brown coal: placebo treatment in 2006



Source: State Working Committee for Energy Balances. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW’s pre-treatment MSPE.

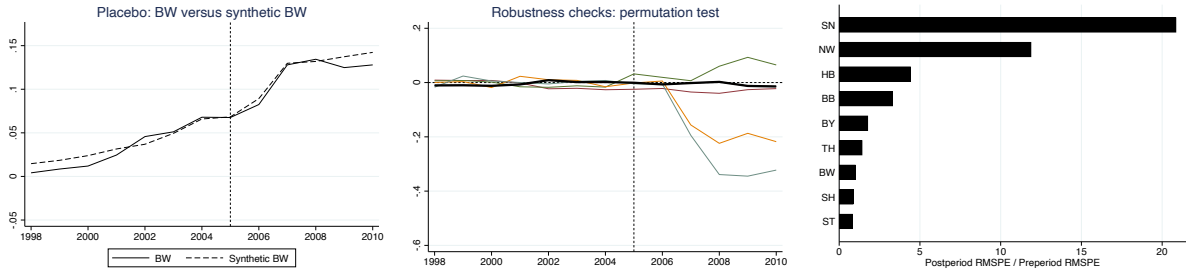
states either have no or just a very few national parks as well, using national parks as an outcome in an SC model is not suitable.

Figure 25: Share water energy: placebo treatment in 2006



Source: State Working Committee for Energy Balances. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

Figure 26: Share wind energy: placebo treatment in 2006



Source: State Working Committee for Energy Balances. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

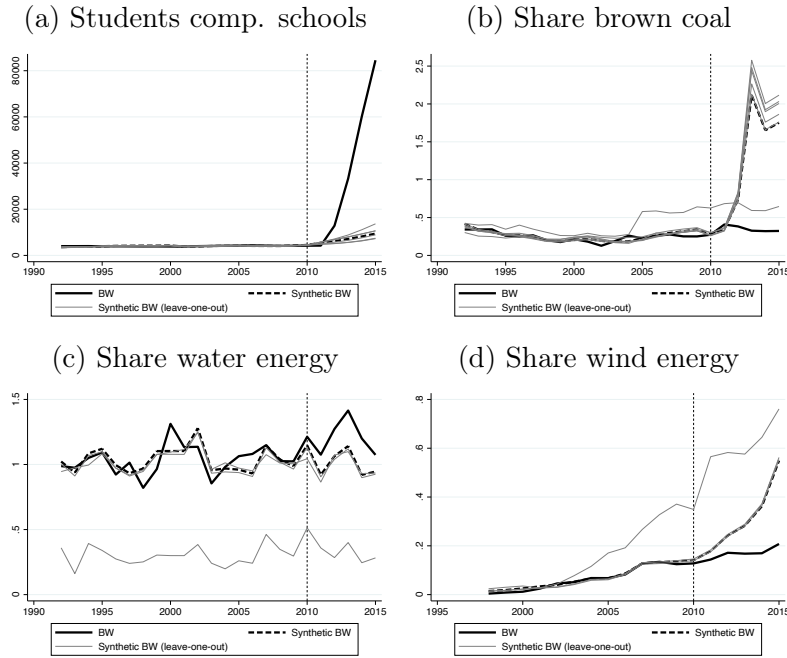
## 5.2 Leave-one-out sensitivity checks

We perform “leave-one-out” sensitivity analyses to examine whether our results are driven by some influential control state (e.g., [Abadie et al., 2015](#)). We iteratively exclude individual states from the donor pool that received positive weight in our SC analysis. Our empirical design features a rather small donor pool consisting of a maximum of 14 states (since we exclude Rhineland-Palatinate from the donor pool). Therefore, removing one control unit is likely to affect the results. Bavaria, in particular, is a very important control unit because Bavaria and BW are quite similar in many respects (low unemployment rates, high GDP, traditionally conservative electorate, etc.). As in Section 5.1, we focus on the outcomes where the ratio of post- and pre-treatment RMSPE for BW is the largest among all states.

Figure 27 presents the results. The findings for students at comprehensive schools do not change when an individual state that received positive weight to measure the synthetic

BW is included or excluded (panel (a)). The results for brown coal usage are driven by an influential control unit. In particular, after excluding Bremen, which receives 70% of the weight in the synthetic BW, the large effect on brown coal usage disappears. Inferences regarding water energy depend on considering Bavaria as control unit (panel (c)), which receives 38% of the weight in synthetic BW. Bavaria is the only state with higher water energy usage than BW. As a result, after excluding Bavaria, SC is no longer able to approximate the level of water energy usage in BW since the constraints on the weights prevent extrapolation beyond the support of the control data. The findings for wind energy also depend on considering Bavaria as control unit (panel (d)). Bavaria receives 95% of the weight in the synthetic BW for wind energy usage. After excluding Bavaria, the pre-treatment fit deteriorates and the effect estimate becomes larger.

