THE EFFECT OF CHURCH MANAGEMENT OF SCHOOLS ON STUDENT PROGRESS: EVIDENCE FROM HUNGARY

By

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ABSTRACT

This thesis considers the effect of church management on previously state-run primary schools in Hungary. As an effort to increase denominational presence, almost 200 schools were taken over by a church in the course of a few years in the 2010s. I analyze the impact of this treatment on students' progress on standardized reading comprehension and mathematics tests between 6^{th} and 8^{th} grade. I employ fixed effects regression and propensity score matching. I find an effect of around 0.05 standard deviation units, which is quite robust to specification. The effect does not seem to last until 10^{th} grade. Furthermore, multinomial regression analysis shows that those exposed to treatment are likelier to get accepted into better secondary schools.

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INTRODUCTION

In the past decade, the number of church-run schools has approximately doubled in Hungary.[1] Surprisingly, this expansion has not come from the establishment of new denominational institutions. Instead, hundreds of existing schools under public management have been transferred to church management, affecting thousands of students.

It is a usual sight in Hungary that a previously state-run school is now named after a saint or another religious personality and even has a cross on its façade. Denominational schools are provided with more funds than public ones, even by the state itself, which is why many school communities welcome their newly granted church status.

Nonetheless, the practice has received much criticism, mainly because it creates fertile ground for segregation as people of high status, regardless of faith, choose better-funded church-run institutions for their children (Ercse 2018). The self-selection and resulting segregation between social groups, however, are not analyzed here.

What I estimate is the effect that these takeovers have had on students' academic progress. My main analysis focuses on primary education and a short time horizon, that is to say, I investigate students who are exposed to church management for 1 or 2 years. Using standardized test scores and a variety of background data from the yearly National Assessment of Basic Competencies, I estimate the impact of church management on the difference between 6^{th} and 8^{th} grade test scores. To assess whether the effect is lasting, I also conduct calculations on the difference between 8^{th} and 10^{th} grade test scores. Progress on test scores provide a relatively good approximation for the added value of the institution over this period. The employed models feature fixed effects regression and propensity score matching. An additional

[1] Unless otherwise noted, facts and figures are based on the dataset.

multinomial logit analysis is carried out to see whether secondary schools are likelier to accept students from affected primary schools.

I find that if a school is taken over by a church, its students' progress increases by about 0.05 standard deviation units, which wears off by 3 to 4 years thereafter. The effect is quite robust to specification for reading comprehension and mathematics. In addition, it seems that affected students tend to get accepted into better secondary schools.

In Chapter 1, I provide more detail about the institutional setting and the changes which happened. Chapter 2 offers an overview of the data. The description of the empirical strategy in Chapter 3 is followed by the presentation of the results in Chapter 4 and the conclusion.

CHAPTER 1 – BACKGROUND

1.1 Education System in Hungary

In Hungary, schools can be categorized into three groups based on the organization which runs them. The most populous category comprises schools which are run by a public institution, such as local governments or the Klebelsberg Institution Maintenance Centre. For simplicity, I refer to them as state-run or public schools. The second group consists of educational institutions which are maintained by a church or a religious organization. Only a small portion of schools are run by other providers such as foundations.

Generally, the Hungarian education system offers primary education for 8 years, while secondary education lasts 4 years. In my analysis, I focus on primary education, which corresponds to ISCED levels 1 and 2. The dataset I use contains test scores for 6^{th}, 8^{th}, and 10^{th} graders. In the main part of the analysis, I measure student progress between the middle and end of ISCED level 2.

It is important to note that some secondary institutions admit students at grade 5 or grade 7, namely the so-called 8-year and 6-year secondary grammar schools. The early selection allows them to pick the best and most talented of each cohort, who are often referred to as early tracking students. Even in their case, 8^{th} grade marks the end of education at ISCED level 2 (European Commission 2019).

Much of the curriculum is set at the national level, prescribing quite specific details and material. The two highest tiers of the three-tier regulation, namely the National Core Curriculum and the so-called framework curricula, are decided centrally. It is only the lowest tier, the local curriculum, which allows some, but not much, liberty for teachers in a school to adjust the students' workload to local characteristics (European Commission 2020).

As for secondary education, there are a few important factors to keep in mind. First, secondary school choice is free, but admission is based on performance on a standardized test; and second, there are significant quality differences between secondary school tracks.

In 8th grade, at the default stage of transition between primary and secondary education, it is up to the student (and the parents) to set a list of preferences regarding the desired programs at the secondary school or schools of choice. This is followed by a standardized entry examination in reading comprehension and mathematics, which is not to be confused with the test score data used in the thesis. The written examination is almost exclusively complimented by an assessment in person. At the end of the procedure, secondary schools make the decision to accept or reject the applicant, whereby the written examination is supposed to have the most weight but subjective elements might also play a role. Students can begin secondary school at the highest in their preference list among the institutions which have admitted them.

There are three secondary school tracks, apart from the 6-year and 8-year exceptional cases discussed above, which I name the following: vocational training school, vocational secondary school, and general secondary school. The Hungarian terms have been changed various times, but the underlying structure has remained the same. The three institutional tracks differ vastly in educational outcomes and prestige, not to mention the way the education itself is organized. The most important characteristics are outlined in Table 1.

Table 1: Overview of secondary educational institutions in Hungary

	Vocational training school	Vocational secondary school	General secondary school
Default duration	3+2 years	4+1 years	4 years
Offers training qualification	×	×	
Offers secondary school-leaving certificate		×	×
Followed by entry to labor market	×	×	
Followed by entry to higher education		×	×
Prestige and selection	Low	Medium	High

Primary students with the best abilities tend to choose general secondary education, which has the objective to prepare students for higher education. In terms of prestige and selection, vocational secondary education is next, which offers a secondary school-leaving examination certificate as well as specialized training as a technician, tradesperson, or artisan. Vocational training, the lowest tier of secondary education, provides limited general education and is focused on specialized training. Unlike the other two tracks, it does not offer a secondary school-leaving examination certificate, making higher education inaccessible. Vocational training schools must usually admit anyone regardless of prior educational outcomes. In addition, attrition is common in vocational training, especially after the school-leaving age was reduced from 18 to 16 (Fehérvári 2015).

