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Do Parents Value Changes in Test Scores? High Stakes Testing in Texas

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Abstract

Texas evaluates, accredits, and financially rewards schools based on student test scores. Test scores increased dramatically following this implementation of high stakes testing. This paper examines whether homebuyers valued these test score increases. The results show little or no relation between changes in test scores and changes in total housing value in a district. Strikingly, improved performance on college entrance exams is associated with increased total housing value. Using the college entrance exams as a benchmark, the results on the state test suggest that high stakes testing failed to increase perceived school quality.

KEYWORDS: accountability, house prices, education

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1. Introduction

The passage of the No Child Left Behind Act of 2001 ties federal education funds to the implementation of statewide accountability programs. These programs must include frequent student evaluation and evidence of annual yearly progress of students.[1] The No Child Left Behind Act follows a trend of states and school districts implementing accountability programs and highlights the importance of determining the value of these programs. This paper estimates the value that parents place on test score increases following the introduction of an accountability program in Texas.

A typical state testing program evaluates students and schools and holds them accountable. This testing is considered high stakes if serious consequences ensue based on these tests' results. For example, high stakes for the students include requiring students to pass an exam to advance to the next grade or to graduate. High stakes for the schools include tying funding to student performance on standardized tests. The controversy over high stakes tests focuses on concerns that teachers "teach to the test" in ways that are poorly correlated with "real" learning. Teachers might spend excessive time teaching students how to choose among multiple choice answers or memorize isolated facts. Proponents of testing argue that high stakes testing provides incentives for schools to improve their instructional quality and for students to put forth more effort.

Texas's high stakes testing program used various grade-specific versions of the Texas Assessment of Academic Skills (TAAS). The state requires students to pass an exit exam for high school graduation and issues school ratings, monetary awards, and accreditations based on student scores and improvements. Since 1990, test scores in Texas have sky-rocketed. The percentage of tenth grade students passing all three TAAS tests (reading, writing, and mathematics) rose from 52% in 1994 to 80% in 2000. The startling nature of this "Texas miracle" has enticed researchers to investigate the claims of highly increased achievement in Texas. However, no consensus has been reached as to the efficacy of the state's testing program.

This paper uses school-district-level panel data to estimate the relation between total house values and test scores. One measure of the value of high stakes testing is the value parents place on changes in test scores as reflected in house prices. The relationship between school quality, as measured by test scores, and house prices is well-documented.[2] Parents who purchase a house in a high quality school district also purchase the right to send their children to that

[1] The U.S. Department of Education provides a detailed overview of the legislation on-line at: http://www.ed.gov/nclb/landing.jhtml (accessed November 5, 2003).

[2] See, for example, Black (1999), Brasington (1997, 1999), Crone (1998), Downes and Zabel (2002), Figlio and Lucas (2004), and Haurin and Brasington (1996).

particular neighborhood school; high quality school districts thus realize high house prices. As a particular school district improves relative to other school districts, demand for that school district increases. The increased demand can increase the prices of existing homes, increase the construction of new homes, or both. Henderson (1985) argues that, if the supply of housing is perfectly elastic, capitalization will occur through new construction.[3]

This paper uses the total value of housing in a school district, allowing for capitalization to occur both through house prices and new construction. Thus, if parents and homeowners value the gains in test scores following high stakes testing, the total value of housing should increase in those districts with large test score gains, holding everything else constant. If "teaching to the test" increases test scores without a corresponding increase in school quality, we expect the total value of housing *not* to respond to those higher test scores.

The literature on the capitalization of school quality in house prices explores which measure of school quality parents value. A school's contribution to student performance is its value-added; student performance, however, is also affected by parental inputs. If parents are savvy, we expect house price to capitalize a school's value-added. Less savvy parents may proxy school quality with average test scores. Black (2001) provides a more detailed overview of the literature. Most studies find that house prices capitalize average proficiency test scores (see, for example, Brasington (1999), Brasington and Haurin (2003), Downes and Zabel (2002), Haurin and Brasington (1996)). Hayes and Taylor (1996) conclude that value-added matters; Brasington and Haurin (2003) further decompose the school quality measures and provide evidence against Hayes and Taylor. Brasington and Haurin (2003) find that parental inputs account for most of the variation in prices in a cross-section of home sales; school inputs and peer quality are valued much less. Researchers typically attribute the lack of house price response to value-added measures as a lack of sophistication.[4] Average test scores are readily available to homebuyers; more sophisticated analysis might be required to determine the value-added of a school.

This paper considers the change in pass rates for all grades from 1993 to 1998. The average test scores for all of these years are available to homebuyers in the form of school report cards; observing a trend in test scores requires less sophistication than the econometric methods used to decompose student achievement into school effects, parental effects, and peer effects as in Brasington and Haurin (2003). If parents value the changes in test scores, we expect to see house values respond to these changes. I find, however, that increases in pass

[3] Brasington (2002) finds some empirical support for Henderson's argument. He finds that school quality is capitalized in house prices more strongly in the center of urban areas than on the edge. Presumably housing supply is more elastic on the outskirts of a city than in the center city.

[4] See, for example, Brasington and Haurin (2003, pg. 21) or Black (2001, pg. 7).

rates on the TAAS have no effect on total house values. This suggests that homebuyers do not value the pass rate increases or the information they provide.

Two main concerns arise in the estimation: the noisiness of test scores and omitted variables bias. Several variations on the estimation strategy account for the potential noisiness of test scores. The value of housing may not respond to changes in test scores because the test scores are too noisy to provide information.[5] Over the six years considered, however, test score changes are persistent. In addition, even after smoothing out some of the noise, total house values do not respond to changes in TAAS pass rates. This again suggests that parents do not value the test score increases or the information they provide.

Panel data allow school district fixed effects to control for any time-invariant district characteristics. The district fixed effects do not control for changing unobservable district characteristics. For example, wealthier parents may move to improving neighborhoods as well as raise children who perform better in school. Omitted variables bias may linger, biasing estimates upward. The potential omitted variables bias suggests the estimates are an upward bound of the relation between pass rates and house prices. This result indicates even more strongly that parents do not value the increases in pass rates

Further, this paper compares the response of total house values to TAAS pass rates to the response of total house values to performance on the SAT and American College Test (ACT). The SAT and ACT are college admissions exams not directly affected by the state accountability program. I use a “pass rate” on these exams, the percent of graduates scoring above either 1000 on the SAT or 24 on the American College Test (ACT). Total house values do respond to changes in the pass rates on these college entrance exams. Although these estimates may be similarly biased, they suggest that a lack of market response, not a low-power test, leads to the zero estimate for the TAAS.

We may be concerned that parents do not value the TAAS, let alone changes in scores on the TAAS. If parents value the information provided by the TAAS, house prices should respond to the introduction of the test in 1991. In fact, controlling for 1990 district performance on the earlier state test, total house value increased more rapidly in school districts with higher TAAS pass rates in 1991. This suggests that homebuyers value the information provided by the TAAS, but that they do not value the increases in pass rates on the TAAS.

This paper next explores the possibility that increased labeling of students as special education or bilingual may have raised TAAS scores. In addition, changes in TAAS scores during the 1990s are negatively correlated with changes in pass rates on college admissions exams. The increases in TAAS pass rates may have

[5] Kane and Staiger (2001) attribute 38% of the variance of fifth grade reading scores in North Carolina to random variation. The examples they give as causes of random variation are a dog barking in a parking lot or a particularly bad flu season.

come at the expense of increases in college preparation. Importantly, homebuyers do not value the increases in pass rates on the TAAS as they would increases in school quality.

This paper is organized as follows: Section 2 describes Texas's education reform. Section 3 presents the empirical strategy. Section 4 presents the data. Section 5 describes the primary results with further considerations discussed in Section 6. I conclude in Section 7.

2. Texas Education Reform

Texas education reform in the 1980s and 1990s includes both school finance reforms as well as experiments with various uses and kinds of state testing.