Figure 27: Leave-one-out sensitivity



*Sources:* Standing Conference of the Ministers of Education and Cultural Affairs of the Laender and State Working Committee for Energy Balances

## 6 Conclusion

In many industrialized countries, party systems have become more fragmented. Green parties have enjoyed electoral success, benefiting from climate change becoming more salient. Green parties have also been willing to form coalition governments with other established political parties such as social-democratic and christian-democratic parties. Therefore, a major question is which policies Green governments are likely to implement and whether Green governments influence macroeconomic and environmental outcomes.

To investigate how Green governments influence economic outcomes, we exploit that the Fukushima natural disaster in Japan gave rise to an unanticipated change of government in the German state BW. The Green party benefited from the Fukushima-disaster and has set the prime minister in BW since 2011; the first and so far only Green prime minister in Germany. To estimate causal effects, we employ the SC method which provides a transparent and data-driven approach for choosing a suitable control group for BW.

We do not find evidence that the Green government influenced macroeconomic outcomes such as GDP per employee and unemployment rates. The Green government implemented education policies, promoting more inclusive schools. Our results suggest that these policies caused the number of students in comprehensive schools (including community schools) to increase.

An interesting result of our study is that environmental and energy outcomes did not change as one would expect. The Green government did not influence CO<sub>2</sub> emissions and particulate matter or increase energy usage from renewable energies overall. While we find a negative effect on brown coal and a positive effect on water energy usage, the share of wind power usage decreased relative to the estimated counterfactual. Against the background that the Fukushima disaster opened a window of opportunity for changes in environmental and energy outcomes, our results are stark.

An important explanation for our unexpected results is that handling intra-ecological conflicts prevented the Green government from implementing drastic changes in environmental and energy outcomes. Expanding wind power, for example, gives rise to trade-offs. On the one hand, wind power is an alternative energy that decreases the relative energy usage of fossil fuels. On the other hand, wind turbines disfigure the landscape (the Greens in BW encouraged direct democracy and needed to deal with “not in my back

yard” movements), and wind turbines curtail natural habitats of animals such as birds. Intra-ecological conflicts were pronounced, and the Green state government needed to handle those intra-ecological conflicts.

The Greens did not enjoy broad political majorities in the counties and municipalities. Some political projects such as expanding wind energy benefit from support at the local level. The lack of political support across all levels of governments made it difficult for the Green state government in BW to implement more policies that reflect their platforms. When Green political parties continue to enjoy political support and have opportunities to build state capacities, future Green governments may well influence macroeconomic and environmental outcomes to a larger extent than the first Green government in BW.

It is conceivable that being in office renders Green politicians pragmatic. Green politicians have to consider employees’ and employers’ interests that may well contradict ecological ideals. Citizens want to be employed, and incumbents are more likely to be re-elected when the economy is performing well than in recessions.

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# Appendix to *Green governments*

Niklas Potrafke      Kaspar Wüthrich

<b>A Party competition in BW and the other German states</b>	<b>1</b>
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<b>C Results for additional outcome variables</b>	<b>6</b>
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<b>E Additional tables</b>	<b>12</b>

## **A Party competition in BW and the other German states**

One may wonder whether our results are driven by the change in government in 2011 being small because the ideological differences between the previous conservative and the new Green government were small. For example, the Greens in BW also won the 2016 state election and have formed a coalition with the conservative CDU since 2016. Therefore, we portray the individual positions of the political parties in the German states. [Bräuninger et al. \(2020\)](#) measure party platforms of the individual parties in the German states. They distinguish between economic policy positions (e.g., taxation and regulation) and social policies (e.g., immigration and homosexuality). Environmental policy positions are not considered because environmental policy positions have not been included in every manifesto that [Bräuninger et al. \(2020\)](#) examine over the period 1990–2019.

