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Does the Increase in Competition between Schools Improve the Quality of the Service? The Role of Educational Reform in Chile

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Abstract

We analyse the effect of geographic competition between schools on academic performance in Chile. The analysis controls for prior pupil performance, and a range of school and municipality characteristics. We allow for the endogeneity of voucher school location, using the number of local Catholic churches as an instrument. We find that a larger number of public schools positively affects the quality of education of other schools located in the same area, particularly amongst middle-class families and in middle-ranking schools. However, the number of voucher schools is associated with lower performance in neighbouring schools, which we attribute to pupil sorting.

JEL codes: I20, I24, I28

Keywords: School choice; Competition; Educational vouchers

Introduction

What effect does providing more competition have on schools' performance? This paper aims to answer this question in the context of Chile, a country where a wide-ranging voucher school programme was put in place in order to provide such competition. The analysis uses data on a large sample of Chilean schools to investigate this issue, distinguishing between competition from voucher schools and from other public schools, controlling for a large number of school and municipality-level variables that could also influence school performance, as well as for the prior performance of the pupils. We also allow for the potential endogeneity of school location choices.

Reforms based on competition, decentralisation and privatisation of the educational market have been advocated as potentially generating the right incentives for an efficient educational system, where schools are more reactive to the needs and preferences of parents, as opposed to a standardised and monopolistic pure public educational system (Friedman, 1962). The arguments in favour include that privatised schools are more efficient in meeting the consumers' (i.e. parents' and pupils') demands, that people enjoy the freedom to choose, and that they produce a better match between pupil and school according to different preferences and needs (Lubienski, *et al.*, 2009). Furthermore, the fact that parents can express their dissatisfaction directly by enrolling their children into another school, compared to the nationalised system where parents can only express their views using political channels, provides schools with the incentive to try to improve their pupils' outcomes. Therefore, a system that includes private and public schools would provide a useful variety of schools and introduce flexibility and competition into the system (Friedman, 1962).

In contrast, one of the main points made by supporters of the nationalisation of schools is that it is not possible to build a stable and democratic society without a minimum

level of education for the majority of individuals and without wide agreement about some common values. In addition, concerns about the increasing levels of social segregation could be raised as the number of private educational institutions increase, if better-resourced families are the ones with access to the private schools. A lack of information available to parents can weaken the competition between schools, which can in turn also increase segregation if those parents who lack information are poorer or less well-educated. Competition could thus potentially create more inequality among schools and children, concentrating poorer or less well-supported children into fewer schools. It has been claimed that the educational system could be one of the main institutional causes of a low intergenerational mobility in society (Breen, 2001). On the other hand, segregation could still incur in the absence of a private sector or vouchers, if school places are allocated on the basis of proximity to schools, and thus a school's roll call reflects the socio-economic characteristics of the area in which it is located.

This paper therefore provides some empirical evidence on the particular issue of whether competition between schools raises pupil outcomes, also considering whether any such effects differ between private and state schools. While the answers obtained are, strictly speaking, applicable only to the case of Chile, they are still informative as to the potential effects of reforms in other countries. The analysis defines the competition faced by a school in terms of the number of other schools in a circle of given radius around the first school, checking the robustness of the results to changes in the radius, and to consideration of the quality rather than the quantity of competitor schools. The results show that competition from public schools increases pupil performance in both other public schools and in voucher schools. Competition from voucher schools, however, is found to be associated with lower performance in both types of schools.

Our study makes a number of key contributions to the literature. First, we take account of the potentially endogenous location of the new voucher schools, using an instrumental variable based on the existence of local catholic churches, since many voucher schools have ties to organised religion. This is the key methodological contribution of the paper. In addition, we go further than simply looking at average effects, by also using quantile regression techniques to understand distributional effects, in particular where in the distribution of school quality the competition effects are most closely felt. We also break the results down by socio-economic background, again to determine how the competition effects vary across the distribution of family background. These results allow us to make some inferences about sorting as well as efficiency effects, the final contribution of our paper.

The next section outlines the Chilean Educational System, to be analysed in the empirical section. Section 3 summarises previous relevant literature, followed by a section that describes the methodology and data to be used. Section 5 describes the results of the analysis, while a final section concludes.

2. Chilean educational system

In Chile, the need to increase the provision of education, increase the efficiency of the public sector and increase the quality of the educational service provision was planned through reforms regarding school choice, in particular, by opening the supply-side provision to non-governmental institutions and reducing the barriers to entry for organisations that can focus on pupils with different preferences and needs. Thus, from 1981, and in the context of a market-oriented transformation of the country, Chile's military non-democratic government

decentralised public schools and started financing some private schools with a voucher system for each pupil.

In practical terms, the reform implied that public and voucher schools receive the same voucher amount which is unrestrictive so every pupil can participate. A voucher is a coupon that a pupil carries with them to the school they choose to attend. When the pupil enrols, the school receives the cash value of the voucher. Voucher schools only receive pupils that want to make use of the voucher; they do not accept pupils where parents want to pay the full extent of their education (these parents send their children to private, fee-paying schools).

The main hope for the reform was that competition would create greater quality with fewer resources. Therefore, spending on education fell in the decade following the reform (in 1990 spending on education was 23% lower than in 1982), with the deepest fall for secondary schools. Chile then became, "a virtual laboratory for a relatively unregulated, decentralised, competitive market in primary and secondary education" (Bravo, *et al.*, 2010, p. 2).

