It Is Never Too Late: Educational Television and Local Economic Development*

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Abstract

Can technology relax constraints on educational supply and expand local productive capacity? We exploit a quasi-natural experiment in postwar Italy to estimate the causal impact of educational television on literacy and local economic activity. In 1960, the Italian public broadcaster and the Ministry of Education expanded televised adult education, with *Non è mai troppo tardi* ("It Is Never Too Late") as a flagship program—a literacy course supported by a national network of collective viewing centers. We digitize historical records of transmitter locations and technical characteristics to predict reception and link these predictions to population and industrial censuses. Identification uses variation in signal diffraction caused by topography, conditional on transmitter placement. Stacked long differences across the 1951, 1961, and 1971 censuses cover roughly 7,700 municipalities. A one-standard-deviation increase in signal strength raised literacy by 0.18 percentage points during the program decade relative to the preceding decade. It also increased labor-force participation by 1.0 percentage point overall and 1.4 points among women, shifted employment out of agriculture, and increased the number of manufacturing establishments. Labor-market outcomes also responded to reception in neighboring municipalities within approximately 15 kilometers, consistent with effects operating across local labor markets. The results suggest that broadcast technology can extend educational provision and support structural transformation, with economic effects extending across municipal boundaries.

JEL: I26, J24, L82, N34, O15, R23. **Keywords:** television, adult literacy, human capital, local labor markets, externalities.

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1 Introduction

Expanding education usually requires expanding the infrastructure that supplies it: schools, teachers, and access to classrooms (Duflo 2001). These requirements can be especially restrictive for adults who left school without basic skills and live far from educational institutions. Communication technology offers a different way to increase supply. A lesson produced in one place can reach learners in many others, spreading the cost of developing instruction across communities. Televised lessons with local support offer one way to extend teaching expertise beyond the locations where instructors work (Borghesan & Vasey 2024). Whether access translates into learning, however, depends on adults' ability to use the material and on the support available where they live (Aker et al. 2012, Escueta et al. 2020). Whether learning translates into economic opportunity also depends on the labor market around them (Foster & Rosenzweig 1996, Adukia et al. 2020).

This paper studies a national attempt to relax these constraints through educational television. In 1960, the Italian public broadcaster, RAI, and the Ministry of Education launched *Non è mai troppo tardi* ("It Is Never Too Late"), a literacy course for adults without an elementary-school certificate. The program ran until 1968 and formed part of RAI's broader educational mission. Its lessons could be received wherever television reception and access to a set permitted; collective viewing centers additionally provided shared access and local instruction. This combination of centrally produced content and distributed delivery made postwar Italy an important early setting in which to study technology as an expansion of educational supply.

We ask whether better access to this educational programming improved literacy and changed local economic activity. We then examine whether the employment response was confined to the municipality receiving the broadcast or extended to neighboring places. The distinction matters for both interpretation and policy. A program that changes skills can affect the allocation of workers and the location of establishments across a labor market. Effects measured only where learners reside may therefore miss part of the geographic response, even when the learning itself occurs locally (Redding & Rossi-Hansberg 2017).

Our design combines newly digitized historical transmitter records with the population and industrial censuses of 1951, 1961, and 1971. We reconstruct the RAI network operating in 1957, recording transmitter locations and technical characteristics, and use the Longley–Rice propagation model to predict reception across roughly 7,700 municipalities. Identification uses variation in signal diffraction caused by topography, conditional on the free-space signal that would be received without intervening terrain. This approach follows Olken (2009) and

Durante et al. (2019). Measuring the network before the literacy program began limits direct targeting of its eventual beneficiaries, while the free-space measure accounts for an important component of nonrandom transmitter placement.

We estimate stacked long differences, comparing the relationship between reception and outcome changes in 1961–71 with the corresponding relationship in 1951–61. The coefficient captures a change in the reception gradient across decades, rather than a cross-sectional difference between well-connected and isolated towns. Its causal interpretation requires that this gradient would otherwise have remained stable, conditional on the specification. The timing is imperfect: television began in 1954 and the literacy program in November 1960, before the 1961 census. We therefore interpret the estimates as the differential response during the main program decade relative to an earlier decade with general television and limited initial program exposure. They measure potential access, not the effect of an individual choosing to watch.

The first result is an improvement in literacy. In the preferred specification, a one-standard-deviation increase in signal raised the literacy rate by 0.18 percentage points in the program decade relative to the preceding decade (standard error 0.07). Relative to the average 2.6-point literacy increase in 1961–71, this is approximately 7%; a tenth-to-ninetieth-percentile difference in signal implies a 0.45-point response, or about 17% of that increase. The coefficient remains positive in smaller municipalities and in comparisons between nearby municipalities with similar free-space reception. Educational attainment responds most clearly at the primary-certificate margin, the qualification targeted by the program. The census outcome reported here covers residents aged six and above; it is consistent with an adult-education mechanism but does not by itself isolate learning among adults already beyond school age at launch.

The second result is a broad labor-market response. A one-standard-deviation increase in signal raised labor-force participation by 1.02 percentage points and employment by 0.80 points. The participation coefficient is larger for women, at 1.43 points, than for men, at 0.67 points. The agricultural employment share declined by 0.93 points and the industrial share increased by 0.86 points. Establishment data provide a separate measure of activity at the workplace: manufacturing establishment counts increased by approximately 3.2%, and total establishment employment rose by 0.77 employees per hundred residents. These patterns connect the expansion of educational television to structural transformation. They do not identify which newly literate residents entered employment or establish that literacy was the only channel through which television affected the economy.

The third result concerns geography. In specifications that include both local and neighboring

reception, labor-force participation and employment respond strongly to the mean signal in other municipalities within 15 kilometers. Distance-ring estimates place the clearest responses within this radius; estimates for the 15–25-kilometer ring are imprecise and close to zero. This pattern is consistent with effects shared across a local labor market. Commuting, changes in labor demand, migration, and the diffusion of information or skills could all contribute. We use an instrumental-variables calculation to relate the employment and literacy responses, but treat it as a mechanism benchmark: its first stage is weak, and interpreting the ratio as a return to literacy requires excluding television's other effects on employment.

The distributional evidence is informative but less uniform. Female participation responds more strongly in point estimates. Literacy effects are also larger in initially less literate towns and in towns with a collective viewing center, but neither difference is statistically precise. Participation responds more in initially more literate towns, suggesting that initial economic conditions may matter for converting educational access into employment. Baseline literacy is not a direct measure of labor demand, so this interpretation remains a hypothesis about the mechanism rather than an identified demand effect.

Our contribution is to connect an expansion of educational supply to both residents' skills and the location of economic activity. Combining population and industrial censuses allows us to study employment among residents alongside jobs in local establishments. These margins need not move together when workers commute or migrate. Neighboring reception then allows us to examine whether economic responses extend beyond the municipality receiving the educational broadcast.

The paper proceeds as follows. Section 2 describes the setting and Section 3 develops the economic mechanisms. Sections 4 and 5 introduce the data and research design. Sections 6 and 7 report the main estimates and sensitivity checks. Section 8 and 9 examines spatial spillovers and heterogeneity. Section 10 discusses what the evidence implies for evaluating the intervention, and Section 11 concludes.

1.1 Related literature

The paper connects research on educational supply, the effects of media content, and human capital in local economies. School construction provides a prominent example of expanding educational supply: Duflo (2001) estimates effects on schooling and wages, while Duflo (2004) examines labor-market responses among workers outside the directly exposed cohorts. Our setting changes how instruction is supplied to people who have already left school. Broadcasting distributes a common curriculum nationally, while receivers and viewing centers

provide local access. This allows us to examine educational provision beyond conventional school-age enrollment and to follow its effects into local employment and establishments.

A closely related literature studies technology as an educational input. Banerjee et al. (2007) evaluate computer-assisted learning alongside a separate remedial-instruction intervention, and Muralidharan et al. (2019) study personalized technology-aided instruction. Escueta et al. (2020) distinguish access to devices from instructional applications and other uses of technology. Particularly relevant to our adult-education setting, Aker et al. (2012) find that adding mobile-phone instruction to adult literacy and numeracy classes in Niger improves learning. Broadcast television offers a different delivery model: common lessons reach geographically dispersed audiences.

Within the television literature, Gentzkow & Shapiro (2008) study early viewing and later achievement, while Kearney & Levine (2019) examine preschool instruction through *Sesame Street*. Mexico's *telesecundarias* provide a particularly close comparison in their use of televised lessons and local facilitators. Borghesan & Vasey (2024) estimate learning gains relative to conventional secondary schools, and Fabregas & Navarro-Sola (2025) study the long-run schooling and earnings effects of expanding access to these schools. The comparison in Borghesan & Vasey (2024) is between two school types among students continuing into secondary education. Our design instead studies variation in broadcast access during an expansion of adult-directed instruction. We examine municipal literacy, including residents aged six and above, alongside workplace outcomes and responses to neighboring reception. The contribution therefore concerns access to basic instruction beyond conventional schooling and its reach across local economies.

The media literature shows why content, audience, and the activities displaced by viewing matter (DellaVigna & La Ferrara 2015). La Ferrara et al. (2012) link access to Brazilian soap operas portraying small families to lower fertility, using naming patterns and program content to investigate the mechanism. Durante et al. (2019) document the later political consequences of early access to Mediaset's entertainment television in Italy and lower adult cognitive skills among those exposed as children. Related studies examine women's status, consumption, and social participation (Jensen & Oster 2009, Bursztyn & Cantoni 2016, Olken 2009). Our contribution is to study broadcasting deliberately used to expand educational provision for the adult population. The literacy and primary-qualification outcomes connect the analysis to the instructional content, while the labor-market and demographic outcomes allow a broader economic assessment. These outcomes can also respond to information, aspirations, and family choices, so comparisons across studies do not identify the effect of replacing entertainment with education.

Finally, the paper relates to human capital and local development (Glaeser 1994, Moretti 2004*a*, 2012). Acemoglu & Angrist (2000) use compulsory-schooling laws to investigate external returns, and Moretti (2004*b*) studies plant productivity and the education of workers elsewhere in the same city. Our establishment records bring the workplace into an evaluation of educational access, although they measure employment and establishment counts rather than productivity. In their evaluation of Empowerment Zones, Busso et al. (2013) distinguish effects on residents from effects on workers employed in the area. We apply this distinction to educational access by examining resident employment and establishment employment separately. Spatial models explain how commuting, migration, and goods and factor markets connect neighboring places (Redding & Rossi-Hansberg 2017). Research on regional development further distinguishes who benefits locally from whether activity expands in the wider economy (Kline & Moretti 2014*a*,*b*). We contribute evidence on the geographic reach of an education intervention, without treating every response to neighboring reception as a human-capital externality.

