Sage Policy
Group, Inc.

The Economic Implications of Howard County's State-Leading School System

Submitted by:

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The Economic Implications of Howard County's State-Leading School System

By Sage Policy Group, Inc., Baltimore, MD

Executive Summary

Superior School Performance Supports Higher Home Values

Howard County residents are known to take pride in their award-winning communities and broadly shared quality of life. This real and perceived high quality of life naturally translates into improved economic outcomes as successful families and young professionals disproportionately choose to locate their households and/or businesses in the county. Not coincidentally, Howard County's incomes are often at or near the top of statewide rankings and unemployment tends to be significantly lower than both statewide and national averages. The county's median income in 2012 was the 3rd highest among the 300+ most populous counties in the U.S.

While there are many elements in support of a high quality of life and solid economic outcomes, the quality of local public schools is believed to be among the most major contributors. This Sage Policy Group, Inc. (Sage) report has focused on only one contributor – public schools. The county has a reputation for educational excellence and student achievement. Sage's task was to determine the economic impact of the Howard County Public School System. Sage has taken a significant step by assessing the impact of Howard County student performance on home values.

Specifically, Sage deployed a hedonic pricing model to establish the statistical impact of student achievement on assessed values. Hedonic pricing models represent a standard econometric apparatus by which to determine the relationship between one phenomenon and another. In this case, the relationship is between 4th grade test scores and home prices in Howard County.

Sage developed and deployed a dataset containing in-depth statistical information of 1,719 randomly selected homes located throughout Howard County. To proxy student achievement, the Sage study team used results of the 2013 Maryland School Assessment (MSA) of 4th grade students.

Sage's analysis generated statistical significance for key variables. The model's R-squared is 0.91, indicating that the model does a good job explaining sources of variability in home prices. The coefficient of greatest interest is the one associated with the variable *TEST*. The variable is statistically significant and has a coefficient of +0.00242.

This means that for each one point advance in average test score at the elementary school level, the average consumer (including families with no school age children) is willing to pay 0.242 percent more for a home. Given the sample average value of $429,005, this means that a one point increase in test score will raise the price of a home by $1,038.19.

This implies a per home difference in value of $56,270 between homes in the top performing school district and bottom performing school district because of higher average 4th grade test scores. It is quite possible that other school attributes not measured here also impact home values in Howard County, including the perceived safety of schools, technology offered, prestige, and the capacity of area high schools to promote college readiness. All of this inures to the benefit of county revenues and homeowner equity.

But that is only where the economic impacts begin. Higher home prices are associated with greater wealth and income effects. In addition, the operations of the Howard County Public School System support significant levels of economic impact in the county. To estimate the annual economic impact of Howard County's public schools, the Sage study team used IMPLAN modeling software that embodies multipliers specific to the local economy.

Exhibit E1: Economic Impact of HCPSS and Howard County Schools

Location and type of impact	Change in Spending ($millions)	Full & Part-Time Jobs	Full-time Equivalent Jobs	Employee Compensation ($millions)	Employee Wages & Salaries ($millions)	Business Sales ($millions)
Wealth effects*	$141.6**	709	626	$30.8	$25.7	$96.3
Income effects*	$265.7**	1,326	1,170	$57.5	$48.0	$180.0
Wealth + Income effects		*2,035*	*1,796*	*$88.2*	*$73.6*	*$276.3*
Operational effects	$940.4	*12,418*	*11,050*	*$464.8*	*$391.9*	*$1,574.5*
Direct:	(7,978 jobs)	7,978	7,080	$277.2	$234.0	$940.4
Indirect:		2,550	2,301	$105.5	$89.3	$377.0
Induced		1,890	1,669	$82.1	$68.6	$257.1
Total Economic Impact:		*14,453*	*12,846*	*$553.1*	*$465.5*	*$1,850.8*
Direct:		7,978	7,080	$277.2	$234.0	$940.4
Indirect:		2,550	2,301	$105.5	$89.3	$377.0
Induced:		3,925	3,465	$170.4	$142.2	$533.4

*In IMPLAN, economic impacts generated by augmented consumer outlays are considered induced impacts.
**Based on estimate of marginal propensity to spend for various income strata.

In total, HCPSS provides support for 14,453 jobs, or 12,846 jobs measured in full-time equivalents. Annual employee compensation associated with these jobs is more than $550 million. The system also supports $1.85 billion in local business sales. In other words, the economic impact of HCPSS on Howard County's economy is equivalent to approximately 8 percent of total annual county output.

The Economic Implications of Howard County's State-Leading School System
By Sage Policy Group, Inc., Baltimore, MD

Introduction

Howard County and its various communities have been frequently recognized for providing a high and broadly shared quality of life. For instance, in 2012, CNN/Money Magazine ranked Ellicott City/Columbia among the ten "Best Places to Live in America," citing the pace of new investment, diversity, and "terrific" schools.

This real and perceived high quality of life naturally translates into improved economic outcomes as successful families and singles disproportionately choose to locate their households and/or businesses in the county. Not coincidentally, Howard County's incomes are often at or near the top of statewide rankings and unemployment tends to be significantly lower than both statewide and national averages. The county's median income in 2012 was the 3rd highest among the 300+ most populous U.S. counties.

Unemployment Rate (UR) by Maryland Jurisdiction, April 2014

Rank	Jurisdiction	UR	Rank	Jurisdiction	UR
1	Howard County	3.9	12	Prince George's County	5.6
2	Montgomery County	4.1	14	Kent County	6.0
3	Carroll County	4.5	15	Garrett County	6.1
3	Frederick County	4.5	16	Allegany County	6.3
5	Calvert County	4.7	16	Caroline County	6.3
6	Anne Arundel County	4.8	16	Cecil County	6.3
6	Queen Anne's County	4.8	19	Washington County	6.4
6	St. Mary's County	4.8	20	Wicomico County	7.1
9	Charles County	5.1	21	Baltimore City	7.8
10	Harford County	5.3	22	Somerset County	7.9
11	Talbot County	5.5	23	Dorchester County	8.2
12	Baltimore County	5.6	24	Worcester County	10.9

Source: Bureau of Labor Statistics

While many elements support a high quality of life and solid economic outcomes, this Sage Policy Group, Inc. (Sage) report focuses on only one – public education. Among other things, Howard County is known for its excellent schools and this reputation is well deserved.

