

Energy Infrastructure and Left Behind Villages in Indonesia: Effects of Electric Energy on Children's Educational Outcomes

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Agenda

- Motivation
- Institutional and Policy Context in Indonesia
- Empirical Specification & Data
- Descriptive Statistics
- Results
- Conclusions and Public Policy Discussion

Motivation

- In New Economic Geography (NEG), there is the spatial distribution of activity (e.g. growth centers and industrial development) → level of infrastructure is different across a country
- From a Human Capital Accumulation perspective (Becker & Chiswick, 1964) comes the question if this spatial distribution results in regional inequalities in human capital accumulation e.g. regional inequality of earnings between the North and the South in the US
- 1) “Do Indonesian children who reside and go to school in underdeveloped areas perform worse than children in other areas?” 2) “Does the allocation and distribution of electricity for the school and home in an underdeveloped area close the gap in educational performance?” “

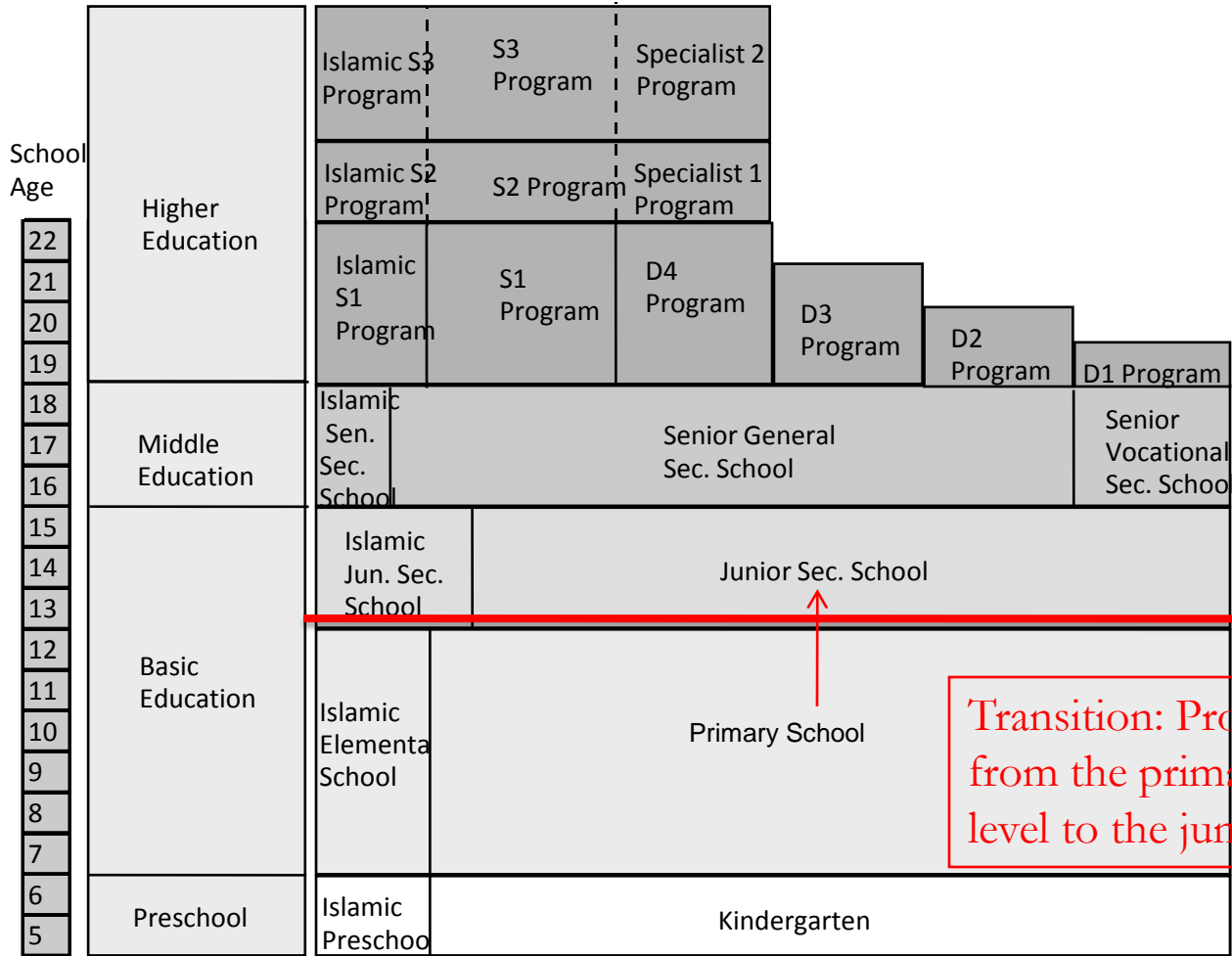
Preview of Results

- For educational performance, there's a positive intervening role of electricity for use in school and at home in an underdeveloped area
- Schooling behavior → Children borrow textbooks from school to continue studying and finish homework at night
- Unexpected role of the energy sector complementing the education sector in closing the test score performance gap over the period of the Asian Financial Crisis

