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No School Left Behind: Do Schools in Underdeveloped Areas Have Adequate Electricity for Learning?

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The 'watch dog' role of the media, the impact of migration processes, health care access for children in developing countries, mitigation of the effects of Global Warming are typical examples of governance issues – issues to be tackled at the base; issues to be solved by creating and implementing effective policy.

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Abstract

In this paper we investigate the effects of access to electricity on learning outcomes. In a spatially differentiated developing country like Indonesia we find that a school that is designated by the central government as being left behind, access to electricity is a mediating factor for improving test scores. Access to electricity in the homes of children aged 12 transitioning to secondary school complements access to electricity in the school where they can continue learning after sunset. The electrification of schools and homes in underdeveloped areas becomes a distinguishing factor in managing the spatial inequalities in human capital accumulation. We shed more light on this distinction during the Asian Financial Crisis when Indonesia's national debt-to-total expenditures ratio escalated and negatively affected its INPRES *Desa Tertinggal* (IDT) Program of reducing regional inequality. Electricity appears to have a positive causal effect on test scores. However there are structural limits to how much electricity schools and households can use and this is attributed to the geography of the archipelago.

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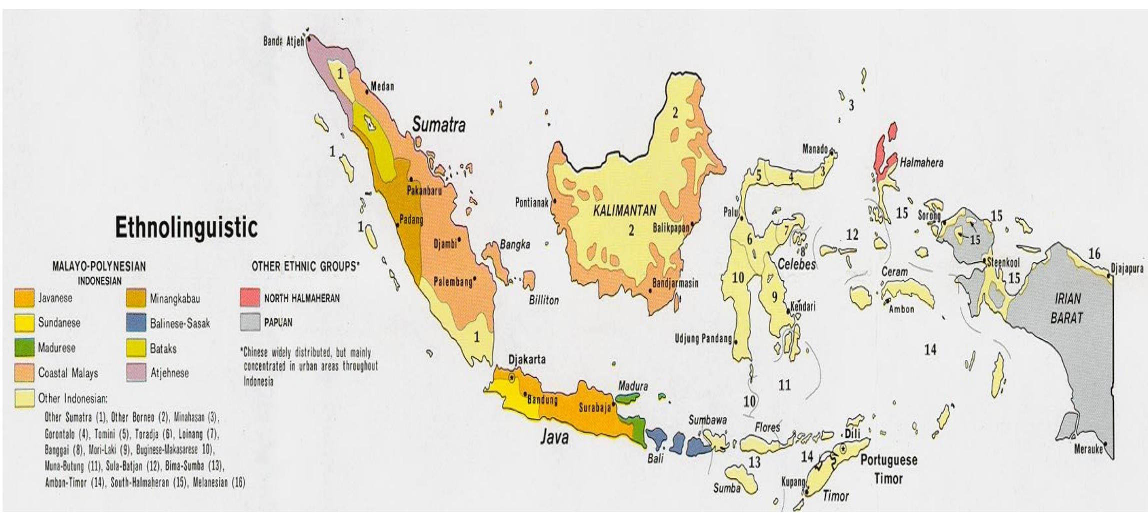
Map 1: Indonesian Provinces

The Indonesian Archipelago of 17,000 islands between the Indian Ocean and the Pacific Ocean spread across 1.3 million square km with 245 million people speaking at least 16 dialects. Java and Bali Islands are distinguished from the surrounding Outer Islands by modernization and its high level of economic development.

Map 2: Indonesian Ethno-linguistics



Bahasa Indonesia, a modified form of Malay is the unifying language for this ethno-linguistically diversified language. After the fall of Suharto, the decentralization process has increased the use of dialect and the introduction of indigenous courses in the school curriculum.

1. Introduction

When aggregate shocks frequently affect households, governments intervene in amongst other ways to protect children's education and health. But in large developing countries such as Brazil, China, Indonesia and India, the accurate targeting of interventions is a priority and a challenge. This is because of the decentralized nature of the supply and provision of public services to a vast population. The supply side constantly struggles through reforms and experiments to close financing gaps and to improve service delivery to the extent that there are empirical studies on why teachers and health workers go missing (Banerjee, Deaton and Duflo, 2004 & Banerjee and Duflo, 2006). But what we are interested in is that given spatial differences in large developing countries, how do supply side and demand side factors interact? Is there a stable equilibrium? Are there limits to gaining and maintaining access to hard-to-reach children?

In this paper we focus on the Indonesian archipelago and study structural factors at the macro level of the economy and how micro level household behavior interacts with these possible constraints. We consider the geography of the archipelago and the institutional structure for public service delivery across this cluster of 17,000 islands. These factors are loosely associated with the "geography hypothesis" (Diamond, 1997 and Sachs, 2000 & 2001) where in its simplest form, this hypothesis emphasizes the time invariant effects of geography variables on effort and productivity. Based on the theory and empirics of the causal relationship between family income and human capital in the presence of liquidity constraints (Becker and Tomes 1986; Card 1999 and 2001; Card and Krueger 1992 and Sparrow 2006 for the Indonesia specific context), we take a variation of this hypothesis in terms of the geographic distribution of infrastructure for electricity to schools and homes to see how children's educational outcomes are affected and how the outcomes can be spatially distinct. Based on our knowledge, this is the first study to use electricity as a proxy for school quality.

Indonesia was on a growth trajectory from 1965 to 1995 where real per capita GDP rose four-fold. The annual growth rate averaged 4.5% until the 1990s when it rose to almost 5.5% (World Bank, 1997). The poverty headcount rate declined from over 40% in 1976 to about under 18% by 1996. Primary school enrollment rates rose from 75% in 1970 to universal enrollment by 1995 and secondary enrollment rates from 13% to 55% over the same period (World Bank, 1997). The total fertility rate fell from 5.6 in 1971 to 2.8 in 1997[1]. Total estimated population in 2006 is 245 million[2]. Using economic history terminology, Indonesia was experiencing a "takeoff" not unlike an "industrial revolution" (Rostow, 1960; Maddison, 1970). However growth was severely interrupted when the Asian Financial Crisis (AFC) hit in 1997/98.

Structural adjustments were made in response to the financial crisis. This included using IMF emergency loans, the Paris Club debt moratorium and foreign aid donors provided grants for social safety nets. See Figure 1 in the Appendix. In 1996 and 1997 prior to the AFC, Indonesia debt consisted of external borrowings only. Then the government's external debt to GDP ratio in percentage terms increased substantially from 20 percentage points in 1997 to 60 percentage points in 1998. In addition domestic debt was incurred in 1998. The total debt to GDP ratio position worsened in 1999 to nearly 100% of GDP consisting of debt. Correspondingly, as can be seen in Figure 1.1, interest payments to service the stock of debt showed an increasing trend from the beginning of the AFC until 2001 when the trend because to reverse itself. Arguably there was a limit to what the state could do to protect the welfare of its citizenry over this period of extreme variability. In the unique case of Indonesia, the AFC spurred on the ousting of the dictator President Suharto and a significant democratization process. Gradually regional and local governments became politically autonomous and were expected to assume greater fiscal responsibility.

[1] Indonesia Central Bureau of Statistics et al. (*Badan Pusat Statistik*, BPS) 1998
[2] *Proyeksi Penduduk 2000 – 2025*, BPS 2005

In this paper, we posit that regardless of national policies and fledgling democratic institutions there are structural factors in spatial terms that strongly influence the human capital accumulation process. Specifically we focus on this process in terms of children aged 12 poised to make the transition from the *Sekolah Dasar* (SD / primary school) level to the *Sekolah Menengah Pertama* (SMP / junior secondary school) level.

To carry out this investigation, we focus on infrastructure in the country which plays a key role in national development planning. Specifically we study the energy sector and how electricity is supplied across the archipelago. At the macroeconomic level, the energy sector promotes industrialization and growth. At the microeconomic level, when there is electricity, economic activities, household activities and learning activities can be carried out after sunset and before sunrise. All this put together in growth economics terms - when there is electricity, the output of workers increases, there is more GDP per capita and the standard of living increases. While growth economists in theory may be able to clearly map out and trace industrialization all the way down to household and individual welfare, policymakers do not really see this. Case in point is structural adjustment policy tends to focus on the liberalization and privatization of the energy sector in a developing country while remaining in the dark in terms of how this sector can profoundly affect how households live and use their hours each day.

The rest of the paper is set up in the following way. Section 2 provides a description of the electrical power grid across Indonesia including the layout of the energy sources (particularly geothermal energy), power plants and transmission lines in the main islands. We also describe the distribution trends for industrial, household (including school) and transport use. Section 3 provides a description of the Indonesian education system including implementing arrangements from the country's INPRES redistribution program that target left behind schools and villages. Section 4 covers the empirical strategy and data. In Section 5 we present the results. This is followed by a discussion of the results for policy design and implementation in Section 6.

2. The Energy Sector and Electricity Infrastructure in Indonesia

According to the Energy Information Administration of the US Government which compiles energy statistics from around the world, Indonesia's power generation sector is dominated by the state-owned electric utility PT PLN (Persero), formerly known as *Perusahaan Listrik Negara*. PT PLN operates 45 power plants, or roughly two-thirds of the country's generating capacity. Indonesia's electricity sector faces severe underinvestment, and the country's energy officials have set out on a program to expand generation capacity. The consequences of underinvestment are bottlenecks in local interconnections between bulk transmission and sub-transmission levels, overloading and voltage problems at sub-transmission levels (World Bank, 2003). The outcome is uneven and interrupted electricity transmission (brownouts – a drop in voltage and lights dim and blackouts – total loss of power) across the archipelago. One of the major obstacles to increasing Indonesia's power generating capacity is pricing. The government sets the price at which PT PLN sells electricity in the country, and since the AFC, it has often had to sell electricity at less than the cost of production. PT PLN's financial difficulties, coupled with its inability to increase power prices, have prevented the company from investing in new infrastructure projects to build up capacity.

