Private school location and neighborhood characteristics

Lisa Barrow

Introduction and summary

Publicly funded elementary and secondary education has played an important role throughout much of U.S. history in ensuring that the population is among the most educated in the world. (See Goldin, 1999, for a brief history of education in the U.S.) At the same time, privately funded elementary and secondary schools have steadily coexisted, largely giving parents the opportunity to provide their children with a religious education in a country believing in the importance of the separation of church and state. In 1900, 8 percent of students enrolled in kindergarten to grade 12 were enrolled in private schools, while today roughly 11 percent of children are enrolled in private schools. The percentage enrolled in private schools has remained relatively constant since 1990; however, private school enrollment rates have been higher in the intervening years, reaching nearly 14 percent in the late 1950s and early 1960s and nearly 13 percent in the 1980s (U.S. Department of Education, National Center for Education Statistics, 2000). The current public school reform debate has focused much on the idea of providing parents with education vouchers, and adopting such a program is likely to lead to an increase in private school enrollment. More specifically, such a program is likely to increase enrollment at schools traditionally defined as private, while blurring the distinction between public and private schools due to the public source of the voucher financing.

Universal and limited education vouchers have played a role in the public school reform debate for many years. The strongest proponents argue that while one may justify the role of the government in financing education, one cannot justify the role of the government in running the schools. More generally, proponents of education vouchers claim that vouchers are a way to increase the competition faced by schools by enabling parents to choose among alternative public schools, as well as enabling more parents to send their children to private schools. The increase in competition is expected to increase public and private school quality as individual schools compete for students. Subsequently, if private schools are more efficient at providing quality education than public schools, then one would expect to see a shift under a universal voucher program from publicly financed public education to publicly and privately financed private education.

Any voucher program that is going to have a major impact on the public education system is likely to require an expansion of private schools in order to accommodate increased demand; however, very little is known about where private schools open and, therefore, how a major voucher program might affect private school availability in various communities. The goal of this article is to examine the relationship between the location of private schools and the local public school and neighborhood characteristics, such as public school test score performance and average household income. To the extent that private schools respond to area characteristics in their location decisions, I hope to shed some light on how changes in the demand for private schooling, arising from an education voucher program, might change the private school composition of local markets. Using data from the Chicago metropolitan statistical area (MSA), I examine the relationship between the number of private schools in a zip code and the characteristics of the public schools and population of the zip code.

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I find statistically significant positive relationships between the number of private schools in 1997 and the percent of the population that is Asian and the percent of persons over 55 years of age. In addition, I find a statistically significant negative relationship between the number of private schools and average household income and a statistically significant positive relationship between the number of private schools and the dispersion of household income within the community.

The article also includes some extensions to the basic results, in which I examine private religious and non-religious schools separately, as well as looking more specifically at entry and exit of private schools. With these extensions, I find some interesting differences in the relationships between the number of schools and community characteristics for non-religious and religious schools, while I find that few community characteristics have statistically significant net effects on the count of private schools when looking at entry and exit more directly.

Previous research

Much of the previous research on private schools has focused on the effect of private schools on public school quality, the relative quality of private and public schools, and the determinants of private school attendance, rather than on the supply side of private school provision. For example, Hoxby (1994) examines the effect of private school competition on public school quality and finds that where public schools face greater competition from private schools, the public school students achieve higher educational attainment, graduation rates, and future wages. Sanders (1996) and Neal (1997) look at the effect of Catholic school attendance—elementary and secondary, respectively—on various measures of achievement and find some positive effects of Catholic school attendance relative to public school attendance. At the same time, Catholic school attendance has a negligible effect on suburban students' achievement (Neal, 1997) and science test scores (Sanders, 1996). Several other studies examine the determinants of private school enrollment, looking both at socioeconomic characteristics of the family associated with private school attendance, such as income and education, and the influence of public school characteristics, such as public school quality, public school finance, or the degree of public school choice. See Clotfelter (1976), Long and Toma (1988), Schmidt (1992), and Downes (1996), for example.

Among the empirical work looking at private schools, Downes and Greenstein's (1996) study is a notable exception in looking more specifically at the supply-side decisions of private schools. Similar to the goals of this article, the Downes and Greenstein (1996) study examines the relationship between counts of private schools and public school and population characteristics of the location. Instead of Chicago MSA zip codes, they use school districts in California in 1979 as the area unit of observation. For results comparable to work in this article, the authors find statistically significant positive relationships between the number of private schools and the public school student–teacher ratio, the percentage of public school students on public assistance, and the percentage of public school sixth graders with limited English proficiency (LEP). They find that the number of private schools is positively related to the percentage of the adult population who are high school graduates, college graduates, Hispanic, and Asian. They find no relationship between the number of private schools and mean family income.

For this study, standardized test scores are available as a measure of school quality in addition to the student–teacher ratio. Standardized test scores are not an ideal measure of school quality because they confound measures of both peer and school quality; however, they may well reflect perceived school quality by parents which may be a more important measure of school quality from the perspective of a private school competitor. I am also able to match private school data over time in order to explore the relationships between private school entry and exit and the local public school and location characteristics.

Data and descriptive statistics

Information on private schools in the Chicago metropolitan area comes from the U.S. Department of Education National Center for Education Statistics (NCES), *Private School Universe Survey, 1997–98* (1999b). From these data, I identify the zip code location, as well as religious affiliation and grade level for each private school. I eliminate schools located in zip codes outside the Chicago MSA, schools in zero population zip codes, and schools for which the program is ungraded or for which kindergarten is the highest grade offered. The breakdown of private school affiliation is presented in figures 1 and 2, while descriptive statistics for the private schools are presented in table 1, panel A.

