

Panel Data Analysis of Charter School Growth in Florida

: Based on School, School District, and School Community Model

Charter School 성장에 대한 패널데이터 분석

: 학교, 교육자치구, 그리고 학교관련 공동체 모형을 중심으로

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Charter schools in Florida have been the best practice of sustainable education system in terms of innovative learning and academic achievement with accountability. However, little is known charter school growth, namely student population change by enrollment growth, so the primary concern of this study is how the charter schools have sustained growth and what causes their growth in Florida. This study uses panel data analysis with 37 school districts that have operated more than 5 years. In doing so, we examined diverse parts of charter school including school and student, school district, and school community which are recognized as important fields through previous studies. The result

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shows that all three parts are important and each part needs to be paid attention to study charter school growth. First, in school and student category, free reduced lunch eligible and class size are important to explain charter school growth. Second, school district category has one significant variable, expenditure for FTE which is related to financial capacity of charter school. Third, school community category has one significant variable, school-aged children in poverty. As for the implication of this study, first, educational welfare support from government and school class environment are more important than educational performance or instructional support. Second, role of school district as a financial distributor or provider greatly influences sustainable charter school growth in that charter school exclusively counts on funding from school district for school management. Third, economic background of family and government welfare resources are important factors related sustainable growth.

□ Keywords: Charter School, School Growth, Panel Data Analysis

미국 플로리다의 charter school은 책무성과 함께 혁신적 학습과 학업성취라는 측면에서 지속 가능한 교육시스템의 성공사례로 평가되어 왔다. 그럼에도 불구하고 charter school 등록학생규모의 변화에 의한 학교규모 성장에 대한 연구 대한 연구가 미비하였다. 이에 연구는 플로리다주의 charter school이 어떻게 성장을 유지해 왔고 이 성장에 영향을 미친 요인들이 무엇인가를 중점적으로 살펴 보고자 하였다. 이 연구는 5년이상 charter school이 운영되어 온 37개 교육자치구를 중심으로 패널데이터분석을 실시하였다. 이 분석의 이론적 분석틀을 위해 선행연구에서 중요한 분야로 인식된 학교와 학생, 교육자치구, 학교관련 공동체 등의 다양한 요인들을 검토하였다. 분석결과 이 세가지 분야가 다 중요한 것으로 파악되었으며, 먼저 학교와 학생분야에서는 무료급식학생수와 학급규모가 중요한 설명요인이었다. 둘째, 교육자치구 분야에서는 재정분야와 관련된 정규학생1인당 예산이 중요한 것으로 파악되었다. 셋째, 학교관련 공동체 분야에서는 빈곤층 학생비율이 유의적으로 영향을 미치는 것으로 나타났다. 이 연구결과의 정책적 함의로는 먼저 정부의 교육복지지원의 지원과 수업환경이 교육성과 또는 교과지원보다 지속적인 성장에 더 중요한 것으로 나타났다. 둘째, charter school이 전적으로 학교운영의 재정을 교육자치구에 의존하기 때문에 재정분배자 또는 공급자로서 교육자치구의 영향력이 크게 나타났다. 끝으로 학부모의 경제수준과 정부의 복지재원이 지속적인 성장과 관련하여 중요한 요인으로 파악되었다.

□ 주제어: 차터스쿨, 학교성장, 패널데이터분석

I. Introduction

Charter school is a good example of sustainable education system for local educational autonomy. The purposes of charter school are to improve student learning and academic achievement, to increase learning opportunities for all students, and to encourage the use of innovative learning methods. To this end, charter school creates innovative measurement tools and provides rigorous competition within the public school district to promote academic success (Hassel & Terrell, 2006).

After charter school legislation passed in 1996, charter schools have operated over 20 years in Florida, USA. Charter schools are schools that receive government funding but are not part of the public school system. The choice of a charter school highlights the desire to eliminate the bureaucratic governing structures of schools in favor of decentralization and deregulation (Chubb & Moe, 2011). According to the Center for Education Reform, charter schools are a type of innovative public school designed by educators, parents, civic leaders, and non-profit or profit organizations. Charter schools are different from traditional public schools and private schools. Compared to the traditional public schools, charter schools have fewer regulatory burdens, but charter schools are highly accountable for academic achievement. Unless they meet certain achievement goals set up by their charter contract, they can be forced to close by the government (Finn et al, 2001).