During the 2011-2012 school year, nearly 93 percent of the students in the Howard County Public School System (HCPSS) scored proficient or advanced on the MSA for reading in

Grades 3 through 8, compared to the statewide average of 85.2 percent.[1] Similarly, at the high school level, Howard County students recorded proficiency rates of 95 percent for both the algebra and biology High School Assessments (HSA), on average, and 92 percent for the English 10 HSA. The corresponding statewide averages were 84 in algebra, 82 in biology, and 83 percent in English 10.[2] Among those HCPSS students who sat for an SAT exam in 2012, the average composite score was 1632 out of 2400 possible points. This compares to the state average of 1467 points and the national average of 1498 points.[3]

These solid outcomes seem to be at least partially attributable to significant ongoing investment in Howard County's public schools. Howard County tops the state in terms of local investment per pupil with spending of over $14,500 per student.[4] Among elementary schools, the average class size in 2012 in Howard County was 21.7 students. This is lower than the statewide average elementary class size by about half a student (0.4). Class sizes are also lower in the HCPSS than statewide averages at both middle and high school levels. HCPSS average class size is 20.4 in middle schools compared to 21.6 statewide, and the average class size in HCPSS high schools is 18.4 compared to 20.4 statewide.[5]

To begin to understand the economic implications of Howard County's high-performing public school system, Sage used a hedonic pricing model to establish the impact of student achievement on homes. Though difficult to implement and fraught with statistical hazards, hedonic pricing models are commonly used. They represent a standard method by which to determine the relationship between one phenomenon and another. Sage's model for the relationship between Howard County's public school system and its housing market has generated robust, statistically-significant results, indicating that households are willing to (and, in fact, do) pay more for their homes to access the benefits of what is arguably Maryland's highest performing school district.

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[1]Maryland State Department of Education. *2013 Maryland Report Card*. Data downloaded from http://www.mdreportcard.org/downloadindex.aspx?K=99AAAA
[2]Howard County Public School System. (2012). *2012 Annual Report*. Retrieved from http://www.hcpss.org/aboutus/2012ar.pdf p.3
[3] Id. Howard County Public School System. (2012). *2012 Annual Report*, p.4
[4] Maryland Department of Education. *2013 Maryland Report Card*
[5] Maryland Department of Education. (January 2013). *2011-2012 Maryland Class Size Report: Student, Course, Grade, and Teacher, Report to the Maryland General Assembly and Governor Martin O'Malley*. Retrieved from http://www.msde.maryland.gov/MSDE/newsroom/special_reports/docs/2011_2012_MD_Class_Size_Report.pdf (See p.12)

Some Basic Facts about Howard County Public Schools

Broad Measures of Student Achievement – the Outputs

The Howard County Public School System (HCPSS) is home to 75 public schools, consisting of 41 elementary schools, 19 middle schools, 12 high schools, and 3 special education centers.[6] Student achievement is generally high. Exhibit 1 reflects results on Maryland School Assessments for fourth graders in 2013. Nearly 63 percent of HCPSS math test-takers scored advanced that year (the highest possible level of achievement). This is easily amongst the highest in Maryland's most populous jurisdictions and third overall. In reading, HCPSS knows no peer and earning the highest scores in 2011, 2012, and 2013.

High school student performance is perhaps even more revealing since it reflects more years of the school system's impact on student academic performance. Passage of the Maryland High School Assessment (HSA) became a state graduation requirement in 2013.[7] All students who entered 9th grade during or after 2005 must pass or achieve a total score of 1602 across all HSA subjects to satisfy graduation requirements. These tests are administered across four content areas: 1) Algebra/Data Analysis, 2) Biology, 3) Government, and 4) English.[8]

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[6] Howard County Public School System. (n.d.) *Schools*. Retrieved on December 30th, 2013, from http://www.hcpss.org/schools/

[7] Maryland High School Assessments. (n.d.) *Chronology of the Maryland High School Assessment*. Retrieved from http://hsaexam.org/about/history/development.html

[8] Maryland Report Card. (n.d.) Retrived on January 30th, 2014, from http://www.mdreportcard.org/Assessments.aspx?K=13AAAA

Exhibit 1: Maryland School Assessment (MSA) Results for 4th Grade Reading & Math: Proportion of Pupils Scoring Proficient* or Advanced, 2013

	Grade 4 math					Grade 4 reading				
County	**% Scoring 'Advanced' (2013)**	*	**2013 Rank**	*2012 Rank*	*2011 Rank*	**% Scoring 'Advanced' (2013)**	*	**2013 Rank**	*2012 Rank*	*2011 Rank*
* Percentages in parentheses are the proportion of pupils scoring 'advanced' and 'proficient.'										
Allegany	54.4	(93.7)	8	*10*	*7*	29.1	(90.7)	12	*11*	*17*
Anne Arundel	58.7	(93.6)	5	*2*	*3*	38.1	(93.4)	4	*7*	*5*
Baltimore City	26.0	(75.9)	23	*24*	*24*	10.0	(72.9)	24	*24*	*24*
Baltimore County	51.3	(92.8)	10	*12*	*10*	33.5	(91.6)	8	*10*	*8*
Calvert	65.1	(94.4)	2	*5*	*2*	41.6	(94.2)	3	*4*	*6*
Caroline	54.1	(93.1)	9	*11*	*12*	28.4	(92.1)	13	*17*	*13*
Carroll	58.2	(95.1)	6	*6*	*8*	36.2	(92.3)	6	*6*	*11*
Cecil	26.7	(83.3)	22	*19*	*22*	26.2	(89.0)	15	*15*	*21*
Charles	43.7	(86.7)	16	*18*	*16*	27.8	(86.9)	14	*16*	*18*
Dorchester	37.8	(79.1)	18	*20*	*20*	16.7	(78.7)	22	*20*	*22*
Frederick	47.9	(91.4)	13	*9*	*15*	31.5	(93.0)	9	*9*	*7*
Garrett	29.1	(85.4)	21	*21*	*17*	22.8	(89.7)	19	*19*	*12*
Harford	54.6	(91.5)	7	*8*	*11*	35.9	(91.8)	7	*8*	*9*
Howard	**62.8**	**(94.3)**	**3**	*2*	*6*	**46.0**	**(94.8)**	**1**	*1*	*1*
Kent	43.9	(81.9)	15	*22*	*21*	24.7	(89.6)	17	*21*	*14*
Montgomery	51.1	(90.5)	11	*15*	*14*	37.1	(91.1)	5	*5*	*3*
Prince George's	30.5	(82.0)	19	*23*	*23*	15.9	(81.0)	23	*22*	*23*
Queen Anne's	25.9	(89.6)	24	*4*	*5*	30.9	(94.6)	11	*3*	*3*
Saint Mary's	59.9	(93.5)	4	*7*	*4*	31.1	(89.3)	10	*12*	*10*
Somerset	44.8	(94.3)	14	*17*	*19*	19.5	(87.6)	21	*23*	*20*
Talbot	30.5	(83.4)	19	*13*	*18*	22.4	(87.0)	20	*14*	*16*
Washington	43.2	(88.4)	17	*14*	*9*	23.0	(85.1)	18	*13*	*15*
Wicomico	49.6	(91.9)	12	*16*	*13*	25.7	(88.3)	16	*18*	*19*
Worcester	68.4	(95.8)	1	*1*	*1*	43.2	(95.8)	2	*2*	*2*
All Schools	**46.7**	**(88.8)**				**29.8**	**(88.2)**			

