Do Environmental Messages Work on the Poor? Experimental Evidence from Brazilian Favelas

Chantal Toledo

UC Berkeley

IPWSD, April 13 2013

Motivation

- The world's poor and near-poor will play a major role in driving medium-run growth in energy consumption (Wolfram, Shelef and Gertler 2012)
- Energy efficient technologies provide energy savings and decrease pollution
- Developed countries use different incentives to encourage energy efficient technology adoption or environmental behaviors:
  - Monetary incentives (ex: subsidies, rebates)
  - Non-monetary incentives (ex: social norms, environmental messages)
- Little evidence on the interplay of these approaches in developing countries

In this Paper

Using a randomized experiment I designed and conducted in 18 favelas (shantytowns) in Rio de Janeiro, Brazil:

1. I estimate the effect of providing:
   - three different monetary incentives and
   - a particular form of environmental persuasive communication

   on the take-up of an energy efficient light bulb (light emitting diode, LED)
2. Analyze the individual or HH characteristics that make individuals more responsive to the communication
   - and those that increase take-up irrespective of the message

Literature Review

1. Empirical evidence on the effects of persuasive communication
   - Bertrand, Karlan, Mullainathan, Shafir and Zinman (2010), DellaVigna and Kaplan (2007)
2. Energy efficient technology adoption
   - Jaffe and Stavins (1994)
3. Experimental evidence of non-pecuniary approaches to increase energy efficient technology adoption or environmental behaviors
   - Herberich, List and Price (2011), Goldstein, Cialdini and Griskevicius (2008)

Favelas

- Favelas: Brazilian shantytowns
  - Initially (late 18th century) the place where former or freed slaves lived
  - 1970s: migration from rural areas
- 2010: 6% of the Brazilian population lives in favelas (11 million), 20% of the population in Rio de Janeiro (1 million)
- Favelas: "subnormal agglomerations" (Brazilian Institute of Geography and Statistics, IBGE)
  - irregular occupation
  - lack of public services or organization
  - high levels of violence and crime
- Recent "pacification" of some favelas (our target population)
  - Pacified favela: favela where the army took control from drug dealers or private militia

Pacification Phases

1. Military police (BOPE) and armed forces enter the favela and occupy some territories
2. Stabilization process: BOPE and armed forces ensure the control of the gained territories
3. Control of favela is given to a Pacifying Unit Police (UPP)
4. "Post occupation" phase: UPP Social undertakes a series of urban, social and economic programs that seek to fully integrate the pacified favela

- Variation in pacification phases within and across favelas
  - May affect income and/or number of illegal connections

Background on Electricity Consumption in Pacified Favelas

- 2010 Census: 99.9% electricity provision in pacified favelas in Rio de Janeiro
- Energy payment is a large share of the poorest HH's income in favelas (14% for the poorest segment) (World Bank)
- Price of electricity for residential consumers varies by income (area) and consumption level
  - average rate for "low income" areas: R$0.23/kWh, average rate: R$0.34/kWh
- Lighting accounts for 11% of residential electricity consumption in Brazil (IBGE)
  - refrigerators: 33%, electric shower: 20%, air-conditioning: 10%
- Large use of illegal connections (30%) (2010 Census, sample)

Experiment Set Up

- Undertaken in July 2012 in street intersections in 18 different pacified favelas in Rio de Janeiro
- Price and persuasion communication randomizations
  - Persuasive communication: "A message provided by one agent (a sender) with at least a potential interest in changing the behavior of another agent (a receiver)" (DellaVigna and Gentzkow, 2010)
- Participants choose between an ILB and a LED but may have to "purchase" the LED
- 377 individual observations (randomization level is the individual)
- Randomized LED prices: R$0, R$11, R$16, market price of LED: R$22
  - Pilots also tested other potential LED prices: R$3, R$6, R$8

Steps

All subjects:

1. are approached on street intersections
2. are surveyed
3. receive technical information on ILBs, CFLs and LEDs
4. are randomly assigned to experimental groups
5. are given additional information on the offered light bulbs
6. are offered the LED at different prices
7. choose between an ILB and a LED
8. give reasons for their light bulb choice

Steps

All subjects:

