Online Appendix: Key Players in Economic Development

Ashani Amarasinghe[*] Roland Hodler[†]
Paul A. Raschky[‡] Yves Zenou[§]

[*] School of Economics, University of Sydney; email: ashani.amarasinghe@sydney.edu.au.
[†] Department of Economics, University of St.Gallen; CEPR, CESifo, and OxCarre; email: roland.hodler@unisg.ch.
[‡] Department of Economics, Monash University; email: paul.raschky@monash.edu.
[§] Department of Economics, Monash University; CEPR and IZA; email: yves.zenou@monash.edu.

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A Theory

A.1 A simple theoretical model

A.1.1 The case of a single network

Consider a network linking different districts. A network (graph) $\boldsymbol{\omega}$ is the pair (N, E) consisting of a set of nodes (here districts) $N = \{1, \ldots, n\}$ and a set of edges (links) $E \subset N \times N$ between them. The neighborhood of a node $i \in N$ is the set $N_i = \{j \in N : (i, j) \in E\}$. The adjacency matrix $\mathbf{\Omega} = (\omega_{ij})$ keeps track of direct links so that $\omega_{ij} \in]0, 1]$ if a link exists between districts i and j, and $\omega_{ij} = 0$ otherwise.[1] We assume that the adjacency matrix $\mathbf{\Omega}$ is row-normalized so that the sum of each of its rows is equal to 1, i.e., $\sum_j \omega_{ij} = 1$ for all i.[2] In the data, $\mathbf{\Omega} = (\omega_{ij})$ will capture connectivity based on geography, the road network or ethnicity.

We assume that the level of economic activity l_i of a district i is given by:

$$l_i = \rho \sum_{j=1}^{J} \omega_{ij} l_j + X_i + \varepsilon_i \tag{1}$$

Indeed, we assume that the economic activity of district i is simply a function of the economic activity of neighboring districts, of the observable characteristics X_i (such as its population) and unobservable characteristics ε_i of this district. In this equation, ρ captures the spillover effects of economic activities between neighboring districts.

Observe that the total level of activity l_i of district i is given by (1) because we would like to describe activities at the *district* level and, more importantly, the transmission of economic shocks between districts. Our theoretical framework, and the empirical analysis, implicitly acknowledge that there are a plethora of possible transmission channels (e.g., prices, wages, trade, or migration). However, the main focus of this paper is analyzing the effect of a district's position on the diffusion of economic shocks within a network. For that purpose, applying a simple, network theoretical model to a more aggregate setting is sufficient.

There are different ways one can microfound equation (1). Let us propose a simple way of doing so.

Assume that the level of prosperity p_i of a district i is given by:

$$p_i = X_i l_i + \rho l_i \sum_{j=1}^{J} \omega_{ij} l_j + l_i \varepsilon_i \tag{2}$$

[1] In spatial econometrics, the adjacency matrix is called the "connectivity matrix." Throughout the paper, we will use these terms interchangeably.

[2] All our theoretical results hold if the adjacency matrix is not row-normalized.

where, as above, l_i is the economic activity in district i, X_i captures the characteristics of district i and ε_i is the error term. In sum, the prosperity level of a district is determined by the district's *observable* and *unobservable* characteristics, the economic activity of the district, and the spillover effects of the economic activity of neighboring districts.

Assume that the entity in charge of district i (this could be an institution or a local government or a local politician) chooses the district's own economic activity level l_i, taking as given the choices of all the other districts. The payoff function of the entity in charge of district i is then given by:

$$U_i = p_i - \frac{1}{2}l_i^2 = X_i l_i + \rho l_i \sum_{j=1}^{J} \omega_{ij} l_j + l_i \varepsilon_i - \frac{1}{2}l_i^2 \tag{3}$$

Indeed, the payoff function consists of the prosperity level of district i minus the cost of maintaining this prosperity level, which is, quite naturally, increasing in economic activity.

Then, taking the first-order condition of (3) leads to (1), which can be written in matrix form as follows:

$$\mathbf{l} = (\mathbf{I} - \rho\mathbf{\Omega})^{-1}(\mathbf{X} + \boldsymbol{\varepsilon}) =: \mathbf{C}^{BO}_{\mathbf{X}+\boldsymbol{\varepsilon}}(\rho, \boldsymbol{\omega}) \tag{4}$$

where $\mathbf{l}$ is a column-vector of l_is, $\mathbf{I}$ is the identity matrix, and $\mathbf{X}$ and $\boldsymbol{\varepsilon}$ are the vectors corresponding to the X_is and ε_is, respectively. In (4), $\mathbf{C}^{BO}_{\mathbf{X}+\boldsymbol{\varepsilon}}(\rho, \boldsymbol{\omega})$, whose ith row is $C^{BO}_{i,X_i+\varepsilon_i}(\rho, \boldsymbol{\omega})$, is the weighted *Katz-Bonacich centrality* (due to Bonacich, 1987, and Katz, 1953), where the weights are determined by the sum of X_i and ε_i for each district i. Denote by $\mu_1(\mathbf{\Omega})$ the spectral radius of $\mathbf{\Omega}$. Then, if $\rho\mu_1(\mathbf{\Omega}) < 1$, there exists a unique interior equilibrium given by (1) or (4). Since the adjacency matrix $\mathbf{\Omega}$ is assumed to be row-normalized, it holds that $\mu_1(\mathbf{\Omega}) = 1$. Thus, the condition for existence and uniqueness can be written as $\rho < 1$.

Consider again (1). Then, ρ has an easy interpretation. In social networks, it is called the social or network multiplier. Here, it is the strength of spillovers in terms of nighttime lights between neighboring districts. To illustrate this, consider the case of a dyad (two districts, i.e., $N = 2$). For simplicity, assume that the two districts are ex ante identical so that $X_1 + \varepsilon_1 = X_2 + \varepsilon_2 = X + \varepsilon$. In that case, if there were no network (empty network) so that the two districts were not linked, then (1) will be given by:

$$l_1^{empty} = l_2^{empty} = X + \varepsilon$$

Consider now a network where the two districts are linked to each other (i.e., $\omega_{12} = \omega_{21} = 1$). Then, if $\rho < 1$, we obtain:

$$l_1^{dyad} = l_2^{dyad} = \frac{X + \varepsilon}{1 - \rho}$$

In other words, because of complementarities, in the dyad, the level of activity of each district is much higher than when the districts are not connected. The factor $1/(1-\rho) > 1$ is the *network multiplier*.[3]

Observe that the way we modeled spillover effects (see (1)) is similar to the way urban economists have been modeling agglomeration effects. For example, in Ahlfeldt et al. (2015), agglomeration effects are modeled as production externalities. In our case, spillover effects might capture those effects but could also be driven by other effects as well.[4]

A.1.2 The case of multiple networks

In the real world, there is more than one type of spillovers between districts. For example, in our main specifications below, we use different adjacency matrices $\mathbf{\Omega} = (\omega_{ij})$ that keep track of the (inverse) spatial distance between districts, the road network and the proximity in terms of ethnicity. In that case, (1) would be written as:

$$l_i = \rho_1 \sum_{j=1}^{J} \omega_{1,ij} l_j + \rho_2 \sum_{j=1}^{J} \omega_{2,ij} l_j + \rho_3 \sum_{j=1}^{J} \omega_{3,ij} l_j + X_i + \varepsilon_i \tag{5}$$

where $\rho_1 > 0$, $\rho_2 > 0$ and $\rho_3 > 0$. We now have three adjacency matrices $\mathbf{\Omega}_1 = (\omega_{1,ij})$, $\mathbf{\Omega}_2 = (\omega_{2,ij})$ and $\mathbf{\Omega}_3 = (\omega_{3,ij})$, which are all assumed to be row-normalized.

This equation says that the spillover effects in terms of economic activities between districts are affected differently by the ways we measure the "proximity" between neighboring districts.[5]

A.2 Theory: Different definitions of node centralities

There are different centrality measures (see Jackson, 2008, for an overview). We first introduce two non micro-founded, purely topological centrality measures and then two micro-founded measures that are strongly linked to our simple model.

[3] Observe that if we keep the ex ante heterogeneity, if $\rho < 1$, we obtain:

$$\begin{pmatrix} l_1 \\ l_2 \end{pmatrix} = \frac{1}{(1-\rho^2)} \begin{pmatrix} X_1 + \varepsilon_1 + \rho\,(X_2 + \varepsilon_2) \\ X_2 + \varepsilon_2 + \rho\,(X_1 + \varepsilon_1) \end{pmatrix}$$

[4] See the overviews by Duranton and Puga (2004) and Fujita and Thisse (2013) who provide different micro-foundations of spillover effects in the context of urban agglomeration.

[5] As above, we can provide a microfoundation of this equation by assuming that the prosperity level of a district is given by:

$$p_i = X_i l_i + \rho_1 l_i \sum_{j=1}^{J} \omega_{1,ij} l_j + \rho_2 l_i \sum_{j=1}^{J} \omega_{2,ij} l_j + \rho_3 l_i \sum_{j=1}^{J} \omega_{3,ij} l_j + l_i \varepsilon_i$$

Then, if $\mu_1\left(\rho_1 \mathbf{\Omega}_1 + \rho_2 \mathbf{\Omega}_2 + \rho_3 \mathbf{\Omega}_3\right) < 1$, there exists a unique interior equilibrium given by (5).

A.2.1 Non micro-founded centrality measures

The two most commonly used individual-level measures of network centrality are betweenness centrality and eigenvector centrality.

The *betweenness centrality*, $C_i^{BE}(\boldsymbol{\omega})$, describes how well located an individual district in the network in terms of the number of shortest paths between other districts that run through it. Denote the number of shortest paths between districts j and k that district i lies on as $P_i(jk)$, and let $P(jk)$ denote the total number of shortest paths between districts j and k. The ratio $P_i(jk)/P(jk)$ tells us how important district i is for connecting districts j and k to each other. Averaging across all possible jk pairs gives us the betweenness centrality measure of district i:

$$C_i^{BE}(\boldsymbol{\omega}) = \sum_{j \neq k: i \notin \{j,k\}} \frac{P_i(jk)/P(jk)}{(n-1)(n-2)/2}$$

It has values in $[0,1]$.

The *eigenvector centrality*, $C_i^{E}(\boldsymbol{\omega})$, is defined using the following recursive formula:

$$C_i^{E}(\boldsymbol{\omega}) = \frac{1}{\mu_1(\boldsymbol{\Omega})} \sum_{j=1}^{n} g_{ij} C_j^{E}(\boldsymbol{\omega}) \tag{6}$$

where $\mu_1(\boldsymbol{\Omega})$ is the largest eigenvalue of $\boldsymbol{\Omega}$. According to the Perron-Frobenius theorem, using the largest eigenvalue guarantees that $C_i^{E}(\boldsymbol{\omega})$ is always positive. In matrix form, we have:

$$\mu_1(\boldsymbol{\Omega})\, \mathbf{C}^{E}(\boldsymbol{\omega}) = \boldsymbol{\Omega}\mathbf{C}^{\mathbf{E}}(\boldsymbol{\omega}) \tag{7}$$

The eigenvector centrality of a district assigns relative scores to all districts in the network based on the concept that connections to high-scoring districts contribute more to the score of the district in question than equal connections to low-scoring agents.

