Investigating the Alternative: Impacts of Local Traditional Secondary Schools on Telesecundaria Achievement

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The COVID-19 pandemic brought remote schooling to the forefront of global conversations on education. In a time when in-person communication was impossible, technology suddenly became the only way to reach students, which forced education leaders around the world to scramble to create virtual programming. However, some countries have been harnessing remote education for decades, primarily as a way to reach students in rural areas. As Borghesan and Vasey (2024) found, Mexico's telesecundarias have been very successful at bringing education to underserved communities. A telesecundaria is a type of secondary school where the school day and curriculum is built around broadcast television lessons. Through a causal analysis of marginal treatment effects, Borghesan and Vasey (2024) found that telesecundarias have large positive effects on math and Spanish achievement. Within just one year, students who attend telesecundarias nearly caught up to their more advantaged and higher scoring peers at traditional secondary schools, with gains of 0.36SD in math and 0.23SD in Spanish. Turning their attention to the social divides in Mexico, they also found that urban/rural and Spanish-speaker/Indigenous language-speaker gaps would be 142% and 43% larger, respectively, without the presence of telesecundarias. Finally, in perhaps their most interesting analysis, Borghesan and Vasey (2024) estimate the effects of two policy interventions. The first, which would involve moving the nearest telesecundaria 5km closer to each student, resulted in 35.5 (0.35SD) and 23.8 (0.24SD) point increases in math and Spanish, respectively. The second, which would bring a telesecundaria within 5km of every primary school without already within that distance, resulted in 21.8 (0.22SD) and 16.4 (0.16SD) point increases.

Borghesan and Vasey (2024)'s work is exciting for the field of education in low and middle income countries. Access to electricity, television, and other technologies necessary for implementing television-based remote education is expanding, making this type of program increasingly feasible. Other countries will likely be paying close attention to how Mexico's telesecundaria program has remained so successful over the years. But despite their findings, Borghesan and Vasey's enthusiasm for telesecundarias is tempered by their belief that the success of telesecundarias is only because they are relatively good in comparison to the existing education system. This paper seeks to investigate whether the heterogeneity of education quality in traditional Mexican secondary schools may influence the gains made by students enrolled at nearby telesecundarias. Investigating this is valuable because evidence that telesecundarias are thriving similarly in locations with both low and higher quality schools in Mexico would signal to other upper-middle and potentially even high income countries that remote education systems might be worth considering. Similarly to Borghesan and Vasey (2024), through using marginal treatment effects estimation, I find that nearby traditional school quality does not significantly change the gains made by telesecundaria students relative to traditional school students, nor is it associated with changes in exam scores of telesecundaria students.

Background

The first wave of televised instruction programs appeared in the 1960s. As part of global pushes to improve public education at the time, programs were implemented in Portugal, Italy, Côte D'Ivoire, El Salvador, and American Samoa, among others (Fabregas, 2019). While differing in their specifics, these programs all involved the use of mass-produced televised instruction inside physical school buildings. Televised instruction was particularly helpful in low-income, rural contexts because it helped alleviate the consequences of qualified teacher shortages in these areas. Using televisions allowed for centralized, high-quality instruction to be delivered around the country. Televised instruction programs reached large numbers of students, with American Samoa's education system being entirely television-based by 1966 (Thomas, 1980). Another notable program in Côte D'Ivoire attracted high investment and interest, with 500 million USD[1] being allocated for televised instruction, with a goal of reaching 720,000 children (Gibbon, 1975). Despite the excitement surrounding their initial implementation, both Côte D'Ivoire and American Samoa saw their programs decline and vanish by the early 1980s (Koné & Jenkins, 1990; Thomas, 1980).

Telesecundarias in Mexico originated alongside the initial group of televised instruction programs. In 1968, the first telesecundarias were constructed in rural areas with the goal of serving marginalized students who were otherwise unable to access secondary education (Fabregas, 2019). Telesecundarias are physical schools where students watch and take notes on mass-distributed televised lessons produced in Mexico City. Lessons are broadcast at set times across the country on specific telesecundaria channels. Instruction is supervised by a single teacher per grade level, who facilitates both the video lesson, and a follow-up lesson for each subject. Teachers are not experts in subject matter, and instead follow a guide for how to supplement the video lesson instruction. Telesecundarias have grown significantly since their initial creation. In 1993, the Mexican constitution was amended to require enrollment in *secundaria*, or junior high school, corresponding to grades 7-9. In the following decade, the number of telesecundarias grew 111%, expanding beyond their original domain of rural areas in Southern Mexico, though that is where they remain most prevalent (Fabregas, 2019). Telesecundarias were appealing as a way to meet the demands of this amendment because they are significantly cheaper to run than traditional public schools in rural areas. As of 2019,

[1] Adjusted for inflation from January 1975 to February 2024, this investment amount is greater than $919 million.

telesecundarias make up 60% of Mexican secondary schools, enrolling approximately 20% of students.