Map 1 provides the layout of power plants, existing bulk transmission lines and planned transmission lines. Sub-transmission lines are not included. In this map, it can be seen that the islands of Java and Bali have four power plants and transmission lines extending from one tip of Bali Island and connecting to the other tip in Java Island. As such, much of Java and Bali are on the grid where up to 77% of total country capacity is available to the residents of these two islands. These transmission lines extend west toward Sumatera Island where there are three power plants. Sumatera receives 13.3% of total country capacity available. The disproportionate distribution when measured in spatial terms is exacerbated for Kalimantan which receives only 3% of total capacity available. This disproportionately low percentage is associated with the absence of any power plant on the island. Kalimantan is located on Borneo Island and this island is shared by three countries – Brunei, Indonesia and Malaysia. Kalimantan to a certain extent is dependent on Malaysia for the transmission and distribution of electricity. The more underdeveloped

Eastern Indonesia which consists of Sulawesi and the Nusa Tenggara & Papua cluster of small islands, receive the remaining miniscule percentage of capacity available.

When zooming in on the period prior to (1997), during (1998 and 1999) and after (2000) the AFC (see Table 2), total installed capacity in the country increased but at a slower rate compared to consumption needs. The measurement of electricity distribution and consumption in Indonesia is by final use in a given sector. Table 3 provides the distribution trend from 1990 – 2005 for use in i) industry ii) household (including school) and commercial enterprise iii) transport and iv) others. Household, school and commercial use tends to make up about 20% of electricity consumption while industrial use dominates in the range of 33% to 42% of total consumption in this time series. From 1997 to 2000, percentage use for industry increases each year. In contrast the percentage use for household / school and commercial use increases by 6% from 1997 to 1998 and then dips by 7% from 1998 to 1999 and falls again by 3% from 1999 to 2000.

To ameliorate the situation, sources of geothermal energy discovered on each of the main islands increases the probability of energy being converted into electricity for local use. While Nusa Tenggara and Sulawesi have geothermal energy sources, the amount of capacity available is still very low compared to what is available overall in Java and Bali. Electricity from power generators, biomass energy and private power companies at the sub-national level; lighting from gas, kerosene and firewood at the local level are used as substitutes for being on the PLN grid.

3. Indonesia Education System and No School-Left-Behind

Figure 2 shows the organizational structure of the school system in Indonesia. The school system is divided into two streams, namely the secular stream under the Ministry of National Education or MONE (public and private[3]) and the Islamic stream under the Ministry of Religious Affairs or MORA (public and private). Islamic schools have an alternative curriculum that is a mix of skill acquisition and the study of the Koran. Table

[3] MONE classifies a private school into three types: subsidized, aided or fully private

4 provides information on the curriculum and the number of teaching hours required per week.

According to the National Education System Law, the education system is organized into two different channels, the conventional in-school or formal education and out-of-school education. Education is a constitutional right. Put in other words, no child should be left behind. The out-of-school education is based on Government Regulation No 73/1991. This is designed to meet the educational needs of the community which cannot be met by attending school that is literally in a fixed, physical structure. The out-of-school basic education consists of Packet A equivalent to Primary Education and Packet B equivalent to Lower Secondary Education. The objective of the combined Packet A and Packet B program is to support the Nine Year Compulsory Basic Education through the out-of-school education channel. Learning activity is held three times a week when a group of learners is formed and this is depending on the consensus reached by the learners, tutor, manager, and organizer. Students study with the tutors but must also study autonomously or in small groups outside the class time. Group study can be carried out anywhere[4]. The learning content is delivered in the form of modules. Students are evaluated by a multiple-choice test on each subject at the end of each semester to determine if they will move on to the next set of modules.

The education system is financed in broad terms by four sources: 1) funds from general government revenue 2) government revenues earmarked for education 3) tuition and other fees 4) voluntary contributions. In terms of the first two sources, this refers to central and regional government where by constitutional law, the central government should fund 20% of the total funding required each year. Revenues earmarked for education include foreign aid assistance. The third source of funding comes from the household and this varies based on the number of children being sent to school at the same time. The fourth source includes gifts from individuals, communities, charitable and religious bodies, domestic or foreign, whether in cash, kind or services; endowments, commercial or private loans; and the schools' own efforts to raise funds (Daroesman, 1971). Based on World Bank records (2007), the general split of funding sources for the

[4] Based on area specific fieldwork, group study has been observed in a hut, by the beach, in the forest, etc.

education system is 1) central government, 20% 2) regional / local government, 20% and 3) other sources including parents' contributions, 60%.

Since the end of the Suharto regime and the introduction of regional autonomy laws UU 22/1999 and UU 25/1999 that complements the 1994 education reform, there is an increasing trend of schooling provision by religious associations and non-governmental organizations. These private providers of education retain the option to adjust the curriculum to a greater extent to meet local indigenous needs.

With the decentralization of school management the MONE and MORA face budgeting and implementation challenges. Funding for non-discretionary costs in schools in local tax jurisdictions are covered by up to 20% from the central government budget. Local governments have full responsibility for paying teacher salaries. But jurisdictions with a weak tax base are over-dependent on parents' contributions. These jurisdictions tend to be characterized as being less developed communities that include farm laborers, peasants, fishermen, forest dwellers and young dropouts. The central government can designate these jurisdictions as INPRES *Desa Tertinggal* (Villages Left Behind). As such schools located within these jurisdictions can be termed as schools-left-behind and qualify for fiscal assistance to make up for the shortfalls faced covering operating expenses.

The different types of curriculum and delivery mechanisms are designed to meet indigenous need and as per the National Education System Law. This is to such an extent that implementation challenges ensue. There are service delivery mechanisms that accommodate children who live in slum dwellings and are not legally registered in a tax jurisdiction; children who live in remote areas and children who come from families with a nomadic way of life. In other words, the school is not built and fixed in one location. A school regardless of the type of service delivery can be formed and it is recognized formally by MONE and MORA using an identifier. This ID is registered in the MONE and MORA school census data.

At the end of each school level children sit for the compulsory EBTANAS national achievement test[5]. It is a requirement that children sit for this test to enable them to progress from the primary school level to the junior secondary school level and then to the senior secondary school level before qualifying for entry into the formal labor market. EBTANAS is considered to be a proxy for child ability and it is a standardized test designed by MONE. This test enables quality comparisons to be made across schools in the country.

4. Empirical Strategy and Data

We start out by thinking about the geographic layout of the PLN transmission lines across the main islands which is depicted in Map 1. We consider the grid as a time invariant geographic or spatial variable which is then a structural constraint that puts a limit on school quality. To test this tentative prediction, we run reduced form specifications where EBTANAS test scores of a 12 year old child in household i in spatial area j and time t are dependent on access and use of electricity. Our base specification comes from Becker and Tomes' classic economic theory of investments in children (1986) and we assume our model to be linear.

$$TestScores_{ijt} = \alpha_0 + \beta_1\alpha_{it} + \beta_2\alpha_{it} + \beta_3\alpha_{jt} + \delta\alpha_j + \phi_{it} + \varphi_t + \varepsilon_{ijt}$$

β_1 = Household income per capita (Ln)

β_2 = Household expenditure on education per child (Ln)

β_3 = Teachers in the child's school who have graduate level degrees (%)

δ = Spatial area variables

ϕ = Access and use of electricity for learning

φ = Year

The first two independent variables are related to family income and parents' preference for education. The third term represents the supply side of education delivery or also known as public expenditure on the human capital of children in families subject to public budget constraints. The fourth independent variable in broad terms is about the

[5] Since 2002, EBTANAS has been replaced by the UAN *(Ujian Akhir Nasional)* and the latest incarnation is UN *(Ujian Nasional)*

spatial or geographic structural factor driving our thinking. The last term relates to how structural factors boil down to human capital outcomes for the household. Put another way, can children switch on the light to read and do their homework?

In this base specification, we attempt to look for positive correlations between β_1 = Household income per capita (Ln) and the dependent variable and between β_2 = Household expenditure on education per child (Ln) and the dependent variable. This should then be consistent with the theory and empirics of family income and a child's education in the context of liquidity constraints. We then proceed to test whether electricity has an intervening effect in terms of strengthening the relationship between family income and education. We run several new specifications to estimate this intervening effect of electricity. As a robustness check we use different measures for electricity access and use by the child. Cross sectional data is used for these specifications.

Because of data availability, we are able to use cross sectional data for two periods to run these specifications. If the access and use of electricity is a positive intervening factor in both periods, a case can then be made for trying to establish a causal relationship where having electricity to read, do homework and cram for exams causes an increase in test scores. For this identification strategy to work, we take data ex-ante and ex-post the AFC where a fall in household income will have caused a reduction in positive educational outcomes. But if test scores remain at similar levels ex-ante and ex-post and electricity remains a positive intervening factor despite reduced incomes and installed electricity capacity being unable to keep up with household and school consumption needs, then electricity has a causal learning effect. As such we include the variable φ = Year (2000 = 1)

There is not a problem with reverse causality in our strategy because an increase in test scores does not increase the use of electricity. This is because the dominant source of electricity is the grid and this is a structural factor. We do not consider that an increased household demand for electricity can override the structural factor.

There is sample selection in the two periods. Hence it is assumed that for a child who is selected into the sample in one or both periods, the magnitude of the selection effect in the reduced form equation which consists of a finite number of estimable parameters, will be the same if the observed variables determining selection remain constant over time.

