

Indirect Rule and Public Goods Provision: Evidence from Colonial India

Online Appendix

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A Literature Overview

The existing literature provides conflicting findings about both direct and indirect rule (Mamdani, 1996; Fisher, 1998; Lange, 2004; Iyer, 2010; Baldwin, 2016; Naseemullah and Staniland, 2016; Mukherjee, 2017). Some scholars claim that direct rule allows for better use of colonizer's institutional capacity in terms of proper provision of developmental goods (Lange, 2009); however it is not inclusive to the local population. Indirect rule, on the other hand, is more integrated into the local environment (Lange, 2009). It can prevent rulers' despotic intentions and the exclusion of natives from civil freedoms (Fisher, 1998). This inclusiveness of natives could lead to better self-governance and prosperity, and, as a result, territories with indirect rule should have better socio-economic outcomes (Iyer, 2010). Additionally, such engagement and local connections of the native rulers may decrease colonial resistance and reduce dissatisfaction and potential violence from natives towards colonizers (Ferwerda and Miller, 2014). At the same time, the effects of indirect rule vary across territories. Some studies show negative effects of indirect rule on development (Lange, 2004) because of the

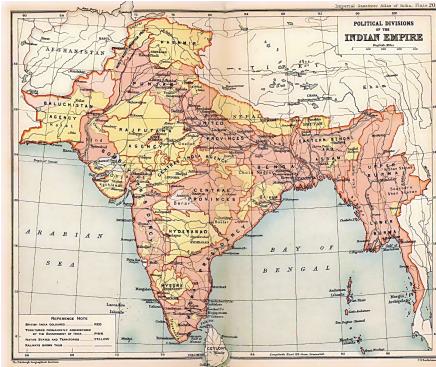
low capacity of the institutional system to provide public goods. Eventually, such inefficiency leads to despotic and autocratic regimes, like decentralized despotism ([Mamdani, 1996](#)).

Following the growing literature that exploits colonial-era borders ([Dell, 2010](#); [Bubb, 2013](#); [Michalopoulos and Papaioannou, 2016](#); [Lechler and McNamee, 2018](#); [Ali et al., 2018](#)), methodologically, this paper uses a spatial regression discontinuity design to estimate the effects of indirect rule.

The analysis and results of this study also have broader implications. They bridge the extensive literature on political and administrative decentralization ([Prud'Homme, 1995](#); [Grindle, 2007](#); [Treisman, 2007](#); [Brancati, 2008](#); [Chhibber and Kollman, 2009](#)) with that on the long-term consequences of colonial presence in developing countries ([Sokoloff and Engerman, 2000](#); [Acemoglu, Johnson and Robinson, 2001](#); [Nunn, 2008](#); [Dell, 2010](#); [Gerring et al., 2011](#); [Lee and Schultz, 2012](#)).

B Graphic Appendix

Figure B.1: Map of Princely States and British Provinces (pre-1947)



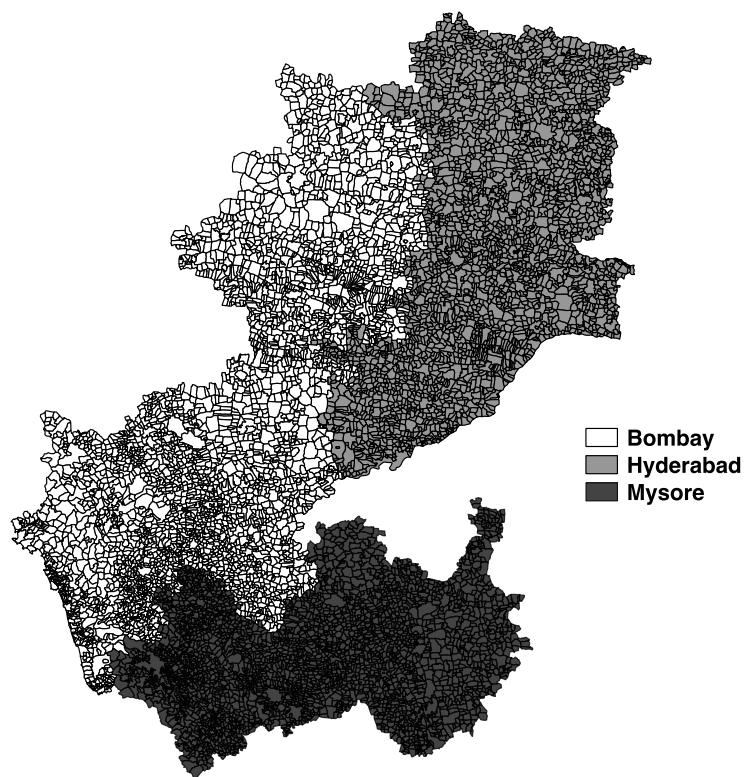
Source of the map: British Indian Empire 1909 Imperial Gazetteer of India
(URL Source: <https://goo.gl/8t1iQq>).