The positions are based on computer-assisted text analyses of manifestos. Computer programs search for individual keywords describing policy positions and count how often they are used and consider contexts. [Bräuninger et al. \(2020\)](#) obtain standardized scores that measure party positions for economic and social policies. Small values of the social policy measure mean that the parties prefer liberal social policies (e.g., advocating immigration and same-sex marriage), large values mean that the parties refer conservative

social policies (e.g., not advocating immigration and promoting traditional family values). In a similar vein, small values of the economic policy measure mean that the parties advocate a large size and scope of government, large values mean that the parties advocate market-oriented economic policies.

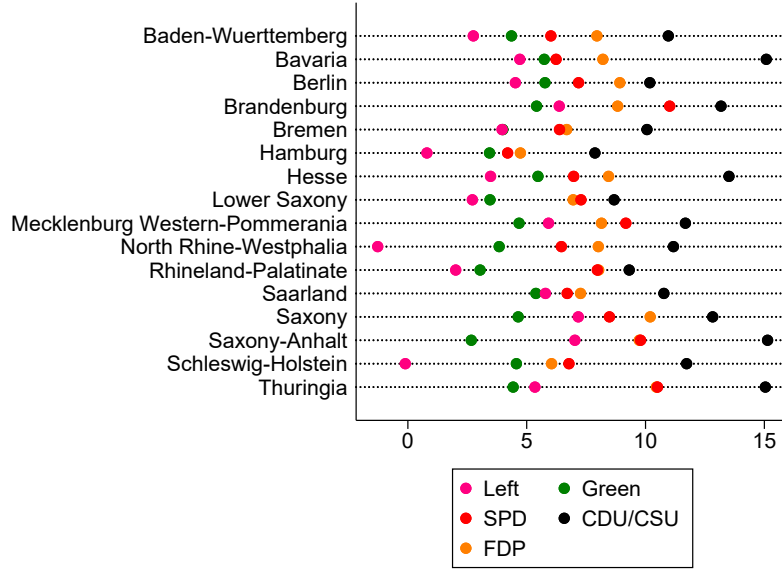
The social policy positions in our sample assume values between -1.27 (the left party in North Rhine-Westphalia) and 15.13 (the CDU in Saxony-Anhalt). The mean and standard deviation are 7.17 and 3.33. The economic policy positions in our sample take values between -0.04 (the left party in North Rhine-Westphalia) and 18.45 (the FDP in Saxony-Anhalt). The mean and standard deviation are 11.23 and 3.74. Our sample covers 2008–2011 and includes one observation per party and state. These data are based on manifestos for state elections that take place every four to five years. We focus on the parties' positions in the year 2011 (when the Green government in BW took office) or earlier if state elections took place in 2010, 2009 or 2008.

We examine party positions of the five major political parties in the year 2011: the Left party, Greens, SPD, CDU, and FDP. The populist rightwing Alternative for Germany (AfD) was founded in the year 2013. Therefore, we do not consider the AfD.

Figure 28 shows that social policy positions differ quite a bit between the political parties in every individual state. In BW, the Greens scored 4.36, and the CDU scored 10.96. These scores are quite comparable, for example, with Schleswig-Holstein, where the Greens scored 4.57, and the CDU scored 11.73. The Greens were somewhat more conservative in Bavaria (5.74), Berlin (5.77), and the Saarland (5.39) than in BW (4.36). The CDU was quite a bit more conservative in Bavaria (15.08), Saxony-Anhalt (15.13), and Thuringia (15.04) than in BW (10.96).

Economic policy positions differed less than social policy positions between the political parties in every individual state (see the economic policy positions in Figure 29). In BW, the Greens scored 9.6, and the CDU scored 12.74, which indicates that the Greens and the CDU agreed more on economic than social policy positions. This is, however, true for many other German states as well. The difference in the economic policy positions between the Greens and the CDU in BW ( $12.74 - 9.6 = 3.14$ ) is, for example, quite similar to the difference between the Greens and the CDU in Berlin ( $11.85 - 8.57 = 3.28$ ). Overall, the differences between the Greens/SPD and the CDU/FDP in BW are comparable to the corresponding differences in the other German states.