Source: Maryland State Department of Education (MSDE)

Exhibit 2 indicates the results of high school standardized exams administered in 2011, 2012, and 2013, respectively. Rankings are based on the proportion of students who scored "advanced" among all test-takers. Howard County dominates in both Algebra and English, ranking first in each category in 2011, 2012, and 2013. No other county comes close. In Algebra in 2013, nearly 53 percent of Howard County students scored at an advanced level; no other county recorded an advanced share above 50 percent (Worcester County; 45.9%). Similarly, in English, nearly 47 percent of Howard County students registered an advanced rating – only one other county was above 40 percent (Calvert County; 40.1%).

Exhibit 2: High School Assessment (HSA) Results of All Test-takers,** Reading & Math: Proportion of Pupils Scoring Proficient* or Advanced, 2013

County	Algebra % Scoring 'Advanced' (2013)	*	2013 Rank	2012 Rank	2011 Rank	English % Scoring 'Advanced' (2013)	*	2013 Rank	2012 Rank	2011 Rank
Percentages in parentheses are the proportion of pupils scoring 'advanced' and 'proficient.'										
Allegany	24.5	(78.0)	19	19	19	19.4	(73.2)	18	15	18
Anne Arundel	41.6	(92.2)	4	7	6	29.2	(87.2)	11	11	11
Baltimore County	26.7	(86.0)	17	17	16	24.6	(85.3)	14	14	13
Calvert	42.2	(96.7)	3	2	3	40.1	(95.1)	2	2	2
Caroline	25.0	(84.0)	18	21	18	16.1	(79.4)	20	20	20
Carroll	39.7	(95.6)	6	5	11	34.6	(92.2)	4	6	5
Cecil	32.9	(91.3)	11	9	10	24.5	(82.5)	15	13	12
Charles	28.2	(90.3)	15	18	17	23.0	(89.6)	16	19	17
Dorchester	23.6	(78.5)	20	15	5	17.2	(68.8)	19	18	22
Frederick	39.3	(92.0)	7	8	8	32.0	(90.0)	5	5	7
Garrett	33.9	(94.5)	10	11	14	26.4	(94.2)	13	16	14
Harford	35.6	(90.7)	9	12	15	30.3	(86.8)	9	10	10
Howard	*52.9*	*(95.0)*	*1*	*1*	*1*	*46.8*	*(91.7)*	*1*	*1*	*1*
Kent	19.6	(73.6)	21	23	23	12.3	(74.7)	23	22	19
Montgomery	40.6	(89.6)	5	4	4	39.8	(88.5)	3	3	3
Prince George's	11.1	(67.7)	23	22	22	14.7	(72.9)	21	23	23
Queen Anne's	31.3	(95.0)	14	13	9	31.6	(93.4)	8	9	4
Saint Mary's	38.5	(92.8)	8	6	12	32.0	(84.1)	5	4	8
Somerset	18.2	(77.8)	22	20	21	14.1	(74.6)	22	21	21
Talbot	31.5	(91.6)	13	14	13	32.0	(82.6)	5	8	15
Washington	32.6	(92.8)	12	10	7	27.7	(89.3)	12	12	9
Wicomico	28.1	(82.2)	16	16	20	22.6	(81.7)	17	17	16
Worcester	45.9	(94.3)	2	3	2	30.1	(87.3)	10	7	6
Baltimore City	7.8	(57.9)	24	24	24	7.9	(58.7)	24	24	24
All Public Schools	**30.8**	**(84.2)**				**27.8**	**(83.0)**			

Source: MSDE; NOTE: **The original data are not organized by the grade level of the test-taker. HSA exams are taken by anyone who has completed the relevant high school courses and some students are allowed to retake exams.[9]

High school graduation rates are also high in Howard County public schools, though along this dimension there appears to be room for improvement. No matter how high the attainment level is, continuous improvement is expected. In 2013, Howard County's four-year adjusted graduation rate was 93.3 percent, 4th among all Maryland jurisdictions and fractionally behind another populous Maryland jurisdiction, Frederick County (Exhibit 3). Among Howard County graduates, more than 92 percent expressed an

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[9]2013 Maryland Report Card. *Definition: High School Assessments*, Retrieved from http://www.mdreportcard.org/supporting/definitions.aspx?WDATA=def&K=99AAAA&inc=hsa

intention to pursue post-secondary education.[10] Additionally, according to the Maryland State Department of Education, roughly 30 percent of Howard County graduates registered a score of 3 or better on at least one Advanced Placement (AP) exam. This represents an important threshold, since a score of 3 or better is often associated with the acquisition of college credits.[11]

Exhibit 3: 2013 High School Graduation Rate Calculated with Four-year Adjusted Cohorts*, Schools in All Maryland Counties

