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

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This paper investigates the impact of television and radio on social capital in Indonesia. I use two sources of variation in signal reception—one based on Indonesia's mountainous terrain, and a second based on the differential introduction of private television throughout Indonesia. I find that increased signal reception, which leads to more time watching television and listening to the radio, is associated with less participation in social organizations and with lower self-reported trust. Improved reception does not affect village governance, at least as measured by discussions in village meetings and by corruption in village road projects. (*JEL* L82, O15, Z13)

Over the last several decades, economists and other social scientists have paid increasing attention to the phenomenon known as "social capital," the variety of social interactions, networks, and groups that link people in society together. Beyond describing the extent of these ties, there has been a vigorous debate as to whether social capital matters for everything from governance to growth to microfinance (Denise DiPasquale and Edward L. Glaeser 1999; Steven N. Durlauf 2002; Francis Fukuyama 1995; Luigi Guiso, Paola Sapienza, and Luigi Zingales 2004; Dean S. Karlan 2007; Stephen Knack and Philip Keefer 1997; Edward Miguel, Paul Gertler, and David I. Levine 2005; Deepa Narayan and Lant Pritchett 1999; Robert D. Putnam 1993; Joel Sobel 2002).

Given the interest in social capital, concern has arisen about recent declines in various measures of social capital, particularly participation in organized social groups. Putnam, in his book *Bowling Alone*, highlighted this decline in the context of the United States, and suggested that the rise of television has played a major role (Putnam 2000). Empirically testing the link between television and social

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capital, however, is challenging. While there are many correlational studies on the relationship between television watching and various measures of social capital, establishing a causal relationship has proved far more difficult.[1,2]

In this paper, I examine the link between media exposure and two measures of social connectedness using data from rural Indonesia: participation in social groups and trust. To identify the impact of media exposure, I exploit two different sources of plausibly exogenous variation in television and radio access: one based on variation in signal strength driven by mountains, and a second based on the differential introduction across time and space of private television in Indonesia. The two empirical methodologies tell a very similar story—increased access to television (and radio) leads to lower levels of social capital.

The primary identification strategy exploits the fact that the mountainous terrain of parts of Indonesia generates plausibly exogenous variation in the ability of villagers in rural areas to receive television and radio signals. Using detailed data I collected from over 600 villages in East and Central Java, I document that the variation in current television reception within rural districts in this part of Indonesia appears approximately balanced with respect to a variety of village characteristics, all of which were collected several years prior to the introduction of private television. I then show that each additional television channel for which the signal is strong enough to be received over-the-air is associated with villagers watching, on average, about seven minutes of additional television per day. I also find that an additional channel of television reception is associated with respondents listening to an additional seven minutes of radio each day, which likely reflects the high correlation between radio and television signals. Since I do not observe radio reception directly, I consider the total effect of an additional channel of better TV reception to be the additional 14 minutes per day spent watching television and listening to the radio, and do not attempt to separate television from radio.[3] This represents an 8 percent increase in time spent watching television and listening to the radio for each additional television channel received.

I find that villages with better access to television and radio signals, and thus villages where villagers spend more time watching television and listening to the radio, have lower levels of 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

[1] Putnam (2000), for example, acknowledges the paucity of causal evidence on this point, and to establish a causal link relies on only one study (Tannis MacBeth Williams 1986) based on the introduction of television in three isolated Canadian communities in the 1970s.

[2] Several authors have recently used the diffusion of radio in the United States to study the impact of media on public finance (David Stromberg 2004) and the diffusion of television in the United States to study its impact on voter participation and education (Matthew Gentzkow 2006; Gentzkow and Jesse M. Shapiro 2008). However, the relative scarcity of detailed data on social participation from the 1950s and earlier has meant similar exercises have not been conducted for participation in social groups.

[3] To investigate whether radio and television signals are positively correlated, I obtained data on the location of radio transmitters in Central Java province. Using the ITM model of electromagnetic signal propagation described in Section VB, I can construct an average radio signal strength in the subdistrict, and compare it to the average television signal strength also calculated using the ITM model. I find that radio and television signal strength are strongly positively correlated, even within districts, with correlation coefficients between 0.52 and 0.70, depending on the measure used.

participating in about 4 percent fewer types of social activities during a 3 month period. The effects are particularly strong among community self-improvement activities, neighborhood associations, school committees, and informal savings groups, and the effects are felt more strongly among wealthier households. These declines in social participation represent a net decline in social activity, rather than a shift from formal social groups to informal gatherings. The estimates imply that villagers participate in 0.30 percent fewer types of activities for every additional minute per day they spend watching television and listening to the radio.

Another important form of social capital is trust (e.g., Knack and Keefer 1997; Rafael La Porta and Florencio Lopez-de-Silanes 1999). Since social networks can help enforce agreements, one might expect that "trust," which could reflect the probability of cooperation among agents in a network, might also decline as social networks decline (Avner Greif 1993; Michihiro Kandori 1992; Markus Mobius and Adam Szeidl 2007). Using the same identification strategy, I find that additional television and radio exposure is associated with substantially lower self-reported levels of trust. These results suggest that the effect of television and radio on social capital may be more than merely a mechanical effect operating through the budget constraint on time.

I then explore the potential consequences of television's impact on social capital. A large part of the interest in social capital stems from the argument, advanced by Putnam (1993), among others, that lower levels of social capital translate into worse governance. To investigate this hypothesis, I use data from 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 above results on participation in social groups, I show that areas with greater television reception had lower attendance at these village-level planning and monitoring meetings.

Despite the negative 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 reduced attendance at meetings, greater television reception did not change the number of people at the road-building meetings who talked, the probability that a corruption-related problem was discussed at a meeting, or the probability that those attending 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 individual villages, it is, of course, possible that media exposure affects village level governance through channels other than social capital. Considerable caution should be used in interpreting the results on governance as identifying the causal effect of social capital, per se, on governance. However, the lack of a negative effect of decreased participation on governance is consistent with

my experimental results in the same setting, which showed little impact of increased participation (Olken 2007).

The results above are identified using cross-sectional variation in television reception within districts of East and Central Java. To confirm the negative impact of television on social capital, I also explore a second identification strategy based on the introduction of private television throughout Indonesia.[4] Prior to 1993, outside of the capital, Indonesia had only a single television station, the government-owned TVRI. After 1993, private television stations began broadcasting, to the point where today there are 11 major television stations broadcasting throughout the country. However, not all locations can receive all private stations. I therefore examine the change in average social participation levels between the time before private television began broadcasting (using data from 1990 and 1991) and after private television began broadcasting (using data from 2003), and examine the relationship between changes in participation and changes in the number of television channels a subdistrict could receive. This approach lets me control flexibly for any pre-period differences in the level of social capital that might be correlated with contemporary television reception. The data comes from the 1990 and 2003 PODES (census of villages) and from the 1991 and 2003 SUSENAS (National Socioeconomic Survey) datasets. Since this data is national in scope, I can explore the impact of television for all of rural Indonesia.

The results from this approach show that each additional television channel introduced into a subdistrict resulted in 0.014 fewer types of social organizations in a typical village, and reduced the probability that an individual participates in any social organization over a 3 month period by 2.4 percentage points. 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 these results are robust to using only the variation in signal strength caused by mountains located in between the villages and the transmission towers. These results, combined with the cross-sectional results from the much richer data available in the East and Central Java survey, tell a consistent story. Improved access to television and radio reduced individual participation in social groups and, in aggregate, reduced both the number and the diversity of groups that exist within a village.

The remainder of the paper is organized as follows. Section I describes the setting and the Java survey. Section II examines the relationship between television reception and village characteristics in the Java data, and shows that better signal strength leads to more time spent watching television and listening to the radio. Section III presents the impacts of television and radio on participation in social groups and on trust using the Java data. Section IV discusses the impact of television reception on governance in village-level road building projects. Section V presents the results from the national panel dataset, using variation in television over time, as well as the

[4] This panel-data approach is the approach more commonly used to estimate the impact of television in other settings (see, for example, Stefano DellaVigna and Ethan Kaplan 2007; Gentzkow 2006; Gentzkow and Shapiro 2008; Robert Jensen and Emily Oster 2009; Alberto Chong, Suzanne Duryea, and Eliana La Ferrara et al. 2008). I am grateful to an anonymous referee for suggesting using this approach in this context.

electromagnetic model of signal propagation, to provide further evidence that television reduced social capital. Section VI concludes.

