Night lights as a proxy for economic growth? an application to structural transformation

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3^{d} January 2022

Data challenges in medium and low income countries

- ▶ Large informal economy
- ▶ Unreliable domestic price index and PPP exchange rates
- ▶ Underfunded statistical agencies
    - ▶ Lack of GDP data and national account data
    - ▶ Short time series, no quarterly data, no regional disaggregation
    - ▶ Delays in data production
    - ▶ Large revision in GDP estimates over time (PWT)
- $->$ Difficulty to monitoring the economy
- $->$ Difficulty to measure the impact of new events/policies

Night time lights: what is it?

(a) Night time lights

NTLs: main features I

Night time lights as a proxy for economic activity

- ▶ Henderson et al. (2012); Chen and Nordhaus (2011)
- ▶ Amount of light that can be observed from outer space
- ▶ Change in NTLs as a measure of income growth
- ▶ Part of remote sensing: data collected from above the earth's surface (satellites)

DMSP : 1992-2013

- ▶ US Air Force **D**efense **M**eteorological **S**atellite **P**rogram
- ▶ Collect low-light imaging data to detect clouds at night
- ▶ Also identify lights from human settlements
- ▶ Observe every location on the planet at some instant

NTLs: main features II

VIIRS : 2013 - current

- ► **V**isible **I**nfrared **I**maging **R**adiometer **S**uite
- ► Available in NRT, better radiometric properties

Heavy data processing:

- ► Lunar lights, auroral activities, bio-mass burning, gas flare, cloud cover
- ► Satellite year dataset: average of valid nights observation
- ► Partly cleaned monthly dataset
- ► Measure of light at pixel level (around 1km2 at the equator)
- ► https://eogdata.mines.edu/products/vnl/

Light-GDP elasticity: 0.2 - 0.3

Ref	Period	Coverage	Elasticity
Henderson et al. (2012)	1992-2006	World	0.277
World-Bank (2017)	1992-2013	World	0.267
	1992-2013	South Asia	0.248
	1992-2013	Poorest decile	0.31
	1992-2013	Decile>2	0.2
Hu and Yao (2019)	1992-2013	World	0.218

Light Employment elasticity?

Limitations:

- Captures services and manufacturing rather than agriculture (elasticity is lower)
- Population vs income
- Cloud free observation at high frequencies
- Still out perform other leading indicators (manufacturing production, imports)

Light-Employment elasticity:

- Light GDP elasticity + Okun's law
- Light/employment elasticity
    - National employment data from ILO
    - Regional data: microdata repository
    - Local data: census data
        - Elasticity = 0.1 for 2d level AE in Africa

NTLs Applications

- ▶ GDP measures: World Bank, IMF
- ▶ **Covid-19**: India, Morocco
- ▶ **Climate change**: natural disasters
- ▶ **Conflicts**
- ▶ City growth and urbanization
- ▶ Infrastructure
- ▶ Regional growth and convergence
- ▶ Structural transformation in low income countries
- ▶ Spatial distribution of economic activity
- ▶ Importance of geographic variables
- ▶ **Regional inequalities**
- ▶ **Nowcasting of employment**
- ▶ **Estimation of informal sector**
- ▶ **Minimum wage reforms**

Ongoing Work

- Economic cost of conflicts in Africa (with S. Bridji)
  - 1 conflict related death = 10 jobs lost
- Impact of Covid-19 in Asia:
- Convergence and structural transformation in Sub-Saharan Africa:

Convergence and structural transformation in sub-Saharan Africa

- ▶ Are poorer areas catching up with richer areas in sub-Saharan Africa?
- ▶ At the local level?
- ▶ Is it a homogenous or heterogenous process?
- ▶ What factors explains whether a given area is catching up
    - ▶ Sector specialization
    - ▶ Conflicts
    - ▶ Geographic characteristics: access to infrastructure, distance to main city
    - ▶ Natural characteristics: ruggedness, land suitability

Contribution to literature

- ▶ Convergence literature:
    - ▶ Use regional GDP per capita data
    - ▶ Africa under-represented for lack of regional data
    - ▶ Does not discuss importance of manufacturing
- ▶ Structural transformation literature:
    - ▶ Use aggregate data
    - ▶ Emphasizes sector specialization
    - ▶ No sub-national dimension

# Light per employment as proxy for local labour productivity

Two innovative datasets

- ▶ Light intensity $->$ income
- ▶ Census data $->$ Employment
- ▶ Census data $->$ Sector specialization

Growth in labour productivity and sector specialization

- ▶ 1136 administrative entities
- ▶ 10 sub-Saharan African countries
- ▶ $2000 -> 2010$
- ▶ Constraint is census data not nighttime lights

Maps of 1136 administrative entities
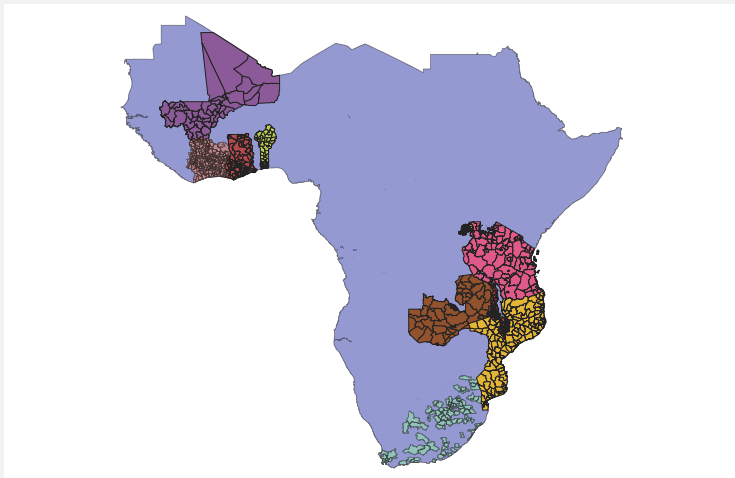
Main results

- ▶ Convergence at 2% annually: iron law of convergence
- ▶ But convergence heterogeneity: areas are left behind
- ▶ Importance of manufacturing employment ...
- ▶ As well as service employment
- ▶ Subsector specialization matters
- ▶ Distance to the main city, distance to conflicts, land suitability

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