Graduation rate as % of adjusted cohorts

County	Rate
Carroll	94.4
Queen Anne's	93.5
Frederick	93.3
Howard	**93.3**
Garrett	92.6
Calvert	91.8
Saint Mary's	91.5
Washington	91.5
Talbot	91.2
Worcester	90.9
Allegany	90.1
Charles	89.8
Harford	89.5
Montgomery	88.3
Kent	88.0
Cecil	86.7
Baltimore County	86.3
Anne Arundel	85.6
All Public Schools	85.0
Caroline	84.2
Dorchester	83.8
Wicomico	82.0
Somerset	77.0
Prince George's	74.1
Baltimore City	68.5

Source: MSDE; *Pool of students are those who entered high school at the same time adjusted for those who transferred in/out during the ensuing 3 years. Graduation rate reflects the proportion of the remaining high school student cohort that graduated within 4 years with a regular high school diploma.

Additional reason to eschew complacency is provided in Exhibit 4. While the overall level of achievement is high, particularly on standardized tests, there is still an apparent achievement gap in Howard County. For instance, while 57 percent of Asian students achieved an advanced score in 4th grade MSA reading in 2013, the corresponding proportions for Hispanics and African-Americans were 30 and 26 percent, respectively. In math, the 4th grade achievement gap is similar, with 81 percent of Asian students scoring advanced compared with 45 percent of Hispanic students and 38 percent of African-

[10]2013 Maryland Report Card. *Grade Twelve Documented Decisions (Howard County)*. Retrieved from http://www.mdreportcard.org/DocumentedDecisions.aspx?PV=38:12:13:AAAA:2:N:0:13:1:2:1:1:1:2:3
[11]Maryland Department of Education (February 20, 2013). *Maryland Still Ranks Number One In Advanced Placement Success*. Retrieved from http://marylandpublicschools.org/press/02_20_2013.html

American students. The good news is that the achievement gap appears to close by high school, at least when one considers the proportion of test-takers that pass exams in English and Algebra, respectively.

Exhibit 4: Race/ethnic Breakdown of Howard County 4th Grade MSA and HSA Tests* Results, 2013

	4th Grade MSA			HSA, All First-time Test Takers*		
Race/Ethnicity	# of Test Taker	# Scoring *'Advanced'*	% of *'Advanced'***	# of Test Taker	# 'passed'	% of *'passed'***
Reading				English		
All Student	**3,930**	**1,812**	*46%*	**4,062**	**3,587**	*88%*
Caucasian	1,711	914	53%	1,950	1,829	94%
African-American	851	223	26%	855	636	74%
Asian	731	419	57%	643	608	95%
Hispanic/Latino of any race	322	95	30%	326	259	79%
Math				Algebra		
All Student	**3,930**	**2,457**	*63%*	**2,109**	**1,607**	*76%*
Caucasian	1,711	1,192	70%	797	696	87%
African-American	851	322	38%	748	478	64%
Asian	731	592	81%	185	167	90%
Hispanic/Latino of any race	322	144	45%	248	163	66%

Source: Howard County Public School System; *Includes all test-takers regardless of grade level. The number of test-takers encompasses only those who took the exam for the first time. Those who retook an exam in 2013 are not included. **Percentages are in terms of all test-takers in corresponding categories.

Spending Per Student – An Input

There is an ongoing debate in America regarding the extent to which greater spending on education translates into improved academic outcomes. It would appear that the residents of Howard County are generally convinced that financial support for schools is a meaningful ingredient in pursuit of broadly shared and elevated academic outcomes.

When one includes expenditure per pupil from all levels of government, Howard County ranks fourth in terms of investment per student in Maryland. The county falls behind two lower-income counties that receive significant support from the State based on an educational funding formula and just behind the affluent and third-ranked Montgomery County. Howard County also ranks 7th in terms of the number of instructors per thousand students, generally behind lower income communities such as Worcester, Dorchester, Somerset, Wicomico, and Allegany counties.

Exhibit 5: Investments on Students, Maryland Counties, 2013

	Expenditure per Pupil*		Instructor per Thousands	
		(Rank)		(Rank)
Allegany	$13,572	8	74.5	6
Anne Arundel	12,519	14	68.3	15
Baltimore County	12,752	12	69.1	14
Calvert	13,018	10	63.7	22
Caroline	11,867	21	74.2	7
Carroll	12,402	16	70.4	12
Cecil	11,924	20	74.2	7
Charles	12,481	15	65.0	19
Dorchester	12,757	11	81.7	2
Frederick	12,176	19	66.4	18
Garrett	14,166	5	75.2	5
Harford	12,520	13	72.1	10
Howard	**14,571**	**4**	**74.2**	**7**
Kent	14,055	6	69.7	13
Montgomery	14,642	3	67.2	17
Prince George's	13,267	9	64.1	21
Queen Anne's	11,246	24	65.0	19
Saint Mary's	11,844	22	62.7	24
Somerset	14,022	7	77.2	3
Talbot	11,284	23	71.3	11
Washington	12,191	18	68.1	16
Wicomico	12,241	17	75.8	4
Worcester	16,277	1	92.1	1
Baltimore City	14,973	2	63.5	23
All Public Schools	**13,375**		**68.0**	

Source: MSDE; *Expenditure* includes amounts spent on administration, student transportation, and operation/maintenance of buildings in addition to instruction.

A Primer on Howard County's Economy

A Quintessential Success Story

By virtually any meaningful standard, Howard County is a wealthy community disproportionately populated by a highly educated, professionally trained workforce. The county is associated with relatively low unemployment (Exhibit 7) and high incomes despite being roughly as old as the balance of the state.

According to the U.S. Census Bureau's three-year average estimate for 2012, the county's population stood at approximately 294,000 in 2012, 6th largest among Maryland's 24 jurisdictions. The median age of the county's population is estimated to be 38.2 years, about equal to the statewide average.[12] As reflected in Exhibit 6, average family size in

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[12]Maryland Department of Planning. (n.d.) *Demographic, socioeconomic, housing and journey to work*

Howard County is 3.21. The Census estimates that 39.2 percent of Howard County households include children under the age of 18, indicating that the proportion of households of families with children is higher than the state average. More than a quarter (25.4%) of Howard County's population is aged below 17 years.[13]

The County's population is ethnically diverse. Unlike virtually all other regions of Maryland, the Asian population in Howard County represents a major minority group, accounting for nearly 15 percent of the county's population (the African-American share is 17.5%). Nearly one-fifth (18.4%) of the population is foreign born.

