December 2014

UNINTENDED EFFECTS OF CHARTER SCHOOL PROGRAMS

Christian Buerger
Syracuse University

Abstract

The dissertation is comprised of three essays, which study unintended effects of charter school programs. Chapter 1 evaluates the influence of charter schools on housing values. The dynamics between school quality and housing markets contribute to the isolation of disadvantaged students in low performing school districts. Charter schools reduce the link between residential location and school services, and hence potentially affect both property values and residential sorting. This chapter examines if charter schools influence the differences in housing prices between school districts and neighborhoods. I begin by developing a theoretical model identifying how charter schools influence school quality and how these changes potentially affect housing prices. Utilizing housing sale data for Upstate New York between 2000 and 2010, I estimate models comparing changes in housing price differences between school districts and neighborhoods. I find that charter schools do not influence the gap in housing prices between districts but affect the differences in housing values between high and low income neighborhoods in districts with charter schools.

Chapter 2 analyzes the location of charter schools in New York, Florida, North Carolina, Michigan, and Ohio. I begin by describing the finance, accountability, and authorizer policies in each state. Then, I derive location and enrollment incentives created by these policies. Estimated negative binomial models reveal consistency between location patterns and finance provisions. In states where charter school payments vary with district location, charter schools are more likely to locate in districts with high expenditures holding cost and performance constant. However, in states where charter school payments do not vary with district location, charter school location is not influenced by district expenditures. Compensations for enrolling disadvantaged students create

location and enrollment incentives if they are sufficient enough to cover the costs of educating these students.

Chapter 3 examines how charter schools influence school district efficiency. Charter school opponents and proponents have been arguing for a long time about the effect of charter schools on district efficiency with very opposing views on the subject. Utilizing data for all New York State school districts from 1998 to 2009, I find that charter schools increase school district efficiency holding cost factors and district performance constant. The magnitude of the effect differs depending on the number of students enrolled in charter schools. The effect ranges between a 1.1 and 3.4 percent decrease in per pupil expenditures for enrollments between 50 and 5000 charter school students respectively. The effect is driven by efficiency gains in the provision of education for students in traditional public schools. The results are confirmed by several falsification tests.

UNINTENDED EFFECTS OF CHARTER SCHOOL PROGRAMS

By

Christian Buerger
M.P.A. University of Connecticut, 2005
Diploma in Public Administration, University of Potsdam, Germany, 2005

DISSERTATION

Submitted in partial fulfillment of the requirements for the
degree of Doctor of Philosophy in Public Administration
in the Maxwell School of Citizenship and Public Affairs of Syracuse University

December 2014

ACKNOWLEDGEMENTS

I owe a special debt to my dissertation advisor, Robert Bifulco Jr.. His high expectations and academic questions helped me to continuously challenge myself, but more importantly, his understanding support helped me to overcome many obstacles, which was crucial to write my dissertation. Additionally, I would like to thank my dissertation committee Ross Rubenstein, Amy Ellen Schwartz, Douglas A. Wolf, and John M. Yinger for their advice and comments. I am also grateful for the support of several faculty members that were not on my committee, yet still took the time to support my intellectual development. In particular, I thank William D. Duncombe, Christopher Rohlfs, and Jeffrey Weinstein. I thank Mary E. Lovely for the support at the finish line.

I also thank the Center for Policy Research and Public Administration staff for their help with all kinds of smaller or bigger problems that came along the road writing this dissertation.

I would like to thank Alex Bogin, Sun Jung Oh, Reiko Käske, and Michael Pahle for their helpful academic discussions and great friendship. Also, I would like to thank Jennifer Chiarilli, Kevin Russell, and Maurice Mengel for their great support and friendship while staying in Syracuse. I am especially indebted to Ludger and Kevin Viefhues-Bailey for their friendship and advice in "allen Lebenslagen". Last but not least, I would like to thank Junghwa Kang for her help, patience, humor, and being a great partner.

Finally, I thank my parents, Irma and Wolfgang Bürger, without whose support this dissertation would not have been possible. Further, I am indebted to my brother Arne and his family, who have been a great support during the work on my dissertation. I dedicate this dissertation to my family.

Table of Content

List of Figures

List of Tables

1. Introduction

Charter schools have been one of the most significant developments in U.S. education over the last twenty years (Bifulco and Bulkley 2014). Since the first charter school program was introduced in Minnesota in 1991, 42 states and the District of Columbia have adopted charter school legislation. According to the National Center for Education Statistics (2014), the percentage of all public schools that were public charter schools increased from 1.7 to 5.8 percent between 1999/2000 to 2011/2012. In over 100 mostly urban school districts charter schools serve more than 10 percent or the public school population. At the same time, charter school enrollment increased from 0.3 million to 2.1 million students nationwide.

Charter schools receive public funding but operate independently of their local school district. A contract with a public agency exempts the school from selected state and local rules. In return for funding and autonomy, the school must meet student performance standards specified in the law and its charter. The contract usually lasts for a set number of years and must be renewed to continue receiving public funding. To enroll into a charter school students have to apply for admission. Charter school students can cross attendance zone and in most states district borders making charter schools clearly a form of school choice. They do not charge tuition and oversubscribed charter schools are normally required to select students by lottery (Nelson et al. 2000; Bifulco and Bulkley 2008).

Research on charter schools has been mainly interested in the effects of charter schools on academic achievement (Bifulco and Ladd 2006; Hoxby and Murarka 2007; Booker et al. 2007; CREDO 2009; Imberman 201; Angrist 2012 et al.; Abdulkadiroglu et al. 2011) and segregation and isolation of particular student groups (Bifulco and Ladd 2007; Bifulco, Ladd, and Ross 2009; Zimmer et al. 2009; Booker, Zimmer, and Buddin 2005; Garcia 2008). Much less attention has been paid to the unintended effects of charter schools on public finance issues. Therefore, in the dissertation I address how charter schools influence housing prices, how charter schools financial provisions influence the location of charter schools, and how charter schools influence school district efficiency.

Chapter 2 analyzes the impact of charter schools on housing values. More specifically, I evaluate whether or not the entry of charter schools lowers the difference in housing prices between adjacent high and low performing jurisdictions. I develop a theoretical framework to analyze the impact of charter schools on housing values. My theory describes ways in which charter schools might influence school quality and thereby the difference in housing prices between either school districts or neighborhoods. The first case describes a positive effect of charter schools on school quality. The charter school is perceived as a valuable schooling option or introduces competition among schools. However, the increase in school quality is not large enough to create an incentive for households to move between jurisdictions. The difference in housing prices can either go up or down depending on the relative changes in school quality between jurisdictions. The second case illustrates an increase in school quality that is large enough to create resorting between jurisdictions. In this case, housing price differences between jurisdictions will decrease. The third case describes how charter schools might decrease school quality. Cream skimming of

educationally advantaged students or a decrease in district resources can degrade school quality. Housing values in jurisdictions with lower school quality will drop leading to an increase in the housing price gap between high and low performing school districts.

To analyze changes in housing price differences, I utilize housing sales for New York State between 2000 and 2010. My final sample consist of the city school districts Syracuse, Niagara Falls, Ithaca and their adjacent districts as well as a group of comparison districts. To analyze the change in housing price differences across districts, I estimate models comparing housing prices between districts with charter schools and their adjacent districts. Further, I compare changes in housing prices between neighborhoods with similar income in the district with charter schools and its adjacent districts. Also, I run regressions using a control group of districts similar to Syracuse, Niagara Falls, and Ithaca.

I do not find statistically significant changes in housing price differences between school districts. However, I do find an effect of charter schools on housing price differences between neighborhoods. In Syracuse, charter schools raise the price of housing by almost 6 percent in neighborhoods having an income below the district's median relative to similar neighborhoods in the adjacent school districts. In contrast, housing prices decrease by 5 percent in neighborhoods with an income above the median compared to similar neighborhoods in the adjacent school district. As a consequence, the difference in housing prices between poorer and richer neighborhoods in Syracuse is decreasing. The results suggests resorting between Syracuse's richer and poorer neighborhoods. Probably households living in Syracuse's richer neighborhoods, who get their child enrolled into one of the high performing charter schools,

move out of their neighborhood into somewhat poorer neighborhoods in Syracuse. As demand decreases in the richer neighborhoods, housing prices in the richer neighborhoods fall. As demand increases in poorer neighborhoods, housing prices in the poorer neighborhoods grow.

After charter school entry, housing prices in Niagara Fall's poorer neighborhoods decrease relative to neighborhoods with similar income levels located in the adjacent school districts. Likewise, after charter school entry, Ithaca's poorer neighborhoods experience declining housing prices relative to similar neighborhoods in the adjacent school districts. In both districts housing prices in richer neighborhoods are not influenced by charter school entry. Consequently, in Niagara Falls and Ithaca, the difference in housing prices between richer and poorer neighborhoods increases after charter school opening.

The empirical results suggest that the impact of charter schools on housing price gaps between neighborhoods is more complex and context specific than described in theoretical models on inter-district choice and voucher programs. More specifically, the effect of charter schools on housing values depend on how charter schools affect expected school quality in jurisdictions. Also, the empirical findings suggest that the effect of charter schools on housing values varies substantially between neighborhoods within the same district. Thus, to detect housing price changes it is necessary to analyze housing prices at the neighborhood level.

Chapter 3 analyzes the influence of finance provisions on charter school location patterns by comparing different states. Supply decisions by charter school operators play an important role in determining which students have access to charter schools, which schools will be subject to

charter school competition, what effects charter schools will have on school and residential segregation, and ultimately on the distribution of the costs and benefits created by charter schools (Bifulco and Buerger 2014).

The chapter provides an empirical test of whether charter school finance provisions influence charter school location and enrollment using a comparison between Michigan, Ohio, North Carolina, Florida, and New York. Applying theory and knowledge on finance provisions, I state hypothesis regarding the relationship between funding policies and charter concentration in five states. The first hypothesis states that in states linking charter school payments to district expenditures, charter schools will be more likely to locate in districts with greater expenditures holding performance and cost factors constant. This hypothesis was corroborated by the empirical analysis. The greater the variance in district expenditures the stronger was the relationship between charter school concentration and district expenditures.

The second hypotheses stated that in states paying the same per pupil amount no matter where the charter school locates, charter schools will move into school districts with relatively low per pupil payments. While the coefficients of the negative binomial models suggest the hypothesized relationship, the results were close to zero and not statistically significant. Thus, the hypothesis cannot be corroborated.

The third hypothesis predicted greater numbers of charter schools in districts with high concentrations of disadvantaged students and greater enrollment of these students in states paying additional money if the charter school enrolls disadvantaged students. The analyses were

able to corroborate this hypothesis for poor students. The results for special education and LEP students show that charter schools do not locate in areas with high concentrations of these students and enroll them less often compared to traditional schools in the same district. A potential explanations is that compensations are insufficient to outweigh the costs of educating these students. Another explanation is that charter schools have an incentive to enroll relatively high performing students to ensure compliance with the charter school contract and to secure sufficient demand for the allotted seats in the school.

The evidence provided in this chapter that charter schools respond to financial incentives in their location and enrollment patterns suggests that policy makers can influence the supply of charter schools by raising or lowering per pupil payments. For instance, a way to potentially encourage charter schools to serve larger shares of disadvantaged students is to increase the per pupil payments for those categories of students.

Second, the decision to either tie charter school payments to district spending or to pay a flat per pupil amount independent of location, has an important impact on charter school supply. Policies tying per pupil payments to district spending levels are likely to attract charter schools in high spending and inefficient districts. The opening of charter schools can increase competition between schools and hence lead to gains in the efficiency of providing education. As this study shows, these gains may be achieved at the expense of strong student stratification. More costly students stay in traditional schools while less costly students go to charter schools. This is more likely if finance policies do not include any or only small compensations for high cost students.

In states where finance policies show no variation in charter school payments with location, revenues have less influence on charter school supply. In these states charter school location may be more demand driven. This will be particularly true if finance policies include sufficient compensations for students not being served well by the existing traditional school system.

Chapter 4 uses the cost function approach as theoretical framework and empirical estimation strategy. Theoretically, I work out how charter schools influence the costs and efficiency of providing education. Empirically, I focus on the effects of charter schools on school district efficiency. In the empirical models, I control for changes in input factors such as teacher salaries and student characteristics as well as changes in performance. Thus, inputs and performance constant the coefficient on the charter school enrollment variable is driven by changes in district efficiency associated with charter school enrollment.

Utilizing data for all New York State school districts outside New York City from 1998/99 to 2009/10, I find that charter school enrollment increases district efficiency. The magnitude of the effect differs depending on the number of students enrolled in charter schools. The effect ranges between a 1.1 and 3.4 percent decrease in expenditures for an enrollments between 50 and 5000 charter school students. Efficiency gains are driven by the increased efficiency in providing education for students in traditional public schools. A charter school enrollment between 50 and 5000 students reduces per pupil expenditures required to produce an increment in student performance by 1.5 and 4.3 percent respectively.

The estimation strategy comes with two caveats. First, the interpretation of the coefficient attached to charter school enrollment as an efficiency effect relies on effective control for all cost factors associated with charter schools. Despite controlling for poverty, limited English ability, and disability status in the school district, I fail to control for the ability of the students crossing district borders to reach the performance objective of the district to which they transferred to. The cost of bringing all students up to a given performance objective will change if large shares of either low or high ability students transfer into the district. Second, given multiple outputs and input sharing in the production of education, the reduction of inefficiencies in the production of test scores may have two different sources. The reduction could reflect decreases in spending for outputs other than test scores. The reduction also could reflect the use of more efficient technologies to educate students. I will deal with both of these problems more in future drafts of the chapter.

In conclusion, the aim of this dissertation was to assess the unintended impact of charter school programs on housing prices, location decisions by charter operators, and school district efficiency in providing education. My conclusion is that charter school have unintended consequences in all three researched aspects. Thus, policy makers have to carefully scrutinized these unintended effects and incorporate them in their decisions on charter school policies.

2. The Impact of Charter Schools on Housing Values

2.1 Introduction

Starting with Oates (1969), an extensive body of literature has examined the link between school quality and residential location documenting that school quality is capitalized into housing values (Ross and Yinger 1999; Nguyen-Hoang and Yinger 2011). No matter if the studies focus on educational inputs such as spending per pupil or school outputs such as test scores, researchers have consistently found that households are willing to pay more for an incremental increase in education (Black 1999; Kane et al. 2006; Brasington and Haurin 2006). Further, studies found that heterogeneous preferences for school quality lead to residential sorting. Households with greater preferences for school quality and higher income sort into different neighborhoods than families with lower preferences for school quality and lower income (Bayer, Ferreira, and McMillan 2007; Yinger 2009). Ultimately, the dynamics between school quality and housing markets have strongly contributed to the isolation of disadvantaged students in low performing school districts (Barrow 2002). This is particularly true for urban areas where the poor are isolated in low performing city school districts and high degrees of segregation are prevalent between city and suburban school districts (Eberts and Gronberg 2005; Urquiola 2005; Bayoh, Irwin, and Haab 2006).

School choice programs reduce the link between residential location and school services, and hence potentially affect both property values and residential sorting. Theoretical papers predict

large effects of voucher programs on housing markets, reducing income and housing value disparities across school districts (Nechyba 2000, 2003; Ferreyra 2007; Epple and Romano 2003). Brunner, Cho, and Reback (2012) find that, in states that adopted inter-district choice programs, school districts with desirable nearby, out of district schooling options experience a relatively large increase in housing values, residential income, and population density. Hence, the authors corroborate the theoretical hypotheses substantiating that school choice programs are a potential instrument for overcoming the isolation of disadvantaged students and student segregation.

This essay focuses on charter schools, a rapidly growing form of school choice, and their impact on housing price disparities between neighborhoods with different income. Charter schools are nonsectarian, publicly funded schools, operating under a contract with a public agency. The contract, or charter, exempts the school from selected state or local rules and regulations. In return for funding and autonomy, the school must meet student performance standards specified in the law and its charter. The contract usually lasts for a set number of years and must be renewed to continue receiving public funding. Typically, students are not enrolled unless parents apply for admission. Charter schools are open to anyone who applies and they do not charge tuition. Oversubscribed charter schools are normally required to select students by lottery (Nelson et al. 2000; Bifulco and Bulkley 2008).

This chapter adds to the small literature on the impact of charter schools on housing values. More specifically, I evaluate whether or not the appearance of charter schools lowers the difference in housing prices between adjacent high and low performing jurisdictions. Prior

research by Imberman, Rourke and Naretta (2014) analyzes the impact of charter schools on housing values in Los Angeles County. The authors use the number of charters and the share of public enrollment in charters within various distances from a parcel as measurements of charter school penetration. Including census block fixed effects to account for endogenous charter locations and changes in the geographic distribution of sales, Imberman and colleagues do not find an impact of charter schools on housing values. Schwartz, Voicu, and Horn (2014) use housing sales in New York City to estimate the effect of choice school on housing values. The authors use the border approach popularized by Black (1999) and find that the opening of a choice school reduces the capitalization of test scores from zoned schools into housing values by approximately one third. They also find that the opening of the choice school is positively capitalized into housing values, suggesting that choice schools in New York City are viewed as neighborhood amenities.

The chapter contributes to the existing literature in two ways. *First*, I develop a theoretical framework to analyze the impact of charter schools on housing values. My theory describes three ideal cases of how charter schools influence school quality and thereafter the difference in housing prices between jurisdictions (either school districts or neighborhoods). The first case describes a positive effect of charter schools on school quality. The charter school is perceived as valuable schooling option or introduces competition among schools. However, the increase in school quality is not large enough to create an incentive for households to move between jurisdictions. The difference in housing prices can either go up or down depending on the relative changes in school quality between jurisdictions. The second case illustrates an increase in school quality that is large enough to create resorting between jurisdictions. In this case, housing price

differences between jurisdictions will decrease. The third case describes how charter school decrease school quality. Cream skimming of educationally advantaged students or a decrease in district resources can degrade school quality. Housing values in jurisdictions with lower school quality will drop leading to an increase in the housing price gap between high and low performing school districts.

Second, this chapter is the first study on the impact of charter schools on housing values outside the two largest cities in the United States, New York and Los Angeles. To analyze changes in housing price differences, I utilize housing sales for New York State between 2000 and 2010. My final sample consist of the city school districts of Syracuse, Niagara Falls, Ithaca and of their adjacent districts as well as a group of comparison districts. Thus, this study sheds light into the impact of charter schools on housing prices for a set of school districts located in metropolitan areas with fewer than 500,000 inhabitants.

To analyze the change in housing price differences across districts, I estimate models comparing housing prices between districts with charter schools and their adjacent districts. Further, I compare changes in housing prices between neighborhoods with similar income in the district with charter school and its adjacent districts. Also, I run regressions using a control group of districts similar to Syracuse, Niagara Falls, and Ithaca.

I do not find statistically significant changes in housing price differences between school districts. However, I do find an effect of charter schools on housing price differences between neighborhoods. In Syracuse, charter schools raise the price of housing by almost 6 percent in

neighborhoods having an income below the district's median relative to similar neighborhoods in the adjacent school districts. In contrast, housing prices decrease by 5 percent in neighborhoods with an income above the median compared to similar neighborhoods in the adjacent school district. As a consequence, the difference in housing prices between poorer and richer neighborhoods in Syracuse decreases. The results probably indicate resorting between Syracuse's richer and poorer neighborhoods. Households living in Syracuse's richer neighborhoods, who get their child enrolled into one of the high performing charter schools, move out of their neighborhood into somewhat poorer neighborhoods in Syracuse. As demand decreases in the richer neighborhoods, housing prices in the richer neighborhoods fall. As demand increases in poorer neighborhoods, housing prices in the poorer neighborhoods grow.

After charter school entry, housing prices in Niagara Fall's poorer neighborhoods decrease relative to neighborhoods with similar income levels located in the adjacent school districts. Likewise, after charter school entry, Ithaca's poorer neighborhoods experience declining housing prices relative to similar neighborhoods in the adjacent school districts. In both districts housing prices in richer neighborhoods are not influenced by charter school entry. Consequently, in Niagara Falls and Ithaca, the difference in housing prices between richer and poorer neighborhoods increases after charter school opening.

The empirical results suggest that the impact of charter schools on housing price gaps between jurisdictions is more complex and context specific than described in theoretical models on inter-district choice and voucher programs. More specifically, the effect of charter schools on housing values depend on how charter schools affect expected school quality in jurisdictions. Also, the

empirical findings suggest that the effect of charter schools on housing values varies substantially between neighborhoods within the same district. Thus, to detect housing price changes it is necessary to analyze housing prices at the neighborhood level.

The remainder of the chapter is structured as follows. Section 2 describes the charter school program in New York State. Section 3 states the theoretical framework and Section 4 applies the theoretical framework to New York State. Sections 5 and 6 explain estimation strategies and comparison groups respectively. Section 7 makes conclusions on the estimation strategies and comparison groups. Section 8 describes the data used for the analysis and provides Summary statistics. Section 9 presents the results and Section 10 states the conclusions.

2.2 Charter School Program in New York State and Sample of School Districts

The New York Charter School Law was established in 1998. According to the law, charter school students are allowed to attend charter schools outside their school district and attendance zone boundaries. However, if charter schools are oversubscribed, they have to select students by lottery. In this lottery process, preference is given to students residing in the school district, where the charter school is locating (NYS Charter School Law Subsection 2854 (2b)). Thus, oversubscribed schools may almost exclusively serve students from the district where they are located.

Charter schools receive per pupil payments from the districts in which their students reside, and these payments are the charter school's primary source of funding. The amount a district pays per student is linked to the approved operating expenses of the district where the student resides. The charter application, approval, and evaluation process is closely regulated by the charter school authorizers[1]. The accountability standards set by authorizers can be considered relatively high compared to other states. Charter schools authorized by the Board of Regents have to perform higher than traditional schools in their district. School authorized by the New York State University are expected to have 75 percent of their students to score "proficient" or higher on state assessments. In a multistate comparison of charter school accountability laws and practices, the Center for Education Reform (CER) rated New York as a state that holds charter schools strictly accountable, pointing out that New York is one of the few states that have closed charter schools for performance reasons (CER 2007). The National Alliance of Public Charter Schools identifies New York as being amongst the few states using performance-based charter contracts, comprehensive school monitoring, and a systematic data collection processes (NAPCS 2012). Further, the charter school law of New York State requires districts to provide transportation to students enrolled in charter schools (NYS Charter School Law Subsection 2853 (4b)).

In 2010, 177 charter schools were operating in New York State. The majority of charter schools are located in NYC. I focus on charter schools outside NYC as I do not have housing sale data available for NYC. Table 1 shows the 14 school districts outside NYC that have charter schools. The first column indicates the year the first charter school was established. The second column shows the number of charter schools in each school district and the third column the share of

[1] Almost all charter schools are authorized by the State University of New York and the Board of Regents. Only two charter schools are authorized by a local school district.

students enrolled in charter schools. The highest counts of charter schools are in Albany, Buffalo, and Rochester. The share varies widely between 1 percent in Yonkers and 74 percent in Wainscott[2]. Further, there are several districts where the share is between 11 and 24 percent including Albany, Buffalo, Lackawanna, Roosevelt, and Kenmore-Tonawanda.

The following columns present the performance of charter schools, regular public schools in the district, and the performance of adjacent districts. Performance is measured using state wide tests for grades 4 and 8 in English Language, as well as grades 4 and 8 in mathematics. After calculating the state average, I standardize the result with regard to the state mean. The resulting performance measurement is zero at the state mean and equals one (and negative one) at one standard deviation above (below) the mean. Charter schools outperform the average public school in the district where they are located except in the Niagara Falls school district. Most of the charter schools locate in school districts that perform below the state average. The exceptions are Ithaca and Kenmore Tonawanda where traditional public schools perform above the state average. The surrounding suburban districts perform in most cases better than the city school districts except in Ithaca, Kenmore-Tonawanda, and Troy, where the performance in the charter school district is greater than in its neighboring districts.

To be included in the analysis, districts have to fulfill two criteria. *First*, there has to be a sufficient number of housing sales observed before and after charter school entry. In Albany, the first charter school opened in 1999. As I do not have housing sales prior 2000, I excluded Albany from the sample. In Buffalo, Rochester, Roosevelt, and Wainscott charter schools started

[2] The Wainscott School District has only two schools including the charter school. The traditional public school has only elementary grades and had an enrollment of 21 students.

operating in 2000. With only 8 months of housing sales before charter school entry, I am unable to estimate the effect of charter schools on housing values in these school districts, and hence excluded them from my analysis. For some districts, particularly those located on Long Island, I have sales information only for parts of the district. These districts have to be excluded as well.

Second, some school districts had a charter school moving into one of their adjacent school district at an earlier point in time. These charter schools may already affected housing values. Therefore, I excluded the school districts Kenmore-Tonawanda, Lackawanna, Troy, and Yonkers. Applying these two criteria leaves Syracuse, Niagara Falls, and Ithaca for the analysis.

2.3 General Theoretical Framework

The theoretical framework is based on the standard model of school quality capitalization as expressed in Ross and Yinger (1999), and Nguyen-Hoang and Yinger (2011). The standard model assumes that households maximize their utility over school quality, housing, and a composite good. Households make bids on housing based on school quality and local property tax rates. Households sort into different districts and attendance zones according to their income and preferences. The model assumes that households are mobile, and hence a key equilibrium condition is that all households in an income taste class achieve the same utility level. Households locate in a metropolitan area with many local governments financed by a property tax. All people who live in the same district are assumed to receive the same level of public services, and the only way to gain access to the public services in a district is to live there. Further, all households are considered homeowners.

A household's budget constraint requires income to equal spending.

$$Y = Z + PH + tV = Z + PH + t\frac{PH}{r} = Z + PH + t^{*}PH = Z + PH(1 + t^{*}) \quad (1)$$

where *Y* is the household's income; *Z* is a composite good; *H* is units of housing services, which are sold at price *P*; *t* is the effective property tax rate[3]; *V* is the market value of a house and equal to *PH/r*, where *r* is the appropriate discount rate; and *t* = t/r*.

The household's problem is to determine how much to pay for *H* given the quality of local public services, *S*, and the effective tax rate, *t*. This problem can be specified by determining the maximum price a household will pay for housing associated with a given *S*, holding their utility constant. More technically, the household problem is defined by solving Equation (1) for *P* and maximizing the result with respect to *H* and *Z* subject to a utility constraint. Thus, a household maximizes

$$P = \frac{Y - Z}{H(1 + t^{*})} \quad (2)$$

subject to

$$U(Z, H, S) = U^{0}(Y) \quad (3)$$

[3] The effective property tax rate equals the nominal tax rate times the assessed value divided by the market value.

where U^0 is the utility achieved by households with income *Y*.

Using the envelope theorem, the following equation can be derived

$$\frac{\partial P}{\partial S} = \frac{U_S/U_Z}{H(1+t)} = \frac{MB_S}{H(1+t^*)} \quad (4)$$

In this equation, $\partial P/\partial S$ is the slope of the households bid function with respect to the quality of local schools. The slope indicates a household's willingness to pay for an additional unit of school quality. According to the standard model, households sort into jurisdictions based upon the slope of their bid functions. Further, U_S/U_Z is the marginal rate of substitution between *S* and the composite good and is also called the marginal benefit from *S* in dollar terms or MB_S.

Households sort according to their bid-functions for educational quality at two jurisdictional levels: school districts and attendance zones. To illustrate how school quality and residential location are linked for both types of jurisdictions consider the case depicted in Figure 1. There are two jurisdictions and two income-taste classes. Jurisdiction 1 has a low school quality and Jurisdiction 2 has a high school quality[4]. Further, there are two income taste classes A and B. Income taste class A has a high marginal willingness to pay for education. Income taste class B has a low marginal willingness to pay for education. Households in income taste class A have a steep bid function for school quality, and they win the bidding competition for housing in

[4] "School quality is a complex and multidimensional concept" (Cullen and Jacob 2007: 6). Measures of school quality can be financial resources, the quality of the match between students and teachers, test scores, etc. In this study, I will use standardized test scores from the NYS report cards as they make comparisons between school districts possible. Further, report cards are well known to parents and potentially guide schooling decisions.

Jurisdiction 2. Households in income taste class B have a flatter bid function for school quality, and they win the bid in Jurisdiction 1. Over time, households will perfectly sort into both school jurisdictions resulting in income and housing prices disparities.

Assume now that a charter school opens in Jurisdiction 1 (similar to Syracuse and Niagara Falls). The appearance of a charter school in Jurisdiction 1 can influence perceived school quality in four different ways. *First*, parents might value the option of sending their child to a low-cost educational alternative. When the existence of that possibility gives rise to a higher level of expected school quality than without it, the option has a value. This value is irrespective of whether the option is exercised or not. Option values are frequently encountered in financial markets, for example when the right to sell or buy in the future at a given price is bargained. The concept is also frequently associated with the valuation of environmental goods (Cameron and Englin 1997; Adamowitz et al. 1998) and transportation options (TCRP 2002), which may or may not be enjoyed in the future. If parents see charter schools as an option value because of their high performance, a particular school theme, or the racial composition of the school, school quality in Jurisdiction 1 and 2 will increase. This effect is likely to be larger in Jurisdiction 1 as the existing school quality is low and potential alternatives will add more value.

Second, charter schools introduce competition to regular public schools. Charter school proponents argue that regular public schools operate in a monopolistic market and are overburdened by the institutions of democratic governance that leave them vulnerable to conflicting demands of multiple interest groups. Thus, they have weak incentives to improve school quality as perceived by parents or to use resources more efficiently (Brennan and

Buchanan 1980; Chubb and Moe 1990). Charter schools introduce competition to the public school system creating market incentives that induce regular public schools to become more efficient and increase their performance (Friedman 1955, 1962). Competitive mechanisms are likely to increase school quality in Jurisdiction 1. In Jurisdiction 2, school quality changes only if the charter school performs at the same or a higher level than the traditional schools in Jurisdiction 2. In that case, the charter schools is able to compete with traditional schools potentially influencing their quality. Generally, the effect of competition is likely to be larger in Jurisdiction 1 as school quality is relatively low and competitive mechanisms will create greater pressure to improve school quality.

Third, charter schools can give rise to "cream skimming". Cream skimming refers to the worry that charter schools will primarily serve the most advantaged students, leaving the disadvantaged to languish in underperforming schools. Cream skimming might arise for two main reasons. There is variation in availability of information about charter schools, and if information is costly to obtain, economically and educationally advantaged families are better able to exercise choice (Hastings and Weinstein 2008). Further, advantaged students are less costly to educate and charter schools might choose a location in the district where students with relatively high socio-economic status live or take other steps to recruit relatively high performing students (Henig and McDonald 2002). Cream skimming is likely to result in high quality charter schools potentially leading to an increased option value. At the same time, traditional public schools will decrease in school quality.

Fourth, charter schools can potentially decrease district resources. Charter schools might have a negative impact on school districts resources in two ways. First, operating two systems of public schools under separate governance arrangements can create excess costs. Excess costs can be a result of increased personnel, facility, transportation, special education, health services, and maintenance costs. Second, charter school financing policies can distribute resources away from districts if state aid payments to districts decrease and local charter school contributions increase (Bifulco and Reback 2012). Decreasing district resources are likely to have a negative impact on the quality of traditional public schools. Charter school quality is unlikely to be influenced by decreasing district resources.

These mechanisms may appear simultaneously, and may offset or complement each other. For instance, it is possible that charter schools introduce "cream skimming" and at the same time competition to the regular district school. Whether overall school quality increases or decreases depends on the relative strength of these effects. The mechanisms can empirically lead to three different cases that I explain in the following sections. In the first case, school quality increases but the change is insufficient to generate resorting. In the second case, the increase in school quality leads to resorting. In the third case, school quality decreases.

Case 1: Increase in School Quality Insufficient to Generate Resorting

In the first case, illustrated in Figure 2, growth in perceived school quality is not large enough to generate resorting. For Type B households the savings in housing generated by a move into District 1 would not be outweighed by the loss in amenities. Case 1 is more likely, if there is a large difference in school quality and other amenities between Jurisdiction 1 and 2 prior to the

charter school opening. Both income taste classes stay in their jurisdiction and compete with families of the same type for housing. However, as school quality has increased households are willing to pay a higher price for a unit of housing holding their utility constant. Population density and average income in both districts stay the same. Depending on the change in school quality for both jurisdictions housing prices will remain the same or go up. Thus, if the school quality in Jurisdiction 2 is greater than in Jurisdiction 1 prior to the appearance of the charter school and no resorting takes place, then

$$\Delta N_1 = 0, \quad \Delta N_2 = 0, \quad \Delta P_1 \geq 0, \quad \Delta P_2 \geq 0, \quad \Delta \overline{Y}_1 = 0, \text{ and } \Delta \overline{Y}_2 = 0.$$

The change in relative housing prices between Jurisdictions 1 and 2 is difficult to predict. However, even if the incremental increase in school quality is smaller in Jurisdiction 2 than in Jurisdiction 1, the effect on housing prices could be larger in Jurisdiction 2 as households have a greater willingness to pay for marginal increases in school quality.

Case 2: Increase in School Quality Leading to Resorting

In the second case, growth in perceived school quality is large enough to generate resorting. This case is illustrated in Figure 3. Increases in Jurisdiction 1's school quality will create an incentive for Type B households living in Jurisdiction 2, to move into Jurisdiction 1 to take advantage of lower housing prices while sending their child to the charter school. Note that Type B households will only move into Jurisdiction 1 if the loss in amenities, they face by leaving Jurisdiction 2, is outweighed by savings in housing. Generally, resorting is more likely if Jurisdictions 1 and 2 are relatively close in the quality of education and other amenities before the appearance of the charter school. The resorting of households leads to an increase in

population density in Jurisdiction 1 and a decline in population density in Jurisdiction 2. As a result housing prices in Jurisdiction 1 will go up and housing prices in Jurisdiction 2 will go down. Since the households choosing to move into Jurisdiction 1 have a greater income than the households already living in Jurisdiction 1, the average income in Jurisdiction 1 will increase. As all households in Jurisdiction 2 belong to the same income taste class there will be no change in average income. Thus, if school quality is greater in Jurisdiction 2 than in Jurisdiction 1 prior to the appearance of the charter school and resorting takes place, then it follows that:

$$\Delta N_1 > 0, \quad \Delta N_2 < 0, \quad \Delta P_1 > 0, \quad \Delta P_2 < 0, \quad \Delta \overline{Y}_1 > 0, \text{ and } \Delta \overline{Y}_2 = 0.$$

where N_1 and N_2 are population densities, and $\overline{Y}_1$ and $\overline{Y}_2$ are the average incomes in Jurisdiction 1 and 2. The difference in housing prices between Jurisdiction 1 and 2 will be reduced as housing prices in Jurisdiction 1 increase and Jurisdiction 2 decrease. Also, the gap in income disparities is reduced as average income increases in Jurisdiction 1.