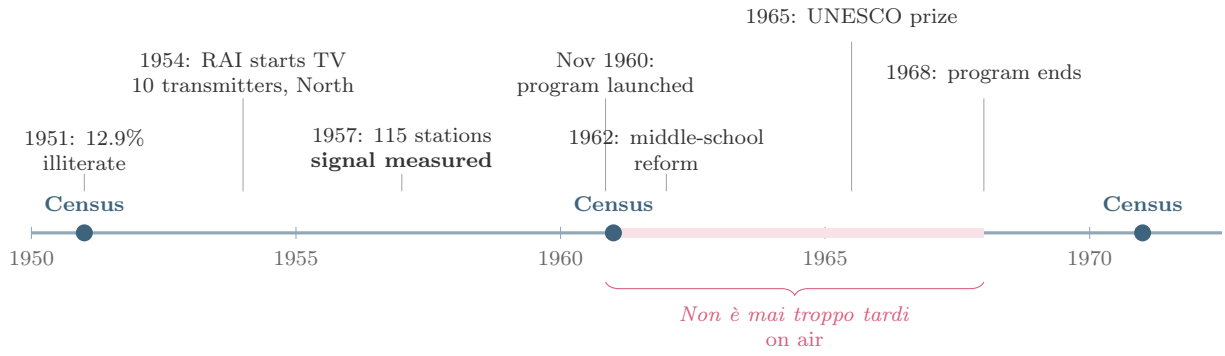
2 Educational supply and television in postwar Italy

2.1 Literacy and the limits of formal schooling

Postwar Italy combined rapid industrialization with large gaps in basic education. The 1951 census recorded an illiteracy rate of 12.9%, with substantial differences across regions and between men and women (Genovesi et al. 2007). Rural and southern communities faced particularly limited educational provision. RAI's contemporary accounts emphasized shortages of schools and teachers, transport difficulties, and the low schooling of earlier generations. These conditions limited access to instruction even as the economy created new demands for basic skills.

Adult education presented a distinct supply problem. Expanding compulsory schooling could improve the education of incoming cohorts, but adults who had already left school needed other routes back into instruction. Law No. 1859 of December 1962 established a unified, free, three-year compulsory middle school following elementary education (Repubblica Italiana 1962, arts. 1 and 8). Televised adult education addressed a different target population: people without an elementary certificate, including those well beyond compulsory-school age. Both changes could nevertheless affect the aggregate census outcomes used here. Their different target groups help motivate the analysis; they do not make the schooling reform irrelevant to identification.

Figure 1: Timing of the research design. The transmitter network is measured in 1957 and the literacy course begins in November 1960. The 1951–61 comparison decade includes the introduction of general television and the first months of the course; 1961–71 contains most of the program's operation.



2.2 RAI and the pre-program transmission network

RAI began regular television broadcasting in 1954. Its initial network was concentrated in northern and central Italy and reached roughly 36% of the population. Coverage expanded rapidly: the historical records used in this project identify 144 transmitting stations active by the end of 1957, when coverage was just under 80%, compared with approximately 98% by 1961. A second channel began broadcasting in 1961. RAI's public-service mission included education as well as information and entertainment, and educational programming developed alongside the expansion of the network.

We reconstruct the network as it stood in 1957. This date precedes the November 1960 launch of the literacy course and avoids using transmitters installed in response to its realized demand. It does not make the network random or fully mature: coverage continued to expand, and early placement could reflect population, economic conditions, and geographic accessibility. The empirical design therefore combines the predetermined network with a propagation model and controls for free-space reception. Figure 1 places the transmitter measurement, the program, the schooling reform, and the censuses on the same timeline.

2.3 The literacy course and collective viewing centers

Educational television preceded the literacy course. RAI introduced *Telescuola* in 1958, combining televised lessons with organized local access. This experience supplied a delivery model for subsequent courses: instruction produced centrally, television sets shared locally,

Figure 2: *Non è mai troppo tardi*, 1960–1968.



(i) Alberto Manzi teaching on RAI.

Italian TV Tunes Villagers In on Nation's Life

By JACK GOULD
Special to The New York Times

. Equally striking are the early evening programs, gracefully entitled "Never Too Late," intended to aid the illiterate and semi-literate. Under a monopo-

(ii) *New York Times*, 1962.

and coordinators or teachers who could support viewers. The distinction between the broader educational service and a particular program is important when interpreting historical accounts of broadcast hours, enrollment, and expenditure.

On 15 November 1960, RAI and the Ministry of Education launched *Non è mai troppo tardi*, presented by the teacher Alberto Manzi (Rai Teche 2025). Its purpose was to help adults acquire literacy and prepare for the elementary-school certificate. Lessons aired in the early evening, allowing people to watch after work. Visual demonstrations, drawings, and familiar examples were used to teach reading and writing to an audience with little formal schooling. The course ran until 1968 and became a prominent example of RAI's educational mission (Figure 2i). Historical accounts associate it with substantial participation and certification, but administrative totals are not estimates of the number who would otherwise have remained illiterate.

The program combined broadcasting with collective viewing centers, known as *punti di ascolto* and referred to below as viewing centers. A shared television set extended access to people without one at home, while local instruction could help learners follow the course and prepare for the examination. This arrangement made receiving infrastructure and learner support potential complements to the broadcast. Our digitized register contains 1,140 centers in 943 municipalities; approximately 40% were hosted by parishes and 15% by schools. These are the centers recorded in the surviving source, not necessarily the complete network in every year. Section 9 examines whether reception effects differed with a recorded center's presence, recognizing that center placement was not random.

3 Educational access and local economic adjustment

Broadcasting can relax a supply constraint by distributing the same lesson to many locations without replicating an entire school in each one. Its effect on learning still depends on access to a receiver, the suitability of the content, and the time and support available to learners. This distinction between equipment and its instructional use also underlies the educational-technology literature (Escueta et al. 2020). In this setting, reception changes potential access to a common curriculum; viewing centers can change the ability to make use of that access. Neither reception nor a center's presence directly measures attendance or learning effort.

The relevant alternative is the instruction adults could obtain without the broadcast. If local courses were scarce, television could expand access; where courses existed, it could supplement or displace them. The availability of primary schools for children is not itself a measure of adult educational provision. Broadcast content and local assistance may also play different roles: centrally produced lessons can economize on specialized teaching, while local staff help learners use them. Distinguishing these mechanisms requires evidence on pre-existing educational options and participation, beyond reception alone.

Three mechanisms connect educational access to the local economy. First, literacy or an elementary certificate may expand the jobs a person can perform or apply for. Second, a larger pool of workers with basic skills may affect establishments' hiring, location, or production decisions. Third, these changes can cross municipal boundaries through commuting, migration, product demand, and the exchange of information. Television may also affect employment independently of literacy, for example by changing aspirations, information, or gender norms. The empirical analysis distinguishes observed responses from these candidate mechanisms.

The skill channel is especially relevant in a changing economy. Nelson & Phelps (1966) emphasize education's role in interpreting information and adapting to new technologies. Foster & Rosenzweig (1996) show that technical change during India's Green Revolution increased returns to schooling and induced educational investment. These contributions motivate a complementarity between access to basic instruction and local productive opportunities. In postwar Italy, literacy could facilitate adjustment to new jobs and production methods; our aggregate outcomes do not directly measure technology adoption.

Educational supply and changing aspirations may also reinforce one another. A viewer may become more willing to pursue paid work or a qualification while receiving instruction that makes those choices feasible. Evidence on television and women's status motivates the role of changing aspirations and household choices (Jensen & Oster 2009, La Ferrara et al. 2012);

the literacy curriculum supplies a concrete basis for the skill channel. This complementarity is a hypothesis about the intervention, not a mediation result. It makes the joint study of skills and economic behavior useful while leaving open how much of the employment response is attributable to each channel.

To organize the spatial evidence, let L_i denote a municipality's literacy rate and E_i an employment outcome. A schematic relationship is

$$\Delta E_i = a\,\Delta L_i + b\,\overline{\Delta L}_{\mathcal{N}(i)} + v_i, \tag{1}$$

where $\mathcal{N}(i)$ contains nearby municipalities. This equation describes possible geographic channels; the reduced-form regressions do not separately identify a and b. In particular, a can include responses of other residents and local establishments, while b can reflect commuting or demand reallocation as well as learning externalities. A response to neighboring reception is therefore evidence about the reach of the intervention, not automatically a technological externality from human capital.

A separate accounting exercise benchmarks how much employment could increase solely because newly literate people became employed. With fixed populations, let N_i^L and N_i^E be the denominators of the literacy and employment rates. If every additional literate person belongs to the employment-eligible population, and each moves from nonemployment to employment while nobody else changes status, then

$$\frac{\Delta E_i^{\text{direct}}}{\Delta L_i} \leq \frac{N_i^L}{N_i^E} \equiv \bar{\pi}_i. \tag{2}$$

The numerator is the literacy population and the denominator the employment population: a given number of people has a larger percentage-point effect on the smaller population. Using the approximate ratio of the two age bases gives a benchmark of $\bar{\pi} = 1.2$. It is a bound on a narrow direct-employment mechanism, not on private earnings returns or welfare. It assumes fixed population composition and comparable rate definitions. Migration, changes among already literate people, or other effects of television can invalidate an inference from exceeding this benchmark to literacy externalities. Section 8 uses it with these qualifications.

