
A new approach for economic impact evaluation of decentralized electrification projects

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FONDATION POUR LES ÉTUDES
ET RECHERCHES
SUR LE DÉVELOPPEMENT
INTERNATIONAL

A presentation for IRENA
15th of February 2021



African Association for Rural Electrification
Association Africaine pour l'Électrification Rurale

Context

- Scarcity of data on the economic effects of decentralized electrification projects, due to the high cost of usual household surveys
- Satellite observation data, now routinely produced, are more and more used by economists as proxy indicators of economic activity.
- NTL (Night-Time Light), in particular, is a good correlate of GDP at macro national and sub-national levels.
- We show that, with NTL data, we can also identify mini-grids' effects on economic activity.

Outline

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- Data: DMSP & VIIRS (most relevant databases for NTL data)
 - Methodology
 - Results obtained on DMSP and DMSP-like data
 - Discussion
 - policy conclusions

Data

- We extracted from CoSMMA 50 projects whose location was precisely known (CoSMMA, for Collaborative Smart Mapping of Mini-grid Action, is a data base on mini-grids that we assembled a couple of years ago)
- We used NTL data observed for 3km by 3km pixels in which these projects were located
- DMSP NTL data are available from 1992 to 2013. Since 2013, DMSP data are no longer available but we have now more precise VIIRS data
- We built homogeneous time series from 1992 to 2018, using data provided by Lee et al. (2020) who transformed VIIRS data into DMSP-like data

Methodology

- We extracted information from years prior to the implementation of projects to build predicted NTL values beyond implementation year.
- We compared NTL observed after implementation to this counterfactual , in view of attributing the difference to the economic effect of the projects.
- The construction of counterfactual trends was associated with the computation of their standard deviation, and the building of statistical tests of significance of divergence of observed NTL from the counterfactual.

