

## Non-public competition and public school performance: evidence from West Virginia

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### ABSTRACT

In this study, we investigate whether non-public school enrolment affects the performance of public school districts. If homeschooling and private schools act as competition, public school districts test scores should be positively associated with non-public enrolment. Using data on West Virginia county school districts, and controlling for endogeneity with an instrumental variables approach, we find that a one standard deviation increase in relative non-public enrolment in a county is associated with statistically significant improvements in public school district test scores. Our findings thus confirm that non-public enrolment and the competition it provides act to improve, rather than impede, public school performance.

### KEYWORDS

Competition; markets; education; homeschooling

### JEL CLASSIFICATION

H52; I28

### 1. Introduction

The public and private returns to educational attainment are high (Hall 2000). For that reason, a considerable amount of focus is placed on school performance. In the United States, jurisdictions have increasingly been turning towards school choice as a way of increasing student performance (Berends 2014). The movement towards school choice has not been without considerable public debate, however, as there are a variety of different perspectives on what the eventual outcome of expanded school choice would actually be. For example, opponents of school choice frequently argue that expanded choice makes the public schools worse off because resources and good peers leave the public schools.<sup>1</sup> Proponents frequently point out that school choice is often targeted and that competition from private schools and charter schools often improves the performance in public schools.<sup>2</sup>

One way that economists have investigated this issue is to look at the effect of historical forms of

school choice: private education and homeschooling. States like West Virginia, although they do not have school choice such as public charter schools or voucher programs, do have these traditional forms of 'school choice'.<sup>3</sup> If competitive forces are in operation with respect to education, areas with more families choosing private education or homeschooling should have better performing public schools, other things being equal. This argument has been tested empirically many times. Belfield and Levin (2002) summarize this literature and find that increased competition (public or non-public) generally has been shown to lead to improved performance of public school systems.<sup>4</sup>

In this preliminary study, we seek to add to the literature on the question of competitive forces in education by using evidence from West Virginia. The state is an interesting laboratory since it has no public charter schools, no education tax credits, and no voucher programs. In addition, inter-jurisdictional choice is circumscribed due to

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<sup>1</sup>See, for example, Ravitch (2011).

<sup>2</sup>See, for example, Forster (2013).

<sup>3</sup>In addition, there is choice across districts. In West Virginia, however, the size of county districts means that there is less traditional public school 'choice' when compared to states like Ohio where school districts are not required to be at the county level. Ohio has 611 school districts and 88 counties, while West Virginia has 55 counties and 55 school districts.

<sup>4</sup>Competition has also been found to lead to other results such as higher public school teacher salaries (Vedder and Hall 2000). It should be noted that some studies do not find a positive relationship between competition and school performance (Simon and Lovrich 1996; Sander 1999; Geller, Sjoquist, and Walker 2006; Marlow 2010). More recent papers on the relationship between local school competition and student performance such as Ponzo (2011), Misra, Grimes, and Rogers (2012), and Thapa (2013) have also found positive results in very different circumstances and situations.

the fact that the state has large county school districts that make it difficult to exercise ‘choice’ by moving to an adjoining district while still maintaining a normal commute. We measure competition as the percentage of students in a county attending non-public schools, either private school or homeschools. Our approach here is most similar to Hall and Vedder (2003) and Couch, Shughart, and Williams (1993), who find that competition from non-public sources leads to greater public school performance in Ohio and North Carolina, respectively.<sup>5</sup>

To preview our results, we find that competition from private schools and homeschooling is associated with increased public school district performance on tests in mathematics, reading, science, and social studies. Our basic results suggest that a one standard deviation increase in non-public enrolment relative to public enrolment would lead to an increase in public school test scores ranging from 1.22 to 1.50 percentage points. After instrumenting for non-public enrolment using the 1890 value of church property, farms per acre in 1890, and the percentage of a county covered by water, we find that our ordinary least squares (OLS) results are overstated by approximately 10%. Our more precise estimates suggest that a one standard deviation increase in non-public enrolment in a West Virginia county is associated with between a 1.10 and 1.35 percentage point improvement in test scores, *ceteris paribus*.