Statewide testing began in 1979-1980 using the Texas Assessment of Basic Skills (TABS) to diagnose problem areas for individual students and schools.[6,7] From 1985 to 1990, Texas used the Texas Educational Assessment of Minimum Skills (TEAMS). These earlier programs assessed mastery of minimum competencies and were used to adjust individuals' and schools' curricula to insure students achieved proficiency in reading, writing, and mathematics. In 1991, Texas switched to the Texas Assessment of Academic Skills (TAAS), an exam more focused on problem solving and analytical thinking than the TABS or TEAMS. The TAAS is also more difficult. The vast majority of students passed the TEAMS on the first or second try, whereas the passing rates on the TAAS are much lower.[8]

In addition, the testing program has become increasingly important for both students and schools. Accreditation for schools was initially based on site visits every three years. Starting in 1985, Texas required school districts to publish annual evaluations based on student test performance and attendance. In 1989, the state began using these evaluations to update accreditation in the interval between site visits. Also, since 1990, Texas has recognized schools' and later, teachers' and administrators', achievements in increasing student scores on the state exams with monetary awards. Student progression through Texas's public schools depends increasingly on state exam performance. Since the Class of 1987, Texas has required students to pass an exit examination to graduate. Beginning with kindergartners in 2001, grade promotion also depends on students passing the state exams.

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[6] The first report published by the Statewide Texas Educational Progress Study (1996) provides a history of accountability systems in Texas.

[7] Throughout the paper, I refer to the school year using the spring semester. Thus, 1980 refers to the 1979-1980 school year.

[8] In the Spring of 2003, Texas implemented a new exam, the Texas Assessment of Knowledge and Skills (TAKS).

This paper considers test scores since the introduction of the TAAS. This new test changed several aspects of testing in Texas. It evaluates a different set of skills, possibly providing new information. As a result, schools scoring high on the earlier TEAMS may perform at a lower level on skills evaluated by the TAAS. Also, the high stakes attached may have pressured schools to reallocate resources to improve test scores.

Concurrent changes in school financing complicate the evaluation of test score increases in Texas. In 1993, Texas responded to the *Edgewood* court decision by reforming its school finance system. Prior to this reform, public schools were funded primarily by local property tax revenues. The new school finance system is called 'Robin Hood' because it redistributes property tax revenues from high property value school districts to low property value school districts. The reform established a combination foundation and guaranteed yield program funded through local property taxes. Property tax rates are expressed as tax per $100 of value. The first $0.86 of local property taxes fund the foundation program; the guaranteed yield program applies to the next $0.64 of local property tax.[9,10]

The foundation part of the program consists of a minimum property tax and a base state allotment. To receive state funds, school districts must impose a property tax of $0.86. Revenues from this minimum property tax go towards the base state allotment. In 1999, the base state allotment averaged $3,300 per student.[11] If locally raised revenues from the minimum property tax do not cover the base allotment, state aid makes up the difference.

The guaranteed yield part of the program guarantees a yield of $21 per student per penny of property tax above the required $0.86.[12] This yield is guaranteed for the next $0.64 of property tax. Districts are not required to raise property taxes above $0.86. A school district with less than $210,000 in property per pupil would raise less than $21 per pupil per penny of property tax. These school districts receive money from the state. School districts with between $210,000 and $280,000 in property per pupil can raise the guaranteed yield within their locality. School districts cannot raise more than $28 per student per penny of tax for these

[9] The average property tax rate from 1994 to 1999 is $1.46 per $100 of value.

[10] For details see U.S. Department of Education (2001). Per pupil refers to per weighted average daily attendance pupil.

[11] The allotment for each district considers the additional cost of education for students in special programs including special education, compensatory education, bilingual education, gifted and talented programs, and vocational education. Small schools or schools in areas with high wages, high poverty, or low population density receive additional funds. For more details see U.S. Department of Education (2001).

[12] Consider a district with a base state allotment of $3,300 per student and $200,000 in property per pupil. With a property tax rate of $0.86, the district raises $1,720 per pupil. The state provides the remaining $1,580 per pupil, so that the district receives $3,300 per student. If the district increases its tax rate to $0.87, it receives an additional $21 per pupil for a total revenue of $3,321 per student.

next \$0.64 of property tax. School districts with more than \$280,000 in property value per pupil are required to reduce their property wealth to \$280,000. Districts typically fulfill this obligation by either purchasing attendance credits from the state or contracting to educate receiving districts' students. School districts retain revenues raised through property taxes above \$1.50.

Texas's school finance reform changed a school district's ability to raise revenues for school funding. Property-rich school districts require higher property tax rates to maintain school spending; property-poor school districts require lower property tax rates to maintain school spending. Properties in property-rich school districts become less attractive, decreasing house prices, *ceteris paribus*. Properties in property-poor school districts become more attractive, increasing house prices, *ceteris paribus*.

As pass rates in property-poor school districts increased more than pass rates in property-rich school districts, we expect house prices in property-poor school districts to rise for two reasons: higher pass rates and a lower price of school financing. As discussed further below, this tends to bias the results towards finding an effect of increased pass rates on house prices. The analysis below attempts to account for the school finance system to disentangle the effect of school finance and high stakes testing on property values. The structure of the school finance system suggests that the effect of tax rates may differ when tax rates are above and below \$1.50. In addition, the effect of tax rates may differ depending on the district's per-pupil house values. I include a set of tax rate variables to allow the effect of the tax rate to differ depending on category of per-pupil house value (under \$210,000, between \$210,00 and \$280,000, and over \$280,000) and whether the tax rate is above or below \$1.50.

3. Basic Methods

If school quality in a school district increases, holding everything else constant, demand for housing in that district will increase. The increase in demand will increase the price of existing homes, increase construction of new homes, or both. High stakes testing may have changed the demand for school districts in two ways. The incentives introduced with high stakes testing may have increased the efficiency of schools, increasing the provision of school quality. In addition, parents and homebuyers may have obtained better information about the level of school quality provided with the introduction of the TAAS.

With this in mind, I consider an estimation equation at the district level such as:

$$\ln\left(\sum_{j=1}^{J} hprice_{jimt}\right) = \alpha_i + \delta_t + \delta_m \delta_t + X'_{it}\beta_1 + \gamma test_{it-1} + \varepsilon_{it} \qquad (1)$$

where $hprice_{jimt}$ is the price of house *j* in district *i* and metropolitan area *m* at time *t*. Sum over all the houses in a school district to calculate the total value of housing. The dependent variable is the natural log of the total value of housing in district *i* at time*t* .

Stable neighborhood characteristics such as proximity to a metropolitan area and invariant job locational characteristics are subsumed into the fixed effect, α_i. The year dummies, δ_t allow for any state-wide trends in house values. Metropolitan-area-specific year dummies, $\delta_t\delta_m$, reflect metropolitan area trends in house prices. Families may initially choose their location based on their jobs. School districts are then chosen from the school districts near their jobs. The metropolitan-area-specific year dummies control for metropolitan area trends in job availability and environmental quality.[13] They do not pick up district differences in job growth or environmental quality; neither do they pick up district changes in income distribution. Aaronson (1999) shows a decline in sorting across school districts in response to school finance equalization; this suggests that Texas's school finance equalization program may have led to gentrification of the more property-poor school districts. The analysis below includes property wealth and student eligibility for free- or reduced price lunch in an attempt to control for this variation.

X' is a vector of time-varying district-specific characteristics. These include measures of school quality other than pass rates such as enrollment in special education and bilingual education, race/ethnicity, and percent eligible for free- or reduced-price lunch. These also include controls for the school finance system such as property tax rates and property values per pupil. If students perform better when surrounded by better peers, variables such as the percentage of the students enrolled in special education or bilingual education may reflect some aspect of school quality negatively correlated with pass rates. Hoxby (2000) suggests that peer effects are stronger within race. Thus, school demographics may affect school quality while the demographics of a neighborhood may also affect the market price of housing. Case and Mayer (1996) observe greater housing price appreciation in towns with low prices at the beginning of the period. They also find that, in Massachusetts, house prices in higher quality school districts grew more slowly than in lower quality school districts. They attribute this difference to large drops in school enrollments. Increased property tax rates would lower house prices in anticipation of higher future tax payments. Dee (2000) finds that house prices and rents capitalize school finance reforms; those poorer school districts receiving funds after reform experience higher house price appreciation.