Related Literature

Since the establishment of telesecundarias and other technology-assisted teaching programs, significant research has been conducted to determine their effects on student learning. In modern contexts, programs similar to telesecundarias often operate using computers, giving rise to the term computer-aided learning (CAL). One notable example of CAL comes from China, where CAL has been used to provide high quality instructional materials and video lectures to rural students since 2004 (Bianchi et al., 2022). An analysis of the program, which is one of the largest educational technology interventions ever, found that exposure to CAL resulted in long-term effects of 0.85 more years of schooling received, 0.18 standard deviations higher math scores, and 0.23 standard deviations higher Chinese scores. This program is particularly similar to telesecundarias because the computer-aided learning lectures are intended to replace standard teaching methods, and there was high involvement from rural teachers, who facilitate lessons and answer questions. The authors note that CAL in China follows the trend of other effective programs in which “the ed-tech materials were of much higher quality than the lectures provided by local teachers” (2). Another study of a program in Ghana found similar results, observing gains of 0.26 standard deviations in numeracy and 0.33 standard deviations in literacy after two years (Johnston & Ksoll, 2022)**.** The program operated similarly to the Chinese program and telesecundarias; video lessons were transmitted to rural schools to replace traditional teaching, with local teachers facilitating implementation. In Ghana, as of 2012, fewer than half of teachers have any professional training, indicating that, like in China and Mexico, there is a low baseline quality of instruction. Bianchi et al. (2022) contrast China, Ghana, and

Mexico's programs with CAL programs in countries with higher quality of general instruction. Studies from Israel (Angrist & Lavy, 2002) and the United States (Goolsbee & Guryan, 2006) show negative or neutral effects from increasing investment in CAL. However, these studies analyze interventions that increase computer and internet access in schools, not those which aim to make the primary mode of instruction in the classroom computer or television-based. This difference makes them largely incomparable to the studies in Ghana, China, or Mexico.

A common thread between Bianchi et al. (2022), Borghesan & Vasey (2024), and Johnson & Ksoll (2022) is that they all state that the effectiveness of distance education is dependent on the quality of the surrounding standard form of schooling. In Mexico, Borghesan and Vasey (2024) regard the quality of traditional and technical schools surrounding telesecundarias as homogeneously low, allowing them to analyze telesecundarias as a whole. While Mexico does have low quality schools overall compared to the OECD as a whole, the OECD's "Equity in Education: Breaking Down Barriers to Social Mobility" (2018) shows Mexico being in the top half of countries for income-based inequality in math, reading, and science scores, at the time when data for this study was being collected. Additionally, OECD data shows that the top 25% of Mexican students in science perform better than students in the bottom 25% socioeconomic tier in all but a handful of East Asian countries. This indicates that education comparable to higher-income countries can be found in Mexico. The following sections of this paper use average ENLACE exam scores as a proxy for school quality, attempting to understand how local traditional school quality affects the relative academic performance of nearby telesecundaria students.

My empirical strategy is based around adding traditional school quality as a covariate in the marginal treatment effect model. If I find a strong association between traditional school quality and telesecundaria exam scores, that would indicate heterogeneity based on local school quality. Marginal treatment effect is a relatively rare estimation strategy, so I have not found literature that conducts a similar analysis of heterogeneity within MTE. But similar analyses have been conducted on heterogeneity between schools using other similar estimation strategies. One study from Pakistan examined the value added of attending a specific school, finding large variation between schools even in the same village (Andrabi et al., 2022). That study found that moving all public school students to the worst private school would only increase test scores by 0.08SD, while moving them to the best private school would increase scores by 0.25SD. In Kenya, researchers of the PRIMR instructional coach program studied variation between schools in zones with many schools versus zones with few schools (Piper & Zuilkowski, 2015). Using the number of schools in the zone as a predictor, they found an association which helped confirm the validity of their causal analysis. In a similar fashion, my finding that local traditional school quality is not associated with academic performance at telesecundarias helps to complicate existing ideas about video-based instruction.

