Do Television and Radio Destroy Social Capital?
Evidence from Indonesian Villages

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ABSTRACT

In "Bowling Alone," Putnam (1995) famously argued that the rise of television may be responsible for social capital's decline. I investigate this hypothesis in the context of Indonesian villages. To identify the impact of exposure to television (and radio), I exploit plausibly exogenous differences in over-the-air signal strength associated with the topography of East and Central Java. Using this approach, I find that better signal reception, which is associated with more time spent watching television and listening to radio, is associated with substantially lower levels of participation in social activities and with lower self-reported measures of trust. I find particularly strong effects on participation in local government activities, as well as on participation in informal savings groups. However, despite the impact on social capital, improved reception does not appear to affect village governance, at least as measured by discussions in village-level meetings and by corruption in a village-level road project.

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1. Introduction

Robert Putnam, in a series of books and articles, famously argued that social capital in the United States has been declining over the past 40 years – and that the rise of television is a major factor behind this decline (Putnam 1995, 2000). Empirically testing this hypothesis, however, is challenging. While there are many correlational studies on the relationship between television watching and participation in social groups, establishing a causal relationship is more difficult. Putnam, for example, acknowledges the paucity of causal evidence on this point, and to establish a casual link relies on only one study, based on the introduction of television in three isolated Canadian communities in the 1970s (Williams 1986, Putnam 2000).[1]

In this paper, I examine the link between media exposure and social capital in over 600 villages in two Indonesian provinces, East Java and Central Java. Rural Java is a particularly attractive setting for studying this question, for several reasons. First, the area is rich in social capital – the typical village contains 179 groups of various types, or one for every 15 adults. Second, the setting provides plausibly exogenous variation in television and radio use, which allows me to investigate the causal impact of television and radio on social capital. My findings suggest that television and radio do appear to reduce social capital, measured either by participation levels in social groups or by self-reported measures of trust.

To identify this relationship, I exploit the fact that the mountainous terrain of parts of East and Central Java generates plausibly exogenous variation in the ability of villagers in rural areas to receive television and radio signals. I show that the variation in television reception within rural districts appears approximately balanced with respect to village characteristics such

[1] Several authors have recently used the diffusion of radio in the United States to study the impact of media on public finance (Stromberg 2004) and the diffusion of television in the United States to study its impact on voter participation and education (Gentzkow 2006, Gentzkow and Shapiro 2006). However, the relative scarcity of detailed data on social participation from the 1950s and earlier have meant similar exercises have not been conducted for participation in social groups.

as population, education rates, and poverty. Furthermore, I use a model of electromagnetic signal propagation, combined with GIS data on the location of transmission towers and the topography of the area, to verify that the results are robust to using only the variation in signal strength caused by mountains located in between the villages and the transmission towers.

Using the variation in signal reception within rural districts, I find that each additional television channel whose signal is strong enough to be received over-the-air is associated with villagers watching, on average, about 5 minutes of additional television per day. I also find that an additional channel of television reception is associated with respondents listening to an additional 6 minutes of radio each day, which likely reflects the high correlation between radio and television signals. Since I do not observe radio reception directly, and since even if observed it would likely be collinear with television reception in any case, I consider the total effect of an additional channel of better TV reception to be the additional 11 minutes per day spent watching television and listening to radio, and do not attempt to separate television from radio. Overall, this represents about a 6% increase in time spent watching television and listening to radio for each additional television channel received.

The results show substantial negative impacts of improved reception, and hence of time spent watching television and listening to radio, on participation in a wide range of village activities. Reception of an extra channel of television is associated with a decline of about 7 percent in the total number of social groups in the village, and with the typical adult in the village attending 12 percent fewer group meetings. The effects are particularly strong among community self-improvement activities, neighborhood associations, school committees, and informal savings groups. These declines in social participation represent a net decline in social activity, rather than a shift from formal social groups to informal gatherings. Overall, the estimates imply that villagers spend between 0.08 - 0.16 fewer hours in group meetings for every additional hour they spend watching television or listening to radio.

In addition to participation in social groups, another form of social capital that has been frequently discussed in the literature is trust (e.g., Knack and Keefer, 1997, La Porta et a. 1997). Consistent with the results on participation in social groups, I also find that additional television and radio exposure is associated with substantially lower self-reported levels of trust, as measured using the same type of World Values Survey trust questions that have been widely used in the literature and that have been shown to be correlated with real trustworthy behavior (Glaeser et al. 2000, Karlan 2005). The results show that the impact of television and radio on social capital are similar across these two very different measures of social capital.

A large part of the interest in social capital stems from a related argument advanced by Putnam (1993) that lower levels of social capital translate into worse governance. In the data, I observe several measures of governance associated with a village-level road building program that took place in all 600 villages during the period the data was collected. The process for building and supervising these village roads was supposed to be participatory – construction was planned at open village meetings, and subsequent village meetings were held at which the construction team had to account for how they used funds. Enumerators attended these meetings, and consistent with the results on participation in social groups, areas with greater television reception had lower attendance at these village-level planning and monitoring meetings.

Despite the impact of better television reception on attendance at meetings, I find little evidence that this translated into worse outcomes for the road project. Even though it reduces attendance, greater television reception does not change the number of people at the road-building meetings who talk, the probability that a corruption-related problem was discussed at a meeting, or the probability that the meetings dedicated to project accountability voted to take any serious action, such as firing someone or calling for an outside audit, to resolve a problem. Moreover, better television reception was not associated with greater theft of funds from the road project, as measured by the difference between the road's official cost and an engineer's ex-post estimate of what the road actually cost to build. Though television and radio broadcasts are largely national, and rarely if ever report on the individual villages I study, it is of course possible that media exposure affects village level governance through channels other than social capital. Considerable caution should therefore be used in interpreting the results on governance as identifying the causal effect of social capital per se on governance. Nevertheless, the results here stand in contrast to cross-country studies, which tend to show a negative correlation between corruption and average levels of trust and social participation (La Porta et al. 1997, Bjornskov 2004).

The remainder of the paper is organized as follows. Section 2 describes the setting and discusses the data used in the paper. Section 3 discusses the empirical strategy, examines the relationship between television reception and village characteristics such as population, education rates, and poverty, and presents the model of electromagnetic signal transmission used to explicitly identify the variation in television reception due to topographic features. It also shows that better reception does indeed lead to more time spent watching television and listening to radio. Section 4 presents the main results on the impact of television and radio on social capital. Section 5 discusses the impact of television reception on village governance, as measured through the monitoring process and final outcomes of a village-level road building project. Section 6 concludes.

2. Setting and Data

This study examines 606 villages in Indonesia's East Java and Central Java provinces. As the data used in this study come from a study of rural road projects, all villages in the study were selected because they were about to begin building a 1-3 km road project under the auspices of the Kecamatan Development Program (KDP), a project funded by the central government from a loan from the World Bank.

Rural Java is one of the most densely populated rural areas in the world, with over 750 people per square kilometer.[2] Consistent with this high population density, districts (*kabupaten*) in Java contain almost one million people on average, but are relatively small geographically – a typical district contains only 1,100 square kilometers, equivalent to a square 33 km on each side. (A list of the various administrative units in Indonesia with their relative sizes is shown in Table 1.) Districts are broken into subdistricts (*kecamatan*), which are in turn broken into villages (*desa*), each of which contains an average of about 4,500 people. Villages are subsequently broken up into hamlets (*dusun*), blocks (*RW*), and neighborhoods (*RT*). All specifications will include fixed effects at the district level, to control for the administrative, locational, and cultural differences that exist across the different parts of East and Central Java.

The data used in this paper come from several surveys designed by the author and conducted between September 2003 and August 2004. In the remainder of this section I describe the data for the three main types of variables used in the study – data on social organizations from a survey of the head of each hamlet, data on television reception from a household survey and television transmitter locations from the Indonesian government, and data on governance

[2] Author's calculations using 2003 PODES dataset. This calculation includes only villages *(desa)*, and includes all agricultural land area as well as residential areas. To the best of my knowledge, only rural Bangladesh has population densities of similar magnitude among rural areas in developing countries.

from a field survey used to measure corruption in the road project and from a first-hand report of attendance and discussions at village meetings associated with building the road.

2.1. *Social organizations*

Javanese villages have a complex network of social groups. As discussed in Alatas et al. (2002) and Miguel et al. (2005), a typical Javanese village includes a wide variety of social organizations, including religious study groups, neighborhood associations, rotating savings and credit associations (ROSCAs, known as *arisan* in Indonesian), and women's groups of various types. Javanese villages also have a strong tradition of community-self help, or *gotong royong*, in which villagers work together to improve community infrastructure.

While many of the groups are formed independently by villagers, some are local chapters of larger organizations. Many of the Islamic study groups, for example, are loosely affiliated with the two national Islamic umbrella organizations, *Nahdlatul Ulama* (NU) and *Muhammadiyah*, though they essentially operate independently in each village. In addition, under the Soeharto regime, neighborhood associations (RTs and RWs) and the national women's organization (PKK) were formalized and encouraged by the central government. Since the end of the Soeharto regime in 1998 and the introduction of regional autonomy in 2002, these groups have been essentially left on their own, with relatively little subsequent support or encouragement from the central government.