We use the RAND Corporation Indonesia Family Life Surveys Wave 2 (1997) and Wave 3 (2000) to implement the empirical strategy. In these household surveys, there is information available on areas that the central government designates as underdeveloped and whether schools in these areas are specifically left behind and a part of the INPRES program. The INPRES designation may or may not be politically driven and may or may not be an effective redistribution policy (Ravallion, 1988; Akita and Szeto, 2000; Duflo, 2001). Schools that receive this designation can receive fiscal transfers to cover school building maintenance and operating costs[6]. These schools have an individual identifier and can be traced within each island to the sub-district level[7]. As consistent with the National Education Law, the data provides information on children moving between schools located within their local community. As such a child can be observed more than once in each time period.

In terms of access and use of electricity, we merge the sub-national level data on the energy sector and electrification with IFLS household data at the island level. We aggregate this in terms of whether a child's household and school is / is not in the Java and Bali Islands. We justify this on the basis that Java and Bali have 77% of total installed capacity while the other islands also known as the Outer Islands have much less capacity. Within Java & Bali Islands and the Outer Islands, we also consider the urban and rural split where there is more economic activity (industry, commerce and transport) and greater electricity consumption in urban areas.

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[6] Duflo in 2001 studied this aspect in terms of the Construction of new school buildings
[7] The US equivalent of the sub-district administrative unit is a county and the average population in a sub-district is 50,000

For the school, IFLS contains information whether the school is on the PLN grid, has adequate electricity during school hours, the start and end hours in a school day and the percentage of children who borrow books from school to read at home at night. Within the household IFLS provides information whether the home uses electricity, keeps perishable food in a refrigerator, uses an electric stove or another type of stove for cooking (gas, kerosene or firewood) and has a television. The type of stove used is a proxy for the level of household poverty within the context of Indonesia.

When using this data to establish potential causal relationships, we are unable to merge it into panel data. This is because we find a small and statistically insignificant sample of households that have a child aged 12 taking EBTANAS in 1997 and a younger child who in the future is aged 12 taking EBTANAS in 2000. As a second best solution, we pool the two cross sections in 1997 and 2000 and compare the children on the basis of having the same demographics and school age.

In our attempt to establish causal mechanisms, our identifying assumption is that our main variable of interest, educational outcome of transition from one school level to another is time lagged. The effects of the regressors in t=1 which in our case is 1997 only play out in t=2 which is 2000. As such we disregard extreme changes that occur in 1998 and 1999 associated with the AFC i.e. capital flight, debt defaults, inflation increasing by at least 200%, etc. Figure 3 provides a graphical representation of our strategy where we define the AFC using the US Dollar-Indonesia Rupiah exchange rate history. Ex-ante behavior in period one is when the exchange rate is at the stable US$1 = IDR 2,500 and ex-post behavior in period two is when the exchange rate regains some steadiness and settles at a new level of around US$1 = IDR 8,000.

5. Results

5.1 Descriptive Statistics

In comparing the means and standard deviations for the variables of interest in 1997 and 2000, we first observe that household incomes fell. See Figure 4 for the shift from the right to the left of the distribution of household incomes per capita in log terms before and after the crisis. However with reference to Table 5 educational expenditures on average increased though at a lower rate of change than household incomes. Theory predicts that there is a positive relationship between income and human capital investment. Richer families will invest more in their children's education. But the reverse is true if there are liquidity constraints and the rates of return are lower than the investment rate. This is unless parents' have an unobserved preference / taste for education. This may seem to be the direction that human capital investments are going in. On average we find that for the outcome variable, mean test scores improved by 6% in 2000 compared to 1997. Likewise with reference to Figure 5, there is a shift to the right for the distribution of test scores in 2000. While parental financial investments are important, the quality of teachers assigned to the schools has to also be considered. In the descriptive statistics, on average the percentage of teachers with a graduate degree increased from 59% to 76%.

In our sample, the characteristics of the 12 year olds and the households that they come from are that a higher percentage, 64% came from urban areas in 1997. In contrast in 2000, a higher percentage, 60% came from rural areas. While migration from the urban areas to the rural areas may perhaps help to explain why this is the case, we fail to find any evidence in the observed data for migration. All we have managed to see is that households tend to stay in the same province and district on a given island and there is a tendency for some movement between sub-districts. However there is no additional information on whether a household has moved from an urban sub-district to a rural sub-district. In 1997, 60% of households in the sample resided in Java and Bali. In contrast in 2000, a slightly smaller 55% resided in these two islands which are the most densely populated islands in the archipelago.

In 1997 for the primary schools that the children attended, 36% were designated as being a part of the INPRES program. In 2000, this figure fell to 21%. Given the amount of debt accumulated at the country level (refer to Figure 1), public coffers may have been insufficient to fund the INPRES program at pre-crisis levels. Redistribution would have presumably been put on hold and macroeconomic stabilization would have been a national priority. 62% of total schools in the sample reported having adequate electricity in 1997. This percentage increased to 73% in 2000. But since this question is coded as a binary variable, it is unknown whether respondents experienced brownouts and blackouts. In both periods, electricity was mainly coming from the PLN grid. In 1997, 58% of schools and in 2000, 73% of schools reported that they were on the grid and this was their main source of electricity. Other sources of electricity in both periods included power generators, biomass energy and private power companies. Alternative sources of lighting included community driven solutions (pooling the use of kerosene lamps, candles, firewood, etc.).

With reference to Table 4 which provides information on the number of teaching hours required per week, primary school children should be spending more hours in school learning as they progress from grade 1 (30 hours) to grade 6 (42) and then culminating with them taking the national standardized test. But in our data we find that teachers only worked on average 24 hours a week in 1997 and an increased 36 hours a week in 2000. Work includes teaching and administrative tasks. As such it is no stretch of the imagination that the children would have to bring home schoolwork and read books at home. 81% of total schools reported children borrowing books to read at night in 1997. This figure increased to 90% in 2000. In 1997, 86% of households in the sample reported using electricity and this figure was 91% in 2000. This is regardless of whether they have high or low incomes. But again, we cannot observe anything in data concerning household brownouts and blackouts. While Table 4 refers to a majority of schools with morning sessions that run while there is sunlight, there are afternoon sessions that can end at 18:00 which is about the time when the sun sets in this country that is located on the equator. In 1997, 11% of schools reported having afternoon sessions. This increased to 17% in 2000.

In Table 6 we proceed to further investigate the correlations between using electricity in school and home with test and to hint that there may be a causal relationship. In both 1997 and 2000, schools that use electricity are associated with high test scores than schools that do not use electricity. When in terms of spatial inequalities, left behind schools that are a part of the INPRES Program produce worse performance and this is ameliorated if the INPRES school uses electricity. However an INPRES school using electricity playing catch up with a non-INPRES school using electricity has a bigger gap in test scores in 2000 compared to 1997. Similar positive correlations are found for the pooled 1997/2000 samples. A third dimension is added in Table 7 which is the use of electricity at home in 1997. These tabulations reinforce the direction found in Table 6. There are similar findings in Table 8 for 2000 and in Table 9 for the pooled 1997/2000.

5.2 Regression Output

Given the positive partial correlations established between test scores and the use of electricity especially for left behind schools in underdeveloped areas, we proceed to run linear regressions with various specifications to check for sensitivity to variation. Test scores as measured in the range of 0 – 50 points for the 5 compulsory subjects that the child has to take. They are Language, Math, Science, Social Studies and Moral / Religious Studies. Output reported in Tables 10 – 16 demonstrate that there is a positive relationship (that even extends to causality) between household income and test scores and this is statistically significant at the 1% level. However the direction and magnitude of educational expenditures is sensitive to different specifications. In Table 10 which reports OLS for the 1997 cross section, education spend is not statistically significant across the five specifications where the electrical related use variables - electricity at home, electricity at school and the use of TV at home are each introduced separately and then entered together. All electrical related use variables are binary. We do not include the use of the refrigerator at home because in the household survey, the question asked is specifically concerned with the storage of perishable food in the refrigerator.

The percentage of graduate level teachers in school has a miniscule positive magnitude and this variable is not statistically significant in any of the specifications. The variables electricity at home and electricity at school when entered into the regression separately have large magnitudes in the region of 2x and are statistically significant at the 1% level. But when entered together with TV into the regression, the magnitude for electricity at home falls to 1.68x and is statistically significant at the 5% level. Electricity at school maintains a large positive magnitude at the statistically significant 1% level.

Controls for spatial differences that include representing the structural factor of the grid are introduced and the output is found in Table 11. Educational expenditures now reverses sign and becomes negatively correlated with test scores whereas residing and attending school in urban areas push up test scores noticeably and this is statistically significant. Residing and going to school in Java or Bali is negatively correlated with test scores but the magnitude is smaller than the size of the coefficient for urban areas. However it is a different story when the spatial variables urban and Java / Bali interact. The interaction variable has a negative sign and its magnitude appears to be ameliorated if the child has a home that uses electricity. But if a child goes to a school that is a part of the INPRES Program located in Java or Bali test scores go up and this is strengthened by the use of electricity in the school and home. This statistically significant coefficient at the 5% level can be seen in specification (v) of Table 11.

In 2000, we find that the results are similar to 1997 before the introduction of controls for spatial differences. In Table 12, statistically significant positive correlations between test scores and electricity used at home and in school remain. The main difference between 2000 and 1997 is that educational expenditures now play a substantive role associated with better learning outcomes. This may be because parents have to make a conscious choice to strictly set aside income for their children's education given the volatile changes brought about by the AFC. The increase in the percentage of graduate level teachers assigned to primary schools does not yield any noticeable and improved results in 2000 compared to 1997.

The importance of allocating household resources for education is diminished when variables for spatial differences are introduced in 2000. This is observed in Table 13. What is arguably more crucial is whether a household resides in an urban area and this helps to reverse if not cancel out the negative effects of a child attending an INPRES school. Both variables are statistically significant. The electricity variables lose power and statistical significance in 2000 when spatial differences are factored into consideration. Where a child resides in the archipelago appears to be far more important for academic performance. It is inferred that after the financial crisis, a child is better off residing and attending school in an urban area on one of the islands or in Java and Bali.