I. Setting and Data: The Java Survey

Rural Java, the area that is the primary focus of this study, is one of the most densely populated rural areas in the world, with over 750 people per square kilometer (km).[5] 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 with 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. All empirical specifications in the paper will include fixed effects at the district level, to control for the administrative and cultural differences that exist across the different parts of Indonesia.

The primary dataset I use, which I will refer to subsequently as the Java survey, was designed by the author and fielded between September 2003 and August 2004. The data were originally collected for a study of rural road projects (see Olken 2007). As a result, 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 with a loan from the World Bank. In the remainder of this section, I describe the subsets of the Java survey that I use to calculate the three main types of variables used in the study: data on social organizations, data on television reception and use, and data on governance.

A. *Social Organizations*

Indonesian villages have a complex network of social groups. As discussed in Vivi Alatas, Pritchett, and Anna Wetterberg (2003) and Miguel, Gertler, and Levine (2005), a typical Indonesian 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. Many Indonesian 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

[5] Author's calculations using the 2003 PODES dataset. This calculation includes only villages (*desa*), and includes all agricultural land area as well as residential areas.

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

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 villages and hamlets, I use data collected from the village head in each village I surveyed.

(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, 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 two types of data: key informant surveys, which allow me to construct a list of all social organizations in the village; and household surveys, which allow me to measure the activities that a particular respondent participated in during the three months prior to the survey. In the key informant surveys, the surveyor interviewed the head of each hamlet in the village, 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 4 or 5 most common activities in that category.[6] I aggregate these data across all hamlets to obtain a complete picture of all groups in the village. In the household surveys, the surveyor interviewed the respondent (a randomly selected adult member of the household), who was asked about all groups he or she participated in, assisted by the same set of prompting questions used in the key informant survey.

The first column of Table 2 presents summary statistics from the Java survey. As shown in column 1 of Table 2, based on the key informant survey, on average, there are 179 total groups per village. This works out to 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

[6] 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 on which 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.

TABLE 2—SUMMARY STATISTICS

Java survey		National sample	
Television reception:			
Average number of TV channels in 2003 out of nine possible stations on the survey	5.067 (2.028) [1.059]	Average number of TV channels in 2005 out of 11 possible stations on the survey	6.122 (4.256) [1.737]
Social capital variables:			
Number of social groups	178.963 (135.324)	Number of types of organizations in village in 1990 (ranges from 0–4)	2.802 (0.725)
Attendance at group meetings per adult in last three months (from key informant data)	10.852 (11.112)	Number of types of organizations in village in 2003 (ranges from 0–4)	3.246 (0.597)
TV and radio watching in 2003*:*			
Television minutes per day	123.168 (76.991)		
Radio minutes per day	59.850 (86.694)		
TV and radio ownership in 2003*:*			
TV ownership	0.703 (0.457)		
Radio ownership	0.727 (0.446)		
Number of subdistricts	155	Number of subdistricts	2,661
Number of households	4,672		

Notes: Means of variable listed shown. Standard deviations are in parentheses. For average number of TV channels, the standard deviation after removing district fixed effects is shown in brackets.

approximately 11 meetings over the 3 months prior to the survey, or about 1 meeting each week.

B. *Television Reception and Use*

Indonesia has 11 television channels that broadcast over the air. These channels include one government-run channel (TVRI), three major networks (RCTI, SCTV, and Indosiar), one all-news station (Metro TV), and six minor networks (ANTV, GLOBALTV, LATIVI, TV7, TransTV, and TPI). 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. Each respondent was asked, for nine of these different networks (all of the above except GLOBALTV and LATIVI), whether "as far as they know, this station could be received in this village clearly enough to watch." As shown in column 1 of Table 2, on average, households report being able to receive about five of these stations. Households report virtually universal coverage for two of the

major networks (RCTI and Indosiar) and much lower coverage rates for the minor networks.

I average the number of channels received over all respondents in a subdistrict.[7] In constructing this average, I only use the data on television reception from those households that have televisions, excluding the 3 percent of households that also own a satellite dish, which yields an average of 20 data points on television reception for each of the 155 subdistricts in the sample.

On average, 70 percent of households own a television and 73 percent own a radio. Only 12 percent of households own neither. Respondents reported spending an average 123 minutes per day watching television and 60 minutes per day listening to the radio.

C. *Governance*

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

Second, I measure "missing expenditures" in each of the road projects that were built. 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. The measure of missing expenditures I examine is the difference in logs between what the village claimed the road cost to build and what the engineers estimated it actually cost to build. 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 in the village report and those found in the engineering survey, weighted by the village's reported prices). Additional details about this measurement can be found in Olken (2007).

[7] All standard errors are clustered by subdistrict to account for the geographic clustering of television reception.

II. Empirical Strategy: Signal Strength and Media Use

A. *Determinants of Signal Strength*

This paper uses television reception as an exogenous determinant of television watching. It is important to use an exogenous determinant of television watching, such as signal strength, 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.

In the data from the Java survey, I focus on cross-sectional identification, using the fact that the mountains of East and Central Java create variation in television reception that is unrelated to other village characteristics. The key issue in doing this type of cross-sectional analysis is to ensure that television reception is, in fact, 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 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 include district fixed effects, which capture 95 percent of the variation in the distance between the subdistrict and the closest of the three listed major cities above. (In Figure 1, district borders are shown in white; subdistrict borders are shown in black.) Not surprisingly, as shown in Table 2, removing district fixed effects also removes 75 percent 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, the distance to the nearest major city (*kotamadya*), as well as the distance and travel time to the nearest major town (defined as a district capital), to further capture differences within districts.

Once proximity to the transmission sites has been removed, the major remaining determinant of reception is geography. In some areas, mountains block television transmission, whereas in others they do not. This can be seen in Figure 1, noting that villages for which the "line of sight" to a major city is blocked by a mountain have substantially less reception than nearby villages with a direct "line of sight." (In Section VB, I use a model of electromagnetic signal propagation and the national panel dataset to exploit this variation more explicitly.) As villages in mountainous areas may have different social structures from villages in low plains, I control for elevation, though doing so does not substantially affect the results.[8] I also control

[8] Controlling, instead, for a flexible spline of elevation to capture nonlinear effects produces similar results.

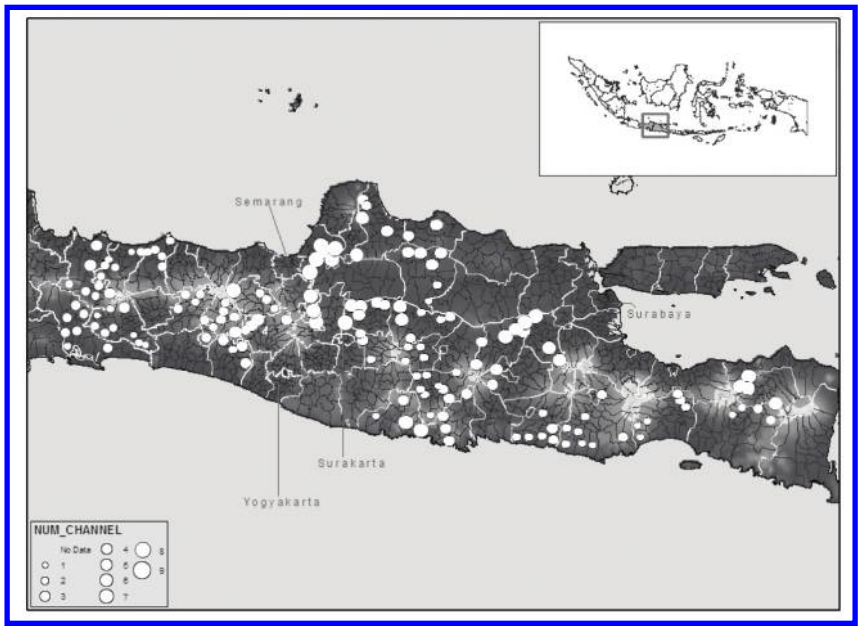

FIGURE 1. TELEVISION RECEPTION AND ELEVATION IN EAST AND CENTRAL JAVA

Notes: Shades indicate elevation, darkest shade represents sea level and medium shade indicates mountainous areas. Each white 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. White lines indicate district (kabupaten) borders; black lines indicate subdistrict (kecamatan) borders. Note that all regressions in the paper include fixed effects for each district (kabupaten).

for dummies for whether the subdistrict faces north, east, or south (with west as the omitted category) and dummies for the subdistrict being coastal, in addition to the district fixed effects and measures of travel distance to nearby major towns and cities previously discussed.