To measure the prevalence and activity of these various types of social groups, I use key informant surveys, which allow me to construct a list of all social organizations in the village. In particular, in each hamlet, the surveyor interviewed the head of the hamlet, and asked him for an exhaustive list of all groups, organizations, activities, meetings, or programs that exist in his hamlet. To ensure that the list was complete, the hamlet head was prompted with a list of 12 different categories of social groups, with each category containing a list of the four or five most common activities in that category. For each group, the hamlet head was asked what type of group it was and whether the group included only members from one neighborhood (RT), members from one neighborhood in the same block (RW), members from multiple areas in the same hamlet (dusun), or members from the entire village.[3] In addition, in one randomly selected hamlet in each village, for each group the hamlet head was also asked about the frequency of meetings, the date of the most recent meeting, the number of men and women who attend a typical meeting, and whether the group meeting included a rotating savings and credit association (ROSCA).

I aggregate these data across all hamlets to obtain a picture of the all groups in the village. Table 2 presents summary statistics of the data. As shown in Table 2, on average there are 179 total groups in each village. This works out to about 1 group for every 15 adults in the village. Using the more detailed data on the average number of attendees and frequency of meetings, I also compute the average number of times an adult in the village attended a meeting in the past three months. On average, each adult attended approximately 11 meetings over the three months prior to the survey, or about 1 meeting each week.

2.2. Television reception

Indonesia has 9 major television channels that broadcast over the air. These channels include one government-run channel (TVRI), three major networks (RCTI, SCTV, and Indosiar),

[3] Hamlet heads typically know the activities in their hamlet in great detail. However, in hamlets with multiple blocks (RWs), hamlet heads may not know about neighborhood organizations in blocks other than the block where they live. Thus, if there are multiple blocks in the hamlet, the hamlet head was asked to list all neighborhood-level (RT) activities only for his block (RW). For all other organizations (i.e., any organization that contains members from multiple neighborhoods (RTs)), he was instructed to list all organizations in his hamlet. Accordingly, to calculate the total number of organizations in the hamlet, I multiply the number of organizations at the neighborhood (RT) level by the average number of blocks (RWs) per hamlet in the village.

one all-news station (Metro TV), and four minor networks (ANTV, TV7, TransTV, and TPI).[4] All of the private channels (except Metro TV) have a range of entertainment programming, such as sitcoms, soap operas, movies, and religious programs, and in addition the government run channel and the major networks all have daily national news shows.

Data on the ability of households to receive each of these channels comes from the household survey. Respondents were selected from a stratified random sample of households in the village.[5] In that survey, each respondent was asked, for each of the 9 networks in Indonesia, whether "as far as they know, this station could be received in this village clearly enough to watch." As shown in Table 2, on average, households report being able to receive about 5 stations, with virtually universal coverage for two of the major networks (RCTI and Indosiar) and much lower coverage rates for the minor networks.

For the main measure of television reception I use in the paper, I average the number of channels received over all respondents in a subdistrict.[6] In constructing this average, I only use the data on television reception from those households that have televisions, excluding the 3 percent of households who also own a satellite dish, which yields an average of 20 datapoints on television reception for each of the 155 subdistricts in the sample. The correlation of these individual responses within a subdistrict is 0.70, which suggests that averaging over 20 households should produce an estimate of the number of channels received with relatively little measurement error.

[4] There are two other even more minor national stations, Global TV and LatTV. These two stations were not asked about explicitly in the household survey, but some households reported receiving them under the category of 'other'. Although I do not include these stations in the main analysis, adding them does not substantially affect the results.
[5] The sampling strategy for the household survey is discussed in detail in Olken (2006).
[6] Averaging television reception at the village level, rather than the subdistrict level, produces very similar results. This is not surprising, given that television reception is highly correlated across villages in the same subdistrict. All standard errors are clustered by subdistrict to account for the geographic clustering of television reception.

On average, 69 percent of sampled households report owning a television, and 71 percent report owning a radio; only 12 percent of households own neither. Overall, respondents reported spending an average of 123 minutes per day watching television and 55 minutes per day listening to radio. The survey also included a series of trust questions similar to those in the World Values Survey, which will be discussed in more detail below.

In addition, I also obtained data from the Indonesian Department of Information and Communications on the locations and signal strengths of all television transmitters in Indonesia. In Section 3.2, I use this data, combined with GIS maps of Java, to predict television reception in each village as a function of the topography between the transmitters and each village in the data. This approach allows me to verify that the variation in television reception is indeed coming from geographic features of East and Central Java.

2.3. Governance

Two types of data on governance are used in the paper. The first measure of governance I examine is data from the open village meetings that were part of the road construction project. Enumerators attended four meetings in each village – one meeting where construction was planned, and three meetings (after 40%, 80%, and 100% of funds were spent) where those who implemented the project had to account for how they used project funds. The enumerator took attendance at the meeting and recorded all of the issues that were discussed at the meeting, as well as how each issue was resolved.

Second, I measure "missing expenditures" in each of the road projects that were built in the project. Specifically, after the road projects were completed, engineers dug core samples in each road to estimate the quantity of materials used, surveyed local suppliers to estimate prices, and interviewed villagers to determine the wages paid on the project. From these data, I construct an independent estimate of the amount each project actually cost to build, and then compare this estimate with what the village reported it spent on the project on a line-item by line-item basis.[7] The difference in logs between what the village claimed the road cost to build, and what the engineers estimated it actually cost to build, is the measure of missing expenditures I examine. I examine four versions of this measure: missing expenditures for the road project, missing expenditures for the road and ancillary projects (which includes accompanying projects such as culverts and retaining walls), missing prices (i.e., the difference in logs between the prices reported by the village and those found in the price survey, weighted by the reported shares of each commodity the village reports it uses), and missing quantities (i.e., the difference in logs between the quantities the village reports and those found in the engineering survey, weighted by the village's reported prices).

3. Empirical Strategy

3.1. Determinants of Television Reception

The empirical strategy is to use television reception as an exogenous determinant of television watching. It is important to use an exogenous determinant of television watching to isolate the causal effect of media exposure because of potential reverse causality issues. For example, if the number of social groups was low for some other reason – say, the village head who organizes the social groups was incompetent – households might respond to the lack of available social activities by watching more television.

The key issue in doing this is to ensure that television reception is orthogonal to other village characteristics that might also affect social capital. In particular, the placement of TV stations, particularly for the minor networks, is determined primarily by the major cities of East and Central Java – in particular, Surabaya, Semarang, and the combined media market of

[7] Additional details about this measurement can be found in Olken (2005).

Surakarta and Yogyakarta. This can be seen in Figure 1, which shows television reception in different geographic areas of East and Central Java (lighter shading indicates higher elevation, and larger circles indicate better television reception). As can be seen in the Figure, the largest circles, corresponding to the best television reception, are all in areas with direct lines of sight to Surabaya, Semarang, Surakarta, and Yogyakarta.

In all specifications, I therefore include district fixed effects, which captures 95% of the variation in the distance between the subdistrict and the closest of the three listed major cities above. (Districts borders are shown in black in Figure 1; subdistrict borders are shown in gray.) Not surprisingly, as shown in Table 2, removing district fixed effects also removes 75% of the variance from the number of channels variable. Including district fixed effects also removes most of the relatively subtle variation in economic or social structure across East and Central Java. In addition, in all specifications, I also include as control variables both the distance and travel time from the village to the nearest city, to further capture locational differences within districts.[8]

Once proximity to the television transmission sites has been removed, the major remaining determinant of television reception is geography. In particular, in some areas, mountains block television transmission, whereas in others they do not. As villages in mountainous areas may have different social structures from villages in low plains, I control for elevation, which may be correlated with reception, though doing so does not substantially affect the results.[9] I also control for dummies for whether the subdistrict faces north, east, or south (with west as the omitted category), and a dummy for the subdistrict being coastal (as opposed to landlocked).

[8] For this definition, cities include all district capitals, the smallest of which might be considered large towns. In addition, I have also verified that all of the results in the paper are robust to including a quadratic of the distance from the center of each subdistrict to the closest of the three major cities in East / Central Java – Surabaya, Semarang, or Surakarta / Yogya – to further capture differences in distance to the major cities within the district.

[9] Controlling instead for a flexible spline of elevation to capture non-linear effects of elevation produces similar results.

Table 3 examines whether, once district fixed effects are removed and elevation and other geographic characteristics are controlled for, the number of television channels appears unrelated to other, presumably exogenous, village characteristics. Specifically, I report the results of the following OLS regression:

$$NUMCHANNELS_{sd} = \alpha_d + X_{vsd}\delta_1 + \delta_2 GEOGRAPHY_{vsd} + \varepsilon_{vsd} \quad (1)$$

where *v* represents a village, *s* a subdistrict, and *d* represents a district. NUMCHANNELS is the average number of channels reported by all TV-owning households (except those who also own a satellite dish) surveyed in the subdistrict, α_d are district fixed effects, $GEOGRAPHY_{vsd}$ are the geographic variables described above (elevation, direction of slope, distance and travel time to nearest city, and coastal dummy) , and X_{vsd} is a set of other village characteristics – log adult population, the log number of hamlets in the village, the mean years of education of adults in the village, ethnic and religious fragmentation, the population share in agriculture, and the village poverty rate. Standard errors are adjusted for clustering at the subdistrict level.

