International Journal of Educational Development 46 (2016) 23–34

Contents lists available at ScienceDirect

International Journal of Educational Development

journal homepage: www.elsevier.com/locate/ijedudev

School competition and efficiency in elementary schools in Mexico

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ARTICLE INFO

Article history:
Received 7 May 2015
Accepted 29 September 2015

JEL classification:
I21
I22
D24
R12

Keywords:
Competition
Stochastic production frontier
Efficiency
Spatial analysis
Panel data

ABSTRACT

This paper examines how competition impacts the technical efficiency of schools. We model competition between schools using Geographical Information System (GIS) tools in order to develop a Herfindahl–Hirschman market concentration index (HHI) and then follow a stochastic frontier analysis with alternative specifications that enable us to obtain the best unbiased efficient estimators. We find three important results. First, a higher degree of competition from public and private schools significantly increases elementary school efficiency in Mexico, as measured by the outcomes in a nationwide standardized test. Second, we find a positive, though small, association between expenditure on education and school outputs. Third, private schools perform significantly better due to the differential incentives they face in terms of competition.

1. Introduction

The improvement of educational outcomes is an important part of the governments' agenda in developing countries. Mexico increased its education expenditure by 24% during 2000–2010, which represents an additional 1.2% of the GDP. This expenditure represents, during that period, the highest increment in educational expenditure among OECD members. Despite these expenditure efforts, the outcomes in education, as measured by the Program for International Student Assessment (PISA) in mathematics, science and reading, are almost unchanged and statistically significant below the OECD average. The meager results achieved by Mexican students in the PISA test suggest two possibilities. The first is that expenditure on education does not have a significant impact on school achievement. The second is that, even if additional expenditure on education has a positive impact on education outcomes, the inefficient use of resources hinders any possible improvements in terms of school achievements.

In addition to a more careful treatment of technical efficient production, in which inputs are associated to the best possible outcome, market environment variables such as competition play an important role in explaining production outcomes. This relationship is not clear in the case of education markets, since education is considered to be a public good. Recent advances in analyzing policies aimed at enhancing parental choice to improve competition have found mixed results. For instance, Dee (1998) found that competition from private schools does have a positive and statistically significant impact on high school educational outcomes. Rouse and Barrow (2008), reviewing the empirical evidence on the impact of education voucher programs, observe a positive association between competition and educational outcomes, but find small achievement gains for students offered education vouchers. Likewise, the evidence presented by Greene and Kang (2004) finds significantly positive effects of private competition for some school outputs (such as dropout rates and standardized tests), but little, if any, effect on measures such as the percentage of students receiving high quality diplomas in New York high schools. Also, Gibbons et al. (2008) distinguish between the effects of competition on achievements and school performance. Using data from elementary schools in England they find little evidence of a link between choice and achievement, but observe a positive association between competition and school

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http://dx.doi.org/10.1016/j.ijedudev.2015.09.015
0738-0593/

performance. Indeed, inefficiency arises from a lack of incentives in schools to behave efficiently and competition can be an incentive mechanism to promote a better use of resources in schools (Grosskopf et al., 2001). It seems that in terms of competition, schools should not be evaluated by their outcomes, but by the efficient use of their inputs.

This paper contributes to the debate on competition and school efficiency. We use data from the Mexican educational system to test the relationship between urban school market concentration (lack of competition) and school technical efficiency (the percentage that represents observed school production out of the maximum school production, given a set of inputs). The estimation process is not straightforward since neither efficiency nor competition is directly observable. In order to measure school efficiency we use the stochastic frontier analysis method (SFA) which allows us to calculate technical efficiency, controlling for the inputs and exogenous factors in which schools operate. Given the lack of consensus on the SFA estimation process, we use a series of estimators following different econometric specifications for panel data, including both fixed and random effects. In addition, we follow Hoxby (2000) to measure competition in a school market by using the Herfindahl–Hirschman market concentration index (HHI) as a proxy of the competition level every school market faces. The index we estimate employs the application of Geographical Information System (GIS) tools to incorporate the degree of competition each school faces from peer schools spatially located within a radius of 1 km in their local market area.