Figure B.2: Village polygons: Mysore-Bombay and Hyderabad-Bombay



Note: Maps illustrate the village polygons of around Mysore-Bombay and Hyderabad-Bombay borders.

Figure B.3: Village polygons Mysore-Bombay-Hyderabad



Note: The map is constructed using GIS village polygons of the 2001 Indian Census.

C Summary Statistics of the Dependent Variables

Table C.1: Summary Statistics for the Dependent Variables. Bandwidth=20km around Mysore-Bombay Border

Statistic	N	Mean	St. Dev.	Min	Max
Health Centers	1,158	0.231	0.422	0	1
Paved Roads	1,158	0.845	0.362	0	1

Table C.2: Summary Statistics for the Dependent Variables. Bandwidth=20km around Hyderabad-Bombay Border

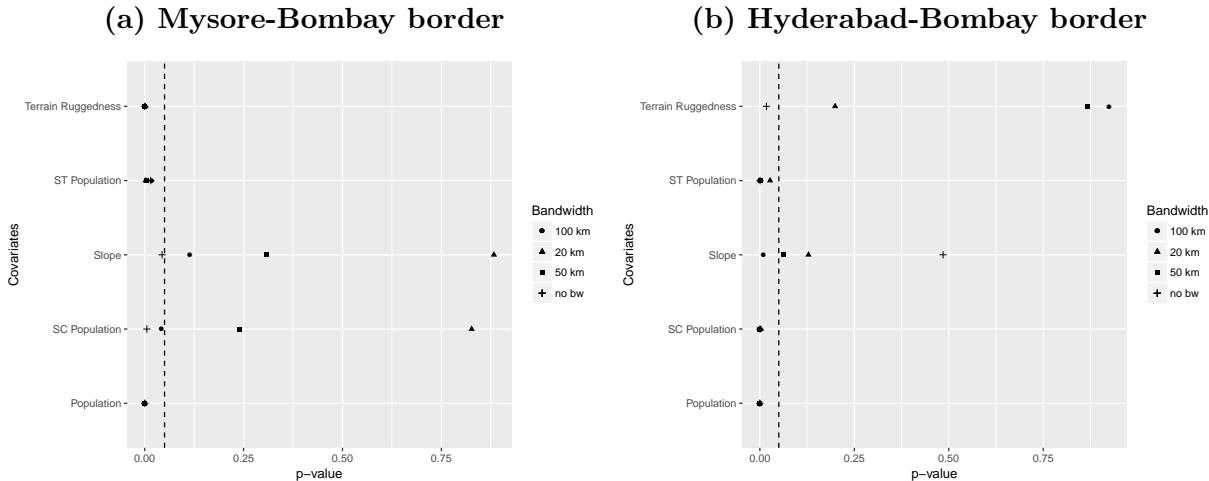
Statistic	N	Mean	St. Dev.	Min	Max
Health Centers	940	0.280	0.449	0	1
Paved Roads	940	0.878	0.328	0	1

D Balance Tests

Figure D.1 shows balance tests for the chosen covariates. The imbalance in terrain ruggedness can be explained by the differences in elevation. To adjust for potential geographic heterogeneity, I control for the slope which is balanced across the border.