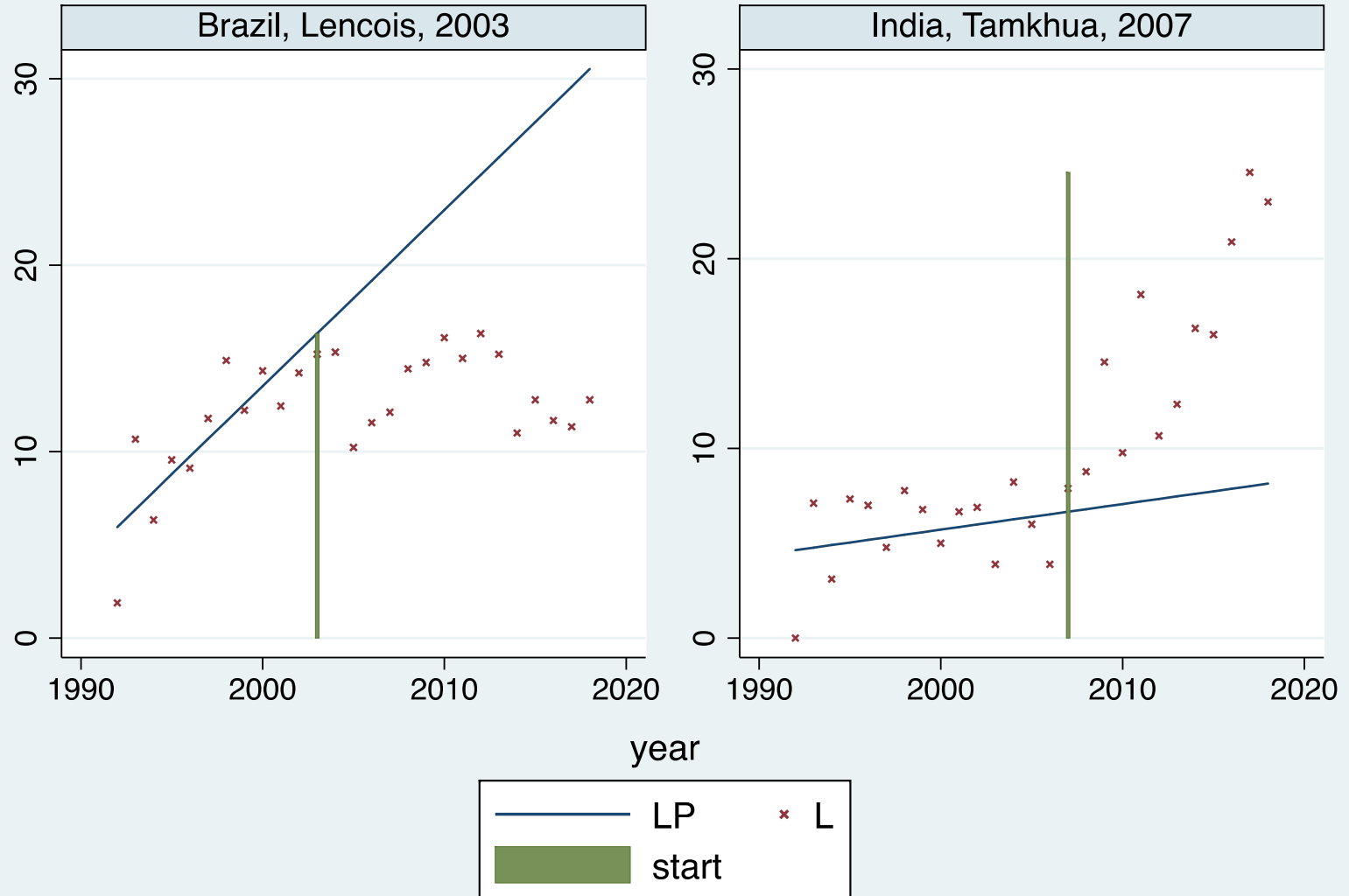
Methodology

- We decided that a project succeeded in the short run (medium run) if its average NTL over years T0+1 to T0+3 (T0+4 to T0+6) was significantly positive.
- The principle technical issue was to design an adequate treatment of zeroes, which are frequently observed for small villages in DMSP and DMSP-like data.
- Zeroes are observed in localities in the darkness at night. We chose in such cases to build conservative estimates, which avoid overestimating the probability of concluding to the existence of an effect.