As of school year 2014-2015, 2.9 million students attended 6,700 charter schools in the 42 states and the District of Columbia. This represents about a four percent growth in the number of charter schools in operation and fourteen percent growth in enrollment of charter school students (Barrows et al, 2017). Over forty percent of all charter schools are located in a few states, such as Arizona, Florida, California, and Wisconsin. Since Florida charter school legislation in 1996, enrollment has grown by more than 200 percent over the last decade, representing the fastest growing school choice in the state. Florida has over 640 charter schools in 46 districts and charter school student enrollment

exceeded 251,000 students in 2014-15. As with charter schools in other states, charter schools in Florida have the flexibility to meet the unique needs of individual students and hold contracts with school districts to meet the high standards set by the Florida Comprehensive Assessment Test and end-of-course exams (Florida Dept. of Education, 2016).

Considering the enormous growth, charter schools in Florida have been the focus of studies interested in charter school formation and diffusion(Zhang & Yang, 2008; Feiock, 2015), student achievement and comparison with traditional public or private schools (Crew & Anderson, 2003; Sass, 2006), and charter school finance (Nelson et al, 2000; Bifulco & Buerger, 2012). Despite of various studies with different topics, there has been few to study charter school growth. Considering lack of empirical study on charter school growth, this research attempts to fill the research gap by focusing on growth of charter school and factors to influence the growth. According to the definition of Wikipedia, growth can be understood as a positive change in size, often over a period of time with a stage of maturation or a process toward fullness or fulfillment. Since there has been positive change in both charter schools and their students in Florida charter schools, this study considers growth of charter school as a positive change of charter school student populations. On the basis of previous studies on charter schools, primary concern of this study is that how the charter schools have grown so fast and what causes their increasing growth.

II. Theoretical Background

Related to charter school, there have been lots of studies in the areas of charter school formation and diffusion, charter school achievement, charter school finance, and charter school characteristics.

Charter School Formation and Diffusion

Finn et al. (2001) studies all types of authorizers and finds that Local Education Agencies (LEAs) and State Education Agencies (SEAs) are major authorizing types for charter schools. LEAs as local school districts took nearly ninety percent of all authorizers, but they authorized a small number of charter schools. Compared to SEAs, LEAs tended to authorize a small portfolio less than ten schools. Although LEAs are the major type of charter school authorizers, they only authorize fifty percent of the charter schools in nation. The LEAs' incentive to authorize the charter schools is different from the other type of authorizers in that charter school may compete for students with the traditional public schools. In this sense, some studies asserted LEAs as local school districts may not prefer to charter school, but in fact, the number of LEAs and the number of charter school authorization are increasing. Therefore, it is necessary to compare LEAs with non-LEAs considering different authorizing approach in terms of approval rates, support after charter school authorization, and the agency structure.

Zhang and Yang (2008) examines whether charter school diffusion has occurred in response to real and perceived educational needs or to political and institutional factors in charter school policy. This study attempts to make a different approach unlike traditional policy adoption and diffusion studies that focus on the state level and use a dichotomous adoption or not. Instead, they focus on local school districts and use the number of operating charter schools as the dependent variable. For empirical analysis, this article conducts generalized event count regression to estimate models rather than uses event history analysis. With Florida's 67 school districts across a six-year time period, this study concludes that charter school diffusion is more influenced by political and institutional factors than by educational needs. In addition, the result shows a dynamic trend of charter school diffusion over time.

Feiock (2015) studies charter school formation in Florida by analyzing the factors related with new charter school adoption. In particular, she considers whether charter schools are profit-based or non-profit-based and addresses

various aspects of charter schools: charter school legislation, academic performance, and school district characteristics. This study presents that market-based charter schools, fixed capital outlay, appointed school superintendents and school board size are significant factors to charter school formation. The study finds that there has been a shift from primarily nonmarket-based charter schools to market-based charter schools in the 18 years since the authorization of the first charter school in the state. Further, expansion in support for fixed capital outlay provided by the state influences market-based charter school formations.

Charter School Achievement

Holmes et al. (2003) examined traditional public schools' competition with charter school in North Carolina using distance between public schools to charter schools. They measured the distance from a traditional public school to the nearest charter school as school competition. This study included county-level variables to reduce the endogeneity of charter locations and found that charter school competition influenced the performance of public schools. Like their previous study with student-level data and distance, they found that traditional public school within six miles distance from the charter school had a positive effect on only math. However, there was a positive impact on reading when the charter school was located within twelve miles. In addition, when they measure competition as the presence of at least one charter school, there were positive significant result with both math and reading.