A.2.2 Katz-Bonacich centrality

In our theoretical model (Section A), we have shown that the unique Nash equilibrium of our game in terms of nighttime lights is equal to the *Katz-Bonacich centrality* of the district. As a result, the level of nighttime lights in district i is given by its weighted Katz-Bonacich centrality, defined in (4), i.e.

$$\mathbf{C}^{BO}_{\mathbf{X}+\boldsymbol{\varepsilon}}(\rho, \boldsymbol{\omega}) =: (\mathbf{I} - \rho\boldsymbol{\Omega})^{-1}(\mathbf{X} + \boldsymbol{\varepsilon})$$

Importantly, in order to calculate the Katz-Bonacich centrality of each district i, we need to know the value of ρ. We will use the estimated value of ρ (IV estimates). We also need to check that the condition $\rho\mu_1(\boldsymbol{\Omega}) < 1$ is satisfied.

A.2.3 Key-player centrality

The Katz-Bonacich centrality was based on the outcome of a Nash equilibrium. Let us now focus on the planner's problem. The key question is as follows: Which district, once removed, will reduce total nighttime lights the most? In other words, which district is the key player? Ballester et al. (2006) have proposed a measure, *key-player centrality*, that answers this question.[6] For that, consider the game with strategic complements for which the utility in each district i is given by (3), and denote $L^*(\boldsymbol{\omega}) = \sum_{i=1}^{n} l_i^*$ the total equilibrium level of activity in network $\boldsymbol{\omega}$, where, assuming $\phi\mu_1(\boldsymbol{\omega}) < 1$, l_i^* is the Nash equilibrium effort given by (1) or (4). Also, denote by $\boldsymbol{\omega}^{[-i]}$ the network $\boldsymbol{\omega}$ without district i. Then, in order to determine the *key player*, the planner will solve the following problem:

$$\max\{L^*(\boldsymbol{\omega}) - L^*(\boldsymbol{\omega}^{[-i]}) \mid i = 1, ..., n\} \tag{8}$$

Then, the *intercentrality* or the *key-player centrality* $C_i^{KP}(\rho, \boldsymbol{\omega})$ of district i is defined as follows:

$$C_{i,u_i}^{KP}(\rho, \boldsymbol{\omega}) = \frac{C_{i,u_i}^{BO}(\rho, \boldsymbol{\omega}) \sum_j m_{ji}(\rho, \boldsymbol{\omega})}{m_{ii}(\rho, \boldsymbol{\omega})} \tag{9}$$

where $C_{i,u_i}^{BO}(\rho, \boldsymbol{\omega})$ is the weighted Katz-Bonacich centrality of district i (see equation (4)) and $m_{ij}(\rho, \boldsymbol{\omega})$ is the (i, j) cell of the matrix $\mathbf{M}(\rho, \boldsymbol{\omega}) = (\mathbf{I} - \rho\boldsymbol{\Omega})^{-1}$. Ballester et al. (2006, 2010) have shown that the district i^* that solves (8) is the key player if and only if i^* is the district with the highest *intercentrality* in $\boldsymbol{\omega}$, that is, $C_{i^*,u_i}^{KP}(\rho, \boldsymbol{\omega}) \geq C_{i,u_i}^{KP}(\rho, \boldsymbol{\omega})$, for all $i = 1, ..., n$. The intercentrality measure (9) of district i is the sum of i's centrality measures in $\boldsymbol{\omega}$, and its contribution to the centrality measure of every other district $j \neq i$ also in $\boldsymbol{\omega}$. It accounts both for one's exposure to the rest of the group and for one's contribution to every other exposure. This means that the key player i^* in network $\boldsymbol{\omega}$ is given by $i^* = \arg\max_i C_{i,u_i}^{KP}(\rho, \boldsymbol{\omega})$, where[7]

$$C_{i^*,u_i}^{KP}(\rho, \boldsymbol{\omega}) = L^*(\boldsymbol{\omega}) - L^*\left(\boldsymbol{\omega}^{[-i]}\right). \tag{10}$$

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[6] For an overview of the way the key player is determined in different disciplines, see Zenou (2016).

[7] Ballester et al. (2006) define the key player in (9) only when the adjacency matrix $\boldsymbol{\Omega}$ is not row-normalized. Since we use row-normalized adjacency matrices when estimating the ρs, we will determine the key player numerically based on its definition in (10).

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B Additional Data Description

B.1 Subnational Districts and Countries

Figure B1: Districts in Africa

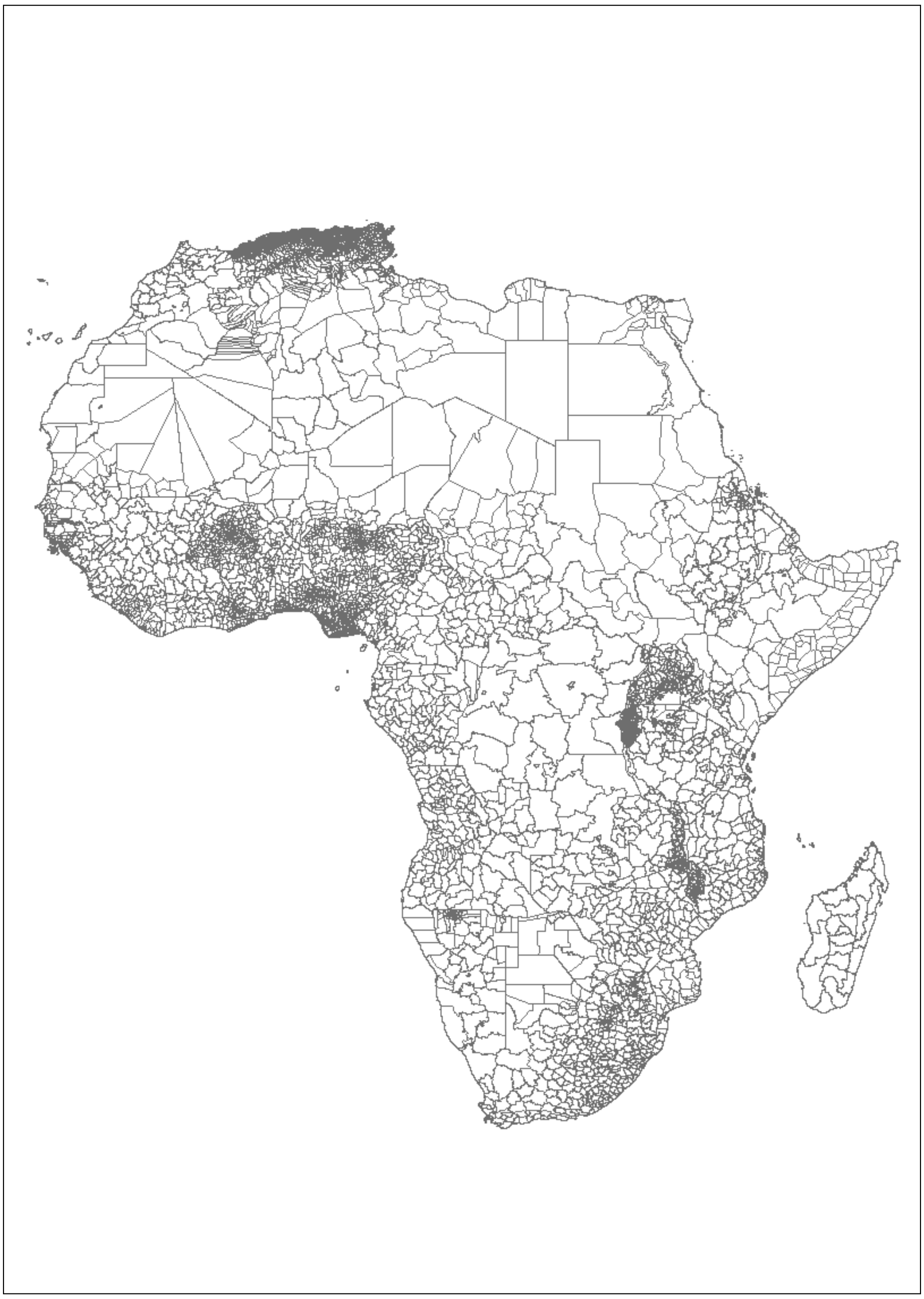


Table B1: List of Countries

	Country	No. of districts
1	Algeria	1,504
2	Angola	163
3	Benin	76
4	Botswana	25
5	Burkina Faso	301
6	Burundi	133
7	Cameroon	58
8	Cape Verde	16
9	Central African Republic	51
10	Chad	53
11	Comoros	3
12	Ivory Coast	50
13	Democratic Republic of the Congo	38
14	Djibouti	11
15	Egypt	26
16	Equatorial Guinea	6
17	Eritrea	50
18	Ethiopia	72
19	Gabon	37
20	Gambia	13
21	Ghana	137
22	Guinea	34
23	Guinea-Bissau	37
24	Kenya	48
25	Lesotho	10
26	Liberia	66
27	Libya	32
28	Madagascar	22
29	Malawi	253
30	Mali	51
31	Mauritania	44
32	Mauritius	10
33	Morocco	54
34	Mozambique	128
35	Namibia	107
36	Niger	36
37	Nigeria	775
38	Republic of Congo	46
39	Rwanda	142
40	Sao Tome and Principe	2
41	Senegal	30
42	Sierra Leone	14
43	Somalia	74
44	South Africa	354
45	Sudan	26
46	Swaziland	4
47	Tanzania	136
48	Togo	21
49	Tunisia	267
50	Uganda	162
51	Western Sahara	4
52	Zambia	72
53	Zimbabwe	60