Table 3 examines whether, controlling for district fixed effects, elevation, and other geographic characteristics, the number of television channels appears unrelated to other, presumably exogenous, village characteristics. Specifically, I report the results of the following OLS regression using data from the Java survey:

$$(1) \qquad NUMCHANNELS_{sd} = \alpha_d + \mathbf{X}_{vsd}\delta_1 + \delta_2\, GEOGRAPHY_{vsd} + \varepsilon_{vsd},$$

where v represents a village, s represents a subdistrict, and d represents a district. *NUMCHANNELS* is the average number of channels reported by all TV-owning households (except those that 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 major town and distance to nearest major city, and coastal subdistrict dummy), and $\mathbf{X}_{vsd}$ is a set of other village characteristics. Where possible, the $\mathbf{X}_{vsd}$ variables are calculated from the 1990 census of villages (PODES)—i.e., from before the introduction of private television. These characteristics include log adult population, the population

TABLE 3—DETERMINANTS OF NUMBER OF TV CHANNELS

	Number of television channels		Log groups in 2003
	(1)	(2)	(3)
Geographic variables:			
Elevation (thousands of meters)	0.010	−0.034	0.016
	(0.039)	(0.030)	(0.010)
Travel distance to nearest major town (km)	−0.004	−0.011	0.001
	(0.008)	(0.007)	(0.003)
Travel time to nearest major town (hours)	−0.064	−0.059	−0.091*
	(0.108)	(0.111)	(0.052)
Travel distance to nearest major city (km)	0.005	−0.002	−0.003
	(0.009)	(0.009)	(0.003)
Coastal subdistrict dummy	0.540*	0.213	0.148
	(0.324)	(0.264)	(0.111)
North-facing subdistrict dummy	0.220	0.220	−0.070
	(0.281)	(0.255)	(0.121)
East-facing subdistrict dummy	0.220	0.040	−0.081
	(0.381)	(0.294)	(0.106)
South-facing subdistrict dummy	−0.301	−0.075	−0.027
	(0.330)	(0.271)	(0.094)
Social capital variables (1990 *census of villages*):			
Number of mosques in village	0.010	0.070	0.016
	(0.161)	(0.134)	(0.034)
Number of mushollas in village	0.021	0.016	0.004
	(0.025)	(0.024)	(0.007)
Number of other religious buildings in village	−0.446	−0.132	−0.019
	(0.274)	(0.219)	(0.098)
Any sports group in village	−1.396	−1.564	0.694*
	(1.203)	(1.205)	(0.364)
Any arts group in village	−0.072	0.138	0.252**
	(0.418)	(0.398)	(0.111)
Any social welfare group in village	−0.655*	−0.518	0.009
	(0.370)	(0.343)	(0.096)
Any youth group in village	2.890	2.803	−0.334
	(3.095)	(3.028)	(1.195)
Other variables (1990 *census of villages*):			
Log adult population	0.746	0.529	0.241
	(0.573)	(0.505)	(0.163)
Population share in agriculture	0.086	−0.085	−0.124
	(0.944)	(0.828)	(0.315)
Number of schools in village	−0.130	−0.125	0.050
	(0.133)	(0.127)	(0.039)
Village characteristics (2000 *population census*):			
Mean adult education	−0.056	−0.064	0.049**
	(0.043)	(0.043)	(0.020)
Ethnic fragmentation	−0.702	−0.757	0.713**
	(0.644)	(0.648)	(0.327)
Religious fragmentation	−0.652	0.713	0.541
	(1.146)	(0.565)	(0.348)

Table 3—Determinants of Number of TV Channels (*Continued*)

	Number of television channels		Log groups in 2003
	(1)	(2)	(3)
Village characteristics (2003 *data*):			
Log number of hamlets	−0.272**	−0.078	0.589***
	(0.136)	(0.100)	(0.052)
Share poor	0.068	0.130	−0.039
	(0.236)	(0.224)	(0.099)
District fixed effects	Yes	Yes	Yes
Sample	Java survey	Java survey, drop high/low subdistricts	Java survey, drop high/low subdistricts
Observations	592	584	584
R^2	0.77	0.82	0.63
Joint *P*-value—social capital variables	0.07	0.31	0.08
Joint *P*-value—all non-geographic variables	0.20	0.34	< 0.01
Joint *P*-value—all listed variables	0.14	0.18	< 0.01
Mean dep. var.	5.07	5.06	4.94

Notes: Each observation is a village. Robust standard errors are in parentheses, adjusted for clustering at the subdistrict level. The dependent variable in columns 1 and 2 is the average number of television channels households in the subdistrict can receive; the dependent variable in column 3 is the log number of social groups in the village. All 1990 variables, as well as distance to nearest city, coastal dummy, and aspect dummies, are calculated as the average value for all villages in the subdistrict. All regressions include district fixed effects.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

share in agriculture, the number of schools in the village, the number of religious buildings (mosques, neighborhood prayer halls (*mushollas*), churches, etc.) in the village, and dummies for whether there was any sports, arts, social welfare, or youth group in the village.[9] In addition, I include some variables that were only available in later datasets: mean adult education, ethnic and religious fragmentation (using a Herfindahl index), the log number of hamlets, and the share of the population that is classified as poor (technically "pre-prosperous" and "prosperous group 1") by the national family planning association (BKKBN). 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 is correlated with only 3 of the 24 variables considered: the presence of any social welfare group in 1990, the log number of hamlets, and whether the subdistrict is coastal. The negative correlation with the "any social welfare group" dummy is a potential source of concern. However, of the seven social capital variables considered (number of mosques, number of mushollas, number of other religious buildings, and whether there is any sports, arts, social welfare, or youth group), three have positive coefficients and four have negative coefficients,

[9] All of these PODES 1990 variables are averaged at the subdistrict level to facilitate matching across time.

suggesting no clear overall relationship between these pre-period social capital measures and television reception. Overall, the p-value from a joint F-test of the 7 social capital variables is 0.07. The p-value from a test of all 15 nongeographic variables is 0.20, and the p-value from a test of all 24 variables is 0.14.

Even these limited 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] When I drop these few outliers, the individual significance on all three of the previously statistically significant variables disappears. In this sample, the p-value from a joint F-test of the 7 social capital variables is 0.31. The p-value from a test of all 15 nongeographic variables is 0.34, and a p-value from a test of all 24 variables is 0.18.

From these regressions, it appears that, for the East and Central Java villages, once I drop the two outlier subdistricts, the number of channels is approximately balanced with respect to pre-period social capital variables and other village characteristics. In the results below, I limit my attention to this restricted sample (i.e., the sample dropping the two outlier subdistricts), although I have verified that all of the results are similar in the full sample. I also include all 24 control variables as additional regressors in all subsequent specifications, although, once again, I have verified that doing so does not substantially alter the results.