Data and Methods

Data

Data for this study comes from publicly available replication data for Borghesan and Vasey (2024), pulled from OpenICPSR. The dataset includes student-level data for a cohort of students who were in sixth grade during the 2007-8 school year, with 186,483 total observations. For each student, ENLACE exam score data was linked with secondary school survey data from a random sample of schools. The result is a rich dataset which includes numerous variables representing the background and academic performance of each student. The ENLACE exam was administered to Mexican students between 2006 and 2013, measuring end-of-year progress in Spanish, mathematics, and a third subject. The exams were low-stakes and had no impact on student progress or grades. ENLACE exams were scored using item response theory, meaning that changes to test scores over time within the same grade can be directly attributed to learning gains (de Hoyos et al., 2019). Due to the random sampling of schools, the data is representative of Mexican schoolchildren during the period of study.

Since attending a telesecundaria was not randomly assigned, I use an instrumental variable to remove the effects of endogenous variables on which type of school a student attends. The instrument I selected is 'relative distance'. To construct relative distance, I found the distance between a student's primary school and the nearest telesecundaria, and the distance between a student's primary school and the nearest traditional school. The relative distance is the difference between these two measures. In short, relative distance shows how much further the nearest telesecundaria is than the nearest traditional school. A negative value indicates that a telesecundaria is closer. It would have been preferable to measure relative distance from a student's home to their secondary school, but home address data was unavailable. In order to be considered a valid instrument, relative distance must be a good predictor of the treatment, conditional on covariates. As seen in Table 3, a one kilometer increase in relative distance increases, on average, a student's likelihood of attending a telesecundaria by 3.1%, which is highly statistically significant. Additionally, relative distance must be exogenous from our outcomes of interest, in this case student exam scores. I assume this to be true by removing students who attend a secondary school more than 15 kilometers away from their primary school. This removes the possibility of students moving closer to schools they know would perform better at on the basis of unobservable characteristics.

To achieve better estimates, I removed certain students from the dataset. First, I removed students who attend private schools, amounting to 8% of observations because families are rarely choosing between telesecundarias and private schools. I also do not have location data for private schools. Next, I removed the 6% of students who dropped out between 6th and 7th grade. These students' gains cannot be measured. Then, I dropped students who were recorded to have been copying or cheating on the ENLACE exam, totalling 0.9% of students. Finally, I removed students whose relative distance score lay outside of the middle 99% of the data or whose secondary school was more than 15km from their primary school. As mentioned earlier, this was to ensure exogeneity of the relative distance instrument, which will be discussed further in the methods section. The final sample for this analysis contained 134,502 students.

Table 1 shows the average ENLACE scores for students across grades and type of school. The table shows large initial differences in scores between the students who attend traditional schools and telesecundarias. As students progress, this difference decreases greatly. In math, telesecundaria students even surpass their traditional school counterparts by grade 9. However, from just these averages, it is impossible to state whether this is because of the type of school attended or other unobservable traits that differ between students at different school types. Table 2 presents summary statistics for the students who attend telesecundarias and traditional schools. The table shows students in telesecundarias are far more likely to be enrolled in the Prospera cash transfer program, live in rural areas, and speak indigenous languages at home. Additionally, those who attend telesecundarias tend to live closer to lower performing traditional schools than their counterparts, though this may just reflect the locations of telesecundarias in less advantaged areas.

Table 1: Comparison of Math and Spanish Scores by Grade and School Type

Grade	Math				Spanish			
	All	Traditional	Telesecundaria	Difference	All	Traditional	Telesecundaria	Difference
Grade 6	523.5	533.1	485.5	−47.6	519.1	529.5	477.8	−51.7
Grade 7	499.9	501.2	494.5	−6.7	499.9	503.6	485.1	−18.5
Grade 8	508.9	505.5	522.5	17.0	478.4	480.3	470.6	−9.7
Grade 9	524.5	518.8	547.5	28.7	500.3	501.9	494.0	−7.8