B.2 Ethnic Homelands

Figure B2: Ethnic Homelands in Africa

B.3 Road Network

Figure B3: Primary and Secondary Roads in Africa

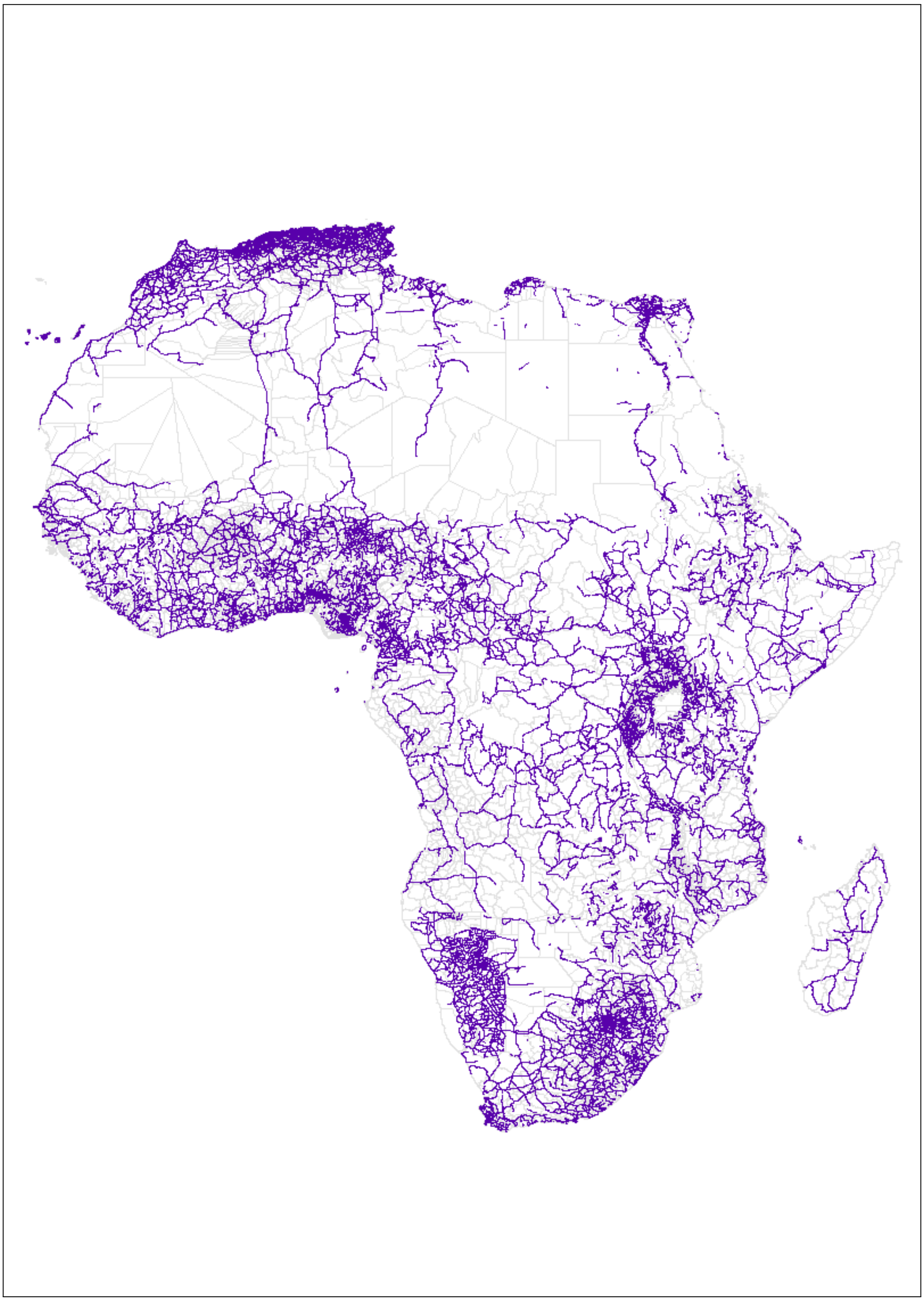
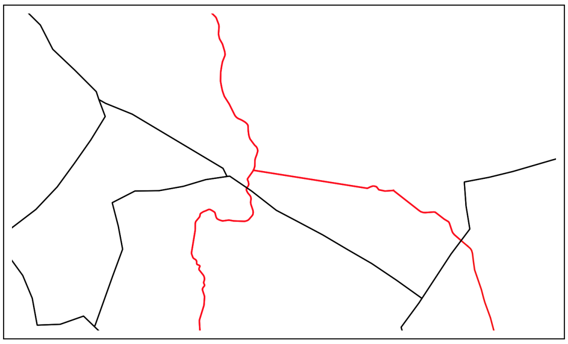
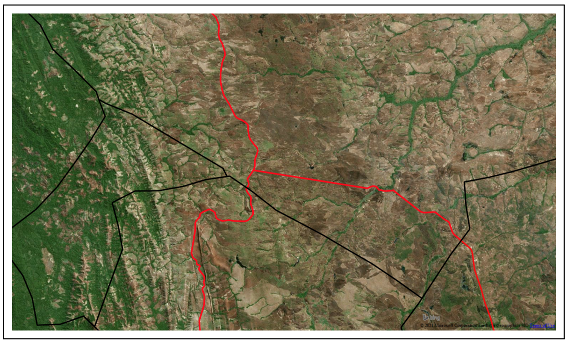


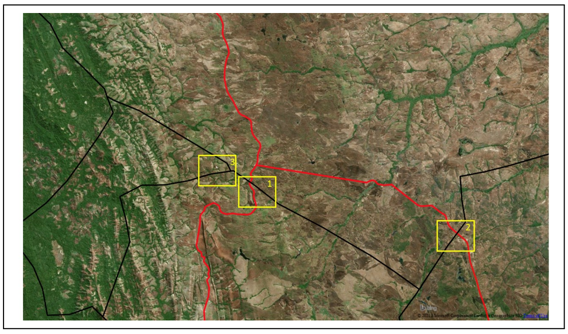
Figure B4: Major Road Connectivity Example - Ambaca, Angola



a) District boundaries of Ambaca (black) and major roads (red)

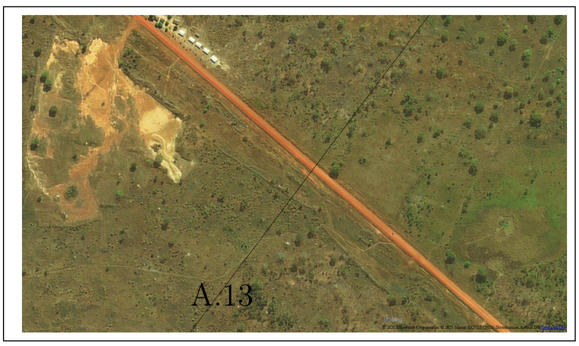


b) District boundaries of Ambaca (black) and major roads (red) with aerial photo



c) District boundaries, major roads, and zoom areas (yellow) with aerial photo

d) Zoom Area 1: Major Road Connection between Ambaca and Samba Caju



e) Zoom Area 2: Major Road Connection between Ambaca and Calandula

B.4 Mines & Minerals

Figure B5: Distribution of Mines in Africa

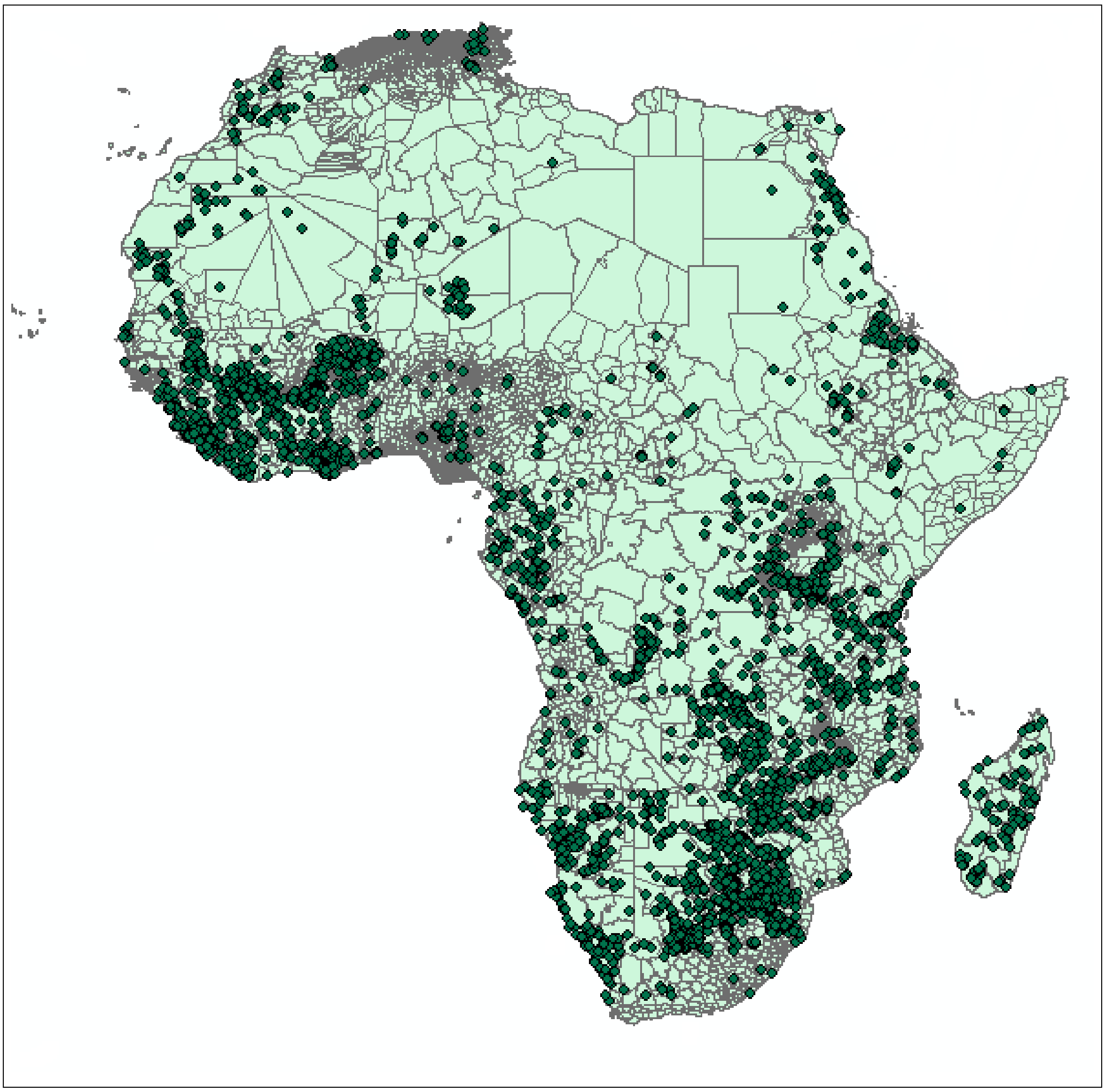
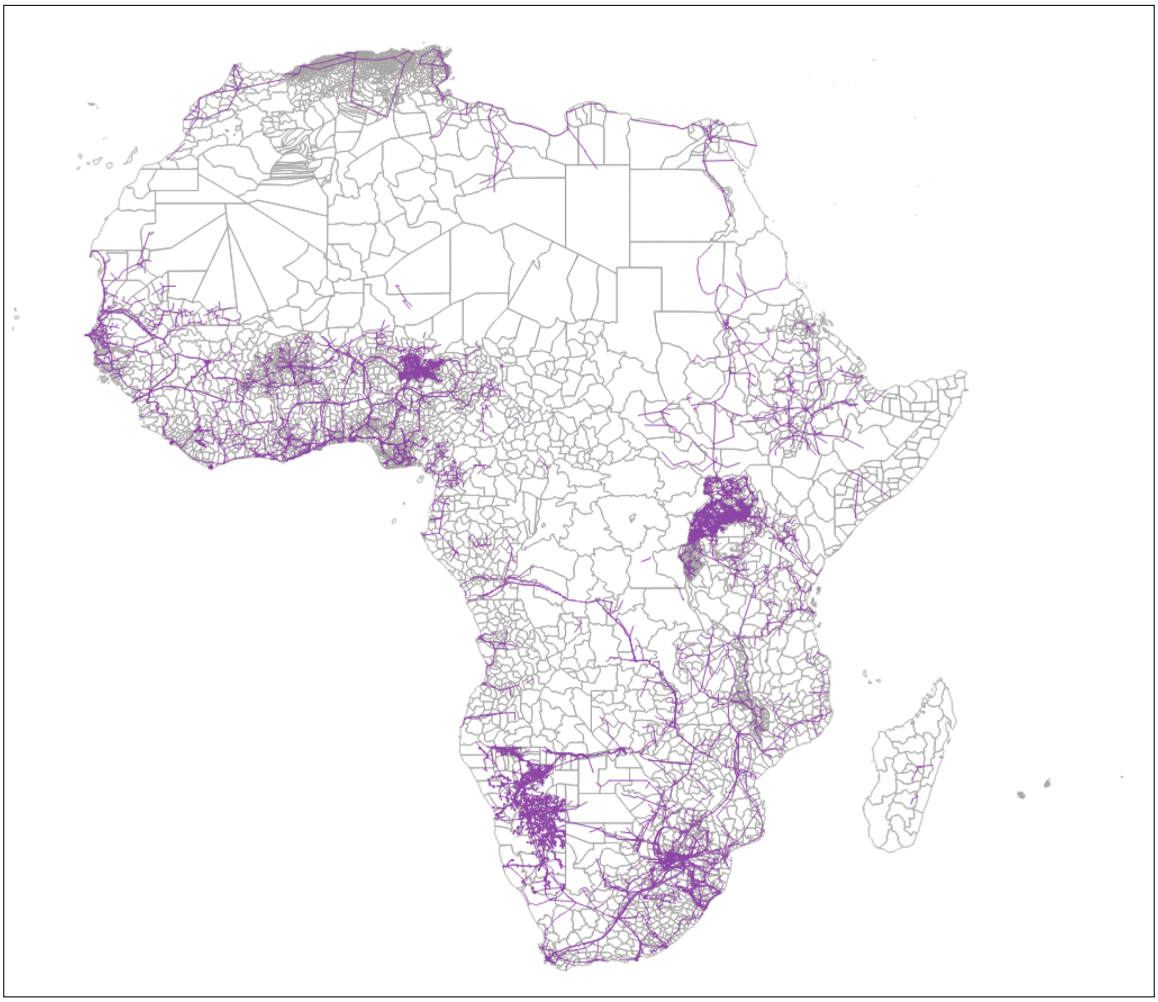


