Mining and Economic Development:

Did China's WTO Accession Affect African Local Economic Development?

Anthony Mveyange (World Bank)

Amadou Boly (AFDB)

Tony Addison (UNU–WIDER)

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Introduction

Natural Resources vs. Africa's Recent Growth Success Story:

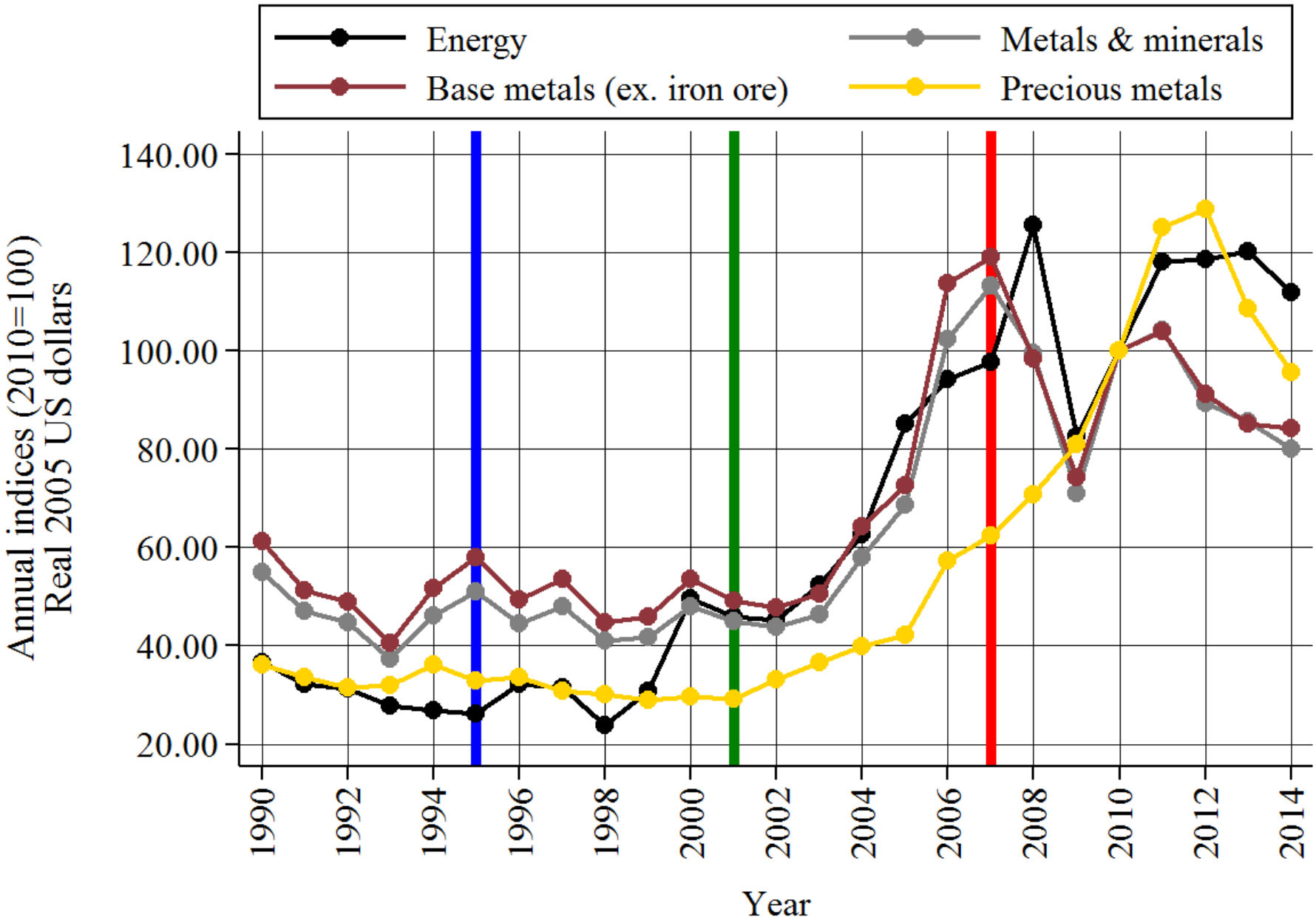
- Super-cycle in commodity prices (Andersen et al. 2014, Beny and Cook, 2009)
- China's WTO Accession and recent commodity boom (Erten and Ocampo, 2013)
  $\Rightarrow$ China is net importer of most metals, oil, and gas (Francis, 2007)
  $\Rightarrow$ China's increased demand of metals from Africa (Pigato and Tang, 2015)
- Africa's increased production and positive trade balance in Ores and metals post 2001.