Given these correlations which show different patterns in 1997 and 2000, we next attempt to look for some potential causal relations by pooling the two cross sections. We start with Table 14. We introduce a dummy for panel families as a consistency check where a fixed effects model would have estimated similar results as a pooled OLS. This dummy remains statistically insignificant throughout all specifications. In this table where the specifications do not have controls for spatial differences we find evidence that is consistent with theory where income and education expenditures increase test scores. However holding all things constant, the gains made are severely negated by the AFC represented by a year dummy (2000 = 1) in the specifications found in Table 14. To investigate the noticeably large negative effects of the AFC, we re-visit the kernel densities for test scores in the cross sectional households (Figure 5) and panel households (Figure 6). Both figures show the distributions of test scores shifting to the right. The difference is that the panel households in Figure 6 have a greater spread ex-ante compared to ex-post. But coming back to both distributions demonstrating a rightward shift, it seems not entirely possible that the AFC would have such a substantially negative effect. We will investigate this further in Table 15. In comparing Table 14 to Table 13, the use of electricity at home and in school regain magnitudes exceeding 2x in the pooled OLS in (ii) and (iii) and dipping down a little in (v) which restores our position that electricity has a causal learning effect.

The results change in Table 15 when spatial differences are reintroduced. The results are similar to Table 13. While the year dummy continues to have the largest negative magnitude which is statistically significant at the 1% level, there is a respite if children reside and attend school in urban areas or in Java and Bali. A child attending an INPRES school is worse off and this is alleviated if the school is located in Java or Bali. In these five specifications, it can be seen that the use of electricity at home is no longer a key causal factor for improving learning outcomes. But the use of electricity at school is a positive and statistically significant causal factor reinforcing the gains coming from the urban and Java / Bali spatial variables.

Where the use of electricity is arguably the strongest, positive factor is under the conditions of a child attending an INPRES designated school. We find this in Table 16 where we drop the urban and Java / Bali variables while maintaining the INPRES variable. The drop in test scores is cancelled out and reversed when the child is able to attend classes where there is electricity in the classroom and is able to do homework and read books using electrical light at home. These conditions reinforce the positive causal role of incomes and education expenditures on the child's human capital. However the output shows that this is not enough to reverse the negative effects of the AFC. The disadvantaged child in a left behind school is still left behind.

6. Preliminary Conclusions & Continuing Research

This paper is motivated by the attempt to understand developing countries with spatial heterogeneity and the challenges that they are confronted with in terms of socio-economic characteristics, demographics and geographic conditions. Using the "geography hypothesis" from growth economics and economic history, we started out by positing that geography has a time invariant effect on effort and productivity. We test this hypothesis where we use the national electricity grid in Indonesia as a fixed factor to see how children's educational outcomes are affected and how the outcomes can be spatially distinct. Given the inherent difficulties of expanding the grid across the archipelago and guaranteeing households full and uninterrupted access (no brownouts and no blackouts) to electricity, we determine this to be a major challenge confronting the country. When there is electricity for learning, children have better academic performance, there is more human capital accumulated. But there is a limit to what can be achieved because the grid cannot be expanded to meet all needs. This limit is at the expense of disadvantaged children residing in underdeveloped villages that have left behind schools.

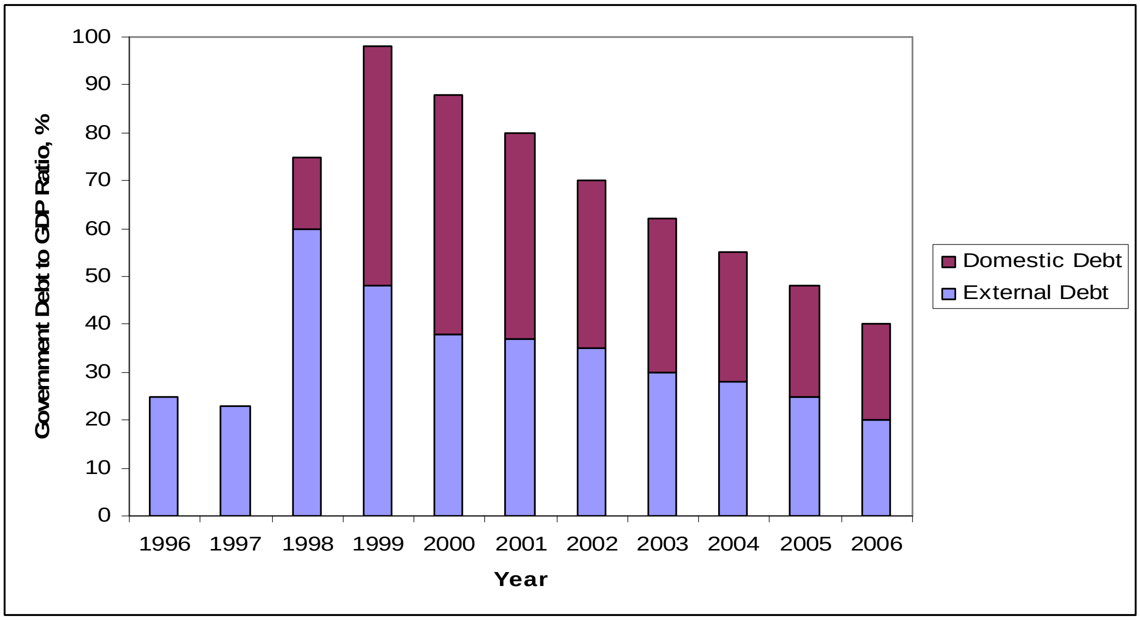
This structural factor inadvertently favors children who reside and go to school in urban areas in all the islands and favors children in Java and Bali. While the central government may attempt to address this through its INPRES redistribution program targeting villages within the islands, there are still children attending left behind schools and scoring less on the national standardized achievement tests. This is despite parents' ability and willingness to invest in their children's education.

On the bright side, we find that over time more households and schools have access to electricity. This is coming from a household being on the grid and having access to alternative sources of energy such as power generators, biomass energy and provision by private power companies. Even with the Asian Financial Crisis and energy sector infrastructure investments badly affected, children could still read and study at night and do better on their exams. But it is uncertain whether the children could learn without any interruptions at night because we do not have information on the extent of brownouts and blackouts. Perhaps there are some children who have electricity in school and at home all the time to power their computers, reading lamps, to go on the Internet and to close the digital divide. Perhaps there are children who have to depend on an array of electrical light substitutes like candle light, torch light, kerosene light and gas light when there is no electricity. But these are inferior substitutes because they are of lower-quality energy and lower efficiency at the point of application.

As continuing research, we aim to secure the longitude and latitude points of the Indonesia national electricity grid and of the households in the observed population. This will enable me to vastly improve the measurement and estimation of the spatial variables. It might then be possible to make a stronger case for positive causality between access to electricity and learning outcomes.

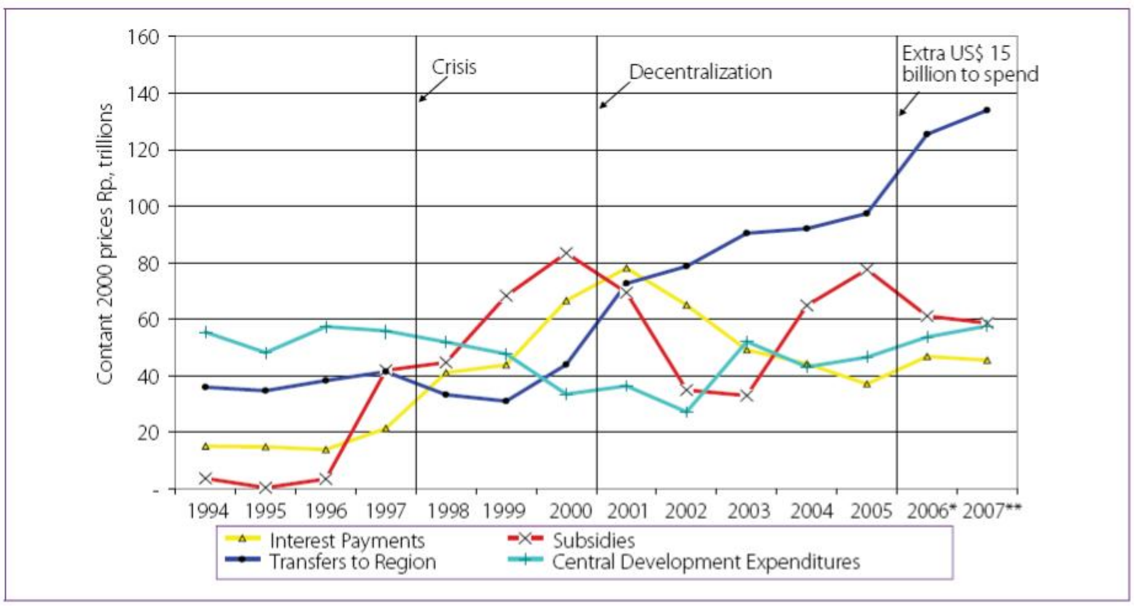
Appendix

Figure 1 Indonesia Country Debt to GDP Ratio (in percentage terms)



Source: Indonesia Ministry of Finance and the World Bank

Figure 1.1 Indonesia Government Public Expenditures 1994 - 2007



Source: World Bank Indonesia

Notes: Refer to the trend line for interest payments on the existing stock of national debt. *2006 are preliminary results as estimated by the World Bank. ** 2007 comes from the National Budget (*Anggaran Pendapatan Belanja Negara)*