Table B2: List of Minerals

	Name	Measure	Source
1	Antimony	Tonnes	USGS Commodity Prices
2	Bauxite	Tonnes	USGS Commodity Prices
3	Chromite	Tonnes	USGS Commodity Prices
4	Coal	Tonnes	World Bank
5	Cobalt	Tonnes	USGS Commodity Prices
6	Copper	Tonnes	World Bank
7	Diamond	Carats	USGS Commodity Prices
8	Gold	Ounces	World Bank
9	Graphite	Tonnes	USGS Commodity Prices
10	Ilmenite	Tonnes	USGS Commodity Prices
11	Iron	Tonnes	World Bank
12	Lead	Tonnes	World Bank
13	Managanese	Tonnes	USGS Commodity Prices
14	Nickel	Tonnes	World Bank
15	Palladium	Ounces	USGS Commodity Prices
16	Phosphate	Tonnes	World Bank
17	Platinum	Ounces	World Bank
18	Rutile	Tonnes	USGS Commodity Prices
19	Silver	Ounces	World Bank
20	Tin	Tonnes	World Bank
21	Tantalum	Tonnes	USGS Commodity Prices
22	Tungsten	Tonnes	USGS Commodity Prices
23	Uranium Oxide	Pounds	IUSGS Commodity Prices
24	Vanadium	Tonnes	USGS Commodity Prices
25	Zinc	Tonnes	World Bank
26	Zircon	Tonnes	USGS Commodity Prices

B.5 Electricty Grid in Africa

Figure B6: Electricity Grid in Africa



C Correlation between Subnational GDP and Subnational Nighttime Lights in Africa

Hodler and Raschky (2014, Appendix B) document a strong correlation between GDP per capita and nighttime lights in subnational administrative regions using the subnational GDP data by Gennaioli et al. (2014). In Table C1, we replicate their analysis using their data, but restricting the sample to the 82 subnational regions from the nine African countries for which Gennaioli et al. (2014) provide subnational GDP data. These countries are: Benin, Egypt, Kenya, Lesotho, Morocco, Mozambique, Nigeria, South Africa, and Tanzania. Comparing the results reported in Table C1 with those in Hodler and Raschky (2014) suggests that the relation between subnational GDP per capita and subnational nighttime lights is very similar in Africa as elsewhere.

Table C1: Subnational GDP and Nighttime Lights in Africa

	(1)	(2)
$Light_{it}$	0.291***	0.354***
	(0.005)	(0.047)
R-squared	0.688	0.688
Observations	1,200	1,200
Region FE	NO	YES

Notes: Dependent variable is the logarithm of regional GDP per capita. OLS regressions. $Light_{it}$ is the logarithm of average nighttime lights. Robust standard errors in parentheses. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

D Main Result (complete table)

Table D1: Connectivity based on ethnicity, geography and roads

	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV
				Dependent variable: $Light_{it}$				
$Ethnicity\ W\ Light_{jt}$	0.547***	0.737***					0.160***	0.310**
	(0.009)	(0.142)					(0.009)	(0.139)
$Inv\ Dist\ W\ Light_{jt}$			0.672***	1.287***			0.432***	0.958***
			(0.010)	(0.179)			(0.013)	(0.153)
$Inv\ Road\ W\ Light_{jt}$					0.502***	0.935***	0.269***	0.327**
					(0.009)	(0.206)	(0.011)	(0.137)
MP_{it}	0.052***	0.067***	0.088***	0.105***	0.049***	0.077***	0.094***	0.123***
	(0.017)	(0.019)	(0.016)	(0.019)	(0.015)	(0.020)	(0.016)	(0.021)
$Population_{it}$	0.166***	0.127***	0.099***	0.026	0.162***	0.034*	0.104***	0.018
	(0.044)	(0.032)	(0.031)	(0.021)	(0.051)	(0.020)	(0.037)	(0.017)
$Ethnicity\ W\ Population_{jt}$	-0.910***	-0.137**					-0.211***	-0.237***
	(0.127)	(0.058)					(0.047)	(0.063)
$Inv\ Dist\ W\ Population_{jt}$			-0.330***	-0.014			-0.045	0.030
			(0.081)	(0.038)			(0.037)	(0.040)
$Inv\ Road\ W\ Population_{jt}$					-0.644***	0.039	-0.235***	0.110*
					(0.136)	(0.029)	(0.081)	(0.048)
$Conflict_{it}$	-0.083***	-0.084***	-0.087***	-0.079***	-0.107***	-0.104***	-0.091***	-0.075***
	(0.009)	(0.010)	(0.008)	(0.009)	(0.007)	(0.009)	(0.008)	(0.010)
$Ethnicity\ W\ Conflit_{jt}$	-0.176***	-0.027**					-0.042**	-0.043
	(0.020)	(0.033)					(0.018)	(0.035)
$Inv\ Dist\ W\ Conflit_{jt}$			-0.171***	0.068**			-0.096***	0.059*
			(0.016)	(0.030)			(0.019)	(0.031)
$Inv\ Road\ W\ Conflict_{jt}$					-0.082***	0.080***	-0.012	0.091***
					(0.014)	(0.029)	(0.015)	(0.024)
First stage:				Dependent variable: $Light_{jt}$				
MP_{jt}		0.057***		0.065***		0.058***		0.078***
		(0.017)		(0.016)		(0.017)		(0.017)
First-stage F-stat		11.17		16.30		12.36		20.44
Observations	142,656	142,656	142,656	142,656	142,656	142,656	142,656	142,656
District FE	YES	YES	YES	YES	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES	YES	YES	YES	YES

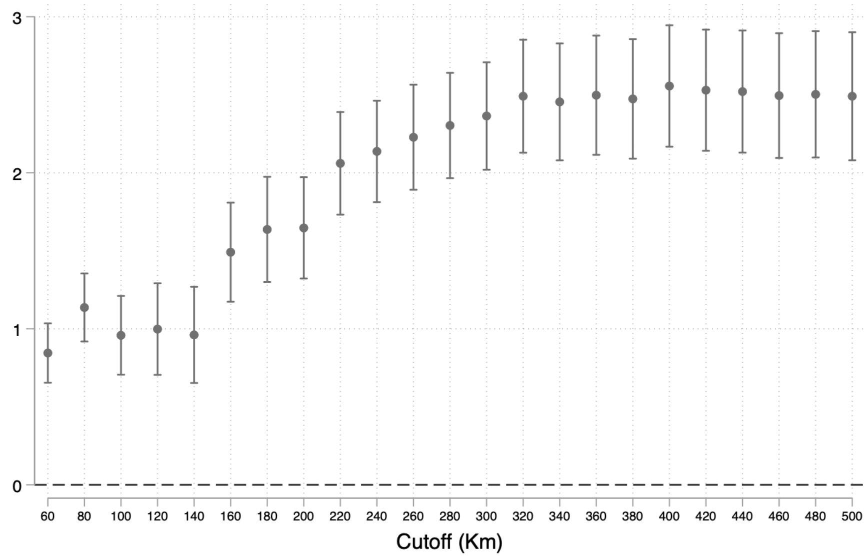
Notes: This table corresponds to Table 3, but reports the coefficient estimates on all (second-stage) control variables. Even columns report standard fixed effects regressions with district and country-year fixed effects, and odd columns IV estimates. See Section 2 for the definitions of all variables. The first stage further includes the control variables indicated in Section 3. Standard errors, clustered at the network level, are in parentheses. ***, **, * indicate significance at the 1, 5 and 10% level, respectively.

