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# The urban–rural gap in healthcare infrastructure: does government ideology matter?

Niklas Potrafke<sup>a</sup> and Felix Roesel<sup>b</sup> 

## ABSTRACT

Spatial inequalities in publicly provided goods such as healthcare facilities have substantial socioeconomic effects. Little is known, however, about why publicly provided goods diverge among urban and rural regions. This study exploits narrow parliamentary majorities in German states between 1950 and 2014 in a regression discontinuity (RD) framework to show that government ideology influences the urban–rural gap in public infrastructure. Left-wing governments relocate hospital beds from rural regions. It is proposed that left-wing governments do so to gratify their more urban constituencies. In turn, spatial inequalities in hospital infrastructure increase, which seems to influence general and infant mortality.

## KEYWORDS

publicly provided goods; spatial inequalities; political business cycles; government ideology; healthcare; hospitals

JEL D72, H42, I18

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## INTRODUCTION


Local differences in the utilization of publicly provided goods such as healthcare facilities influence morbidity and mortality, especially in underutilized rural regions (e.g., Buchmueller, Jacobson, & Wold, 2006; Zhang & Kanbur, 2005). Against the background of well-documented urban–rural inequalities in income and productivity (e.g., Brueckner, Thisse, & Zenou, 1999; Essletzbichler, 2015; Glaeser, 2013; Wei, 2015), very little is known about why governments distribute publicly provided goods differently among urban and rural regions.

We examine the role of government ideology as an as-yet-ignored determinant of spatial inequalities in publicly provided goods. In ageing societies, voters are particularly concerned with the level and spatial distribution of publicly provided goods such as healthcare infrastructure. Politicians would seem to be well advised to provide public goods to gratify the needs of their constituencies that differ across space. Political preferences are correlated with geographical features: left-wing parties receive more electoral support in urban than in rural regions (Chen & Rodden, 2013; Lipset & Rokkan, 1967; Martin & Webster, 2018; Nall, 2015; Rodden, 2010; Scala & Johnson, 2017). Figure 1 shows that this pattern hardly changed over


time: the vote shares of left-wing parties in state elections was larger in cities than rural regions in the 1970s, 1990s and also 2010s. Politicians are well aware of their traditional strongholds and have been shown to gratify the needs of their core supporters, for example, by granting fiscal transfers (e.g., Albouy, 2013; Kauder, Potrafke, & Reischmann, 2016; Levitt & Snyder, 1995). However, there is still no evidence to show how politicians gratify the needs of their core supporters by providing public goods in urban and rural regions, and the subsequent consequences for spatial inequalities.

We investigate how state government ideology influences the scope and the spatial distribution of publicly provided goods. We exploit narrow parliamentary majorities in a panel of German states where state governments have had considerable discretion to design the scope and location of all (both public and private) hospitals and hospital beds in their regional hospital capacity planning since the 1950s. We link self-compiled data measuring the scope and the spatial concentration of hospital infrastructure within the 10 West German states between 1950 and 2014 to state government ideology, which is an outcome of state elections. Regression discontinuity (RD) design results show that government ideology influences the spatial distribution of facilities and, in particular, the urban–rural


## CONTACT

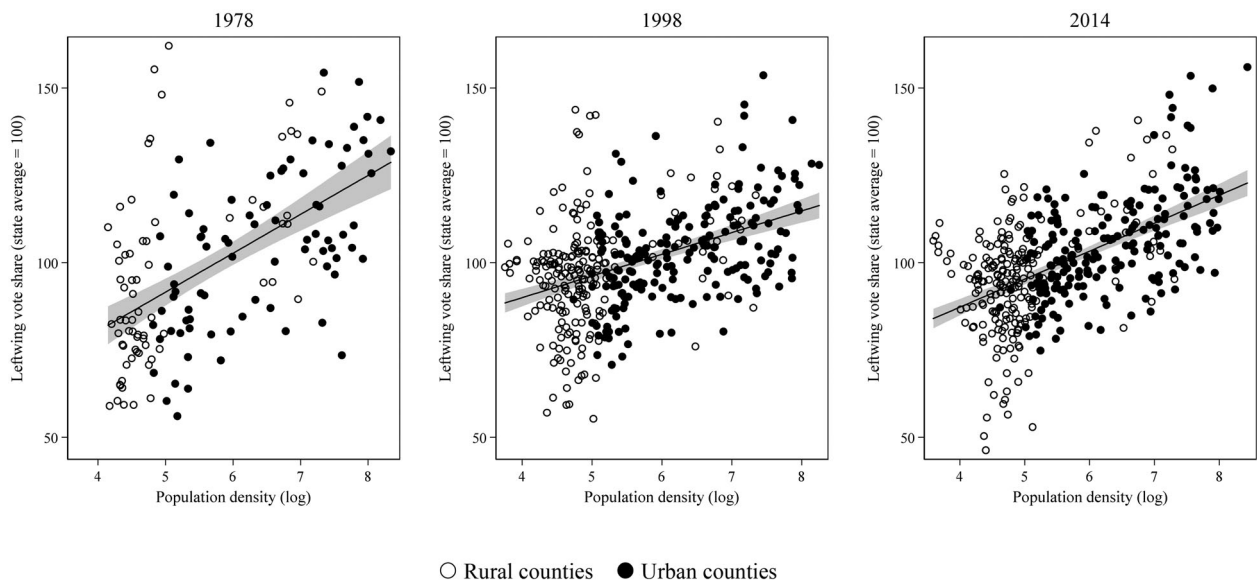
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**Figure 1.** Urbanization and left-wing vote shares in German state elections.

Note: Population density (inhabitants/km<sup>2</sup>; log) is plotted against left-wing vote shares (sum of vote shares for the SPD, Bündnis 90/Die Grünen and Die Linke) in German state elections at the county level. Filled circles represent urban counties; unfilled circles are rural counties according to the classification by German authorities. Because the timing of elections varies across states, we use state elections that are closest to the end of 1978, 1998 and 2014. Left-wing vote shares are normalized by the state average vote share to make the figures comparable across states. For 1978, data are only available for the two largest German states in population terms (North Rhine-Westphalia and Bavaria).

gap in public infrastructure. Left-wing governments shift hospital infrastructure from rural regions to cities. We propose that left-wing governments do so to gratify their more urban constituencies.