Howard County's population is highly educated; nearly 60 percent of the population aged 25 years or older holds at least a bachelor's degree. Accordingly, household income is high. According to the Census Bureau's three-year average estimate, median household income in Howard County was $106,222 in 2012, the highest in the state and third highest in the nation among populous counties.[14] The county's poverty rate is just 5 percent, the lowest in Maryland.[15]

Homeownership in Howard County is high, with more than 73 percent of the population living in personally-owned homes. This is the second highest proportion in Maryland and well above the national proportion of 64.7 percent.[16] Over the 2010-2012 period, the median value of a Howard County home was $417,700, easily exceeding the statewide median home value of $289,300 (Howard County's median home value exceeds the state's by more than 44%).[17]

data for Maryland's incorporated and unincorporated areas & jurisdictions: American Community Survey 2010 – 2012 Three-Year Estimates. Retrieved on January 3rd, 2014, from http://www.mdp.state.md.us/MSDC/American_Community_Survey/2010-2012/ACS_2010-2012_SummaryProfile.PDF p.6

[13]Census Bureau. (n.d.) 2010-2012 American Community Survey 3-year Estates: Selected Social Characteristics (DP02). Data accessed from http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_12_3YR_DP02&prodType=table

[14]Census Bureau. (n.d.) 2010-2012 American Community Survey 3-year Estates: Median income in the past 12 months, in 2012 inflation-adjusted dollars (S1903). Data accessed from http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_12_3YR_S1903&prodType=table

[15] Maryland Department of Planning. (n.d.), p.8

[16]Census Bureau. (n.d.) 2010-2012 American Community Survey 3-year Estates: Selected housing characteristics (DP04). Retrieved on January 3rd, 2013, from http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_12_3YR_DP04&prodType=table

[17] Maryland Department of Planning. (n.d.), p.12

Exhibit 6: Howard County Demographic Statistics, Based on 2010-2012 Three-year Average Estimates

	Howard County	Maryland
Total population:	**293,972**	**5,837,378**
% who are: Caucasian	58.3%	54.2%
African American	17.5%	29.0%
Asian	14.6%	5.6%
Hispanics	6.0%	8.4%
Others	3.6%	2.7%
% of foreign born population	*18.4%*	14.0%
Population 17 years of age or younger	25.4%	23.1%
Adults* with bachelor's degree	59.7%	36.6%
Total Households:	**106,284**	**2,141,086**
Median household income	$106,222	$71,707
% of households with one or more people under age 18	39.2%	33.7%
Average family size	3.21	3.24
Total housing units	*110,627*	*2,387,867*
% of vacant homes	3.90%	2.00%
Total occupied housing units	**106,284**	**2,141,086**
Home ownership	73.6%	67.1%
Median home value	$417,700	$289,300
NOTE: *Population aged 25 years or older		

Source: Census Bureau; Maryland Department of Planning

According to the *Quarterly Census of Employment and Wages* produced by the Bureau of Labor Statistics, nearly one-third of Howard County's jobs are related to professional services. Somewhat surprisingly, because of a dearth of federal and state agencies operating within the county's boundaries, public sector employment is surprisingly limited. As of the third quarter of 2013, only 10.5 percent of employment within the county was in the public sector, the second lowest proportion among all other Maryland jurisdictions (the lowest being Talbot County with 9.9 percent).[18]
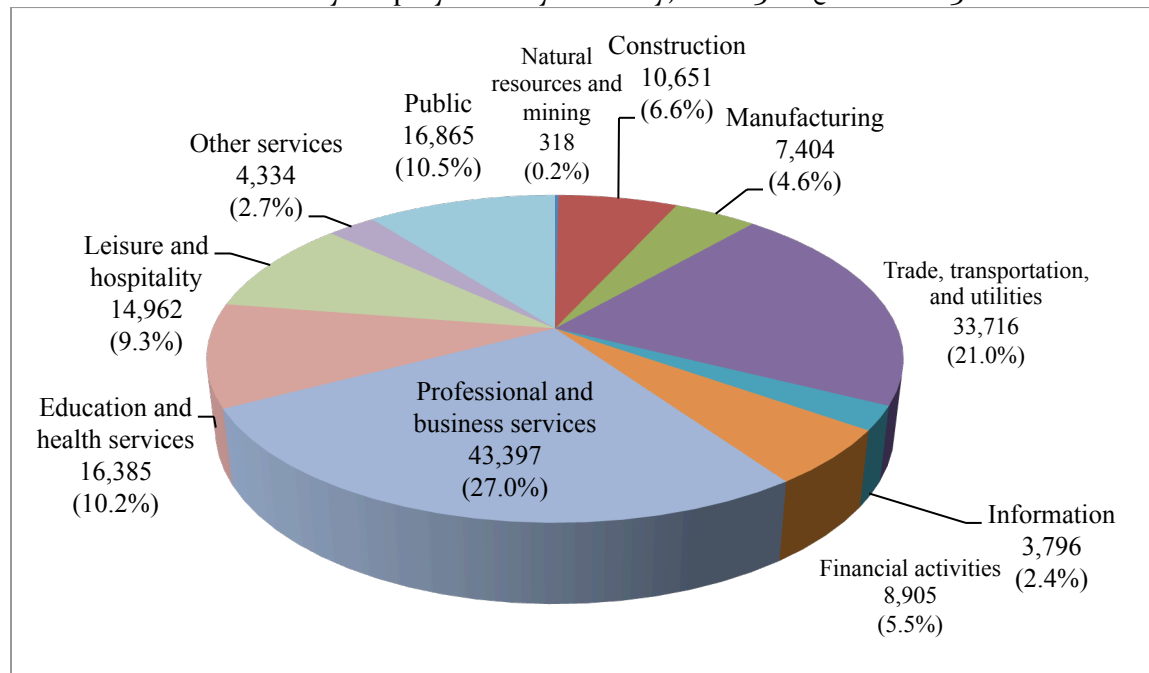
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[18] Bureau of Labor Statistics. (n.d.) Quarterly Census of Employment and Wages. Calculation made by Sage.

