

A new approach for economic impact evaluation of decentralized electrification projects

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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

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- We extracted from CoSMMA¹ 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

¹ <https://ferdi.fr/en/indicators/data-collaborative-smart-mapping-of-mini-grid-action-cosmma>

Methodology

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- We extracted information, from years prior to the implementation of projects, to build predicted NTL values beyond the 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

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- We decided that a project succeeded in the short run (*medium run*) if its average NTL over the 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

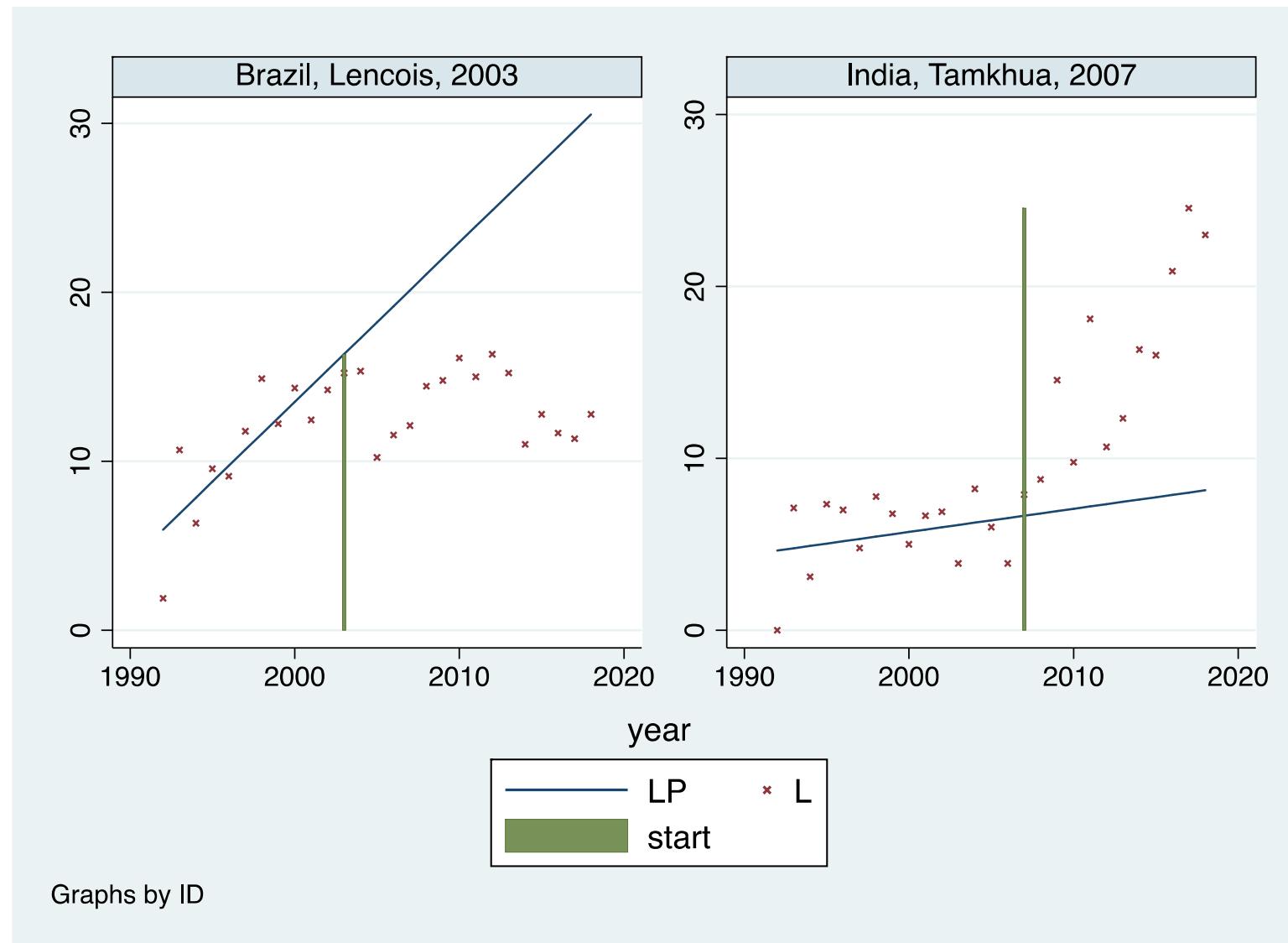


Illustration 2

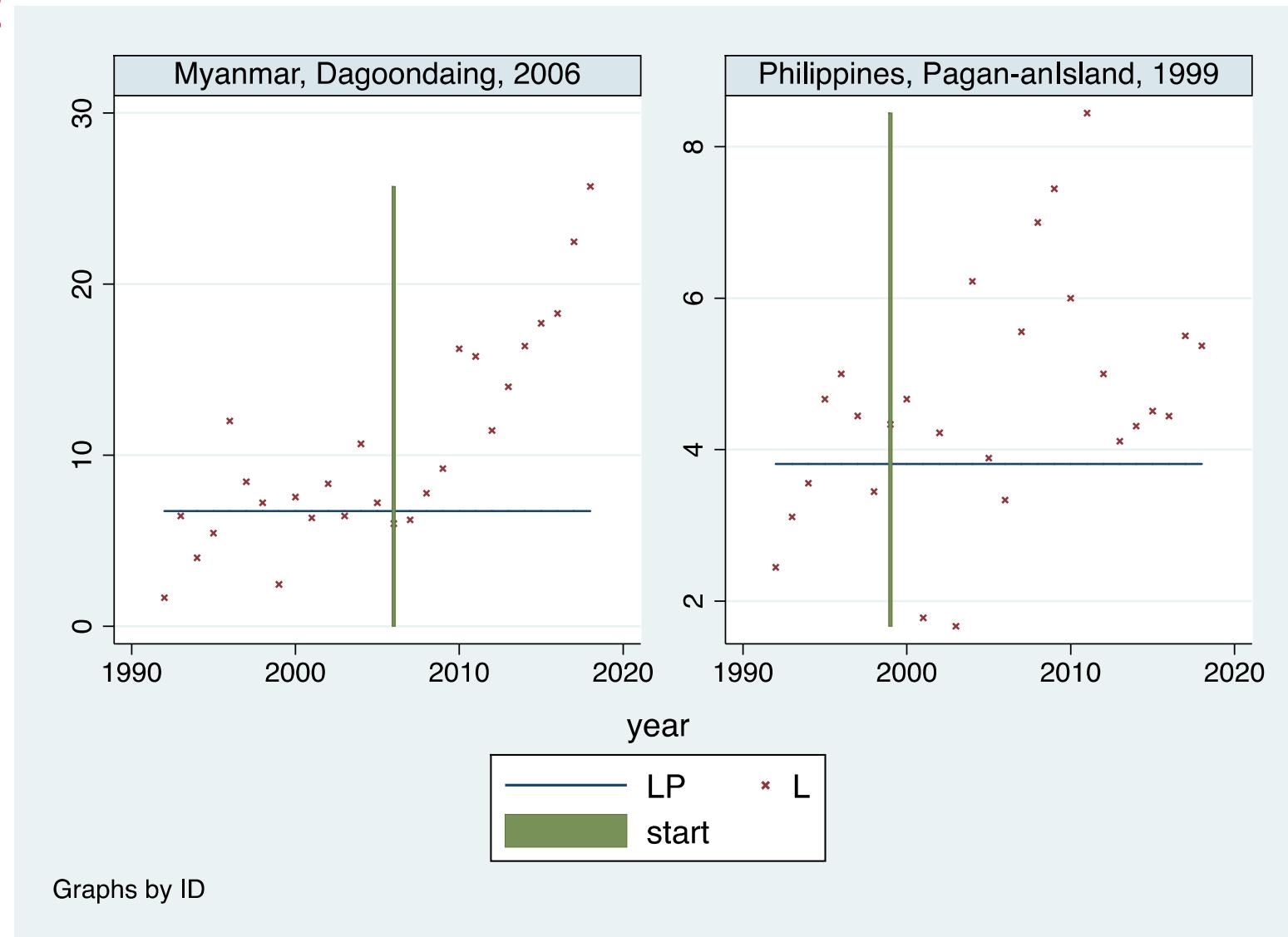
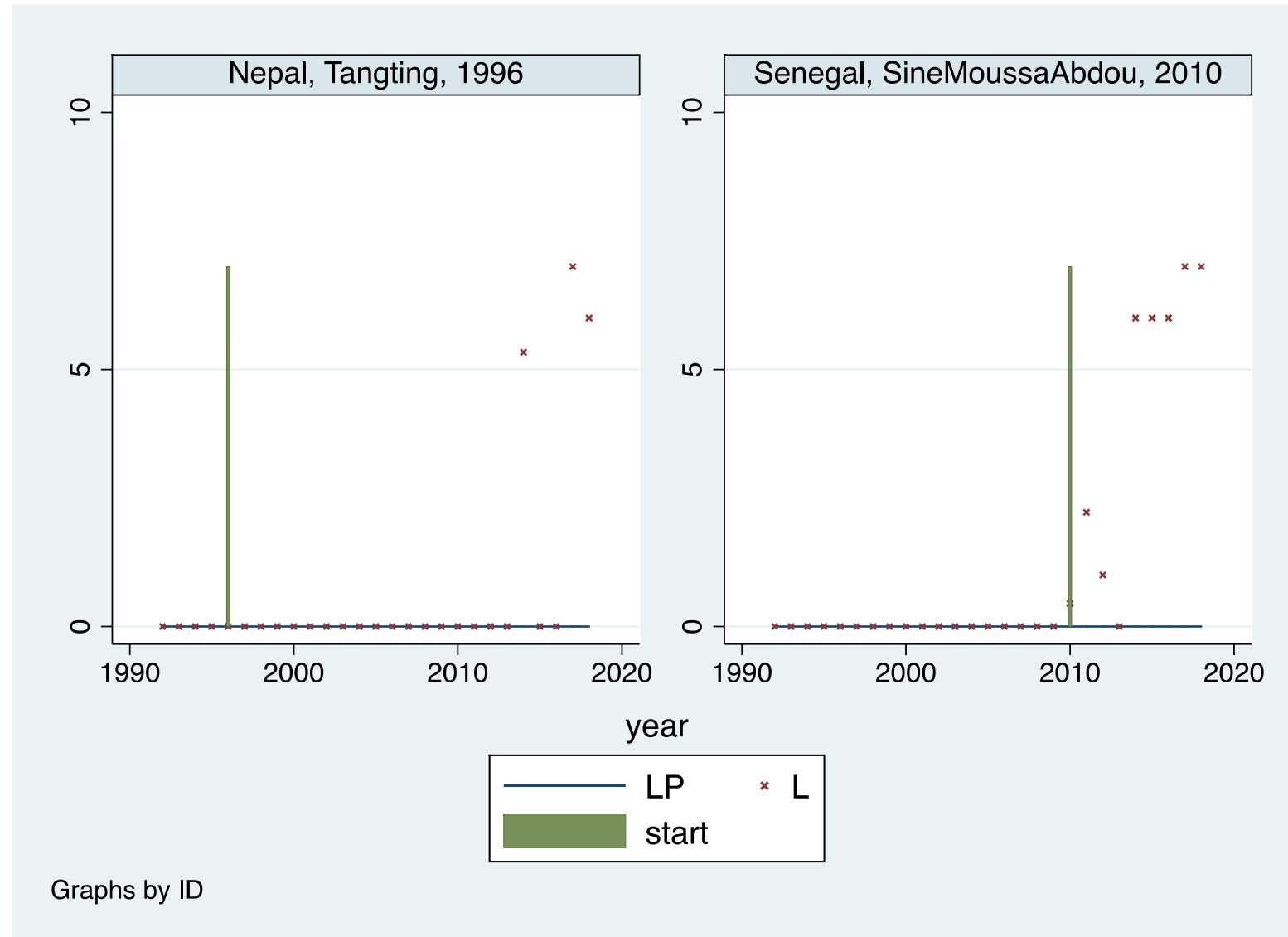