Illustrations

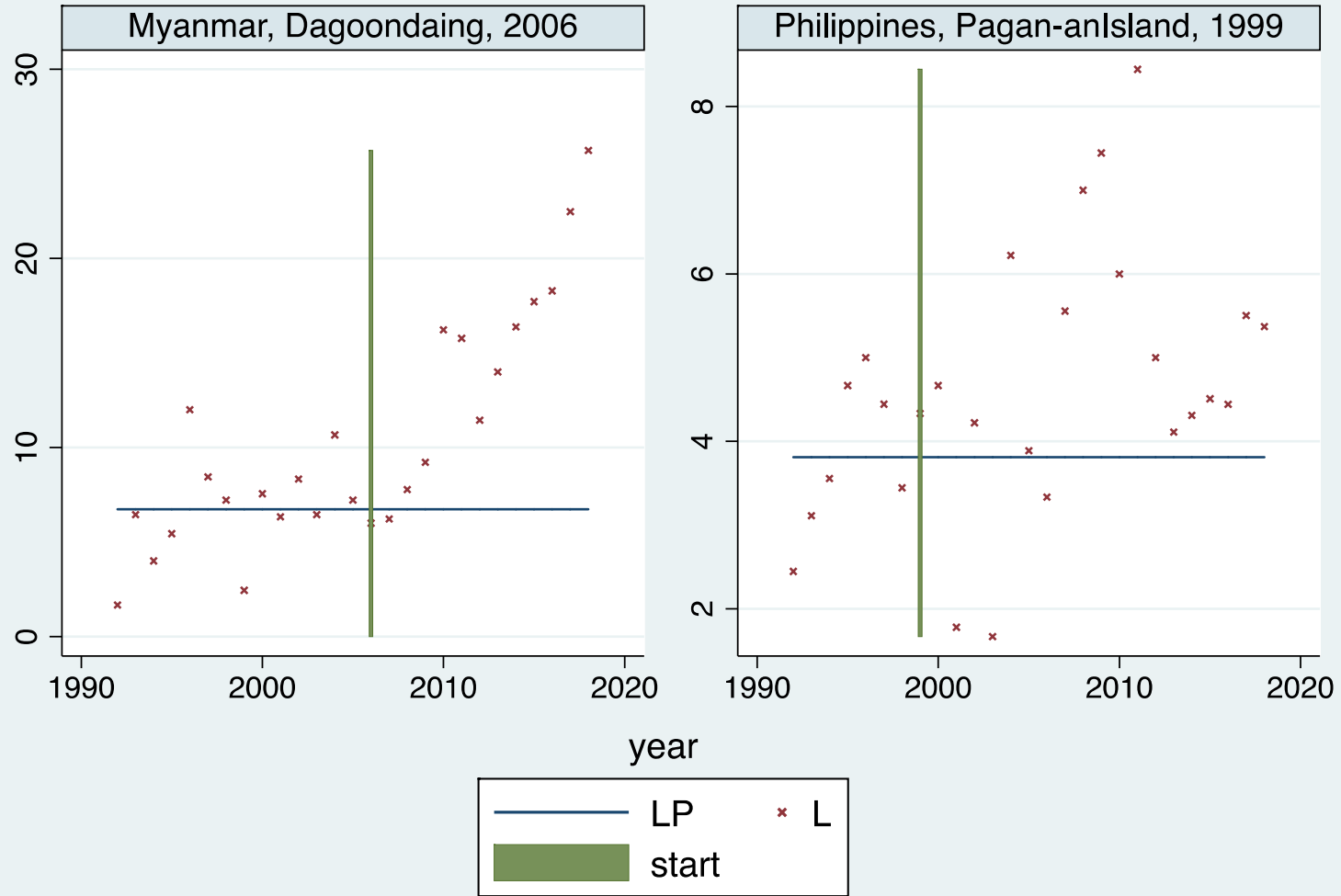


Illustration 1



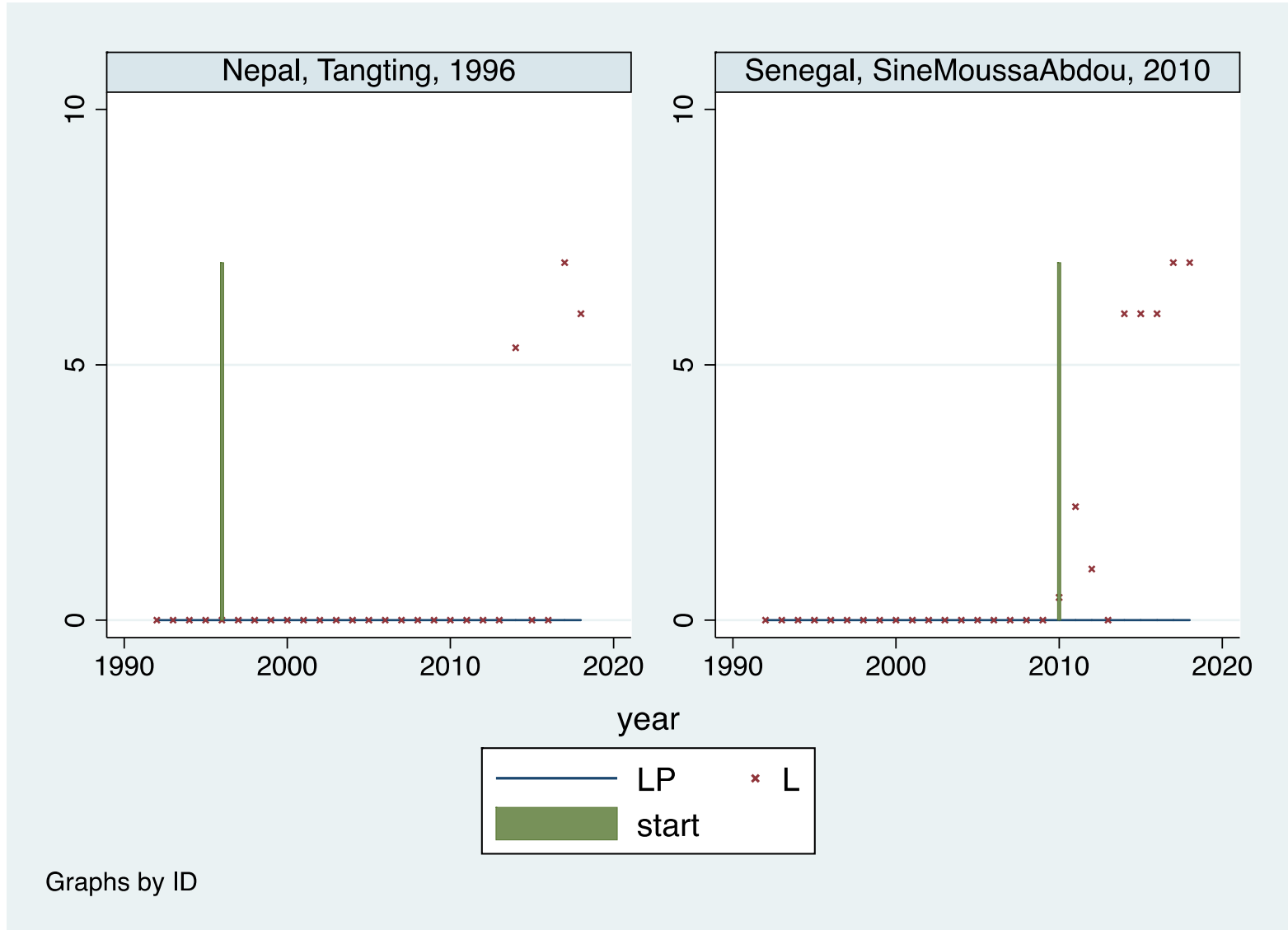
Graphs by ID

Illustration 2



Graphs by ID

Illustration 3



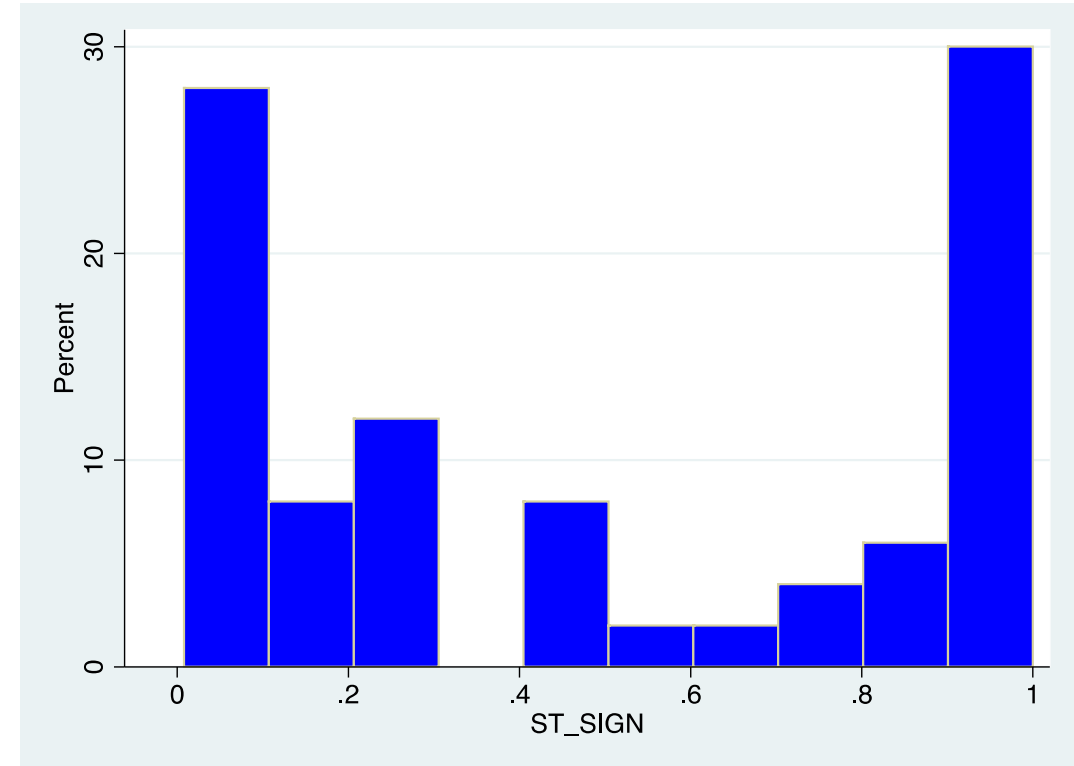