## RELATED LITERATURE

This study adds several new aspects to the literature. First, scholars examine the manifold facets of the urban–rural gap. The most prominent example is income per capita, which tends to be higher in cities than in rural regions (Essletzbichler, 2015; Wei, 2015), this being an important reason why cities attract well-educated and productive citizens. The needs of well-educated and productive citizens differ from those of less-educated and less-productive citizens (e.g., cultural activities).<sup>1</sup> Economies of scale explain why many public goods are provided in cities and not rural regions. Public universities require a critical mass of young adults who are willing to study. Hospital infrastructure for individual treatments needs to be provided and requires a critical mass of patients demanding treatments. Well-trained physicians employed in hospitals bring their families, which often demand education and cultural activities and are, in turn, more easily attracted to cities than rural regions. Also, patients' characteristics such as health status or supply-side and structural variables may influence regional differences in the utilization of healthcare services (Finkelstein, Gentzkow, & Williams, 2016; Kopetsch & Schmitz, 2014). The extent to which government ideology influences the urban–rural gap in publicly provided healthcare infrastructure has been ignored to date. We show that government ideology gives rise to spatial differences in the utilization of publicly provided goods.

Second, evidence is limited as to whether left- and right-wing governments differ in designing healthcare policies. The partisan theories describe government ideology as influencing economic policy-making: left-wing governments are expected to implement more expansionary policies than right-wing governments (Alesina, 1987; Chappell & Keech, 1986; Hibbs, 1977; see Potrafke 2017, 2018, for surveys of empirical studies on partisan politics). Left-wing governments may offer encompassing social insurance to attract poorer voters and voters with higher health risks than right-wing governments (De Donder & Hindriks, 2007). However, there are also good reasons to expect right-wing governments to increase the availability of public health services. Right-wing governments receive electoral support especially from the older generation, which is likely to benefit from and to lobby for encompassing healthcare services. Therefore, the effects of government ideology on healthcare policies are a priori unclear. The empirical evidence as to whether government ideology predicts public health expenditure is mixed (Béland & Oloomi, 2017; Brändle & Colombier, 2016; Castro & Martins, 2018; Herwartz & Theilen, 2014; Jensen, 2011; Joshi, 2015; Kousser, 2002; Potrafke, 2010, 2012; Wiese, 2014). Almost all previous studies use health expenditure as the dependent variable.<sup>2</sup> Expenditure describes the overall level of healthcare, but does not reflect the important spatial dimension of healthcare infrastructure. For example, some politicians may prefer fewer but larger hospitals, while others would favour smaller and more densely distributed hospitals in rural regions. Thus, even the same number of hospital beds and expenditures can be distributed in very different ways. We show that left-wing governments shift hospital infrastructure toward

urban regions, whereas right-wing governments prefer hospital infrastructure in more rural regions. This gives rise to spatial inequalities in hospital infrastructure under left-wing governments.

Third, fiscal transfers and public investment expenditure across jurisdictions have been shown to be influenced by political ideology. In Germany, state governments use discretionary fiscal grants to gratify their core supporters in municipalities (Kauder et al., 2016). Another prominent example of ideology-induced fiscal transfers are grants by US federal governments to individual states or electoral districts (Albouy, 2013; Levitt & Snyder, 1995). Federal highway spending is higher in regions with larger Republican than Democratic delegation shares in the House of Representatives. The spending advantage is, however, only present for rural regions with large Republican delegation shares (Goetzke, Hankins, & Hoover, 2019). Also, in Greece, Turkey and Chile, the geographical distribution of public investment expenditure is influenced by political manipulation. In Greece and Turkey, for example, regions with many core supporters are rewarded with public investment expenditure (Lambrinidis, Psycharis, & Rovolis, 2005; Luca & Rodríguez-Pose, 2015; Rodríguez-Pose, Psycharis, & Tselios, 2016). In Chile, the central government grants large amounts of public investment expenditure to regions in which the mayor is politically aligned with the central government (Livert & Gainza, 2018). Previous studies considered how the political alignment of politicians active in different layers of government in federal states (e.g., national and state level or state and local level) and central states (e.g., in central government and in prefectures) influenced spatial inequalities in the granting of transfers and public goods. We focus on how government ideology influences the urban–rural gap in publicly provided goods.

## INSTITUTIONAL BACKGROUND

The German hospital care sector is an excellent long-term laboratory to investigate political economic motives in publicly provided infrastructure. The German constitution of 1949 specifies that the state governments have means to implement hospital policies in Germany. The federal government designs hospital reimbursement schemes for current expenditure (current expenditure is funded by statutory health insurance). State governments, by contrast, decide on hospital infrastructure, regulation and provide hospital capital funds. Important policy measures include, for example, regional hospital capacity planning, allocating funds to hospital investment, running university hospitals and training medical students (Mätzke, 2013; Pilny, 2017).

Hospital capacity planning and capital funding is of particular interest for this study. In hospital plans, state governments decide on the location and the number of hospitals and beds as well as on discretionary funding for all types of ownership. Hospital plans differ a great deal across states regarding the timing of revisions and the level of detail. Some plans even include the precise number of beds for all departments of an individual hospital within