Figure 1: Distribution of 10th-grade standardized test scores in different secondary tracks

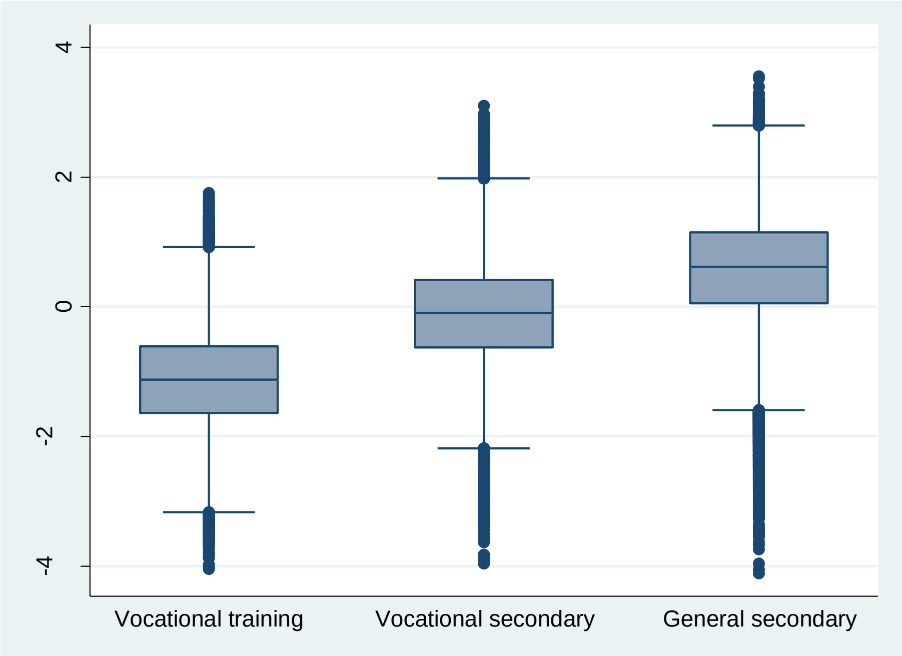
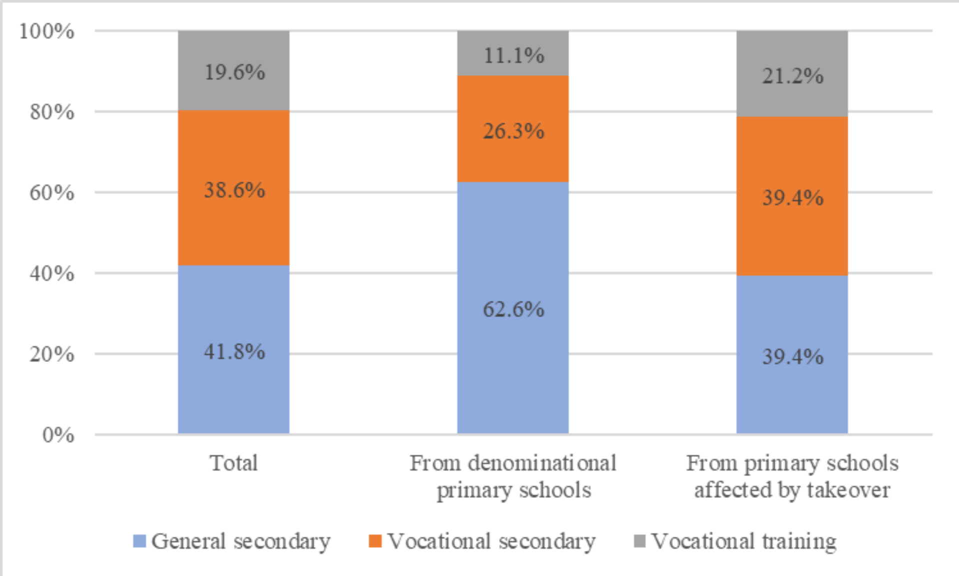


Figure 1 depicts the distribution of standardized combined test scores at 10th grade for the three tracks.[2] If considering test scores in ascending order, the figure for the first quartile of students in general secondary schools is higher than the national average or the median for

[2] The test scores were collected in the framework for the National Assessment of Basic Competencies, discussed in Chapter 2.

vocational secondary schools. The first quartile for vocational secondary schools is in turn about as high as the third quartile for vocational training. This reveals significant selection among tracks, which is not diminished but rather reinforced by the system (Köllő 2017). I believe the figure illustrates that those who can do choose the more prestigious track; if not for the quality of the education, simply because of the peers.

Figure 2: Distribution of secondary students across different tracks by primary school



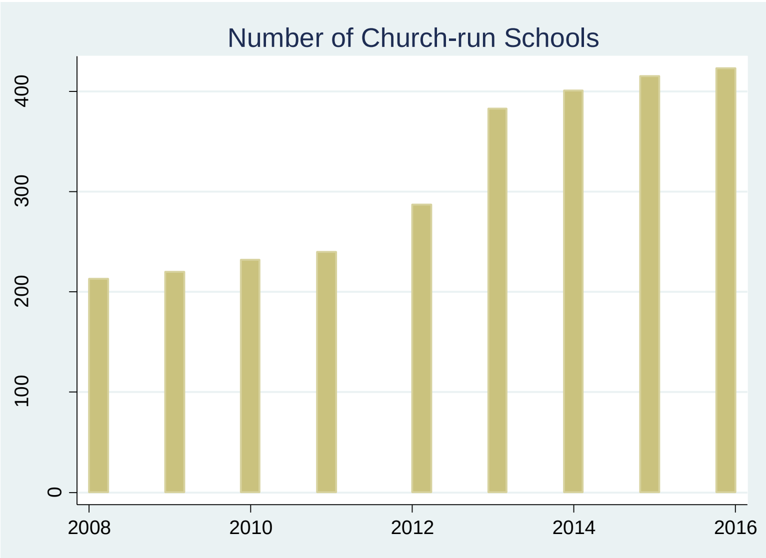
The first column in Figure 2 shows the share of students in the different secondary school tracks. The share is similar for general secondary and vocational secondary schools, while only a fifth of students attend vocational training. The second column in Figure 2 shows the distribution among those who were taught in denominational primary schools. It is evident that the most favorable outcome, namely general secondary education, is achieved by a significantly larger proportion than in the aggregate. Presumably, this is the combined effect of three factors: denominational primary schools select students from wealthier and more educated families; they somehow provide better education (Hermann & Varga 2016); and students from denominational primary schools are more welcome at general secondary schools than students from public primary schools.

The third column in Figure 2 shows the distribution among students who were affected by school takeovers, that is to say, whose school became a church-run institution from a public one. The pattern is more similar to the overall distribution than the one restricted to denominational primary schools, which highlights that the schools which were taken over were not the very best in terms of students' socio-economic composition and academic outcomes.

1.2 School Takeovers

My thesis focuses on the extraordinary surge in the number of church-run schools in Hungary after 2010, as displayed on Figure 3. In this period, especially between 2012 and 2014, churches took over state-run schools by the dozen, which accounts for most of the increase.