Map 1 Indonesia Main Power Plants and Transmission Lines

Source: Perusahaan Listrik Negara, PLN 1997

Table 1 Geothermal Energy Sources by Island

No	Location	Source		Planned Exploration			Total
		Speculation	Hypothesis	Estimated (1)	Estimated (2)	Actual	
1	Sumatera	5,385	2,303	5,681	15	389	13,773
2	Java	2,363	1,521	2,980	603	1,837	9,304
3	Bali – Nusa Tenggara	365	359	943	-	14	1,681
4	Sulawesi	900	125	905	110	65	2,105
5	Maluku	250	117	157	-	-	524
6	Kalimantan	50	-	-	-	-	50
7	Papua	50	-	-	-	-	50
Total		9,363	4,425	10,666	728	2,305	27,487

Source: Indonesia Ministry of Energy and Natural Resources

Table 2 Indonesia Total Installed Capacity and Electricity Consumption 1997 - 2000

Indonesia	1997	1998	1999	2000
Recent Total Installed Capacity (Billion Kilowatt Hours)	97,549	100,233	103,445	108,147
Rate of Increase		2,75%	3,20%	4,55%
Electricity Consumption (Billion Kilowatt Hours)	64,23	67,07	71,97	77,57
Rate of Increase		4,42%	7,31%	7,78%

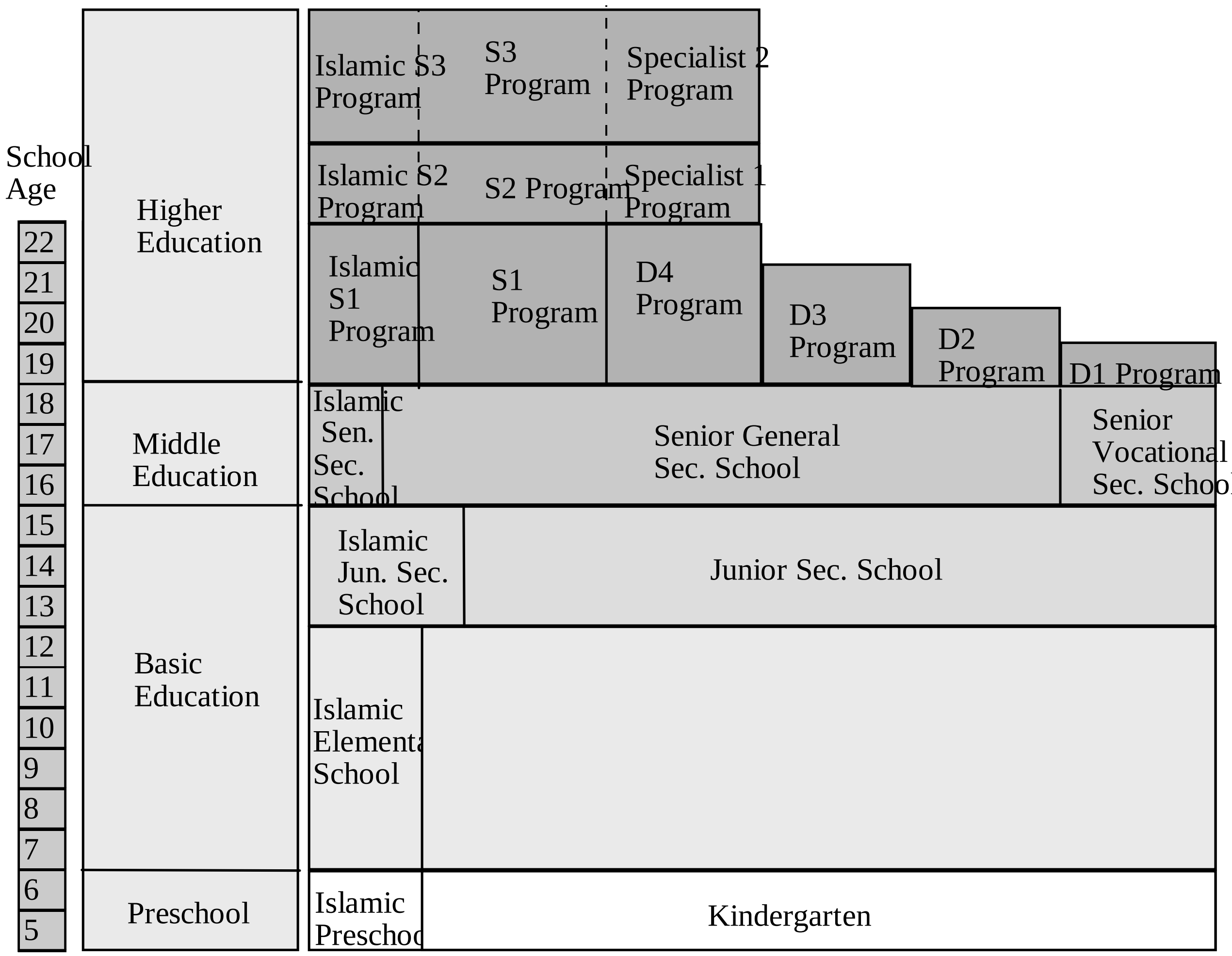
Source: Energy Information Administration, Department of Energy, US Government
Notes: "Recent Total Installed Capacity" is the measure for how much cumulative capacity a country has to generate electricity. "Electricity Consumption" measures how much electrical power is used by all sectors in the country

Table 3 Distribution of Final Energy Use by Sector in Indonesia (Percentage 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.

Figure 2 Indonesian Education System



Source: Ministry of National Education (MoNE)

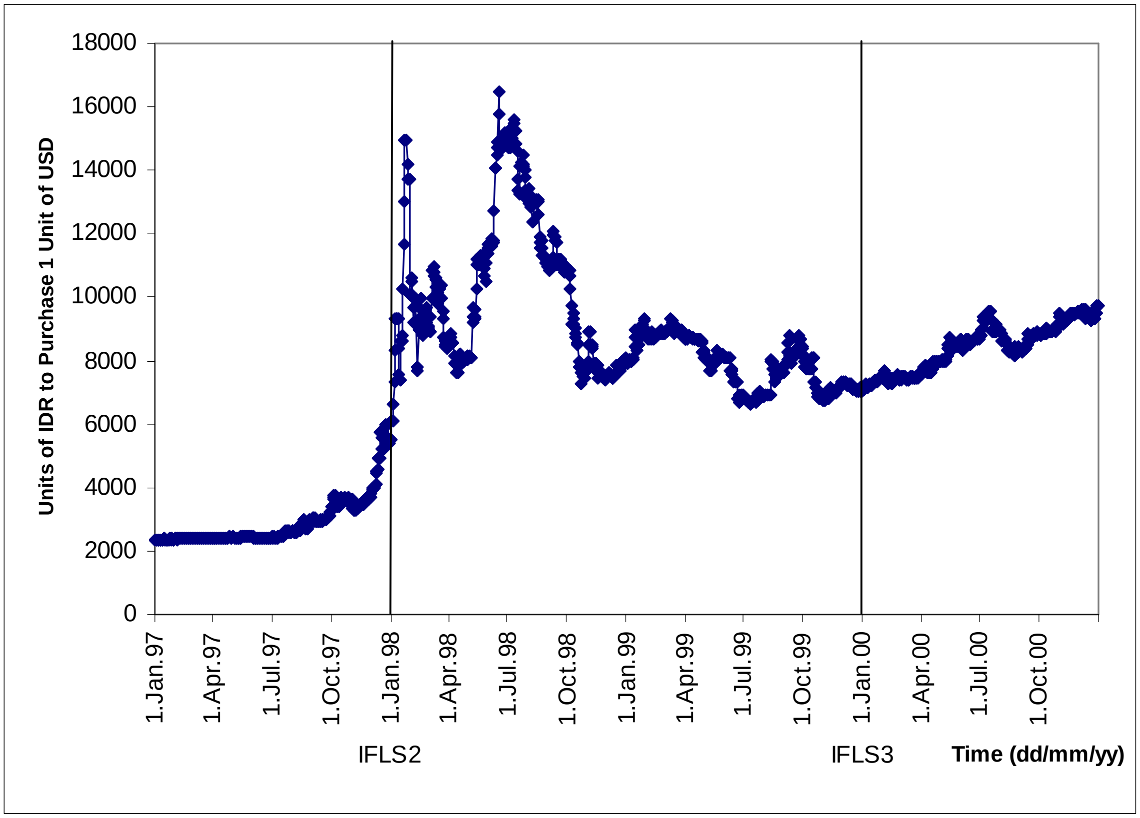
Notes: We study children aged 12 which are defined as being their school age as opposed to birth age. At age 12, children sit for the national standardized test formerly known as EBTANAS and is now known as *Ujian Nasional*. If they pass this test, they are qualified to transition from the SD primary school level to the SMP junior secondary school level. We assume that children in this age group do not repeat grades. This is consistent with the information we have from MoNE concerning children in primary school and to a lesser extent lower secondary school who have a high probability of completing each school grade without repetition. However we do not have comprehensive information concerning Islamic Schools. These schools are regulated by the Ministry of Religious Affairs where the student's religious formation is a key objective.