Research Question

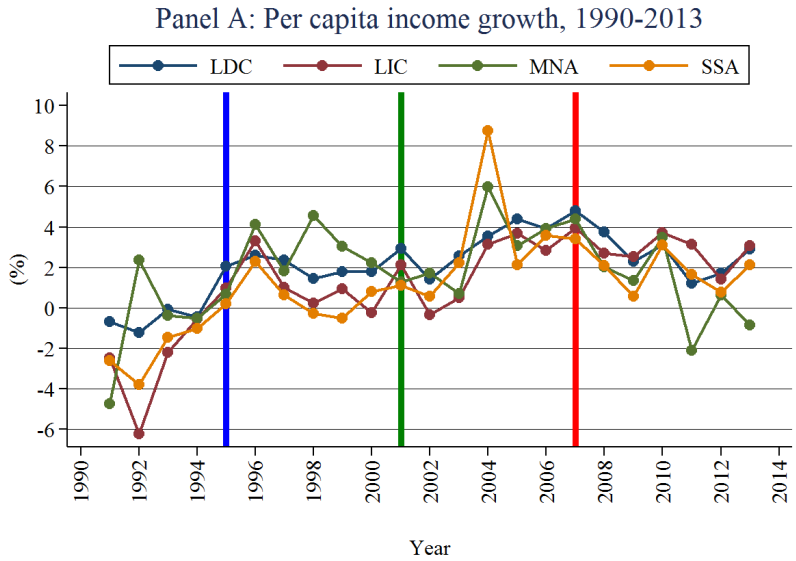
- Did China's increased demand for metals, after her Accession to WTO, impact local economies in Africa?
  1. Local economic development
  2. Spatial inequality
  3. Migration
  4. Welfare

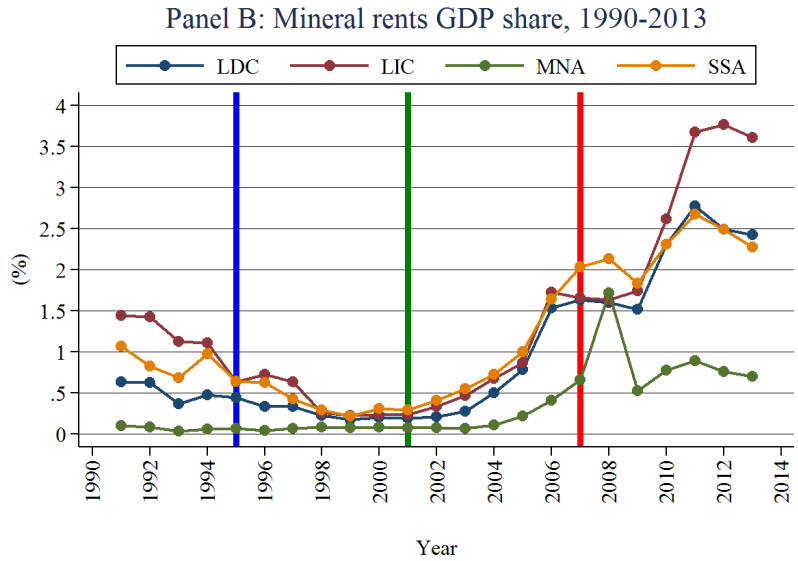
Context

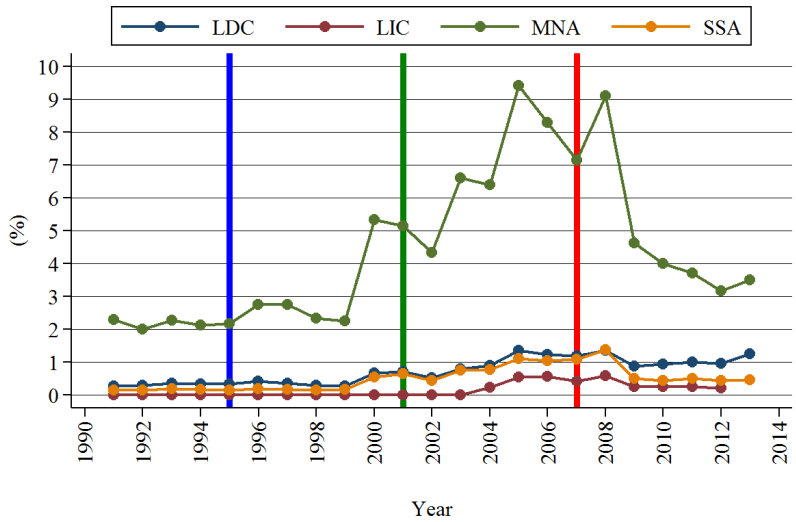
How did the accession affect world prices?

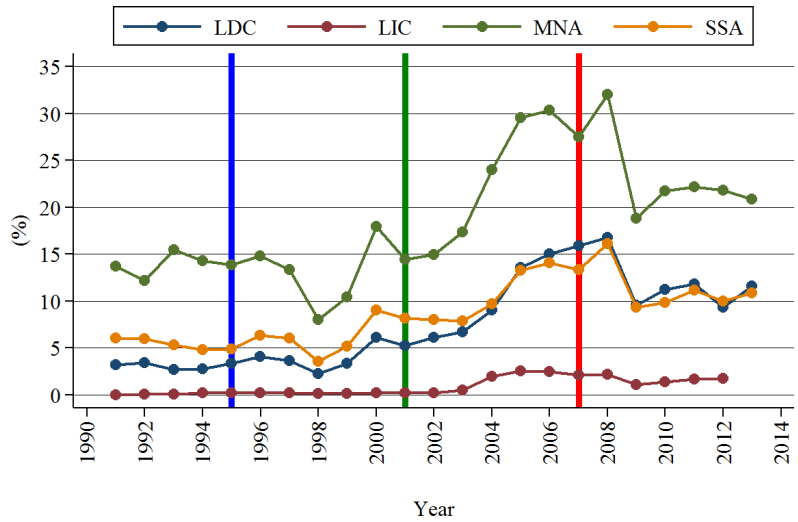


How did the accession affect the developing world?