1. are approached on street intersections
2. are surveyed
3. receive technical information on ILBs, CFLs and LEDs
4. are randomly assigned to experimental groups
5. are given additional information on the offered light bulbs
6. are offered the LED at different prices
7. choose between an ILB and a LED
8. give reasons for their light bulb choice

Steps

All subjects:

1. are approached on street intersections
2. are surveyed
3. receive technical information on ILBs, CFLs and LEDs
4. are randomly assigned to experimental groups
5. are given additional information on the offered light bulbs
6. are offered the LED at different prices
7. choose between an ILB and a LED
8. give reasons for their light bulb choice

Steps

All subjects:

1. are approached on street intersections
2. are surveyed
3. receive technical information on ILBs, CFLs and LEDs
4. are randomly assigned to experimental groups
5. are given additional information on the offered light bulbs
6. are offered the LED at different prices
7. choose between an ILB and a LED
8. give reasons for their light bulb choice

Steps

All subjects:

1. are approached on street intersections
2. are surveyed
3. receive technical information on ILBs, CFLs and LEDs
4. are randomly assigned to experimental groups
5. are given additional information on the offered light bulbs
6. are offered the LED at different prices
7. choose between an ILB and a LED
8. give reasons for their light bulb choice

Steps

All subjects:

1. are approached on street intersections
2. are surveyed
3. receive technical information on ILBs, CFLs and LEDs
4. are randomly assigned to experimental groups
5. are given additional information on the offered light bulbs
6. are offered the LED at different prices
7. choose between an ILB and a LED
8. give reasons for their light bulb choice

Steps

All subjects:

1. are approached on street intersections
2. are surveyed
3. receive technical information on ILBs, CFLs and LEDs
4. are randomly assigned to experimental groups
5. are given additional information on the offered light bulbs
6. are offered the LED at different prices
7. choose between an ILB and a LED
8. give reasons for their light bulb choice

Steps

All subjects:

1. are approached on street intersections
2. are surveyed
3. receive technical information on ILBs, CFLs and LEDs
4. are randomly assigned to experimental groups
5. are given additional information on the offered light bulbs
6. are offered the LED at different prices
7. choose between an ILB and a LED
8. give reasons for their light bulb choice

Insights from the Psychology Literature

Persuasion communication (Cialdini 2003) aligns:

- **injunctive norms:** perceptions of which behaviors are typically approved or disapproved
  - "there are several ways individual can limit their impact in their environment, among which is the use of LEDs"
- **descriptive norms:** perceptions of which behaviors are typically performed
  - "thousands of carioca households already use LED light bulbs"
- **environmental information:**
  - "LEDs use 80% less energy than ILBs (...) by decreasing the amount of energy produced by power plants, they reduce by 5 to 10 times the amount of carbon dioxide emitted into the atmosphere"