[13] Bui and Mayer (2003), however, find no evidence that Massachusetts house prices respond to newly reported toxic emissions measures. They also review an extensive literature that finds that pollution lowers house values.

The variable of interest in equation (1) is $test_{it-1}$, the percentage of students in district *i* passing the TAAS at time *t-1*. I use the lagged value of pass rates because the results are made available to the public almost a year after students take the tests. I assume that parents get their information about school quality from TEA published reports. If parents already know or perfectly predict any changes in school quality, pass rate changes would not cause house prices to vary. If more years of test scores provide additional information to parents, house prices should respond to that information. In particular, if changing test scores reflect changes in school quality, house prices should respond to that information.

Total house values will respond to changes in school quality as long as families are *willing* to move, whether or not they actually move, in response to these changes. However, families in Texas are fairly mobile. Hanushek, Kain, and Rivkin (2004), using the Texas Schools Project data, find that about one-third of Texas elementary school students move at least once over a three-year period. 13% of students change schools between districts and 8.4% change within school districts. About 7% of students exit the Texas school system annually. The within-district transfers may dampen the estimated magnitude of the total house value response to changes in school quality as measured at the district level.

The two main problems with estimating equation (1) are: the endogeneity of pass rates and the noisiness of pass rates. The typical concern when estimating the relationship between house prices and school quality is that wealthier neighborhoods have both higher house prices as well as students from better socio-economic backgrounds. Even with similar parental preferences for education, these students are likely to perform better in school as a result of greater family resources.

Black (1999) provides the most generally accepted estimate of the value of test scores as capitalized in house prices. She solves the endogeneity problem by including school attendance boundary fixed effects. In essence, she uses school district boundaries that fall in the middle of neighborhoods to compare houses on opposite sides of the street that send their children to different schools. She finds that parents in Massachusetts are willing to pay about 2% more for a one standard deviation increase in test scores. This estimate is about half the size of her unrestricted estimate. The unrestricted estimate controls for many observable neighborhood characteristics such as race, income, and education.

District fixed effects control for time-invariant district characteristics; metropolitan-area-specific year dummies control for any trends for the metropolitan area. Any omitted variables bias must arise from changing district-specific characteristics such as local crime rates or the type of families residing in a district. For example, if families who devote more resources to education move into a district, they increase test scores and house values. Thus, even after controlling for observed and time-invariant district characteristics, estimates of

γ may be biased upward.[14] The estimate of γ is then an upper bound on the effect of pass rate changes on total housing value appreciation.

A second concern is that pass rates tend to be noisy; they vary greatly from year to year for reasons unrelated to school quality. For example, the test questions may match a teacher's curriculum better or the class may include a particularly disruptive student. To alleviate this problem I long-difference equation (1) and estimate the cross-sectional relation between changes in the logged total value of housing in a district, $ln(hprice_{imt})$, and changes in pass rates. Five year changes in pass rates are more likely to be persistent changes and not just random variation.

$$\ln(hprice_{im1999}) - \ln(hprice_{im1994}) = \qquad (2)$$
$$\delta_{1999} - \delta_{1994} + \delta_m * \delta_{1999} - \delta_m * \delta_{1994} + (X'_{i1999} - X'_{i1994})\beta + \gamma(test_{i1998} - test_{i1993}) + \varepsilon_{i1999} - \varepsilon_{i1994}$$

I estimate the above using Feasible Generalized Least Squares (FGLS) allowing the variance in the change in total district house value to depend on the number of housing units in the district, n_{it}.[15] Rewrite equation (2) as:

$$\Delta hprice_{im,1999-1994} = \Delta\delta_{1999-1994} + \Delta\delta_{m,1999-1994} + \Delta X_{i,1999-1994}\beta + \gamma\Delta test_{i,1999-1994} + w_{i,1999-1994} \quad (3)$$

with $w_{it}=\alpha_{it}+u_{it}$, $\text{Var}(\alpha_{it})=\sigma_\alpha^2$, and $\text{Var}(u_{it})= \sigma_u^2/n^2_{it}$. FGLS takes the estimated residuals from an OLS regression and regresses the squared residuals on a constant and the inverse of the square of the number of housing units. The fitted values of this second regression are then used as weights to calculate the parameter estimates.

4. Data

The Texas Education Agency (TEA) provides the test score data at the campus and school district level. House prices, however, are more readily available at the district level. Districts in Texas, with some exceptions, are small. There are about 6300 schools including approximately 1100 high schools and 1050 school districts. Texas's data have several advantages over other states' with similar programs, namely, its large population and numerous school districts.

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[14] A similar argument follows for crime rates. An increase in local crime rates likely lowers property values. We are only concerned if the increase in crime is correlated with the change in test scores. If crime and test scores are negatively correlated, estimates of γ are again biased upward.

[15] Donald and Lang (2001) suggest that aggregating the data up to the district level produces more accurate standard errors. I aggregate over different numbers of schools in each district, leaving heteroskedasticity, for which I correct.

Texas was one of the first states to implement its testing program and has had varying success across school districts. The longer time series and large variance in variables facilitate the analysis.

The TEA also provided the data on district characteristics and test scores. The TEA published a condensed annual report entitled *Snapshot* for 1990 through 2000. These reports include demographic information, school finance data, and student performance variables at the district level. I focus on the most aggregated measure of test scores, the percentage of students in all grades passing all parts of the TAAS.[16] This measure does not include exempted special education or limited English proficiency students.[17] Scoring at least a 70% on the exam constitutes passing. To ensure comparability, the passing mark is set so that students must score the equivalent of 70% on the 1992 exam to pass.

I also use data on the percent of graduates scoring above 1000 on the SAT or 24 on the ACT.[18,19] The SAT cut-off is adjusted to 1110 after the re-centering for the Class of 1996. With the Class of 1996, the variable reported changes from the percent of graduates scoring above the cut-off to the percent of examinees scoring above the cut-off. I adjust the later data to percent of graduates scoring above the cut-off. The percent of graduates passing the SAT or ACT measures the percent of high school graduates in the district that are prepared for and intend to enroll in college. Increases in this percentage reflect a combination of more students taking and more students performing better on college entrance exams.

The Texas State Comptroller provided the information on residential market values and number of housing units for each school district. The Comptroller annually estimates and certifies the total taxable value of all property within a

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[16]Much of the literature on school quality and house prices focuses on elementary school test scores. Examining pass rates by grade, specifically lower level grades, may produce different results. I have grade-specific data only for 1994-1998 and so consider differences over four, not five, years. Regressions for pass rates in third, fourth, fifth and sixth grades, in Table A1, produce similar results.

[17] A Spanish version of the TAAS is available for the elementary school tests. Students taking the Spanish TAAS, special education students, and limited English proficiency students are all excluded from the pass rate measure used in this analysis. In 1999, about 0.5 percent of students took the Spanish TAAS in grades 4, 5, and 6; across regions, this percentage varies from zero percent to 2.8 percent.

[18] Texas reports three measures of performance on college admissions exams: the mean score, the percent scoring at or above the criterion score, and the percent of graduates taking a college admissions exam. The criterion scores for the ACT and SAT were set by the Texas School Board of Education for accountability purposes. A student who exceeds the cut-off on either test passes.