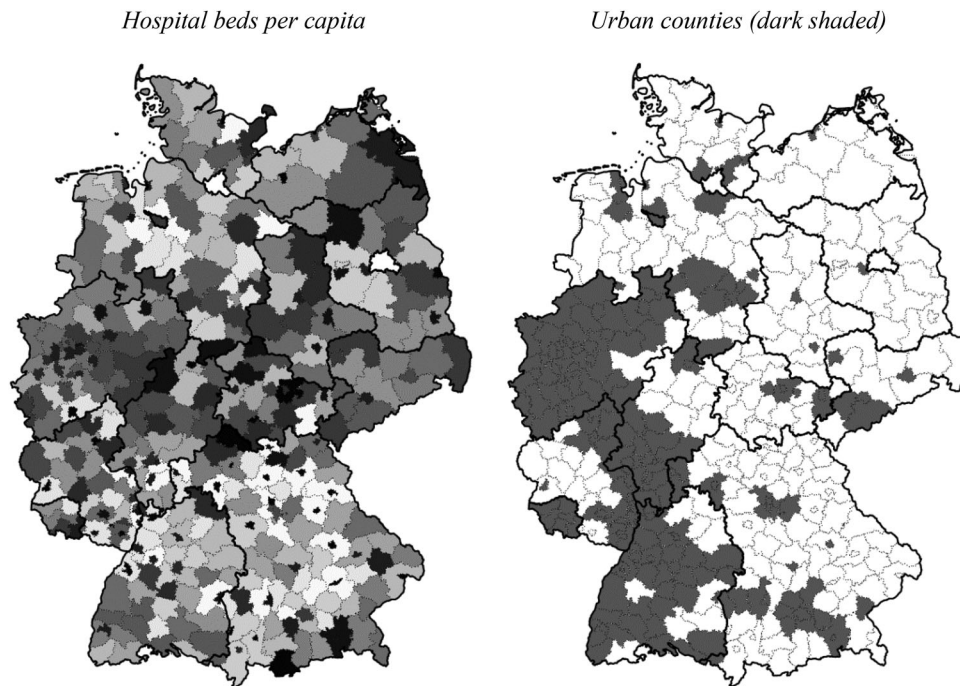
the state. Only hospitals that are included in a state hospital plan qualify for statutory health insurance reimbursement and for investment funding by the states (Karmann & Roesel, 2017; Pilny, 2017; Pilny & Roesel, 2019). State governments can easily change hospital plans and shift infrastructure across space by reducing or increasing the number of beds in individual hospitals. Thus, German state governments ‘play an active part in day-to-day health policy’ (Wassener, 2002, p. 99), especially in the hospital sector. Anecdotal evidence suggests that state governments use their powers and discretion in line with their political preferences. Right-wing politicians were quite critical of decisions by left-wing governments to close departments in individual rural hospitals or to close hospitals themselves. In the German state of Thuringia, for example, the conservative CDU claims to ‘stand against hospital closing in rural regions’ by the ruling left-wing state government.<sup>3</sup> Newspapers also report that hospital policy plays a role in state elections (Bohsem, 2015).

## EMPIRICAL STRATEGY

### Data

We assemble new data for the 10 West German states over the period 1950–2014.<sup>4</sup> Because of several data gaps in the 1950s and 1960s, the panel is imbalanced and includes up to 630 observations. We digitize hard copies of publications by the German Federal Statistical Office and publications by the health ministries of the German states.<sup>5</sup> We collect state-level data on the scope of hospital infrastructure which is designed by state governments: the number of hospitals (all types of ownership) and hospital beds, public hospital capital expenditure (state discretionary expenditure on hospital infrastructure such as buildings, excluding expenditure for treatments, etc.) over the period 1973–2014.<sup>6</sup> Data refer to the number of beds and hospitals available in the respective year and not to planned future beds. We derive four measures: (1) hospitals per capita, (2) hospital beds per capita, (3) beds per hospital (approximating state-average hospital size) and (4) capital expenditure per capita in 2014 prices.

We are also interested in the *spatial distribution* of hospital care *within* the states and compute four measures based on another hand-collected data set of county-level hospital data. We collect all available data on hospitals, hospital beds, population and the urban–rural classification (according to German authorities<sup>7</sup>) at the level of the 400 German counties from the 16 statistical offices of the German states.<sup>8</sup> The left-hand side of Figure 2 shows, for example, the number of hospital beds per capita for all German counties in the sample year 2014. The map on the right-hand side in Figure 2 shows the binary classification of rural and urban counties in Germany. We use county-level information on hospitals and the urban–rural classification to compute (1) the state-level share of hospitals in urban regions and (2) the share of hospital beds in urban regions. We also compute state-specific Gini coefficients portraying the spatial inequality of the number of hospitals (3) and number of beds (4) across state population. We



**Figure 2.** Hospital infrastructure and settlement structure in German states, 2014.

Note: The number of hospital beds per capita (left-hand side) and the classification of urban regions (right-hand side) are shown at the level of the around 400 German counties for 2014. The left-hand map is organized in quantiles: the darker a shaded county, the larger the respective variable. Dark shaded counties in the right-hand map are classified as urban counties. Light borders: counties; bold borders: states. Geodata: © GeoBasis-DE/BKG 2017.

compute the standard Gini coefficient  $G$  for each state-year observation as follows; observations are sorted in ascending order of  $X$ : where

$$G_{it} = 1 - 2 \frac{\sum_{c=1}^N W_{cit} \sum_{j=1}^c \left( W_{jit} X_{jit} - \frac{W_{cit} X_{cit}}{2} \right)}{\sum_{c=1}^N W_{cit} X_{cit} \sum_{c=1}^N W_{cit}} \quad (1)$$

where  $X_{cit}$  describes either the number of hospitals or the number of hospital beds in county  $c$  (or  $j$ ) of state  $i$  in year  $t$ ; and  $W_{cit}$  is the population of county  $c$  (or  $j$ ) of state  $i$  in year  $t$ . We derive two Gini coefficients that relate to (1) the cumulative shares of hospitals to cumulative population shares (Gini hospitals–population) and (2) the cumulative shares of hospital beds to cumulative population shares (Gini beds–population). The Gini indices assume values between 0 (an identical number of beds per capita across counties; full equality) and 1 (all beds concentrated to a single county within a state; full inequality).

We link our hospital variables to self-compiled data on state government ideology and seat margins in German state parliaments. We use information on the outcomes of all state elections between 1945 and 2014, parties forming coalitions, and the party of the health minister, as collected by Pilny and Roesel (2019). The sample includes 94 left-wing and 149 right-wing governments in West German states. Finally, we collect control variables at the state level including the share of the state population living in urban regions, unemployment, the elderly population share (population older than 65 years), real gross domestic product (GDP) per capita, birth rates, three dummy variables

measuring election cycles (pre-election, election and post-election years),<sup>9</sup> and a dummy variable for years before German reunification in 1990 (Cold War). For descriptive statistics for all dependent and explanatory variables, see Table A1 and Figure A1 in Appendix A in the supplemental data online.