The first column of Table 3 shows that, after controlling for district fixed effects, the number of channels received appears negatively correlated with three of the fourteen variables considered: the number of hamlets in the village, the population share in agriculture, and average education levels. The p-value from a joint test of all fourteen village characteristics listed in the regression is 0.09, and the p-value on a joint test of the seven non-geographic village controls is 0.04. As shown in columns (2) and (3), however, these correlations are largely driven by a few outliers on the television reception variables. In column (2), I drop the highest and lowest subdistrict in terms of TV reception (after having removed district means) – i.e., I drop 2 subdistricts out of 155 in the sample.[10] In column (3), I further drop the highest and lowest 2.5%

[10] These two subdistricts really are outliers -- the lowest subdistrict in terms of number of channels received is 3.5 standard deviations below the mean, whereas the second-lowest subdistrict is only 2.6 standard deviations below the

of subdistricts in terms of television reception, which increases the P-value on the joint F-test of all fourteen variables to 0.24 and the P-value on the joint F-test on the seven non-geographic variables to 0.23.

For the remainder of the paper, to be conservative I restrict the analysis to this third sample (i.e., the sample in column (3) of Table 3), where the variation in television reception within districts appears approximately balanced with respect to geographic variables and village characteristics. Furthermore, in all subsequent specifications I include all of these geographic variables and village characteristics as control variables. I have verified, however, that the results in the paper are similar if I use the less restrictive sample (i.e., the sample in column (1) of Table 3), or if I omit the geographic and village control variables from the specifications below.

3.2. Identifying the role of topography directly

Although I have argued that the residual variation in television reception must be due to geographic idiosyncrasies, I have not yet provided direct evidence that this is the case. In this section, I use a physical model of electromagnetic signal propagation, combined with data on the locations of television transmitters and the topography of East and Central Java, to specifically isolate that part of television reception that is due to the topography between villages and television transmission locations.

In the absence of mountains, air, or other factors, the strength of electromagnetic signals declines proportionally with the inverse square of the distance between the transmitting and receiving location. In practice, the decay rates of television and radio signals are a much more complex function of the mountains that block signals, diffraction caused by the air, and the curvature of the earth. As shown in Figure 2 (reproduced from Ellington et al. 1980), the

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mean. Similarly, the highest subdistrict is 3.9 standard deviations above the mean, whereas the next highest subdistrict is only 2.4 standard deviations above the mean.

strongest signals are received in areas with direct lines of sight to the transmitter. If mountains block sight lines, signals can diffract around the mountains to some extent, but they will be less powerful than if the receiver had a direct line of sight. The degree to which this diffraction takes place, and thus the strength of the signals that can be received behind mountains, depends on the frequency of the signal (higher frequencies diffract less). As illustrated in the right section of Figure 2, in the presence of multiple mountain peaks these diffraction patterns can become quite complex.

To calculate the impact of topography on actual transmission patterns, I use the Irregular Terrain Model (Hufford 2002), a modified version of the Longley-Rice model of electromagnetic propagation over the Earth's surface (Longley and Rice, 1968). The model takes as inputs the geographic location and height of the transmitting and receiving antennas, as well as the frequency of transmission and several characteristics about the surface and air. The model uses GIS software, combined with elevation data from the Shuttle Radar Topography Mission (NASA 2005), to look up the topography between the transmission and reception points. I also obtained the geographic coordinates of each village in the sample, as well as of each television transmitter.[11] For each village - television station pair, I use the ITM model to calculate the actual signal loss between the village and each of that television station's transmitters throughout East and Central Java. I then subtract the signal loss from the television station's transmission power to obtain, for each village-transmitter pair, the predicted signal power a receiver would get. For each village-channel pair, I take the maximum of these predicted signal powers in that

[11] I take the center of the village as the geographic coordinate of the village. For the transmitters, when the specific mountain or location of the transmitter was specified, I used that location; if not, I use the coordinate of the center of the village where the transmitter was located. When heights or signal powers of transmitting towers were missing, I used the values from similar-sized stations located in similar areas.

village across all transmission towers as the “predicted signal strength” of that channel in that particular village.

This “predicted signal strength” captures both the effects of topography as well as the facts that some villages are simply closer to transmission locations than others. To isolate the effect of topography, I do an analogous exercise, also using the ITM model, to get the “predicted free-space signal strength” for each channel in each village, i.e., the signal strength that would have obtained in that village if there was a direct line of sight between the transmitter and the receiver. By controlling flexibly for the “predicted free-space signal strength” of each channel, I can isolate the variation in signal strength that is due only to topographical idiosyncrasies and the curvature of the earth.

To examine whether the model of signal transmission accurately predicts television reception, Figure 3 shows the relationship between predicted signal strength and actual reception. For each channel, I plot the results of a Fan (1992) non-parametric locally-weighted regression, where the dependent variable is whether the respondent reports that they can receive a particular channel and the independent variable is the predicted signal strength (labeled “Power” in the Figure). To parallel the construction of the number of channels variable above, the sample is limited to those households who own a television. The dashed lines indicate bootstrapped 95% confidence intervals, where the bootstrap resampling is conducted at the subdistrict level to account for clustering at the subdistrict level. Figure 3 shows a strong, positive relationship between predicted signal strength and the number of households who report being able to receive the channel. This upward sloping relationship appears for all channels except RCTI and Indosiar, and suggests that with the exception of these two channels (which have nearly universal coverage anyway), the signal strength data does, in fact, strongly predict actual television reception.[12]

Given that the model accurately predicts television reception, the next question is whether there is significant statistical power to identify the residual impact of television using only the variation in signal strength caused by topography. To investigate this, I estimate the following model:

$$NUMCHANNELS_{sd} = \alpha_d + \sum_i \left(\beta_{1i} SIGNAL_{vsdi} + \beta_{2i} SIGNAL_{vsdi}^2 + \beta_{3i} FREE_{vsdi} + \beta_{4i} FREE_{vsdi}^2 \right) + X_{vsd}\delta_1 + \delta_2 GEOGRAPHY_{vsd} + \varepsilon_{vsd} \quad (2)$$

where *i* represents a channel, SIGNAL represents the predicted signal strength of channel *i* in village *v*, and FREE represents the predicted free-space signal strength of channel *i* in village *v* (i.e. what the signal strength would have been if there was a direct line of sight between the transmitter and receiver). I include the square of the signal strength variables to capture the potential non-linear effects visible in Figure 3. As in equation (1), I cluster the standard errors by subdistrict. In all specifications, I continue to include district fixed effects and all of the geographic controls and village characteristics used in Table 3 above. Since the television stations are positioned primarily to capture the major media markets in the cities, once I control for the free space loss and village elevation, which rural villages receive reception is driven largely by the happenstance of topography. The coefficients on SIGNAL and $SIGNAL^2$ in equation (2) capture precisely this effect.

If I estimate equation (2) without the FREE variables and without district fixed effects, the F-statistic on a joint test of the SIGNAL and $SIGNAL^2$ variables is 14.08 (p-value < 0.001),

[12] An interesting question is why the data for RCTI and Indosiar does not follow this pattern. Indeed, given the transmitter locations and power data reported to the Indonesian Department of Information and Communications, one would not predict nearly as broad coverage as these stations appear to have. One possibility is that these stations have extra transmitters not reported to the government, or operate their transmitters at a higher-than-approved power level, though I have no direct evidence that this is the case.

which confirms that the ITM model is doing an accurate job predicting television reception. If I add district fixed effects and the additional FREE variables to isolate the variation coming from geography, the F-statistic on a joint test of the SIGNAL and $SIGNAL^2$ variables is 2.96 (p-value < 0.001).[13] This lower F-statistic is not surprising given that, as shown in Table 2, district fixed effects alone capture 75% of the variation in television reception.[14]

There are advantages and disadvantages to using only the variation from the ITM model to analyze the impact of television reception. The advantage of this approach is that it allows me to precisely identify the exact source of the variation in television reception I am using. It also may potentially help correct for measurement error in the number of channels variable. The disadvantage of this approach is that it discards other potentially valid variation in reception that is not captured in the ITM model. For example, reflections off buildings and air quality affect television transmission, and these factors are not captured in the ITM model. Furthermore, the information on transmitter locations and signal strength provided by the Indonesian Department of Information and Communications may not be entirely accurate, making the instrument less than a perfect predictor of reception. Given all these factors, in the remainder of the paper, I report two sets of results – one set of results using the full residual variation in number of channels received (as in Section 3.1), and one set of that isolate the effect of topography by using SIGNAL and $SIGNAL^2$ as instruments for the number of channels received, controlling for

[13] These F-statistics are conservative, in the sense that I have chosen the level of clustering that produces the smallest F-statistics. If I cluster at the district level, an even higher level of aggregation (with 30 districts as opposed to 155 subdistricts), the F-statistic on the SIGNAL variables in the regression with district fixed effects and controls for FREE and $FREE^2$ is substantially higher, at 14.52 instead of 2.96.

[14] However, they do raise potential concerns about weak instruments (although weak instruments tends to bias the results *towards* the OLS results, whereas the IV results below tend to be substantially larger than the OLS results, suggesting that weak instruments is not a major problem). Of course, as discussed in footnote 13, the reported F-statistics are quite conservative, and if I use district level clustering the implied first-stage F-statistics are more than sufficient for IV analysis.

FREE and $FREE^2$. I focus my discussion on the results using the full residual variation, viewing the second set of results as a useful complement.