[19] The number of graduates does not include special education students; the number of students meeting or exceeding the cut-off does include special education students. The testing companies report only the most recent score for each test to Texas.

school district.[20] The property category that I consider is Category A: Single Family, Residential Property.[21] Using the U.S. city average consumer price index for housing calculated by the Bureau of Labor Statistics, I convert these values into real 2000 dollars. Using the total value of single-family, residential property in a school district allows the capitalization of school quality to occur through the construction of new housing on available land and the appreciation of current housing.[22]

Parents typically choose to live in an area based first on their jobs. Given the location of their jobs, parents then choose which nearby district they prefer for themselves and their children. Outside a Metropolitan Statistical Area (MSA), the choice of districts near to one's job is more limited. I restrict the sample to include only those districts inside a MSA. This includes 428 school districts out of 1103. I further limit the sample to those school districts reporting college entrance exam scores so that the sample considered is the same in each set of regressions. This excludes another 42 school districts, leaving 386 observations. I omit another 22 school districts that are missing data, leaving 364 school districts in 27 MSA's.[23] Performing the analysis using the entire sample does not significantly affect the results.[24]

Table 1 presents summary statistics of the variables used in the analysis below. The sample is divided into three categories based on the size of the change in pass rates on the TAAS from 1994 to 1998. The third column, for

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[20] See http://www.window.state.tx.us/taxinfo/proptax/pvs01/index.html for a detailed description of the methods used for the 2000 School and Appraisal Districts' Property Value Study (accessed 4/20/02).

[21] The other real property categories are as follows: Category B: Multifamily, Residential, Category C: Vacant Lots and Tracts, Category D/E: Acreage, Market Value and Farm and Ranch Improvements, Category D1: Acreage, Productivity Value, Category F1: Commercial, and Category G: Oil, Gas, and other Minerals. There are two additional categories: Category J: Real and Tangible Personal Property: Utilities and Category L1: Personal Property: Commercial. I follow the literature in considering just single family residences for the sake of comparability. I thank Catherine Kilgore in the Texas State Comptroller's office for her assistance in obtaining the house price data.

[22] A previous version of this paper in Dills (2003) performs a similar analysis using the average property value. Although this specification does not allow capitalization to occur through new construction, the results are qualitatively similar.

[23] The MSAs and the number of school district in each are Abilene (4), Amarillo (3), Austin (24), Beaumont/Port Arthur (15), Brazoria (7), Brownsville/Harlinger/San Benito (7), Bryan/College Station (2), Corpus Cristi (16), Dallas (66), El Paso (7), Fort Worth/Arlington (33), Galveston/Texas City (8), Houston (38), Killeen/Temple (12), Laredo (3), Longview/Marshall (19), Lubbock (8), McAllen/Edinburg/Mission (14), Odessa/Midland (3), San Angelo (4), San Antonio (22), Sherman/Denison (12), Texarkana (8), Tyler (7), Victoria (2), Waco (13), and Wichita Falls (7).

[24] If anything, the results using the whole sample are stronger. The estimates on lagged TAAS pass rates tend to be *more* negative and statistically significant. Results are available from the author.

Table 1: Summary Statistics by Magnitude of Change in Test Scores

	School districts with changes in test scores that are			all
	small	medium	large	
Δ ln(total house value)	**0.236**	**0.295**	**0.282**	**0.278**
Δ TAAS pass rate	**16.772**	**26.166**	**37.040**	**26.601**
ln(total house value)	19.530	19.362	18.854	19.279
	[2]	[1.67]	[1.348]	[1.698]
real total house value (in millions $2000)	$1,650	$952	$359	$972
	[3380]	[2350]	[521]	[2410]
TAAS pass rate	81.398	80.148	80.384	80.497
	[9.894]	[8.093]	[7.201]	[8.344]
SAT/ACT "pass" rate	28.680	23.345	16.994	23.055
	[13.602]	[10.15]	[9.828]	[11.673]
1993 coefficient of variation for TAAS	0.198	0.220	0.244	0.220
1993 coefficient of variation for SAT/ACT	0.183	0.147	0.141	0.154
% black	10.588	9.665	7.330	9.316
	[14.415]	[12.895]	[10.132]	[12.693]
% Hispanic	15.200	24.340	41.875	26.445
	[15.218]	[25.14]	[36.081]	[28.037]
% Free- or Reduced Price Lunch	29.847	39.857	52.978	40.692
	[18.043]	[19.2]	[22.673]	[21.354]
% Special Education	12.800	13.665	13.875	13.514
	[3.674]	[3.619]	[4.042]	[3.749]
% Bilingual/ESL	4.741	5.822	10.182	6.624
	[7.347]	[8.862]	[13.318]	[10.017]
Equalized Property Tax Rate	1.569	1.542	1.527	1.545
	[0.162]	[0.132]	[0.104]	[0.134]
1994 property value per pupil	$181,075	$147,280	$148,195	$155,393
% with property per pupil under $210,000	0.741	0.880	0.864	0.843
% with property per pupil between $210,000 & $280,000	0.094	0.052	0.057	0.063
% with property per pupil over $280,000	0.165	0.068	0.080	0.093

Means for 1994-1999. Standard deviations are in brackets. Small changes are changes in the TAAS less than 21.35%; medium changes are changes from 21.35% to 31.35%; large changes are increases greater than 31.35%.

example, includes those school districts that had the largest increases in pass rates; on average, their pass rates increased 37 percentage points (say from 50% to 87%). The final column reports summary statistics for the entire sample.

The first two rows in Table 1 suggest this paper's main result. Those school districts that had the average, not the largest, increases in their pass rates (column 2) had the greatest housing price appreciation. Total housing value appreciated 29.5% compared to the state mean of 27.8%.

The school districts with the largest increases in the pass rates differ from the school districts with smaller increases on the TAAS. They are smaller with a total housing value of $359 million compared to the state average of $972 million. These school districts also have a greater percentage of their school population qualifying for free- or reduced-price lunch (53% compared to the state average of 41%) and are more Hispanic (42% compared to 27%). They also experienced smaller increases in Hispanic students and larger decreases in black students.

We may be concerned about the re-labeling of students. The districts with larger than average increases on the TAAS also had larger than average increases in special education enrollment and smaller than average increases in bilingual/English as a Second Language education. These school districts also had slightly smaller than average increases in pass rates on college entrance exams.

The passing rates on the TAAS vary substantially, both across school districts and over time. In 1993, the average passing rate on the TAAS was 53.8 percent wtih a standard deviation of 11.98; in 1999, it was 80.3 percent with a standard deviation of 8.46. In 1993, only 1 of these school districts had 85 percent or more of its students passing the TAAS; in 1998, there were 107.

To verify the typical relation between test scores and house prices, I estimate a basic Feasible Generalized Least Squares (FGLS) regression for 1994. The results of this regression are in column (1) of Table 2. As expected, house prices are higher in school districts with higher pass rates. This estimate of the coefficient on pass rates does not account for the endogeneity of pass rates but serves as a check on the data. A one standard deviation increase in TAAS pass rates corresponds to total house values that are $95 million higher. Black's (1999) OLS estimates are twice as large as her instrumented estimates. Applying this magnitude of bias to the cross-sectional results, one would expect total house values to be about $47.5 million higher in districts with one standard deviation higher pass rates.