### Identification

The party composition and ideology of a state government is likely to be endogenous to economic outcomes including healthcare. One reason is reverse causality. It is conceivable that citizens vote governments out of office because they disagree with the economic policies pursued by the incumbent governments. Most importantly, however, omitted variables are an issue. Voting decisions and the demand for healthcare facilities are likely to follow a mutual unobservable trend. Both reverse causality and omitted variables may bias ordinary least squares (OLS) estimates when regressing measures of healthcare infrastructure to government ideology. In this case, effects cannot be interpreted in a causal way.

One avenue for identifying unbiased causal effects is tight parliamentary seat margins. In many German states, left- or right-wing governments rely on a one-seat majority only, which is a result of polarization and tight political races in state elections. Smaller parties such as the Green Party or the market-oriented party FDP often scatter around the 5% vote-share threshold that is required to enter state parliaments. In the state election of 2016 in Saxony-Anhalt, for example, the market-oriented FDP missed the 5% threshold by just a few votes and did not enter parliament. A few more votes would have changed the

majorities in the state parliament. Close parliamentary majorities in German state parliaments are driven by a few votes, which arguably depend on somehow exogenous events, such as flu epidemics or weather conditions. Arnold and Freier (2016), for example, show that conservative parties benefit from rain on election day in Germany. If there had been more sunshine on election day, a narrow right-wing majority may have swung to a left-wing majority.

The RD design allows one to exploit the quasi-random assignment of narrow left- and right-wing majorities (e.g., Ferreira & Gyourko, 2009; for a general discussion of the RD approach, see Lee & Lemieux, 2010). We apply an RD framework to exploit the fact that political races are close in German states. Joshi (2015) and Béland and Oloomi (2017) use a similar approach to estimate the causal effect of government ideology on healthcare expenditure in US states. Hyytinen, Meriläinen, Saarimaa, Toivanen, and Tukiainen (2018) show that RD may well be equivalent to a randomized experiment in the context of close election outcomes when using certain RD estimation techniques developed by Calonico, Cattaneo, and Titiunik (2014) and Calonico, Cattaneo, and Farrell (2018). We follow this suggestion and estimate local polynomial RD using the optimal polynomial and bandwidth procedure and robust RD standard errors using the instructions of those authors. The dependent variable is the growth rate in one of the four measures of hospital infrastructure (hospitals, beds, beds per hospital and capital expenditure per capita), or the growth rate in one of the four measures of spatial inequalities (share of hospitals in urban regions, share of beds in urban regions, Gini hospitals–area and Gini beds–area). We use growth rates to avoid any concerns about stationarity and spurious regression.<sup>10</sup> Inferences do not change when we use first differences. The running parameter is the margin of a left-wing majority in state parliament; the RD threshold is set at more than 50% of all seats in the state parliament. Our RD estimator measures the local average treatment effect, describing whether closely elected left-wing governments differ from their right-wing counterparts in implementing hospital policies.<sup>11</sup> This gives the causal effect of government ideology on hospital infrastructure and spatial inequalities. To estimate a sharp RD, we always exclude crossbench coalitions where left- and right-wing parties form joint coalitions. We include control variables  $X_{kit}$  that are also likely to influence state governments' healthcare infrastructure, as described above. When we investigate spatial inequalities, we also include the share of the state population living in urban regions.

For robustness tests, we will also validate our local polynomial sharp RD estimates against fuzzy RD results and manually specified RD specifications using the following corresponding pooled OLS panel data model:

$$\Delta \log \text{Hosp}_{it} = f(\text{Ideology}) + \sum \theta_k X_{kit} + \varepsilon_{it} \quad (2)$$

with  $i = 1, \dots, 10$ ;  $t = 1, \dots, 65$ ; and  $k = 1, \dots, 9$ .

Again, we use our eight dependent variables on hospital infrastructure but manually define a quadratic RD

polynomial  $f(\text{Ideology})$  and set the seat margin bandwidth of governments/minorities to  $\pm 10$  percentage points.<sup>12</sup>  $\varepsilon_{it}$  is the error term. As a second robustness test, we use a fuzzy RD that refers to the party of the state health minister. In the case of a 'clear' left-wing government, the health minister is inevitably also left-wing. In some cases, however, crossbench coalitions are formed because neither the left- nor the right-wing camp holds a majority (often because extreme left- or right-wing parties take some parliamentary seats). In this case, the left-wing camp may have missed the 50% threshold in terms of parliamentary seats, but the health minister may nevertheless be a member of a left-wing party. Therefore, not all left-wing health ministers can rely on a left-wing seat majority in state parliament. We implement a fuzzy RD which is basically equivalent to an instrumental variables (IV) setting. In the first stage, seat margins predict the party of the health minister, which is then used in the second stage to explain hospital policy.

The main assumption of any RD approach is that there are no discontinuities in further covariates across the threshold. Table A2 in Appendix A in the supplemental data online shows that there are no discontinuities in the covariates across the RD threshold when we use a local polynomial sharp RD (Calonico et al., 2014, 2018). One exception is the share of the elderly and our dummy measuring the period before 1990. This variable is discontinuous at the 10% significance level at the left-wing seat margin threshold. However, when we use conventional instead of robust standard errors (data not shown), the coefficient does not turn out to be significant. We also perform tests proposed by McCrary (2008); we do not find a significant clustering of observations at either side of the cut-off (see Table A3 in Appendix A in the supplemental data online). We do not have compelling evidence for further discontinuities in control variables that would concern our identification strategy. However, to rule out any bias of confounding factors, we include all control variables in our RD specifications.

