

Rural Electrification, Migration and Structural Transformation: Evidence from Ethiopia

Stephie Fried David Lagakos
Carleton College UCSD, NBER and IGC

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Structural Transformation

- Moving from “traditional” to “modern” agricultural production
 - Use of fertilizer, hybrid seeds, irrigation, mechanization
- Moving into non-agricultural activities
 - More manufacturing and services in rural areas
 - Rural-urban migration, growth of urban non-ag sector
- Central component of economic development process

Structural Transformation and Rural Electrification

- Hard to imagine structural transformation without electricity
- Explicit goal of rural electrification policy
 - e.g. Ethiopia's Growth and Transformation Plan (GTP)
- Empirical evidence on effects of rural electrification on structural transformation still lacking

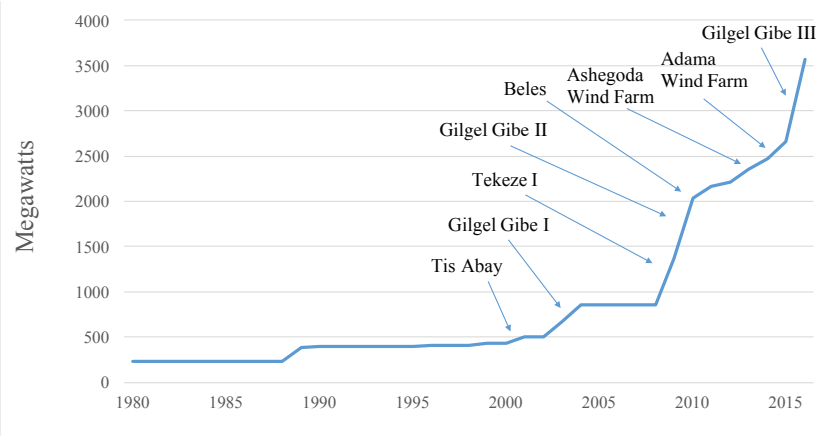
This Paper: Effects of Rural Electrification in Ethiopia

- Use panel of rural Ethiopian villages, 2012 to 2014
- Effects of electrification on
 1. Non-agricultural business activity
 2. Agricultural techniques and productivity
 3. Migration patterns
 4. Investment in household durable goods

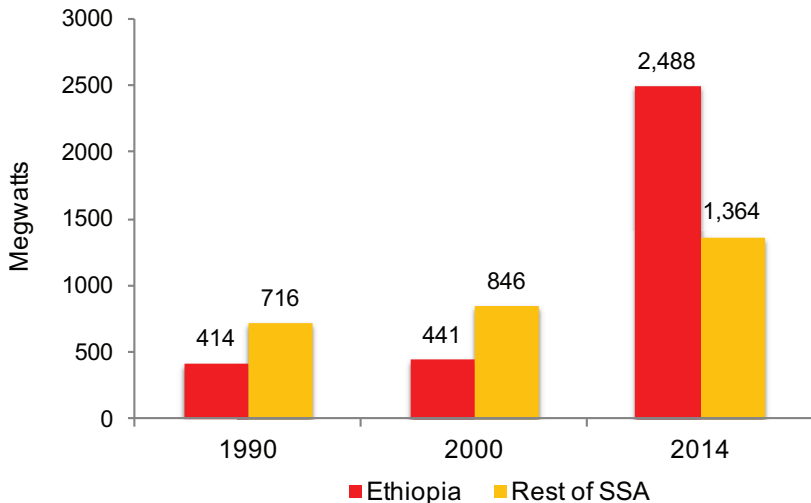
Broad Relevance of Ethiopian Case

- If rural electrification isn't transformative here, may not be anywhere
 - Massive increases in electricity generation capacity
 - Central policy focus on rural electrification (e.g. GTP)
 - Huge scope for structural transformation

Ethiopia's Massive Increases in Electricity Generation



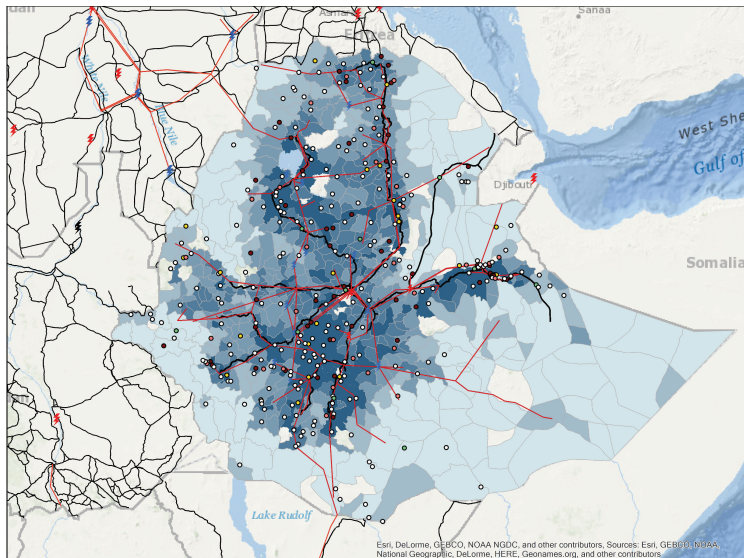
Ethiopia's Massive Increases in Electricity Generation