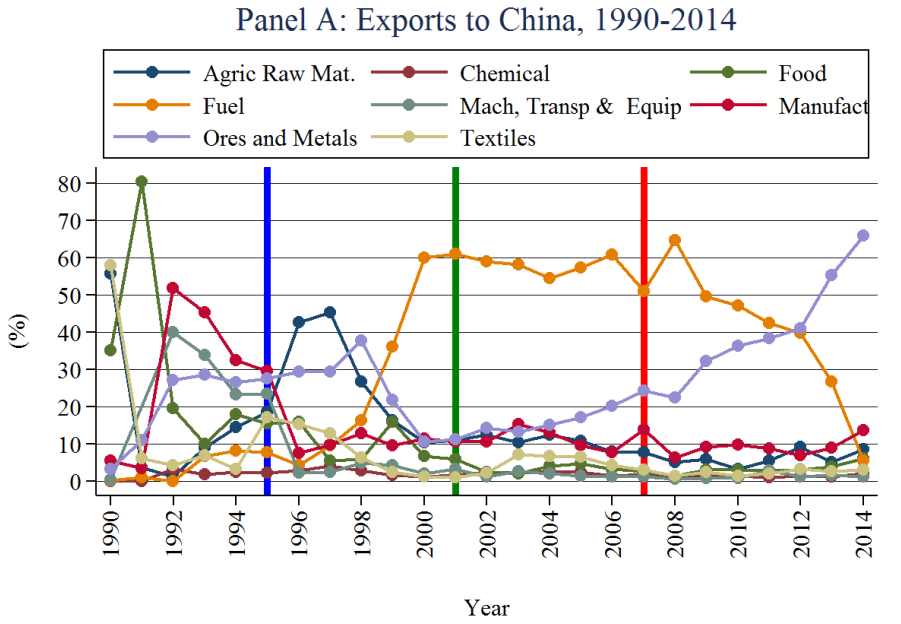


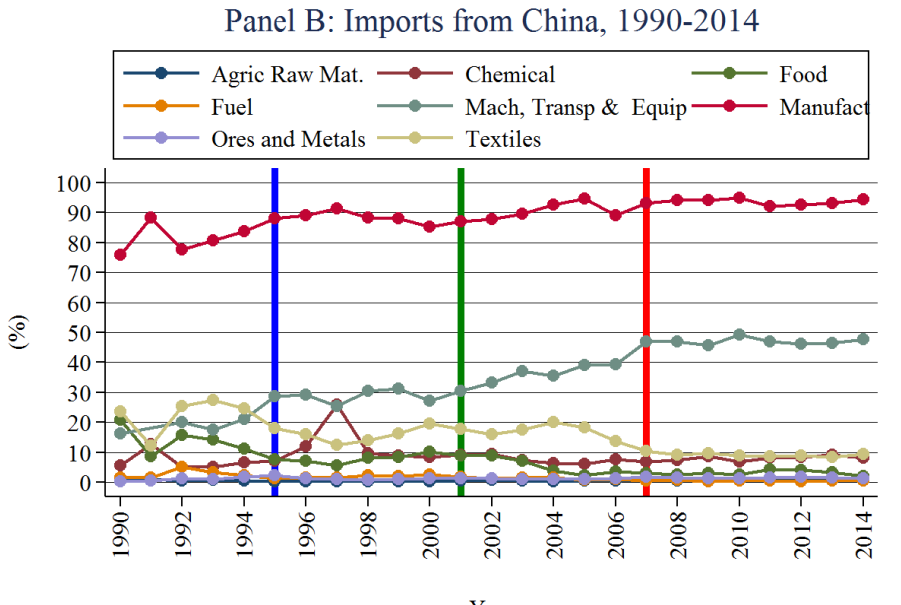






How did the accession affect Africa?





Why our study?