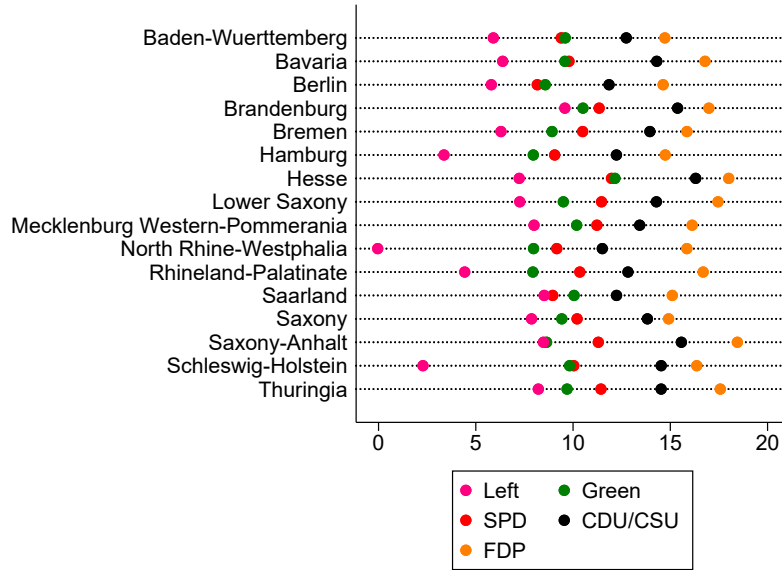
Figure 28: Social policy positions of political parties, state level, 2008–2011



Sources: Bräuninger et al. (2020)

We focus on the manifestos in the year 2011 or the elections before 2011 to relate to issues before the 2011 election in BW as closely as possible. One may be concerned that the results are driven by the public debt crisis that began in the year 2009. They are not. The results regarding policy positions both across and within German states hardly change when manifestos over the period 1990-2019 are considered (Bräuninger et al., 2020).

Figure 29: Economic policy positions of political parties, state level, 2008–2011



Sources: Bräuninger et al. (2020)

One may also want to compare differences in party positions of leftwing and rightwing coalitions and examine benchmark cases. In North Rhine-Westphalia, for example, a leftwing SPD/Green government succeeded a rightwing CDU/FDP government in the year 2010. Comparing the average economic policy position of the previous CDU/FDP government  $((11.50 + 15.85)/2 = 13.68)$  and the succeeding leftwing SPD/Green government  $((9.16 + 7.97)/2 = 8.57)$  yields a difference of  $13.68 - 8.57 = 5.11$ . In BW in 2011, the economic policy position of the previous CDU/FDP government and the succeeding Green/SPD government were  $((12.74 + 14.72)/2 = 13.73)$  and  $((8.58 + 8.16)/2 = 8.37)$ . The difference of  $13.73 - 8.37 = 5.46$  is quite comparable to the difference in North Rhine-Westphalia.<sup>17</sup>

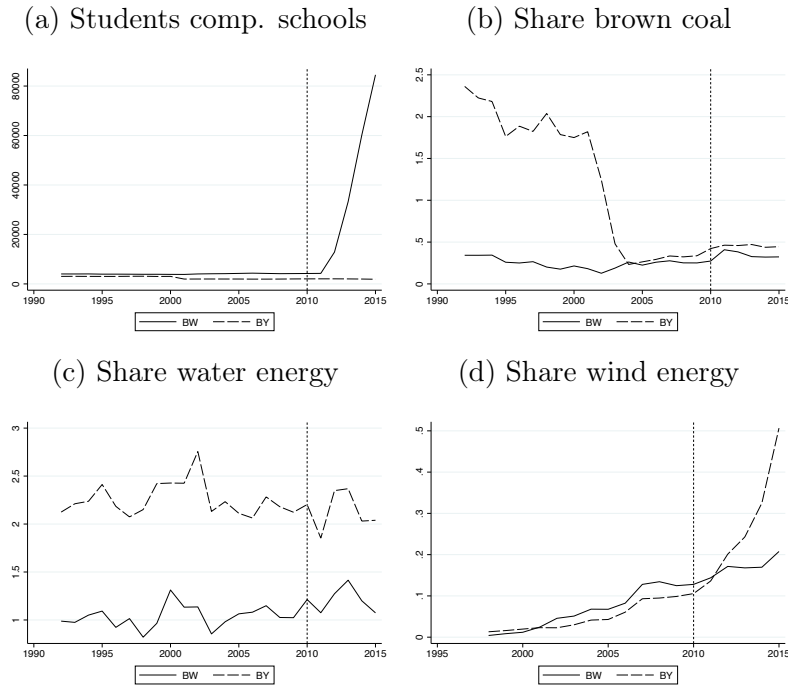
In sum, party competition and changes in government in BW are comparable with party competition in the other German states.

<sup>17</sup>The social policy positions of the CDU/FDP and SPD/Greens governments in North Rhine-Westphalia were  $((11.17 + 8.01)/2 = 9.59)$  and  $((6.46 + 8.34)/2 = 7.40)$ . The difference is  $9.59 - 7.40 = 2.19$ . The social policy positions of the CDU/FDP and the Green/SPD governments in BW were  $((10.96 + 7.95)/2 = 9.46)$  and  $((7.18 + 4.36)/2 = 5.77)$ . The difference is  $9.46 - 5.77 = 3.69$ .