The development of the literature on production outcomes and efficiency is scattered among several approaches which are restricted to specific interests. This analysis follows two strands in the literature. One, related to the estimation procedure using panel data to isolate the effect of competition on the efficiency of public school districts (Millimet and Collier, 2008; Kirjavainen, 2012). The other analyzes the effect of competition on public schools' efficiency following the stochastic frontier analysis and using the geographic information system approach to measure the degree of competition (Misra et al., 2012). We apply the stochastic frontier analysis, but use a single equation estimation procedure in order to avoid the potential biases a two-stage estimation procedure may cause. Our panel consists of 27,068 schools which represent 63% of urban elementary schools in Mexico during the 2009–2011 academic periods 2009–2011. We focus our analysis in urban elementary education markets since they are less concentrated than rural elementary education markets, where in many localities there is public education monopoly. On the other hand, there is low quality of data for rural elementary education associated to an under-representation of indigenous schools due to a very low participation in public evaluation programs. The panel covers both private and public schools; at national level private schools represent 8.68% of the elementary school market. The private school ratio varies considerably across the country, for instance, private schools are mostly concentrated in urban areas where the ratio average is 19.1% while in some states, such as Aguascalientes, can be as high as 36%. The data was obtained from Mexican Ministry of Education through the national system of statistic information on education (SNIEE, for its Spanish acronym). The educational output we use is a standardized performance test known as ENLACE, which is a partial measure of an education process but is the best available proxy that enables us to achieve objective, transparent comparisons.

We found three main results in our analysis. The first consists of showing that the lack of competition is positively and significantly related to schools' technical inefficiency. We found that school markets that are more competitive are more efficient in their use of school inputs, for both public and private schools. These results go in tandem with previous findings observed by Grosskopf et al. (2001) and Millimet and Collier (2008) for other countries. The results suggest that promoting competition between schools, either public or private, can improve schools' technical efficiency, which may translate into better educational outcomes. The second result is that public expenditure per student has a small and positive impact on the *ENLACE* test in Spanish and mathematics. This result suggests that increasing expenditure on education per student would increase the outcomes in the ENLACE test, *ceteris paribus*. However, the increment in expenditure would have to be very high for the improvement in outcomes to become evident. This result is similar to Barrow and Rouse's (2005) findings which also conclude that expenditure on education is significant yet higher in the case of public schools. The third result shows that the most relevant factor to explain the outcomes in the ENLACE tests is the type of school (public or private) considered. On average, private schools obtain better results in the ENLACE test outcomes than their public counterparts. Other studies using Mexican data have found similar results (Díaz Gutiérrez and Flores Vázquez, 2010; Blanco, 2011). It is highly evident that the incentive structure private schools face is a key determinant of their efficient performance.

The rest of paper is structured as follows. Section 2 briefly discusses the theoretical basis of frontier efficiency and the measurement of school competition. Section 3 introduces the data and the empirical estimation strategy. The results of the estimations appear in Section 4. Finally section 5 concludes the article.

2. Competition in elementary schools in Mexico

School competition has been widely studied in the literature. It is a complex issue and the evidence found in empirical estimations is sometimes contradictory. In this study we focus our analysis on 42,552 Mexican urban elementary schools, 82.6% of which are public and 17.43% private. Moreover, we stress two issues regarding methodologies and implementations of the competition concept: the delimitation of a school market and the way of measuring competition within a school market.

We employ three factors for the delimitation of the school market: the geographic factor, the school type (public or private) and the school shift. The geographic factor delimits the school markets through specific geographic zones: regions, counties, school districts, etc. The idea is that parents look for a place to live in relation to the places where the best schools for their children are located and that schools are concentrated in specific school districts.

Several authors have delimited the school market according to geographic zones and county sizes (Barrow and Rouse, 2005; Millimet and Collier, 2008), while others have used the school district markets in metropolitan areas (Hoxby, 2000; Greene and Kang, 2004). Nevertheless, Misra et al. (2012) pointed out that geographic delimitation is subject to an aggregation bias given that sometimes the real competition is not captured. In order to avoid this, they proposed a novel method to delimit the market influence zone of every school, using geographic information system (GIS) tools to create a school competition index for the state of Mississippi. In order to define different school market sizes, the authors drew circles, such as a 5, 15 and 25 mile radius, around each school.

The availability of a geo-referenced database of Mexican elementary schools allows us to use the GIS tools proposed by Misra et al. (2012), with the differences that result from the educational market structure in Mexico. Given the geographic concentration, we draw a circle of a 1 km radius around each public or private school. This choice may seem arbitrary, yet it is supported by several sensitivity tests carried out using GIS tools.