In 1998, 753 private schools existed in the Chicago metropolitan statistical area. Just over half of the private schools are Roman Catholic (54 percent) and roughly 14 percent are non-religious (see figure 1). These affiliation percentages are not weighted by enrollment, however, and when looking at the enrollment-weighted shares in figure 2, the Catholic schools are much larger on average than other private school types. Nearly three-quarters of the private school enrollment is in Catholic schools, while only 6.6 percent of the enrollment is in non-religious schools. Compared with national statistics, private schools in the Chicago area are much more likely to be Catholic and are less likely to have no religious affiliation. Nationally, roughly 30 percent of private schools are Catholic and 22 percent are non-religious, while 50 percent of private school students are enrolled at Catholic schools and 16 percent are enrolled in non-religious schools.[1]

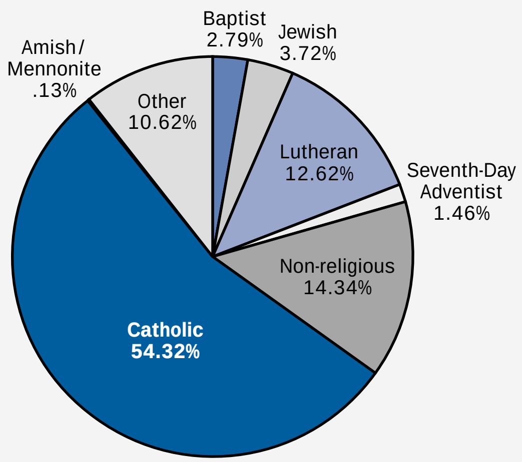
The average private school has roughly 278 students; 62 percent are white, 21 percent are African-American, and 13 percent are Hispanic (see table 1, panel A). The average student–teacher ratio is 16.9, and the majority of private schools have elementary grades, 78 percent, while 13 percent offer only secondary grade levels. Similar characteristics for public schools in the Chicago MSA from the NCES Common Core of Data, 1997–98, are presented in panel B of table 1. In comparison, the public schools are much larger, on average, with 662 students, and more diverse, with an average of 51 percent of the students being white, 27 percent African-American, and 16 percent Hispanic. The average student–teacher ratio is higher in the public schools at 18 pupils per teacher. Note that the table 1 statistics are not weighted by school size and, therefore, reflect the characteristics of the average school, not the characteristics of the school experienced by the average public or private school student.

To examine the relationship between the number of private schools and local area characteristics, I combine the data into zip-code-level observations. For each zip code, I construct the count of private schools in the zip code, the number of private schools existing in 1997 that did not exist in 1980 (defined as entry), the number of private schools that existed in 1980 and no longer existed in 1997 (defined as exit), the average public school characteristics in the zip code using Illinois 1997 school report card data, the average 1990 census characteristics of people in the zip code, and the 1980 to 1990 change in census zip code characteristics.

Table 2 (on page 17) presents summary statistics for the zip codes for the 281 of 284 zip codes in the Chicago MSA I use in the following analysis. (The three excluded zip codes had zero population in 1990.) Each zip code has an average of 2.68 private schools, most of which have some religious affiliation. The zip code public schools have an average student–teacher ratio of 17.9, with 9 percent of the sixth grade students not meeting Illinois Goal Assessment Program (IGAP) standards and 28.6 percent exceeding IGAP standards. People in Chicago MSA zip codes have a relatively low incidence of difficulty with the English language. Only 2.65 percent are limited English proficient as defined by the U.S. census, compared with 2.9 percent for the U.S. as a whole; however, in some zip codes more than 20 percent of the population is

FIGURE 1

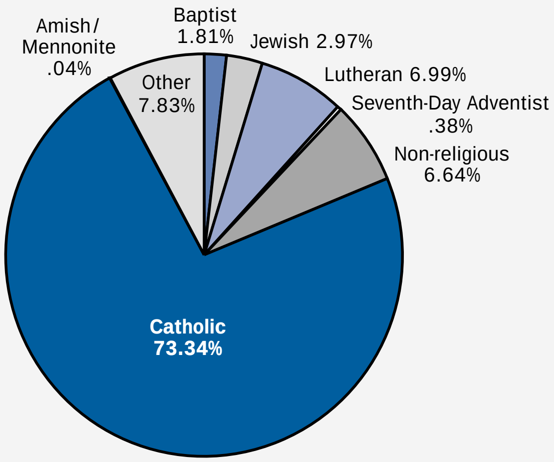
Chicago MSA private school affiliations



Source: Author's calculations based on data from the U.S. Department of Education, National Center for Education Statistics (1998b).

FIGURE 2

Chicago MSA private school affiliations weighted by enrollment



Source: Author's calculations based on data from the U.S. Department of Education, National Center for Education Statistics (1998b).

TABLE 1

Descriptive statistics of Chicago MSA private and public schools

	Mean	Standard deviation	Minimum	Maximum
A. Private schools				
Enrollment	278.26	248.05	7	2,050
White, percent	61.98	36.77	0	100
African-American, percent	20.55	33.68	0	100
Asian, percent	4.12	10.39	0	100
Hispanic, percent	13.09	22.18	0	99.15
Student–teacher ratio	16.89	12.67	1.67	289.14
Elementary, percent	78.49			
Secondary, percent	13.01			
Coeducational, percent	92.96			
All-female, percent	3.45			
Number of schools	753			
B. Public schools				
Enrollment	662.27	474.27	24	4,217
White, percent	51.24	37.43	0	100
African-American, percent	27.16	37.08	0	100
Asian, percent	3.57	6.07	0	58
Hispanic, percent	16.33	24.24	0	100
Student–teacher ratio	18.11	3.31	5.70	42.00
Elementary, percent	73.34			
Secondary, percent	11.85			
Number of schools	1,823			

Notes: All means are unweighted. The student–teacher ratio is missing for 12 public schools due to missing data on full-time equivalent classroom teachers. For school level, the omitted categories are junior high and combined elementary and secondary. None of the public schools fall into the "combined" category. Elementary schools are defined as having a low grade from pre-kindergarten to sixth grade and a high grade from first to ninth grade. Secondary schools are defined as having a low grade between fifth and tenth grade and a high grade between tenth and twelfth grade.

Sources: Panel A—Author's calculations based on data from the U.S. Department of Education, National Center for Education Statistics (1998b); Panel B—Author's calculations based on data from the U.S. Department of Education, National Center for Education Statistics (1998a).

LEP. The majority of people in the Chicago MSA are white, 82 percent, with roughly 12 percent African-American and 3 percent Asian. The area population is relatively well educated; just under 20 percent of persons 25 years and older have less than a high school diploma and 25 percent have a bachelor's degree or higher. On average, 19 percent of the zip code population is over 55 years of age, while 18 percent falls in the school-aged range of 5 to 17 years of age. Average household income is $64,826 in real 1999 dollars, 5 percent of households receive some public assistance income, and the constructed measure of the standard deviation of household income is nearly $50,000 in real 1999 dollars. Finally, the zip code school-aged population averages 4,800 people.