## B Comparison to Bavaria

Figure 30 provides a comparison between BW and Bavaria for the outcomes where BW exhibits the largest ratio of post- and pre-treatment RMSPE.

Figure 30: Comparison with Bavaria



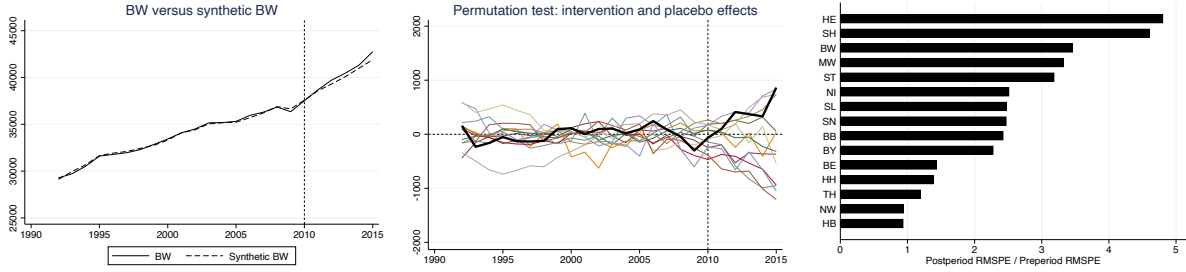
Sources: Standing Conference of the Ministers of Education and Cultural Affairs of the Laender and State Working Committee for Energy Balances



## C Results for additional outcome variables

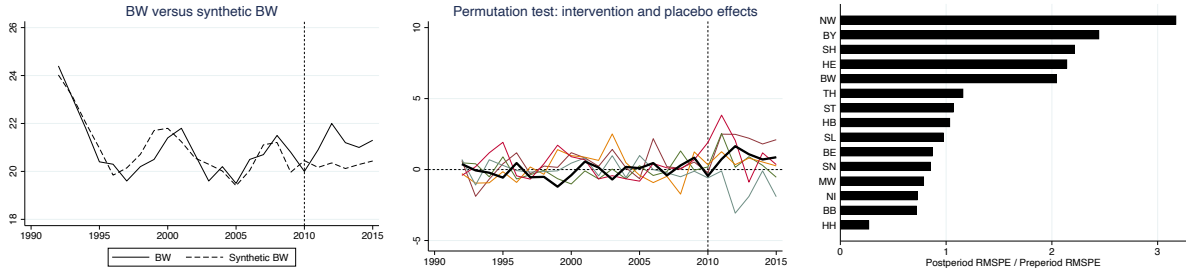
### C.1 Macroeconomic outcomes

Figure 31: Compensation per employee



Source: Regional Accounts VGRdL. Note: The center panel excludes states for which the pre-treatment MSPE (mean squared prediction error) is at least 10 times larger than BW's pre-treatment MSPE.

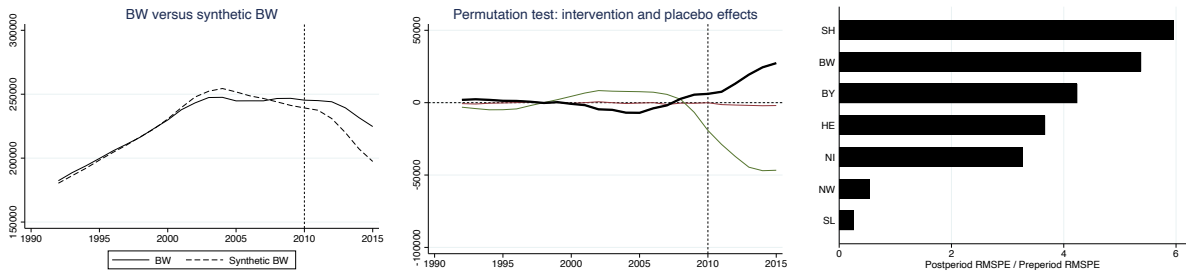
Figure 32: Gross investments as a share of GDP



Source: Regional Accounts VGRdL. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