One of the immediate effects of the reform was that more than a thousand new voucher schools were opened within the first five years. In 1980 there were 1,627 voucher schools, but by 1985 there were 2,643 such schools (Hsieh and Urquila, 2006). This expansion of the supply side was followed by a large increase in the number of pupils receiving a formal education and an increase in demand for privately administered schools. For example, only 50% of children in the relevant age group were attending secondary school in 1990, but in 2006, 70% were attending (Ministry of Education, 2008)

Even though these improvements in educational coverage were observed, it has been suggested that it was the decrease in public spending on education which created the incentive to open new voucher schools (Checchi and Jappelli, 2003). In particular, public schools had fewer resources, generating a decline in the service provided (though if competition was effective and increased efficiency, this effect could be cancelled out). A

further decline in public school performance could be observed due to sorting effects, given that voucher schools can select their pupils, thereby leaving the pupils who have the most difficulties to go to the public schools. Even though parents have the freedom to choose the school that they want without restrictions of area of residence, the pupil selection process can be based upon academic tests, parental interviews, or religious affiliation, so the voucher schools can secure for themselves the better pupils. In contrast, public schools accept all applicants if the total number remains below their maximum provision, and can only use selection criteria, such as parental interviews and academic tests, when faced with an over-demand. The implications of the reform are therefore diverse, and cannot be predicted with certainty a priori.

Given the criticisms of the implementation of the neoliberal educational reform mentioned, some elements were reversed by the government in the return to democracy in 1990 (OECD, 2004). However, the voucher school system has remained, even during successive changes implemented by the subsequent democratic governments. In 1994, voucher schools were allowed to charge pupil tuition fees on top of the voucher obtained by the pupil[i], a policy which may further increase any segregation by income levels across schools (Narodowski and Nores, 2002). In 1995, with an already stable democracy established in the country, the government's increase in spending on education became the priority in terms of social policy. From 1996 the 'Full Day School' reform was implemented together with a curriculum reform, to support the poorest schools, and a programme to increase quality and equity in education was provided. Finally, in 2008, an increase of 50% in the value of the voucher per pupil classified as vulnerable by the Ministry of Development and Planning was established.

3. Previous literature

Literature on school competition and educational outcomes is relatively scarce and also largely inconclusive. Often the biggest limitation is a lack of appropriate data. Many of the previous studies have thus either been theoretical, or have focussed upon experiments in the USA (Hoxby, 2003). Estimates of competition effects in other countries exist for Sweden, where independent schools cannot select pupils by ability or family background (Böhlmark and Lindahl, 2008 and Lindbom, 2010) and New Zealand (Ladd and Fiske, 2003), and in analyses of the effect of competition in mainly publicly-administered educational systems such as the UK (Bradley and Taylor, 2002, and Gibbons et al., 2006). Additionally, some examples exist from developing countries, such as Bangladesh where vouchers are supplied only to females attending grades 6-10, in Guatemala where vouchers are supplied only to selected girls between the ages of 7-14 from low income families (West, 1996) and India, where voucher school allocation was done via lottery (Muralidharan and Sundararaman, 2015).

Existing results regarding the effect on school performance due to competition are diverse. Arum (1996) points out that in the US the proportion of private subsidised schools in an area has an important positive influence on the performance of public schools, as theory predicts. However, the improvement does not seem to be related to an increase in efficiency through competition, but rather because of an increase in the resources provided to public schools. In addition, Hoxby (2003) uses data from American school choice programmes to find that pupil achievement improves when they attend voucher schools and that public schools respond positively to competition. On the other hand, Gibbons et al. (2006) in the case of London's primary schools, analyse the effect of increasing school choice and increasing school competition separately, finding no significant evidence to suggest that

geospatial competition affects performance positively. The most likely reason behind the inconclusive finding is the large variety of types of voucher systems implemented around the world.

Chile is a good source of empirical evidence, as a simultaneous voucher and privatisation system has been implemented nationwide for more than 30 years in the country with very distinctive characteristics (i.e. in contrast to most of the voucher systems introduced in other countries, positive selection was allowed). This was supposed to produce an increase in competition and therefore, an increase in educational quality in the municipalities that had a larger proportion of private institutions (Ladd and Fiske, 2003). It is considered that location and quality of school play an important role in school choice in Chile (Gallego and Hernando, 2009). Patrinos and Sakellariou (2008) point out that overall, the reforms improved the efficiency of the educational system, but that benefits were achieved at the expense of equity. The study by Hsieh and Urquiola (2006) is most similar to ours, in that they investigate how the differences in change in school performance at the regional level are related to the differences in the growth of private voucher schools across regions. They find that in Chile, competition from voucher schools does not seem to improve pupil performance and point out the importance of distinguishing between the effects of school productivity and school sorting. Our study differs from theirs in that we investigate the relationship at the school level, and also allow for the endogeneity of voucher school location.

Endogeneity of competition effects has been one of the main concerns in the competition-effect literature. Voucher schools may prefer to settle in areas with characteristics favourable to higher existing pupil performance, such as good socio-economic background (omitted variable issues) or voucher schools may deliberately set up in areas with low-quality existing public education (reverse causality).To rule out these concerns, Hoxby (1994) analysed the effect of school choice in the USA on improving the quality of education

provided using as an instrument for voucher school enrolment the percentage of Catholic people in the area, finding that voucher school competition improves public school performance. A related instrument is used in this study, namely the number of Catholic churches in the local area.

The research presented here is motivated by the desire to contribute with evidence to the study of the effect of competition and market-oriented educational provision on the academic performance of schools, treating the latter as an indicator of the quality of education that schools provide. The results are important if one considers that the Chilean educational system seems to be in crisis, reflected, among other things, by a permanent underperforming in international educational tests (Medrano and Contreras, 2009)[ii] and by a highly segregated educational system (Manzi *et al*, 2008) and also considering that the arguments against voucher systems are often more ideological than supported by empirical evidence (Arenas, 2004).

