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Parent behavior and yardstick competition: Evidence from Chile's national voucher program

(draft)

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Abstract

This paper develops a model of school behavior in a competitive marketplace, where parents choose whether or not to remain in their current school or change schools, using local schools to evaluate the performance of their child's school. Parents are assumed to make comparisons between schools to overcome asymmetric information. This forces schools into a "yardstick competition" in which they care about what other local schools are doing. I provide a theoretical framework and empirical evidence using a unique panel georeferenced data set I've constructed to examine the extensive and long running system of school choice in Chile. The results are encouraging to the view that the level of quality a school chooses affects its chances of maintaining and increasing enrollments. The findings also suggest that school behavior can be affected by parents using neighboring schools as a benchmark. While differential behavior is also found across private voucher school types (for-profit and non-profit) and across socioeconomic groups, the differences do not always comport with theory.

El presente artículo desarrolla un modelo de comportamiento escolar en el contexto de un mercado competitivo, donde los padres eligen quedarse o cambiar de colegio usando las escuelas vecinas como referencia para evaluar el desempeño del colegio de sus hijos. El modelo supone que los padres comparan colegios para superar la asimetría de información. Esto llevaría a las escuelas a participar de una "competencia yardstick", en la cual considerarían el comportamiento de los colegios vecinos. El artículo propone un marco teórico y presenta evidencia empírica de una base de datos panel de colegios georreferenciados, construida con el propósito de examinar el largo camino recorrido por el sistema de elección escolar en Chile. Los resultados indican que el nivel de calidad de una escuela efectivamente incide en las decisiones de los padres y afecta la probabilidad de que el colegio mantenga o aumente su matrícula. Asimismo, los hallazgos sugieren que el comportamiento de las escuelas se ve influido por las comparaciones que realizan los padres con escuelas vecinas. Si bien encontramos diferencias de comportamiento entre distintos tipos de colegios subvencionados (con y sin fines de lucro) y entre distintos grupos socioeconómicos, estas diferencias no siempre son consistentes con la teoría.

1 Introduction

Fundamental to the push for educational vouchers is the idea that choice unleashes competitive pressure on schools that makes them deliver higher quality schooling at a lower cost (Barrow and Rouse, 2008). Friedman (1962) argues that the public school system is a monopoly in which schools are guaranteed students no matter how well they perform. The result is that they have few incentives to produce high quality education, to respond to parents, and to allocate their funds efficiently. He argues that allowing private schools to compete for tax dollars would bring new schools into the neighborhood that offered better education for the same price as public schools.

Chubb and Moe (1990) developed a theory of educational governance to help explain how politics affects the organization and efficiency of schools. They argue that given the way incentives are structured in politics, the top-down forms of control tend to bury schools in bureaucracy and erode efficiency. Chubb and Moe (1990) maintain that the problem of overregulation has been especially burdensome in education because the regulators continually change the rules and this leads to large amounts of cumbersome paperwork, limits autonomy of principals and teachers, and stifles innovation and creativity. They argue that the only way to get improvement and innovation is to shift from top-down control of schools to a market based education system of vouchers where schools compete for students.

Voucher skeptics have identified both demand side and supply side critiques of school choice and competition. On the demand side, they are concerned about whether families, especially low-income parents, have the time, ability and resources to choose the best schools for their children (Smith and Meier, 1995; Henig, 1994; Carnegie Foundation, 1992). On the supply side, critics have raised concerns about the effect of competition and parental choice on the schools themselves. For instance, some skeptics argue that faced with competitive pressure in an industry that provides complex services to poorly informed parents, schools will have incentives to economize on quality (Levin, 2002) and undertake "glitzy" reforms that have nothing to do with actual

educational performance (Lubienski, 2005).[1] A number of formal models in the literature have demonstrated that school quality declines when competition increases. For instance, McMillan (2005) develops a theoretical model that predicts that schools will respond to the competitive pressures of vouchers by reducing effort and lowering school quality (also see Epple and Romano, 1998; and Nechyba, 2000).

While the arguments put forth by both choice advocates and skeptics suggest that schools will respond to competitive pressures either by providing higher quality schooling at a lower cost or lower quality education that parents cannot easily observe, the consequence of their actions may vary across local schooling markets. For instance, if parents are skeptical about declining test scores, even a small decrease may trigger them to change schools. However, if performance is low in most schools in the neighborhood, parents may be less concerned about test scores and they may focus on other indicators when evaluating the relative performance of their children's school. In a market in which parents make comparisons between neighborhood schools, schools may examine their local competitor's quality before making policy choices that may affect parental decisions. This would give rise to a yardstick competition between schools, each school paying attention to what the other local schools are doing.

Over the last decade, scholars have developed a substantial body of empirical literature that analyzes the demand side of school choice - how parents gather and use information about schools[2] and the supply side - whether or not greater competition is associated with higher student achievement[3] and spurs schools to innovate in pro-

[1] In Chile, the adoption of English names for schools is an example of the latter tendency (Espinola, 1993).

[2] Most empirical research confirms skeptic's concerns. Parents have scant information about the schools their children attend (Schneider et al., 1998), they are more likely to choose schools based on the class or racial composition of the student body than on objective academic performance (Elacqua et al., 2006; Buckley and Schneider, 2002), and access to high quality information about schools is stratified by social class (Lareau, 2003). However, recent experimental research finds that targeted policies aimed to disseminate quality information to low-income parents can improve the effectiveness of parental decision making (Hastings et al., 2007)

[3] The empirical evidence on the effects of greater school competition on efficiency is mixed. Hoxby (2000) assessed the impact of competition by comparing what happens in metropolitan areas in which there is a lot of competition among school districts to those in which there is only a little. She found a clear relationship between competition and schooling outcomes. However, after replicating Hoxby's

ductive ways,[4] but research and evidence about the interplay between the supply and the demand side of school choice is considerably more limited. There has been little systematic analysis of how parents and schools themselves respond to the competitive pressures in their local educational markets.[5] Yet, when considering school choice policies and programs, this issue is crucial to understanding if and how educational markets work. How schools actually respond to their local competitive marketplace created by parental choice will greatly affect the future and success of educational reforms.

In this paper I will present a simple theoretical model of school competition, where parents choose whether or not to remain in their current school or change schools, using local schools to evaluate the performance of their child's school. The structure of the theoretical model is very similar to that of Besley and Case (1995), which models incumbent governor and voter behavior in the United States. I will assume that there is asymmetric information between parents and schools; schools are assumed to know more about the cost of providing quality schooling than parents. Schools differ in their type. "Good" schools provide quality schooling at cost, while "bad" ones offer low quality schooling. Parents must attempt to tell the difference between the two school types. Consistent with the literature on firm and incumbent behavior (Schleifer, 1985; Besley and Case, 1995), I will show that, in competitive schooling markets, it makes sense for parents to evaluate their school's relative performance. In particular,

(2000) analysis, Rothstein (2007) concluded that her findings are not robust to small alterations of the sample, or to the instrumental variables used (streams). In a review of the studies of competition from private schools, Belfield and Levin (2002) find that over half of the 92 estimates in the literature are not statistically significant and any positive impacts of competition are either substantively small or subject to question based on subsequent studies. They also report that some of the estimates are negative. The evidence on whether greater competition is associated with higher student achievement is also mixed in Chile. See, for example, Hsieh and Urquiola (2006) and Gallego (2005).

[4] A small body of literature has examined whether or not schools respond to competitive pressures by adopting policies that improve student performance. For example, Teske et al. (2000) and Hess (2002) find that public school administrators respond to charter school competition by making changes designed to produce more effective services. In a recent empirical analysis of Florida's accountability system, Rouse et al. (2008) find that competition and accountability pressures induce school principals to change their behavior in educationally beneficial ways.

[5] Hanushek et al. (2007) investigate the effects of school quality on the parental decision to exit a school in districts with public and charter school choice and Bayer and McMillan (2005) examine whether or not increases in the competitiveness of a schools local education market leads to an increase in school performance. However, they do not consider the possibility of yardstick competition.

if a school provides lower quality education relative to its local competitors, parents interpret this as evidence that their school is "bad" and change schools the following year. Thus, we have a kind of yardstick competition, put forth by Schleifer (1985) and others, in which firms and consumers use the performance of local competitors as a benchmark. I will extend this theoretical framework to develop an empirical foundation for the model that I will implement with a highly-detailed unique data set I've constructed to analyze Chile's long standing national voucher program.