Table D2: Main Results - Stepwise addition of control variables

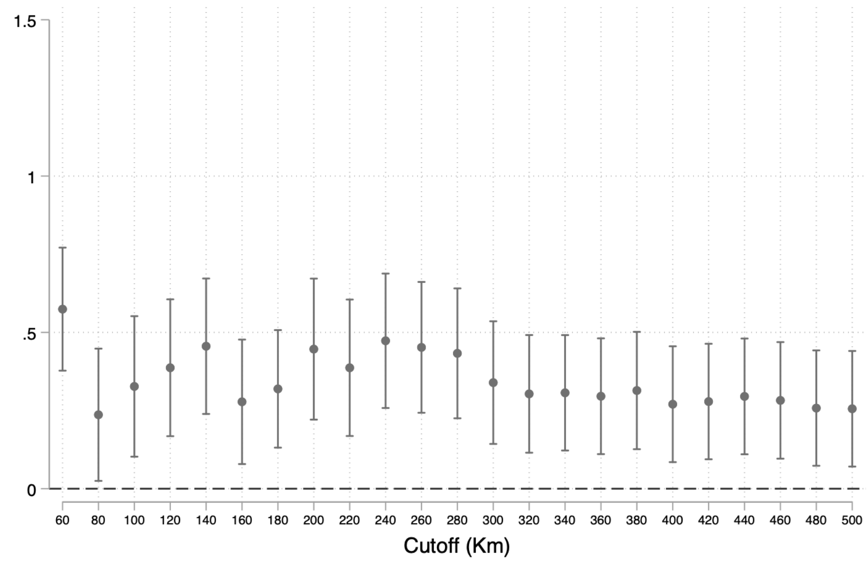
	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV
	Dependent variable: $Light_{it}$							
$Ethnicity\ W\ Light_{jt}$	0.159***	0.552**	0.163***	0.184	0.156***	0.504***	0.160***	0.310**
	(0.009)	(0.222)	(0.009)	(0.203)	(0.009)	(0.142)	(0.009)	(0.139)
$Inv\ Dist\ W\ Light_{jt}$	0.437***	2.018***	0.431***	1.106***	0.438***	1.076***	0.432***	0.958***
	(0.013)	(0.261)	(0.013)	(0.195)	(0.013)	(0.183)	(0.013)	(0.153)
$Inv\ Road\ W\ Light_{jt}$	0.261***	-0.407*	0.270***	0.446**	0.261***	0.017	0.269***	0.327**
	(0.010)	(0.240)	(0.011)	(0.180)	(0.010)	(0.171)	(0.011)	(0.137)
MP_{it}	0.085***	0.164***	0.076***	0.134***	0.089***	0.124***	0.094***	0.123***
	(0.016)	(0.021)	(0.016)	(0.022)	(0.016)	(0.020)	(0.016)	(0.021)
$Population_{it}$			0.128***	0.004			0.104***	0.018
			(0.045)	(0.016)			(0.037)	(0.017)
$Ethnicity\ W\ Population_{jt}$			-0.284***	-0.199***			-0.211***	-0.237***
			(0.057)	(0.060)			(0.047)	(0.063)
$Inv\ Dist\ W\ Population_{jt}$			0.001	-0.093***			0.045	-0.030
			(0.031)	(0.037)			(0.037)	(0.040)
$Inv\ Road\ W\ Population_{jt}$			-0.343***	0.095**			-0.235***	0.110**
			(0.114)	(0.046)			(0.081)	(0.048)
$Conflict_{it}$					-0.091***	-0.071***	-0.091***	-0.075***
					(0.008))	(0.010)	(0.008)	(0.010)
$Ethnicity\ W\ Conflict_{jt}$					-0.048***	-0.017	-0.042**	-0.043
					(0.018)	(0.036)	(0.018)	(0.036)
$Inv\ Dist\ W\ Conflict_{jt}$					-0.098***	0.82***	-0.096***	0.059***
					(0.019)	(0.032)	(0.018)	(0.031)
$Inv\ Road\ W\ Conflict_{jt}$					0.008	0.055**	-0.016	0.091***
					(0.015)	(0.025)	(0.015)	(0.024)
First stage:	Dependent variable: $Light_{jt}$							
MP_{jt}		0.077***		0.076***		0.079***		0.078***
		(0.017)		(0.017)		(0.018)		(0.017)
First-stage F-stat		19.55		19.21		20.89		20.44
Observations	142,656	142,656	142,656	142,656	142,656	142,656	142,656	142,656
District FE	YES	YES	YES	YES	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES	YES	YES	NO	NO

Notes: Even columns report standard fixed effects regressions, and odd columns IV estimates. See Section 2 for the definitions of all variables. The first stage further includes the control variables indicated in Section 3. Standard errors, clustered at the network level, are in parentheses. ***, **, * indicate significance at the 1, 5 and 10% level, respectively.

Figure D1: Coefficients on the Spatial Lag of the Dependent Variable



Coefficient on $Inv\ Dist\ W\ Light_{jt}$



Coefficient on $Inv\ Road\ W\ Light_{jt}$

Notes: Dots show the coefficients on $Inv\,Dist\,W\,Light_{jt}$ and $Inv\,Road\,W\,Light_{jt}$ from the second-stage regression reported in Table 1, column (8), when applying different distance cutoffs for the weighting matrices for geographic and road connectivity. The vertical lines show the 90% confidence interval based on standard errors clustered along the relevant network.

E Robustness checks

E.1 Robustness: Province-Year Fixed Effects

Table E1: Province-Year Fixed Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	Dependent variable: $Light_{it}$							
$Ethnicity\ W\ Light_{jt}$	0.048***	0.394***					-0.012	0.283**
	(0.009)	(0.138)					(0.009)	(0.139)
$Inv\ Dist\ W\ Light_{jt}$			0.259***	0.812***			0.208***	0.310**
			(0.010)	(0.167)			(0.012)	(0.139)
$Inv\ Road\ W\ Light_{jt}$					0.166***	-0.019	0.129***	0.333**
					(0.007)	(0.186)	(0.009)	(0.142)
First stage:	Dependent variable: $Light_{jt}$							
MP_{jt}		0.097***		0.096***		0.099***		0.098***
		(0.017)		(0.016)		(0.017)		(0.019)
First-stage F-stat		30.71		32.86		34.41		27.30
Observations	142,656	142,656	142,656	142,656	142,656	142,656	142,656	142,656
District FE	YES	YES	YES	YES	YES	YES	YES	YES
Province-year FE	YES	YES	YES	YES	YES	YES	YES	YES
Additional controls	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Even columns report standard fixed effects regressions with district and province(ADM1)-year fixed effects, and odd columns IV estimates. $Ethnicity\,W\,Light_{jt}$ is weighted $Light_{jt}$ with weights based on the row-normalized ethnicity matrix. $Inv\,Dist\,W\,Light_{jt}$ ($Inv\,Road\,W\,Light_{jt}$) is weighted $Light_{jt}$ with weights based on the row-normalized matrix of the inverse altitude-adjusted geodesic distances (inverse road distances) truncated at 100km. Additional control variables are population, conflict and MP_{it} as well as weighted population and conflict in districts $j \neq i$. MP_{jt} is an interaction term based on cross-sectional information on the location of mines and time-varying world prices of the commodities produced in these mines. Standard errors, clustered at the network level, are in parentheses. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

E.2 Robustness: Temporal and Spatial Lags

Table E2: Temporal and Spatial Lags

	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV
				Dependent variable: $Light_{it}$				
$Ethnicity\ W\ Light_{jt-1}$	0.455***	0.665***					0.135***	0.284**
	(0.011)	(0.144)					(0.011)	(0.142)
$Inv\ Dist\ W\ Light_{jt-1}$			0.560***	1.168***			0.365***	0.933***
			(0.012)	(0.178)			(0.014)	(0.156)
$Inv\ Road\ W\ Light_{jt-1}$					0.411***	0.681***	0.214***	0.283**
					(0.009)	(0.211)	(0.010)	(0.140)
First stage:				Dependent variable: $Light_{jt-1}$				
MP_{jt-1}		0.061***		0.069***		0.062***		0.078***
		(0.018)		(0.017)		(0.017)		(0.018)
First-stage F-stat		12.07		16.61		13.38		18.67
Observations	136,712	136,712	136,712	136,712	136,712	136,712	136,712	136,712
District FE	YES	YES	YES	YES	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES	YES	YES	YES	YES
Additional controls	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Even columns report standard fixed effects regressions with district and country-year fixed effects, and odd columns IV estimates. $Ethnicity\,W\,Light_{jt}$ is weighted $Light_{jt}$ with weights based on the row-normalized ethnicity matrix. $Inv\,Dist\,W\,Light_{jt}$ ($Inv\,Road\,W\,Light_{jt}$) is weighted $Light_{jt}$ with weights based on the row-normalized matrix of the inverse altitude-adjusted geodesic distances (inverse road distances) truncated at 100km. Additional control variables are population, conflict and MP_{it} as well as weighted population and conflict in districts $j \neq i$. MP_{jt} is an interaction term based on cross-sectional information on the location of mines and time-varying world prices of the commodities produced in these mines. Standard errors, clustered at the network level, are in parentheses. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

E.3 Robustness: Spatial Clustering of Standard Errors

Table E3: Spatial Clustering of Standard Errors

	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV
				Dependent variable: $Light_{it}$				
$Ethnicity\ W\ Light_{jt}$	0.547***	0.737***					0.160***	0.310**
	(0.011)	(0.146)					(0.008)	(0.138)
$Inv\ Dist\ W\ Light_{jt}$			0.672***	1.287***			0.432***	0.958***
			(0.010)	(0.179)			(0.009)	(0.149)
$Inv\ Road\ W\ Light_{jt}$					0.502***	0.935***	0.269***	0.327**
					(0.012)	(0.227)	(0.009)	(0.138)
First stage:				Dependent variable: $Light_{jt}$				
MP_{jt}		0.057***		0.065***		0.058***		0.078***
		(0.017)		(0.016)		(0.017)		(0.016)
First-stage F-stat		10.74		16.29		11.31		23.28
Observations	142,656	142,656	142,656	142,656	142,656	142,656	142,656	142,656
District FE	YES	YES	YES	YES	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES	YES	YES	YES	YES
Additional controls	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Even columns report standard fixed effects regressions with district and country-year fixed effects, and odd columns report IV estimates. $Ethnicity\,W\,Light_{jt}$ is weighted $Light_{jt}$, with weights based on the row-normalized ethnicity matrix. $Inv\,Dist\,W\,Light_{jt}$ ($Inv\,Road\,W\,Light_{jt}$) is weighted $Light_{jt}$, with weights based on the row-normalized matrix of the inverse altitude-adjusted geodesic distances (inverse road distances) truncated at 100km. Additional control variables are population, conflict and MP_{it} as well as weighted population and conflict in districts $j \neq i$. MP_{jt} is an interaction term based on cross-sectional information on the location of mines and time-varying world prices of the commodities produced in these mines. Spatially clustered standard errors are in parentheses, allowing for spatial correlation up to 70km and for infinite serial correlation. ***, **, * indicate significance at the 1, 5 and 10% level, respectively.

