The Effects of For-profit and Nonprofit Schools on Academic Performance: Evidence from Chile

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Abstract

In a context with multiple treatments, I estimate the effects of attending for-profit and nonprofit high schools in Chile. I do so by estimating a structural model of high school-type choice and academic performance, that allows me to control for endogenous outcomes and students' unobserved heterogeneity. The identification strategy helps interpret the unobserved heterogeneity as a combination of students' latent academic abilities. I fit my model to rich administrative data for the universe of Chilean students attending public and voucher subsidized private (for- and nonprofit) schools. Using the estimates from the model, I define and compute treatment on the treated (TT) effects of attending a public, private for-profit, and private nonprofit high school. My results show that attending a public high school decreases verbal scores by about 0.11–0.15 standard deviations (σ), and decreases math scores by about 0.18–0.24σ. Attending a for-profit high school has associated the following TT effects: -0.07–0.04σ for verbal, and -0.09–0.11σ for math. Finally, attending a nonprofit high school increases verbal scores by about 0.11–0.13σ, and increases math scores by about 0.13–0.21σ. I also show important heterogeneity in the TT effects with respect to the unobserved ability and the level of education of the mother.

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1 Introduction

Private schools are experiencing a boom in developing countries. The enrollment shares of private schools are as high as 34.7% in Pakistan (for primary education, in 2013), and have been rapidly increasing over time, with countries such as Sierra Leone seeing its private enrollment share for primary education doubling in two years (going from 3.5% in 2011 to 7.8% in 2013).[1] This rapid emergence of private schools in the developing world is thought to come as a response to a general parental dissatisfaction with government schools, that are characterized by teachers absenteeism, and bad teaching practices (Ashley, Claire, Aslam, Engel, Wales, Rawal, Batley, Kingdon, Nicolai, and Rose, 2014). In this paper, I study the private sector of education in Chile, a middle-income country with more than 30 years of experience with subsidized private schools, to draw conclusions on whether and why private schools are effective (or not) in providing good quality education. I use my results as a benchmark for the private education experience in the developing world.

In contrast to what happens in the United States and other developed countries, where private schools are a privilege of the rich, in poorer countries families of all social classes send their children to private institutions. Most of these schools are single operators that charge a few dollars a month, and many use abandoned warehouses to instruct the lectures. Chains of schools are also part of the supply.[2] The costs of education delivery are known to be low, and lower than those of state schools, often due to lower salaries for teachers compared to their government counterparts (Ashley, Claire, Aslam, Engel, Wales, Rawal, Batley, Kingdon, Nicolai, and Rose, 2014). In spite of this, recent studies argue that the quality of teaching is better in private schools than in state schools, in terms of higher levels of teacher presence and teaching activity.[3] Also, private school students achieve better learning outcomes than children in state schools. The evidence is ambiguous about whether private schools reach the most disadvantaged, but it

[1] All these numbers are according to The World Bank.

[2] Bridge International Academies in Kenya, and BRAC in Bangladesh are two good examples of these chains.

[3] See Kremer and Muralidharan (2008), Muralidharan and Sundararaman (2013), and Ashley, Claire, Aslam, Engel, Wales, Rawal, Batley, Kingdon, Nicolai, and Rose (2014).

does note that private schools are more prevalent in urban than in rural areas, and that financial constraints limit poorer households from enrolling private schools.

Despite the fact that our understanding of the channels through which private schools impact children's learning in developing countries has advanced rapidly in the last decade, there are still some gaps and challenges for research that haven't been paid too much attention to. First, there are not enough studies that focus exclusively on secondary schools. Second, it is problematic to compare the effectiveness of private schools with government schools, because a large proportion of private schools are unregistered and therefore typically missing from the analysis (Tooley, Bao, Dixon, and Merrifield, 2011). Third, it is hard to distinguish between for-profit and nonprofit schools due to data limitations. This paper helps close these gaps by focusing only on secondary schools and students. It also uses tax records data that allow me to observe the profit motive of private schools. Finally, and since in Chile all schools are registered and regulated by the government (through the Ministry of Education), my empirical analysis necessarily includes all of the schools in the system.

I estimate the effects of attending different types of schools (i.e. public, private for-profit, private nonprofit) on students' learning by estimating a model of school choice and academic performance in the spirit of Roy (1951) and Willis and Rosen (1979), that allows for endogenous outcomes, and controls for unobserved heterogeneity.

My results show that private schools do a better job in increasing learning outcomes than public schools. The effects are heterogeneous in the profit motive of the school (i.e. for-profit or nonprofit), and in the school-type attended in primary level. Specifically, attending a for-profit secondary school increases test scores for students that choose to attend that type of school, but only for those that didn't attend a nonprofit school in primary. Attending a nonprofit secondary school has positive effects on test scores for all students that choose to attend that type of school. Finally, attending a public secondary school decreases test scores for all students choosing to attend a public school.

This papers adds to the literature that focus on understanding the factors that determine school choice. There is a vast literature that approximates parental school selection. BLP-type of models (Berry, Levinsohn, and Pakes, 1995, 2004) are often used in this setting, as they have the advantage of being able to accommodate choice sets with a large number of alternatives, and to be estimated using either individual or aggregated level data. They also control for unobserved characteristics from both the demand and the supply sides. Bau (2015), Carneiro, Das, and Reis (2013), Gallego and Hernando (2009), and Hastings, Kane, and Staiger (2009) are good examples BLP applications in educational settings. Most of these studies coincide that proximity to school is an important attribute that parents consider when choosing schools. Average test scores are shown to be relevant in some cases, as in the Chilean one (Gallego and Hernando, 2009), but not so much in others, like in the Pakistani one (Carneiro, Das, and Reis, 2013). The school selection part of my model can be thought of being a simplification of BLP, in the sense that I assume that parents choose among types of schools rather than between individual schools. In this respect, my model is more closely related to Bravo, Mukhopadhyay, and Todd (2010), that model school-type selection within a dynamic model of school attendance and work decisions that controls for unobserved heterogeneity à la Heckman and Singer (1984). This type of models allows for a more straightforward computation of counterfactual gains of attending a certain of type of school relative to others. This paper also adds to the literature that compares the effectiveness of different types of schools on children's learning outcomes. In particular, I contribute to the existing evidence on the effects of for-profit schools, where Sahlgren (2011) finds no significant difference on academic performance between for-profit and nonprofit private schools for the case of Sweden, and Elacqua (2011) documents a slightly poorer performance of profit-seeking schools relative to nonprofits in Chile. I extend and improve these papers' analyses by estimating joint distributions of counterfactual gains from a model that accounts for school selection and individuals' unobserved heterogeneity. My results suggest that accounting for all of this is important to accurately predict actual choices and outcomes. Other papers looking at the for-profit sector in Chile include Elacqua and Santos (2013), Elacqua, Martinez, and Santos (2011), Elacqua, Santos, and Martinez (2014), Beyer (2014), and Urzua (2014).

The remainder of the paper is organized as follows. Section 2 describes and characterizes the education system in Chile. Section 3 presents a reduced form analysis for estimating the effects of attending different types of secondary schools. Section 4 presents the main empirical approach of the paper. It describes a structural model of school-type choice and academic performance, presents the empirical implementation and the data, and shows and discusses the results. Section 5 concludes.

2 The Context

2.1 Types of Schools in Chile

Schools in Chile can be grouped into three main groups according to their administration and financing scheme: public schools, private-voucher schools, and private-fee-paying schools. Both public and private-voucher schools are financed by a per-student voucher subsidy paid by the government directly to the schools. Private-fee-paying schools are financed by fees charged to parents. They serve the country's richest families, and the high amount of their fees makes of them an unrealistic alternative for the vast majority of students in Chile.[4] In fact, administrative data shows that private-fee-paying schools enroll about 7% of all students, and that school transitions between this type of school and any other one are very rare (around 3%).

Additionally, private-voucher schools can be either for-profit or nonprofit. Among for-profit schools, we find schools that belong to chains, and schools that are independent. Chains are usually controlled by a group of owners, and are characterized by networks of campuses. Independent schools are small in size, and are often owned by former public school teachers. Nonprofit schools include religious and non-sectarian organizations. They receive donations, and are most of the time subsidized by the Church or local businesses. They are also characterized by networks of campuses.[5]

[4]Fees charged by private fee-paying schools are on average three times the amount of the voucher subsidy.
[5]See Elacqua, Santos, and Martinez (2014) for a more detailed description of the private-voucher sector in Chile.

My empirical analysis doesn't include private-fee-paying schools, for the reasons described above, and treats for-profit and nonprofit private-voucher schools as separate alternatives in parents' choice set. Thus, I assume that parents' school-type choice set includes the following three alternatives: public, private-voucher for-profit, and private-voucher nonprofit.

Table 1 displays the number and share of schools and students for each type of school, for the year 2013.[6] Panel *i* presents figures for all schools offering primary and/or secondary levels.[7] Panel *ii* does the same for schools offering primary education—that may or may not offer secondary education—and for children attending primary grades. Panels *iii* and *iv* do analogously for conventional secondary education and vocational secondary education, respectively. Overall, a little more than half of all schools are publicly administered. 27.3% of all schools are private-voucher for-profit, and 12.4% are private-voucher nonprofit. Only 4.7% of all schools are private-fee-paying. In terms of enrollment, 39.7% of students attend pubic schools, while almost a third attend voucher for-profit schools, and a fifth go to nonprofit institutions. Only 7.8% of all students are enrolled in private-fee-paying schools. Very similar figures are observed in panel *ii* for primary education. In conventional secondary education (panel *iii*), the private-fee-paying sector becomes more important, at the expense of public schools. The share of enrollment for voucher for-profit schools is similar to that observed for public schools—33.1% and 32.9%, respectively. Nonprofit schools enroll 21.7% of all students. In the vocational secondary level, the private-fee-paying sector is practically nonexistent. The public and private-voucher sector equally share the market, with both for-profit and nonprofit voucher schools enrolling a quarter of all students.

2.2 Characterizing Public, For-profit and Nonprofit Schools

Schools in each school-type share common characteristics, and therefore attending a school of a particular type implies having access to characteristics that are distinctive to that type. This section characterizes each school-type in terms of regulation, school organization, and institutional

[6] All numbers come from administrative data from the Ministry of Education of Chile.

[7] In Chile, primary education consists of grades 1st-8th, while secondary education consists of grades 9th-12th.

and peers characteristics.

In terms of regulation, public schools are different from privates in that they are not allowed to select students unless it can be shown that they are oversubscribed. Private institutions can select their students. In public schools, teachers' job contracts are governed by the Teacher Statute, wages are based on uniform pay-scales, and schools have dismissal restrictions. In private schools, teachers' job contracts are ruled by the Labor Code, which allows schools to more freely hire and dismiss teachers. In addition, the regulation for for-profit schools is different than the one for nonprofits. The main difference is that nonprofit organizations in Chile are eligible for tax exemptions that for-profits are not eligible for, including exemptions on income, valued added, inheritance, and real estate taxes, as well as industrial and commercial patents, custom tariffs, and social security.[8] However, the process of creating a nonprofit organization is slower, more costly, and more bureaucratic than the process for creating a for-profit organization.

Tables 2–9 display a number of school characteristics by type of school in 2013, where I compare public, for-profit, and nonprofit institutions in terms of enrollment, class size, fees and tuition, teacher inputs, religious orientation, admission criteria, and demographic characteristics.

Table 2 displays the average enrollment, number of classes, and class size in the public, for-profit, and nonprofit sectors. Panel *i* presents numbers for both primary and secondary education levels, while the rest of the panels do the same separately for primary, conventional secondary, and vocational secondary education levels. Overall, for-profit schools are smaller than nonprofits, both in terms of enrollment (362 vs. 509.5) and number of classes (12.1 vs. 15.2). For-profits also have on average slightly smaller class sizes than nonprofits (24.6 vs. 29.1). Public schools are significantly smaller than both for-profits and nonprofits, and also have smaller class sizes. This pattern remains the same when I compare the sectors separately by education level. In panel *ii*, we additionally observe that public schools have the largest share of multigrade teaching (23.2%), followed by for-profit schools (10.9%), and then by nonprofits (5.5%).[9]

[8]For a description of the legal requirements of nonprofit organizations in Chile and the liability of their members, see Viveros (2007) and Chile-Transparente (2008).

[9]Schools are allowed to combine grades only in preschool and primary levels, and the grades that can be combined

Table 3 presents evidence on annual fees and monthly tuition charged by schools. Each cell represents the percentage of schools in a particular type of school (public, for-profit, or nonprofit) charging an amount within the price range given by the row title. I include all public, for-profit, and nonprofit schools that offer primary and/or secondary levels for children and adolescents. There is almost no public school charging any fee or tuition, and schools that do, charge a small amount. 79.6% of for-profits, and 65.8% of nonprofits charge zero annual fees. For-profits and nonprofits charge similar monthly tuition, where 45.5% of for-profits and 42.2% of nonprofits charge zero, and almost ten percent of both types of schools charge more than $78.13.[10] In Table 4, I present the same analysis as in Table 3 but restricted to schools that offer secondary education levels—that may or may not offer primary levels.[11] Half of public schools charge no annual fees, and most of the schools that charge a positive amount, charge less than $15.63. The majority of public schools charge no monthly tuition, 13.4% charge less than $15.63, and 1.3% charge between $15.63 and $39.06. There is a higher percentage of for-profit schools charging zero annual fees than nonprofits (54.4% vs. 47.2%), but this pattern reverses when it comes to monthly tuition (16.1% vs. 24.2%). In general, for-profits secondary schools charge higher monthly tuition than nonprofits.

Table 5 compares a number of teacher inputs by type of school. Specifically, I show figures on pupil-teacher ratios, teachers' degree characteristics, and type of teachers' contract. I present the numbers for primary and secondary education levels in panel *i*, and separately for primary, conventional secondary, and vocational secondary in panels *ii*, *iii*, and *iv*, respectively. In general, public schools have smaller pupil-teacher ratios than both for-profits and nonprofits, and for-profits are similar to nonprofits in this respect—except in secondary education, where all three types of school have similar ratios. All three types of school have very similar percentages of teachers with a degree in education, of teachers with a degree from a university, and of teachers with a degree from a 2- or 4-years higher education technical institutions. In general, there is a

in primary are 1st–6th and 7th–8th.

[10]For a reference, the typical (median) monthly salary in Chile is about $400.

[11]In this paper, I am interested in the dynamics of the secondary education level.

larger share of teachers with indefinite contracts in nonprofits schools than in for-profits, while the opposite is observed for teachers with fixed-term contracts. Public schools have a smaller share of teachers with indefinite contracts and a larger share of teachers with fixed-term contracts than both for-profits and nonprofits.

Table 6 compares public, for-profit, and nonprofit schools in terms of religious orientation and admission criteria. Non-profit schools are in general less secular and more Catholic than for-profit schools, which in turn are fairly similar to public schools in their religious orientation. Both types of private schools are shown to be more selective than public schools, at least with respect to the requirements asked to parents at the moment of trying to enroll their children in a school.[12] Nonprofit schools are also more selective than for-profits.

Table 7 shows demographic characteristics at the municipality level for each type of school, as well as the urban status of the school as defined by the Ministry of Education. Public schools are in general located in less wealthy, predominantly poorer, and smaller in population municipalities than both for-profit and nonprofit schools. They are also more rural. For-profit schools don't differ much from nonprofits in terms of the average income per capita and the poverty rate of the municipality where they are located. They are, however, located in areas with larger population, and are somewhat more rural than nonprofit schools.

Table 8 displays SEP characteristics by type of school. SEP, or *Ley de Subvención Escolar Preferencial*, is a new source of subsidy introduced in 2008 to complement the existing voucher in the form of a targeted voucher to disadvantaged students. This new subsidy added extra per-pupil funds of 50 percent over the base voucher for eligible students that attend any participating public or private-voucher school.[13] The Ministry of Education closely monitors all participating schools, which are required to set goals and develop an improvement plan to increase the performance. The Ministry classifies each of the SEP schools into one of three categories, according to the

[12]The admission requirements I consider are: preschool evaluation, civil marriage certificate, transcripts from previous school, baptism and/marriage through the Church certificates, income certificate, parents' interview, exam, and psychological evaluation/report.

[13]Student's eligibility is mainly determined by students' family income. See Neilson (2013) and Elacqua, Santos, and Martinez (2014) for more on SEP eligibility.

previous performance of their students on standardized tests:

- *Autonomous.* Schools with good performance.
- *Emerging.* Schools not being able to achieve good performance, plus all new participating schools.
- *Recovering.* Schools with repeated poor performance, plus all emerging schools not presenting the improvement plan on time.

Additionally, participating schools are required not to charge eligible students any tuition fee, and can't select students on the basis of previous academic performance. I present, in Table 8, the percentage of schools with at least one SEP student, the share of schools in each category of the Ministry of Education classification mentioned above, the percentage of SEP students in SEP participating schools, and the percentage of priority students.[14] Almost all public schools have a student that is eligible for the targeted voucher subsidy. 73.7% of for-profit schools serve SEP students, and 66.5% of nonprofits do the same. The vast majority of public schools are classified as *emerging*, a ten percent are classified as *autonomous*, and only two percent are in the *recovering* SEP category. A higher share of nonprofit schools are classified as autonomous than for-profits, and the opposite is true for the other categories. That is, the typical SEP nonprofit school has a better better SEP classification than the typical SEP for-profit school. Both types of private schools are better SEP classified than public schools. A little more than half of students in participating public schools are SEP-eligible, while 49% and 43.7% of students in for-profit and nonprofit schools, respectively, are SEP-eligible. Finally, more than half of students in public schools are classified as priority students. For-profit and nonprofit schools have each a little less than fifty percent of their total enrollment being classified as priority students.

Table 9 displays average test scores and family background characteristics for each type of school. Students in nonprofit schools have higher test scores (on average) on standardized exams than students in for-profit schools, which in turn have higher test scores than students in public

[14] According to the second article of the Act 20.248, a student classified as a priority is one for whom the socioeconomic situation in her household makes the education process more difficult.

schools. Parents of students in private schools are slightly more educated than parents of students in public schools. Finally, students in private schools come from families that are predominantly wealthier than families of students in public schools.

Summing up, a public secondary school is a school that faces stringent regulation regarding teachers' job contracts, has relatively small class-sizes, has low or no fees, has no particular religious orientation, is in general non-selective, is present in rural areas, enrolls disadvantaged students, and its students come from relatively poor backgrounds. A for-profit secondary school is a school that faces a flexible teachers' contract regulation, charges relatively high fees, has no particular religious orientation, is selective, has low presence in rural areas, enrolls a relatively low share of disadvantaged students, and its students come from relatively wealthy environments. Finally, a nonprofit secondary school is a school that faces a flexible teachers' contract regulation, is eligible for tax exemptions, charges relatively high fees, is predominantly Catholic, is selective, has low presence in rural areas, enrolls a relatively low share of disadvantaged students, and its students come from relatively wealthy environments.