The remainder of this paper is organized as follows. Section I describes the system of school choice in Chile which provides the institutional milieu in which this topic will be studied. Section II sets out the model. Section III provides an empirical foundation to the model. Section IV concludes.

2 Background on Chile

During the 1980s, the military government enacted a sweeping education reform program (1973-1990). First, the Ministry of Education decentralized education service delivery to regional and provincial offices and the administration of public schools to municipal governments, whose maximum authority is an elected mayor. Second, the government altered the financing scheme of public and most private schools. Municipalities and private school owners that did not charge tuition started to receive vouchers on a per-student basis.[6] As a result, enrollment gains or losses began to have an impact on their budgets. Fee-charging private schools continued to operate without public funding.

The provision of education in Chile has become increasingly privatized since the voucher reforms were instituted. In 1981, 15 percent of Chilean K-12 students attended private schools that received some public subsidies, and another 7 percent attended more elite, fee-charging private schools. By 1990, 31 percent of students

[6]Chile's voucher formula includes adjustments for rural schools and high schools, but until very recently did not take into account student socioeconomic characteristics or the existence of a high concentration of poor students in public schools.

attended private voucher schools. By 2007, enrollment in such schools had reached 45 percent of total enrollment. Adding in the 7 percent of students in elite private non-voucher schools, leaves more than half of Chilean primary and secondary students in private schools (see Figure 1). In the more densely populated areas, particularly in the Metropolitan Region (R.M.), total private school enrollment (voucher and non-voucher) is much higher, closer to 70 percent.

Figure 1 Here

Private voucher schools are both religious (mostly Catholic) and secular. The latter, mostly for-profit, account for 24 percent of schools and 26 percent of enrollments (table 1).[7] For-profit schools also accounted for most of the substantial growth of the private enrollment share after 1990 (table 2). Non-profit voucher schools account for about 9 percent of schools and close to 15 percent of enrollments (table 1).[8]

Table 1 Here

Table 2 Here

Finally, it is worth noting that the essential features of the decentralized voucher system enacted by the military government have remained in place for 28 years. Since the return of democracy in Chile in 1990, the center-left coalition in power has chosen to focus on improving the quality and equity of schools through increased investment in targeted programs, teachers' salaries, textbooks, and longer school days, while maintaining the organizational and funding components introduced in the eighties by the dictatorship (Cox, 2003). They also introduced a teacher labor law (*el Estatuto Docente*) that established centralized bargaining, a single pay structure of wages, and made it virtually impossible to fire a public school teacher who is not performing adequately (OECD, 2004). The only significant change, which is important for this study, was in 1994, the Ministry instituted a shared financing scheme that allowed all private

[7]For-profit schools are owned and managed by individual entrepreneurs and shareholders. Many of the individual entrepreneurs are former public school teachers who were expelled by the military government (Elacqua, 2009b).

[8]Non-profit schools are owned and managed by religious congregations and non-sectarian foundations. Over two-thirds of non-profit schools are run by the Catholic Church (Elacqua, 2009b).

voucher to charge limited tuition (Montt et al., 2006).[9] The "shared financing" law in Chile allows private voucher schools to charge fees that can be up to 1.6 times the voucher payment. The voucher is discounted on a sliding scale based on the amount of fees that a school charges.

3 The Model

The theoretical model has four underlying assumptions about parent behavior and incentives for schools to raise the quality of schooling.

Assumption 1: There is asymmetric information between parents and schools about school quality. More specifically, schools are better informed than parents about the mix of schooling inputs that are required to produce a quality education.[10] This is consistent with the school choice literature in the United States (Schneider et al., 2000).

[9] In 2007, Congress passed a law that differentiated the voucher by the students socioeconomic status and introduced some measures of accountability in the schooling system (Elacqua et al., 2009). The Preferential Subsidy Law (Ley SEP) was instituted in 2008 and thus its impact on parent and school behavior will not be considered in my analysis.

[10] I assume that schools aim to produce higher quality schooling which is defined by outcomes on standardized tests and other indicators that may serve as proxies for quality.

Assumption 2: Voting with their feet (re-enrolling or exiting the school) is the primary mechanism used by parents to hold schools accountable.[11] The literature on educational vouchers and accountability allows for other mechanisms by which school owners can be disciplined, such as firing the principal or shutting down the school (Rouse et al., 2008; Hanushek and Raymond, 2001). These alternative schemes likely affect the incentives and behavior of school owners. However, parents usually do not have a say over these mechanisms.

Assumption 3: Parents have the information to evaluate their school's relative performance. I assume that parents can gain access to information about the quality of neighboring schools, which serves as a benchmark for evaluating their children's school. This is a fairly strong assumption, particularly in an empirical context. The empirical literature suggests that parents have scant information about their children's schools (Schneider et al., 1998), though this is likely changing as more detailed information becomes available to parents (Hastings et al., 2007).

Assumption 4: There will be an elastic supply of schools. I assume that unproductive schools will be forced to close. I also assume that schools can expand schooling operations in response to greater parental demand. While research suggests that the supply of new private schools is somewhat elastic (Brasington, 2000), the optimal size and scale of operations of schools is a hotly debated issue in educational policy reform discussions.[12]

For ease of exposition, I will use the most straightforward case: for-profit voucher schools.[13] Such a case is very typical in Chile and might become a common model if

[11] I also assume that changing schools is a relatively low cost endeavor for parents. This is a strong assumption in light of the empirical literature that examines the costs of changing schools. For instance, Hanushek and Raymond (2001) find that changing schools entails a substantial cost both for movers and non-movers alike. The negative impact is substantial for lower income and minority students who typically attend much higher turnover schools.

[12] One view is that increasing the size of schooling operations would lower per-pupil costs and free up resources for use at the school and classroom level (Chubb, 2001). However, skeptics have argued that it is unlikely that a private school will be able to expand enrollments into a large-scale educational corporation without sharply increasing unit costs (Levin, 2002; Steifel et al., 2000).

[13] As some scholars have noted, the key difference between a for-profit and non-profit organization

educational vouchers are widely enacted in other countries.

Consider that there are two for-profit voucher schools, labeled A and B, whose owners provide one unit of an educational service each for a given quality, financed entirely by a flat per-pupil voucher.[14] Each school is assigned the same number of students in period one. For simplicity, parents are also assumed to have unfettered choice in period two after being assigned their initial school. I also assume that schools must accept applicants on a random basis. They receive the voucher for each student enrolled.

For now, I will assume that schools do not know each other's type and that parents do not have access to information about school quality in both schools. They only have information about their child's school.

Schools are assumed to aim to maximize enrollments in order to increase profits. Parents are assumed to prefer the school that offers the highest quality (Q). Thus, when a school sets its quality, it keeps in mind that producing the type of schooling that parents demand often implies, on the one hand, more students enrolling and greater revenues, but, on the other hand, it often entails higher costs associated with higher quality.

The cost of providing a quality education is θ_i, which is stochastic and observed only by the school owners. The shock θ_i can take on one of three values: low, medium or high (denoted L, M, H), which are evenly spaced. I will assume that the distance between θ_i and θ_{i-1} is χ. The probabilities of the three outcomes are: (p_L, p_M, p_H).

is the distribution of surplus (e.g. Glaeser and Schleifer, 2001). While for profit schools distribute profits to its school owners, non-profits cannot pay them in a straightforward way to anyone. However, they can use surpluses to improve working conditions for teachers and pursue the schools mission (e.g. bilingual instruction). Given that the nature of the surplus is less efficient than cash, non-profits have less incentive to expand simply to increase the size of the surplus (Hoxby, 2003). In other words, the problem facing a non-profit school owner is unlikely to maximize profit.

[14] It is assumed here that parents are not allowed to "top up" the voucher with extra tuition payments from their own funds. I will relax this assumption below.