Additionally, I observe some imbalance in the population characteristics, particularly in scheduled castes and scheduled tribes population. These are generally the economically poor population groups. Figure D.1 indicates that scheduled castes population is balanced only for Mysore-Bombay border at twenty kilometers and fifty kilometers bandwidths; the rest of the variables are not balanced. This demonstrates the existence of a population variability across the border. However, I argue that the creation of the borders is exogenous to the socio-economic status of the territories, and is defined by exogeneity in the conflict and in the annexation process. Moreover, tables D.1 and D.2 provide evidence that the indirectly ruled territories on average have less scheduled castes and scheduled tribes population. That helps to rule out a mechanism that the negative effect on the provision of public goods in the indirectly ruled areas can be explained by the economic poverty of these territories.

Figure D.1: Balance Tests of pre-treatment covariates around the borders



Note: Figures present p-values. P-values are calculated for the null hypotheses about the absence of statistical differences between the covariates' means. Different symbols correspond to different bandwidths around the border. The dashed line shows a cutoff of p-value = 0.05.

Table D.1: Balance Tests for Mysore-Bombay border (Bandwidth=20km)

	Mean Tr	Mean Cont	T-Test P.Value
Total Population	844.766	1,445.905	0
Total Scheduled Castes Pop	278.085	282.091	0.827
Total Scheduled Tribes Pop	160.096	206.048	0.002
Slope	88.837	88.740	0.883
Terrain Rugness	2.312	2.755	0.002

Table D.2: Balance Tests for Hyderabad-Bombay border (Bandwidth=20km)

	Mean Tr	Mean Cont	T-Test P.Value
Total Population	1,385.179	1,669.790	0.00002
Total Scheduled Castes Pop	354.623	423.661	0.003
Total Scheduled Tribes Pop	248.146	210.045	0.027
Slope	88.702	87.302	0.129
Terrain Rugness	1.130	1.206	0.199

E Additional Balancing

Figure E.1: Covariates distribution across Mysore-Bombay Border (bw=20 km)

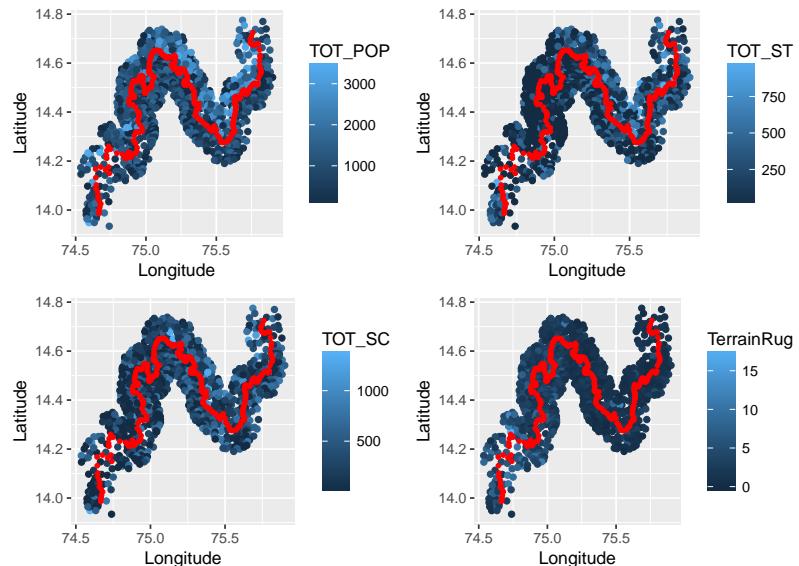


Figure E.2: Covariates distribution across Mysore-Bombay Border (bw=200 km)