4 Data

4.1 Population and establishment outcomes

We combine the population and industrial censuses of 1951, 1961, and 1971, harmonized to constant 1971 municipal boundaries. The population censuses measure literacy, educational attainment, labor-force participation, employment, and sectoral employment shares. The literacy rate is the share of residents aged six and above who can read and write. It is a population outcome, rather than a panel measure of adults who were illiterate when the program began. We use "adult education" to describe the intervention's target population and "literacy rate" to describe this measured outcome.[1]

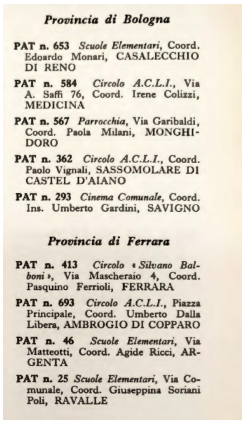
Educational attainment distinguishes no qualification, primary, lower-secondary, upper-secondary, and university qualifications. Labor-force participation and employment are reported overall and by sex; employment shares distinguish agriculture, industry, services, and commerce. The historical age coverage and classification of economic activity must be taken into account when comparing levels across censuses. Our design studies the reception gradient in decade changes, but common changes in definitions could still matter if they affect places differently. Births, deaths, and marriages per thousand residents provide additional demographic outcomes.

The industrial censuses measure activity at the workplace. They report local units and employees by industry, which we group into manufacturing, commerce, and other services. A local unit is an establishment rather than necessarily a separate enterprise. We therefore use "establishments" for these outcomes, and distinguish employees located in a municipality from employed residents counted in the population census. Jointly, the two sources describe changes in residents' employment and the local availability of jobs. They do not link workers to workplaces: differences in coverage and denominators prevent us from interpreting the difference between their estimated effects as a commuting response. Changes in establishment counts measure net changes in the stock; without linked establishment histories, they do not separately identify gross entry, exit, or relocation.

We also assemble municipality-level public works and industrial subsidies financed by the *Cassa del Mezzogiorno* from the ASET database. These measures allow a sensitivity check for contemporaneous development spending in southern Italy. The common census panel

[1] Residents who can only read or only write are classified as illiterate. The elementary *proscioglimento* certificate was counted as an elementary qualification in 1951 but not from 1961 onward, when its holders were classified as literate without a title. This change does not alter the literacy definition but matters for interpreting changes in primary attainment across the two decades.

Figure 3: Newly digitized archival sources.



Provincia di Bologna

PAT n. 653 *Scuole Elementari*, Coord. Edoardo Monari, CASALECCHIO DI RENO

PAT n. 584 *Circolo A.C.L.I.*, Via A. Saffi 76, Coord. Irene Colizzi, MEDICINA

PAT n. 567 *Parrocchia*, Via Garibaldi, Coord. Paola Milani, MONGHIDORO

PAT n. 362 *Circolo A.C.L.I.*, Coord. Paolo Vignali, SASSOMOLARE DI CASTEL D'AIANO

PAT n. 293 *Cinema Comunale*, Coord. Ins. Umberto Gardini, SAVIGNO

Provincia di Ferrara

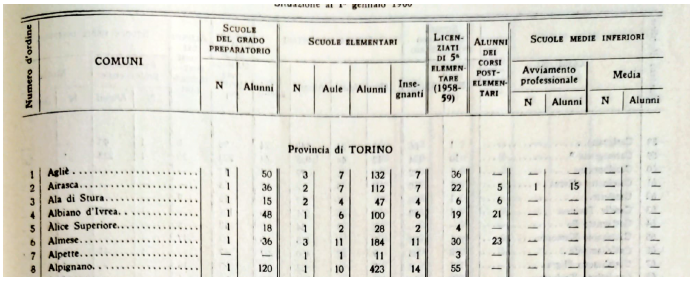
PAT n. 413 *Circolo «Silvano Balboni»*, Via Mascheraio 4, Coord. Pasquino Ferrioli, FERRARA

PAT n. 693 *Circolo A.C.L.I.*, Piazza Principale, Coord. Umberto Dalla Libera, AMBROGIO DI COPPARO

PAT n. 46 *Scuole Elementari*, Via Matteotti, Coord. Agide Ricci, ARGENTA

PAT n. 25 *Scuole Elementari*, Via Comunale, Coord. Giuseppina Soriani Poli, RAVALLE

(i) Collective viewing-center register.



Numero d'ordine	COMUNI	Scuole del grado preparatorio		Scuole elementari				Licenziati di 5ª elementare (1958-59)	Alunni dei corsi post-elementari	Scuole medie inferiori			
										Avviamento professionale		Media	
		N	Alunni	N	Aule	Alunni	Insegnanti			N	Alunni	N	Alunni
	Provincia di TORINO												
1	Agliè	1	50	3	7	132	7	36	—	—	—	—	—
2	Airasca	1	36	2	7	112	7	22	5	1	15	—	—
3	Ala di Stura	1	15	2	4	47	4	6	6	—	—	—	—
4	Albiano d'Ivrea	1	48	1	6	100	6	19	21	—	—	—	—
5	Alice Superiore	1	18	1	2	28	2	4	—	—	—	—	—
6	Almese	1	36	3	11	184	11	30	23	—	—	—	—
7	Alpette	—	—	1	1	11	1	3	—	—	—	—	—
8	Alpignano	1	120	1	10	423	14	55	—	—	—	—	—

(ii) Primary-school statistics.

contains roughly 7,700 municipalities. Individual regressions can differ in coverage; the reported estimates should be interpreted for their available samples.

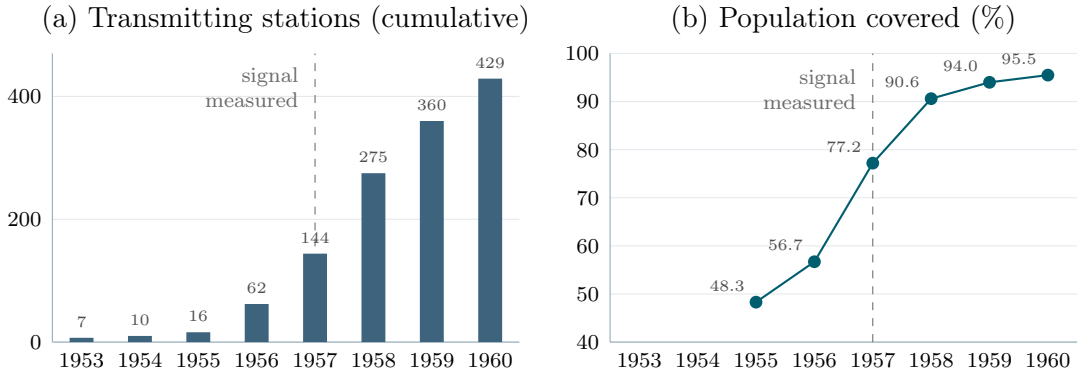
4.2 Program infrastructure and schools

We digitize the viewing-center register, including the municipality and host institution of each recorded center, and municipal primary-school statistics from the Ministry of Education for 1960 and 1965. The school records report schools, classes, teachers, pupils, and primary certificates awarded. Figure 3 illustrates both sources. The center register enters the heterogeneity analysis; the school records document the infrastructure against which broadcast education expanded. Their availability alone does not establish whether television substituted for, or complemented, formal schooling.

4.3 Measuring television reception

We digitize historical records for RAI transmitters active by 1957. The *RAI Yearbooks* provide activation dates; the *Gazzetta Ufficiale* provides coordinates and altitude; RAI's financial statements report frequency, channel, and polarization; and *Elettronica e Telecomunicazioni* supplies transmitting power. We combine these technical characteristics with terrain elevation to reconstruct reception using the Longley–Rice Irregular Terrain Model (ITM), following applications in Olken (2009), Enikolopov et al. (2011), Yanagizawa-Drott (2014), and Durante et al. (2019).

Figure 4: Expansion of the RAI television network before the literacy program. Panel (a): cumulative number of transmitting stations by year of activation. Panel (b): share of the population within reach of the signal. The dashed line marks 1957, the year in which we measure the network; the program went on air in November 1960.

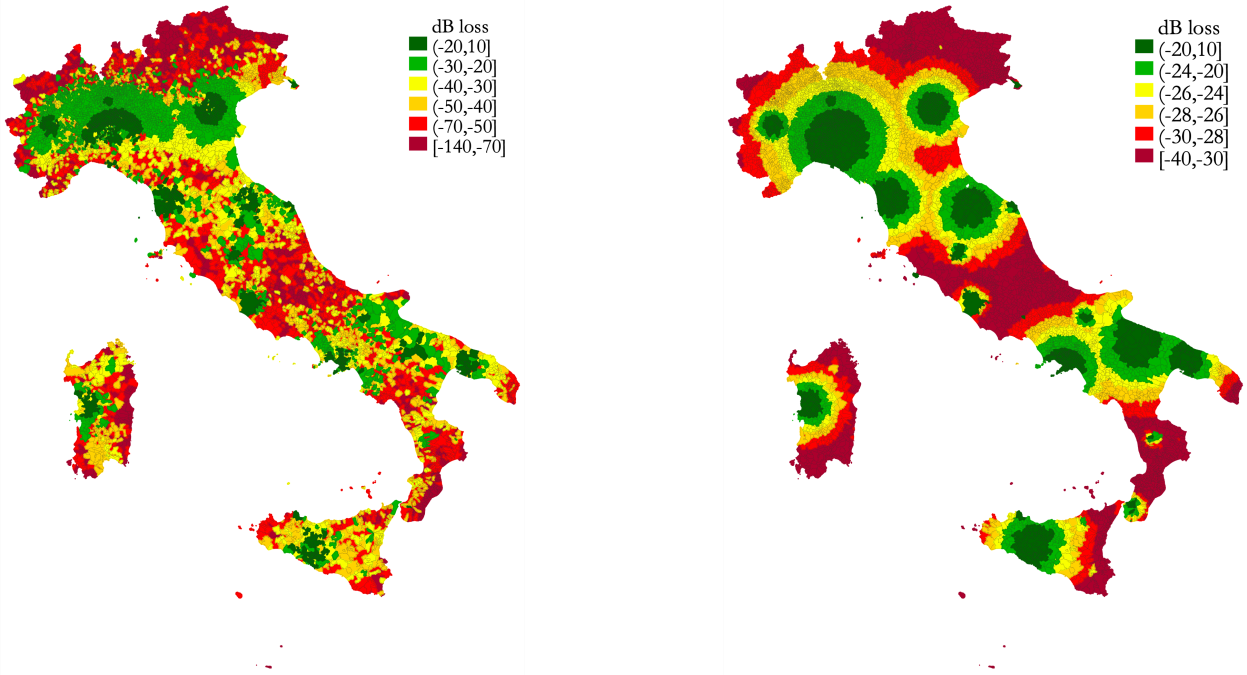


The propagation model predicts losses along the path from each transmitter to a municipality, including the effects of terrain on line of sight and diffraction (Hufford 1999). We define predicted signal, SS_i, as the maximum received power across the available transmitters. This summarizes the strongest available reception under the model; it does not measure household ownership of a television, actual viewing, or attendance at a center. In the exhibits, "actual signal" denotes this terrain-adjusted prediction.