Case 3: Decrease in School Quality

In the third case, the charter school decreases overall school quality in Jurisdiction 1. This case is depicted in Figure 4. As school quality has decreased, Type B households will pay less for a unit of housing holding their utility constant. Type A households will not be attracted by the low performing schools in Jurisdiction 1. Thus, housing prices in Jurisdiction 2 will not change. Under this scenario, the same income taste classes continue living in Jurisdiction 1 and Jurisdiction 2. Also, population density and average income in both Jurisdictions stay the same. Depending on the decrease in school quality for Jurisdiction 1 housing prices will go down.

Thus, if the school quality in Jurisdiction 2 stays the same and school quality in Jurisdiction 1 decreases, then

$$\Delta N_1 = 0, \quad \Delta N_2 = 0, \quad \Delta P_1 \leq 0, \quad \Delta P_2 = 0, \quad \Delta \overline{Y}_1 = 0, \text{ and } \Delta \overline{Y}_2 = 0.$$

The difference in housing prices between Jurisdiction 1 and 2 will increase as housing prices in Jurisdiction 1 decrease and Jurisdiction 2 stay the same. Population density and average income stay the same in both Jurisdictions.

Differential Effect of Charter Schools on Housing Values with Distance

The effects described in the above cases are likely to differ by households' distance to the charter school. Epple and Romano (2003) describe how with increasing distance from the charter school transportation costs increase. Increasing transportation costs will decrease households' option values of sending a child to a charter school. Thus, it is likely that the effect of charter schools on housing values is also declining with distance.

2.4 Application of Theoretical Framework

The theoretical framework can be applied to school districts and neighborhoods. I start with an application to housing prices changes between districts and then explain implications for housing price changes between neighborhoods. For each jurisdiction, I state how changes in housing price gaps are likely to occur.

The New York State charter school program and the location of the three school districts in the sample have two important implications for applying the above described theory. *First*, oversubscribed schools in New York have to give enrollment preference to students living in the school district the charter school is located. Thus, for oversubscribed schools, the option value of the charter school is very small for families living outside the district. *Second*, charter schools in Niagara Falls and particularly Syracuse have lower levels of performance relative to the traditional public schools in their adjacent districts (see Table 1). In these areas, it is unlikely that parents will send their children to a charter school which has lower levels of performance than the traditional public school the family can access.

These assumptions are supported by the charter school enrollment figures in 2010[5]. In Syracuse and Niagara Falls, 95 percent of the students enrolled in charter schools reside in the district where the charter school is located. In Ithaca, the share of students enrolled from outside the district is greater. Still about 60 percent of the students in the Ithaca charter school are from Ithaca. Consequently, the gap in housing prices between districts with charter schools and their adjacent districts is most likely driven by changes in housing prices in districts with charter school particularly in Syracuse and Niagara Falls.

In sum, for the Syracuse and Niagara Falls metro areas, I expect changes in housing price differences between districts to be driven by housing price changes in districts with charter school. The gap in housing prices between districts will converge if housing prices in the district with charter school increase. The housing price gap will diverge if housing prices in the district

[5] Enrollment is taken from the New York State report cards.

with charter school decrease. In Ithaca, the change in housing price differences is likely to be driven by housing price changes in Ithaca and its adjacent school districts. If housing prices decrease or decrease more in Ithaca than in its adjacent districts, housing prices will converge. If housing prices increase or increase more in Ithaca than in its adjacent school districts, housing prices will diverge.

Changes in housing price differences between neighborhoods are expected to follow a different pattern. *First*, it is important to note that changes in housing price differences between neighborhoods can occur in two ways. On one hand, the difference in housing prices between neighborhoods located in the same districts can change. On the other hand, the difference in housing prices between neighborhoods in different districts can change. *Second*, resorting between neighborhoods is more likely, as gaps in amenities are smaller compared to gaps in amenities between districts. *Third*, neighborhoods within a school district are often very heterogeneous. Usually, the socio-economic status of residents and the quality of schooling available differ between neighborhoods. Thus, charter school may impact housing prices in varying neighborhoods differently.

If households move between neighborhoods or bid up housing prices in some neighborhoods but not in others, the housing price difference between districts is probably influenced as well. However, the changing housing prices may not show up in an across district analysis for the following reasons. *First*, the effect of charter schools may strongly differ between neighborhoods even if the effect goes in the same direction. In an across district analysis, a heterogeneous charter school effect would lead to imprecisely measured results leaving the researcher in

uncertainty if there is an effect of charter schools on housing values. *Second*, the effects of charter school may be positive in some neighborhoods while being negative in other neighborhoods. In an across district analysis these effect would cancel each other out leading the researcher believe that there is no effect of charter schools on housing values.

Altogether, I expect the gap in housing prices between neighborhoods to converge if households resort between neighborhoods. In this case, housing prices in the neighborhood with formerly low school quality increase and housing prices in the neighborhood with formerly high school quality decrease. Further, housing prices between neighborhoods will converge if housing price changes in the neighborhood with formerly low school quality are greater than in the neighborhood with formerly high school quality. I anticipate housing prices to diverge if school quality decreases in the neighborhood with low school quality leading to lower housing values while housing prices in the neighborhood with formerly high school quality stay the same. Also, charter schools may lead to an increase in housing prices in formerly low and high performing neighborhoods but more so in the neighborhood with high school quality. This case is likely as households in the neighborhood with high school quality have a steeper bid function and housing prices are likely to react more to an incremental increase in school quality.

2.5 Empirical Methods: Estimation Strategy

The section on empirical methods consist of three parts. The first part explains the estimation strategies used in the chapter. The second part describes in more detail the comparison groups utilized in the empirical methods. The third part compares advantages and disadvantages of the empirical strategies used.

Estimation Strategy 1

The baseline specification is based on a difference in difference framework. I estimate the shift in neighborhood housing price trends comparing housing values before and after the charter school entry in the district where the charter school enters to the shift in housing values in its adjacent districts. I use census tract fixed effects to control for time invariant neighborhood characteristics. I also include quarter by year fixed effects to control for seasonality and specific year characteristics. The baseline estimating equation is written as follows:

$$\log P_{indqy} = \beta_0 + \beta_1 Post_{qy} + \beta_2 \left(Post_{qy} \times Inside_d\right) + \varphi X_{indqy} + \delta_n + \theta_n T_y + \mu_{qy} + \varepsilon_{indqy} \quad (5)$$

where ***P*** is the price of a house ***i***, in neighborhood ***n***, in district ***d***, during a quarter of the year ***q***, and year ***y***. $Post_{qy}$ indicates the time after charter school entry[6]. $Inside_d$ indicates the district with the charter school. The vector *X* stands for housing characteristics including the overall condition of the house, the availability of a fireplace, the construction grade, the availability of central air conditioning, the number of bathrooms, the number of bedrooms, the living area, the living area squared, the age of the house, and the age of the house squared. The term δ_n stands for neighborhood fixed effects at the census tract level. The term $\theta_n T_y$ indicates the slope of the neighborhood specific trend and μ_{qy} indicates month by year fixed effects. The last term ε_{indqy} is a randomly distributed error term.

[6] I set the start of the post period equal to the opening of the first charter school in the area.

The coefficient of interest in the above equation is β_2. The coefficient compares housing price trends in districts with charter schools to housing price trends in their adjacent districts before and after charter school entry. The coefficient measures the average treatment effect of charter schools on housing values in the district in which they are located under the provision that the adjacent districts act as an appropriate counterfactual for the change in housing prices in absence of the charter school. I expect the coefficient to be positive, if charter schools raise housing prices in the district they locate. I expect a negative sign, if charter schools decrease housing prices in the district they locate.

There are three potentially useful modifications of the baseline model. In the *first* modification, I will reduce the sample to housing sales taking place half a mile away from the district border. By reducing the sample to housing sales close to the district border, I can effectively control for amenities relevant to residents on either side of the border.

In the *second* modification, I control for distance between charter school and parcel. As stated in the theoretical section, with distance grow transportation costs. Increased transportation costs are likely to decrease the option value of the charter school. Thus, the effect of charter schools on housing values probably decreases with distance.

To control for distance in the baseline specification, I measure the distance between each house sold and the charter school. I add a distance term to Equation 5. Further, I interact distance with *Post* and *Inside*. The coefficient I am after is attached to the triple interaction between distance

and *Post X Inside*. The coefficient tells me how the effect of the charter school is changing if the distance to the charter school increases by one mile.

Third, theoretical models on the relationship of school quality and housing values have stressed the importance of household income on the willingness to pay for education (Nguyen-Hoang and Yinger 2011; Epple and Romano 2003; Epple, Romer, and Sieg 2001). These models emphasize that high-income households are willing to pay more for increases in their child's educational achievement and hence are willing to pay more for increases in the quality of their child's school. Therefore, a charter school may be highly valued by families living in a high income neighborhood. On the other hand, households living in high income neighborhoods are likely to have already access to relatively high performing public or private schools. Thus, charter schools may not add additional value for them. Households living in low income neighborhoods are likely to have only access to low performing schools, and a potential alternative will be highly valued. However, poor households are unlikely to be able to pay relatively large amounts of money for increases in the quality of their child's school.

As the effect of charter schools on housing values is likely to differ between neighborhoods with varying income, I estimate the baseline specification separately for neighborhoods with different income. In the first of these models, I reduce the sample to housing sales in neighborhoods with an income below the median in the district with charter school. In the second model, I reduce the sample to housing sales in neighborhoods above the median in the district with charter school. In both models, I include only neighborhoods in the charter school district that have a similar income compared the neighborhoods in the adjacent districts and vice versa. With limiting the

sample to similar neighborhoods in the district with charter school and its adjacent districts, I avoid bias resulting from comparisons that are not supported on either side of the border.

Estimation Strategy 2

The next empirical specification is based on a triple difference framework. I estimate the shift in neighborhood housing price trends comparing housing values before and after charter school entry, between the metropolitan areas in the sample and their matched metropolitan areas, and between the focal districts in these areas with their adjacent districts. Similar to the previous equation, I include a several fixed effects to control for time-invariant neighborhood characteristics, neighborhood housing price trends, seasonality, and year effects. The empirical model can be expressed as follows:

$$\log P_{indqy} = \beta_0 + \beta_1 Post_{qy} + \beta_2 \left(Post_{qy} \times Inside_d\right) + \beta_3 \left(Post_{qy} \times Treat_d\right) + \beta_4 \left(Post_{qy} \times Inside_d \times Treat_d\right) + \varphi X_{indqy} + \delta_n + \theta_n T_y + \mu_{qy} + \varepsilon_{indqy} \quad (6)$$

In this model, $Inside_d$ indicates the district with charter and its direct comparison district in a matched metropolitan area. $Treat_d$ is a dummy variable being one in the district with charter school and its adjacent districts. The dummy equals zero for all districts in the control group.

The coefficient of interest is β_4. The coefficient compares metropolitan areas with each other, compares the district with charter school and its direct comparison district with their adjacent school districts, and compares the time before and after charter school entry. The coefficient will

be positive if charter schools impact properties more positively (or less negatively) in districts with charter schools compared to its adjacent districts and a set of similar school districts in another metropolitan area. Therefore, a positive coefficient can indicate two effects. If the charter school moved into a district with lower housing values than its adjacent district, the housing price gap will decrease. If the charter moved into a district with greater housing prices than its adjacent districts, the housing price gap will increase. The coefficient will be negative if the impact of charter school entry is more negative (or less positive) in the district with the charter school compared to its adjacent districts and a set of school districts in another metropolitan area. Thus, a negative coefficient can imply two effects. If the charter school moved into a district with lower housing values than its adjacent districts, the housing price gap will increase. If the charter school moved into a district with greater housing prices than its adjacent districts, the housing price gap will decrease.

It is important to note that the empirical strategy stated above does not rely on similarity in district characteristics. If districts with charter schools and without charter schools are not becoming more or less dissimilar prior charter school opening, the estimated effect should identify the causal impact of charter schools on housing values. More specifically, identification of the causal effect requires that housing prices follow parallel trends conditional on the observable covariates in the absence of any intervention. If that is the case, any difference in housing prices in the period after charter school entry can be attributed to charter schools. Importantly, this assumption cannot be explicitly tested as we do not observe the true counterfactual. In the next section, I will analyze the parallel trend assumption using graphical evidence.

2.6 Empirical Methods: Comparison Groups

The goal of the empirical strategy is to estimate changes in housing price differences between districts with and without charter schools. For causal inference, however, it is not sufficient to compare housing prices in school districts before and after charter school opening. An appropriate comparison group is required to estimate what would have happened to housing prices in the absence of the charter school. To help estimate the counterfactual, I select different control groups. How I select control groups is explained in more detail below.

Comparison Group 1: Adjacent School Districts

The *first* control group consists of all housing sales in the adjacent school districts. I define adjacent districts as all districts that border the district with the charter school. This is illustrated in Figure 5, which shows Syracuse and its adjacent districts. The Syracuse City School District is located in the center and the two charter schools are highlighted. Adjacent school districts are all districts touching the border of the Syracuse City School District. The focus of my analyses is changes in housing price gaps between school districts after charter school entry. Thus, the adjacent school districts are a natural comparison group. Further, as the adjacent school districts are in the same metropolitan area, they are likely to be affected by the same housing market shocks as the district with charter school.

As stated earlier, for my empirical strategy it is important that housing price trends between districts with charter school and their adjacent districts are not becoming more or less dissimilar prior charter school opening. As this so called parallel trends assumption cannot be explicitly tested, I graphically analyze housing price trends prior charter school opening.

To analyze if districts with charter schools have similar trend compared to their adjacent districts, I regress the log of housing prices on a full set of quarter by year fixed effects for the time period prior to charter school entry. Then, I plot the monthly average residual for the charter school district and the adjacent school districts. The time fixed effects in the regression control for potential shocks over time. The residuals show how monthly housing sales in districts with charter schools and in their adjacent districts differ from the respective trends. In Figures 6 to 8, I plot the monthly residuals with a local linear fit[7] to make the trend line more visible.

Figure 6 shows housing price trends for Syracuse. Panel 1 compares trends between all housing sales in Syracuse and its adjacent districts. The trends are parallel. At the end of the observed time period the trends start to slightly diverge probably because of an anticipation effect of the charter school on housing values. Panel 2 reduces the sample to sales half a mile away from the district border. As expected, the trends are closer to each other. Further, the trends are relatively parallel and do not show a potential anticipation effect for the time period prior charter school entry.

Figure 7 shows housing price trends for Niagara Falls and its adjacent school districts. Using all housing sales, the trends are parallel (see Panel 1). Limiting the sample to housing sales close to the district border, trends are still parallel but the distance between them is less (see Panel 2).

[7] I use Stata's lpoly command to produce the local line fit line. The command performs a kernel-weighted local polynomial regression of the residual and time in months. Displayed is a graph of the smoothed values with confidence bands

Figure 8 shows housing price trends for Ithaca and its adjacent school districts. Using all housing sales, the trends are less parallel compared to Syracuse and Niagara Falls (see Panel 1). It is difficult to say why these differences in trends occur. A potential explanation is that the more rural districts surrounding Ithaca have somewhat different housing markets compared to Ithaca. Also, the housing markets in the adjacent school districts could be less homogenous than in the other two districts. Reducing the sample to sales at the district border, trends seem to be even less parallel. The space between both graphs varies considerably.

Comparison Group 2: Similar Metropolitan Areas

The second comparisons group consist of districts located in metropolitan areas other than Syracuse, Niagara Falls, and Ithaca. Searching for metropolitan areas that match the districts in the sample and their adjacent districts, I face the following dilemma. I have plenty of information on school district characteristics but only a small number of metropolitan areas in New York State. To overcome this dilemma, I use a judgmental approach with the following formal procedure. All three districts in the study sample with charter schools are city school districts, thus I start with a list of all city school districts in New York State. Next, I limited the sample to districts that, like Syracuse, Niagara Falls, and Ithaca, are located in western or central New York. Finally, I select the districts and their adjacent districts that are the closest match to Syracuse, Niagara Falls, Ithaca, and their adjacent districts on variables drawn from school district tabulations of the 2000 U.S. Census. Specifically, I find the closest match, on mean performance, enrollment, share of black students, and share of students in poverty. The four variables are good determinants of factors influencing housing prices making them a good approximation for differences in housing price trends between districts. The results of this

matching process are presented in Table 2. A graphical comparison between housing price trends is shown in Panels 3 and 4 in Figures 6 to 8.

Compared to other school districts in western and central New York, Syracuse stands out as a school district having a relatively high enrollment, low performance, high rates of poverty, and a large share of black students. Syracuse is surrounded by school districts having a much lower enrollment, higher levels of student performance, a lower share of students in poverty, and a lower share of black students as depicted in Table 2. These figures suggest that there is a high degree of socio-economic segregation between Syracuse and its adjacent districts. The unique characteristics of the area will strongly influence the difference in housing prices between Syracuse and its adjacent districts making it difficult to find comparison districts. However, I can exploit the variation in the timing of charter school entrance between districts and can compare Syracuse with Niagara Falls. Niagara Falls is the closest match for Syracuse among districts that did not contain charter schools earlier than Syracuse (see Table 2). Its enrollment and share of black students is somewhat smaller than Syracuse, but in all other categories Niagara Falls and its adjacent districts show great similarities with Syracuse and its neighboring districts. The first charter school moved into Syracuse in 2002, while Niagara Falls had its first charter school in 2006. Thus, I can use Niagara Falls as the control district for Syracuse during the pre-2006 period. Therefore, the pre-period for Syracuse are the 2 years before charter school entry. The post period are the years following the charter school entrance up to the point when Niagara Falls had its charter school[8].

[8] As families might anticipate the opening of the charter school in Niagara Falls, I exclude the 6 months before charter school opening in Niagara Falls from the analysis.

Figure 9 shows the pre trends for Syracuse and Niagara Falls. The first panel shows housing price trends for Niagara Falls and its adjacent school districts. The trends are parallel. Panel 2 compares the difference in housing price trends between Syracuse and its adjacent school districts with the difference in housing price trends between Niagara Falls and its adjacent school districts. The residuals in Panel 2 are calculated in the following way. In a first step, I subtract the residuals in Syracuse from the residuals in its adjacent districts. I do the same for Niagara Falls. Then I plot the difference separately for both metro areas. The trend lines are again based on a local linear fit. The trends are parallel in the beginning of the time period but converge at the end. The result suggests that Syracuse's adjacent school districts are a better comparisons group.

In the next step, I have to find comparison districts for Niagara Falls. The Niagara Falls school district is characterized by schools that perform about one standard deviation below the state average, have an enrollment that is smaller than in the big upstate cities but substantially larger than in rural school districts, and a relatively high share of students in poverty (see Table 2). Niagara Fall's adjacent districts perform better and have a smaller enrollment. Their shares of black and poor students are less than the state average. School districts that serve as a good comparison are Binghamton and Dunkirk. They are somewhat smaller than Niagara Falls but have performance below the state mean and enrollment of black and poor students above the state mean. Their adjacent districts are suburban and comparable to Niagara's adjacent districts.

Figure 10 shows the pre trends for Niagara Falls and Binghamton and Dunkirk. As previously shown, trends between Niagara Falls and its adjacent school districts are parallel (see Figure 7).

Trends in Binghamton, Dunkirk, and their adjacent districts are the same in the beginning of the observed time period. Then, the trend in Dunkirk and Binghamton drops a bit. Again, I plot the differences in residuals between Niagara Falls and its adjacent districts and Binghamton and Dunkirk and their adjacent districts. The trends are parallel for most of the observed time period. However, similar to the Syracuse case, trends converge at the end of the observed time period. Thus, the adjacent school districts seem to be a better comparisons group for Niagara Falls.

Ithaca is located in a small metropolitan area and is strongly influenced by its higher education industry. Ithaca enrolls fewer students than the other districts in the sample and has much higher student performance compared to its adjacent school districts. The share of black and poor students is much lower compared to other districts with a charter school. The surrounding districts are rural, have lower student achievement than Ithaca, smaller enrollment, a similar share of black students, but fewer students in poverty (see Table 2). Saratoga Springs and Oneonta are districts that share these characteristics. They have institutions of higher education in the district and they are surrounded by rural districts. Their performance is above the state mean and their enrollment is relatively small. The share of black students in Saratoga Springs is less than in Ithaca and the share of poor students is higher in Oneonta. Saratoga Springs and Oneonta have adjacent school districts with lower performance and smaller enrollment. These characteristics make Saratoga Springs and Oneonta good comparison districts for Ithaca.

Figure 11 shows pre trends for Ithaca as well as for Saratoga Springs and Oneonta. As already mentioned, trends between Ithaca and its adjacent school districts are less parallel compared to Syracuse, Niagara Falls and their adjacent school districts. Oneonta and Saratoga show similar

trends except five years prior charter school entry. Again, I plot the difference in residuals between Ithaca and its adjacent districts and Ithaca's direct comparison districts and their adjacent districts. Trends converge and diverge at different points in time periods and do not seem to be parallel for most of the observed time. Ithaca's adjacent school districts seem to be a better comparisons group than Saratoga Springs and Oneonta.

2.7 Empirical Methods: Concluding Remarks

While both specifications estimate the change in housing price gaps between school districts, the underlying assumptions and identification strategies are different. Equation 5 assumes that housing price trends between districts with charter schools and their adjacent districts are parallel prior charter school opening. Equation 6 assumes that the trend of housing price difference between districts in the metropolitan area with charter school are similar to trends in housing price differences between districts in a matched control area. As the graphical analysis of pre trends showed, the parallel trends assumption is meet best by districts adjacent to the district with charter school. Thus, Equation 5 is the preferred specification.

Equation 5 estimates the effect of charter schools on the housing price gap between districts by using a difference in difference estimator. Using this strategy, I can effectively control for common shocks to housing prices in the metropolitan area. Equation 6 uses a triple difference strategy. Using this strategy, I can effectively control for housing price shocks in the metropolitan area and for common shock between city school districts and their adjacent districts. While the triple difference has the advantage of a more robust analysis, the housing

price trends prior charter school opening were less parallel. Thus, generally, I will give more weight to the results of Equation 5.

2.8 Data

The data for these analyses are drawn from several sources. Property sales information and housing characteristics were obtained from the New York Office of Real Property Services (ORPS). The database includes information on property location, class, sales date, and sales price. Information from the sales database was merged with detailed parcel-level data from the New York State Real Property System (RPS) database. The Real Property System collects information from local assessors on a number of parcel characteristics such as construction grade of the house (which refers to the quality of the material and workmanship used to construct the house and is graded from A to E), size (for living space measured in square feet, number of bathrooms, number of bedrooms, etc.), and special features (for example full basement, central air conditioninging, fireplace, etc.). In most cases, housing characteristics were only available for the first time a house was sold. Thus, the data does not provide information on parcel traits that varies over time. Combining both datasets, I constructed a pooled cross-sectional dataset that spans from January 2, 2000 to August 6, 2010[9]. It is important to note that neither of the combined datasets includes information on housing sales in NYC, and hence I have to exclude NYC from my analysis. Information on charter school entry and location was drawn from the New York Charter School Institute web page hosted by the State University of New York[10].

[9] The New York Office of Real Property Services puts a flag on all housing sales that are not arm's length. I do not include these sales in my data set as they are unlikely to reflect the market price of a parcel.
[10] Housing sales and charter schools were geo coded and placed into the census tracts and districts using ArcGis.

Tables 3 to 6 show Summary statistics for housing sales in Syracuse, Niagara Falls, and Ithaca. In each table Columns 1 and 2 compare the housing characteristics in the district with charter schools to housing characteristics in the adjacent school districts. In Columns 3 and 4, I compare the housing characteristics for the same district but for houses located ½ mile away from the district border. Finally, Columns 5 and 6 contrast housing characteristics for the direct comparison of the charter school district and its adjacent school districts.

Table 3 compares housing characteristics for Syracuse. Columns 1 and 2 show that houses in Syracuse cost $37,598 less than in the adjacent districts (about 27 percent). Further, houses in Syracuse are of somewhat inferior quality, are less likely to have air conditioning, and are on average 32 years older compared to houses in the adjacent school districts. Therefore, housing characteristics in Syracuse and its adjacent school district mirror to some extent the socio-economic segregation between the school districts. Comparing houses characteristics for sales ½ mile away from the district border, the gap in housing prices is somewhat greater averaging $38,504 (a difference of about 26 percent). The housing quality in Syracuse is still inferior to its neighbors. Also, the share of houses with central air conditioning is higher in the adjacent school districts and the age gap is less compared to the previous sample.

Contrasting houses in Niagara Falls and its adjacent school districts, houses in Niagara Falls have lower sales prices and are of lower quality than in the adjacent school districts. The difference in housing prices is on average $83,734 (about percent 51 percent). Houses in Niagara Falls are more likely to have central air conditioning and they are older.

Comparing Syracuse and its adjacent school districts with Niagara Falls and its adjacent school districts, it is apparent that the housing price gap between Niagara Falls and its adjacent districts is somewhat greater. Further, the gap in housing size is greater while the gap in housing age is smaller between Niagara Falls and its adjacent districts. All other housing characteristics look similar.

Table 4 presents summary statistics for Niagara Falls. As already described earlier, houses in Niagara Falls are of less value and of somewhat less quality compared to houses in the adjacent school district. Using the reduced sample around the district border for Niagara Falls, the gap in housing prices is much smaller averaging $20,782 (about 18 percent). Houses in Niagara Falls are of somewhat better quality, more likely to have air central air conditioning, and to be older.

Dunkirk and Binghamton have less valuable and lower quality houses than their adjacent districts. The difference in housing prices is $41,484 (about 32 percent). Further, houses in the Dunkirk and Binghamton are less likely to have central air conditioning. Comparing the differences in housing stock between Niagara Falls and its adjacent districts with Dunkirk and Binghamton and their adjacent school districts the following points are evident. The housing price difference between Niagara Falls and its adjacent districts is greater. Also, the differences in housing size and age are greater in Niagara Falls. All other housing characteristics look relatively similar.

Table 5 presents summary statistics for Ithaca. Columns 1 and 2 compare housing characteristics in Ithaca and its surrounding districts. It is notable that housing prices and the quality of housing

in Ithaca are greater than in its adjacent school districts. The difference in housing prices is $62,003 (about 43 percent). Also, houses in Ithaca are more likely to have central air conditioning. The reduced sample shows for Ithaca a decline in the housing price difference. The difference in housing prices is reduced to $29,492 (about 13 percent). Overall, the gap in housing quality, share of houses with air conditioning, and age is reduced.

In Oneonta and Saratoga, housing prices and housing quality are greater than in their adjacent school districts. The difference is $54,223 (about 21 percent). Further, houses are more likely to have central air conditioning. Comparing the differences in housing characteristics between Ithaca and its adjacent districts with differences between Oneonta and Saratoga and its adjacent districts, it is evident that there is a greater difference in the housing prices and quality between Ithaca and its adjacent districts. All other housing characteristics look relatively similar.

2.9 Results

The results are presented separately for Syracuse, Niagara Falls, and Ithaca in Tables 6 to 8 respectively. Models 1 and 2 estimate Equation 5 using the adjacent school districts as control group. In Model 2, the sample is reduced to housing sales ½ mile away from the district border. The main focus in the first two models is the coefficient on the interaction between post and inside. The effect captures the change in housing prices differences between school districts with charter schools and their adjacent districts after charter school entry.

Model 3 estimates Equation 6 using the matched metropolitan areas. The main effect is captured by the triple interaction between post, inside, and treatment. The coefficient compares the change

in housing price differences between the districts with charter school and its comparison district and between the control districts and their adjacent school districts after charter school entry.

Models 4 to 6 estimate Equation 5 but differentiate by distance and neighborhood income. Model 4 interacts the coefficient of interest with distance in miles. In Model 5, the sample consist only of sales in neighborhoods having a neighborhood income below the median in the district with charter school. Model 6 presents the same model for housing sales taking place in neighborhoods with an income above the median. In Models 5 and 6, I include only neighborhoods in the charter school district that have a similar income compared the neighborhoods in the adjacent districts and vice versa. With limiting the sample to similar neighborhoods on each side of the border, I avoid bias resulting from comparisons that are not supported on either side of the border.

Results Syracuse

Table 6 presents the results for Syracuse. In Models 1 and 2, the coefficients on the interaction between post and inside are negative and imply an increase in the housing price gap between Syracuse and its adjacent school districts. However, the estimated coefficient are imprecisely estimated and not statistically significant. Model 3 shows no effect of the charter school indicating that the difference in housing prices between Syracuse and its adjacent district relative to the difference in housing prices between Niagara Falls and its adjacent districts is not changing after charter school entry. Model 4 shows a main effect being close to zero and statistically insignificant. The coefficient on the triple interaction including distance suggests that with increasing distance, the effect of the charter school is reduced. Being a mile further away

reduces the impact of the charter school in housing prices by 1.4 percent. As the coefficient is imprecisely estimated, this cannot said with certainty.

Model 5 shows a positive and statistically significant coefficient on the interaction between post and inside. Housing prices in Syracuse's poor neighborhoods increase by about 6 percent after charter school entry compared to similar neighborhoods in the adjacent school districts. Model 6 shows a negative and statistically significant coefficient on the interaction between post and inside. Housing prices in Syracuse's richer neighborhoods decreased by 5 percent after charter school entry compared to similar neighborhoods located in the adjacent school districts.

The results for Models 5 and 6 probably indicate resorting between Syracuse's richer and poorer neighborhoods. Households living in Syracuse's richer neighborhoods, who get their child enrolled into one of the high performing charter schools, move out of their neighborhood into somewhat poorer neighborhoods in Syracuse. As demand decreases in the richer neighborhoods, housing prices fall. As demand increases in poorer neighborhoods, housing prices grow. Thus, the result for neighborhoods in Syracuse is similar to Case 2 in the theoretical section.

Results Niagara Falls

Table 7 shows the results for Niagara Falls. In Model 1, the coefficient on the interaction between post and inside is close to zero implying no change in the housing price gap between Niagara Falls and its neighboring districts. Reducing the sample to housing sales close to the district border the coefficient becomes positive indicating a decrease the housing price gap. The coefficients in both models are not statistically significant. In Model 3, the coefficient on the

triple interaction is close to zero. The coefficient indicates that the difference in housing prices between Niagara Falls and its adjacent districts is not changing differently compared to districts in the matched metro area. In Model 4, the main effect is close to zero and not statistically significant. The coefficient on the triple interaction is positive indicating a greater impact on housing values for parcels that are further away from the charter school. However, the coefficient is imprecisely estimated and not statistically significant.

Model 5 shows a statistically significant negative coefficient on the interaction between post and inside. Housing prices in Niagara Falls poor neighborhood decreased by 2.9 percent compared to similar neighborhoods in the adjacent school districts. Model 6 shows a positive but not statistically significant coefficient on the interaction between post and inside. The results indicate an increasing gap between housing prices in Niagara Falls neighborhoods. Housing prices in poorer neighborhoods decrease while they remain unchanged in richer neighborhoods. The result is potentially explained by declining school quality in Niagara Fall's poorer neighborhoods. As the charter school is low performing compared to other schools in the district, a reduction in school quality is unlikely based on cream skimming. It is more likely that resources or services declined in schools located in low income neighborhoods. As school quality decreases, households have to be compensated by lower housing prices. The situation in Niagara Falls is best explained by theoretical case number three.

Results Ithaca

Table 8 presents the results for Ithaca. In Model 1, the coefficient on the interaction between post and inside is negative and indicates a decline in the housing prices gap between Ithaca and its

neighboring districts. Reducing the sample to housing sales at the district border, the coefficient becomes positive. Both coefficients are imprecisely estimated and they are not statistically significant. In Model 3, the coefficient on the triple interaction is close to zero. The coefficient indicates that the difference in housing prices between Ithaca and its adjacent districts is not changing differently compared to districts in the matched metro area. Differentiating the effect by distance, the main effect in Model 4 is close to zero. The coefficient on the triple interaction is close to zero suggesting no relationship between distances and housing price changes. Both coefficients are not statistically significant.

Model 5 shows a negative and statistically significant negative coefficient on the interaction between post and inside. Housing prices in Ithaca's poor neighborhood decrease by 1.9 percent compared to similar neighborhoods in the adjacent school districts. Model 6 shows a positive but not statistically significant coefficient on the interaction between post and inside. The results indicate an increasing gap between housing prices in Ithaca's neighborhoods. Housing prices in poorer neighborhoods decrease while they stay the same in richer neighborhoods. Similar to Niagara Falls, the result is potentially explained by declining school quality in the poorer neighborhoods in Ithaca. As performance measurement in the charter school's 2012 and 2013 report cards reveal, the Ithaca charter school is lower performing compared to its traditional counterparts. Thus, a reduction in school quality is unlikely to be based on cream skimming.

It is more likely that resources or services declined in schools located in low income neighborhoods. As school quality decreases, households have to be compensated by lower housing prices. The situation in Niagara Falls is best explained by theoretical case number three.

More likely is that resources or services declined in schools located in low income neighborhoods. As school quality decreases, households have to be compensated by lower housing prices. Similar to Niagara Falls, the situation in Ithaca is best explained by theoretical case number three.

