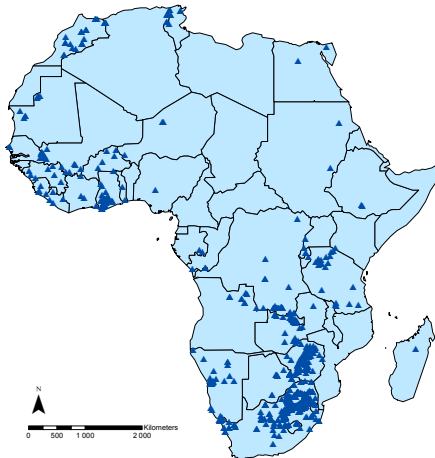# Mineral Mining and Female Employment

Anja Tolonen
Andreas Kotsadam
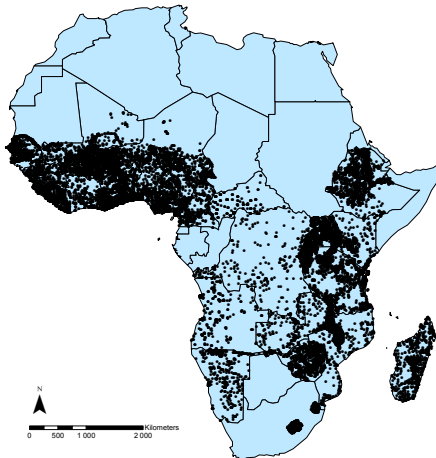
Institute ISEO summer school

17/06/2013

Industrial mineral mines in Africa

DHS clusters

Outline

1. Introduction

2. Identification

3. Data & Results

4. Robustness

5. Summary

Motivation

- Women are not directly employed in (industrial) mining (ILO 1999, ISG report 2011)

- Women dominate service sector in Sub-Saharan Africa (ILO 2012), also around mines (Hinton 2005, ILO 1999)

- Does industrial mining lead to job opportunities for women?

    - Empowerment (WDR 2012) $\Rightarrow$ education, health, fertility, child mortality (Duflo, 2011)

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Background

- Local effects of mining
    - Stylized fact: Mine as an enclave (Hirschman 1956, Aragon and Rud 2013a, African Mining Vision 2012).
    - Measure: Backward & Forward Linkages, Local Multipliers (Moretti 2010).
    - Effects: Welfare (Aragon and Rud 2013a), Pollution and agricultural productivity (Aragon and Rud 2013b), HIV/Aids (Wilson, 2012).
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Data on individuals and mines

- DHS data from 29 countries, 21 years, 525 180 women and 22,350 clusters.
- Data on more than 800 industrial mines across Africa and production levels for three decades.

Identification

$$Y_{ijrt} = \alpha_r + g_t + \delta_{rt} + \beta_1 \cdot active20_j + \beta_2 \cdot inactive20_j + \lambda X_i + \varepsilon_{ijrt}$$

- Using spatial-temporal variation to explore mine opening effects.
- Compare clusters far away and clusters close to mine and clusters with an active mine to clusters with a not yet active mine.
- Y is employment outcomes: working, services, sales or agriculture.
- Parameters of interest: β_1 and $\beta_1 - \beta_2$
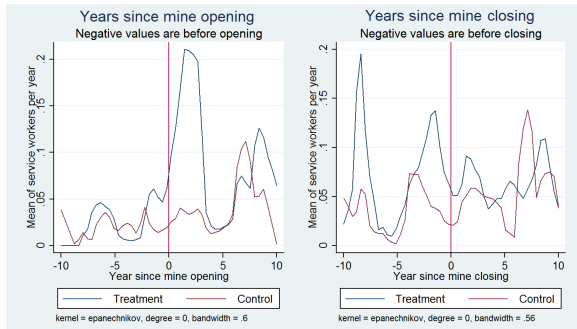
Identification 2

- Identifying assumptions
  - Effects attenuate with distance.
  - Parallel trends assumption.