## II. Empirical specification and data description

The empirical model employed to investigate the effect of differences in non-public to public school enrolment ratio on test proficiency is given by the following:

$$MATH_i = \beta_0 + \beta_1 ENROLLRT_i + \beta_{2,...,k} X_i + \varepsilon_i, \quad (2.1)$$

$$READ_i = \alpha_0 + \alpha_1 ENROLLRT_i + \alpha_{2,...,k} X_i + \varepsilon_i, \quad (2.2)$$

$$SCI_i = \gamma_0 + \gamma_1 ENROLLRT_i + \gamma_{2,...,k} X_i + \varepsilon_i, \quad (2.3)$$

$$SOSCI_i = \delta_0 + \delta_1 ENROLLRT_i + \delta_{2,...,k} X_i + \varepsilon_i. \quad (2.4)$$

The first dependent variable, *MATH*, is the percentage of students in each school district who have achieved the level of proficiency in the mathematics section of West Virginia Educational Standards Test 2 (WESTEST2). The test is conducted once a year and is designed to evaluate both student performance and educational effectiveness in West Virginia for grades 3–11. Students’ knowledge in the following three areas is also tested: reading and writing, science, and social studies. Accordingly, the following additional three dependent variables are employed in the study: *READ*, the percentage of district students who are proficient in the reading and writing section of the test; *SCI*, the district percentage of students who are proficient in the science section of the test; and *SOSCI*, the percentage of district students who are proficient in the social studies section of the test. The West Virginia Department of Education provides WESTEST2 assessment data.

The independent variable of greatest interest is *ENROLLRT*. It is constructed by dividing total K-12 enrolment in non-public schools by total K-12 enrolment in public schools for each school district and multiplying the ratio by 100.<sup>6</sup> In West Virginia, homeschooled children are included in the non-public school enrolment count. West Virginia Department of Education provides data for both types of enrolment. The mean enrolment ratio in the sample is 5.61, meaning that for each 1,000 students enrolled in public schools there are about 56 students enrolled in non-public schools (private schools and homeschooling). This data are obtained from the West Virginia Department of Education (2014).

*X* is a vector of control variables that include school district-related variables, such as spending

<sup>5</sup>Public choice scholars have a long history of studying education and its effects. For example, Cebula (1977) looks at how attitudes towards spending affect migration, while Flowers (1975), Akin and Lea (1982), Denzau and Grier (1984), Burnell (1991), Marlow and Orzechowski (1996), Aaberge and Langørgen (2003), Holcombe and Kenny (2007), and Holcombe and Kenny (2008), use schools to look at various public choice aspects related to public expenditures such as the influence of unions and fiscal illusion.

<sup>6</sup>Although WESTEST only covers grades 3–11, we are not able to deduce enrolment by grade for homeschooled students. As such, we can only look at the aggregate effect of non-public completion on the district as a whole, rather than competition at different grade levels, which might be preferable.

per pupil (*SPEND*), average class size (*SIZE*), salary of the instructional staff (*SALARY*), and attendance rates (*ATTENDANCE*). As documented by Belfield and Levin (2002), omitting these variables could lead to omitted-variable (resource-omission) bias. In any case, it is noteworthy that Verstegen and King (1998) review an extensive amount of literature of studies that investigate the effects of school spending and other factors on educational outcomes. They conclude that, among other factors, spending per pupil, average class size, and the salary of the instructional staff exercise significant impacts on academic outcomes.<sup>7</sup> More recently, Cebula, Mixon, and Montez (2015) find, using Los Angeles County High Schools as the focus of their study, that higher academic performance is associated with higher teacher salaries. Similarly, academic performance has been shown to be positively associated with attendance rates (Lamdin 1996; Roby 2004; Hall 2006).<sup>8</sup> All of the school-related variables are for the

academic year 2010–2011 and were obtained from West Virginia Department of Education (2014). We also include mean family income within each school district (*INCOME*) to control for family and household influences that might influence school district performance.<sup>9</sup> Data on mean family income by county were obtained from the U.S. Census (2014a). Summary statistics for all variables are included in Table 1.