## RESULTS

### Baseline

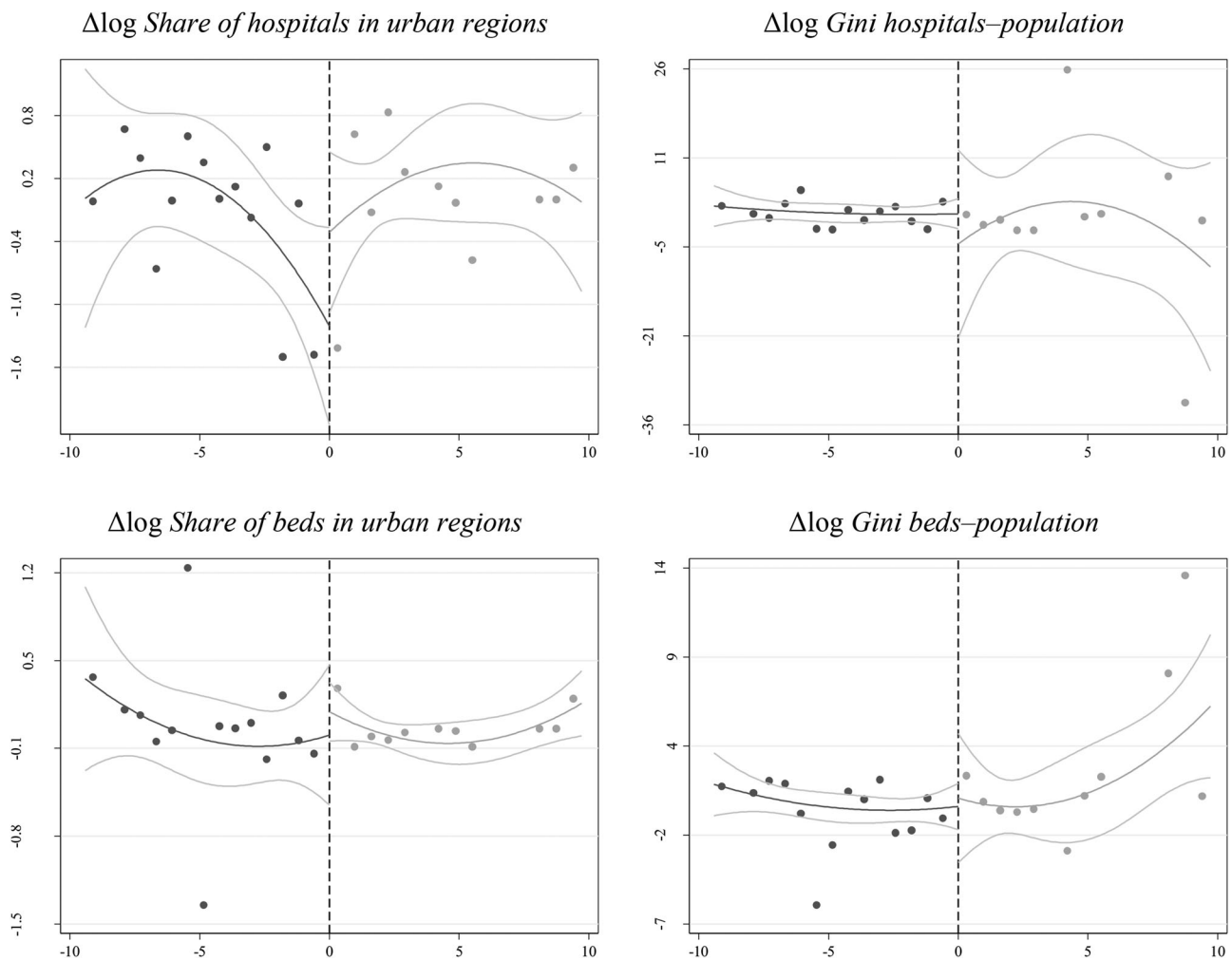
Panel A in Table 1 shows the baseline RD estimates for our eight measures of hospital infrastructure and spatial inequalities in hospital infrastructure using three different ways of computing standard errors.<sup>13</sup> The third row refers to robust standard errors, which are shown to be the preferred specification (Hyytinen et al., 2018). When we use the growth rate of the four measures for hospital infrastructure, the left-wing government RD estimate does not turn out to be statistically significant (columns (1) to (4)). The results do not suggest that government ideology influences the scope of hospital infrastructure. Left-wing governments do not implement more or fewer beds than right-wing counterparts.

Turning to the spatial distribution of hospital facilities, however, inferences change (see also Figure 3). We do not find that left-wing governments are more active in

**Table 1.** Baseline results.

|                             | Scope of infrastructure                |                                   |                                     |  | Spatial inequalities in infrastructure                |   |  |  |
|-----------------------------|--|-----------------------------------|-------------------------------------|--|---|---|--|--|
|                             | $\Delta \log$ Hospitals per capita (1) | $\Delta \log$ Beds per capita (2) | $\Delta \log$ Beds per hospital (3) | $\Delta \log$ Capital expenditure per capita (4) | $\Delta \log$ Share of hospitals in urban regions (5) | $\Delta \log$ Gini hospitals-population (6) | $\Delta \log$ Share of beds in urban regions (7) | $\Delta \log$ Gini beds-population (8) |
| <b>A. Growth rates</b>      |  |                                   |                                     |  |   |   |  |  |
| <i>Left-wing government</i> |  |                                   |                                     |  |   |   |  |  |
| Conventional RD             | -0.453<br>(0.875)                      | -0.598<br>(0.648)                 | 0.486<br>(0.725)                    | 5.009<br>(5.388)                                 | -0.127<br>(1.170)                                     | 0.198<br>(2.819)                            | 0.842**<br>(0.387)                               | 2.864**<br>(1.191)                     |
| Bias-corrected RD           | -0.151<br>(0.875)                      | -0.690<br>(0.648)                 | 0.388<br>(0.725)                    | 5.946<br>(5.388)                                 | -0.014<br>(1.170)                                     | -0.856<br>(2.819)                           | 0.968**<br>(0.387)                               | 3.687***<br>(1.191)                    |
| Robust RD                   | -0.151<br>(1.104)                      | -0.690<br>(0.810)                 | 0.388<br>(0.855)                    | 5.946<br>(6.534)                                 | -0.014<br>(1.486)                                     | -0.856<br>(3.739)                           | 0.968**<br>(0.491)                               | 3.687***<br>(1.391)                    |
| Observed (robust RD)        | 420                                    | 422                               | 420                                 | 325  | 211   | 211   | 211  | 211                                    |
| <b>B. First differences</b> |  |                                   |                                     |  |   |   |  |  |
| <i>Left-wing government</i> |  |                                   |                                     |  |   |   |  |  |
| Conventional RD             | -13.079<br>(23.048)                    | -5.070<br>(4.931)                 | -0.116<br>(0.289)                   | 0.161<br>(0.250)                                 | -0.519<br>(0.399)                                     | -0.034<br>(0.579)                           | 0.350**<br>(0.145)                               | 0.650***<br>(0.236)                    |
| Bias-corrected RD           | -6.331<br>(23.048)                     | -7.096<br>(4.931)                 | -0.232<br>(0.289)                   | 0.204<br>(0.250)                                 | -0.598<br>(0.399)                                     | -0.323<br>(0.579)                           | 0.368**<br>(0.145)                               | 0.807***<br>(0.236)                    |
| Robust RD                   | -6.331<br>(29.474)                     | -7.096<br>(6.243)                 | -0.232<br>(0.343)                   | 0.204<br>(0.286)                                 | -0.598<br>(0.472)                                     | -0.323<br>(0.671)                           | 0.368**<br>(0.185)                               | 0.807***<br>(0.291)                    |
| Observed (robust RD)        | 420                                    | 422                               | 420                                 | 325  | 211   | 211   | 211  | 211                                    |
| Further controls            | Yes                                    | Yes                               | Yes                                 | Yes  | Yes   | Yes   | Yes  | Yes                                    |