1. Fresh empirical evidence on the impacts of China's WTO accession in African countries
2. Use of novel data to understand the local impacts of such big policy changes as China's WTO Accession!
3. Spatial dimension of Africa's economic development
4. Wider geographical coverage: over 2000 districts in 37 countries
   - Proximity to mining sites
   - Fine-grained analysis
   - Local level analysis has been elusive in Africa

Preview of the results

1. Welfare impacts
   $\Rightarrow$ Large scale, low value, processing activities
2. No impacts on local economic development, migration, and spatial inequality

Data

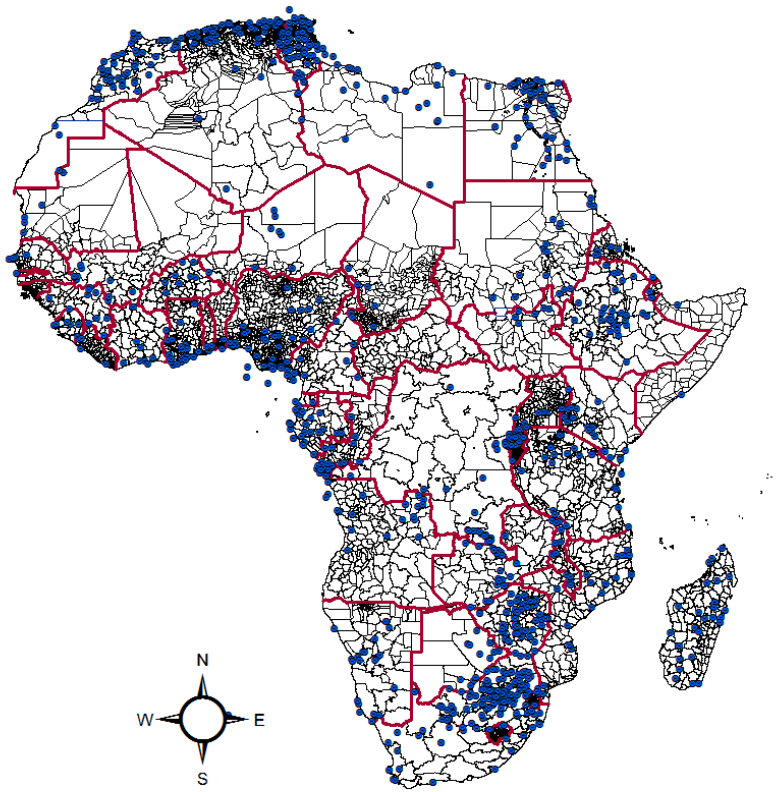
Type and sources

1. Mineral & Price data: USGS
2. Night Lights Data: NOAA, US Defense Ministry
3. Population Data:

   $\Rightarrow$ SEDAC (NASA)
4. Rainfall Data: TAMSAT (University of Reading)
5. The Armed Conflict Location and Event Data (ACLED)

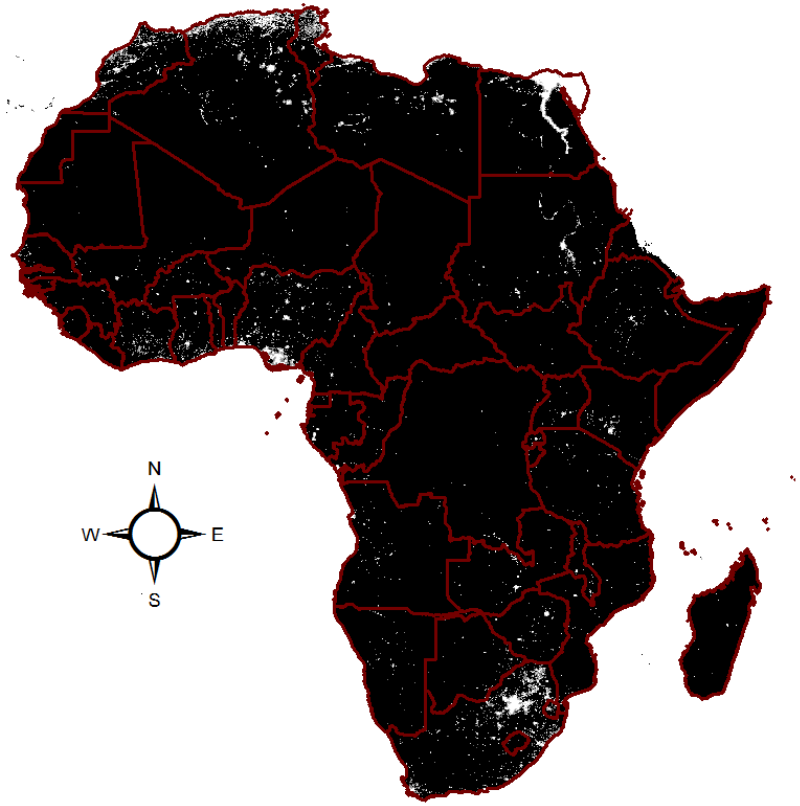
A glance at the spatial dimension of our data

Mineral deposits by districts in Africa



Source: US Geologicl Survey - Mineral Resources Deposit System (MRDS)

Light Intensity Distribution in Africa - 2012



Source: Natioanal Ocean Atmospheric Administration (NOAA)

Empirical Strategy

Difference-in-Difference (DID) Estimator

Policy Shock - China's Accession to WTO

$$Post = \begin{cases} 1 & \text{After Accession: 2002 – 2007} \\ 0 & \text{Before Accession: 1997 – 2001} \end{cases}$$

Mineral endowment

$$Deposits = \begin{cases} 1 & \text{Available} \\ 0 & \text{Otherwise} \end{cases}$$