Figure 3: The number of church-run primary schools over time in Hungary



There are several reasons why churches and other religious organizations have been able to take over previously public schools and run them under church management with explicit approval from the school community. First, the state budget provides substantially more funds to denominational schools than to public ones, and the difference even widened in the investigated period (Hermann & Varga 2016). Second, churches have enjoyed considerable support from the government for expansionary activities in recent years. Since religious organizations defined education in Hungary for centuries, transferring schools to church management can be perceived as the natural continuation of an old tradition (Bacskai & Pandy 2017). Third, public schools have faced shrinking autonomy and growing bureaucratic burdens since 2010. Even though, as mentioned previously, curricula for all schools are prescribed centrally, church-run institutions have more liberty with respect to textbook choice, teacher salaries, and equipment procurement (Bárdits 2017). The result of the listed factors is that churches have been able to increase their presence using public funds, without opposition from school communities.

1.3 Denominational Distribution

Not all denominations used the opportunity to expand at the same rate. Table 2 shows the changes in the number of schools by provider. The largest Christian denomination in Hungary, the Catholic Church, operated 100 more schools in 2016 than six years before. The Reformed Church expanded its educational activities at a somewhat lower rate. There is sizable heterogeneity among smaller Christian churches: while some denominations did not take over any institution, Adventists, Baptists and Pentecostals together quadrupled the number of schools under their management.

Table 2: Number of schools by provider in 2010 and 2016 in Hungary

	2010	2016	Difference
Public schools	2,543	2,249	-294
Other providers	105	84	-21
Church-run schools, of which:	232	418	186
Catholic	121	221	100
Reformed Church	70	118	48
Other Christian	39	75	36
Non-Christian	2	4	2

It seems from the dataset, however, that denominations mirrored one another in the prestige-enhancing school takeovers: they were similar in their selection of schools to consider for church management. As a result, I do not differentiate between denominations when I examine church takeovers in my analysis.

1.4 Consequences of Church Management

Unfortunately, no studies have been published which describe in detail the changes which have been brought about at institutions with newly granted church status. Nevertheless, it is clear that in the first two years after the takeover, the affected schools did not go through fundamental transformation. Instead of structural changes, the first measures were always the ones which were easy to implement: schools were renamed to include the denomination in their name, sometimes even alongside a saint or religious figure; religious symbols were placed; attendance on certain religious occasions such as year opening ceremony at the church were prescribed. In some cases, a new principal was appointed.

It can be presumed, although it is not possible to prove it, that the new management instructed teachers to spend more resources on training students for measurable outcomes such as test scores or secondary school admissions. This would have provided (and probably did provide) vindication for proponents of such takeovers even in one or two years following the change.

Furthermore, the schools in question enjoyed significantly more funding and less bureaucracy right from the takeover. This made it possible to offer higher remuneration for teachers and procure the necessary equipment more easily, which is likely to have had a significant impact on students and their achievement. In fact, teachers in the public sector are underpaid to such an extent that it is not implausible that a raise should improve their teaching and efficiency significantly. In short, schools which were transferred to church management went through some symbolic changes and became much less budget constrained.

In the longer run, however, fundamental transformations have happened and are happening now. Parents of relatively high status started to favor denominational schools over public ones regardless of faith, causing a segregation process reinforced by the institutions themselves, which do not place equal weight on the presence and content of pastoral letters of recommendation for applicants of different social backgrounds. The result is usually that in the same geographic area there is a prosperous denominational school with students of favorable background and an underfunded public one with the underprivileged (Ercse 2018). This much-criticized phenomenon is outside the scope of my investigation, however.

CHAPTER 2 – DATA

2.1 Dataset

In my analysis, I use an individual-level dataset from 2008 to 2016 which contains mathematics and reading comprehension test scores in 6th and 8th grade for every primary school student in Hungary. In addition, 10th grade scores and secondary school tracks are also included. Data were collected in the framework of the annual National Assessment of Basic Competencies, which is conducted by the Office for Education in Hungary. The dataset comprises a wide variety of socio-economic indicators at the individual level, some measures about the class, and detailed school characteristics.

To appreciate the nature of the data, one must understand how the National Assessment of Basic Competencies (NABC) is structured. All students take an examination at a specified date in the late spring when they are in 6th, 8th, and 10th grade. The test consists of two sets of exercises: one for mathematics and one for reading comprehension. The two sections need to be solved on the same day, with a break in between. The exercises do not focus on taught material but rather investigate students' ability to understand texts and solve quantitative and logic-related problems which are frequent in real life. As the name of the examination suggests, the goal is to assess students' "basic competencies", which are essential in the labor market. Performance on NABC tests is not supposed to influence students' grades as it is not an exam, although teachers sometimes do grade the tests. Correction and further assessment occur at the Office for Education.

Obviously, NABC test scores cannot reflect individuals' cognitive abilities and basic competencies in a completely accurate way. However, a recent study (Hermann et al. 2019), which analyzes the first cohort for whom both test score data and labor market data are available, shows that better test scores indeed translate into favorable labor market outcomes: a mathematics score higher by one standard deviation is associated with 8–9 percent higher earnings and 2.7 percent lower unemployment probability (Hermann et al. 2019). Consequently, NABC scores are worth investigating because they measure skills which are actually valued by the labor market.

2.2 Definition of Treatment and Control

The treatment group consists of those who took their 6th and 8th grade tests in the same school but it was run by the state in 6th grade and by a church in 8th grade. Institutions are connected in the dataset based on their physical address, which ensures that the continuity of schools in the dataset remains even if there has been a change in the name (and in the official identification number).

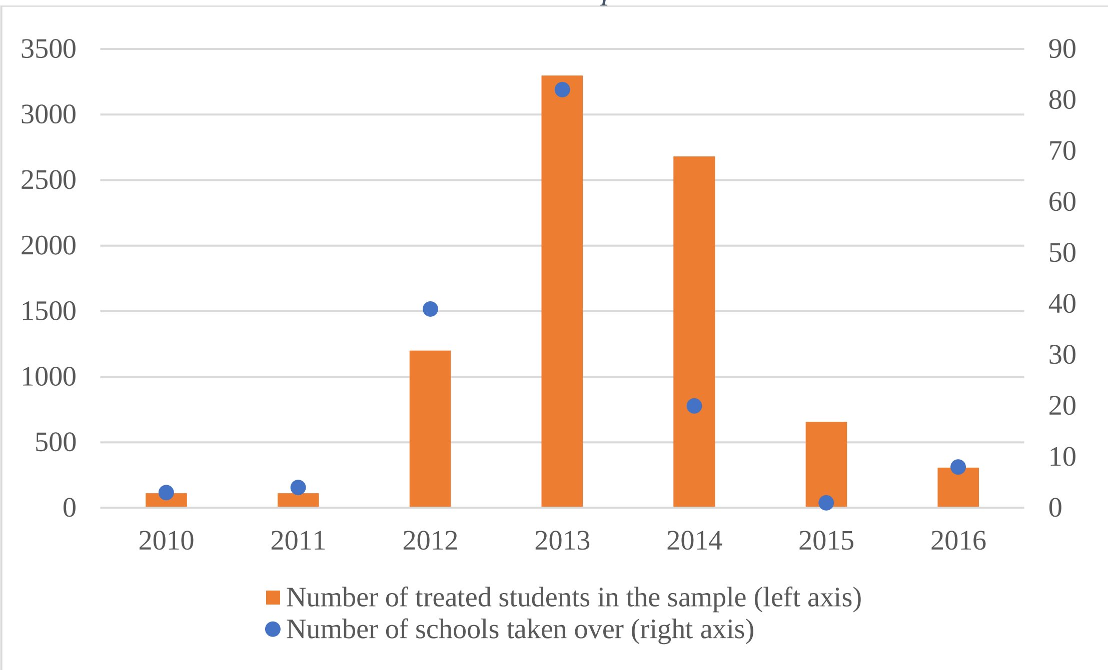
According to my definition, the takeover could have happened either at the beginning of 7th or 8th grade. Consequently, those in the treatment group had either one or two years of exposure to the new denominational management. While it might be problematic that there is some heterogeneity in the treatment, I argue that exposure of one or two years is almost equivalent because at the end of either of these periods, immediate changes (symbolic gestures, pay rises for teachers, equipment purchases) had been long made but structural reorganization had not been implemented, especially among 7th and 8th graders.[3]