4. Data and methodology

To study the effects of school competition on academic performance, information on academic assessment of pupils is used to measure the performance of schools, namely the SIMCE (System of Measurement of Quality of Education) data sets, provided by the Chilean Ministry of Education since 1990. These data sets contain information on academic tests in mathematics, reading/writing (Spanish), natural sciences and history[iii], which are taken every year in every urban school in Chile, regardless of the school's type of funding.[iv] Here we make use of each school's average score in the mathematics and Spanish academic assessments.

Each year, SIMCE surveys a different year group within schools, alternating between fourth grade and eighth grade in primary schools and second grade in secondary schools. Two years of data were specifically chosen to be analysed, namely 2005 and 2009. In 2005, pupils were evaluated in their 4^{th} primary grade, while the 2009 survey focused on 8^{th} primary grade. Thus, the pupils surveyed within each school in these two years were, with the exception of a small number of school-movers, the same children. Using these two years therefore allows us to look at changes over time in test scores (so-called 'value added' specifications), or equivalently to control for the starting test scores of the pupils, and so control for the quality of each school's intake.

The other key variable to define is the level of competition faced by each school. This is measured as the number of other schools in a fixed geographic radius around each school. We use information on geographical coordinates for each school in the country to measure distances between them, using the Universal Transverse Mercator (UTM) of two dimensional Cartesian coordinates to represent the surface of the Earth.

A range of other explanatory variables, from a variety of sources, are used in the estimated equation to control for other determinants of pupil performance. These include average characteristics of the pupils in each school, other school level characteristics including type of school, and characteristics of the municipalities in which schools are located. These data were obtained from a range of sources, as described in Table A1 in Appendix A, with descriptive statistics provided in Table B1 in Appendix B.

The sample obtained, when combining the various data sources mentioned above, contains a similar proportion of public schools (55%, or 2,450 schools) and voucher schools (45%, or 2,007 schools), of which one-third are totally free voucher schools and two-thirds are voucher schools charging tuition fees. Out of a total number of 346 municipalities, 330

are included in the analysis. Of the included municipalities, 238 have at least one voucher school.

The impact of competition between schools on school quality is estimated using the model below, as suggested by Gibbons *et al.* (2006):

$$y_{st} = \alpha y_{st-1} + \theta_P CI\_Public_{st} + \theta_V CI\_Voucher_{st} + \sigma X_{st} + \varepsilon_{st}$$

y_{st} corresponds to the average academic performance of children in school *s* in year *t* (2009).[v] y_{st-1} is the average performance of the same children in an earlier year (2005) in the same school *s*. CI_Public_{st} corresponds to the competition index of school *s* in year *t* from public schools. The index CI_Public_{st} is the number of public schools that are in a straight line distance of less than 3 km from the school analysed[vi]. In a similar way, $CI\_Voucher_{st}$ represents the competition index of the school *s* in year *t* from voucher schools. X_{st} is a vector of pupil, school and neighbourhood characteristics and ε_{st} is the error term.

Separate variables measuring the number of public schools and the number of vouchers schools within 3km are therefore included in the estimated equation. We have no a priori prediction about the relative size of the competition effect from each type of school, and so do not impose any restriction that they should have equal coefficients by including a single variable measuring the total number of schools.

The competition indices are applied only to primary schools in urban areas. Only primary schools are considered since children often move between schools when they pass to secondary education, so that past performance of the same children in each school could not be controlled for if the second grade in secondary school data were used (many primary schools do not allow for the possibility of continuing secondary studies at the same institution).

We undertake a number of checks to determine the robustness of the results to changes in the definition of these competition variables. For example, competition indices could undesirably capture the effect of urban density and school size effects (Gibbons, *et al.*, 2006). Therefore, per capita competition indices were also calculated, dividing the raw competition indices above by the number of people living in the municipality where the school *s* is located.

Since the choice of 3km distance was chosen somewhat arbitrarily (as the average distance travelled to school), alternative distances were also used, namely 2km and 4km, to check the robustness of the results to this choice. A final variation considered competition in terms of the *quality* of other schools, rather than the *quantity*. The quality of competition was measured as the average test performance of public schools located less than 3km from school *s*, and the average test performance of voucher schools located less than 3km from school *s*, as suggested by Bradley, *et al.* (1999).

Another potential issue here is that Chile has a programme of teacher pay premiums (SNED) based on 4th and 8th grade SIMCE scores by school (Mizala and Romaguera, 2002). As argued by Carnoy *et al.* (2007), it is easier to achieve gains in scores in the 4^{th} grade than in the 8^{th} grade, so that if schools are trying to increase the probability that they win a pay premium, then they might move their best teachers into the 4th grade in test years. If schools facing more competition are more likely to do this, then this could cause a downward effect of competition on 8^{th} grade scores, conditional on 4^{th} grade scores, which could be a partial explanation for some of our results that follow. We therefore estimated a further OLS specification, where we add to the list control variables, two variables measuring the whether the individual school was selected for a SNED premium in 2005, and the proportion of primary schools in school *s*'s municipality to be selected to receive such a premium.[vii]

As well as the specification of the equation in terms of included variables, we also check the robustness of the results to the econometric methodology used. Most importantly, competition from voucher schools is likely to be an endogenous variable. One possible argument is that more schools could be established in a particular area because, for example, better performing pupils are located there, so that the academic performance in school *s* and the competition index (number of other schools in the area) would both be a function of other variables that influence pupil performance, such as the socio-economic background of the area. This will be controlled for as far as possible through the municipality characteristic variables. However, to the extent that some characteristics that determine the degree of competition and pupil performance are unobserved, then this would cause a correlation between the competition variable and the error term and OLS estimation would be biased and inconsistent. Alternatively, the number of voucher schools could be endogenous to public school quality (i.e. more voucher schools set up where public schools suffer from a bad reputation, precisely because of the poor choice of available public schools).