### III. Empirical results

Table 2 presents the results of regressing the share of students who are proficient on the math section of WESTEST2 on the ratio of non-public to public school enrolment. In the first specification of the table, we control for school-related variables and the average income of each school district. The relationship between non-public competition and public school district test scores is statistically significant

**Table 1.** Summary descriptions and statistics of variables included in regressions.

Variable	Description	Mean	Std. Dev.	Min.	Max.
<i>MATH</i>	Percentage of students proficient in the math section of the test	44.95	6.16	34.28	62.63
<i>SOCSCI</i>	Percentage of students proficient in the social studies section of the test	34.96	6.22	18.29	49.19
<i>SCI</i>	Percentage of students proficient in the science section of the test	39.52	6.28	26.37	54.51
<i>READ</i>	Percentage of students proficient in the reading section of the test	46.04	6.24	31.55	60.81
<i>ENROLLRT</i>	Ratio of private to public school enrolled students	5.61	4.53	0.73	27.84
<i>INCOME</i>	Mean family income in 1000s	48.72	7.93	29.92	62.63
<i>SPEND</i>	Total current spending per pupil 1000s	11.55	0.99	9.73	14.62
<i>SIZE</i>	Average class size	15.92	1.30	12.30	18.30
<i>SALARY</i>	Average contracted salaries of teachers in 1000s	44.95	1.40	41.33	48.54
<i>ATTENDANCE</i>	Attendance rate, %	97.13	1.18	92.89	99.08
<i>Instrumental Variables</i>					
<i>ALLPROP</i>	Church property value in 1890	68543.2	99422.05	2000	657000
<i>RATIOF</i>	Ratio of number of farms to county area in 1890	3.44	1.59	0.00	6.76
<i>WATER</i>	County area occupied by water, %	1.03	1.14	0.02	6.1
<i>Robustness Checks</i>					
<i>HHI</i>	Inverted Herfindahl–Hirschman index	11.33	0.90	10	14.70
<i>PRIVATERT</i>	Private school enrolment to public school enrolment ratio	2.87	1.86	0	29.11
<i>HOMERT</i>	Homeschool enrolment to public school enrolment ratio	3.67	4.81	0	8.31
<i>Panel Variables</i>					
<i>ENROLLRT</i>		5.86	4.63	0.53	32.96
<i>INCOME</i>	Mean family income in 1000s	47.89	8.25	28.41	77.72
<i>SPEND</i>	Total current spending per pupil 1000s	10.87	0.95	8.71	14.24
<i>SIZE</i>	Average class size	15.81	1.69	12.10	19.50
<i>SALARY</i>	Average contracted salaries of teachers in 1000s	44.22	1.55	40.21	48.49
<i>ATTENDANCE</i>	Attendance rate, %	96.51	1.38	91.54	99.08

The summary for each variable is based on 55 observations (the number of school districts in West Virginia). The summary for each panel variable is based on 110 observations.

<sup>7</sup>Not all papers find a statistically significant relationship between these variables and test scores. For example, Hall (2007) actually finds a negative and statistically significant relationship between district expenditures per pupil and Ohio school district math scores. Hall and Vedder (2003) find a negative, but not statistically significant, relationship between class size and a number of different test scores at the district level in Ohio.

<sup>8</sup>See, for example, Roby (2004).