The schools can offer lower quality education of either χ or 2χ, giving a rank - from highest to lowest - of five possible levels of school quality,[15] denoted by

$$(Q_1, Q_2, Q_3, Q_4, Q_5) \equiv (\theta_L, \theta_M, \theta_H, \theta_H + \chi, \theta_H + 2\chi)$$

It is assumed that schools can provide low quality schooling that does not benefit parents and students. I will, however, assume that there are some limits on low school quality. This may be due to government's monitoring of school quality (i.e. reporting test scores) and regulations on schooling inputs (i.e. legal maximum class sizes, teacher certification standards, etc.).

Each for-profit voucher school is run by a school owner.[16] There are two kinds of school owners: "good" or "bad" (denoted G and B). The former provide the quality of schooling at cost, while the latter are either inefficient and/or provide lower quality schooling than the cost of the vouchers they receive. Therefore, the "bad" school owner provides either $+\chi$ or $+2\chi$ lower quality schooling than the cost of educational services. School owners' pure strategies are denoted $Q(\theta_i, j)$ ($i \in (L, M, H)$; $j \in (G, B)$). "Good" school owners (G) always behave in the following manner: $Q(\theta_L, G) = Q_1$; $Q(\theta_M, G) = Q_2$; $Q(\theta_H, G) = Q_3$.

The model has two time periods and the parents' and school owners' discount rates are δ, which satisfy $\frac{1}{2} < \delta < 1$. This guarantees that a school owner is willing to give up the additional profits she would receive by lowering quality by χ in order not to lose students in period two. The school parents are assigned to in period one has a "good" school owner with probability η. After observing quality by the period one school owner, parents decide whether or not to re-enroll their child in period two, bearing in mind that the probability that the second school owner is "good" is also η. For now, as mentioned above, I will assume that parents have no information about the

[15] Q_1 is the highest rank and Q_5 is the lowest rank.

[16] For-profit voucher school owners can be thought of as either private owners or shareholders.

second school's first period quality and that if they decide not to re-enroll their child in the current school, they must choose the second school, which is also "good"with probability η. I will relax this assumption below.

I assume that parents care about maximizing their period 2 school quality, and use period one school quality to update their beliefs (Bayes' rule) that the school owner is "good". Parents' pure strategies are denoted $\nu(Q_i) \in [0,1]$ $(i \in 1,2,3,4,5)$, which represents the probability that they will re-enroll their child in a school that sets its period one quality of Q_i. If a "bad" school does not lose students (or increases period one enrollment), school owners are not disciplined by parents in period-two and therefore set quality equal to $\theta_i + 2\chi(i \in (L, M, H))$. "Good" school owners provide the quality of education at cost in period 2.

I find perfect Bayesian equilibria in this school quality choice game.[17] First, nature selects a school owner type (G, B) and a cost of providing school quality shock $(\theta_L, \theta_M, \theta_H)$. "Bad" school owners then set their quality to maximize their profits. Parents observe their school's quality and update their beliefs using Bayes' rule. Their choice of whether or not to re-enroll their child in the school or to change schools is based on maximizing expected period two school quality.

Parents will always believe that a school owner who sets Q_4 or Q_5 is "bad" with probability one therefore $\nu(Q_4) = \nu(Q_5) = 0$. Given $\delta < 1$, there also cannot be an equilibrium where $Q(\theta_L, B) = Q_1$, $Q(\theta_M, B) = Q_2$, $Q(\theta_H, B) = Q_3$, therefore $\nu(Q_1) = 1$.

Thus, if $p_H \geq \frac{1}{2}$, then the following is an equilibrium:

(1) "Good" school owners provide $Q(\theta_L, G) = Q_1$, $Q(\theta_M, G) = Q_2$, $Q(\theta_H, G) = Q_3$;

(2) "Bad" school owners provide $Q(\theta_L, B) = Q_3$, $Q(\theta_M, B) = Q_3$, $Q(\theta_H, B) = Q_5$;

[17] As I mentioned above, the structure of this theoretical model is similar to Besley and Case (1995)'s model of voter and incumbent behavior.

(3) Parents choose $\nu(Q_1) = 1$, $\nu(Q_2) = 1$, $\nu(Q_3) = 1$, $\nu(Q_4) = 0$, $\nu(Q_5) = 0$.

The "bad" school owner takes a loss in profit when the cost of education shock is θ_M in order to avoid losing students in period 2. She is willing to do this because $\frac{1}{2} < \delta$. In a two period model, parents are willing to re-enroll their child when the school owner provides Q_3, because the probability that the school owner is "good" given a choice of Q_3 is

$$\frac{\eta p_H}{[\eta p_H + (1-\eta)(p_L + p_M)]} \geq \eta$$

if $p_H \geq \frac{1}{2}$. This is important because parents need some assurance that the likelihood that a school owner who chooses Q_3 is "good" is sufficiently high, so they are willing to re-enroll their child in the same school in period two if they see Q_3.

Next, I introduce yardstick competition, by assuming that parents are able to assess a school's relative performance in period 1. Specifically, I assume that parents have access to information about quality in both schools, A and B. Here I assume that the two schools have indistinguishable environments and cost shocks, but parents may be assigned to schools in period one with owners of different types. I assume that school owners know each other's type and that $p_H \geq$ 1-η.

Consider three scenarios of yardstick competition:

(1) Both school owners are "good". I find the same outcome as above. School owners A and B set quality equal to θ_i, $i \in (L, M, H)$.

(2) Both school owners are "bad". The equilibrium described above is a perfect Bayesian equilibrium for the two school owners. The parent in one school now decides to re-enroll her child in the school if she sees Q_3 in both schools if:

$$\frac{\eta^2 p_H}{[\eta^2 p_H + (1-\eta)^2(p_L + p_M)]} > \eta$$

which reduces to $p_H > 1 - \eta$. This condition is different from the one outlined above when parents did not have information about the second school because parents allow for the possibility that both school owners are "good" or "bad" in their updating of beliefs when they see Q_3 in both schools. The condition for this pure strategy is much weaker if $\eta > \frac{1}{2}$ because when parents observe that both schools provide the same level of school quality, it gives them more confidence that both are "good" when the probability that any school owner is "good" is sufficiently high.

Thus, both "bad" school owners have fewer incentives to provide lower quality schooling when the cost of providing educational services shock is θ_M.

(3) One school owner is "good" and the other is "bad". The "bad" school owner knows that his type will be revealed by providing a lower quality education than the other school, and he can know longer provide Q_3 when the educational shock is θ_M as he did before when parents only had information about their child's current school: providing Q_3 will result in parents changing schools in period 2. Recall that the "good" school owner will provide Q_2 when the educational cost shock is θ_M. Therefore the "bad" school owner with shock θ_M will provide Q_4, which implies that period one school quality will be lower overall under yardstick competition. However, since the "bad" school owners' type is revealed after period one, parents will enroll their children in higher quality schools in period two. Therefore, the advantage of yardstick competition is that parents can identify "bad" school owners in period one. The presence of the "good" school owner increases the probability that parents with children enrolled in the school run by the "bad" school owner will change schools and attend higher quality schools in period two. The cost of yardstick competition is that these same parents receive a lower quality education in period one than they did when they were not informed about the other school's quality.

4 Empirical example

The yardstick competition in education model illustrates two important features. First, it suggests that the level of quality a school chooses affects its chance of maintaining and increasing enrollments. Second, it demonstrates that school behavior can be affected by parents using neighboring schools as a benchmark.

In this section, I provide an empirical foundation for the model by presenting an example from Chile's long running national voucher system that demonstrates that school behavior varies in ways predicted by the yardstick competition in education model.

4.1 Empirical strategy

I hypothesize that changes in a school's net enrollment can be modeled as a function of changes in school quality. Changes in school quality are most likely to represent responses to shocks. Shocks can be considered changes in the costs of running a school due, for example, to increased school input expenses, such as teacher salaries, facilities, and other educational technologies. After these events occur, parents must determine whether the change in quality is warranted. I use ΔQ_{it} to denote change in quality in school i at time t and ΔQ_{-it} to denote the change in quality in school i's neighbors at time t. Since parents may take more than a year to react to changes in school quality, I will analyze changes in quality in year t relative to (t-3).[18]

A parent with a child enrolled in school i will decide whether or not to re-enroll in the school if the expected value of future quality increases in the school is greater than, all else equal, that of neighboring schools.