E.4 Robustness: Grid-Cells as Unit of Observation

Table E4: Grid-Cells as Unit of Observation

	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV
				Dependent variable: $Light_{it}$				
$Eth\ W\ Light_{jt}$	0.859***	0.665***					0.126***	1.509***
	(0.004)	(0.062)					(0.006)	(0.078)
$Inv\ Dist\ W\ Light_{jt}$			0.944***	1.901***			0.859***	1.009***
			(0.002)	(0.090)			(0.007)	(0.046)
$Inv\ Road\ W\ Light_{jt}$					0.463***	0.938***	-0.026***	-0.336***
					(0.005)	(0.054)	(0.003)	(0.067)
First stage:				Dependent variable: $Light_{jt}$				
MP_{jt}		0.077***		0.076***		0.050***		0.042***
		(0.022)		(0.018)		(0.019)		(0.020)
First-stage F-stat		12.25		17.42		7.27		4.22
Observations	248,040	248,040	248,040	248,040	248,040	248,040	248,040	248,040
District FE	YES	YES	YES	YES	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES	YES	YES	YES	YES
Additional controls	YES	YES	YES	YES	YES	YES	YES	YES

Notes: The units of observation are rectangular grid cells of 0.5 × 0.5 degrees (i.e., around 55 × 55km at the equator). Even columns report standard fixed effects regressions with district and country-year fixed effects, and odd columns report IV estimates. $Ethnicity\,W\,Light_{jt}$ is weighted $Light_{jt}$, with weights based on the row-normalized ethnicity matrix. $Inv\,Dist\,W\,Light_{jt}$ ($Inv\,Road\,W\,Light_{jt}$) is weighted $Light_{jt}$, with weights based on the row-normalized matrix of the inverse altitude-adjusted geodesic distances (inverse road distances) truncated at 100km. Additional control variables are population, conflict and MP_{it} as well as weighted population and conflict in districts $j \neq i$. MP_{jt} is an interaction term based on cross-sectional information on the location of mines and time-varying world prices of the commodities produced in these mines. Standard errors, clustered at the network level, are in parentheses. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

E.5 Robustness: Excluding Top Mineral Producers

Table E5: Dropping Large Players

	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV
	Dependent variable: $Light_{it}$							
$Ethnicity\ W\ Light_{jt}$	0.561***	0.707***					0.155***	0.173
	(0.009)	(0.166)					(0.009)	(0.162)
$Inv\ Dist\ W\ Light_{jt}$			0.682***	1.151***			0.426***	0.709***
			(0.011)	(0.188)			(0.013)	(0.161)
$Inv\ Road\ W\ Light_{jt}$					0.540***	0.806***	0.291***	0.600***
					(0.008)	(0.204)	(0.010)	(0.136)
First stage:	Dependent variable: $Light_{jt}$							
MP_{jt}		0.115***		0.130***		0.114***		0.139***
		(0.022)		(0.020)		(0.021)		(0.021)
First-stage F-stat		28.02		41.66		30.56		43.20
Observations	134,160	134,160	134,160	134,160	134,160	134,160	134,160	134,160
District FE	YES	YES	YES	YES	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES	YES	YES	YES	YES
Additional controls	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Sample is restricted to districts of countries that do not belong to the top ten producers for any mineral under consideration over the sample period. Even columns report standard fixed effects regressions with district and country-year fixed effects, and odd columns IV estimates. $Ethnicity\,W\,Light_{jt}$ is weighted $Light_{jt}$ with weights based on the row-normalized ethnicity matrix. $Inv\,Dist\,W\,Light_{jt}$ ($Inv\,Road\,W\,Light_{jt}$) is weighted $Light_{jt}$ with weights based on the row-normalized matrix of the inverse altitude-adjusted geodesic distances (inverse road distances) truncated at 100km. Additional control variables are population, conflict and MP_{it} as well as weighted population and conflict in districts $j \neq i$. MP_{jt} is an interaction term based on cross-sectional information on the location of mines and time-varying world prices of the commodities produced in these mines. Standard errors, clustered at the network level, are in parentheses. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

E.6 Robustness: Fiscal Channel

Table E6: Controlling for Connectivity based on ADM1 Networks

	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV
					$Light_{it}$			
Ethnicity W $Light_{jt}$	0.223***	0.107					0.086***	-0.149
	(0.009)	(0.134)					(0.008)	(0.125)
Inv Dist W $Light_{jt}$			0.417***	0.810***			0.313***	0.739***
			(0.010)	(0.144)			(0.011)	(0.129)
Inv Road W $Light_{jt}$					0.289***	0.520***	0.208***	0.365***
					(0.009)	(0.153)	(0.009)	(0.121)
$ADM1\ W\ Light_{jt}$	0.613***	1.116***	0.444***	1.050***	0.528***	1.414***	0.331***	0.813***
	(0.010)	(0.181)	(0.010)	(0.186)	(0.009)	(0.223)	(0.010)	(0.160)
First stage:					$Light_{jt}$			
MP_{jt}		0.063***		0.069***		0.062***		0.077***
		(0.018)		(0.017)		(0.018)		(0.018)
First-stage F-stat		11.71		16.40		11.94		17.91
Observations	142,656	142,656	142,656	142,656	142,656	142,656	142,656	142,656
District FE	YES	YES	YES	YES	YES	YES	YES	YES
Country Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Additional Controls	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Even columns report standard fixed effects regressions with district and country-year fixed effects, and odd columns IV estimates. *Ethnicity W* $Light_{jt}$ is weighted $Light_{jt}$ with weights based on the row-normalized ethnicity matrix. *Inv Dist W* $Light_{jt}$ (*Inv Road W* $Light_{jt}$) is weighted $Light_{jt}$ with weights based on the row-normalized matrix of the inverse altitude-adjusted geodesic distances (inverse road distances) truncated at 100km. $ADM1\, W\, Light_{jt}$ is weighted $Light_{jt}$ with weights based on the row-normalized ADM1 matrix, which identifies whether districts belong to the same ADM1 unit. Additional control variables are population, conflict and MP_{it} as well as weighted population and conflict in districts $j \neq i$. MP_{jt} is an interaction term based on cross-sectional information on the location of mines and time-varying world prices of the commodities produced in these mines. Standard errors, clustered at the network level, are in parentheses. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

E.7 Robustness: Contiguity Network

Table E7: Connectivity based on contiguity

	(1) OLS	(2) IV
	Dependent variable: $Light_{it}$	
$Contiguity\ W\ Light_{jt}$	0.919***	2.026***
	(0.004)	(0.257)
First stage:	Dependent variable: $Light_{jt}$	
MP_{jt}		0.062***
		(0.015)
First-stage F-Stat		16.95
Observations	142,656	142,656
District FE	YES	YES
Country-year FE	YES	YES
Additional controls	YES	YES

Notes: Column (1) reports the standard fixed effects regression with district and country-year fixed effects, and column (2) the IV estimates. $Contiguity\,W\,Light_{jt}$ is weighted $Light_{jt}$ with weights based on the row-normalized contiguity matrix. Additional control variables are population, conflict and MP_{it} as well as weighted population and conflict in districts $j \neq i$. MP_{jt} is an interaction term based on cross-sectional information on the location of mines and time-varying world prices of the commodities produced in these mines. Standard errors, clustered at the network level, are in parentheses. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

E.8 Robustness: Geodesic Network without Adjustment for Variability in Altitude

Table E8: Geodesic Network without Adjustment for Variability in Altitude

	(1) OLS	(2) IV	(3) OLS	(4) IV
	Dependent variable: $Light_{it}$			
$Ethnicity\ W\ Light_{jt}$			0.160***	0.352**
			(0.010)	(0.143)
$Inv\ Dist\ W\ Light_{jt}$	0.689***	1.240***	0.423***	1.166***
	(0.011)	(0.155)	(0.014)	(0.151)
$Inv\ Road\ W\ Light_{jt}$			0.287***	0.225*
			(0.012)	(0.134)
First stage:	Dependent variable: $Light_{jt}$			
MP_{jct}		0.068***		0.079***
		(0.016)		(0.017)
First-stage F-stat		17.50		20.47
Observations	142,656	142,656	142,656	142,656
District FE	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES
Additional controls	YES	YES	YES	YES

Notes: Even columns report standard fixed effects regressions with district and country-year fixed effects, and odd columns IV estimates. $Ethnicity\, W\, Light_{jt}$ is weighted $Light_{jt}$ with weights based on the row-normalized ethnicity matrix. $Inv\, Dist\, W\, Light_{jt}$ ($Inv\, Road\, W\, Light_{jt}$) is weighted $Light_{jt}$ with weights based on the row-normalized matrix of the inverse geodesic distances without adjustment for the variability in altitude (inverse road distances) truncated at 100km. Additional control variables are population, conflict and MP_{it} as well as weighted population and conflict in districts $j \neq i$. MP_{jt} is an interaction term based on cross-sectional information on the location of mines and time-varying world prices of the commodities produced in these mines. Standard errors, clustered at the network level, are in parentheses. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

E.9 Robustness: Alternative Ethnicity Network

Table E9: Alternative Ethnicity Network

	(1) OLS	(2) IV	(3) OLS	(4) IV
	Dependent variable: $Light_{it}$			
$Ethnicity\ W\ Light_{jt}$	0.631***	0.990**	0.166***	0.935**
	(0.019)	(0.427)	(0.013)	(0.376)
$Inv\ Dist\ W\ Light_{jt}$			0.465***	0.382***
			(0.012)	(0.083)
$Inv\ Road\ W\ Light_{jt}$			0.279***	0.281***
			(0.011)	(0.075)
First stage:	Dependent variable: $Light_{jt}$			
MP_{jt}		0.024		0.065***
		(0.026)		(0.024)
First-stage F-stat		0.86		7.10
Observations	142,656	142,656	142,656	142,656
District FE	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES
Additional controls	YES	YES	YES	YES

Notes: Even columns report standard fixed effects regressions with district and country-year fixed effects, and odd columns IV estimates. $Ethnicity\,W\,Light_{jt}$ is weighted $Light_{jt}$ with weights based on the row-normalized alternative ethnicity matrix, as discussed in Section 6.2. $Inv\,Dist\,W\,Light_{jct}$ ($Inv\,Road\,W\,Light_{jt}$) is weighted $Light_{jt}$ with weights based on the row-normalized matrix of the inverse altitude-adjusted geodesic distances (inverse road distances) truncated at 100km. Additional control variables are population, conflict and MP_{it} as well as weighted population and conflict in districts $j \neq i$. MP_{jt} is an interaction term based on cross-sectional information on the location of mines and time-varying world prices of the commodities produced in these mines. Standard errors, clustered at the network level, are in parentheses. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

E.10 Networks within and across Countries

Table E10: Within-Country Networks

	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV
				$Light_{ict}$				
$Ethnicity\ W\ Light_{jct}$	0.433***	0.798***					0.116***	-0.052
$(Within\ Country)$	(0.009)	(0.115)					(0.008)	(0.117)
$Inv\ Dist\ W\ Light_{jct}$			0.595***	0.986***			0.390***	0.734***
$(Within\ Country)$			(0.009)	(0.172)			(0.010)	(0.141)
$Inv\ Road\ W\ Light_{jct}$					0.444***	0.871***	0.237***	0.339***
$(Within\ Country)$					(0.008)	(0.187)	(0.009)	(0.122)
First stage:				$Light_{jct}$				
MP_{jct}		0.039**		0.059***		0.053***		0.065***
		(0.016)		(0.015)		(0.016)		(0.017)
First-stage F-stat		5.81		13.87		10.88		14.73
Observations	142,656	142,656	142,656	142,656	142,656	142,656	142,656	142,656
District FE	YES	YES	YES	YES	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES	YES	YES	YES	YES
Additional controls	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Even columns report standard fixed effects regressions with district and country-year fixed effects, and odd columns IV estimates. $Ethnicity\,W\,Light_{jct}\,(Within\,Country)$ is weighted $Light_{jct}$ for districts belonging to the same country, with weights based on the row-normalized ethnicity matrix. $Inv\,Dist\,W\,Light_{jt}\,(Within\,Country)$ $(Inv\,Road\,W\,Light_{jct}\,(Within\,Country))$ is weighted $Light_{jct}$ for districts belonging to the same country, with weights based on the row-normalized matrix of the inverse altitude-adjusted geodesic distances (inverse road distances) truncated at 100km. Additional control variables are population, conflict and MP_{ict} as well as weighted population and conflict in districts $j \neq i$. MP_{jct} is an interaction term based on cross-sectional information on the location of mines and time-varying world prices of the commodities produced in these mines. Standard errors, clustered at the network level, are in parentheses. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