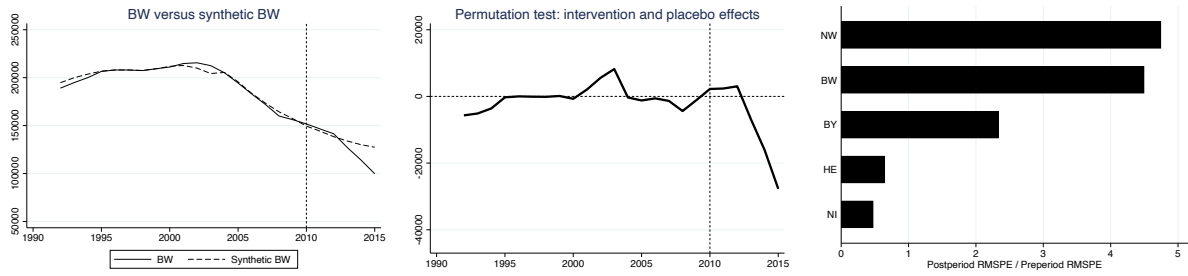
### C.2 Education and cultural outcomes

Figure 33: Number of students in secondary schools



Source: Standing Conference of the Ministers of Education and Cultural Affairs of the Laender. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

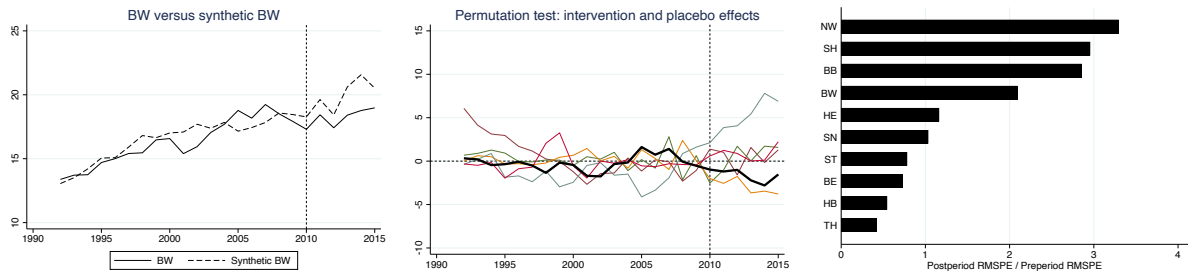
Figure 34: Number of students in lower secondary schools



Sources: Standing Conference of the Ministers of Education and Cultural Affairs of the Laender. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

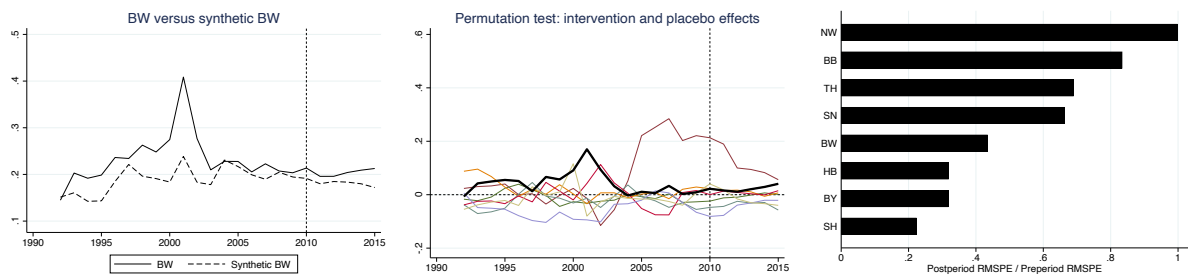
### C.3 Energy and environmental outcomes

Figure 35: Share gas



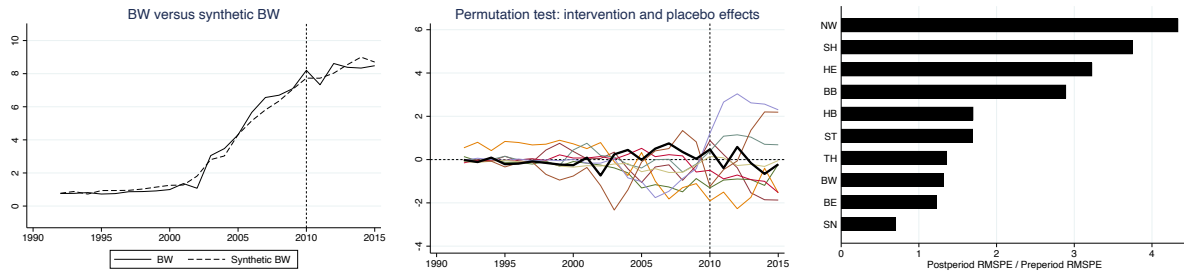
Source: State Working Committee for Energy Balances. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