Private school location and neighborhood characteristics

Although little is understood about how private schools make location decisions, a reasonable starting point is to hypothesize that private schools generally choose to locate where there is demand for private schooling. Therefore, it is useful to consider what characteristics likely affect demand for private schooling. Most obviously, one would expect to see more private schools in areas with a larger school-aged population, because greater population is likely to be associated with greater numbers of students desiring enrollment in private schools. Considering the role of public schools in the private school/public school choice, on the one hand, one might expect poor-quality public schools to be associated with greater numbers of private schools, as the value of the net increase in school quality from switching to private school would exceed the cost of private schooling. On the other hand, to the extent that private schools provide competition for public schools as suggested in some of the education literature, greater numbers of private schools may be associated with better performing public schools.

TABLE 2

Descriptive statistics of Chicago metro area zip codes

	Mean	Standard deviation	Minimum	Maximum
Private school counts				
Total schools	2.68	2.90	0	16
Non-religious schools	0.38	0.73	0	4
Religious schools	2.30	2.57	0	14
Total schools entering, 1980 to 1997	0.66	1.06	0	9
Total schools exiting, 1980 to 1997	0.68	1.41	0	10
Non-religious schools entering, 1980 to 1997	0.26	0.53	0	2
Non-religious schools exiting, 1980 to 1997	0.11	0.40	0	2
Religious schools entering, 1980 to 1997	0.41	0.82	0	8
Religious schools exiting, 1980 to 1997	0.57	1.23	0	8
Public school characteristics				
Average student–teacher ratio	17.88	2.02	11.90	24.13
Zip codes without student–teacher ratio data, percent	9.25			
Sixth graders not meeting IGAP standards, percent	9.12	9.34	0	45.11
Sixth graders exceeding IGAP standards, percent	28.55	15.73	1.61	69.68
Zip codes without sixth grade IGAP scores, percent	14.59			
Population characteristics				
Limited English proficiency, percent	2.65	3.76	0	22.33
White, percent	82.00	24.40	0.48	100.00
African-American, percent	11.73	23.10	0	99.20
Asian, percent	2.77	3.51	0	21.37
Hispanic, percent	6.90	10.32	0	67.27
Less than high school diploma, percent	19.81	11.99	0	62.42
Bachelor's degree or higher, percent	25.04	17.37	0	89.29
Over 55 years of age, percent	19.46	7.77	0	70.42
Households receiving public assistance, percent	5.10	7.05	0	46.72
Average household income	64,826	31,051	13,522	270,653
Standard deviation of household income	49,541	22,166	320	136,520
Zip codes without income data, percent	0.71			
Number of school-aged children	4,774	4,680	0	28,098

Notes: There are 281 zip codes. All dollar values are in 1999 dollars.
Sources: Author's calculations from the U.S. Department of Education, National Center for Education Statistics (1998b), Illinois State Board of Education (1998), and U.S. Department of Commerce, Bureau of the Census (1990).

Demographic characteristics of the zip code population may also be correlated with demand for private schooling and, hence, the numbers of private schools. For example, Hispanics are on average more likely to be Catholic and, therefore, are likely to have a greater preference for Catholic education. In addition, people may prefer that their children attend school with other children of the same race, which might lead to racial segregation between private and public schools. Further, education and income characteristics of the community may also be associated with differences in demand for private schools. Higher education may be correlated with greater preference for higher quality education than is offered in the public schools. Alternatively, education is positively correlated with income, which is likely to be correlated with greater demand for high quality education, so one would expect both education and income to be associated with demand for private schooling. Lastly, Tiebout sorting (the sorting of households into communities with similar public good preferences) or rather the lack of Tiebout sorting may also relate to the demand for private education. If households with very different demands for high quality education live in the same community, one might expect greater demand for private schools in order for the different demands to be met. For example, assuming household income is positively correlated with demand for high quality schools, communities with large variance in household income may have greater demand for private schools as households sort into public and private schooling based on their different demands.

Correlations

For a first look at the relationship between the number of private schools and public school quality and neighborhood characteristics, table 3 presents simple correlation coefficients along with p-values for the correlations between the count of private schools and various zip code characteristics that might influence private school location (column 1). P-values ≤0.01 imply a statistically significant correlation at the 1 percent level of significance, and p-values ≤0.05 imply a statistically significant correlation at the 5 percent level of significance. Columns 2 and 3 present similar correlations between the zip code characteristics and the counts of non-religious and religious schools. As expected, the number of private schools is positively correlated with the number of school-aged children;

TABLE 3

Correlations between counts of private schools and characteristics of public schools and population

	Private schools	Non-religious private schools	Religious private schools
School-aged population	0.7191 (0.0000)	0.3971 (0.0000)	0.6983 (0.0000)
Student–teacher ratio	0.1164 (0.0513)	–0.0279 (0.6411)	0.1391 (0.0197)
Public school sixth graders failing standards, percent	0.3674 (0.0000)	0.2664 (0.0000)	0.3388 (0.0000)
Public school sixth graders exceeding standards, percent	–0.2611 (0.0000)	–0.0842 (0.1594)	–0.2705 (0.0000)
Limited English proficiency, percent	0.4381 (0.0000)	0.1750 (0.0032)	0.4443 (0.0000)
White, percent	–0.3977 (0.0000)	–0.3428 (0.0000)	–0.3513 (0.0000)
African-American, percent	0.2801 (0.0000)	0.2981 (0.0000)	0.2313 (0.0001)
Asian, percent	0.2066 (0.0005)	0.1273 (0.0329)	0.1969 (0.0009)
Hispanic, percent	0.3774 (0.0000)	0.1509 (0.0113)	0.3828 (0.0000)
Less than high school diploma, percent	0.3630 (0.0000)	0.0853 (0.1537)	0.3851 (0.0000)
Bachelor’s degree or higher, percent	–0.0872 (0.1449)	0.1332 (0.0256)	–0.1360 (0.0226)
Over 55 years of age, percent	0.1941 (0.0011)	–0.0155 (0.7963)	0.2231 (0.0002)
Households receiving public assistance, percent	0.3431 (0.0000)	0.2444 (0.0000)	0.3176 (0.0000)
Average household income	–0.2068 (0.0005)	–0.0305 (0.6101)	–0.2245 (0.0001)
Standard deviation of household income	–0.1058 (0.0767)	0.0702 (0.2406)	–0.1391 (0.0196)

Notes: There are 281 observations; p-values are in parentheses. All dollar values are in 1999 dollars.

that is, generally speaking, communities with greater numbers of school-aged children also have more private schools. The school quality measures are correlated with the counts of private schools in a negative direction; that is, higher public school quality is associated with lower numbers of private schools. Lower student–teacher ratios (usually assumed to reflect higher school quality) are associated with fewer total private schools. There are more private schools in communities with larger shares of students failing to meet IGAP standards, and there are fewer private schools in communities with larger shares of students exceeding the IGAP standards.