3.3. Impact on Media Use and Ownership

Having explored the determinants of reception, the next question is whether better television reception is associated with more time spent watching TV and listening to radio. I focus on the total number of minutes spent watching TV and listening to radio, since villages that receive better television reception may also receive better radio reception.[15] I estimate the following OLS regression:

$$\text{MINUTES}_{hvsd} = \alpha_d + \beta\ \text{NUMCHANNELS}_{sd} + \text{Y}_{hvsd}\ \gamma + \text{X}_{vsd}\ \delta + \varepsilon_{hvsd} \qquad (3)$$

where *h* represents a household, MINUTES is the number of minutes per day spent watching television and listening to radio, Y is a vector of household controls (gender, predicted per-capita expenditure, and whether household has electricity), X is the vector of village controls used in Table 3 (including the geographic controls), and α_d are district fixed effects.[16] Note that while I include all of the village level covariates in Table 3 in all regressions, the results are similar if they are not included. I estimate this regression via OLS at the household level, and adjust the standard errors for clustering at the subdistrict level.

The results, using the full residual variation in reception, are presented in column (1) of Panel A of Table 4. They show that each additional television channel that people in the subdistrict can receive is associated with an extra 11 minutes per day spent watching television

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[15] I do not have independent data on how many radio channels the households receive, so it is not possible with the data to separately identify their effects; even if I did have data on radio reception, the two types of signals are likely to be collinear in any case.

[16] Note that one of the household controls is per-capita expenditure. This is not actual expenditure (which was not measured), but rather predicted per-capita expenditure, where the prediction is based on the household's assets. (See Olken 2006 for more details on predicting expenditure from assets in this context.) In the version of predicted per-capita expenditure I use in this paper, I do not include ownership of television, radio, or satellite dish in the expenditure prediction equation. Note also that for all household-level equations, the 'number of TV-channels' variable is an average of all households in the subdistrict *except* the household in question, to avoid mechanical biases that this might introduce.

and listening to radio, about a 6 percent increase from the mean level. In columns (2) and (3), I re-estimate equation (3) separately for minutes per day spent watching TV and for minutes per day spent listening to radio. The results suggest each additional channel of television that can be received leads to an additional 5 minutes of television watching per day and an additional 6 minutes of radio listening per day.[17] As discussed above, the positive effect on radio is not surprising, given that radio and television signal reception are likely highly correlated. Since I cannot separately identify the impact of reception on television and radio, for the remainder of the paper, I therefore interpret the effect of television reception as the total effect of greater media exposure – i.e., the extra 11 minutes that a respondent spends each day watching television and listening to radio.

In Panel B of Table 4, I present the results using the television transmission model to isolate the impact of topography. Specifically, I re-estimate (3), adding $FREE_{vsdi}$ and $FREE^2_{vsdi}$ as control variables (to control for loss in signal strength that would have occurred had there been a direct line of sight between transmission towers and receivers) and using $SIGNAL_{vsdi}$ and $SIGNAL^2_{vsdi}$ as instruments for NUMCHANNELS. The results are broadly consistent with the results in Panel A, with larger but less precisely estimated coefficients. In particular, the Panel B results show that each additional television channels is associated with a statistically significant 27 minutes of additional television watching per day, as opposed to the 11 minutes per day in Panel A. This increase in coefficients is consistent with the presence of measurement error in the number of channels received variable. The Panel B results also suggest that about two-thirds of

[17] Note that the sample includes all households, including those that do not own televisions, because television ownership is potentially endogenous and also because many people who not own televisions watch television at friends' or relatives' houses and still may listen to radio. In practice, however, I find that the effect of additional channels on television watching comes almost entirely from those households that own a television (results not reported).

this increase is due to increases in time spent listening to radio, as opposed to just over one-half estimated in Panel A.

A natural question is whether better quality television reception leads to a change on the extensive margin of television ownership. In column (4), I estimate the same equation, where the dependent variable is whether the household owns a television. To simplify interpretation of coefficients with binary dependent variables, throughout the paper I report results from linear probability and linear IV models; results are qualitatively similar with Probit and IV Probit models except where explicitly noted. Column (4) shows no effect of television reception on television ownership, which suggests that the impact of more channels is only on the intensive margin of television watching, rather than the extensive margin of television ownership.

If over-the-air television reception is poor, wealthy households can use an alternate, much more expensive technology – satellite dishes. These are quite rare in rural Java – only 2.1 percent of the sample owns a satellite dish – so they are unlikely to substantially mitigate the overall effect of poor television reception on the village. However, if the television reception variable really is capturing the quality of over-the-air television, we would expect that households where over-the-air television reception is better would be less likely to purchase satellite dishes. Column (5) of Panel A shows that this is, indeed, the case – each additional channel of television reception is associated with a 0.9 percentage point decline in the likelihood of owning a satellite dish. Somewhat puzzlingly, however, Panel B gives the opposite sign, though it is not statistically significant.

4. Impacts on Social Capital

4.1. Participation in Social Groups

The first measure of social capital I examine in this paper is participation in social groups. This was the primary measure used by Putnam (1993), and it has in many ways become the canonical measure of social capital in the literature. Overall, as discussed above, a typical village with 2,600 adults has 179 groups of various types, and a typical adult participates in about 1 meeting each week.

Table 5 investigates the impact of better television reception on the number of social groups and the frequency with which they meet. As in Table 4, I present both results using the full residual variation in number of channels received (Panel A), and results that use the television transmission model to explicitly isolate the effect of topography (Panel B).

In Panel A I estimate the following equation via OLS:

$$LOGGROUPS_{vsd} = \alpha_d + \beta\ NUMCHANNELS_{sd} + X_{vsd}\ \delta + \varepsilon_{vsd} \qquad (4)$$

Column (1) of Panel A of Table 5 shows the results, where the dependent variable, LOGGROUPS, is the log of the total number of social groups in the village. I estimate this regression in logs, controlling for the log adult population and log number of hamlets, to allow the baseline number of groups in the village to vary flexibly with the size and structure of the village. The regression includes district fixed effects and the same set of village-level controls used in Table 3 above, and clusters standard errors by subdistrict. The results suggest that adding an extra channel of television – or about one standard deviation on the de-meaned television variable – is associated with 6.9 percent fewer groups existing in the village. As with the previous analysis of media use in Table 4, the results in Panel B using the ITM model show larger effects, which though less precisely estimated are still statistically significant.

An alternative measure of participation considers not just the number of groups, but the frequency with which they meet and the number of people that attend each meeting. This represents the intensity of social interactions in the village. To examine this, Column (2) of Table 5 presents the results from re-estimating equation (4) where the dependent variable is the log of the total number of times each adult in the village attended a group meeting in the last 3 months. The results show that each extra television channel is associated with 12 percent lower attendance at meetings per person over a 3 month period. Once again, the point estimates in Panel B are somewhat larger, though given the increased size of the standard errors they are no longer statistically significant.

To gauge these magnitudes, it is useful to compare these estimates with the estimated impact of television reception on media usage reported in Table 4. In Panel A of Table 4, we saw that each additional channel was also associated with about 11 minutes of additional time spent watching television and listening to radio per day. Combined, this adds up to about 16.5 hours of additional time spent watching television and listening to radio over a 3 month period. If we assume that each group meeting takes an average of 2 hours, the comparable estimates in Panel A of Table 5 suggest that each additional channel was associated with about 2.6 fewer hours spent at meetings over a 3 month period.[18] Combined, these two estimates suggest that each hour spent watching television or listening to radio results in a reduction of about 0.16 hours participating in social activities.[19] Doing the analogous exercise using the coefficients from Panel B of both tables yields a somewhat smaller estimate – each hour spent watching television or listening to radio results in a reduction of about 0.08 hours participating in social activities. These relative magnitudes need to be interpreted with caution, however, as there are other channels through which television and radio exposure could affect participation in social groups besides the pure effect of fewer minutes spent watching television and listening to radio.[20]

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[18] To see this, note that a typical village adult attends 11 meetings over a 3 month period, and each additional channel of television reduces this by 12 percent. So 11 meetings * 2 hours / meeting * -.12 change = -2.64 hours in meetings per 3 months.

[19] Since the total time budget does not change, it would be interesting to know what other activities are crowded out. Unfortunately, since the data do not contain complete time diaries, this question cannot be answered using this data.

[20] For example, the results in Section 4.2 below show that additional television and radio exposure is associated with less trust in the village, which could in turn influence social participation. Given this potential issue, I focus

To investigate whether there is a differential impact of media exposure on different types of groups and organizations, I re-estimate equation (4), splitting the dependent variable separately by non-religious and religious groups. On average religious groups make up only 21 percent of the number of groups in the village, but represent 41 percent of attendance at group meetings. This is because these religious groups, which tend to be various types of Koran and religious study groups, meet quite frequently. The results, presented in Table 6, show substantial, robust declines in both the number non-religious groups and the frequency of participation in such groups. In results not presented in the table, I further decompose these non-religious groups, and find that the largest single effect is coming from groups associated with local village government, which consists of volunteer labor for public goods maintenance (called *gotong royong* in Indonesian), neighborhood associations, and school committees. Other types of groups also show declines; only health and women's groups to not seem to be affected.[21] For religious groups, the evidence is more mixed, with the results showing smaller, and generally not statistically significant, declines.