3 Reduced Form Analysis

Before turning to the analysis of the structural model, I motivate my upcoming results by presenting a conventional reduced form analysis. Consider the following linear model for academic achievement:

$$T = \alpha S + X\beta + \varepsilon, \tag{1}$$

where T represents the score of a student in a particular test, $S = \sum_{j=1}^{\bar{S}} jD_j$ is a categorical variable denoting the type of the school, with D_j a dummy that takes a value of one if the individual attends a school of type j and zero otherwise, X is a vector of family background and environment characteristics affecting test scores, and ε is an idiosyncratic error term.

S is very likely correlated with ε, and therefore α, the parameter of interest, is a random variable that may be statistically dependent on S.[15] Within this framework, OLS is inconsistent for α in equation (1). To overcome this potential endogeneity problem, many scholars have used instrumental variables approaches (Card, 1999, 2001), where a variety of instruments, including compulsory schooling laws, and difference in the accessibility of schools have been proposed and used.[16] In what follows, I adopt this approach, and perform IV regressions, paying special attention to the interpretation of the estimates.

I use administrative data from the 2013 version of SIMCE, a battery of standardized tests that measure the performance of Chilean students in a variety of subjects according to the official curriculum.[17] I observe students taking the exams in 10th grade, after they have attended a specific type of school (public, for-profit, or nonprofit) for two consecutive years during their secondary education (9th and 10th grades). Students take verbal and mathematics exams. I run one separate 2SLS regression for each subject. And, because there is a considerable number of students changing school-types when they transition from primary to secondary levels, I perform the analysis separately for each school-type attended in primary education.[18] That is, I run three sets of 2SLS regressions: one using the sample of students that were enrolled in public schools in primary, another one using the sample of students that were enrolled in for-profit schools in primary, and a last one using the sample of students that were enrolled in nonprofit schools in primary. My argument for doing this is that the decision of the school-type in primary is endogenous by nature, and therefore it is reasonable to expect that the three samples are formed by different groups of individuals, and that the effect of attending a particular type of school varies from one group to another. I use the % of for-profit schools in the municipality as the instrument for the choice of attending a for-profit secondary school, and the % of nonprofit schools in the municipality as the instrument for the choice of attending a nonprofit school. Both

[15] Correlation between S and ε occurs whenever there exist unobserved factors that simultaneously affect school selection and academic performance (e.g. ability, motivation). See Heckman, Urzua, and Vytlacil (2006), and Heckman and Urzua (2010).

[16] See Angrist and Krueger (1991), and Cameron and Taber (2004).

[17] See Section 4.4 for a detailed description of the data I use.

[18] Table 10 presents the school-type transitions between primary and secondary levels.

these instruments are common in the literature of school choice.[19]

Table 11 presents the results from the 2SLS estimations. Panel *i* presents the results for students that attended public schools in primary. The effect of attending a for-profit secondary school for two consecutive years is negative and statistically significant for both verbal and math tests (-0.264σ and -0.138σ, respectively). The effect of attending a nonprofit secondary school is positive and statistically significant. Attending a nonprofit school increases verbal scores by 0.08σ, and math scores by 0.156σ. Panel *ii* presents the results for students that attended for-profit schools in primary. The effect of attending a for-profit school is negative for verbal (-0.185σ), and positive for math (0.329σ). Attending a nonprofit school decreases test scores. The estimated effects are -0.271σ for verbal, and -0.45σ for math. Finally, Panel *iii* shows the results for students that attended nonprofit schools in primary. The effect of attending a for-profit secondary school is positive and significant for both tests (2.181σ for verbal, and 0.882σ for math). The effect of attending a nonprofit secondary school is not statistically different from zero for verbal, and 0.133σ and statistically significant for math.

Although the interpretation of the 2SLS estimates seems straightforward, it needs a more careful look. It's crucial to understand the exact economic question that the 2SLS (or IV) estimator is answering. In an unordered choice model, IV estimates a weighted average of the mean gross gain to persons induced into a choice state by a change in the instrument compared to their next best alternative (Heckman and Urzua, 2010). It averages the returns to a destination state over all origin states. In the school-type choice context presented above, the IV estimated "effect" of attending a for-profit school is a weighted average of the gains for individuals induced to attend a for-profit school by a change in the availability of for-profits schools (the instrument) compared to their next best alternative, which for some is attending a public school and for other is attending a nonprofit school. Without imposing additional structure, IV does not enable to identify the returns at each of the different margins (i.e. the returns for individuals that are indifferent between a for-profit school and a public school, and the returns for individuals that are

[19]See, for example, Elacqua (2011).

indifferent between a for-profit school and a nonprofit school). As noted by Heckman and Urzua (2010), structural methods provide a more complete description of the effect of the instrument (policy). They identify mean returns as well as distributions of returns for individuals coming to a destination sate from each margin. They also identify the proportion of people induced into a state from each origin state. Armed with this, the definition of a wide variety of treatment effects parameters that answer well posed economic questions is straightforward. In the next section, I develop a structural model of school-type choice and academic achievement that allows me to estimate the average gains of attending a specific type of school for individuals that endogenously choose to attend that type of school, or the "average treatment effect on the treated", a relevant and important parameter in contexts where the treatment status is endogenously chosen.

4 Structural Analysis

4.1 A Model of School-Type Choice and Academic Performance

Following the literature on structural choice models with factor components, I approximate the school-type selection process of Chilean students with a discrete-continuous econometric model of school-type choice and test scores.[20] I assume that there are S types of secondary schools, and that parents choose the optimal type, s^*, according to a utility-maximizing argument:

$$s^* = \underset{s \in \{1,\ldots,S\}}{\operatorname{argmax}} \{I(s)\},$$

where I assume a linear-in-parameters form for $I(s)$:

$$I(s) = Z\gamma_s + \eta^D(s) \qquad \text{for each } s \in \{1,\ldots,S\}. \tag{2}$$

[20]See Aakvik, Heckman, and Vytlacil (1999), Aakvik, Heckman, and Vytlacil (2005), Cameron and Heckman (2001), Carneiro, Hansen, and Heckman (2003), Hansen, Heckman, and Mullen (2004), Sarzosa and Urzua (2013), Urzua (2008) for applications of similar models in other contexts.

Z is a vector of observed variables relevant to the decision, and $\eta^D(s)$ is the error term that also contains unobserved (but relevant) characteristics. $I(s)$ should be interpreted as the value of the indirect utility function associated to the choice s. This indirect utility function is the result of a standard utility maximization problem, and consequently Z contains variables associated to the utility function and to the budget constraint. I allow $\eta^D(s)$ and $\eta^D(s')$ to be correlated for any $s \neq s'$. I impose a factor structure to the model. Specifically,

$$\eta^D(s) \;=\; \alpha_s^D f + \nu^D(s) \qquad \text{for each } s \in \{1, \ldots, S\}, \tag{3}$$

where f is one-dimensional and denotes the unobserved heterogeneity. $\nu^D(s)$ represents an idiosyncratic error term, and satisfies $\nu^D(s) \perp\!\!\!\perp \nu^D(s') \perp\!\!\!\perp f \perp\!\!\!\perp (Z, X)$ for any s and $s' \neq s$, where $\perp\!\!\!\perp$ denotes statistical independence.[21]

I also model academic performance for each school-type $s \in \{1, \ldots, S\}$ as test scores equations. Let $T(s)$ denote a $J \times 1$ vector of test scores, given schooling choice s. I assume the following linear-in-parameters form for $T(s)$:

$$T(s) \;=\; X^T \beta_s^T + \alpha_s^T f + \nu^T(s) \qquad \text{for each } s \in \{1, \ldots, S\}, \tag{4}$$

where X^T contains observed variables determining test scores, and $\nu^T(s) \perp\!\!\!\perp \nu^T(s') \perp\!\!\!\perp f \perp\!\!\!\perp (Z, X)$ for any s and $s' \neq s$.

Finally, I posit a linear measurement system to identify the distribution of the unobserved factor, f, that is independent of the observed optimal school-type s^*. I supplement the model described above with a vector of linear equations linking early taken test scores with observed characteristics and the unobserved heterogeneity. This allows me to interpret f as a combination of different latent abilities affecting measured ability.[22] I model each of the equations in the

[21] $X = (X^T, X^M)$ is a vector containing all the observable variables from the other parts of the model.

[22] In this setting, f includes unobserved factors that directly determine test scores such as cognitive and non-cognitive abilities.

measurement system as:

$$M_l = X_l^M \beta_l^M + \alpha_l^M f + \nu_l^M \qquad \text{for each } l \in \{1, \ldots, L\}, \tag{5}$$

where L is the total number of linear equations in the system. The error term ν_l^M is independent of the factor, the observable variables, and of $\nu^D(s)$ and $\nu^T(s')$ for any school-types s and s'.

This model of school-type choice and test scores shares the structure of the model in Hansen, Heckman, and Mullen (2004), and consequently I can directly apply their argument to prove its non-parametric identification. Specifically, I can apply Theorem 1 in Hansen, Heckman, and Mullen (2004) and Kotlarski Theorem (Kotlarski, 1967) to prove the identification of the distribution of the latent factor as well as the identification of the parameters in the latent utilities and test scores equations. Appendix **??** describes the identification in more detail.

4.2 Estimation Strategy

I am able to observe the optimal school-type decisions (s^*), as well as the associated observable characteristics (Z, X). I also observe test scores as outcomes (T), which combine counterfactuals and decisions in the following fashion:

$$T_i = \sum_{s=1}^{S} T_i(s) \times D_i(s),$$

where $D_i(s) \equiv \mathbb{1}[s = s^*]$, and $\mathbb{1}[\cdot]$ is an indicator function that takes a value of one if the argument is true, and zero otherwise. Also, $\sum_{s=1}^{S} D_i(s) = 1$. Finally, I observe early taken test scores (M). The key insight of my approach is that, conditional on the unobserved heterogeneity (f), all error terms are mutually independent. Thus, the likelihood function can be written as:

$$\prod_{i=1}^{N}\int\left\{\begin{array}{c}[g(\mathbf{T}_i(1)|X_i,f,D_i(1)=1)]^{D_i(1)}\,Pr\left[D_i(1)=1|X_i,f\right]\\ \vdots\\ [g(\mathbf{T}_i(S)|X_i,f,D_i(S)=1)]^{D_i(S)}\,Pr\left[D_i(S)=1|X_i,f\right]\end{array}\right\}\Pi_{j=1}^{J}h(M_{ij}|X_i,f)dG(f).$$

I also assume that f is distributed according to a three-component mixture of normals. Formally,

$$f \sim p_1N(\mu_1,\sigma_1^2)+p_2N(\mu_2,\sigma_2^2)+p_3N(\mu_3,\sigma_3^2).$$

This assumption provides enough flexibility and doesn't impose normality a priori. I estimate the entire model using Markov Chain Monte Carlo methods, and I use the sampling proposed by Gibbs. My use of Bayesian methods is merely for computational reasons, and to avoid the computation of the integral in the likelihood function. I am interested primarily in the mean of the posterior distribution, and therefore my analysis follows the classical perspective and is interpreted as an estimator that has the same asymptotic sampling distribution as the maximum likelihood estimator. See Robert and Casella (1999) for more details. See also Appendix C in Hansen, Heckman, and Mullen (2004) for the exact estimation procedure.

4.3 Definition of the Treatment Parameter of Interest

In this multiple potential outcomes setting, I am interested in estimating the effects of attending a school of type s^*, where s^* is optimal in the choice set $\{1,\ldots,S\}$ relative to attending a school of type k^*, where k^* is optimal in the choice set $\{1,\ldots,S\}\setminus s^*$. That is, I want to estimate counterfactual gains for first-best vs. second-best pairs. To do so, I define the Average Treatment Effect on the Treated (TT) of attending a school of type s^* as follows:[23]

$$TT(s^*) \;=\; \sum_{k^*\in\{1,\ldots,S\}\setminus s^*} E\left[Y_i(s^*)-Y_i(k)|D_i(s^*)=1\right]\times Pr\left[D_i(k^*)=1|D_i(s^*)=1\right],$$

[23]See Heckman, Urzua, and Vytlacil (2006) and Heckman and Vytlacil (2007).

where $s^* = \text{argmax}_{s \in \{1,\dots,S\}}\{I(s)\}$, and $k^* = \text{argmax}_{k \in \{1,\dots,S\} \setminus s^*}\{I(k)\}$. That is, the TT parameter compares the first-best alternative with the second-best alternative for each individual, and takes the average over all individuals who's first-best is s^*. The TT parameter is of interest in any program where the treatment status is endogenously determined by the agents, as it informs about the effect of the program for those who choose to be treated.

4.4 Data and Empirical Implementation

I use data from the SIMCE 2013 database for 10th graders. SIMCE is a mandatory national standardized battery of tests aimed at measuring the degree of students' learning in a number of subjects at various educational levels. Specifically, SIMCE is taken by all students in 4th grade every year, and since 2005 it rotates between 8th and 10th grades in a yearly fashion. The subjects evaluated in 10th grade are verbal and mathematics. SIMCE data contain information on test scores, school characteristics, and student and family characteristics. I merge these data with tax records for school providers, so I can identify the for-/nonprofit status of the schools, and with CASEN 2011 and SIMCE 2012 for 10th graders data sets to construct the exclusion restrictions that I use in the choice equations. CASEN is the national socioeconomic characterization survey, and is representative at the national, regional, and municipal level. I use the year 2011 for CASEN as this is the year in which 10th graders in 2013 were in 8th grade, and therefore were deciding the school-type for their secondary education. Ideally, I would also use SIMCE data for 10th graders in 2011 to construct the instruments, but since SIMCE wasn't administered to 10th graders in 2011, I use the 2012 version instead.

As outcome variables I use test scores for the two subjects evaluated in the SIMCE 2013 exams. The exogenous variables that I use in both the choice and the outcomes equations are: gender, mother's highest grade completed, father's highest grade completed, and region indicators. In addition, I include the following variables in the choice equations: the difference between the average test scores of 10th grade students in for-profit schools in a municipality and the average test scores of 10th grade students in public schools in that municipality in 2012, the difference between the average test scores of 10th grade students in nonprofit schools in a municipality and the average test scores of 10th grade students in public schools in that municipality in 2012, the percentage of secondary schools that are for-profit in a municipality in 2012, the percentage of secondary schools that are nonprofit in a municipality in 2012, municipality's log population in 2011, and municipality's urbanization rate in 2011.

Additionally, I use 8th grade test scores from SIMCE 2011 to form the measurement system. Students in this grade take exams in verbal, mathematics, social sciences, and natural sciences, and I use the scores from all four exams to identify the distribution of the unobserved factor.[24] Exogenous variables in the measurement system include the same variables as in the outcomes equations plus household composition indicators.[25] Table 12 displays the variables inclusion rules for the measurement system, choice, and outcomes equations.

Table 10 shows the school-type transitions between primary and secondary levels for the sample I use in the empirical analysis. It presents both the total number and the percentage (in parentheses) of individuals transitioning from each school-type in primary to any other one in secondary[26]. Most of the students stay in the same school-type; however, there is still a considerable number of students changing school-types. In particular, 67.7% of students in public schools, 69.6% of students in for-profit schools, and 74.3% of students in nonprofit schools remain in the same school-type when transitioning to secondary education. Also, 18.4% of students in

[24]An important feature of SIMCE tests is that they are constructed to measure learning at the school-level, as opposed to the student-level. That is, two students from the same school take tests that evaluate different contents from the official curriculum for a particular subject (e.g. verbal) with a positive probability. Thus, scores are comparable only at the school-level (i.e. school-level averages). My empirical analysis remain valid despite this feature of SIMCE, for the following reasons. First, I use individual 8th grade test scores only to obtain information that allows me to estimate the distribution of the unobserved factor. Second, I take averages of predicted 10th grade test scores at the school-type level to compute the estimated treatment parameters. And, since each school-type includes several schools, my estimates are correctly specified.

[25]Information on household composition is not available in the SIMCE 2013 data sets, so I can't include it in the choice and outcomes equations.

[26]Note that this is a simplification of the actual school transitions between primary and secondary levels. Specifically, I am not distinguishing between students that remain in the same school (and school-type) from students that change schools but remain in the same school-type. This is most interesting for students that attend primary schools that also offer secondary level (since students in primary schools that do not offer secondary level are forced to change schools). In my sample data, 46% of students in 8th grade in 2011 are enrolled in primary schools that also offer secondary level. Of those, 86% remain in the same school-type. And, only 14% of the students in that group change schools between primary and secondary.

public primary schools switch to a for-profit secondary school, and 13.9% of the same pool of students switch to a nonprofit secondary schools. Similarly, of all students in for-profit primary schools, 18.4% switch to public secondary schools, and 12% switch to nonprofit secondary schools. Lastly, 13.9% and 11.9% of students in nonprofit primary schools switch to public and to for-profit schools, respectively.

I estimate the model outlined in section 4.1 separately for each type of school attended in primary education. That is, I estimate one separate model for students that attended public schools in primary, another one for students that attended for-profit schools in primary, and a third one for students that attended nonprofit schools in primary. My argument for doing so is that the decision of the school-type to attend in primary is endogenous by nature, and therefore it is reasonable to expect that the three samples are formed by different groups of individuals, and that the effect of attending a particular type of secondary school varies from group to group. Figures 1 and 2 illustrate the scheme of decisions associated to the models that I estimate.

I construct the final data set I use in the empirical analysis in the following way. I begin with a balanced panel of 163,751 students that take at least one of the 8th grade and one of the 10th grade SIMCE exams. I keep only students that take all four exams in 8th grade. I lose 6,937 observations for this reason. Next, I drop all individuals with a least one missing covariate. In order to avoid dropping observations with missing parental education information and differences in schools' test scores, I impute all missing observations in these variables with a value of zero, and include dummy variables that take a value of one if the respective covariate is non-missing and zero otherwise.[27] I lose 11,533 additional observations. I end up with a final data set consisting of 145,281 individuals, of whom 66,388 attended a public school in primary, 46,671 attended a for-profit school in primary, and 32,222 attended a nonprofit school in primary.

Tables 13 and 14 show summary statistics for the variables used in the empirical analysis.

[27]More specifically, an variable x that is imputed is transformed in the following way,

$$x' = x \times \mathbb{1}\left[x = \text{ non-missing}\right].$$

I include both x' and $\mathbb{1}\left[x = \text{ non-missing}\right]$ variables in the equations to be estimated.

Table 13 describes the variables used in the measurement system. Almost half of the sample are men. Both parents have on average a little less than 11 years of formal education. The majority of the individuals in the sample live with both parents and with siblings, while 28% live with other relatives or non-relatives. The vast majority (71%) of students reside in the central region. Table 14 describes the variables that I include in the choice and outcomes equations. The figures follow closely what we observe in Table 13. We additionally observe that there is an average share of 32% of for-profit secondary schools and 28% of nonprofit secondary schools in the municipalities. Both for-profit and nonprofit schools outperform public schools in verbal and mathematics exam scores. Finally, the average log population in a municipality is 11.57, and the urbanization rate is 86%.