Looking at race and ethnicity, communities that are less white, more African-American, more Asian, and more Hispanic have fewer private schools. Also, areas in which larger shares of the population are high school dropouts or over the age of 55 have more private schools. Finally, a greater share of households receiving public assistance income is associated with more private schools, higher average household income is associated with fewer private schools, and higher community standard deviation of household income is associated weakly with fewer total private schools. This last result is somewhat surprising. Higher income standard deviation is assumed to be associated with greater differences in demand for public goods, such as public schooling, which might translate into greater private school enrollment to accommodate different demands for schooling in the community. Of course, these simple bivariate correlations do not control for multiple community characteristics. This is particularly important in the case of household income, because areas with higher average household income are likely to have greater income dispersion as well. As I explain below, the standard deviation of household income is positively associated with the number of private schools once average household income is also taken into account.

Results from Poisson regression

The correlation results above provide bivariate descriptions of the data, but they do not let us consider more complex, multivariate relationships in the data that may paint a somewhat different picture of private school location due to correlations between the covariates themselves, as well as between the covariates and counts of private schools. The results below utilize Poisson regression analysis in order to consider these more complex relationships in the data (see box 1). However, due to the small number of data points, the specifications below control for only a few covariates at any one time. In consequence, there may still be biases in the coefficient estimates due to omitted variables that are correlated with the included variables.

First, I present the results that focus on the relationship between total counts of private schools and community characteristics. Next, I highlight some interesting differences between religious and nonreligious private school counts and community characteristics. Finally, I consider the more difficult question of how private school entry and exit are related to location characteristics and changes in location characteristics over time.

Counts of private schools

Estimation results from Poisson regression of the counts of private schools on the logarithm of the school-aged population and various school quality measures are presented in table 4. With the exception of the school-aged population coefficient, the coefficient estimates can be interpreted as the proportional change in the expected number of private schools associated with a one-unit change in the variable of interest. The school-aged population coefficient

BOX 1

Poisson regression

The random variable of the number of occurrences of a particular event (in this case the number of private schools in a zip code) is assumed to have a Poisson distribution with parameter λ_i, where i indexes the zip code. For a random variable with a Poisson distribution with parameter λ, the expected value of the random variable equals λ, and the variance of the random variable equals λ.

The probability that the number of private schools in zip code i, denoted Y_i, equals y can be written as follows:

$$\Pr(Y_i = y) = \exp(-\lambda_i)\frac{(\lambda_i)^y}{y!}.$$

Next, I parameterize λ_i by specifying that the natural logarithm of λ_i is a linear function of the explanatory variables, that is,

$$\ln \lambda_i = \alpha + \sum_{j=1}^{J} \beta_j x_{ij}.$$

Poisson regression then estimates parameter values for α and β_j using maximum likelihood estimation (see Maddala, 1983, for a more complete discussion of Poisson regression). Throughout the article, I report results for the estimates of β_j without reporting the estimates of α.

TABLE 4

Relationship between counts of private schools and public school quality estimated by Poisson regression

Log of school-aged population	0.817*** (0.049)	0.832*** (0.049)	0.823*** (0.062)	0.788*** (0.053)
Student–teacher ratio	—	–0.024 (0.023)	—	—
Public school sixth graders failing standards, percent	—	—	–0.002 (0.004)	—
Public school sixth graders exceeding standards, percent	—	—	—	–0.002 (0.003)
Log-likelihood	–505	–504	–504	–504

***Significantly different from zero at the 1 percent level.

Notes: Standard errors are in parentheses. The dependent variable is the number of private schools in the zip code in 1997. There are 281 observations in each estimation. Each column also includes a dummy variable indicating whether the logarithm of the school-aged population is missing and a dummy variable indicating whether the variable of interest is missing.

reflects the percentage change in private schools associated with a 1 percent change in the school-aged population. Since I expect the number of private schools to be highly related to the size of the market (population of school-aged children), all estimates control for the logarithm of the school-aged population. Column 1 of table 4 controls only for the logarithm of the population of school-aged children, while the remaining estimates control for the logarithm of the number of school-aged children and at least one additional covariate.

Looking at the school-aged population result, communities with 1 percent larger school-aged populations have 0.8 percent more private schools on average. Combined with the fact that the share of school-aged children attending public school is unrelated to the number of school-aged children in Chicago zip codes, a school-aged population coefficient estimate less than 1 indicates that larger communities have larger private schools on average. Throughout the specifications in tables 4 and 5, the school-aged population coefficient estimate ranges from 0.775 to 0.901 and is always statistically different from 1.0 at the 1 percent level of significance.

The remaining specifications in table 4 control for public school quality measures. For all three school quality measures—average student–teacher ratio, percentage of students failing to meet IGAP standards, and percentage of students exceeding IGAP standards—there is no statistically significant relationship with private school counts. This finding is not altogether surprising, given that the expected direction of the relationship between private schools and public school quality is uncertain.[2]

In table 5, I present estimates of the relationship between private school counts and a select set of neighborhood characteristics of the zip codes, namely, language, race, ethnicity, and education in specifications 1 through 6. Neither English proficiency nor population education levels—percentage without a high school diploma and percentage with at least a bachelor’s degree—are statistically related to the number of private schools in a zip code. In contrast, zip codes with 1 percentage point more Asians have 2.4 percent more private schools; however, neither the percentage of the population that is African-American nor the percentage of the population that is Hispanic is statistically related to the number of private schools in the zip code.

Finally, table 5 also includes estimates of the relationships between private school counts and age and income of the neighborhood that are presented in specifications 7 through 11. The percentage of the population over 55 years is positively related to the number of private schools in the zip code. A 1 percentage-point increase in the percentage of persons over 55 years of age is associated with a 5.2 percent increase in the expected number of private schools. The wealth of a community, as reflected by the percent of households receiving public assistance income, is negatively related to the number of private schools, while wealth as measured by average household income has no statistical relationship with the number of private schools. The standard deviation of household income also has no statistically significant relationship with the number of private schools.