Mining status

$$Mine = \begin{cases} 1 & \text{Active} \\ 0 & \text{Closed or None} \end{cases}$$

Model 1: Mineral endowment

$$Y_{d,c,t} = \gamma_d + \Phi_t + \beta_0 Post_t + \beta_1 Deposit_{dct} + \boxed{\beta_2(Deposits_{dct} \times Post_t)} + X'_{dct}\beta_3 + \gamma_d + \Phi_t + \Gamma_{ct} + \varepsilon_{dct} \quad (1)$$

Where $Y_{d,c,t}$ captures:

1. Local economic development proxied by lights per capita growth
2. District inequality proxied by lights-based Spatial Gini index
3. Migration measured by population densities
4. Welfare proxied by lights-based spatial sen index

Model 2: Mining activities

$$Y_{d,c,t} = \gamma_d + \Phi_t + \delta_0 Post_t + \delta_1 Active_{dct} + \boxed{\delta_2 (Active_{dct} \times Post_t)} + X'_{dct}\delta_3 + \gamma_d + \Phi_t + \Gamma_{ct} + \varepsilon_{dct} \quad (2)$$

Identification & Threats

Assumptions

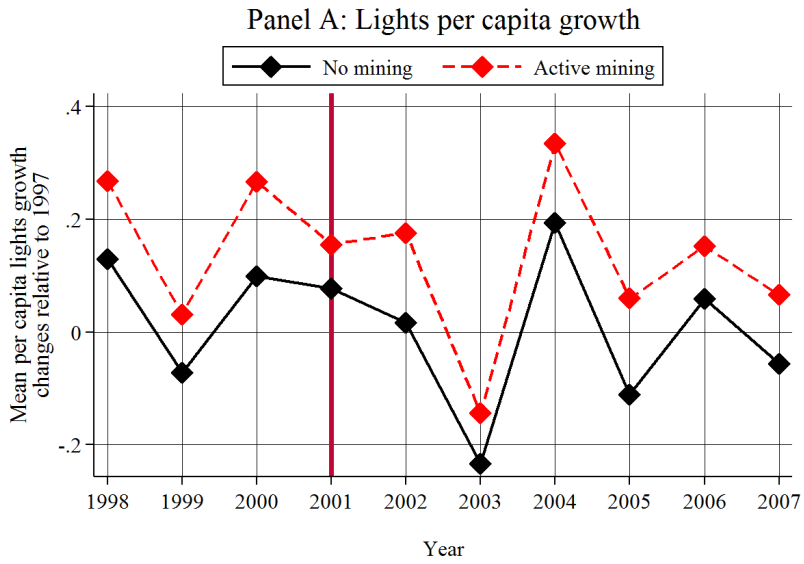
$$E[\varepsilon_{dct}|z_j] = 0 \tag{3}$$

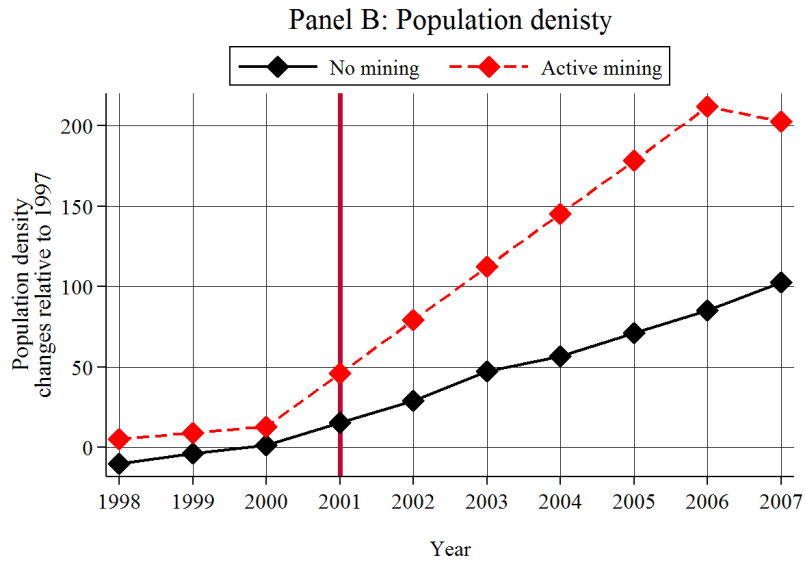
$$CoV[z_j, \varepsilon_{dct}] = 0 \tag{4}$$