For the same transmitter network we also compute free-space signal, $SSFS_i$, which abstracts from obstruction by intervening terrain. It captures how reception varies with transmitter locations and technical characteristics in the absence of those obstructions. Conditioning on this benchmark is intended to separate topographic propagation from network placement. It cannot by itself rule out every relationship between topography and economic development. That distinction motivates the geographic controls, baseline comparisons, and nearby-municipality exercises in Section 5.

We standardize the two measures to unit variance; one standard deviation of predicted signal is approximately 23 dB in the analysis. Because no municipality-level viewing data are available for the period, the estimates measure responses to potential reception. Evidence in other settings suggests that stronger reception generally increases access, but does not supply a calibrated first stage for viewing in 1960s Italy (Olken 2009, Bursztyn & Cantoni 2016). We use continuous signal variation and assess sensitivity to its extreme values by winsorizing at the 2.5th and 97.5th percentiles. Figures 4–6 show the expansion of coverage, the two signal measures, and the reconstructed network.

Figure 5: Terrain-adjusted and free-space reception across Italian municipalities, 1957. Identification uses variation in predicted reception conditional on the free-space measure and the reported controls.



(i) Predicted signal (with terrain)

(ii) Free-space signal (no obstruction)

4.4 Descriptive statistics

Table 1 places the estimates against the changes occurring during Italy's postwar transformation. The mean municipal literacy rate rose by 2.6 percentage points between 1961 and 1971. Overall labor-force participation fell by 1.0 point, combining a 3.5-point decline for men with a 1.9-point increase for women. Overall employment fell by 1.8 points. Thus, a positive reception coefficient can represent a smaller decline as well as a larger increase. These municipal averages provide a scale for the coefficients; they are not population-weighted national effects or counterfactual estimates of the program's contribution.

Figure 6: RAI transmitters, 1957.

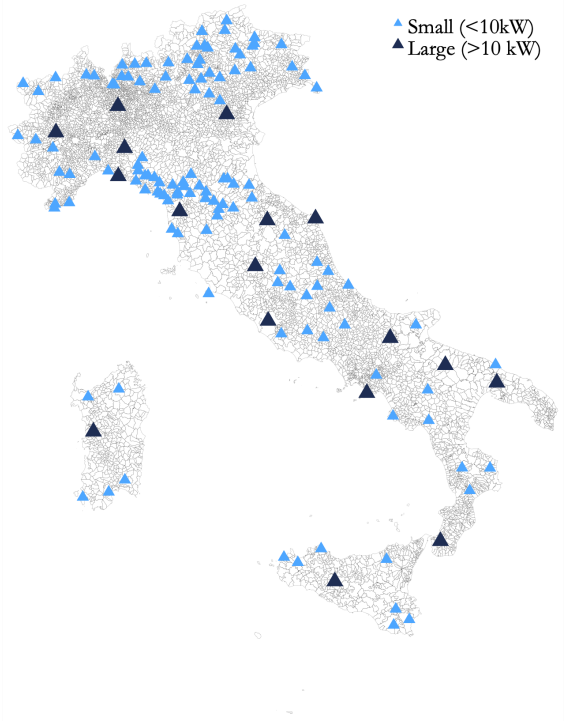


Table 1: Selected descriptive statistics.

	Level, 1951	Change, 1961–71
Literacy rate (%)	87.6	+2.6
Labor-force participation, all (%)		−1.0
men		−3.5
women		+1.9
Employment rate, all (%)		−1.8
Establishments per 1,000 residents	33.5	
of which manufacturing	13.6	
Establishment employees per 100 residents	9.4	
Municipalities	≈ 7,700	
Viewing centers (municipalities)	1,140 (943)	

Population and industrial censuses of 1951, 1961, and 1971, harmonized to 1971 municipal boundaries. Changes are municipality averages of the decade difference.

5 Empirical strategy

5.1 Estimand and timing

The object of interest is the effect of access to educational television on local outcomes. Individual viewing is unobserved and would be a choice: people with greater motivation to learn might be more likely to watch. We therefore use predicted reception as a measure of potential access and estimate reduced-form responses at the municipality level. These coefficients should not be interpreted as treatment effects on viewers, as returns to a year of schooling, or as the number of people taught by the program.

The timing permits a comparison of two decade changes. We define $\Delta Y_{i0} = Y_{i,1961} - Y_{i,1951}$ and $\Delta Y_{i1} = Y_{i,1971} - Y_{i,1961}$. The first decade includes the introduction of television in 1954 and the first months of the literacy course, which began in November 1960; the second includes most of its operation. A positive coefficient means that the outcome–reception gradient became more positive in the second decade. It does not require that the outcome increased in every high-signal town.

Initial program exposure before the 1961 census complicates a literal before–after interpretation. Early learning could already enter the first difference and the baseline of the second. Without knowing the timing of learning, later persistence, and other television effects, the direction and size of the resulting difference from a wholly untreated baseline cannot be established. The design is best understood as a change in the intensity and duration of exposure to educational broadcasting, measured with a fixed pre-program network.

5.2 Specification

For $t \in \{0, 1\}$, we estimate

$$\begin{aligned} \Delta Y_{it} = \alpha + \lambda \,\mathrm{Post}_t + \rho SS_i + \phi SSFS_i + \beta(SS_i \times \mathrm{Post}_t) \\ + \gamma(SSFS_i \times \mathrm{Post}_t) + X_i'\delta + \mu_{\ell(i)} + \varepsilon_{it}, \end{aligned} \tag{3}$$

where Post_t is one for 1961–71. The vector X_i includes area, altitude, ruggedness and their squares, together with log population in 1951. The term $\mu_{\ell(i)}$ denotes a local-labor-market fixed effect. The main signal effects permit the outcome–reception relationship to differ from zero in the earlier decade, and β measures its subsequent change. The free-space interaction allows the gradient associated with network placement to change across decades. Standard errors are clustered by local labor market.

The displayed specification makes explicit the main effects in the reported stacked design. Geography and local-market fixed effects enter with common coefficients across the two decade observations. They account for persistent differences in average decade changes, but do not allow each geographic characteristic or local market to have its own change in trend. In a balanced two-period stack, common time-invariant controls cancel when the two equations are differenced. Thus, their inclusion should not be described as controlling for geography-specific changes between decades. Allowing such changes requires interactions with Post; these are a distinct sensitivity exercise, not a reinterpretation of the estimates reported here.

5.3 Identification and alternative explanations

Identification requires that, absent the change in educational broadcasting, the reception gradient in decade changes would have remained stable after accounting for the terms in equation (3). The assumption concerns changes in the gradient, not unconditional random placement of transmitters or identical development paths for all towns. The principal threats follow directly from that distinction.

Topography and network placement. The network is measured before the program's launch, and the free-space measure captures reception associated with its placement and technical characteristics. The remaining variation reflects terrain-dependent propagation, including diffraction along the transmitter–receiver path. Topography can also affect transport, market access, and settlement. The identifying assumption rules out a change in those economic effects that is correlated with the residual signal gradient. Geographic controls and comparisons between nearby municipalities help assess this concern; neither makes it disappear by construction.

Other television content and contemporaneous policies. The signal carries RAI programming, not only the literacy course. A program-specific interpretation therefore requires that changing effects of other content do not generate the measured break. The timing and primary-attainment response are informative about this interpretation, but are not an exclusion test. The 1962 schooling reform is another relevant change, particularly because the literacy outcome includes children. We also examine sensitivity to *Cassa del Mezzogiorno* spending. This is a check for observed development policy, not proof that all concurrent interventions are accounted for.

Differential trends. Subtracting the earlier reception gradient removes its persistence, but not a new trend correlated with reception. With only three censuses, there is one comparison decade and no series of earlier decade changes with which to test stability. Baseline balance, small-town samples, and nearby-town comparisons supply complementary evidence. A local spatial pattern is economically informative but does not independently rule out geographically localized confounding.

Population composition. Census rates can change because residents acquire skills or because the composition of residents changes. Migration, mortality, and cohort replacement can affect literacy and employment rates even when their denominators are normalized. Baseline-population controls and weights address scale and influence, not selection itself. We therefore report population responses alongside the main outcomes and distinguish an improvement in local literacy from demonstrated learning by the same individuals.

5.4 Baseline comparisons

Tables 2–4 and Figure 7 examine how reception relates to baseline characteristics. For outcomes observed in 1951 we estimate

$$Y_{i,1951} = \tau SS_i + \gamma SSFS_i + X_i'\delta + \mu_{\ell(i)} + u_i. \tag{4}$$

Conditional associations are generally smaller after geography and local-market fixed effects are included. Town size remains a relevant correlate, motivating the population control and the weighted sensitivity specification. The development-spending measures in Table 4 concern the periods indicated there, rather than a single 1951 snapshot. These comparisons describe the observable differences associated with reception. Lack of statistical significance in a baseline coefficient is not evidence of exact balance, nor does balance in levels establish stability of subsequent trends.

Table 2: Balance I: literacy and the labor market in 1951.

	Mean	Univariate		FE and controls	
1951		coef.	s.e.	coef.	s.e.
Literacy rate (%)	87.64	0.440	(0.478)	0.063	(0.073)
LFP (%)	55.55	1.004***	(0.261)	0.021	(0.161)
LFP, men (%)	83.33	0.203*	(0.106)	−0.129*	(0.071)
LFP, women (%)	28.29	1.758***	(0.486)	0.259	(0.286)
Employment rate (%)	53.11	0.703***	(0.244)	−0.016	(0.161)

Coefficient on predicted signal (1 SD). The first column controls for free-space signal; the second adds geography and local-labor-market fixed effects. Population-census outcomes are measured in 1951. Standard errors are clustered by local labor market.

Table 3: Balance II: sectoral composition in 1951.