TABLE 5

Relationships between counts of private schools and location characteristics estimated by Poisson regression

	Specification										
	1	2	3	4	5	6	7	8	9	10	11
Log of school-aged population	0.775*** (0.061)	0.844*** (0.054)	0.816*** (0.050)	0.810*** (0.060)	0.807*** (0.060)	0.841*** (0.051)	0.901*** (0.049)	0.883*** (0.061)	0.808*** (0.053)	0.836*** (0.052)	0.780*** (0.054)
Limited English proficiency, percent	0.014 (0.009)	—	—	—	—	—	—	—	—	—	—
African-American, percent	—	–0.002 (0.002)	—	—	—	—	—	—	—	—	—
Asian, percent	—	—	0.024* (0.013)	—	—	—	—	—	—	—	—
Hispanic, percent	—	—	—	0.001 (0.003)	—	—	—	—	—	—	—
Less than high school diploma, percent	—	—	—	—	0.001 (0.003)	—	—	—	—	—	—
Bachelor's degree or higher, percent	—	—	—	—	—	0.004 (0.003)	—	—	—	—	—
Over 55 years of age, percent	—	—	—	—	—	—	0.052*** (0.005)	—	—	—	—
Households receiving public assistance, percent	—	—	—	—	—	—	—	–0.010** (0.005)	—	—	—
Average household income ($10,000s)	—	—	—	—	—	—	—	—	–0.008 (0.020)	—	–0.203*** (0.053)
Standard deviation of household income ($10,000s)	—	—	—	—	—	—	—	—	—	0.025 (0.022)	0.274*** (0.055)
Log-likelihood	–503	–504	–501	–505	–505	–503	–461	–502	–504	–504	–491

***Significantly different from zero at the 1 percent level.
**Significantly different from zero at the 5 percent level.
*Significantly different from zero at the 10 percent level.
Notes: See notes for table 4.

Perhaps the most interesting results are presented in specification 11. In this specification, I control for both average household income and the standard deviation of household income within the community. In contrast to the two previous specifications, the specification 11 estimates indicate that both average household income and standard deviation of household income are statistically related to the number of private schools. A $10,000 increase in average household income decreases the number of private schools by 20 percent, while an increase in the standard deviation of household income by $10,000 increases the number of private schools by 27 percent. The standard deviation of income result is consistent with the notion that communities with greater heterogeneity in their demand for public school quality may have greater demand for private schools. Communities with a larger standard deviation of household income are more likely to have households with very different demands for public school quality. Thus, higher income households who are likely to demand better school quality than lower income households may opt for private schooling for their children instead.

Religious versus non-religious private school counts

Generally speaking, private schools may be viewed as distinguishing themselves along two dimensions: academic quality and religion. As such, religious school location decisions may be very different from the location decisions of non-religious schools. For example, one might think that schools offering no religious affiliation may be more responsive to public school quality. Similarly, Catholic schools may tend to be located in areas with larger Catholic populations, for example, areas with more Hispanics. The results presented in tables 6 and 7 provide separate estimates for the relationships between counts of non-religious and religious schools and certain location characteristics.

Once again, I control for the logarithm of the number of school-aged persons in the zip code in each specification, but these coefficient estimates are not shown in the tables. On average, 1 percent more school-aged children is associated with 0.8 percent more private schools, with coefficient estimates ranging from 0.7 to 1.0. Turning to the school quality results in table 6, non-religious private schools are less prevalent in areas in which the public school student–teacher ratio is higher. The estimate suggests that one more student per teacher on average is associated with 16 percent fewer private, non-religious schools. None of the other school-quality to private-school count relationships are statistically significant. The student–teacher result is more consistent with the notion that private schools improve public schools through competition; however, this conclusion is a bit strong given the lack of evidence from the other school quality measures.

The results presented in table 7 indicate some interesting statistical differences between counts of private non-religious schools and religious schools and community characteristics. Contrary to speculation above, the percentage of the population that is Hispanic, and thus likely to be more Catholic, has no statistically significant relationship with either the number of non-religious private schools or the number of religious schools. Instead, the percentage of the population that is African-American, and thus less Catholic, on average, is positively related to the number of non-religious private schools and negatively related

TABLE 6

Relationship between counts of private schools and public school quality by non-religious and religious private schools

	Non-religious schools			Religious schools		
Student–teacher ratio	–0.157** (0.070)	—	—	–0.002 (0.024)	—	—
Public school sixth graders failing standards, percent	—	0.006 (0.010)	—	—	–0.003 (0.004)	—
Public school sixth graders exceeding standards, percent	—	—	0.006 (0.008)	—	—	–0.004 (0.003)

**Significantly different from zero at the 5 percent level.

Notes: Standard errors are in parentheses. Each column represents a separate specification. The dependent variable in columns 1, 2, and 3 is the number of non-religious private schools in the zip code in 1997. The dependent variable in columns 4, 5, and 6 is the number of religious private schools in the zip code in 1997. There are 281 observations in each estimation. Each column also includes the logarithm of the 1990 school-aged population of the zip code, a dummy variable indicating that the school-aged population is missing, and a dummy variable indicating that the variable of interest is missing.

to the number of religious schools (see specification 2 in table 7). The education level of the community is significantly related to the number of private, non-religious schools, but is not statistically related to the number of private, religious schools. Higher percentages of persons with less than a high school diploma are negatively associated with the number of private, non-religious schools, and higher percentages of persons with a bachelor's degree or higher education are positively associated with the number of private, non-religious schools. These education results likely reflect differences in the demand for school quality associated with either preferences or income.

Finally, the age and income results show that the positive relationship between the percentage of the population over 55 and the number of private schools reflects the positive relationship between the percentage of persons over 55 years of age and the number of private, religious schools. The income results mostly confirm the education results of specifications 5 and 6, although higher average household income is associated with greater numbers of private, non-religious schools without controlling for income dispersion. The significant relationship between percentage of households receiving public assistance income and the number of religious schools suggests a relationship between religious private school location and income as well. Lastly, unlike the overall results, the number of non-religious private schools is positively associated with the standard deviation of household income even without controlling for average income. Controlling for both average income and standard deviation of income yields similar results for both religious and non-religious schools: Communities with greater income heterogeneity, controlling for average household income, have more private schools.