<sup>9</sup>While income and private school enrolment are positively correlated it is important to note that this leads to higher standard errors and a *reduced* likelihood of finding a significant relationship but does not change the estimated coefficients. Additional demographics available include the percentage of district residents with a bachelor's degree and racial data. These data are highly collinear with mean family income but produce similar results when substituted for income in our regressions. In addition, Hall and Leeson (2010) discuss the difficulty in interpreting a variable such as non-white in the context of district level regressions.

**Table 2.** OLS estimates from regressions of the percentage of students proficient in the math section of WESTEST2 on the ratio of private to public school enrolment.

	(1)
ENROLLRT	0.282** (0.115)
INCOME	0.325** (0.124)
SPEND	0.0124 (0.836)
SIZE	0.726 (0.790)
SALARY	0.280 (0.805)
ATTENDANCE	0.633 (0.599)
Observations	55
R-squared	0.390

\*\*, and \*\*\* denote, respectively, significance at the 10%, 5%, and 1% levels. White heteroscedasticity-standard errors are in parentheses. Dependent variable is MATH. Constants are included in the regressions, although not reported above.

and positive. In terms of magnitude, a one standard deviation increase in the percentage of non-public school students in a county school district is expected, *ceteris paribus*, to be associated with an increase in the share of students proficient in Math (as documented by public school test scores) at the district level by 1.27 percentage points.<sup>10</sup> This is about one-fifth of a standard deviation in public school district share of students proficient in Math. So while not quantitatively large in terms of magnitude, it is important to remember that many individuals fear that increases in non-public enrolment will make the public schools worse off. Our initial results suggest that this is *not* the case, at least in West Virginia.<sup>11</sup>

The other control variable that seems to be significantly correlated with the West Virginia public school district math scores is the mean family income by school district. This result is similar to what has been found by a number of previous studies in the education production function literature (Hall 2006; Eide and Showalter 2012). Its coefficient is statistically significant and positive such that a one standard deviation in mean family income (\$7,930) is associated with a 2.57 percentage point increase in scores, or just over four-tenths of a standard deviation.<sup>12</sup> Changes in circumstances that affect

family income would seem to play a more important role in explaining test scores across counties than school-related variables, given the lack of statistical significance in other variables in Table 2.

To see how robust the findings of Table 2 are, in Table 3 we estimate the same empirical model on all three remaining tests: reading, science, and social studies. For all of the subjects the share of non-public enrolment and mean family income are statistically significant and positively correlated with the share of proficient students; additionally, the attendance also seems to have a statistically significant impact on the dependent variable. A one standard deviation increase in the ratio of non-public to public school enrolment is associated with a 1.5 percentage point increase in the share of students proficient in reading, a 1.22 percentage point increase in the share of students proficient in social science, and a 1.27 percentage point increase in the share of students proficient in science.<sup>13</sup> The effect of relative non-public enrolment on public school test scores therefore varies between one-fifth and one-fourth of a standard deviation, depending upon the subject.

It is noteworthy that the remaining control variables with the exception of attendance rates, do not seem to

**Table 3.** OLS estimates from regressions of the percentage of students proficient in the social studies, science, and reading sections of WESTEST2 on the ratio of private to public school enrolment.

	(1) READ	(2) SOSCI	(3) SCI
ENROLLRT	0.332** (0.125)	0.270** (0.105)	0.282*** (0.102)
INCOME	0.285** (0.116)	0.386*** (0.0872)	0.366*** (0.119)
SPEND	0.264 (0.690)	0.103 (0.637)	-0.154 (0.732)
SIZE	0.287 (0.653)	0.887* (0.503)	0.795 (0.575)
SALARY	0.730 (0.617)	-0.079 (0.501)	-0.704 (0.649)
ATTENDANCE	1.283* (0.653)	1.796*** (0.502)	1.739*** (0.601)
Observations	55	55	55
R-squared	0.509	0.635	0.505

\*, \*\*, and \*\*\* denote, respectively, significance at the 10%, 5%, and 1% levels. White heteroscedasticity-standard errors are in parentheses. Dependent variables are: READ, SOSCI, and SCI. Constants are included in the regressions, although not reported above.