Graphs by ID

Results



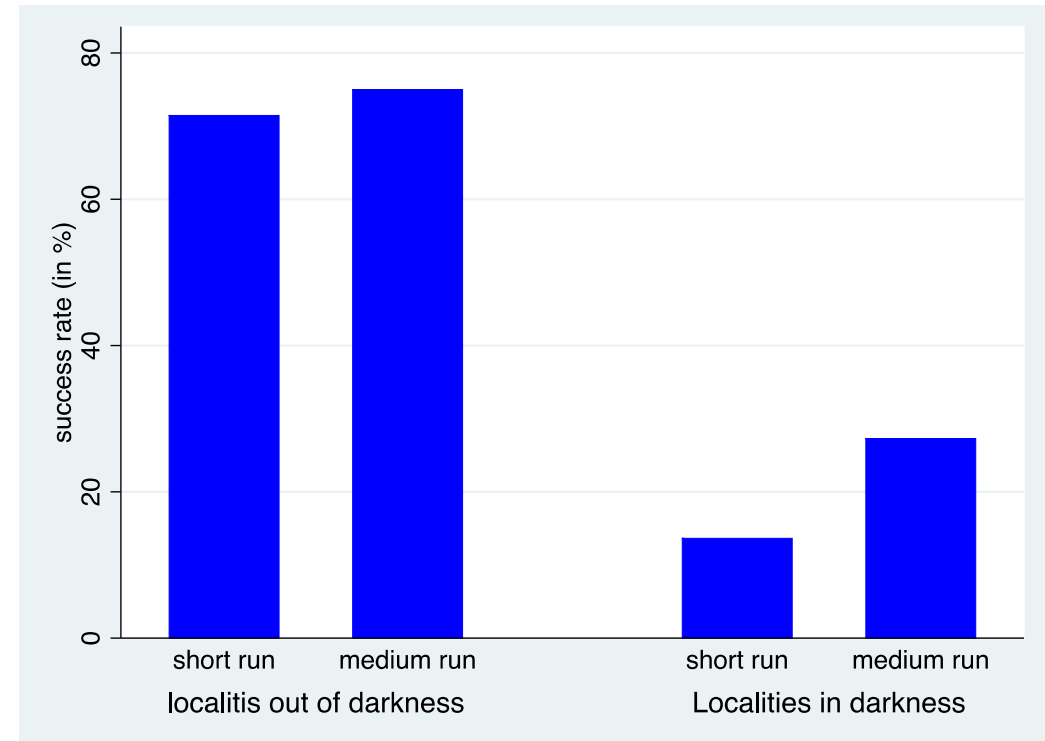
Identification of probably successful projects

- 46% projects were successful in the short run, with a probability above or equal 80%.