Entry and exit

There are at least two reasons why one might be skeptical of the relevance of the above results. First, the relationship between school counts and area characteristics, other than school quality, is based on private school locations in 1998 and census data

TABLE 7

Relationships between counts of private schools and location characteristics by non-religious and religious schools

Specification	Non-religious private schools	Religious private schools
1 Limited English proficiency, percent	–0.014 (0.023)	0.018* (0.010)
2 African-American, percent	0.005* (0.003)	–0.003* (0.002)
3 Asian, percent	0.027 (0.018)	0.023 (0.014)
4 Hispanic, percent	–0.008 (0.009)	0.002 (0.003)
5 Less than high school diploma, percent	–0.021** (0.008)	0.004 (0.003)
6 Bachelor's degree or higher, percent	0.029*** (0.006)	–0.001 (0.003)
7 Over 55 years of age, percent	0.011 (0.018)	0.058*** (0.005)
8 Households receiving public assistance, percent	–0.003 (0.010)	–0.012** (0.005)
9 Average household income ($10,000s)	0.067* (0.039)	–0.024 (0.020)
10 Standard deviation of household income ($10,000s)	0.152*** (0.049)	–0.001 (0.022)
11 Average household income ($10,000s)	–0.365*** (0.136)	–0.175*** (0.054)
Standard deviation of household income ($10,000s)	0.614*** (0.151)	0.211*** (0.063)

***Significantly different from zero at the 1 percent level.
**Significantly different from zero at the 5 percent level.
*Significantly different from zero at the 10 percent level.
Notes: Standard errors are in parentheses. The dependent variable for each estimate in column 1 is the number of non-religious private schools in the zip code in 1997. The dependent variable for each estimate in column 2 is the number of non-religious private schools in the zip code in 1997. There are 281 observations in each estimation. Specifications 1 through 10 each control for only the location characteristic listed in addition to the logarithm of the 1990 school-aged population of the zip code, a dummy variable indicating that population is missing, and a dummy variable indicating that the variable of interest is missing. Both average household income and the standard deviation of household income are included in specification 11, in addition to the logarithm of the 1990 school-aged population of the zip code, a dummy variable indicating that population is missing, and a dummy variable indicating that the household income data are missing.

TABLE 8

Relationships between private school entry and exit and public school quality estimated by Poisson regression

Specification	Entry	Exit	Combined effect
1 Log of 1990 school-aged population	0.688*** (0.105)	1.371*** (0.127)	–0.683*** (0.171)
1980 to 1990 change in log school-aged population	–0.211 (0.253)	–1.789*** (0.455)	1.578*** (0.495)
2 Student–teacher ratio	0.024 (0.043)	0.036 0.059	–0.012 (0.067)
3 Public school sixth graders failing standards, percent	0.002 (0.008)	0.016* (0.009)	–0.014 (0.012)
4 Public school sixth graders exceeding standards, percent	–0.003 (0.005)	–0.017*** (0.006)	0.014* (0.007)

***Significantly different from zero at the 1 percent level.
*Significantly different from zero at the 10 percent level.
Notes: The dependent variable is the count of private school entrants and exits in each zip code. Standard errors are in parentheses. Results are reported for four specifications. There are 281 zip codes used in the estimation. For each specification, the effects of covariates on private school entry and exit are estimated simultaneously. The results in the "entry" column correspond to the effects of the various covariates on private school entry; the results in the "exit" column correspond to the effects of the various covariates on private school exit; and the results in the "combined effect" column represent the net effect of the covariates on entry. In addition to the covariates listed in the second column, specifications 2 through 4 also control for the change in the log school-aged population between 1980 and 1990 and the logarithm of the school-aged population in 1990. Specification 1 includes only the school-aged population controls. All specifications include the appropriate set of dummy variables indicating missing observations for included variables.

from 1990. Second, current counts of private schools by location may be based largely on past location decisions. An alternative approach is to examine the relationships between changes in the number of private schools and changes in location characteristics. I do this by matching private schools in 1980 with private schools in 1997 to determine how many schools have entered and exited the community on aggregate over the 17 years. The results presented in tables 8–13 look at the relationships between counts of private school entry or exit and changes in location characteristics from 1980 to 1990.

The results in tables 8 and 9 focus on the number of private schools entering or exiting a zip code from 1980 to 1997. Each covariate is allowed to have a different effect on entry than on exit, but the relationships are estimated simultaneously. Each numbered row in the table represents one specification. Estimates of the effect of covariates on private school entry are presented in the "entry" column, estimates of the effect of covariates on private school exit are presented in the "exit" column, and estimates of the net effect on numbers of private schools are presented in the last column. If the net effect equals zero, then the effects of the covariate on entry and exit cancel each other out. If the net effect is either positive or negative, then the effect of the covariate on entry must dominate the effect on exit or vice versa, implying that there will be a net change in the number of private schools in the zip code between 1980 and 1997. In each specification I control for the logarithm of the school-aged population in 1990, as well as the change in the logarithm of the school-aged population from 1980 to 1990. These results are presented only for the first specification (rows labeled 1 in table 8), which includes no other covariates.

As seen in specification 1, the 1990 level of the school-aged population has a statistically significant relationship with entry, exit, and net entry. Additionally, the growth in the school-aged population between 1980 and 1990 has no statistically significant relationship with the number of schools entering the zip code but is significantly related to exit and net entry. Zip codes with larger numbers of school-aged children have both more entries and more exits of private schools from 1980 to 1997. However, the positive effect of the number of school-aged children on the number of schools exiting outweighs the positive effect on entry, such that on net, areas with 1 percent more school-aged population in 1990 have 0.7 percent

TABLE 9

Relationships between private school entry and exit and location characteristics estimated by Poisson regression

Specification	Entry	Exit	Combined effect
1 Limited English proficiency, change in percent	0.021 (0.073)	0.083 (0.052)	–0.063 (0.072)
2 African-American, change in percent	0.004 (0.009)	0.002 (0.008)	0.002 (0.013)
3 Asian, change in percent	0.116* (0.062)	0.020 (0.067)	0.095** (0.042)
4 Hispanic, change in percent	–0.024 (0.015)	0.046*** (0.015)	–0.070*** (0.021)
5 Less than high school diploma, change in percent	0.011 (0.026)	–0.043* (0.023)	0.054* (0.031)
6 Bachelor's degree or higher, change in percent	0.032* (0.017)	0.019 (0.020)	0.013 (0.028)
7 Over 55 years, change in percent	–0.046 (0.032)	–0.107*** (0.026)	0.060 (0.037)
8 Households receiving public assistance, change in percent	0.0002 (0.0003)	–0.0001 (0.0003)	0.0003 (0.0005)
9 Change in average household income ($10,000s)	–0.030 (0.046)	–0.157 (0.098)	0.127 (0.107)
10 Change in standard deviation of household income ($10,000s)	0.027 (0.056)	–0.093 (0.098)	0.120 (0.109)
11 Change in average household income ($10,000s)	–0.385*** (0.135)	–0.631** (0.272)	0.245 (0.295)
Change in standard deviation of household income ($10,000s)	0.478*** (0.155)	0.580** (0.286)	–0.101 (0.324)