Table E11: Outside-Country Networks

	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV
				$Light_{ict}$				
Ethnicity W $Light_{jct}$	0.213***	1.088***					0.075***	0.625***
(*Outside Country*)	(0.008)	(0.095)					(0.011)	(0.135)
Inv Dist W $Light_{jct}$			0.363***	1.207***			0.266***	2.042***
(*Outside Country*)			(0.012)	(0.241)			(0.014)	(0.210)
Inv Road W $Light_{jct}$					0.262***	0.236***	0.135***	-0.560
(*Outside Country*)					(0.006)	(0.102)	(0.009)	(0.168)
First stage:				$Light_{jct}$				
MP_{jct}		0.054***		0.038***		0.049***		0.063***
		(0.015)		(0.015)		(0.015)		(0.017)
First-stage F-stat		12.20		6.26		10.54		13.19
Observations	142,656	142,656	142,656	142,656	142,656	142,656	142,656	142,656
District FE	YES	YES	YES	YES	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES	YES	YES	YES	YES
Additional controls	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Even columns report standard fixed effects regressions with district and country-year fixed effects, and odd columns IV estimates. $Ethnicity\, W\, Light_{jct}$ $(Outside\, Country)$ is weighted $Light_{jct}$ for districts not belonging to the same country, with weights based on the row-normalized ethnicity matrix. $Inv\, Dist\, W\, Light_{jct}$ $(Outside\, Country)$ ($Inv\, Road\, W\, Light_{jct}$ $(Outside\, Country)$) is weighted $Light_{jct}$ for districts not belonging to the same country, with weights based on the row-normalized matrix of the inverse altitude-adjusted geodesic distances (inverse road distances) truncated at 100km. Additional control variables are population, conflict and MP_{ict} as well as weighted population and conflict in districts $j \neq i$. MP_{jct} is an interaction term based on cross-sectional information on the location of mines and time-varying world prices of the commodities produced in these mines. Standard errors, clustered at the network level, are in parentheses. ***, **, * indicate significance at the 1, 5 and 10%-level, respectively.

Table E12: Incorporating the Electricity Network

	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV
	Full Sample		Full Sample		Excluding districts connected to the grid	
	Dependent variable: $Light_{ict}$					
Ethnicity W $Light_{jct}$			0.161***	0.480***	0.152***	-0.043
			(0.009)	(0.122)	(0.010)	(0.253)
Inv Dist W $Light_{jct}$			0.427***	0.489***	0.456***	0.717***
			(0.016)	(0.102)	(0.014)	(0.219)
Inv Road W $Light_{jct}$			0.272***	0.107***	0.224***	0.357***
			(0.013)	(0.085)	(0.010)	(0.106)
Electricity W $Light_{jct}$	-0.167***	0.967***	-0.163***	0.875**		
	(0.022)	(0.378)	(0.016)	(0.426)		
First stage:	Dependent variable: $Light_{jct}$					
MP_{jct}		0.048**		0.093***		0.135***
		(0.020)		(0.019)		(0.025)
First-stage F-stat		5.83		24.27		29.53
Observations	142,656	142,656	142,656	142,656	118,848	118,848
District FE	YES	YES	YES	YES	YES	YES
Country-year FE	YES	YES	YES	YES	YES	YES
Additional controls	YES	YES	YES	YES	YES	YES

Notes: Even columns report standard fixed effects regressions with district and country-year fixed effects, and odd columns report IV estimates. *Ethnicity W* $Light_{jct}$ is weighted $Light_{jct}$, with weights based on the row-normalized ethnicity matrix. *Inv Dist W* $Light_{jct}$ (*Inv Road W* $Light_{jct}$) is weighted $Light_{jct}$, with weights based on the row-normalized matrix of the inverse altitude-adjusted geodesic distances (inverse road distances) truncated at 100km. *Electricity W* $Light_{jct}$ is weighted $Light_{jct}$, with weights based on the row-normalized network of districts connected to the electricity grid. Additional control variables are population, conflict and MP_{ict} as well as weighted population and conflict in districts $j \neq i$. MP_{jct} is an interaction term based on cross-sectional information on the location of mines and time-varying world prices of the commodities produced in these mines. Columns (1)-(4) use the full sample of districts, while Columns (5)-(6) use only the set of districts not connected to the electricity grid. Standard errors, clustered at the network level, are in parentheses. ***, **, * indicate significance at the 1, 5 and 10% level, respectively.

F Key Player Rankings

Table F1: Top-Ten Key Player Rankings

(1) Country	(2) Province	(3) District	(4) Overall KP Rank	(5) Overall Katz-Bon Rank	(6) Overall Betw. Rank	(7) Overall Eig. Rank	(8) Ethnicity KP Rank	(9) Road KP Rank	(10) Inv.Dist KP Rank	(11) Nighttime Light Rank
					Nigeria					
Nigeria	Lagos	Ikeja	1	249	654	432	5	1	2	2
Nigeria	Kano	Fagge	2	478	186	529	3	2	3	5
Nigeria	Lagos	Ajeromi/Ifelodun	3	244	270	438	2	4	5	4
Nigeria	Lagos	Apapa	4	239	660	439	12	5	11	12
Nigeria	Lagos	Agege	5	264	638	430	4	3	1	8
Nigeria	Kano	Tarauni	6	476	697	529	14	11	9	14
Nigeria	Rivers	Obio/Akp	7	752	736	86	19	18	17	18
Nigeria	Lagos	Surulere	8	226	649	435	8	6	7	3
Nigeria	Lagos	Ifako/Ijaye	9	280	611	426	11	8	6	11
Nigeria	Lagos	Mainland	10	212	651	436	9	9	4	6
					Kenya					
Kenya	Nairobi	Nairobi*	1	9	29	14	1	1	1	1
Kenya	Coast	Kilifi	2	19	32	14	16	48	48	20
Kenya	Coast	Mombasa	3	24	43	14	2	2	2	2
Kenya	Central	Kiambu	4	6	41	14	3	3	3	3
Kenya	Rift Valley	Nakuru	5	5	3	14	25	47	7	14
Kenya	Eastern	Machakos	6	14	22	14	8	6	24	7
Kenya	Nyanza	Kisumu	7	39	18	14	5	7	5	5
Kenya	Central	Kirinyaga	8	45	24	14	7	9	11	8
Kenya	Western	Vihiga	9	36	17	14	9	10	9	9
Kenya	Eastern	Embu	10	46	27	14	10	17	20	15

Notes: Overall KP Rank is based on the ρs estimated in column (8) of Table 1. Overall Katz-Bonacich Rank is based on the ρs estimated in column (8) of Table 1 and a weighting vector of 1. Ethnicity KP Rank is based on ρ_1 estimated in column (2) of Table 1. Inv.Dist KP Rank is based on ρ_2 estimated in column (4) of Table 1. Road KP Rank is based on ρ_3 estimated in column (6) Table 1. * indicate districts that are (part of) capital cities. Nigeria has 775 districts, and Kenya has 48 districts.

Table F2: Top-Ten Key Player Rankings for Populous Countries

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Country	Province	District	Overall	Overall	Overall	Overall	Ethnicity	Road	Inv.Dist	Nighttime
			KP	Katz-Bon	Betw.	Eig.	KP	KP	KP	Light
		Rank	Rank	Rank	Rank	Rank	Rank	Rank	Rank	Rank
Ethiopia										
Ethiopia	Addis Ababa	Zone 2*	1	64	44	1	4	1	1	5
Ethiopia	Addis Ababa	Zone 3*	2	63	15	1	8	4	2	8
Ethiopia	Addis Ababa	Zone 6*	3	61	55	1	9	9	6	9
Ethiopia	Addis Ababa	Zone 4*	4	65	50	1	5	3	3	4
Ethiopia	Tigray	Mekele	5	57	52	53	6	5	4	6
Ethiopia	Amhara	Bar Dar Sp. Zone	6	56	62	15	7	7	7	7
Ethiopia	Amhara	West Gojam	7	53	12	15	29	72	9	24
Ethiopia	Addis Ababa	Zone 5	8	68	46	1	3	6	5	3
Ethiopia	Oromia	North Shewa (K4)	9	62	51	9	18	10	16	17
Ethiopia	Oromia	West Shewa	10	70	4	10	65	8	15	19
Egypt										
Egypt	Suhaj		1	26	4	21	6	5	2	6
Egypt	Asyut		2	25	6	20	5	7	1	5
Egypt	Al Qalyubiyah		3	17	16	5	1	1	3	1
Egypt	Al Minufiyah		4	18	17	7	2	2	4	2
Egypt	Al Gharbiyah		5	19	15	4	3	3	5	3
Egypt	Dumyat		6	16	22	16	4	4	7	4
Egypt	Al Buhayrah		7	21	8	6	13	12	6	13
Egypt	Al Qahirah*		8	6	5	8	10	9	10	10
Egypt	Al Fayyum		9	24	23	11	15	14	12	15
Egypt	Bani Suwayf		10	23	14	12	14	15	11	14
Democratic Republic of the Congo (DRC)										
DRC	Kivu	Sud-Kivu	1	26	7	31	17	3	20	18
DRC	Katanga	Lubumbashi	2	7	32	32	2	2	2	2
DRC	Bas-Congo	Matadi	3	35	27	1	1	1	1	1
DRC	Bas-Congo	Boma	4	38	26	32	4	6	5	4
DRC	Kasai-Oriental	Mbuji-Mayi	5	3	32	1	3	4	3	3
DRC	Bas-Congo	Bas-Fleuve	6	34	25	32	14	10	12	15
DRC	Kinshasa City	Kinshasa*	7	2	15	32	5	7	6	5
DRC	Kivu	Bukavu	8	28	31	30	6	8	7	6
DRC	Kasai-Oriental	Tshilenge	9	4	29	1	29	23	4	28

DRC	Bas-Congo	Lukaya	10	1	30	32	16	22	8	14
South Africa (SA)										
SA	Gauteng	Johannesburg*	1	203	216	20	4	1	4	11
SA	Western Cape	Mitchells Plain*	2	172	349	20	7	3	3	7
SA	Western Cape	Kuils River*	3	174	172	20	10	4	6	12
SA	Gauteng	Boksburg*	4	151	129	20	2	2	1	6
SA	Gauteng	Roodepoort*	5	221	211	20	1	8	2	5
SA	Gauteng	Benoni	6	143	323	20	3	5	5	9
SA	Gauteng	Soshanguve*	7	304	160	20	9	6	7	3
SA	KwaZulu-Natal	Durban	8	120	333	20	11	7	10	14
SA	Western Cape	Wynberg*	9	176	350	20	15	15	8	16
SA	KwaZulu-Natal	Chatswoth	10	130	347	20	8	11	11	10
Tanzania										
Tanzania	Dar-Es-Salaam	Kinondoni	1	80	52	59	3	3	1	3
Tanzania	Arusha	Arusha	2	105	108	59	4	4	5	4
Tanzania	Dar-Es-Salaam	Ilala	3	84	54	59	5	5	3	5
Tanzania	Kilimanjaro	Moshi Urban	4	42	125	59	6	6	6	6
Tanzania	Zanzibar West	Mjini	5	60	104	29	21	1	2	1
Tanzania	Mwanza	Nyamagana	6	9	109	59	2	2	4	2
Tanzania	Zanzibar South and Central	Zanzibar Central	7	63	112	4	56	17	16	31
Tanzania	Zanzibar South and Central	Kusini	8	68	131	4	31	31	28	30
Tanzania	Kaskazini-Unguja	Kaskazini 'B'	9	59	121	2	24	12	22	25
Tanzania	Dar-Es-Salaam	Temeke	10	81	60	59	8	7	7	7

Notes: Overall key-player (KP) rank is based on the ρs estimated in column (8) of Table 1. Overall Katz-Bonacich rank is based on the ρs estimated in column (8) of Table 1 and a weighting vector of 1. Ethnicity KP rank is based on ρ_1 estimated in column (2) of Table 1. Inverse distance KP rank is based on ρ_2 estimated in column (4) of Table 1. Road KP rank is based on ρ_3 estimated in column (6) Table 1. * indicate districts that are (part of) capital cities. South Africa has three capital cities i.e. Pretoria (Gauteng), Bloemfontein (Free State) and Cape Town (Western Cape). The number of districts per country are: Ethiopia 72, Egypt 26 (ADM1 level), DRC 38, South Africa 354, and Tanzania 136.