[18] I also consider changes in quality over three years out of convenience. In Chile, students are tested every three years.

The problem facing school owners is to maximize profit (Π) over the choice of enrollment(s) and school quality(Q).

$$\max_{s,Q} \Pi = r(v, Q, s) - c(Q)(s)$$

The problem states that a school maximizes the differences between revenues r (the voucher v times the number of students who enroll s) and costs (per-student costs c times the number of students who enroll s).

I assume that school quality is observed by parents. It is also assumed that per-student costs are increasing in the quality of schooling provided. Given that I also assume that families choose the highest quality school in their neighborhood, enrollment s will increase in quality Q. It is also assumed that a school enrolls all students in a neighborhood if it offers quality that is higher than other local schools. I also assume that the school will share enrollments with similar quality schools.

In these circumstances, the best that a school owner can do is maximize quality Q subject to the constraint that its per-student cost c must not exceed the voucher v. A school must maximize its productivity or a competitor will enroll all students in the neighborhood. If a school's students are attracted away by a competing school that offers higher quality, the school naturally has to increase its quality. I assume that there will be an elastic supply of schools and that productive schools can expand operations. I also assume that unproductive schools will be forced to close.

Formally, I posit that linear models of the following form can explain changes in student enrollment:

$$\Delta s_{it} = \beta_i \Delta Q_{it} + \beta_{-i} \Delta Q_{-it} + \beta_i \Delta Z_{it} + \beta_{-i} \Delta Z_{-it} + \beta_{-i} \Delta s_{-it} + \Delta \epsilon_{it} \tag{1}$$

where (Δs_{it}) is the net rate of enrollment changes of the ith school in year t is a function of changes in school quality (ΔQ_{it}), and quality changes (ΔQ_{-it}) in neighboring schools, changes in other variables that may affect parental decision making (ΔZ_{it}) in the ith school in the year t and changes in these indicators ($\beta_{-i} \Delta Z_{-it}$) in neighboring

schools, a vector of local educational market characteristics ($\beta_{-i}\Delta s_{-it}$) to control for changes in enrollment rates in each school's local market, as well as a disturbance term (ϵ_{it}).

Using the estimates of β, one can predict the increase (or decline) in enrollment rates of a "typical" school associated with changes in school quality, holding the quality of neighboring schools and other factors that may influence parental decisions constant. If the independent variables perfectly account for parental decision making, then the strategy outlined above yields unbiased estimates. More likely is that there are unique attributes of schools that are not the result of random variation but represent fixed, longstanding differences.

For these reasons, a simple pooled OLS is unlikely to give unbiased estimates of the impact of a change in a school's quality (and neighboring schools' quality) on enrollment rates. The availability of panel data allows researchers to estimate unbiased slope coefficients for those variables included in the model. A number of methods have been introduced using panel data that eliminate potential bias brought about by unobservable heterogeneity (Hsiao, 2003). I will use school fixed effects to account for the unobserved school effect prior to estimation.

4.2 Data

The previous model will be estimated with an original school panel dataset (1996-2007) that I have constructed from the administrative records of the Ministry of Education of Chile. This dataset contain highly detailed information on school enrollment, school quality, other factors that influence parental decisionmaking, and local schooling market characteristics in Chile.

Once these data sources were combined into a comprehensive dataset, several additional modifications were made to target the population that I am interested in studying. First, as I mentioned above, because for-profit and non-profit face different incentives, I will analyze school and parental behavior of for-profit and non-profit schools separately. Second, I exclude private non-voucher schools from the analysis

because they enroll students mainly from high income families and therefore, they likely do not compete with public and private voucher schools for students. Third, I only analyze urban schools in the Metropolitan Region of Santiago (R.M.) because this is the region where schools face the most competitive pressures from other schools and parents have the greatest opportunities to choose from a range of neighborhood schools. Schools face few competitors and parents have limited private voucher school options in rural and urban areas outside of the nation's capital. Finally, I only consider elementary schools. High school students are more mobile than elementary school students - over 50 percent of high school students in the R.M. attend schools outside of their home municipality - and, therefore likely consider a wider range of options outside of their neighborhoods when choosing a school. I also exclude high school students so that differential dropout (or early graduation) rates do not confound the results.

The basic measure of parental behavior is change in elementary school enrollment. This is a net measure that reflects the differences between departures and new enrollments. This net measure cannot identify whether exiting students take the form of enrolling in a neighboring school, moving to another market or simply dropping out. Nor can it capture the choice of choosing the original school in the first place. Where s_t and s_{t-3} are enrollments in years t and $t-3$, the change in school enrollment rate is expressed as the exponential rate (g) in equation (2):

$$s_{it} = s_{it-3}e^{gt} \tag{2}$$

Expressed as a percentage, the growth rate between t and $t-3$ is:

$$100g = 100ln\left(\frac{\frac{s_t}{s_{t-3}}}{3}\right) \tag{3}$$

Private voucher schools in Chile have developed a wide variety of educational models, including alternative curricular and pedagogical focus, emphasizing discipline or other values, including religious instruction. Parents likely make their decisions based on some of these factors that are not captured by student achievement.[19] Neverthe-

[19]For example, Gallego and Hernando (2009) presents survey evidence that suggests that parents

less, in designing their national standardized tests, the Ministry of Education of Chile has made higher student achievement and wide dissemination of school level test score results a primary objective, which leads me to investigate how school performance on the national tests factors into parental decision making.

The data reveal that average test scores vary markedly between schools. For example, *El Colegio Particular Los Angeles*, a small for-profit voucher school located in downtown Santiago, scored 179 out of a possible 350 points on the Spanish portion of the test, while the average score of *Escuela Particular Francisco Ramirez* - a large for-profit school located in an adjacent municipality - was 326. A large part of these differences reflect factors outside of a school's control, such as differences in student demographics and motivation across schools. It thus makes greater sense to focus on improvements in school test scores rather than on levels. I measure changes in a school's 4th grade Spanish test scores (t-3),[20] which have been publicly available to parents since 1996.[21] I acknowledge, as Kane and Staiger (2002a) and others have pointed out, that it is difficult to discern the degree to which test score gains represent actual improvements in school quality as opposed to pre-existing differences in

prefer schools that teach values and promote a disciplined environment. See Hoxby (1999), for survey evidence in the United States.

[20] I use a three year time span because 4th grade students were tested every three years between 1996 and 2005. Results are reported the following year and I assume that parents decide whether or not to re-enroll their children after results are released. For example, 1996 4th grade results were released in the fall (April) of 1997 and parents chose whether or not to re-enroll their children in the fall of 1998. Therefore, I examine changes in net enrollment in 1998 associated with changes in 1996 test scores.

[21] Chile's national standardized test, *Sistema de Medicion de la Calidad de la Educacion* (System of Measurement of the Quality of Education - SIMCE), assesses students in grades 4, 8, and 10 in language, mathematics, communications, history and geography, and natural sciences. This analysis only examines changes in 4th grade language scores. Language test scores are widely disseminated to the public and the media often base their school rankings on these results. The change in Spanish test scores were originally expressed as the number of items correct on the test, although I standardized these variables to a mean of 0 and a standard deviation of 1. The results are substantively similar when I examine changes in test scores between 1999 and 2005 to account for test score dissemination programs that were introduced by the Ministry of Education in 2000. These findings are available upon request. I would like to thank Lorena Meckes, the former national commissioner of SIMCE, for making this suggestion.

family background that may affect a student's trajectory,[22] sampling variation,[23] or measurement error in achievement tests. Thus, when parents make their school exit or re-enrollment decisions based on the test score gains or losses that they observe, their judgements likely capture both noise and actual school quality changes.