As a basis of comparison, in column 3, I repeat the same regression as in column 2, but this time with the log number of social groups in the village as the dependent variable. By comparing the coefficients from columns 1 and 2 with the coefficients in column 3, one can compare the correlation between these village characteristics and the dependent variable in the subsequent analysis—social capital—and the correlation between these village characteristics and the independent variable in the subsequent analysis—television reception. The coefficients in column 3 reveal that most geographic variables are not major determinants of the level of social capital, though villages with less travel time to the nearest major town do have somewhat fewer social groups. Looking at the 1990 social capital variables, villages that had sports groups or arts groups in 1990 are more likely to have more social groups in 2003, suggesting that participation levels persist over time. Overall, these variables are highly significant predictors of the number of social groups in 2003 (p-value on social capital variables $= 0.08$, p-value on all nongeographic variables < 0.01), and in some cases, the coefficients are of the opposite sign of the coefficients in columns 1 and 2. The fact that these coefficients are of opposite sign emphasizes the importance of including these covariates as controls, limiting attention to the sample, where these covariates are balanced with respect to television reception, and investigating the panel as well as the cross-section.

[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 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.

B. *Impact on Media Use and Ownership*

Having explored the determinants of reception, the next question is whether better television reception is, in fact, associated with more time spent watching TV and listening to the radio. I focus on the total number of minutes spent watching TV and listening to the radio, since villages that receive better television reception may also receive better radio reception.[11] I estimate the following OLS regression using data from the Java survey:

$$(2) \qquad MINUTES_{hvsd} = \alpha_d + \beta\, NUMCHANNELS_{sd} + \mathbf{Y}_{hvsd}\,\gamma + \mathbf{X}_{vsd}\,\delta + \varepsilon_{hvsd},$$

where h represents a household, *MINUTES* is the number of minutes per day spent watching television and listening to the radio, $\mathbf{Y}$ is a vector of household controls (gender, age, predicted per capita expenditure, and whether the household has electricity), $\mathbf{X}$ is the vector of village controls used in Table 3 (including the geographic controls), and α_d are district fixed effects.[12] I estimate this regression via OLS at the household level, and adjust the standard errors for clustering at the subdistrict level.

The results are presented in column 1 of Table 4. They show that each additional television channel received is associated with an extra 14 minutes per day spent watching television and listening to the radio, about an 8 percent increase from the mean level. In columns 2 and 3, I re-estimate equation (2) separately for minutes per day spent watching TV and for minutes per day spent listening to the radio. The results suggest each additional channel of television leads to an additional seven minutes of television watching per day and an additional seven minutes of radio listening per day.[13] As discussed above, the positive effect on radio is not surprising, given that radio and television signal reception are highly correlated. Since I cannot separately identify the impact of reception on television and radio, for the remainder of the paper, I interpret the effect of television reception as the total effect of greater media exposure—i.e., the extra 14 minutes that a respondent spends each day watching television and listening to the radio.

A natural question is whether better television reception leads to a change on the extensive margin of television ownership. In column 4, I estimate the same equation with owning a television as the dependent variable. To simplify interpretation of coefficients with binary dependent variables in fixed effects regressions, throughout

[11] Conceptually, one might imagine that television and radio might have very different effects on social participation, since radio can be listened to while doing another activity, whereas television is more demanding of a person's attention. Unfortunately, I do not have independent data on radio reception, so I cannot separately identify its effects. Furthermore, as documented above, television and radio signals are highly correlated (see footnote 3), so even better data disentangling radio from television empirically would be difficult.

[12] Note that one of the household controls is predicted per capita expenditure based on the household's assets. Details on how this variable is constructed are in Olken (2009). In predicting per capita expenditure in this paper, I exclude television, radio, or satellite dish from 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.

[13] Note that the sample includes all households, including those that do not own televisions, since television ownership is potentially endogenous and since people may watch television at friends' or relatives' houses. 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).

Table 4—Media Usage and Ownership

	Individual-level data (Java survey)			
	Total minutes per day (1)	TV minutes per day (2)	Radio minutes per day (3)	Own TV (4)
Number of TV channels	14.243***	6.948***	6.997***	−0.007
	(2.956)	(1.827)	(1.881)	(0.008)
Observations	4,213	4,250	4,222	4,266
R^2	0.18	0.16	0.10	0.17
Mean dep. var.	180.15	124.54	55.82	0.70

Notes: Each observation is a household. Robust standard errors are in parentheses, adjusted for clustering at subdistrict level. The dependent variable for each column is listed in the column heading. All regressions include district fixed effects, the geographic variables, and other village characteristics from Table 3, the respondent's gender, education, age, predicted per capita household expenditure, and a dummy for whether the household has electricity.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

the paper, I report results from linear probability models. Results are qualitatively similar with Probit models. 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. This result may not be surprising, given that television ownership rates are already 70 percent, and that 97 percent of households already report watching at least some television on an average day.

III. Impacts on Social Capital

A. *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, in many ways, is the canonical measure of social capital in the literature. I examine measures of participation in social groups from both the village-level key informant survey and from the individual survey. I estimate the following cross-sectional equation via OLS:

$$LOGGROUPS_{vsd} = \alpha_d + \beta\, NUMCHANNELS_{sd} + \mathbf{X}_{vsd}\,\delta + \varepsilon_{vsd}. \tag{3}$$

I estimate this regression in logs, controlling for log adult population and log number of hamlets, to allow the baseline number of groups to vary flexibly with the size and structure of the village.

Table 5 shows the results. In column 1, I present results in which the dependent variable is the log total number of social groups in the village, using data from the key-informant survey. The regression includes district fixed effects and the same set of village-level controls used in Table 3, and clusters standard errors by subdistrict.

Table 5—Participation in Social Groups
(*Cross sectional data*)

	Village-level data (Java survey)		Individual-level data (Java survey)	
	Log number of groups in village (1)	Log attendance per adult at group meetings in past three months (2)	Number types of groups participated in during last three months (3)	Number times participated in last three months (4)
Number of TV channels	−0.068**	−0.111**	−0.186*	−0.970
	(0.026)	(0.045)	(0.096)	(0.756)
Observations	584	556	4,268	4,268
R^2	0.64	0.49	0.40	0.29
Mean dep. var.	4.94	1.97	4.27	22.77

Notes: In columns 1 and 2, each observation is a village. In columns 3 and 4, each observation is an individual. Robust standard errors are in parentheses, adjusted for clustering at subdistrict level. The dependent variable for each column is listed in the column heading. All regressions include district fixed effects and the geographic variables and other village characteristics from Table 3.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

The results suggest that an extra television channel—or about 1 standard deviation on the demeaned television variable—is associated with 6.8 percent fewer groups existing in the village. Column 2 presents the results from re-estimating equation (3), where the dependent variable is the log total number of times each adult in the village attended a group meeting in the last three months, once again using aggregate data on participation from the key informant survey. The results show that each extra television channel is associated with 11 percent lower attendance at meetings per person over a 3 month period.

Columns 3 and 4 present analogous variables from the household survey. Since about 6 percent of households participate in no activities, I estimate columns 3 and 4 in levels, rather than in logs, to avoid dropping zeros.[14] Column 3 shows that each additional television channel is associated with respondents participating in 0.19 fewer types of social groups, or about a 4.4 percent reduction from the mean level. Column 4 shows that each additional channel is associated with participation in 0.97 percent fewer group meetings, about a 4.2 percent reduction from the mean level, although this result is not statistically significant.

In results not reported in the table, I use the household data to test for heterogeneity in the response to additional channels by interacting the number of channels received with the respondent's education, gender, age, and predicted per capita

[14] As an alternative, I have estimated columns 3 and 4 as quasi-MLE robust Poisson regressions, which produce coefficients with similar interpretation to log-dependent variable regressions but do not require dropping zeros (Jeffrey M. Wooldridge 1999). The quasi-MLE robust Poisson approach produces similar results to those reported in the table, once one accounts for the fact that Poisson coefficients are interpretable as percent changes, not changes in levels. Specifically, in the number of groups regression (as in column 3), the coefficient on number of television channels is −0.049 (p-value 0.037), and in the number of times participated regression (as in column 4), the coefficient on number of television channels of −0.038 (p-value 0.23).

household expenditure. The only statistically significant interaction I find is that richer respondents reduce the number of times they participate in social groups more in response to increased television reception.