Finally, as shown in the last two columns, there appears to be a decline in rotating savings and credit mechanisms (ROSCAs), a very common form of small scale savings mechanism in developing countries (Besley, Coate, and Loury 1993). Many groups in Java involve a ROSCA as part of their regular meetings. Overall, the number of groups that include a ROSCA as part of their regular meetings declines by 17-28 percent with each additional television channel in the village, and participation in such groups declines by 20-24 percent with

primarily on the reduced form effect of additional television and radio exposure on social participation, rather than the implied Wald estimate of participation in social groups on the number of minutes spent watching television and listening to radio.

[21] One reason women's groups may show a smaller effect is that women's media consumption is less elastic with respect to the number of channels available; re-estimating equation (3) interacting the number of channels with gender shows that women watch television and listen to radio only about 6 additional minutes per day for each additional channel they can receive, as compared to 10 minutes per day for men (results not reported).

each additional channel. Moreover, in results not reported in the table, I find that the average amount contributed to a ROSCA at each meeting (conditional on a meeting taking place) does not change with additional channels, so the decline in ROSCA groups represents a net decline in total ROSCA contributions in the village. Since ROSCAs are a potentially important savings mechanism for villagers, this suggests that the decline in social capital may have productive costs as well.

Thus far, I have only examined participation in organized social groups. However, television and radio may be associated with substitution from participation in organized social groups to more informal gatherings at houses of friends. For example, one might imagine that people would gather at the home of a friend to watch television. To investigate this, I use data from the household survey, in which respondents were asked to report on social visits to and from friends and neighbors over the past week. In results not reported in the table, I find that, if anything, these reported social visits also seem to decrease in areas with better television reception, although the results are not statistically significant. This suggests that the reduction in participation in social organizations represents a net decline in social capital, rather than merely a substitution from one form to another.

4.2. Trust

In addition to participation in social groups, the literature on social capital has also focused on a second measure of social capital – trust. Both theory and evidence from other settings suggests that participation in social groups and trust are related, as social networks of the form created by social groups provide a mechanism to enforce agreements among network members (Kandori 1992, Greif 1993, Mobius and Szeidl 2006, Karlan forthcoming).

Much of the empirical work on the impact of trust, such as Knack and Keefer (1997) and La Porta et al. (1997), measures trust through the trust question from the General Social Survey and World Values Survey, which asks: “Generally speaking, would you say that most people can be trusted, or that you can’t be too careful in dealing with people?” Glaeser et al. (2000) and Karlan (2005) show that the answers to this self-reported trust question predict real economic activity; in particular, they are correlated with trustworthy play in the trust game and with repayment rates for microcredit.

I therefore examine whether increased media exposure affects answers to this self-reported trust question. In addition to asking the question for ‘people in general,’ the household survey also asked the same trust question about a variety of other groups, including people from the same neighborhood, from the same village, the government, the President of Indonesia, and so on. I define the TRUST variable as a dummy equal to 1 if the respondents say that they would generally trust a person, and 0 if they say that you can’t be too careful in dealing with people. I then re-estimate equation (3), using the individual responses to the TRUST question as the dependent variable.

The results are presented in Table 7. The results in Panel A of Table 7 show that increased media exposure is associated with declines of about 4 percentage points – or 16 percent from the mean level – in the percent of respondents responding affirmatively to the trust question. Interestingly, the responses appear similar – declines of 2-5 percentage points – when more specific trust questions are asked about the respondents’ willingness to trust other groups, even though the means of the trust variables vary quite considerably, from a low of 26% trusting ‘people in general’ to a high of 72% trusting the village head. The groups which see the smallest decline in being trusted is ‘people who live in your neighborhood,’ which declines by a statistically insignificant 1.7 percentage points, and surprisingly, the President of Indonesia, which declines by a statistically insignificant 1.3 percentage points. The results in Panel B are qualitatively similar and larger in magnitude, as with the results presented in previous tables. Interestingly, the fact that the change in trust levels is essentially irrespective of *who* the respondent is being asked to trust is consistent with the findings of Glaeser et al. (2000) and Karlan (2005) that the trust question measures the respondent's own trustworthiness, rather than the degree to which the respondent trusts others, although this does not explain the differences in means between these variables.

The fact that the two different measures of social capital I examine – trust and participation – both show similar effects provides confirmatory evidence for the effect of television and radio. Moreover, the fact that there is an effect on trust suggests that the impact of television and radio on social capital are not due only to the mechanical effects of a time budget constraint – television and radio exposure appears to change attitudes as well.

5. Governance

The previous sections showed a clear relationship between exposure to television and radio and social capital, whether measured by participation in social groups or as measured by trust. This section explores the second half of the social capital equation – the suggestion by Putnam (1993) and others that lower social capital is associated with worse governance. In particular, I focus on governance surrounding the road projects that were being built in the villages at the time the data was collected.[22] I examine three measures of governance in the projects – attendance at village level meetings that planned and monitored construction, the quality of discussion at those meetings, and ultimately the percentage of funds used in the project that could not be accounted for by an independent engineering team. For each of these measures,

[22] Another natural variable to examine would be voter turnout, as in Gentzkow (2006). However, turnout in Indonesia is so high (in part as a holdover from the Soeharto era, when voting was effectively compulsory) that there is almost no variation in this variable. In fact, in my sample 99% of respondents reported voting in the most recent national parliamentary elections.

I examine whether or not increased television reception, which we have seen is associated with lower levels of social capital in the village, is associated with worse outcomes.

An important question, of course, is the validity of the implicit exclusion restriction that television and radio reception affects governance *only* through the channel of its effects on social capital. At higher levels of government, this is unlikely to be the case, as the media may have a direct effect on governance beyond the effect on social capital discussed here. For example, increasing the population's access to news reports may provide incentives for politicians to change their behavior (e.g., Stromberg 2004). For the level of governance examined here – village level road construction projects – this direct effect is unlikely to be present, as television and radio news reports are largely national in scope and extremely unlikely to cover village events. Nevertheless, it is possible television may have other effects on governance besides those through the social capital channels. As a result, while the reduced form estimates of the impact of television and radio media exposure on governance are well identified, interpreting the results in this section as identifying the causal effect of social capital on governance is more speculative.

As discussed above, survey enumerators attended four meetings in each village associated with the road project – one meeting at which the road project was planned, and three meetings at which the village had to approve of how the village had spent the funds on the road project. These meetings were open to the public, and attendance at these meetings was observed directly by the project enumerator, who circulated an attendance list and noted who on the list spoke during the meeting.[23] To estimate the impact of media exposure on attendance at the

[23] As described in Olken (2005), experiments were conducted in which additional invitations to these meetings were distributed in some villages, and in other villages anonymous comment forms were distributed along with these villages. These treatments were randomly assigned within subdistricts, so their presence will be orthogonal to the number of television channels received and other pre-determined village characteristics. Nevertheless, in Table 8 I control for dummies for the experimental treatments interacted with which type of meeting it was, and in Table 9 below I control for dummies for the different treatment groups. I also control for whether a subdistrict was randomly assigned to receive external audits of the road project.

meetings, I re-estimate a version of equation (4), where each observation is a village meeting. I include dummies for which type of meeting it was, interacted with the experimental treatments discussed above.

The results are presented in Table 8. The results, in both panels of Table 8, suggest that each additional television channel is associated with a decline of about 5 percent in the number of people attending a meeting, though the Panel B estimate is essentially 0 in this case. This 5 percent estimate is slightly smaller, but of the same order of magnitude, as the declines in attendance at other types of group meetings discussed above. I classify all those who attend as either 'insiders' (members of the village government, the project implementation team, or other types of informal leaders in the village) or 'outsiders' (everyone else). Somewhat surprisingly, the lower attendance associated with media exposure appears more pronounced among insiders than among outsiders, with the Panel B results actually showing increases in outsider attendance. One possible explanation, consistent with the earlier findings, is that there are simply fewer 'insiders' in total in villages with greater media exposure, as some people spend more time watching television and listening to radio instead of becoming deeply involved in village government.

Second, I investigate whether television and radio has an effect on the quality of the discussion at the meetings. In column (4), I show that even though there are fewer people attending the meetings, there is no statistically significant reduction in the number of people who talk at the meetings. In columns (5), (6), and (7), I further examine alternative measures of the quality of the discussion at the meetings. Column (5) examines the number of problems or issues that were discussed at the accountability meetings.[24] The point estimate in Panel A suggests that

[24] A "problem" was defined as the topic of any substantial discussion other than the routine business of the meeting; the median problem reported in the data was discussed for 7 minutes.

villages with more media exposure have slightly less discussion at meetings, with fewer problems or issues being raised, although this effect is not statistically significant and the effect does not appear at all in Panel B. Column (6) focuses on whether any corruption-related problems were discussed, and finds no effect of media exposure.[25] Similarly, Column (7) finds that there is no effect on the probability of a serious response being taken to resolve a problem at a meeting.[26] Overall, these results suggest that while television and radio exposure affected the quantity of participation in the meetings, it did not measurably affect the quality of discussion at the meetings.

The third measure of governance I examine in 'missing expenditures' from the road project. As discussed in Section 2.3 above, 'missing expenditures' is the difference in logs between what the village claimed the road cost to build and what an independent team of engineers estimated it cost to build. The coefficients are therefore interpretable as percentage point changes in the share of expenditures that could not be accounted for by the independent engineering estimate.