In the control group, we find students who took their 6th and 8th grade tests in the same public school. It is important to emphasize that I only analyze those who took their 6th grade test in a public school because they can be compared based on whether their school was taken over by a church. Importantly, I exclude those who changed schools between the two tests as it is not possible to distinguish to which school their progress should be attributed, as well as those who

[3] This is also reflected in the data. Table 11 in the Appendix shows a fixed-effects regression with test score differences as the dependent variable, the controls listed in Table 4, and the following dummy variables: 1 year after the takeover, 2 years after the takeover, and 3 or more years after the takeover. The treatment effect of 0.05 standard deviation units, which I find in the specifications presented below, is concentrated in the first year, while the contribution of the second year is negligible. As a consequence, one or two years of exposure can indeed be considered equivalent.

for some reason (such as an illness or exchange semester) took a year off between 6th and 8th grade.

Figure 4: The number of institutions transferred to church management and affected students in the sample



When looking at the distribution of treatment over time on Figure 4, it can be seen that the largest number of schools were transferred to church management in 2013, followed by 2012 and 2014. As a result, most students who received treatment are concentrated in the 2013 and 2014 cohorts. One is most likely to pick up any potential effect in the data for those years, due to the relatively high proportion of treated students as opposed to students in the control group. It is also clear that the changes have affected hundreds of primary schools and thousands of primary students.

To summarize, students in the treatment group took their 6th-grade test in a public school, which was transferred to church management by 8th grade. Students in the treatment group also took their 6th-grade test in a public school, where they remained until 8th grade, but the school never left state management.

2.3 Outcome Variables

The dependent variable throughout most of my analysis is the test score difference between 6th and 8th grade for both reading and mathematics. Test scores are standardized each year for each grade and subject, so a test score difference of zero standard deviation units is calculated if the student is in the same position in the aggregate distribution on both occasions. Investigating test score differences measures student progress and also eliminates the variance in test score levels, which is due to unobservable characteristics such as differences in ability.

Table 3: Summary statistics of outcome variables and selected controls by treatment

	Mean (standard deviation)		T-test	
	Treated	Control	t	p>|t|
Reading score difference	0.020	-0.006	3.46	0.001
	(0.008)	(0.001)		
Mathematics score difference	0.027	0.000	3.332	0.001
	(0.008)	(0.001)		
Secondary school track				
Vocational training	0.179	0.179	0.00	0.999
	(0.007)	(0.001)		
Vocational secondary	0.357	0.366	-1.27	0.203
	(0.007)	(0.001)		
General secondary	0.323	0.344	-2.94	0.003
	(0.007)	(0.001)		
Female	0.491	0.493	-0.39	0.659
	(0.005)	(0.001)		
Parents' highest education				
primary	0.141	0.108	9.27	0.000
	(0.004)	(0.001)		
vocational training	0.344	0.307	7.16	0.000
	(0.005)	(0.001)		
secondary	0.322	0.324	-0.42	0.675
	(0.005)	(0.001)		
tertiary	0.192	0.260	-13.68	0.000
	(0.004)	(0.001)		
Location				
capital	0.024	0.013	-29.25	0.000
	(0.002)	(0.001)		
large town	0.068	0.181	-26.67	0.000
	(0.003)	(0.001)		
small town	0.526	0.364	30.54	0.000
	(0.005)	(0.001)		
village	0.381	0.322	11.54	0.000
	(0.005)	(0.001)		

Table 3 includes the means of score difference variables by treatment, which are the primary outcome variables.[4] It is evident that those who have been exposed to church management improve their score on average, whereas the unaffected do not change their position in the distribution substantially. In this crude analysis, the treatment group displays a score increment of 0.02–0.03 standard deviation units, on average. The difference is statistically significant, as shown by a t-test.

It is also worth noting that the distributions of score difference measures are, by construction, symmetric. For a share of students who move up the aggregate distribution between 6th grade and 8th grade, a similar share will drop in the aggregate distribution. In expectation, students should display a score difference of zero. If a school systematically achieves positive score increments for its students, it means that it must have some special effect on the students during the investigated period.

One specification also features score differences between 8th and 10th grade for both reading comprehension and mathematics as outcome variables. To avoid confusion with the main outcome variables, namely the score differences between 6th and 8th grade, summary statistics for these secondary indicators are not featured in Table 3. Nevertheless, t-test results reveal that the treatment and control groups are not distinguishable statistically in this respect (p=0.69 and p=0.13 for reading comprehension and mathematics, respectively).

Another important outcome variable is the secondary school track to which students in the treatment and control groups get admitted. It seems that the differences in the proportion of admissions to vocational training schools and vocational secondary schools are statistically not significant. However, a larger proportion of students in the control group are accepted into general secondary education than in the treatment group.

[4] Further summary statistics for the main outcome variables can be found in Table 10 of the Appendix.

2.4 Control Variables

In the main analysis, I employ a variety of control variables, which are listed in Table 4. Some of them are proxies for socio-economic status, such as the indicators which show the number of books at home and parents' highest level of education. These are highly correlated with wealth in the family, home literacy, and inherited cultural capital (Park 2008). By controlling for socio-economic characteristics, I plan to isolate the share of academic achievement which can be attributed to the family instead of the school.

Table 4: List of control variables in the models

Parents' maximum education	Number of books at home	Cohort size at school
Gender	Special education needs	Settlement type
Early tracking student	Failed a subject or not	

I also control for other student-specific control variables such as gender, special education needs, history of failed subjects, and a dummy variable for early tracking. It is worth mentioning that children with special education needs are assigned extra resources and receive extraordinary attention from teachers.