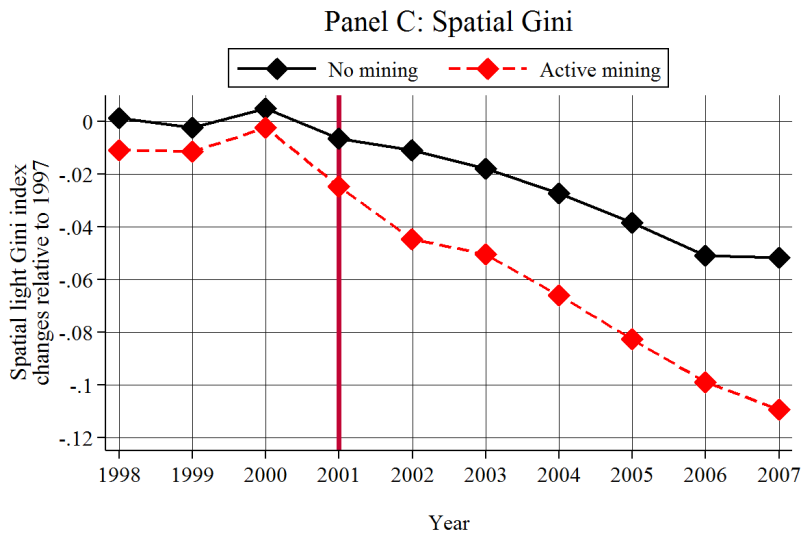
$z_j \in [Treat, X_{dct}, \gamma_d, \Phi_t, \Gamma_{dct}]$

- Pre-treatment dynamic trends test following Mora and Regio (2012, 2014)
  1. Common pre-treatment dynamics
  2. Equivalent pre-treatment paths
  3. Equality of the effect on all post-treatment periods

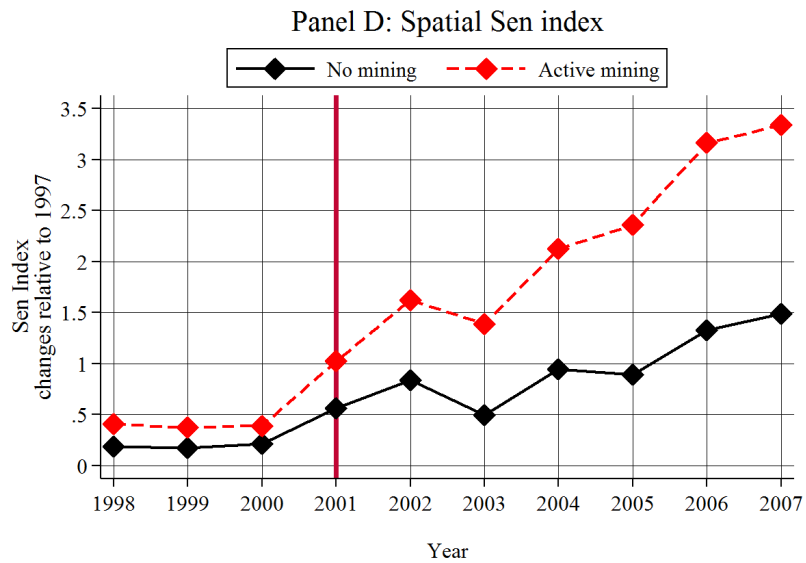
Parallel Trends







Source: Authors' construction using lights and population data.



Pre-treatment dynamics tests

Parallel-q	*Years*	*Annual growth*	*Population density*	*Spatial Gini*	*Spatial Sen Index*
Panel A - H0: Common pre-treatment dynamics					
		0.489	0.693	0.927	0.979
Panel B - H0: q=q-1					
q=1	1997	-	-	-	-
q=2	1998	0.960	0.847	0.369	0.794
q=3	1999	0.781	0.894	0.405	0.992
q=4	2000	0.665	0.989	0.536	0.809
q=5	2001	0.790	0.946	0.659	0.729
Panel C - H0: s=s-1					
q=1	1997	0.274	0.992	0.811	0.985
q=2	1998	0.282	1.000	0.987	0.999
q=3	1999	0.259	1.000	0.971	0.999
q=4	2000	0.332	1.000	0.976	0.996
q=5	2001	0.359	1.000	0.978	0.996

Notes: (1) q refers to all pre-treatment periods; (2) q=q-1 is a null hypothesis of equivalent parallel pre-treatment paths; (3) s=s-1 is a null of hypothesis of a test on the equality of the effect on all post-treatment periods.

Identification Threats

Anticipation effects

Similar to Lu and Yu (2015):

$\rightarrow$ Added two terms in our specifications:
$Deposit^0_{dct} \times Year_{2000}$ and $Active^0_{dct} \times Year_{2000}$

Forum on China-Africa Cooperation, FOCAC

$\rightarrow$ *Country* $\times$ *year* fixed effects

SUTVA concerns

$\rightarrow$ We do not have data on trade patterns at the district level, so we only rely on *district* and *country* $\times$ *year* fixed effects

Results

Deposits

Dependent variables:	*Per capita Growth*		*Population density*		*Spatial Gini*		*Spatial Sen Index*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post *x* Deposit	0.068	0.058	75.381	106.864	-0.030**	-0.018	1.040***	0.716**
	[0.043]	[0.063]	[62.894]	[85.422]	[0.012]	[0.015]	[0.232]	[0.272]
No. Deposits *x* Year 2000		-0.059		9.408		-0.008		0.103**
		[0.142]		[8.593]		[0.009]		[0.050]
Log (Constant Prices)		0.096		-54.523		-0.008		0.386
		[0.071]		[63.127]		[0.014]		[0.268]
Climate	No	Yes	No	Yes	No	Yes	No	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Conflict dummy	No	Yes	No	Yes	No	Yes	No	Yes
N	24856	22764	24957	22864	20315	18378	20315	18378
R-squared	0.074	0.076	0.969	0.969	0.795	0.791	0.951	0.950
Dep. Variable [mean]	0.029	0.029	288.423	283.912	0.254	0.247	4.003	3.626