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. To do so, in results not reported in the table, I re-estimate the regressions presented in Table 5 using instrumental variables, with the number of minutes spent watching television and listening to the radio as the endogenous right-hand-side variable and the number of channels received as the excluded instrument. The IV results suggest that each additional minute a household spends watching television or listening to the radio each day is associated with 0.44 percent fewer social groups existing in the village (standard error 0.22; *p*-value 0.041). At the individual level, the IV results suggest that each additional minute spent watching television or listening to the radio each day is associated with participation in 0.013 fewer types of activities (standard error 0.0075; *p*-value 0.092), and attendance at 0.068 fewer social meetings each month (standard error 0.056; *p*-value 0.23). These relative magnitudes need to be interpreted with caution, however, as there are other mechanisms through which media exposure could affect participation in social groups, besides the pure effect of fewer minutes spent watching television and listening to the radio.[15]

To investigate whether there is a differential impact of media exposure on different types of groups, I re-estimate equation (3) using the key-informant data, splitting the dependent variable separately by nonreligious 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 groups, predominantly Koran and other religious study groups, meet quite frequently. The results presented in Table 6 show that the declines are predominantly coming from nonreligious groups. In results not presented in the table, I further decompose these nonreligious 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 (*gotong royong*), neighborhood associations, and school committees. Other types of groups also show declines. Only health and women's groups do not seem to be affected.

The last two columns of Table 6 show that media exposure is associated with a decline in ROSCAs, a common form of savings mechanism in developing countries (Timothy Besley, Stephen Coate, and Glenn Loury 1993). Many groups in Java involve a ROSCA as part of their regular meetings. The number of groups that include a ROSCA declines by 14 percent with each additional television channel, and participation in such groups declines by 17 percent with 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

[15] For example, the results in Section IIIB show that additional media exposure is associated with less trust, which could influence social participation. The content of the additional channels could also affect participation directly.

TABLE 6—IMPACT ON DIFFERENT TYPES OF GROUPS

	Non-religious groups		Religious groups		Groups with ROSCAs	
	Log number groups (1)	Log attendance (2)	Log number groups (3)	Log attendance (4)	Log number groups (5)	Log attendance (6)
Number of TV channels	−0.077*** (0.027)	−0.174*** (0.051)	−0.033 (0.043)	0.019 (0.050)	−0.136*** (0.040)	−0.165*** (0.049)
Observations	584	554	578	514	557	532
R^2	0.62	0.49	0.65	0.47	0.54	0.44
Mean dep. var.	4.71	1.28	3.12	1.12	2.21	0.75

Note: See notes to Table 4.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

important savings mechanism, 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 in all specifications.[16] This suggests that the reduction in participation in social organizations represents a net decline in social interactions, rather than merely a substitution from one form to another.

B. *Trust*

In addition to participation in social groups, the literature has also focused on a second measure of social capital—trust. Both theory and evidence from other settings suggest 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 (Greif 1993; Kandori 1992; Karlan 2007; Mobius and Szeidl 2007).

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 (GSS) and World Values Survey, which asks: "Generally speaking, would you say that most people can be trusted, or that you can't be too

[16] Intriguingly, the declines are strongest when I examine social visits to and from households that do not own a television. One possible explanation is that, as the number of channels increase, those households owning televisions increasingly prefer staying at home watching television rather than visiting their non-television-owning neighbors.

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 of "people in general," the household survey also asked the same trust question 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 one if the respondents say that they would generally trust a person, and zero if not. I then re-estimate equation (2), using the individual responses to the *TRUST* question as the dependent variable.

The results, presented in 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. The effects appear across a wide range of questions about who is being trusted. The group that sees the smallest decline in being trusted is "people who live in your neighborhood," which declines by a statistically insignificant 1.2 percentage points, and the groups that see the largest effect are "people who live in your village" and "the village parliament," which decline by 5.3 percentage points.

The fact that the two different measures of social capital I examine (trust and participation) 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 limited only to the mechanical effects of a time budget constraint—television and radio exposure appears to change attitudes as well.

IV. Impacts on 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 another part 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 measures related to the road projects that were being built in the villages at the time the data from the Java survey was being collected.[17] I examine three measures of governance in the road 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, I examine whether or not increased

[17] 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 the Java survey, 99 percent of respondents reported voting in the most recent national parliamentary elections.

TABLE 7—TRUST

	People in general (1)	People who live in your neighborhood (2)	People who live in your village (3)	The government (4)	The president of Indonesia (5)	The village head (6)	The village parliament (7)
Number of TV channels	−0.036*** (0.010)	−0.012 (0.015)	−0.053*** (0.016)	−0.036** (0.015)	−0.033** (0.016)	−0.040** (0.016)	−0.053*** (0.018)
Observations	4,157	4,236	4,187	3,730	3,523	4,104	3,979
R^2	0.28	0.17	0.24	0.19	0.19	0.17	0.20
Mean dep. var.	0.25	0.71	0.52	0.55	0.53	0.71	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 one if the response was that they could be trusted, and zero if you have to be careful in dealing with them.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

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 (e.g., James M. Snyder and Stromberg 2008; 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 occurring through 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 road project meetings per village—one planning meeting and three meetings at which the village had to approve the use of project funds. These meetings were open to the public, and attendance was observed directly by the enumerator, who circulated an attendance list and noted who spoke.[18] To estimate the impact of media exposure on attendance, I re-estimate a version of equation (3), where each observation is a village meeting. I include dummies for which type of meeting it was, interacted with the experimental treatments discussed above.

[18] As described in Olken (2007), experiments were conducted in which additional invitations to these meetings were distributed in some villages, and anonymous comment forms were distributed along with the invitations in other villages. These experiments 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, 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.

Table 8—Attendance and Discussion at Village Development Meetings

	Log attendance at meeting (1)	Log attendance of "insiders" at meeting (2)	Log attendance of "outsiders" at meeting (3)	Log number of people who talk at meeting (4)	Number of problems discussed (5)	Any corruption-related problem (6)	Any serious action taken (7)
Number of TV channels	−0.030**	−0.047**	−0.009	0.002	0.019	−0.009	0.000
	(0.015)	(0.020)	(0.032)	(0.020)	(0.059)	(0.008)	(0.003)
Observations	2,273	2,266	2,124	2,200	1,702	1,702	1,702
Mean dep. var.	0.26	0.19	0.26	0.22	0.37	0.15	0.15
	3.75	2.77	2.71	2.07	1.18	0.06	0.02

Notes: Each observation represents one meeting. Columns 1–4 include 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 are in parentheses, adjusted for clustering at the subdistrict level. All regressions include district fixed effects and the geographic variables and other village characteristics from Table 3.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

The results are presented in Table 8. The results suggest that each additional television channel is associated with a decline of about 3 percent in the number of people attending a meeting. Next, I classify all those who attend as either "insiders" (members of the village government, the project implementation team, or other types of informal leaders) or "outsiders" (everyone else). Somewhat surprisingly, the lower attendance associated with media exposure appears more pronounced among insiders than outsiders. One possible explanation, consistent with the earlier findings, is that there are simply fewer "insiders" 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.

I investigate whether television and radio affect discussions at the meetings. In column 4, I show that even though meeting attendance is lower, there is no statistically significant reduction in the number of people who talk. In columns 5, 6, and 7, I further examine 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.[19] The point estimate suggests that villages with more media exposure have slightly more discussion at meetings, with more problems or issues being raised, although this effect is not statistically significant. Column 6 focuses on whether any corruption-related problems were discussed, and finds no effect of media exposure. 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.[20] Overall, these results suggest that while television and radio exposure affected attendance, they did not measurably affect the quality of discussion at the meetings.

[19] A "problem" was defined as the topic of any substantial discussion other than the routine business of the meeting.

[20] "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.