Success depends on initial conditions

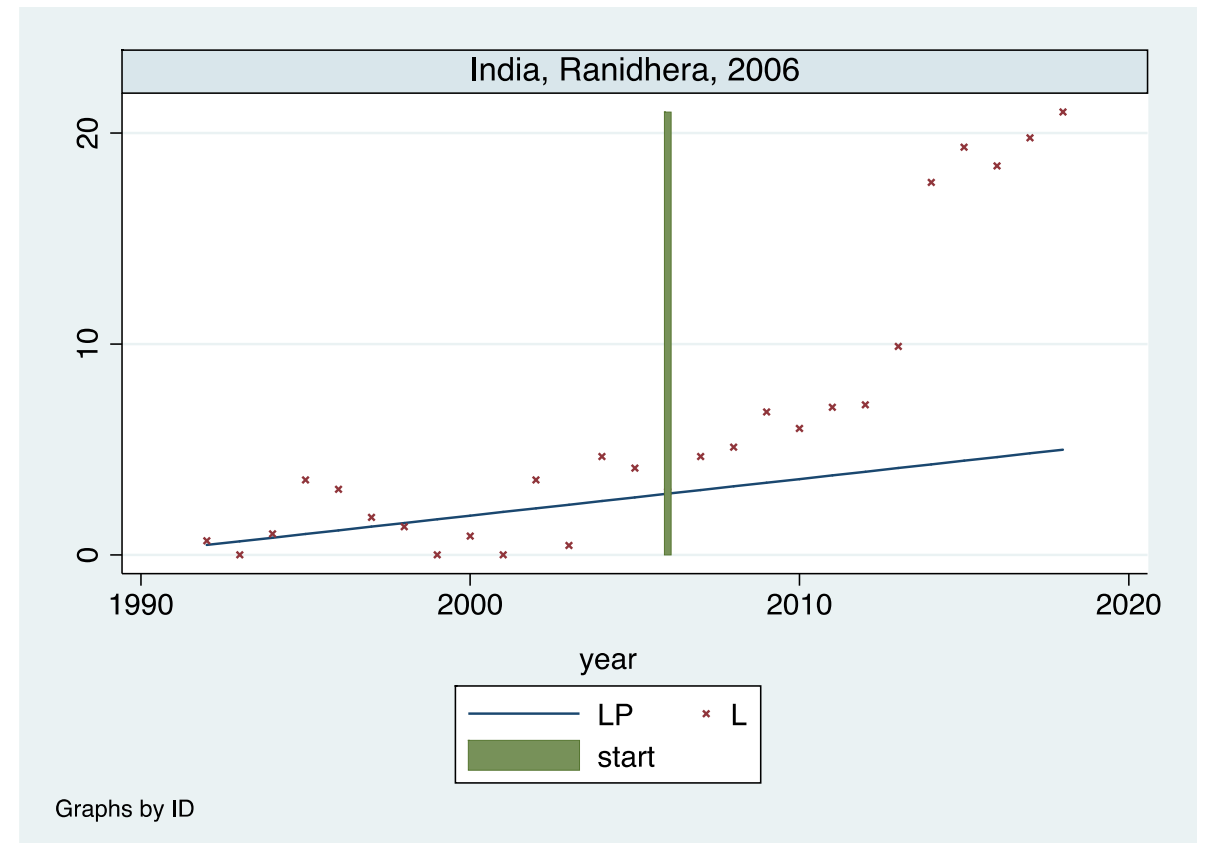
- Success rate of projects in localities Initially “out of the darkness” *versus* “in the darkness”