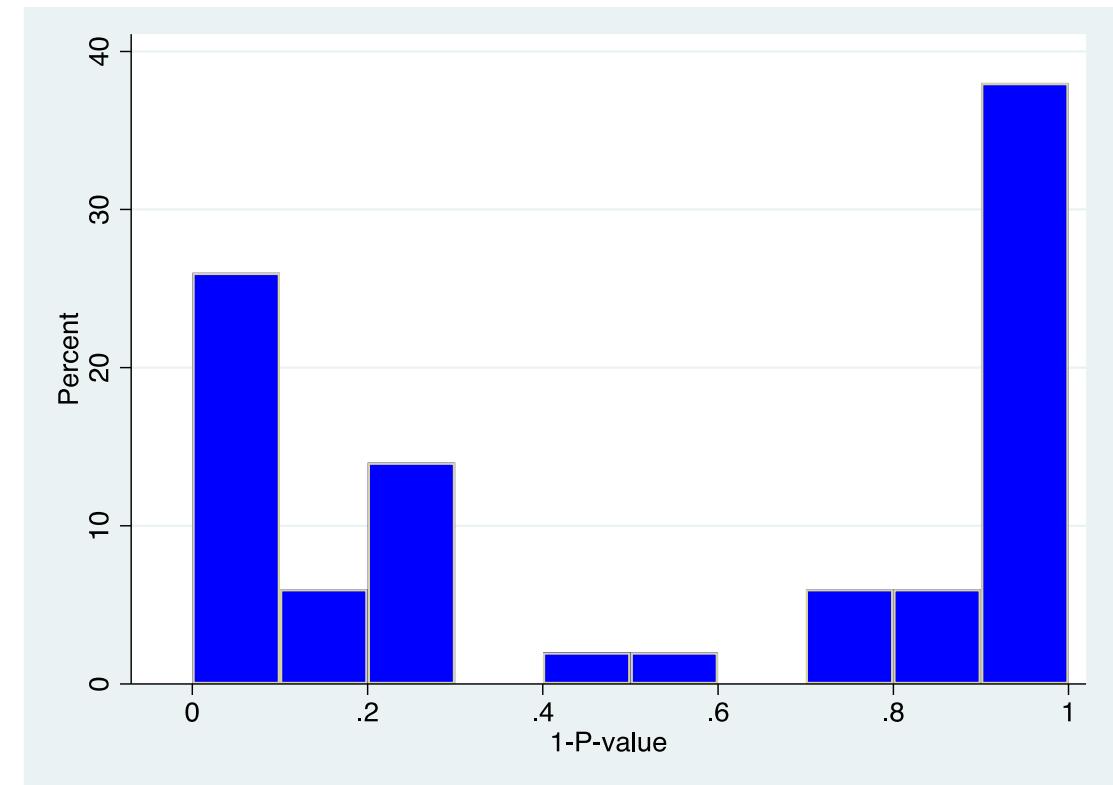
Illustration 3



Results

Identification of probably successful projects

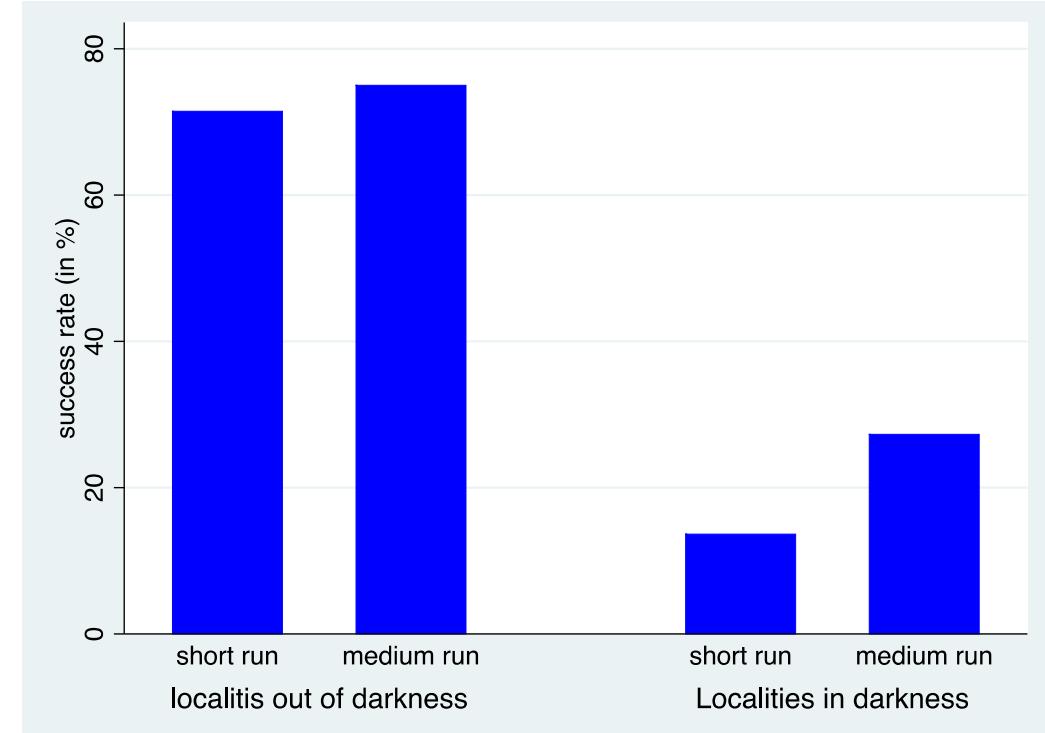
- 48 % projects were successful in the short run, with a probability above or equal 80%.