National Education Sector - Institutional and Policy Context

- MDG#2 – Nine years of universal basic education to be achieved by 2015 → 6 years of primary school and 3 years of junior high (age 7 – 15). Nearly full Net Enrollment Rates (NER) for all grades of primary school but not the case for junior high transition
- Because of fiscal and administrative decentralization across the largest island nation in the world, Ministry of Education (MONE /MORA) have implementation challenges managing the quality of school inputs → main one is electricity connected to the state owned PLN grid

Education Structure



Transition: Progression from the primary school level to the junior high level

National Curriculum by Academic Hours Per Week

No	Subject	Primary School Grade						Junior High Grade		
		1	2	3	4	5	6	1	2	3
1	Pancasila Education	2	2	2	2	2	2	2	2	2
2	Religion	2	2	2	2	2	2	2	2	2
3	Indonesian Language	10	10	10	8	8	8	6	6	6
4	Math	10	10	10	8	8	8	6	6	6
5	Sciences	-	-	3	6	6	6	6	6	6
6	Social Sciences	-	-	3	5	5	5	6	6	6
7	Handicraft and Arts	2	2	2	2	2	2	2	2	2
8	Health and Sport	2	2	2	2	2	2	2	2	2
9	English	-	-	-	-	-	-	4	4	4
10	Local Indigenous Content	2	2	4	5	7	7	6	6	6
	Total	30	30	38	40	42	42	42	42	42

Source: Ministry of National Education

Electricity Distribution by Final Use

Year	Industry	Household & Commercial	Transportation	Others
1990	33.25	23.93	34.91	7.90
1991	32.56	23.64	35.64	8.16
1992	33.75	22.63	35.87	7.75
1993	34.11	22.18	35.13	8.58
1994	35.67	21.94	33.52	8.87
1995	36.03	21.50	33.26	9.21
1996	34.16	21.63	34.43	9.78
1997	34.60	21.91	33.98	9.52
1998	34.79	23.34	34.71	7.16
1999	39.93	21.68	32.08	6.31
2000	41.81	21.05	31.21	5.94
2001	42.35	20.86	31.03	5.75
2002	41.42	21.25	31.58	5.75
2003	39.40	21.96	32.86	5.78
2004	41.94	20.63	32.11	5.31
2005	42.10	20.53	32.11	5.23

Source: Indonesia Ministry of Energy and Natural Resources

Notes: This table provides a breakdown of electrical power consumed by different users from 1990 – 2005. The users are defined as i) industry ii) household and commercial use iii) transportation and iv) others. The definition for electrical power used includes all sources of energy - petroleum, dry natural gas, coal, net hydro, nuclear, geothermal, solar, wind, wood and waste electric power. But biomass energy is excluded.

National Redistribution Program

- Presidential Instruction INPRES Desa Tertinggal → Left Behind Villages
- Characteristics – subsistence economies, low level of development, household rationing of electricity enough for three lighted bulbs, electricity is priced using a “social tariff”.
- Central level government block grants to the Left Behind Villages for promoting job creation (1994 – 1998, no funding until after 2001)
- Villages get to decide on how to use the funding e.g. infrastructure improvements
- In the literature, there are evaluations of this program one of which Alatas (1999) finds unexpectedly an increase in school enrollment

Empirical Specification

Let Y_{it} equal the child's educational performance at time t and let D_{it} denote whether the child is in an underdeveloped area or not. The observed Y_{it} is either Y_{0it} or Y_{1it} depending on where the child resides and goes to school. Suppose further that

$$E[Y_{0it} | S_i, X_{it}, t, D_{it}] = E[Y_{0it} | S_i, X_{it}, t] \quad \dots(1)$$

where X_{it} is a vector of observed time-varying covariates and S_i is a vector of observed and unobserved fixed confounders. S_i consists of the spatial variables that historically have driven or constrained development. Rewrite as a linear model:

$$E[Y_{0it} | S_i, X_{it}, t] = \alpha + \lambda_t + S_i' \gamma + X_{it}' \beta \quad \dots(2)$$

Assume that being an INPRES Left Behind Village has an additive and constant effect on children's educational performance where:

$$E[Y_{1it} | S_i, X_{it}, t] = E[Y_{0it} | S_i, X_{it}, t] + \rho \quad \dots(3)$$