Table 2: Summary Statistics

	Telesecundaria		Traditional			
	Mean	SD	Mean	SD	Diff	T Score
Relative Distance	−6.33	5.60	4.77	3.40	9.73	290.08***
Telescore	488.13	46.47	480.55	45.01	−7.57	-24.54***
Tradscore	486.87	33.16	491.13	35.37	4.27	17.91***
Age	12.19	0.82	11.92	0.61	−0.26	-59.29***
Number Siblings	3.72	2.41	2.41	1.67	−1.31	-104.07***
Prospera	0.66	0.47	0.37	0.16	−0.50	-187.33***
Female	0.50	0.50	0.51	0.50	0.00	1.40
Computer @ Home	0.13	0.33	0.42	0.49	0.29	91.16***
Rural	0.70	0.46	0.09	0.29	−0.61	-272.08***
Northern State	0.06	0.23	0.30	0.46	0.25	85.71***
Indigenous	0.16	0.37	0.04	0.20	−0.12	-69.93***
Books in Home $\leq$ 10	0.69	0.46	0.46	0.50	−0.23	-68.02***
Books in Home $\leq$ 20	0.17	0.38	0.25	0.44	0.08	28.39***
Books in Home $\leq$ 50	0.06	0.25	0.15	0.36	0.09	38.09***
Books in Home $\geq$ 100	0.07	0.26	0.13	0.34	0.06	26.06***
Mother's Education: Primary	0.75	0.43	0.41	0.49	−0.34	-104.74***
Mother's Education: Middle	0.18	0.39	0.28	0.45	0.09	31.82***
Mother's Education: Secondary	0.04	0.19	0.23	0.42	0.19	73.28***
Mother's Education: Post-Secondary	0.02	0.15	0.08	0.27	0.06	32.81***
Income (Pesos/mo) $\leq$ 2500	0.57	0.50	0.23	0.42	−0.34	-115.50***
Income (Pesos/mo) $\geq$ 2500 $\leq$ 2999	0.25	0.43	0.29	0.46	0.04	13.80***
Income (Pesos/mo) $\geq$ 3000 $\leq$ 7499	0.11	0.31	0.31	0.46	0.20	66.36***
Income (Pesos/mo) $\geq$ 7499	0.07	0.25	0.17	0.38	0.10	42.70***

*** indicates significance at the 0.01 level

Books in Home is limited by the available data, which did not include information about what the possible values mean. Labels were inferred based on Borghesan and Vasey (2024). Telescore and Tradscore refer to mean scores at the nearest telesecundaria and traditional school, respectively. Indigenous refers to students who speak an indigenous language at home.

Methods

This paper estimates the effects of attending a telesecundaria over a traditional school by calculating marginal treatment effects (MTE). The MTEs calculated are based on a value added model, where the results indicate how much better or worse a student performs on the ENLACE exam by attending a telesecundaria instead of a traditional school. MTE is useful because it estimates the average treatment effect (ATE) at a particular margin of resistance to receive treatment. This means that based on unobservable characteristics, the model estimates an individual student's resistance to receiving treatment, assigning the student a propensity score. Then, using this propensity score, the model estimates the ATE at that margin, which makes for a more useful model to understand differences in gains between types of students.

To model the MTE, I first define the outcome model. The outcomes, Y_1 and Y_0, refer to the test score (in either math or Spanish) a student is estimated to receive at a telesecundaria and traditional school, respectively. Y_1 and Y_0 can be calculated using the following equations:

$$Y_1 = X\beta_1 + U_1 \tag{1}$$

$$Y_0 = X\beta_0 + U_0 \tag{2}$$

X refers to a vector of observable characteristics that affect test scores, and U refers to unobserved characteristics. My analysis differs from Borghesan and Vasey (2024) because I include a measure of the quality of the nearest traditional school in the vector X. This essentially creates a student-level characteristic that measures proximity to a high-quality traditional school. A full list of observable characteristics can be seen in Table 4. The selection model I used can be generalized in equation 3, where D is whether a student attends a telesecundaria, Z is the continuous instrumental variable that influences school choice, and V is the resistance to attending a telesecundaria. This equation models whether or not a student attends a telesecundaria.

$$D = 1(Z\gamma > V) \tag{3}$$

Using a Roy model, and following Heckman and Vytlacil (2005), I can transform equation 3 into

$$D = 1(P(Z) > U_D) \tag{4}$$

Equation 4 shows that whether or not a student attends a telesecundaria is dependent upon whether or not their propensity for attending a telesecundaria $P(Z)$, based on observable characteristics and the instrument, is greater than their resistance to attending, based on unobservables. The observable characteristics used to calculate propensity scores can be found in Table 3. I did not include traditional school quality because families are unlikely to have perfect information about school quality. Using this transformed equation, the MTE can now be written as

$$MTE(x, u_D) = E[Y_1 - Y_0 | X = x, U_D = u_D] \tag{5}$$

Before using the MTE model, it's important to ensure the setting meets certain assumptions. There are five assumptions for using MTE, outlined in Heckman and Vytlacil (2005).

(A-1) Z is a nondegenerate random variable conditional on X.