Mbuyi Mayi mine in DRC
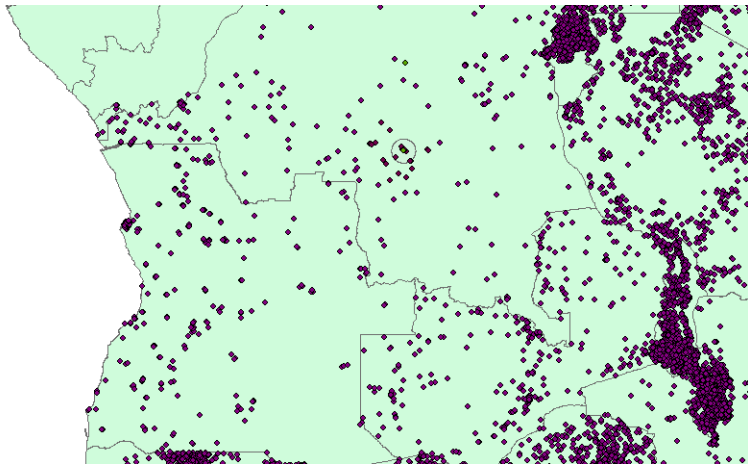
Trends in service employment

*The treatment group is situated 0 to 20 km from a mine, and the control group 50 to 100 km from a mine.

Summary statistics

Variable	Definition	Mean	Obs.
distance	to a mine (km)	246.4	525 180
distance active	to an active mine (km)	363.6	525 180
active (20 km)	1 if $\geq$ 1 active mine w/in 20 km*	0.016	8 195
inactive (20 km)	1 if $\geq$ 1 inactive mine w/in 20 km*	0.005	2 334
suspended (20 km)	1 if $\geq$ 1 suspended mine w/in 20 km*	0.013	6 812

* All distances are calculated from the DHS cluster.

* Categories are mutually exclusive.

Summary statistics

Variable	Definition	all sample	active (20km)	inactive (20km)
working	1 if currently working	0.662	0.649	0.753*
services	1 if in services	0.036	0.096	0.031*
sales	1 if in sales	0.172	0.178	0.176
agriculture	1 if in agriculture	0.329	0.200	0.399*
urban	1 if living in urban area	0.330	0.545	0.377*
age	age in years.	28.4	28.4	28.6
schoolyears	years of education	4.202	6.0	3.5*
never moved	1 if never moved	0.455	0.368	0.424
Observations		525 180	8 195	2 334

* Two-sample t-test with equal variances comparing sample mean of inactive and

active.

Result 1: Miner

VARIABLES	Woman is miner	Partner is miner
active (20 km)	0.005*	0.054***
	(0.003)	(0.011)
inactive (25 km)	0.012	0.014
	(0.010)	(0.020)
F test: active-inactive=0	0.409	2.987
p-value	0.522	0.0840
region, year f.e.	yes	yes
region time trends	yes	yes
Observations	251,207	175,460

Robust standard errors clustered at DHS cluster level.

Controls for age, education, religion, urban.

*** p<0.01, ** p<0.05, * p<0.1

Result 2: Occupation

VARIABLES	Working	Service	Sales	Agriculture
active (20 km)	0.026***	0.020***	0.001	-0.009
	(0.010)	(0.005)	(0.008)	(0.012)
inactive (20 km)	0.081***	0.000	-0.014	0.065***
	(0.020)	(0.005)	(0.015)	(0.024)
F-test active-inactive=0	6.154	7.152	0.751	7.423
p-value	0.0131	0.00750	0.386	0.00645
region, year f.e.	yes	yes	yes	yes
region time trend	yes	yes	yes	yes
Observations	518,368	518,368	518,368	518,368

Robust standard errors clustered at DHS cluster level.