In conclusion, there are no statistically significant results on the coefficients of interest for Models 1 to 4. Most of the results are imprecisely measured and do not allow any further conclusions about and whether the gap in housing prices changes. The models 5 and 6 show statistically significant coefficients indicating changes in housing prices for neighborhoods within Syracuse, Niagara Falls, and Ithaca. The heterogeneity of the charter school effect amongst neighborhoods with different income is most likely the reason why models focusing on overall effects at the district level show either imprecise or no results. In Syracuse, households living in neighborhoods with higher median income move into neighborhoods with lower median income located in Syracuse. The difference in housing prices between neighborhoods in Syracuse is decreasing. In Niagara Falls and Ithaca low income neighborhoods experience declining housing prices. As housing prices in higher income neighborhoods do not change, the gap in housing prices between neighborhoods is increasing.

2.10 Conclusions

Theoretical models of bidding and sorting suggest that charter schools can have a significant effect on housing markets and residential sorting. In this chapter, I provide an direct empirical test of whether those predicted effects occur. My theory describes three cases how charter schools influence school quality and housing prices. The first case describes a positive effect of

charter schools on school quality. However, the increase in school quality is not large enough to generate resorting. The difference in housing prices between high and low performing jurisdictions can either go up or down depending on the relative changes in school quality between jurisdictions. The second case illustrates an increase in school quality that is large enough to create resorting. In this case, housing price differences between high and low performing jurisdictions decrease. The third case describes how charter school decrease school quality leading to a decline in housing prices in the lower performing jurisdiction. In this case, the gap in housing prices between districts increases.

Empirically, I do not find statistically significant changes in housing price differences between school districts. However, I do find an effect of charter schools on housing price differences between neighborhoods. In Syracuse, charter school raise the price of housing by almost 6 percent in neighborhoods having an income below the district's median relative to similar neighborhoods in the adjacent school districts. In contrast, housing prices decrease by 5 percent in neighborhoods with an income above the median compared to similar neighborhoods in the adjacent school district. As a consequence, the difference in housing prices between poorer and richer neighborhoods in Syracuse is decreasing. The results probably indicate resorting between Syracuse's richer and poorer neighborhoods. Households living in Syracuse's richer neighborhoods, who get their child enrolled into one of the high performing charter schools, move out of their neighborhood into somewhat poorer neighborhoods in Syracuse. As demand decreases in the richer neighborhoods, housing prices fall. As demand increases in poorer neighborhoods, housing prices grow.

Syracuse is exemplary for the effect of high performing charter schools on housing values in districts with much lower performing traditional public schools. The charter schools are an amenity that is valued by some families who willing to move out of their neighborhood into a poorer neighborhood.

In Niagara Falls poorer neighborhoods, housing prices decrease relative to neighborhoods with similar income levels located in the adjacent school districts. Likewise, Ithaca's poorer neighborhoods experience declining housing prices relative to similar neighborhoods in the adjacent school districts after charter school entry. In both districts housing prices in richer neighborhoods are not influenced by charter school entry. Consequently, in Niagara Falls and Ithaca, the difference in housing prices between richer and poorer neighborhoods increased after charter school opening.

Niagara Falls and Ithaca are exemplary for the effect of charter schools on housing values that performing lower than the traditional public schools in the district. The charter schools takes students and money away from traditional schools. Their low performance is likely to be acknowledge by residents and seen as a disamenity.

The empirical results suggest that the impact of charter schools on housing price gaps between jurisdictions is more complex and context specific compared to inter-district choice and voucher programs. More specifically, the effect of charter schools on housing values depend on how charter schools impact expected school quality in jurisdictions. Also, the empirical findings suggest that the effect of charter schools on housing values varies tremendously between

neighborhoods within the same district. Thus, to detect housing price changes it is necessary to analyze housing prices at the neighborhood level.

Additional research has to be conducted to explore the relationship between charter schools and housing prices further. Particularly, my analysis is limited by the availability of housing sales before 2000 and only focuses on areas with small charter school enrollment. Using different samples may lead to somewhat different results. Further, I did not have attendance zones for school districts to explore within district changes on housing prices further. Future research could address these deficiencies to create a better understanding how charter school influence housing prices.

Figure 1: Perfect Sorting without Charter Schools

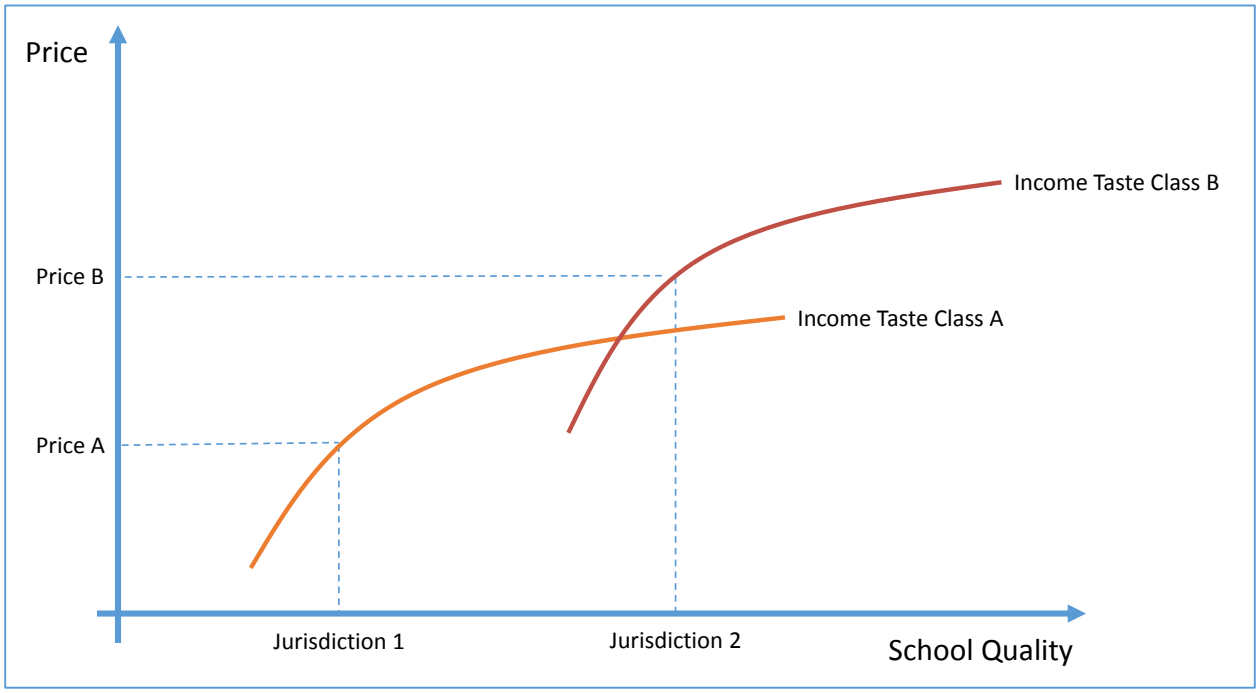


Figure 2: School Quality Increase Without Resorting

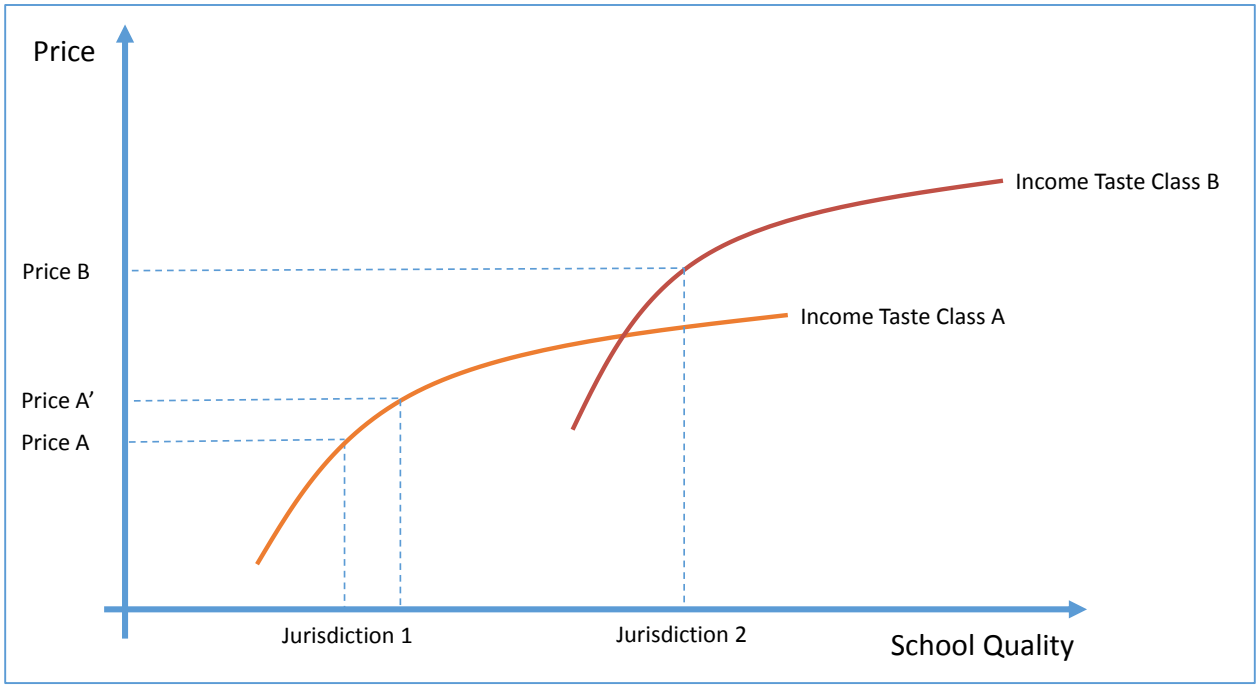


Figure 3: School Quality Increase With Resorting

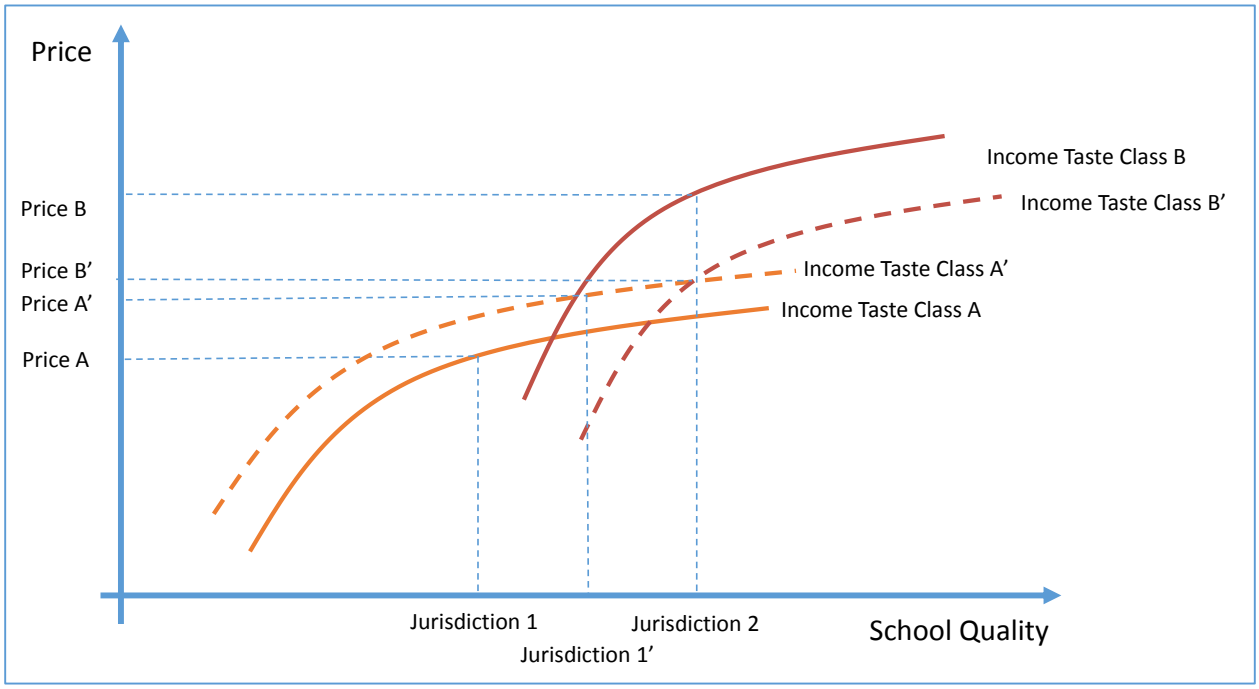


Figure 4: School Quality Decrease

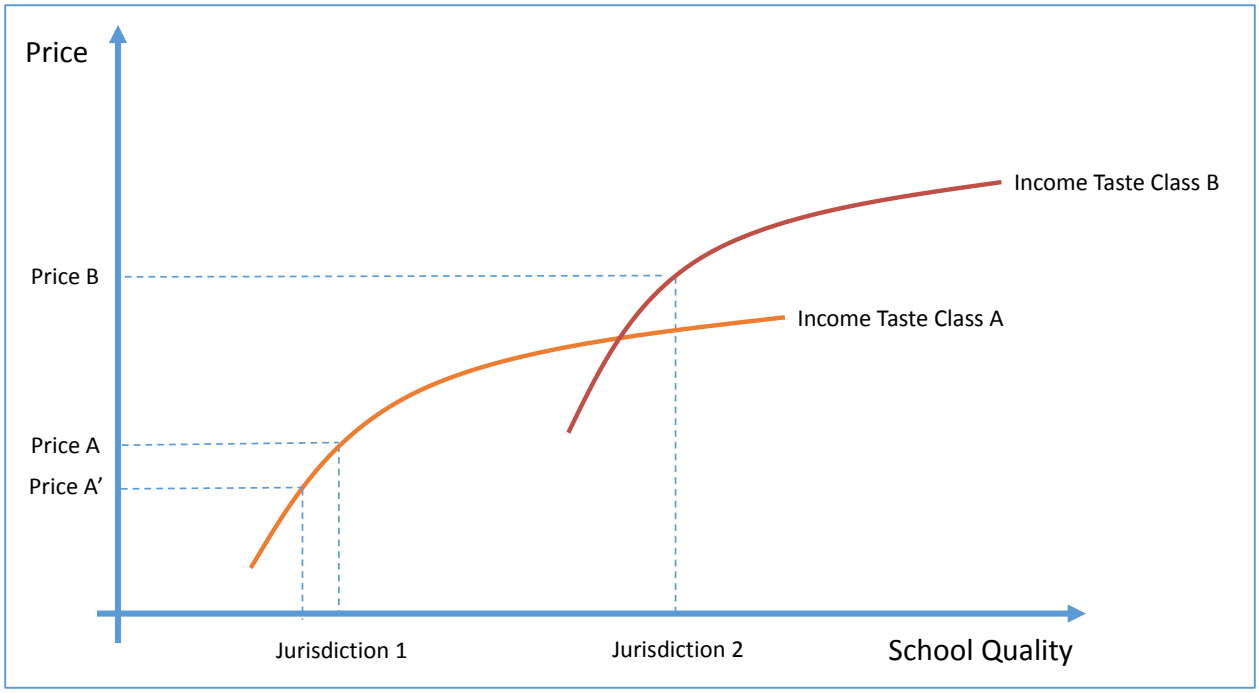


Figure 5: Syracuse City School School District and Its Adjacent School Districts

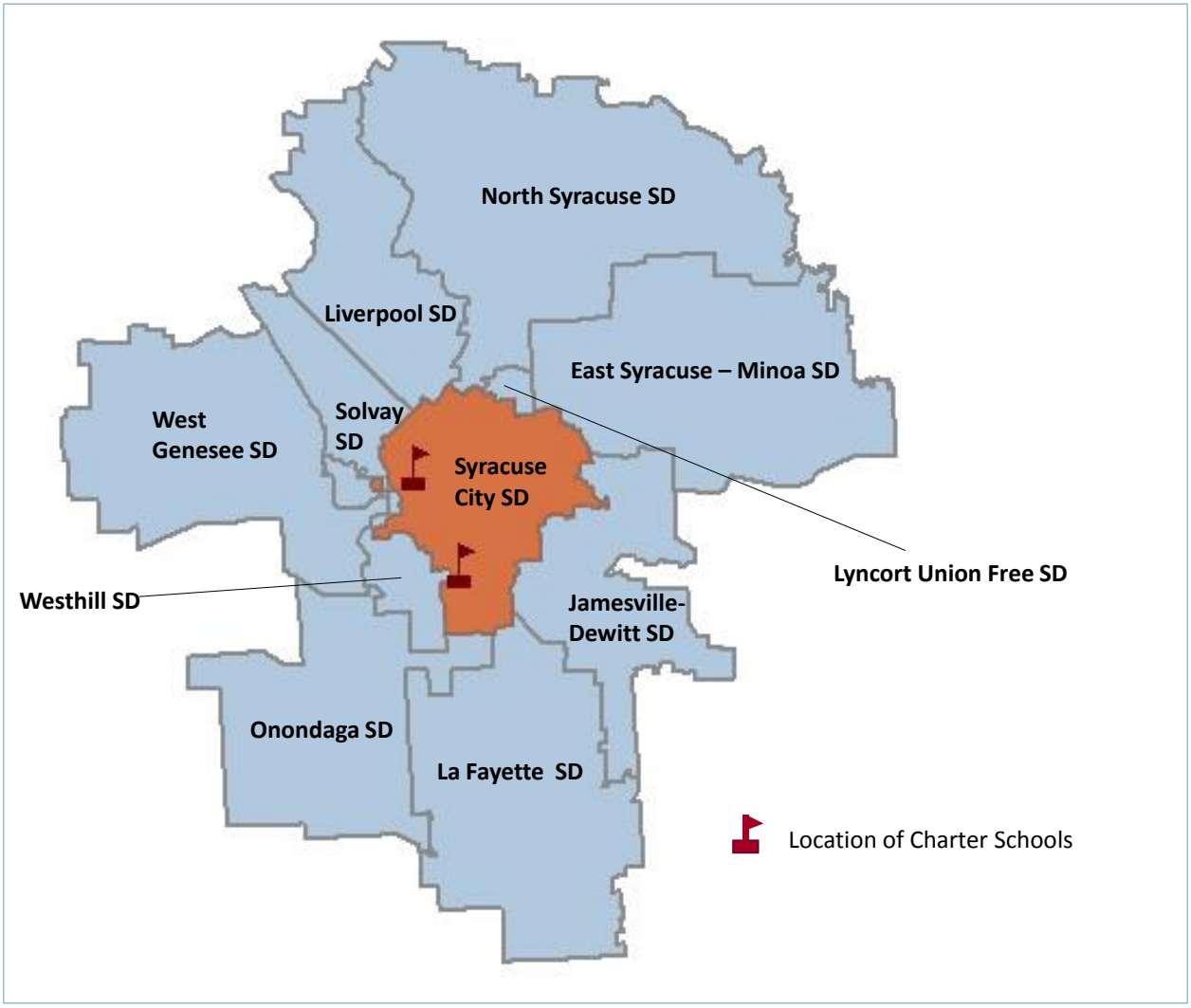
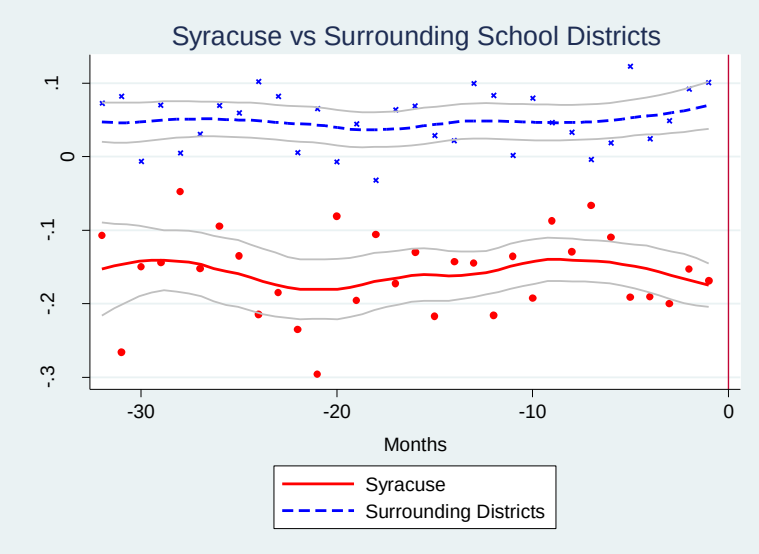


Figure 6: Sale Price Residuals by Month for Syracuse

1)



2)

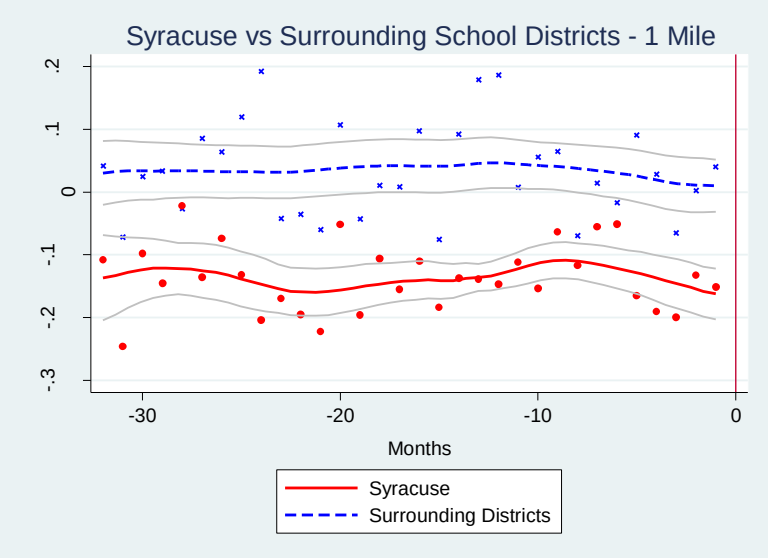
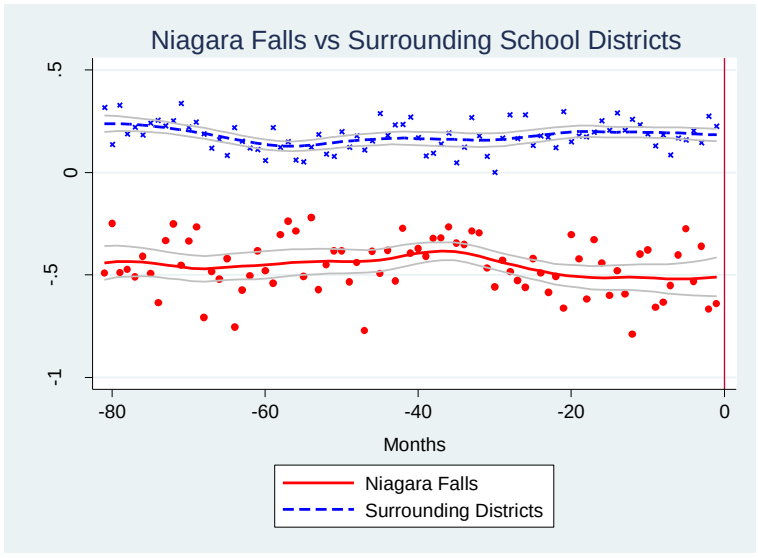


Figure 7: Sale Price Residuals by Month for Niagara Falls

1)



2)

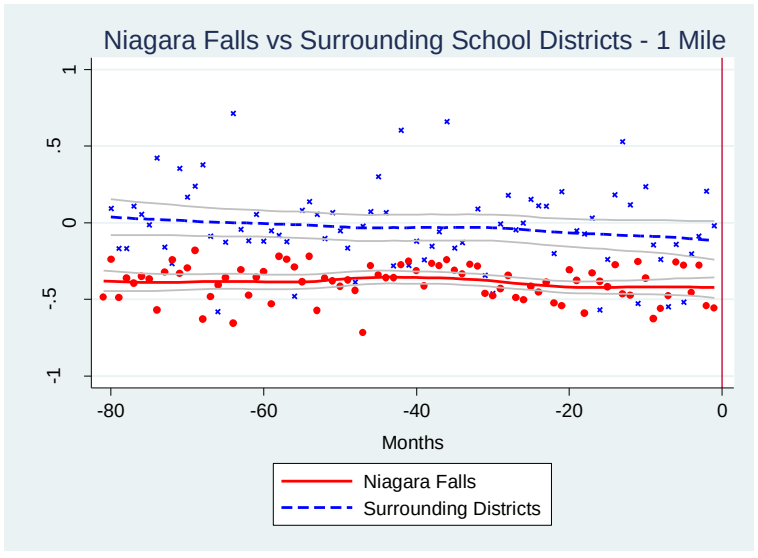
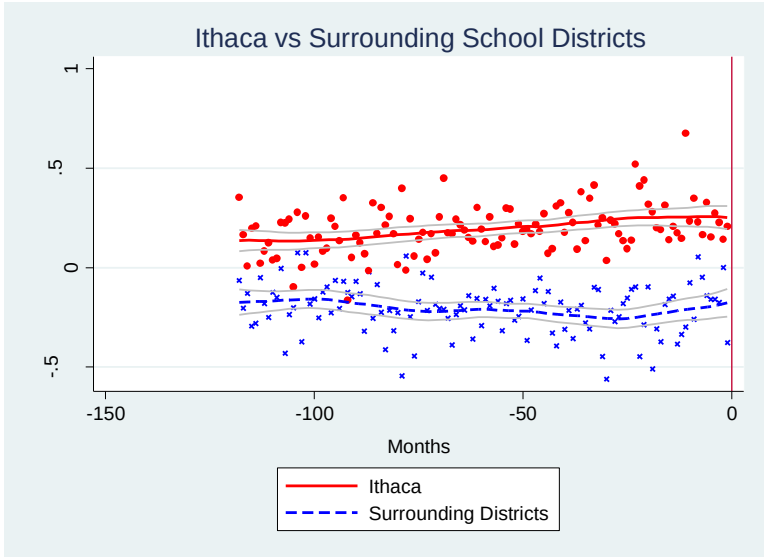


Figure 8: Sale Price Residuals by Month for Ithaca

1)



2)

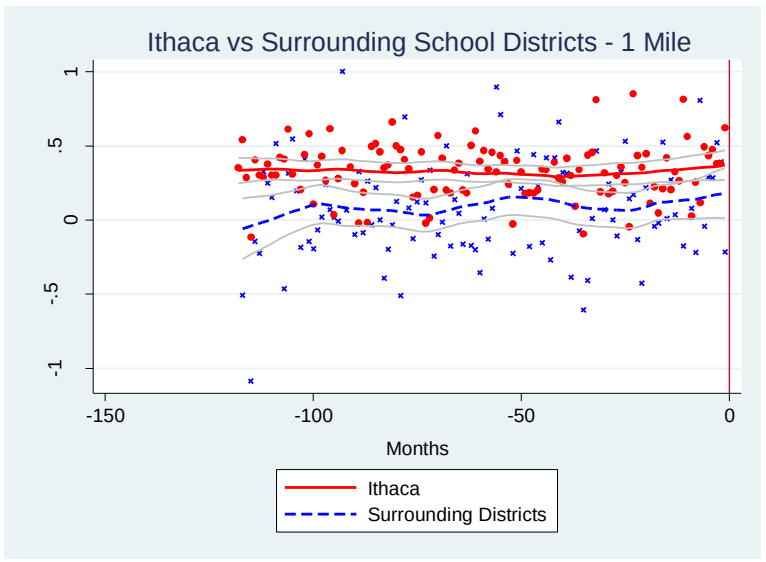
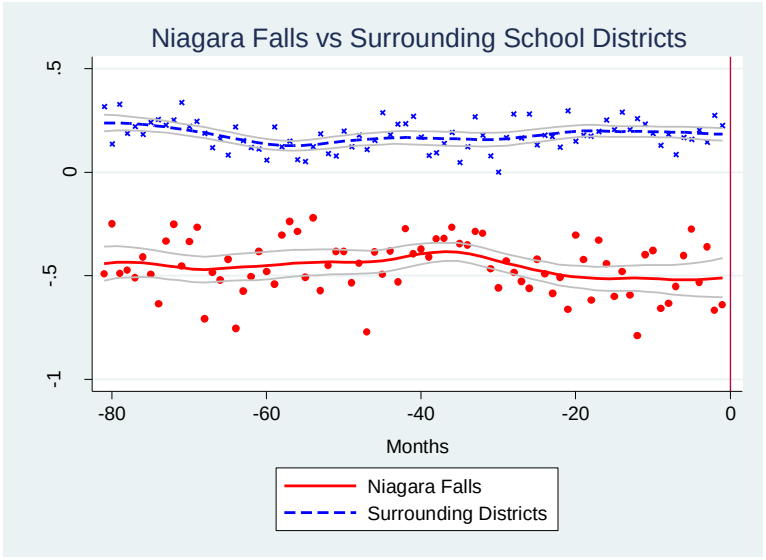


Figure 9: Sale Price Residuals by Date for Syracuse and Metro Comparison

1)



2)

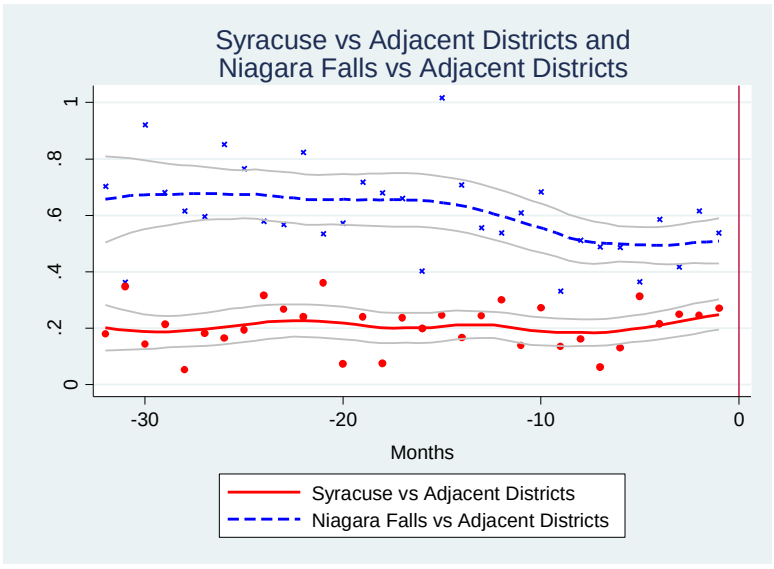
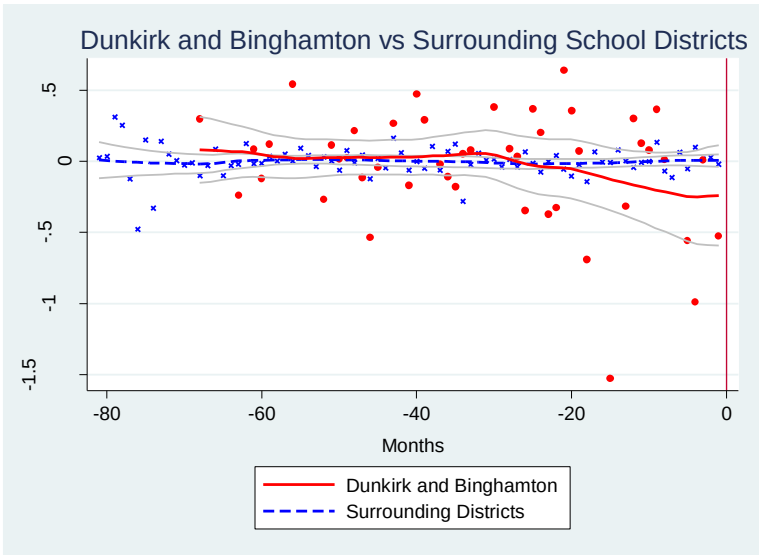


Figure 10: Sale Price Residuals by Date for Niagara Falls and Metro Comparison

3)



4)

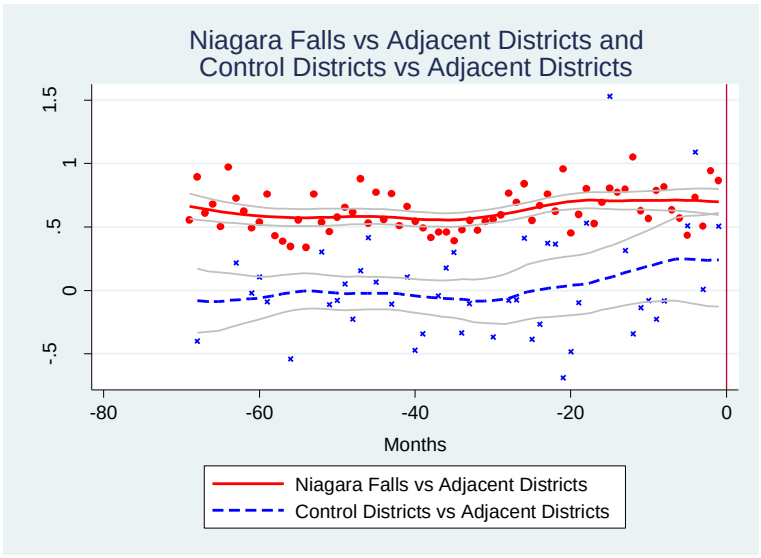
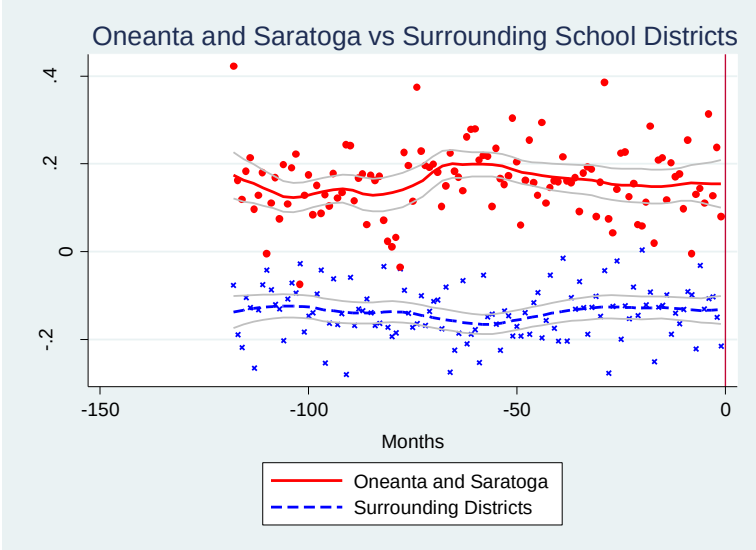


Figure 11: Sale Price Residuals by Date for Ithaca and Metro Comparison

3)



4)

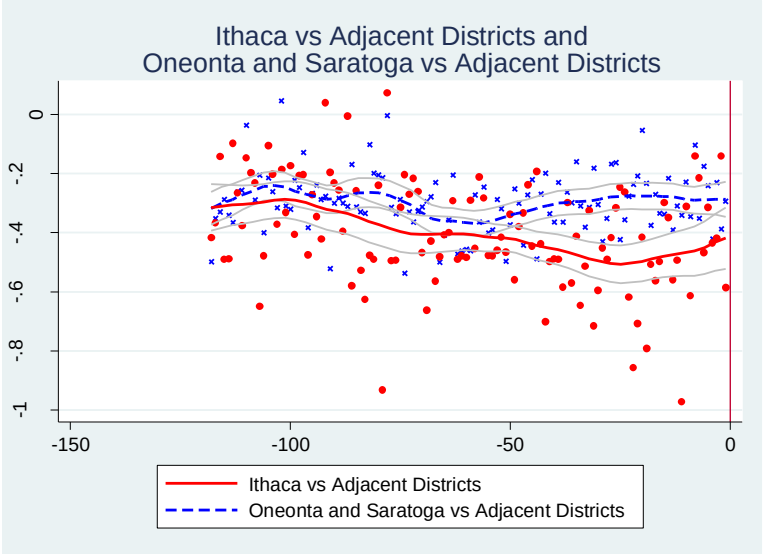


Table 1: Performance of Charter Schools and Districts in 2010

District	First Charter Established	Number of Charter Schools	Share of District Enrollment	Sufficient Pre Period	Housing Sales Available	Charter School in Adjacent District	Average Performance Charter Schools	Average Performance District Schools	Average Performance Surrounding Districts	Included in Final Sample
Albany	1999	12	24%	No	Yes	No	-0.18	-0.97	0.63	No
Buffalo	2000	15	19%	No	Yes	No	-0.44	-1.58	0.18	No
Rochester	2000	6	4%	No	Yes	No	N/A	-0.90	0.74	No
Roosevelt	2000	1	8%	No	Yes	No	N/A	0.15	-0.53	No
Wainscott	2000	1	74%	No	Yes	No	-0.25	-1.17	-1.14	No
Riverhead	2001	1	2%	Yes	No	No	-0.59	-0.22	0.34	No
Kenmore-Tonawanda	2001	1	2%	Yes	Yes	Yes	0.91	-0.07	0.60	No
Troy	2001	2	11%	Yes	Yes	Yes	-0.84	-1.71	0.48	No
Lackawanna	2002	1	19%	Yes	Yes	Yes	-0.60	-0.84	0.30	No
Syracuse	2002	2	5%	Yes	Yes	No	-0.89	-2.20	0.22	Yes
Yonkers	2005	1	1%	Yes	Yes	Yes	N/A	0.42	0.14	No
Niagara Falls	2006	1	5%	Yes	Yes	No	-0.49	-1.29	-0.17	Yes
Hempstead	2009	2	7%	Yes	No	No	-0.19	N/A	0.56	No
Ithaca	2009	1	2%	Yes	Yes	No	1.13	-1.04	0.83	Yes

Source: Number of charter schools and year of establishment are taken from the SUNY Charter School Institute web page (http://www.newyorkcharters.org). Enrollment figures are taken from the Common Core of Data 2010 Public Elementary/Secondary School Universe Survey. Performance measures are taken from the 2010 New York State report cards

Performance is computed by averaging the standard scores for grade 4 ELA, grade 4 math, grade 8 ELA and grade 8 math for each school in New York State. Then, the measurement is converted into standard scores with a mean of zero and standard deviation of one.