The results from estimating equation (4) with missing expenditures as the dependent variable are presented in Table 9. As in Table 8, in addition to district fixed effects and a set of village level controls, this specification also includes dummy variables for the experimental treatments (audits, invitations, and comment forms). I examine four versions of the missing expenditure variable – missing expenditures in the road project, missing expenditures in the road project and the ancillary projects that accompanied it (including culverts, retaining walls, etc),

[25] The enumerator recorded each problem or issue that was discussed at the meeting, and coded whether the problem was potentially corruption-related or not.

[26] "Serious response" is defined as agreeing to replace a supplier or village office, agreeing that money should be returned, agreeing for an internal village investigation, asking for help from district project officials, or requesting an external audit. Although the probability of these actions being taken is low overall, Olken (2005) reports that the experimental intervention of introducing anonymous comment forms led to a statistically significant increase in these actions being taken.

the discrepancy in prices in the road project (i.e. the difference between the unit prices reported by the village and the unit prices the surveyors found in their independent price survey), and the discrepancy in quantities in the road project (i.e. the difference between the quantity of materials reported by the village and those measured by the engineers).

The results in both panels of Table 9 show no relationship between television reception and missing expenditures. In fact, in three of the four specifications, the coefficient is actually negative (and in one case statistically significantly so) – i.e., more television reception, and hence lower social capital, is associated with *fewer* missing expenditures, rather than more. This is inconsistent with the cross-country evidence, which tends to show a negative correlation between average levels of trust and social participation and corruption (La Porta et al. 1997, Bjornskov 2004), though as discussed above, considerable caution is needed when interpreting the reduced form results on the impact of television reception on corruption as being about the effect of changes in social capital. These results are, however, consistent with the experimental evidence presented in Olken (2005), which showed that increasing participation in the monitoring meetings through an experimental intervention also had no statistically significant impact on missing expenditures from the road project.

6. Conclusion

In this paper, I use variation in the number of television channels households can receive due to the topographical features of rural Java to explore the relationship between television and radio and social capital. I show that this variation in television reception appears to be plausibly exogenous with respect to the variables of interest here, and that villagers in areas with better reception are likely to watch more television and spend more time listening to the radio. On average, each additional channel of television reception is associated with 11 additional minutes per day spent watching television and listening to the radio.

I find a substantial impact of better television reception on participation in social groups. On average, the main results suggest that each additional channel of television reception is associated with 7 percent fewer social groups existing in the village, and with each adult in the village attending 12 percent fewer group meetings. These estimates imply about 0.16 fewer hours spent in social activities for each hour spent watching television or listening to radio. I find particularly strong effects of reception on community development activities, neighborhood associations, and informal savings associations. I also find that greater television reception is associated with lower levels of participation in village development meetings, and with lower levels of self-reported trust.

I then examine the relationship between television and radio exposure and governance. Despite the impact of better television on attendance at village meetings, I find no impact on what happens at the meetings. I also find no relationship at all between television reception and 'missing expenditures' in the road project. Together, these results suggest that to the extent that television reception leads to plausibly exogenous variation in social capital, this does not translate into worse governance outcomes, at least as measured here.

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Table 1: Organizational Structure of Indonesia

Name in English	Name in Indonesian	Average Population Per Geographic Unit in East Java and Central Java Provinces	Number of units in sampled villages
Province	Propinsi	32,500,000	2
District	Kabupaten	986,000	30
Subdistrict	Kecamatan	53,900	155
Village	Desa	4,380	606
Hamlet	Dusun	1,100	2,417
Block	Rukun Warga (RW)	624	4,255
Neighborhood	Rukun Tangga (RT)	162	16,375

Notes: To compute average population for province, district, and subdistrict, I use data from the 2003 PODES, restricted to East and Central Java. For district and subdistrict population, I exclude major cities. To compute average population for village, hamlet, block, and neighborhood, I use data collected from the village head in each village I surveyed.

Table 2: Summary Statistics

Total number of channels received:		*Geographic variables*	
Average number of TV channels	5.067	Elevation (thousands of meters)	0.314
	(2.028)		(0.313)
Average number of TV channels	0	Distance to nearest city (km)	26.883
(after removing district FE)	(1.059)		(18.778)
		Travel time to nearest city (hours)	1.072
Share of villages receiving channel:			(0.695)
TVRI (government run)	0.616	Coastal subdistrict dummy	0.133
	(0.341)		(0.340)
RCTI (major network)	0.908		
	(0.163)	*Village characteristics*	
SCTV (major network)	0.751	Number of Social Groups	178.963
	(0.324)		(135.324)
Indosiar (major network)	0.916	Attendance at Group Meetings Per Adult	10.852
	(0.172)	(total attendance per adult in last 3 mths)	(11.112)
Metro TV (news station)	0.327	Adult population (thousands)	2.668
	(0.350)		(1.616)
ANTV	0.331	Number hamlets	3.988
	(0.379)		(2.005)
TV 7	0.306	Mean years of adult education	4.882
	(0.378)		(1.290)
Trans TV	0.391	Ethnic fragmentation	0.028
	(0.401)		(0.078)
TPI	0.520	Religious fragmentation	0.021
	(0.415)		(0.056)
		Population share in agriculture	0.670
TV and radio ownership:			(0.212)
TV ownership	0.694	Poverty rate	0.412
	(0.460)		(0.208)
Radio ownership	0.713		
	(0.452)	Number villages	606

Notes: Means of variable listed shown. Standard deviations in parentheses.

Table 3: Determinants of Number of TV Channels

	(1)	(2)	(3)
Geographic variables			
Elevation (thousands of meters)	0.100	-0.328	-0.323
	(0.356)	(0.277)	(0.254)
Distance to nearest city (km)	-0.002	-0.007	-0.007
	(0.006)	(0.005)	(0.005)
Travel time to nearest city (hours)	-0.006	-0.024	0.049
	(0.100)	(0.093)	(0.080)
Coastal subdistrict dummy	0.547	0.153	0.161
	(0.347)	(0.248)	(0.255)
North-facing subdistrict dummy	0.045	-0.081	-0.025
	(0.258)	(0.252)	(0.244)
East-facing subdistrict dummy	0.041	-0.205	-0.029
	(0.375)	(0.317)	(0.303)
South-facing subdistrict dummy	-0.201	-0.107	-0.075
	(0.297)	(0.243)	(0.205)
Other village characteristics			
Log adult population	0.118	-0.010	-0.015
	(0.144)	(0.121)	(0.110)
Log number hamlets	-0.340*	-0.070	-0.038
	(0.187)	(0.135)	(0.104)
Mean years of adult education	-0.130**	-0.125***	-0.082*
	(0.051)	(0.048)	(0.042)
Ethnic fragmentation	-0.977	-0.833	-1.064*
	(0.598)	(0.568)	(0.583)
Religious fragmentation	-2.515	-0.266	-0.542
	(1.620)	(0.802)	(0.803)
Population share in agriculture	-0.736**	-0.552*	-0.458*
	(0.361)	(0.299)	(0.271)
Poverty Rate	-0.016	0.023	-0.073
	(0.219)	(0.207)	(0.194)
District fixed effects	YES	YES	YES
Sample	All	Drop highest and lowest subdistrict	Drop highest 2.5% and lowest 2.5% subdistricts
Observations	595	587	566
R-squared	0.75	0.81	0.86
P-value from joint F-test of all listed variables	0.09	0.15	0.24
P-value from joint F-test of other village controls (i.e., excluding geography variables)	0.04	0.13	0.23
Mean dep. Var	5.08	5.08	5.06

Notes: Robust standard errors in parentheses, adjusted for clustering at subdistrict level. Dependent variable is average number of television channels households in the subdistrict can receive. All specifications include district fixed effects. Each observation is a village.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4: Media Usage and Ownership

	(1)	(2)	(3)	(4)	(5)
	Total minutes per day	TV minutes per day	Radio minutes per day	Own TV	Own Satellite Dish
Panel A: Full residual variation					
Number of TV channels	10.567**	4.586*	5.673**	-0.007	-0.009***
	(4.259)	(2.548)	(2.519)	(0.009)	(0.003)
Observations	4087	4124	4095	4139	4120
R-squared	0.13	0.11	0.08	0.15	0.04
Mean dep. Var	178.63	123.77	55.10	0.70	0.02
Panel B: Isolating effect of topography					
Number of TV channels	27.263***	8.974	17.518***	0.016	0.019
	(8.151)	(5.799)	(4.578)	(0.030)	(0.012)
Observations	4087	4124	4095	4139	4120
R-squared	0.13	0.13	0.08	0.15	0.03
Mean dep. Var	178.63	123.77	55.10	0.70	0.02

Notes: Each observation is a household. Robust standard errors in parentheses, adjusted for clustering at subdistrict level. The dependent variable for each column is listed in the column heading. All specifications include district fixed effects, the geographic variables and other village characteristics from Table 3, the respondent's gender, predicted per-capita household expenditure, and a dummy for whether the household has electricity. In Panel A, number of TV channels is average number of television channels households in the subdistrict can receive, excluding the respondent's own answer. In Panel B, number of TV channels is the same as in Panel A, but instrumented with SIGNAL and $SIGNAL^2$ for each channel. Panel B also includes FREE and $FREE^2$ for each channel as control variables. Sample drops highest and lowest 2.5% of subdistricts in terms of number of channels, as in column (3) of Table 3; results are similar if entire sample is included.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5: Participation in Social Groups