	Mean	Univariate		FE and controls	
1951		coef.	s.e.	coef.	s.e.
Agriculture share (%)	57.39	−1.798	(1.160)	−0.447	(0.343)
Industry share (%)	27.61	1.997*	(1.132)	0.142	(0.287)
Services share (%)	7.21	−0.231*	(0.122)	0.157	(0.111)

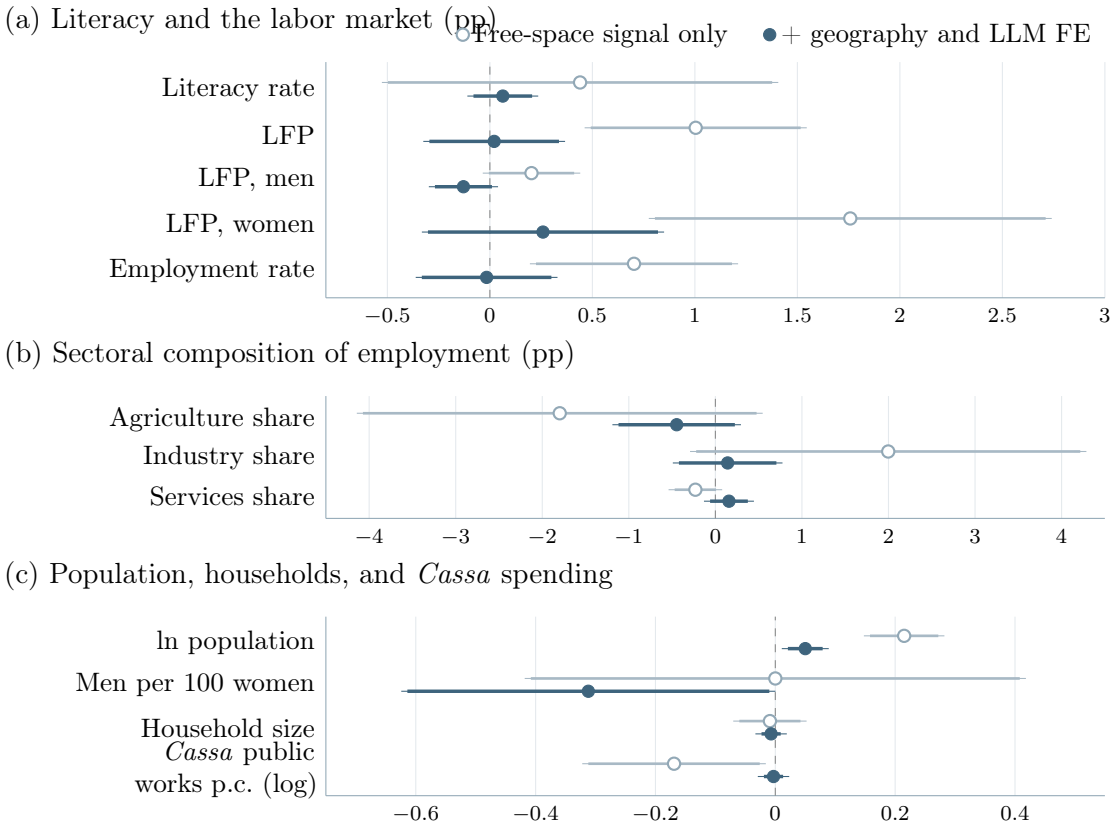
See notes to Table 2.

Table 4: Baseline comparisons: population, households, and development spending.

	Mean	Univariate		FE and controls	
1951		coef.	s.e.	coef.	s.e.
ln population	7.95	0.215***	(0.029)	0.050***	(0.015)
Men per 100 women	98.70	0.000	(0.208)	−0.312**	(0.154)
Household size	4.11	−0.009	(0.026)	−0.007	(0.008)
Cassa: public works p.c. (log)	1.35	−0.169**	(0.073)	−0.003	(0.008)

See notes to Table 2.

Figure 7: Balance: what signal predicts in 1951. Coefficient on actual signal (1 SD) in the 1951 cross-section, with 95% confidence intervals. Hollow gray: controlling only for free-space signal. Solid blue: adding geography (area, altitude, ruggedness, and their squares) and local-labor-market fixed effects. Standard errors clustered by local labor market.



6 Literacy and local economic activity

6.1 Literacy and educational attainment

Table 6 reports the reception coefficient across the specification sequence. In the preferred specification, a one-standard-deviation increase in signal raises the literacy rate by 0.177 percentage points in 1961–71 relative to 1951–61 (standard error 0.068). The estimate falls from 0.278 to 0.177 when free-space signal is added, and remains between 0.169 and 0.193 across columns (2)–(5). This pattern supports the importance of accounting for transmitter placement and shows stability across the subsequent baseline specifications. The separate illiteracy-per-capita coefficient is −0.164 (standard error 0.088); because its denominator differs, it need not be the exact negative of the literacy-rate coefficient.

Two comparisons convey the scale. One standard deviation implies a response of about 7% of the average 2.6-point municipal literacy gain over 1961–71. An interdecile difference in signal, approximately 2.5 standard deviations, implies $2.5 \times 0.177 = 0.44$ points, or about 17% of that gain. These are effect-size benchmarks. They do not estimate the share of national literacy growth caused by the program, which would require a counterfactual distribution of reception and appropriate population aggregation.

Table 5 examines qualifications. The primary-certificate coefficient is 3.20 points (standard error 1.42), while the coefficients for higher qualifications are small and statistically imprecise. The concentration at the primary margin is consistent with the curriculum and certification route. Upper-secondary and university attainment provide useful comparison outcomes because they lie well beyond the course's immediate objective. The use of these comparison outcomes follows the logic of looking for responses tied to program content, rather than relying on reception alone (La Ferrara et al. 2012, Durante et al. 2019). The insignificant coefficients are not equivalence tests, however, and do not exclude every other television channel. Certification and literacy are also distinct: people who already knew how to read could acquire a certificate, and the classification of primary qualifications changed between 1951 and 1961. The attainment pattern supports the educational interpretation without establishing that all certificate gains represent newly acquired literacy.

The literacy response also remains positive in smaller towns and in the nearby-municipality comparison, where the estimate is 0.10 points (standard error 0.04). These checks narrow the comparison to places with more similar location and network exposure. They reduce some concerns about broad geographic differences, but cannot distinguish learning from

Table 5: Educational qualifications.

	Primary cert.	Middle school	HS diploma	University
Signal × Post	3.20**	0.09	−0.02	−0.04
	(1.42)	(0.07)	(0.04)	(0.08)

Signal × Post, preferred specification; outcomes are the change in holders of each highest degree per capita, 1961–71 relative to 1951–61. Standard errors clustered by local labor market.

Table 6: Main estimates I: the literacy rate.

	(1)	(2)	(3)	(4)	(5) **preferred**	(6)	(7) pop. weights	(8) winsorized
Literacy rate	0.278***	0.177***	0.193***	0.169**	0.177***	0.095*	0.271***	0.192***
	(0.068)	(0.067)	(0.068)	(0.067)	(0.068)	(0.052)	(0.105)	(0.071)
Free-space signal		✓	✓	✓	✓	✓	✓	✓
Geography			✓	✓	✓	✓	✓	✓
LLM FE				✓	✓	✓	✓	✓
ln Pop_{1951}					✓	✓	✓	✓
Cassa del Mezzogiorno						✓		

Signal × Post from stacked long differences over 1951–61 and 1961–71; outcomes in Δ percentage points. Column (5) is the preferred specification; column (6) additionally controls for *Cassa del Mezzogiorno*; column (7) weights by 1951 population; column (8) winsorizes signal at the 2.5th and 97.5th percentiles. Standard errors clustered by local labor market. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

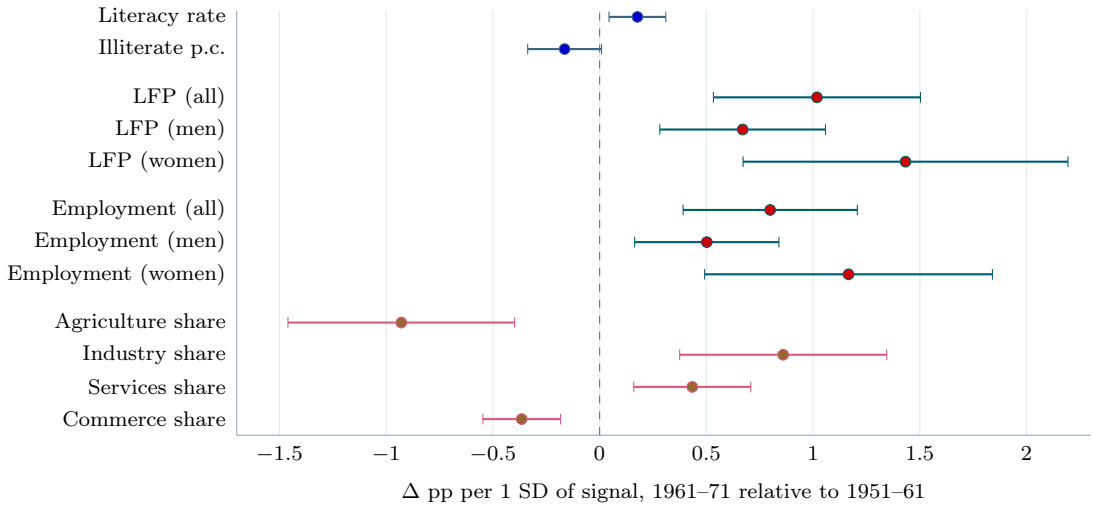
selective population change. Section 7 reports the sensitivity of the coefficient to development spending, weighting, and the signal distribution.

6.2 Participation and employment

Table 7 reports positive effects on labor-force participation and employment. The preferred coefficients are 1.018 percentage points for participation (standard error 0.248) and 0.799 for employment (standard error 0.208). Both are close to zero without the free-space control and become positive when it is included. Their interpretation therefore depends materially on separating topographic propagation from transmitter placement. Figure 8 collects these estimates with the literacy and sectoral responses.

The point estimates are larger for women. Participation increases by 1.433 points for women and 0.670 for men; employment increases by 1.166 and 0.502 points, respectively. The female participation coefficient is large relative to the mean 1.9-point increase over the decade, whereas the male coefficient partly offsets a mean decline of 3.5 points. These comparisons

Figure 8: Results at a glance. Preferred specification; points are Signal × Post coefficients with 95% confidence intervals. Blue: literacy; teal: participation and employment; rose: employment shares by sector.



describe scale and incidence, not the fraction of the national change attributable to television. The census aggregates also do not reveal whether the additional workers were the people whose literacy changed. Joint responses of literacy and employment are consistent with the proposed mechanism, but do not constitute a mediation estimate.