<sup>10</sup> $4.53 \times 0.282 = 1.277$ .

<sup>11</sup>It should also be noted that when a student transfers to a private school or is homeschooled, total school spending per pupil usually rises as locally raised revenue does not change (although state revenue that is based on enrolment will be reduced). It is an empirical question whether public school districts are able to achieve cost savings from enrolment declines in the short-run given the lumpy nature of much of their costs, such as teachers or transportation.

<sup>12</sup> $7.93 \times 0.325 = 2.57$ .

<sup>13</sup>Reading =  $[4.53 \times 0.332 = 1.50]$ , social studies =  $[4.53 \times 0.270 = 1.22]$ , and science =  $[4.53 \times 0.282 = 1.27]$ .

be significantly associated with the public school test scores. For example, similar to Hall and Vedder (2003), we find that spending per pupil does not have a significant relationship with the learning outcomes of students.<sup>14</sup> Likewise, neither do class size nor the salaries of instructional staff. The reason for this could be correlation between spending per pupil and class size or correlation between salaries and spending per pupil. Multicollinearity results in higher standard errors and a lower likelihood of finding a statistically significant relationship. However, the correlation coefficient between *SPEND* and *SIZE* is 0.074 and the correlation between *SPEND* and *SALARY* is 0.066. As such, we feel that multicollinearity is not an issue.

Attendance, however, does appear to be very important in explaining district test scores, except in mathematics. A one standard deviation increase in a district's attendance rate would, other things equal, be expected to lead to a 2.05% increase in the share of students proficient in science as measured by their test scores.<sup>15</sup> This finding is consistent with previous studies such as Lamdin (1996). Given that there is substantial variation between the maximum and minimum values for this variable in West Virginia, it seems to be an area – in addition to school competition – where innovative attendance public policy might have a role to play.<sup>16</sup>

#### IV. Robustness checks

Although it is quite possible that larger ratio of non-public school enrolment relative to public school enrolment improves academic performance in public schools, there exist possible confounds of this study. For example, there could be an ability-omission bias, as suggested by Belfield and Levin (2002), where only a certain type of student chooses to enrol in private or homeschools. For example, Leonard (2015) finds that given choice students prefer to take the alternative education option, and conditional on taking the alternative choose groups with stronger peers. To control for potential omitted variables and to possibly identify causality we employ an instrumental variables approach. As

long as the variables that we are utilizing as instruments do not affect public school quality and are correlated with the share of non-public school enrolment, we should be able to identify the causal relationship.

Similar to Hoxby (1994), Cohen-Zada (2009), and Carattini et al. (2012), the instrumental variables that determine non-public school enrolment in this study are related to the presence of religious population by school district and as in Hoxby (2000) to the topology of each school district. School district borders in West Virginia match county borders; thus, we employ the value of church property in 1890 in each county, ratio of number of farms to each county area in 1890, and share of county area occupied by water.<sup>17</sup> All three of these variables are provided by U.S. Census Bureau: the first two from the 1890 U.S. Census (2014b, 2014c) and the last one from 2010 U.S. Census (2014d) gazetteer files. All three are plausibly orthogonal to current test scores but help explain levels of non-public enrolment by county.

A higher church value in 1890 would suggest a higher share of religious population that was able to afford the founding and funding of a private school. Since public school district borders are defined by county borders, they are not necessarily dictated by topology, as in Hoxby (2000). However, non-public school location might be affected by topology such as bodies of water and/or numerous elevation differences that would constitute an obstacle to getting to the nearest public school, stimulating demand for private education or homeschooling. Finally, counties with more rugged terrain were likely to have more farms in 1890 and therefore more private schools and homeschooling today.