4.5 Results

4.5.1 Estimates

The measurement system in each of the models comprises four linear equations, one for each test taken in 8th grade (verbal, mathematics, social sciences, and natural sciences). Tables 15-17 present the estimates for these equations. Table 15 does so for students that attended public schools in primary, Table 16 for students attended for-profit schools in primary, and Table 17 for students that attended nonprofit schools in primary. In all three models females outperform males in verbal exams, and the opposite is true for all other tests. This pattern has already been documented for the case of Chile.[28] Both parents' education are significant determinants of test scores, with mother's education being somewhat more important than father's. The indicators for household composition are not always statistically different from zero, and an interesting pattern is found for the dummy for living with siblings. It increases math scores, but decreases social sciences'. Geographical variables are also important, and their effects vary across models and tests. For students in public primary schools, living in the South is associated with higher scores,

[28]See, for example, Reyes, Rodriguez, and Urzua (2013).

for all exams. Finally, the unobserved component of the model (ability) is a strong predictor of academic performance. It has a positive and significant effect in all equations. Note that to secure identification, I normalize the factor's loading to being equal to one in all three math scores equations.

The importance of including the factor in the model can be analyzed in Figure 3, which presents a variance decomposition exercise for all four test scores in the measurement system, and for each estimated model. The exercise is very simple: it quantifies how much of the total variance is explained by the observables ($X\beta$), the factor (αf), and the error term (ν). We observe that observables are not able to explain much of the total variance, with 9% being the largest proportion they explain. Adding the factor helps capture much more of it. In fact, the factor explains at least 18% of the total variance in all equations. There is still a large amount of the variance that is left unexplained, but the factor improves considerably the capability of the model to explain it.

Tables 18, 19, and 20 present the estimates for the secondary school-type choice equations for the models for students in public schools in primary, students in for-profit schools in primary, and students in nonprofit schools in primary, respectively. The omitted choice is the public type. In general, being a male decreases the probability of choosing both a for-profit school and a nonprofit school, in all models. Parents' schooling increases such probabilities. Geographical variables are also important. Students from the South are more likely to choose schools of the public type in the public-in-primary model. This pattern reverses for other two models. The availability of for-profit and nonprofit schools in the municipality is possibly the most important predictor of choice. Their associated coefficients are large and statistically significant in all models. It is likely that this effect is operating through distance to school; for instance, a higher share of for-profit schools in an individual's municipality might very well imply that there is a better chance that schools of such type are near to the individual's house.[29] Average differences in school test scores are also shown to be strong determinants of the choice. Large cities are usually associated

[29]Hastings and Weinstein (2008), Gallego and Hernando (2009), and Gomez, Chumacero, and Paredes (2012) document an important role of proximity to school when choosing schools.

to choosing a private school, and high urbanization rates increase the probability of choosing a for-profit school, but reduces the probability of choosing a nonprofit school. Finally, high-ability students choose private schools more frequently, especially nonprofits.

Tables 21-23 present the estimates for the outcomes equations—i.e. verbal and math test scores in 10th grade. Table 21 does so for the public-in-primary model, Table 22 for the for-profit-in-primary model, and Table 23 for the nonprofit-in-primary model. The results are in line with what we found for the measurement system. That is, females perform better than males in verbal exams but not in math exams, and parental and geographic variables are important determinants of academic performance. Once again, the factor is a strong determinant of test scores, with its loadings being all positive and statistically different from zero.

4.5.2 Goodness of Fit

To validate the models, I simulate one million observations using the estimates for the covariates and the distributions of the factor and the error terms, and the sample data, for each of the three models. The exercise is as follows. I randomly select an observation from the data, and draw a value for the factor and the error term from their estimated distribution functions. With that in hand, I compute the predicted value of the indirect utility, $I(s)$, for each of the three school-type choices. Thus, I get $I(\text{public})$, $I(\text{for-profit})$, and $I(\text{nonprofit})$, and can compute the optimal choice, s^*, by selecting the school-type associated with the highest indirect utility level. I also predict counterfactual outcomes for each of the three school-type choices. I repeat this process one million times.

Tables 24-26 present the goodness of fit of the simulated models. Table 24 compares the actual school type choices with the ones predicted by the models. All three models do an excellent job in reproducing the actual choices. Similar is the conclusion for the measurement systems and the outcomes, as shown in Tables 25 and 26. The models predict well the first two moments of the actual distributions.

4.5.3 Distribution of the Unobserved Ability

Figures 4-6 present the estimated distributions of the unobserved ability, shown separately for each of the three models. The estimated parameters are presented at the bottom of the figures. The shapes of all three densities confirm my approach of not assuming normality a priori, and the estimated probabilities show that all mixture components are necessary to well approximate the distributions.

Figures 7-9 present the distributions of the unobserved ability by secondary school-type choice, shown separately for each of the three models. In the public-in-primary model (Figure 7), nonprofit schools seem to attract more high-ability students than both public and for-profit schools. Similar is the case for the nonprofit-in-primary model (Figure 9). In the for-profit-in-primary model (Figure 8), both types of private schools are shown to be equally good (and better than public schools) in attracting high-ability students. Note that the patterns found in these figures are in line with the estimated loadings in the multinomial models presented in Tables 18-20. They also confirm the results of theoretical models of competition between public and private schools under voucher regimes, such as Epple and Romano (1998) and MacLeod and Urquiola (2009), that predict a concentration of high-ability students in private schools.

4.5.4 Treatment Effects

I use the simulated models to compute the average treatment on the treated effect (TT) parameter defined in Section 4.3. Each estimate should interpreted as the average gain of attending a particular school-type relative to the second-best alternative, for individuals choosing to attend that particular school-type. The second-best alternative varies across individuals, and the TT parameter weighs each of the margins accordingly. Table 27 presents the estimated TT effects for all three models. The outcomes are scores in verbal and mathematics exams. In the public-in-primary model (panel i), attending a public secondary school has a negative effect on test scores. Specifically, it reduces verbal scores in 0.112σ, and math scores in 0.18σ. For-profit secondary enrollment is associated with positive effects on test scores—0.034σ in verbal, and 0.061σ in math. Attending a secondary nonprofit school improves verbal and math scores—the estimated treatment parameters are 0.122σ in verbal and 0.202σ in math. A similar pattern is observed in the for-profit-in-primary model (panel *ii*), both in sign and magnitude.[30] In the nonprofit-in-primary model (panel *iii*), attending either a public or a for-profit secondary school is associated with negative effects on performance in both verbal and math exams. Attending a nonprofit secondary school increases verbal scores in 0.127σ, and math scores in 0.205σ.

In order to interpret the magnitude of the estimated effects, note that a standard deviation is the distance between the middle of the class and ranking at the 84th percentile. According to Allan and Fryer (2011), a student typically improves by about one standard deviation over the course of 1.4 academic school years, or 12.5 months. Therefore, an effect of 0.1σ translates into 1.25 months of schooling, and an effect of 0.2σ into 2.5 additional months. Thus, the estimated effects do not seem to be too large, as they don't imply more than a 3 months difference in schooling. However, it is hard to find evidence on educational programs that are associated with larger effects.

I now turn to study the heterogeneity of the treatment effects along two important dimensions: the unobserved ability, and mother's schooling. Figures 10-21 present the results.

Figures 10-15 show how the estimated effects vary as a function of the unobserved ability. In general, the TT parameter is increasing on ability for the treatment of attending a public school, and for the treatment of attending a for-profit school. That is, individuals with higher levels of ability experience larger gains. This pattern reverses when we look at the treatment of attending a nonprofit institution.

Figures 16-21 display how the TT parameter varies as a function of mother's schooling. We observe in general that, for the treatments of attending a public school and attending a nonprofit school, the effects (positive or negative) are more pronounced for individuals with less educated mothers. For the treatment of attending a for-profit school, the effects are rather flat on the education of the mother.

[30] However, note that the estimates are not comparable across models, given that the identification is secured for each model separately.

5 Conclusions

In this paper, I study the private sector of education in Chile, a middle-income country with more than 30 years of experience with subsidized private schools, to draw conclusions on whether and why private schools are effective (or not) in providing good quality education. I do so by estimating a structural model of secondary school-type choice and academic performance, that allows me to control for endogenous outcomes and unobserved heterogeneity, which I interpret as a combination of student's inherent abilities. My results show that private schools are more effective than public schools in increasing learning outcomes. I also show that the effect that private schools have on test scores varies according to the profit motive of the school (i.e. for-profit, nonprofit). Heterogeneity of the estimated effects with respect to the unobserved ability and family background is also documented.

School choice systems with private school vouchers, such as the Chilean one, are found to have the potential to raise both equity and efficiency, and to provide an effective means of improving learning outcomes of students.[31] Developing countries experiencing a growing private sector in education may very well consider moving into this direction. However, it's important to note that the effects of a program depend crucially on the conditions under which it is implemented, and the design of the specific policy. In this respect, the case of Chile provides an excellent opportunity to learn about the effects that a large-scale vouchers program have on schools and students. According to my results, the majority of students benefit from attending private schools that would presumably not exist hadn't the voucher reform been introduced in the system. These schools, however, tend to locate in urban areas and serve students from less disadvantaged backgrounds. All these factors need to be taken into account when considering adopting and designing this type of school system. Moreover, the international experience provides important and valuable insight into public-private partnerships in education under various situations and in various countries.[32]

[31] Barrera-Osorio (2009), Bettinger (2009), Wossmann (2009), Bravo, Mukhopadhyay, and Todd (2010).
[32] Chakrabarti and Peterson (2009).

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A Tables

Table 1: Schools and Enrollment by Type of School

type of school		schools		enrollment	
		level	%	level	%
i. overall					
public		5098	55.7	1120811	39.7
private-voucher					
	total	3629	39.6	1480889	52.5
	for-profit	2495	27.3	903097	32.0
	nonprofit	1134	12.4	577792	20.5
private-fee-paying		428	4.7	219487	7.8
ii. primary					
public		4740	55.3	785042	40.4
private-voucher					
	total	3412	39.8	1013514	52.1
	for-profit	2385	27.8	634195	32.6
	nonprofit	1027	12.0	379319	19.5
private-fee-paying		419	4.9	145805	7.5
iii. secondary - conventional					
public		624	25.2	196532	32.9
private-voucher					
	total	1476	59.6	327820	54.8
	for-profit	926	37.4	198078	33.1
	nonprofit	550	22.2	129742	21.7
private-fee-paying		375	15.2	73658	12.3
iv. secondary - vocational					
public		445	50.6	139237	49.9
private-voucher					
	total	433	49.2	139555	50.1
	for-profit	233	26.5	70824	25.4
	nonprofit	200	22.7	68731	24.7
private-fee-paying		2	0.2	24	0.0

Notes: Calculated using administrative data from the Ministry of Education. All figures are for the year 2013. Only schools offering primary and/or secondary education for children and adolescents are included. Schools that offer both primary and secondary levels are included in both the panel for primary education and in the respective panel for secondary level.

Table 2: Enrollment and Classes by Type of School

	public	for-profit	nonprofit
i. overall			
avg. enrollment	219.9	362.0	509.5
avg. number of classes	8.9	12.1	15.2
class size	17.8	24.6	29.1
ii. primary			
avg. enrollment	154.0	254.2	334.5
avg. number of classes	6.8	8.8	10.1
class size	16.8	24.3	29.1
% of multigrade classes[a]	23.2	10.9	5.5
iii. secondary - conventional			
avg. enrollment	38.6	79.4	114.4
avg. number of classes	1.2	2.4	3.3
class size	30.2	31.1	32.9
iv. secondary - vocational			
avg. enrollment	27.3	28.4	60.6
avg. number of classes	0.9	0.9	1.8
class size	25.3	28.1	30.9

Notes: Calculated using administrative data from the Ministry of Education. All figures are for the year 2013. Only schools offering primary and/or secondary education for children and adolescents are included.

[a] Multigrade classes are allowed only in preschool and primary levels. Schools can combine 1st to 6th grades and 7th and 8th grades for the case of primary education.

Table 3: Fees and Tuition by Type of School - Schools Offering Primary and/or Secondary Education

	public	for-profit	nonprofit
annual fee (% of schools)[a]			
no charge	92.6	79.6	65.8
$1.56-$15.63[b]	7.2	16.8	28.3
$15.63-$39.06	0.1	1.4	1.3
$39.06-$78.13	0.0	1.4	0.7
$78.13-$156.25	0.0	0.6	0.8
monthly tuition (% of schools)[a]			
no charge	96.1	45.6	42.2
$1.56-$15.63[b]	2.3	8.4	7.9
$15.63-$39.06	0.2	19.8	19.5
$39.06-$78.13	0.0	16.5	17.5
$78.13-$156.25	0.0	9.0	9.6

Notes: Calculated using administrative data from the Ministry of Education. All figures are for the year 2013. Only schools offering primary and/or secondary education for children and adolescents are included.
[a] All numbers represent percentages of schools by each type of school.
[b] As of March 16th, 2015, one dollar exchanges for 640 Chilean pesos. I converted the original price ranges in Chilean pesos to US dollars. The original ranges are:

$$Ch\$1,000 - Ch\$10,000$$
$$Ch\$10,001 - Ch\$25,000$$
$$Ch\$25,001 - Ch\$50,000$$
$$Ch\$50,001 - Ch\$100,000.$$

Table 4: Fees and Tuition by Type of School - Schools Offering Secondary Education

	public	for-profit	nonprofit
annual fee (% of schools)[a]			
no charge	52.9	54.4	47.2
\$1.56-\$15.63[b]	45.9	39.7	47.3
\$15.63-\$39.06	0.6	1.8	0.9
\$39.06-\$78.13	0.3	2.8	0.5
\$78.13-\$156.25	0.1	1.2	1.2
monthly tuition (% of schools)[a]			
no charge	84.6	16.1	24.2
\$1.56-\$15.63[b]	13.4	8.1	9.9
\$15.63-\$39.06	1.3	26.1	22.5
\$39.06-\$78.13	0.0	30.7	25.3
\$78.13-\$156.25	0.0	18.7	15.5

Notes: Calculated using administrative data from the Ministry of Education. All figures are for the year 2013. Only schools offering secondary education for children and adolescents—that may or may not offer primary level—are included.

[a] All numbers represent percentages of schools by each type of school.

[b] As of March 16th, 2015, one dollar exchanges for 640 Chilean pesos. I converted the original price ranges in Chilean pesos to US dollars. The original ranges are:

$$Ch\$1,000 - Ch\$10,000$$
$$Ch\$10,001 - Ch\$25,000$$
$$Ch\$25,001 - Ch\$50,000$$
$$Ch\$50,001 - Ch\$100,000.$$

Table 5: Teacher Inputs by Type of School

	public	for-profit	nonprofit
i. overall			
pupil-teacher ratio	11.1	16.4	16.9
teachers' degree			
degree in education (%)[a]	96.1	95.2	94.3
institution attended: university (%)	90.0	89.4	91.0
institution attended: 2-y or 4-y technical (%)[b]	6.4	6.3	5.8
type of contract			
indefinite (%)	46.8	57.2	60.6
fixed term (%)	43.8	37.9	35.3
ii. primary			
pupil-teacher ratio	10.7	15.8	16.4
teachers' degree			
degree in education (%)[a]	97.5	96.9	97.4
institution attended: university (%)	90.3	89.4	91.5
institution attended: 2-y or 4-y technical (%)[b]	6.2	6.5	5.8
type of contract			
indefinite (%)	46.7	58.3	61.2
fixed term (%)	43.3	36.6	34.3
iii. secondary - conventional			
pupil-teacher ratio	12.5	13.0	12.7
teachers' degree			
degree in education (%)[a]	92.9	92.1	94.1
institution attended: university (%)	92.2	92.4	93.4
institution attended: 2-y or 4-y technical (%)[b]	4.1	2.7	3.4
type of contract			
indefinite (%)	43.6	49.8	59.5
fixed term (%)	51.5	47.4	38.4
iv. secondary - vocational			
pupil-teacher ratio	16.7	19.2	16.6
teachers' degree			
degree in education (%)[a]	63.3	66.2	71.5
institution attended: university (%)	78.0	77.9	81.9
institution attended: 2-y or 4-y technical (%)[b]	15.9	15.9	12.5
type of contract			
indefinite (%)	36.8	54.5	63.7
fixed term (%)	59.5	43.0	34.2

Notes: Calculated using administrative data from the Ministry of Education. All figures are for the year 2013. Only schools offering primary and/or secondary education for children and adolescents are included.

[a] Only degrees in education obtained from higher education institutions are considered.

[b] Only 2-years technical institutions (CFT) and 4-years professional institutes (IP) are considered.

Table 6: Religious Orientation and Admission Criteria by Type of School

	public	for-profit	nonprofit
religious orientation (% of schools)[a]			
secular	52.0	54.0	17.9
catholic	40.9	30.5	65.0
other religion	7.1	15.4	13.7
admission requirements (% of schools)[a]			
preschool evaluation	18.1	24.0	29.4
civil marriage certificate	2.4	3.4	11.4
transcripts from former school	68.8	69.8	64.2
baptism and/or marriage through the Church certificates	0.9	2.1	28.5
income certificate	2.4	6.1	9.9
parents' interview	18.3	42.3	57.6
exam	20.6	41.7	55.5
psychological evaluation/report	19.6	26.3	25.3

Notes: Administrative data from the Ministry of Education for schools offering primary and/or secondary education for children and adolescents were used to construct the indicators on religious orientation. Responses to the SIMCE parents' questionnaire were used to construct the indicators on admission requirements. All figures are for the year 2013.

[a] All numbers represent percentages of schools by each type of school.

Table 7: Municipality Characteristics and Urban Status by Type of School

	public	for-profit	nonprofit
municipality's monthly income per capita[a]	476.81	509.28	513.76
municipality's poverty rate	17.6	14.4	15.3
municipality's population	121719	223629	168975
school urban status (%)	42.1	73.5	83.2

Notes: Municipality characteristics come from CASEN 2013 survey data. School's urban status comes from administrative data from the Ministry of Education for schools offering primary and/or secondary education for children and adolescents. All figures are for the year 2013.

[a] I converted the original amounts to US$, where, as of March 16th, 2015, one dollar exchanges for 640 Chilean pesos.

Table 8: Targeted Voucher (SEP) Status and Priority Students by Type of School

	public	for-profit	nonprofit
schools with SEP students (%)	98.4	73.7	66.5
school SEP classification			
autonomous (%)	9.6	19.1	31.8
emerging (%)	88.2	77.8	66.6
recovering (%)	2.2	3.1	1.6
SEP eligible students (%)[a]	54.3	49.0	43.7
priority students (%)[b]	67.4	49.8	46.3

Notes: Calculated using administrative data from the Ministry of Education. All figures are for the year 2013. Only schools offering primary and/or secondary education for children and adolescents are included.

[a] Only for schools with at least one SEP student.

[b] According to the second article of the Act 20.248, a priority student is one for whom the socioeconomic situation in the household makes the education process more difficult.