(A-2) $(U_0, U_1, U_D) \perp\!\!\!\perp Z | X$

(A-3) U_D is absolutely continuous with respect to the Lebesque measure.

(A-4) $E|Y_1|$ and $E|Y_0|$ are finite.

(A-5) $1 > P(D = 1|X) > 0$

Assumptions (A-3)-(A-5) are technical assumptions that are met by the nature of the variables in the setting. Assumptions (A-1) and (A-2) require more investigation as they concern the validity of the instrument. (A-1) requires that Z, the instrument that predicts attendance at a telesecundaria, is affected by observable covariates, X. This can be verified by looking at the makeup of the propensity score estimator. As seen in Table 3, relative distance has a highly significant effect on the propensity score, with a one kilometer increase in relative distance resulting in a 3.1% decrease in likelihood of attending a telesecundaria. Assumption (A-2) describes the exogeneity of the instrument, Z. To be considered valid, relative distance must be independent of unobservable variables that affect student performance. In the Data section, I described measures taken to ensure that movement on the basis of unobservables will not have an impact. Additionally, because the model includes controls for lagged test scores and family characteristics, (A-2) would only be violated if distance from school impacted test scores. I assume this to not be the case, though further investigation could prove or disprove this, potentially invalidating my results.

To produce MTE estimates, I employ a parametric model. A semiparametric model would almost certainly be more robust, given that it removes potential for bias from a subpopulation who experience different treatment effects, but technical limitations required me to stick to a simpler parametric model. In the parametric model, propensity scores are estimated via probit regression as described in Brave & Walstrum (2014). Additionally, I assume that the unobservables from both the selection model (ie. propensity score), and outcome model operate under a joint normal distribution. Following this, the MTE equation achieves a functional form of:

$$MTE(X,\, u_D) \;=\; X(\beta_1 \;-\; \beta_0) \;+\; (\sigma_{1V} \;-\; \sigma_{0V})\Phi^{-1(U_D)} \tag{6}$$

The estimates for β_0, β_1, σ_{0V}, σ_{1V} come from the two-stage model, where first the propensity scores are calculated using the selection model, and then outcome estimates are calculated using those scores and a vector of covariates. Estimates for the outcome variables are achieved through:

$$E(Y_1|D = 1, X, Z) = X\beta_1 + E(U_1|D = 1) \tag{5}$$

$$= X\beta_1 + \sigma_{1V}(-\frac{\phi(\Phi^{-1}(P(Z))}{P(Z)})$$

$$E(Y_0|D = 0, X, Z) = X\beta_0 + E(U_0|D = 0) \tag{6}$$

$$= X\beta_1 + \sigma_{1V}(-\frac{\phi(\Phi^{-1}(P(Z))}{P(Z)})$$

The estimates calculated using these equations allow us to create a table showing the impact of each covariate. Standard errors were calculated through 50 bootstrap repetitions.

Results

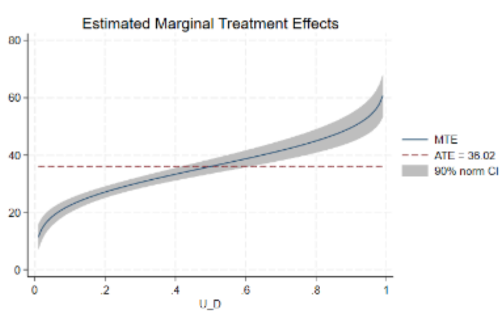
Running the marginal treatment effect calculations produced a few types of results. First, the probit regression margins show the effect of each observable characteristic on the propensity score. These are presented in Table 3. The instrument, relative distance, is shown to have a sizable, significant impact. The main output of the MTE model is the outcome of the second stage, which produces estimates for either 7th grade math scores or 7th grade Spanish scores. MTE estimates can be seen in Figure 1. The horizontal axis of Figures 1 shows the continuous unobserved resistance to treatment, while the vertical axis shows the effect of attending a telesecundaria on the outcome variable at each margin. Interpretations of these figures should take into account the value-added framework of the model. For example, a student with a calculated resistance to treatment of 0.7 would, on average, score 40 points higher on the 7th grade mathematics ENLACE exam if they attended a telesecundaria over a traditional school. Figure 1(a) shows the MTE for 7th grade math scores where traditional school quality is not considered, while in Figure 1(b), traditional school quality is considered.