	(1)	(3)
	Log Number of Groups	Log Attendance Per Adult at Group Meetings In Past Three Months
Panel A: Full residual variation		
Number of TV channels	-0.069**	-0.119**
	(0.028)	(0.058)
Observations	566	538
R-squared	0.73	0.50
Mean dep. Var	4.95	1.98
Panel B: Isolating effect of topography		
Number of TV channels	-0.195**	-0.144
	(0.084)	(0.131)
Observations	566	538
R-squared	0.74	0.53
Mean dep. Var	4.95	1.98

Notes: Each observation is a village. Robust standard errors in parentheses, adjusted for clustering at subdistrict level. The dependent variable for each column is listed in the column heading. All specifications include district fixed effects and the geographic variables and other village characteristics from Table 3. In Panel A, number of TV channels is average number of television channels households in the subdistrict can receive, excluding the respondent's own answer. In Panel B, number of TV channels is the same as in Panel A, but instrumented with SIGNAL and $SIGNAL^2$ for each channel. Panel B also includes FREE and $FREE^2$ for each channel as control variables. Sample drops highest and lowest 2.5% of subdistricts in terms of number of channels, as in column (3) of Table 3; results are similar if entire sample is included.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6: Impact on Different Types of Groups

	(1)	(2)	(3)	(4)	(5)	(6)
	Non-Religious Groups		Religious Groups		Groups with ROSCAs	
	Log Number Groups	Log Attendance	Log Number Groups	Log Attendance	Log Number Groups	Log Attendance
Panel A: Full residual variation						
Number of TV channels	-0.076***	-0.205***	-0.076	0.027	-0.165***	-0.205***
	(0.026)	(0.063)	(0.066)	(0.061)	(0.044)	(0.054)
Observations	566	536	561	498	539	514
R-squared	0.71	0.50	0.66	0.47	0.53	0.46
Mean dep. Var	4.71	1.28	3.13	1.14	2.20	0.77
Panel B: Isolating effect of topography						
Number of TV channels	-0.160*	-0.207	-0.394**	-0.127	-0.281**	-0.240
	(0.083)	(0.155)	(0.159)	(0.169)	(0.133)	(0.170)
Observations	566	536	561	498	539	514
R-squared	0.73	0.55	0.65	0.49	0.55	0.48
Mean dep. Var	4.71	1.28	3.13	1.14	2.20	0.77

Notes: See Notes to Table 5.

Table 7: Trust

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	People in general	People who live in your neighborhood	People who live in your village	The Government	The President of Indonesia	The village head	The village parliament
Panel A: Full residual variation							
Number of TV channels	-0.037**	-0.017	-0.054**	-0.024	-0.013	-0.035	-0.039
	(0.014)	(0.022)	(0.025)	(0.020)	(0.022)	(0.022)	(0.024)
Observations	4034	4110	4061	3618	3416	3979	3856
R-squared	0.26	0.13	0.21	0.15	0.14	0.14	0.17
Mean dep. Var	0.25	0.71	0.52	0.56	0.54	0.72	0.69
Panel B: Isolating effect of topography							
Number of TV channels	-0.118***	-0.098*	-0.202***	-0.101**	-0.079	-0.138***	-0.195***
	(0.037)	(0.053)	(0.062)	(0.047)	(0.050)	(0.052)	(0.052)
Observations	4034	4110	4061	3618	3416	3979	3856
R-squared	0.27	0.17	0.23	0.19	0.19	0.17	0.19
Mean dep. Var	0.25	0.71	0.52	0.56	0.54	0.72	0.69

Notes: See Notes to Table 4. The trust question asked is the same as that in the GSS and the World Values Survey: "In your opinion, can […] be trusted, or do you have to be careful in dealing with them?" where […] is the group of people listed in the column heading. The dependent variable is a dummy variable that takes 1 if the response was that they could be trusted, and 0 if you have to be careful in dealing with them.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 8: Attendance and discussion at village development meetings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Log attendance at meeting	Log attendance of 'insiders' at meeting	Log attendance of 'outsiders' at meeting	Log number of people who talk at meeting	Number of problems discussed	Any corruption-related problem	Any serious action taken
Panel A: Full residual variation							
Number of TV channels	-0.045**	-0.074***	-0.028	-0.001	-0.059	-0.004	-0.004
	(0.017)	(0.022)	(0.039)	(0.024)	(0.058)	(0.009)	(0.004)
Observations	2204	2197	2062	2131	1651	1651	1651
Mean dep. Var	3.75	2.76	2.72	2.06	1.16	0.06	0.02
Panel B: Isolating effect of topography							
Number of TV channels	-0.005	-0.127**	0.258**	-0.066	0.074	0.017	0.003
	(0.049)	(0.062)	(0.130)	(0.063)	(0.150)	(0.036)	(0.013)
Observations	2204	2197	2062	2131	1651	1651	1651
Mean dep. Var	3.75	2.76	2.72	2.06	1.16	0.06	0.02

Notes: Each observation represents one meeting. Columns (1) – (4) include both the planning meeting and the three accountability meetings; columns (5) – (7) include only the accountability meetings. The dependent variable for each column is listed in the column heading. All regressions are estimated with linear probability models with kabupaten fixed effects, as well as fixed effects for meeting type interacted with experimental treatment. Robust standard errors in parentheses, adjusted for clustering at subdistrict level. All specifications include district fixed effects and the geographic variables and other village characteristics from Table 3. In Panel A, number of TV channels is average number of television channels households in the subdistrict can receive, excluding the respondent's own answer. In Panel B, number of TV channels is the same as in Panel A, but instrumented with SIGNAL and $SIGNAL^2$ for each channel. Panel B also includes FREE and $FREE^2$ for each channel as control variables. Sample drops highest and lowest 2.5% of subdistricts in terms of number of channels, as in column (3) of Table 3; results are similar if entire sample is included.

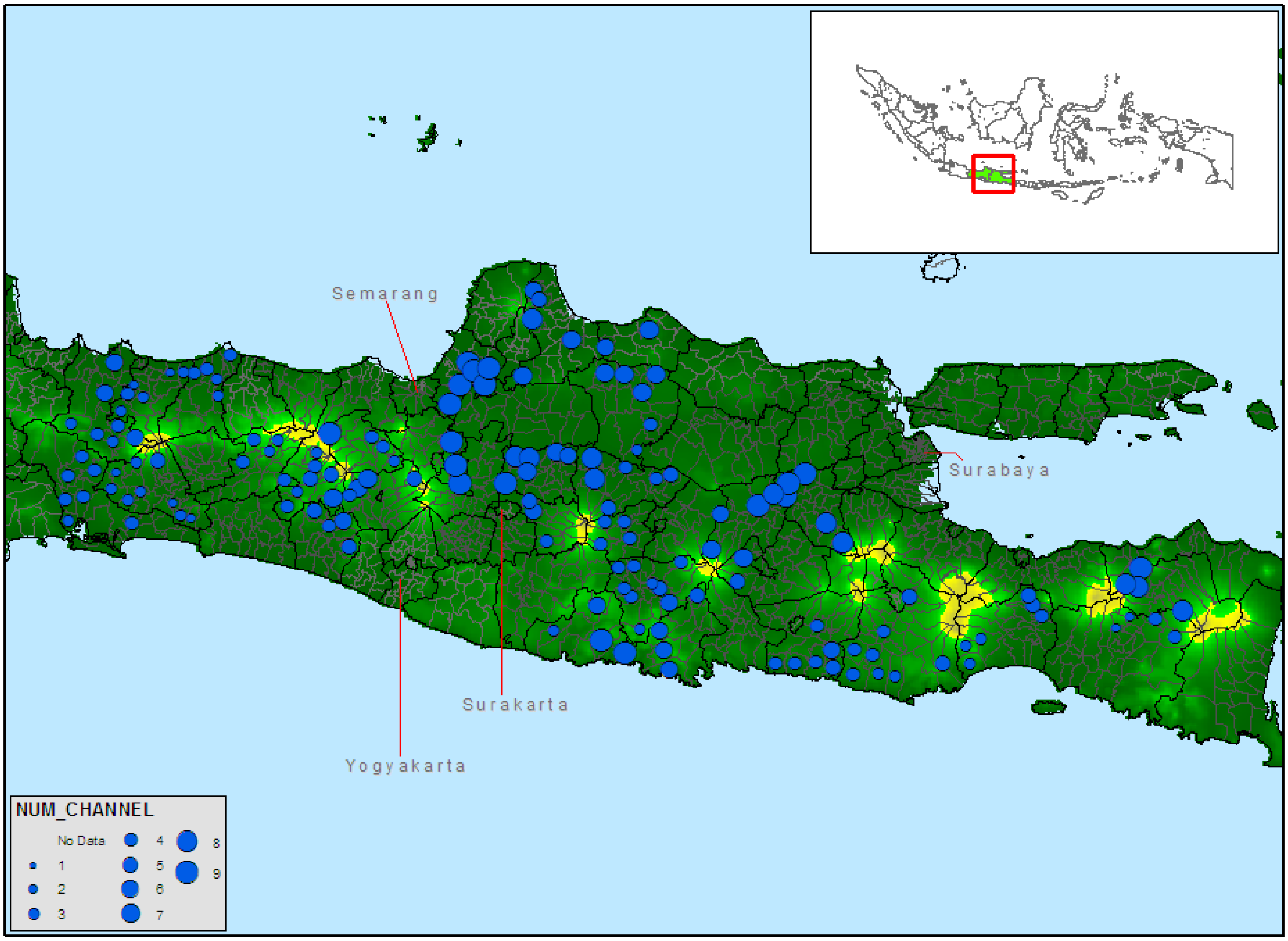
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 9: Impact on 'Missing Expenditures'