Table 2: Charter Districts and Matched Control Districts

	District				Adjacent Districts Averages			
	Mean Performance	**Enrollment**	**Black Population in %**	**Population in Poverty in %**	**Mean Performance**	**Enrollment**	**Black Population in %**	**Population in Poverty in %**
Measurement								
state mean	0.00	3082.23	4.09	8.38	0.14	3487.26	4.21	8.47
state standard deviation	1.00	4198.70	9.29	5.22	0.46	3261.23	5.75	3.65
District								
ITHACA	1.02	7620.00	7.33	7.61	-0.03	1501.25	2.17	7.88
Control: Saratoga Springs	0.58	7915.00	1.48	5.68	0.06	2107.50	1.02	7.30
Control: Oneonta	0.65	2705.00	7.33	14.99	-0.22	691.67	0.31	11.72
NIAGARA FALLS	-0.96	11075.00	28.65	19.64	0.24	4162.86	1.13	4.40
Control: Binghamton	-0.23	8135.00	14.47	18.34	0.41	3020.00	2.57	7.86
Control: Dunkirk	-1.36	2610.00	5.07	24.70	0.14	1657.50	1.11	9.72
SYRACUSE	-2.17	28575.00	40.45	22.54	0.25	4193.33	2.49	5.97
Control: Niagara Falls	-0.96	11075.00	28.65	19.64	0.24	4162.86	1.13	4.40

All variables are used for the school year 1999

Performance computed by converting mean score of each district in the state into a standard scores with a mean of zero and standard deviation of one using statewide test specific means and standard deviations, and then averaging the standard scores for grade 4 ELA, grade 4 math, grade 8 ELA and grade 8 math.

Any additional measure from the district tabulations of the 2000 U.S. Census

Table 3: Summary Statistics Syracuse

	Syracuse		Syracuse		Niagara Falls	
	All housing sales Syracuse	All housing sales adjacent districts	1 Mile around the border Syracuse	1 Mile around the border adjacent school districts	All housing sales Niagara Falls	All housing sales adjacent districts
Number of sales	5,053	13,470	2,943.00	1,481.00	2,314.00	5,464.00
Sales price in $	100,362	137,959	105530.6	144035	80,677.15	164,411.50
	(52,368)	(73,248)	(44,553)	(78,981)	(39,099)	(78,217)
Share condition fair or poor	0.04	0.03	0.03	0.02	0.04	0.02
	(0.19)	(0.17)	(0.17)	(0.14)	(0.18)	(0.14)
Share condition good or excellent	0.04	0.10	0.03	0.08	0.05	0.09
	(0.20)	(0.29)	(0.18)	(0.27)	(0.23)	(0.28)
Share no fire place	0.50	0.53	0.45	0.43	0.69	0.38
	(0.50)	(0.50)	(0.50)	C(0.49)	(0.46)	(0.49)
Share construction grade A or B	0.05	0.06	0.04	0.09	0.06	0.16
	(0.22)	(0.24)	(0.19)	(0.29)	(0.24)	(0.37)
Share construction grade D or E	0.16	0.13	0.12	0.11	0.00	0.01
	(0.36)	(0.34)	(0.33)	(0.32)	(0.02)	(0.08)
Share central air condition	0.15	0.27	0.19	0.34	0.37	0.24
	(0.36)	(0.44)	0.39)	(0.47)	(0.48)	(0.43)
Average number of full baths	1.23	1.40	1.23	1.46	1.25	1.51
	(0.51)	(0.58)	(0.51)	(0.62)	(0.48)	(0.60)
Average number of bedrooms	3.10	3.11	3.03	3.06	3.08	3.20
	(0.73)	(0.70)	(0.65)	(0.72)	(0.76)	(0.72)
Average number square feet living area	1533.96	1580.09	1,501.17	1,633.74	1,367.62	1,766.08
	(531.02)	(582.57)	(471.83)	(660.78)	(440.47)	(619.31)
Average age	66.84	34.74	64.59	48.50	61.61	36.06
	(15.66)	(20.91)	(15.38)	(20.37)	(16.02)	(20.97)

Notes: Prices were deflated to January 2000 dollars using the "CPI Inflation Calculator" from the Bureau of Labor Statistics.

Table 4: Summary Statistics Niagara Falls

	Niagara Falls		Niagara Falls		Dunkirk and Binghamton	
	All housing sales Niagara Falls	All housing sales adjacent districts	1 Mile around the border Niagara Falls	1 Mile around the border adjacent school districts	All housing sales Dunkirk and Binghamton	All housing sales adjacent districts
Number of sales	2,314	5,464	790.00	212.00	966.00	15,966.00
Sales price in $	80,677	164,412	97441.94	118223.5	89,351.64	130,835.90
	(39,099)	(78,217)	(41,239)	(100,389)	(52,203)	(80,980)
Share condition fair or poor	0.04	0.02	0.01	0.03	0.12	0.07
	(0.18)	(0.14)	(0.11)	(0.17)	(0.33)	(0.26)
Share condition good or excellent	0.05	0.09	0.10	0.01	0.07	0.07
	(0.23)	(0.28)	(0.30)	(0.10)	(0.26)	(0.26)
Share no fire place	0.69	0.38	0.63	0.58	0.70	0.54
	(0.46)	(0.49)	(0.48)	(0.49)	(0.46)	(0.50)
Share construction grade A or B	0.06	0.16	0.11	0.24	0.06	0.10
	(0.24)	(0.37)	(0.31)	(0.43)	(0.23)	(0.30)
Share construction grade D or E	0.00	0.01	0.00	0.00	0.08	0.06
	(0.02)	(0.08)	(0)	(0)	(0.28)	(0.23)
Share central air condition	0.37	0.24	0.43	0.12	0.07	0.21
	(0.48)	(0.43)	(0.50)	(0.33)	(0.25)	(0.41)
Average number of full baths	1.25	1.51	1.26	1.33	1.24	1.40
	(0.48)	(0.60)	(0.49)	(0.54)	(0.48)	(0.58)
Average number of bedrooms	3.08	3.20	3.04	2.92	3.11	3.11
	(0.76)	(0.72)	(0.62)	(0.72)	(0.87)	0.7629268
Average number square feet living area	1367.62	1766.08	1,350.82	1,451.51	1,509.62	1,607.15
	(440.47)	(619.36)	(411.61)	(609.22)	(476.92)	(594.69)
Average age	61.61	36.06	53.87	46.05	67.29	47.70
	(16.02)	(20.97)	(17.36)	(19.61)	(16.72)	(22.37)

Notes: Prices were deflated to January 2000 dollars using the "CPI Inflation Calculator" from the Bureau of Labor Statistics.

Table 5: Summary Statistics Ithaca

	Ithaca		Ithaca		Oneanta and Saratoga	
	All housing sales Ithaca	All housing sales adjacent districts	1 Mile around the border Syracuse	1 Mile around the border adjacent school districts	All housing sales Oneanta and Saratoga	All housing sales adjacent districts
Number of sales	3,777	3,112	539.00	228.00	6,435.00	20,833.00
Sales price in $	207,012	145,009	227882.8	198390.4	257,702.90	203,479.60
	(122,708)	(108,677)	(122,426)	(112,922)	(173,751)	(135,591)
Share condition fair or poor	0.03	0.06	0.02	0.01	0.05	0.04
	(0.16)	(0.25)	(0.13)	(0.11)	(0.21)	(0.20)
Share condition good or excellent	0.43	0.28	0.43	0.49	0.12	0.18
	(0.50)	(0.45)	(0.50)	(0.50)	(0.32)	(0.38)
Share no fire place	0.48	0.71	0.40	0.51	0.48	0.56
	(0.50)	(0.46)	(0.49)	(0.50)	(0.50)	(0.50)
Share construction grade A or B	0.15	0.08	0.13	0.20	0.18	0.11
	(0.36)	(0.28)	(0.34)	(0.40)	(0.39)	(0.31)
Share construction grade D or E	0.11	0.17	0.10	0.20	0.05	0.08
	(0.32)	(0.38)	(0.30)	(0.40)	(0.22)	(0.26)
Share central air condition	0.16	0.05	0.19	0.13	0.43	0.26
	(0.36)	(0.22)	(0.39)	(0.34)	(0.50)	(0.44)
Average number of full baths	1.67	1.51	1.88	1.74	1.63	1.56
	(0.71)	(0.63)	(0.67)	(0.68)	(0.67)	(0.64)
Average number of bedrooms	3.16	3.10	3.42	3.29	3.19	3.10
	(0.86)	(0.78)	(0.80)	(0.78)	0.8216371	0.8013503
Average number square feet living area	1681.48	1654.07	1,897.15	1,807.02	1,800.00	1,662.80
	(659.52)	(607.48)	(650.88)	(640.79)	(693.98)	(627.25)
Average age	48.05	44.47	36.51	36.16	35.45	37.88
	(26.07)	(26.73)	(20.35)	(24.90)	(27.77)	(27.46)

Notes: Prices were deflated to January 2000 dollars using the "CPI Inflation Calculator" from the Bureau of Labor Statistics.

Table 6: Analysis for Syracuse

	Syracuse and Adjacent Districts	Syracuse and Adjacent Districts - 1/2 Mile	Syracuse and Control Districts - inl. Adjacent Districts	Syracuse and Adjacent Districts - with Distance Interaction	Syracuse and Adjacent Districts - Income below Median	Syracuse and Adjacent Districts - Income above Median
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.0544**	0.0892*	0.0114	0.0637*	-0.0757	0.0748***
	(0.0222)	(0.0457)	(0.0204)	(0.0337)	(0.0550)	(0.0228)
Distance				-0.0113		
				(0.0111)		
Post X Inside	-0.0243	-0.0351	-0.0336	0.00998	0.0597**	-0.0503**
	(0.0171)	(0.0231)	(0.0256)	(0.0364)	(0.0274)	(0.0231)
Post X Treatment			0.0466***			
			(0.0146)			
Post X Distance				-0.00109		
				(0.00355)		
Inside X Distance				0.0530		
				(0.0712)		
Post X Inside X Distance				-0.0139		
				(0.00871)		
Post X Inside X Treatment			0.00829			
			(0.0307)			
Neighborhood Fixed Effects	YES	YES	YES	YES	YES	YES
Neighborhood Trend	YES	YES	YES	YES	YES	YES
Quarter/Year Fixed Effects	YES	YES	YES	YES	YES	YES
Number of observations	18,517	4,423	23,379	18,517	3,451	4,429
R^2	0.605	0.571	0.606	0.606	0.440	0.629

Notes: Regressions are estimated with OLS. The post period starts on September 1st of the school year the first charter school opens.

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 7: Analysis for Niagara Falls

	Niagara Falls and Adjacent Districts	Niagara Falls and Adjacent Districts - 1/2 Mile	Niagara Falls and Control Districts - inl. Adjacent Districts	Niagara Falls and Adjacent Districts - with Distance Interaction	Niagara Falls and Adjacent Districts - Income below Median	Niagara Falls and Adjacent Districts - Income above Median
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.126**	0.133**	0.151***	0.121*	0.033***	0.118**
	(0.0460)	(0.0555)	(0.0469)	(0.0665)	(0.0054)	(0.0469)
Distance				0.00359		
				(0.00966)		
Post X Inside	0.00987	0.0325	0.0784	-0.0109	-0.0291***	0.0139
	(0.0211)	(0.0391)	(0.0568)	(0.0776)	(0.0016)	(0.0105)
Post X Treatment			-0.0401*			
			(0.0232)			
Post X Distance				0.000684		
				(0.00518)		
Inside X Distance				-0.190**		
				(0.0749)		
Post X Inside X Distance				0.0282		
				(0.0194)		
Post X Inside X Treatment			-0.0511			
			(0.0614)			
Neighborhood Fixed Effects	YES	YES	YES	YES	YES	YES
Neighborhood Trend	YES	YES	YES	YES	YES	YES
Quarter/Year Fixed Effects	YES	YES	YES	YES	YES	YES
Number of observations	7,772	1,001	15,953	5,507	1,294	1,792
R^2	0.618	0.688	0.565	0.642	0.548	0.644

Notes: Regressions are estimated with OLS. The post period starts on September 1st of the school year the first charter school opens.

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 8: Analysis for Ithaca

	Ithaca and Adjacent Districts	Ithaca and Adjacent Districts - 1/2 Mile	Ithaca and Control Districts - inl. Adjacent Districts	Ithaca and Adjacent Districts - with Distance Interaction	Ithaca and Adjacent Districts - Income below Median	Ithaca and Adjacent Districts - Income above Median
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.0344	0.0328	-0.0311	0.747**	0.0211***	0.0164
	(0.0664)	(0.122)	(0.0345)	(0.334)	(0.0041)	(0.0802)
Distance				-0.0153**		
				(0.00628)		
Post X Inside	-0.0504	0.0421	-0.0245	-0.01297	-0.0191***	0.0199
	(0.0417)	(0.0854)	(0.0229)	(0.0292)	(0.0033)	(0.0408)
Post X Treatment			0.0476*			
			(0.0286)			
Post X Distance				-0.00534**		
				(0.00231)		
Inside X Distance				-0.00601		
				(0.0124)		
Post X Inside X Distance				0.00560		
				(0.0138)		
Post X Inside X Treatment			0.0468			
			(0.0453)			
Neighborhood Fixed Effects	YES	YES	YES	YES	YES	YES
Neighborhood Trend	YES	YES	YES	YES	YES	YES
Quarter/Year Fixed Effects	YES	YES	YES	YES	YES	YES
Number of observations	6,876	767	20,782	4,763	1,351	4,686
R^2	0.627	0.715	0.627	0.587	0.709	0.594

Notes: Regressions are estimated with OLS. The post period starts on September 1st of the school year the first charter school opens.

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

3. The Influence of Finance Policies on Charter School Locations in New York, Florida, North Carolina, Michigan, and Ohio

3. 1 Introduction

The nature and effects of state charter school programs depend partly on the location decisions made by potential charter school operators. These supply decisions influence the composition of charter schools, their effects on the enrollments and finances of traditional public schools, and the type of competition charter schools will create. Despite their importance, supply decisions have been largely neglected in the study of charter schools (Bifulco and Buerger 2012).

Among the understudied questions of charter school location is how finance provisions influence charter school locational decisions. Although state policies regarding charter school finance policies vary widely, charter schools in all states share the following characteristics. First, enrollment is not guaranteed. Second, charter school funding is determined by the number of students. Third, charter schools have to fulfill performance goals. Therefore, all charter school operators must be concerned with: (1) reaching achievement standards, (2) attracting enough students to fill their allotted number of seats, and (3) keeping costs sufficiently low to maintain financial viability. These three factors are likely to influence the locational decision of charter school operators. States can affect these factors by their funding policies (Bifulco 2014).

This chapter examines the influence of finance provisions on charter school location patterns by comparing different states. Using data for Michigan, Ohio, North Carolina, Florida, and New York, the results show that locational and particularly enrollment patterns are consistent with the incentives created by financial policies. In states tying charter school payments to school districts expenditures, charter schools are more likely to locate in districts having greater expenditures. In states paying flat per pupil amounts independent of charter location, charter schools are more likely to move into low spending school districts. The analysis also shows that additional payments for enrolling disadvantaged students encourages charter schools to locate in high poverty areas and to enroll more disadvantaged students, but only if payments are large enough to outweigh the cost of educating those students.

The chapter is organized as follows. Section 2 explains the analysis sample and Sections 3, 4, and 5 describes the finance, accountability, and authorizer policies for each state in the study sample. Section 6 discusses the location and enrollment incentives created by the different policies in each state. Using policies and theoretical considerations, Section 7 states the studies hypotheses. Section 8 describes the empirical methods used to test the hypotheses. Section 9 presents the results, and finally Section 10 makes conclusions.

3.2 Sample

Table 9 shows the decision making process determining the study's sample. Column two and three show the number of charter schools and the share of charter school students in states with charter school programs. I first select states having large charter school programs regarding the

number of schools and charter school enrollment (see also Bifulco 2014 for similar criteria). Next, I keep states where payments are determined by charter school laws rather than through negotiation between authorizer and charter school operator. In a final step, I select only states where the data for my empirical models is available. More particularly, I need performance information prior the start of the charter school program. Thus, the final sample consists of Michigan, Ohio, North Carolina, Florida, and New York.

3.3 Charter School Finance, Accountability, and Authorizing Policies

I expect charter schools to make location decisions that increase the likelihood of reaching performance goals, attracting enough students, and staying financially viable. How likely it is for a charter school operator to reach these three goals is influenced by each states' finance, accountability, and authorizing policies. By making it easier to reach the three goals in some locations than in others, charter school policies create location and enrollment incentives. To understand how these incentives emerge, I describe the finance, accountability, and authorizing policies for each state separately in the next sections.

3.3.1 Charter School Finance Systems in New York, Florida, North Carolina, Michigan, and Ohio

Allotments to charter schools consist of two parts: base payments and additional payments for students with certain characteristics (henceforth compensations). *Base payments* are determined by the legislature in each state in the study sample. For each charter school, the total amount is

calculated by multiplying the base payment by the number of full time students in the school. In New York, Florida, and North Carolina base payments vary with the location of the charter school. In Michigan[11] and Ohio payments are the same no matter where the school is located. *Compensations* are additional payments for high cost students. Charter schools can receive compensations for students with disabilities, living in poverty, and having limited English proficiency (LEP). The additional payments are calculated either by weighting these groups of students differently in the calculation of base payments or by directly adding a specific per pupil amount of money to the base payment. In all the states in the study sample, charter schools receive additional payments for students with disabilities. Only in Michigan and Ohio do charter schools receive compensation for enrolling poor students. In all states in the study sample but New York, charter schools receive additional payments for enrolling LEP students.

Table 10 lists base payments and compensations for each state in the sample. All figures are displayed for 2007, as this is the most recent year in the sample detailed information for all states can be determined. I describe first, how base payments are determined in each state.

Base Payments

In *New York*, charter schools receive payments for each enrolled student from the district where the student resides. Per pupil payments are determined by the approved operating expenses of the district from two years earlier divided by a weighted pupil count (also from two years earlier) multiplied by an adjustment factor[12]. Approved operating expenses are total district expenditures excluding expenditures for capital outlay and debt service for school buildings; transportation;

[11] In Michigan there is a small variation of $300.
[12] The adjustment factors is supposed to correct for inflation.

lunch programs; tuition payments; and some other miscellaneous expenditures. The adjustment is based on the statewide change in approved operating expenses from three years prior to one year prior (Bifulco and Buerger 2012). In 2007, the approved operating expenditures per pupil that charter school could have received varied between $6,081 and $17,915 with a mean of $9,987 and a standard deviation of $2,497.

In *Florida*, the per pupil payments to charter schools are calculated by dividing the operating funds of the district in which the charter school is located by the number of weighted full-time equivalent students in the school district. The result is multiplied by weighted full-time students in the charter school. Operating funds include gross state and local funds, discretionary lottery funds, and funds from the school district's current operating discretionary millage levy (Florida Statutes Title XLVIII Chapter 1002.33 (17)). In 2007, the per pupil payments for weighted students counts ranged from $6,776 to $10,745 with a mean of $7,913 and a standard deviation of $802.

In *North Carolina*, the state pays charter schools the average per pupil revenues of the district in which the charter school is located excluding funding for students with special needs or limited English proficiency (G.S. § 115C-238.29H a 1). If charter schools enroll students with special needs or LEP, they receive additional funds from the state. These revenues are explained in the next section. Further, charter schools obtain per pupil payments from the school district in which a student resides. The amount of these payments have to equal the per pupil local expenditure (G.S. 115C-238.29H). Calculations for these amounts are done by the school district. The Department of Public Instruction neither oversees nor intervenes with the calculation and

payment of local appropriations (Charter School Financial Guide 2010). In 2007, the payments charter schools could have received varied between $3,943 and $8,864 depending on the district the charter school locates and excluding payments for students with disabilities or limited English proficiency. The distribution had a mean of $5,047 and a standard variation of $770.

In *Michigan*, the charter school finance system is strongly influenced by Proposal A, a constitutional amendment approved by Michigan voters in 1994. Proposal A decoupled the local property tax from the financing of local education agencies and established the state's sales tax as primary source of education funding. Under Proposal A, the Legislature annually calculates a per-pupil funding allowance for each school district. The amount of the allowance is related to district spending prior to Proposal A. Districts having spent more prior the proposal receive a greater allowance. All districts receive at least the minimum allowance from the state. Charter schools receive either the minimum allowance or a charter school allowance (Summers 2013). In 2007, the minimum allowance was $7,085 and the charter school allowance was $7,385. Charter schools located in districts receiving an allowance less than $7,385 obtained the minimum allowance. Charter schools located in districts receiving an allowance greater than $7,385 obtained the charter school allowance. Therefore, the maximum difference between districts in charter school payment was $300 (Olson and LaFaive 2007).

In *Ohio*, all charter schools receive the per pupil base cost amount from the state regardless of location. The per pupil base cost formula is determined statewide by the General Assembly according to the cost of the three input factors: base classroom teacher compensation, other personnel support, and non-personnel support. The General Assembly decides on the base

classroom teacher compensation by defining a teacher to student ratio and a base classroom teacher compensation for the whole state that is necessary for the state-defined basic education. Per pupil payments for personnel and non-personnel support are calculated using an adjustment factor determined by the legislature and revenues in the previous year. In 2007, the per pupil base cost formula was $5,403 (Legislative Service Commission 2008).

Base Payment Adjustments

Base payments to charter schools are often adjusted for district or student characteristics. Adjustments are done by either weighting students differently or by adding specific dollar amounts for certain types of students. I present the weights for each state in Table 10. To compare additional payments resulting from these weights, I multiply state's average unweighted base payment by the specific student weight. If specific dollar amounts are added, I show the payments in 2007.

In two states charter school revenues are *adjusted for district characteristics*. In Florida, charter schools receive additional funding if they locate in districts with small enrollments. Payments are based on a sparsity index. The index is computed by dividing the full time equivalent enrollment of the district by the number of permanent senior high school centers (not to exceed three). In 2007, potential payments to charter schools ranged between $2 and $533 per pupil. Further, Florida law also requires that payments to charter schools are adjusted for the cost of living in the district. Adjustments are done using an annually computed District Cost Differential (DCD), The DCD is calculated by adding each district's Florida Price Level Index for the most recent three years and dividing the sum by three. The result is multiplied by 0.800, divided by 100, and

0.200 is added to the product. In 2007, the weights ranged between 0.9221 and 1.0271. Using the average unadjusted payments to charter schools of $7,913, the adjustment would results in deductions or payments between -$616 and $214.

In Ohio, charter schools receive additional funding if they locate in school districts that are below the 80th percentile in the state's income and property wealth distribution. The amount of the so called parity aid is determined by the state's legislature. In 2007, parity aid ranged between $9 and $594 per pupil depending on district's position in the wealth distribution of the state.

States also adjust their payments to charter schools according to *student characteristics*. In addition to location-specific incentives, these adjustments create incentives to enroll (or exclude) specific students. All states use weights that increasing payments to charter schools for enrolling students with disabilities. In Michigan and North Carolina, these weights do not distinguish between different forms of disabilities with flat weights of 0.286 and 0.125 respectively. In Ohio, Florida, and New York weights vary with the severity of the disability. Weights range in Ohio between 0.28 and 4.73, in Florida between 0.035 and 5.201, and in New York between 0.9 and 1.65. Therefore, weights for students with severe disabilities are greatest in Ohio and Florida while they are smallest in North Carolina and Michigan. The weight for students with less severe disabilities is greatest in New York and smallest in Florida. Comparing actual payments, Ohio and Florida have the highest payments for students with severe disabilities while Florida has by far the smallest payment for students with less severe disabilities. New York has a relatively high

per pupil payment for students with severe disabilities while North Carolina and Florida have relatively low payments.

Adjustments for enrolling students living in poverty are made in Michigan and Ohio. In Michigan, charter schools receive additional payments for students qualifying for free breakfast, milk or lunch under federal law. In 2007, the federal eligibility threshold for a one person household was a monthly gross income of $850 per month. The weight for poor students was 0.115 leading to an additional payment of $832. In Ohio, charter schools receive additional payments for students whose parents participate in the Ohio Works First program. The program provides time-limited cash assistance to families with a gross monthly income of less than $773. Only charter schools located in districts having more poor students than the average school district in the state receive additional payments for enrolling poor students. In 2007, the per pupil payment varied depending on the degree of poverty in the district. The in the poorest school district was $1,208.

In all states but New York, base payments are adjusted for enrolling LEP students. The weight in Florida is 0.275 leading to an additional payment of $2,176. In North Carolina, charter schools receive a compensation of $683 for enrolling an LEP student. In Michigan, LEP students receive the same weight as poor students if they are not already counted as a poor student. If they are already counted as a poor student they do not receive an additional weight. Also, the legislature appropriates annually money for LEP students. In 2007, appropriations were $2,800,000 and 41,842 LEP students were counted in the state. Hence, the state paid an additional $67 for every LEP student enrolled in a charter school. In Ohio, the weight varies with the number of LEP

students living in the district where the charter school is located. If there are more LEP students than in the average school district, charter schools receive additional payments for LEP students. The weights vary between 0.125 and 0.25 leading to additional payments between $675 and $1,350 respectively. Therefore, weights and payments for LEP students are greatest in Florida followed by Ohio and Michigan. Payments are smallest in North Carolina.

Florida is the only state adjusting payments to charter schools according to grade enrollment. The weight for enrolling students in classes K to 3 is 0.035 and for enrolling students in classes 9 to 12 is 0.088. Additional payments are $277 and $360 respectively.

3.3.2 Accountability

Charter schools programs are based on the idea of performance-based accountability (Bulkley 2001). The strength of a performance-based accountability system depends on both the rigor of the performance goals and how these goals are enforced (Bulkley 1999, Hill et al. 2001). Charter schools have to fulfill the same NCLB goals as do other schools in their state (US Department of Education 2001). If standards are relatively high compared to other states, it will be more challenging for charter schools to reach the performance goals. NCES has compared each state's standard for proficient performance in reading and mathematics in grades 4 and 8 by placing the state standards onto a common scale defined by NAEP scores. Table 11 compares the percentage of students that are proficient according to the state and the NAEP standard for each state in the study sample for 2007. Differences between NAEP and state standards tend to be smaller in New York and Florida, indicating relatively demanding standards. North Carolina has less demanding

reading standards than New York and Florida, but similar standards in mathematics. Michigan and Ohio tend to have less demanding standards than New York and Florida in both math and reading.

The instruments charter school authorizers use to enforce performance standards start with the application process and end with the renewal of the charter school contract. Performance based contracts between authorizer and operator, and the systematic data collection and monitoring of the school are important factors as well (Bulkley 2001). The National Alliance for Public Charter Schools (NAPCS) has developed a model charter school law including the accountability mechanisms a "flawless" charter school law should have. Further, NAPCS has transparently compared the availability of these mechanisms with charter school laws nationwide. I use the NAPCS model charter school law to compare the availability of accountability mechanisms between the five states in my sample.

Table 12 depicts the four NAPCS accountability criteria. The first criterion analyzes accountability mechanisms during the application process. The criterion highlights the inclusion of comprehensive academic, operational, governance, and performance requirements in the application. The second criterion examines whether or not charter school laws require performance based contracts created as separate post-application documents between authorizers and public charter schools, and whether or not these contracts detail academic performance expectations, operational performance expectations, and school and authorizer rights and duties. The third criterion captures the processes that allow authorizers to monitor and collect data on the compliance with the performance contract. Finally, the last criterion analyzes the renewal

process with a focus on school closure and dissolution procedures. NAPCS assigns points from 0 to 4 for each of these criteria with 0 indicating that accountability instruments are not in place and 4 representing that all instruments of the model law are part of the charter school law.

Table 12 shows the scores assigned to the five states and the state average according to the NAPCS ranking. Florida and New York are rated as having more extensive accountability provisions, while Michigan, Ohio, and particularly, North Carolina are rated as having weaker accountability provisions. Therefore, New York and Florida have both more rigorous performance standards and more extensive charter school accountability provisions than Michigan, Ohio, and North Carolina.

3.3.3 Authorizers

Authorizers decide on charter applications, and hence potentially influence the location of charter schools. I scrutinize each state's charter school law for preferences towards applicants intending to serve certain types of students or to locate in a specific area. Also, I investigated authorizers' mission statements for priorities towards certain locations or student groups.

In *New York*, charter schools can be authorized by the local school districts, the State Board of Regents (Regents), or the trustees of the State University of New York (SUNY). New York charter School Law states that authorizers are "encouraged to give preference to applications that demonstrate the capability to provide comprehensive learning experiences to students identified by the applicants as at risk of academic failure" (Charter School Law S 2852 (2)). Consequently,

the mission statements of Regents and SUNY state a preference towards applicants intending to serve students that are at a greater risk of not meeting the State's academic standards.

In *North Carolina*, the charter school law allows local school boards, the University of North Carolina, and the state board of education to serve as authorizers. Charter schools approved by local school boards and the University of North Carolina must also be approved by the State Board of Education. As the State Board of Education has the final decision on a charter school application, the board acts ha the last decision on authorizing a charter school. North Carolina Charter School Law states that in reviewing charter school applications the "State Board is encouraged to give preference to applications that demonstrate the capability to provide comprehensive learning experiences to students identified by the applicants as at risk of academic failure" (§ 115C-238.29 D (a)).

In *Florida*, local school boards, state universities (for lab schools[13] only) and community college district boards of trustees (for charter technical career centers only) can serve as authorizers. In practice, however, 99 percent of the charter schools are authorized by local school boards and 1 percent by higher education institutions (NACSA 2012). Neither the Florida Charter School Law nor the Florida Charter School Application Evaluation Instrument, used by authorizers to assess charter school applications, state preferences towards applicants serving a particular student population or locating in specific neighborhoods. The Florida Association of Charter School

[13] Laboratory or developmental research schools are affiliated with the college of education within the state university of closest geographic proximity. Lab schools serve as a vehicle for the conduct of research, demonstration, and evaluation regarding management, teaching, and learning (Florida Statutes Title XLVIII, Chapter 1002).

Authorizers (FACSA) does not state a preference in providing education to certain student groups either.