Table 3: Propensity Score Model

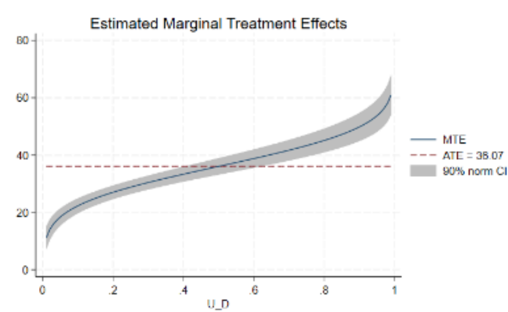
Variable	Coefficient	Std. err.
Relative Distance	-0.0309***	0.0004
Math 6	-0.0001***	0.0000
Spanish 6	-0.0001***	0.0000
Age	0.0153***	0.0010
Number Siblings	0.0045***	0.0004
Prospera	0.0304***	0.0017
Female	0.0028**	0.0014
Computer @ Home	-0.0241***	0.0017
Rural	0.0243***	0.0019
Northern State	-0.0355***	0.0024
Indigenous	0.0084***	0.0024
Books in Home $\leq$ 20	-0.0120***	0.0017
Books in Home $\leq$ 50	-0.0187***	0.0024
Books in Home $\geq$ 100	-0.0101***	0.0025
Mother's Education: Middle	-0.0159***	0.0017
Mother's Education: Secondary	-0.0350***	0.0025
Mother's Education: Post-Secondary	-0.0134***	0.0038
Income (Pesos/mo) $\geq$ 2500 $\leq$ 2999	-0.0134***	0.0017
Income (Pesos/mo) $\geq$ 3000 $\leq$ 7499	-0.0188***	0.0020
Income (Pesos/mo) $\geq$ 7499	-0.0189***	0.0027

*** indicates significance at the 0.01 level, ** at the 0.05 level. Books in Home variables are limited by the available data, which did not include information about what the possible values mean. Labels were inferred based on Borghesan and Vasey (2024). Telescore and Tradscore refer to mean scores at the nearest telesecundaria and traditional school, respectively. Indigenous refers to students who speak an indigenous language at home.

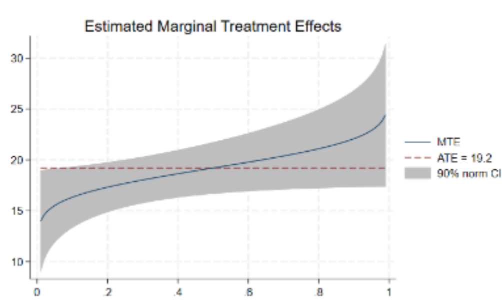
Figure 1: Marginal Treatment Effects



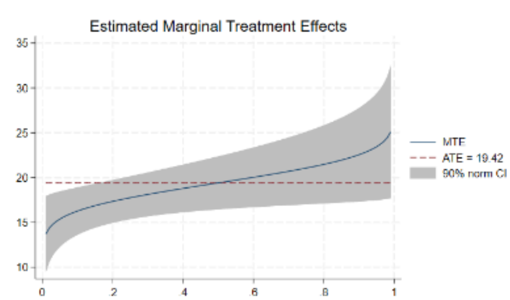
(a) 7th Grade Math – No Trad. School Scores



(b) 7th Grade Math – With Trad. School Scores



(c) 7th Grade Spanish – No Trad. School Scores



(d) 7th Grade Spanish – With Trad. School Scores

Evidently, the graphs are nearly identical, indicating that traditional school quality does not change the average amount of gains on math exams seen by telesecundaria students relative to traditional students. The same can be said for 7th grade Spanish scores.

Other interesting results concern the association between the traditional school quality covariate and the outcome variables. The coefficients for the observable covariates used in the second stage of the estimation model can be seen in Table 4. Traditional school quality is notably insignificant for estimating exam scores in telesecundarias. Many other variables have much stronger associations with the outcome variable.

Despite the lack of difference when adding in traditional school quality as a covariate, the overall effects of telesecundarias are still impressive. The average treatment effect of attending a telesecundaria on 7th grade math scores is a relative increase of 36 points, equal to 35.7 standard deviations. This is a large increase and it shows that telesecundarias are helping their students quickly catch up to their peers. A smaller, but still strong average gain of 19 points, equal to 0.19 standard deviations was seen on 7th grade Spanish exams. One interesting phenomenon found in these graphs is the presence of negative sorting on gains. Negative sorting on gains can be seen in the upward slope of the MTE lines, and is much stronger in mathematics. Students at the high end of the resistance to treatment distribution also have the highest MTE, meaning those who are least likely to attend a telesecundaria also benefit the most.