Sass (2006) examined the performance of charter school and its competition with traditional public school using student-level longitudinal data. Employing student-level fixed effects, this study found lower performance in charter schools at initial operating stages, but in five years of operation, charter school showed similar achievement with the average public schools in math and higher scores in reading than public schools. However, special education showed lower performance and for-profit education charter school showed no difference. Finally, traditional public schools competed with charter schools showed modest

increases in math, so there was competition impact on the traditional charter schools.

Booker et al. (2008) studied the effect of charter school competition with longitudinal data for the expansion of charter schools allowed. Using an eight year student-level panel data in Texas, they found that there were substantial positive effects on both math and reading. Considering charter school competition occurs at district level by students mobility with funding, they included both school-level and district-level enrollment loss to explain the hierarchical competitive impact. In addition, they also used the number of charter schools within distance radii.

Charter School Finance

Zimmer (2009) argued that charter school competition would be caused from the different part of the public school structure rather than student outcomes. Since school district officials sensed competition between the traditional public schools and charter schools, they try to retain enrollment of public schools by changing district expenditures. Thus, expenditure change is more accurate measurement to explain the competition considering student outcomes as achievement would be affected by other variables rather than competition.

Linkow, Streich and Jacob (2011) studied charter school competition by using charter enrollment in Michigan district. They measured competition as a proportion of charter school enrollment in district enrollment and analyzed the following variables with the charter school enrollment proportion: instructional expenditure, student support services, capital improvement, athletics programs and advertising. This study found charter school competition led to a positive financial impact on student support services, instructional support services, and capital outlays.

Miron et all (2011) found that charter school spend less per-pupil than traditional public schools by around \$1,500. In addition to less spending, charter school had different expense structure than public schools. With less restriction, charter school spent the largest expense on personnel expenses between 50-70

percent of the budget. Around 5-20 percent of budget spent for charter school financial and operational needs and 5-15 percent spent for curriculum materials, books, computers, equipment, and supplies. Under this spending level, charter school spent more money on school administration and support services and less on instructions than traditional public schools.

Arsen and Ni (2011) studied charter school competition with financial perspective and examined the allocation of expenditures in traditional public schools in Michigan. If public schools recognize better performance of charter school measured through higher test score, they will spend more on instructional activities and less on other activities. On this assumption, Arsen and Ni measure the percentage of students who attended charter schools with the public school district as competition variable. As a result, there was not any significant or consistent effect by charter school competition on traditional public schools.

Charter School Characteristics

Hoxby (2000) studied the change of school personnel management system through charter school competition. She assumed that charter school competition will affect teacher composition by changing hiring, retaining, and firing system. Based on School and Staffing Survey and surveys from charter schools teachers, she found that charter school teachers had highly qualified education, math and science skills, and more contribution to education. This type of teacher composition in charter schools, however, does not change composition of public school teacher in terms of experience, wage, and education.

Dee and Fu (2004) examined impact of charter school newly created within a district on composition of public school students. As a charter school competition mechanism, traditional public schools faced some change in the quality of their students. Since charter schools may draw away students with lower achievement score, the traditional public schools may raise scores, or vice versa. In the case of Arizona, they found that charter school competition cause to reduce white and non-Hispanic students in the public schools. Because white

and non-Hispanic students have higher achievement scores on average, there was reading scores decrease by 0.32 points on average in the traditional public schools.

Carruthers (2012) compared teacher quality of those teachers that transfer to charter schools with those that stay. Considering traditional public schools are restricted by some rules, such as, tenure and compensation system, charter schools free from those regulations are more likely to hire teachers with higher quality. This study found that teachers moved to charter schools were less experienced, had less regular license, had lower licensing test scores, and had less graduate degree than the traditional public schools. It is concluded that charter school hired below average teachers from the traditional public schools.

Summary

With regard to charter school, there have been lots of studies including charter school formation and diffusion, charter school achievement, charter school finance, and charter school characteristics. Studies about charter school formation and diffusion is associated with charter school legislation and its adoption considering the location of intra and interstate. Charter school achievement studies mainly focused on charter school competition with traditional public schools and attempted to find significant result of the competition by academic test scores. Following to charter school creation and achievement, charter school finance literatures are interested in relationship between education expenditure and student achievement or enrollment. Finally, studies about charter school characteristics included quality of teacher, student composition, etc. These studies examined changes of teacher and student by charter school competition and impact of those changes on student achievement.

First, results of charter school in each area of previous studies are not clear and consistent. It is because charter schools had different policy environment in terms of legislation, administrative education agency, funding, and school characteristics. Thus, it would be better approach to study charter school focusing on specific state and district within the state considering charter

schools in different policy setting.