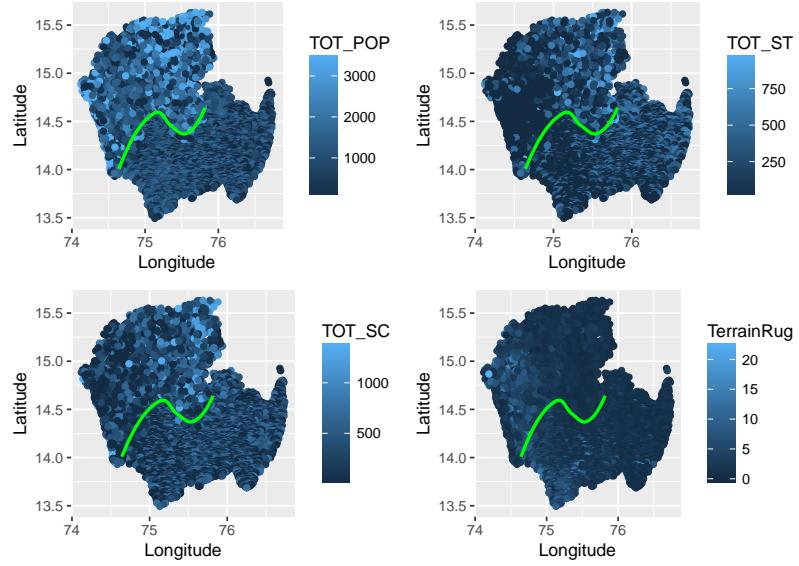


Figure E.3: Covariates distribution across Hyderabad-Bombay Border (bw=20 km)

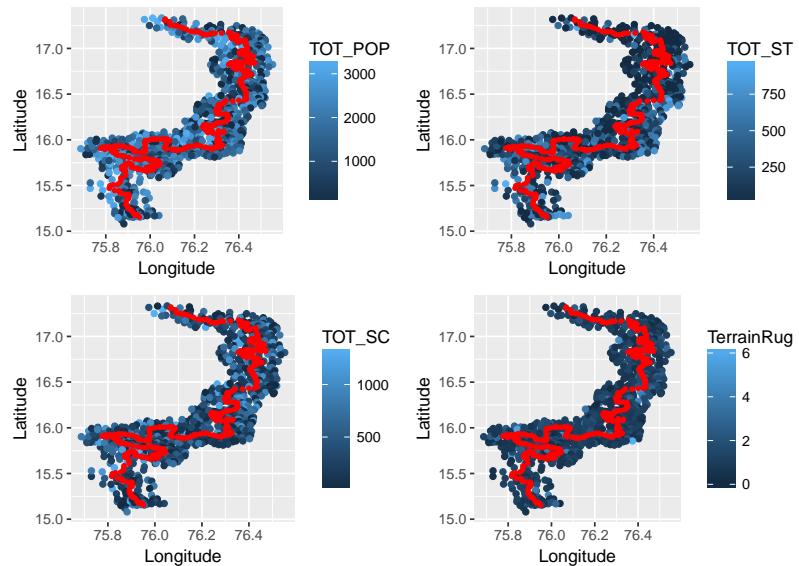
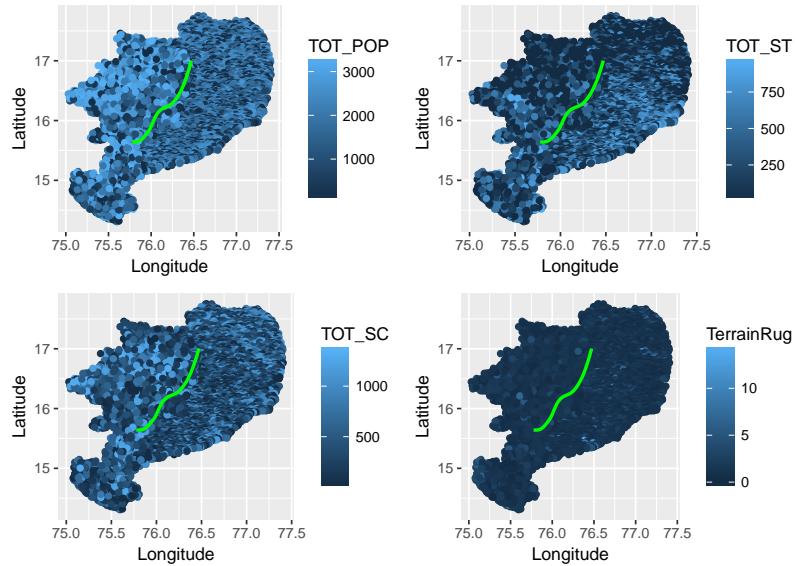


Figure E.4: Covariates distribution across Hyderabad-Bombay Border (bw=200 km)