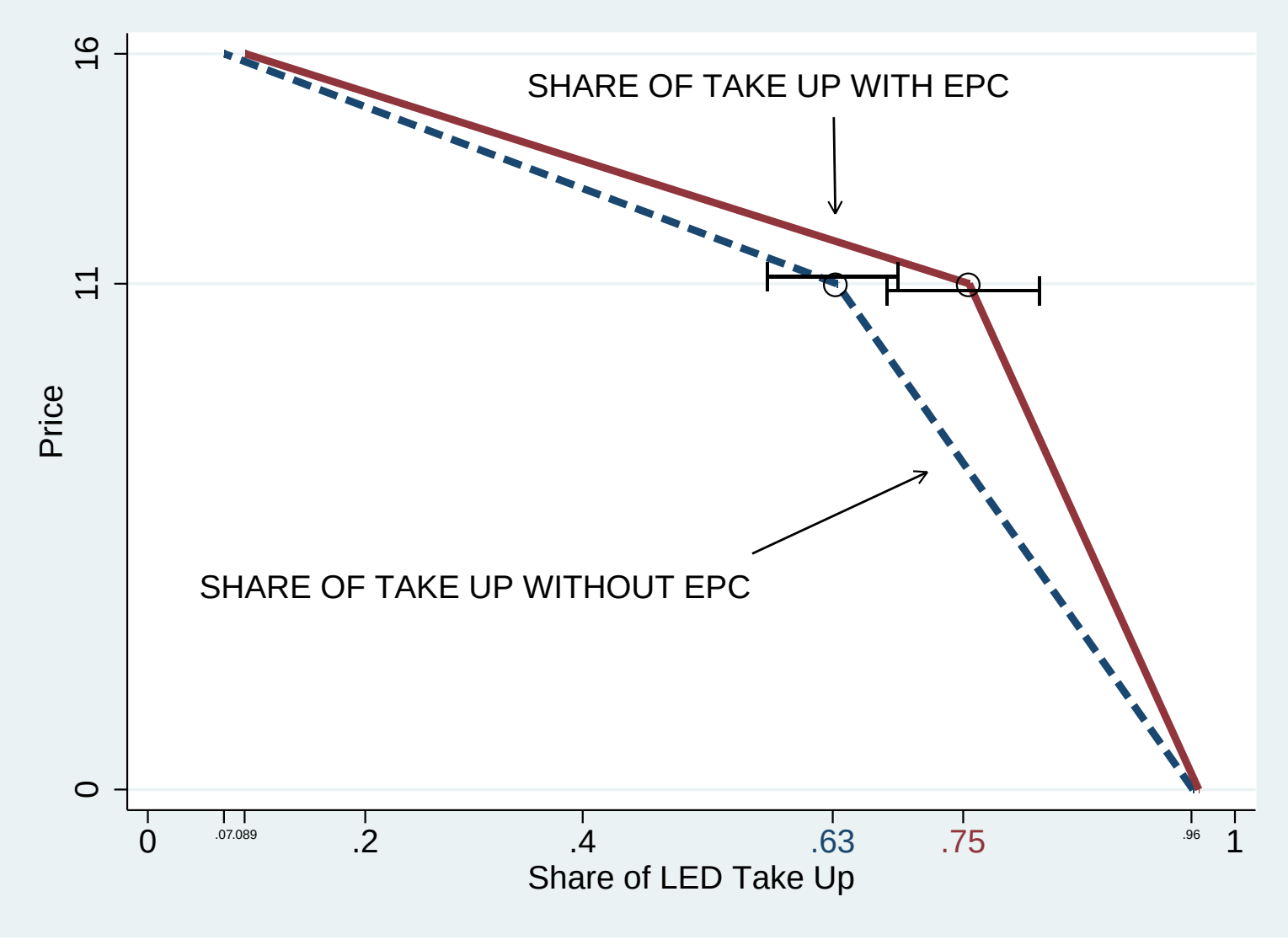
Estimation Strategy

Linear Probability Model (LPM) or logit:

$$Takeup_{ij} = \alpha + \beta EPC_{ij} + \gamma Price_{ij} + \lambda X_{ij} + \delta_e + \eta_j + \varepsilon_{ij}$$

- $Takeup_{ij}$ =1 if individual i living in favela j chooses the LED and 0 if she chooses the ILB
- EPC_{ij} =1 if i living in j receives the EPC and 0 otherwise
- $\gamma Price_{ij}$ are indicator variables for each price group
- X_{ij} includes relevant controls that might affect LED adoption
  - gender, age, education, household size, poor, whether the individual has an EELB at home, whether she fully pays the electricity she consumes and the importance of environmental problems such as global warming
- δ_e is an enumerator fixed effect
- η_j is a favela fixed effect
- ε_{ij} is a random error term