Exhibit 7: Local Unemployment Rate, March 2004 – March 2014, Maryland v. Howard County
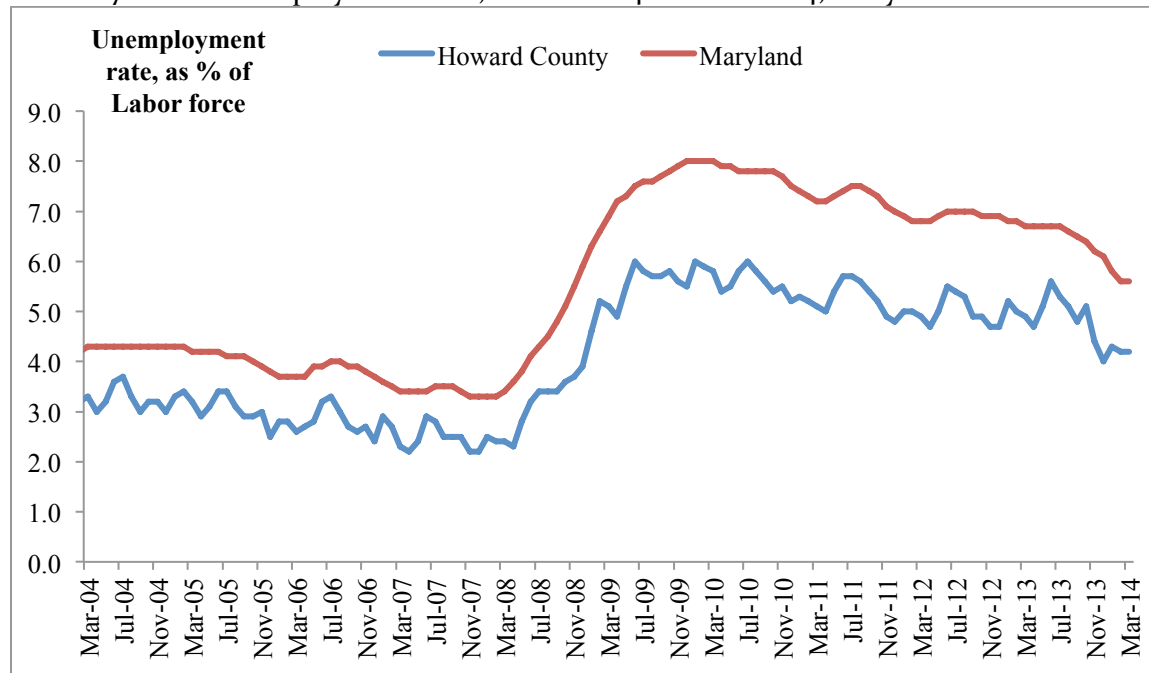
Source: Bureau of Labor Statistics, Local Area Unemployment Statistics

Exhibit 8: Howard County Employment by Industry, As of 3rd Quarter 2013

Source: Bureau of Labor Statistics, Quarterly Census of Employment and Wages

Exhibit 9 provides data regarding per capita personal income. In 2012, per capita income totaled a whopping $70,533, second only to Montgomery County. Nationally, Howard County ranks 42nd place among more than 3,100 national counties/parishes/etc.

Exhibit 9: Personal Income Per Capita, 2012

| County	Personal Income Per Capita	National Rank	County	Personal Income Per Capita	National Rank
Montgomery	$73,206	34	St. Mary's	$47,609	417
Howard	*$70,533*	*42*	Charles	$47,365	432
Talbot	$60,868	85	Baltimore City	$44,263	623
Anne Arundel	$59,711	100	Prince George's	$43,672	662
Queen Anne's	$53,974	195	Cecil	$43,104	711
Baltimore	$53,717	208	Garrett	$41,083	889
Harford	$52,351	238	Washington	$38,489	1176
Kent	$52,078	250	Dorchester	$37,609	1296
Calvert	$50,482	296	Wicomico	$37,084	1372
Frederick	$49,544	323	Caroline	$36,031	1530
Carroll	$48,919	353	Allegany	$34,547	1792
Worcester	$48,354	378	Somerset	$30,571	2480

Source: Bureau of Economic Analysis

Exhibits 10 and 11 reflect the performance of Howard County's housing market in recent years. Between 2007 and 2009, median home prices in Howard County fell rapidly (by nearly 13%).   During the corresponding period, the pace of home sales slid 16.7 percent, almost as significantly as the statewide performance of -17.3 percent.

Since that time, the housing market has been on the mend. Home sales achieved another post-recession high in 2013 even as the median price approached its pre-downturn level. The pace of home sales is up nearly 20 percent since 2009. Median home price is likely to have more than fully recovered by the end of 2014 and has risen 13.2 percent since its cyclical nadir. By contrast, statewide median prices rose by less than 2 percent during the corresponding period (approx. $256,000 to $261,000).[19]
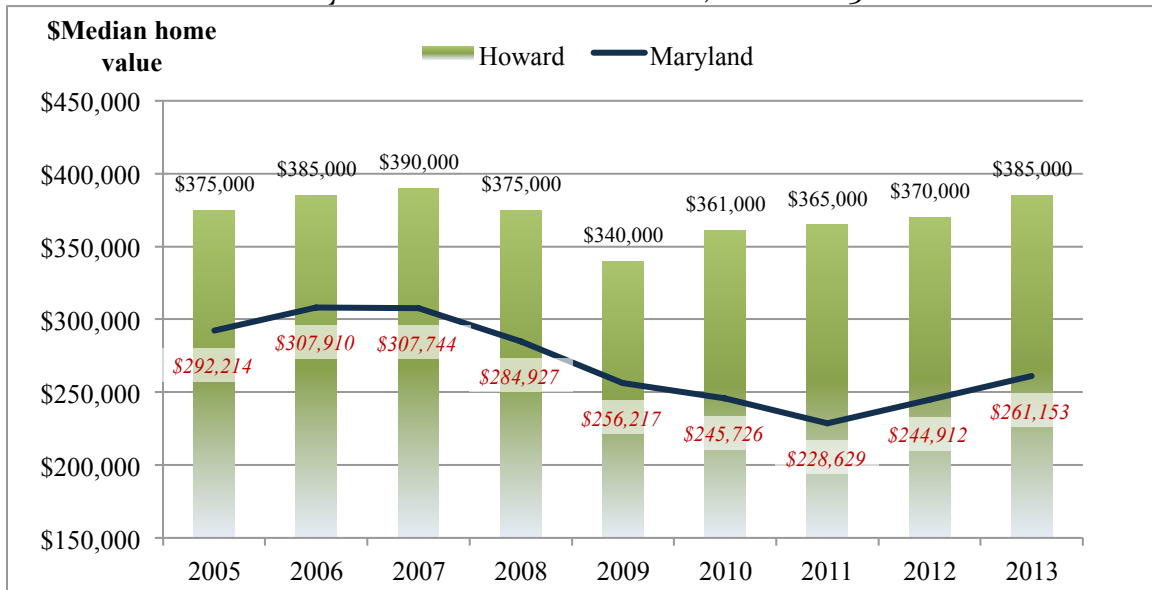
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[19] Maryland Association of Realtors. Data down loadable from
http://www.mdrealtor.org/housingstatistics/housingstatistics.aspx