F Alternative Specification

Table F.1: OLS Estimation of the Indirect Rule on the Public Goods Outcomes controlled for the Cubic Polynomial (bandwidth=20 kilometers)

	<i>Dependent variable:</i>			
	Health Centers (1)	Paved Roads (2)	Health Centers (3)	Paved Roads (4)
Indirect Rule (Mysore)	-0.001 (0.011)	-0.126*** (0.035)		
Indirect Rule (Hyderabad)			-0.093*** (0.021)	-0.009 (0.073)
Constant	-46,305.380 (47,332.330)	-49,469.980 (40,972.960)	-96,428.040 (60,642.290)	-57,746.760 (53,923.800)
Controls	✓	✓	✓	✓
Observations	1,158	1,158	940	940

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Robust standard errors clustered on districts are in the parentheses. Models 1 and 2 show the results for the effect of indirect rule on the Mysore-Bombay border, and models 3 and 4 present results for the effect of indirect rule on Hyderabad-Bombay border. All models are controlled for the cubic polynomial of the latitude and longitude, slope, terrain ruggedness, total population, scheduled castes and scheduled tribes population.

G Alternative Estimation

The existing literature is skeptical about linear estimation of the spatial regression discontinuity models, because it evaluates the average effect alongside the border (Keele and Titiunik, 2015). Here I provide a non-parametric estimation, which helps to identify the potential heterogeneous effects and take them into account in the estimation of an average treatment effect. Table G.1 demonstrates the results of this estimation.¹ Here the border is presented as a set of points, and the estimated effect is the mean of the average treatment effects at each of these points. The results show a consistent negative effect of indirect rule without any heterogeneity between princely states and between different types of public good.

Table G.1: Non-Parametric Estimation of the Indirect Rule Effect on Public Goods Outcomes

Mysore-Bombay Border	Outcomes	Coefficient	Lower CI Bound	Upper CI Bound
	Health Centers	-0.046	-0.059	-0.034
	Paved Roads	-0.173	-0.187	-0.158
<hr/>				
Hyderabad-Bombay Border	Outcome	Coefficient	Lower CI Bound	Upper CI Bound
	Health Centers	-0.119	-0.129	-0.108
	Paved Roads	-0.019	-0.038	-0.0004

Note: Coefficients show the average effects of indirect rule on the availability of health centers and paved roads across the border points. They were calculated using the bootstrap technique from the coefficients estimated on the set of points alongside the border. CI stands for the 95% confidence intervals for the estimated average effects across the border points, also calculated using a bootstrap technique.

¹For the estimation of the treatment effects on each point of the border, I used the methodology offered by Keele and Titiunik (2015). Confidence intervals were constructed using a bootstrap method (Larget, 2014).

H Alternative Bandwidths

Table H.1: OLS Estimation of Indirect Rule Effect on Public Goods Outcomes (50 km bandwidth)

	<i>Dependent variable:</i>			
	Health Centers		Paved Roads	
	(1)	(2)	(3)	(4)
Indirect Rule (Mysore)	-0.024 (0.028)	-0.119*** (0.036)		
Indirect Rule (Hyderabad)			-0.061*** (0.022)	0.008 (0.061)
Constant	-6.162** (2.876)	-2.865 (2.147)	7.196* (4.344)	7.311 (4.494)
Controls	✓	✓	✓	✓
Observations	2,525	2,525	1,849	1,849

Note: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors clustered on districts are in the parentheses. Models 1 and 2 show the results for the effect of indirect rule on the Mysore-Bombay border, and models 3 and 4 present results for the effect of indirect rule on Hyderabad-Bombay border. All models are controlled for the latitude and longitude, slope, terrain ruggedness, total population, scheduled castes and scheduled tribes population.