5. House Prices and TAAS Score Increases

To evaluate how house prices responded to *increases* in pass rates on the TAAS, I first directly estimate equation (1) using the entire panel of house prices between 1994 and 1999 and pass rates between 1993 and 1998. Lagged pass rates account for the time lags in releasing the information to the public, although

Table 2: FGLS Estimates of Log Real Total House Values on lagged TAAS Pass Rates and lagged ACT/SAT Pass Rates

	(1) cross-section 1994	(2) panel estimates 1994-1999 (6 years)	(3)
lagged TAAS pass rates	**0.0449**	**-0.0007**	**-0.0006**
	(3.73)	**(1.27)**	**(1.07)**
lagged ACT/SAT "pass" rates			**0.0012**
			(3.48)
tax rate	0.2470	0.0123	0.0134
	(0.47)	(0.47)	(0.52)
% Black	0.0615	-0.0017	-0.0017
	(6.98)	(1.03)	(1.05)
% Hispanic	0.0375	-0.0197	-0.0196
	(4.00)	(6.74)	(6.76)
% Free- or Reduced Price Lunch	-0.0376	-0.0017	-0.0017
	(2.85)	(4.10)	(4.06)
% Special Education	-0.0916	-0.0036	-0.0037
	(3.12)	(1.89)	(1.95)
% Bilingual Education	0.0393	-0.0019	-0.0020
	(1.89)	(1.03)	(1.05)
Constant	17.1898	19.9850	19.9561
	(14.05)	(235.49)	(238.31)
Observations	364	2184	2184
R-squared	0.4288	0.9986	0.9986
Test if lagged TAAS rate = lagged ACT/SAT rate (p-value)			7.845 0.0052
Effect of one s.d. change in TAAS pass rate on Total House Value	$95.21	-$2.02	-$1.73
Effect of one s.d. change in ACT/SAT pass rate on Total House Value			$2.79

t-statistics in parentheses. MSA fixed effects included in cross-sectional regression in column (1). Metropolitan-area-specific year dummies and school district fixed effects included in panel regressions in columns (2) and (3). House values are in millions of real 2000 dollars.

results with contemporaneous pass rates are similar.[25] I include district fixed effects and metropolitan-area-specific year dummies, but suppress their coefficient estimates.

Column (2) of Table 2 presents panel data estimates for the six years from 1994-1999 from a regression of logged total house value on lagged TAAS pass rates. TAAS pass rates have no effect on house values. The coefficient estimates are small, negative, and insignificant; a one standard deviation increase in TAAS pass rates decreases total house value by $2 million dollars (about -1% of the average total change over this period).

Student performance on college admission tests also may affect property values. If college admissions tests provide different information about school quality, omitting these tests from the regression biases the estimates.[26] Levels of TAAS scores and level of college entrance exam scores are positively correlated (0.58); changes in the two tests are negatively correlated (-0.13).

Column (3) in Table 2 presents panel data estimates from a regression of logged total house value on lagged TAAS pass rates and lagged college admissions test pass rates. TAAS pass rates still have no effect on total house values; the coefficients estimates are small, negative, and insignificant. College admissions test pass rates enter positively and significantly; a one standard deviation increase in pass rates on the ACT/SAT increases total house value by $2.8 million dollars (1.5% of the average total change over this period). These estimates are significantly different from each other.[27]

This result suggests that home buyers value increases in scores on college admissions tests but not on the state TAAS exam. As noted above, omitted variables may result in upward-biased estimates. Using the estimate on the college admissions tests as a benchmark, the results on the state test suggest that increases in pass rates on the state high stakes test are not perceived as increases in school quality.

One problem with the fixed effects estimation is that pass rates tend to be noisy. To allow for this possibility, I difference over five years and estimate equation (2) using FGLS. The long differences reflect more persistent changes in pass rates and less random variation.

Column (1) of Table 3 presents the estimates from the cross-sectional regression of changes in log total house values from 1994 to 1999 on changes in TAAS pass rates and changes in ACT/SAT pass rates from 1993 to 1998.[28] The

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[25] Results are available from the author.

[26] Estimating the effect of just the SAT/ACT strengthens the results in column (3).

[27] One concern in comparing the two tests is that everyone is required to take the TAAS but students choose whether or not to take a college entrance exam. 60 percent of graduates take either the ACT or the SAT.

[28] Estimates from regressions with shorter differences (over 2 years, 3 years, and 4 years) and over different years in the sample produce quantitatively and qualitatively similar results. Regressions

coefficient on the TAAS scores is small, insignificant, and negative; increases in TAAS pass rate have little or no effect on total house value. The coefficient on the ACT/SAT scores is positive and significant. The point estimate is again small with a one standard deviation larger increase in ACT/SAT pass rates increasing total housing value by about $3.9 million – about two percent of the average total change during this period.

The regression in column (1) may not adequately account for two factors. The data are measured at the district level, neglecting the large variation in school quality within a school district. Also, the tax rate may not adequately account for how the school finance program affects home values in Texas.

To address the first issue, the regression in column (2) of Table 3 includes the coefficient of variation in TAAS pass rates and in ACT/SAT pass rates for each district.[29] The coefficient of variation equals the standard deviation of school pass rates within the district divided by the mean school pass rates. The coefficient of variation for the TAAS is equal to zero in the seven districts with only one school; the coefficient of variation for the ACT/SAT is equal to zero in 295 of the 368 districts, as many districts have only one high school. Districts with more variation in pass rates among their schools, on either exam, appreciated more slowly. Only the estimate on the coefficient of variation for TAAS pass rates is significant, however. House values increasing for particular schools may be offset by house values decreasing for other schools in the district. The inclusion of the coefficient of variation does not, however, significantly affect the estimates on pass rates.

Including the tax rate in the previous regressions provides a rough control for the cost to home owners of school financing. The school finance scheme adopted in 1993, however, imposed different tax prices on districts based on the property value per pupil in the school district.[30] The guaranteed yield aspect of the school financing plan varies the tax price of education financing among three categories of school districts: those with less than $210,000 property per pupil, between $210,000 and $280,000 property per pupil, and above $280,000 property per pupil. Districts with less than $210,000 in property per pupil receive money from the state so that each penny of property tax raises $21 per pupil. Districts with between $210,000 and $280,000 of property per pupil keep property tax revenues raised (between $21 and $28 per pupil). Districts with over $280,000 of property

without any control variables also produce quantitatively similar results. Results available from author upon request.

[29] If the response of house prices to increases in pass rates is non-linear, the estimates may be biased. Since most school districts in Texas have one or no high schools, looking only at the tenth grade pass rates may alleviate this problem. These estimates, in Table A1, are actually quite similar and confirm the earlier results.

[30] See Texas Educational Excellence Project (1999) for more details. I thank an anonymous referee for pointing out the potential importance of Texas's school finance equalization.

Table 3: FGLS Cross-Section Regressions of Changes in Log Real Total House Values on Changes in Lagged TAAS Pass Rates and Lagged ACT/SAT Pass Rates, 1999-1994

	(1)	(2)	(3)	(4)
	Δ ln(total house value) 1999-1994			
lagged Δ TAAS pass rates	**-0.0011**	**-0.0009**	**-0.0011**	**-0.0009**
	(0.81)	**(0.69)**	**(0.85)**	**(0.62)**
lagged Δ ACT/SAT pass rates	**0.0022**	**0.0023**	**0.0024**	**0.0025**
	(1.67)	**(1.79)**	**(1.85)**	**(1.97)**
Δ tax rate	-0.0080	-0.0209		
	(0.11)	(0.32)		
Δ % Black	-0.0009	-0.0006	-0.0021	-0.0028
	(0.27)	(0.20)	(0.69)	(0.90)
Δ % Hispanic	-0.0226	-0.0199	-0.0204	-0.0212
	(3.93)	(3.29)	(3.49)	(3.64)
Δ % Free- or Reduced Price Lunch	-0.0053	-0.0046	-0.0046	-0.0045
	(2.58)	(2.60)	(2.65)	(2.59)
Δ % Special Education	-0.0030	-0.0036	-0.0034	-0.0028
	(0.68)	(0.86)	(0.83)	(0.68)
Δ % Bilingual Education	0.0008	0.0020	0.0019	0.0017
	(0.17)	(0.43)	(0.43)	(0.37)
1993 Coefficient of Variation in TAAS		-0.3033	-0.2995	-0.2939
pass rates		(4.39)	(4.09)	(4.08)
1993 Coefficient of Variation in ACT/SAT		-0.0124	-0.0200	-0.0279
pass rates		(0.50)	(0.79)	(1.16)
Property per pupil < $210,000 * Δ tax rate			-0.2381	-0.2464
if below $1.50			(1.89)	(1.90)
Property per pupil < $210,000 * Δ tax rate			0.0137	-0.0333
if above $1.50			(0.19)	(0.44)
Property per pupil < $280,000 and			-0.0571	-0.1886
> $210,000 * Δ tax rate if below $1.50			(0.33)	(0.69)
Property per pupil < $280,000 and			0.0845	-0.0219
> $210,000 * Δ tax rate if above $1.50			(0.37)	(0.10)