Second, the previous studies limited to issues in initial setup stage, such as charter school achievement and competition effect on traditional public schools. Since charter schools have operated less than 30 years, many studies tried to examine whether or not charter school has been an effective school choice. It is proved that charter schools have been effective school choice, so it is time to move study focus from charter school achievement to charter school growth.

Third, the previous literature has dealt with variables related to part of charter school, not comprehensive charter school variables. Most of charter school studies dealt with one of data level among student, school, and school district. Moreover, main variables were limited to data including student enrollment, test score, and demographics which are basic and general part of charter school. To draw a big picture on charter school, it is useful model to include all level of data, such as, student and school, school district, and school community as well as consider specific and direct charter school variables, not by indirect public schools.

III. Research Design

1. Analytical Framework

Although numerous factors would influence charter school growth, this study chooses the variables likely to have significant impacts on charter school growth. The dependent variable and three main categories include twelve variables. The dependent variable is the enrollment change in charter schools and the independent variables are from school and student, school district, and school community categories.

The 7 years (2007-2013) of student, school, and district data is collected from 37 districts among the total of 67 districts in which charter schools had been operating for more than 5 years because the performance of the schools have

stabilized in 5 years (Sass, 2006). To measure the variables, we collect data from sources including the Florida Department of Education, Florida Department of State, Bureau of Economic and Business Research, and National Alliance for Public Charter Schools (Table 1).

〈Table 1〉 Measurement of Variables

Variables		Description	Data Source
Dependent Variable	Charter School Growth	Change of Charter School Student Population	National Alliance for Public Charter Schools http://dashboard.publiccharters.org/dashboard/reports
School & Student	School Achievement	District school grade for charter Schools	Florida Department of Education http://schoolgrades.fldoe.org/
	Free Reduced Lunch Eligible	Percentage of charter school student received free reduced lunch	National Alliance for Public Charter Schools http://dashboard.publiccharters.org/dashboard/reports
	White Student Population	Percentage of white student in charter school	National Alliance for Public Charter Schools http://dashboard.publiccharters.org/dashboard/reports
	Charter School Class Size	Number of student per classroom	Florida Department of Education http://www.fldoe.org/finance/budget/class-size/class-size-reduction-averages.shtml
School District	Expenditure for FTE	Per pupil spending in public school	Bureau of Economic and Business Research https://www.bebr.ufl.edu/data/localities/275/county
	Fixed Capital Outlay	Per pupil charter school capital outlay	Florida Department of Education http://www.fldoe.org/finance/fco/charter-school-capital-outlay/index.shtml
	Superintendent Appointment	Dichotomous indicator of school superintendent appointment	Florida Department of State
	School Board Size	Number of school board members	Florida Department of State

Variables		Description	Data Source
School Community	Median Household Income	Median household income	Bureau of Economic and Business Research https://www.bebr.ufl.edu/data/localities/4319/county
	Private Schools	Percentage of private school student	Bureau of Economic and Business Research http://www.bebr.ufl.edu/data/localities/468/county
	High School Graduate	Percentage of High School Graduate	Florida Department of Education http://www.fldoe.org/accountability/data-sys/edu-info-accountability-services/pk-12-public-school-data-pubs-reports/archive.shtml
	School-aged Children in Poverty	Percentage of 5-17 year olds in poverty	Bureau of Economic and Business Research https://www.bebr.ufl.edu/data/localities/2115/county

2. Research Hypothesis

1) Hypotheses: School and Student

Hypothesis 1: School achievement would positively influence student enrollment change in charter schools.

Since charter schools are created because of public school failure due to low performance, school policy stakeholders are interested in increasing school achievement. Related to school achievement, Sass (2006) found lower performance in charter schools at initial operating stages, but in five years of operation, charter schools showed similar achievement with the average public schools in mathematics and higher scores in reading than public schools. Henig and MacDonald (2002) found that charter schools tend to locate in communities with public schools that have low achievement. Moreover, Schwenkenberg and Vanderhoff (2015) found that student test score as achievement is the primary factor to charter school survival.

Hypothesis 2: Free reduced lunch eligible would positively influence student enrollment change in charter schools.

Students from families with an income at or below 130 percent of the poverty level (\$30,615) and between 130 percent and 185 percent of poverty level (\$43,568) are eligible for the free lunch program and reduced price lunch program, respectively. Participation rate for this National School Lunch Program (NSLP) has increased from 54 percent of charter schools in 2009 to 74 percent in 2012 (The Center for Education Reform, 2014). The main reason not to participate in NSLP is because the particular charter school does not have adequate facilities to meet the federal regulations and does not have room the excessive paperwork required by the United States of Department of Agriculture. In this context, free reduced lunch eligible would be a significant variable to influence the growth of charter schools in terms of management capacity.