Welfare improvement by $\approx 20\%$

Active mines

Dependent variables:	*Per capita Growth*		*Population density*		*Spatial Gini*		*Sen Index*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post *x* Active mines	0.066	0.072	86.988	129.015	-0.029**	-0.019	1.099***	0.744**
	[0.044]	[0.068]	[67.306]	[90.002]	[0.012]	[0.015]	[0.246]	[0.297]
Inactive mines *x* Year 2000		-0.124		10.962		-0.002		0.110*
		[0.145]		[9.272]		[0.007]		[0.055]
Log (Constant Prices)		0.100		-55.337		-0.009		0.412
		[0.071]		[62.318]		[0.014]		[0.277]
Climate	No	Yes	No	Yes	No	Yes	No	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Conflict dummy	No	Yes	No	Yes	No	Yes	No	Yes
N	24856	22764	24957	22864	20315	18378	20315	18378
R-squared	0.074	0.076	0.969	0.969	0.795	0.791	0.951	0.950
Dep. Variable [mean]	0.029	0.029	288.423	283.912	0.254	0.247	4.003	3.626

Welfare improvement by $\approx 21\%$

Robustness checks

Deposits

	USGS average prices				*World Bank GEM real prices*			
Dependent variables:	*Per capita Growth*	*Pop. density*	*Spatial Gini*	*Sen Index*	*Per capita Growth*	*Pop. density*	*Spatial Gini*	*Sen Index*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Post *x* Deposit	0.041	111.856	-0.017	0.645**	0.076	-30.848	-0.033	0.674*
	[0.069]	[88.718]	[0.016]	[0.242]	[0.110]	[26.118]	[0.020]	[0.380]
No Deposit *x* Year 2000	-0.057	7.403	-0.008	0.114**	-0.134	-1.795	0.007	0.148***
	[0.142]	[6.880]	[0.009]	[0.049]	[0.195]	[3.128]	[0.011]	[0.047]
Log(Prices)	0.106	-44.683	-0.009	0.438	0.154	23.617	-0.022	0.876**
	[0.075]	[57.909]	[0.013]	[0.277]	[0.194]	[22.835]	[0.015]	[0.392]
Climate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Conflict dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	22764	22864	18378	18378	21451	21547	17201	17201
R-squared	0.076	0.969	0.791	0.950	0.076	0.972	0.796	0.953
Dep. Variable [mean]	0.029	283.912	0.247	3.626	0.030	273.537	0.240	3.642

Welfare improvement by $\approx 17\% - 18\%$

Active mines

	USGS average prices				*World Bank GEM real prices*			
Dependent variables	*Per capita Growth*	*Pop. density*	*Spatial Gini*	*Sen Index*	*Per capita Growth*	*Pop. density*	*Spatial Gini*	*Sen Index*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Post x Active mines	0.055	134.561	-0.018	0.671**	0.068	-24.982	-0.034	0.787**
	[0.072]	[93.083]	[0.015]	[0.267]	[0.114]	[28.253]	[0.020]	[0.355]
Inactive mines x Year 2000	-0.121	8.969	-0.002	0.121**	-0.169	-2.349	0.005	0.132**
	[0.145]	[7.503]	[0.007]	[0.051]	[0.211]	[3.553]	[0.011]	[0.057]
Log(Prices)	0.108	-47.181	-0.010	0.469	0.171	16.011	-0.024	0.850*
	[0.074]	[57.252]	[0.014]	[0.279]	[0.197]	[23.692]	[0.015]	[0.433]
Climate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Conflict dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	22764	22864	18378	18378	21451	21547	17201	17201
R-squared	0.076	0.969	0.791	0.950	0.076	0.972	0.796	0.953
Dep. Variable [mean]	0.029	283.912	0.247	3.626	0.030	273.537	0.240	3.642

Welfare improvement by $\approx$ 19% – 22%

Heterogeneous Effects

Model

$$Y_{d,c,t} = \gamma_d + \Phi_t + \tau_0 Post_t + \tau_1 Active_{dct}^{status} + \boxed{\tau_2 (Active_{dct}^{status} \times Post_t)} + X'_{dct}\tau_3 + \Gamma_{ct} + \epsilon_{dct} \quad (5)$$