Data Source

- Sample of 211 villages (enumeration areas) in 2012 and 2014, from Ethiopian Rural Socioeconomic Survey (ERSS)
- Focus on enumeration areas that (1) are identified as “rural”, (2) are at least 25km from Addis, (3) have less than 10,000 people, (4) are NOT electrified in 2012
- Compare villages that get electrified by 2014 to those still not electrified in 2014

ERSS Villages and Population Density in 2012



Electrified vs Non-Electrified Villages

Focus on “Non-electrified” vs “Electrified by 2014”

- Non-electrified villages
 - None (0%) of households have grid electricity in 2012 or 2014
- Electrified by 2014
 - None of households have grid electricity in 2012; positive fraction of households ($>0\%$) have grid electricity in 2014
- Rationale: unlikely that electrification rate increases from zero due to income effect; more likely interpretation: grid reached village

Which Rural Villages Get Electrified?

- Policy version: what was criterion for determining which small rural villages got electrified?

- Econometric version: On parallel trends in 2012? If so, causal interpretation of differences in differences

Policy Version: Which Rural Villages Get Electrified?

- Each region proposes list of villages given quota from central government; power company assess cost, vetoes high-cost areas
- Primary goals: equity and cost (e.g. population, distance to grid)
- Source: meetings with Ethiopian Electric Utility, Ethiopian Electric Power and Ministry of Water, Irrigation and Energy

Econometric Version: Which Rural Villages Get Electrified?

- Compare village and household characteristics in 2012
- Try to predict electrification by 2014 using observables in 2012
- Assess plausibility of parallel trends assumption

Village Characteristics in 2012

	Village Type		
	Non-Electrified	Electrified by 2014	Difference (<i>p</i> -val)
Population	4,574	4,925	350 (0.38)
Dist. to Major Road (km)	53	46	7 (0.46)
Dist. to Addis (km)	336	325	11 (0.63)
Dist. to Addis via road (km)	512	461	-51 (0.14)
Dist. to Djibouti via road	962	895	-67 (0.19)
Dist. to Electrified E.A.	44	38	-6 (0.49)
On Line From Dam to Addis,%	16.3	9.3	-7 (0.25)
Health center, %	18.1	27.9	9.8 (0.15)
Tar road, %	16.3	18.6	2.3 (0.71)
Received Migrants, %	23.2	20.9	-2.3 (0.75)
Sent Migrants, %	43.0	55.8	12.8 (0.13)

Average Household Characteristics in 2012

	Village Type		
	Non-Electrified	Electrified by 2014	Difference (<i>p</i> -val)
Tap Water (%)	9.6	8.9	0.7 (0.86)
Flush Toilet (%)	2.0	0.2	-1.8 (0.36)
Mud Floor (%)	96.9	94.8	-2.1 (0.14)
Primary School (%)	3.5	4.7	1.2 (0.16)
Non-agric. Bus. (%)	4.8	5.4	0.6 (0.65)
Use Generator (%)	23.7	24.2	0.5 (0.93)
Mobile Phone	19.7	27.2	7.5* (0.08)
Electric Stove	1.0	1.8	0.8 (0.22)
Sewing Machine	1.5	2.5	1.0 (0.17)
Television	1.6	2.7	1.1 (0.16)

Can One Predict Which Villages Get Electrified?

- In short, NO, not with these observables
- Regression of “electrified by 2014” using observables in 2012 in previous tables has adjusted R^2 of -0.0092
- All explanatory variables individually insignificant
- F -stat for joint significance is 0.90, p -value is 0.59

Summary: Plausible that on Parallel Trends in 2012

- Similar in village and household characteristics
- Can't predict who gets electrified based on observables in 2012
- Consistent with equity and cost being the primary goal of rural electrification, rather than expected village growth trends
- Plausible, but not certain, that on parallel trends