In addition to the above, I also use cohort size at the school as a control to distinguish between smaller and larger schools. Where the specification permits, the settlement type is also included in the equation, to reflect whether the school is located in a village, in a small or large town, or in the capital.

Table 3 also displays means and standard deviations for some of the control variables by treatment. The share of female students is almost identical between the two groups, which is also supported by the t-test. By contrast, the socio-economic composition of the two groups is not as similar. While there is no discernible difference in the proportion of parents with at most a secondary school-leaving examination certificate between treatment and control, the treatment group has relatively fewer higher educated parents and relatively more poorly educated parents.

In conclusion, students in the treatment group come from a less favorable socio-economic background than those in the control group.

As for the location, schools affected by the takeover are much more likely to be located in a village or, especially, in a small town. At the same time, the proportion of large-town schools is significantly higher in the control group than in the treatment group. This is consistent with the explanation that churches had the goal of increasing denominational presence with school takeovers, which was most easily achieved by transferring rural and small-town schools to church management. In such areas, churches as school providers had hardly been present. Since villages and small towns are populated with people of less favorable educational and financial background, it is expected that parents in the treatment group, on average, are not as well educated as parents in the control group.

CHAPTER 3 – MODELS

3.1 Main Specification

The default models I estimate can be described by the following equation:

$$Y_{ist}^{j} - Y_{is(t-2)}^{j} = \alpha_{ist} + \beta takeover_{st} + \mu_s + \nu_t + X_{ist}'\delta + \varepsilon_{ist} \quad (1)$$

where Y_{ist}^{j} is the NABC test score in subject j (either mathematics or reading comprehension) for individual i in school s at year t. The coefficient β of the treatment dummy ($takeover_{st}$) is of main interest. A vector of control variables (X_{ist}) as well as time fixed effects (ν_t) are featured in each model. Most models also include school fixed effects (μ_s).

There is reason to believe that selection into treatment is not completely random. Hermann and Varga (2016) point out that the decision of churches to take over certain schools were mainly motivated by the possibility of establishing presence in a region. Churches had usually possessed institutions in the capital and large towns. As a consequence, most schools which were transferred to church management were selected from underdeveloped regions, where denominational presence had been low. Since students from poorer regions have usually lower academic performance, the affected schools indeed lagged behind in terms of NABC test scores compared to existing institutions under church management.

I use different techniques to address potential endogeneity in the data. On the left hand side of the regression equation, score differences are present, which eliminate individual characteristics which do not change over time. On the right hand side, an array of student-level and school-level control variables as well as time fixed effects are featured for a more precise estimate. School fixed effects help to address the potential problem of selection on time-invariant school characteristics.

3.2 Additional Methods

In addition to fixed effects, I also conduct nearest neighbor propensity score matching to obtain a matched sample. For this, I use the *psmatch2* command in Stata to match on year, students' socio-economic composition, school characteristics and other listed indicators (Leuven & Sianesi 2003).

The built-in tests of *psmatch2* reveal that there is no significant difference in most respects between treatment and control groups which are created this way.[5] In the few instances where statistical differences do arise, their economic significance is negligible to none. For example, average cohort size at the school is 42 in the treatment group and 41 in the control group of the matched sample, which might be statistically distinct but is hardly relevant.

With the matched sample, I am able to compare students who are very similar to each other in several dimensions and, in essence, only differ in the fact whether their school has been taken over by a church or not. One would reasonably predict that students in the same year who come from highly similar social backgrounds and attend comparable schools in identical settlement types in fact achieve similar scores on the NABC. Consequently, the true effect of the intervention is uncovered more easily. A disadvantage of the matched sample is, however, that many observations are lost.

Additionally, I include the interaction of treatment and time in some specifications. Allowing the treatment effect to vary over time might reveal heterogeneity in its size. It could be possible that transfer to church management did not have the same impact on schools in different years. Furthermore, since the takeovers were not evenly distributed over time, as shown in Figure 4, it can also be expected that the potential effect is statistically more significant in years with various transfers.

[5] The means of the control group and the treatment group for the matched variables as well as corresponding t-tests can be found in Table 12 of the Appendix. The distribution of propensity scores is displayed on Figure 6 in the Appendix.

The time-variant specifications can be represented by the following equation:

$$Y_{ist}^{j} - Y_{is(t-2)}^{j} = \alpha_{ist} + \sum_{\tau=2010}^{2016} \beta_\tau takeover_s \times I(year = \tau) + \mu_s + \nu_t + X_{ist}'\delta + \varepsilon_{ist} \quad (2)$$

where, again, Y_{ist}^{j} is the NABC test score in subject j (either mathematics or reading comprehension) for individual i in school s at year t. The coefficients β_τ of the interaction between the treatment dummy ($takeover_s$) and the year are of main interest. A vector of control variables (X_{ist}) as well as time fixed effects (ν_t) are also featured in the time-variant models. Some time-variant models also include school fixed effects (μ_s).

To assess the persistence of the effects, I also estimate equation (1) for score differences between 8th and 10th grade. The method is identical to the main specification in most respects, but the equation also contains the secondary school track as a control, to capture the added value of the secondary school. If the coefficient β of the treatment dummy ($takeover_{st}$) were significant in these equations, it would mean that the takeover has had an impact on students' academic outcomes which is even perceivable 3 to 4 years thereafter.

3.3 Multinomial Logit

Another highly important outcome for primary students is the secondary school track they get accepted to. I estimate a multinomial logit model to uncover whether the takeovers have influenced students' admission chances into vocational training, vocational secondary education, and general secondary education.

The multinomial logit model I estimate can be characterized by the following equations:

$$\Pr(Y_{ist} = q) = \begin{cases} \frac{1}{1+E}, \; if\ q = voc.tr. \\ \frac{e^{\alpha_{ist}^{(q)} + \beta^{(q)} takeover_{st} + \gamma^{(q)} recentscore_{ist} + \nu_t^{(q)} + X_{ist}'\delta^{(q)}}}{1+E}, \; if\ q = voc.sec. \\ \frac{e^{\alpha_{ist}^{(q)} + \beta^{(q)} takeover_{st} + \gamma^{(q)} recentscore_{ist} + \nu_t^{(q)} + X_{ist}'\delta^{(q)}}}{1+E}, \; if\ q = gen.sec. \end{cases} \quad (3)$$

$$E = \sum_{m=voc.sec.}^{gen.sec} e^{\alpha_{ist}^{(m)} + \beta^{(m)} takeover_{st} + \gamma^{(m)} recentscore_{ist} + \nu_t^{(m)} + X_{ist}'\delta^{(m)}} \quad (4)$$

where Y_{ist} is the secondary school track to which individual i from primary school s at year t gets accepted. The possible tracks (q) are the following: vocational training school (abbreviated $voc.tr.$), vocational secondary school (abbreviated $voc.sec.$), and general secondary school (abbreviated $gen.sec.$). The equation is normalized: coefficients are compared to the baseline, which is vocational training.