***Significantly different from zero at the 1 percent level.
**Significantly different from zero at the 5 percent level.
*Significantly different from zero at the 10 percent level.
Notes: The dependent variable is the count of private school entrants and exits in each zip code. Standard errors are in parentheses. Results are reported for 11 specifications. There are 281 zip codes used in the estimation. For each specification, the effects of covariates on private school entry and exit are estimated simultaneously. The results in the "entry" column correspond to the effects of the various covariates on private school entry, and the results in the "exit" column correspond to the effects of the various covariates on private school exit. The results in the "combined effect" column represent the net effect of the covariates on entry. In addition to the covariate(s) listed in the second column, each estimate also controls for the change in the logarithm of the school-aged population between 1980 and 1990 and the logarithm of the school-aged population in 1990. Specifications 1 through 10 control for only one location characteristic other than the school-aged population measures, while both the change in average household income and the change in the standard deviation of household income are included in specification 11. All specifications include the appropriate set of dummy variables indicating missing observations for included variables.

fewer private schools in 1997. This estimate averages –0.62 across specifications, ranging from –0.70 to –0.54. Not surprisingly, larger growth in the school-aged population between 1980 and 1990 is associated with fewer private school exits over the period and a significant positive net effect on the number of private schools in 1997. A 1 percentage-point greater increase in the number of school-aged children from 1980 to 1990 is associated with a net 1.6 percent more private schools in 1997.

Public school quality measures have few statistically significant relationships with private school entry and exit. Average school quality measures are unavailable for 1980, so the public school quality measures are 1997 measures of school quality as used in the previous estimates. A higher percentage of sixth graders failing to meet the IGAP standards is associated with greater private school exit; however, the net effect of entry and exit is not statistically significant. A higher percentage of sixth graders exceeding the IGAP standards is associated with fewer private school exits from 1980 to 1997—1 percentage point more students exceeding is associated with 1.7 percent fewer exits—and a net positive effect on the change in the number of private schools. A 1 percentage point increase in the percentage of students exceeding the standards is associated with a net positive increase in the number of private schools of 1.4 percent.

Turning to the census characteristics results in table 9, we find statistically significant relationships with entry, exit, or the net effect on the number of private schools only among control variables that show some statistical significance in the overall results looking at private school counts in 1997. A 1 percentage-point greater increase in the percentage of the population that is Asian is associated with nearly 12 percent more private school entries. Taking into account the positive, but statistically insignificant, effect of the change in percentage Asian on exits, I find that a 1 percentage-point greater increase in the percentage of Asians is associated with a net increase of nearly 10 percent more private schools. The percentage of the population that is Hispanic has nearly the opposite effect on private schools. An increase in the percentage of Hispanics is associated with more private school exits from 1980 to 1997 and, thus, on net fewer private schools in 1997. A 1 percentage-point greater increase in the percentage of Hispanics is associated with a net 7 percent fewer private schools in 1997.

A larger increase in the percentage of adults with less than a high school education is somewhat surprisingly associated with fewer private school exits and an, on net, positive effect on private school counts. A 1 percentage-point greater increase in the percentage of adults without a high school degree is associated with a 5 percent increase in the net additions to private school counts. An increase in the percentage of the population that has a bachelor's degree or more education is positively related to the number of private school entrants. A 1 percentage-point greater increase in this variable is associated with 3 percent more entrants. However, the net effect on additions to private school counts is statistically insignificant.

Once again, a greater percentage of the population over 55 years of age is associated with greater numbers of private schools. As seen in specification 7 in table 9, this operates through the negative relationship between percentage over 55 and the number of private school exits. A 1 percentage-point change in the percentage of persons over 55 is associated with an 11 percent decline in the number of exits; the net effect is statistically insignificant. Finally, the effects of

TABLE 10

Relationships between private, non-religious school entry and exit and public school quality estimated by Poisson regression

Specification	Entry	Exit	Combined effect
1 Log of 1990 school-aged population	0.905***	1.080***	–0.176
	(0.144)	(0.209)	(0.248)
1980 to 1990 change in log school-aged population	–0.216	–3.116***	2.900**
	(0.329)	(1.184)	(1.171)
2 Student–teacher ratio	–0.129*	–0.011	–0.119
	(0.066)	(0.107)	(0.116)
3 Public school sixth graders failing standards, percent	–0.005	–0.002	–0.003
	(0.013)	(0.020)	(0.022)
4 Public school sixth graders exceeding standards, percent	0.011	0.002	0.009
	(0.008)	(0.014)	(0.015)

***Significantly different from zero at the 1 percent level.
**Significantly different from zero at the 5 percent level.
*Significantly different from zero at the 10 percent level.
Notes: See notes to table 8. The dependent variable is the count of private, non-religious school entrants and exits in each zip code.

