Does Large-Scale Gold Mining Reduce Agricultural Growth?
Case studies from Burkina Faso, Ghana, Mali and Tanzania

Magnus Andersson (Malmö University)

Joint work with Ola Hall and Niklas Olén (Lund University) and Anja Tolonen (Gothenborg University)
Outline of the presentation

I. Aim of the paper
II. Mining and local economy
III. Analytical framework
IV. Data
V. Models and Results
VI. Conclusions

Presentation based on paper:

“Does Large-Scale Gold Mining Reduce Agricultural Growth?
Case studies from Burkina Faso, Ghana, Mali and Tanzania” (with Magnus Andersson, Punam Chuhan-Pole, Andrew Dabalen, Ola Hall, Niklas Olén, Aly Sanoh and Anja Tolonen)
Aim of the paper

- Consequences of resource extraction
- Location of mines and its impact on local economy
- Impact on local agricultural growth

Our argument:

Remote sensing data can be used to interpolate the lack of local economic growth data to measure and analyse changes due to mining location (Keola, Andersson and Hall, 2015).
Mining and local economy

Spillover effects on local economy and agriculture:

- a rise in local wages – exit of households from farming
- negative environmental consequences – lower productivity
- Mini-boom in local economy – increase in local food demand

Will the above translate into observable changes in electricity consumption and land cover/land use in relation to the studied mines?
Analytical Framework

1. Establishing the relationship between greenness index (NDVI) and local (district) level agricultural production

2. Establishing the relationship between nighttime lights and GDP on national and local levels

3. Applying NDVI and nighttime lights in a local difference-in-difference framework based on buffer distance around mines
Data

National Statistics – used for ground truthing

- Production data from mines in Burkina Faso, Ghana, Mali and Tanzania provided by World Bank
- Official GDP (World Bank, 2014)
- Agricultural production (Ghana, Tanzania and Mali)

Remote Sensing

- MODIS NDVI Aqua & Terra
  Duration: 2000 – 2013
  Spatial: 250x250m
  Temporal: 23x2 obs./year
- Hansen (2013) Forest Cover
  Duration: 2000 – 2010
  Spatial: 30x30m
  Temporal: Annual
- DMSP-OLS Nighttime Lights
  Duration: 1992 – 2012
  Spatial: 1x1km
  Temporal: Annual
Normalized Difference Vegetation Index (NDVI)

Provides an estimate of vegetation
- Health of vegetation
- Changes over time
Nighttime lights

- Nighttime lights
- 365-day average
- 1000-m spatial resolution
- 1992- present
Results: NDVI and agriculture

Geographically Weighted Regression (GWR) using NDVI and district level agricultural production data
Results: National Growth Model

Using parameters on local economic growth

Log GDP ~ Log Nightlight

Log GDP ~ Log Nightlight + NDVI

Log GDP ~ Log Nightlight + NDVI + Forestloss
## Results: National Growth Model (II)

<table>
<thead>
<tr>
<th>Model</th>
<th>Nighttime light</th>
<th>NDVI</th>
<th>Forestloss</th>
<th>R-squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ghana</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>log(GDP)~log(light)</td>
<td>1.90616</td>
<td>***</td>
<td></td>
<td>0.9986</td>
</tr>
<tr>
<td>log(GDP)~log(light)+ndvi</td>
<td>1.795e+00</td>
<td>*** 3.049e-06</td>
<td></td>
<td>0.9987</td>
</tr>
<tr>
<td>log(GDP)~log(light)+ndvi+forest</td>
<td>1.796e+00</td>
<td>*** 3.471e-06</td>
<td>-4.802e-07</td>
<td>0.9987</td>
</tr>
<tr>
<td>Tanzania</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>log(GDP)~log(light)</td>
<td>2.61125</td>
<td>***</td>
<td></td>
<td>0.9995</td>
</tr>
<tr>
<td>log(GDP)~log(light)+ndvi</td>
<td>2.608e+00</td>
<td>*** 1.413e-07</td>
<td></td>
<td>0.9995</td>
</tr>
<tr>
<td>log(GDP)~log(light)+ndvi+forest</td>
<td>2.604e+00</td>
<td>*** 1.314e-07</td>
<td>1.725e-08</td>
<td>0.9995</td>
</tr>
<tr>
<td>Mali</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>log(GDP)~log(light)</td>
<td>2.50808</td>
<td>***</td>
<td></td>
<td>0.9976</td>
</tr>
<tr>
<td>log(GDP)~log(light)+ndvi</td>
<td>1.248e+00</td>
<td>*** 1.113e-05</td>
<td>***</td>
<td>0.9993</td>
</tr>
<tr>
<td>log(GDP)~log(light)+ndvi+forest</td>
<td>1.279e+00</td>
<td>*** 1.069e-05</td>
<td>** 2.374e-06</td>
<td>0.9994</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>log(GDP)~log(light)</td>
<td>2.648</td>
<td>***</td>
<td></td>
<td>0.9994</td>
</tr>
<tr>
<td>log(GDP)~log(light)+ndvi</td>
<td>1.749e+00</td>
<td>*** 8.703e-06</td>
<td>***</td>
<td>0.9998</td>
</tr>
<tr>
<td>log(GDP)~log(light)+ndvi+forest</td>
<td>1.751e+00</td>
<td>8.657e-06</td>
<td>** 1.170e-07</td>
<td>0.9998</td>
</tr>
</tbody>
</table>

Notes: Significance codes 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Results: Spatial dimensions of National Growth Model

National Statistics from Ghana

R² = 0.906

GDP vs. Household expenditure per capita

R² = 0.8628

District light/area vs. District population/area

National Statistics from Ghana

a. Ghana

b. Mali

c. Tanzania

d. Burkina Faso
Results: National Growth Model – NDVI

- General high growth in NDVI
- Large country variation
Results: Empirical Estimation Difference-in-difference

Does night lights and greenness change with the onset of mining?

![Graphs showing Night Light and NDVI values over time](image)

Mean values in Night lights, NDVI

<table>
<thead>
<tr>
<th></th>
<th>0 – 20 km</th>
<th>50 – 100km</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Night Lights</td>
<td>7276.43</td>
<td>2899.59</td>
<td>134</td>
</tr>
<tr>
<td>NDVI</td>
<td>95387.83</td>
<td>63633.97</td>
<td>60</td>
</tr>
</tbody>
</table>
Conclusions

• The onset of mines is associated with increase in economic activity

• Country variation – large different in the size of districts in between countries

• We do not find a decrease in agricultural production

• Increase the sample size
New findings – night time lights

Underestimation of human settlement – Burkina Faso

Underestimation of population decrease in Europe