In *Michigan*, boards for local districts, intermediate school districts[14], community colleges, and public universities can authorize charter schools, with jurisdictional restrictions for all but tribal community colleges and public universities. The most active authorizers are local school boards and higher education organizations. While local school boards authorize smaller numbers of charter schools[15], higher education organizations often oversee large numbers of charter schools[16]. The charter school law gives priority to authorizing schools replacing charter schools that have been closed for low performance and that intend to operate the same grade levels as the closed school (Sec 380.503 (2)). Amongst the authorizers overseeing large numbers of charter schools, only the Bay Mills Community College has in its mission to ensure a quality education for urban, minority, and poor children.

In *Ohio*, the law allows a wide variety of entities to serve as authorizers if they are approved by the state board of education. Active authorizers are the state's education department, local school districts, higher education institutions, and not-for-profit organizations. Higher education institutions and not-for-profit organizations oversee larger numbers of charter schools than local school boards. Neither the charter school law nor the mission statements of the largest charter school authorizer mention a preference towards a location or student group.

[14] Intermediate school districts are organized at the county or multi-county level and provide services for school districts including services for special education students and vocational education. Additionally they collect data for the state department of education.
[15] The Detroit School District is the largest local authorizer with overseeing 18 schools in 2010.
[16] In 2010, the Bay Mills Community College oversaw 43 charter schools, Grand Valley State University 42, and Central Michigan University 59 charter schools.

3.4 Location Incentives and Disincentives

Reasons for establishing a charter school can vary tremendously between charter school operators. However, given the terms under which charter school are financed and authorized, charter school operators have to meet three key objectives. First, they have to reach student achievement standards specified in their charter agreements. Second, operators have to attract enough students to fill their allotted seats. Finally, charter schools have to keep costs low enough to maintain financial viability (Bifulco and Buerger 2012). Following Bifulco and Buerger (2012), I expect that charter operators will make supply decisions that increase the likelihood of meeting these objectives. Given this assumption, Bifulco and Buerger (2012) identify several locational incentives that charter school financing and accountability provisions create for charter school operators. In this section, I recap those incentives, and identify few additional incentives created by aspects of charter financing policies not discussed by Bifulco and Buerger (2012).

Location Incentives Based on Variation in Charter School Base Payment

In states where charter school payments depend on district expenditures, districts with a high expenditure-to-cost ratio are an attractive location for charter school operators. A large number of low cost students and high expenditures will make it relatively easy for the charter operator to fulfill the achievement goals in the charter school contract. However, a high spending to cost ratio is also likely to allow the district to operate traditional public school that are appealing to students and parents. Thus, attracting enough students to stay financially viable might be difficult. Districts with high spending-to-cost ratios, which use their resources inefficiently, are

more likely to be an attractive location for charter schools. Therefore, in states where charter school base payments vary with school location, I expect larger concentrations of charter schools in inefficient districts with high spending-to-cost ratios (Bifulco and Buerger 2012).

In states where charter school payments do not vary with the location of charter schools, I would expect a different picture. In these states, including Michigan and Ohio, charter school payments can be more or less than expenditures in the surrounding district. Charter schools are more likely to move into districts with relatively low per pupil expenditures. In these districts, charter schools have more funding than traditional public schools enabling them to provide attractive programs to students and parents. Thus, in states that have no variation in charter school payments, I expect to see a larger concentration of charter schools in districts with low per pupil payments, holding districts costs and performance levels constant.

Bifulco and Buerger (2012) analyze charter school location patterns in New York a state having a high variation in per pupil district payments linked to differences in district expenditures. Controlling for the cost of providing education and mean student performance, they find that districts with higher per pupil operating expenditures have greater concentrations of charter schools. Holding district spending and cost of education constant, districts with lower mean student performance have more charter schools, which suggests that charter schools are more likely to move into relatively inefficient school districts.

Location Incentives Based on Cost Factors

A substantial literature in education finance maintains that education costs depend on district and student characteristics (Downes and Pogue 1994; Reschovsky and Imazeki 1998; Duncombe and Yinger 2000, 2005). District characteristics influencing education costs include teacher wages and facility costs. Holding other factors constant, charter schools have an incentive to locate in districts with low teacher wages and rents to decrease their operational costs (Bifulco and Buerger 2012).

Student characteristics influencing costs are mainly students' learning and language abilities. Supplemental payments for different grade levels, poor, LEP, and disabled student can offset disincentives created by high costs. By serving high shares of students in groups that generate additional payments, charter schools can generate higher per pupil revenues than surrounding schools. Whether or not charter schools have financial incentive to serve high cost students depends on the relationship between costs and supplemental payments. Holding everything else equal, in states where supplemental payments equal or exceed costs, charter schools will enroll relatively large amounts of high cost students. In states were costs are greater than additional revenues, charter schools will not have incentive to enroll high cost students. Ultimately, how costly high need students are, will depend on the performance standards in the charter school contract and if an effective set of policy instruments is in place to enforce these standards. Costs will be greater in states having higher performance goals and more effective instruments and lower in states with lower performance standards and less effective instruments costs (Bifulco and Buerger 2012).

Lacireno-Paquet et al. (2002) present evidence from Washington, D.C. that suggests that this type of financial incentive can influence charter school enrollments. Specifically, they find that charter schools are less likely than regular public schools to serve students whose language or special education needs make them more costly to educate. Interestingly, only charter schools that they classified as market-oriented, rather than mission-oriented, showed this tendency, suggesting that this type of financial incentive influences the supply decisions of some types of charter school providers more than others.

Location Incentives Based on Performance of Students and Schools

Attracting high achieving students increases the likelihood of reaching required achievement standards. The more demanding the student achievement standards, the stronger the incentive to attract high achieving students. Also, schools that offer high achieving peers are attractive to parents both because such peers might have positive spill-over effects and because parents might use the achievement level of students as a proxy indicator of instructional quality. Of course, high achieving students often have other attractive schooling options either because they live in areas with high quality public schools or have access to private or magnet schools. Thus, a charter school which chooses a location attractive to high achieving students may face more competition and have a harder time filling seats, which might weaken the strength of this incentive (Bifulco and Buerger 2012).

Parents whose children attend low performing schools are more likely to be dissatisfied with their current schooling options and to find a charter school attractive. Thus, locating in low performing school districts makes it more likely that a charter school can fill its allotted seats.

However, many of the students attracted to the charter school might be high need or low achieving students. Enrolling these students will make it more difficult to reach the student achievement standards without sufficient additional payments. If charter schools have a cost effective model to educate high need students, low performing school districts will be an attractive charter school location (Bifulco and Buerger 2012).

Also, charter schools locating in low performing districts can try to attract students from more advantaged backgrounds. For instance students whose parents are college educated may be more likely to use school choice programs compared to students of parents with less education. There is consistent empirical evidence that parental preferences are very heterogeneous and that low-income parents place lower values on academic characteristics when choosing schools (Schneider and Buckley 2002; Hastings, Kane, and Staiger 2006; Jacob and Lefgren 2007). Further, Hastings and Weinstein (2008) show that if information is costly to obtain, economically and educationally advantaged families are better able to exercise choice. Using a nationally representative data set, Butler et al. (2013) find students of parents having a somewhat greater socio-economic status than their peers having a higher likelihood enrolling into a charter schools. Thus, charter school operators in low performing school districts may be able to attract higher performing students out of low performing schools (Bifulco and Buerger 2012).

Evidence that these considerations may influence charter school locations is provided by a study in Washington, D.C. Henig and MacDonald (2002) found that charter schools were more likely to locate in census tracts with high proportions of African-American and Hispanic residents than in predominantly white census tracts. However, among census tracts with concentrations of

nonwhite residents, charter schools tended to locate in those with middle income and high home ownership rates. This location pattern suggests a strategy of targeting the more advantaged students within groups of traditionally disadvantaged students. Corroborating these findings, Bifulco and Buerger (2012) find that New York charter schools are more likely to locate in districts with concentrations of college educated adults as well as high levels of diversity in educational attainment.

Location in Diverse Districts

The preceding discussion suggests that a strategy targeting advantaged students who would otherwise attend schools with concentrations of disadvantaged students might be attractive to charter school operators. Such a strategy, if successful, would make reaching achievement standards, attracting a sufficient number of students, and keeping per pupil costs low each more likely. Thus, many charter school operators might look to locate near schools with diverse populations of students that include significant concentrations of both educationally disadvantaged groups and more advantaged, higher achieving student groups (Bifulco and Buerger 2014).

Glomm, Harris, and Lo (2005) make a more general argument of this kind. They argue that a diverse population is likely to have a dispersed distribution of parental preferences for different types of educational programs. As a result, schools or districts that serve diverse populations will have a difficult time satisfying the preferences of all of their parents, creating a demand for charter schools that can differentiate their offerings from the local school or district. They also

present evidence, consistent with their argument, that charter schools in Michigan are more likely to locate where populations are diverse in terms of race and adult education levels.

Another important factor is how in a diverse school district students sort into schools. It is possible that the schools reflect the diversity of the district residents. However, it is also very likely that students already sort into schools. If students are to sort into schools according to the preferences, I do not expect a high demand for students in these districts. However, families compete for entry into a neighborhood and may do not get to match their preferences towards education with the neighborhood they end up living. Thus, I expect charter schools to move into school districts with greater variation in residents and at the same time great disparities in schools' performance and student characteristics.

Location Incentives Based on Authorizer Preferences

As described earlier, authorizers in New York, North Carolina, and Michigan have preferences to approve applications for charter schools locating in areas with high shares of students at risk of academic failure. Charter operators applying for opening a charter school at a location preferred by the authorizer will have greater chances of getting their charter application approved. Charter schools will only locate in these areas if they have a cost effective model to educate high need students, or if they can enroll high performing students from these areas.

Although charter school authorizers are widely accepted as a crucial institution for the success of charter school programs, policymakers and researchers have largely overlooked them (Finnigan 2004). Using information from interviews and focus groups Finnigan et al. (2004) provide some

evidence that state authorizers are much more likely than local authorizers to consider in their sponsoring decisions the improvement of the public school systems, creating competition, and fulfillment of the state law. Thus, it is possible that charter school authorizers, particularly at the state level, actively encourage operators to move into certain areas. However, at this point it is unclear how strong this effect is.

3.5 Hypotheses

Taking into account base payments as well as accountability and authorizing policies in each state, I offer the following hypotheses.

> H1. *Holding performance and cost factors constant, I expect a positive relationship between district expenditures and the number of charter schools in states where charter school payments vary with district spending.*

The incentive to move into a high spending school district will be greater if there is a greater variance in district expenditures.

> H2. *In states where charter school payments do not vary with district expenditures, holding performance and cost factors constant, I expect a negative relationship between expenditures and the number of charter schools in a district.*

In states where charter school payments are unrelated to district spending, charter schools will have a competitive advantage in districts where per pupil spending in traditional public schools is low.

Taken into account the weights and additional payments for disadvantaged students, I can offer the following hypotheses.

> H3. *In states compensating charter schools for the enrollment of disadvantaged students, I expect a positive relationship between charter concentration (charter enrollment) and the share of disadvantaged students in a district (school).*

The relationship between the number of charter schools and the share of disadvantaged students in a school district is altered by the amount of additional payments, authorizer preferences, and the strength of the accountability system in the state. Additional payments have to be perceived as sufficient by charter school operators to create an incentive. Authorizer preferences can enforce incentives created by additional payments. High accountability standards with rigid enforcement increase the costs for charter schools to educate disadvantaged students and mitigate incentives created by additional payments.

3.6 Empirical Methods

To test the above stated hypotheses, I conduct two sets of analysis. The first analysis examines the distribution of charter schools across districts and the second analysis examines the

enrollment in charter schools. Focusing on the districts where charter schools are located allows me to examine the effect of financial considerations that vary at the district level such as per pupil payments. Looking at enrollment allows me to investigate the alignment of actual student shares with compensation schemes for high cost students.

Location Across Districts

The goal of this study is to determine how finance and accountability policies in different states influence locational decisions of charter schools. The empirical estimation follows the approach used by Downes and Greenstein (1996), Glomm, Harris, and Lo (2005), and Bifulco and Buerger (2012) to examine school location and estimate the following regression model in each of the five states:

$$Ch_i = f(E_i, P_i, C_i, D_i, N_i, \varepsilon_i) \quad (1)$$

where Ch_i is the number of charter schools in district i, E_i is per pupil spending in the district, P_i is a measure of student performance in the district, C_i are indicators of educational costs in the district including teacher wages and student need indicators, D_i are measures of the diversity of the population in the district, N_i is a control for the number of school age children, R_{it} are rental costs, and ε_i is a random error term.

Two main issues arise in estimating and interpreting the proposed regression. *First*, the count of charter schools only occurs in non-negative integer values and several districts will not experience a charter school moving in at all. In this case, researchers typically estimate either a

Poisson or a negative binomial model. I used two tests to determine the correct model for the count of charter schools in each state. First, I calculated the over-dispersion parameter alpha using a log likelihood test. Alpha is the variance of the multiplicative random effect. If the value of alpha is close to zero, the distribution has a variance that is close to the mean. In this case, a Poisson model is preferred over a negative binomial model. If alpha is significantly different from zero, a negative binomial model is preferred. The value of alpha is significantly different form zero in all states suggesting that a negative binomial is a better fit for my models[17].

Second, I follow Cameron and Trivedi (2005) and conducted the following analysis. In a first step, I estimated the fitted frequencies for different numbers of charter schools using a Poisson and negative binomial model. Then, I compared the actual to the fitted frequencies of the two models. Frequencies for the actual and fitted counts are quite similar in New York, Michigan, and Ohio in both models. In North Carolina and Florida, the Poisson regression substantially underpredicts the proportion of zero charter schools and overestimates the proportion of having one or two charter schools. This pattern in the lack of fit is associated with the neglect of overdispersion in the data. In count data, overdispersion arises when for the variance for a count exceeds its mean. This is particularly true in North Carolina and Florida[18]. The negative binomial model predicts the count of charter schools much better, and hence I use this model for my estimation.

[17] The alpha values are all statistically significant at the .01 level. The values are: New York 297.45; Florida 504.4; North Carolina 266.39; Michigan 569.08; and Ohio 928.09.
[18] The mean and variances are: New York 0.07 and 0.06; North Carolina 0.8 and 190.2; Florida 6.7 and 222.36; Michigan 0.33 and 7.89; and Ohio 0.48 and 11.62.

A *second* issue concerns potentially endogenous relationships. Each of the independent variables I propose to examine is potentially influenced by the presence of charter schools. To address this issue, I regress the number of charter schools in 2009-10 on measures of the independent variables before charter school entry. For instance, all measurements based on census tabulations will be from 1990. None of the five states had a charter school program in 1990. Further, performance measurements will be from standardized tests at least one year before the charter school program was established. Using district characteristics before charter school opened should minimize potential simultaneity problems.

The data to estimate Equation 1 comes from several sources. The charter school counts come from charter school lists administered by each state and available at the state's education department web page. The operating expenditures in a district were calculated using the Common Core of Data School District Finance Survey (CCD). The per pupil expenditure in each district is calculated by dividing the current operating expenditure[19] for elementary and secondary education instructional programs by the number of students enrolled in the district. Current operating expenditures reflect in states with varying charter school payments revenues for charter schools. In states with flat payments they reflect how much the traditional schools spend charter schools are competing with. Performance measurements are computed by converting mean scores of each district in the state into standardized scores with a mean of zero and standard deviation of one using statewide test specific means and standard deviations, and

[19] The current operating expenditures are defined as the sum of the current expenditures for instruction, the current expenditures for support services, and the current expenditures for other services (including food services and enterprise operations). I exclude capital expenditures as they fluctuate strongly according to building projects in the districts. Further, I exclude debt as these costs do not reflect operating expenditures of a given year.

then averaging the standard scores for grade 4 English, grade 4 mathematics, grade 8 English and grade 8 mathematics.

Measurements of student characteristics, mean years of education, the diversity measurements for education and race, rent for residential property and enrollment figures were computed using data from district tabulations of the 1990 U.S. Census. The measures of educational and racial diversity are versions of a Herfindahl index. The Herfindahl index for parental education is constructed using 4 different years of education categories[20]. The Herfindahl index for race is constructed using 5 racial categories[21]. Values for the Herfindahl indices range from 0 to 100 with greater numbers indicating *more* diversity.

Finally, the measure of teacher wages in each of the state's metropolitan areas is the Labor Market Comparable Wage index produced by the National Center for Education Statistics. This measure is determined by wages paid for comparable occupations in the local labor market and thus reflects the underlying costs of teachers rather than district decisions about teacher salaries.

Enrollment in Charter Schools

Choosing a location is only one of several supply decisions that charter school operators make. They also make decisions about what programs to offer, and how to advertise and recruit students. Together with the educational preferences of parents and students, these supply decisions may influence who attends charter schools. Once charter school operators have chosen a location where there is healthy demand, charter schools may have an incentive to choose

[20] The categories are less than high school degree, high school degree, some college, and college degree.
[21] The categories are white, black, Indian, Asian, and Hispanic.

programs and recruitment strategies that attract higher achieving students or students who require fewer resources to reach student achievement standards. I do not observe the decisions charter schools make about programming, recruiting and advertising in this study. However, I can compare the enrollments of charter schools to the surrounding traditional public schools to see if their programs and recruitment strategies attract certain types of students. Further, I can evaluate if charter school enrollment patterns are consistent with the incentives set by each state's finance policies (Bifulco and Buerger 2012).

Using report card information from 2010 in each of the five states, I compare the compositions of charter schools to the schools in the district where they are located. Charter school students are able to cross district school borders, however, in most states enrollment preferences are given to the students residing in the district where the charter school is located[22]. I use a regression framework for comparing enrollment in charter and traditional schools in the same district. The dependent variables measure the share of students with disabilities, being poor, and having limited English proficiency. The independent variable is a charter school dummy. In such a regression, the intercept simply states the share of at risk students in traditional schools. The coefficient on the charter school dummy shows how charter schools deviate from traditional schools in their enrollment and if the disparity is statistically significant. To make comparisons only within districts, I add district fixed effects to the regression. To control for potential

[22] The charter school law in New York states that in case of oversubscription "enrollment preference shall be provided to pupils […] residing in the school district in which the charter school is located" (Charter School Law S 2854. 2 (b)). In Florida, charter schools can give preference to students residing "within a reasonable distance of the charter school" (Title XLVIII 1002.33 10 (d)) and can give preference to students that live in the municipality the charter school is located (Title XLVIII 1002.33 10 (b)). "A resident of a municipality that operates a charter school-in-a-municipality pursuant to paragraph (15) (c). In Ohio, charter schools can restrict enrollment to students in the district they are located in (2013 Ohio Charter Law Guidebook). In case of oversubscription, Ohio charter schools have to give preference to students residing in the district the school is located (2013 Ohio Charter Law Guidebook).

heteroskedasticity, I weight each regression by school enrollment. More formally, I estimate the following equation:

$$X_{si} = \beta_0 + \beta_1 charter_s + \delta_i + u_{si}$$

where X_{si} stands for characteristics of students enrolled in school *s*, in district *i*. The characteristics include the share of students in poverty, LEP students, and students with. *Charter* is an indicator that turns on for charter schools. The term δ_i stands for districts fixed effects.

3.7 Empirical Results

First I discuss the results for the analysis of charter location across districts and then the enrollment analysis.

Location Across Districts

Table 13 presents descriptive statistics for the variables used in the district level analysis. In New York, Michigan, and Ohio charter schools move into relatively low performing school districts with relatively high concentrations of poor students. In contrast, in North Carolina and Florida, charter schools move into relatively high performing school districts and have a relatively low concentration of poor students. In all states except New York charter schools move into districts with relatively high teacher wages and rents, which is probably explained by the fact that charter schools are locating in urban areas that tend to have higher wages and rent prices. Districts where charter schools locate have greater educational diversity but do not differ greatly from other

districts in the level of adult education. In terms of racial diversity, charter schools move into more racially diverse districts in New York, Ohio, and Michigan. Charter schools locate in less diverse districts in Florida and North Carolina. In all states charter schools move into districts with greater enrollment and with greater operating expenditures per pupil.

The patterns of charter school location detailed in Table 13 does not allow me to say much about the incentives created by finance policies. Finance, accountability, and authorizer policies create countervailing incentives and it would be useful to know which of the variables listed in Table 13 are independently associated with the number of charter school, after controlling for other variables. Further, Table 13 ignores the considerable amount of variation in the number of charter schools across districts with charter schools. To help assess whether the theoretically described incentives influence which districts have the highest concentration of charter schools, I show the results of the regression analysis in Table 14.

New York, Florida, and North Carolina are states where charter school payments vary with operating expenditures in the district. New York has the greatest variation followed by Florida and North Carolina. For these states, I predicted positive coefficients and greater magnitudes in states with greater variation in expenditures. The predications are confirmed by the coefficients in Table 14. For all three states, the coefficients are positive. The effect of operating expenditures on the concentration of charter schools in the district is greatest in New York followed by Florida, and North Carolina. In New York, a one percent increase in the per pupil expenditures is associated with a 6 percent increase in charter schools. Thus, if a district would increase per pupil spending by 16 percent, the number of charter schools in the district would double. In

Florida, a one percent change in operating expenditures leads a 2.4 percent increase in charter schools. If a district would increase operation expenditures per pupil by 41 percent the number of charter schools would double. In North Carolina a one percent increase in operating expenditures is associated with a 1.7 percent increase in charter schools. To double the amount of charter schools a district would have to spend 58 percent more per pupil.

In Michigan and Ohio payments to charter schools do not vary with district expenditures. I predicted a negative coefficient on the variable measuring the operating expenditures. The coefficients in Table 14 show negative coefficients for Michigan and Ohio. In Michigan, a one percent increase in operating expenditures leads to a decrease in charter schools by 0.3 percent. In Ohio, a one percent increasing in operating expenditures leads to a decrease in charter school concentration of 0.1 percent. Both coefficients show relatively small effects that are not statistically significant. The initial hypothesis cannot be corroborated; however, the relationship between operating expenditures and charter school concentration is negative as predicted.

For variables measuring student characteristics such as the share of students with disabilities, being poor, and having limited English proficiency, I predicted greater concentrations of charter schools in states paying compensations for these students. The coefficients on the variable measuring the share of students with disabilities are close to zero and statistically insignificant in all states but New York. In New York, the coefficient on the share of students with disabilities is statistically significant and negative. A one standard deviation increase in the number of disabled students decreases the number of charter schools by 50 percent. The weights for students with disabilities are neither high nor low compared to the other states in the sample. However, charter

schools in New York State seem to avoid places with high concentrations of students with disabilities. Thus, the finding is not consistent with the predictions in the theoretical section of the chapter.

The coefficients on the variables measuring the share of poor students in the districts are close to zero and statistically insignificant in all states but Ohio. In Ohio, a one standard deviation change in the share of poor students increases the number of charter schools in the district by 85 percent. Out of all states, Ohio has the highest additional payments for poor students. Thus, the result confirms the hypotheses stated in the theoretical section of the chapter.

The coefficients on the variable measuring the share of students with limited English proficiency are close to zero and statistically insignificant in Florida and Ohio. The coefficients are imprecisely measured in New York and North Carolina. In Michigan, the coefficient is positive and statistically significant indicating that charter schools are more often located in districts with higher shares of LEP students. The coefficient implies that a one standard deviation increase in the share of LEP students leads to a 24 percent increase in charter schools. Michigan is not a state with high compensations for LEP students. Thus, the initial hypothesis is not corroborated.

The analysis of the relationship between student characteristics and charter school concentration did not show a consistent pattern. The results corroborated the theoretical predictions regarding the relationship between the share of poor students and the concentration of charter schools. The results did not corroborate the theoretical predications for the relationship between the share of students with disabilities and limited English proficiency and the concentration of charter schools

in the school district. There are two potential explanations for the inconsistency between empirical results and theoretical predictions. First, if there are large variations in the student population within districts, the across district analysis cannot pick up differences between districts. This could be particularly true for Florida and North Carolina where districts are very large and match county borders. Second, the incentives created by compensations may be offset by the higher cost of educating these students. In this case, compensations are not high enough to create a location incentive. The enrollment analysis will help to understand which of these two explanations is likely to be true.

Further, I predicated a negative relationship between costs factors including teacher wages and building rents and the number of charter schools in the district. However, only in New York does an increase in the teacher wage index leads to a decrease in charter schools. In all other states, the coefficients on the teacher wage variable are close to zero and not statistically significant. A potential explanation why the results in these four states deviate from the theoretical predictions could be that charter schools pay salaries below the conventional wages for similar occupation in the area. According to the National Center for Education Statistics, the gap in salaries between traditional and charter schools teacher was $8,900 in 2012 (NCES 2013). Thus, charter schools might be able to avoid high costs by paying their teachers lower salaries.

I proxy for commercial rent with the rent for residential properties as researchers have shown the strong correlation between both real estate sectors and their similarities in rent patterns (Gyourko 2009; Rosen 1979; Roback 1982). The coefficients in all states are close to zero and not statistically significant. The result indicates that rent differences between school districts do not

have an impact on how charter school operators choose their location. One potential explanation is that other factors such as per pupil payments are more important factors when charter school operators look for potential locations.

The predictions on the relationship between district performance and the concentration of charter schools in the district were ambiguous. On one hand, charter schools could be drawn to move into high performing districts making it easier to fulfill performance goals. On the other hand, charter schools could be inclined to move into low performing district where the demand for alternative educational programs is high. I find a statistically significant result only for New York, where charter schools locate more often in school district with low performance. In the other states, there is no statistically significant relationship between performance and charter concentration. The result is possibly explained by the countervailing incentives performance creates for charter school operators.

I predicted that charter schools are more likely to move into districts with both concentrations of college educated parents but also considerable diversity in educational levels among parents. The coefficients on the variable measuring the mean years of education are not statistically significant in any of the states. In New York and North Carolina the coefficients on the variable measuring the educational diversity in the district are statistically significant. The coefficient in New York implies that a one standard deviation increase in diversity is associated with a 116 percent increase in the number of charter schools. In North Carolina the coefficient is much smaller suggesting that a one standard deviation increase in diversity is associated with a 21

percent increase in charter schools. Therefore, I can only partially corroborate the initially stated hypotheses.

Controlling for educational diversity, the amount of racial diversity in a district does not have statistically relationship with the concentration of charter schools for all states except Ohio. The coefficient in Ohio implies that a one standard deviation increase in racial diversity is associated with a 60 percent increase in charter schools.

In all states charter schools are more likely to move into school districts with high enrollment numbers. Similar to the operating expenditures, the coefficient on the enrollment variables can be interpreted as an elasticity. The effects in all states are relatively small suggesting that to double the number of charter schools the enrollment would have to increase by 100 percent.

In Table 15, I pool all states and rerun Equation 1 including dummy variables for each state and interacting these dummies with the log of operating expenditures. The coefficients on the interactions are statistically significant for New York, Florida and North Carolina. The magnitude of the effect is somewhat smaller for New York and larger for North Carolina compared to the results in Table 14. The reason for these differences are the relative numbers of charter schools in each state. New York has a relative small number of charter school compared to Florida and North Carolina. Thus, the concentration of charter schools is also greater in these states. The coefficients on the interactions for Michigan and Ohio are not statistically significant. Overall, the results of the pooled regression confirms the results of Table 14.

In conclusion, the across district comparisons shows the following results. The first hypothesis predicted a positive relationship between expenditures and the concentration of charter schools in states with varying charter payments. The analysis corroborated the hypothesis showing a positive and statistically significant relationship between expenditures and the number of charter schools in a school district. The relationship was stronger in states having a greater variation in charter payments. The second hypothesis states a negative relationship between district expenditures and charter concentration for states with no variation in charter payments. The hypothesis was partially confirmed as the coefficients showed the expected sign but were not statistically significant. The third hypothesis predicted a positive relationship between the share of disadvantaged students and the concentration of charter schools for states paying compensations. The analysis did not show a consistent pattern for all groups of disadvantaged students. For poor students the regressions showed a positive and statistically significant result in Ohio. Ohio is the state that pays the largest compensation for poor students of all states in the sample. Thus, the hypothesis was confirmed. For students with disabilities and with limited English proficiency the regression did not show the predicted effects. The inconsistency between theoretical predictions and empirical results may be explained by within district variation in these variables or compensations insufficient to create location incentives.

Enrollment in Charter Schools

Table 16 presents for each state the share of students with disabilities, living in poverty, and having limited English proficiency. I calculated the measurements using school level report cards for each state. The first notable result is that students in Florida are more likely to be poor, and limited in their English proficiency. Students in Ohio are much less likely to be poor and have

limited English skills. In general, the variance between states is greatest in the number of students receiving free lunch and relatively small for students with limited English proficiency.

Table 16 does not allow a direct comparison between charter and traditional schools in the same district. In the next step, therefore, I regress each measure of disadvantaged students on a charter school dummy and district fixed effects. I am weighting each regression by school enrollment to avoid potential heteroscedasticity. Also, I cluster at the district level to control for potential shocks in the enrollment of disadvantaged students. To increase the comparability across states, I standardized each measure of disadvantaged students with regard to the state's mean. Table 17 presents the coefficients on the charter school dummy with their corresponding standard error.

I predicted that in states paying compensations to charter schools for enrolling disadvantaged students, enrollments of disadvantages students will be higher than in states not paying compensations. This is exactly what the coefficients on the charter dummy show for the regressions using the share of poor students in a school as dependent variable. In Michigan and Ohio the coefficients are positive and statistically significant suggesting that charter schools enroll more poor students than the traditional public schools in the same district. Payments for poor students are much higher in Ohio compared to Michigan. Consistently, the coefficient is greater in Ohio than in Michigan. The coefficient for Ohio implies that charter schools enroll 0.4 of a standard deviation more poor students than the traditional public schools located in the same district. In Michigan, charter schools enroll 0.27 of a standard deviation more poor students than traditional schools in their district. In Florida and North Carolina the coefficients are negative and statistically significant. The coefficients show that charter schools enroll 0.5 and 1.43

standard deviations fewer poor students than the traditional schools in their district. In New York, the coefficient is positive but imprecisely estimated. New York does not pay any additional funding for enrolling poor students.

The regressions using the share of students with disabilities or the share of students with limited English proficiency as dependent variables, show negative and statistically significant coefficients on the charter school dummy. The results suggest that charter schools enroll smaller numbers of these students than traditional schools in the same school district. For students with disabilities, the difference between charter and traditional schools is greatest in Ohio. Charter schools enroll 0.34 standard deviations fewer special education students compared to traditional public schools. For LEP students, the difference is greatest in Florida, where charter schools enroll over one standard deviation fewer LEP students than traditional public schools.

There are two potential explanations for the discrepancy between theoretical predications and empirical results. First, compensations for these students are not large enough to create an enrollment incentive. In fact, Duncombe and Yinger (2005) estimate that the additional costs of educating an LEP or special education student are much higher than for a poor student. Estimating cost functions for New York State school districts, they find that students coming from poor families are 111 percent and LEP students are 215 percent more costly to educate compared to regular students. Further, they estimate the costs of educating special education students to be 264 percent more costly compared to regular students.

Second, charter school operators may try to avoid disadvantaged students to ensure the school is high performing. Even though charter schools cannot selectively admit students, they can choose their mission and establish unique curricula making it less likely for disadvantaged students to apply (Renzulli and Evans 2005). If the school admits larger shares of less disadvantaged students it is easier to fulfill performance goals in the charter contract and hence avoid the risk of being closed or not renewed. Also, high performing charter schools are more likely to attract students, making it easier to fill the allotted seats in the school.

In conclusion, the enrollment analysis shows the following results. The third hypothesis predicted greater enrollments of disadvantaged students in states paying compensations. The hypothesis was confirmed for the enrollment of poor students. The hypothesis was not confirmed for the enrollment of special education and LEP students. The results are most likely explained by two factors. First, compensations for disadvantaged students are likely to not outweigh the cost of educating them. Second, charter schools prefer high performing students to ensure a proper licensing and demand for the school.

3.8 Conclusion

Supply decisions by charter school operators play an important role in determining which students have access to charter schools, which schools will be subject to charter school competition, what effects charter schools will have on school and residential segregation, and ultimately on the distribution of the costs and benefits created by charter schools.

This chapter provides the first empirical test of whether charter school finance provisions influence charter school location and enrollment using a comparison between different states. Applying theory and knowledge on finance provisions, I state hypothesis regarding the relationship between funding policies and charter concentration in five states. The first hypothesis states that in states linking charter school payments to district expenditures, charter schools will be more likely to locate in districts with greater expenditures holding performance and cost factors constant. This hypothesis was corroborated by the empirical analysis. The greater the variance in district expenditures the stronger was the relationship between charter school concentration and district expenditures.

The second hypotheses stated that in states paying the same per pupil amount no matter where the charter school locates, charter school will move into school district with relatively low per pupil payments. While the coefficients of the negative binomial models where indicating the hypothesized relationship, the results were close to zero and not statistically significant. Thus, the hypothesis cannot be corroborated.

The third hypothesis predicted greater numbers of charter schools in districts with high concentrations of disadvantaged students and greater enrollment of these students in states paying compensations. The across district and enrollment analysis were able to corroborate these hypotheses for poor students. The results for special education and LEP students show that charter schools do not locate in areas with high concentrations of these students and enroll them less often compared to traditional schools in the same district. A potential explanations is that compensations are insufficient to outweigh the costs of educating these students. Another

explanation is that charter schools have an incentive to enroll relatively high performing students to ensure compliance with the charter school contract and to secure sufficient demand for the allotted seats in the school.

The evidence provided in this chapter that charter schools respond to financial incentives in their location and enrollment patterns has important policy implications. First, it suggests that policy makers can influence the supply of charter schools by raising or lowering per pupil payments. For instance, a way to potentially encourage charter schools to serve larger shares of disadvantaged students is to increase the per pupil payments for those categories of students.

Second, the decision to either tie charter school payments to district spending or to pay a flat per pupil amount independent of location, has an important impact on supply decision by charter operators. Policies tying per pupil payments to district spending levels are likely to attract charter schools in high spending and inefficient districts. The opening of charter schools can increase competition between schools and hence lead to gains in the efficiency of providing education. As this study shows, these gains may be achieved at the expense of strong student stratification. More costly students stay in traditional schools while less costly students go to charter schools. This is more likely if finance policies do not include any or only small compensations for high cost students.