Table 4: Combined Coefficients and Standard Errors

Treated	**Spanish**		**Math**	
	Coefficient	**Std. err.**	**Coefficient**	**Std. err.**
Math 6	0.1028***	0.0054	0.3479***	0.0059
Spanish 6	0.4896***	0.0081	0.2440***	0.0066
Traditional School Avg. Score	0.0111	0.0171	-0.0167	0.0163
Age	-7.5670***	0.6733	-8.2542***	0.5108
Number Siblings	-0.7337***	0.2361	-0.5830***	0.1961
Prospera	-2.3493*	1.2116	-2.5549**	1.2854
Female	23.5861***	1.0082	-3.5569***	1.0276
Computer @ Home	-0.0472	1.5294	4.1049***	1.4851
Rural	0.3877	1.1769	-0.1053	1.5087
Northern State	-4.5308*	2.3628	-0.1398	2.5806
Indigenous	-1.4466	1.2715	2.9949**	1.3646
Books in Home $\leq$ 20	1.8375	1.1361	0.4791	1.4083
Books in Home $\leq$ 50	2.9662	1.8245	1.0349	1.9871
Books in Home $\geq$ 100	1.1582	2.0695	1.2237	1.7717
Mother's Education: Middle	3.1807***	1.2057	4.2236***	1.4219
Mother's Education: Secondary	4.0374	3.0670	4.2535*	2.4060
Mother's Education: Post-Secondary	9.6049**	4.1177	9.5864***	2.7917
Income (Pesos/mo) $\geq$ 2500 $\leq$ 2999	2.5068**	1.2205	6.3513***	1.0568
Income (Pesos/mo) $\geq$ 3000 $\leq$ 7499	3.4004*	1.7654	5.7273***	1.8489
Income (Pesos/mo) $\geq$ 7499	-6.7996***	2.3039	-0.5441	2.0923
Untreated				
Math 6	0.1238***	0.0026	0.426***	0.0031
Spanish 6	0.4854***	0.0033	0.2129***	0.0035
Traditional School Avg. Score	0.1251***	0.0082	0.0855***	0.0072
Age	-4.4823***	0.3968	-4.6010***	0.3841
Number Siblings	-0.9901***	0.1098	-0.3161	0.1592**
Prospera	-0.7337	0.6659	1.5016**	0.6771
Female	23.7940***	0.4132	-6.7726***	0.4183
Computer @ Home	0.6252	0.4380	0.5786	0.4983
Rural	4.2328***	1.0033	4.2151***	0.7340
Northern State	-0.3281	0.4505	3.1560***	0.5409
Indigenous	5.1497***	1.1076	4.8452***	0.9350
Books in Home $\leq$ 20	2.9629***	0.5395	0.7696*	0.4619
Books in Home $\leq$ 50	4.0982***	0.7130	3.4646***	0.6304
Books in Home $\geq$ 100	6.9641***	0.7836	4.7177***	0.7334
Mother's Education: Middle	0.4220	0.5039	0.2534	0.6268
Mother's Education: Secondary	2.4071 ***	0.5604	2.2171***	0.7063
Mother's Education: Post-Secondary	4.5461***	1.0639	4.5689***	0.9972
Income (Pesos/mo) $\geq$ 2500 $\leq$ 2999	1.4080**	0.7073	2.4496***	0.5992
Income (Pesos/mo) $\geq$ 3000 $\leq$ 7499	3.0385***	0.6781	5.2379***	0.5713
Income (Pesos/mo) $\geq$ 7499	4.0558 ***	0.8416	6.8244***	0.8227

Discussion

Through telesecundaria, Mexico has clearly developed an effective, innovative model of providing education in areas that lack the human capital to sustain high quality traditional schools. The results of my analysis confirms this, aligning with the findings of Borghesan and Vasey (2024). Telesecundaria students see impressive learning gains in comparison to students from similar backgrounds at traditional schools. Using relative distance as an instrument to calculate marginal treatment effects, this study finds average treatment effects of attending a telesecundaria on ENLACE exam scores to be approximately 0.19SD for Spanish and 0.36SD for Math. These show that telesecundarias have the power to supercharge learning in students who started off behind. However, telesecundarias have their limits, the main one of which this study failed to prove or disprove. If telesecundarias truly do not work in settings with high quality baseline education systems, we would expect to see telesecundarias adding less value in areas with higher quality schools. Recall that the treatment effects in this study are value-added meaning they represent how much better a student performs at a telesecundaria rather than if they had attended a traditional school. After including a measure of nearby traditional school quality as a covariate in the outcome model, I found no meaningful change in ATE or MTE, nor did I find a correlation between traditional school quality and value added for attending a telesecundaria. Essentially, even if they have a high quality traditional school nearby, students appear to see the same gains from attending a telesecundaria.