Table H.2: OLS Estimation of the Indirect Rule on the Public Goods Outcomes controlled for the Cubic Polynomial (bandwidth=50 kilometers)

	<i>Dependent variable:</i>			
	Health Centers		Paved Roads	
	(1)	(2)	(3)	(4)
Indirect Rule (Mysore)	0.002 (0.007)	-0.119*** (0.013)		
Indirect Rule (Hyderabad)			-0.095*** (0.019)	0.0002 (0.074)
Constant	-2,796.069 (12,968.610)	28,425.830 (24,687.170)	-29,929.680* (18,083.590)	-7,973.379 (43,530.970)
Controls	✓	✓	✓	✓
Observations	2,525	2,525	1,849	1,849

Note: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors clustered on districts are in the parentheses. Models 1 and 2 show the results for the effect of indirect rule on the Mysore-Bombay border, and models 3 and 4 present results for the effect of indirect rule on Hyderabad-Bombay border. All models are controlled for the cubic polynomial of the latitude and longitude, slope, terrain ruggedness, total population, scheduled castes and scheduled tribes population.

I Placebo Tests

Table I.1: Placebo Tests for Mysore-Bombay Border

<i>Dependent variable:</i>				
	Health Centers -10 km	Paved Roads (1)	Health Centers (2)	Paved Roads +10 km
Placebo Indirect Rule	−0.051 (0.032)	0.001 (0.027)	0.006 (0.007)	0.033 (0.021)
Constant	−8.571*** (0.474)	−8.057*** (2.923)	−9.155 (5.599)	−0.148 (0.970)
Controls	✓	✓	✓	✓
Observations	1,014	1,014	1,110	1,110

Note: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors clustered on districts are in the parentheses. Models 1 and 2 show the results for placebo border that is -10 kilometers (closer to the princely state) from the original Mysore-Bombay, and models 3 and 4 show the results for placebo border that is +10 kilometers (further to the princely state) from the original Mysore-Bombay. All models are controlled for latitude, longitude, slope, terrain ruggedness, total population, scheduled castes and scheduled tribes population.

Table I.2: Placebo Tests for Hyderabad-Bombay Border

<i>Dependent variable:</i>				
	Health Centers -10 km	Paved Roads (1)	Health Centers (2)	Paved Roads +10 km
Placebo Indirect Rule	−0.009 (0.041)	−0.013 (0.028)	−0.052*** (0.011)	0.010 (0.020)
Constant	−2.010 (3.585)	8.087*** (1.776)	23.063** (10.229)	1.711 (8.803)
Controls	✓	✓	✓	✓
Observations	740	740	819	819

Note: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors clustered on districts are in the parentheses. Models 1 and 2 show the results for placebo border that is -10 kilometers (closer to the princely state) from the original Hyderabad-Bombay, and models 3 and 4 show the results for placebo border that is +10 kilometers (further to the princely state) from the original Hyderabad-Bombay. All models are controlled for latitude, longitude, slope, terrain ruggedness, total population, scheduled castes and scheduled tribes population.

J Alternative Mechanisms

The long-term effects can be explained by physical or cultural persistence. Public goods that were provided during the colonial times can be used and expanded in a certain capacity today, which forms physical persistence. At the same time historical experience may result in a greater propensity to maintain and improve these goods, which would indicate cultural persistence. In the main part of the paper, I show that the driving mechanism of long-term effects of indirect rule was physical persistence. Here I provide some empirical evidence that allows me to rule out cultural persistence as a potential alternative mechanism.

Cultural persistence mechanism suggests that differences between the leaders in directly and indirectly ruled areas created differences in the local populations' mobilization activity and their propensity to carry out collective actions.² Poor incentives of the local leaders and population apathy in the princely states built a lack of interest in collective action, which led to the lack of mobilization. Direct rule, on the contrary, pushed the local population to unite in the face of a common enemy – colonizer's authority, and to mobilize against it. Historians show that people in the Bombay region had myriad grievances driven by the presence of colonizers and their extraction interests ([Ramaswamy and Patagundi, 2007](#)). Although there is evidence that certain norms, like collective action ability and local cooperation, or certain attitudes towards authorities were preserved even in post-colonial times ([Wucherpfennig, Hunziker and Cederman, 2016](#); [Lowes et al., 2017](#); [Dell, Lane and Querubin, 2018](#)), I argue that in this case cultural persistence is not the main mechanism that explains long-term effects on contemporary public goods heterogeneity.