6.3 Sectoral reallocation and establishments

The employment response is accompanied by a shift in sectoral composition (Table 8). Per standard deviation of reception, agriculture's employment share falls by 0.929 points and industry's share rises by 0.860 points. The reported services coefficient is positive and the commerce coefficient negative. Sectoral shares describe the allocation of measured employment; they do not track individual workers moving between sectors. Together with the participation and employment estimates, they indicate a change in local economic structure during the period of educational broadcasting.

The industrial census provides an independent view from the workplace (Table 9). Manufacturing establishment counts rise by 0.032 log points, approximately 3.2%, and manufacturing employment rises by 0.559 employees per hundred residents. Across all sectors, establishment employment rises by 0.765 employees per hundred residents, while establishment density falls by 0.791 per thousand residents, principally through commerce. More workplace employment alongside a changing establishment mix is consistent with a response of local production.

Table 7: Main estimates II: labor-force participation and employment.

	(1)	(2)	(3)	(4)	(5) **preferred**	(6)	(7) pop. weights	(8) winsorized
LFP	0.146	1.017***	0.967***	0.998***	1.018***	0.993***	1.084***	1.117***
	(0.222)	(0.244)	(0.246)	(0.246)	(0.248)	(0.243)	(0.232)	(0.260)
LFP, women	0.092	1.400***	1.369***	1.400***	1.433***	1.339***	1.458***	1.593***
	(0.343)	(0.381)	(0.386)	(0.385)	(0.388)	(0.375)	(0.366)	(0.405)
Employment rate	−0.131	0.773***	0.743***	0.776***	0.799***	0.791***	0.815***	0.893***
	(0.186)	(0.204)	(0.206)	(0.205)	(0.208)	(0.208)	(0.196)	(0.219)
Free-space signal		✓	✓	✓	✓	✓	✓	✓
Geography			✓	✓	✓	✓	✓	✓
LLM FE				✓	✓	✓	✓	✓
ln Pop_{1951}					✓	✓	✓	✓
Cassa del Mezzogiorno						✓		

See notes to Table 6.

Table 8: Main estimates III: sectoral composition of employment.

	(1)	(2)	(3)	(4)	(5) **preferred**	(6)	(7) pop. weights	(8) winsorized
Agriculture share	−1.380***	−0.781***	−0.867***	−0.886***	−0.929***	−0.962***	−0.825***	−0.891***
	(0.260)	(0.267)	(0.269)	(0.270)	(0.271)	(0.271)	(0.229)	(0.276)
Industry share	1.418***	0.690***	0.789***	0.800***	0.860***	0.821***	0.624***	0.841***
	(0.253)	(0.248)	(0.246)	(0.247)	(0.248)	(0.246)	(0.237)	(0.249)
Free-space signal		✓	✓	✓	✓	✓	✓	✓
Geography			✓	✓	✓	✓	✓	✓
LLM FE				✓	✓	✓	✓	✓
ln Pop_{1951}					✓	✓	✓	✓
Cassa del Mezzogiorno						✓		

See notes to Table 6.

The count data alone cannot establish gross entry or commercial consolidation: entry, exit, relocation, and changes in population can all contribute to these stock and density outcomes. Unlike the plant-level production-function approach in Moretti (2004*b*), these measures do not establish productivity gains from a more educated local workforce.

6.4 Demographic outcomes

Tables 10 and 11 extend the analysis to vital rates. In the preferred specification, a one-standard-deviation increase in signal lowers births by 0.57 per thousand residents, deaths by 0.55, and marriages by 0.30. The birth-rate coefficient is approximately 17% of the average decline of 3.4 births per thousand over the decade; the birth response also appears when normalized by the number of women.

Table 9: Establishments and workplace employment, 1951–1971.

	Establishments per 1,000 residents	Employees per 100 residents	Δ ln establishments (net change)
All sectors	−0.791***	0.765***	0.003
	(0.276)	(0.213)	(0.008)
Manufacturing	0.305**	0.559***	0.032**
	(0.122)	(0.197)	(0.015)
Commerce	−0.882***	−0.056	−0.016**
	(0.162)	(0.038)	(0.007)
Other services	0.049	0.012	0.038**
	(0.048)	(0.011)	(0.017)

Signal × Post, preferred specification. In 1951, towns averaged 33.5 establishments per 1,000 residents (13.6 in manufacturing) and 9.4 employees per 100 residents; signal predicts neither in 1951. Standard errors clustered by local labor market.

Table 10: Demographic responses I: births.

	Preferred	With neighbors' signal (≤15 km)		Mean Δ
		Own	Neighbors	1961–71
Births per 1,000 residents	−0.57***	−0.33*	−0.54	−3.4
	(0.16)	(0.20)	(0.34)	
Births per 1,000 women	−0.69***	−0.40*	−0.67*	−3.4
	(0.17)	(0.22)	(0.40)	

Signal × Post, preferred specification. The middle columns add the mean signal of other towns within 15 km. Standard errors clustered by local labor market.

The fertility result has a useful benchmark in La Ferrara et al. (2012): entertainment content portraying small families can change childbearing without being a literacy course. Our birth-rate response therefore need not be downstream of the measured literacy gain. Educational access could change skills and the opportunity cost of time, while other programming could change desired family size or women's aspirations. Both channels could contribute to higher female participation and lower births. Jensen (2012) provides a complementary labor-demand benchmark: expanding young women's access to jobs in rural India changed work, schooling, and family decisions. The available aggregates do not identify their relative importance. Population age structure and migration can also change vital rates. The specifications including neighboring reception suggest a more local birth response and a broader association for deaths and marriages; these geographic differences are descriptive and do not by themselves identify the underlying mechanism.

Table 11: Demographic responses II: deaths and marriages.

	Preferred	With neighbors' signal (≤15 km)		Mean Δ
		Own	Neighbors	1961–71
Deaths per 1,000 residents	−0.55***	−0.20	−0.80***	+0.7
	(0.13)	(0.18)	(0.27)	
Deaths per 1,000 women	−0.61***	−0.24	−0.86**	+0.7
	(0.14)	(0.22)	(0.33)	
Marriages per 1,000 residents	−0.30***	0.04	−0.78***	−0.3
	(0.10)	(0.12)	(0.18)	

See notes to Table 10.

7 Sensitivity and interpretation

Municipality size. Tables 12–14 restrict the sample to progressively smaller municipalities. Literacy and labor-market coefficients remain positive in samples below ten thousand inhabitants. Since small municipalities may have been less important targets for network placement, this exercise helps assess whether results are driven by large urban centers. It does not make their coverage random: small places can still differ systematically in terrain, transport access, and development.

Nearby municipalities. We compare municipalities within 10 kilometers whose standardized free-space signals differ by less than 0.25, with pair fixed effects. The literacy coefficient is 0.10 points (standard error 0.04). Similar free-space reception and proximity reduce differences in network placement and broad location, while terrain can still generate reception differences within a pair. Local-market outcomes need not display the same within-pair contrast if they respond to reception across a shared area. Pair proximity also cannot remove unobserved differences specific to each municipality.

Development spending. Reception does not significantly predict the reported *Cassa del Mezzogiorno* measures: coefficients are −0.003 (standard error 0.008) for public works in the 1950s, −0.001 (0.009) for the 1960s, and 0.002 (0.019) for industrial subsidies. Adding development spending leaves the labor-market estimates similar: participation is 0.993 points, female participation 1.339, and the agricultural share −0.962. The literacy coefficient falls from 0.177 to 0.095 points (standard error 0.052). The attenuation indicates sensitivity of the literacy result to development-spending controls, despite the imprecision of the separate signal–spending associations.

Table 12: Municipality-size restrictions I: the literacy rate.

	All	No province	Population in 1951 below			
	(preferred)	capitals	50,000	20,000	10,000	5,000
Literacy rate	0.177***	0.175**	0.176***	0.176**	0.166**	0.123
	(0.068)	(0.068)	(0.068)	(0.068)	(0.070)	(0.075)
Obs.	15,362	15,142	15,204	14,786	13,784	11,198

Signal × Post, preferred specification, restricting to towns below the indicated population threshold. Standard errors clustered by local labor market.

Weighting and population change. Weighting by 1951 population yields a literacy coefficient of 0.271 points (standard error 0.105), compared with 0.177 in the unweighted specification. The weighted regression gives greater importance to larger initial populations and changes the estimand as well as the influence of individual municipalities. Reception also predicts population growth: the coefficient on the change in log population is 0.021 (standard error 0.004). This may reflect migration, retention, or demographic adjustment. Rates and baseline weights do not rule out a compositional explanation for part of the literacy or employment response.

Signal tails. Winsorizing reception at the 2.5th and 97.5th percentiles gives a literacy coefficient of 0.192 points (standard error 0.071), with similar labor-market results. The conclusions are therefore not driven solely by the most extreme signal predictions.

Taken together, these checks support a positive reception response across several comparisons and expose two material limits: literacy is sensitive to development-spending controls, and local population composition changes alongside the economic outcomes. They strengthen the reduced-form evidence without establishing a program-specific learning channel on their own.

Table 13: Municipality-size restrictions II: participation and employment.

	All	No province	Population in 1951 below			
	(preferred)	capitals	50,000	20,000	10,000	5,000
LFP	1.018***	1.022***	1.022***	1.011***	1.008***	0.981***
	(0.248)	(0.250)	(0.249)	(0.250)	(0.255)	(0.273)
LFP, women	1.433***	1.440***	1.440***	1.419***	1.423***	1.414***
	(0.388)	(0.392)	(0.391)	(0.391)	(0.396)	(0.427)
Employment rate	0.799***	0.799***	0.801***	0.788***	0.788***	0.766***
	(0.208)	(0.210)	(0.209)	(0.210)	(0.215)	(0.238)
Obs.	15,362	15,142	15,204	14,786	13,784	11,198

See notes to Table 12.

Table 14: Municipality-size restrictions III: sectoral composition.

	All	No province	Population in 1951 below			
	(preferred)	capitals	50,000	20,000	10,000	5,000
Agriculture share	−0.929***	−0.919***	−0.927***	−0.911***	−0.937***	−0.987***
	(0.271)	(0.273)	(0.272)	(0.275)	(0.286)	(0.313)
Industry share	0.860***	0.861***	0.866***	0.853***	0.870***	0.864***
	(0.248)	(0.250)	(0.250)	(0.253)	(0.260)	(0.283)
Obs.	15,362	15,142	15,204	14,786	13,784	11,198

See notes to Table 12.