I am interested in the possibility that parents compare their child's school's test score changes with those in neighboring schools before deciding on whether or not to re-enroll their child in their current school. I posit that parents are more likely to exit the school, all else equal, if test scores declined and more likely to re-enroll if neighboring schools' test scores declined.[24] If this were the case, schools would be sensitive to their comparative performance on school quality. Thus, I expect to find the following patterns. First, a school's student growth rate would be positively correlated with test score increases. In addition, test score increases in their neighboring schools would be negatively correlated with student growth rates. I define "neighbor's" test score change as the average change in 4th grade test scores (t-3) of all public and private voucher (for-profit and non-profit) schools[25] within a one half-kilometer distance from each for-profit school in R.M.[26] I use a geographical definition of neighborliness for two reasons. First, geographic neighbors likely experience similar shocks that affect their

[22]For instance, Kane and Staiger (2002a) find that students with more educated parents not only have higher average scores, but also improve more from year to year.

[23]Kane and Staiger (2002b) point out the following one-time factors that may lead to volatility in test scores and are likely unrelated to actual changes in school quality: a dog barking on the day of the test, teacher turnover, a severe flu season, one particularly disruptive student in class or the favorable chemistry between a teacher and a particular class (p. 58).

[24]I also examined whether parents were responsive to changes in a school's test score ranking in the local schooling market every three years. Here I only report changes in test scores, but the patterns are similar when I replace change in test score ranking with change in absolute scores. These results are available upon request. I would like to thank the participants at the Universidad Adolfo Ibanez School of Government's seminar for suggesting this alternative measure.

[25]As I've noted above, I do not include non-voucher schools in this analysis for two reasons. First, private non-voucher schools enroll students from high-income families and therefore, they likely do not compete with public and private voucher schools for students. Second, tuition data is not available for these schools.

[26]To identify neighboring schools, I used Google Earth Pro to georeference schools. Each school address in Chile is translated into a latitude and longitude. The distance between all voucher schools and other neighboring schools is calculated and the schools within one-half kilometer are identified. As expected, the results are sensitive to my definition of neighboring schools. I will explore this topic in more detail in future work.

school quality policy decisions. Second, survey data in Chile suggests that primary school parents stress the school's proximity to their home or work as one of the most important factors when choosing a school (Gallego and Hernando, 2009; Elacqua and Fabrega, 2007).[27]

I've collected a third set of data from the Ministry of Education for all elementary schools in the sample, which includes objective characteristics of schools that are publicly available to parents and that may influence their school choice decisions. The objective school data I examine fall into three domains.[28] The first domain is associated with changes in school tuition.[29] I would expect student growth rates to vary inversely with tuition increases and positively with tuition increases in neighboring schools.[30] A second attribute focuses on the changes in the demographic make-up of student populations. I assume that costs are increasing for school owners and parents as the quality of the student body declines. Disadvantaged students are more expensive to educate due to Chile's flat per-pupil voucher and survey research suggests that parents prefer schools with "better" demographics (Elacqua et al., 2006). I will use the vulnerability index (IVE) which is constructed by *Junta Nacional de Auxilio Escolar y Becas* (JUNAEB, National Scholarship and School Aid Board), to measure student demographics. JUNAEB estimates the IVE on the basis of the results of a school survey.

[27]Enrollment patterns corroborate the survey evidence. Over 80 percent of primary school students in the Metropolitan Region of Santiago go to school in their home municipality.

[28]I've also examined whether parents were responsive to changes in a school's ranking in the local schooling market across the three dimensions. My results are substantively similar when I use this alternative measure. These results are available upon request.

[29]In 1994, the Ministry instituted a shared financing scheme that allowed all private voucher schools-both primary and secondary-and public secondary schools to charge limited tuition (Montt et al., 2006). Public elementary schools cannot charge tuition. The "shared financing" law in Chile allows private voucher schools and public high schools to charge fees that can be up to 1.6 times the basic voucher payment. Discounts to vouchers are applied progressively. If monthly tuition is less than half the level of the Unidad de Subvencin Escolar (USE), no discount is applied. Tuition fees between one half and one USE incur a 10 percent deduction. Fees between one and two USE incur a 20 percent deduction. Fee charging schools must also devote up to 10 percent of their additional income to finance scholarships.

[30]Recent marketing research, however, suggests that increasing the price of a product may actually increase perceived quality. For instance, Plassmann et al. (2008) scanned human subjects using MRIs while they sampled different wines and found that increasing the price of a wine increased subjective reports of flavor pleasantness.

These surveys provide information about the enrolled children's background. The IVE index has a minimum value of 0 that represents children with no social risk, and goes up to a maximum of 100 indicating the most vulnerable schools.[31] I expect student growth rates to be negatively correlated with an increase in IVE and positively correlated with increases in IVE in neighboring schools. The third domain reflects changes in schooling inputs as reflected by changes in class size.[32] It is assumed that smaller classes are more costly to maintain than larger classes[33] and that parents prefer smaller class sizes. Therefore I expect student growth rates to be negatively correlated with increases in voucher school class sizes and positively correlated with class size increases in neighboring schools. I also control for the voucher school's initial absolute values for each indicator. If a school has high average test scores (or a low proportion of low-income students), it is unlikely that small changes over time will affect parental choice behavior.

To account for differences in overall elementary student growth among local schooling markets, as defined by schools within one-half kilometer of each voucher school in the R.M., the net elementary student growth rate, expressed as a percentage, is included as an explanatory variable:

$$100gLM = 100ln\left(\frac{\frac{s_{-it}}{s_{-i(t-3)}}}{3}\right) \tag{4}$$

I will also include controls for the number of private non-voucher schools, public schools, and private voucher schools in each voucher school's neighborhood (one-half mile radius).

[31] I acknowledge that using this indicator as a proxy for low socioeconomic status is not perfect. I chose this index for three reasons. First, qualifications for the program are dependent on the family demonstrating low levels of income and education. Second, the Ministry of Education uses the vulnerability index to determine eligibility for school breakfast and lunch programs. Third, IVE has published school level indices since 1996.

[32] In the empirical analysis, I use first grade class size. I posit that parents are more likely to observe changes in first grade class size than changes in average primary school class size. However, the results do not change if I substitute first grade class size for average primary grade class size.

[33] Class size cannot exceed the government enforced class size cap of 45 students.

4.3 For-profit voucher schools

Table 3 provides descriptive statistics for the for-profit schools and neighboring schools in the R.M. that comprise the sample. The data show that the number of for-profit voucher schools and primary enrollments increased between 1997 and 2007, however the average net growth rate of elementary school enrollments declined. This resulted, on average, in fewer public resources (voucher) per school and greater competition as evidenced by a decrease in average first grade class size. Over the ten year span, the average increase in test scores has increased slightly (less than .05 standard deviations). Private resources have increased substantially, associated with a 94 percent increase in the real for-profit monthly school tuition. The decline in the average percentage of low-income students in the for-profit sector is consistent over time. However, the changes appear to be concentrated in some schools as evidenced by the increasing number of low-income students over time in the for-profit sector.

The direction and magnitude of the changes for neighboring schools are quite different, which is likely due to the fact that most for-profit schools have a diverse group of competitors (public, for-profit, and non-profit) in their local markets (table 3).[34]

Table 3 Here

Table 4 presents the basic model explaining growth in for-profit elementary school enrollments estimated for the full sample of urban elementary schools (public and private voucher) in the R.M. [column (1)] and a restricted sample of urban elementary schools in R.M. (excluding schools that were either created or closed between 1997 and 2007) [column (2)]. The first set of estimates present changes in the net growth rate of enrollment as a function of the change in Spanish test scores (t-3) in for-profit voucher school i and changes in Spanish test scores for for-profit voucher school i's neighbors. An increase in test scores has statistically significant estimated coefficients in both samples. Equations (1) and (2) for example, imply that a one standard deviation

[34] As noted above, I do not include private non-voucher schools because they enroll students from wealthy families and likely do not compete with voucher schools for students.

increase in 4th grade Spanish test scores is associated with a small and statistically significant increase in the growth rate of elementary enrollment of .03 percent a year. However, table 4 also reveals that if neighboring schools improve test scores at the same time, then the neighbors' test score increases offset the the effect of test score increases at the home for-profit voucher school.[35] For example, equations (1) and (2) show that a one standard deviation increase in the average neighboring schools' 4th grade Spanish test scores is associated with a decline in the growth rate of elementary enrollment of .03 percent a year.

