

# Short Term Effects of Rural Electrification: Experimental Evidence from El Salvador

Manuel Barron<sup>1</sup> and Maximo Torero<sup>2</sup>

<sup>1</sup>Department of Economics, Universidad del Pacífico

<sup>2</sup>IFPRI

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# Introduction

- ▶ 1.3 billion people worldwide live without electricity
- ▶ Kerosene lighting, no refrigeration, no power tools
- ▶ Some but limited access to: cellphone, TV
- ▶ Electrification is argued to have impacts on labor supply (Dinkelman 2011), income and education (van de Walle 2013), manufacturing output (Rud 2012)
- ▶ Barron and Torero (WP) Reduction in  $PM_{2.5}$ , with improvements in respiratory health

# Research Question

- ▶ How does household electrification affect time allocation?
- ▶ Children: time studying
- ▶ Adults: nonfarm employment, home business operation

# Time Studying

Theoretically ambiguous effect:

- ▶ Better study environment, less effort required.
- ▶ Higher (expected) returns to education, as electrification may indicate economic progress (or unravel it!).  
(Aspirations?)
- ▶ But the marginal value of leisure increases (TV)

# Labor Supply

- ▶ Electricity increases the marginal value of leisure and of labor.
- ▶ Potentially new activities.
- ▶ Or people may simply work more because they need to pay for their new appliances and electric bill.

# Study Setting: Northern El Salvador

- ▶ 80% of the El Salvadorian population had access to electricity.
- ▶ Our sample: Mostly rural, poor
- ▶ Household heads: 45% illiterate, 70% male
- ▶ 70% farmers
- ▶ 3.7 years of schooling (heads = 2.8)
- ▶ Household income  $\sim$ \$2,000 /year (median \$1K).

# The Electrification Program

- ▶ Intensification and Extension of the electric grid in northern El Salvador (2009).
- ▶ Government covered all the installation costs up to the electric meter.
- ▶ Households pay for internal wiring and a safety inspection fee.
- ▶ Fee: \$100

# Experimental Design

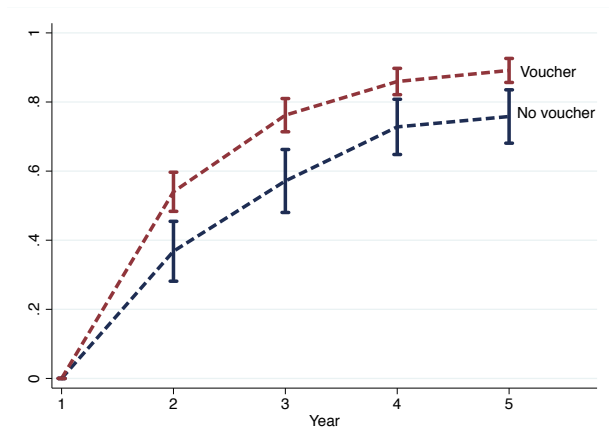
- ▶ Discount vouchers (Bernard and Torero 2015)
- ▶ Three encouragement levels:
  - ▶ 180 high-discount (\$50 off)
  - ▶ 180 low-discount (\$20 off)
  - ▶ 140 control.
- ▶ Voucher: reimbursement for the safety inspection.  
Non-transferable, valid for 9 months.



# Vouchers

- ▶ Vouchers work in several potential ways:
  - ▶ Reducing the fixed cost of formal connection
  - ▶ Lifting credit constraints (reimbursement can pay for interest rate)
  - ▶ Nudge
  - ▶ “Endowment effect” (households may feel they lose money by not connecting)
- ▶ All in all, vouchers can be thought of encouraging a random subsample of households to connect to the grid.