8 The geographic reach of the effects

8.1 Own and neighboring reception

Municipal boundaries need not contain the economic effects of improved educational access. Commuting and migration link the locations of residence and production, as emphasized by Redding & Rossi-Hansberg (2017). We augment the design with the mean signal in other municipalities within 15 kilometers, including own reception and the corresponding controls. The resulting coefficients separate the association with a municipality's own reception from that with reception in its surrounding area. They are reduced-form effects of exposure, not estimates of the literacy coefficients in equation (1).

Table 15 shows that the participation response is concentrated in neighboring reception when both measures enter. The coefficient on neighbors' signal is 2.168 points (standard error 0.456), compared with 0.127 (0.196) on own signal. For female participation the corresponding coefficients are 3.178 (0.715) and 0.129 (0.348); for employment they are 1.764 (0.393) and 0.082 (0.193). The nearby-pair participation contrast is small and imprecise, while the employment contrast is negative and marginally significant. The pair estimates therefore

Table 15: Own and neighboring reception: participation and employment.

	Own and neighbors' signal		Neighbor pairs
	Own	**Neighbors** (≤15 km)	≤10 km, $\lvert\Delta SSFS\rvert < 0.25$
LFP	0.127	2.168***	−0.191
	(0.196)	(0.456)	(0.168)
LFP, women	0.129	3.178***	−0.253
	(0.348)	(0.715)	(0.278)
Employment rate	0.082	1.764***	−0.307*
	(0.193)	(0.393)	(0.171)

Neighbors' signal is the mean signal of all other towns within 15 km, interacted with Post; the town's own signal is included throughout. Neighbor pairs: adjacent towns within 10 km with $|\Delta SSFS| < 0.25$, with pair fixed effects. Outcomes in Δ percentage points (population in Δ ln). Standard errors clustered by local labor market.

Table 16: Own and neighboring reception: literacy, sectors, and population.

	Own and neighbors' signal		Neighbor pairs
	Own	**Neighbors** (≤15 km)	≤10 km, $\lvert\Delta SSFS\rvert < 0.25$
Literacy rate	0.096	0.183	0.101**
	(0.060)	(0.143)	(0.042)
Agriculture share	−0.612***	−0.611	−0.704***
	(0.222)	(0.504)	(0.198)
Industry share	0.442**	0.846	0.577***
	(0.221)	(0.518)	(0.218)
Δ ln population	0.005*	0.037***	0.000
	(0.003)	(0.008)	(0.003)

See notes to Table 15.

suggest some heterogeneity within shared areas, while the neighboring-signal coefficients indicate that the employment response extends beyond own reception.

Table 16 reports literacy, sectoral, and population outcomes. A geographically broader employment response than literacy response is consistent with local-market adjustment after a distributed education intervention. It can arise through workplace demand and commuting, information transmission, or sorting, as well as through human-capital externalities. Common local shocks correlated with neighboring signal are an additional identification concern. We use the distance profile to describe the spatial scale, not to distinguish these mechanisms conclusively.

Table 17: Distance gradient I: participation and employment, by ring.

	Own	Neighbors' signal, by distance ring			
	signal	0–5 km	5–10 km	10–15 km	15–25 km
LFP	0.092	0.757**	0.589	1.073**	−0.041
	(0.186)	(0.355)	(0.394)	(0.533)	(0.678)
LFP, women	0.036	1.098*	0.827	1.435	0.188
	(0.330)	(0.567)	(0.669)	(0.905)	(1.139)
Employment rate	0.088	0.467	0.784**	0.879*	−0.262
	(0.186)	(0.326)	(0.385)	(0.519)	(0.639)

Each ring enters the mean signal (and free-space signal) of towns at that distance, interacted with Post, with indicators for empty rings; all rings entered jointly with the town's own signal. Outcomes in Δ percentage points (population in $\Delta \ln$). A disc version is in Appendix B. Standard errors clustered by local labor market.

8.2 Distance profile

We replace the 15-kilometer average with signal in four disjoint rings: 0–5, 5–10, 10–15, and 15–25 kilometers. All rings enter jointly with own reception and the corresponding free-space measures (Tables 17 and 18). Participation coefficients are positive in the first three rings; the 0–5 and 10–15 estimates are significant at conventional levels, while the 5–10 estimate is less precise. Employment coefficients are also positive within 15 kilometers. The estimates in the outer ring are close to zero relative to their standard errors.

This profile is consistent with effects operating over a local labor market rather than only inside the municipality of residence. Fifteen kilometers is a descriptive radius, not an observed historical commuting boundary or an estimated sharp cutoff. Failure to reject an outer-ring coefficient of zero does not establish the absence of more distant effects. Moreover, without a counterfactual for all affected places, positive local responses cannot distinguish aggregate job creation from reallocation across a wider economy. Cumulative-distance specifications in Appendix B provide an alternative description of the spatial pattern.

8.3 Relating the employment and literacy responses

We next scale the economic response by the literacy response. Instrumenting the change in literacy with $SS_i \times \text{Post}_t$ gives an employment coefficient of 4.52 percentage points per point of literacy (standard error 2.10; Table 19). The corresponding participation coefficient

Table 18: Distance gradient II: establishment employment and population, by ring.

	Own	Neighbors' signal, by distance ring			
	signal	0–5 km	5–10 km	10–15 km	15–25 km
Firm employees p.c.	−0.168	0.617	0.509	0.427	0.930
	(0.305)	(0.381)	(0.450)	(0.609)	(0.865)
Δ ln population	0.004	0.007	0.006	0.010	0.017
	(0.003)	(0.006)	(0.006)	(0.007)	(0.011)

See notes to Table 17.

is 5.77 (2.54). These ratios summarize the joint reduced-form responses in the reported specification. They equal causal returns to literacy only under the stronger restriction that reception affects the economic outcome through the instrumented literacy change and no other channel, together with the usual relevance and identification conditions.

The employment point estimate exceeds the approximate direct-employment benchmark of 1.2 in equation (2). Under fixed population composition and a valid literacy exclusion restriction, that comparison would suggest responses beyond newly literate residents entering employment themselves. However, the Kleibergen–Paap first-stage F statistic is 6.8, and the reported uncertainty is substantial. Even a conventional normal-approximation interval, $4.52 \pm 1.96 \times 2.10$, includes 1.2; weak-instrument-robust inference is needed for a formal comparison (Andrews et al. 2019). The reported tests against zero do not establish that the direct-employment benchmark is exceeded.

Other channels of television exposure and changes in resident composition also break the proposed interpretation as a literacy externality. The ratio therefore cannot distinguish external returns to literacy from these alternative channels. The spatial regressions establish the geographic pattern of the reception response more directly; the IV exercise identifies which additional assumptions and evidence would be needed to attribute that pattern to literacy.

Table 19: Employment and participation responses scaled by literacy (2SLS).

Outcome (Δ pp)	2SLS: per +1 pp literacy	s.e.
Employment rate	4.52**	(2.10)
LFP	5.77**	(2.54)
LFP, men	3.79**	(1.84)
LFP, women	8.11**	(3.65)
First-stage F (Kleibergen–Paap)	6.8	

Two-stage least squares of the decade change in each outcome on the change in the literacy rate, instrumented by Signal × Post, preferred specification. The approximate direct-employment benchmark is 1.2 points under the fixed-population assumptions of Section 3. This is not a welfare bound; see the weak-first-stage discussion in the text. Standard errors clustered by local labor market.

Table 20: Sectoral and workplace responses scaled by literacy (2SLS).

Outcome (Δ pp)	2SLS: per +1 pp literacy	s.e.
Industry share	4.87**	(2.11)
Firm employees per 100	4.33**	(1.98)
First-stage F (Kleibergen–Paap)	6.8	

See notes to Table 19.

9 Heterogeneity and delivery infrastructure

9.1 Women and men

The female participation and employment point estimates are approximately twice the male estimates: 1.43 versus 0.67 points for participation, and 1.17 versus 0.50 for employment. This pattern is consistent with larger scope for changes in women's economic activity. Educational access may be one explanation, but television's effects on information, norms, or household decisions could also contribute (Jensen & Oster 2009, DellaVigna & La Ferrara 2015). Separate coefficients do not establish a statistically significant gender difference without a joint test, and municipal aggregates do not identify the viewers responsible for the response. We therefore describe the incidence of the estimated effects without assigning it to an unobserved individual mechanism.

9.2 Initial literacy

We split municipalities at the median of the 1951 literacy rate. The literacy coefficient is 0.22 points below the median and 0.08 above it, but the difference is imprecise ($p = 0.26$). The point estimates are consistent with larger educational gains where initial literacy was lower; they do not establish that television compressed spatial literacy gaps.

The participation response is larger in initially more literate municipalities ($p = 0.002$), while the movement out of agriculture is larger in initially less literate municipalities ($p = 0.05$). These contrasts suggest that skill acquisition and economic adjustment need not have the same geographic incidence. A possible explanation is that existing job opportunities affect how educational access translates into work. This complementarity is related to evidence that technological change and improved economic opportunities shape educational investment (Foster & Rosenzweig 1996, Jensen 2012, Adukia et al. 2020). Initial literacy also proxies for many other features of local development, however, and the current comparison does not identify labor demand as the source of heterogeneity.

9.3 Collective viewing centers

Viewing centers could increase access to television and supply help in using the lessons. The combination has a close parallel in televised lessons supported by local facilitators in Mexico's *telesecundarias* (Borghesan & Vasey 2024, Fabregas & Navarro-Sola 2025). Evidence from adult classes in Niger also illustrates how technology can be embedded within instruction (Aker et al. 2012). These studies motivate examining delivery infrastructure; they do not establish the contribution of centers in our setting. Their placement was selective. Table 21 shows that recorded centers were more common in larger towns with better reception. This describes where the infrastructure operated, but does not establish its placement rule or its causal effect.

Figure 9 compares reception effects by center presence. The literacy point estimate is 0.35 points in the 814 municipalities with one recorded center and 0.17 in the 6,819 without one. The difference is not statistically significant ($p = 0.33$). Municipalities with multiple centers are a separate, smaller group. Matching estimates in Appendix Table 26 supply additional comparisons, but do not remove selection on unobserved determinants of center placement.