Hypothesis 3: White student population would negatively influence student enrollment change in charter schools.

Charter school applications and new schools have increased new formation in school districts with student population diversity. Renzulli (2005) found that school districts with large populations and less white students have had more charter schools. Glomm et al. (2005) found that there was increased support for charter school legislation in states with greater population diversity. They presented that school districts with higher black and Hispanic populations had more charter schools. Thus, growth of charter schools may face challenges in school districts with higher white student populations.

Hypothesis 4: Charter school class size would negatively influence student enrollment change in charter schools.

When parents choose schools to enroll their children, the first thing to consider is the educational quality. In this respect, the most important thing is good teachers and high quality instructions through a class environment with a low student-to-teacher ratio. Schanzenbach (2014) found that class size is an important determinant to influence student outcome, and that increased class

size negatively influences student outcomes. In particular, the effect of class size reduction is greater for students from low-income families and non-white students. Therefore, we would expect that charter school class size would negatively influence student enrollment in charter schools.

2) Hypotheses: School District

Hypothesis 5: Expenditure for FTE in public schools would negatively influence student enrollment change in charter schools.

In Florida, all public schools including public charter schools are funded through the Florida Education Finance Program (FEFP) in the school district. For the operation of charter schools, the FEFP funds charter schools based on the number of FTE students enrolled. According to the Center for Education Reform (2014), charter schools spend per student about 68 percent of the amount traditional public schools spend. If we consider the expenditure of charter schools to be markedly less than traditional public schools, greater expenditures for public schools would have a negative impact on charter school financing.

Hypothesis 6: Capital outlay would positively influence student enrollment change in charter schools.

Capital outlay funded through the school district is used for facility space and management of school facilities. Without the outlay funds, it is not easy for charter schools to start up or to expand student enrollment. The Florida Legislature provides charter schools with capital outlay funds to spend for extensive purposes like construction or leasing of school facilities to operating resources. Thus, charter school capital outlay allocation is important in establishing and growing charter schools. Considering that charter schools depend on capital outlay for their financing, we would expect that per pupil capital outlay would positively influence student enrollment in charter schools.

Hypothesis 7: School district superintendent appointment would positively influence student enrollment change in charter schools.

Zhang and Yang (2008) found that appointed superintendents in school districts support charter schools because the superintendents are free from political interests groups and accountability to school board members. Meanwhile, an elected superintendent may be likely to support traditional public schools considering that the majority voters are parents of public school students (Moe, 2005). Therefore, it is reasonable to propose that school districts with appointed superintendents would positively influence charter school enrollment.

Hypothesis 8: The size of the school board membership would negatively influence student enrollment change in charter schools.

In Florida, the school board is the only authorizer of charter schools and offers various services to charter schools including transportation and financial services. Hess and Meeks (2010) found that less than 10% of school board members agreed that charter schools would contribute to improving student achievement. In addition, Ruble and Harris (2014) argued that elected school boards' position relies upon majority parents' preferences in the school district. Feiock (2015) presented that small size of school board membership with appointed superintendents support charter schools.

3) Hypotheses: School Community

Hypothesis 9: County Median income would negatively influence student enrollment change in charter schools.

A 2014 survey by the Center for Education Reform reported that 61 percent of charter schools serve student populations where more than 60 percent of the students qualify for the free and reduced lunch program offered to low-income families. In addition, 27 percent of charter schools serve populations with at least 60 percent of students categorized as at-risk. Glomm et al. (2005) found less support for charter school formation in school districts in urbanized areas with higher median incomes, greater poverty, and higher income inequality.

Hypothesis 10: The percent of private school students in the county would positively influence student enrollment change in charter schools.

It can be argued that the education offered by charter schools is very similar to private school education, so parents who are unsatisfied with traditional public schools are likely to choose charter schools. This similarity between charter and private schools and the tuition costs associated with the latter could generate competition between the school options for students. Ewert (2003) found that charter school growth is negatively related to private school enrollment. Toma, Gronberg, and Jones (2006) reported that in Michigan approximately 20% of the charter school students were from private schools.

Hypothesis 11: High school graduation rate in the county would positively influence student enrollment change in charter schools.

High school graduation rate is an important indicator of charter school enrollment as it is a school outcome. In Washington D.C, the high school graduation rate from charter schools (80 percent) was over 20 percent higher than the 59 percent rate from traditional public schools (The Washington Post, 2012) . This gap would be a strong incentive to attract parents and students to charter schools.