Successful projects trigger a large acceleration of local incomes

- The effect of successful projects on economic activity has a median of 14 %

In Ranidhera, India (Mdiam project), income per capita doubled in ten years

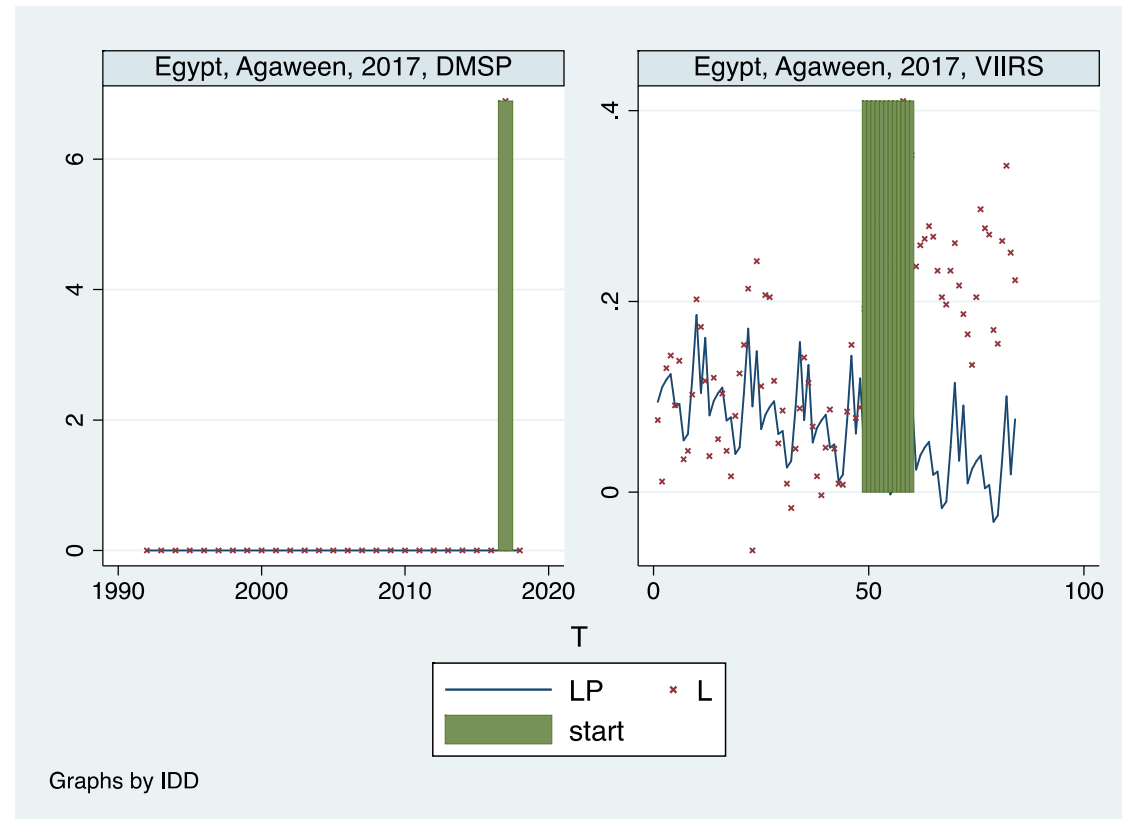


Discussions

- Results are similar when we change the size of pixels
- Results are more precise when we use the recent VIIRS data
- Results are consistent with traditional evaluations observed in CoSMMA.