Controls for age, education, religion, urban.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Result 3: Remuneration

▸ Sum stat

VARIABLES	Cash	Cash & kind	In kind	Not paid
active (20 km)	0.016	-0.029***	0.015*	-0.002
	(0.015)	(0.011)	(0.008)	(0.012)
inactive (20 km)	-0.049	0.016	0.059***	-0.026
	(0.030)	(0.020)	(0.018)	(0.030)
F-test active-inactive=0	3.777	4.165	4.653	0.568
p-value	0.052	0.041	0.031	0.451
Observations	254,029	254,029	254,029	254,029

Robust standard errors clustered at DHS cluster level.

Controls for age, education, religion, urban, region f.e., year f.e., region trend.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Result 4: Seasonality

VARIABLES	All year	Occasional	Seasonal
active (20 km)	0.057***	0.017**	-0.074***
	(0.013)	(0.008)	(0.014)
inactive (20 km)	0.027	-0.023	-0.004
	(0.026)	(0.015)	(0.030)
F-test active-inactive=0	1.135	5.588	4.541
p-value	0.287	0.018	0.033
region, year f.e.	yes	yes	yes
region time trend	yes	yes	yes
Observations	306,087	306,087	306,087

Robust standard errors clustered at DHS cluster level.

Controls for age, education, religion, urban.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Result 5: Non-movers

VARIABLES	Working	Service	Sales	Agriculture
active (20 km)	0.018	0.026***	0.019	-0.029*
	(0.014)	(0.008)	(0.012)	(0.017)
inactive (20 km)	0.116***	0.007	-0.000	0.071***
	(0.026)	(0.007)	(0.018)	(0.026)
F test: suspended-active=0	11.22	3.164	0.797	10.44
p-value	0.000811	0.0753	0.372	0.00124
region, year f.e.	yes	yes	yes	yes
region time trend	yes	yes	yes	yes
Observations	194,103	194,103	194,103	194,103

Robust standard errors clustered at DHS cluster level in parentheses

Controls for age, education, religion, urban.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Result 6: Mine closing

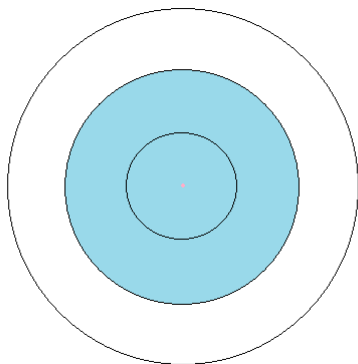| VARIABLES	Working	Service	Sales	Agriculture
suspended (20 km)	0.026*	0.002	0.007	0.013
	(0.014)	(0.006)	(0.009)	(0.017)
active (20 km)	0.024**	0.020***	0.001	-0.010
	(0.010)	(0.005)	(0.008)	(0.012)
F-test suspended-active=0	0.00895	5.377	0.265	1.341
p-value	0.925	0.0204	0.607	0.247
region, year f.e.	yes	yes	yes	yes
region time trends	yes	yes	yes	yes
Observations	525,180	525,180	525,180	525,180

Robust standard errors clustered at DHS cluster level.

Controls for age, education, religion, urban.

*** p<0.01, ** p<0.05, * p<0.1

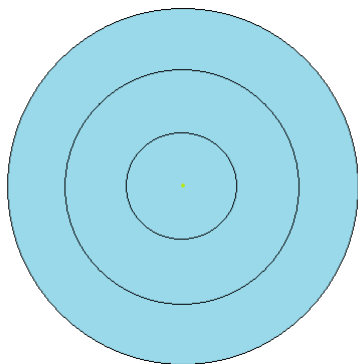# Robustness 1: Varying the distance
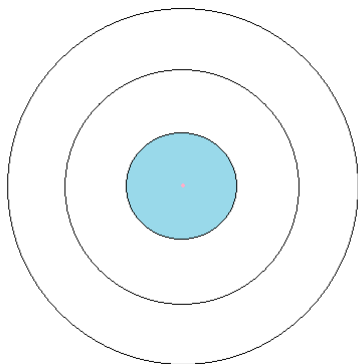
Robustness 1: Varying the distance