Again, it is important to note that my findings rest on the assumption of significant heterogeneity within Mexican traditional schools located near to telesecundarias. Based on the rapid expansion of telesecundaria, their presence across the country, and the OECD data that indicates some Mexican students are performing well, I suspect this heterogeneity exists.

Assuming it does, this provides support for building telesecundarias in places with higher quality schools that may need more capacity, such as middle class neighborhoods. Assuming heterogeneity does not exist, then this analysis would not allow us to make conclusions about the relationship between traditional school quality and telesecundaria student exam performance.

Beyond heterogeneity assumptions, this study faces a few other limitations. First, using parametric estimation rather than semiparametric estimation means that subpopulations may have an outsized impact on the estimates. If a subpopulation experiences substantially different treatment effects than the rest of the sample, this would bias the MTE graph. More information on this can be seen in Borghesan and Vasey (2024), which includes examples of semiparametric estimation. In addition to using a semiparametric model, this study could have benefitted from estimating other parameters such as treatment on the treated and treatment on the untreated. Treatment on the untreated may have been particularly interesting to capture the impacts of attending a telesecundaria on students who are attending high quality schools. Another limitation is the potential lack of external validity. Mexico's telesecundarias have a long history and are embedded into the educational fabric of the country. Students and teachers have experience with video-based instruction and know what to expect. In other countries, the institutional knowledge and cultural buy-in that telesecundarias experience may not be present. Despite these limitations, this study reaffirms the positive effects of telesecundarias on student achievement and supplies evidence that expanding telesecundarias to areas with better baseline school quality may not diminish their effectiveness.

References

Andrabi, T., Bau, N., Das, J., & Khwaja, A. (2022). Heterogeneity in School Value-Added and the Private Premium. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4269919

Angrist, J., & Lavy, V. (2002). New Evidence on Classroom Computers and Pupil Learning. *The Economic Journal*, *112*(482), 735–765. https://doi.org/10.1111/1468-0297.00068

Bianchi, N., Lu, Y., & Song, H. (2022). The effect of computer-assisted learning on students' long-term development. *Journal of Development Economics*, *158*, 102919. https://doi.org/10.1016/j.jdeveco.2022.102919

Borghesan, E., & Vasey, G. (2024). The Marginal Returns to Distance Education: Evidence from Mexico's Telesecundarias. *American Economic Journal: Applied Economics*, *16*(1), 253–285. https://doi.org/10.1257/app.20220065

De Hoyos, R., Estrada, R., & Vargas, M. J. (2018). *Predicting Individual Wellbeing Through Test Scores: Evidence from a National Assessment in Mexico*. World Bank, Washington, DC. https://doi.org/10.1596/1813-9450-8459

Fabregas, R. (2019). *Broadcasting education: The long-term effects of Mexico's telesecundarias*. Working Paper.

Gibbon, R. A. (1975). Analysis of the Ivory Coast Educational Television Project. *The Journal of Negro Education*, *44*(1), 90–99. https://doi.org/10.2307/2966760

Goolsbee, A., & Guryan, J. (2006). The Impact of Internet Subsidies in Public Schools. *The Review of Economics and Statistics*, *88*(2), 336–347.

Heckman, J. J., & Vytlacil, E. (2005). Structural Equations, Treatment Effects, and Econometric Policy Evaluation. *Econometrica*, *73*(3), 669–738.

Johnston, J., & Ksoll, C. (2022). Effectiveness of interactive satellite-transmitted instruction: Experimental evidence from Ghanaian primary schools. *Economics of Education Review*, *91*, 102315. https://doi.org/10.1016/j.econedurev.2022.102315

Koné, D. H., & Jenkins, J. (1990). The Programme for Educational Television in the Ivory Coast. *Education Media International*. https://doi.org/10.1080/0952398900270208

OECD. (2018). *Equity in Education*. https://doi.org/10.1787/9789264073234-en

Piper, B., & Zuilkowski, S. S. (2015). Teacher coaching in Kenya: Examining instructional support in public and nonformal schools. *Teaching and Teacher Education*, *47*, 173–183. https://doi.org/10.1016/j.tate.2015.01.001

Thomas, R. M. (1980). The Rise and Decline of an Educational Technology: Television in American Samoa. *Educational Communication and Technology*, *28*(3), 155–167.