Success depends on initial conditions

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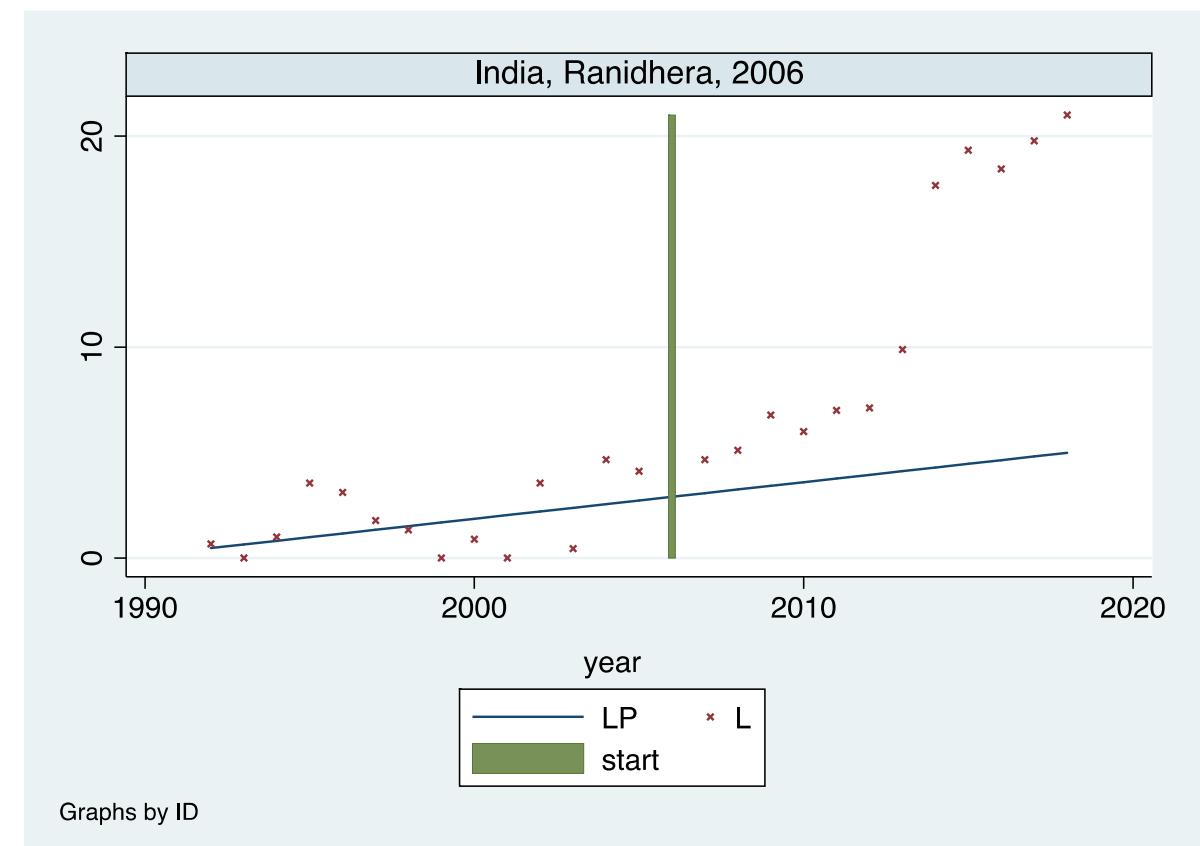
- Success rate of projects in localities varies depending on villages initially “out of darkness” *versus* “in darkness”