The results of the two stage least squares (2SLS) regression are presented in Table 4. The first-stage *f*-statistic for all four regressions is 27.025, showing that there is enough evidence to reject the null of weak instruments. The presence of multiple instruments allows us to test for over-identifying restrictions. The *j*-statistic, reported at the bottom of columns 1–4 of Table 4, shows that there is not

<sup>14</sup>Spending per student might not matter since some spending categories could have a positive relationship with student test scores, other categories might have a negative relationship. Such as spending on public school administrators, see Anderson, Shughart, and Tollison (1991).

<sup>15</sup> $1.18 \times 1.739 = 2.05$ .

<sup>16</sup>For more on reducing truancy and improving school attendance see Reid (2013).

<sup>17</sup>In many states in the northeast and midwest, county borders and school district borders are not congruous (Ross, Hall, and Resh 2014). This makes West Virginia, despite the number of counties only equaling 55, a great state to investigate the effect of private school competition given the correspondence between county-level data for instruments and current county school districts.

**Table 4.** 2SLS estimates from regressions of the percentage of students proficient in math, reading, social studies, and science sections of WESTEST2 on the ratio of private to public school enrolment.

	(1)	(2)	(3)	(4)
	MATH	READ	SOCIAL SCIENCES	SCIENCE
ENROLLRT	0.210 (0.163)	0.299** (0.126)	0.244** (0.092)	0.265** (0.118)
INCOME	0.331** (0.131)	0.287** (0.118)	0.386*** (0.087)	0.366*** (0.120)
SPEND	0.100 (0.859)	0.305 (0.716)	0.257 (0.635)	0.000 (0.731)
SIZE	0.602 (0.783)	0.230 (0.661)	0.790 (0.522)	0.708 (0.626)
SALARY	0.290 (0.824)	0.734 (0.629)	−0.112 (0.528)	−0.742 (0.691)
ATTENDANCE	0.623 (0.621)	1.278* (0.658)	1.797*** (0.509)	1.742*** (0.599)
<i>j</i> -Stat.	2.152	0.299	0.451	0.778
<i>f</i> -Stat. (first stage)	27.025***			
Observations	53	53	53	53

\*, \*\*, and \*\*\* denote, respectively, significance at the 10%, 5%, and 1% levels. White heteroscedasticity-consistent standard errors are in parentheses. Dependent variable are: MATH, READ, SOSCI, and SCI. Constants are included in regressions though not reported. Instrumental variables are value of church property in 1890, ratio of number of farms in 1890 to county area, share of county area occupied by water.

enough evidence to reject the null hypothesis that all the instruments are exogenous.

For all but one dependent variable, namely, proficiency in the mathematics section of the WESTEST2 assessment, the relationship of interest holds: a ratio of non-public school enrolment relative to public enrolment has a positive effect on public schools' academic outcomes. The scale of the effect is not very different from the OLS results; however, for all sections of the test, the effect is somewhat smaller than the relationship shown in Table 3. This suggests a potential upward bias in the coefficients provided by OLS technique. The influence of competition from non-public school enrolment ranges from an approximately 1.10 percentage points in social sciences to 1.35 percentage points in reading. These results highlight the importance of dealing with potential endogeneity of non-public enrolment in studies of this type, as the quantitative effects are approximately 10% smaller than the results found with a simple OLS estimation.

A cross-section of data might additionally suffer from omitted variables pertaining to the time period chosen. While it would be ideal to also look at this issue using a panel data approach to address the issue of omitted variables and investigate the dynamic relationship between non-public enrolment and public school quality, we are constrained by data

**Table 5.** OLS estimates from panel regressions of the percentage of students proficient in math, reading, social studies, and science sections of WESTEST2 on the ratio of private to public school enrolment.