Table 4 Structure of Academic Hours for the National Curriculum by Primary School *(SD / Sekolah Dasar)* and Junior Secondary School *(Sekolah Menengah Pertama)*

		SD Grade						SMP Grade		
No	Subject	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

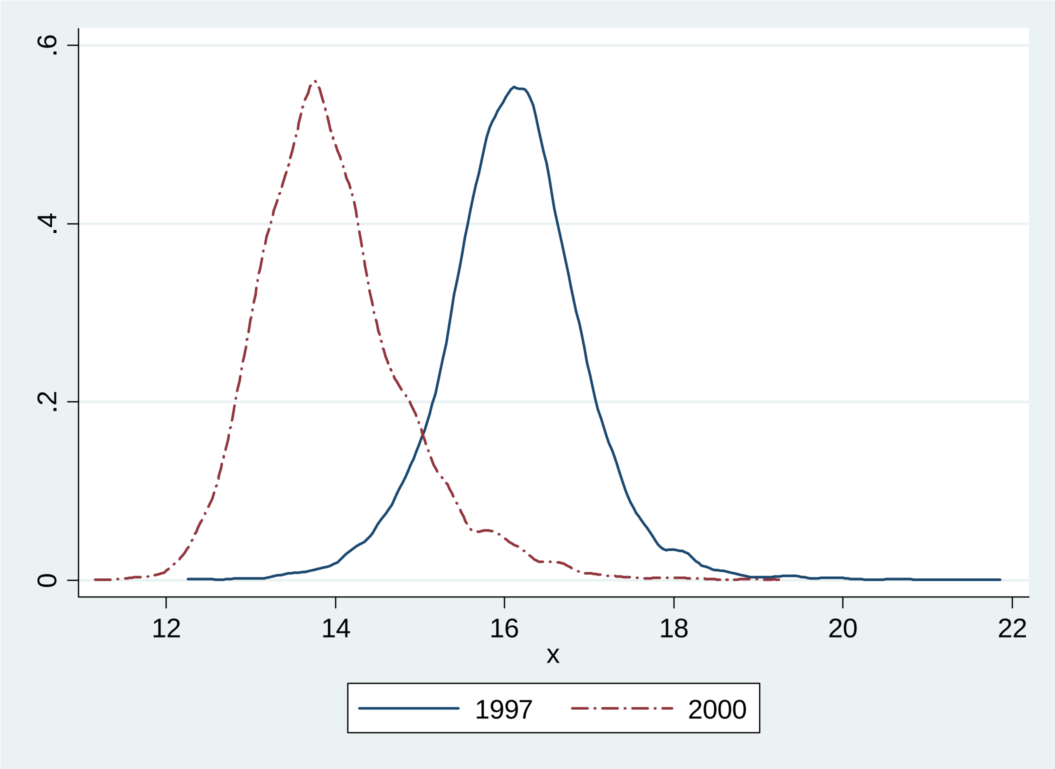
Source: Ministry of National Education

Figure 3 US Dollar – Indonesian Rupiah Exchange Rate 1997 – 2000



Source: www.oanda.com online currency exchange website
Notes: Figure 3 is a graphical representation of our empirical strategy and identifying assumptions. It traces the dynamic changes of the AFC using the US Dollar – Indonesian Rupiah exchange rates and observes household behavior using data from the RAND Corporation. IFLS2 is data where individual, household and community units of analysis were observed prior to the exogenous shock. IFLS3 is data of the units of analysis with the same characteristics after the exogenous shock.

Figure 4 Real Household Income Per Capita (log and expressed in 1997 terms)



Notes: Real household income is expressed in 1997 terms for welfare levels before the financial crisis hit. The proxy used for household income is consumption and savings. Consumption is measured using the market valued prices of goods and services. One of our variables of interest education expenditures, are included in the calculations for consumption. This price data is tracked by BPS but the data has an urban bias because prices come from urban outlets spread across Indonesia. The values of in-kind transfers and own production are not included. Savings is measured using cash on hand, bonds and stocks. It is assumed that this liquidity stems from the year observed and is not accumulated stock over time. All values are deflated by using the Modified Lespeyres deflator and this is consistent with the convention used by BPS. For the construction of this deflator, the arithmetic mean for price relatives is used. For seasonal goods & services, the geometric mean is used.

Figure 5 Distribution of Test Scores from the 1997 Cross Section and 2000 Cross Section

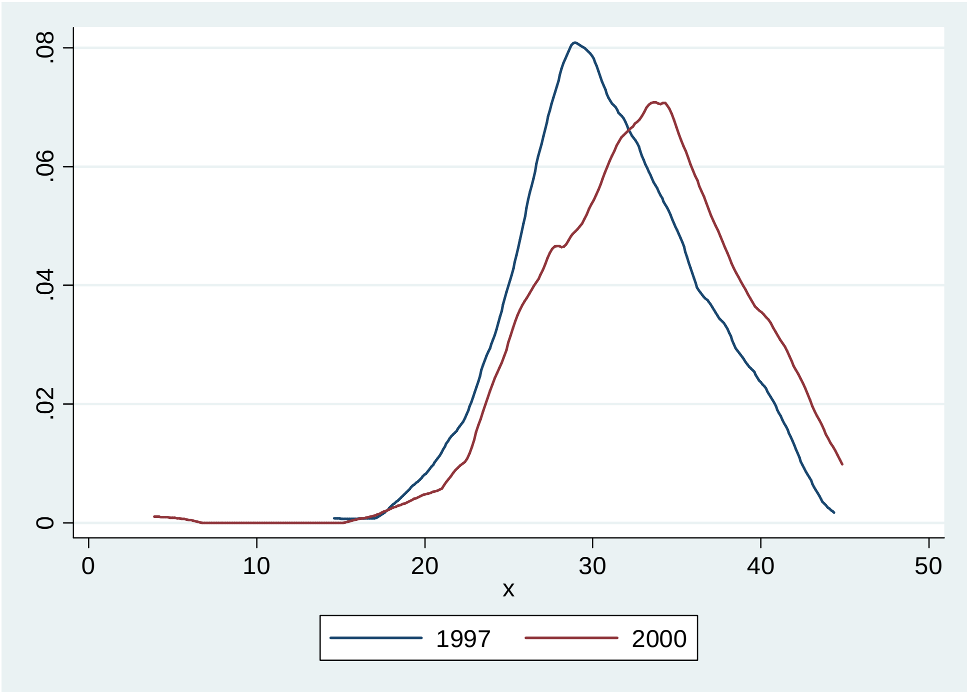


Figure 6 Distribution of Test Scores from Families in the Panel Data 1997 & 2000

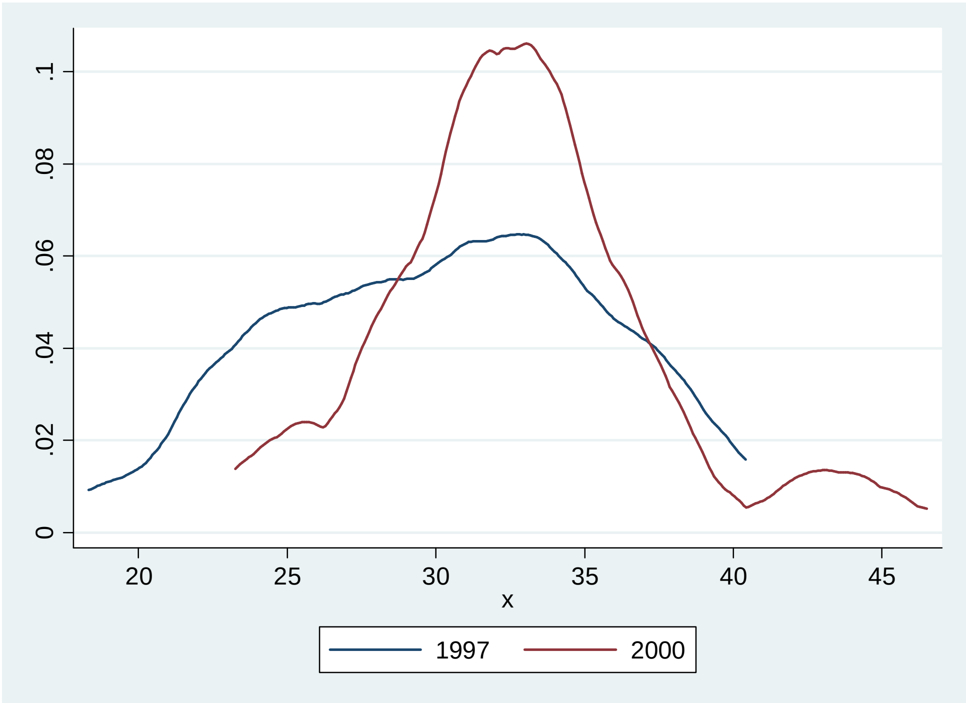


Table 5 Descriptive Statistics

Educational Outcomes	1997	2000
EBTANAS Test Scores Per Child (Points)	30.91 (5.17)	32.94 (5.65)
Household Characteristics		
Household Income Per Capita (Ln)	16.34 (.81)	13.78 (.83)
Educational Expenditures Per Capita (Ln)	10.84 (.82)	11.19 (.83)
Number of Households in Urban Areas	596	475
Number of Households in Java and Bali Islands	559	669
Number of Houses that Report Using Electricity	805	1,091
Child Brings Home Books from School to Read at Night		
- Reads in a House that Does Not Use Electricity (%)	7	5
- Reads in a House that Does Use Electricity (%)	93	95
Type of Cooking Stove Used at Home (Number of Units)		
- Electric	489	877
- Gas	431	2
- Kerosene	10	2
- Firewood	0	3
- Missing Values	0	316
School Characteristics		
Graduate Level Teachers in School (%)	59 (31)	76 (18)
Number of Schools Designated as Part of the INPRES Program	336	257
Number of Schools that Report Having Adequate Electric Light	584	884
Schools that Report the Main Source of Electricity is the PLN Grid (%)	58	73
School Ending Hours (% of Schools)		
- Morning Session Ending in the Time Range 10:00 – 14:00	89	
- Morning Session Ending in the Time Range 09:00 – 17:00		83
- Afternoon Session Ending in the Time Range 12:00 – 18:00	11	17
Children Borrowing Books from School to Read at Night (%)	81	90
Sample Size	930	1,200

Notes: Means and SD in Parentheses are reported for test scores, income, educational expenditures and graduate level teachers. For the number of schools that report having adequate electric lightning in IFLS Wave 2 (1997), this school characteristic is modified in question form in IFLS Wave 3 (2000) where the school has to respond to whether any electric lighting is used. For ending hours, a school can report having one or two sessions and the two sessions combined add up to 100% reported for each period in the data. The upper limit for the ending hour is 18:00. Indonesia is on / slightly below the equator and is two time zones. The sun sets around 17:53 in Western Indonesia and equivalently at 18:53 in Eastern Indonesia.