Exhibit 10: Howard County Annual Home Sales, 2006 – 2013

Units
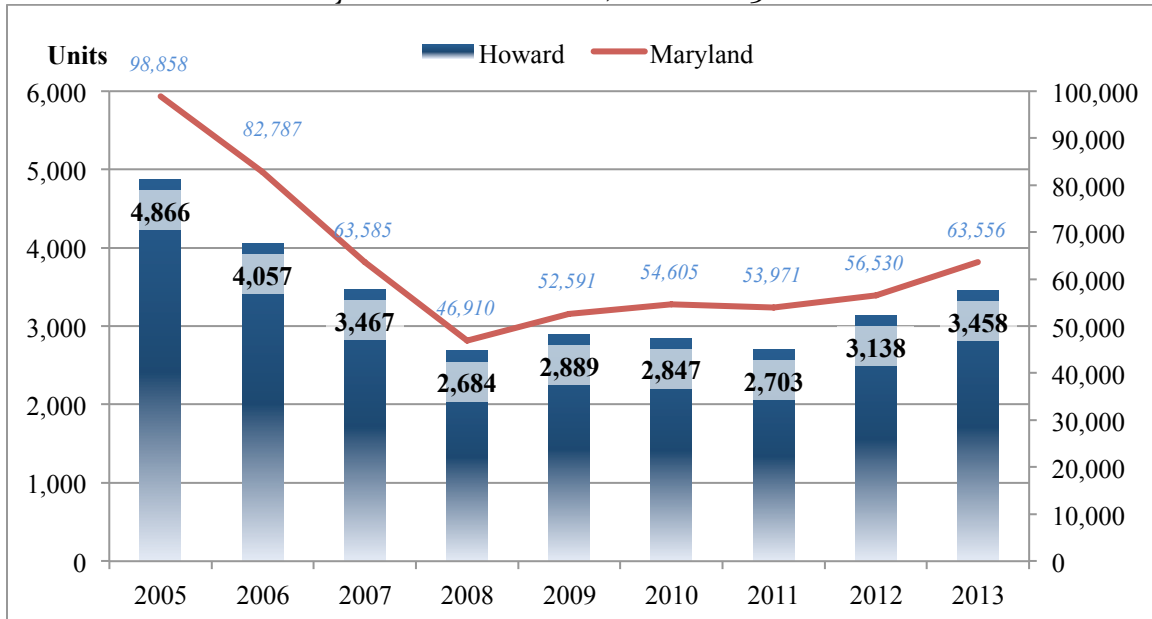
Source: Maryland Association of Realtors

Exhibit 11: Howard County Annual Median Home Price, 2006 – 2013

$Median home value

Source: Maryland Association of Realtors

Student Achievement and Economic Outcomes – A Brief Discussion of High-Profile Research

<u>Scholars Identify Multiple Connections Between Educational Quality and Economic Outcomes</u>

Better Educational Outcomes Signify Better Economic Ones

Between 1970 and 2000¸ the percentage of academic studies within the economic field that address the topic of education had grown more than four-fold.[20] Economic literature reveals positive correlations between educational quality and improved economic outcomes that are unmistakable.

For instance, in their analysis of men born between 1920 and 1949, labor economists David Card and Alan Krueger (1990) proved that men educated in states with better schools also enjoyed higher earnings. The study determined that reducing the pupil-to-teacher ratio from 30 to 25 is associated with a 0.4 percent increase in earning.[21, 22] Similarly, in their longitudinal analysis of the British National Child Development Survey, Currie and Thomas (1999) found that men and women in the lowest quartile of the reading test score distribution have wages 20 percent lower at age 33 than those who scored in the highest quartile.[23]

In his 2002 study, Eric Hanushek argues that both *quality* (educational achievement, measured by standardized test scores) and *quantity* of schooling are essential to increasing human capital and maintaining national competitiveness. Reflecting upon past studies, he contends that "student achievement has a direct impact on earnings after allowing for differences in the quantity of schooling, the experiences of workers, and other factors that might also influence earnings." Therefore, "higher quality as measured by tests . . . is closely related to individual productivity and earnings."[24] Furthermore, Hanushek states that education creates "externalities" in society that drives economic expansions.   More specifically, "a more educated society may lead to higher rates of invention . . . make everybody more productive through the ability of firms to introduce

[20] Krueger, Alan B. (2000). *Education Matters*. Northampton, MA: Edward Elgar.

[21] Card, David & Alan Krueger. (May 1990). Does school quality matter? Returns to education and the characteristics of public schools in the United States. (Working paper #265, Princeton University). Retrieved from   http://dataspace.princeton.edu/jspui/bitstream/88435/dsp01js956f81r/1/265.pdf

[22] In the 1990 Card-Krueger study tested three input measure of school quality, including pupil to teacher ratio, average term length, and the relative pay of teachers.