Hypothesis 12: School aged children poverty rate in the county would positively influence student enrollment change in charter schools.

Charter schools serve low-income and minority students compared to traditional public schools. 61 percent of charter schools in Florida qualify for the free reduced lunch program due to their family's low income. Moreover, Florida charter school participation rate for the NSLP has increased from 54 percent in 2009 to 74 percent in 2012 (The Center for Education Reform, 2014). If there is high school-aged childhood poverty in the county, it is likely that charter school enrollment would grow.

3. Data Analysis

Panel data analysis involved 37 school districts in operation for more than 5 years. The panel data set was from the school years 2006-2007 to 2012-2013¹⁾, with 259 observations from 37 school districts for the 7-year period²⁾. The dependent variable was annual charter school enrollment. Independent variables were school district, school and student, and school community. The one-year time gap between general statistical year and school year was reflected in the statistical analysis. Thus, the independent variables were collected from the 2006 to 2012 and dependent variable from 2007 to 2013. Table 2 provides descriptive data in charter school enrollment.

〈Table 2〉 Descriptive Analysis for Charter School Enrollment

	Variable	Observed	Mean	Standard Deviation	Minimum	Maximum
Dependent Variable	<i>Charter School Growth</i>	259	414.16	992.44	-892.00	6988.00
	<i>School Achievement</i>	259	4.36	0.73	1.00	5.00
Independent Variable	<i>Free Reduced Lunch Eligible</i>	259	0.39	0.18	0.04	0.99
	<i>White Student Population</i>	259	0.60	0.24	0.01	0.99
	<i>Charter School Class Size</i>	259	17.52	2.51	12.19	35.11
	<i>Expenditure for FTE</i>	259	8728.70	988.07	7479.00	12883.00
	<i>Fixed Capital Outlay</i>	259	419.97	212.35	0.00	1060.65
	<i>Superintendent Appointment</i>	259	0.54	0.50	0.00	1.00
	<i>School Board Size</i>	259	5.55	1.13	5.00	9.00
	<i>Median Household Income</i>	259	44965.12	6197.44	31150.00	63299.00
	<i>Private School Students</i>	259	8.09	4.49	0.00	20.85
	<i>High School Graduate</i>	259	65.47	8.74	32.67	86.19
	<i>School-aged Children in Poverty</i>	259	19.37	5.70	9.60	38.80

1) 46 school districts across Florida have adopted charter school policy since 1996. In 2002 and 2005, no new charter policies were adopted by districts and the year 2006 resumed adopting charter school policy in the districts. For enough data collection, we consider the year 2006 as starting point of data analysis.

2) According to Sass (2006), charter schools reach average level of performance in 5 year operation in order to compare with the average traditional public school. To examine the growth effect, we considered 7 year-data which is more than 5 year's operation of charter school.

For school growth over time, in general, a fixed effect or a random effect model is considered. A fixed effect model³⁾ is used when individual district unobserved permanent effects are correlated with any independent variable. Based on the fixed effect model, we set up the model as follows:

$$\text{Charter School Growth}_{it} = \alpha_i + \beta_1 \text{School Achievement}_{it} + \beta_2 \text{Free Reduced Lunch Eligible}_{it} + \beta_3 \text{White Student Population}_{it} + \beta_4 \text{Class Size}_{it} + \beta_5 \text{Expenditure for FTE}_{it} + \beta_6 \text{Fixed Capital Outlay}_{it} + \beta_7 \text{Superintendent Appointment}_{it} + \beta_8 \text{School Board Size}_{it} + \beta_9 \text{Median Household Income}_{it} + \beta_{10} \text{Private School Students}_{it} + \beta_{11} \text{High School Graduate}_{it} + \beta_{12} \text{School-aged Children in Poverty}_{it} + u_{it}$$

(where i = entity and t = time, α_i is the unknown intercept for each school district, β is the coefficient for the independent variable, u_{it} is the error term).

The Hausman test⁴⁾ revealed a correlation between independent variables and unobserved factors; the random effect model was rejected and the fixed effect model was selected as appropriate for this panel data. In addition to the Hausman test, we used Harris-Tzavalis unit-root test⁵⁾. There was no time-trend with the dependent variable, but there were unit-root problems with independent variables, school board size and high school graduate in Table 3.