Note: Local polynomial regression discontinuity (RD) estimates running the optimal bandwidth procedure are reported (Calonico et al., 2014, 2018). Dependent variables measure the scope and spatial distribution of hospital infrastructure at the level of 10 West German states over the period 1950–2014. Yearly observations and three different methods in computing standard errors apply to both panels. In the panel A, we use growth rates; in the panel B, we use first differences of the dependent variable. Further control variables in all specifications: Pre-election year, Election year, Post-election year,  $\Delta \log$  Unemployed per capita,  $\Delta \log$  GDP per capita,  $\Delta \log$  Share of elderly,  $\Delta \log$  Births per capita, Cold War. Additional control variable in columns (9) to (16):  $\Delta \log$  Share of population in urban regions. Significance levels (standard errors according to row labels in parentheses): \*\*\*0.01, \*\*0.05, \*0.10.



**Figure 3.** Regression discontinuity (RD) plots (spatial inequalities).

Note: Figures report RD plots according to Table 2, panel B (parametrical RD), columns (5) to (8). Four variables measuring the spatial distribution of hospital infrastructure at the level of 10 West German states over the period 1950–2014 are the dependent variables. Left-wing seat margins in state parliaments are the running variable, the cut-off is 0% the maximum bandwidth is set to  $\pm 10\%$ , and positive values indicate a left-wing government. No controls included. Figure A2 in Appendix A in the supplemental data online includes four more plots for the scope of hospital infrastructure.

increasing the number of hospitals in urban regions (columns (5) and (6)), but the state share of beds allocated to cities increases compared with right-wing governments (column (7)). Spatial inequalities in hospital beds also change under left-wing governments (column (8)): hospital beds per capita are less equally distributed than under right-wing governments. Different findings for beds and hospitals are likely to be driven by institutions. Changing the number of hospital beds is much easier than closing or opening entire hospitals. Owners of hospitals subject to closure are likely to take legal actions that take many years. Therefore, changes in the number of hospitals may take some considerable time, whereas reducing or increasing the number of hospital beds is possible at short notice. The effects are numerically substantial. The growth rate in the share of hospital beds in urban regions is about 0.97 percentage points ( $> 1$  SD (standard deviation)) and the growth rate in the Gini coefficient beds–population is about 3.69 percentage points (around 0.25 SD) higher under left- than right-wing governments. When holding

the total German number of hospital beds constant, increasing the share of beds in urban regions by 1 percentage point would imply reallocating some 3300 beds from rural regions to the cities. In urban regions, hospital beds per capita would increase from 6.5 to 6.6 beds per 1000 capita. The results are robust in terms of different ways of computing standard errors and when we use first differences instead of growth rates (see panel B in Table 1). These findings suggest that government ideology influences the spatial distribution of healthcare infrastructure. Left-wing governments shift hospital infrastructure from rural regions.<sup>14</sup> This, in turn, increases spatial inequalities of hospital infrastructure within states.

### Robustness

We submit all the results to further robustness tests. Panels A–C of Table 2 show the results of three alternative RD specifications. First, we include fixed year and state effects to control for temporal shocks and regional idiosyncrasies. The standard procedure by Calonico et al. (2014, 2018)