Share of LED Take Up By Price and EPC



Effect of EPC on Overall LED Take Up

	LED Take Up (1=yes, 0= no)					
	LPM (1)	Logit (2)	LPM (3)	Logit (4)	LPM (5)	Logit (6)
EPC (1=yes, 0=no)	0.0565	0.0573	0.0595	0.0595*	0.0615*	0.0683**
	(0.0517)	(0.0506)	(0.0362)	(0.0347)	(0.0372)	(0.0344)
Price 11			-0.275***	-0.305***	-0.259***	-0.282***
			(0.0474)	(0.0830)	(0.0485)	(0.0777)
Price 16			-0.894***	-0.722***	-0.868***	-0.691***
			(0.0386)	(0.0701)	(0.0432)	(0.0651)
Female					-0.0109	-0.0216
					(0.0380)	(0.0376)
Age					0.000578	0.000154
					(0.00162)	(0.00155)
High School Education					0.0709	0.0596
					(0.0438)	(0.0396)
Higher Education					-0.0372	-0.0573
					(0.0806)	(0.0766)
HH Size					0.00927	0.0119
					(0.0118)	(0.0107)
Poor HH					-0.139**	-0.116**
					(0.0577)	(0.0473)
Has an EELB at home					0.0662	0.0859**
					(0.0410)	(0.0389)
Fully Pays Electricity					0.0255	0.0150
					(0.0468)	(0.0421)
Importance Env Pbls					0.0311	0.0222
					(0.0276)	(0.0238)
Constant	0.441***		0.961***		0.860***	
	(0.0924)		(0.0751)		(0.0974)	
Observations	377	371	377	371	377	371
Demographic Controls	No	No	No	No	Yes	Yes
R-squared/Pseudo R-squared	0.066	0.038	0.545	0.487	0.571	0.529

Robust s.e. in parentheses *** p<0.01,** p<0.05,* p<0.1. Includes favela and enumerator fixed effects.

Mean take-up at R$0 without EPC: 0.96. Overall take-up without EPC: 0.44. Logit shows average marginal effects.

Effect of EPC on LED Take Up at R$11

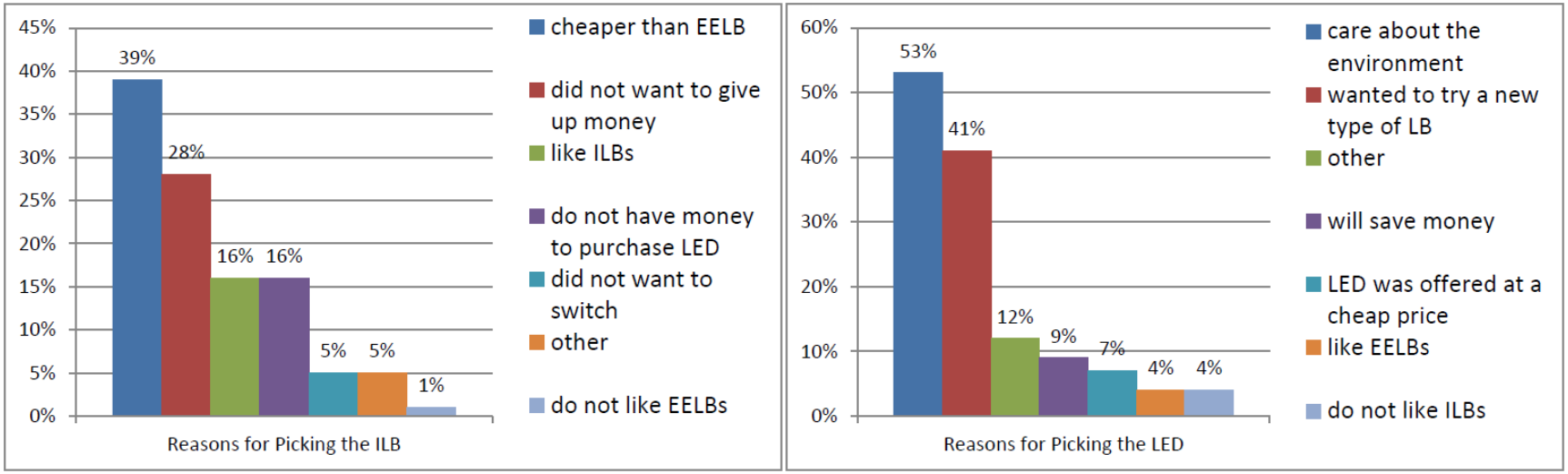
	LED Take Up (1=yes, 0= no)			
	LPM	Logit	LPM	Logit
	(1)	(2)	(3)	(4)
EPC (1=yes, 0=no)	0.129*	0.141**	0.131*	0.140**
	(0.0710)	(0.0689)	(0.0690)	(0.0685)
Female			0.0273	0.0145
			(0.0716)	(0.0823)
Age			-0.000312	0.000436
			(0.00315)	(0.00339)
High School Education			0.191**	0.211***
			(0.0876)	(0.0793)
Higher Education			0.0136	0.00424
			(0.146)	(0.148)
HH Size			0.0225	0.0252
			(0.0209)	(0.0230)
Poor HH			-0.228**	-0.201**
			(0.110)	(0.0891)
Has an EELB at home			0.0908	0.104
			(0.0845)	(0.0824)
Fully Pays Electricity			0.0211	0.00618
			(0.0913)	(0.0943)
Importance Env Pbls			0.0380	0.0390
			(0.0449)	(0.0510)
Constant	0.722***		0.539***	
	(0.111)		(0.148)	
Observations	161	144	161	144
Demographic Controls	No	No	Yes	Yes
R-squared/Pseudo R-squared	0.221	0.126	0.325	0.244