We continue to treat the public school competition index as exogenous throughout. Public schools do not have to make the same location choices, choosing between alternative areas on the basis of the most beneficial site for the school owners. In addition, few new public schools are opened, and the closure of public schools does not occur. The location and hence the number of public schools in a given area can therefore be treated as exogenous to other schools in the period in question.

The solution to the problem of voucher school competition endogeneity is to use an instrumental variable approach. The instrument we use is the number of Catholic churches by municipality. The argument is that the more churches there are in a municipality, then the more voucher schools are likely to be created there on average, since a significant percentage of voucher schools are officially Catholic and many others are at least named after Catholic

saints.[viii] More churches aid the creation of schools by offering buildings to share and providing more available teachers (nuns and priests). However, the number of churches should have no effect on school performance, other than through its effect on the number of voucher schools. In particular, the church variable is measured at the municipality level and so does not directly influence individual particular schools.

It could possibly be argued that the number of Catholic churches in a municipality is itself a function of the characteristics of the local population. However, we argue that the number of churches is exogenously determined, by historical factors rather than current population characteristics, and thus is a valid instrument. Chilean churches were all built some time ago, in colonial times (before 1818) or during independence, but before 1950[ix]. From 1492 to the early 19th century Chile was part of the Spanish Empire. During this period, many churches were built on the basis of a large rural population, around which towns then developed. After Independence, a further wave of churches were built between 1928 and 1940, due to the rising number of clergy during this period, as young men from middle or low social classes were encouraged to become priests (Checa-Artasu, 2015). Since this period, however, the Catholic Church in Chile has not built new churches, but only refurbished ones damaged by fire or earthquakes. In some cases it has built chapels when a community asked for one[x]. Therefore unlike churches, chapels continue to be built, and according to characteristics of the local population. Chapels were therefore not included in the instrumental variable used here; only main churches (parishes) were included.

The church variable was created using information posted on-line by Catholic archbishoprics on their respective web sites. It was not possible to acquire information for all municipalities, due to no information on church location or inexistent records available to the general public or researchers. Therefore, there are only 212 municipalities that have

information related to the number of Catholic churches (approximately two-thirds of the total number of 330 municipalities).

An alternative to an IV methodology to control for endogenous voucher school location is a Fixed Effects framework. To the extent that voucher school location reflects characteristics of the local area not controlled for in our analysis, and if those characteristics remain constant between the years considered here, then including fixed effects for local areas will remove any bias on the competition coefficients due to this unobservable area heterogeneity. It was not possible to include fixed effects at the municipality level, because there is a lack of variation in the competition variable within municipalities. Within a municipality, each school will be competing with the other schools in the municipality, so that the competition indices will be the same (or at least very similar, depending on exact distances) for each school within the municipality. We therefore added area fixed effects at a higher level of aggregation, at the regional level. For this reason, this is not our preferred methodology, but if it is shown to produce similar results to those obtained through IV, then it will increase confidence in those results.

5. Results

5.1 Descriptive statistics

In terms of average academic performance, voucher schools perform better than public schools, with average test scores of 238 in public schools, 241 in free voucher schools, and 264 in fee-paying voucher schools. Looking at *changes* in performance (value-added), the percentage of schools that improved their average academic performance between 2005 and 2009 is higher among free voucher schools (64%) and very similar between public schools and private voucher schools (49% and 50% respectively).[xi]

The descriptive statistics in Table B1 show that the mean school level performance in Mathematics and Language, averaged across all schools, is very similar in 2005 and 2009 (245 in 2005 and 246 in 2009). This does not mean, however, that there is little variation in individual's schools performance over time to be explained, only that the positive and negative changes observed over time in individual schools tend to average out across all schools. As Figure 1 shows, there is significant variation around any 45 degree line of equality between 2005 and 2009 individual school level scores

Turning to the competition variables, these vary depending on the type of school analysed. Schools face competition from an average of 2.7 public schools within a 3 km radius, and from an average of 9.1 voucher schools. Schools face more competition from voucher schools that charge tuition fees (7.3), as expected since free voucher schools are usually run by charitable institutions, and so are unlikely to cluster in areas where provision is already available.

5.2 OLS estimates of the competition effect

<Table 1 around here>

Table 1 reports the results from different OLS specifications, investigating the performance-competition relationship. The results for the base specification in column a suggest that *each* additional public school in the area (within 3 km) improves a school's academic performance by 1.6 points, while the effect of voucher schools in the area decreases the average performance of neighbouring schools by 0.8 points. Both effects appear small considering that average academic performance in schools varies from 175 to 334 points with a standard deviation of 24 points. However, the effect is economically meaningful given that previous academic performance results (year 2005) are controlled for. Thus, each additional

competing public school is associated with 1.6 points greater *improvement* in scores in school *s* between 2005 and 2009, relative to a school with the same initial score in 2005.

The effect of competition may depend on the ease of travel, since a competing school is only a realistic competitor if it is accessible. Therefore, the competition variables were interacted with a variable measuring the perception of being close to the public transportation system. A higher value to this variable represents having better access to public transportation. However, contrary to what was expected, the effect of such access is to reduce the effect of competition from public schools by -0.018 test score points per transport perception point, while the effect from voucher schools increases by 0.008 test score points per transport perception point. Therefore, the effect of competition on school performance tends towards zero in either case, as the perception of good access to public transport increases. One possible reason for this effect could be a decrease in the quality of the transport service as it expands, since the question concerns *access to* transport, rather than the quality of that transport.[xii]

The remaining columns of Table 1 estimate the alternative specifications outlined in the previous section, to determine the robustness of the results to such changes. Column b measures competition as the *quality* of surrounding schools, rather than quantity. The results show, however, that the effect of this competition variable is highly statistically insignificant, in the case of both public and voucher schools. It therefore seems that if schools respond to surrounding other schools, it is the number of them that they respond to, rather the results obtained by them.