continued next page

Table 3 *continued*

	(1)	(2)	(3)	(4)
Property per pupil > $280,000 *			-0.4858	-0.3203
Δ tax rate if below $1.50			(2.52)	(1.95)
Property per pupil > $280,000 *			-0.0946	0.1377
Δ tax rate if above $1.50			(0.45)	(0.58)
1994 Property per pupil if below				0.5350
$210,000 (in $millions)				(2.11)
1994 Property per pupil if between				0.3590
$210,000 & $280,000 (in $millions)				(1.32)
1994 Property per pupil if above				0.0320
$280,000 (in $millions)				(0.39)
Constant	0.3864	0.4442	0.4609	0.3986
	(9.82)	(10.51)	(10.76)	(7.25)
Observations	364	364	364	364
R-squared	0.3742	0.4126	0.4249	0.4338
Test if lagged TAAS rate = lagged	2.78	2.9	3.42	3.13
ACT/SAT rate (p-value)	(0.10)	(0.09)	(0.07)	(0.08)
Effect of one s.d. change in TAAS pass rate on Total House Value	-$1.76	-$1.45	-$1.84	-$1.38
Effect of one s.d. change in ACT/SAT pass rate on Total House Value	$3.88	$4.10	$4.24	$4.48

t-statistics in parentheses. MSA fixed effects included in regressions but coefficients suppressed. House values are in millions of real 2000 dollars.

per pupil receive only $28 per pupil per penny of property tax. The relation between tax rates and education revenues is non-linear. Property tax rates above $1.50 are treated differently than property tax rates below $1.50.

To better account for the piecewise nature of the school finance scheme, the regression in column (3) includes the change in the tax rate for each of six categories of districts. It includes the tax rate for districts in the three property wealth categories: below $210,000, between $210,000 and $280,000, and above $280,000 per pupil. For each of these categories, I include the tax rate separately for above and below $1.50. The tax rate variables are jointly significant. The effect of changes in the tax rate differs significantly when the rate is above versus below $1.50 only for districts with less than $210,000 property per pupil. Tax rate increases below $1.50 lower property values more than tax rate increases above

$1.50. The effect of tax rate increases below $1.50 is greatest for the most property-rich school districts. Again, the coefficients on the pass rates are unaffected.

To allow a looser accounting for the school finance scheme, the regression in column (4) also includes the 1994 housing value per pupil and allows the effect of the initial housing value to differ for the three categories of school districts (those with per pupil housing values below $210,000, between $210,000 and $280,000, and above $280,000). Those districts with high per pupil housing values in 1994 had slower housing price appreciation. We expect the 'Robin Hood' aspects of the school finance plan to lower property values in those school districts required to pay into the system. Again, the coefficients on the pass rates are unaffected.

The regressions in Table 3 control for observable gentrification and peer characteristics with demographic variables. The percent of students that are black enters negatively but insignificantly. The percent of students that are Hispanic enters negatively and is statistically significant. The magnitude of the effect of Hispanics is large, a one standard deviation increase in the percent of students that are Hispanic (about 2.4%) decreases total house value by $9.6 million. The percent of students qualifying for free- or reduced-price lunch has a relatively large and negative effect on house values as well; a one standard deviation increase in the percent of economically disadvantaged students (about 2.7%) decreases total house value by $11 million. The effects of participation in special education and in bilingual programs are economically small and statistically insignificant.

Bilingual program participation is strongly correlated with the percent of students that are Hispanic (0.5032 p-value = 0.0000) and the percent of students on free- or reduced-price lunch (0.1813 p-value = 0.0005). Multicollinearity does not bias the estimates on these variables, but generally inflates the standard errors. Omitting the percent of students that are Hispanic, for example, produces a large, negative, and statistically significant coefficient estimate on participation in bilingual programs. A one standard-deviation larger increase in bilingual participation (about 3%) decreases total house value by $3.6 million. Other parameter estimates are not significantly affected. Since my focus is on the effect of test scores, I continue to include the percent of students that are Hispanic to avoid potential omitted variables bias.

TAAS pass rates consistently enter negatively and insignificantly; the effect of increased TAAS pass rates on total house value is essentially zero. College entrance exam pass rates enter positively and significantly; a one standard deviation larger increase in pass rates increases house values by around $4 million. These estimates are significantly different from each other at the ten percent level.

I compare the estimates in Table 3 to the cross-sectional estimate in Table 2. The estimate in Table 2 shows that a one-standard deviation increase in TAAS pass rates corresponds to $95 million higher total house value appreciation. Combined with Black's (1999) result, unbiased estimates of the response of house prices to changing TAAS pass rates should be around $47.5 million for a one-standard deviation increase. Hausman tests reject the equality of the projected $47.5 million response and the estimates in Table 3.

6. Further Considerations

The general conclusion from the analysis above is that total housing values responded very little, if at all, to the large increases in TAAS pass rates in Texas. In this section, I explore several possibilities for the minimal response.

One main concern is that the year-to-year fluctuations in the percent passing the TAAS are too noisy to provide additional information. Kane and Staiger (2001) analyze North Carolina elementary schools and attribute 38% of the variance in fifth grade reading scores to either sampling variation (28%) or other non-persistent sources. If year to year changes are too noisy to provide new information, house prices may not respond to changes in pass rates. The differences over five years used in this analysis allow for this possibility.

A five-year change in pass rates is more likely to result from persistent changes than non-persistent changes.[31] In addition, the district level data likely exhibit less random variation in pass rates than school level data. In Kane and Staiger (2001) sampling variation is much less of a problem for elementary schools with more than 100 students per grade level. The average school district in this sample of Texas has about 2300 students; one district has fewer than 100 students.

To reduce the possible noise in the test score changes, I take two year moving averages of pass rates and difference the averages. The results are shown in column (1) of Table 4. A one standard deviation increase in TAAS pass rates has essentially zero effect on house value appreciation. Meanwhile, a one standard deviation increase in ACT/SAT pass rates increases house value appreciation by a significant $8.9 million. The coefficient estimates on the two pass rates are significantly different from each other. Comparing the two estimates, the market response to college entrance exams supports the interpretation that house prices did not respond to changes in TAAS scores. [32]

[31] Regressions using four-, five-, six-, or seven-year differences produce qualitatively and quantitatively similar estimates.

[32] An alternative is to instrument for the changes in pass rates from 1993 to 1998 with the changes in pass rates from 1992 to 1997. The correlation comes through the true change between 1992 and 1993 and any persistence in pass rate changes. The use of instruments eliminates the random part

Parents may care about what the TAAS measures, but may choose a school district based on relative school quality, not levels of school quality. If changes in TAAS pass rates did not change the rank order of school districts in a MSA, house values may not be affected. I consider how total house values vary with a school district's change in pass rates relative to the MSA change in pass rates. The results, in column (2) of Table 4, are qualitatively and quantitatively similar.

Another possibility is that parents simply do not value what the TAAS measures. For example, maybe only fairly well off families can afford to pay for school quality and these families are the same families that send their children to college. Therefore, they would likely be more concerned with a higher standard of school quality such as that measured by college entrance exams.[33] The minimum skills measured by the TAAS may be below their radar. To see if parents did respond to the introduction of the TAAS, I next regress the change in total house value on the *level* of the TAAS scores.

Examining the introduction of the TAAS requires pass rates from 1990, the last year of the TEAMS, and 1991, the first year of TAAS. Since data on many of the controls in the previous regressions are not available for this entire period, only the tax rate is used as a control for the school financing scheme. The data to calculate the coefficients of variation are also unavailable. However, the results in Table 3 suggest that the estimates on pass rates are robust to less flexible controls for the school financing scheme and the omission of within-district variation.