Together with (1), this implies that:

$$E[Y_{it} | S_i, X_{it}, t, D_{it}] = \alpha + \lambda_t + \rho D_{it} + S_i' \gamma + X_{it}' \beta \quad \dots(4)$$

where ρ is the positive intervening effect of interest

Data

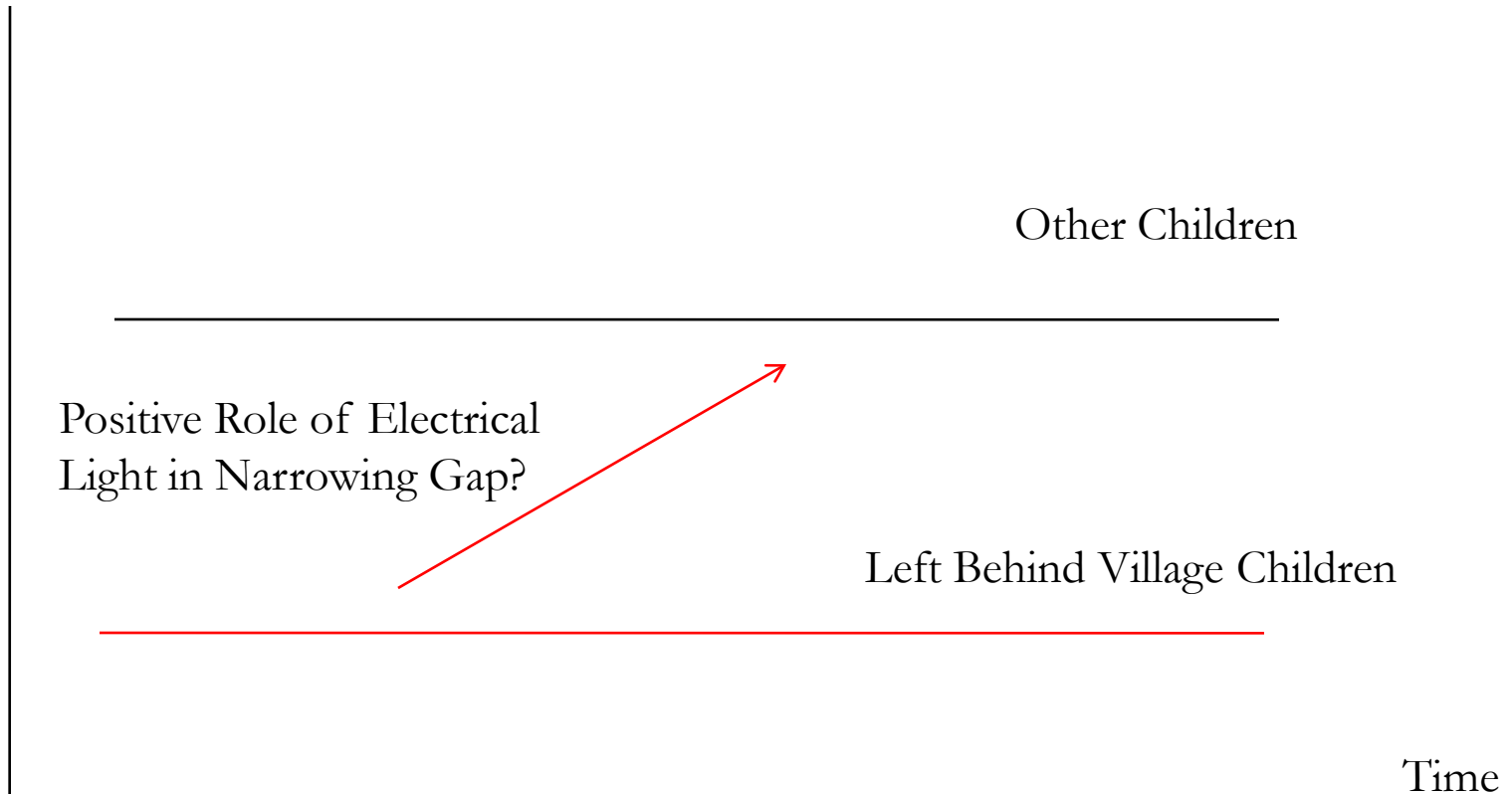
- RAND Corporation Indonesia Family Life Surveys Wave 2 – 1997 and Wave 3 – 2000
- Data on 12 year old child's EBTANAS transition from primary school to junior high test scores, school inputs, household characteristics merged from different IFLS books → failed to get a balanced panel
- Next best solution is to use the information from the two cross sections → 1997 $n = 930$ and 2000 $n = 1,200$

Specification Difficulties

- Child's heritable endowments unobservable
- Data sets on all school and home inputs are incomplete / omitted variable bias (e.g. incomplete input histories and / or missing inputs)
- Inputs may be chosen endogenously
- Selection bias of President Suharto's Left Behind Village program