Table 9—Impact on "Missing Expenditures"

	Missing expenditures in road project (1)	Missing expenditures in road and ancillary projects (2)	Discrepancy in prices in road project (3)	Discrepancy in quantities in road project (4)
Number of TV channels	−0.033*	−0.042**	−0.030***	0.003
	(0.019)	(0.019)	(0.010)	(0.021)
Observations	460	517	476	460
R^2	0.35	0.29	0.30	0.32
Mean dep. var.	0.24	0.25	−0.01	0.24

Note: See notes to Table 8.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

The final measure of governance I examine is "missing expenditures" from the road project. As discussed in Section IC, "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 (3) 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.), 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 Table 9 show that, if anything, having more television channels (and hence lower social capital) is associated with *less* corruption, rather than more as Putnam (and others) might have predicted. In particular, in three of the four specifications, the coefficient is actually negative and statistically significant.[21] The lack of a relationship between participation and corruption is consistent with the experimental evidence presented in Olken (2007), which showed, in the same setting, that increasing participation in the monitoring meetings, through an experimental intervention, had no statistically significant impact on missing expenditures from the road project. The lack of a detrimental effect of television exposure on corruption suggests that the other potential channels through which social capital could affect

[21] Note that the statistical significance of these results is not robust to alternative sample definitions, i.e., not dropping outliers, or dropping the top and bottom 2.5 percent of districts in terms of television reception. Nevertheless, in all these other samples, the point estimates remain negative.

governance—such as a broader decline in social interactions in which the project might be discussed—do not, on net, lead to an increase in corruption, at least as measured by the village road project.

V. Impacts on Social Capital: Further Evidence from National Panel Data

The evidence presented thus far is based on cross-sectional differences in television reception within districts in East and Central Java. Although Table 3 showed that differences in television reception within districts are unrelated to pre-period village characteristics, and thus plausibly exogenous with respect to media exposure, one might still be concerned about omitted variables. To provide further evidence of the negative impact of television on social capital, in this section, I present results using an alternative identification strategy, based on the introduction of private television throughout Indonesia starting in 1993. I use a model of electromagnetic signal propagation to precisely isolate the variation in new private television reception being driven by mountains. Section VA discusses the national panel dataset I use for this analysis. Section VB introduces the model of electromagnetic signal propagation, and Section VC presents the results.

A. *The National Dataset*

Data on Social Organizations.—To investigate the impact of television's introduction over time, I use a national dataset, based on data collected by the Indonesian Central Bureau of Statistics (BPS). This data has been collected over time, which allows me to compare the same subdistricts before and after the introduction of private television. Unfortunately, this data has only limited questions on social capital, unlike the more comprehensive data available from the Java survey, which is why I examine data from both sources in the paper.

I examine questions on social capital from both key informant surveys and individual household surveys. The key informant data come from the 1990 and 2003 PODES datasets, and are available for every village in Indonesia.[22] The data are obtained from the head of each village. I focus on the variables pertaining to the existence of social organizations that are common to both waves: sports, arts, public service, and youth activities.[23] I restrict the sample to exclude major cities (*kotamadya)* such as Jakarta, Surabaya, and Medan, and drop the conflict-ridden provinces of Aceh, Maluku, East Timor, and Irian Jaya, where there are serious concerns about data quality in all Indonesian government surveys. The summary statistics on participation in these activities, shown in column 2 of Table 2, reveal an increase in the

[22] The PODES has been conducted in Indonesia every three to four years since 1976. I use the 1990 wave as this is the most recent wave available prior to the introduction of private television in 1993. I use the 2003 wave to match the Java survey. While intermediate waves (e.g., 1993, 1996, and 2000) exist and contain some social capital measures, I do not have any intermediate measurements of television reception, so I cannot make use of this additional data.

[23] Specifically, for each village, I add up the number of types of activities (sports, arts, public service, and youth) that exist in the village. I then take the average value of this index for all villages in the subdistrict.

presence of these activities over time, with villages averaging 2.8 out of these 4 types of activities in 1990, and 3.2 out of these 4 types of activities in 2003.

The household survey data comes from the 1991 and 2003 SUSENAS socio-cultural module. The module was administered to 17,849 people in 1991 and to 155,832 people in 2003. The SUSENAS question on social capital asks if the respondent participated in any of a number of types of social organizations in the three months prior to the survey. I examine the types of social organizations that were asked about in both the 1991 and 2003 waves: religious organizations, sports groups, arts groups, youth groups, women's organizations, and mutual burial societies. In particular, I focus on a dummy variable for whether the respondent participated in any of these groups.

Data on Television Reception.—For the national sample, data on the number of channels received after the introduction of private television comes from the 2006 PODES, which was the first round of the PODES to include questions on television reception. This survey asked each village head in Indonesia whether each of the 11 national stations could "be received in his village without using either a satellite antenna or cable television."[24] As shown in column 2 of Table 2, on average, villages can receive about 6 of these 11 stations. In villages for which I have both television data from the Java survey and television data from PODES, the PODES data report substantially higher rates of reception for each station. This may be due to the fact that the PODES survey asked merely whether the station could be received in the village, whereas the Java survey asked if the station could be received clearly enough to watch, which is a somewhat more restrictive standard.[25]

For the panel analysis, I take advantage of the fact that private television was introduced in Indonesia (outside of Jakarta, which, as discussed above, is dropped from the sample) beginning in 1993.[26] I therefore assume that all subdistricts had access to only one channel (TVRI, the government channel) in the period prior to the introduction of private television.[27]

[24] Unfortunately, since this question on media access was not asked in any of the prior PODES surveys, I cannot construct finer detail on the rollout of private television across Indonesia.

[25] In the villages for which I have both datasets, the correlation between the television reception measures in the two datasets is 0.56. However, when I repeat the analysis from the Java survey using the PODES number of channels variable rather than the Java survey's number of channels variable, I find no statistically significant effects of the PODES number of channels variable on either the amount of time spent watching television or the number of social organizations in the village. I similarly find no effects if I instrument using the predicted signal strength estimated in Section VB. This may reflect the fact that the question used in the Java survey more precisely captures the variation in television reception relevant for actual television watching decisions.

[26] Prior to 1988, the only television available in Indonesia was the state-controlled TVRI station. Private television in Indonesia began in 1988 in Jakarta and 1990 in Surabaya, when RCTI and SCTV (respectively) began broadcasting scrambled signals that could be watched only with specially purchased decoders. Free, over-the-air, private broadcasts began in 1990 in Jakarta, in 1991 in Bandung and Denpasar, and in 1993 in other locations. (Depinfokom 2004).

[27] In the analysis based on the 1991 SUSENAS (individual-level data), I limit the sample to those subdistricts in which at least one individual reported watching any television in the previous week, so the assumption that there was one television station with reception in that area seems reasonable. Unfortunately, in the 1990 PODES, I have no information on whether television could be received in the village, so I assume that all villages can receive exactly one station.

B. *Identifying the Role of Topography Directly*

To further isolate the role of topography, I use a physical model of electromagnetic signal propagation, combined with data on the locations of television transmitters and the topography of Indonesia, to specifically isolate that part of private television reception that is due to the topography between villages and television transmission locations. For statistical power reasons, in this analysis, I focus on the national panel data.[28]

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 with permission from H. I. Ellington, E. Addinall, and M. C. Hately 1980), the 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-hand side 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 (George Hufford 2002), a modified version of the Longley-Rice model of electromagnetic propagation over the Earth's surface (A. G. Longley and P. L. 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 (Tom G. Farr et al. 2007), to look up the topography between the transmission and reception points. I also obtained the geographic coordinates of each subdistrict, as well as of each television transmitter.[29] For each subdistrict–television station pair, I use the ITM model to calculate the actual signal loss between the subdistrict and each of that television station's transmitters throughout Indonesia. I then subtract the signal loss from the television station's transmission power to obtain, for each subdistrict-transmitter pair, the predicted signal power a receiver would get. For each subdistrict-channel pair, I take the maximum of these predicted signal powers in that subdistrict across all transmission towers as the "predicted signal strength" of that channel in that particular subdistrict.

[28] As shown in the working paper version of this paper (Olken 2006), while a similar instrumentation strategy works for the Java study, the first-stage *F*-statistic on the excluded instruments is only 2.96, which suggests that there is not sufficient power to use this approach for the Java study.

[29] I take the center of the subdistrict as the geographic coordinate of the subdistrict. For the transmitters, when the specific mountain or location of the transmitter was specified, I used that location. If not, I used the coordinate of the center of the village in which 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.