Table 9: Average Tests Scores and Family Background Characteristics by Type of School

	public	for-profit	nonprofit
language score[a]	-0.20	0.04	0.29
math score[a]	-0.29	0.09	0.37
father's years of education	9.9	11.5	11.6
mother's years of education	10.0	11.5	11.7
household monthly income: less than \$312.5 (%)[b]	37.0	19.4	19.0
household monthly income: \$312.5–\$468.75 (%)[b]	26.3	21.5	21.5
household monthly income: \$468.75–\$625 (%)[b]	13.3	14.4	14.8
household monthly income: more than \$625 (%)[b]	20.1	41.7	41.9

Notes: Calculated using administrative data from SIMCE 2013 and SIMCE 2013 responses to parents' questionnaire, for 10th graders.
[a] I normalize test scores to have an overall mean of zero and standard deviation of one.
[b] As of March 16th, 2015, one dollar exchanges for 640 Chilean pesos. I converted the original price ranges in Chilean pesos to US dollars. The original ranges are:

$$\begin{aligned} &\text{less than } Ch\$200,000 \\ &Ch\$200,000 - Ch\$300,000 \\ &Ch\$300,000 - Ch\$400,000 \\ &\text{more than } Ch\$400,000. \end{aligned}$$

Table 10: School-Type Transition Matrix

	school-type 10th grade			
school-type 8th grade	public	voucher for-profit	voucher nonprofit	total
public	50,433	13,678	10,345	74,456
	(67.7)	(18.4)	(13.9)	(100.0)
voucher for-profit	9,795	37,029	6,373	53,197
	(18.4)	(69.6)	(12.0)	(100.0)
voucher nonprofit	4,994	4,294	26,810	36,098
	(13.8)	(11.9)	(74.3)	(100.0)
total	65,222	55,001	43,528	163,751
	(39.8)	(33.6)	(26.6)	(100.0)

Notes: Calculated using 8th grade SIMCE 2011 and 10th grade SIMCE 2013 data. Row percentages in parentheses.

Table 11: 2SLS Estimation Results

	verbal	mathematics
i. public 8th grade		
for-profit 10th grade	-0.264***	-0.138***
nonprofit 10th grade	0.080***	0.156***
ii. for-profit 8th grade		
for-profit 10th grade	-0.185**	0.329***
nonprofit 10th grade	-0.271***	-0.450***
iii. nonprofit 8th grade		
for-profit 10th grade	2.181***	0.882**
nonprofit 10th grade	-0.015	0.133***

Notes: This table displays results from different 2SLS estimations that mirror the structural model analysis. Each estimation regresses test scores on family background and environment characteristics and a categorical variable denoting the type of secondary school attended, which is instrumented using the % of for-profit schools in the municipality when I estimate the effect of attending a for-profit secondary school, and the % of nonprofit schools in the municipality when I estimate the effect of attending a nonprofit secondary school. *** denotes statistically significance at 99% level, ** denotes statistically significance at 95% level.

Table 12: Variables Used in the Empirical Analysis

variable	measurement system	choice	outcomes
gender	✓	✓	✓
mother's education	✓	✓	✓
father's education	✓	✓	✓
household composition	✓		
region	✓	✓	✓
avg. scores for-profit schools - avg. scores public schools[a]		✓	
avg. scores nonprofit schools - avg. scores public schools[a]		✓	
% for-profit schools[a]		✓	
% nonprofit schools[a]		✓	
log population[a]		✓	
urbanization rate[a]		✓	
factor	✓	✓	✓

Notes: I exclude household composition indicators from the 10th grade choice and outcomes equations because SIMCE 2013 data doesn't provide that information.

[a] Calculated at the municipality level.

Table 13: Summary Statistics - Variables Used in the Estimation of the Measurement System

	mean	std. dev.	min	max
male	0.48	0.50	0	1
father's years of education	10.88	3.29	0	22
mother's years of education	10.88	3.15	0	22
living with both parents	0.59	0.49	0	1
living with siblings	0.67	0.47	0	1
living with others	0.28	0.45	0	1
region: north	0.13	0.34	0	1
region: center	0.71	0.45	0	1
region: south	0.16	0.36	0	1

Notes: Test scores are normalized to have an overall mean of zero and a standard deviation of one. The total number of observations is 145,281. All variables were constructed using SIMCE 2011 data sets.

Table 14: Summary Statistics - Variables Used in the Estimation of School-Type Choices and Test Scores in 10th Grade

	mean	std. dev.	min	max
male	0.48	0.50	0	1
father's years of education	10.91	3.33	0	22
mother's years of education	10.98	3.16	0	22
region: north	0.13	0.34	0	1
region: center	0.71	0.45	0	1
region: south	0.16	0.36	0	1
% for-profit schools[a]	0.32	0.21	0	0.94
% nonprofit schools[a]	0.28	0.16	0	1
avg. scores for-profit schools - avg. scores public schools: verbal[a]	0.33	0.53	-1.21	2.02
avg. scores nonprofit schools - avg. scores public schools: verbal[a]	0.52	0.47	-0.79	1.69
avg. scores for-profit schools - avg. scores public schools: math[a]	0.43	0.57	-1.36	1.84
avg. scores nonprofit schools - avg. scores public schools: math[a]	0.64	0.51	-0.83	2.05
log population[a]	11.57	1.09	6.83	13.67
urbanization rate[a]	0.86	0.18	0	1

Notes: Test scores are normalized to have an overall mean of zero and a standard deviation of one. The total number of observations is 145,281. All variables were constructed using CASEN 2011, SIMCE 2012, and SIMCE 2013 data sets.

[a] Calculated at the municipality level.

Table 15: Estimates: Measurement System - Students in Public Schools in Primary

	verbal	mathematics	social sciences	natural sciences
male	-0.218	0.173	0.172	0.098
	(0.007)	(0.007)	(0.007)	(0.007)
father's years of education[a]	0.011	0.011	0.013	0.012
	(0.001)	(0.001)	(0.001)	(0.001)
mother's years of education[a]	0.017	0.020	0.024	0.019
	(0.001)	(0.001)	(0.001)	(0.001)
living with both parents	0.006	0.003	0.022	0.019
	(0.007)	(0.007)	(0.007)	(0.006)
living with siblings	0.009	0.040	-0.024	0.011
	(0.007)	(0.006)	(0.006)	(0.006)
living with others	0.011	-0.004	0.000	-0.002
	(0.006)	(0.006)	(0.006)	(0.006)
region: north	-0.190	-0.151	-0.205	-0.176
	(0.013)	(0.012)	(0.012)	(0.013)
region: center	-0.150	-0.038	-0.094	-0.099
	(0.010)	(0.009)	(0.009)	(0.010)
non-missing: father's years of education[b]	-0.110	-0.118	-0.149	-0.117
	(0.016)	(0.016)	(0.017)	(0.015)
non-missing: mother's years of education[b]	-0.108	-0.137	-0.204	-0.149
	(0.020)	(0.020)	(0.021)	(0.020)
intercept	-0.027	-0.368	-0.261	-0.277
	(0.020)	(0.019)	(0.020)	(0.019)
factor	1.063	1.000	0.943	1.053
	(0.005)		(0.005)	(0.004)

Notes: Estimates from the measurement system part of the model, where coefficients for a linear-in-parameters equation are estimated. All explanatory variables come from SIMCE 2011 for 8th graders database. Standard errors in parentheses. The total number of observations is 66,388.

[a] Missing values replaced with a zero.

[b] Dummy variable being equal to one if the corresponding variable is non-missing, and zero otherwise.

Table 16: Estimates: Measurement System - Students in For-Profit Schools in Primary

	verbal	mathematics	social sciences	natural sciences
male	-0.180	0.190	0.223	0.116
	(0.009)	(0.008)	(0.008)	(0.009)
father's years of education[a]	0.013	0.021	0.022	0.018
	(0.001)	(0.001)	(0.001)	(0.001)
mother's years of education[a]	0.024	0.028	0.034	0.028
	(0.001)	(0.002)	(0.002)	(0.001)
living with both parents	-0.008	-0.007	0.000	0.000
	(0.008)	(0.008)	(0.008)	(0.007)
living with siblings	0.008	0.049	-0.023	0.016
	(0.008)	(0.008)	(0.008)	(0.007)
living with others	0.018	-0.005	-0.010	-0.004
	(0.007)	(0.008)	(0.008)	(0.007)
region: north	-0.066	0.080	-0.049	0.019
	(0.017)	(0.017)	(0.017)	(0.017)
region: center	-0.131	0.002	-0.043	-0.058
	(0.014)	(0.013)	(0.014)	(0.014)
non-missing: father's years of education[b]	-0.139	-0.220	-0.259	-0.184
	(0.023)	(0.023)	(0.024)	(0.022)
non-missing: mother's years of education[b]	-0.251	-0.301	-0.379	-0.309
	(0.027)	(0.028)	(0.028)	(0.026)
intercept	0.244	-0.055	0.089	0.077
	(0.027)	(0.025)	(0.026)	(0.025)
factor	1.013	1.000	0.961	1.056
	(0.005)		(0.005)	(0.005)

Notes: Estimates from the measurement system part of the model, where coefficients for a linear-in-parameters equation are estimated. All explanatory variables come from SIMCE 2011 for 8th graders database. Standard errors in parentheses. The total number of observations is 46,671.

[a] Missing values replaced with a zero.

[b] Dummy variable being equal to one if the corresponding variable is non-missing, and zero otherwise.

Table 17: Estimates: Measurement System - Students in Nonprofit Schools in Primary

	verbal	mathematics	social sciences	natural sciences
male	-0.202	0.174	0.219	0.124
	(0.010)	(0.010)	(0.010)	(0.010)
father's years of education[a]	0.014	0.022	0.022	0.018
	(0.002)	(0.002)	(0.002)	(0.002)
mother's years of education[a]	0.024	0.028	0.034	0.032
	(0.002)	(0.002)	(0.002)	(0.002)
living with both parents	-0.012	0.006	0.017	0.010
	(0.009)	(0.009)	(0.009)	(0.008)
living with siblings	0.010	0.049	-0.020	0.013
	(0.009)	(0.009)	(0.010)	(0.009)
living with others	0.019	-0.009	0.024	0.002
	(0.009)	(0.009)	(0.010)	(0.009)
region: north	-0.042	0.035	-0.024	-0.016
	(0.019)	(0.019)	(0.020)	(0.020)
region: center	-0.022	0.108	0.084	0.029
	(0.013)	(0.013)	(0.013)	(0.013)
non-missing: father's years of education[b]	-0.135	-0.197	-0.254	-0.210
	(0.028)	(0.028)	(0.029)	(0.027)
non-missing: mother's years of education[b]	-0.307	-0.402	-0.427	-0.390
	(0.034)	(0.034)	(0.034)	(0.033)
intercept	0.372	0.147	0.166	0.238
	(0.030)	(0.030)	(0.031)	(0.029)
factor	0.987	1.000	0.953	1.030
	(0.006)		(0.006)	(0.006)

Notes: Estimates from the measurement system part of the model, where coefficients for a linear-in-parameters equation are estimated. All explanatory variables come from SIMCE 2011 for 8th graders database. Standard errors in parentheses. The total number of observations is 32,222.

[a] Missing values replaced with a zero.

[b] Dummy variable being equal to one if the corresponding variable is non-missing, and zero otherwise.

Table 18: Estimates: Secondary School-Type Choice - Students in Public Schools in Primary

	choice:	
	voucher for-profit	voucher nonprofit
male	-0.145	-0.016
	(0.018)	(0.018)
father's years of education[a]	0.015	0.010
	(0.004)	(0.004)
mother's years of education[a]	0.025	0.029
	(0.004)	(0.004)
region: north	-0.475	-0.237
	(0.036)	(0.036)
region: center	-0.143	-0.288
	(0.026)	(0.025)
% for-profit schools[b]	3.772	
	(0.050)	
% nonprofit schools[b]		2.953
		(0.060)
avg. scores for-profit schools - avg. scores public schools: verbal[a,b]	-0.125	
	(0.056)	
avg. scores nonprofit schools - avg. scores public schools: verbal[a,b]		0.719
		(0.054)
avg. scores for-profit schools - avg. scores public schools: math[a,b]	-0.072	
	(0.051)	
avg. scores nonprofit schools - avg. scores public schools: math[a,b]		-0.805
		(0.050)
log population[b]	-0.105	0.133
	(0.013)	(0.014)
urbanization rate[b]	0.928	-0.327
	(0.083)	(0.079)
non-missing: father's years of education[c]	-0.151	0.052
	(0.055)	(0.059)
non-missing: mother's years of education[c]	-0.028	-0.115
	(0.057)	(0.059)
non-missing: avg. score difference for-profit vs. public (verbal and math)[c]	1.825	
	(0.101)	
non-missing: avg. score difference for-profit vs. public (verbal)[c]		1.203
		(0.340)
non-missing: avg. score difference for-profit vs. public (math)[c]		0.090
		(0.342)
intercept	-3.481	-4.501
	(0.136)	(0.127)
factor	-0.004	0.168
	(0.013)	(0.013)

Notes: Estimates from the multinomial choice part of the model, where the base school type choice is "public"—that is, all estimated coefficients are relative to the choice of choosing a public school in 10th grade. All variables were constructed using CASEN 2011, SIMCE 2012, and SIMCE 2013 data sets. Standard errors in parentheses. The total number of observations is 66,388. [a] Missing values replaced with a zero. [b] Calculated at the municipality level. [c] Dummy variable being equal to one if the corresponding variable is non-missing, and zero otherwise.

Table 19: Estimates: Secondary School-Type Choice - Students in For-Profit Schools in Primary

	choice:	
	voucher for-profit	voucher nonprofit
male	-0.139	-0.085
	(0.020)	(0.025)
father's years of education[a]	0.073	0.044
	(0.005)	(0.006)
mother's years of education[a]	0.063	0.035
	(0.005)	(0.006)
region: north	0.128	0.024
	(0.044)	(0.053)
region: center	0.046	-0.171
	(0.036)	(0.041)
% for-profit schools[b]	2.952	
	(0.054)	
% nonprofit schools[b]		2.025
		(0.079)
avg. scores for-profit schools - avg. scores public schools: verbal[a,b]	0.670	
	(0.061)	
avg. scores nonprofit schools - avg. scores public schools: verbal[a,b]		1.377
		(0.072)
avg. scores for-profit schools - avg. scores public schools: math[a,b]	-0.200	
	(0.056)	
avg. scores nonprofit schools - avg. scores public schools: math[a,b]		-1.039
		(0.066)
log population[b]	0.090	0.208
	(0.015)	(0.018)
urbanization rate[b]	-0.594	-0.244
	(0.105)	(0.114)
non-missing: father's years of education[c]	-0.715	-0.444
	(0.073)	(0.087)
non-missing: mother's years of education[c]	-0.484	-0.11
	(0.078)	(0.090)
non-missing: avg. score difference for-profit vs. public (verbal and math)[c]	1.545	
	(0.078)	
non-missing: avg. score difference for-profit vs. public (verbal)[c]		-0.606
		(0.643)
non-missing: avg. score difference for-profit vs. public (math)[c]		1.191
		(0.641)
intercept	-2.434	-3.801
	(0.147)	(0.175)
factor	0.178	0.157
	(0.014)	(0.018)

Notes: Estimates from the multinomial choice part of the model, where the base school type choice is "public"—that is, all estimated coefficients are relative to the choice of choosing a public school in 10th grade. All variables were constructed using CASEN 2011, SIMCE 2012, and SIMCE 2013 data sets. Standard errors in parentheses. The total number of observations is 46,671. [a] Missing values replaced with a zero. [b] Calculated at the municipality level. [c] Dummy variable being equal to one if the corresponding variable is non-missing, and zero otherwise.

Table 20: Estimates: Secondary School-Type Choice - Students in Nonprofit Schools in Primary

	choice:	
	voucher for-profit	voucher nonprofit
male	-0.150	-0.060
	(0.033)	(0.026)
father's years of education[a]	0.026	0.050
	(0.008)	(0.006)
mother's years of education[a]	0.023	0.077
	(0.007)	(0.006)
region: north	0.119	0.620
	(0.066)	(0.055)
region: center	0.178	0.459
	(0.044)	(0.036)
% for-profit schools[b]	2.404	
	(0.076)	
% nonprofit schools[b]		2.108
		(0.086)
avg. scores for-profit schools - avg. scores public schools: verbal[a,b]	0.023	
	(0.099)	
avg. scores nonprofit schools - avg. scores public schools: verbal[a,b]		0.876
		(0.073)
avg. scores for-profit schools - avg. scores public schools: math[a,b]	0.259	
	(0.092)	
avg. scores nonprofit schools - avg. scores public schools: math[a,b]		-0.169
		(0.067)
log population[b]	0.061	0.166
	(0.023)	(0.018)
urbanization rate[b]	0.097	-0.584
	(0.147)	(0.116)
non-missing: father's years of education[c]	-0.068	-0.394
	(0.113)	(0.090)
non-missing: mother's years of education[c]	-0.322	-0.637
	(0.113)	(0.092)
non-missing: avg. score difference for-profit vs. public (verbal and math)[c]	1.216	
	(0.125)	
non-missing: avg. score difference for-profit vs. public (verbal)[c]		1.305
		(0.378)
non-missing: avg. score difference for-profit vs. public (math)[c]		-0.116
		(0.382)
intercept	-3.166	-2.804
	(0.233)	(0.173)
factor	0.005	0.386
	(0.022)	(0.018)

Notes: Estimates from the multinomial choice part of the model, where the base school type choice is "public"—that is, all estimated coefficients are relative to the choice of choosing a public school in 10th grade. All variables were constructed using CASEN 2011, SIMCE 2012, and SIMCE 2013 data sets. Standard errors in parentheses. The total number of observations is 32,222. [a] Missing values replaced with a zero. [b] Calculated at the municipality level. [c] Dummy variable being equal to one if the corresponding variable is non-missing, and zero otherwise.

Table 21: Estimates: Test Scores in 10th Grade - Students in Public Schools in Primary

	verbal			mathematics		
school type in 10th grade:	public	for-profit	nonprofit	public	for-profit	nonprofit
male	-0.214	-0.211	-0.229	0.166	0.123	0.182
	(0.009)	(0.014)	(0.016)	(0.008)	(0.014)	(0.014)
father's years of education[a]	0.014	0.010	0.012	0.016	0.015	0.019
	(0.002)	(0.003)	(0.003)	(0.001)	(0.003)	(0.003)
mother's years of education[a]	0.019	0.012	0.020	0.027	0.023	0.023
	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
region: north	-0.118	-0.225	-0.146	-0.105	-0.108	-0.030
	(0.015)	(0.030)	(0.028)	(0.014)	(0.029)	(0.028)
region: center	-0.143	-0.204	-0.179	-0.014	-0.114	-0.077
	(0.012)	(0.022)	(0.020)	(0.011)	(0.022)	(0.018)
non-missing: father's years of education[b]	-0.109	-0.066	-0.171	-0.120	-0.131	-0.159
	(0.022)	(0.041)	(0.047)	(0.020)	(0.038)	(0.045)
non-missing: mother's years of education[b]	-0.096	-0.048	-0.118	-0.186	-0.148	-0.153
	(0.022)	(0.042)	(0.05)	(0.021)	(0.041)	(0.046)
intercept	-0.152	-0.010	0.097	-0.542	-0.317	-0.282
	(0.013)	(0.024)	(0.022)	(0.012)	(0.025)	(0.021)
factor	0.919	0.927	0.842	0.927	0.919	0.876
	(0.006)	(0.011)	(0.012)	(0.005)	(0.010)	(0.011)

Notes: Estimates from the outcomes part of the model, where coefficients for a linear-in-parameters equation are estimated. All variables were constructed using CASEN 2011, SIMCE 2012, and SIMCE 2013 data sets. Standard errors in parentheses. The total number of observations is 66,388.