The evidence therefore does not precisely establish an incremental effect of a recorded center. It also does not demonstrate that centers were ineffective or that home viewing alone produced the learning. Incomplete historical coverage, access to centers in neighboring municipalities,

Figure 9: Reception effects by recorded viewing-center presence. Estimates and 95% confidence intervals for 6,819 municipalities without a recorded center and 814 with one. The test of equal effects has $p = 0.33$.

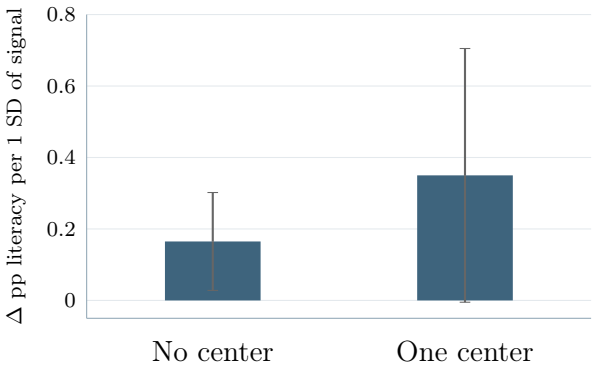


Table 21: Location of collective viewing centers.

Outcome: town hosts ≥1 listening spot	One at a time	Jointly
Literacy rate 1951 (pp)	0.002*	0.002*
	(0.001)	(0.001)
ln population 1951	0.036***	0.040***
	(0.006)	(0.007)
Agriculture share 1951 (pp)	−0.001**	0.000
	(0.000)	(0.000)
TV signal (SD)	0.017***	0.015**
	(0.006)	(0.006)
Mean of outcome	0.121	

1951 cross-section, linear probability model for the presence of a viewing center, with local-labor-market fixed effects, geography, and free-space signal. Standard errors clustered by local labor market.

and differences in staffing or attendance can weaken a comparison based only on recorded presence. Distinguishing access to a set from instructional support would require more detailed participation data.

10 Implications for evaluating educational technology

The results speak to two choices in the evaluation of educational technology: what constitutes the intervention and where to measure its effects. The Italian intervention combined broadcast content with access to receivers and, in some places, collective instruction. Reception changes the opportunity to access this system; it does not measure the marginal productivity of a

television lesson holding all other inputs fixed. The viewing-center estimates are too imprecise to establish whether a broadcast-only delivery model would have achieved the same result. This distinction parallels the separation between access to technology and its pedagogical use in Escueta et al. (2020).

The employment responses also show why the geographic unit of evaluation matters. A municipality can respond to educational access in surrounding places, so a comparison restricted to its own reception can miss part of the relevant exposure. Two further questions concern who benefits and whether activity expands overall (Kline & Moretti 2014*b*). The population and industrial censuses distinguish employment among current residents from jobs located in a place, but cannot allocate gains among original residents, newcomers, and commuters. Similarly, local job growth may combine expansion with relocation from other municipalities. Estimates for whole labor markets would help distinguish expansion at that scale from redistribution within it, while leaving possible displacement across markets unresolved. These distinctions matter even though educational provision can change skills and productive opportunities, unlike a policy that only subsidizes the location of otherwise unchanged activity.

We do not report a benefit–cost ratio. Historical accounts sometimes combine the adult literacy course with the broader *Telescuola* service, and certificates awarded are not the same as additional literate people caused by the intervention. Appendix A reports an archival expenditure series and explains the outstanding attribution problem. A credible cost-effectiveness calculation would match program-specific incremental costs to a population-scaled causal outcome. A welfare calculation would additionally require earnings or productivity effects and an explicit treatment of spillovers, displacement, and other benefits. The employment-to-literacy IV ratio is not a substitute for these objects.

11 Conclusion

Italy's expansion of educational television illustrates how communication technology can extend instruction beyond the reach of conventional schools. Using historical transmitter records and topographic variation in reception, we find improvements in municipal literacy during the main program decade, together with higher participation and employment, a shift away from agriculture, and an increase in manufacturing establishments. The labor-market response also depends on reception in nearby municipalities, indicating that the relevant geographic scale extends beyond the place where the broadcast is received.

The findings support the importance of studying educational supply and local economic adjustment together. Aggregate census outcomes do not follow the same learners over time, reception exposes viewers to other programming, and spatial responses can reflect several economic mechanisms. Establishing how much of the employment effect operates through adult learning requires sharper evidence on age groups, population composition, and viewing.

The main policy lesson is therefore about reach and evaluation. Broadcast technology can distribute educational content widely, and the associated economic responses can operate across a local labor market. Evaluations should consider both the local infrastructure that enables access and the wider area over which workers and establishments adjust. The Italian evidence connects the distribution of educational content to the distribution of economic activity, while leaving the welfare consequences and the contribution of each mechanism for further analysis.

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A Expenditure records and program attribution

Table 22 reports a preliminary transcription of annual educational-broadcast expenditure. Attribution to individual programs remains unresolved: each observation must be matched to its budget heading and the relevant educational service. In particular, *Telescuola*, which began in 1958, must be distinguished from *Non è mai troppo tardi*, which began in November 1960. Broadcast hours, centers, enrollment, and examinations cannot be assigned to the literacy course solely because they appear in the same annual report.

For this reason we do not divide the expenditure series by certificates awarded or describe that ratio as a causal cost per newly literate adult. The required numerator is incremental expenditure attributable to the intervention, including the relevant local delivery costs; the denominator is the additional outcome induced by that intervention. Shared transmission infrastructure and other educational broadcasts require an explicit allocation rule. Administrative certification totals can describe scale but do not supply the causal denominator.

Table 22: Historical educational-broadcast expenditure series (provisional scope).

Year	Reported expenditure (million lire)
1961	279.0
1962	269.4
1963	249.6
1964	281.5
1965	262.8
1966	293.5

Preliminary transcription from RAI annual reports and financial statements. The budget headings and allocation between educational programs require verification; these figures are not used as program-specific costs or as a cost-effectiveness estimate.

B Additional results

This appendix collects supporting material. Tables 23 and 24 report the distance-gradient estimates using cumulative discs rather than disjoint rings, as an alternative to Tables 17 and 18. Tables 25–26 report regression and matching comparisons between municipalities with and without a recorded viewing center.

Table 23: Distance gradient, cumulative discs I: participation and employment.

	Neighbors' mean signal within			
	5 km	10 km	15 km	25 km
LFP	1.361***	1.769***	2.173***	2.205***
	(0.364)	(0.383)	(0.455)	(0.514)
LFP, women	1.992***	2.614***	3.187***	3.345***
	(0.545)	(0.586)	(0.714)	(0.822)
Employment rate	1.015***	1.471***	1.767***	1.710***
	(0.313)	(0.326)	(0.392)	(0.447)

Neighbors' mean signal within each radius (separate regressions, with own signal). Outcomes in Δ percentage points (population in $\Delta \ln$). Standard errors clustered by local labor market.

Table 24: Distance gradient, cumulative discs II: establishments, population, and literacy.

	Neighbors' mean signal within			
	5 km	10 km	15 km	25 km
Firm employees p.c.	1.240***	1.617***	1.943***	2.228***
	(0.402)	(0.461)	(0.541)	(0.668)
Δ ln population	0.019***	0.030***	0.038***	0.044***
	(0.006)	(0.007)	(0.008)	(0.009)
Literacy rate	0.143	0.066	0.181	0.349**
	(0.099)	(0.131)	(0.143)	(0.167)

See notes to Table 23.

Table 25: Viewing centers: regression and matching estimates.

	Regression	Matched DiD (ATT)		Placebo
	DiD, all towns	Propensity score within province	Nearest neighbor, exact province	1951–61 change (prop. score)
Literacy rate	−0.45***	−0.11	−0.25	−0.07
	(0.13)	(0.16)	(0.16)	(0.14)
LFP	−0.05	−0.07	−0.32	−0.08
	(0.38)	(0.40)	(0.41)	(0.26)
LFP, women	−0.59	−0.18	−0.33	0.33
	(0.62)	(0.70)	(0.72)	(0.49)
Employment rate	0.17	−0.16	−0.41	−0.07
	(0.36)	(0.42)	(0.41)	(0.28)
Agriculture share	−0.77	−0.51	0.49	0.40
	(0.49)	(0.57)	(0.51)	(0.41)
Industry share	0.42	0.69	−0.20	−0.50
	(0.47)	(0.55)	(0.50)	(0.37)
Δ ln population (%)	−2.71***	−0.95	−1.24**	−1.36*
	(0.58)	(0.65)	(0.59)	(0.74)
Towns with a spot / without	942 / 6,820	942 / 6,536		942 / 6,536

Table 26: Viewing centers: comparisons with non-center municipalities.

	Literacy rate	LFP	Employment rate	Δ ln pop. (×100)
Regression DiD, all towns	−0.45*** (0.13)	−0.05 (0.38)	0.17 (0.36)	−2.71*** (0.58)
PSM, 1951 levels only	−0.11 (0.16)	−0.07 (0.40)	−0.16 (0.42)	−0.95 (0.65)
PSM, levels + pre-trends, 1:1	0.01 (0.15)	−0.41 (0.33)	−0.47 (0.33)	−2.03** (0.95)
PSM, levels + pre-trends, 1:3	0.03 (0.12)	−0.18 (0.26)	−0.27 (0.26)	−1.44* (0.83)
Entropy balancing	−0.16** (0.07)	−0.18 (0.19)	−0.23 (0.20)	−0.34 (0.69)
Entropy balancing + regression	−0.07 (0.06)	−0.06 (0.15)	−0.12 (0.15)	−0.63 (0.42)
IPWRA (doubly robust)	−0.09 (0.07)	−0.18 (0.15)	−0.24 (0.15)	−1.00** (0.43)
DR-DiD (Sant'Anna & Zhao)	−0.05 (0.07)	−0.52*** (0.16)	−0.58*** (0.16)	−2.08*** (0.46)
Coarsened exact matching	−0.08 (0.08)	0.06 (0.21)	−0.05 (0.21)	−0.94 (0.67)
Nearest geographic neighbor	0.03 (0.12)	−0.29 (0.27)	−0.30 (0.27)	−0.37 (0.62)