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

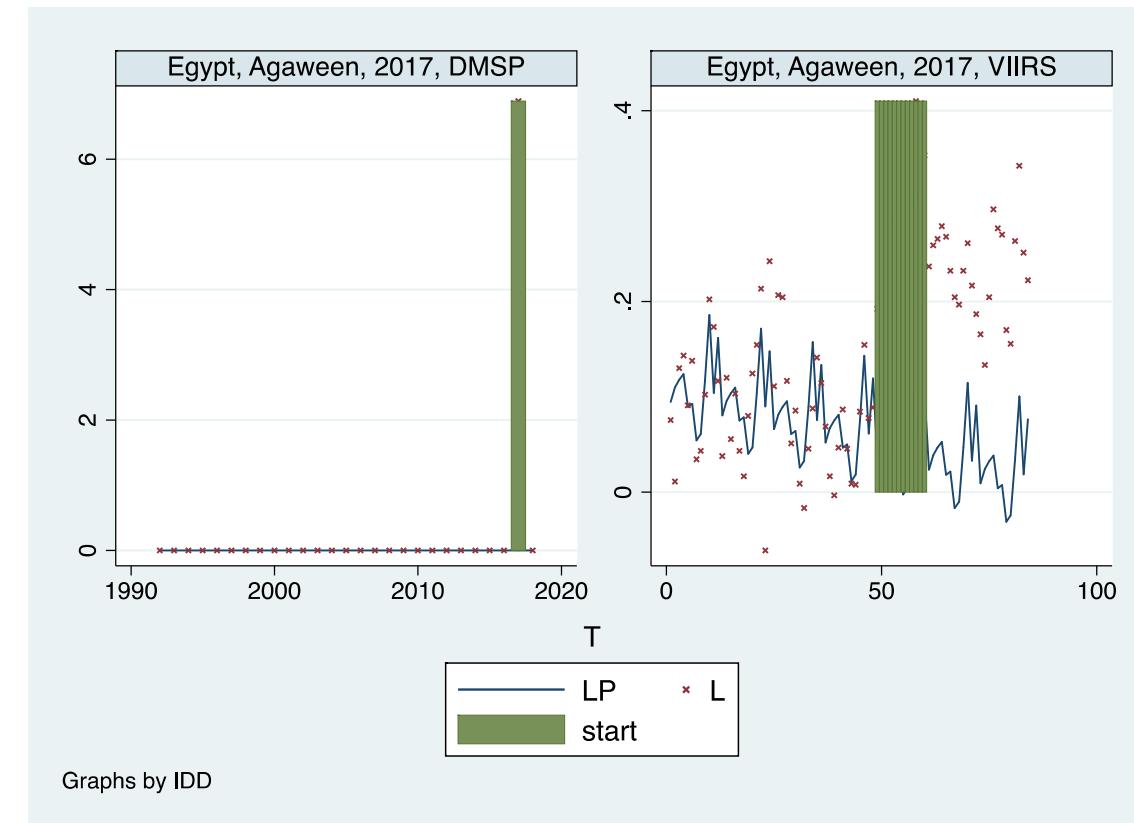


Discussions

- Results are similar when we change the size of pixels (from 3*3 km to 9*9 km)
- Results are more precise when we use the recent VIIRS data
- Results are consistent with traditional evaluations observed in CoSMMA.