Robust s.e. in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Includes favela and enumerator fixed effects.

Mean take-up at R$11 without EPC: 0.63. Logit shows average marginal effects.

Reasons for ILB and LED Adoption

ILB (left panel), LED (right panel)



Note: Percentages do not add up to 100% because subjects were allowed to give more than one reason.

Summary of the Results and Discussion

1. Persuasive communication significantly increases the probability of LED take-up at the middle price by 13 percentage points
   - no significant effect at the high price or at the low price
2. Find evidence of heterogeneous effects
   - income, gender, environmental preferences
3. Identify some characteristics that make individuals more/less likely to adopt (irrespective of the communication)
   - High school education, having an energy efficient light bulb at home increase the probability of take-up
   - Being poor decreases the probability of take-up

Thank you!

Thank you!

Experimental Groups

Compensation for participating: R$11

	No Env. Persuasion Com	With Env. Persuasion Com
Price of LED=R$0	Group 1	Group 4
Price of LED=R$11	Group 2	Group 5
Price of LED=R$16	Group 3	Group 6

Technical Information (Shown to Participants)

	Incandescent (ILB)	CFL	LED
			
ENERGY EFFICIENCY & ENERGY COSTS (25 watt ILB)			
Average Life Span (in hours)	750	8000	30000
Watts of Electricity Used	25W	5W-6W	2W-3W
Annual Operating Cost	R$8.4	R$1.8	R$0.8
For 1 LB, based on 4 hrs/day, R$0.23/kWh. Cost depends on rates and use.			
OTHER TECHNICAL DIFFERENCES			
Sensitivity to Temp.	Some	Yes	None
Sensitivity to Humidity	Some	Yes	None
On/Off Cycling	Some	Yes	No Effect
Turns Off Instantly	Yes	No	Yes
Durable	Not Very	Not Very	Very

Source: U.S. Dept of Energy/Osram, costs and usage adapted.

Effect of EPC at R$11 With Interactions

	LED Take Up (1=yes, 0= no)			
	LPM	Logit	LPM	Logit
	(1)	(2)	(3)	(4)
EPC (1=yes, 0=no)	0.000944	0.00982	0.0197	0.0329
	(0.0554)	(0.159)	(0.0623)	(0.149)
Price 11	-0.341***	-0.335***	-0.320***	-0.311***
	(0.0693)	(0.116)	(0.0734)	(0.109)
Price 16	-0.903***	-0.722***	-0.860***	-0.673***
	(0.0519)	(0.114)	(0.0586)	(0.105)
EPC* Price 11	0.119	0.0654	0.109	0.0606
	(0.0896)	(0.165)	(0.0927)	(0.155)
EPC* Price 16	0.0181	0.0167	-0.0141	-0.0179
	(0.0707)	(0.173)	(0.0754)	(0.161)
Constant	0.995***		0.889***	
	(0.0719)		(0.0934)	
EPC + EPC * Price 11	0.120*	0.075*	0.129*	0.093**
	(0.070)	(0.041)	(0.067)	(0.042)
EPC + EPC * Price 16	0.019	0.026	0.005	0.015
	(0.043)	(0.066)	(0.046)	(0.063)
Observations	377	371	377	371
Demographic Controls	No	No	Yes	Yes
R-squared/Pseudo R-squared	0.548	0.488	0.574	0.531

Robust s.e. in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Includes favela and enumerator fixed effects.

Mean take-up at R$11 without EPC: 0.63. Mean take-up at R$16 without EPC: 0.07.