# First Stage



# First Stage

Dep. Var. Household Has a Connection to the Grid (0/1), Least Squares Estimates

	(1)	(2)	(3)	(4)
Voucher x post	0.157*** (0.039)	0.157*** (0.039)	0.120*** (0.041)	0.116*** (0.042)
s100 x post			0.130*** (0.037)	0.126*** (0.037)
s200 x post				0.025 (0.035)
Household Fixed Effects	No	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Households	494	494	494	494
Mean Y, Control	0.606	0.606	0.606	0.606
Mean Voucher	0.729	0.729	0.729	0.729
Mean s100	0.448	0.448	0.448	0.448
Mean s200	0.371	0.371	0.371	0.371

Notes: Standard errors clustered at the household level. Significantly different than zero at 90(\*), 95(\*\*), and 99(\*\*\*) percent confidence.

# Variables of Interest

- ▶ Electrification measure: Having or not a connection at time  $t$  (1/0)
- ▶ Robustness:
  1. Years with a connection by time  $t$  (number of years)
  2. Having at least “ $k$ ” years of connection by time  $t$  (1/0)
- ▶ Instruments:
  - ▶ voucher
  - ▶ robustness checks
    - ▶ low-discount, high-discount
    - ▶ "fee" (\$100, \$80, \$50)
  - ▶  $s^{100}$ : share of eligible neighbors that received a voucher within 0-100m (spillovers)
  - ▶ Neighbors within: 100-200m, 200-300m (no effect)

# Household Electrification and Time Allocation, School-Age Children (extensive margin)

Dep.Var. Participated in Activity, IV Estimates

	(1)	(2)	(3)	(4)
	Education	Chores	Work	Leisure
Connected	0.779** (0.397)	0.963* (0.506)	-0.230 (0.330)	-0.045 (0.075)
Household and Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	747	747	747	747
Individuals	196	196	196	196
Mean Y, t=1	0.221	0.669	0.191	1.000
Mean Y, t>1	0.157	0.577	0.264	0.960
Mean Y   Y > 0	6.123	3.486	6.700	8.682

Notes: The excluded instruments are voucher and  $s^{100}$ . Standard errors clustered at the household level. Significantly different than zero at 90(\*), 95(\*\*), and 99(\*\*\*) percent confidence.

# Household Electrification and Human Capital Investment, School-Age Children (extensive margin)

Dep.Var. Participated in Activity, IV Estimates

	Education		Studying		Other Educ	
	(1)	(2)	(3)	(4)	(5)	(6)
Connected	0.779** (0.397)		0.539* (0.292)		0.840** (0.398)	
connected x female		0.621 (0.379)		0.566** (0.274)		0.621 (0.379)
connected x male		1.209 (1.297)		0.415 (0.840)		1.454 (1.394)
Household and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	747	747	747	747	747	747
Individuals	196	196	196	196	196	196
Mean Y, t=1	0.221	0.221	0.147	0.147	0.213	0.213
Mean Y, t>1	0.157	0.157	0.068	0.068	0.152	0.152
Mean Y   Y > 0	6.123	6.123	2.073	2.073	5.298	5.298

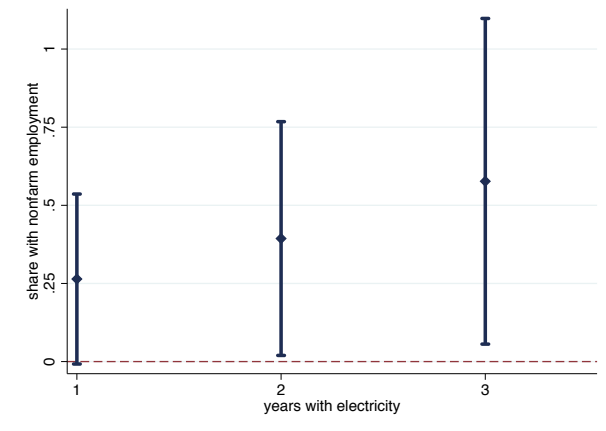
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# Adults

- ▶ Working age: 16-65 year olds
- ▶ Males and females
- ▶ Not participating in non-farm employment at baseline