Figure 36: Share biogas



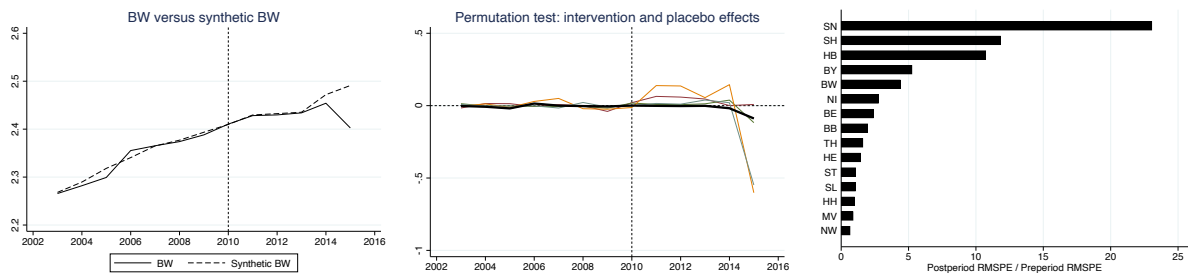
Source: State Working Committee for Energy Balances. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

Figure 37: Share biomass



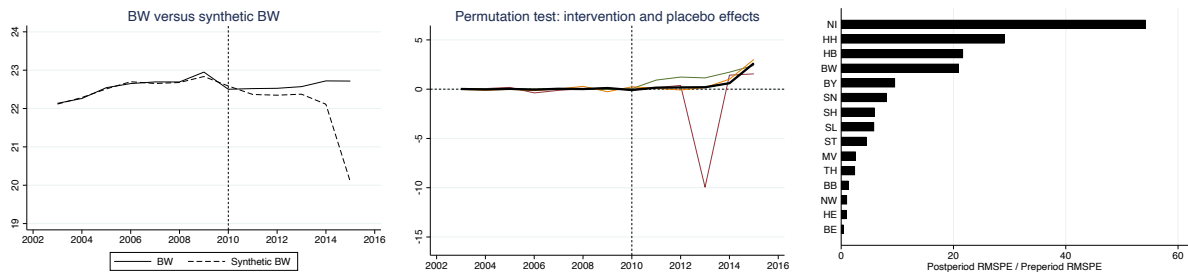
Source: State Working Committee for Energy Balances. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

Figure 38: Nature reserves



Source: Federal Agency for Nature Conservation. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

Figure 39: Landscape conservation areas



Source: Federal Agency for Nature Conservation. Note: The center panel excludes states for which the pre-treatment MSPE is at least 10 times larger than BW's pre-treatment MSPE.

## D Synthetic control weights

Table 2: Weights to measure the synthetic BW - additional macro outcomes

	Compensation per employee	Investments (% of GDP)	Public debt-to-GDP ratio
Brandenburg	0	0	0
Berlin	0	0	0.003
Bavaria	0.279	0.005	0.876
Bremen	0	0.142	0.087
Hesse	0.446	0	0
Hamburg	0	0.266	0
Mecklenburg-Pommerania	0	0	0
Lower-Saxony	0	0.483	0
North Rhine-Westphalia	0	0.021	0.033
Schleswig-Holstein	0	0	0
Saarland	0.275	0	0
Saxony	0	0	0
Saxony-Anhalt	0	0	0
Thuringia	0	0.084	0

Table 3: Weights to measure the synthetic BW – Education outcomes (students and spending on culture)

	Comprehensive schools	High schools	Secondary schools	Lower secondary schools	Spending on culture
Brandenburg	0	0.081			0.042
Berlin	0.019	0			0
Bavaria	0.451	0.836	0.188	0.557	0.147
Bremen	0.036	0			0.138
Hesse	0.011	0	0.268	0.163	0.131
Hamburg	0	0			0
Mecklenburg-Pomerania	0	0			0
Lower-Saxony	0	0.083	0.026	0.279	0.277
North Rhine-Westphalia	0	0	0.519	0	0.232
Schleswig-Holstein	0	0	0		0
Saarland	0	0	0		0.033
Saxony		0			0
Saxony-Anhalt	0.255	0			0
Thuringia	0.228	0			0