[a] Missing values replaced with a zero.

[b] Dummy variable being equal to one if the corresponding variable is non-missing, and zero otherwise.

Table 22: Estimates: Test Scores in 10th Grade - Students in For-profit Schools in Primary

	verbal			mathematics		
school type in 10th grade:	public	for-profit	nonprofit	public	for-profit	nonprofit
male	-0.188	-0.203	-0.208	0.168	0.136	0.180
	(0.019)	(0.010)	(0.021)	(0.016)	(0.010)	(0.019)
father's years of education[a]	0.022	0.020	0.011	0.025	0.029	0.022
	(0.004)	(0.002)	(0.005)	(0.004)	(0.002)	(0.004)
mother's years of education[a]	0.019	0.025	0.015	0.029	0.035	0.025
	(0.004)	(0.002)	(0.005)	(0.004)	(0.002)	(0.004)
region: north	-0.047	-0.034	-0.083	0.021	0.080	0.130
	(0.038)	(0.021)	(0.041)	(0.034)	(0.020)	(0.039)
region: center	-0.110	-0.108	-0.095	0.057	0.012	0.090
	(0.026)	(0.017)	(0.029)	(0.024)	(0.017)	(0.029)
non-missing: father's years of education[b]	-0.180	-0.232	-0.136	-0.177	-0.282	-0.265
	(0.059)	(0.030)	(0.065)	(0.054)	(0.028)	(0.062)
non-missing: mother's years of education[b]	-0.130	-0.237	-0.129	-0.229	-0.426	-0.170
	(0.061)	(0.033)	(0.072)	(0.056)	(0.030)	(0.065)
intercept	0.025	0.220	0.295	-0.352	0.035	-0.042
	(0.030)	(0.019)	(0.034)	(0.028)	(0.018)	(0.032)
factor	0.886	0.884	0.817	0.872	0.917	0.830
	(0.012)	(0.007)	(0.015)	(0.012)	(0.006)	(0.013)

Notes: Estimates from the outcomes part of the model, where coefficients for a linear-in-parameters equation are estimated. All variables were constructed using CASEN 2011, SIMCE 2012, and SIMCE 2013 data sets. tandard errors in parentheses. The total number of observations is 46,671.

[a] Missing values replaced with a zero.

[b]Dummy variable being equal to one if the corresponding variable is non-missing, and zero otherwise.

Table 23: Estimates: Test Scores in 10th Grade - Students in Nonprofit Schools in Primary

	verbal			mathematics		
school type in 10th grade:	public	for-profit	nonprofit	public	for-profit	nonprofit
male	-0.193	-0.213	-0.211	0.169	0.094	0.138
	(0.026)	(0.028)	(0.012)	(0.024)	(0.025)	(0.010)
father's years of education[a]	0.020	0.027	0.020	0.033	0.028	0.028
	(0.005)	(0.006)	(0.002)	(0.005)	(0.005)	(0.002)
mother's years of education[a]	0.030	0.015	0.021	0.035	0.038	0.032
	(0.005)	(0.006)	(0.002)	(0.005)	(0.005)	(0.002)
region: north	0.032	-0.031	0.050	-0.022	0.035	0.121
	(0.049)	(0.057)	(0.022)	(0.045)	(0.047)	(0.020)
region: center	-0.0180	-0.007	0.066	0.053	0.051	0.154
	(0.028)	(0.036)	(0.015)	(0.026)	(0.031)	(0.014)
non-missing: father's years of education[b]	-0.302	-0.375	-0.212	-0.365	-0.410	-0.294
	(0.077)	(0.087)	(0.032)	(0.075)	(0.077)	(0.028)
non-missing: mother's years of education[b]	-0.108	-0.006	-0.258	-0.285	-0.233	-0.386
	(0.078)	(0.092)	(0.035)	(0.076)	(0.08)	(0.032)
intercept	0.120	0.206	0.337	-0.069	0.064	0.212
	(0.034)	(0.043)	(0.018)	(0.031)	(0.037)	(0.017)
factor	0.889	0.845	0.863	0.880	0.862	0.852
	(0.017)	(0.019)	(0.007)	(0.016)	(0.017)	(0.007)

Notes: Estimates from the outcomes part of the model, where coefficients for a linear-in-parameters equation are estimated. All variables were constructed using CASEN 2011, SIMCE 2012, and SIMCE 2013 data sets. Standard errors in parentheses. The total number of observations is 32,222.

[a] Missing values replaced with a zero.

[b]Dummy variable being equal to one if the corresponding variable is non-missing, and zero otherwise.

Table 24: Goodness of Fit - School-Type Decisions

	school type 10th grade:					
	public		voucher for-profit		voucher nonprofit	
school-type primary:	actual	model	actual	model	actual	model
public	67.60	67.55	18.26	18.23	14.14	14.22
voucher for-profit	18.57	18.33	69.23	69.32	12.20	12.35
voucher nonprofit	13.81	13.62	11.61	11.67	74.58	74.71

Notes: The simulated data (model) contain one million observations generated using the model's estimates. The actual data (actual) contain 163,751 observations from SIMCE 2011 and SIMCE 2013 data sets. Each cell displays the percentage of individuals choosing a corresponding school type.

Table 25: Goodness of Fit - Measurement System

		mean		std. dev.	
school-type primary	test	actual	model	actual	model
public					
	verbal	-0.198	-0.199	0.984	0.976
	mathematics	-0.252	-0.253	0.948	0.936
	social sc.	-0.258	-0.258	0.945	0.934
	natural sc.	-0.263	-0.264	0.957	0.946
voucher for-profit					
	verbal	0.091	0.090	0.990	0.978
	mathematics	0.125	0.124	0.994	0.975
	social sc.	0.148	0.148	0.995	0.975
	natural sc.	0.147	0.146	0.989	0.971
voucher nonprofit					
	verbal	0.275	0.274	0.963	0.951
	mathematics	0.338	0.337	0.979	0.963
	social sc.	0.316	0.315	0.982	0.966
	natural sc.	0.330	0.329	0.96	0.944

Notes: The simulated data (model) contain one million observations generated using the model's estimates. The actual data (actual) contain 163,751 observations from SIMCE 2011 and SIMCE 2013 data sets.

Table 26: Goodness of Fit - Test Scores in 10th grade

		mean		std. dev.	
school-type	test	actual	model	actual	model
i. public in primary					
public 10th grade					
	verbal	-0.267	-0.314	0.977	0.964
	mathematics	-0.384	-0.433	0.948	0.928
voucher for-profit 10th grade					
	verbal	-0.232	-0.234	0.959	0.966
	mathematics	-0.304	-0.305	0.929	0.932
voucher nonprofit 10th grade					
	verbal	0.006	-0.045	0.934	0.933
	mathematics	-0.017	-0.073	0.918	0.913
ii. for-profit in primary					
public 10th grade					
	verbal	-0.177	-0.172	1.001	1.006
	mathematics	-0.207	-0.207	0.945	0.944
voucher for-profit 10th grade					
	verbal	0.141	0.098	0.987	0.974
	mathematics	0.230	0.183	0.977	0.956
voucher nonprofit 10th grade					
	verbal	0.172	0.155	0.94	0.945
	mathematics	0.245	0.219	0.911	0.905
iii. nonprofit in primary					
public 10th grade					
	verbal	-0.074	-0.058	1.001	0.989
	mathematics	-0.083	-0.061	0.955	0.942
voucher for-profit 10th grade					
	verbal	0.019	0.030	0.993	0.981
	mathematics	0.058	0.074	0.945	0.929
voucher nonprofit 10th grade					
	verbal	0.409	0.373	0.931	0.929
	mathematics	0.526	0.489	0.889	0.878

Notes: The simulated data (model) contain one million observations generated using the model's estimates. The actual data (actual) contain 163,751 observations from SIMCE 2011 and SIMCE 2013 data sets.

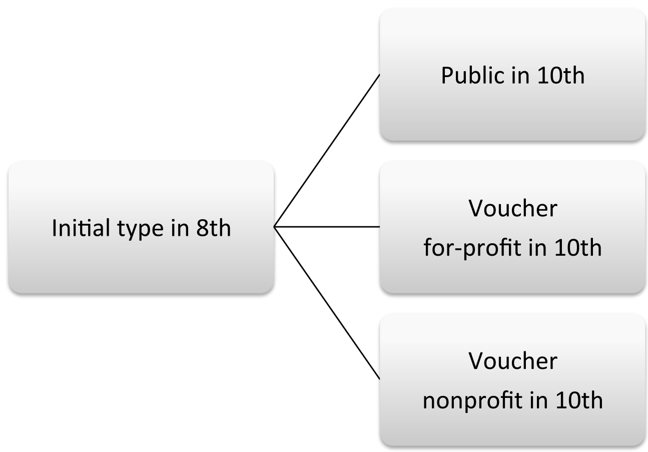
Table 27: Estimated Treatment on the Treated Effects

	verbal	mathematics
i. public in primary		
public 10th grade	-0.112***	-0.180***
for-profit 10th grade	0.034***	0.061***
nonprofit 10th grade	0.122***	0.202***
ii. for-profit in primary		
public 10th grade	-0.146***	-0.244***
for-profit 10th grade	0.041***	0.108***
nonprofit 10th grade	0.114***	0.132***
iii. nonprofit in primary		
public 10th grade	-0.134***	-0.218***
for-profit 10th grade	-0.066***	-0.090***
nonprofit 10th grade	0.127***	0.205***

Notes: All treatment on the treated parameters estimates were computed using the simulated model. *** denotes statistically significance at 99% level. To compute significance tests, I performed mean tests on the simulated expressions for treatment on the treated parameter. The null hypothesis is the treatment parameter being equal to zero.

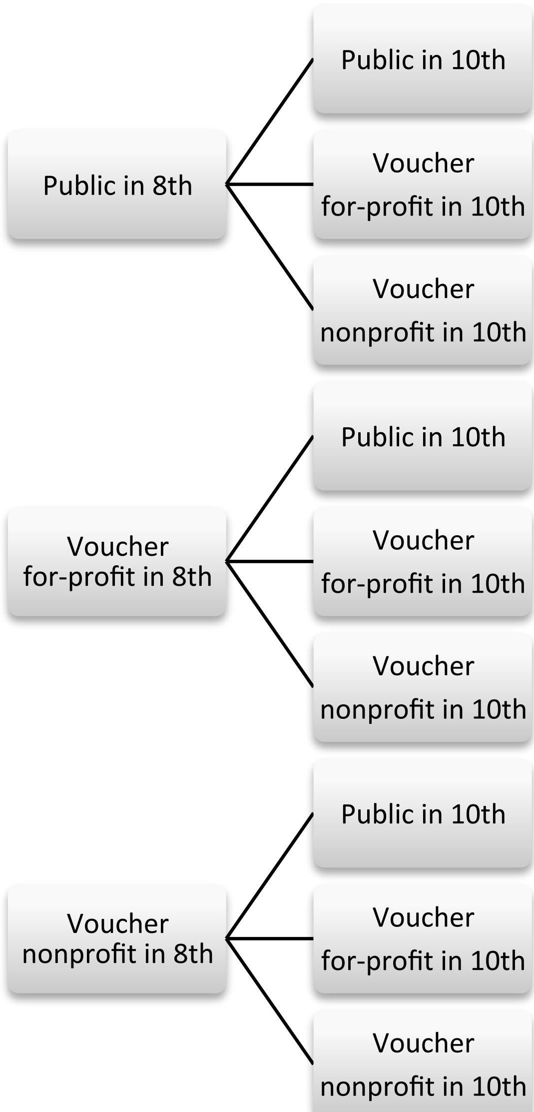
B Figures

Figure 1: Scheme of Decisions



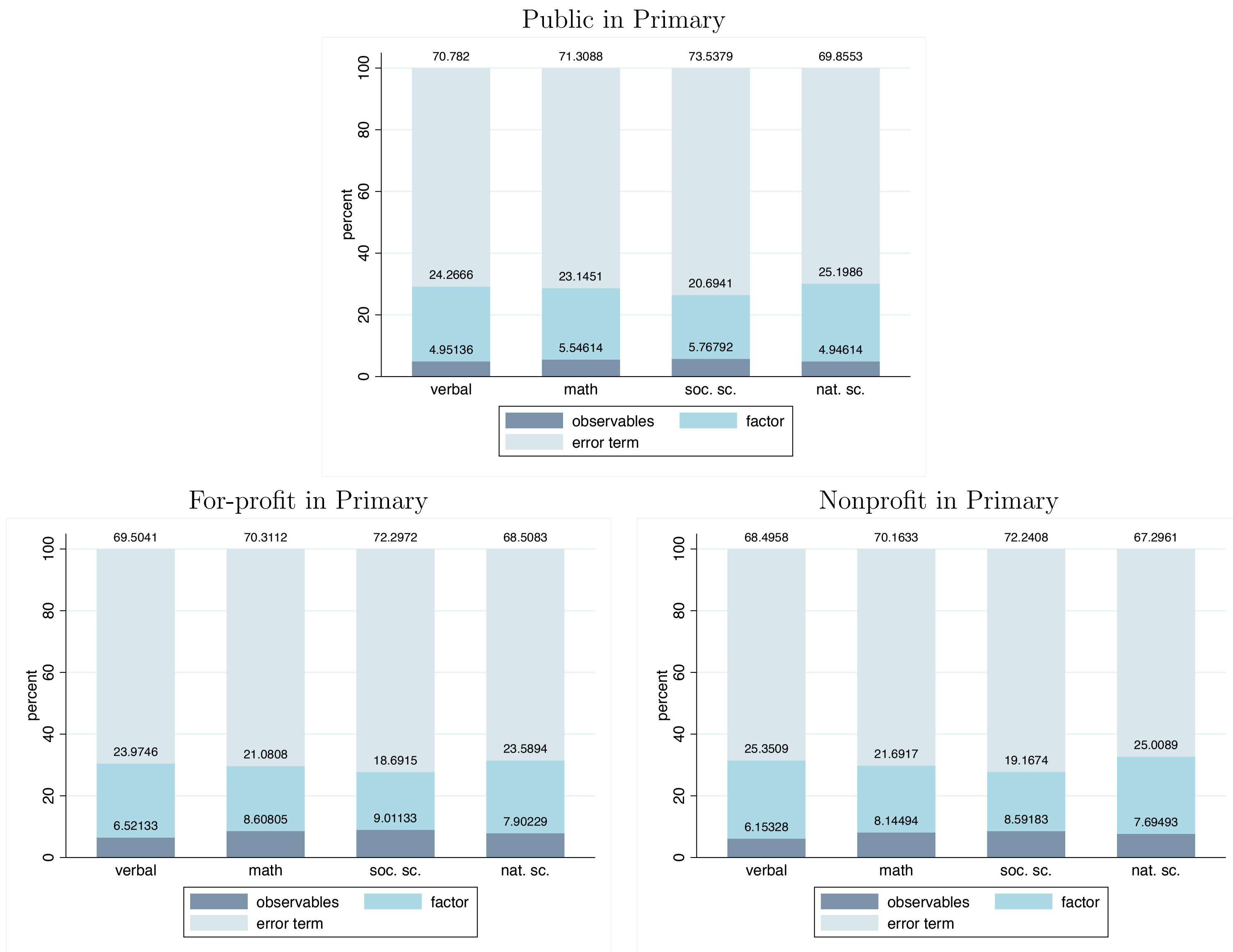
Notes: This figure displays the school-type decision that students face for their secondary education. Given a particular school-type chosen in primary, they choose to attend one of three types of secondary school: public, for-profit, nonprofit.

Figure 2: Scheme of Decisions: Empirical Implementation



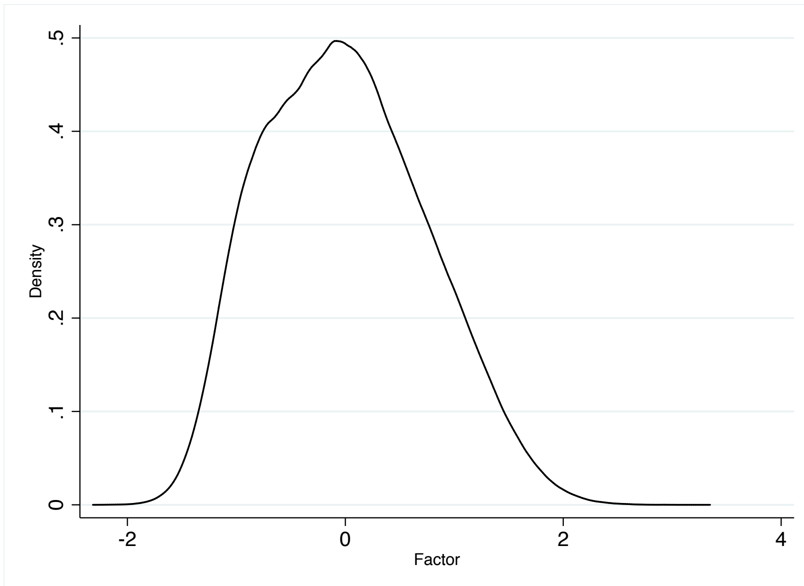
Notes: This figure displays the school-type decision that students face for their secondary education. Given a particular school-type chosen in primary, they choose to attend one of three types of secondary school: public, for-profit, nonprofit.

Figure 3: Variance Decomposition - Measurement System



Notes: Each bar indicates the percentage of the variance of test scores in the measurement system that is explained by the observables, the unobserved factor, and the error term.

Figure 4: Distribution of Factor - Students in Public in Primary



$$f \sim p_1 N(\mu_1, \sigma_1^2) + p_2 N(\mu_2, \sigma_2^2) + p_3 N(\mu_3, \sigma_3^2)$$

where

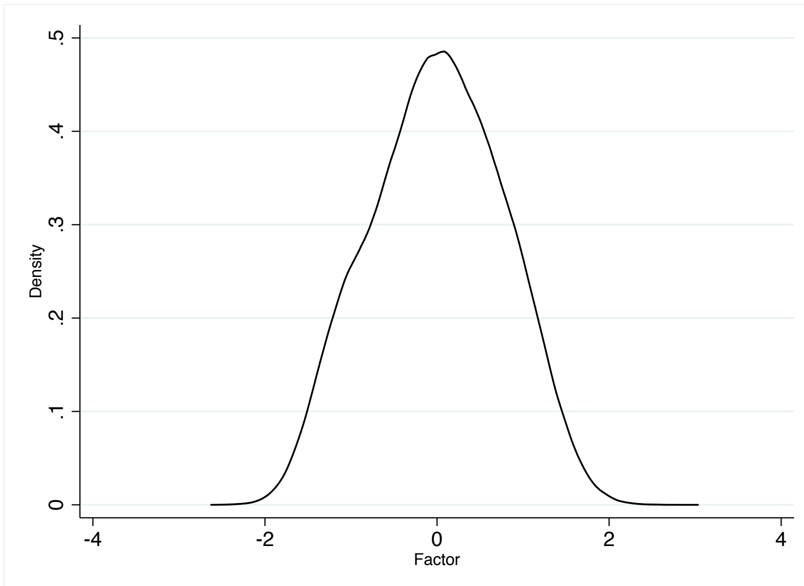
$$\mu = (-0.13, \quad -0.09, \quad 0.75)$$

$$\mathbf{1/\sigma^2} = (4.86, \quad 11.25, \quad 3.53)$$

$$\mathbf{p} = (0.48, \quad 0.20, \quad 0.33)$$

Notes: The factor is simulated using the estimates of the model. The simulated data contain one million observations.