	(1)	(2)	(3)	(4)
	Missing Expenditures in Road Project	Missing Expenditures in Road and Ancillary Projects	Discrepancy in Prices in Road Project	Discrepancy in Quantities in Road Project
Panel A: Full residual variation				
Number of TV channels	-0.005	-0.024	-0.026**	0.029
	(0.020)	(0.022)	(0.013)	(0.022)
Observations	448	503	464	448
R-squared	0.31	0.24	0.27	0.29
Mean dep. Var	0.24	0.25	-0.02	0.25
Panel B: Isolating effect of topography				
Number of TV channels	-0.033	-0.026	-0.072*	0.064
	(0.064)	(0.061)	(0.039)	(0.064)
Observations	448	503	464	448
R-squared	0.38	0.29	0.32	0.35
Mean dep. Var	0.24	0.25	-0.02	0.25

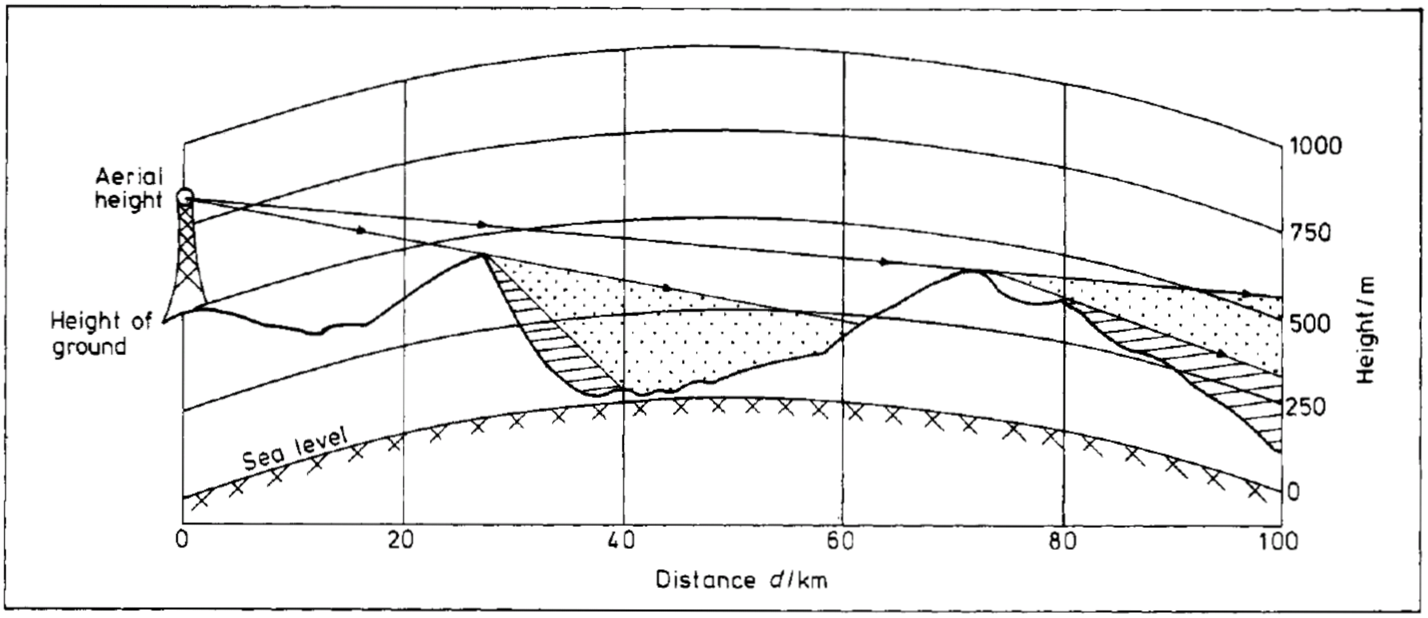
Notes: See Notes to Table 5.

Figure 1: Television reception and elevation in East and Central Java



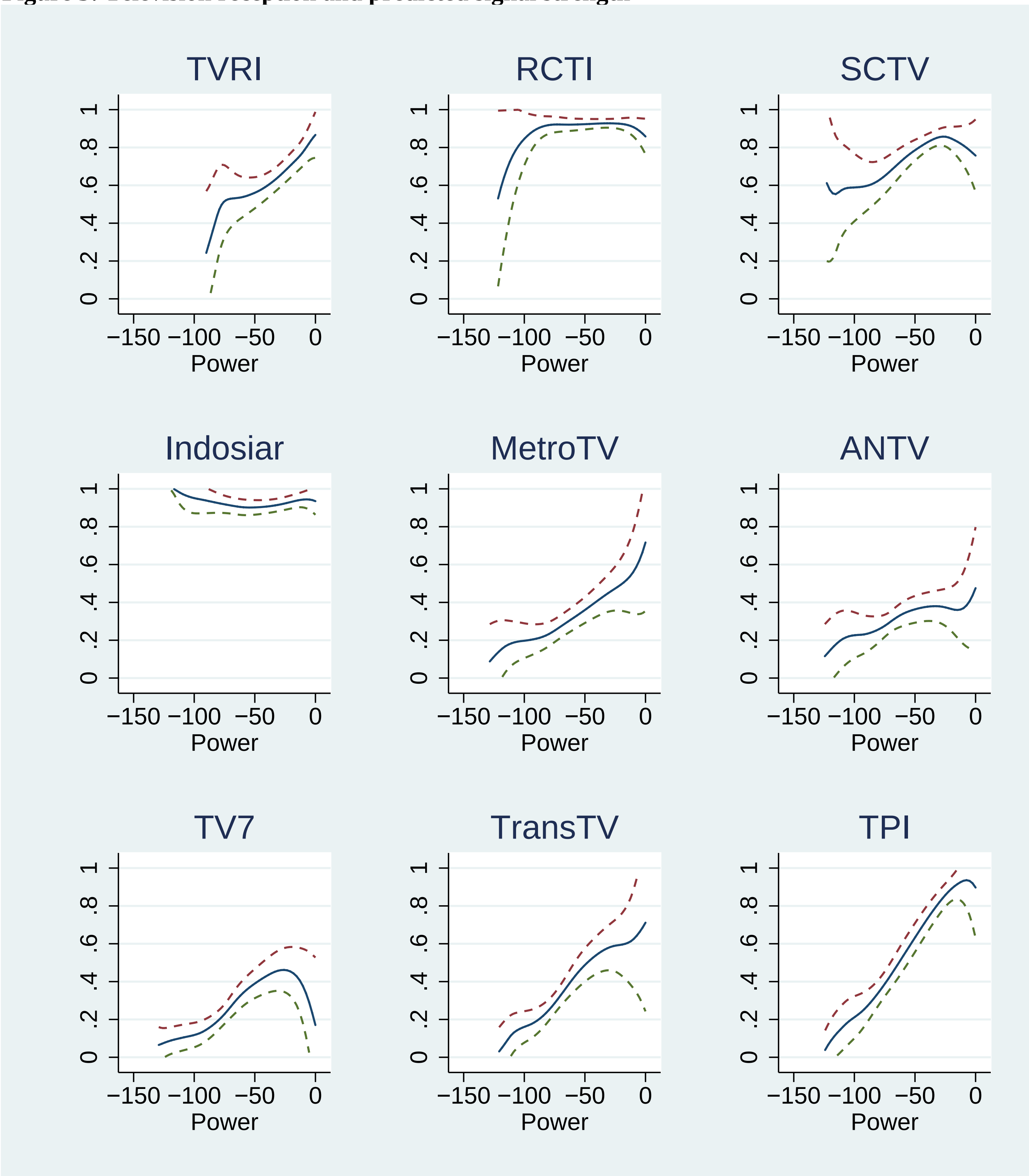
Notes: Background colors indicate elevation, where dark green represents sea level and yellow indicates mountainous areas. Each blue circle represents one subdistrict (kecamatan), where larger circles indicate more TV channels and smaller circles indicate fewer channels. Circles are only shown in the subdistricts included in the sample. Dark black lines indicate district (kabupaten) borders; faint gray lines indicate subdistrict (kecamatan) borders. Note that all regressions in the paper include fixed effects for each district (kabupaten).

Figure 2: The Physics of Broadcasting



Notes: The dotted areas denote reduced reception; the hatched areas show regions of almost nil reception. In mountain to the left, the area of nil reception is caused by the tight angle of refraction required. In the mountain to the right, the area of nil reception is caused by double-refraction off the primary and secondary peak. Figure and description reproduced with permission from Ellington et al (1980).

Figure 3: Television reception and predicted signal strength



Notes: Each graph shows the results of a Fan (1992) regression for a particular television channel. The independent variable is the predicted signal strength of each channel (in decibels below the power required for top quality signal reception), and the dependent variable a dummy for whether a given household reports that the channel can be received in his or her village. Sample is limited to those household who own a television. Bootstrapped 95% confidence intervals are shown in dashes, adjusting for clustering at the subdistrict level.