TABLE 11

Relationships between private, non-religious school entry and exit and location characteristics estimated by Poisson regression

Specification	Entry	Exit	Combined effect
1 Limited English proficiency, change in percent	–0.064 (0.086)	0.012 (0.078)	–0.075 (0.103)
2 African-American, change in percent	–0.0003 (0.016)	0.002 (0.009)	–0.002 (0.018)
3 Asian, change in percent	0.030 (0.048)	–0.024 (0.083)	0.053 (0.086)
4 Hispanic, change in percent	–0.037 (0.024)	–0.036 (0.042)	–0.001 (0.046)
5 Less than high school diploma, change in percent	0.026 (0.037)	–0.028 (0.028)	0.054 (0.044)
6 Bachelor's degree or higher, change in percent	0.086*** (0.025)	0.112*** (0.033)	–0.026 (0.041)
7 Over 55 years of age, change in percent	–0.031 (0.040)	–0.062 (0.048)	0.031 (0.059)
8 Households receiving public assistance, change in percent	0.0003 (0.0004)	0.0004 (0.0007)	–0.0001 (0.0008)
9 Change in average household income ($10,000s)	0.096* (0.050)	0.111 (0.090)	–0.014 (0.092)
10 Change in standard deviation of household income ($10,000s)	0.202*** (0.073)	0.222* (0.119)	–0.020 (0.121)
11 Change in average household income ($10,000s)	–0.393** (0.201)	–0.387 (0.534)	–0.006 (0.588)
Change in standard deviation of household income ($10,000s)	0.699*** (0.251)	0.706 (0.635)	–0.007 (0.712)

***Significantly different from zero at the 1 percent level.
**Significantly different from zero at the 5 percent level.
*Significantly different from zero at the 10 percent level.
Notes: See notes to table 9. The dependent variable is the count of private, non-religious school entrants and exits in each zip code.

income on private school entry and exit are very similar when controlling for both average household income and standard deviation of household income. As such, the net effect on the number of private schools is not statistically different from zero. Controlling for income standard deviation, an increase in average household income by $10,000 is associated with 39 percent fewer entries and 63 percent fewer exits. Similarly, a $10,000 increase in the standard deviation of household income is associated with a 48 percent increase in private school entries and a 58 percent increase in private school exits. This similarity in the effects of the average income and standard deviation of income across entries and exits suggests that these results may not be consistent with a lack of Tiebout sorting story as discussed in the initial results.

Tables 10, 11, 12, and 13 present entry, exit, and net effect results estimated separately for non-religious and religious schools. For non-religious schools, only the change in the percentage of the population that is school-aged has a significant net effect on the number of private schools. A 1 percentage-point increase in the percentage of the population between 5 and 17 years old is associated with a net increase in the number of private schools of 2.9 percent. This result is also statistically significant for religious private schools, for which a 1 percentage-point increase in the percentage of the population that is school-aged is associated with

TABLE 12

Relationships between religious school entry and exit and public school quality estimated by Poisson regression

Specification	Entry	Exit	Combined effect
1 Log of 1990 school-aged population	0.566*** (0.116)	1.435*** (0.142)	–0.870*** (0.186)
1980 to 1990 change in log school-aged population	–0.206 (0.315)	–1.532*** (0.492)	1.326** (0.559)
2 Student–teacher ratio	0.106** (0.052)	0.048 (0.058)	0.058 (0.075)
3 Public school sixth graders failing standards, percent	0.004 (0.010)	0.019** (0.009)	–0.015 (0.013)
4 Public school sixth graders exceeding standards, percent	–0.011** (0.006)	–0.022*** (0.007)	0.010 (0.009)

***Significantly different from zero at the 1 percent level.
**Significantly different from zero at the 5 percent level.
Notes: See notes to table 8. The dependent variable is the count of private, religious school entrants and exits in each zip code.

a net increase in the number of private schools of 1.3 percent. The other statistically significant results are fairly consistent with the other results reported in table 9. A 1 percentage-point increase in the percent of the population that is Asian is associated with a net 13 percent increase in the number of religious private schools. A similar increase in the percentage of the population that is Hispanic is associated with an 8 percent decline in the number of religious private schools.

Conclusion

The results in this article reveal some interesting relationships between private school location and neighborhood characteristics. In particular, the relationship between the number of private schools and household income dispersion in the community is consistent with predictions and somewhat different from the findings of the Downes and Greenstein (1996) study, which does not include a measure of community heterogeneity. Zip code neighborhoods in which households are less well sorted by income, that is, zip codes with higher income dispersion, have more private schools on average than neighborhoods that are more homogenous in terms of household income. This is consistent with expectations that households with similar income levels will have similar demands for education quality; and thus neighborhoods with greater income homogeneity will have less demand for private schooling and, therefore, fewer private schools.

The entry and exit results are more difficult to interpret and, as such, make it difficult to draw conclusions about how a universal voucher program might change the private school composition of various neighborhoods. I plan to explore the entry/exit results in more detail in future work, as well as considering other dimensions of private school supply, namely increasing enrollment and offering more grade levels. These are likely to be dimensions on which schools may respond more easily to changes in private school demand and, thus, may yield more informative results. Also, increasing the information on the changes in public school quality over time will help clarify whether there is a link between private school location and public school quality.

NOTES

[1]Broughman and Colaciello (1999).

[2]One way to use test scores to better measure school quality is to control for some measure of how well the students might perform on the test without the school's input. Using the percent of adults with a bachelor's degree or higher to control for differences in the expected test scores of the students, there is a significant, negative relationship between the number of private schools and the percent of students exceeding the IGAP standards. Including the education variable does not affect the other test score result.

TABLE 13

Relationships between religious school entry and exit and location characteristics estimated by Poisson regression

Specification	Entry	Exit	Combined effect
1 Limited English proficiency, change in percent	0.069 (0.090)	0.106* (0.059)	–0.037 (0.087)
2 African-American, change in percent	0.006 (0.011)	0.003 (0.012)	0.004 (0.016)
3 Asian, change in percent	0.159** (0.070)	0.029 (0.074)	0.130*** (0.046)
4 Hispanic, change in percent	–0.015 (0.020)	0.060*** (0.017)	–0.075*** (0.025)
5 Less than high school diploma, change in percent	0.003 (0.033)	–0.049* (0.025)	0.052 (0.035)
6 Bachelor's degree or higher, change in percent	0.001 (0.021)	–0.016 (0.031)	0.017 (0.039)
7 Over 55 years of age, change in percent	–0.053 (0.037)	–0.115*** (0.027)	0.062 (0.040)
8 Households receiving public assistance, change in percent	0.0001 (0.0004)	–0.0002 (0.0003)	0.0004 (0.0005)
9 Change in average household income ($10,000s)	–0.135** (0.067)	–0.289** (0.138)	0.154 (0.152)
10 Change in standard deviation of household income ($10,000s)	0.095 (0.071)	–0.205* (0.124)	0.110 (0.145)
11 Change in average household income ($10,000s)	–0.439** (0.173)	–0.789*** (0.268)	0.351 (0.278)
Change in standard deviation of household income ($10,000s)	0.389** (0.190)	0.593** (0.279)	–0.204 (0.309)

***Significantly different from zero at the 1 percent level.
**Significantly different from zero at the 5 percent level.
*Significantly different from zero at the 10 percent level.

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