Table 4 Here

4.3.1 Parent behavior by SES

Discussions of the effects of vouchers and greater competition have often raised questions about social equity. It is often asserted that expanding the right of parents of lower socio-economic status to leave their low performing local schools for higher performing ones may reduce stratification (Neal, 2002; Sugarman, 1999). A common criticism of parental choice is the idea that low-income parents cannot be counted on to make choices by reference to sound academic criteria. The concern is that if low-income families choose schools based on non-academic dimensions while high-income parents focus their choice of schools on measurable performance indicators, then schools will become more stratified as higher-income families choose better-performing schools, leaving the children of lower-income parents behind in low-performing schools (Henig, 1994). Table 5 investigates this possibility by examining parent behavior for a subset of low SES for-profit schools (over 35 percent at-risk students) and a subset of high SES schools (0 percent at-risk students).[36] Offsetting skeptics' concerns, the results suggest that parents with children in low-SES schools are more responsive to changes in test scores,

[35]The similarity of the estimates [columns (1) and (2)] undercuts any notion that new schools and schools that close confound the results with regard to the mechanisms driving net enrollment growth.

[36]Columns (1 and 3) are the full sample of low and high SES schools in R.M. and columns (2 and 4) are the restricted sample that excludes low and high SES schools that have opened or closed between 1996 and 2007.

all else equal, than parents with children enrolled in high SES schools. Equations (1) and (2) for example, imply that a one standard deviation increase in 4th grade Spanish test scores in low SES schools is associated with a small and statistically significant increase in the growth rate of elementary enrollment of .08 percent a year. The test score changes for high SES schools do not have statistically significant coefficients in either sample (equation 3 and 4). The results for low SES schools are consistent with the theoretical model of parent behavior and yardstick competition, though they are more likely to use neighboring school tuition as a benchmark than test scores. For instance, changes in the average neighboring schools' test scores are not statistically significant for low SES schools. However, table 5 reveals that parents with children enrolled in low SES schools are responsive to changes in neighboring schools' monthly tuition. Equations (1) and (2), for example, imply that an increase in neighboring schools' tuition of 10,000 pesos (about USD17) - say from 5,000 to 15,000 - over a year, would have been associated with an acceleration of enrollment gains, in the form of a small and statistically significant increase in the growth rate of primary enrollment of .06 percent a year. The estimated effect for increases in the current school's tuition for low SES schools is negative and slightly larger in (2), but is not statistically significant in sample (1).

Table 5 Here

In addition to changes in language test scores, a variable with consistently significant coefficients are student demographics. An increase in the proportion of low-income students is associated with the acceleration of enrollment losses, in the form of a decrease in the growth rate of enrollment. Equations (1) and (2) in tables 4 and 5, for example, indicate that an increase in the proportion of low-income students of 10 percent-say from 15 percent to 25 percent- would have been associated with a significant decrease in the rate of enrollment .6 percent a year in the full sample (table 4) and 1 percent a year in low SES schools (table 5). The effect of student demographics is very much in line with previous research that suggests that parental decisions are

influenced by social class (Buckley and Schneider, 2002; Elacqua et al., 2006).[37] Tables 4 and 5 also reveal that, across the board, changes in neighboring schools' demographics are not statistically significant, implying that parents do not use this indicator as a benchmark when evaluating their current school.[38]

The other major school policy variable in the equations is the change in first-grade class size. It is interesting to note that despite the importance that researchers, policymakers, and teacher unions have given to smaller class sizes as an important goal for education reform (Michel and Rothstein, 2002), few parents in the sample appear to consider this indicator to be important. On the contrary, the results suggest that an increase in first grade class size has positive and statistically significant estimated coefficients in all six samples. Equations (1) and (2), for example, imply that a class size increase of 10 students-say from 30 to 40- would have been associated with a small and statistically significant increase in the growth rate of primary enrollments of .02 percent a year. The estimated effect is somewhat smaller in low SES schools, but is larger in high SES schools. High quality for-profit voucher schools are likely characterized by larger class sizes because they can fill their classes to the legal limit, whereas low quality schools likely have more vacancies and smaller classes.[39] In other words, parents likely select more popular schools with larger classes so their children can be with other smart students.[40]

In sum, the findings for for-profit schools are consistent with the theoretical model of parent behavior and yardstick competition. Moreover, the results provide little support for the fear that low-income families are less informed consumers of school quality. Though it is important to acknowledge that for-profit school parents are not

[37]High SES for-profit schools that charge tuition enroll very few students from low-income families and therefore, there is very little variation in school demographics over time.

[38]I also analyzed interaction effects, between changes in 4th grade Spanish test scores and changes in student demographics. The findings, which are not reported here and are available upon request, are not statistically significant.

[39]This is consistent with findings reported by Urquiola and Verhoogen (2009)

[40]This helps to shed light on Woessman and West (2006) findings that indicate that the highest performing schools on the Trends in International Mathematics and Science Study (TIMSS) tend to have the largest class sizes.

randomly drawn from the school population. For instance, parents who enroll their children in for-profit schools may have other attributes (such as placing a higher value on test scores) than families who choose other school types.[41]

4.4 Non-profit voucher schools

There is a vigorous debate on the comparative behavior of for-profit and non-profit organizations. Some scholars have argued that for-profit firms will take advantage of poorly informed clients by providing low quality products that customers do not have the ability to evaluate (Hausmann, 1987). In contrast, non-profit providers exist to provide trustworthy products to poorly informed consumers (Weisbrod, 1998). Critics maintain that non-profits are insulated from competition and do not have incentives to manage their organizations efficiently (Glaeser and Schleifer, 2001). For instance, non-profit voucher schools may offer a trustworthy brand (i.e the Church) that parents' value and are willing to pay for that for-profit voucher schools cannot offer. This reputation may give non-profits more leeway to shirk on quality. In terms of the model, a non-profit school that competes for enrollments with a for-profit school of the same type that experience the same cost shocks (i.e. θ_M), may be able to offer lower quality schooling Q for the same price without being penalized by parents.

To examine differences across school types in the context of the yardstick competition in education model, I estimate the same empirical models described above for non-profit voucher schools in the R.M. Table 6 provides descriptive statistics for the non-profit schools and neighboring schools in the R.M.. The data show that the number of non-profit voucher schools decreased between 1997 and 2000 and increased between 2000 and 2007. Non-profit primary enrollments have increased at a moderate and constant rate between 1997 and 2007. The average net growth rate of elementary school enrollments followed a very different pattern. They increased between 1997 and

[41] It is also important to note that I do not have information on the parents exiting and enrolling in for-profit schools. For example, parents who choose to exit a for-profit school after they observe school quality changes may have higher levels of education and motivation than other families with children enrolled in the same school.

2000 and declined between 2000 and 2007. Note that average test scores are considerably higher than for-profit schools (over fifteen points or .3 standard deviations higher). Over the ten year span, average test scores have increased slightly (less than .05 standard deviations). Private resources have increased substantially, associated with a 156 percent increase in the real non-profit monthly school tuition. The average percentage of low-income students increased between 1997 and 2003 and then declined between 2003 and 2006. This is likely due to the student demographics of the new non-voucher schools that entered the market between 2003 and 2006. Many of these new schools were previously elite private non-voucher schools that converted into private voucher schools (Elacqua, 2009a). This also likely explains the sharp increase in average monthly tuition between 2003 and 2006.

Table 6 Here

Table 7 presents the basic model explaining growth in non-profit elementary school enrollments estimated for the full sample of urban elementary schools (public and private voucher) in the R.M. [column (1)] and a restricted sample of urban elementary schools in R.M. (excluding schools that were either created or closed between 1997 and 2007) [column (2)]. The findings are not consistent with the theoretical model of yardstick competition and education. The estimated effect for changes in a school's test scores, student demographics, and monthly tuition and neighboring schools' test scores, demographics, and monthly tuition are not statistically significant in samples (1) and (2) in table 6. To probe these findings further, I compared parent and school behavior in low SES (over 35 percent low-income) and high SES (0 percent low-income) non-profit schools in the R.M. The results, which are not reported here and are available upon request, do not change the substantial findings of the previous analysis of non-profit schools.[42] The only statistically significant finding across the board is first grade class size. Consistent with the for-profit school findings, an increase in first grade class size has positive and statistically significant estimated coefficients in all samples of

[42]In addition, the findings are substantively similar when I only consider non-profit Catholic schools in the R.M.. These results are also available upon request.

non-profit schools.