Table 4: Weights to measure the synthetic BW - Energy outcomes

	CO2 emissions	Particulate matter	Mineral oil	Brown coall	Stone coal	Renewable energies	Water energy	Wind energy	Solar energy	Gas	Biogas	Biomass
Brandenburg	0	0.655	0	0	0.593	0.229	0	0	0	0.263	0	0
Berlin	0.095	0	0	0.001	0	0	0	0	0	0	0	0
Bavaria	0.330	0	0.527	0.001	0	0	0.380	0.948	0.456	0	0	0
Bremen	0	0	0.179	0.704	0.106	0.629	0	0	0	0.230	0.454	0.555
Hesse	0.330	0	0.064	0.241	0	0	0.026	0	0.184	0.044	0	0
Hamburg	0	0	0	0	0	0	0	0	0	0	0	0
Mecklenburg-Pomerania	0	0	0	0	0	0	0	0	0	0	0	0.082
Lower-Saxony	0	0.067	0	0	0.137	0	0	0.044	0	0	0.546	0
North Rhine-Westphalia	0	0	0.123	0.051	0	0	0	0	0.087	0.464	0	0.005
Schleswig-Holstein	0	0.278	0	0	0.163	0	0	0	0	0	0	0
Saarland	0	0	0	0	0	0	0	0	0	0	0	0
Saxony	0	0	0	0	0	0	0	0.008	0	0	0	0.359
Saxony-Anhalt	0	0	0	0	0	0	0	0	0	0	0	0
Thuringia	0.245	0	0.107	0.003	0	0.141	0.594	0	0.273	0	0	0

## E Additional tables

Table 6: Ministers Cabinet Kretschmann

<b>Name</b>	<b>Ministry</b>	<b>Party</b>
Winfried Kretschmann	Prime Minister	Green
Nils Schmid	Deputy Prime Minister; Finance and Economics	SPD
Silke Krebs	State Ministry	Greens
Reinhold Gall	Interior	SPD
Rainer Stickelberger	Justice	SPD
Gabriele Warminski-Leitheusser (until 01/07/2013) Andreas Stoch (from 01/23/2013)	Education, Youth and Sports	SPD
Theresia Bauer	Science, Research and Culture	Greens
Katrin Altpeter	Labor, Social Affairs, Families, Women and Senior Citizens	SPD
Winfried Hermann	Transport and Infrastructure	Greens
Franz Untersteller	Environment, Climate Protection and Energy	Greens
Alexander Bonde	Rural Affairs and Consumer Protection	Greens
Bilkay Öney	Integration	SPD
Peter Friedrich	Bundesrat, Europe and International Affairs	SPD

Table 7: Dependent variables and data sources

	Data period	Source
GDP per employee	1992-2015	Regional Accounts VGRdL
Number of employees	1992-2015	Regional Accounts VGRdL
Compensation per employee	1992-2015	Regional Accounts VGRdL
Investments (% of GDP)	1992-2015	Regional Accounts VGRdL
Unemployment rate	1992-2015	Federal Agency of Work
Public debt-to-GDP ratio	1992-2015	Federal Statistical Office
Comprehensive schools: students	1992-2015	CMC
High schools: students	1992-2015	CMC
Secondary schools: students	1992-2015	CMC
Lower secondary schools: students	1992-2015	CMC
Public expenditure on cultural affairs (% of GDP)	1995-2015	Federal Statistical Office
CO2 emissions in 1000t per inhabitant*	1992-2015	State Working Committee for Energy Balances
Particulate matter (microgram per cubic meter)	2002-2015	Federal Environment Agency
Mineral oil (% of primary energy usage)*	1992-2015	State Working Committee for Energy Balances
Brown coal (% of primary energy usage)*	1992-2015	State Working Committee for Energy Balances
Stone coal (% of primary energy usage)*	1992-2015	State Working Committee for Energy Balances
Renewable energies (% of primary energy usage)*	1992-2015	State Working Committee for Energy Balances
Water energy (% of primary energy usage)*	1992-2015	State Working Committee for Energy Balances
Wind energy (% of primary energy usage)*	1998-2015	State Working Committee for Energy Balances
Solar energy (% of primary energy usage)	2003-2015	State Working Committee for Energy Balances
Gas (% of primary energy usage)*	1992-2015	State Working Committee for Energy Balances
Biogas (% of primary energy usage)*	1992-2015	State Working Committee for Energy Balances
Biomass (% of primary energy usage)	1992-2015	State Working Committee for Energy Balances
Nature reserves (area in % of state's overall area)	2003-2015	Federal Agency for Nature Conservation
Landscape conservation area (area in % of state's overall area)	2003-2015	Federal Agency for Nature Conservation

Notes: \* means temperature adjusted outcome.