Relative Positions in Test Score Performance

EBTANAS



Descriptive Statistics

	1997	2000
<u>School Characteristics</u>		
Teachers with Undergraduate Degrees in School (%)	59	76
	(31)	(18)
Average Number of Hours of Teaching / Week	31	25
	(9)	(10)
Number of Schools Serving in an INPRES Left Behind Village	336	257
Number of Schools that Report Having Adequate Electrical Light	584	884
Schools Reporting Main Source of Electricity (%)		
- The PLN Grid	0.97	0.99
- Local Government Agency	0.00	0.002
- School Generator	0.00	0.002
- Social Self Reliance	0.01	0.003
- Private Company or Cooperative	0.02	0.00
Schools Reporting Ever Losing Electrical Power that Disrupted Study Activities (%)	0.14	0.15
Schools Reporting that When there is Electrical Power Loss, there is a Substitute Electricity Source Available (%)	0.01	0.19
School Ending Hours (% of Schools)		
- Morning Session Ending in the 10:00 – 14:00	0.89	
- Morning Session Ending in the 09:00 – 17:00		0.83
- Afternoon Session Ending in the 12:00 – 18:00	0.11	0.17
Children Borrowing Books from School to Read at Night (%)	0.81	0.90
<u>Household Characteristics</u>		
Household Income Per Capita (Ln)	16.34	13.78
	(.81)	(.83)
Educational Expenditures Per Capita (Ln)	10.84	11.19
	(.82)	(.83)
Number of Rural Households in an INPRES Left Behind Village	136	362
Number of Rural Households in Java and Bali Islands	157	873
Number of Households in Java and	559	1,709
Number of Houses that Report Using Electricity	805	2,683
Child Brings Home Books from School to Read at Night		
- Reads in a House that Does Not Use Electricity (%)	0.07	0.05
- Reads in a House that Does Use Electricity (%)	0.93	0.95
<u>Educational Outcomes</u>		
EBTANAS Test Scores Per Child (Points On Average)	30.91	32.33
Observations	930	1,200

Results

DV = EBTANAS End of Primary School Cycle Exam Scores, Child Aged 12
(SE is in Parentheses)

	OLS 1997 (i)	OLS 2000 (ii)	Pooled OLS (iii)	Pooled OLS (iv)
<u>School Characteristics</u>				
School Serves in Left Behind Village	-.5079 (.6396)	-1.5850 (.6189)	-2.5167*** (.4964)	-1.5771** (.5049)
Graduate Level Qualified Teachers in School	.0011 (.0064)	.0088 (.0067)	.0152** (.0054)	.0019 (.0044)
<u>Household Characteristics</u>				
Household Income Per Capita	1.6192*** (.2683)	1.1070*** (.1520)	.7296*** (.1571)	-.1817 (.1578)
Educational Spending	.1757 (.2493)	.4113** (.1417)	.8537*** (.1693)	.0031 (.0549)
<u>Location of School and Home</u>				
Java & Bali	1.029** (.5247)	1.8797*** (.2631)	2.4325*** (.3560)	
School is in INPRES Program in Java & Bali	-3.2842** (.9628)	-1.1416* (.5986)	-1.2560*** (.1834)	.3664** (.1274)
<u>Source of Electricity and Use</u>				
Electricity for Use at School Serving Left Behind Village (Study Use)	2.9739*** (.8086)	1.3922** (.6642)	.6451 (.5754)	1.9042*** (.4509)
Electricity for Use at Home (Study Use)	1.8961** (.7522)	.4906 (.4597)	2.3639*** (.4929)	2.1915** (.8334)
Electricity for Use at Home (Non-Study Use)	.3746 (.5101)	.9382** (.2746)	.3119 (.2238)	1.0495*** (.2499)
Village Fixed Effects			No	Yes
Constant	.0870 (4.6313)	9.7802 (2.3377)	7.9593 (3.4414)	29.9626 (2.8953)
R ²	0.14	0.11	.14	0.02
Observations	625	1,200	1,486	1,486

Results

- EBTANAS test score performance gap for Left Behind Village and other is larger for the pooled OLS. With Village FE control added, gap is smaller
- A school administered by MONE / MORA defined as serving children in the Left Behind Village plays a more important role than the number of graduate level teachers
- Family income and investment in education matters for performance but only to a certain extent. The physical environment for education matter more.
- Electricity use at home complements PLN connected school electricity in improving test score performance in the Left Behind Village. But this is only in Java and Bali Islands, not Outer Islands

Conclusions

- Energy sector unexpectedly complemented the education sector in maintaining educational achievement over the volatile and unpredictable financial crisis
- While there is less regional inequality of human capital in Java and Bali Islands, there are still concerns for the Outer Islands which have fewer growth centers
- The energy sector should not just be about industrial development. Consider too what electric energy does for children's educational outcomes in relation to MDG#2. This is a concrete case of the social benefit of energy infrastructure investment