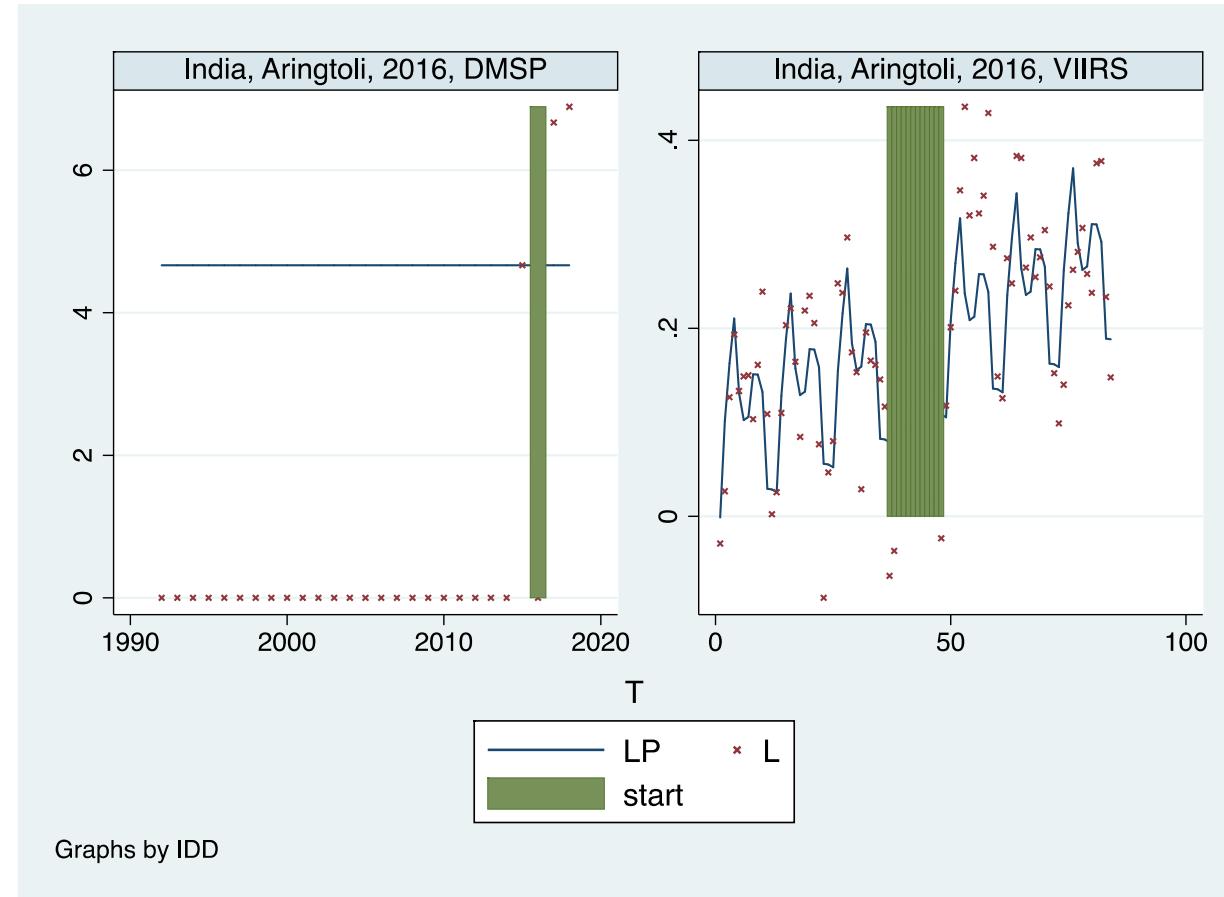
Comparison with monthly VIIRS data for recent projects