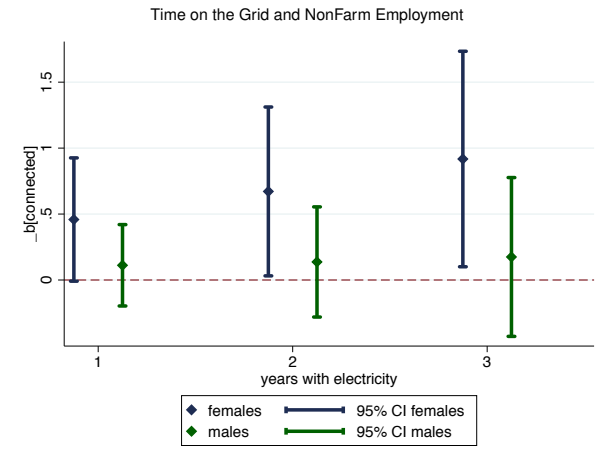
# Electrification and Non-Farm Employment

Probability of Engaging in Nonfarm Employment





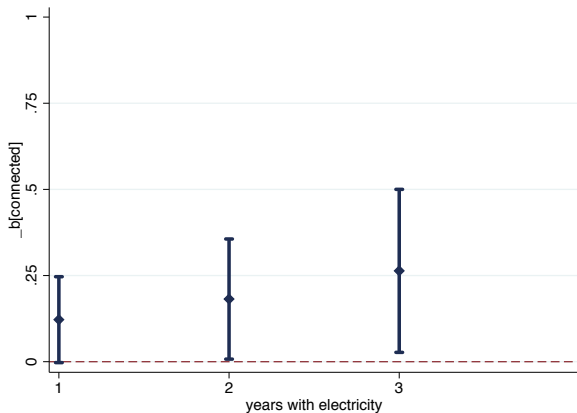
# Electrification and Non-Farm Employment, by Gender



- Effects seem concentrated among women

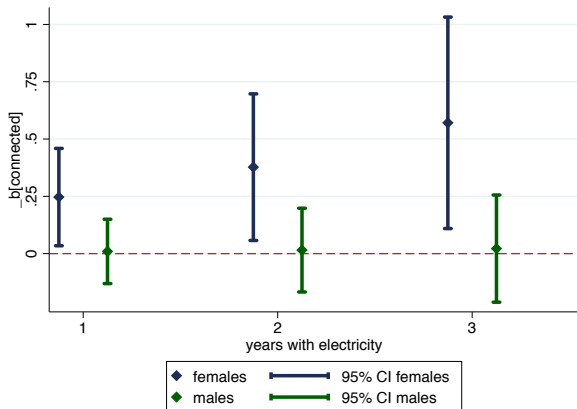
# Electrification and Home Businesses

Dep.Var. Individual Operates a Home Business (1/0), IV Estimates



# Electrification and Home Businesses, by Gender

Dep.Var. Individual Operates a Home Business (1/0), IV Estimates



# Electrification and Household Income, IV (Gross Income)

Dep.Var. Household Income (US\$ per year)

	Total Income		Labor Income		Non-Labor Income	
(mean) connected	5.449*		5.923**		-0.474	
	(2.854)		(2.883)		(0.510)	
(mean) t_conn		2.252*		2.423**		-0.170
		(1.187)		(1.197)		(0.207)
Household and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2147	2147	2147	2147	2147	2147
Households	469	469	469	469	469	469
Mean Y, t=1	1.776	1.776	1.465	1.465	0.312	0.312
Mean Y, t>1	2.567	2.567	2.005	2.005	0.562	0.562
Mean X, t>1	0.730	1.628	0.730	1.628	0.730	1.628

Notes: The excluded instruments are voucher and  $s^{100}$ . Standard errors clustered at the household level. Significantly different than zero at 90(\*), 95(\*\*), and 99(\*\*\*) percent confidence.

# Summing up

In our study setting, electrification

- ▶ ↑ investment in education
- ▶ ↑ Participation in non farm employment (home business) among women. ⇒ ↑ household income.

# Into the Fray

- ▶ What happens with the intensive margins
- ▶ Truncation at zero: Answers require additional assumptions.
- ▶ Business Characteristics?

Thanks!