	(1)	(2)	(3)	(4)
	MATH	READ	SOCIAL SCIENCES	SCI
ENROLLRT	0.306*** (0.0742)	0.304*** (0.0636)	0.231*** (0.0566)	0.245*** (0.0639)
INCOME	0.316*** (0.0876)	0.342*** (0.0865)	0.449*** (0.0707)	0.461*** (0.0748)
SPEND	0.400 (0.703)	0.107 (0.510)	−0.105 (0.461)	−0.215 (0.542)
SIZE	0.367 (0.490)	−0.351 (0.457)	0.594 (0.443)	1.051** (0.451)
SALARY	0.0325 (0.586)	0.742 (0.464)	−0.208 (0.422)	−1.076** (0.446)
ATTENDANCE	0.528 (0.334)	0.0257 (0.316)	0.542 (0.328)	0.994*** (0.340)
States	55	55	55	55
Observations	110	110	110	110
R-squared	0.384	0.595	0.556	0.479

\*, \*\*, and \*\*\* denote, respectively, significance at the 10%, 5%, and 1% levels. White heteroscedasticity-consistent standard errors are in parentheses. Dependent variables are: MATH, READ, SOSCI, and SCI. Fixed year effects are included in the regressions, although not reported above.

availability. The West Virginia Department of Education has yet to digitize and disseminate most historical education data unfortunately. However, we were able to obtain data from an additional earlier time period (2009–2010) for which we could also obtain data from the American Community Survey that did not overlap with our baseline year (2013–2014). Table 5 contains results of regressions of WESTEST proficiency data on the private to public enrolment ratio for those two time periods (2009–2010 and 2013–2014 school years) with year fixed effects included in the regressions. As previously, the relationship between the test proficiency and the enrolment ratio is positive and statistically significant, in addition, it is of the same order of magnitude as in the Tables 2–4. While future work is necessary employing more years of data when available, the relationship seems to be not driven by year-specific processes.

One might be interested to see if it is the home-schooling or private schooling option that drives the positive relationship. We separate the enrolment ratio into two: private school enrolment to public school enrolment (*PRIVATERT*) and homeschool enrolment to public school enrolment (*HOMESCHOOLRT*). West Virginia Department of Education provides the data for homeschool enrolment and private school enrolment separately starting with school year 2011–2012, thus we update the

**Table 6.** OLS estimates from regressions of the percentage of students proficient in math, reading, social studies, and science sections of WESTEST2 on the ratios of private to public school enrolment and homeschool to public school enrolment.

	(1)	(2)	(3)	(4)
	MATH	READ	SOCIAL SCIENCES	SCIENCES
<i>PRIVATERT</i>	0.162 (0.105)	0.228** (0.0947)	0.120 (0.0824)	0.162* (0.0961)
<i>HOMESCHOOLRT</i>	0.322 (0.522)	−0.108 (0.461)	0.556 (0.416)	0.597 (0.435)
<i>INCOMES</i>	0.312*** (0.0877)	0.306*** (0.0697)	0.358*** (0.0556)	0.320*** (0.0915)
<i>SPEND</i>	0.204 (0.864)	0.605 (0.726)	0.266 (0.636)	−0.104 (0.742)
<i>SIZE</i>	0.759 (0.738)	0.218 (0.595)	0.998** (0.427)	0.993* (0.496)
<i>SALARY</i>	0.0976 (0.909)	0.187 (0.724)	−0.0432 (0.628)	−0.600 (0.828)
<i>ATTENDANCE</i>	0.727 (0.559)	1.413*** (0.506)	1.778*** (0.533)	1.737*** (0.558)
Observations	55	55	55	55
R-squared	0.416	0.545	0.650	0.505

\*, \*\*, and \*\*\* denote, respectively, significance at the 10%, 5%, and 1% levels. White heteroscedasticity-consistent standard errors are in parentheses. Dependent variables are: *MATH*, *READ*, *SOSCI*, and *SCI*. Constants are included in the regressions, although not reported above.

rest of the control variables to 2011–2012. Table 6 contains results of the regressions. As previously, the relationship between WESTEST2 proficiency in the four subjects and the enrolment ratios is positive, however it is the competition from private schools that has a statistically significant relationship with students' proficiency in reading and science. At the same time, the relationship between homeschooling enrolment percentage and test scores is not statistically different from zero.