Column c include interactions between the competition variables and the type of school being considered, to determine whether competition from different types of school affects public and voucher schools differently. The results show that public school competition has a positive impact on the performance of both public and voucher schools, but

significantly larger for voucher schools. The coefficient on the interaction with the voucher school competition variable is extremely small and statistically insignificant, suggesting no difference in the effect of competition from voucher schools on schools of different types.

In columns d and e, the level of competition within 2 km and 4 km radii is considered, to determine the robustness of the results to the choice of distance within which to measure competition. The results show that the absolute size of the competition effects declines, the wider the area around the school in which the competition variable is measured. It therefore appears that the strength of the competition effect depends on the proximity of the schools being considered.

Finally in column f, variables for the receipt of a SNED premium at the school level and the proportion in receipt at the municipality level are added. Comparing the results to those in column a, it can be seen that this makes no difference at all to the estimated coefficients on the competition variables.[xiii]

5.3 Allowing for endogeneity of voucher school competition

<Table 2 around here>

Table 2 presents the results when we allow for the potential endogeneity of competition from voucher schools, using IV and Fixed Effects estimators, as discussed in the Methodology section above. Column a presents the IV results, treating competition from voucher schools as endogenous and instrumented by the number of Catholic churches in the region. The first stage of the estimation[xiv] shows that the number of Catholic churches is a good instrument for the number of voucher schools, revealing a positive and significant relationship between the two variables. Using the rule of thumb of having a joint significance (F-test) in the first stage above 10, it is possible to suggest that it is a good instrument[xv].

The second stage IV estimation includes bootstrapped standard errors, because of the use of the predicted voucher competition index.[xvi] The results in column a show that the statistically significant negative coefficient on the voucher school competition variable remains, and indeed is larger in absolute value compared to the OLS specification in Table 1. Having ruled out reverse causality and endogenous variation in the extent of voucher school competition, through the use of IV, it therefore still seems to be the case that a random, exogenous increase in the number of voucher schools is *negatively* related to performance in other local schools. The positive and statistically significant effect of competition from other public schools also still remains, after the quantity of voucher school is instrumented.

Column b introduces interaction terms between the competition variables and the type of school being considered. The coefficients on both of these interaction variables are small and highly insignificant. There is therefore no difference between public and voucher schools in how they react to competition from other schools – in both types of school, performance goes up in response to more competition from public schools, and down in response to more competition from voucher schools.

Column c adopts an alternative method of controlling for any unobserved heterogeneity of local areas that might have influenced location of voucher schools, with the introduction of region fixed effects. The resulting coefficients for the competition variables are very similar to those estimated without Fixed Effects as observed in column a of Table 1. Similarly there is little difference in results between OLS and Fixed Effects results when including interaction terms between the competition variables and type of school (comparing column c of Table 1 to column d of Table 2).

In summary then, it does not appear as though the original results for the competition variables, and in particular the apparent negative effect of competition from local voucher

schools on a school's academic performance, are due to endogenous location choices of voucher reflecting characteristics of the local areas.

6. Conclusions

The principal finding of this paper is that increased competition from the presence of more voucher schools in a local area is not associated with improved performance at other schools in the area, in terms of their pupils' test scores. Indeed, the association is negative, suggesting average test scores fall in schools which face an increase in competition from voucher schools. On the other hand, an increase in the number of public schools in an area is associated with higher test scores in other schools in that area, so that beneficial competition effects are observed in such cases.

Thus there do not appear to be any efficiency gains from introducing new private voucher schools, in terms of performance at other schools. Indeed, such performance in other, public, schools, appears to fall. What could be the explanation for such a finding? One possible explanation is that the observed effect is not a causal one, but rather simply reflects endogenous location choices of voucher schools, which may be set up in areas selected on the basis of unobserved characteristics that also influence public school performance. The negative correlation may also be due to reverse causality, with voucher schools established in certain areas *because* of the low performance in public schools. When we allow for such endogeneity, however, trying both an IV and a Fixed Effects specification, then the results are unaltered qualitatively, with a statistically significant negative coefficient on voucher school competition still observed.

Having ruled out reverse causality and area unobserved heterogeneity stories, another possible explanation that remains is a sorting one, whereby better pupils leave public schools

to join voucher schools, therefore reducing average performance in public schools. We cannot offer proof that this is the causal mechanism behind our main result, since we do not observe transitions of pupils between schools, but we can offer some findings that are consistent with such an interpretation. First, if voucher schools are attracting higher attaining pupils from public schools, then we would expect to see that academic performance is higher on average in voucher schools. This is indeed what we observe, with the full regression results in Table C.1 in Appendix C showing that pupils in voucher schools score on average almost 14 points higher, after controlling for all the other determinants of performance.

Second, if there are sorting effects such that some families are tempted to move their children to voucher schools as they become available, then we might expect that it is middle class parents who take advantage of such opportunities, given they are more likely to have the financial resources to pay relocation or travel costs as well as any additional fees required by voucher schools. Poorer families will not have such financial resources, while the richest families mostly send their children to private schools and are not influenced by voucher school availability. If the reason for the negative effects of voucher school competition are sorting effects, we might therefore expect to see larger such negative effects in schools with more middle class families. Again, this is exactly what we observe, which we investigated in two ways. First, the sample was divided into five according to the average socioeconomic status of families that attend each school, as given by the Ministry of Education and using the conglomerate technique,[xvii] using information on the education and monthly income of each household, and the vulnerability index of pupils. When the analysis was undertaken separately for each such socio-economic band (bands A to E, with A being the poorest) then the effect of competition from voucher schools is largest amongst the middle group, band C, with this being the only socio-economic band where the effect is statistically significant. Second, we ran a quantile regression, the results of which showed the negative effect of

competition from voucher schools to be statistically significant only in the middle of the conditional distribution (statistically significant at the median quantile but at neither the upper nor lower quantile).