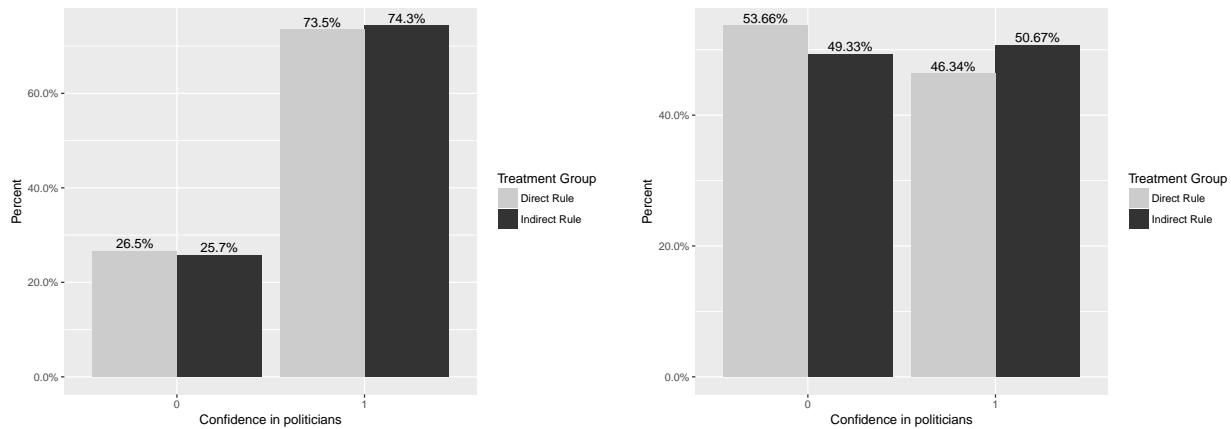
People in the directly ruled territories had less trust of local leaders. That enhanced the collective action and more efficient mobilization capacity. Local population in the indirectly ruled areas, on the contrary, had more trust of local leaders, which led to a lack of mobiliza-

²[Lawrence \(2013\)](#) cites [Hechter \(2000\)](#) and says that “direct rule prompts nationalist mobilization, but indirect rule thwarts nationalism because it reduces the demand for sovereignty and raises the costs of collective action”.

tion against these leaders and absence of any potential collective actions. Cultural persistence mechanism will argue that these trust attitudes on both sides of the former borders persist today and affect the ability of the local population to be vocal with their authorities and demand public goods provision. To see whether the persistence of trust holds through the

Figure J.1: Indian Human Development Survey Results

(a) First Wave of the Survey (2005) (b) Second Wave of the Survey (2011-2012)



Note: The charts are based on the individual survey data and present the survey results only for the districts of Karnataka that were used in the baseline results. For confidence level, the category 1 was constructed with the aggregation of responses - "A great deal" and "Only some" for 2005 wave, and "A great deal of confidence" and "Only some confidence" for 2011-2012 wave. Category 0 means "Hardly any confidence". The first wave of the survey (2005) consisted such options for the respondents as "Don't know", "Valid blank", "Valid skip", and "-". Dropping of the "Don't know" category could have impacted the results of the first wave. The exact question in the survey was the following: "I am going to name some institutions in the country. As far as the people running these institutions are concerned, would you say you have confidence in politicians to fulfill their promises?".

time, I provide the results for the two waves of the Indian Human Development Survey: wave of 2005³ and wave of 2011-2012⁴. Figure J.1 presents the summary of the responses about confidence in politicians to fulfill their promises.⁵ I choose respondents from the districts of Karnataka that are used in the baseline models, identifying the districts of the former princely states as the treatment group and the districts of the British province as the control group. These figures show that, in both time periods, there is no significant differences

³Data is available at the ICPSR website: <https://www.icpsr.umich.edu/icpsrweb/DSDR/studies/22626>.

⁴Data is available at the ICPSR website: <https://www.icpsr.umich.edu/icpsrweb/DSDR/studies/36151>.

⁵Here I grouped the three-level scale of the responses to a binary measure.

between confidence in politicians in both former directly and indirectly ruled territories. It indicates that even if the variation in trust and confidence in authorities attitudes existed back during the colonial times, it does not hold today. This helps to eliminate a cultural persistence mechanism and point towards the original physical persistence explanation.

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