I regress logged changes in total house value from 1992 to 1999 on the 1991 pass rate on the TAAS, the 1991 pass rate on college admission tests, and the 1990 pass rate on the TEAMS. I present the effects of one standard deviation changes in test scores only in column (1) of Table 5; the coefficient estimates are presented in column (1) of Table A3. Since parents already have the information from the ACT and SAT from the previous year and these scores are noisy, the additional year of data should not provide much new information. If the introduction of the new TAAS test provided new information to homebuyers, we would expect total house values to capitalize this information.

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of the change as long as it is pure classical measurement error. The first and second stage results are in Table A2. The significant F-tests for the first stage results show that the long-run changes in pass rates are persistent. The second stage results are qualitatively and quantitatively similar. The long-term changes in TAAS pass rates are persistent changes but are not valued by parents. A one standard deviation larger increase in ACT/SAT pass rates increases house value appreciation by about $22 million. The coefficient estimates are significantly different only at the 11% level. Note that, if omitted variables bias is a problem for the FGLS estimates it may also be a problem with the IV estimates. In this case the IV estimates may be more biased than the FGLS estimates.

[33] I also consider the percent of students taking college admissions exams. House values do not appear to capitalize increases in college admissions test participation; the estimates are small, positive, and statistically insignificant. Including the percent of students taking admissions exams does not, however, affect the estimates on changes in the TAAS or ACT/SAT pass rates.

Table 4: FGLS Estimates of the 1994-1999 Change in Log House Prices on Changes in Various Additional Measures of Pass Rates

	(1)	(2)
	Δ ln(total house value) 1999-1994	
Δ 2 year average of lagged TAAS pass rates	**0.0003**	
	(0.18)	
Δ 2 year average of lagged ACT/SAT pass rates	**0.0043**	
	(2.68)	
lagged Δ TAAS Pass Rates relative to MSA change in pass rate		**-0.0009**
		(0.62)
lagged Δ SAT/ACT Pass Rates relative to MSA		**0.0025**
		(1.97)
Observations	364	
R-squared	0.4398	
Test if lagged TAAS rate =	3.16	2.61
lagged ACT/SAT rate (p-value)	0.0763	(0.11)
Effect of one s.d. change in TAAS pass rate on Total House Value	$0.74	-$1.59
Effect of one s.d. change in ACT/SAT pass rate on Total House Value	$8.91	$5.18

MSA fixed effects included but coefficients suppressed. t-statistics in parentheses. Changes in lagged pass rates instrumented with twice lagged pass rates. Instrumental Variables Regression includes controls for percent black, percent Hispanic, percent eligible for free or reduced-price lunch, percent enrolled in special education, percent enrolled in bilingual education, the 1993 coefficients of variation of TAAS pass rates and ACT/SAT pass rates, the tax rate above and below 150 mills for school districts in three categories of property wealth (less than $210,000, between $210,000 and $280,000, and above $280,000 per pupil), and the 1994 property value per pupil for school districts in the same three categories of property wealth.

The estimate on TAAS pass rates is positive and significant; the estimate on the TEAMS is small, negative, and statistically insignificant. This suggests that the TAAS provided more information than the TEAMS and the collegetests. The estimate on the college admissions test is negative and insignificant. The extra year of college entrance exam scores did not provide additional information.

An additional concern is that the value of changes in pass rates on the TAAS varies depending on the initial pass rate. For example, increasing the pass rate from 30% to 40% may reflect a different change in school quality than increasing the pass rate from 80% to 90%. The poorest districts in Texas experienced the largest increases in pass rates; districts with more average property wealth experienced the largest increases in house value. To allow the effect of changes in pass rates to vary at different points in the test score distribution, I explore several specifications.

In column (2) of Table 5, I allow the effect of the change in pass rates on the TAAS to vary according to the quartile of the distribution of TAAS pass rates in 1992.[34] TAAS pass rates have zero effect on house prices at all points in the distribution. Neither can I reject that all four of the coefficients on TAAS pass rates are equal to zero. The pattern of the point estimates suggest that increases are more valuable at higher pass rates, although the differences are not significant. The results are robust to adding the squared change in TAAS pass rates and to different number or placement of break points in the test score distribution. There appears to be no empirical evidence of non-linearities in the response of total house values to changes in the TAAS pass rates.[35]

Table 5: Response of Total House Values to the Introduction of the TAAS and a Test of Whether the Effect of the TAAS Varies Across Quartiles

	(1)	(2)
	Δ ln(total house value)	
	1999-1992	1999-1994
Effect of one s.d. change in		
TAAS pass rate on Total House Value	$15.91	
ACT/SAT pass rate on Total House Value	-$5.04	$4.82
TEAMS pass rate on Total House Value	-$1.31	
TAAS pass rate on Total House Value:		
bottom quartile of 1992 TAAS		-$2.05
second quartile of 1992 TAAS		-$0.88
third quartile of 1992 TAAS		-$0.31
top quartile of 1992 TAAS		$0.86
Demographics Included?	yes	yes
All Tax Variables Included?	no	yes
Observations	360	364
R-squared	0.4726	0.4366

See FGLS coefficient estimates in Table A3.

[34] The coefficient estimates are presented in column (2) of Table A3.
[35] Results available from author upon request.

This leaves the question of why parents do not value the increases in pass rates on the TAAS. The distribution of benefits, teaching to the test, cheating, and the re-labeling of students may all play a role. One possibility is that some students benefit from the policy while other students are harmed and the effects balance out. The high stakes testing debate tends to fall along income lines with wealthier parents against it as a diversion of resources from a college preparatory curriculum and poorer parents for it as a possible source of improvement for 'failing' schools. I compare the reaction of poorer school districts to wealthier school districts using instrumental variables estimates similar to those in column (3) of Table 4 and splitting the sample by property wealth. These estimates suggest that there is no difference between richer and poorer school districts in how house prices capitalize the pass rate increases.[36]

McNeil and Valenzuela (2000) document the transfer of focus in Texas schools to test drills and practice exams, particularly in more disadvantaged schools. They present anecdotal evidence of a reduction in content taught to "isolated skills and fragments of fact." Teachers report that students are so focused on the test format that they are unable to transfer these skills to materials either more difficult or longer than the test materials. Jacob and Levitt (2003) find evidence of cheating in 4-5% of elementary school classrooms in Chicago. They suggest that even minor changes in incentives affect the prevalence of cheating. In fact, in 1999, 11 school districts in Texas were investigated on charges of cheating and tampering with test results (Houston Chronicle March 21, 1999). Deere and Strayer (2001) demonstrate that resources in Texas are being diverted to those students most likely to improve enough to receive a passing score and to the exams that are used for accountability purposes.

There is also some evidence of schools re-labeling students into special education or bilingual education so that they do not lower the schools' passing rate.[37] Table 6 presents FGLS estimates of the cross-section regression of changes in TAAS pass rates on changes in special education and bilingual enrollments. These results suggest changes in special and bilingual education are positively correlated with increases in TAAS pass rates; neither effect is statistically significant.[38]

If these enrollment variables are measured with error, the uninstrumented estimates are biased toward zero. Column (2) of Table 6 presents IV estimates using the lagged values of bilingual and special education enrollments as instruments for the current values. As expected, the estimates are larger than those

[36] Results available from author upon request.

[37] Figlio and Getzler (2002) present evidence from Florida that schools increase labeling of students as special education in response to high-stakes testing. Cullen (2003) presents evidence from Texas that schools increase labeling of students as special education in response to state aid.

[38] Omitting the percent Hispanic does not qualitatively affect the results. Available upon request.