**Table 2.** Robustness tests.

|                                   | Scope of infrastructure                |                                   |                                     |  | Spatial inequalities in infrastructure                |   |  |  |
|-----------------------------------|--|-----------------------------------|-------------------------------------|--|---|---|--|--|
|                                   | $\Delta \log$ Hospitals per capita (1) | $\Delta \log$ Beds per capita (2) | $\Delta \log$ Beds per hospital (3) | $\Delta \log$ Capital expenditure per capita (4) | $\Delta \log$ Share of hospitals in urban regions (5) | $\Delta \log$ Gini hospitals–population (6) | $\Delta \log$ Share of beds in urban regions (7) | $\Delta \log$ Gini beds–population (8) |
| <b>A. Including fixed effects</b> |  |                                   |                                     |  |   |   |  |  |
| Left-wing government              | −0.550<br>(1.052)                      | −0.822<br>(0.652)                 | 0.470<br>(0.804)                    | 3.612<br>(6.194)                                 | −0.432<br>(0.429)                                     | 12.681<br>(8.340)                           | 0.304**<br>(0.141)                               | 7.176<br>(5.285)                       |
| Observed                          | 420                                    | 422                               | 420                                 | 325  | 211   | 211   | 211  | 211                                    |
| <b>B. Parametrical RD</b>         |  |                                   |                                     |  |   |   |  |  |
| Left-wing government              | −0.770<br>(0.497)                      | −0.105<br>(0.355)                 | 0.665<br>(0.560)                    | −2.614<br>(2.350)                                | 1.144**<br>(0.449)                                    | 0.119<br>(3.609)                            | 0.408**<br>(0.190)                               | −0.293<br>(0.872)                      |
| Observed                          | 341                                    | 341                               | 341                                 | 277  | 188   | 188   | 188  | 188                                    |
| $R^2$                             | 0.069                                  | 0.134                             | 0.106                               | 0.046  | 0.124   | 0.049                                       | 0.136  | 0.124                                  |
| <b>C. Fuzzy RD</b>                |  |                                   |                                     |  |   |   |  |  |
| Left-wing government              | −0.949<br>(1.342)                      | −1.369<br>(1.240)                 | 0.225<br>(1.244)                    | 6.113<br>(9.294)                                 | 0.024<br>(1.530)                                      | −0.832<br>(8.757)                           | 0.858*<br>(0.455)                                | 6.506***<br>(2.253)                    |
| Observed                          | 553                                    | 565                               | 550                                 | 400  | 278   | 278   | 278  | 278                                    |
| <b>D. Including East Germany</b>  |  |                                   |                                     |  |   |   |  |  |
| Left-wing government              | −0.111<br>(1.147)                      | −0.928<br>(0.966)                 | −0.851<br>(1.188)                   | 2.268<br>(4.428)                                 | 0.440<br>(1.123)                                      | 4.702<br>(6.197)                            | 0.679*<br>(0.370)                                | 2.506**<br>(1.234)                     |
| Observed                          | 495                                    | 497                               | 495                                 | 400  | 263   | 263   | 263  | 263                                    |
| <b>E. Excluding city states</b>   |  |                                   |                                     |  |   |   |  |  |
| Left-wing government              | 1.730<br>(1.598)                       | −0.338<br>(0.631)                 | −1.414<br>(1.415)                   | 1.644<br>(4.705)                                 | 0.052<br>(1.502)                                      | −1.087<br>(3.237)                           | 1.091**<br>(0.458)                               | 3.848***<br>(1.424)                    |
| Observed                          | 361                                    | 363                               | 361                                 | 272  | 185   | 185   | 185  | 185                                    |
| <b>F. Election-term median</b>    |  |                                   |                                     |  |   |   |  |  |
| Left-wing government              | −0.728<br>(0.805)                      | −0.425<br>(0.970)                 | 0.127<br>(0.779)                    | 0.179<br>(3.852)                                 | −1.768<br>(2.021)                                     | −12.253<br>(11.125)                         | 0.963***<br>(0.215)                              | 1.080<br>(1.290)                       |
| Observed                          | 108                                    | 108                               | 108                                 | 87   | 55  | 55  | 55   | 55                                     |

(Continued)

The urban–rural gap in healthcare infrastructure: does government ideology matter?

Table 2. Continued.

|                                     | Scope of infrastructure                |                                   |                                     | Spatial inequalities in infrastructure           |   |   |  |  |
|-------------------------------------|--|-----------------------------------|-------------------------------------|--|---|---|--|--|
|                                     | $\Delta \log$ Hospitals per capita (1) | $\Delta \log$ Beds per capita (2) | $\Delta \log$ Beds per hospital (3) | $\Delta \log$ Capital expenditure per capita (4) | $\Delta \log$ Share of hospitals in urban regions (5) | $\Delta \log$ Gini hospitals-population (6) | $\Delta \log$ Share of beds in urban regions (7) | $\Delta \log$ Gini beds-population (8) |
| <b>G. Post-Cold War (&gt; 1990)</b> |  |                                   |                                     |  |   |   |  |  |
| Left-wing government                | -0.899<br>(2.273)                      | -4.084***<br>(1.065)              | -3.998*<br>(2.204)                  | 2.296<br>(5.536)                                 | -0.534<br>(1.124)                                     | -2.282<br>(3.541)                           | 0.782*<br>(0.421)                                | 2.219<br>(1.926)                       |
| Observed                            | 190                                    | 190                               | 190                                 | 190  | 152   | 149   | 152  | 149                                    |
| Further controls                    | Yes                                    | Yes                               | Yes                                 | Yes  | Yes   | Yes   | Yes  | Yes                                    |

Note: Local polynomial regression discontinuity (RD) estimates running the optimal bandwidth procedure are reported (Calonico et al., 2014, 2018), if not denoted otherwise. Dependent variables measure the scope and spatial distribution of hospital infrastructure at the level of 10 West German states over the period 1950–2014. Panel A: we include year and state fixed effects by manually subtracting year and state averages from each observation. Panel B: we apply a parametric RD approach using a quadratic-interacted polynomial and a left-wing seat margin of  $\pm 10\%$ . Panel C: we include cross-bench coalitions and use a fuzzy RD approach with the sharp RD optimal bandwidths. Panel D: we include the five East German states. Panel E: we exclude the two city states. Panel F: median of election terms instead of yearly observations. Panel G: post-Cold War period after 1990 only. Significance levels (robust standard errors in parentheses): \*\*\*0.01, \*\*0.05, \*0.10.

does not allow for fixed effects. Therefore, we manually double de-mean our dependent variables inspired by similar approaches in the spatial econometrics literature (e.g., Borck, Fossen, Freier, & Martin, 2015). Inferences for the share of beds in urban regions do not change (column (7)), but the coefficient of the government ideology variable lacks statistical significance when we use the Gini index as the dependent variable (column (8)).

Second, we estimate a parametric RD with quadratic-interacted polynomial and  $\pm 10\%$  threshold (panel B), and a fuzzy RD with local polynomial and robust RD standard errors (panel C). In panel C, we include crossbench coalitions and refer to the party of the health minister. The results confirm that left-wing governments increase the growth rate in the share of hotel beds in urban areas (column (7)). The ideology-induced effect on the growth rate in the Gini beds-population is confirmed in panel C, but lacks statistical significance in panel B. In panel B, however, we find that left-wing governments also increase the share of urban hospitals. Again, government ideology does not seem to influence the scope of hospital infrastructure. In panels D and E, we resample the data by including East German states and excluding city states. Inferences do not change compared with our baseline findings. Panel F also reports similar results when we use election-term averages. In panel G, we use the post-Cold War period after 1990 only. Again, the RD coefficient for left-wing governments is statistically significant in the case of beds in urban regions. In this subsample for more recent years, we also find that left-wing governments tend to decrease the total number of hospital beds (column (2)) giving rise to smaller hospitals (column (3)). However, the number of observations is comparably low, and this finding should be treated with caution. Throughout all robustness tests, however, we confirm that left-wing governments tend to shift hospital beds from rural to urban regions.