Policies paying flat amounts most likely will see less influence of district expenditures on charter location. In these states charter school location may be more demand driven. This will be

particularly true if finance policies include sufficient compensations for students not being served well by the existing traditional school system.

Third, charter school accountability seems to play an important role in charter location and enrollment. States with low accountability standards and relatively high compensations are likely to see concentrations of charter schools in areas with disadvantaged students and greater enrollments of these students in charter schools. Good examples are Michigan and Ohio where states pay compensations for poor students and accountability systems are not as demanding as in other states. Therefore, high accountability standards probably have to be accompanied by greater compensations for disadvantaged students. Otherwise, charter schools are likely to be discouraged from locating in areas with high shares of these students or to enroll them.

Finally, the authorizer preferences stated in charter schools laws do not seem to have a great influence on charter school locations in the five states analyzed. In states having preferences towards charter applications intending to serve certain types of students or to locate in specific area, the analysis did not show a larger concentration of charter schools in areas with high concentrations of students emphasized in the law. There are two reasons why this could be the case. First, authorizers might not follow the priorities set in the law and may emphasize other criteria in authorizing and renewing charter schools. Second, as earlier discussed, charter school operators may be avoiding areas with high concentrations of disadvantaged students for cost reasons. The analysis in this chapter suggests that location priorities are likely to have to be backed up by greater compensations for enrolling disadvantaged students.

Table 9: Decisions Process for Sample

State	Number of charter schools[1]	Share of charter schools students[23]	Predetermined Payments[24]	Data Availability[25]
Alabama	No program	No program	-	-
Alaska	25	3.95%	-	-
Arizona	504	10.57%	predetermined payments	no
Arkansas	38	1.80%	-	-
California	813	5.14%	predetermined payments	no
Colorado	158	8.03%	predetermined payments	no
Connecticut	18	0.92%	-	-
Delaware	18	7.35%	-	-
Florida	412	5.23%	predetermined payments	yes
Georgia	63	2.25%	-	-
Hawaii	31	4.37%	-	-
Idaho	36	5.26%	-	-
Illinois	39	1.71%	-	-
Indiana	53	1.77%	-	-
Iowa	9	0.12%	-	-
Kansas	35	1.00%	-	-
Kentucky	No program	No program	-	-
Louisiana	77	4.56%	-	-
Maine	No program	No program	-	-
Maryland	42	1.41%	-	-
Massachusetts	62	2.86%	-	-
Michigan	294	6.84%	predetermined payments	yes
Minnesota	181	4.23%	predetermined payments	no
Mississippi	1	0.08%	-	-
Missouri	48	2.01%	-	-
Montana	No program	No program	-	-
Nebraska	No program	No program	-	-
Nevada	35	2.67%	-	-
New Hampshire	15	0.41%	-	-
New Jersey	70	1.66%	-	-
New Mexico	72	3.94%	-	-
New York	140	1.62%	predetermined payments	yes
North Carolina	96	2.64%	predetermined payments	yes
North Dakota	No program	No program	-	-
Ohio	323	5.16%	predetermined payments	yes
Oklahoma	18	0.96%	-	-
Oregon	102	3.31%	negotiations	-
Pennsylvania	134	4.49%	predetermined payments	no
Rhode Island	12	2.25%	-	-
South Carolina	39	1.80%	-	-
South Dakota	No program	No program	-	-
Tennessee	20	0.45%	-	-
Texas	536	3.06%	predetermined payments	no
Utah	72	5.83%	-	-
Vermont	No program	No program	-	-
Virginia	3	0.01%	-	-
Washington	No program	No program	-	-

[23] Calculations based on the 2010 Common Core of Data assembled by the National Center of Education Statistics.
[24] Own research based on state charter school laws and budget information.
[25] Inquiries were made to the state education departments regarding data necessary for the analysis.

West Virginia	No program	No program	-	-
Wisconsin	206	4.14%	negotiations	-
Wyoming	3	0.31%	-	-

Table 10: Charter School Finance Systems in Michigan, Ohio, North Carolina, Florida, and New York

	New York	Florida	North Carolina	Michigan	Ohio
Base Payments					
Payments (in 2007)	$6,081 to $17,915 with a mean of $9,987 and a standard deviation of $2,497	$6,776 to $10,745 with a mean of $7,913 and a standard deviation of $802	$3,943 to $8,864 with a mean of $5,047 and a standard variation of $770	$7,085 or $7,385 with a mean of $7,159 and standard deviation of $129	$5,403
Adjustments for district characteristics					
Adjustment for low wealth districts	no adjustments	no adjustments	no adjustments	no adjustments	Payments: $9 - $594 depending on district wealth and determined by the legislature
Small districts/Sparcity	no adjustments	Payments: $2 to $533 depending on district enrollment; determined by the legislature	no adjustments	no adjustments	no adjustments
Cost of living	no adjustments	Weights: between 0.9221 to 1.0271 Deductions/Payments: -$616 to $214	no adjustments	no adjustments	no adjustments
Adjustments for student characteristics					
Disabilities	Weight: 1.65 for students with severe disabilities and 0.9 for students with less severe disabilities Payments: $14,182 for students with severe disabilities and $7,735 for students with less severe disabilities[26]	Weights for less severe disabilities: grades K to 3 = 0.035; grades 9 to 12 = 0.088 Weights for severe disabilities: 3.734 and 5.201 Payments for less severe disabilities: $277 and $696 Payments for severe disabilities: $21,634 and $33,242	Weight: 0.125 Payment: $631	Weight: 0.286 Payment: $2,069	Weight: 0.28 – 4.73 based on the severity of the disability Payments: $1,513 – $20,153
Poverty	no adjustments	no adjustments	no adjustments	Weight: 0.115 Payment: $832	

[26] Calculation is based on the maximum amount of expenditures that can be multiplied with the weights. The amount was $8,500 in 2007 (NYS Education Commissioner 2007).

					Payment: $1,208 determined by the legislature
Limited English Proficiency	no adjustments	Weight: 0.275 Payment: $2,176	Payment: $683 determined by the legislature	Weight (if student is not already counted as poor): 0.115 Payment (if student is not already counted as poor): $832 Payment: $67 determined by the legislature	Weights: 0.125 – 0.25 depending on the # of LEP students in the district Payments: $675 – $1,350

Table 11: Strength of Accountability Systems in Five States According to NAPCS Model Charter School Law

	Strength Charter School Law				
	Charter Application, Review, and Decision-making Processes	Performance-Based Charter Contracts Required	Comprehensive Charter School Monitoring and Data Collection Processes	Clear Processes for Renewal, Nonrenewal, and Revocation Decisions	Average Score
New York	2	3	3	3	2.75
Florida	2	2	2	2	2.00
North Carolina	1	2	1	1	1.25
Michigan	1	2	2	2	1.75
Ohio	1	1	3	2	1.75
NAPCS Average	1.725	1.525	2.025	2.075	1.84

Table 12: Comparison of State and NAEP Proficiency Levels for Five States

	Comparison State and NAEP Proficiency Levels				
	Reading Grade 4 Proficiency Difference between State and NAEP Standards	Reading Grade 8 Proficiency Difference between State and NAEP Standards	Mathematics Grade 4 Proficiency Difference between State and NAEP Standards	Mathematics Grade 8 Proficiency Difference between State and NAEP Standards	Average Difference
New York	-32	-25	-37	-29	-30.75
Florida	-41	-19	-26	-32	-29.5
North Carolina	-56	-60	-27	-31	-43.5
Michigan	-46	-44	-40	-42	-43
Ohio	-44	-44	-30	-37	-38.75
NCES Average	-41.90	-39.71	-32.79	-30.66	-36.26

Table 13: Description of Variables for the Analysis of Charter School Location Across Districts in 5 States:

	New York		Florida		North Carolina		Michigan		Ohio	
	With Charter	Without Charter	With Charter	Without Charter	With Charter	Without Charter	With Charter	Without Charter	With Charter	Without Charter
Number of Districts	14	466	38	23	47	63	96	278	38	544
Number of Charter Schools	3.54 (4.43)	0 (0)	10.63 (18.43)	0 (0)	2.06 (2.35)	0 (0)	2.73 (7.93)	0 (0)	6.68 (12.1)	0 (0)
Current Operating Expenditures	9,589.36 (1,320.51)	9,173.31 (2,288.58)	4,515.56 (404.8)	4,393.64 (387.83)	4,458.13 (546.45)	4,364.13 (356.72)	4,662.48 (952.77)	3,906.67 (827.03)	5,499.65 (780.8)	4,654.92 (1,084.58)
Mean Student Performance	-1.09 (1.28)	0.19 (0.94)	0.17 (0.97)	-0.37 (1.06)	0.2 (0.94)	-0.18 (1.05)	-0.28 (1.15)	0 (0.83)	-1.38 (1.52)	0.09 (0.88)
Teacher Wage Index	103.88 (10.39)	106.02 (12.58)	82.84 (6.47)	75.3 (6.91)	87.14 (7.33)	83.55 (6.28)	96.07 (6.65)	91.73 (6.86)	91.98 (5.2)	87.97 (6.31)
Child Poverty Rate	14.62 (6.95)	6.64 (4.46)	19.26 (6.25)	26.04 (7.35)	16.88 (7.2)	20.6 (8.47)	15.16 (12.34)	12.75 (8.52)	21.21 (13.56)	13.49 (9.21)
Mean Years of Education	13.18 (0.99)	13.67 (0.87)	12.4 (0.56)	11.76 (0.45)	12.32 (0.69)	11.91 (0.46)	12.77 (0.8)	12.73 (0.72)	12.54 (0.8)	12.53 (0.86)
Educational Diversity	90 (2.65)	86.66 (3.52)	95.74 (2.39)	92.57 (2.88)	95.23 (4.4)	94.24 (2.86)	90.67 (7.33)	89.44 (5.05)	92.11 (6.95)	87.47 (7.45)
Racial Diversity	53.22 (20.74)	23.29 (20.02)	41.55 (13.02)	43.04 (15.03)	41.97 (18.62)	42.84 (21.9)	21.67 (20.7)	10.71 (12.02)	35.41 (22.38)	7.58 (10.19)

Enrollment	15,960.38 (18,711.25)	3,410.47 (3,091.61)	42,937.95 (60,548.71)	4,719.91 (4,367.73)	13,572.38 (15,889.62)	5,657.6 (4,355.33)	8,748.55 (20,813.85)	2,408.69 (19,27.88)	15,663.42 (20,057.64)	2,374.24 (18,56.13)
Disability Rate	7.4 (1.97)	8.74 (3.49)	22.02 (5.76)	27.75 (5.73)	20.52 (5.02)	23.89 (4.79)	17.66 (6.36)	17.29 (5.19)	20.06 (6.55)	17.27 (5.63)
Rate English not First Language	0.85 (0.09)	0.9 (0.08)	10.11 (9.72)	7.3 (8.49)	4.33 (1.96)	4.33 (1.58)	5.81 (4.73)	4.06 (3.07)	4.61 (2.77)	4.33 (6.11)
Median Rent	524.46 (184.04)	538.28 (197.64)	445.84 (92.2)	311.13 (70.1)	348.6 (64.15)	310.94 (51.14)	444.96 (76.7)	403.18 (81.36)	395.45 (80.49)	375.02 (83.7)

1. Average Operating Expenditures calculated using the Common Core of Data Fiscal Files from 1999.

2. Computed by converting the mean score for each district in the state into a standardized score with a mean of zero and standard deviation of one using statewide test specifics means and standard deviations, and then averaging the score for grade levels 4 and 8 in subjects Math and English, Language, and Art. Tests are taken from state accountability systems prior to the charter school program.

3. Teacher comparable wage index for consolidated metropolitan statistical areas obtained from National Center for Education Statistics downloaded from: http://nces.ed.gov/edfin/adjustments.asp

4. Measure from district tabulations of the 1990 U.S. Census.

5. Herfindal index constructed using four different years of education categories. Values range between 1 and 100 with greater values indicating more diversity.

6. Herfindahl index constructed using five different categories of race. Values range between 1 and 100 with greater values indicating more diversity.

All measures in parentheses are standard deviations

Table 14: Charter School Location Across School Districts in 5 States using Negative Binomial

Variation of Per Pupil Expenditures by Charter Location	Large		Small	No	No
Count Charter Schools	New York	Florida	North Carolina	Michigan	Ohio
Log of Avg Operating Expenditures	6.154***	2.439**	1.722*	-0.314	-0.108
	(1.584)	(1.206)	(1.021)	(0.712)	(1.075)
Mean Student Performance	-1.674**	-0.147	0.159	-0.134	-0.236
	(0.770)	(0.120)	(0.174)	(0.176)	(0.158)
Teacher Wage Index	-0.137***	-0.00352	0.0268	0.0156	0.0138
	(0.0438)	(0.0236)	(0.0221)	(0.0181)	(0.0436)
Child Poverty Rate	0.00154	-0.0188	-0.0116	0.0167	6.262**
	(0.115)	(0.0505)	(0.0368)	(0.0215)	(2.916)
Mean Years of Education	0.741	0.0671	0.505	0.00881	0.0407
	(0.688)	(0.431)	(0.365)	(0.230)	(0.400)
Educational Diversity	0.436**	0.0482	0.0470*	0.00524	0.0433
	(0.173)	(0.0688)	(0.0282)	(0.0104)	(0.0546)
Racial Diversity	0.00228	0.0117	0.00790	0.00451	0.0270***
	(0.0244)	(0.0152)	(0.00893)	(0.00672)	(0.00727)
Log of Enrollment	0.963**	1.007***	0.707***	0.998***	1.199***
	(0.460)	(0.179)	(0.156)	(0.0909)	(0.283)
Disability Rate	-0.252**	0.000354	-0.00932	0.00726	0.0356
	(0.109)	(0.0523)	(0.0516)	(0.0396)	(0.0882)
Rate English not First Language	4.184	-0.00283	-0.100	0.0499***	0.000404
	(5.383)	(0.0144)	(0.0895)	(0.0121)	(0.0421)
Median Rent	-0.000602	-0.000473	-0.00157	0.00168	0.00508
	(0.00352)	(0.00272)	(0.00306)	(0.00196)	(0.00458)
Constant	-104.4***	-34.43***	-33.19***	-9.656	-20.67

	(25.75)	(12.02)	(8.154)	(6.221)	(12.57)
Log-likelihood Value	-47.488	-112.959	-104.146	-267.721	-134.186
R-squared	0.853	0.973	0.902	0.981	0.788
Observations	480	61	110	374	582

R-squared is computed as the square of the correlation between the dependent variable and the predicted value of the dependent variable.

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 15: Pooled Negative Binomial for 5 States

	Count of Charter Schools
Operating Expenditures X Dummy New York	2.812***
	(0.915)
Operating Expenditures X Dummy Florida	2.944***
	(0.838)
Operating Expenditures X Dummy North Carolina	3.125***
	(0.842)
Operating Expenditures X Dummy Michigan	0.904
	(0.749)
Operating Expenditures X Dummy Ohio	0.245
	(0.583)
Dummy New York	-1.273
	(11.54)
Dummy Florida	1.907
	(10.16)
Dummy North Carolina	25.10***
	(7.868)
Dummy Michigan	19.39**
	(8.939)
Mean Student Performance	-0.308***
	(0.0981)
Teacher Wage Index	-0.00170
	(0.0120)
Child Poverty Rate	0.178***
	(0.0446)
Mean Years of Education	0.0884
	(0.164)
Educational Diversity	-0.0195*
	(0.0100)
Racial Diversity	-0.00571
	(0.00446)
Log of Enrollment	1.217***
	(0.0765)
Disability Rate	0.0142
	(0.0173)
Rate English not First Language	0.00880
	(0.0165)
Median Rent	-0.000452
	(0.00109)
Constant	-39.32***
	(6.914)

Log-likelihood Value	-799.163
R-squared	0.805
Observations	1,603

R-squared is computed as the square of the correlation between the dependent variable and the predicted value of the dependent variable.

Robust standard errors in parentheses ** p<0.01, ** p<0.05, * p<0.1

Table 16: Summary Statistics for All Schools in a State

	New York	Florida	North Carolina	Michigan	Ohio
% With Disabilities	15.12	N/A	15.43	18.59	15.68
	(12.38)	N/A	(15.64)	(20.84)	(10.63)
% Students Free Lunch	43.05	63.41	51.41	50.99	48.86
	(29.75)	(24.11)	(19.51)	(24.68)	(27.11)
% Limited English Proficiency	7.26	29.33	6.53	8.06	1.92
	(11.8)	(37.18)	(8.73)	(12.66)	(6.97)

All figures are computed from 2010 report cards for individual schools. The table is showing means and in parentheses standard deviations for all schools in the state.

Table 17: Enrollment Differences between Charter School and Traditional Schools

	New York	Florida	North Carolina	Michigan	Ohio
% With Disabilities	-0.135***	N/A	-0.141***	-0.271***	-0.337***
	(0.0112)	N/A	(0.0409)	(0.0243)	(0.115)
% Students Free Lunch	0.220	-0.508***	-1.426***	0.271***	0.404***
	(0.145)	(0.0527)	(0.174)	(0.0576)	(0.108)
% Limited English Proficiency	-0.502***	-1.072***	-0.744***	-0.130*	-0.367***
	(0.118)	(0.186)	(0.0810)	(0.0747)	(0.127)

All coefficients are from regressing the normalized share of students on a charter school dummy and district fixed effects. All regressions are weighted by school enrollment and clustered at the district level.

4. The Effect of Charter Schools on District Efficiency: The Case of New York State

4.1 Introduction

Charter schools are a rapidly growing form of schools choice in the United States. According to the National Center for Education Statistics (2014), the percentage of all public schools that were public charter schools increased from 1.7 to 5.8 percent between 1999/2000 to 2011/2012. At the same time, charter school enrollment increased from 0.3 million to 2.1 million students. Since the beginning of charter school programs, concerns have been raised that charter schools would reduce resources from traditional schools (Moodey's 2013; Molnar 1996; Arsen, Plank, and Sykes 1999). Given the financial constraints many school districts face after the "Great Recession" (Hull 2010) and the growing number of charter schools, the question of how charter schools influence school district efficiency, costs, and expenditures is more salient than ever.

Despite the growing interest there is almost no research on the topic. Arsen and Ni (2012) utilize fixed effect models to analyze the impact of charter school enrollments on school district budgets. They find that higher levels of charter school enrollments are associated with declining fund balances, and more rapidly declining revenues than expenditures in districts losing students to charter schools. Bifulco and Reback (2014) evaluate the influence of charter schools on district revenues and expenditures for the city school districts of Albany and Buffalo in New York State. Using information from school district budgets, they authors find that charter schools had negative fiscal impact on the two school districts. Gronberg, Jansen, and Taylor (2012) use a stochastic cost frontier approach to analyze the cost efficiency of charter schools relative to

traditional public schools, and explore the extent to which those differences are attributable to differences in hiring and compensation practices, or to differences in the length of time a campus has been operating. Their main finding suggest that charter schools are able to produce educational outcomes at lower cost than traditional public schools.

In this chapter, I use the cost function approach as theoretical framework and empirical estimation strategy. Theoretically, I work out how charter schools influence the costs and efficiency of providing education. Empirically, I focus on the effects of charter schools on school district efficiency. In the empirical models, I control for changes in input factors such as teacher salaries and student characteristics as well as changes in performance. Thus, holding inputs and performance constant the coefficient on the charter school enrollment variable is driven by changes in district efficiency associated with charter school enrollment.

Utilizing data for all New York State school districts outside New York City from 1998/99 to 2009/10, I find that charter school enrollment increases overall district efficiency. The magnitude of the effect differs depending on the number of students enrolled in charter schools. The effect ranges between a 1.1 and 3.4 percent decrease in per pupil expenditures for enrollments between 50 and 5000 charter school students respectively. Efficiency gains are driven by the increased efficiency in providing education for students in traditional public schools. A charter school enrollment between 50 and 5000 students reduces per pupil expenditures needed to achieve a given level of performance by 1.5 and 4.3 percent respectively.

To confirm the results, I conduct a series of falsification tests and analyze the heterogeneity of the charter school effect. In a first falsification test, I test for differences in trends between districts with and without charter school enrollment prior charter school opening. Then, I test for events at the county level being correlated with both: charter school enrollment and declining per pupil expenditures. Finally, I use local expenditure for fire services to test for events at the district level being correlated with charter school enrollment and declining per pupil expenditures. All falsification tests confirm the initial findings.

I analyze the heterogeneity of the charter school effect using different subsamples of school districts based on location and need/resources capacity. Further, I differentiate the charter school effect by grades offered and evaluate the timing of the charter school effect. The charter school effect is driven by districts having low and high needs for resources and by charter enrollments in grades K to 6. Further, the charter school effect is most evident 4 to 6 years after the first charter school enrollment in the districts.

The estimation strategy comes with two caveats. First, the interpretation of the coefficient attached to charter school enrollment as efficiency effect relies on effective control for all cost factors associated with charter schools. Despite controlling for poverty, limited English ability, and disability status in the school district, I fail to control for the ability of the students crossing district borders to reach the performance objective of the district they transferred to. The cost of bringing all students up to a given performance objective will change if large shares of either low or high ability students transfer into the district. Second, given multiple outputs and input sharing in the production of education, the reduction of inefficiencies in the production of test scores

may have two different sources. The reduction could reflect decreases in spending for outputs other than test scores. The reduction also could reflect the use of more efficient technologies to educate students.

The remainder of the chapter is structured as follows. Section 2 describes the charter school program in New York State. Section 3 states the theoretical framework and Section 4 applies the framework. Sections 5 explains data and measurements used in the empirical models. Section 6 states the empirical strategy. Section 7 presents the results and Sections 8 and 9 provide falsification and robustness checks. Section 10 makes conclusions.

4.2 New York State Charter School Program

The New York Charter School Law was established in 1998. Charter schools receive per pupil payments from the districts in which their students reside, and these payments are the charter school's primary source of funding. Charter school enrollments in New York are not restricted by any residency requirements. If charter schools are oversubscribed, they have to select students by lottery. In this lottery process, preference is given to students residing in the school district, where the charter school is located (NYS Charter School Law Subsection 2854 (2b)). Although the majority of charter schools students live in the district where the charter school is located, most charter schools serve at least some students from other districts as well (Bifulco and Buerger 2013).

The payments for a charter school student come from the district where the student lives and are based on per pupil spending in that district. The amount a district pays per student is equal to the

approved operating expenses per pupil in the district[27]. In 2009, the approved operating expenditures varied between $6,258 and $29,456 with a mean of $12,001 and a standard deviation of $3,480. Charter schools receive additional funding for students with disabilities. The additional payments are 1.65 for students with severe disabilities[28] and 0.9 for students with less severe disabilities. Charter schools do not receive additional funding for students with limited English proficiency or being poor. Further, the district where a charter school is located is also required to provide textbooks and software, transportation, health and special education evaluation services to charter schools.

The amount that a district spends on capital outlays and debt service for school buildings is not included in the calculation of approved operating expenses that determine charter school payments in New York. Also, charter schools are not eligible to apply for the largest building aid program offered by the state. In the years until 2014, the New York City Department of Education provided space for a large number of charter schools for nominal rental fees, and absorbs utility and janitorial service costs for those schools (NYC-IBO 2010). A new state law that passed in April 2014 gives New York City two options to meet the demands of the growing charter school sector. The city either hands over free space in public or private buildings or gives money to the school to find their own space (Hernandez and Craig 2014). Districts outside New

[27] Per pupil payments are determined by the approved operating expenses of the district from two years earlier divided by a weighted pupil count (also from two years earlier) multiplied by an adjustment factor. Approved operating expenses are total district expenditures excluding expenditures for capital outlay and debt service for school buildings; transportation; lunch programs; tuition payments; and some other miscellaneous expenditures. In the weighted pupil count, aidable summer session pupils, pupils with special education needs, non-disabled secondary pupils, and students in particular disability categories receive additional weights. The adjustment is based on the statewide change in approved operating expenses from three years prior to one year prior.

[28] Students with severe disabilities students have limited cognitive abilities combined with behavioral and/or physical limitations and who require highly specialized education, social, psychological and medical services in order to maximize their full potential for self-fulfillment and meaningful participation in society (Sections 100.5, 100.6, 100.9 and 200.5 of the Regulations of the Commissioner of Education).

York City, however, have not been as generous in providing space for charter schools. The state has also used federal funds to provided start-up and facilities grants for charter schools (Bifulco and Buerger 2013).

The charter application, approval, and evaluation process is closely regulated by the charter school authorizers. The accountability standards set by authorizers are be considered relatively high compared to other states. Charter schools authorized by the Board of Regents have to perform higher than traditional schools in their district. School authorized by the New York State University are expected to have 75 percent of their students to score "proficient" or higher on state assessments. In a multistate comparison of charter school accountability laws and practices, the Center for Education Reform (CER) rated New York as a state that holds charter schools strictly accountable, pointing out that New York is one of the few states that have closed charter schools for performance reasons (CER 2007). The National Alliance of Public Charter Schools identifies New York as being among the few states using performance-based charter contracts, comprehensive school monitoring, and a systematic data collection processes (NAPCS 2012). Further, the charter school law of New York State requires districts to provide transportation to students enrolled in charter schools (NYS Charter School Law Subsection 2853 (4b)).

In 2009, the last year in this studies sample, 121 charter schools were enrolling students in New York State[29]. The majority of charter schools are located in NYC. I focus on charter schools outside NYC as I do not have the data to estimate cost functions including NYC. Table 18 shows the 12 school districts outside NYC having charter schools opening until 2008-09. The first

[29] The count is based on the Basic Educational Data System (BEDS) run by the New York State Education Department.

column indicates the year the first charter school was established in the district. The first charter school outside NYC was opened in Albany in 1999-00. The second column shows the total number of charter schools in each district in 2008-09. The highest counts of charter schools are in Albany, Buffalo, and Rochester.

The next two columns state the districts' location. Most districts having charter schools are located in Upstate, West, and Central New York. However, there are also three districts in the downstate area around New York City with charter schools. The following columns indicate whether the district is considered a high need or average need district according to the Need/Resource Capacity Index conducted by the New York State Education Department[30]. The index compares the share of students in poverty to a district's local contribution per student. Most districts having charter schools fall into the category high need even though there are two districts that are considered average need. No charter school is located in a district considered having a low need/resource capacity.

The next columns present summary statistics on charter school enrollment. It is evident that most charter school students in New York State (outside NYC) are in grades K to 6. While many fewer less students enroll in classes 7 to 12. There are two potential explanations why this is the case. In New York State charter school payments are not adjusted for grades. Thus, if high school students are more costly to educate, there is an incentive for charter schools to educate students in lower and less costly classes. Another potential explanation is that charter schools

[30] Exact description of the index can be found here:
http://sap.questar.org/publications/guidebooks/state_aid_formulas_guidebook.pdf and
http://www.p12.nysed.gov/irs/accountability/2011-12/NeedResourceCapacityIndex.pdf

often start with lower grades and open higher grades later creating a “conveyer belt” system from early childhood education to college (Dobbie and Fryer 2011).

The following columns show the share of charter school students residing in the school district compared to all students living in the same district. The share ranges from about 1 percent to more than 19 percent. There are three districts with shares over 15 percent including Albany, Buffalo, and Lackawanna. The last column states the number of students enrolled in a one of the district’s charter school but living outside the school district. In some districts like Syracuse and Niagara Falls the number is relatively small. However, Rochester, Roosevelt, and Kenmore-Tonawanda enroll large shares of charter school students from outside the district.

4.3 Theoretical Framework

In this chapter, I use the cost function approach as theoretical framework and empirical estimation strategy. Theoretically, I use the approach to identify how charter schools influence cost factors and efficiency. Empirically, the approach enables me to include variables controlling for district cost and efficiency. Further, I can analyze a large number of school districts. I start with using the cost function approach as a theoretical framework.

Following prior work on cost functions (see Downes and Pogue 1994; Duncombe and Yinger 1998, 2005, 2008, 2011a, 2011b; Rechovsky and Imazeki 2001, 2003), I assume that educational cost C in district i during time t depend on a performance objective S; resource prices W; student need measures P; and student enrollment N. Thus, more formally:

$$C_{it} = f(S_{it}, W_{it}, P_{it}, N_{it}) \quad (1)$$

The above cost equation indicates minimum spending required to reach a given level of student performance assuming that the districts use the best available technology to provide education. Researchers cannot observe costs but often know actual school district spending. Spending may exceed costs as districts do not use the best available technologies. Districts exceeding costs are considered as inefficient. Therefore, researchers cannot study determinants of school district's cost without controlling for school district's efficiency.

To extend Equation 1 and control for efficiency let *e* stand for district efficiency in delivering *S*. The value of *e* is to 1.0 in an efficient district. The value of *e* is between zero and one in inefficient districts. A district that does not use best practice ($0 < e < 1$) must spend more than an efficient district ($e = 1$) to achieve the same level of performance *S*, holding all else equal. Using *e* to scale Equation 1 the cost and efficiency equation is:

$$E_{it} = \frac{C_{it}}{e_{it}} = \frac{f(S_{it}, W_{it}, P_{it}, N_{it})}{e_{it}} \quad (2)$$

Duncombe and Yinger (2011a) point out an important conceptual misunderstanding regarding efficiency in the context of education. The production of public education is strongly characterized by multiple outputs and input sharing. The same teachers and classrooms, supported by the same administrative services produce many different outputs. Among these

outputs are student performance in English and mathematics, graduation rates, as well as student performance in art, music, athletics and citizenship.

Given multiple outputs and input sharing in the production of education, inefficiencies in the production of test scores may have two different sources. First, inefficiencies can reflect spending to promote outputs other than test scores. Second, inefficiencies can reflect the overpayment in inputs or the ignorance of least cost technology in the production process. For example, a school district that is efficient in delivering student performance in test scores may not be efficient in delivering student performance in art or athletics. Indeed, spending for art and athletics may have little impact on test scores. Therefore, it is a source of inefficiency in the production of test scores. A good art and athletics program may, of course, contribute to students' general conceptual skills with some spillover to mathematics. However, in most cases spending on these programs will not have an impact comparable to an increase in spending on instruction in classes where students are tested.

4.4 Application of Theoretical Framework

The entry of charter schools can influence expenditures per pupil by affecting cost factors (*W*, *P*, *N*), performance objectives (*S*), or efficiency (*e*). I start with analyzing the direct effect of charter schools on cost factors. To analyze the effects for each cost factor separately, I am assuming performance, efficiency, and the respective other cost factor to be constant. In a next step, I evaluate the effect of charter schools on performance objectives. Then, I discuss the effects of charter schools on district efficiency. In a last step, I look into different conceptualizations of per pupil expenditures.

It has to be noted that charter school influence cost factors, performance outputs, and efficiency through two separate mechanisms. First, charter schools can influence inputs, outputs, and efficiency of traditional public schools. Second, cost factors, output, and efficiency may be different for charter schools than for traditional schools. Both effects together create the net effect in which charter schools influence per pupil expenditures in public schools.

Direct Influence of Charter Schools on Cost Factors

Important cost factors in the provision of education are resource prices (*W*), student needs (*P*), and enrollment size (*N*). Each factor is discussed separately in the following sections. Resource prices for traditional public and charter schools (*W*), and particularly teacher salaries, are strongly influenced by school district characteristics such as the cost of living, local amenities, labor market conditions, and working conditions for employees (Duncombe and Yinger 2008). The cost of living in a school district are defined as the resources required to purchase a standard bundle of goods and services. The greater the cost of living is the more a school districts or a charter school must pay to attract employees of a given quality. Holding all other factors constant, charter schools are unlikely to have a direct effect on the cost of living in the school district.

School district amenities are access to or proximity to natural sites, transportation, cultural events, and other state or local services (Duncombe and Yinger 2008). Holding all other factors constant, including performance objectives, charter schools are unlikely to have a direct effect on amenities in the school district.

Labor market conditions can also affect the salaries a school district or a charter school is required to pay. For instance, if an areas unemployment rate for professionals is high relative to the rest of the state, then teachers and school administrator in that area may have relatively limited choices of alternative jobs and hence be more apt to accept school district offers with lower salaries and benefits (Duncombe and Yinger 2008). Charter schools are unlikely to influence overall labor market conditions.

Also, districts and charter schools may trade off spending on factors related to working conditions against increased teacher compensation. Working conditions reflect both: school district policies and factors outside districts control (Duncombe and Yinger 2008). School district policies include school and class size, spending for professional development, school leadership and culture. Working conditions outside school districts influence are strongly influenced by students' characteristics and will be discussed together with student need measures.

Charter schools are exempt from certain local and state regulations and are likely to have different working conditions than traditional public schools (Ni 2012; Malloy and Wohlstetter 2003). Charter schools can reduce compensation if they offer better working conditions than traditional public schools. Charter schools have to increase compensations if their working conditions are worse compared to traditional public schools. Further, charter schools could influence the working conditions in traditional schools. Districts may start emulating working conditions in charter schools, Districts will have to pay greater compensations if working

conditions decrease compared to the time prior charter school entry. Districts will have to pay less compensation if working conditions improve.

Student needs (*P*) are another important input factor. School districts with high concentrations of students living in poverty or with limited English proficiency face much greater costs than other school districts to reach a given performance objective (Duncombe and Yinger 2008). Further, student characteristics can affect mobility decisions of teachers (Hanushek, Kain, Rifkin 2004). Districts with high concentrations of high cost students need to pay greater compensation than other districts to have the same quality of teachers. These districts also have higher costs in recruiting and training teachers.

Charter school students can cross attendance zone boundaries and change the student composition of schools located in the same district as the charter school (Bifulco and Bulkley 2014). Holding all other factors constant, including efficiency, I do not expect costs to increase if students only switch schools within a district. However, charter schools students can cross district boundaries as well and change the student composition of districts receiving and loosing students. In the receiving district, the cost of educating students increase if the share of high cost students increases. Contrarily, cost decrease if the share of high cost students decreases. In the school district loosing students, cost increase if low cost students leave the district and cost decrease if high cost students leave the district.