Differences in Differences: 2012 to 2014

Difference-in-Difference Strategy

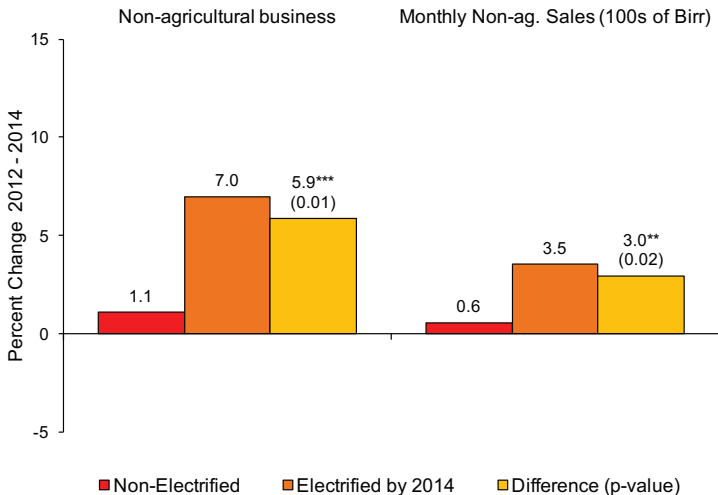
- ① Non-agricultural businesses activity
- ② Agricultural techniques and productivity
- ③ Migration patterns
- ④ Electricity-using household durables

Non-Agricultural Business Activity

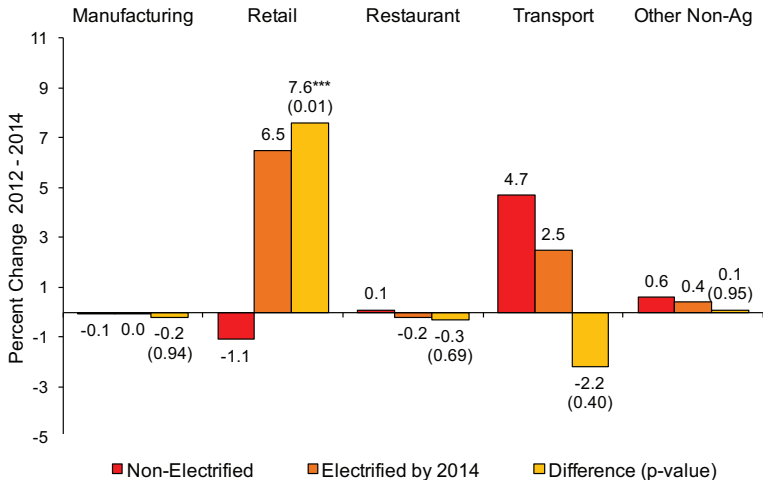
Non-Agricultural Business Activity

- More households operating non-agricultural business?
- Greater non-agricultural incomes?
- What type of non-agricultural businesses?

Non-Agricultural Businesses, Percent Changes 2012 to 2014

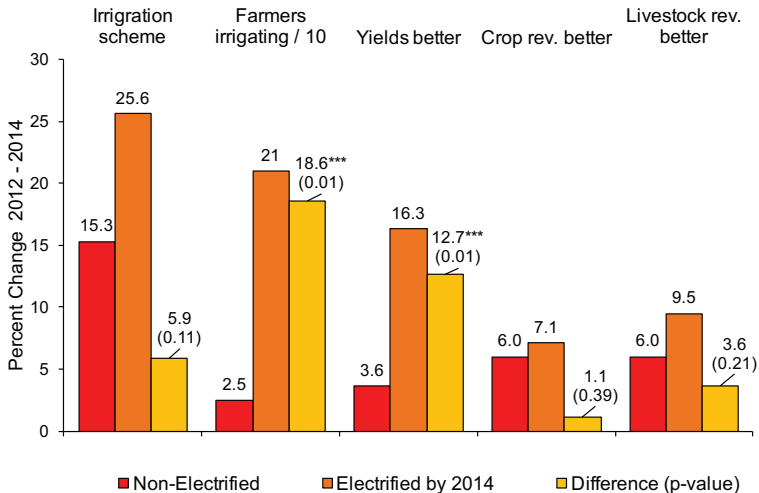


Non-Agriculture Businesses, Percent Changes 2012 to 2014



Agricultural Technology and Productivity

Agricultural Production, Percent Changes 2012 to 2014



Effects of Electrification on Agriculture: Summary

- Irrigation increases, agricultural yields increase
- Much scope for future research here
 - Quantify yield increases
 - More plantings per year?
 - Different crops?
 - More land cultivated?