Hsieh and Urquiola (2006), in attempting to explain the absence of competition effects from increased numbers of voucher schools in their area-level study discussed earlier, also came to the same conclusion that sorting effects are the likely explanation, after showing that the socio-economic status of public school pupils declined more in those areas where the number of voucher schools increased most. As stated above, such results as ours above and those of Hsieh and Urquiola (2006) do not prove that sorting is the causal mechanism, but they are consistent with a sorting story, and at least suggest that the sorting effect is worthy of further research, if suitable longitudinal data at the pupil can be sourced.

In conclusion, the main finding of this research is that there is no evidence that voucher schools have produced positive competition effects on other schools in Chile, thus leaving doubts about whether or not a privatised market of education achieves all of its objectives. This is especially so considering that the benefits of competition could be enjoyed by implementing school choice without the need for implementing a strongly privatised educational system, such as the Chilean one. These results could be taken as an alert for other nations that want to implement similar educational reforms. Great care needs to be exercised when creating new voucher schools, to limit the impact of sorting effects, and the consequent increased inequality in educational outcomes.

This does not mean that creating competition between *public* schools has no effect, however, and our results suggest that higher numbers of *public* schools in an area is associated with improved performance in schools in that area. Thus competition can lead to efficiency gains, within a purely public-provided system.

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Tables

Table 1: Competition Index Regressions – OLS Regression Results

	a:OLS Quantity 3km	**b:OLS Quality 3km**	**c:OLS Quantity 3km intera'ns**	**d:OLS Quantity 2km**	**e:OLS Quantity 4km**	**f: OLS Quantity 2km SNED**
Competition from public schools	1.598**	0.203	1.450**	2.705**	1.024**	1.576**
	(0.625)	(0.387)	(0.610)	(1.216)	(0.460	(0.638)
Competition from voucher schools	-0.763**	-0.063	-0.761**	-1.290**	-0.485*	-0.845**
	(0.377)	(0.334)	(0.376)	(0.646)	(0.272)	(0.379)
Competition from public schools * Voucher school			0.284*			
			(0.149)			
Competition from voucher schools * Voucher school			-0.039			
			(0.045)			
Number of observations	2,909	1,755	2,909	2,909	2,909	2,909
R^2	0.659	0.659	0.659	0.659	0.658	0.660

Notes: *** p<0.01, ** p<0.05, * p<0.1

Standard errors in parentheses, adjusted for clustering by municipality.

Column titles report whether competition variables measures the quantity of competing schools or their quality, as well as the distance around each school within which competition is measured.

Table 2: Competition Index Regressions – IV and Fixed Effects Regression Results

	a:IV	b:IV (Interact)	c:Region Fixed Effects	d:Region Fixed Effects (Interact)
Competition from public schools	3.092**	3.024*	1.129**	1.015*
	(1.449)	(1.556)	(0.550)	(0.534)
Competition from voucher schools	-1.646*	-1.649*	-0.479*	-0.482*
	(0.916)	(0.951)	(0.257)	(0.253)
Competition from public schools *		0.328		0.252*
Voucher school		(0.260)		(0.144)
Competition from voucher schools		-0.086		-0.035
* Voucher school		(0.171)		(0.046)
Number of observations	2,578	2,578	2,887	2,887
R^2	0.651	0.651	0.664	0.665

Notes: *** p<0.01, ** p<0.05, * p<0.1

Standard errors in parentheses, adjusted for clustering by municipality.

Appendix A

Table A.1: Data Sets, Variables and Years Included

Source	Variables	Years
SIMCE 2009, Ministry of Education http://www.simce.cl/	Average academic test performance (SIMCE) by school	2009
	Average income of parents in schools	2009
	Educational level of father by school	2009
	Educational level of mother by school	2009
	Average income of households by school	2009
	Socio-economic level of school	2009
	Type of school	2009
SIMCE 2005, Ministry of Education http://www.mineduc.cl/	Average Academic Test Performance (SIMCE) by School	2005
Schools Directory, Ministry of Education http://www.mineduc.cl/	Number of pupils by school	2009

Enrolment, Ministry of Education http://www.mineduc.cl/	Number of teachers by school	2009
	Teachers' working hours by school	2009
	Gender of pupils by school	2009
Vulnerability Index, Ministry of Education http://www.mineduc.cl/	Vulnerability index of schools	2009
	Pupils' socioeconomic groups	2009
Voucher Registration, Ministry of Education http://www.mineduc.cl/	Type of voucher school (fee or free)	2009
Vulnerable Children, Ministry of Education http://www.mineduc.cl/	Number of vulnerable children by school	2009
School Geographic Location, Ministry of Education, Chilean Government http://www.mineduc.cl/	(X,Y) coordinates of school	2009

CASEN 2006, Ministry of Development and Planning http://www.ministeriodesarrollosocial.gob.cl	Poverty level by municipality	2006
Municipality Indicators, Ministry of Housing and Urbanism http://www.observatoriourbano.cl/ indurb/seleccion.asp	Perception close to public transportation by municipality	2010
	Perception of traffic jam level by municipality	2010
	Books per capita by municipality	2001
	Illiteracy level by municipality	2006
	Water coverage by municipality	2006
	Electricity coverage by municipality	2006
	Average schooling population by municipality	2006
Municipality Information, SINIM: Municipality Information National System http://www.sinim.gov.cl/	Education spending per capita by municipality	2006