Student enrollment (*N*) influences the cost of providing education through economies of scale. Economies of scale are the result of declining per unit costs as the number of units increases. In

education, the focus has been on economies of size, which refer to a decline in per-pupil expenditures with an increase in district enrollment, controlling for other cost factors (Andrews, Duncombe, and Yinger 2002). There are mainly four explanations for economies of size in education. First, some district service such as central administration are relatively fixed. Thus, the same administrative staff may be able to serve a significant range of enrollment without decline in service. Second, larger districts may be able to employ more specialized labor which could improve the quality of instruction at no additional costs. Third, in larger districts teachers have more possibilities to draw on the experience of other teachers. Fourth, larger districts may be able to negotiate better prices for bulk purchases of supplies and equipment[31] (Duncombe and Yinger 2008).

Charter schools are likely to influence economies of size at the district and the school level. By attracting students from outside the district charter schools change the enrollment in the district they are located and the district students are transferring out.

Influence of Charter Schools on Performance Objectives

Performance objectives (*N*) are set by a political-administrative process in the school district (Meier and Stewart 2001; Meier and O'Toole 2003; Chubb and Moe 1990). According to Meier and O'Toole (2003), the process is likely be influenced by organizational structures of the school district, organizational stability, and management efforts to exploit the environment and to buffer

[31] The existence of economies of scale has been challenged by several authors (see Hanley 2007; Gronberg et al. 2013; Kuziemko 2006). However, cost functions provide consistently evidence for the existence of economies of scale (Andrews, Duncombe, and Yinger 2002).

environmental shocks. The cost of providing education change with modifications of the performance objectives.

If charter school entry triggers greater performance objectives for traditional public schools, costs for traditional public schools are likely to increase. Costs for traditional schools are likely to decrease if charter schools lead to lower performance objectives. Charter school set their performance objects in a process separate from the school district. Costs for charter schools will be greater than for traditional schools if performance objectives are greater than for traditional schools. Costs for charter schools will be lower than for traditional public schools if charter performance objectives are lower than for traditional schools. Therefore, the net effect of charter schools on performance objectives and ultimately costs is driven by both: the effect of charter schools on performance objectives for traditional schools and the performance objectives charter schools set for themselves.

How Charter Schools Influence Efficiency

In the cost function context, efficiency is concerned with changes in the technology to produce a given performance objective. Efficiency can be improved in two ways. First, technology can reduce the inputs necessary to produce a given performance objective. Second, technology can increase the performance level reached with a given set of inputs. Conversely, efficiency decreases if more inputs are necessary to reach a given level of performance or a lower level of performance is realized with a given set of inputs. Charter schools alter the efficiency of providing education and can either increase or decrease efficiency. I start with describing two mechanisms leading to increasing efficiency before turning to mechanisms decreasing efficiency.

The first mechanism leading to an increase in efficiency is created through competition for students. It has been argued that the traditional public school system does not provide incentives for local school districts to produce education in an efficient way (Hanushek 1986). The reason for the lack of incentives is seen in education monopoly of local school districts and the absence of competition. Charter schools create competition for traditional schools. According to charter school proponents, competition for students will lead to more efficient use of resources (*W*) (Hoxby 2000, 2003a, 2003b; Dee 1998).

Charter schools are exempt from many local and state rules including collective bargaining agreements. Hence, charter schools may have an opportunity to choose technologies that are more efficient compared to the technologies traditional public schools in the same district use. Also, traditional schools may start emulating successful charter schools in their educational practices or develop new technologies to compete for students. Both effects, the use of more efficient technologies by charter schools and the change in technology by traditional public schools may lead to an increase in school district efficiency.

A second mechanism leading to an increase in efficiency operates through student composition (*P*). If students sort differently into schools after charter school entry, concentrations of high and low costs students may change. The change is likely to involve charter as well as traditional public schools simultaneously. For instance, if charter schools attract large shares of high cost students, it is likely that the remaining low costs students enroll into traditional public schools and vice versa. Compositional changes impact efficiency through at least two channels (Booker

et al. 2008). First, the composition of the student body may affect the instructional technique decisions of teachers. The best technique for delivering effective instruction to a classroom of students homogeneous in composition may differ from that technology which works best with a heterogeneous class.

Second, the composition of the student body may directly affect performance via peer effects. For example, adding a disruptive student to a classroom might well reduce the ability of other students to learn. Also, performance is affected by the mean ability of the individual's peers, peer group racial, and gender composition (Hoxby 2001). Hence, student responses to the same change in peers may be quite different. The net effect of any compositional changes accompanying charter school entry is ambiguous ex ante, as the precise dimension of the compositional changes and the directional impact of those changes is not clear. However, to the extent that compositional effects have a positive impact on student performance, the equilibrium sort under the new institutional structure may lead to improved performance among students remaining behind at existing public schools.

There are three mechanisms leading to decreasing efficiency (see for these mechanisms Bifulco and Reback 2014). The first mechanism operates through the provision of services for charter schools. Districts in many states have to provide services for charter schools such as transportation, health services, and special education evaluations (Bifulco and Buerger 2014). If charter schools increase enrollment the unit costs of these services could decrease. However, the cost of providing these service may be higher if districts have to deliver services to students spread across a large number of schools. Particularly, for transportation this will be true.

Additionally, administering charter school payments and coordinating service to charter school increase the workload in district offices. Thus, it is likely that charter schools increase the costs for administrative and central services (Bifulco and Reback 2014).

A second mechanism decreasing efficiency takes place at the school level. Charter schools introduce a second public schools system. Hence, charter school entry is likely to increase the number of school buildings and associated facility and maintenance costs. Closing a public school is contentious undertaking as discussions of recent school closure in Chicago and Philadelphia show[32]. Often closure is not possible until enrollment is sufficiently small to and decreases in enrollment are likely to persist for future school years. Also, school districts have to maintain facilities in case charter schools close or their enrollment drops suddenly. All these aspects are likely to increase costs of educating students (Bifulco and Reback 2014).

A third mechanism operates through personnel cost. Charters schools are likely to attract only few students out of each classroom in traditional public school. Consequently, the number of teachers in traditional public schools cannot be reduced while the district has to pay for additional teachers in charter schools. Generally, the uncertainty regarding charter school enrollments a school district faces make it more difficult to maintain targeted class sizes and student teacher ratios. School districts willing to maintain their targets have to put err on the side

[32] For Chicago: http://www.nytimes.com/2013/05/23/education/despite-protests-chicago-closing-schools.html?_r=0 For Philadelphia: http://www.nytimes.com/2013/03/08/education/philadelphia-officials-vote-to-close-23-schools.html

of smaller classes increasing costs. Again, all these aspects are likely to increase costs of educating students (Bifulco and Reback 2014).

4.5 Data and Measurements

To estimate the effect of charter schools on school district expenditures, I utilize a data set including New York State school districts for the years 1998-99 to 2008-09. I exclude New York City, as I do not have data necessary to include it in the cost function. Further, I exclude 33 non-K-12 districts as their cost functions differ from districts providing education for all students. Further, I reduce my sample to school districts that are located within a metropolitan statistical area (MSA). All charter schools in NYS are located in MSAs, and hence I only compare them to other districts located in MSAs. After dropping a few districts because of missing variables, the final sample includes 440 school districts. The sample period is ideal for studying the effect of charter schools as one year before the opening of the first charter school is included in the data. Further, I can consistently measure school district performance for the entire time period.

The following sections explains the variables used in the analysis in more detail. Table 19 provides the summary statistics for all the variables presented.

Spending Measures

To measure spending, I used school district expenditure measures from the Annual Financial Report (ST3) of the NYSED. The ST3 expenditure measure includes general support services, instruction, transportation, community services, employee benefits, debt services (principal and interest) and interfund transfers. Using the ST3 measure I construct current and operating

expenditures (Eom, Nguyen-Hoang, and Yinger 2014). Current expenditures are derived by subtracting payments on debt service from total expenditures. Operating expenditures equal current expenditures minus transportation spending. Transportation cost are not linked directly to student performance and involve a unique set of cost factors such as the districts area and population density. Thus, the effect of charter schools on operating expenditures is my primary concern in this chapter. However, as transportation has to be provided by districts to charter school students, I include models using current expenditures in the analysis as well.

Using these two expenditure measurements, I can conceptualize spending in three different ways. The first way uses the above described measures including district payments to charter schools. Charter school are not considered to be local education agency in New York State. Hence, charter school receive most of the state and federal payments they are eligible for through the school districts their students reside. Assuming that charter schools spend the received payments, the measure is a good approximation for charter school expenditures.

I divide the expenditures for regular and for charter schools by the enrollment of traditional and charter school students residing in the district. Therefore, the enrollment equals regular public school students and the students enrolled in charter schools living in the same district. The resulting quotient is an approximation of the burden placed on tax payers by the entry of charter schools.

A second way of conceptualization expenditures adds private contributions to charter schools to the first measurement. The second measurement can be used to analyze how charter school

influence the burden placed on society as a whole to educate students in public schools. Baker and Ferris (2011) argue that private contributions are particularly high for charter schools in New York City. For the FY 2007-08, the authors find private contributions between $0 and $15,000 per pupil in donations. Thus, in extreme cases, private contributions make up to 60 percent of all charter school revenue. The picture for charter schools outside NYC, which are analyzed in this study, is somewhat different. In 2011[33], on average only 4 percent of revenues were coming from private contributions (SUNY 2014). Therefore, as the amount of private contributions is small and private contributions for years prior 2010 are not available for all charter schools, I do not construct the second measurement.

The third measurements is the quotient of school district expenditures, excluding payments to charter schools, and district enrollment, excluding the enrollment in charter schools. The measurement can be used to evaluate how charter schools effect spending on students in traditional public schools. Unfortunately, I am unable to exclude the expenditures imposed on school districts for services to charter schools such as special education evaluation, transportation, and health services.

Performance Measures

Student performance is a key variable in cost functions. Performance measures for this study have to cover a range of student performance indicators and have to be consistently measured across years. I use performance measures based on New York State report cards. The report cards are based on standardized tests examining student proficiency and mastery particularly in

[33] I analyze the financial audits in FY 2011 as audits for earlier time periods are not available for all charter schools (http://www.newyorkcharters.org/progress/school-performance-reports/).

mathematics and English. The examinations are central to New York State's accountability system and NYSED publishes the test results as part of each school's annual report card. Starting in 1998-99, this system was used consistently until the 2009-10 school year when NYSED changed the cut scores for proficiency levels. To avoid inconsistency, I limit my sample to the years 1998-99 to 2008-2009.

I construct a performance index consisting of the equally weighted average percentage of students reaching proficiency levels in reading and mathematics exams in 4th and 8th grade. Further, I include the percentage of students receiving a Regents Diploma by passing at least five Regents exams and the percentage of students not dropping out of high school. I can include or exclude the performance of charter school students into the measurement. Including charter school performance makes the measurement representative for all school in the district. Excluding the performance of charter school students makes the measurement representative for all traditional public schools in the district.

Enrollment Measures

I compute three different enrollment measures in this chapter. First, I count the students residing in a school district that are enrolled into a charter school. For these enrollment counts, I include students who cross the district border to attend a charter school in another district. Second, I count students residing in a school district that are enrolled in traditional public schools. Third, I construct a measure including all students residing in a school district enrolled in charter or traditional public schools (as the sum of the first and second measurement). As in other work on cost functions, I use the log of student enrollment and allow for a nonlinear relationship between

per pupil expenditures and enrollment including a squared term $[\log(\text{enrollment})]^2$ (Duncomber and Yinger 2008, 2011b). Both measures are taken from the Basic Educational Data System (BEDS).

Similar to Rockoff (2010), Duncomber and Yinger (2011b), and Eom, Nguyen-Hoang, and Yinger (2014), I include change in district enrollment in the cost function as well. I define enrollment change as the percentage change in enrollment over a two year period. I estimate the impact of enrollment increase and decreases of students in traditional public schools separately. Changes in enrollment are outside a district's control and can be interpreted as cost factors. As I am controlling for district enrollment, the enrollment change variables indicate whether two districts with the same enrollment and performance have different costs if one of these districts experiences a change in enrollment and the other one is not.

Cost-Related Measures

Researchers have long recognized that cost of education depend on many factors outside a school district's control. These factors include wage environment, student enrollment, and concentration of disadvantaged students among the student population (see Duncombe and Yinger 2008 for an overview). Thus, I include the following variables in the cost models:

- *Teacher Salary:* Teacher salary data comes from the "personnel master file" (PMF) administered by the New York State Education Department (NYSED). The salary variable is the average salary a district pays to teachers with one to five years of experience, controlling for the actual experience and education of teachers in that district.

- *Percent share students free and reduced price lunch:* Information on free and reduced price lunch are taken from the BEDS.
- *Percentage share of students with limited English proficiency:* Information on students with limited English proficiency are taken from the BEDS.
- *Percentage share of students with severe disabilities:* Information on students with severe disabilities are taken from the BEDS. As severely disabled count students that require teacher consultation services or spend at least 60 percent of their time out of the regular classroom.

Efficiency-Related Measures

Costs are defined as the minimum spending of district resources required to provide students an opportunity to reach a given level of student performance. However, the dependent variable in the cost model is per pupil spending. As discussed earlier, inefficiency in the cost function context can include both waste and district's choice to focus on non-tested subjects areas (e.g. arts and athletics). While it is not possible to measure efficiency directly, it is possible to control for it indirectly and thereby to minimize the possibility of omitted variable bias.

I follow Duncombe and Yinger (2005, 2011a) and apply two techniques to control for efficiency. First, I will run specifications including district fixed effects enabling me to control for all district characteristics including efficiency that do not vary over time. A general limitation of the approach is that it removes all cross-section variation and undermines the ability to estimate the impact of *S*, *W*, and *P* on costs. However, in this study I am mainly interested in the effect of

charter school enrollment on district efficiency. Charter school enrollment varies tremendously over time and its effects on costs can still be observed.

Second, I include variables in the cost function that have been linked to school district efficiency in previous research. Note that none of the following variables has to be linked to the impact of charter schools on efficiency. Following Duncombe and Yinger (2005, 2008, 2011a, 2011b), I include various income sources, tax price, and other factors affecting voter involvement in monitoring district officials in my models. Income may affect efficiency in two ways. First, higher income may weaken voter's incentive to monitor school officials. Second, a higher income may encourage voters to push for a broader set of education objects. A tax price decrease, similar to an increase in income, weakens voter's incentive to monitor school officials. Contrarily, an increase in tax prices is likely to boost voter's incentive to monitor school officials. Demographic factors such as the share of college educated parents and the share of children in the total population have been found to be negatively influencing school district efficiency. Thus, I include these demographic factors in the cost models as well. I use the following variables to control for district efficiency:

- *STAR tax share:* The School Tax Relief Program (STAR) provides state funded property tax relief for home owners in New York State. Eom, Nguyen-Hoang, and Yinger (2014) show that STAR increases school district inefficiencies, and hence I include the star tax share in the cost function. I construct this measurement using data from the NYSED Fiscal Profile Reporting System (FPRS) and the American Community Survey (ACS).

- *State aid ratio:* To control for the amount of state aid a school district receives, I adjust state aid payments to the school district by district income, property value, and received STAR payments. Information is comes from FPRS and ACS.
- *Local tax share:* The local tax share is calculated by dividing the market price of houses in a district by the property value per pupil. Information on the local tax share comes from FPRS and ACS.
- *Income per pupil:* Information on per pupil income in the district is coming from FPRS.
- *Percentage share of college graduates:* This variable measures the share of parents with college education in a school district.
- *Percentage share of youth:* This variable measures the share of 5 to 7 year olds in a school district.

4.6 Empirical Strategy

The empirical strategy focuses on the effects of charter schools on the efficiency of providing education. In the empirical models, I control for changes in input factors such as teacher salaries and student characteristics as well as performance. Thus, holding cost factors constant the coefficient on the charter school enrollment variable is driven by changes in district efficiency associated with charter school enrollment. The caveat in the interpretation of the coefficient attached to charter school enrollment as efficiency effect relies on effective control for all cost factors associated with charter schools. Despite controlling for poverty, limited English ability, and disability status in the school district, I fail to control for the ability of the students crossing district borders to reach the performance objective of the district they transferred to. The cost of

bringing all students up to a given performance objective will change if large shares of either low or high ability students transfer into the district. The coefficient on the charter school enrollment variable will be downwardly biased if the incoming students have a high ability to reach the performance goal set by the district. The coefficient on the charter school enrollment variable will be upwardly biased if the incoming students have a low ability to reach the performance goal set by the district.

The estimation strategy is similar to a difference-in-differences framework. I compare per pupil expenditure in districts with and without charter school enrollment before and after charter school entry. The estimation assumptions are that trends in per pupil expenditure in district with charter school enrollment were parallel prior charter school opening. To ensure the fulfillment of this assumption, I conduct falsification tests examining the similarity in trends prior charter entry. Further, charter school entry should not be correlated with other events influencing school district per pupil expenditures or efficiency. To ensure the fulfillment of this assumption, I conduct falsification tests examining changes in per pupil expenditures for districts without charter school enrollment but located in a county with at least one charter school and per pupil expenditure for another local service.

For other parts of my empirical strategy, I follow Eom, Nguyen-Hoang, and Yinger (2014) who estimate a cost function for a similar time period to evaluate the effects of New York State's property tax relief for home owners on district spending. Similar to their work, I treat the STAR tax share and the adjusted aid ratio as endogenous because STAR induced changes in spending or performance may be capitalized into housing values. I construct instruments that substitute the

predicted market price of houses in a district and the property value per pupil into the STAR tax share and adjusted aid ratio. The predications are based on 1999 values inflated by the Case-Shiller home price indices for New York published by the Federal Reserve Bank of St. Louis. Using this approach, I can capture growth in the market prize of houses and property value per pupil while removing the impact of STAR at the same time.

In their review of literature on cost functions Duncombe and Yinger (2008) point out that teacher salary and student performance are treated as endogenous as well. Following Eom, Nguyen-Hoang, and Yinger (2014), I instrument for teacher salary with the average manufacturing wage in the districts county. The instruments for performance are exogenous traits of school districts in the rest of the district's county. A districts own choice are likely to be influenced by choice of nearby districts, and the choice of nearby districts are influenced by their exogenous traits. More specifically, I use average percentage of high cost students and LEP students in the rest of the county as instruments[34].

Similar to Eom, Nguyen-Hoang, and Yinger (2014), I examine the appropriateness of the instruments using two instrument tests namely overidentification and weak instrument tests. The results of these tests will be discussed in the next section. Further, I use Fuller's estimator (k=4), which according to Hahn, Hausman, and Kuersteiner (2004), proves to be less subject to potential bias from weak instruments than two-stage-least squares.

[34] In future drafts, I will instrument for charter school enrollment using the diversity of parent education and race as instrument.

I estimate all cost functions including district fixed effects, linear district time trends, and year fixed effects. District fixed effects control for unobserved, time-invariant districts influencing efficiency or cost. The district trends control for a district's spending trajectory and the year fixed effects for specific characteristics of the years included in the sample.

4.7 Results

Table 20 presents results for cost functions using charter school indicators and counts of charter school in the district as independent variables of interest. For the sake of brevity, I report only the estimated coefficients on the charter school indicators but note that all specifications reported in Table 20 and all subsequent tables include the full set of control variables, district fixed effects, and district specific trends. The first set of results in Table 20 are based on models using per pupil expenditures including payments to charter schools for a student count including charter school students as dependent variable. The second set of result uses expenditures excluding payments to charter schools and a student count without charter school students as dependent variable. All subsequent tables follow the same format.

The first two columns state results for charter school indicators turning on after a charter school moves into a school district. The estimated coefficients on the indicator are negative, close to zero, and not statistically significant. Columns III and IV use a charter school count as independent variable of interest. The coefficients are negative and statistically significant. The result suggest that an additional charter school decreases the per pupil expenditures used to achieve a given level of achievement in the district by 1.5 percent. Columns V and VI split up the charter school count in measurements indicating different numbers of charter schools. The

coefficients on the indicators up to two charter schools are close to zero and statistically not significant. The coefficient on the indicator for three charter school is negative and statistically not significant. The coefficients on the remaining indicators are negative and statistically significant. Having four or more charter schools in the district decrease current and operating expenditures used to achieve a given level performance level by about 7 percent[35] relative to a district with no charter school.

The second set of columns presents results for regressions using expenditures without charter school payments as dependent variable. In Column VII and VIII, similar to the previous estimations, the coefficients on the charter school indicator are negative and not statistically significant. Columns IX and X show negative and statistically significant coefficient on the charter school count. The result suggest that an additional charter school in the district decreases the per pupil expenditures used to achieve a given level of performance by traditional schools by about 2 percent. Columns XI and XII report the coefficients on the measurements indicating different numbers of charter schools. The coefficients are all negative. The coefficients attached to the first two indicators are not statistically significant. The coefficients on the following indicators are statistically significant. They indicate that three charter schools decrease per pupil spending used to achieve a given level of performance by about 6 percent and four or more charter schools decrease spending by about 10 percent.

Table 21 states results using charter school enrollment as independent variable of interest. The models in Table 21 take charter school enrollments from outside the district into consideration,

[35] It is important to note that there are only 4 districts with more than one charter school.

and hence are preferred to the results presented in Table 20. Again, the first set of results are based on models using expenditures including charter payments as dependent variable. The second set of results are based on models using expenditures without charter school payments as dependent variable. Columns I and II report coefficients on indictors for different charter school enrollments. The coefficients on the first two indicators are close to zero and statistically not significant. The following indicators have negative and statistically significant coefficients. Enrolling between 200 and 300 students in charter schools decreases district expenditures used to achieve a given level of student performance by about 3.5 percent. Enrolling between 300 and 500 students in charter schools decreases expenditures by about 3 percent. Finally, enrolling more than 500 students in charter schools reduces spending by about 8 percent.

The next model represents the specification I prefer for estimating the effect of charter schools on district expenditures. The first term is the log of charter school enrollment in the school district and the second term is the log of enrollment squared. The specification gives full functional form flexibility while at the same time even small changes in charter school enrollment are taken into account. In Columns III and IV, the coefficients on both terms are statistically significant. To illustrate the magnitude of the charter school effect, I calculate the effect for different enrollments and graph the result in Figure 12. Charter schools decrease district expenditures between 1.1 and 3.4 percent depending on the number of students enrolled in charter schools. The effect grows with increasing charter school enrollment. The graph shows a step fall of the effect up to the enrollment of 500 students. Afterwards, the effect decreases at a slower rate.

The next columns in Table 21 use an expenditure measurement without charter school payments as dependent variable. In Columns V and VI, similar to the pervious specification, the coefficients on the indictors for a charter school enrollment up to 300 have coefficients close to zero and they are not statistically significant. The coefficients on the next indicators are negative and statistically significant. Enrolling between 200 and 500 charter school students decreases spending for students in traditional schools by 4.5 percent. Enrolling more than 500 students in charter school decreases spending for students in traditional public schools by about 9.7 percent.

Columns VII and VIII include the log of charter school enrollment and the squared log of charter school enrollment as independent variables of interest. The coefficients on both measurements are statistically significant. The varying magnitude of the charter school effect is depicted in Figure 13. Charter schools decrease spending for students in traditional schools between 1.5 and 4.3 percent. The effect is more negative with increasing charter school enrollment. Again, the effect decreases sharply up to an enrollment of 500 students. Afterwards, decreases at a slower rate.

The results stated in Table 20 and 21 are estimated using instruments for teacher salary, the STAR and state aid term. I conducted Hansen's *J* over-identification tests for the 2SLS models and the results were consistent with valid instrumental variables: p-values ranging from .37 to .53 for rejecting the null hypothesis of exogenous instrumental variables. Further, the instruments are strongly correlated with the endogenous variables. I report the first stages of the two stage estimations in Table 22. All coefficients are statistically significant. Further, the F-statistics in the first stage regressions range between 34.41 and 139.53, and hence are greater

than the suggested value of 10 suggested by Staiger and Stock (1997). These statistics and the use of the Fuller (k=4) estimator suggest that the results are unlikely to be biased due to weak instruments.

4.8 Falsification Tests

While the results in Tables 20 and 21 provide evidence that charter schools increase school district efficiency, one may be concerned that charter schools move into districts already experiencing increasing trends in efficiency. Moreover, one may be concerned that charter school enrollment is correlated with other events increasing efficiency in providing education. I investigate these two issues by conducting three falsification tests. The idea behind the falsification tests is simple, if the effects of charter school enrollment on district spending are truly causal than they should only hold for the relevant time period, areas that have charter schools, and local expenditures related to education.

Table 23 summarizes the results of the falsification tests. All tests are based on models with operating expenditures as dependent variable, a logged charter school enrollment term, and a squared term of the logged charter school enrollment. The first column states results for a falsification test including enrollment leads for one and two years prior the first charter school enrollment in the district. The lead variables are equal to the charter school enrollment one and two years after charter school opening in the same district. The coefficients on the lead variables are not statistically significant and much smaller than in the previous models. The effect of the false charter school enrollment is close to zero. Thus, there is little reason to suspect a large bias in the initial estimates due to uncontrolled differences in trends prior charter school opening.

Column II states a falsification test using districts without charter school enrollment. For these district, I create a false charter school enrollment. The false enrollment equals the enrollment in the district with the most charter school students in the same county. As control group serve districts being located in counties having no charter school enrollment prior 2008/09. The coefficients on the two charter school enrollment terms are not statistically significant and the effect size is very close to zero. The results suggest that charter school enrollment is not correlated with other events at the county level influencing spending decisions.

The third column presents a falsification test using the per pupil expenditures for another local service as dependent variable. I collected the expenditure for the local fire services from the webpage of the New York State comptroller[36]. Then, I merge this information to the corresponding school districts. Using these false per pupil expenditures, I rerun my main specification. The coefficients are all close to zero and not statistically significant. The results suggest that charter school enrollment is not correlated with other events at the district level influencing spending decisions.

The second part of Table 23 uses the same specifications but with per pupil expenditures without charter school payments. The results are similar accept for the specification using leads for one and two years prior the first charter school enrollment. The coefficients on the logged enrollment for both lead years are statistically significant. However, the effect is close to zero meaning that

[36] The webpage can be found here: http://www.osc.state.ny.us/localgov/datanstat/findata/index_choice.htm. As the areas of the local fire services and school district do not match perfectly in all cases, I was unable to provide information for all school districts. .

charter school enrollment leads to a 0.00 percent increase or decrease in expenditures. The next two columns show coefficients suggesting no effect of charter schools on spending. All coefficients are not statistically significant and the magnitude of the effects is close to zero. The results confirm that charter school enrollment is not coincidently related to other events at the county or district level influencing per pupil expenditures.

4.9 Heterogeneity of the Estimates

Tables 24 and 25 provide several robustness checks using different samples of school districts, charter school enrollment in different grades, and differentiates the charter school effect by time. The first two columns in Table 24 show results for subsamples of districts located up or downstate. The coefficients are not statistically significant and the charter school effect is much smaller than in the main specification. Given the results, charter schools do not seem to have a different effects in areas close to New York City and areas further away.

Column III to V present models using subsamples of districts with different need/resource capacities. The model using a subsample with high need districts shows statistically significant coefficients on both enrollment terms. The magnitude of the effect is larger than in the main specification ranging from -1.8 to -7.3 percent for enrollments between 50 and 5000 charter school students. The larger magnitude is not a surprise as most charter schools locate in districts with high need/resource capacity and these districts are likely to drive the overall result.

The model using a subsample with average need districts shows statistically insignificant coefficients. The magnitude of the effect is close to zero. The result is somewhat surprising as

two districts having charter schools are located in districts with average need/resource capacity. According to the theoretical framework, there are two potential explanations for the result. First, charter school enrollment does neither create efficiency gains nor access cost. Second, both mechanism cancel each other out.

In Column V, I present results using a sample of districts with low need resource capacity. Recall from Table 18 that none of the charter schools is located in a low need district, and hence charter school enrollments in this sample are solely based on students crossing school district borders. The coefficients on the two enrollment terms are statistically significant. The magnitude ranges between -0.7 and -7.2 percent for enrollments between 2 and 20 students. The magnitude is similar compared to districts with high need/resources capacity. Therefore, the effect of charter school enrollments on per pupil expenditures is driven by districts with high and low need/resource capacity.

The following columns present the results for models using per pupil expenditures without charter school payments as dependent variable. Models using the subsamples of districts located up or downstate do not show statistically significant coefficients and the charter school effect is close to zero (Columns VI and VII). The result indicates that the effect of charter school enrollment does not differ between regions closer or further away from New York City. In Columns VII to X I re- run the main specification using samples of school districts with high, average, or low need/resource capacity. Similar to the earlier presented results in the same table, the coefficients for subsamples using high and low need/resource capacity school districts are statistically significant. The magnitude of the effect for district with high need capacity ranges

between -1.5 and -6.7 percent for charter enrollments between 50 and 5000 students. The magnitude of the effect for districts with low need capacity ranges between -0.8 and -7.3 percent for enrollments between 2 and 20 students. Again, the effect of charter school enrollments on per pupil expenditures is driven by districts with high and low need/resource capacity.

The first two columns of Table 24 present a robust check based on different grades offered by charter schools. The first column presents the results using a subsample with charter school enrollment in grades K to 6. The coefficients on the enrollment terms are statistically significant. The effect ranges between -1.1 and -3.2 percent for enrollments between 50 and 4000 students. The coefficients on the enrollment terms for the subsample of students in grades 7 to 12 are not statistically significant. Therefore, the overall result is driven by charter enrollments in grades K to 6. This is not a surprises as a greater shares of charter school students is enrolled I the grades (see Table 18).

Column III presents the results for a model splitting the post period up in tree intervals of three years each. The coefficients on the interactions between enrollment and a post period of 4^{th} to 6^{th} year after the first charter school enrollment are statistically significant. The magnitude of the effect ranges between -1.0 and -3.3 percent for enrollments of 50 and 5000 students respectively. The result suggests that reductions in per pupil expenditures are mainly realized 4 to 6 years after charter school entry.

The second section of Table 25 presents the results using per pupil expenditures without charter school payments. The results are similar to the results presented in the first part of the table. The

coefficients on the charter school enrollment terms are statistically significant for the subsample of charter school students in grades K to 6. The effect ranges between -0.8 and -2.7 for enrollments or 50 to 4000 students respectively. Again, the result suggest that the overall result for models using expenditures without charter school enrollment are driven by enrollments in grades K to 6.

Column VI investigates the timing of the charter school effect. Similar to the previous results, the coefficients on the interactions between enrollment and a post period of 4^{th} to 6^{th} year after the first charter school enrollment are statistically significant. The magnitude of the effect ranges between -1.3 and -3.9 percent for enrollments of 50 and 5000 students respectively. Again, the result suggests that reductions in per pupil expenditures for traditional public school students are mainly realized 4 to 6 years after charter school entry.

4.10 Conclusions

In the theoretical section of the chapter, I work out how charter schools affect school district performance and the costs and efficiency of providing education. The empirical strategy aims at estimating the effects of charter school enrollments on efficiency while controlling for costs and performance. Utilizing data for all New York State school districts (excluding New York City) from 1998/99 to 2009/10, I find that charter school increase the efficiency of providing education. The results are confirmed by several falsification and robustness checks.

The magnitude of the efficiency effect differs depending on the number of students enrolled in charter schools. The effect ranges between -1.1 and -3.4 for enrollments between 50 and 5000

charter school students holding performance and cost factors constant. Given average per pupil expenditures of $15,395 (including charter payments), charter school reduce district expenditure on average between $169 and $523 per pupil.

The caveat in the interpretation of the coefficient attached on charter school enrollment as efficiency variable is that I have to control for all potential cost factors associated with charter schools that could influence per pupil expenditures. However, in this draft of the chapter, I cannot control for the ability of the students crossing district borders. Later drafts will shine more light into transferring students and will instrument for charter school enrollment.

Given multiple outputs and input sharing in the production of education, the reduction of inefficiencies in the production of test scores may have two different sources. First, the reduction could reflect decreases in spending for outputs other than test scores. Second, the reduction could reflect the use of more efficient technologies to educate students.