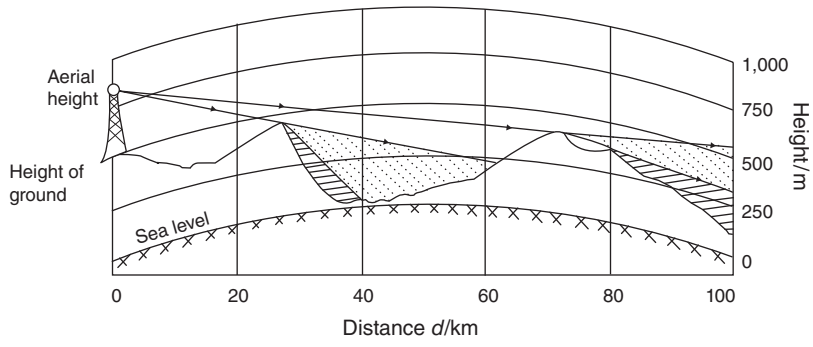

FIGURE 2. THE PHYSICS OF BROADCASTING

Notes: The dotted areas denote reduced reception; the hatched areas show regions of almost nil reception. In the mountain to the left, the area of no reception is caused by the tight angle of refraction required. In the mountain to the right, the area of no reception is caused by double-refraction off the primary and secondary peak. The figure and description are reproduced with permission from Ellington, Addinall, and Hately (1980).

This "predicted signal strength" captures both the effects of topography as well as the facts that some subdistricts 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 subdistrict (i.e., the signal strength that would have been obtained in that subdistrict 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 Jianqing Fan (1992) nonparametric, locally weighted regression, where the dependent variable is whether the village head reports that the channel can be received in the village and the independent variable is the predicted signal strength (labeled "Power" in the Figure). The dashed lines indicate bootstrapped 95 percent confidence intervals. Figure 3 shows a strong, positive, and tightly estimated relationship between predicted signal strength and the percent of villages that report being able to receive the channel for each of the 11 channels I examine. Moreover, the *S*-shape relationship between signal strength and television reception appears virtually identical for all channels.

Given that the model predicts 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:

$$(4) \qquad NUMCHANNELS_{sd} = \alpha_d + \gamma_1 SIGNAL_{sd} + \gamma_2 FREE_{sd} + \mathbf{X}_{sd}\delta_1 + \delta_2 GEOGRAPHY_{sd} + \varepsilon_{sd},$$

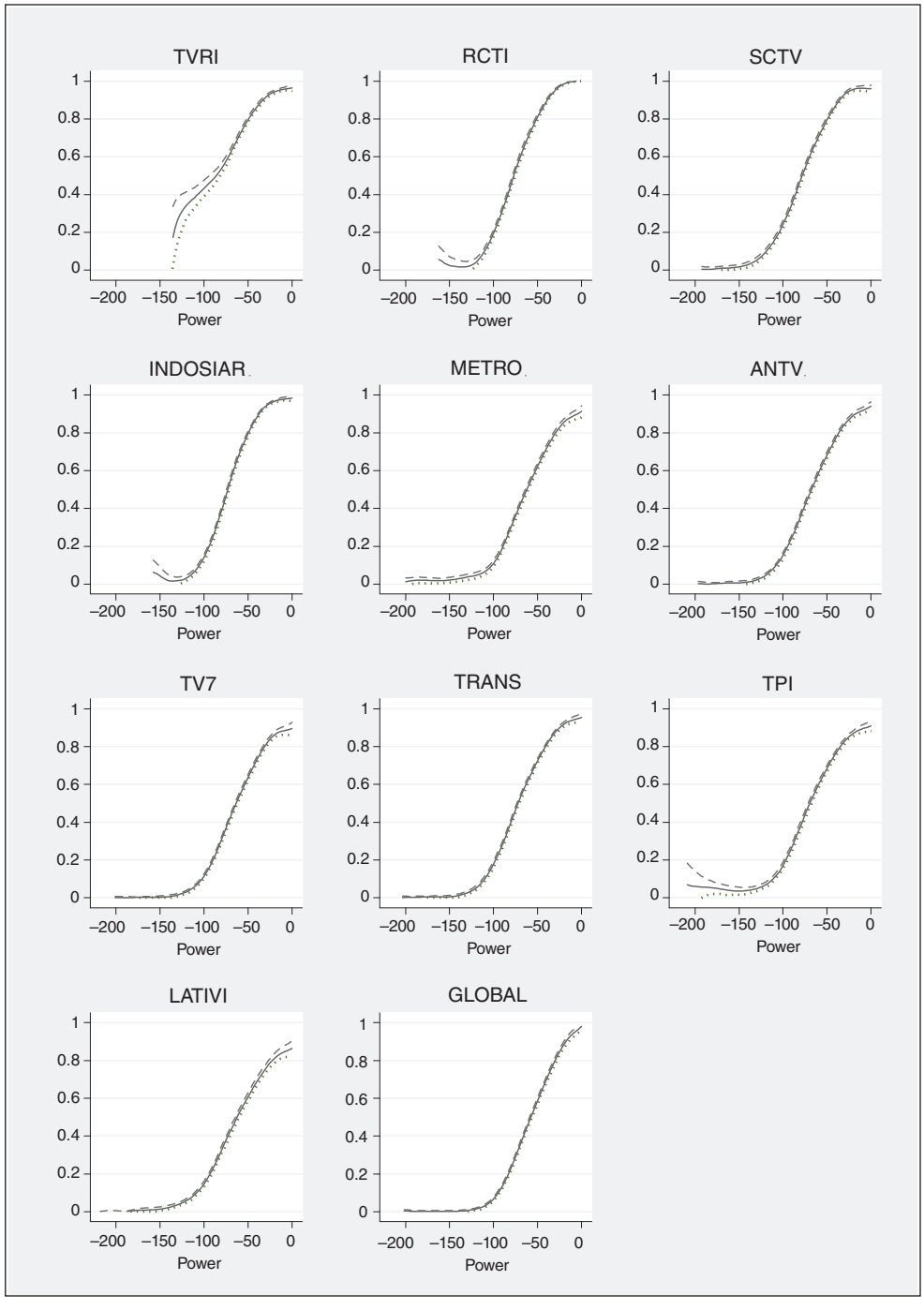

FIGURE 3. TELEVISION RECEPTION AND PREDICTED SIGNAL STRENGTH

Notes: Each graph shows the results of a Fan (1992) regression for a particular television channel using all subdistricts in the 2006 PODES dataset. 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 is the percentage of village heads in the subdistrict reporting that the channel can be received in his or her village. Bootstrapped 95 percent confidence intervals are shown in dashes, adjusting for clustering at the subdistrict level.

where *SIGNAL* represents the average signal strength of all channels in subdistrict *s*, and *FREE* represents the average free-space signal strength of all channels in subdistrict *s* (i.e., what the signal strength would have been if there was a direct line of sight between the transmitter and receiver). In all specifications, I continue to include district fixed effects (α_d), and all of the geographic controls and subdistrict characteristics used in Table 3 that are available in the national data.[30] 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 subdistrict elevation, which rural subdistricts receive reception is driven largely by the happenstance of topography. The coefficient on *SIGNAL* captures precisely this effect.

The results from estimating equation (4) are shown in Table 10. Column 1 reports the results for all subdistricts present in the 1990 and 2003 PODES datasets, and column 2 reports the results for all subdistricts present in the 1991 and 2003 SUSENAS datasets. (There are far fewer subdistricts in SUSENAS since SUSENAS is a sample, whereas PODES is a census.) As expected given Figure 3, I find a strong, positive relationship between average signal strength and the number of channels reported. The fact that the *SIGNAL* results are strong, even controlling for *FREE*, confirms that there is significant variation in signal strength due to mountains blocking signal transmission. Moreover, the *F*-statistic on the average signal strength variable (conditional on average free-space signal strength, district fixed effects, and the other control variables) is 92.5 in the PODES sample and 42.0 in the SUSENAS sample, which suggests that the instrument is quite strong (Douglas Staiger and James H. Stock 1997).

There are advantages and disadvantages to using only the variation from the ITM model to analyze the impact of television reception. One advantage is that this approach allows me to pinpoint the variation in television reception I am using. It also may potentially help correct for measurement error in the number of channels variable. One disadvantage 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. For the national sample, I report two sets of results. One set using the full residual variation in number of channels received, and another set that isolates the effect of topography by using *SIGNAL* as an instrument for the number of channels received, controlling for *FREE*.