Figure 5: Distribution of Factor - Students in For-profit in Primary



$$f \sim p_1 N(\mu_1, \sigma_1^2) + p_2 N(\mu_2, \sigma_2^2) + p_3 N(\mu_3, \sigma_3^2)$$

where

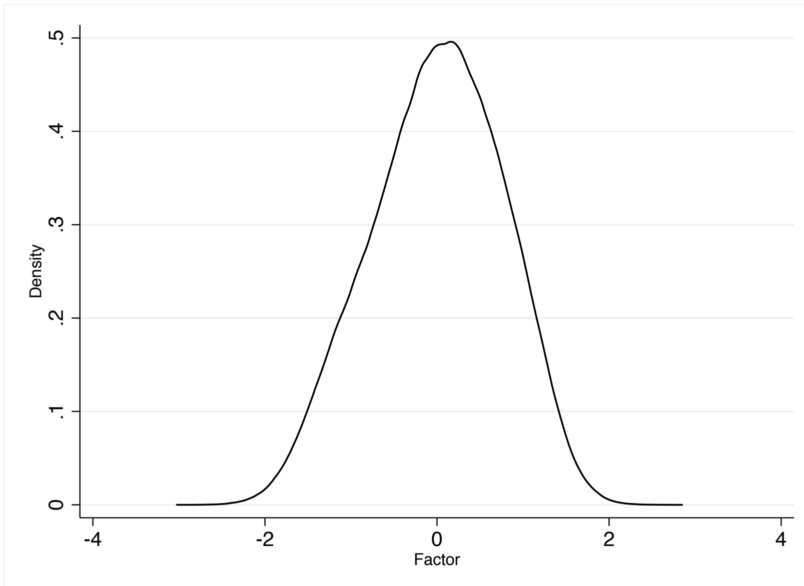
$$\mu = (-1.11, \quad -0.10, \quad 0.85)$$

$$\mathbf{1}/\boldsymbol{\sigma^2} = (8.28, \quad 3.82, \quad 5.35)$$

$$\mathbf{p} = (0.15, \quad 0.58, \quad 0.27)$$

Notes: The factor is simulated using the estimates of the model. The simulated data contain one million observations.

Figure 6: Distribution of Factor - Students in Nonprofit in Primary



$$f \sim p_1 N(\mu_1, \sigma_1^2) + p_2 N(\mu_2, \sigma_2^2) + p_3 N(\mu_3, \sigma_3^2)$$

where

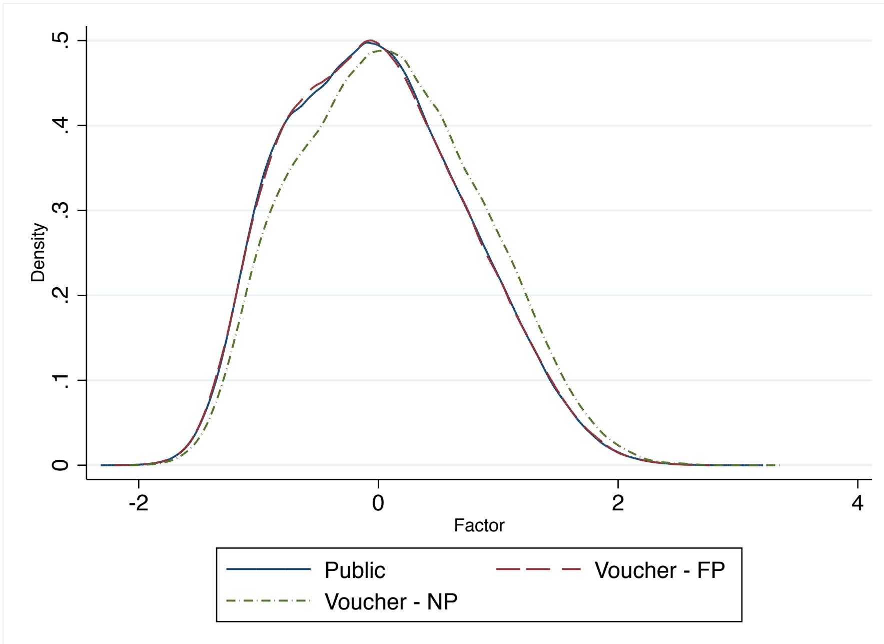
$$\mu = (-1.03, \quad -0.02, \quad 0.85)$$

$$\mathbf{1/\sigma^2} = (5.38, \quad 4.02, \quad 6.18)$$

$$\mathbf{p} = (0.20, \quad 0.55, \quad 0.25)$$

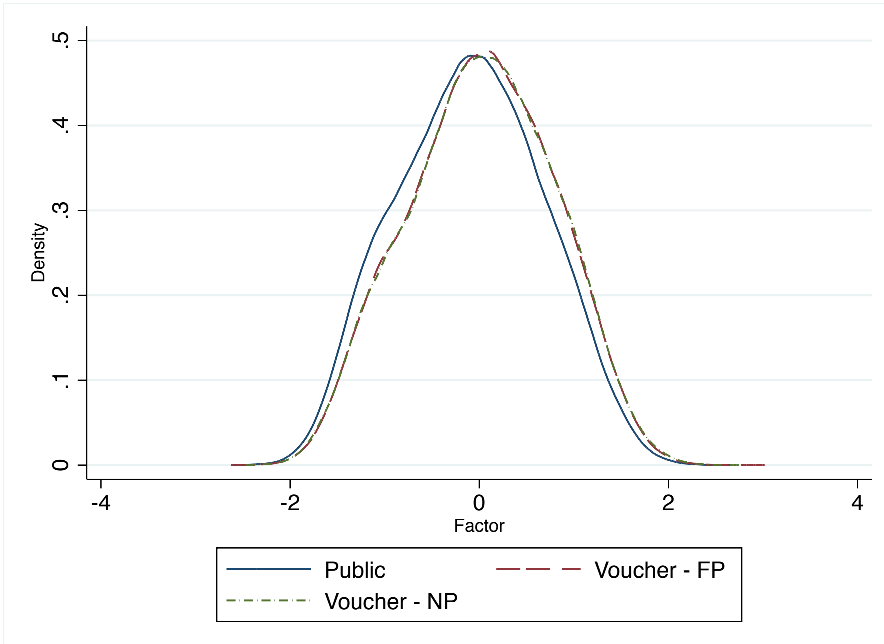
Notes: The factor is simulated using the estimates of the model. The simulated data contain one million observations.

Figure 7: Distribution of Factor by School-Type in 10th Grade - Students in Public Schools in Primary



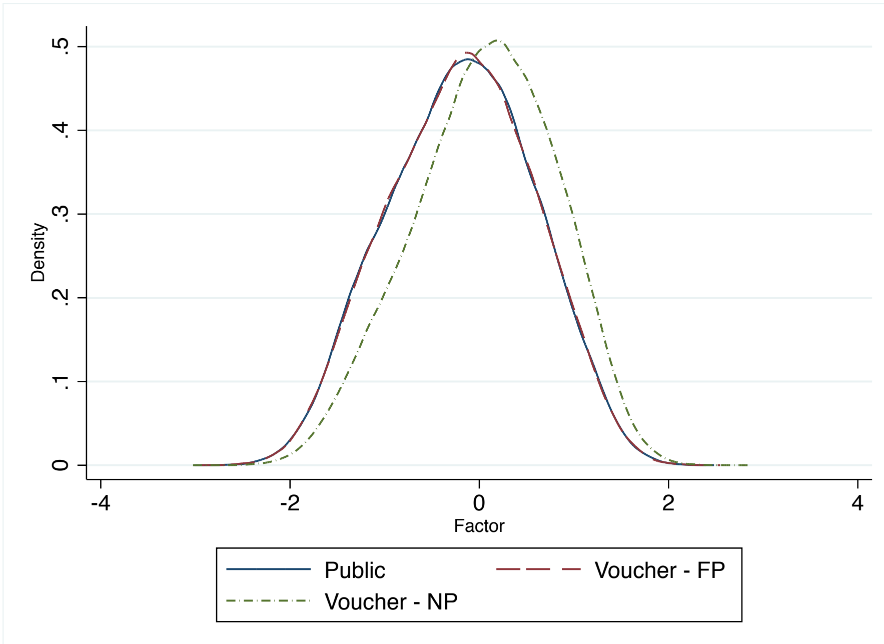
Notes: The factor is simulated using the estimates of the model. The simulated data contain one million observations.

Figure 8: Distribution of Factor by School-Type in 10th Grade - Students in For-Profit Schools in Primary



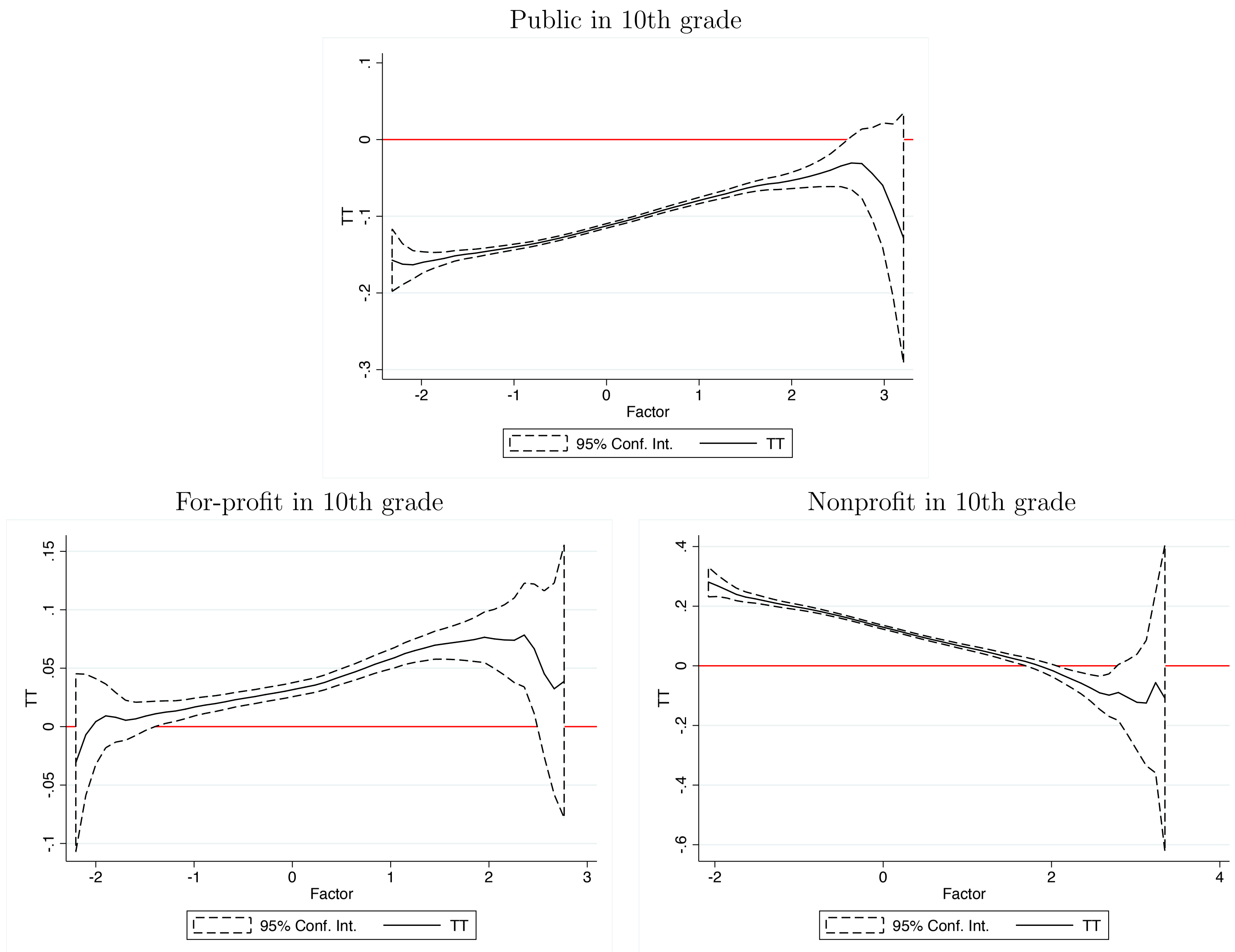
Notes: The factor is simulated using the estimates of the model. The simulated data contain one million observations.

Figure 9: Distribution of Factor by School-Type in 10th Grade - Students in Nonprofit Schools in Primary



Notes: The factor is simulated using the estimates of the model. The simulated data contain one million observations.

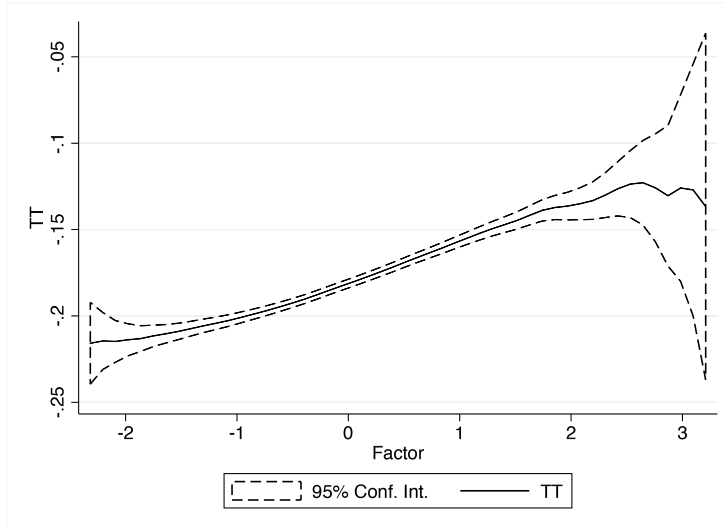
Figure 10: TT(verbal) as a Function of Unobserved Ability - Students in Public Schools in Primary



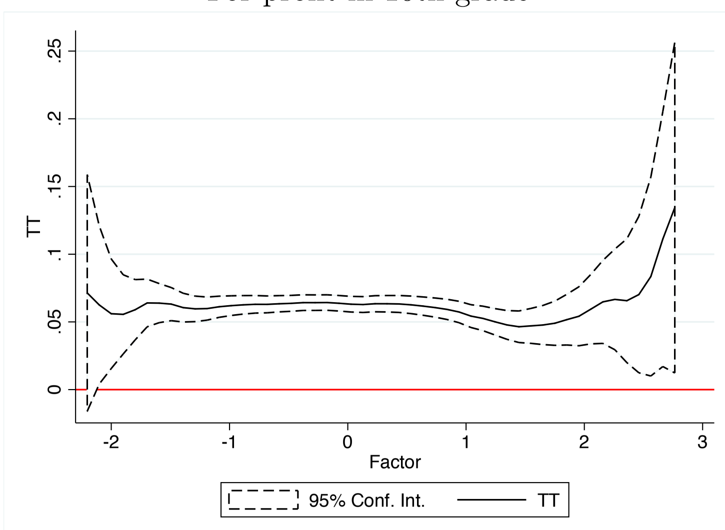
Notes: Each panel plots the Treatment on the Treated (TT) parameter of attending a particular type of secondary school on verbal test scores, as a function of the unobserved ability (factor). 95% confidence intervals in dashed lines.

Figure 11: TT(math) as a Function of Unobserved Ability - Students in Public Schools in Primary

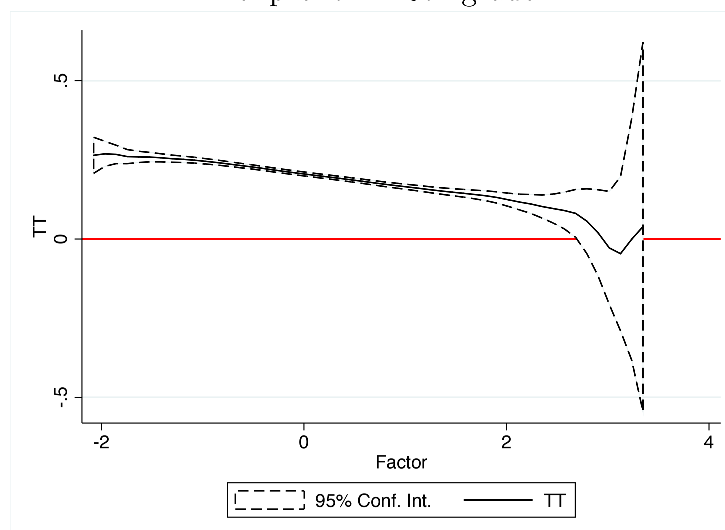
Public in 10th grade



For-profit in 10th grade

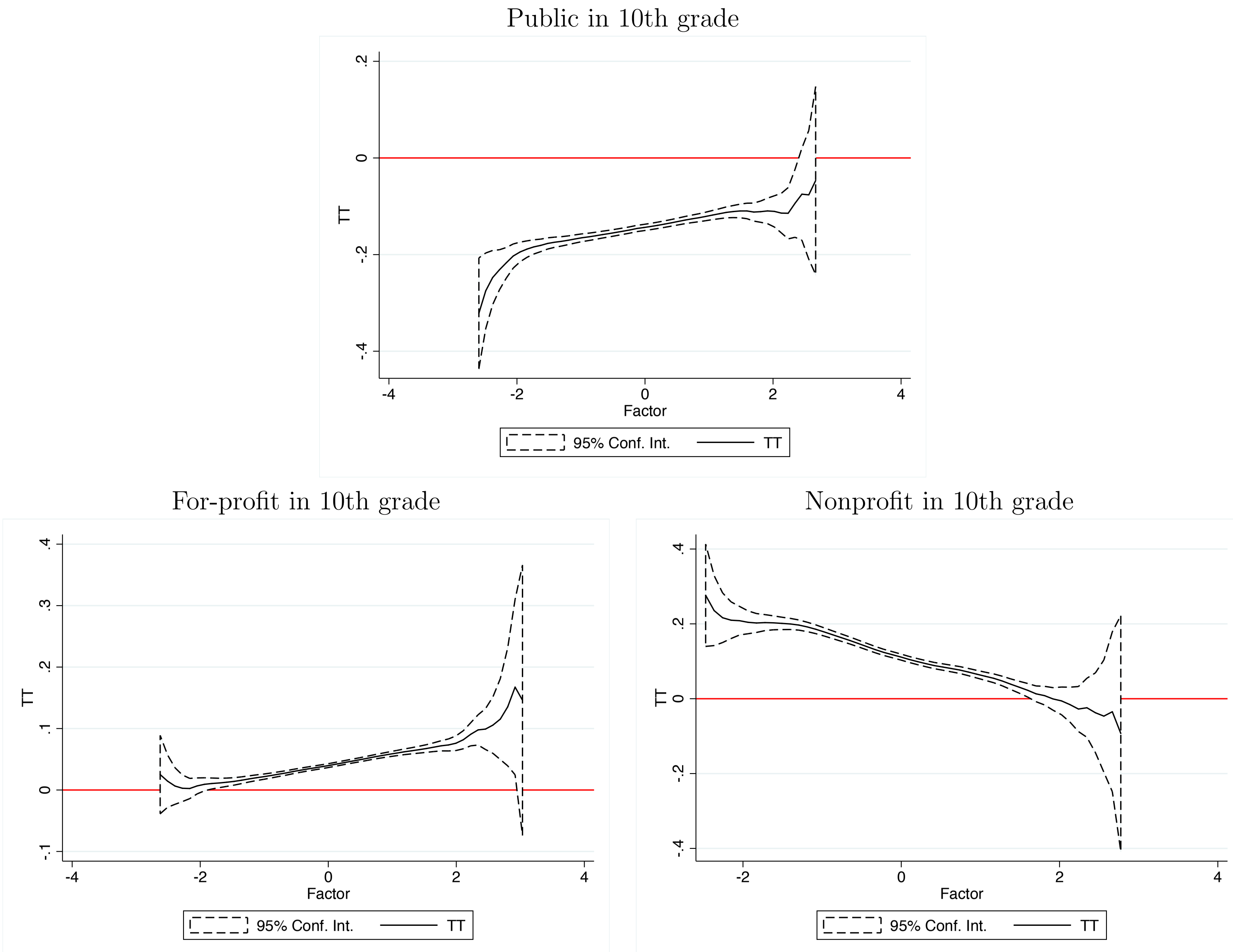


Nonprofit in 10th grade



Notes: Each panel plots the Treatment on the Treated (TT) parameter of attending a particular type of secondary school on mathematics test scores, as a function of the unobserved ability (factor). 95% confidence intervals in dashed lines.