Table 6

Test Scores for Children with the Characteristics of i) Using Electricity at School ii) Attending School in an INPRES Program
Means and SD (in Parentheses) Are Reported

	School is in the INPRES Program?					
	1997		2000		Pooled 97/00	
Using Electricity at School?	No	Yes	No	Yes	No	Yes
No	30.06 (5.64)	29.38 (4.33)	31.83 (4.53)	29.88 (4.62)	31.09 (5.10)	29.52 (4.41)
Yes	31.66 (5.15)	31.49 (5.01)	34.25 (5.33)	30.64 (6.87)	33.29 (5.41)	31.04 (6.08)
Number of Children in Sample	925		1,200		2,125	

Notes: There are 5 missing values for reported test scores in 1997

Table 7

Test Scores for Children with the Characteristics of i) Using Electricity in School ii) Using Electricity at Home iii) Attending School in an INPRES Program in 1997
Means and SD (in Parentheses) Are Reported

	School is in the INPRES Program in 1997? Then Does House Use Electricity?					
Using Electricity at School?	No, School is Not in the INPRES Program in 1997			Yes, School is in the INPRES Program in 1997		
	No, House Doesn't Use Electricity	Yes, House Uses Electricity	Total	No, House Doesn't Use Electricity	Yes, House Uses Electricity	Total
No	29.14 (4.38)	30.19 (5.80)	30.07 (5.65)	28.07 (3.85)	30.14 (4.43)	29.38 (4.33)
Yes	27.67 (5.51)	32.04 (4.97)	31.67 (5.16)	25.81 (0.65)	31.75 (4.98)	31.50 (5.02)
Total	28.22 (5.13)	31.50 (5.29)	31.19 (5.36)	27.84 (3.72)	31.10 (4.82)	30.43 (4.80)

Notes: In comparing Table 6 and Table 7, it can be seen how electric light at home complements electric light in school to improve test scores in 1997

Table 8

Test Scores for Children with the Characteristics of i) Using Electricity in School ii) Using Electricity at Home iii) Attending School in an INPRES Program in 2000
Means and SD (in Parentheses) Are Reported

	School is in the INPRES Program in 2000? Then Does House Use Electricity?					
Using Electricity at School?	No, School is Not in the INPRES Program in 2000			Yes, School is in the INPRES Program in 2000		
	No, House Doesn't Use Electricity	Yes, House Uses Electricity	Total	No, House Doesn't Use Electricity	Yes, House Uses Electricity	Total
No	29.49 (4.25)	32.16 (4.49)	31.83 (4.54)	28.67 (3.57)	30.54 (5.03)	29.88 (4.63)
Yes	31.67 (5.87)	34.43 (5.26)	34.26 (5.34)	30.17 (5.11)	30.67 (6.97)	30.64 (6.88)
Total	30.79 (5.35)	33.87 (5.17)	33.63 (5.25)	29.10 (4.05)	30.64 (6.61)	30.43 (6.34)

Notes: In comparing Table 5 and Table 8, it can be seen how electric light at home complements electric light in school to improve test scores in 2000

Table 9

Test Scores for Children with the Characteristics of i) Using Electricity in School ii) Using Electricity at Home iii) Attending School in an INPRES Program in 1997/2000
Means and SD (in Parentheses) Are Reported

	School is in the INPRES Program in 1997 / 2000? Then Does House Use Electricity?					
Using Electricity at School?	No, School is Not in the INPRES Program in 1997/2000			Yes, School is in the INPRES Program in 1997/2000		
	No, House Doesn't Use Electricity	Yes, House Uses Electricity	Total	No, House Doesn't Use Electricity	Yes, House Uses Electricity	Total
No	29.35 (4.27)	31.33 (5.16)	31.09 (5.10)	28.24 (3.76)	30.26 (4.60)	29.53 (4.42)
Yes	29.90 (6.02)	33.55 (5.28)	33.29 (5.42)	28.38 (4.45)	31.18 (6.13)	31.05 (6.08)
Total	29.68 (5.39)	32.96 (5.34)	32.69 (5.42)	28.26 (3.86)	30.89 (5.70)	30.43 (5.51)

Notes: In comparing Table 5 and Table 8, it can be seen how electric light at home complements electric light in school to likely cause an increase in test scores in the pooled cross section

Table 10 1997 Cross Section OLS Regressions for Things that Use Electricity & Test Scores
DV = Test Scores (0 to 50 points)
(SE is in Parentheses)

Independent Variables	(i)	(ii)	(iii)	(iv)	(v)
Household Income Per Capita (ln)	1.73*** (.25)	1.48*** (.26)	1.80*** (.25)	1.56*** (.26)	1.55*** (.26)
Education Spend (ln)	.32 (.24)	.36 (.24)	.17 (.24)	.19 (.25)	.15 (.24)
Grad Teachers	.003 (.006)	.005 (.006)	-.004 (.006)	.005 (.006)	-.001 (.006)
Electricity at Home		2.72*** (.61)			1.68** (.66)
Electricity at School			2.39*** (.40)		2.10*** (.41)
TV				1.13** (.47)	.55 (.50)
Constant	-1.29 (4.53)	-.039 (4.47)	-1.79 (4.41)	2.00 (4.72)	.65 (4.58)
R^2	.08	.11	.13	.09	.15
Observations	606	606	606	606	606

Statistically significant at the 1%***, 5%** and 10%* level

Table 11 1997 Cross Section OLS Regressions for Things that Use Electricity & Test Scores
Controls for Spatial Differences are Included
DV = Test Scores (0 to 50 points)
(SE is in Parentheses)

Independent Variables	(i)	(ii)	(iii)	(iv)	(v)
Household Income Per Capita (ln)	1.53*** (.26)	1.45*** (.26)	1.65*** (.26)	1.50*** (.26)	1.55*** (.26)
Education Spend (ln)	-.19 (.25)	-.12 (.25)	-.27 (.25)	-.20 (.25)	-.21 (.25)
Grad Teachers	.004 (.006)	.004 (.006)	.0006 (.006)	.005 (.006)	.0008 (.006)
Urban	2.65*** (.68)	2.13** (.74)	2.35** (.67)	2.6*** (.68)	1.76** (.74)
School is in INPRES Program	.16 (.58)	.39 (.60)	.51 (.58)	.18 (.59)	.79 (.60)
Java & Bali Islands	-.26 (1.04)	-1.0 (1.14)	-1.77 (1.08)	-.25 (1.04)	-2.66** (1.18)
Urban Areas of Java & Bali Islands	-1.33 (.84)	-.86 (.88)	-1.19 (.83)	-1.35 (.84)	-.67 (.88)
School is in INPRES Program in Java & Bali Islands	.66 (.41)	.77* (.41)	.89** (.41)	.66 (.41)	1.02** (.41)
Type of Stove Used for Cooking	-.60 (.45)	-.59 (.45)	-.45 (.45)	-.55 (.46)	-.42 (.46)
Electricity at Home		1.29* (.76)			1.44** (.80)
Electricity at School			2.11*** (.46)		2.16*** (.46)
TV				.26 (.49)	.076 (.52)
Constant	6.64 (4.99)	6.48 (4.98)	5.01 (4.92)	7.04 (5.05)	4.9 (4.9)
R^2	.15	.15	.17	.15	.18
Observations	606	606	606	606	606

Statistically significant at the 1%***, 5%** and 10%* level

Table 12 2000 Cross Section OLS Regressions for Things that Use Electricity & Test Scores
DV = Test Scores (0 to 50 points)
(SE is in Parentheses)

Independent Variables	(i)	(ii)	(iii)	(iv)	(v)
Household Income Per Capita (ln)	1.77*** (.23)	1.67*** (.23)	1.67*** (.23)	1.50*** (.25)	1.42*** (.24)
Education Spend (ln)	1.03*** (.23)	.95*** (.23)	.98*** (.23)	.92*** (.24)	.85*** (.23)
Grad Teachers	.003 (.01)	.002 (.009)	.0008 (.009)	.005 (.009)	.002 (.009)
Electricity at Home		2.35*** (.66)			1.74** (.66)
Electricity at School			2.08*** (.46)		1.71*** (.46)
TV				1.43** (.44)	1.03** (.44)
Constant	-3.37 (3.60)	-3.17 (3.57)	-2.88 (3.56)	.477 (3.77)	-.04 (3.73)
R^2	.10	.12	.13	.12	.14
Observations	880	880	880	880	880

Statistically significant at the 1%***, 5%** and 10%* level

Table 13 2000 Cross Section OLS Regressions for Things that Use Electricity & Test Scores
Controls for Spatial Differences are Included
DV = Test Scores (0 to 50 points)
(SE is in Parentheses)

Independent Variables	(i)	(ii)	(iii)	(iv)	(v)
Household Income Per Capita (ln)	1.55*** (.24)	1.54*** (.24)	1.52*** (.24)	1.46*** (.25)	1.44*** (.25)
Education Spend (ln)	.13 (.24)	.13 (.24)	.16 (.24)	.12 (.24)	.15 (.24)
Grad Teachers	.003 (.009)	.003 (.009)	.002 (.009)	.004 (.009)	.003 (.009)
Urban	2.32*** (.60)	2.17*** (.61)	2.10** (.61)	2.19*** (.61)	1.87** (.62)
School is in INPRES Program	-2.66*** (.62)	-2.59*** (.62)	-2.61*** (.62)	-2.68*** (.62)	-2.57*** (.62)
Java & Bali Islands	1.96*** (.54)	1.82** (..54)	1.76** (.55)	1.89** (.54)	1.59** (.56)
Urban Areas of Java & Bali Islands	-.02 (.77)	.13 (.78)	.08 (.78)	.02 (.78)	.25 (.78)
School is in INPRES Program in Java & Bali Islands	.53 (.90)	.39 (.90)	.43 (.90)	.55 (.90)	.34 (.90)
Type of Stove Used for Cooking	.04 (.31)	.14 (.32)	.05 (.31)	.12 (.32)	.20 (.32)
Electricity at Home		1.03 (.67)			.92 (.67)
Electricity at School			.79** (.47)		.70 (.47)
TV				.63 (.44)	.55 (.44)
Constant	8.22 (4.45)	7.14 (4.51)	7.82 (4.46)	8.86 (4.47)	
R^2	.20	.21	.21	.21	.21
Observations	880	880	880	880	880