C. *Results: Impacts on Social Capital*

I estimate the following regression, using both subdistrict-level aggregate data from the key informant based PODES and individual-level data from the SUSENAS:

$$(5) \quad SOCIALCAPITAL_{sdti} = \alpha_{sd} + \alpha_{dt} + \beta\, NUMCHANNELS_{sdt} + \mathbf{X}_{sdti}\,\delta + \varepsilon_{sdti}.$$

[30] The *F*-statistic on *SIGNAL* is even larger if these village controls are not included.

TABLE 10—ISOLATING THE IMPACT OF TOPOGRAPHY—NATIONAL PANEL SAMPLE

	Number TV channels	
	PODES 1990–2003 sample (1)	SUSENAS 1991–2003 sample (2)
Average signal strength	0.037***	0.043***
	(0.004)	(0.007)
Average free-space signal strength	0.027	0.026
	(0.021)	(0.041)
Observations	2,025	725
Mean dep. var.	6.95	6.58
F-test of average signal strength	92.54	41.98

Notes: Unit of observation is a subdistrict. All specifications include district fixed effects and all village controls in Table 3. Robust standard errors are in parentheses. Subdistrict and district variables are defined using 1990 boundaries.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

In this equation, $SOCIALCAPITAL_{sdti}$ are the various social capital measures I examine (described in more detail below), t represents a wave of the survey, $NUMCHANNELS_{sdt}$ is the number of channels that can be received in subdistrict s (located in district d) in year t, α_{sd} is a subdistrict fixed effect, and α_{dt} is a district $\times$ survey wave fixed effect. For individual-level regressions, i represents an individual, and $\mathbf{X}_{sdti}$ represent individual-level control variables, including age, gender, education, log per capita household expenditure, and whether the household has electricity. There are two waves of the data, with the first wave (1990 for subdistrict-level data and 1991 for individual-level data) coming from the period when there was only one private television channel, and the second wave (2003) coming from the period after private television had been introduced. As discussed above, in the first period, I set $NUMCHANNELS_{sdt}$ equal to one, and in the second period, I set $NUMCHANNELS_{sdt}$ equal to the average number of channels that the village heads in that subdistrict reported being able to receive in 2006. Note that by including district $\times$ survey wave fixed effects (α_{dt}), I allow flexibly for changes in the social-capital environment, over time, in different parts of Indonesia.[31] This specification is therefore the panel equivalent of equation (3), and is identified off of subdistrict-by-subdistrict changes in television reception looking within districts of Indonesia.[32]

To isolate the impact of topography using the model of electromagnetic signal propagation, I re-estimate equation (5), where I treat $NUMCHANNELS_{sdt}$ as an endogenous variable, include $FREE_{sd} \times WAVE2003_t$ as an additional control, and use $\text{SIGNAL}_{sd} \times WAVE2003_t$ as an instrument. This approach isolates the variation

[31] For example, district $\times$ time fixed effects would absorb all the variation in industrialization used by Miguel, Gertler, and Levine (2006).

[32] Note that although private radio was well established prior to 1991, it is possible that radio access may also have been increasing during this period. Since radio reception is likely correlated with television reception, these effects should, once again, be thought of as identifying net effects of television and radio on social capital.

Table 11—Participation in Social Groups—Subdistrict Panel, National Sample

	Village-level data (PODES)	Individual-level data (SUSENAS)
	Number of types of organizations in village (1)	Participate in any organization in last 3 months (2)
Panel A. Full residual variation		
Number of TV channels	−0.014**	−0.024**
	(0.006)	(0.010)
Observations	5,274	55,234
Mean dep. var.	3.03	0.54
Panel B. Isolating impact of topography		
Number of TV channels	−0.005	−0.080***
	(0.020)	(0.022)
Average free-space signal strength	0.005	−0.003
× wave dummy	(0.006)	(0.006)
Observations	4,500	49,796
Mean dep. var.	3.03	0.55

Notes: In column 1, the unit of observation is a subdistrict in a particular wave of the survey, where subdistrict variables represent the average value of the variable for all villages in the subdistrict. In column 2, the unit of observation is an individual respondent, and include controls for the respondent's age, gender, log per capita expenditure, and years of education. All regressions include district × wave fixed effects and subdistrict fixed effects. Robust standard errors are in parentheses, adjusted for clustering at subdistrict level. In panel B, estimation is by two-stage least squares, with the average signal strength interacted with a wave dummy as the excluded instrument. Subdistrict and district boundaries are all defined using 1990 boundaries.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

in signal strength among the new signals that are due to mountains that lie between the transmitting and receiving location.

The panel results using the full residual variation are presented in panel A of Table 11, and the panel results isolating the impact of topography are presented in panel B of Table 11. In column 1 of panel A, the dependent variable is the average number of types of organizations present in villages in the subdistrict using data from the PODES. Since the PODES contains data on the presence of four types of social organizations—sports, arts, public service, and youth activities—the dependent variable ranges from zero to four. The estimate in column 1 shows that each additional channel is associated with a reduction of 0.014 in the number of types of organizations present in the village. While this effect may seem small, it is worth remembering that the variables in the PODES captures only whether each of these four types of organizations exists, and has no information about the intensity of participation, so these small changes in the number of types of organizations that exist may mask much larger changes in participation rates.

In column 2 of panel A, I repeat the same specification using the individual-level SUSENAS data. The dependent variable is a dummy for whether the individual participated in any of six types of social activities (religious organizations, sports

groups, arts groups, youth groups, women's organizations, and mutual burial societies) over the previous three month period. The impact of improved television reception is negative and quite large in magnitude. Each additional channel of television reception reduces the percentage of respondents participating in social activities by 2.4 percentage points, or about 5 percent of the mean level of the dependent variable. In results not reported in the table, I have also examined the impacts one-by-one for individual types of groups. The point estimates suggest that this reduction comes from declines in religious groups (the point estimate is a 1.7 percentage point reduction in participation per additional television channel), youth organizations (the point estimate is a 0.6 percentage point reduction in participation per additional television channel), and mutual burial societies (the point estimate is a 2.1 percentage point reduction in participation per additional television channel).

The results isolating the impact of topography are presented in panel B of Table 11. In column 1, using the instrumented version of signal strength attenuates the coefficient, so that the effect of an additional channel is a (statistically insignificant) reduction of 0.005 in the number of types of organizations present in the village. Using the household data in column 2, the instrumented results suggest that an additional television channel reduces the percentage of respondents participating in social activities by a statistically significant 8.0 percentage points, or about 14 percent of the mean level of the dependent variable. The fact that these results are qualitatively similar using the instrumental variables approach suggests that the variation due to mountains between transmitting and receiving locations is indeed driving the results.

VI. Conclusion

This paper examines the link between exposure to television and radio, and social capital. To do so, I exploit two sources of plausibly exogenous variation in the number of television (and radio) channels households can receive. One method uses the fact that the topographical features of rural Indonesia mean that some villages receive many channels, whereas nearby villages, for which direct "line of sight" to major cities is blocked by mountains, receive fewer channels. The second method examines the differential introduction of private television in Indonesia between the early 1990s, when the only television station was the government-run TVRI, and the mid 2000s, when there were as many as 11 television stations broadcasting across the country.

These two methods tell a very consistent story: increased access to television signals led to reduced participation in social groups. I show that each additional channel of television reception is associated with 14 additional minutes per day spent watching television and listening to the radio. This translates into participation in substantially fewer social groups. 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 participating in about 4 percent fewer types of groups over a 3 month period. The results that detail the impact of the introduction of private television tell a similar story. Each additional channel of television that can be received in a village is associated with fewer types of social organizations existing in villages and lower rates of participation in those organizations. Using a model of

electromagnetic signal propagation to isolate the effect of mountains in the panel data shows qualitatively similar results. The data also reveal 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 of a village road-building program. Despite finding a negative impact of better television on attendance at village meetings about the road project, 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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