3) Panel Data Fixed Effect Model: $Y_{it} = \beta_1 X_{it} + \alpha_i + u_{it}$,

Where α_i ($i=1 \dots n$) is the unknown intercept for each entity (n entity-specific intercepts); Y_{it} is the dependent variable (DV) where i = entity and t = time; X_{it} represents one independent variable (IV); β_1 is the coefficient for that IV; u_{it} is the error term

4) Hausman test score is $\text{Prob} > \text{Chi}^2 = 0.0007$. This test score reject H_0 : difference in coefficients not systematic.

5) Harris-Tzavalis unit-root test assumes that time is fixed and whereas No of cases go to infinity. Harris-Tzavalis test with dependent variable, Student Enrollment Change shows $p\text{-value} = 0.0000$, so we reject H_0 : Panels contain unit roots and accept H_a : Panels are stationary.

〈Table 3〉 Harris-Tzavalis unit-root test

	Variable	Statistic	z	p
Dependent Variable	<i>Charter School Growth</i>	0.37	-4.24	0.00
Independent Variable	<i>School Achievement</i>	-0.05	-11.01	0.00
	<i>Free Reduced Lunch Eligible</i>	0.44	-3.08	0.00
	<i>White Student Population</i>	0.43	-3.23	0.00
	<i>Charter School Class Size</i>	0.10	-8.51	0.00
	<i>Expenditure for FTE</i>	0.26	-5.99	0.00
	<i>Fixed Capital Outlay</i>	0.24	-6.35	0.00
	<i>Superintendent Appointment</i>	0.00	-10.21	0.00
	<i>School Board Size</i>	0.75	2.04	0.98
	<i>Median Household Income</i>	0.42	-3.31	0.00
	<i>Private School Students</i>	0.42	-3.36	0.00
	<i>High School Graduate</i>	0.95	5.37	1.00
	<i>School-aged Children in Poverty</i>	0.40	-3.71	0.00

IV. Findings and Discussion

Based on the panel data analysis with a fixed effect model, this study found that four variables were significant for charter school enrollment as sustainable charter school growth. Since School Board Size and High School Graduate showed unit root problems, we rearranged the independent variables deleting two variables with unit root problems in Table 4.

〈Table 4〉 Corrected Results of Fixed Effect Model for Charter School Enrollment Change

	Variable	Coefficient	Standard Error	t	P> t
Independent Variable	<i>School Achievement</i>	-7.26	89.73	-0.08	0.94
	<i>Free Reduced Lunch Eligible*</i>	955.35	484.01	1.97	0.05
	<i>White Student Population</i>	1280.39	872.45	1.47	0.14
	<i>Charter School Class Size***</i>	-72.50	19.02	-3.81	0.00
	<i>Expenditure for FTE***</i>	-0.44	0.12	-3.54	0.00
	<i>Fixed Capital Outlay</i>	-0.13	0.25	-0.50	0.62
	<i>Superintendent Appointment</i>	-766.96	630.47	-1.22	0.23
	<i>Median Household Income</i>	-0.01	0.01	-0.93	0.35
	<i>Private Schools</i>	22.72	33.06	0.69	0.49
	<i>School-aged Children in Poverty**</i>	31.32	14.43	2.17	0.03
	<i>Constant</i>	4697.05	1485.40	3.16	0.00
Fixed-effects (within) regression		Number of obs		=	259
Group variable: District		Number of groups		=	37
R-sq = 0.18					
corr(u_i, Xb) = -0.79					
Prob > F = 0.00					

*** $p < .01$, ** $p < .05$, * $p < .1$

After rerunning the model, we finalized the result of panel data analysis in Table 5. Overall, independent variables from each category in school and student, school district, and school community are important for sustainable charter school growth. Among four significant variables, two variables (Free Reduced Lunch Eligible and Charter School Class Size) are from school and student category, one variable (Expenditure for FTE) from school district, and one variable (School-aged Children in Poverty) is from school community.

Concerning school and student factors, free reduced lunch eligible and charter school class size are statistically significant in charter school student enrollment change. However, school achievement and white student population are not associated with charter school student enrollment change. Different from our expectation, school achievement which is one of important factor in charter school growth showed no significance. We can reason that measurement method

by school grade⁶⁾ rather than exam score causes this insignificant result. This implies that more students who are eligible for free reduced lunch program prefer charter schools. In addition, charter schools with free reduced lunch program may have facilities that meet the federal regulations and are able to manage the excessive paperwork required by the USDA. We expected charter school class size would negatively influence student enrollment in charter schools because education stakeholders consider an intimate class environment as the most important thing for high quality education. We can reason that effective education by small class size is very important because it gives students comprehensive impact on both test achievement and emotional development.