Robustness 1: Varying the distance

VARIABLES	Working	Service	Sales	Agriculture
active (5 km)	0.038	0.023	-0.016	-0.008
inactive (5 km)	0.215***	-0.022	0.035	0.132***
p value	0.000	0.0307	0.151	0.001
active (10 km)	0.020	0.028***	0.010	-0.049***
inactive (10 km)	0.154***	-0.012	0.016	0.112***
p value	0.000	0.007	0.838	0.000
active (15 km)	0.018	0.024***	0.000	-0.025*
inactive (15 km)	0.137***	-0.001	-0.001	0.111***
p value	0.000	0.031	0.935	0.000
active (20 km)	0.026***	0.020***	0.001	-0.009
inactive (20 km)	0.081***	0.000	-0.014	0.065***
p value	0.013	0.008	0.386	0.006
active (50 km)	0.038***	0.004	-0.010*	0.040***
inactive (50 km)	0.024*	0.000	-0.012	0.025
p-value	0.304	0.314	0.905	0.452

Robustness 2: Spline
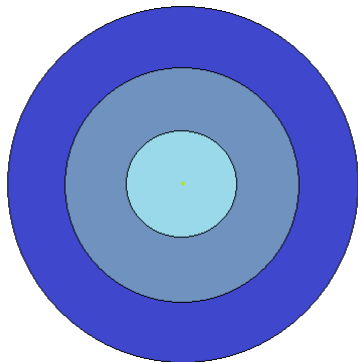
Robustness 3: Limiting control group
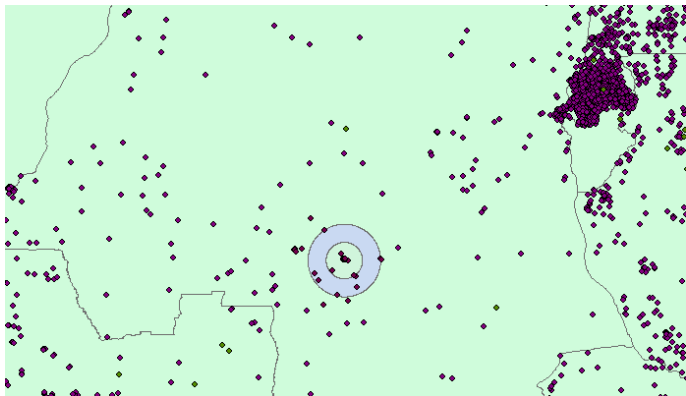
▸ Results

- Extensions and heterogeneity
    - Intensity: the more mines the stronger effects.
    - Marital status: stronger effects for divorced women.
    - Young women (15-20 years): increased schooling.

- Alternative mechanisms
    - Prostitution: lifetime number of sexual partners as a proxy. No significant change. ▸ Prostitution
    - Infrastructure: distance to paved road (time invariant data).
    - Artisanal and small scale mining: CSCW diamond data ▸ Diamonds , USGS mineral data ▸ USGS .

- Distance
    - Proximity measures: cut-off, spline, continuous measure, distance to active mine, log distance, horse race distance to active and distance to inactive mine.

- Control group
    - Drop non-mining countries.
    - Drop non-mining regions.
    - Drop further away than 100 or 200 km from a mine.

- Estimation
    - Fixed effects: Mine, Metal.
    - Clustering: Mine, Two way (mine and year).

Summary

- The opening of an industrial mine induces a structural shift
  - decrease in agricultural employment
  - increase in service sector employment
  - increase in cash earning probability
  - more all year, rather than seasonal, work participation.

- Mine suspension
  - reduces the likelihood of service sector employment
  - but there is no return to agricultural employment.

- The mining industry creates non-agricultural employment opportunities despite women's absence from the mining workforce.
- Back of the envelope calculation estimates that 95 000 women have benefited from service sector jobs close to SSA's industrial mines.

Thank you!