Figure 12: Effect of Charter Schools Enrollment on Per Pupil Expenditures Including Charter Payments

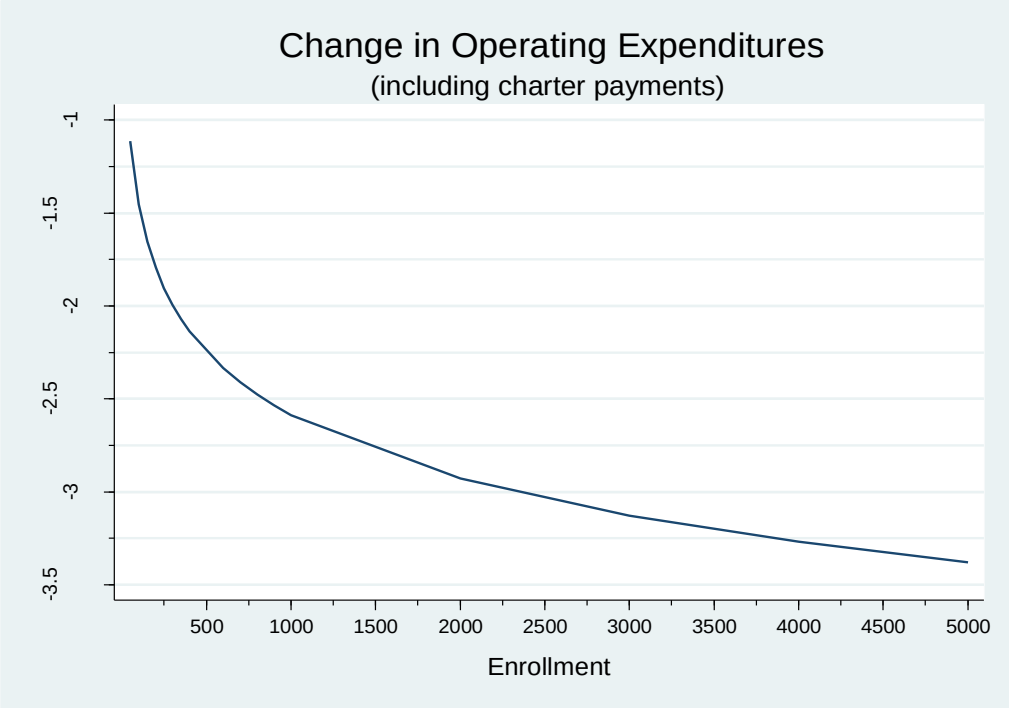


Figure 13: Effect of Charter Schools Enrollment on Per Pupil Expenditures Without Charter Payments

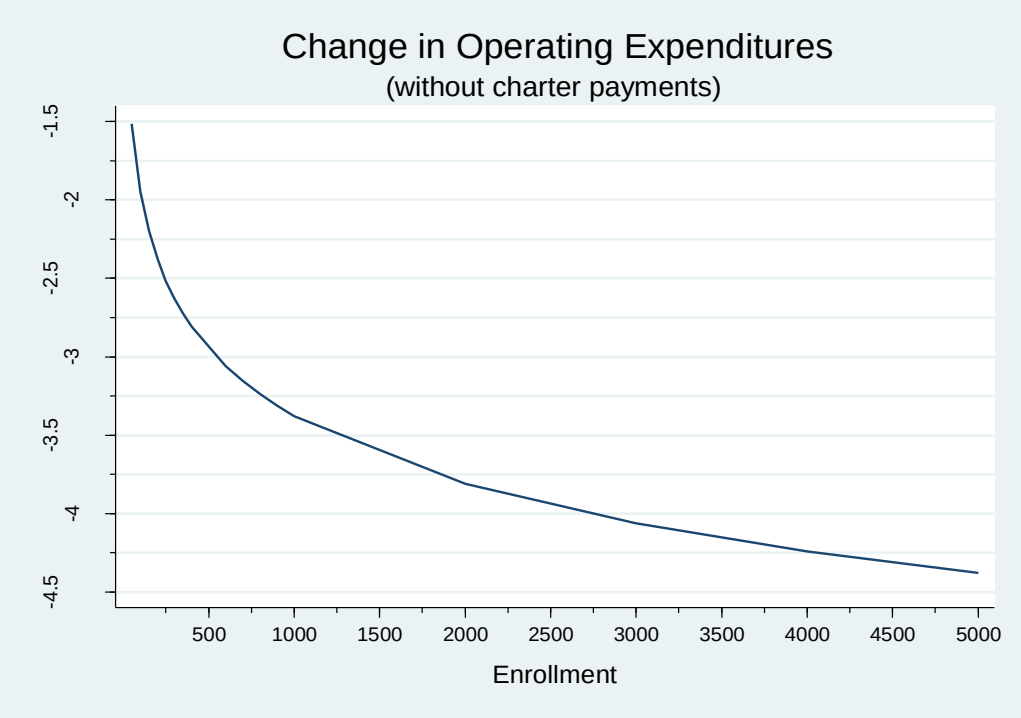


Table 18: Summary of Charter School Openings and Enrollments

District	First Charter Established	Number of Charter Schools in 2008/09	Location: Downstate	Location: Upstate	High Need District	Average Need District	Charter Enrollment K to 6	Charter Enrollment 7 to 12	Share of District Enrollment	Charter Enrollment Outside District
Albany	1999/00	9		Yes	Yes		1536	313	19.18%	381
Buffalo	2000/01	14		Yes	Yes		3845	2400	15.91%	1385
Rochester	2000/01	5		Yes	Yes		783	190	2.84%	53
Roosevelt	2000/01	1	Yes		Yes		178	50	7.64%	273
Riverhead	2001/02	1	Yes			Yes	117	0	2.48%	115
Kenmore-Tonawanda	2001/02	1		Yes		Yes	85	37	1.44%	1441
Troy	2001/02	1		Yes	Yes		321	16	7.54%	152
Lackawanna	2002/03	1		Yes	Yes		299	46	15.09%	178
Syracuse	2002/03	2		Yes	Yes		505	364	4.14%	44
Yonkers	2005/06	1	Yes		Yes		242	2	1.04%	114
Niagara Falls	2006/07	1		Yes	Yes		319	0	4.11%	17

Source: Number of charter schools and year of establishment are taken from the SUNY Charter School Institute web page (http://www.newyorkcharters.org).

Table 19: Summary Statistics

	Mean	Standard Deviation	Min	Max
Dependent Variables				
Current expenditures per pupil (with charter school payments)	16,314	4,470	9,750	49,920
Current expenditures per pupil (without charter school payments)	16,319	4,474	9,750	49,920
Operating expenditures per pupil (with charter school payments)	15,395	4,266	9,160	48,449
Operating expenditures per pupil (without charter school payments)	15,399	4,269	9,160	48,449
Charter School Variables				
Number of charter schools	0.03	0.45	0.00	14.00
Charter School enrollment (by residence)	15.06	199.76	0.00	6245.00
Performance Variable				
Performance Index (incl. student proficiency, diploma rates, non-dropout rates)	75.29	11.14	29.18	97.94
Cost Related Variables				
Teacher salary (1 - 5 years experience)	22,505	9,324	1	61,744
Enrollment (by residence)	3,317	3,721	208	45,459
Percent of students with severe disabilities	1.31	0.82	0.00	7.46
Percent LEP students	2.04	3.52	0.00	33.21
Percent free lunch	19.84	15.82	0.00	90.84
Efficiency Variables				
Local tax share	0.44	0.14	0.03	1.05
STAR tax share	0.78	0.13	0.32	1.00
State aid term	0.02	0.02	0.00	0.22
Income per pupil	115,776	95,391	25,180	993,261
Percent college graduates	28.33	14.91	6.00	83.40
Percent yout (age 5 - 7)	17.54	2.34	8.81	26.56
Instrumental Variables				
Average percent of high cost students in the county (excluding focal district)	1.30	0.36	0.00	2.60
Average percent of LEP students in the county (excluding focal district)	1.71	1.84	0.00	5.98
Annual county average salary of manufactering jobs	48,560	13,875	20,756	99,889
STAR tax share with inflated 1999 property values	0.75	0.09	0.44	1.00
Adjusted state aid ratio with 1999 property values	0.02	0.02	0.00	0.38

Notes: Summary measurements include fiscal years 1999 to 2009. All monetary variables are adjusted for inflation and displayed in 2009 dollars.

Table 20: Charter School Effect on District Expenditures Using Charter Indicators

	Expenditure including Charter School Payments						Expenditure without Charter School Payments					
	Current (I)	Operating (II)	Current (III)	Operating (IV)	Current (V)	Operating (VI)	Current (VII)	Operating (VIII)	Current (IX)	Operating (X)	Current (XI)	Operating (XII)
Charter School variables												
Charter school indicator	-0.00289	-0.00249					-0.0176	-0.0185				
	(0.0151)	(0.0155)					(0.0159)	(0.0164)				
Charter school count			-0.0150***	-0.0157***					-0.0215***	-0.0229***		
			(0.00545)	(0.00555)					(0.00521)	(0.00531)		
Indicator for 1 charter school					0.00615	0.00651					-0.00192	-0.00239
					(0.0151)	(0.0156)					(0.0157)	(0.0163)
Indicator for 2 charter schools					0.00293	0.00742					-0.00889	-0.00512
					(0.0356)	(0.0362)					(0.0411)	(0.0425)
Indicator for 3 charter schools					-0.0428	-0.0420					-0.0597**	-0.0605**
					(0.0275)	(0.0276)					(0.0275)	(0.0278)
Indicator for 4 charter schools					-0.0723**	-0.0725*					-0.103***	-0.107***
					(0.0360)	(0.0374)					(0.0355)	(0.0370)
Indicator for 5 or more charter schools					-0.0719**	-0.0730**					-0.0954**	-0.0989**
					(0.0358)	(0.0367)					(0.0383)	(0.0398)
Observations	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731
R squarred	0.793	0.772	0.795	0.774	0.791	0.770	0.792	0.771	0.796	0.775	0.791	0.769

Note: All regressions are estimated with controls for performance, cost variables, efficiency variables and enrollment variables. Further, district fixed effects, district trends, and year fixed efefcts are included. The sample consist of all districts outside NYC that belong to a metroplitan statistical area and serve classes K to 12. Regressions are estimated using the fuller estimator and robust standard errors. Instruments are used for teacher salary, STAR tax share, and state aid term.

Robust standard errors in paranthesis: *** p < 0.01; ** p < 0.05; * p < 0.1

Table 21: Charter School Effect on District Expenditures Using Charter Enrollment

	Expenditure including Charter School Payments				Expenditure without Charter School Payments			
	Current (I)	Operating (II)	Current (III)	Operating (IV)	Current (V)	Operating (VI)	Current (VII)	Operating (VIII)
Charter School variables								
Charter enrollment < 100	0.000845	0.000738			0.000227	0.000071		
	(0.00364)	(0.00382)			(0.00372)	(0.00390)		
Charter enrollment < 200 students and > 100	0.000734	5.14e-05			-0.00427	-0.00548		
	(0.0118)	(0.0121)			(0.0114)	(0.0118)		
Charter enrollment < 300 students and > 200	-0.0354*	-0.0369*			-0.0441**	-0.0465**		
	(0.0200)	(0.0212)			(0.0194)	(0.0205)		
Charter enrollment < 500 students and > 300	-0.0290**	-0.0299**			-0.0442***	-0.0465***		
	(0.0128)	(0.0131)			(0.0134)	(0.0136)		
Charter enrollment > 500	-0.0795***	-0.0802***			-0.0960***	-0.0984***		
	(0.0209)	(0.0217)			(0.0216)	(0.0225)		
Log charter enrollment			0.00776**	0.00812**			0.00871**	0.00919**
			(0.00379)	(0.00400)			(0.00388)	(0.00409)
Log charter enrollment squarred			-0.00238***	-0.00246***			-0.00295***	-0.00311***
			(0.000833)	(0.000870)			(0.000837)	(0.000875)
Observations	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731
R squarred	0.794	0.773	0.793	0.772	0.794	0.773	0.793	0.771

Note: All regressions are estimated with controls for performance, cost variables, efficiency variables and enrollment variables. Further, district fixed effects, district trends, and year fixed efefcts are included. The sample consist of all districts outside NYC that belong to a metroplitan statistical area and serve classes K to 12. Regressions are estimated using the fuller estimator and robust standard errors. Instruments are used for teacher salary, STAR tax share, and state aid term.

Robust standard errors in paranthesis: *** p < 0.01; ** p < 0.05; * p < 0.1

Table 22: First Stage Coefficients

	Dependent Variables			
	Performance Index	Teacher Salary	STAR Tax share	Adjusted aid ratio
Average percent of high cost students in the county (excluding focal district)	0.0012	0.0219***	-0.0002***	0.0001
	(0.0046)	(0.004)	(0.0001)	(0.0004)
Average percent of LEP students in the county (excluding focal district)	0.0063**	0.0293**	0.0138***	0.0007**
	(0.003)	(0.0144)	(0.0019)	(0.0003)
Annual county average salary of manufactering jobs	0.0507***	0.4438***	-0.0054	-0.0005
	(0.0109)	(0.0638)	(0.0061)	(0.0011)
STAR tax share with inflated 1999 property values	-0.0412	0.354**	1.3250***	0.0799***
	(0.0397)	(0.1737)	(0.0189)	(0.0049)
Adjusted state aid ratio with 1999 property values	0.0001*	-0.0001**	-0.0001**	-0.0001***
	(0.0000218)	(0.000027)	(0.000027)	(0.000021)

Note: Other variables in the first stage results are not displayed.

Robust standard errors in paranthesis: *** p < 0.01; ** p < 0.05; * p < 0.1

Table 23: Falsification Tests

	Operating Expenditure including Charter School Payments			Operating Expenditure without Charter School Payments		
	Leads	Area Change	Spending Fire Dept.	Leads	Area Change	Spending Fire Dept.
	(I)	(II)	(III)	(IV)	(V)	(VI)
Charter School variables						
Log charter enrollment (1 year lead)	-0.00056			-0.00086**		
	(0.00045)			(0.00041)		
Log charter enrollment squarred (1 year lead)	-0.0004			-0.00069		
	(0.00044)			(0.00044)		
Log charter enrollment (2 year lead)	0.000275			0.00019**		
	(0.00105)			(0.00097)		
Log charter enrollment squarred (2 year lead)	-0.000161			0.00015		
	(0.000981)			(0.00011)		
Log charter enrollment	0.00512**	0.0272	-0.0129	0.0082*	0.0272	-0.0138
	(0.00044)	(0.0217)	(0.0391)	(0.00442)	(0.0218)	(0.0374)
Log charter enrollment squarred	-0.00257**	-0.00198	0.000629	-0.00343***	-0.00197	0.00114
	(0.001)	(0.00208)	(0.00742)	(0.00092)	(0.00208)	(0.00652)
Control Variables						
Performance Variable	Yes	Yes	Yes	Yes	Yes	Yes
Enrollment Variables	Yes	Yes	Yes	Yes	Yes	Yes
Cost Variables	Yes	Yes	Yes	Yes	Yes	Yes
Efficiency Variables	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects and Trends						
District fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
District trends	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,731	775	2,946	4,731	775	2,946
R squarred	0.782	0.752	0.357	0.780	0.752	0.356

Note: All regressions are estimatd with district and year fixed effects. Sample consist of all districts outside NYC that belong to a metroplitan statistical area and serve classes K to 12. Regressions are estimated using the fuller estimator and robust standard errors. Instruments are used for teacher salary, STAR tax share, and state aid term.

Robust standard errors in paranthesis: *** p < 0.01; ** p < 0.05; * p < 0.1

Table 24: Heterogeneity Checks Using Area and Need/Resource Capacity Subsamples

	Operating Expenditure including Charter School Payments					Operating Expenditure without Charter School Payments				
	downstate urban	upstate urban	high need	avg. need	low need	downstate urban	upstate urban	high need	avg. need	low need
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)	(X)
Charter School variables										
Log charter enrollment	-0.00654	0.00101	0.0289***	-0.00458	0.0318**	-0.00710	0.000215	0.0281***	-0.00544	0.033**
	(0.00967)	(0.00488)	(0.00758)	(0.00693)	(0.0122)	(0.00972)	(0.00492)	(0.00786)	(0.00689)	(0.0123)
Log charter enrollment squarred	0.000772	-0.00119	-0.00599***	-0.000173	-0.01743**	0.00159	-0.000552	-0.00559***	0.000719	-0.0178**
	(0.00206)	(0.00112)	(0.00117)	(0.00183)	(0.0052)	(0.00206)	(0.00118)	(0.00123)	(0.00180)	(0.0052)
Observations	1,441	2,847	385	2,692	1,045	1,441	2,847	385	2,692	1,045
R squarred	0.779	0.795	0.805	0.677	0.804	0.783	0.793	0.803	0.680	0.804

Note: All regressions are estimated with controls for performance, cost variables, efficiency variables and enrollment variables. Further, district fixed effects, district trends, and year fixed efefcts are included. The sample consist of all districts outside NYC that belong to a metroplitan statistical area and serve classes K to 12. Regressions are estimated using the fuller estimator and robust standard errors. Instruments are used for teacher salary, STAR tax share, and state aid term.

Robust standard errors in paranthesis: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Table 25: Heterogeneity Checks Using Grade Enrollment Subsamples and Interactions with Time

	Operating Expenditure including Charter School Payments			Operating Expenditure without Charter School Payments		
	(I)	(II)	(III)	(IV)	(V)	(VI)
Charter School variables						
Log charter enrollment (K to 6)	0.00775**			0.00789*		
	(0.00392)			(0.00405)		
Log charter enrollment squarred (K to 6)	-0.00242***			-0.00212**		
	(0.000859)			(0.000916)		
Log charter enrollment (7 to 12)		-0.00742			-0.00783	
		(0.00675)			(0.00673)	
Log charter enrollment squarred (7 to 12)		-0.000808			-0.000604	
		(0.00153)			(0.00151)	
Log charter enrollment X 1st to 3rd year post			0.00408			0.00475
			(0.00394)			(0.00393)
Log charter enrollment squarred X 1st to 3rd year post			-0.00155**			-0.00203***
			(0.000676)			(0.000679)
Log charter enrollment X 4th to 6th year post			0.00828*			0.00875*
			(0.00450)			(0.00453)
Log charter enrollment squarred X 4th to 6th year post			-0.00243***			-0.00278***
			(0.000644)			(0.000673)
Log charter enrollment X 7th to 9th year post			0.00369			0.00335
			(0.00608)			(0.00625)
Log charter enrollment squarred X 7th to 9th year post			-0.000815			-0.000904
			(0.000857)			(0.000900)
Observations	4,731	4,731	4,731	4,731	4,731	4,731
R squarred	0.785	0.785	0.782	0.786	0.786	0.782

Note: All regressions are estimated with controls for performance, cost variables, efficiency variables and enrollment variables. Further, district fixed effects, district trends, and year fixed efefcts are included. The sample consist of all districts outside NYC that belong to a metroplitan statistical area and serve classes K to 12. Regressions are estimated using the fuller estimator and robust standard errors. Instruments are used for teacher salary, STAR tax share, and state aid term.

Robust standard errors in paranthesis: *** p < 0.01; ** p < 0.05; * p < 0.1

References

Adamowicz, Wiktor, Peter Boxall, Michael Williams, and Jordan Louviere. (1998). Stated preference approaches for measuring passive use values: choice experiments and contingent valuation. American Journal of Agricultural Economics 80, no. 1: 64-75.

Andrews, M., Duncombe, W., & Yinger, J. (2002). Revisiting economies of size in American education: are we any closer to a consensus?. Economics of Education Review, 21(3), 245-262.

Angrist, J. D., & Lavy, V. (1999). Using Maimonides' Rule to Estimate the Effect of Class Size on Scholastic Achievement*. The Quarterly journal of economics, 114(2), 533-575.

Arsen, D., & Ni, Y. (2012). The effects of charter school competition on school district resource allocation. Educational Administration Quarterly, 48(1), 3-38.

Arsen, D., Plank, D., & Sykes, G. (1999). School Choice Policies in Michigan: The Rules Matter. For full text: http://edtech. connect. msu. edu/choice/conference/default. asp.

Baker, B. D., & Ferris, R. (2011). Adding up the Spending: Fiscal Disparities and Philanthropy among New York City Charter Schools. National Education Policy Center.

Barrow, Lisa. (2002). School choice through relocation: Evidence from the Washington, D.C. area. Journal of Public Economics 86: 155–189.

Barrow, M., & Wagstaff, A. (1989). Efficiency measurement in the public sector: an appraisal. Fiscal Studies, 10(1), 72-97.

Bayoh, Isacc, Elena Irwin and Timothy Haab. (2006). Determinants of residential location choice: How important are local public goods in attracting homeowners to central city locations? Journal of Regional Science 46(1): 97-120.

Bayer, Patrick, Fernando Ferreira, and Robert McMillan. (2007) A unified framework for measuring preferences for schools and neighborhoods. No. w13236. National Bureau of Economic Research,.

Bifulco, R. (2014). Charter School Location: Evidence and Policy Implications. In: Education, Land and Location. Ingram, G. K. & Kenyon, D. A. (eds.) Lincoln Institute Press: Cambridge, MA.

Bifulco, Robert, and Christian Buerger. (2012). The Influence of Finance and Accountability Policies on Charter School Locations. Working Paper, Syracuse University,

Bifulco, R., & Buerger, C. (2014). The Influence of Finance and Accountability Policies on Charter School Locations. forthcoming in Journal of Education Finance.

Bifulco, R., & Reback, R. (2014). Fiscal Impacts of Charter Schools: Lessons from New York. Education Finance and Policy, 9(1), 86-107.

Bifulco, Robert, and Katrina Bulkley. (2007). Charter schools." Handbook of research in education finance and policy: 425-446

Black, Sandra E. (1999). Do better schools matter? Parental valuation of elementary education. The Quarterly Journal of Economics 114, no. 2: 577-599.

Black, S., & Machin, S. (2011). Housing valuations of school performance. Handbook of the Economics of Education, 3, 485-519.

Bogin, Alexander Nicholas. (2012). Three Essays on the Property Value Impact of Neighborhood Disamenities. Dissertation, Syracuse University.

Brasington, David M., and Donald R. Haurin. (2009). Parents, peers, or school inputs: Which components of school outcomes are capitalized into house value? Regional Science and Urban Economics 39, no. 5: 523-529.

Brennan, Geoffrey, and James M. Buchanan. (1980). The power to tax: Analytic foundations of a fiscal constitution. Cambridge University Press,.

Brunner, Eric J., Sung-Woo Cho, and Randall Reback. (2012) Mobility, Housing Markets, and Schools: Estimating the Effects of Inter-District Choice Programs. Journal of Public Economics.

Buddin, R. (2012). The impact of charter schools on public and private school enrollments. Cato Institute Policy Analysis, (707).

Bulkley, K. (2001). The accountability bind. education policy analysis archives,9, 37.

Butler, J. S., Carr, D. A., Toma, E. F., & Zimmer, R. (2013). Choice in a world of new school types. Journal of Policy Analysis and Management, 32(4), 785-806.

Cameron, Trudy Ann, and Jeffrey Englin. (1997) Respondent experience and contingent valuation of environmental goods. Journal of Environmental Economics and Management 33, no. 3: 296-313.

Center for Education Reform (CER). (2007). Charter facts & stats. Available http://charterschoolresearch.com/. Accessed 21 May 2012.

Center for Research on Education Outcomes (CREDO). 2009. Multiple Choice: Charter School Performance in 16 States. Stanford.

Crane, E. H. (2003). Cato Handbook for Congress: Policy Recommendations for the 108th Congress. Cato Institute.

Chubb, John E., and Terry M. Moe. (1988) Politics, markets, and the organization of schools. The American Political Science Review: 1066-1087.

Chubb, J. E., & Moe, T. M. (1991). Politics, markets and America's schools.

Cullen, Julie Berry, and Brian A. Jacob (2007). Is gaining access to selective elementary schools gaining ground? Evidence from randomized lotteries. In The Problems of Disadvantaged Youth: An Economic Perspective, pp. 43-84. University of Chicago Press.

Dee, T.S., (1998). Competition and the quality of public schools. Economics of Education Review 17, 419–428.

Dobbie, W., & Fryer Jr, R. G. (2011). Are high-quality schools enough to increase achievement among the poor? Evidence from the Harlem Children's Zone. American Economic Journal: Applied Economics, 158-187.

Downes, Thomas A., and Thomas F. Pogue. 1994. Adjusting school aid formulas for the higher cost of educating disadvantaged students. National Tax Journal, 67(2): 89-110.

Duncombe, W., & Yinger, J. (1998). School finance reform: aid formulas and equity objectives. National Tax Journal, 51, 239–262.

Duncombe, William, and John M. Yinger. 2000. Financing higher student performance standards: The case of New York State. Economics of Education Review 19(5): 363-386.

Duncombe, W., & Yinger, J. (2005). How much more does a disadvantaged student cost? Economics of Education Review, 24(5), 513-532.

Duncombe, W., & Yinger, J. (2008). Measurement of cost differentials. Handbook of research in education finance and policy, 238-256.

Duncombe, W., & Yinger, J. (2011a). Are education cost functions ready for prime time? An examination of their validity and reliability. Peabody Journal of Education, 86(1), 28-57.

Duncombe, W., & Yinger, J. (2011b). Making do: state constraints and local responses in California's education finance system. International Tax and Public Finance, 18(3), 337-368.

Eberts, Randall and Timothy Gronberg. (1981). Districtal homogeneity and the Tiebout hypothesis. Journal of Urban Economics 10: 227-239.

Eom, T., Duncombe, W., Nguyen-Hoang, P., & Yinger, J. (2014). The Unintended Consequences of Property Tax Relief: New York's STAR Program. Education Finance and Policy, forthcoming.

Epple, Dennis N., and Richard Romano. (2003) Neighborhood schools, choice, and the distribution of educational benefits. In: The Economics of School Choice, University of Chicago Press: 227-286.

Ferreyra, Maria Marta (2007). Estimating the effects of private school vouchers in multidistrict economies. The American Economic Review: 789-817

Finnigan, K., Adelman, N., Anderson, L., Cotton, L., Donnelly, M. B., & Price, T. (2004). Evaluation of the Public Charter Schools Program: Final Report. PPSS-2004-08. US Department of Education.

Friedman, Milton. (1995) The role of government in education. From Economics and the Public Interest.

Friedman, Milton. (1969) Capitalism and freedom. University of Chicago press.

Glomm, Gerhard, Douglas T. Harris, Te-Fen Lo. (2005). Charter school location. Economics of Education Review 24(4): 451-457.

Gronberg, T. J., Jansen, D. W., & Taylor, L. L. (2012). The relative efficiency of charter schools: A cost frontier approach. Economics of Education Review, 31(2), 302-317.

Hahn, J., Hausman, J., & Kuersteiner, G. (2004). Estimation with weak instruments: Accuracy of higher-order bias and MSE approximations. The Econometrics Journal, 7(1), 272-306.

Hanushek, Eric A., John F. Kain, Steven G. Rivkin, and Gregory F. Branch. (2007).Charter school quality and parental decision making with school choice. Journal of Public Economics 91, no. 5: 823-848.

Hastings, Justine S., and Jeffrey M. Weinstein. (2008) Information, school choice, and academic achievement: Evidence from two experiments. The Quarterly Journal of Economics 123, no. 4: 1373-1414.

Hastings, J. S., Kane, T. J., & Staiger, D. O. (2006). Gender and performance: Evidence from school assignment by randomized lottery. The American economic review, 232-236

Henig, Jeffrey R., and Jason A. MacDonald. (2002) Locational decisions of charter schools: Probing the market metaphor. Social Science Quarterly 83, no. 4: 962-980.

Hernandez and Craig 2014: Cumo played a pivotal role in charter School Push. http://www.nytimes.com/2014/04/03/nyregion/cuomo-put-his-weight-behind-charter-school-protections.html?action=click&contentCollection=N.Y.%20%2F%20Region&module=RelatedCoverage&region=Marginalia&pgtype=article

Hill, P., Lake, R., Celio, M. B., Campell, C., Herdman, P., & Bulkley, K. (2001). A study of charter school accountability. Seattle: Center on Reinventing Public Education, University of Washington.

Hoxby, C.M., (2000). Does competition among public schools benefit students and taxpayers? American Economic Review 1, 209–238.c

Hoxby, C.M., (2001). Peer effects in the classroom: Learning from gender and race variation. Working paper No. 7867, National Bureau of Economic Research.

Hoxby, C.M., (2003a). School choice and school productivity (or, Could school choice be the tide that lifts all boats?). In: Hoxby, C.M. (Ed.), The Economics of School Choice. Univ. of Chicago Press, Chicago.

Hoxby, C.M., (2003b). School choice and school competition: Evidence from the United States. Swedish Economic Policy Review 10, 11–67.

Imberman, Scott, Michael Naretta, and Margaret O'Rourke. (2014) The Value of Charter Schools: Evidence from Housing Prices. (2014). Working Paper presented at the AEFP.

Jacob Brian A., Lefgren Lars. 2007. "What Do Parents Value in Education? An Empirical Investigation of Parents' Revealed Preferences for Teachers." Quarterly Journal of Economics 122(4): 1603–37.

Kane, Thomas J., Douglas O. Staiger, Gavin Samms, Edward W. Hill, and David L. Weimer. (2003) School Accountability Ratings and Housing Values [with Comments]. Brookings-Wharton Papers on Urban Affairs: 83-137.

Kane, Thomas J., Riegg, Stephanie K., Staiger, Douglas O., (2006). School quality, neighborhoods, and housing prices. American Law and Economics Review 8 (2), 183–212.

Lacireno-Paquet, Natalie., Thomas T. Holyoke, Michele.M. Moser, and Jeffrey R. Henig. 2002. Creaming versus cropping: Charter school enrollment practices in response to market incentives. Educational Evaluation and Policy Analysis, 24(2): 145-158.

Ludner, M. (2007). The impact of charter schools on catholic schools: A comparison of programs in Arizona and Michigan. Catholic Education: A Journal of Inquiry and Practice. 11(1), 102-114.

Lussier 2014 Traditional school districts work to overcome loss of students, money going to charter schools. http://theadvocate.com/news/10162103-123/traditional-school-districts-work-to

Malloy, C. L., & Wohlstetter, P. (2003). Working Conditions In Charter Schools What's the Appeal for Teachers?. Education and urban society, 35(2), 219-241.
Meier, K. J., & Stewart J. (1991). The Politics of Hispanic Education. Albany, NY: State University of New York Press.

Meier, K. J., & O'Toole, L. J. (2003). Public management and educational performance: The impact of managerial networking. Public Administration Review, 63(6), 689-699.
Molnar, A. (1996). Charter Schools: The Smiling Face of Disinvestment. Educational Leadership, 54(2), 9-15.

Moody's 2013 Announcement: Moody's: Charter schools pose greatest credit challenge to school districts in economically weak urban areas. Global Credit Research - 15 Oct 2013. https://www.moodys.com/research/Moodys-Charter-schools-pose-greatest-credit-challenge-to-school-districts--PR_284505

National Alliance for Public Charter Schools (NAPCS). (2012). Measuring Up to the Model: A Tool for Comparing State Charter School Laws. Available http://www.publiccharters.org/law/ViewComponent.aspx?comp=21). Accessed 21 May 2012.

National Center for Education Statistics (2014): Charter School Enrollment. Available at: http://nces.ed.gov/programs/coe/indicator_cgb.asp

Nechyba, Thomas J. (2000) Mobility, targeting, and private-school vouchers. American Economic Review: 130-146.

Nechyba, Thomas. (2003) School finance, spatial income segregation, and the nature of communities. Journal of Urban Economics 54, no. 1: 61-88.

Nelson, Beryl, Paul Berman, John Ericson, Nancy Kamprath, Rebecca Perry, Debi Silverman, and Debra Solomon. (2000) The State of Charter Schools, National Study of Charter Schools. Fourth-Year Report. US Government Printing Office, Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328. For full text: http://www. ed. gov., 2000.

New York Times More Scrutiny for Charter Schools in Debate Over Expansion (2010) available under: http://www.nytimes.com/2010/05/26/education/26charters.html?pagewanted=all&_r=0

New York Times More Lessons About Charter Schools (2013) available under http://www.nytimes.com/2013/02/02/opinion/more-lessons-about-charter-schools.html

Nguyen-Hoang, Phuong, and John Yinger. (2011) The capitalization of school quality into house values: A review. Journal of Housing Economics 20, no. 1: 30-48.

Ni, Y. (2012). Teacher working conditions in charter schools and traditional public schools: A comparative study. Teachers College Record, 114(3), 1-21.

Oates, Wallace E. (1969) The effects of property taxes and local public spending on property values: An empirical study of tax capitalization and the Tiebout hypothesis. The Journal of Political Economy 77, no. 6: 957-971.

Olson, R. S., & LaFaive, M. D. (2007). A Michigan School Money Primer for Policymakers, School Officials, Media and Residents. Mackinac Center for Public Policy.

Renzulli, L. A., & Evans, L. (2005). School choice, charter schools, and white flight. Social problems, 52(3), 398-418.

Reschovsky, Andrew, and Jennifer Imazeki. 1998. The development of school finance formulas to guarantee the provision of adequate education to low-income students. In Developments in School Finance, 1997: Does Money Matter?, edited by William. J. Fowler Jr., pp. 121-148. Washington, D.C.: National Center for Educational Statistics.

Reschovsky, A., & Imazeki, J. (2001). Achieving education adequacy through school finance reform. Journal of Education Finance, 26, 373–396.

Reschovsky, A., & Imazeki, J. (2003). "Let No Child Be Left Behind: Determining the Cost of Improving Student Performance." Public Finance Review 31 (3): 263–290.

Rockoff, J. E. (2010). Local response to fiscal incentives in heterogeneous communities. Journal of Urban Economics, 68(2), 138-147.

Ross, Stephen, and John Yinger. (1999) Sorting and voting: A review of the literature on urban public finance. Handbook of Regional and Urban Economics 3: 2001-2060

Schneider, M., & Buckley, J. (2002). What do parents want from schools? Evidence from the Internet. Educational evaluation and policy analysis, 24(2), 133-144.

Schwartz, Amy, Ioan Voicu, and Keren Mertens Horn. (2014) Do Choice Schools Break the Link Between Public Schools and Property Values? Evidence from House Prices in New York City. Working Paper at the DEPARTMENT OF ECONOMICS UNIVERSITY OF MASSACHUSETTS BOSTON No. 3.

Staiger, D. O., & Stock, J. H. (1994). Instrumental variables regression with weak instruments.

Toma, E. F., Zimmer, R., & Jones, J. T. (2006). Beyond achievement: Enrollment consequences of charter schools in Michigan (Vol. 14, pp. 241-255). Emerald Group Publishing Limited.

TRANSIT COOPERATIVE RESEARCH PROGRAM (TCRP) (2002) Estimating the Benefits and Costs of Public Transit Projects: A Guidebook for Practitioners. National Research Council.

Urquiola, Miguel. (2005). Does school choice lead to sorting? Evidence from Tiebout variation. American Economic Review 95(4): 1310-1326.

US Department of Education (2001): http://www2.ed.gov/nclb/choice/charter/charter-faq.html

Yinger, John (2009). Hedonic markets and explicit demands: bid-function envelopes for public services, neighborhood amenities, and commuting costs. Center for Policy Research Working Paper 114.

VITA

NAME OF AUTHOR: Christian Buerger

PLACE OF BIRTH: Potsdam, Germany

DATE OF BIRTH: October 18th, 1977

EDUCATION:

M.P.A. University of Connecticut, 2005

Diploma in Public Administration, University of Potsdam, Germany, 2005

RESEARCH EXPERIENCE AND EMPLOYMENT:

Teaching Assistant, Department of Public Administration and International Affairs, 2011-2014

Research Assistant, Department of Public Administration and International Affairs, 2009-2014

Graduate Associate, Center for Policy Research, 2009-2014

Consultant at Rambøll Management GmbH, 2005-2008