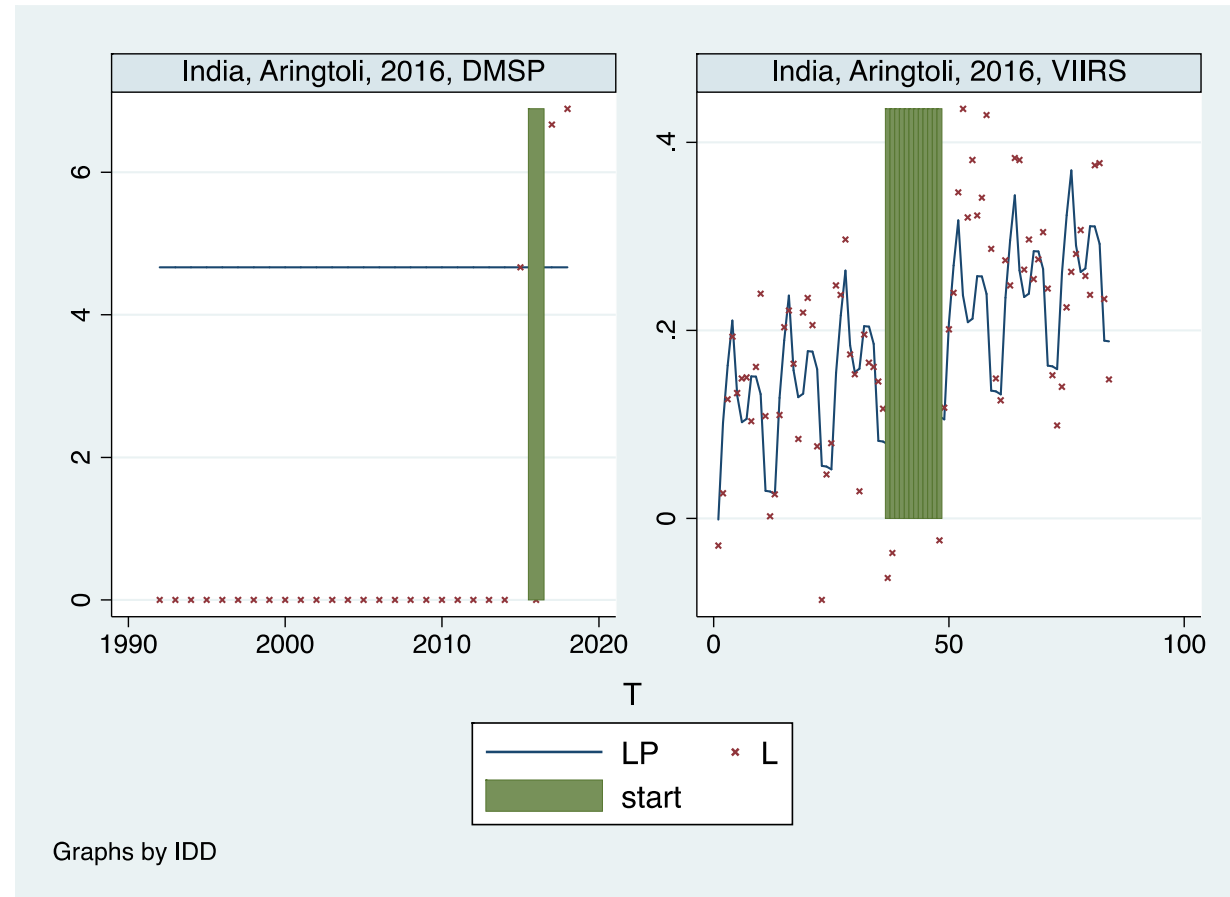
Comparison with monthly VIIRS data for recent projects

- Project [Egypt , Agaweenn 2017] failed with DMSP data, but was successful with VIIRS data



Comparison with monthly VIIRS data for recent projects

- Project | India Aringtoli 2016] successful withMSP data, failed with VIIRS data