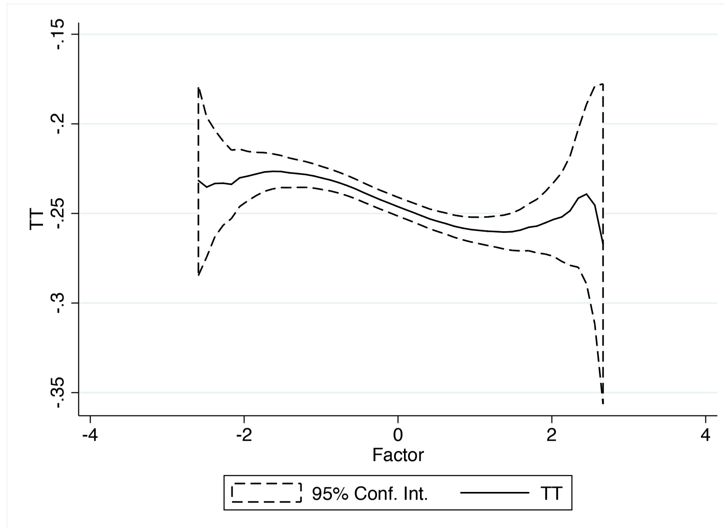
Figure 12: TT(verbal) as a Function of Unobserved Ability - Students in For-Profit Schools in Primary



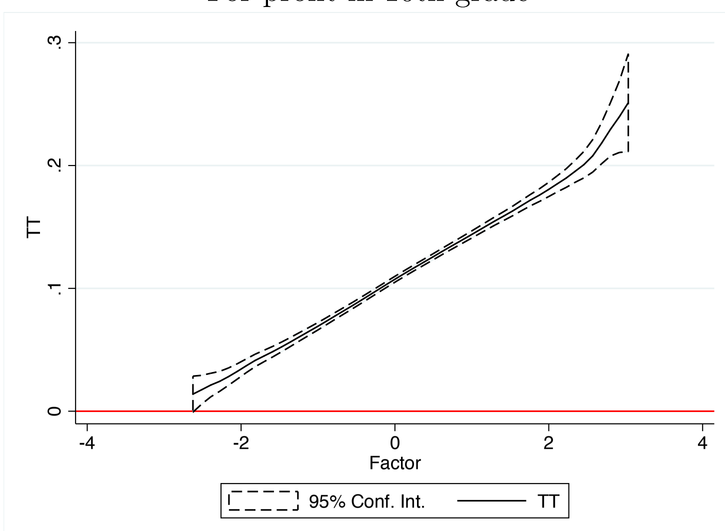
Notes: Each panel plots the Treatment on the Treated (TT) parameter of attending a particular type of secondary school on verbal test scores, as a function of the unobserved ability (factor). 95% confidence intervals in dashed lines.

Figure 13: TT(math) as a Function of Unobserved Ability - Students in For-profit Schools in Primary

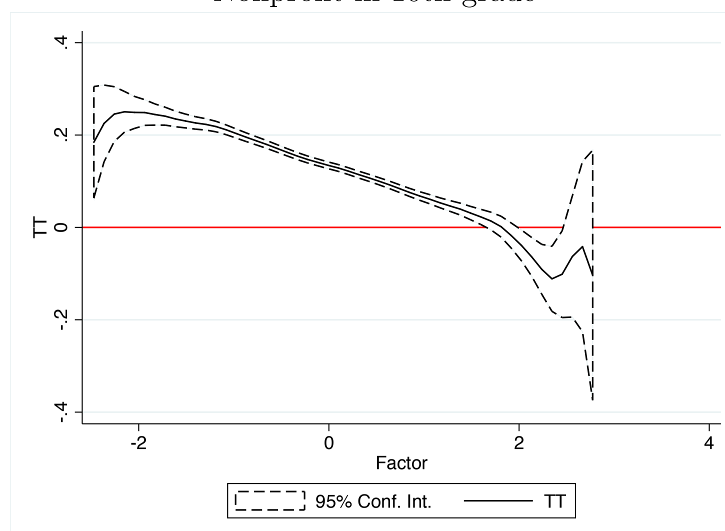
Public in 10th grade



For-profit in 10th grade



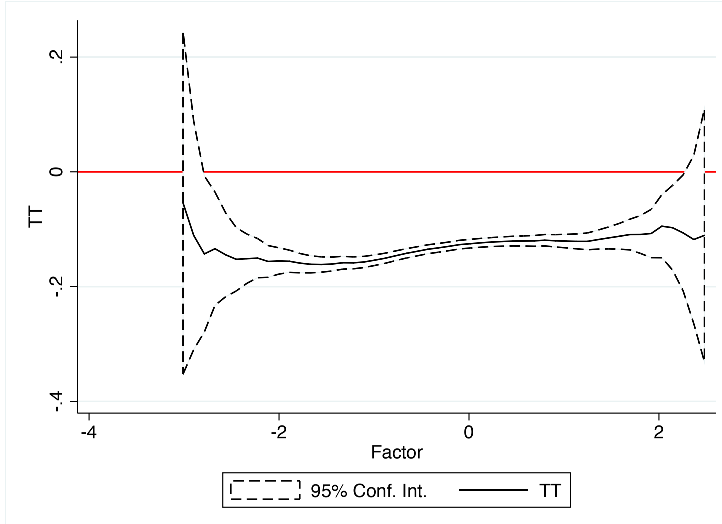
Nonprofit in 10th grade



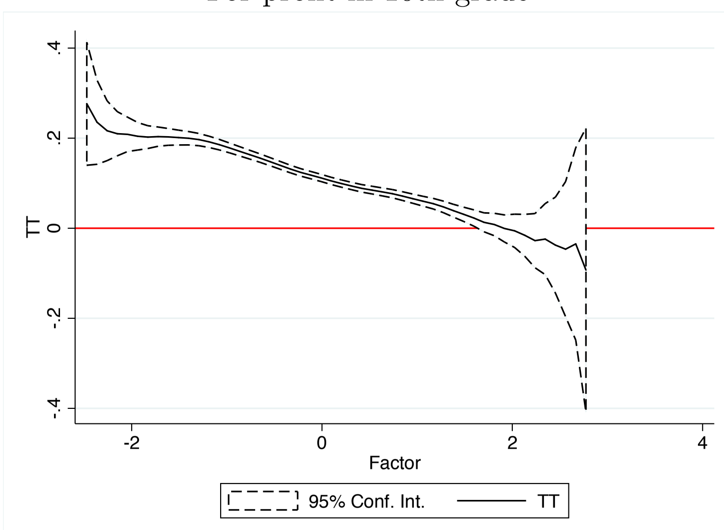
Notes: Each panel plots the Treatment on the Treated (TT) parameter of attending a particular type of secondary school on mathematics test scores, as a function of the unobserved ability (factor). 95% confidence intervals in dashed lines.

Figure 14: TT(verbal) as a Function of Unobserved Ability - Students in Nonprofit Schools in Primary

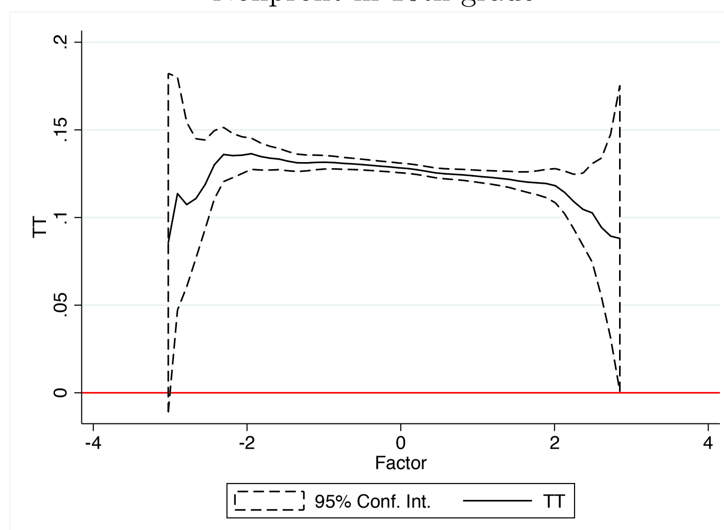
Public in 10th grade



For-profit in 10th grade



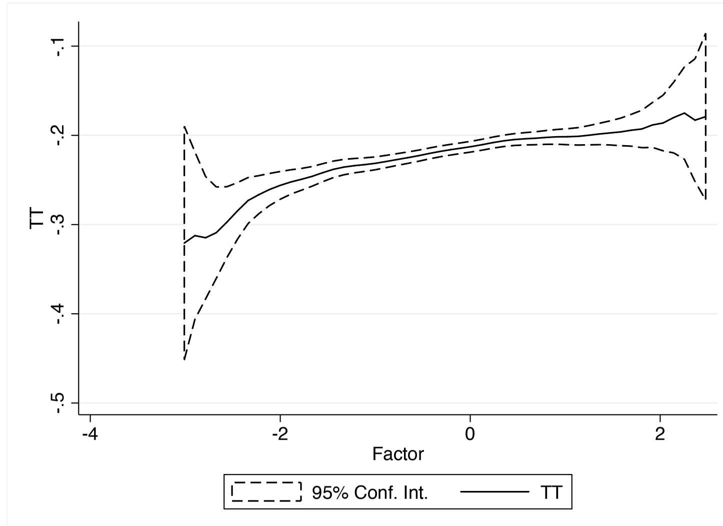
Nonprofit in 10th grade



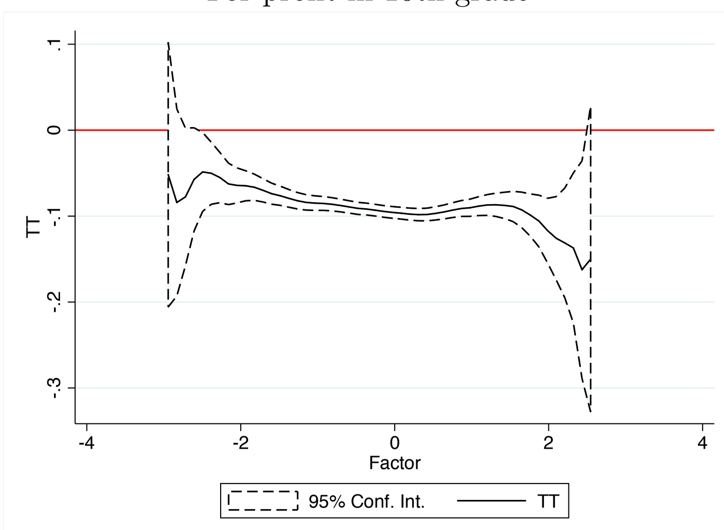
Notes: Each panel plots the Treatment on the Treated (TT) parameter of attending a particular type of secondary school on verbal test scores, as a function of the unobserved ability (factor). 95% confidence intervals in dashed lines.

Figure 15: TT(math) as a Function of Unobserved Ability - Students in Nonprofit Schools in Primary

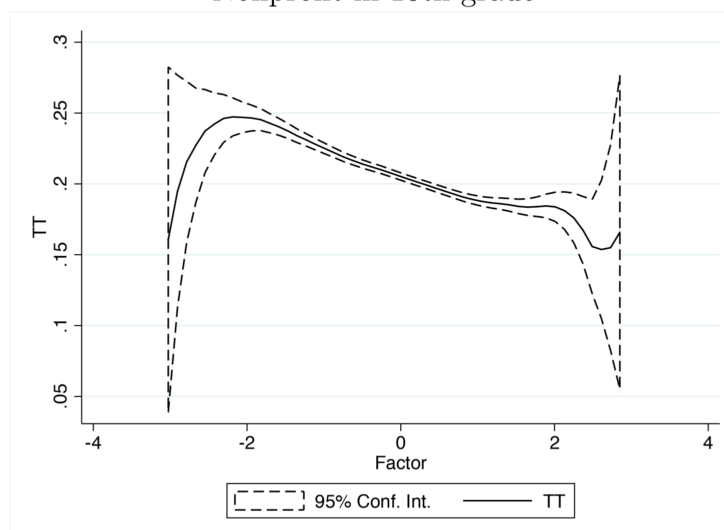
Public in 10th grade



For-profit in 10th grade

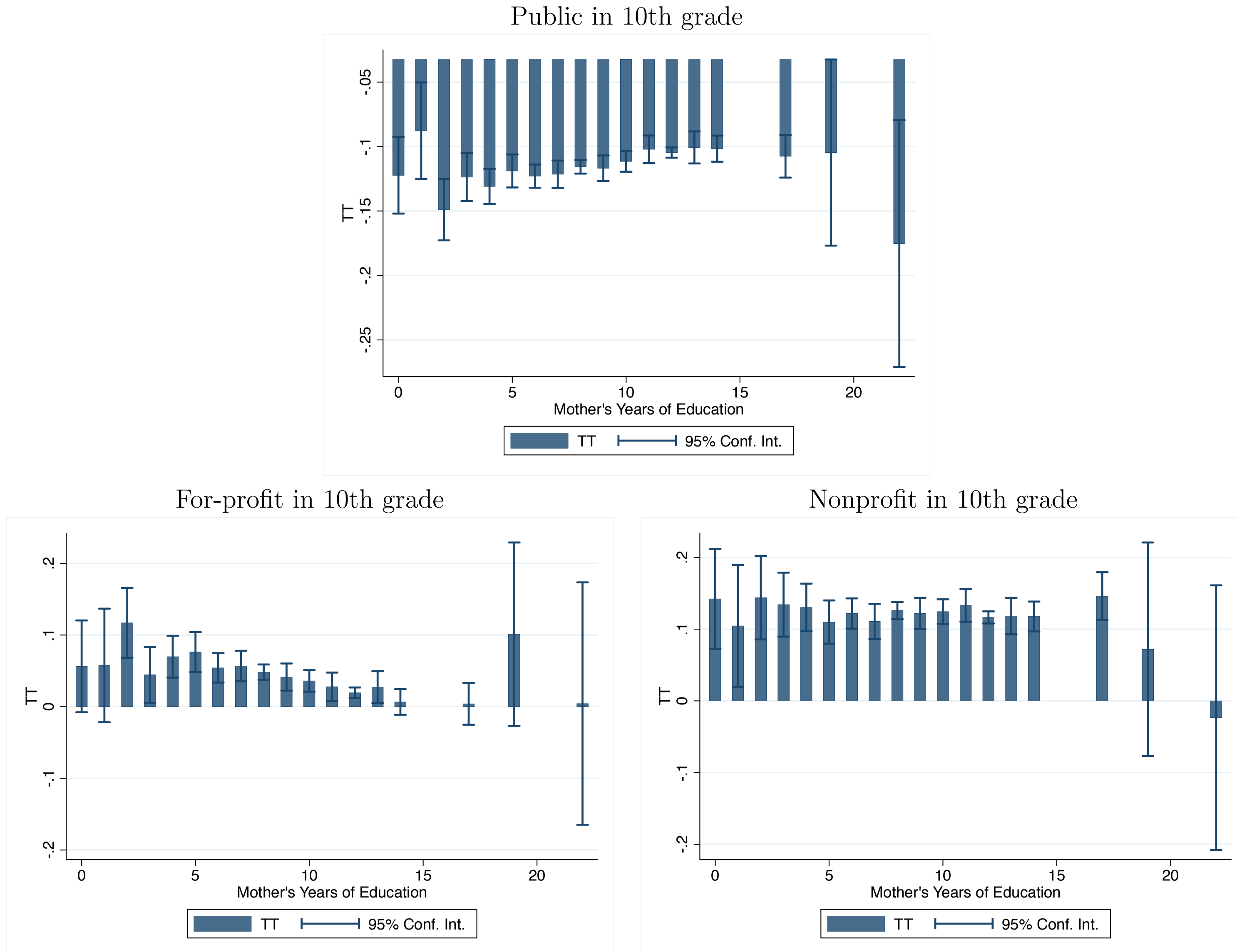


Nonprofit in 10th grade



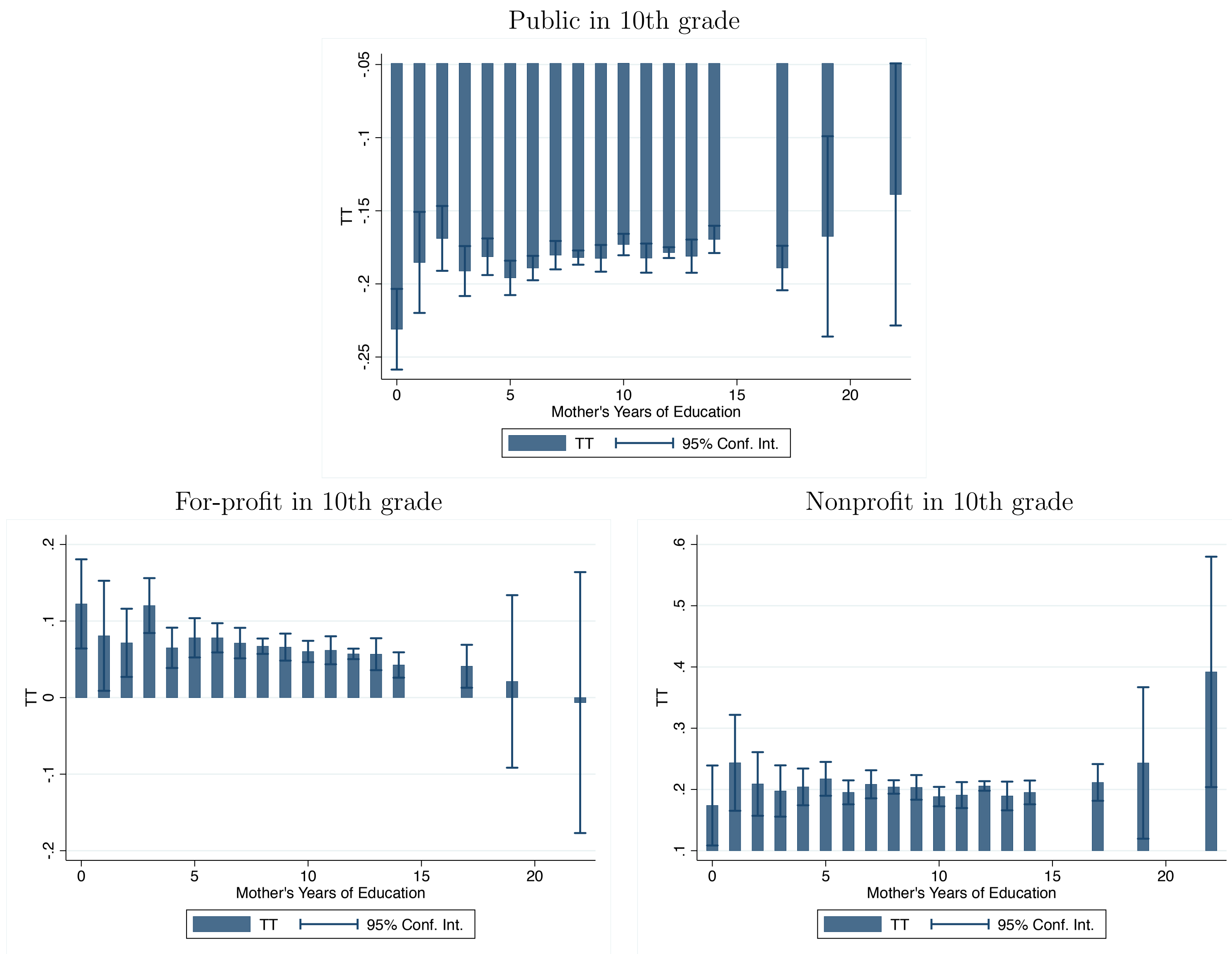
Notes: Each panel plots the Treatment on the Treated (TT) parameter of attending a particular type of secondary school on mathematics test scores, as a function of the unobserved ability (factor). 95% confidence intervals in dashed lines.