Table 7 Here

5 Conclusion

This paper develops a model of parent and school behavior in an education marketplace, where parents choose whether or not to remain in their current school or change schools, using neighborhood schools to evaluate the performance of their child's school. Parents are assumed to make comparisons between schools to overcome asymmetric information. This forces schools into a "yardstick competition" in which they care about what other local schools are doing. I provide a theoretical framework and empirical evidence using a unique panel survey data set I've constructed to examine the extensive and long running system of school choice in Chile. The results are encouraging to the view that the level of quality a school chooses affects its chances of maintaining and increasing enrollments. The findings also suggest that school behavior can be affected by parents using local schools as a benchmark. The results, however, are not consistent across school types (for-profit and non-profit) and socioeconomic groups (high SES and low SES schools).

The results for for-profit schools - particularly for middle-class and low-income for-profit schools - are consistent with the theoretical model of parent behavior and yardstick competition: school test score improvements over time are associated with small and statistically significant net enrollment growth rate increases and changes in local competitor school quality offset the effect of these improvements. Low SES for-profit school parents are more likely to use neighboring school tuition as a benchmark than test scores. Across the board, I also find that an increase in the proportion of low-income students and class size increases (proxy for popular schools) are both associated with an increase in the growth rate of primary enrollments.

The findings for non-profit schools and high SES for-profit schools, however, do not comport with the yardstick competition in education theory. Some scholars have

argued that non-profit schools are insulated from competitive pressures and thus have little incentive to manage their schools efficiently (Glaeser and Schleifer, 2001). Researchers have also suggested that high SES parents may assume (accurately or not) that schools with more advantaged students are able to attract more motivated students and families, raise more local private funds, recruit and retain higher-quality teachers, and add greater value to their childs education (Fiske and Ladd, 2000). Indeed, it may be rational and sensible for a parent in R.M. in Chile to re-enroll in an elite voucher school with declining test scores over an alternative public or private voucher school that serves middle-class students where the scores are improving. For example, recent research in Chile suggests that a school's elite reputation is an important factor in the determination of earnings in the labor market.[43]

Much scope still remains to study parent behavior and yardstick competition. For instance, how sensitive are different schooling markets to the geographic definition of neighborliness? Are schooling markets larger in more sparsely populated areas? Does the theoretical model predict parent and school behavior in small urban educational markets outside of the R.M.? Or does the yardstick competition and the education model only apply to densely populated areas in the R.M.? Are their additional implications of yardstick competition for high school students and their families? Given that high school students are more mobile, do they consider a wider spectrum of schooling options when choosing a school and evaluating whether or not to re-enroll in their current school? Why is the model a better predictor of for-profit and low-income parent behavior than non-profit and high-income parent enrollment decisions? Are these schools insulated from competitive pressures? Or do parents that choose these schools make their decisions based on other factors that are not captured in the empirical model (i.e. social networks, discipline, religious values)? Data on Chile's national voucher program are a rich source for exploring these questions.

[43]Nunez and Gutierrez (2004) find that, holding academic merit constant, a student that attends an elite private school is likely to earn more than a student that goes to public school.

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Figure 1 Enrollment share in public and private schools, 1981–2007.

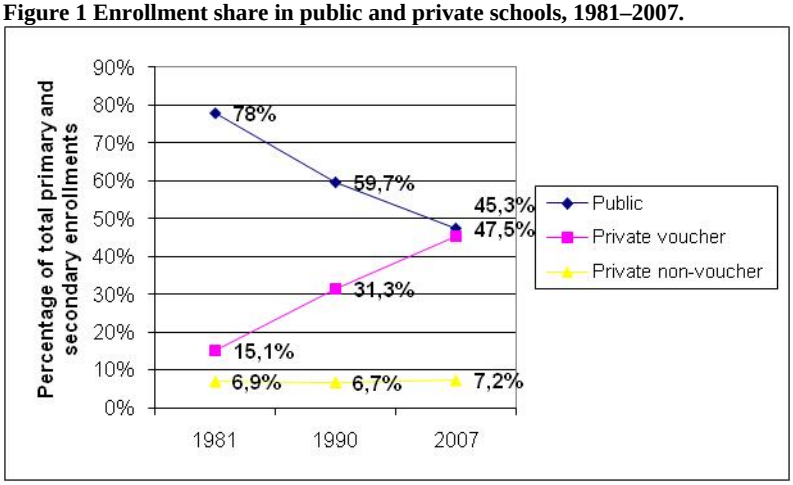

Table 1: Distribution of primary schools and students across school types, 2007

	Percent of schools	Percent of enrollments
Public	62.1	50.8
For-profit voucher	23.8	26.9
Non-profit voucher	8.8	15.4
Private non-voucher	5.3	6.9
Total	100	100
Number of schools or students	8,377	2,034,769

Table 2 The growth of private primary schooling in Chile, 1990-2007

School type	School numbers			Student enrollments		
	1990	2007	Percent change	1990	2007	Percent change
Public	5,707	5,201	-7.1%	1,219,601	1,034,244	-15.2%
For-profit voucher	1,500	1,994	32.9%	363,125	547,511	50.8%
Non-profit voucher	622	736	18.3%	251,190	312,727	24.5%
Private non-voucher	508	446	-12.2%	136,882	140,287	2.5%
Total	8,337	8,377	0.5%	1,970,798	2,034,769	3.2%

Table 3 Sample means for-profit primary schools in the R.M. (Standard deviations)

School year	1997/1998	2000/2001	2003/2004	2006/2007
Number of for-profit schools	519	570	644	687
Number of primary students	256,345	269,670	272,223	276,454
Average primary students	493.92 (446.78)	474.77 (436.05)	438.36 (400.02)	413.24 (376.23)
Growth rate of enrollments		- .01 (.08)	-.02 (.09)	-.03 (.09)
Spanish test score	247.67 (26.68)	249.2 (24.75)	249.98 (27.21)	255.45 (25)
Δ Spanish test score (st. dev)		0.02 (.23)	0.003 (.23)	.04 (.23)
Monthly tuition*	5578.29 (8470.02)	7147.66 (7762.04)	8866.78 (10768.35)	10809.17 (11.135.23)
Δ Monthly tuition		1321.99 (6516.61)	1029.79 (7350.66)	587.59 (6962.89)
Student demographics	.19 (.20)	.164 (.159)	.165 (.1683)	.155 (.166)
Δ Student demographics		-0.073 (.14)	.193 (.0983)	.008 (.088)
Class size	36.09 (8.28)	34.75 (9.31)	31.84 (9.78)	31.46 (10.10)
Δ Class size		-1.33 (7.80)	-2.52 (7.90)	-.69 (7.86)
Neighoring schools' growth rate of enrollments		-.01 (.05)	-.03 (.06)	-.03 (.07)
Δ Neighboring schools' Spanish test score (st. dev.)		.001 (.17)	-.002 (.15)	.05 (.16)
Δ Neighboring schools' monthly tuition		1044.92 (2204.22)	834.62 (4206.89)	722.29 (3738.98)
Δ Neighboring schools' student demographics		-.193 (.0861)	.023 (.067)	.09 (.064)
Δ Neighboring schools' class size		-.8 (4.9)	-2.95 (5.67)	-.33 (5.88)
Number of neighboring public schools	1.11 (1.06)	1.10 (1.02)	1.10 (1.03)	1.02 (1.03)
Number of neighboring private voucher schools	2.23 (2.03)	2.20 (2.05)	2.24 (2.12)	2.62 (2.37)
Number of neighboring private non-voucher schools	.49 (.88)	.54 (.89)	.50 (.91)	.33 (.76)

* Chilean pesos adjusted for inflation. 523 Chilean pesos + 1USD in 2007

Table 4 Estimated equations explaining growth rate in for-profit primary enrollments in R.M., 1997-2007.