VARIABLES	Working	Service	Sales	Agriculture
Distance to active				
0 to 10 km	0.027	0.032***	0.003	-0.038*
	(0.018)	(0.011)	(0.013)	(0.020)
10 to 20 km	0.028**	0.019***	-0.015	0.021
	(0.012)	(0.006)	(0.010)	(0.016)
20 to 30 km	0.022**	0.001	-0.008	0.033**
	(0.011)	(0.005)	(0.008)	(0.013)
30 to 40 km	0.004	0.010**	-0.026***	0.024*
	(0.011)	(0.005)	(0.008)	(0.014)
40 to 50 km	0.022**	-0.003	-0.019**	0.047***
	(0.011)	(0.004)	(0.008)	(0.014)
Observations	495,832	495,832	495,832	495,832

Robustness: Limiting control group

VARIABLES	Working	Service	Sales	Agriculture
active (20 km)	0.025***	0.020***	0.001	-0.008
	(0.010)	(0.005)	(0.008)	(0.013)
inactive (20 km)	0.067***	0.002	-0.015	0.051**
	(0.020)	(0.005)	(0.015)	(0.025)
F-test active-inactive=0	3.613	5.896	0.637	4.480
p-value	0.057	0.015	0.425	0.034
region, year f.e.	yes	yes	yes	yes
region time trend	yes	yes	yes	yes
Observations	518,368	518,368	518,368	518,368

Robust standard errors clustered at DHS cluster level.

Controls for age, education, religion, urban.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Robustness: Diamonds

Robustness: Diamonds

VARIABLES	Working	Service	Sales	Agriculture
diamond (20 km)	0.001	0.006*	0.028***	-0.053***
	(0.009)	(0.004)	(0.010)	(0.013)
region, year f.e.	yes	yes	yes	yes
region time trends	yes	yes	yes	yes
Observations	525,180	525,180	525,180	525,180

Robust standard errors clustered at DHS cluster level.

Controls for age, education, religion, urban.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

▸ Back

Robustness: USGS

Robustness: USGS

VARIABLES	Working	Service	Sales	Agriculture
usgs (20 km)	-0.003	0.009***	0.008***	-0.026***
	(0.004)	(0.002)	(0.003)	(0.005)
region, year f.e.	yes	yes	yes	yes
region time trends	yes	yes	yes	yes
Observations	525,180	525,180	525,180	525,180

Robust standard errors clustered at DHS cluster level.

Controls for age, education, religion, urban.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

▸ Back

Robustness: Lifetime number of sexual partners

VARIABLES	All	Under 25	In services	No partner
active (20 km)	-0.106*	-0.107**	-0.726***	-0.223
	(0.055)	(0.051)	(0.151)	(0.142)
inactive (20 km)	0.771***	0.708***	0.492**	0.691***
	(0.172)	(0.175)	(0.224)	(0.156)
F test: active-inactive=0	23.61	20.02	20.15	19.17
p-value	0.000	0.000	0.000	0.000
region, year f.e.	yes	yes	yes	yes
region time trends	yes	yes	yes	yes
Observations	210 456	64 672	12 049	49 128

Robust standard errors clustered at DHS cluster level.

Controls for age, education, religion, urban.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Summary statistics by distance spans

At least one	...active mine	...inactive mine	...suspended mine
within 5 km	905	519	1 029
within 10 km	2 651	739	3 895
within 15 km	5 573	1 131	5 338
within 20 km	8 195	2 334	6 812
within 50 km	30 209	7 719	26 233

▸ Back

Summary statistics

▶ Back

Variable	Definition	all sample	active (20km)	inactive (20km)
cash	1 if earns cash	0.463	0.704	0.403*
cash & kind	1 if earns cash & kind	0.167	0.106	0.163*
in kind	1 if earns in kind	0.082	0.042	0.151*
seasonally	1 if seasonal	0.317	0.247	0.338*
all year	1 if all year	0.573	0.622	0.587*
occasionally	1 if occasional	0.111	0.130	0.075*
Observations		525 180	8 195	2 334

* Two-sample t-test with equal variances.