Figure 16: TT(verbal) as a Function of Mother's Years of Education - Students in Public Schools in Primary



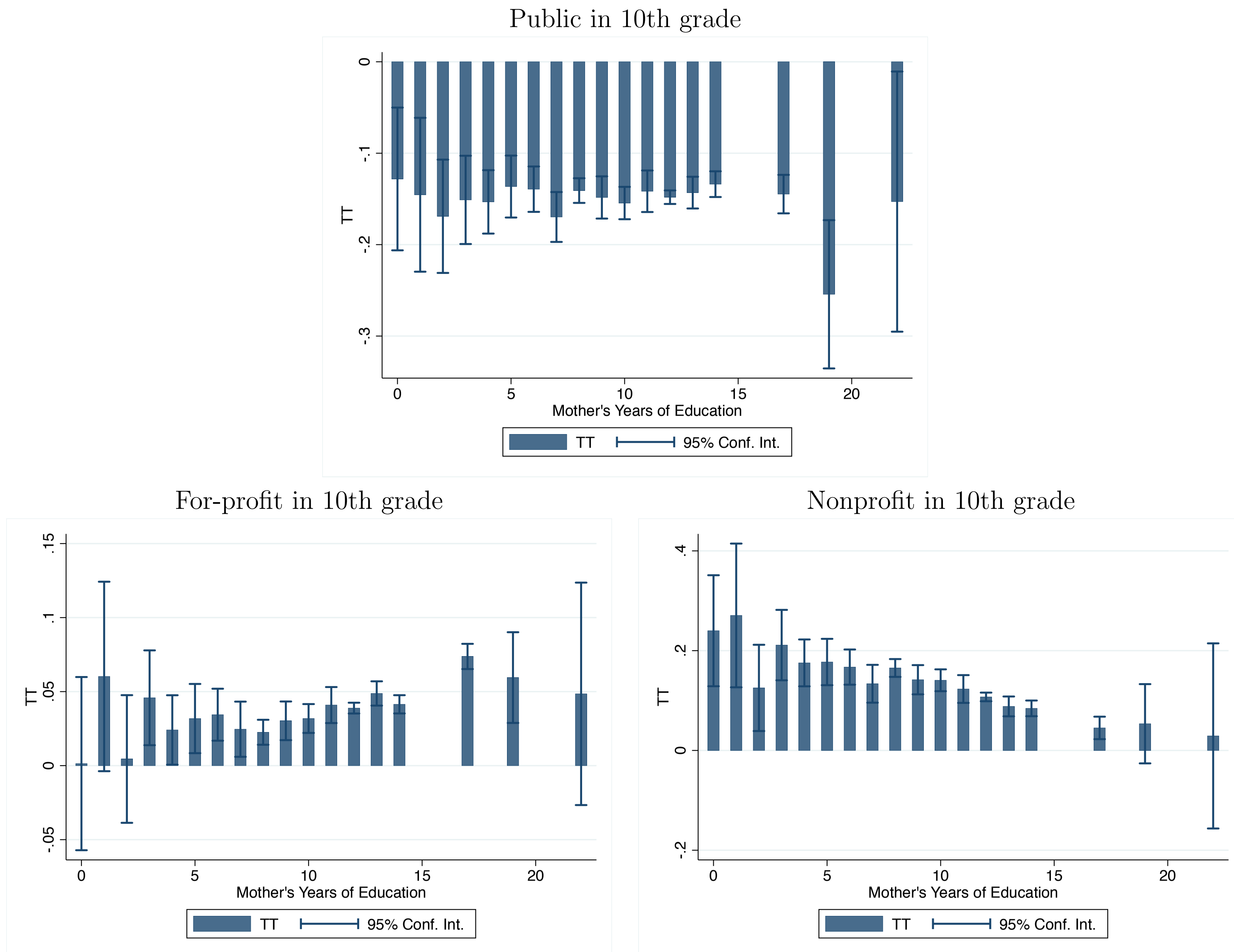
Notes: Each panel plots the Treatment on the Treated (TT) parameter of attending a particular type of secondary school on verbal test scores, as a function of mother's years of education. 95% confidence intervals on top of each bar.

Figure 17: TT(math) as a Function of Mother's Years of Education - Students in Public Schools in Primary



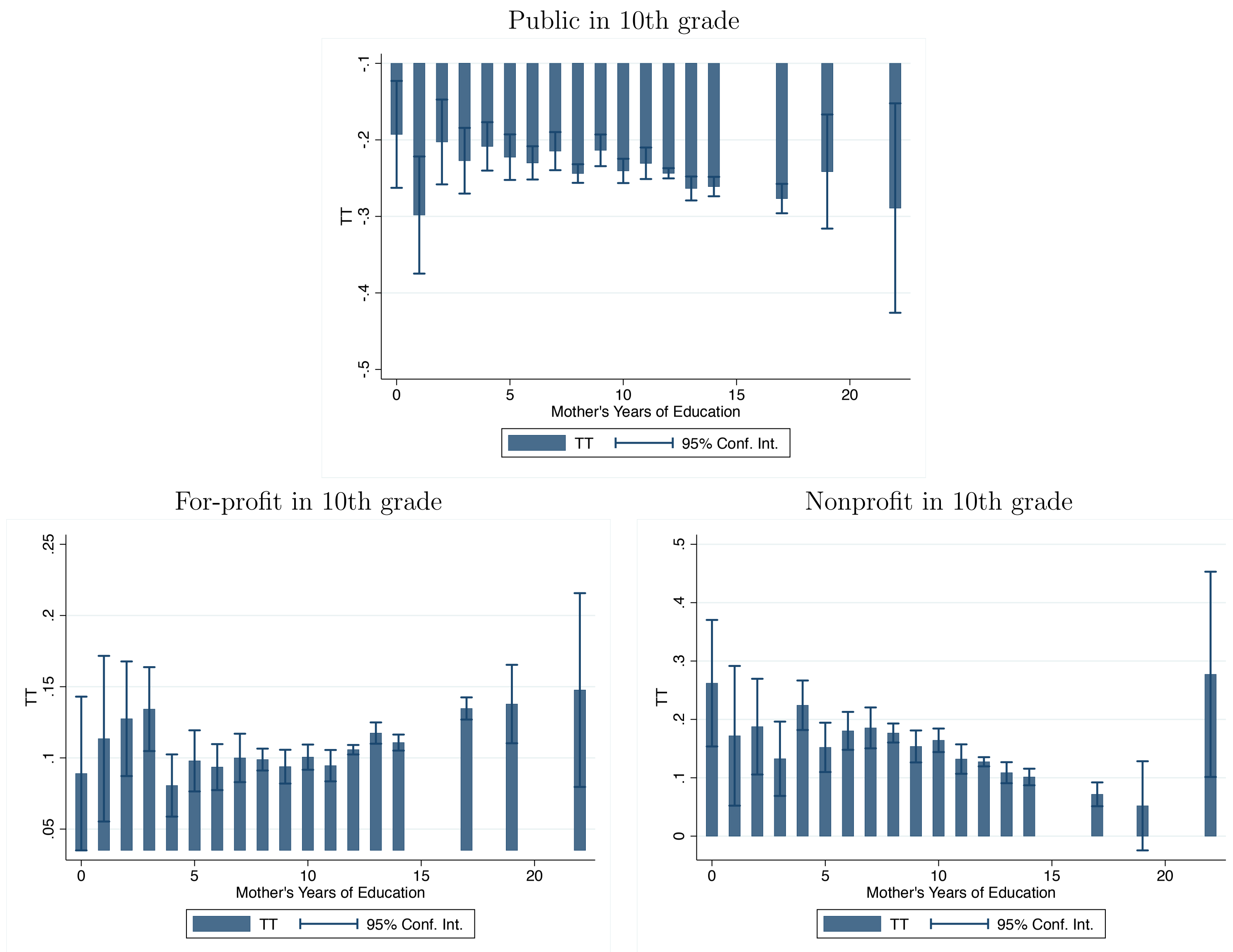
Notes: Each panel plots the Treatment on the Treated (TT) parameter of attending a particular type of secondary school on mathematics test scores, as a function of mother's years of education. 95% confidence intervals on top of each bar.

Figure 18: TT(verbal) as a Function of Mother's Years of Education - Students in For-profit Schools in Primary



Notes: Each panel plots the Treatment on the Treated (TT) parameter of attending a particular type of secondary school on verbal test scores, as a function of mother's years of education. 95% confidence intervals on top of each bar.

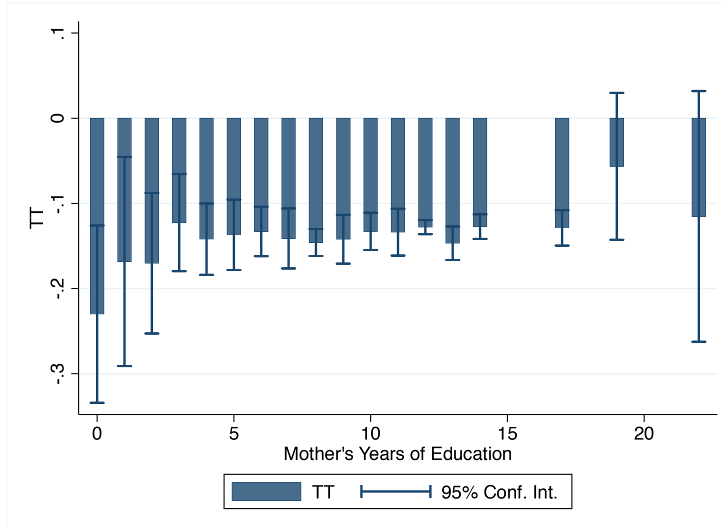
Figure 19: TT(math) as a Function of Mother's Years of Education - Students in For-profit Schools in Primary



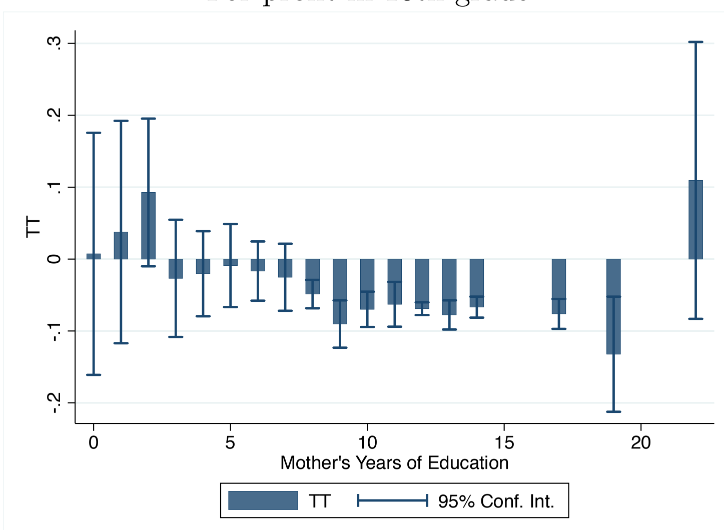
Notes: Each panel plots the Treatment on the Treated (TT) parameter of attending a particular type of secondary school on mathematics test scores, as a function of mother's years of education. 95% confidence intervals on top of each bar.

Figure 20: TT(verbal) as a Function of Mother's Years of Education - Students in Nonprofit Schools in Primary

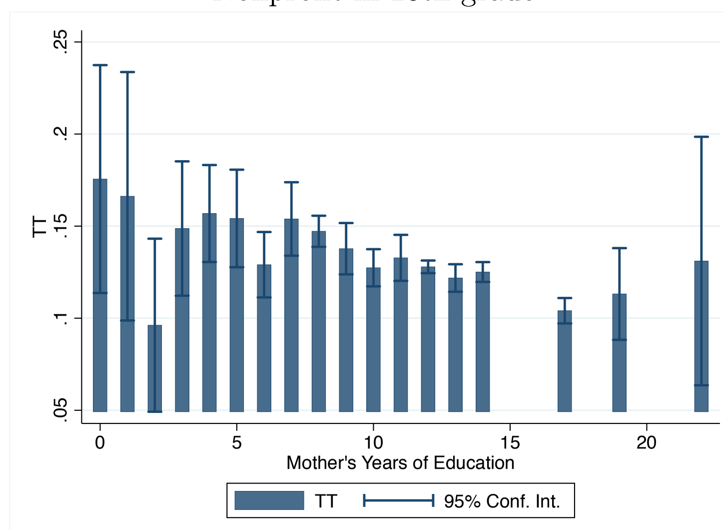
Public in 10th grade



For-profit in 10th grade

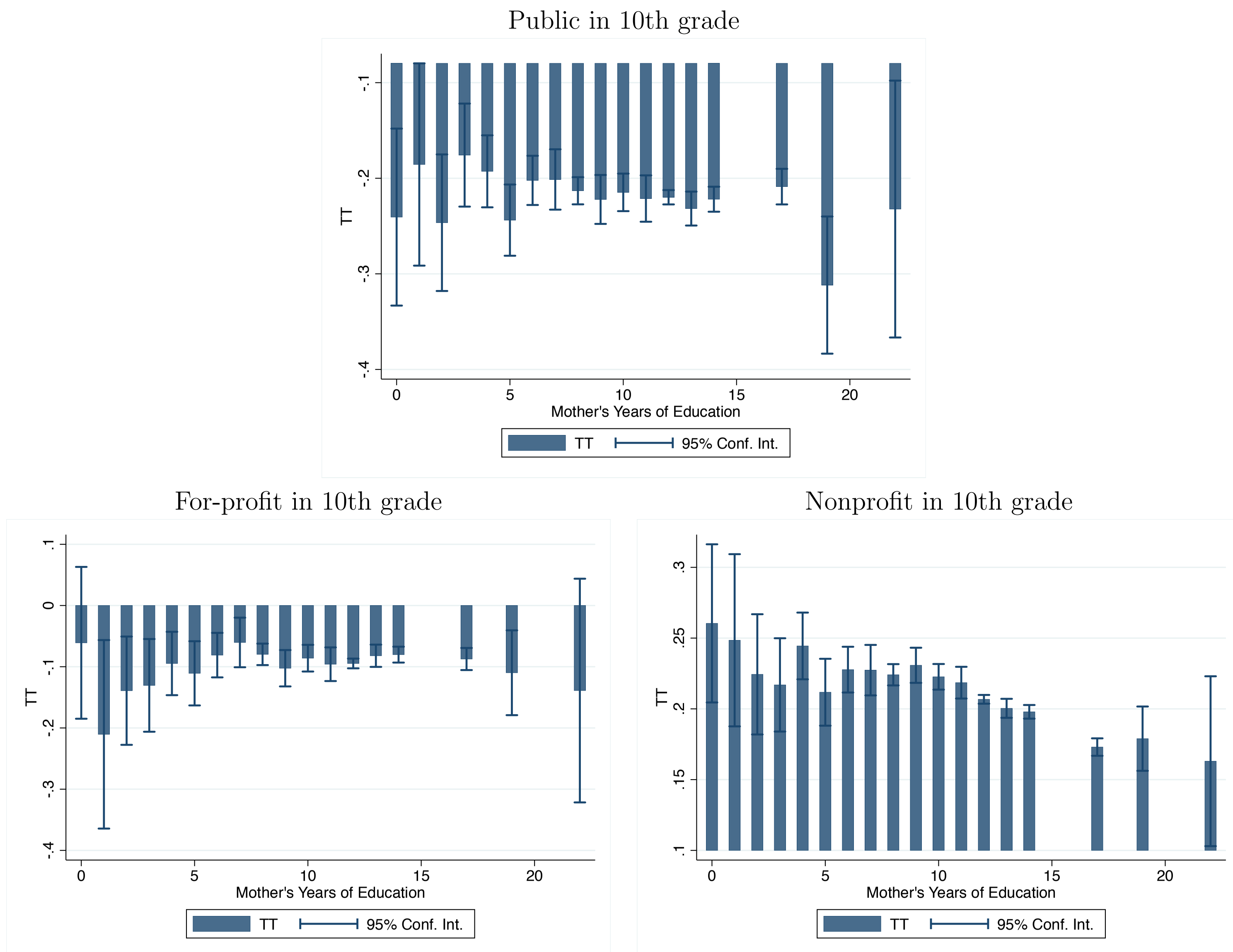


Nonprofit in 10th grade



Notes: Each panel plots the Treatment on the Treated (TT) parameter of attending a particular type of secondary school on verbal test scores, as a function of mother's years of education. 95% confidence intervals on top of each bar.

Figure 21: TT(math) as a Function of Mother's Years of Education - Students in Nonprofit Schools in Primary



Notes: Each panel plots the Treatment on the Treated (TT) parameter of attending a particular type of secondary school on mathematics test scores, as a function of mother's years of education. 95% confidence intervals on top of each bar.