Human Development Index by Municipality, UNDP & Ministry of Development http://www.desarrollohumano.cl/	Human development index by municipality	2003
Census 2002, National Estadistics Institute) http://www.ine.cl/	Number of indigenous people by municipality	2002
	Number of Catholic people by municipality	2002
	Population Density by municipality	2002
	Population total of 5 to 14 years olds by municipality	2002

Appendix B: Table B.1: Descriptive Statistics

Variable	Obs	Mean	Std dev	Min	Max
Language score in 2009 by school	4,457	243.80	23.71	154	329
Maths score in 2009 by school	4,457	248.95	25.64	180	340
Language score in 2005 by school	4,386	249.59	25.28	150	329
Maths score in 2005 by school	4,382	240.84	27.01	150	326
Average SIMCE score in 2009 by school	4,457	246.37	23.82	175	334
Average SIMCE score in 2005 by school	4,380	245.23	25.64	150	325
% + perception of public transport by munic.	3125	85.10	7.54	43.20	99.00
Weekly hours of teachers / pupil by school	4,457	1.73	0.70	0.31	7
% fathers with university degree by school	4,355	4.95	9.17	0	100
% mothers with university degree by school	4,355	4.04	7.69	0	100
Average income of parents by school	4,355	283,954	189,536	50,000	1,631,429
Fee by school	4,457	5,178	11,742	0	76,402
Density (5 to 14 years old) per km^2 by munic.	4,457	3,340	6,075	0	29,654
Total population by municipality	4,457	121,110	115,789	507	492,915
Population (5 to 14 years old) by municipality	4,473	21,749	21,777	8	102,760
% poverty by municipality	4,455	14.79	6.69	0.60	51
% Indigenous by municipality	4,457	5.49	9.43	0.18	78
% Illiteracy by municipality	4,058	4.19	2.92	0.30	14.09
Av. schooling population by munic. (years)	4,016	8.34	1.46	5.57	14
Ed spending/capita (000s of Pesos) by munic.	4,415	74.21	37.93	9.39	297.84
Number of churches by municipality	3,529	7.08	6.06	1.00	28.00
% Catholics by municipality	4,457	70.71	9.53	23.04	96

Appendix C: Table C.1: Competition Index Regressions – Full Regression Results

	OLS
Competition from public schools	**1.598 (0.625) ****
Competition from voucher schools	**-0.763 (0.377)****
Perception transport coverage * Competition from public schools	-0.018 (0.007)**
Perception transport coverage* Competition from voucher schools	0.008 (0.004)*
Voucher School	13.903 (2.014)***
Average test scores in 2005	0.559 (0.017)***
Voucher * aver. hours per pupil	-5.455 (1.119)***
Average hours per pupil	0.460 (0.712)
% fathers with university degree	0.228 (0.089)**
% mothers with university degree	0.240 (0.100)**
Average income of parents	0.451 (0.517)
Boys school	9.320 (2.328)***
Girls school	9.604 (1.287)***
Fee	0.043 (0.068)
Density 5-14 year olds per km^2 †	-1.158 (6.071)
% Poverty †	-0.013 (0.072)
% Indigenous †	-0.040 (0.060)
Books per capita 2001 †	0.222 (0.096)**
% Illiterate 2006 †	0.869 (0.253)***
Av. years of schooling in pop †	-0.022 (0.243)
Education spending per capita †	-6.894 (19.103)
Constant	99.609 (4.532)***
Number of observations	2,909
R^2	0.659

Notes: *** p<0.01, ** p<0.05, * p<0.1

Standard errors in parentheses, adjusted for clustering by municipality.

All variables measured at the school level except those indicated by †, which are measured at the municipality level.