In the multinomial logit model, the coefficient β of the treatment dummy ($takeover_{st}$) is of main interest. A vector of control variables (X_{ist}) as well as time fixed effects (ν_t) are featured in each model. In addition, the variable $recentscore_{ist}$ is also included in the model, representing an 8^{th}-grade NABC composite score (that is, mathematics and reading comprehension are considered together). As a result, the coefficient of interest, β, shows the effect of school takeovers on admission chances which is independent from the students' achievement on a standardized test of reading and mathematics. In other words, the subjective assessment of a denominational school as opposed to the public one is captured.

3.4 Summary of Models

To sum up, I use score differences between 8^{th} grade and 6^{th} grade to estimate equation (1) on the large sample using OLS with school fixed effects and on the matched sample using OLS. I run regression (2) by OLS on the large sample with school fixed effects and on the matched sample. I also estimate equation (1) with score differences between 10^{th} grade and 8^{th} grade. I run each regression twice: once for mathematics score differences and once for reading comprehension score differences. In addition to the above, I estimate a multinomial logit model characterized by equations (3) and (4).

Each model is denoted with a number and a letter. The letter stands for the subject: the letter "a" represents reading comprehension, while the letter "b" marks mathematics. The numbers, in turn, represent different specifications. Model 1 uses OLS with school and year fixed effects on the large sample, with robust standard errors clustered at the school level. Model 2 employs OLS with year fixed effects on the matched sample, with robust standard errors clustered at the school level. As for models with time-variant coefficients, Model 3 uses OLS with school and year fixed effects on the large sample, with robust standard errors clustered at the school level and Model 4 conducts OLS with year fixed effects on the matched sample, with robust standard errors clustered at the school level. As opposed to the above, where score differences between 8^{th} grade and 6^{th} grade were evaluated, Model 5 uses OLS on score differences between 10^{th} grade and 8^{th} grade, with primary school and year fixed effects and secondary school tracks, featuring the large sample, with robust standard errors clustered at the primary school level. Model 6 is a multinomial logit model with vocational training, vocational secondary education, and general secondary education as the three categories, with year fixed effects and 8^{th}-grade score controls, featuring the large sample, with robust standard errors clustered at the primary school level.

CHAPTER 4 – RESULTS

4.1 Results for Reading Comprehension

Although I run two regressions for each of the two subjects, all estimates for the overall treatment effect have a positive sign and are within the range of 0.04–0.06 standard deviation units. The significance of the estimates, however, varies by subject: the results are vaguely more convincing for reading comprehension score differences.

Table 5: Regression results for the treatment effect on reading comprehension test score differences

	Reading comprehension score difference	
	Ordinary Least Squares	
	(1a)	(2a)
Treatment effect	0.04*	0.05**
	(0.02)	(0.02)
Sample	Large	Matched
Controls	×	×
School FE	×	
Year FE	×	×
Standard errors	Clustered	Clustered
Observations	367,400	10,398
Number of schools	2,603	1,147
R-squared	0.002	0.009

Standard errors, in parentheses, are clustered at the school level.
*The list of included control variables can be found in Table 4. *** p<0.01, ** p<0.05, * p<0.1*

Table 5 contains results for reading comprehension NABC score differences. The fixed effect regression on the large sample yields a slightly significant positive impact of 0.04 standard deviation units. Furthermore, the result from the matched sample indicates a positive effect in the vicinity of 0.05 standard deviation units, which is significant at the conventional 5% significance level. It is safe to say that those whose primary school has been transferred to church management show larger progress in reading comprehension compared to their peers who still attend a public institution.

As regards the coefficients, it can be concluded that the coefficient found in the matched sample is larger in size than that in the unmatched one.

It is also important to mention that the estimates are comfortably within each other's confidence intervals, so it is possible that the underlying effect is in fact in the estimated range. To conclude, those who have been exposed to the treatment increase their NABC reading comprehension score, on average, by approximately 0.05 standard deviation units, which holds across specifications in a robust manner.

4.2 Results for Mathematics

By contrast, the significance of estimates for mathematics NABC score differences is slightly less robust, as reported in Table 6. Since standard errors are larger, the matched coefficient bears smaller statistical significance than in the previous case. The OLS estimates of 0.06 standard deviation units are significant at the 10% level.

Table 6: Regression results for the treatment effect on mathematics test score differences

	Mathematics score difference	
	Ordinary Least Squares	
	(1b)	(2b)
Treatment effect	0.06*	0.06*
	(0.03)	(0.03)
Sample	Large	Matched
Controls	×	×
School FE	×	
Year FE	×	×
Standard errors	Clustered	Clustered
Observations	367,257	10,404
Number of schools	2,603	1,147
R-squared	0.001	0.012

Standard errors, in parentheses, are clustered at the school level.
*The list of included control variables can be found in Table 4. *** p<0.01, ** p<0.05, * p<0.1*

The phenomena observed for reading comprehension score differences, namely that the matched-sample coefficient is higher, cannot be observed for mathematics score differences. Nevertheless, the estimated coefficients for mathematics are basically identical to and overlap with those for reading comprehension.

4.3 Results with Time-variant Coefficients

If I allow the treatment effect to vary over student cohorts, I find that it does not seem to be constant over time. Coefficients are the highest for 2013 and 2014 both in size and in significance, which is not surprising because more than 70 percent of all treated students are concentrated in these two cohorts. While the effect is very close to and statistically indistinguishable from zero for 2011 and 2012, when few students were affected, it is positive for 2015, although still insignificant.

Figure 5: Time-variant treatment effects for reading comprehension score differences

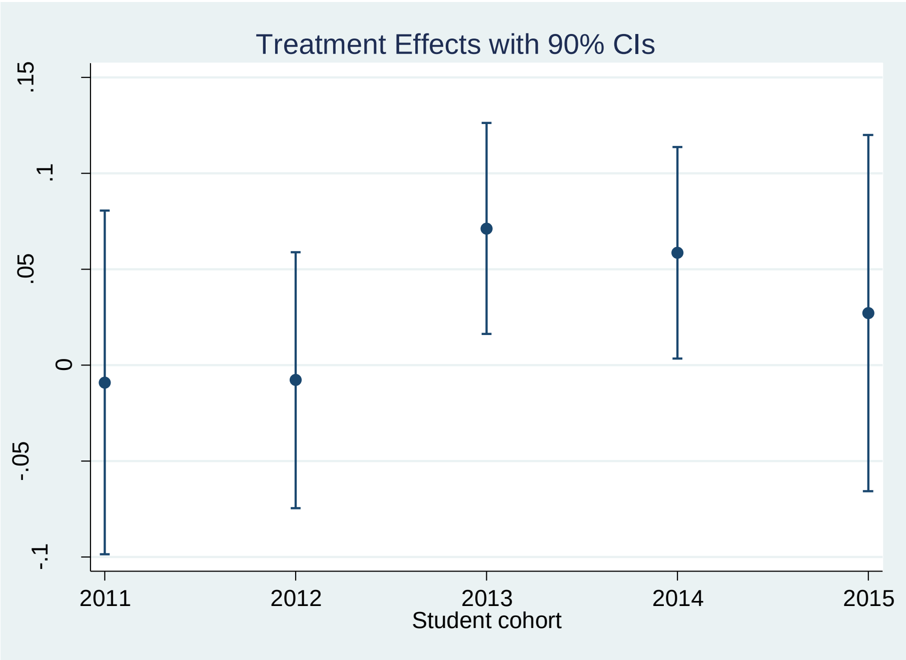


Figure 5 shows the evolution of coefficients with respective confidence intervals over time, based on Model 3a. This means that the displayed findings are the result of OLS estimation in the large sample with school and year fixed effects, with regard to reading comprehension score differences.