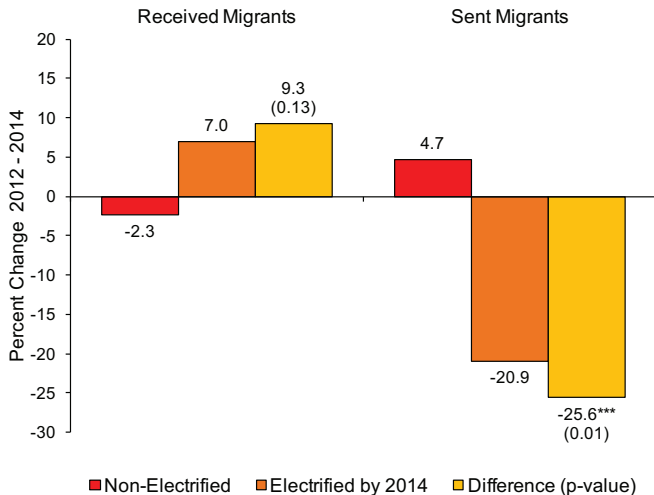
Internal Migration Patterns

Migration Question in ERSS

In the last five years, have there been more people who moved into this community or more people who moved away?

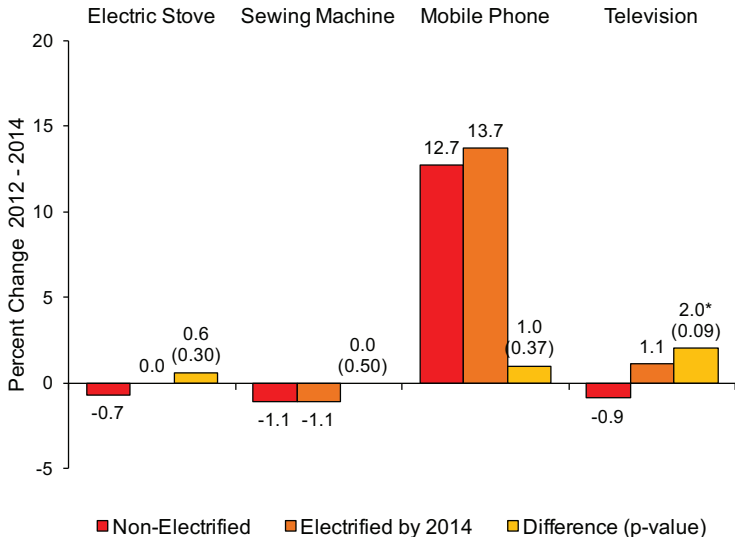
- “Received migrants”: more people moved into community
- “Sent migrants”: more people moved away

Migration, Percent Changes from 2012 to 2014



Household Durables Using Electricity

Household Durables, Percent Changes 2012 to 2014



Other Contemporaneous Changes

Differences in Differences: Other Contemporaneous Changes

	Percentage Point Changes 2012-2014		
	Non-Electrified	Electrified in 2014	Difference
Distance to school	0.3	-1.5	-1.8 (0.20)
Health clinic in village	3.0	-7.0	-10.0 (0.16)
Have tap water	3.5	14.4	10.9** (0.05)
Have tar road	1.7	-4.4	-6.1 (0.37)

Source: Author's Calculations Using ERSS (2012, 2014)

Other Contemporaneous Chances: Summary

- Electrified villages more likely to have been connected to water grid
- No significant difference in road quality, school access or health clinic access
- Suggests water and power grid networks extended simultaneously?
- Or, once have electricity, can hook up electric water pumps?

Conclusions So Far

- Evidence that rural electrification led to structural transformation in Ethiopia
- Electrified villages saw new non-agricultural business, higher agricultural yields through irrigation
- Electrified villages had reduced out-migration
- Causal interpretation when no correlation with underlying potential for structural change; plausible given strong similarities in 2012

Policy Implications I: Effects on Agriculture

- Policymakers expect transformation from rural electrification, not just more lights and TVs
- Effects on irrigation and productivity new relative to findings of impact study of Ethiopian Electric Power:

The study did not find any significant impacts in raising productivity of agriculture through irrigation and collective mechanization,

- In contrast, our results suggests transformation rather than “just lights and TVs”

Policy Implications II: Migration

- Surprisingly little focus from Ethiopian policymakers on migration (at least that I talked to)
- Migration can raise income, but taxes urban infrastructure
- Don't want everyone to move to Addis? Facilitate higher productivity in village and out-migration slows down

Thank You!

Extra Slides

Electrification Rates Increased Substantially from 2012 to 2014

Grid Electrification Rate	Percent of Villages		
	2012	2014	Difference
Not electrified (none of hh's have grid electricity)	67.5	60.3	-7.2
Electrified (positive fraction have grid electricity)	32.5	39.7	+7.2

Source: Author's Calculations Using ERSS (2012, 2014); all EAs.