Table 6: FGLS Regressions of Changes in TAAS Pass Rates on Changes in Special Education and Bilingual Education Enrollments

	(1) FGLS	(2) IV
	Δ TAAS Pass Rates (1998-1993)	
Δ % Special Education	0.2881	0.4877
	(1.31)	(1.48)
Δ % Bilingual Education	0.0749	0.3925
	(0.42)	(1.66)
Observations	368	368
R-squared	0.2929	0.2824

MSA fixed effects included but coefficients suppressed. t-statistics in parentheses. Changes in special education enrollment and bilingual education enrollment instrumented with lagged changes in special education and biligual education enrollment. Instrumental Variables Regression includes controls for percent black, percent Hispanic, percent eligible for free or reduced-price lunch, the 1993 coefficient of variation of TAAS pass rates, the tax rate above and below 150 mills for school districts in three categories of property wealth (less than $210,000, between $210,000 and $280,000, and above $280,000 per pupil), and the 1994 property value per pupil for school districts in the same three categories of property wealth.

in column (1). Changes in special education and bilingual education are both positively correlated with increases in TAAS pass rates. The average change in special education enrollments explains 9 percent of a standard deviation in TAAS pass rates, or about a 0.7 percentage point gain in pass rates; the average change in bilingual education enrollment explains 4 percent of a standard deviation increase in TAAS pass rates, or about a 0.3 percentage point gain in pass rates. If TAAS pass rates are, at least partly, increasing as a result of re-labeling, this lends support to the earlier result of house prices not responding to TAAS pass rates.

7. Discussion

Texas implemented a statewide high stakes testing program that increases the importance of student performance on state exams. Student scores on these exams have since skyrocketed. However, homebuyers do not value these pass rate gains, suggesting that they do not reflect actual increases in school quality. This lack of response to changes in TAAS pass rates occurs prior to media coverage of two RAND studies investigating Texas's performance on the TAAS relative to its performance on the National Assessment of Educational Progress.

The first RAND study, Grissmer, Flanagan, Kawata, and Williamson (2000), points out that Texas's gains on the National Assessment of Educational Progress

(NAEP) from 1992 to 1998 do reflect the gains Texas realized on the state TAAS. The second, Klein, Hamilton, McCaffrey, and Stecher (2000), finds that reductions in the racial test score gap on the TAAS are not reflected in changes in racial test score gaps in Texas on the NAEP, raising doubts about the validity of test score gains on the TAAS. RAND released these two reports during George W. Bush's 2000 presidential campaign and received a lot of media attention. I find, however, that, even prior to the RAND studies, homebuyers did not value the changes in test scores. In this regard, homebuyers appear to be knowledgeable consumers.

Estimates of long-differences in TAAS pass rates on long-differences in logged total house values are small, frequently negative, and statistically insignificant. Pass rates are noisy but smoothing the pass rates to remove some of the noise produces similar results. Estimates on ACT and SAT scores show that house prices respond to other measures of school quality. Although both of these estimates may be biased upward, the comparison of the results suggests that markets respond to changes in school quality as measured by college entrance exams, but not to the TAAS scores. Parents appear to have valued the new information provided by the introduction of the TAAS; home values increased more rapidly in those school districts that scored higher on the TAAS given their scores on the earlier TEAMS test.

Figlio and Lucas (2004) find similar results for house prices in Florida. Florida issues district grades based primarily on test scores; even after controlling for the variables which determine district grades, house prices increase in response to higher district grades. Interestingly, this effect is dissipated by the sixth month after the grade announcement.

The questions of why parents do not value the increases in pass rates on the TAAS remains. I provide some evidence that increases in TAAS pass rates may arise from the increased labeling of students as special education. Cheating and "teaching to the test" may also play some role in increasing TAAS pass rates. Over time, students and teachers acclimate to the test format, increasing scores.

Although Hoxby (2002) suggests that accountability programs are relatively inexpensive, the analysis presented suggests that high-stakes testing is also rather ineffective. High-stakes testing may lead to inflated pass rates unaccompanied by perceived increases in school quality. Greater oversight to minimize cheating or re-labeling may enhance the success of these programs.

Table A1: FGLS Estimates of Changes in Log House Prices on Changes in Various Additional Measures of Pass Rates

	(1) 3rd Grade	(2) 4th Grade	(3) 5th Grade	(4) 6th Grade	(5) 10th Grade
	Δ ln(total house value) 1999-1995				
lagged Δ TAAS pass rates	**0.0001**	**-0.0003**	**0.0000**	**0.0003**	**-0.0004**
	(0.15)	**(0.55)**	**(0.02)**	**(0.44)**	**(0.48)**
Observations	364	364	364	364	363
R-squared	0.4226	0.4231	0.4222	0.4229	0.4225
Effect of one s.d. change in TAAS pass rate on Total House Value	$0.32	-$0.94	-$0.04	$0.83	-$1.11

t-statistics in parentheses. MSA fixed effects included but coefficients suppressed. All regressions include controls for percent black, percent Hispanic, percent eligible for free or reduced-price lunch, percent enrolled in special education, percent enrolled in bilingual education, the 1993 coefficients of variation of TAAS pass rates and ACT/SAT pass rates, the tax rate above and below 150 mills for school districts in three categories of property wealth (less than $210,000, between $210,000 and $280,000, and above $280,000 per pupil), and the 1994 property value per pupil for school districts in the same three categories of property wealth.

Table A2: First Stage and IV Estimates of Changes in Log House Prices on Changes in TAAS and ACT/SAT Pass Rates

	(1) First Stage Δ lagged TAAS	(2) First Stage Δ lagged ACT/SAT	(3) IV Estimates Δ ln(total house value) 1999-1994
lagged Δ TAAS pass rates			**0.0032** **(1.12)**
lagged Δ ACT/SAT pass rates			**0.0107** **(2.24)**
twice lagged Δ TAAS pass rates	0.6364 (13.74)		
twice lagged Δ ACT/SAT pass rates		0.3576 (6.51)	
Observations			364
R-squared			0.4398
F-test	188.90	42.42	
Test if lagged TAAS rate = lagged ACT/SAT rate (p -value)			2.61 (0.11)
Effect of one s.d. change in TAAS pass rate on Total House Value			$5.97
Effect of one s.d. change in ACT/SAT pass rate on Total House Value			$22.27

t-statistics in parentheses. MSA fixed effects included but coefficients suppressed. All regressions include controls for percent black, percent Hispanic, percent eligible for free or reduced-price lunch, percent enrolled in special education, percent enrolled in bilingual education, the 1993 coefficients of variation of TAAS pass rates and ACT/SAT pass rates, the tax rate above and below 150 mills for school districts in three categories of property wealth (less than $210,000, between $210,000 and $280,000, and above $280,000 per pupil), and the 1994 property value per pupil for school districts in the same three categories of property wealth.

Table A3: Response of Total House Values to the Introduction of the TAAS and a Test of Whether the Effect of the TAAS Varies Across Quartiles

	(1)	(2)
	Δ ln(total house value)	
	1999-1992	1999-1994
1991 TAAS Pass Rates	0.0056 (2.88)	
1991 ACT/SAT Pass Rates	-0.0025 (1.28)	
1990 TEAMS Pass Rates	-0.0006 (0.23)	
lagged Δ TAAS pass rates for bottom quartile of 1992 TAAS		-0.0011 (0.76)
lagged Δ TAAS pass rates for second quartile of 1992 TAAS		-0.0005 (0.33)
lagged Δ TAAS pass rates for third quartile of 1992 TAAS		-0.0002 (0.10)
lagged Δ TAAS pass rates for top quartile of 1992 TAAS		0.0005 (0.24)
lagged Δ ACT/SAT pass rates		0.0023 (1.76)
Demographics Included?	yes	yes
All Tax Variables Included?	no	yes
Observations	360	364
R-squared	0.4726	0.4366

t-statistics from FGLS regressions in parentheses. MSA fixed effects included but suppressed. Total house values in millions of real 2000 dollars. Both regressions include controls for the tax rate, the percent of students that are black, the percent of students that are Hispanic, the percent of students eligible for free- or reduced-price lunch, and the percent of students enrolled in special education and bilingual education programs. The regression in column (2) also includes controls for the 1993 coefficients of variation of TAAS pass rates and ACT/SAT pass rates, the tax rate above and below 150 mills for school districts in three categories of property wealth (less than $210,000, between $210,000 and $280,000, and above $280,000 per pupil), and the 1994 property value per pupil for school districts in the same three categories of property wealth. Column (2) allows the effect of changes in TAAS pass rates to differ for different test score quartiles.

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