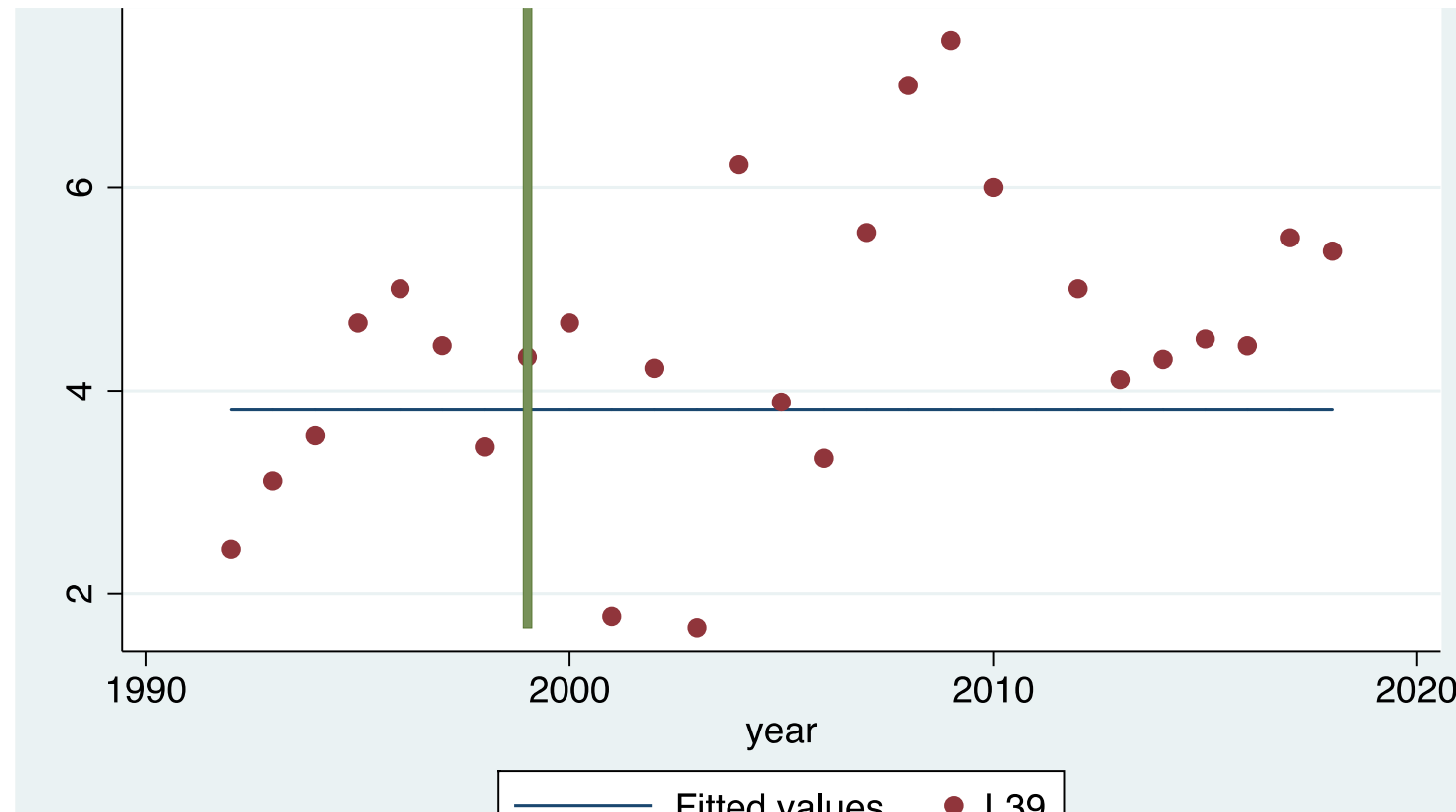


Does this approach confirm
—results obtained with traditional
evaluation methods?

For triangulation of CoSMMA evaluations, we selected projects with at least 3 independent indications that they had positive effects

Project	ENERGY		ECON.		COM-		INFO&
	ACCESS	EDUC.	TRANSF.	ENVIRT.	MUNITY	Health	
Bangladesh, Rangamati, 2010	X			X		X	
Brazil, Garapé, 2004	X		X	X	X		
India, Tamkhua, 2007	X	X	X	X	X	X	X
Kenya, Mpeketoni, 1994	X	X	X			X	
Namibia, Tsumkwe, 2008	X	X	X				
Namibia, Tsumkwe, 2012	X	X	X				X
Philippines, Pagan-an Island, 1999	X	X		X			
Senegal, Sine Moussa Abdou, 2010	X	X			X		
South Africa, Lucingweni, 2011	X			X			X

Only 1 out of 9 projects for which triangulation was feasible (and concluding to success) actually failed according to our data.
(Philippines, Pangan An Island, 1999)



Policy conclusions

- NTL data provide a costless and efficient way of monitoring the effects of mini-grids on economic activity. Identification of successes and failures is easy and costless, and can be repeated over years.
- Successful projects are associated with large effects on local economic growth. This should lead policy makers to pay more attention to distributed electrification projects.
- About half of projects have failed. Given the previous conclusion, it is urgent to identify factors that may facilitate, or otherwise hinder the success of such projects. One key element of failure seems to be the initial energy poverty of localities concerned.

Thank you