Statistically significant at the 1%***, 5%** and 10%* level

Table 14 Pooled OLS Regressions for Things that Use Electricity & Test Scores
DV = Test Scores (0 to 50 points)
(SE is in Parentheses)

Independent Variables	(i)	(ii)	(iii)	(iv)	(v)
Household Income Per Capita (ln)	1.77*** (.17)	1.60*** (.17)	1.73*** (.17)	1.54*** (.18)	1.48*** (.18)
Education Spend (ln)	.74*** (.17)	.71*** (.17)	.66*** (.17)	.62*** (.17)	.57** (.17)
Grad Teachers	.004 (.005)	.005 (.005)	-.001 (.005)	.006 (.005)	.001 (.005)
Year Dummy (2000 = 1)	-6.30*** (.57)	-5.81*** (.57)	-5.95*** (.56)	-5.76*** (.58)	-5.32*** (.57)
Dummy for Panel Families	-.23 (.41)	-.20 (.40)	-.09 (.40)	-.13 (.41)	-.02 (.40)
Electricity at Home		2.54*** (.45)			1.75*** (.47)
Electricity at School			2.20*** (.31)		1.89*** (.31)
TV				1.29*** (.32)	.80** (.33)
Constant	-.16 (2.71)	.11 (2.68)	-.02 (2.66)	3.25 (2.83)	2.28 (2.78)
R^2	.12	.14	.15	.13	.16
Observations	1,486	1,486	1,486	1,486	1,486

Statistically significant at the 1%***, 5%** and 10%* level

Table 15 Pooled OLS Regressions for Things that Use Electricity & Test Scores
Controls for Spatial Differences are Included
(SE is in Parentheses)

DV = Test Scores	(i)	(ii)	(iii)	(iv)	(v)
Household Income Per Capita (ln)	1.54*** (.17)	1.51*** (.17)	1.54*** (.17)	1.48*** (.18)	1.47*** (.18)
Education Spend (ln)	.07 (.17)	.10 (.17)	.09 (.17)	.06 (.17)	.10 (.17)
Grad Teachers	.004 (.005)	.005 (.005)	.002 (.005)	.005 (.005)	.003 (.005)
Year Dummy (2000 = 1)	-5.60*** (.68)	-5.31*** (.70)	-5.23*** (.68)	-5.36*** (.70)	-4.78*** (.72)
Dummy for Panel Families	-.12 (.39)	-.11 (.39)	-.08 (.39)	-.08 (.39)	-.04 (.39)
Urban	2.38*** (.45)	2.16*** (.46)	2.09*** (.45)	2.29*** (.45)	1.84*** (.47)
School is in INPRES Program	-1.65*** (.31)	-1.61*** (.31)	-1.63*** (.31)	-1.64*** (.31)	-1.59*** (.31)
Java & Bali Islands	2.33*** (.40)	2.14*** (.41)	1.97*** (.41)	2.31*** (.40)	1.79*** (.42)
Urban Areas of Java & Bali Islands	-.51 (.56)	-.28 (.57)	-.36 (.56)	-.49 (.56)	-.15 (.57)
School is in INPRES Program in Java & Bali Islands	-.56** (.18)	-.59** (.18)	-.63** (.18)	-.56** (.18)	-.66*** (.18)
Type of Stove Used for Cooking	-.17 (.25)	-.10 (.25)	-.13 (.25)	-.12 (.25)	-.02 (.25)
Electricity at Home		.88* (.49)			.76 (.49)
Electricity at School			1.21*** (.33)		1.20*** (.33)
TV				.44 (.33)	.34 (.33)
Constant	9.46 (3.30)	8.66 (3.33)	8.60 (3.29)	9.90 (3.31)	8.26 (3.34)
R^2	.20	.20	.21	.20	.21
Observations	1,486	1,486	1,486	1,486	1,486

Table 16 Pooled OLS Regressions for Things that Use Electricity & Test Scores
(SE is in Parentheses)

DV = Test Scores	(i)	(ii)	(iii)	(iv)	(v)
Household Income Per Capita (ln)	1.59*** (.18)	1.52*** (.18)	1.60*** (.18)	1.46*** (.18)	1.47*** (.18)
Education Spend (ln)	.49** (.17)	.52** (.17)	.46** (.17)	.44** (.17)	.44** (.17)
Grad Teachers	.002 (.005)	.003 (.005)	-.001 (.005)	.004 (.005)	.0006 (.005)
Year Dummy (2000 = 1)	-7.07*** (.64)	-6.40*** (.65)	-6.53*** (.64)	-6.46*** (.67)	-5.70*** (.68)
Dummy for Panel Families	-.26 (.40)	-.23 (.40)	-.14 (.40)	-.18 (.40)	-.07 (.40)
School is in INPRES Program	-1.77***	-1.64*** (.31)	-1.63*** (.31)	-1.74*** (.31)	-1.53*** (.31)
Type of Stove Used for Cooking	-.73** (.24)	-.50** (.24)	-.55** (.24)	-.56** (.24)	-.28 (.24)
Electricity at Home		1.96*** (.46)			1.37** (.47)
Electricity at School			1.94*** (.31)		1.75*** (.31)
TV				.95** (.33)	.65** (.33)
Constant	8.05 (3.38)	6.10 (3.39)	6.42 (3.34)	9.07 (3.39)	5.91 (3.39)
R^2	.15	.16	.17	.15	.18
Observations	1,486	1,486	1,486	1,486	1,486

Statistically significant at the 1%***, 5%** and 10%* level

References

Acemoglu, Daron, Johnson, Simon and Robinson, James A. "Reversal of Fortune: Geography and Institutions in the Making of the Modern World Income Distribution" *The Quarterly Journal of Economics*, Vol. 117, No.4 (Nov, 2002), pp. 1231 - 1294

Akita, Takahiro and Szeto, Jesse J.K. "INPRES Desa Tertinggal (IDT) Program and Indonesian Regional Inequality" *Asian Economic Journal* 2000 Vol. 14 No.21

Banerjee, Abhijit, Deaton, Angus and Duflo, Esther "Wealth, Health and Health Services in Rural Rajasthan" *The American Economic Review,* Vol. 94, No.2, Papers and Proceedings of the One Hundred Sixteenth Annual Meeting of the American Economic Association San Diego, CA, January 3 – 5, 2004 (May, 2004), pp. 326 – 330

Banerjee, Abhijit and Duflo, Esther "Addressing Absence" *The Journal of Economic Perspectives,* Vol. 20, No.1 (Winter, 2006), pp.117 - 132

Becker, Gary S and Tomes, Nigel (1986) "Human Capital and the Rise and Fall of Families" *Journal of Labor Economics*, 4(3): S1 - 39

Card, David and Krueger, Alan B. (1992) "Does School Quality Matter? Returns to Education and the Characteristics of Public Schools in the United States" Journal of Political Economy, 100(1), pp. 1 - 40

Carneiro, Pedro and Heckman, James J. (2003) "Human Capital Policy" Working Paper 9495, National Bureau of Economic Research

Diamond, Jared M. *Guns, Germs and Steel: The Fate of Human Societies* (New York: NY: W. W. Norton & Co, 1997)

DiNardo John E. and Pischke Jorn-Steffen "The Returns to Computer Use Revisited: Have Pencils Changed the Wage Structure Too?" *The Quarterly Journal of Economics*, Vol. 112, No. 1 (Feb 1997), pp. 291 - 303

Duflo, Esther (2001) "Schooling and Labor Market Consequences of School Construction in Indonesia: Evidence from an Unusual Policy Experiment" American Economic Review, 91(4), pp. 795 – 813

Energy Information Administration, Department of Energy, US Government http://www.eia.doe.gov/emeu/international/contents.html

Federman, Maya and Levine, David I. "The Effects of Industrialization on Education and Youth Labor in Indonesia" *Contributions to Macroeconomics* Volume 5, Issue 1, 2005

Frankenberg, E. and D. Thomas. "The Indonesia Family Life Survey (IFLS): Study Design and Results from Waves 1 and 2". March, 2000. DRU-2238/1-NIA/NICH

Ravallion, Martin “INPRES and Inequality: A Distributional Perspective on the Center’s Regional Disbursements” Bulletin of Indonesian Economic Studies, Volume 24, Issue 3 December 1988, pages 53 - 71

Sachs, Jeffrey D., "Notes on a New Sociology of Economic Development," in Lawrence E. Harrison and Samuel P. Huntington, eds., Culture Matters: How Values Shape Human Progress (New York, NY: Basic Books, 2000).

-, "Tropical Underdevelopment," NBER Working Paper No. 8119, 2001.

Strauss, J., K. Beegle, B. Sikoki, A. Dwiyanto, Y. Herawati and F. Witoelar. “The Third Wave of the Indonesia Family Life Survey (IFLS3): Overview and Field Report”. March 2004. WR-144/1-NIA/NICHD.

World Bank Energy and Mining Sector Unit East Asia and Pacific Region (2003) “Project Appraisal Document on a Proposed Loan in the Amount of US$140 Million to the Republic of Indonesia for a Java-Bali Restructuring and Strengthening Project”

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