G Top-Ten Rankings from Policy Experiments for Kenya and Nigeria

Table G1: Top-Ten Rankings from Policy Experiment 1 – Nighttime Lights

(1) Country	(2) Province	(3) District	(4) Overall Rank	(5) Overall Key-Player Rank
		Nigeria		
Nigeria	Bayelsa	Brass	1	771
Nigeria	Bayelsa	Nembe	2	769
Nigeria	Lagos	Mushin	3	774
Nigeria	Rivers	Ogu/Bolo	4	772
Nigeria	Lagos	Surulere	5	8
Nigeria	Lagos	Oshodi/Isolo	6	33
Nigeria	Lagos	Mainland	7	10
Nigeria	Lagos	Shomolu	8	19
Nigeria	Kano	Dala	9	773
Nigeria	Lagos	Ikeja	10	1
		Kenya		
Kenya	Coast	Lamu	1	48
Kenya	Central	Murang'a	2	41
Kenya	Central	Kiambu	3	4
Kenya	Coast	Kwale	4	47
Kenya	Central	Machakos	5	44
Kenya	Rift Valley	Nakuru	6	5
Kenya	Nairobi	Nairobi	7	1
Kenya	Eastern	Embu	8	10
Kenya	Eastern	Machakos	9	6
Kenya	Central	Kirinyaga	10	8

Notes: Overall rank reflects the district's overall impact from increasing its average nighttime light pixel value by 10 on average nighttime lights across African districts. This counterfactual exercise is based on the ρs estimated in column (8) of Table 1. Nigeria has 775 districts, and Kenya has 48 districts.

Table G2: Top-Ten Rankings from Policy Experiment 2 – Roads

(1) Country	(2) Province	(3) District	(4) Overall Rank	(5) Overall Key-Player Rank
		Nigeria		
Nigeria	Rivers	Khana	1	135
Nigeria	Rivers	Okrika	2	16
Nigeria	Rivers	Bonny	2	763
Nigeria	Rivers	Andoni/O	4	128
Nigeria	Delta	Burutu	5	111
Nigeria	Delta	Ughelli South	6	59
Nigeria	Rivers	Gokana	7	84
Nigeria	Delta	Warri North	8	70
Nigeria	Rivers	Akukutor	9	728
Nigeria	Delta	Warri South	10	72
		Kenya		
Kenya	Coast	Taita Taveta	1	16
Kenya	Nyanza	Homa Bay	2	27
Kenya	Western	Busia	3	20
Kenya	Coast	Tana River	4	34
Kenya	Central	Murang'a	5	41
Kenya	Eastern	Machakos	5	6
Kenya	Central	Nyeri	7	11
Kenya	Eastern	Menu	7	42
Kenya	Rift Valley	Narok	9	17
Kenya	Rift Valley	Laikipia	10	18

Notes: Overall rank reflects the district's overall impact from adding a road link to the contiguous district with the highest average night-time light pixel value to which there exists no road link. This counterfactual exercise is based on the ρs estimated in column (8) of Table 1. Nigeria has 775 districts, and Kenya has 48 districts.

H Top-Ten Rankings from Policy Experiments for Other Populous Countries

Table H1: Top-Ten Rankings from Policy Experiment 1 (Nighttime Lights) for Populous Countries

(1) Country	(2) Province	(3) District	(4) Overall Rank	(5) Overall KP Rank
		Ethiopia		
Ethiopia	Amhara	West Gojam	1	7
Ethiopia	Addis Ababa	Addis Ababa	2	16
Ethiopia	Addis Ababa	Zone 1	3	69
Ethiopia	Addis Ababa	Zone 5	4	8
Ethiopia	Addis Ababa	Zone 4	5	4
Ethiopia	Addis Ababa	Zone 3	6	2
Ethiopia	Amhara	South Gonder	7	70
Ethiopia	Addis Ababa	Zone 2	8	1
Ethiopia	Addis Ababa	Zone 6	9	3
Ethiopia	Afar	Zone 5	10	71
		Egypt		
Egypt	Ad Daqahliyah		1	16
Egypt	Al Buhayrah		2	7
Egypt	Asyut		3	2
Egypt	Suhaj		4	1
Egypt	Al Minufiyah		5	4
Egypt	Ash Sharqiyah		6	12
Egypt	Al Gharbiyah		7	5
Egypt	Bani Suwayf		8	10
Egypt	Al Qalyubiyah		9	3
Egypt	Al Bahr al Ahmar		10	24

Democratic Republic of the Congo (DRC)				
DRC	Kasai-Oriental	Tshilenge	1	9
DRC	Katanga	Haut-Shaba	2	37
DRC	Bas-Congo	Boma	3	4
DRC	Bas-Congo	Bas-Fleuve	4	6
DRC	Bas-Fleuve	Matadi	5	3
DRC	Kasai-Occidental	Lulua	6	21
DRC	Equateur	Sud-Ubangi	7	38
DRC	Katanga	Lubumbashi	8	2
DRC	Bas-Congo	Lukaya	9	10
DRC	Kivu	Bukavu	10	8
South Africa (SA)				
SA	Gauteng	Germiston	1	24
SA	Gauteng	Soweto	2	47
SA	Gauteng	Brakpan	3	15
SA	Gauteng	Boksburg	4	4
SA	Gauteng	Alberton	5	27
SA	Gauteng	Kempton Park	6	26
SA	Gauteng	Benoni	7	6
SA	Gauteng	Springs	8	19
SA	Mpumalanga	Delmas	9	324
SA	KwaZulu-Natal	Chatswoth	10	10
Tanzania				
Tanzania	Mwanza	Ilemela	1	134
Tanzania	Zanzibar West	Magharibi	2	133
Tanzania	Kilimanjaro	Moshi Rural	3	48
Tanzania	Arusha	Arumeru	4	12
Tanzania	Zanzibar West	Mjini	5	5
Tanzania	Mara	Musoma Rural	6	101
Tanzania	Mbeya	Mbeya Rural	7	131
Tanzania	Mwanza	Nyamagana	8	6
Tanzania	Dar-Es-Salaam	Ilala	9	3
Tanzania	Dar-Es-Salaam	Kinondoni	10	1

Notes: Overall rank reflects the district's overall impact from increasing its average nighttime light pixel value by 10 on average nighttime lights across African districts. Overall key-player (KP) rank is based on the ρs estimated in column (8) of Table 1. The number of districts per country are: Ethiopia 72, Egypt 26 (ADM1 level), DRC 38, SA 354, and Tanzania 136.

Table H2: Top-Ten Rankings from Policy Experiment 2 (Roads) for Populous Countries

(1) Country	(2) Province	(3) District	(4) Overall Rank	(5) Overall KP Rank
		Ethiopia		
Ethiopia	Addis Ababa	Zone 5	1	8
Ethiopia	Tigray	Central Tigray	2	19
Ethiopia	Tigray	Eastern Tigray	3	12
Ethiopia	Amhara	North Wollo	4	55
Ethiopia	Amhara	West Gojam	5	7
Ethiopia	Amhara	South Gonder	5	70
Ethiopia	SNNP*	Basketo Special Woreda	7	49
Ethiopia	SNNP*	Wolayita	8	23
Ethiopia	SNNP*	Sidama	7	18
Ethiopia	SNNP*	Burji Special Woreda	10	51
**Southern Nations, Nationalities and Peoples*				
		Egypt		
Egypt	Al Wadi al Jadid		1	14
Egypt	Al Minya		2	20
Egypt	Al Jizah		2	19
Egypt	Shamal Sina'		4	21
Egypt	Matruh		5	26
Egypt	Kafr ash Shaykh		6	11
Egypt	Al Gharbiyah		6	5
Egypt	Al Minufiyah		6	4
Egypt	Dumyat		6	6
Egypt	Al Buhayrah		6	7
		Democratic Republic of the Congo (DRC)		
DRC	Kivu	Sud-Kivu	1	1
DRC	Bas-Congo	Bas-Fleuve	2	6
DRC	Bas-Congo	Cataractes	3	35
DRC	Bas-Congo	Matadi	4	3
DRC	Bas-Congo	Boma	4	4
DRC	Kasaï-Occidental	Kasaï	6	27
DRC	Kasaï-Occidental	Lulua	7	21
DRC	Équateur	Sud-Ubangi	8	38
DRC	Bandundu	Mai-Ndombe	9	16
DRC	Katanga	Haut-Shaba	10	37

South Africa (SA)				
SA	Orange Free State	Bloemfontein	1	95
SA	Orange Free State	Botshabelo	1	22
SA	Orange Free State	Thaba'Nchu	3	82
SA	Orange Free State	Dewetsdorp	4	205
SA	Mpumalanga	Moutse	5	61
SA	Mpumalanga	Mbibana	6	53
SA	Gauteng	Cullinan	7	21
SA	Mpumalanga	Mdutjana	8	35
SA	Mpumalanga	Moretele	8	354
SA	Limpopo	Soutpansberg	10	312
Tanzania				
Tanzania	Pwani	Bagamoyo	1	16
Tanzania	Kilimanjaro	Same	2	126
Tanzania	Kilimanjaro	Moshi rural	3	48
Tanzania	Kilimanjaro	Mwanga	3	48
Tanzania	Kagera	Bukoba Rural	3	125
Tanzania	Mbeya	Mbarali	5	83
Tanzania	Manyara	Simanjiro	6	96
Tanzania	Mwanza	Nyamagana	7	6
Tanzania	Mwanza	Lake Victoria	7	36
Tanzania	Morogoro	Ulanga	9	69
Tanzania	Mwanza	Msungwi	10	39

Notes: Overall rank reflects the district's overall impact from adding a road link to the contiguous district with the highest average nighttime light pixel value to which there exists no road link. Overall key-player (KP) rank is based on the ρs estimated in column (8) of Table 1. The number of districts per country are: Ethiopia 72, Egypt 26 (ADM1 level), DRC 38, SA 354, and Tanzania 136.