Second, with regard to school district factors, expenditure for FTE is the only statistically significant variable to student enrollment in charter schools. However, fixed capital outlay and superintendent appointment are not related to student enrollment in charter schools. It is proven that the reduced expenditure of charter schools compared to traditional public schools negatively influenced student enrollment in charter school.

Third, concerning school community, school-aged children in poverty is the only significant factor; other factors including median income and percent of private student are not significant. We proposed that school-aged children in poverty of school district would positively influence student enrollment in charter schools. This proposition is statistically supported by the higher student enrollment in charter schools with high rate of school-aged children in poverty in school district.

⁶⁾ School grade is calculated by the sum of performance of reading/math/writing/science and learning gains of all students and in the lowest performing 25%. Thus, school grade can be more appropriate than individual exam score to measure school achievement in that it is standardized as well as comprehensive to examine various aspects of student performance.

V. Conclusion

This study attempted to clarify factors influencing sustainable growth of charter schools for local educational autonomy. We examined diverse parts of charter school including school and student, school district, and school community and found that all three are important and each needs attention in studies of sustainable charter school growth as well as local educational autonomy.

In the school and student category, free reduced lunch eligible and charter school class size are important to explain sustainable charter school growth. This finding suggests student welfare support and class environment are more important than educational performance or student composition. In previous studies, free reduced lunch program variable was used to understand the financial background of schools and parents, but this variable implies more than parents financial capacity. If charter schools manage the free reduced price lunch program, these schools have administrative and managerial capacity, which is important infrastructure for sustainable charter school growth. In addition, the significance of charter school class size variable suggests that many parents consider charter school similar to private school with intimate class environment. Parents of non-white students prefer charter schools due to the small class size, which is similar to private schools in terms of intimacy with class members.

Second, the school district category had one significant variable, expenditure for FTE, which is related to the financial capacity of charter schools. It means that role of school district as financial distributor or provider is important to sustain the growth of charter schools. Negative impact of expenditure for FTE on sustainable charter school growth confirmed the result of previous studies that there is budget distribution disparity between traditional public schools and charter schools.

Third, the school community category has one significant variable, school-aged children in poverty. This finding indicates that related to sustainable charter school growth, the economic background of the family and government support are very important factors. As free reduced lunch eligible variable shows positive impact

on charter school growth, school-aged children in poverty indicates same positive direction as a similar economic background variable. In addition, this result makes sense in that charter schools utilize government resources to mobilize and realize new and innovative ideas for sustainable charter school students.

Finally, this study has some limitations. Although 46 school districts in Florida include charter schools, this study covered 37 school districts that had operated for more than 5 years. Due to problem of long-term data availability for panel data, this study dealt with 7 years of data which did not have any missing data. In addition, this study had some difficulty in collecting appropriate charter school data for independent variables, such as expenditure for FTE, pupil-teacher ratio, and parent education level.

Despite these limitations, this study has value in terms of research focus, locus, and analysis. First, this study shifted main focus from student achievement by comparison with traditional public schools to sustainable school growth by enrollment. Second, previous studies focused on micro level data like student level characteristics, but this study covered both micro and macro level data including student, school, and school district. This study would make a contribution to filling this gap from the existing literature considering 7 years of student and school, school district, and school community data on enrollment growth in Florida. Third, different from previous studies, this study reviewed diverse variables related to charter school growth and does comprehensive analysis which covers extensive factors, such as, institution, finance, and environment. Moreover, this study attempts to focus on school districts and growth of charter schools because local school districts are the only public agency to authorize charter school operation. There has been very little empirical study about how charter school has grown in local school districts considering enrollment growth of charter school. Therefore, this study would contribute to getting some lessons and bench-marking from the US practices in order to set up and implement local educational autonomy in Korea.

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강 인 성: 미국 플로리다주립대학교(Florida State University)에서 행정학 박사학위를 취득하고, 현재 송실대학교 행정학과 부교수로 재직중이다. 관심분야는 지역 및 도시정책, 국제협력, 거버넌스, 정부간관계 등이다. 주요논문으로 서울시 기업체에 있어서 고학력 경력단절 여성의 재취업방안 및 지원정책에 관한 연구(2012, 국가정책연구), 지방공기업의 수익성에 영향을 미치는 요인에 관한 연구: 경기도 지방공기업을 중심으로(2014, 국가정책연구), 비용효과분석을 통한 서울시 지하철 9호선 혼잡도 개선방안에 관한 연구(2017, 한국공공관리학회) 등이 있다(iik3411@ssu.ac.kr).