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



Comparison with monthly VIIRS data for recent projects

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



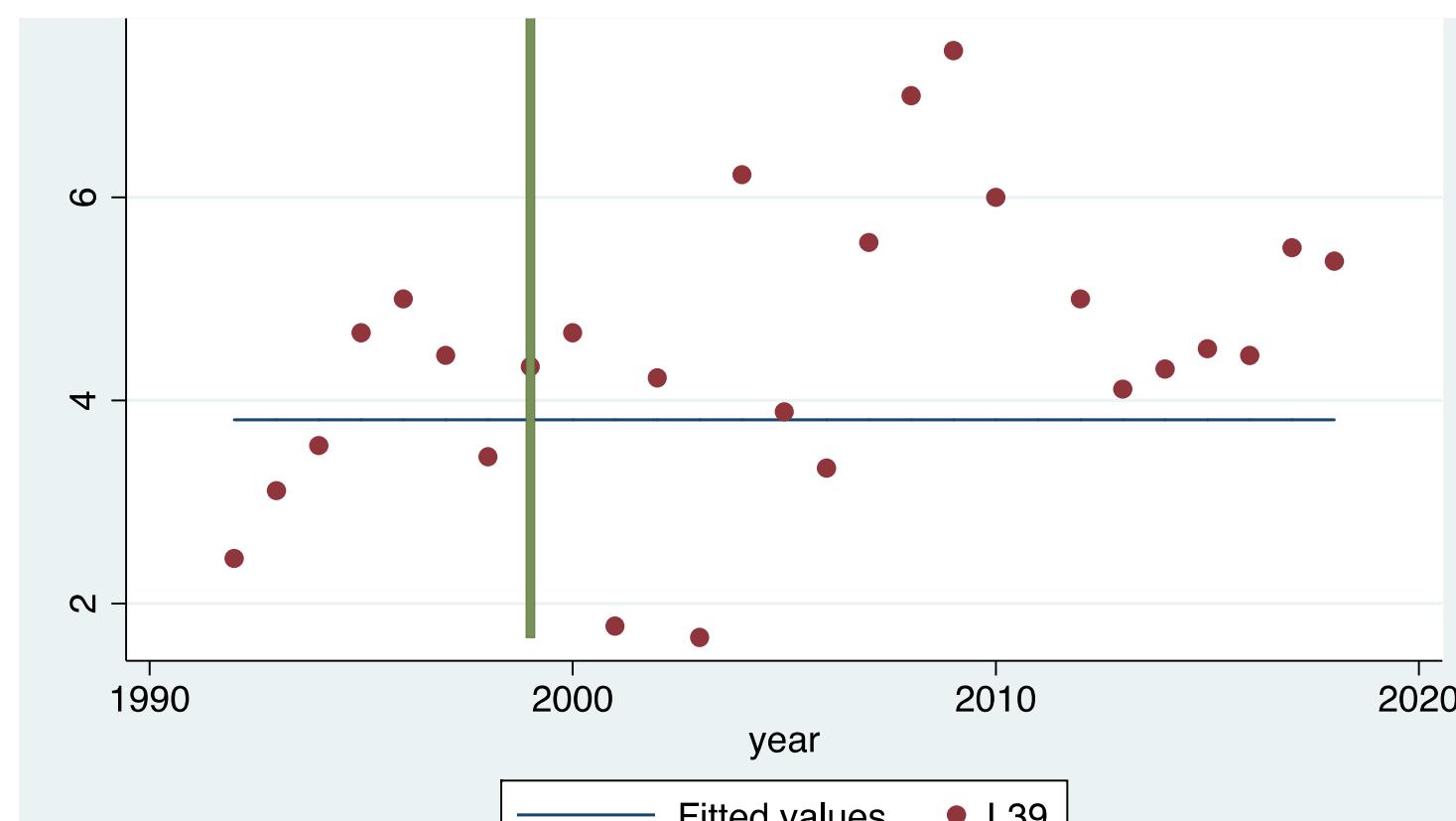
— Does this approach confirm results obtained with more traditional evaluation methods?

For triangulation, out 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	COMM	
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, Lusingweni, 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, efficient and more systematic way of monitoring the effects of mini-grids on economic activity. Identification of successes and failures is easier and cheaper. Project monitoring can be repeated over the years.
- Successful project are associated with large effects on local economic growth. This should lead policy makers to pay more attention to installed electrification projects.
- About half of the 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.

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Thank you for your attention