	For-profit in RM	
	(1)	(2)
Δ Spanish test score (st. Dev)	0.0304*	0.032**
	(0.016)	(0.016)
Δ Monthly tuition	0.0003	0.0004
	(0.0005)	(0.0005)
Δ Student demographics	-0.062**	-0.061**
	(0.031)	(0.031)
Δ Class size	0.0016***	0.0016***
	(0.0005)	(0.0005)
Neighboring schools' growth rate of enrollments	0.0007	0.024
	(0.049)	(0.049)
Δ Neighboring schools' Spanish test score (st. Dev.)	-0.0264*	-0.031**
	(0.015)	(-2.01)
Δ Neighboring schools' monthly tuition	0.0009	0.0008
	(0.0007)	(0.0007)
Δ Neighboring schools' student demographics	-0.023	-0.03
	(0.037)	(0.04)
Δ Neighboring schools' class size	0.0001	0.0001
	(0.0004)	(0.0004)
Number of neighboring private non-voucher schools	0.014**	0.013*
	(0.007)	(0.007)
Number of neighboring public schools	-0.007	0.002
	(0.021)	(0.022)
Number of neighboring private voucher schools	0.004	0.004
	(0.005)	(0.005)
Observations	1136	1020

Notes: Numbers in parentheses are standard errors. Monthly tuition (x$1000 pesos) is adjusted for inflation.
* significant at 10%; ** significant at 5%; *** significant at 1%
(1) Includes all urban for-profit voucher schools in the R.M.
(2) Excludes new for-profit voucher schools and for-profit voucher schools that close

Table 5 Estimated equations explaining growth rate in low SES and high SES for-profit primary enrollments in R.M., 1997-2007.

	Low SES for-profit in RM (>35% IVE)		*High SES for-profit in RM (0% IVE)*	
	(1)	(1)	(3)	(4)
Δ Spanish test score (st. Dev)	0.074***	0.077***	-0.037	0.012
	(0.024)	(0.024)	(0.059)	(0.057)
Δ Monthly tuition	-0.0054	-0.0064*	-0.002	0.002
	(-0.004)	(0.0036)	(0.003)	(0.003)
Δ Student demographics	-0.1***	-0.11***	N/A	N/A
	(0.035)	(-0.036)		
Δ Class size	0.001*	0.001*	0.004**	0.004**
	(0.0006)	(0.0006)	(0.002)	(0.002)
Neighboring schools' growth rate of enrollments	-0.078	-0.066	0.075	0.128
	(0.077)	(0.077)	(0.183)	(0.177)
Δ Neighboring schools' Spanish test score (st. Dev.)	-0.0178	-0.02	0.065	0.069
	(0.022)	(0.022)	(0.06)	(0.061)
Δ Neighboring schools' monthly tuition	0.006**	0.0055*	0.002	0.001
	(0.003)	(0.003)	(0.004)	(0.004)
Δ Neighboring schools' student demographics	0.034	0.018	-0.14	-0.14
	(0.05)	(0.05)	(0.19)	(0.19)
Δ Neighboring schools' class size	0.0005	0.0003	0.0004	0.0002
	(0.0007)	(0.0007)	(0.0012)	(0.0013)
Number of neighboring private non-voucher schools	-0.006	-0.009	0.018	0.008
	(.015)	(0.016)	(0.022)	(0.26)
Number of neighboring public schools	0.014	0.022	0.032	0.0191
	(0.038)	(0.041)	(0.051)	(0.048)
Number of neighboring private voucher schools	0.004	0.0024	0.001	-0.004
	(0.011)	(0.011)	(0.017)	(0.018)
Observations	396	373	175	132

Notes: Numbers in parentheses are standard errors. Monthly tuition (x$1000 pesos) is adjusted for inflation.
* significant at 10%; ** significant at 5%; *** significant at 1%
(1), (3) Include all urban for-profit voucher schools in the R.M.
(2), (4) Exclude new for-profit voucher schools and for-profit voucher schools that close

Table 6 Sample means non-profit primary schools in R.M. (Standard deviations)

School year	1997/1998	2000/2001	2003/2004	2006/2007
Number of non-profit schools	236	219	232	391
Number of primary students	99,799	105,015	107,277	109,749
Average primary students	653.61 (536.11)	683.12 (548.75)	612.98 (499.48)	499.07 (419.45)
Growth rate of enrollments		.00003 (.07)	-.02 (.05)	-.001 (.07)
Spanish test score	261.71 (25.18)	266.63 (23.99)	265.88 (27.85)	266.12 (27.49)
Δ Spanish test score (st. dev)		0.054 (.19)	0.011 (.17)	.051 (.22)
Monthly tuition*	5127.70 (6549.13)	7705.76 (8273.25)	9086.37 (9526.61)	13152.38 (20,291.42)
Δ Monthly tuition		2195.35 (5383.76)	1386.90 (3535.62)	3380.41 (17,820.42)
Student demographics	.12 (.17)	.12 (.15)	.14 (.17)	.11 (.16)
Δ Student demographics		.005 (.11)	.03 (11)	.02 (.10)
Class size	39.08 (7.30)	39.30 (7.09)	36.07 (9.44)	34.01 (9.96)
Δ Class size		-.41 (4.96)	-2.73 (5.82)	-.90 (6.69)
Neighoring schools' growth rate of enrollments		-.005 (.06)	-.04 (.06)	-.023 (.07)
Δ Neighboring schools' Spanish test score (st. dev.)		.008 (.18)	-.005 (.16)	.06 (.17)
Δ Neighboring schools' monthly tuition		1142.87 (3003.77)	1134.73 (4712.81)	1223.198 (8017.41)
Δ Neighboring schools' student demographics		-.013 (.08)	.02 (.08)	.009 (.074)
Δ Neighboring schools' class size		-.61 (5.51)	-3.60 (5.47)	-.11 (5.68)
Number of neighboring public schools	1.11 (1.15)	1.02 (1.13)	1.03 (1.14)	.96 (1.03)
Number of neighboring private voucher schools	1.92 (1.87)	1.88 (1.93)	1.90 (1.91)	2.11 (1.99)
Number of neighboring private non-voucher schools	.72 (1.11)	.64 (1.01)	.61 (1.05)	.41 (.88)

* Chilean pesos adjusted for inflation. 523 Chilean pesos + 1USD in 2007

Table 7 Estimated equations explaining growth rate in non-profit primary enrollments in R.M., 1997-2007

	Non-profit in RM	
	(1)	(2)
Δ Spanish test score (st. Dev)	0.032	0.034
	(0.021)	(0.021)
Δ Monthly tuition	-0.0005	-0.0005
	(0.0008)	(0.0008)
Δ Student demographics	0.05	0.05
	(0.04)	(0.041)
Δ Class size	0.0024***	0.002***
	(0.0007)	(0.0007)
Neighboring schools' growth rate of enrollments	0.028	0.026
	(0.061)	(0.062)
Δ Neighboring schools' Spanish test score (st. Dev.)	0.018	0.018
	(0.014)	(0.014)
Δ Neighboring schools' monthly tuition	0.0009	0.0008
	(0.001)	(0.001)
Δ Neighboring schools' student demographics	0.05	0.051
	(0.03)	(0.033)
Δ Neighboring schools' class size	-0.0002	-0.0002
	(0.0004)	(0.0004)
Number of neighboring private non-voucher schools	0.004	0.004
	(0.008)	(0.008)
Number of neighboring public schools	-0.17	0.002
	(0.014)	(0.017)
Number of neighboring private voucher schools	-0.0003	-0.0003
	(0.006)	(0.006)
Observations	356	330

Notes: Numbers in parentheses are standard errors. Monthly tuition (x$1000 pesos) is adjusted for inflation.
* significant at 10%; ** significant at 5%; *** significant at 1%
(1) Includes all urban non-profit voucher schools in the R.M.
(2) Excludes new non-profit voucher schools and for-profit voucher schools that close