I report time-variant regression coefficients for the 2013 and 2014 student cohorts in Table 7. I find that estimates for reading score differences are somewhat higher but still relatively similar to those reported in Table 5, which enhances the robustness of former results.

Coefficients from these years are between 0.06–0.08 standard deviation units and are slightly or comfortably significant.

By contrast, mathematics progress is not similar for the two reported cohorts. The coefficients range from 0.08 to 0.12 standard deviation units, as opposed to the overall effect of 0.06 standard deviation units reported in Table 6.

Table 7: Regression results for time-variant treatment effects on test score differences

	Reading difference		Mathematics difference	
	Ordinary Least Squares			
	(3a)	(4a)	(3b)	(4b)
Treatment effect 2013	0.07**	0.07*	0.08*	0.08*
	(0.03)	(0.04)	(0.05)	(0.05)
Treatment effect 2014	0.06*	0.08**	0.12**	0.09*
	(0.03)	(0.04)	(0.05)	(0.05)
Sample	Large	Matched	Large	Matched
Controls	×	×	×	×
School FE	×		×	
Year FE	×	×	×	×
Standard errors	Clustered	Clustered	Clustered	Clustered
Observations	367,400	10,398	367,257	10,404
Number of schools	2,603	1,147	2,603	1,147
R-squared	0.002	0.009	0.001	0.012

*Standard errors, in parentheses, are clustered at the school level. Treatment effects for other years are not displayed. The list of included control variables can be found in Table 4. *** p<0.01, ** p<0.05, * p<0.1*

Although the dispersed nature of estimations for mathematics score differences does not support one particular result, it is still interesting to observe that the mathematics NABC score difference for one year, 2014, amounts to as much as 0.12 standard deviation units. This would mean that the treatment contributed to students' progress in the aggregate distribution to a rather appreciable extent.

Overall, the findings are more concentrated for reading comprehension score differences than for mathematics score differences. Nonetheless, there is one element which is true across all models: the phenomenon of overlapping confidence intervals. It cannot be excluded that the effect is in fact constant (or very similar) across models, specifications, years, and even subjects.

Based on this, a cautious conclusion might be drawn that the effect of church management on students' progress is around 0.05–0.06 standard deviation units.

4.4 The Persistence of Effects

I have concluded that novel church management of a primary school is associated with its students' significant progression in the aggregate distribution between 6th grade and 8th grade. To test whether the effect is persistent, I estimate a model which is very similar to Model 1 with two notable exceptions: first, the dependent variable is the score difference between 10th grade and 8th grade; and second, the secondary school track is included as a control.

As a result, the coefficient of interest shows whether the initial "push" provided by the school takeover in the final one or two years of primary school lasts enough to be detected after two years of secondary school. Since the different secondary school tracks diverge in their value added substantially, as described previously, the secondary school track is included as a control variable.

Table 8: Regression results for the treatment effect on test score differences 2 years after primary school

	Reading difference	Mathematics difference
	Ordinary Least Squares	
	(5a)	(5b)
Treatment effect	-0.02	-0.01
	(0.02)	(0.03)
Sample	Large	Large
Controls	×	×
Primary school FE	×	×
Secondary school track	×	×
Year FE	×	×
Standard errors	Clustered	Clustered
Observations	210,022	215,057
Number of schools	2,757	2,758
R-squared	0.02	0.02

Standard errors, in parentheses, are clustered at the school level.
*The list of included control variables can be found in Table 4. *** p<0.01, ** p<0.05, * p<0.1*

The results reported in Table 8 show that the previously discussed effects are not persistent after two years of secondary school. The coefficients are close to and statistically indistinguishable from zero. This does not mean, however, that affected students have profited from the takeover in primary school only: the secondary school track they have been accepted to, which is a control variable in Model 5, has a larger impact on their lives than any standardized score.

4.5 Another Outcome: Admission to Secondary School

The Hungarian education system features substantial inequality in outcomes. What is more, the initial inequality due to family background is not diminished but rather reinforced by the system, especially by secondary education, where the different tracks escalate the disparities further (Horn et al. 2016). For instance, those who attend vocational training schools can only enter higher education through considerable extra effort and cost; in other words, some students are virtually already excluded from higher education at the age of 14.

Following from the above, it is crucial for primary students to get accepted into the best secondary institution they can. In primary schools, secondary school admissions are treated by students and teachers alike as the most important achievement to be faced. The outcome of admission is investigated in depth in this section.

Table 9 reports relative risk ratios of the treatment in a multinomial logit model which intends to explain the factors behind secondary school admission. The three possible secondary school tracks are: vocational training school (baseline), vocational secondary school, and general secondary school.

It is very important to note that the model includes the 8^{th}-grade NABC test score as a control variable. The 8^{th}-grade NABC test is the closest to the standardized entry examination in both time and content. Both are written in the second semester of 8^{th} grade and both contain reading comprehension exercises and mathematics tasks, although the entry examination is somewhat more curriculum-centered. Arguably, these two scores are the best proxies for each other. The displayed coefficients, as a consequence, represent the effect of the treatment after taking into account the students' socio-economic and academic background, the characteristics of the primary school, and the objective part of the secondary admission process, namely the test score on the standardized entry examination.

Table 9: Multinomial regression results for the treatment effect on secondary school admission

	Secondary school admission
	Multinomial logit Relative risk ratios (6)
Vocational training	
Baseline	1.00
Vocational secondary	
Treatment effect	1.34***
	(0.10)
General secondary	
Treatment effect	1.64***
	(0.18)
Sample	Large
Controls	×
8^{th}-grade score	×
Year FE	×
Standard errors	Clustered
Observations	259,133
Number of schools	2,903
Log pseudo-likelihood	-236,908
Pseudo-R-squared	0.260

Standard errors, in parentheses, are clustered at the school level. The reported values represent relative risk ratios: as a result of treatment, by what factor is the relative probability compared to the baseline multiplied.
*The list of included control variables can be found in Table 4. *** p<0.01, ** p<0.05, * p<0.1*

The results are both economically and statistically significant. Students from schools with novel church management are 1.3 times more likely to get admitted to a vocational secondary school than to a vocational training school, as opposed to students from unaffected public primary schools. In addition, students in the treatment group are 1.6 times more likely to get accepted by a general secondary school than by a vocational training school, compared to the control group.