Scale of Operations

	USGS Constant prices				*World Bank (GEM) real prices*			
Dependent variables:	*Per capita Growth*	*Pop. density*	*Spatial Gini*	*Sen Index*	*Per capita Growth*	*Pop. density*	*Spatial Gini*	*Sen Index*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Post x Small Scale	-0.522	-59.260	0.042	2.203	-0.268	-37.802**	0.009	5.375
	[0.375]	[58.193]	[0.063]	[2.776]	[0.296]	[17.473]	[0.101]	[5.679]
Post x Large Scale	0.094	117.424	-0.021	0.654**	0.096	-30.461	-0.034	0.504*
	[0.066]	[90.463]	[0.016]	[0.246]	[0.118]	[27.695]	[0.020]	[0.295]
Log(Prices)	0.093	-56.479	-0.008	0.404	0.151	23.590	-0.022	0.887**
	[0.072]	[63.154]	[0.013]	[0.279]	[0.195]	[22.774]	[0.015]	[0.402]
Inactive mines x Year 2000	-0.157	9.817	-0.008	0.106*	-0.231	-1.687	0.006	0.154***
	[0.144]	[8.899]	[0.010]	[0.054]	[0.204]	[3.185]	[0.011]	[0.048]
Climate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Conflict dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	22764	22864	18378	18378	21451	21547	17201	17201
R-squared	0.076	0.969	0.792	0.950	0.076	0.972	0.796	0.953
Dep. Variable [mean]	0.029	283.912	0.247	3.626	0.030	273.537	0.240	3.642

Welfare $\uparrow \approx 14\% - 18\% \rightarrow$ large scale operations

Minerals' Values

	USGS Constant prices				*World Bank (GEM) real prices*			
Dependent variables:	*Per capita Growth*	*Pop. density*	*Spatial Gini*	*Sen Index*	*Per capita Growth*	*Pop. density*	*Spatial Gini*	*Sen Index*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Post x High	0.071	-11.582	-0.024	0.601	0.114	-5.159	-0.002	0.391
	[0.145]	[39.568]	[0.023]	[0.447]	[0.164]	[40.038]	[0.020]	[0.691]
Post x Low	0.052	154.146	-0.016	0.763**	0.060	-41.405	-0.046*	0.797*
	[0.045]	[112.815]	[0.016]	[0.333]	[0.107]	[26.671]	[0.024]	[0.403]
Log(Prices)	0.099	-74.459	-0.009	0.367	0.151	21.681	-0.024	0.895**
	[0.067]	[68.539]	[0.012]	[0.253]	[0.195]	[20.436]	[0.015]	[0.387]
Inactive mines x Year 2000	-0.066	12.829	-0.010	0.108	-0.068	-3.383	0.009	0.148***
	[0.139]	[11.245]	[0.011]	[0.067]	[0.137]	[3.429]	[0.008]	[0.054]
Climate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Conflict dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	22764	22864	18378	18378	21451	21547	17201	17201
R-squared	0.076	0.969	0.791	0.950	0.076	0.972	0.796	0.953
Dep. Variable [mean]	0.029	283.912	0.247	3.626	0.030	273.537	0.240	3.642

Welfare $\uparrow \approx 21\% \rightarrow$ low value minerals

Nature of Mining Activities

	USGS Constant prices				*World Bank (GEM) real prices*			
Dependent variables:	*Per capita Growth*	*Pop. density*	*Spatial Gini*	*Sen Index*	*Per capita Growth*	*Pop. density*	*Spatial Gini*	*Sen Index*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Post x Extract	0.018	66.288	-0.022	0.451	0.034	-33.500	-0.031	0.493
	[0.068]	[85.842]	[0.016]	[0.310]	[0.094]	[24.096]	[0.020]	[0.451]
Post x Transform	0.178*	240.262	-0.008	1.523**	0.281	-18.436	-0.039	1.398***
	[0.090]	[219.465]	[0.035]	[0.566]	[0.246]	[57.794]	[0.024]	[0.471]
Log(Prices)	0.089	-79.908	-0.009	0.212	0.146	23.437	-0.022	0.872**
	[0.071]	[62.417]	[0.011]	[0.274]	[0.196]	[22.827]	[0.015]	[0.385]
Inactive mines x Year 2000	-0.365	16.149	-0.024	0.138	-0.559	-4.189	0.006	0.237**
	[0.248]	[19.272]	[0.015]	[0.145]	[0.599]	[7.002]	[0.009]	[0.092]
Climate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Conflict dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	22764	22864	18378	18378	21451	21547	17201	17201
R-squared	0.076	0.969	0.792	0.950	0.076	0.972	0.796	0.953
Dep. Variable [mean]	0.029	283.912	0.247	3.626	0.030	273.537	0.240	3.642

Welfare $\uparrow \approx 38\% - 42\% \rightarrow$ processing activities

Conclusions

1. Suggestive evidence that China's WTO accession had impacts on local welfare

   $\rightarrow$ Understanding the pathways for this finding is relevant for policy

2. No evidence to support claims of impacts on local economic development, migration, and spatial inequality

   $\rightarrow$ Downplays widespread anecdotal claims in favor of China's positive economic influence in Africa

3. Similar findings hold with heterogeneity checks.
   $\rightarrow$ Large scale, low value, processing activities.

Policy takeaways

1. Insights on mining policies design in Africa.

   $\rightarrow$ Potential backward linkages to local economies: employment in artisanal mining and smelting industries.

   $\rightarrow$ No impact on local economic development but on welfare finding can be useful for policy design.

2. Economic policy needs to do more to translate the benefits of aggregate shocks to local economies!

Thank you !!