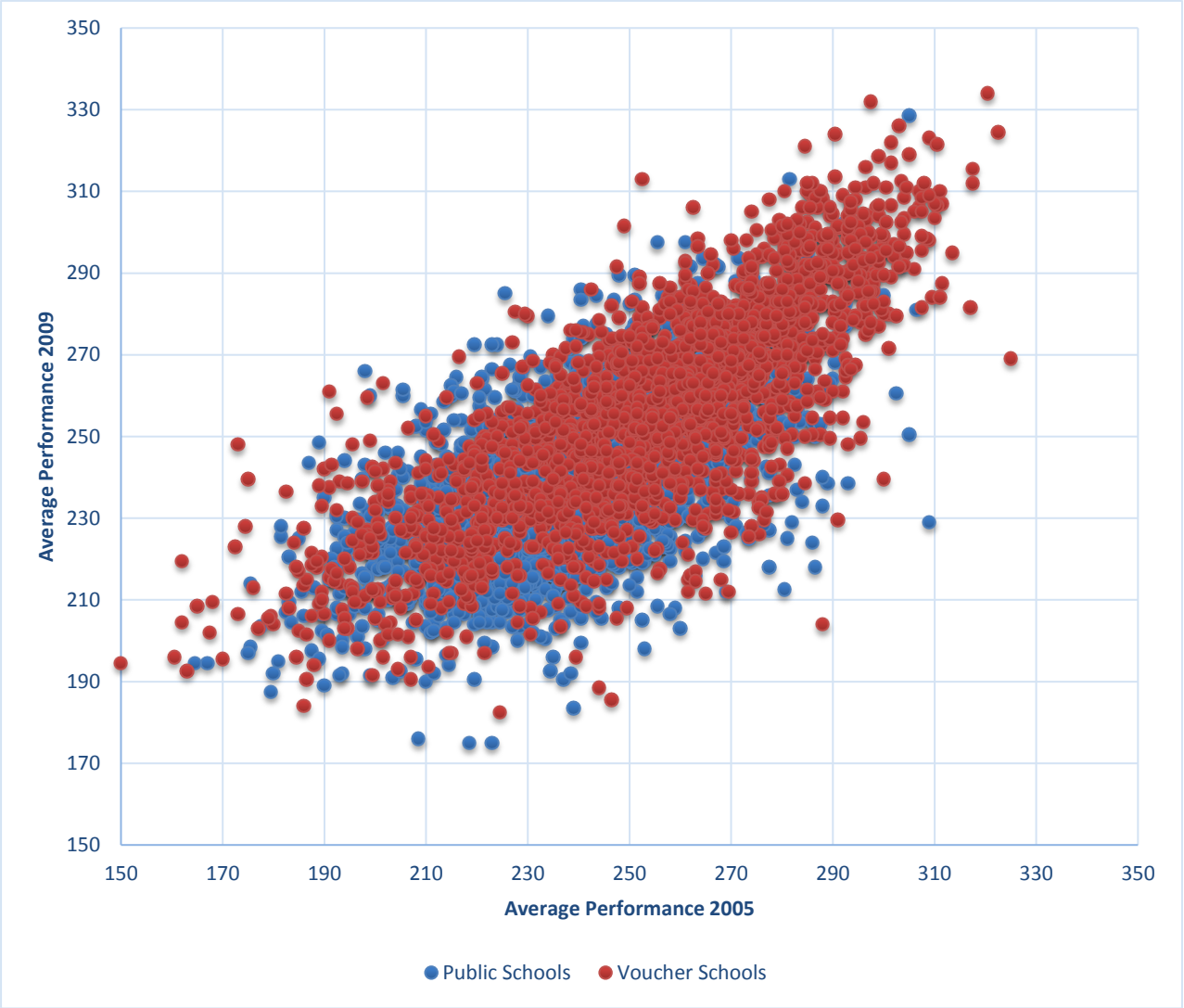
Appendix D: Table D.1: First Stage Estimation (IV). Dependent Variable: Competition from Voucher Schools

	Coef (se)
Number of Catholic Churches †	0.256 (0.109)**
Competition from public schools	1.012 (0.153)***
Average test scores in 2005	0.030 (0.010)***
Average hours per pupil	-0.546 (0.513)
Voucher school	0.698 (1.589)
Voucher * average hours per pupil	-0.637 (0.639)
% Fathers with university degree	-0.070 (0.062)
%_Mothers with university degree	0.019 (0.035)
Average income of parents	-0.308 (0.333)
Boys school	1.000 (1.620)
Girls school	0.977 (1.261)
Fee	-0.002 (0.029)
Density 5-14 year olds per km^2 †	47.062 (11.636)***
% Poverty †	-0.134 (0.093)
% Indigenous †	-0.000 (0.094)
Education spending per capita †	-77.556 (21.491)***
Books per capita 2001 †	0.169 (0.149)
% Illiterate 2006 †	-0.386 (0.188)**
Average years of schooling in pop †	0.004 (0.391)
Constant	6.690 (3.818)*
Number of observations	3,092
R^2	0.586

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses, adjusted for clustering by municipality. All variables measured at the school level except those indicated by †, which are measured at the municipality level.

Figures

Figure 1: Average Pupil Performance in 2005 and 2009 by School (Mathematics & Language)



[i] Public schools were also allowed to top up their public funding but only at the level of secondary education.
[ii] Although scores on the PISA test have been improving since the early 2000s, Chile still scores the lowest of all 35 OECD countries, with the exception of Mexico and Turkey (OECD, 2015).
[iii] In more recent years, English and physical education have also been added.
[iv] For this research, private schools are dropped from the analysis, since they were never part of the voucher reform and tuition is fully paid by families, with almost no control from the government.

[v] Alternatives to using such an output measure (pupil performance) as an indicator of quality of education provision, are input measures such as class size, expenditures, or measures of teachers' skills (Hanushek, 1986). We prefer to use the output measure as capturing the effects of all inputs, rather than focus on a specific input.
[vi] The distance was selected using the average distance that pupils travel from their residence to their school presented by Chumancero, *et al*. (2009).
[vii] Information on which schools received a SNED premium is available at:
http://datos.mineduc.cl/dataviews/235866/VISTA-SNED-2004-2005/
[viii] The proportion of voucher schools within regions with catholic links varies in 2016 between around 30% and 50%, with an average value across regions. Source: Ministry of Education (2017).
[ix] http://www.tourismchile.com/themes/churches_of_chile/articles/638
http://www.chilecontact.com/en/sugerencia/churchesChapels.php
[x]http://www.cncr.cl/611/articles-50335_archivo_6.pdf
[xi] Any level of improvement has been considered.
[xii] For example, the Metropolitan Region public transportation service has experienced a thorough modernisation and expansion in its coverage, since the 'TranSantiago' plan was first implemented in 2005. However, massive chaos was faced by commuters and the new system was largely rejected by popular opinion.
[xiii] The same is observed when the SNED variables are entered separately. Note that the school level SNED indicator attracts a positive and significant coefficient, while the variable measuring the proportion of schools in the municipality in receipt of SNED has an insignificant effect.
[xiv] See Table D.1 in Appendix D.
[xv] F(19,148)=36.21, Prob>F=0.000
[xvi] The first stage was estimated manually because the instrumented competition variable was interacted with other variables in the second stage regression (column b). Without using bootstrapping (300 iterations) the standard errors in the second stage would be wrong (Wooldridge, 2002).
[xvii] In this way, a school's characteristics within the same group are similar and different to a school's characteristics in other groups.