In the admission process, the secondary school possesses the following information: entry examination scores, academic history, the attended primary school, and the impressions collected during the personal interview. The multinomial logit model covers almost everything from the list. The entry examination scores are proxied by NABC scores; academic history is incorporated in some control variables; the measurable characteristics of the primary school are included. It is possible that some students make a better impression in the personal interview (because, say, they are better dressed or demonstrate a larger vocabulary), but this is also in part captured by the model, due to the presence of socio-economic control variables (which are highly correlated with being appropriately dressed or possessing an impressive vocabulary). The only remaining factor is the novel denominational status of the primary school, represented by the treatment dummy.

In summary, the multinomial logit analysis reveals that those whose primary school has been transferred into church management are likelier to get into a better secondary school than students of ordinary public primary schools, even if their test scores, socio-economic background, birth year, and additional characteristics are identical or very similar.

CONCLUDING REMARKS

In this thesis, I find a significant effect of around 0.05 on standardized test scores when I estimate the effect of church management on student progress in Hungary. In other words, students who attend schools which have been transferred to church management between 6th and 8th grade move ahead in the aggregate distribution of test scores by around 0.05 standard deviation units. To appreciate the figure in context, Holden (2016) finds that an extra payment of $96.90 per student for textbooks in California yields an effect of the same magnitude (0.07).

In addition, I also find that the effect on test scores seems to fade by 10th grade. However, a longer lasting impact is warranted for affected students by the improved chances of getting accepted by a more prestigious secondary institution. I argue that this phenomenon can be best explained by the favorable image of denominational primary schools among secondary school teachers and officials.

There is no definite explanation for the mechanism which translates church management into better student progress, but I list some factors which were most likely at play, along with their interactions. Firstly, it is possible that the new management instructed teachers to make students practice tests like the NABC or the entry examination, to show immediate results and to provide ex-post justification for the takeover. Secondly and maybe most importantly, church status lifted severe budget constraints and bureaucratic burdens, which allowed teachers to work with students more effectively, with more resources at their disposal and, most certainly, relieved from their prior financial and organizational stress.

The third explanation is somewhat speculative but should not be disregarded: it is related to what is called the Matthew effect, whereby an advantage leads to a further advantage (Kerckhoff & Glennie 1999). Students who have got admitted to a better-than-expected secondary school due to the novel denominational status of their primary school could feel more confident, valued, and intelligent, resulting in a higher NABC test score than one might predict.

This is plausible because acceptance results are published just weeks before the NABC test. Suppose a student who has received treatment gets accepted by a general secondary school instead of, as everyone expected, a vocational secondary school because officials in the more prestigious school value the denominational status of the primary school and incorporate it in the subjective part of the assessment. Once the student learns of the result, everybody around her is sure to praise and applaud her, especially her teachers. The constant encouragement could provide a sense of confidence and psychological advantage, which might also be reflected in an 8^{th}-grade NABC score which is significantly higher than the 6^{th}-grade one. Thus, one advantage results in another.

It is important to mention that my results are limited in that they only address the effect of a process which occurred at a specific time under special conditions. While some studies compare education outcomes between different providers in general (Dronkers & Robert 2008), I only focus on Hungarian public schools, some of which were taken over by a church in the course of a few years due to expansionary ambitions. Furthermore, I consider treatment as one or two years of exposure. This only allows one side of the story to emerge, namely the immediate impact, but the longer-term consequences of self-selection into denominational or public schools based on social background, which plays a greater role in shaping society, is not discussed.

At the same time, it follows from the analysis that even a relatively small amount of extra money and reducing the suffocating bureaucracy could make a sizable difference for the gravely underfunded state-run primary schools in Hungary.

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APPENDIX

Table 10: Distributional characteristics of score difference outcome variables

	Reading score difference		Mathematics score difference	
	Not treated	Treated	Not treated	Treated
Mean	-0.006	0.020	0.000	0.027
Standard deviation	0.634	0.651	0.683	0.710
First quartile	-0.398	-0.386	-0.405	-0.399
Median	0.000	0.018	0.007	0.030
Third quartile	0.394	0.404	0.414	0.453
N	422,691	7,469	422,499	7,467

Table 11: Regression results for the effect of different treatment exposure lengths on test score differences

	Reading and mathematics score difference
	Ordinary Least Squares (A1)
Treatment effect	
by time elapsed since takeover:	
1 year	0.044
	(0.03)
2 years	0.01
	(0.03)
3+ years	0.02
	(0.03)
Sample	Large
Controls	×
School FE	×
Year FE	×
Standard errors	Clustered
Observations	409,103
Number of schools	2,949
R-squared	0.003

Standard errors, in parentheses, are clustered at the school level.
*The list of included control variables can be found in Table 4. *** p<0.01, ** p<0.05, * p<0.1*

Table 12: Differences between treatment and control groups in the matched sample

	Mean		T-test	
	Treated	Control	t	p>|t|
Reading score difference	0.032	-0.019	3.64	0.001
	(0.015)	(0.015)		
Mathematics score difference	0.032	-0.021	3.29	0.001
	(0.016)	(0.016)		
Early tracking	0.034	0.032	0.59	0.558
Female	0.513	0.517	-0.54	0.588
Cohort				
2010	0.012	0.011	0.82	0.415
2011	0.013	0.014	-0.38	0.707
2012	0.137	0.139	-0.35	0.723
2013	0.388	0.397	-0.97	0.334
2014	0.332	0.326	0.69	0.492
2015	0.080	0.078	0.52	0.604
2016	0.038	0.036	0.46	0.643
Parents' highest education				
vocational training	0.343	0.332	1.27	0.203
secondary	0.338	0.347	-1.1	0.269
tertiary	0.202	0.210	-1.06	0.290
Failed once	0.012	0.010	1.17	0.244
Failed more than once	0.003	0.001	2.3	0.022
Number of books at home				
around 50	0.180	0.176	0.59	0.553
50–150	0.248	0.250	-0.22	0.824
150–300	0.147	0.147	-0.02	0.980
300–600	0.107	0.112	-0.95	0.341
600–1000	0.057	0.066	-2.14	0.032
over 1000	0.041	0.040	0.27	0.789
Special education needs	0.038	0.025	4.18	0.000
Location				
large town	0.064	0.068	-0.98	0.325
small town	0.535	0.525	1.17	0.241
village	0.381	0.385	-0.45	0.653
Cohort size	41.984	40.937	2.77	0.006

Figure 6: Distribution of propensity score by treatment status in the matched sample