Finally, we employ an alternative measure of competition. Namely, Herfindahl–Hirschman index (HHI). To construct the index we find enrolment percentages within the district for each private school, those being homeschooled, and public school enrolment, square and sum the results. We then divide one by the calculated HHI index, thus a higher number indicates lower market concentration. As the data for homeschooling enrolment are available starting with the school year 2011–2012, we again employ the rest of the control variables for 2011–2012. The results of the regression are presented in Table 7. The relationship is positive and statistically significant between the index and student proficiency in sciences, and social sciences meaning that districts with lower market concentration have more students passing the science and social science part of WESTEST2.

**Table 7.** OLS estimates from regressions of the percentage of students proficient in math, reading, social studies, and science sections of WESTEST2 on the Herfindahl–Hirschman index of school enrolment.

	(1)	(2)	(3)	(4)
	MATH	READ	SOCIAL SCIENCE	SCIENCE
<i>HHI</i>	0.918 (0.687)	1.052 (0.779)	1.203** (0.471)	1.274** (0.563)
<i>INCOME</i>	0.303*** (0.0891)	0.299*** (0.0817)	0.328*** (0.0592)	0.296*** (0.0947)
<i>SPEND</i>	0.264 (0.824)	0.581 (0.670)	0.372 (0.595)	0.00858 (0.724)
<i>SIZE</i>	0.727 (0.718)	0.310 (0.544)	0.947** (0.430)	0.925* (0.512)
<i>SALARY</i>	0.0316 (0.857)	0.415 (0.632)	−0.241 (0.565)	−0.803 (0.737)
<i>ATTENDANCE</i>	0.832 (0.522)	1.367** (0.553)	2.018*** (0.439)	1.968*** (0.534)
Observations	55	55	55	55
R-squared	0.413	0.536	0.650	0.501

\*, \*\*, and \*\*\* denote, respectively, significance at the 10%, 5%, and 1% levels. White heteroscedasticity-consistent standard errors are in parentheses. Dependent variables are: *MATH*, *READ*, *SOSCI*, and *SCI*. Constants are included in the regressions, although not reported above.

## V. Conclusion

The argument for introducing market forces into the school education system has been a subject of discussion for quite some time now. The introduction of education vouchers, tax credits, charter schools, and magnet schools would presumably act to promote market forces. Their proponents believe that more vigorous competition from non-public schools will require public schools to perform better than in a setting where there are very few substitutes for public school services (which is an outcome observed in many states).

We attempt to test the argument empirically by using the data from West Virginia public school education system. We first find that more vigorous competition as measured by non-public school enrolment to public school enrolment ratio is associated with improved public school district test results. Employing an instrumental variables (IV) approach, we additionally show that the effect is potentially causal. Our IV results show that a one-standard deviation increase in the percentage of students in a county attending non-public schools (private or homeschooling) is associated with an increase of between 1.10 and 1.35 percentage points in the share of students proficient in various subjects as measured by public school test scores, other things being equal. These results seemingly suggest, at a minimum, that efforts to increase non-public school enrolment in the State of West

Virginia will not harm students remaining in the public schools.<sup>18</sup> Presumably, greater insight and conviction regarding this issue will be available at some point in the future when more data are available for analysis.

This study is to our best knowledge the first one to investigate the effect of competition on public school education outcomes in West Virginia. It joins a number of studies that find there to be a positive relationship between academic performance and competition. It builds upon much of the previous literature by adopting an IV strategy suggested by the economics of education literature in order to obtain a better idea of the causal relationship between non-public school attendance and public school performance.

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<sup>18</sup>For example, see the arguments raised in opposition to a pilot program on public charter schools in West Virginia (Hodousek 2015).

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