We assign pseudo-thresholds. The results of pseudo-treatments are shown in Table A4 in Appendix A in the supplemental data online. Column (2) reproduces our baseline findings shown in Table 1: the effects of the left-wing government at the ‘real’ seat margin are positive and statistically significant when we use the growth rate in the share of hospital beds in urban regions (panel A) and the Gini beds-population (panel B) as the dependent variable. We assign two pseudo-cut-offs by reducing (column (1)) or increasing (column (3)) from zero the ‘real’ seat margin cut-off by 0.5 SD in seat margins, which is around 3.46. The results in columns (1) and (3) do not suggest any ideology-induced effects when we use pseudo-thresholds.

## CONCLUSIONS

Determinants of spatial inequalities between urban and rural regions have been examined for a long time. Scholars investigate spatial inequality in many outcome variables such as income and productivity. We have focused on publicly provided goods as an important, but yet hardly investigated policy outcome. We use panel data on the scope and spatial distribution of German hospital infrastructure

between 1950 and 2014. We do not confirm ideology-induced effects on the scope but on the spatial distribution of hospital infrastructure. The results show that left-wing governments shift hospital infrastructure from rural to urban regions. We propose that left-wing governments do so to gratify their more urban constituencies. It is also possible that left-wing governments are more aware of the efficiency potentials of consolidating and centralizing hospital infrastructure. However, previous research has shown that left-wing governments are less inclined towards hospital efficiency than right-wing governments in Germany (Karmann & Roesel, 2017). We also do not observe that increasing the need for more hospitals increases in urban regions (see the balancing test on urban mortality in the lower part of Table A2 in Appendix A in the supplemental data online). Thus, catering core voters is the more likely explanation for the results. Government ideology contributes to the urban–rural gap in publicly provided infrastructure – an issue that has been overlooked by previous studies so far.

Spatial concentration of hospital infrastructure may have direct consequences for health outcomes. On the one hand, one may want to have large hospitals in cities because there are economies of scale in providing sophisticated methods of treatment and employing well-trained physicians. For example, in-hospital morbidity and mortality following pancreas surgeries was lower in hospitals with high volume: Krautz, Nimptsch, Weber, Mansky, and Grützmann (2018), therefore, propose to initiate centralization in the field of pancreatic surgery. Schmitt (2017) also shows that larger hospitals tend to be more cost efficient. On the other hand, one may want to advocate smaller hospitals in rural regions because visits from close relatives and friends accelerate patients' healing processes (e.g., Olsen, Dysvik, & Hansen, 2009). Relatives and friends are less likely to visit patients in hospital the longer they need to travel to the hospital. What is more, diseases such as heart attacks require prompt treatment (Buchmueller et al., 2006). In the end, net effects of hospital centralization on health outcomes (i.e., increases in spatial inequalities in hospital infrastructure) are ambiguous. Table A5 in Appendix A in the supplemental data online also suggests that spatial inequalities in hospital infrastructure seem to be somewhat correlated with general mortality and infant mortality, but the direction is not clear. Future research needs to examine in more detail whether spatial inequalities, specialization and centralization in healthcare infrastructure affect health outcomes.

The results may have implications for other countries and economic policy fields. Like Germany, many other countries have decentralized discretionary capacity planning in hospital care to lower levels of government – examples include Austria, France, Italy and Switzerland. The results may have direct implications for these and other countries with comparable institutions. One may also conjecture that political manipulation is even more likely in countries with an entirely state-run national health service and a clear urban–rural divide in election results; the allocation of healthcare facilities in the UK might be an

interesting subject for further research. Future research may also examine how government ideology influences spatial inequality in other public or publicly provided goods such as schools, kindergartens, universities, theatres, operas and libraries. Education facilities are provided by state authorities in many countries and are therefore a prominent candidate for political manipulation. In any event, decision-makers who seek to mitigate short-term political incentives may well introduce long-term planning in public infrastructure and build on broad parliamentary majorities.

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## NOTES

1. Well-educated and productive citizens demand high-quality education for their children and enjoy cultural activities such as visiting theatres and operas. Cultural expenditure has been used both to attract and to prevent citizens from leaving cities (Buettner & Janeba, 2016).
2. A few studies investigate outcomes other than expenditure (Westert & Groenewegen, 1999; Karmann & Roesel, 2017).
3. Press release. Retrieved December 2, 2016, from <http://www.cdu-landtag.de/index.php?ka=1&kska=1&idn=2456>. See also *Der Westen* (2016).
4. In our baseline analysis, we exclude the six East German states (including Berlin) because data for East Germany are only available since German reunification in 1990. We also investigate the six East German states for robustness tests.
5. The data are based on Umfrage der AG Krankenhauswesen der Arbeitsgemeinschaft der Obersten Landesgesundheitsbehörden (AOLG).
6. Hospital capital funding by state governments was implemented in 1972. Data are only available aggregated at the state level and not for individual counties.

7. We use the definition by the Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR): Laufende Raumbeobachtung – Raumabgrenzungen: Städtischer und Ländlicher Raum.
8. We contacted the statistical offices of all German states and use all available data. Data availability is state specific and varies between 1960 and 2015 (Bremen) and between 1995 and 2014 (Baden-Württemberg, Rhineland-Palatinate, Saarland). All data are transferred to the territorial status of 2017.
9. Inferences do not change when we exclude election years.
10. In 1990, the statistical definition of hospitals was revised. Data on 1989 and 1990 hospitals and hospital beds do not match. We therefore exclude the growth rate in 1989–90.
11. We consider the SPD, Bündnis90/Die Grünen, Die Linke and KPD as left-wing parties (e.g., Kauder et al., 2016).
12. We include the polynomial  $\theta_1\text{Left} + \theta_2\text{Majority} + \theta_3\text{Left} \times \text{Majority} + \theta_4\text{Majority} \times \text{Majority} + \theta_5\text{Left} \times \text{Majority} \times \text{Majority}$ , which refers to the seat margin in parliament.
13. For RD plots for a parametrical specification without controls, see Figure A2 in Appendix A in the supplemental data online.
14. We cannot necessarily conclude from the results that the absolute number of beds increased in urban regions and decreased in rural regions. For example, the number of beds may have increased in both regions, but a bit more in urban regions (and less in rural regions) under left-wing governments.

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