[23] Currie, Janet & Duncan Thomas. (February 1999). *Early Test Scores, Socioeconomic Status and Future Outcomes* (Working paper No. 6943, National Bureau of Economic Research). Retrieved from http://www.nber.org/papers/w6943

[24] Hanushek, Eric A. (2002). The importance of school quality. Retrieved from http://media.hoover.org/sites/default/files/documents/0817939210_141.pdf (See p.146 paragraph 2).

new and better production methods . . . and may lead to more rapid introduction of new technologies."[25]

Exhibit 12: Average State Economic Indicators by Rankings in 2013 NAEP results for Grade 4 Math

	Unemployment Rate, Average 2013	2008-2013 Employment Growth	Real State GDP Growth, 2011-2012	Average Median Income (2012 1-year Est.)
Top 17 States₁	6.1	0.5%	2.6%	$56,042
Middle 17 States₂	6.6	-0.4%	1.8%	$52,143
Bottom 17 States₃	7.6	-1.1%	1.9%	$47,739

1. Minnesota, Massachusetts, New Hampshire, Indiana, Vermont, Colorado, New Jersey, Wyoming, North Dakota, Washington, Kansas, Virginia, Maine, Iowa, Ohio, Maryland, North Carolina 2. Wisconsin, Pennsylvania, Montana, Connecticut, Hawaii, Nebraska, Delaware, Utah, Texas, Florida, Kentucky, Rhode Island, South Dakota, Idaho, New York, Arizona, Oregon 3. Georgia, Arkansas, Tennessee, Missouri, Illinois, Oklahoma, West Virginia, Michigan, South Carolina, Nevada, Alaska, California, Alabama, New Mexico, Louisiana, Mississippi, District of Columbia,

NOTE: Statistics are averaged across the states comprising each group. These are not weighted by the state total.

Source: Bureau of Labor Statistics (Unemployment rate & employment growth); Bureau of Economic Analysis (State GDP growth); Census Bureau (Median household income)

Sporadic student achievement in the U.S. may help explain the nation's inability to grow at a historic pace. Treasury Secretary Jack Lew, citing information produced by the Congressional Budget Office, recently stated that Americans can expect their economy to grow by an average of 2.1 percent going forward, far short of the 3+ percent growth enjoyed for much of the post-World War II period. The most recent results from the OECD's Program for International Student Assessment (PISA) indicate that U.S. 15-year-old test-takers performed below average in mathematics, ranking 27th place among 34 OECD countries. The U.S. ranked 17th and 20th in reading and science, respectively.[26]

The PISA results also reveal significant intra-country differences in student performance. According to an OECD analysis of 2009 PISA results, public schools in the northeastern part of the U.S. performed 17 points above the OECD average with a total of 510 PISA score points.[27] The northeast is also America's best economic performer. Moreover, statistics indicate that the top 17 states (see Exhibit 12) generally outperform the balance of the United States along key economic dimensions, including unemployment, 5-year employment growth, real GDP growth, and median income.

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[25] Id. Hanushek (2002), See p.148 paragraph 3.

[26] OECD. (2012). Programme for International Student Assessment (PISA): Key Findings. *Country Note* (United States). Retrieved from http://www.oecd.org/unitedstates/PISA-2012-results-US.pdf (See p.1)

[27] OECD. (2010). *Viewing Education in the United States Through the Prism of PISA.* Retrieved from http://www.oecd.org/unitedstates/46579895.pdf (p.2 paragraph 1).

Hanushek (2002) notes that while the quantity of schooling has increased substantially over the past century in the U.S. with the expansion of access to secondary education, the quality of education has suffered with "less learning each year." This is evidenced by the lesser achievement of graduates.[28] He concludes that for the U.S. to maintain competitiveness in the global economy, the "long-term goal of the U.S. should be to improve educational quality, or achievement at each grade level."[29]

Here is the broader point - the connection between school quality and economics goes far beyond adult incomes. The connection also encompasses, for instance, the general pace of economic growth, technological innovation, and migration patterns. In his iconic study of local public expenditure, Charles Tiebout hypothesizes that consumers pick "that community which best satisfies his preference pattern for public goods."[30] Therefore, households with children will prefer locations with better schools; households without children will demand other things such as well-maintained parks and effective policing. Tiebout's theory implies that communities that are the most efficient at satisfying these diverse demands for local amenities will enjoy the highest property values.[31]

Evidence connecting school quality and real estate values can be located both in survey data and in peer-reviewed journals. According to a survey conducted by the National Association of Realtors authored by Weiss (2004), quality of public schools along with neighborhood safety rank as the two most important factors people consider when selecting where to live.[32]

In their review of home prices, Brashington and Haurin (2004) found that home prices vary by 14 percent when comparing a school district with student achievement one standard deviation above the mean against one that is one standard deviation below.[33] In today's Howard County context, that translates into a figure exceeding $50,000.

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[28] Hanushek, Eric A. (2002). The Importance of School Quality. In *Our Schools and Our Future...Are We Still at Risk?* Ed. by Paul E. Peterson, Chapter 5. (Hoover Institution Press: Stanford, CA) Retrieved from http://media.hoover.org/sites/default/files/documents/0817939210_141.pdf (See p.156)

[29] Id. Hanushek (2002).

[30] Tiebout, Charles. (1956). A Pure Theory of Local Expenditures. *Journal of Political Economy*, Vol.64(5). 416-424. Retrieved from http://www.unc.edu/~fbaum/teaching/PLSC541_Fall08/tiebout_1956.pdf (See p.418 paragraph 5).

[31] Mackenzie, John. (2006). *Public School Funding and Performance* (University of Delaware). Retrieved from http://www.udel.edu/johnmack/research/school_funding.pdf (See p.5)

[32] Weiss, Jonathan D. (2004). Public Schools and Economic Development: What the Research Shows (Knowledge Works Foundation: Cincinnati, OH) Retrieved from http://www.mea.org/tef/pdf/public_schools_development.pdf (See p.22 paragraph 1)

[33] Brasington, David & Donald R. Haurin. (2004). Educational outcomes and house values: A test of the value-added approach. Retrieved from http://www.bus.lsu.edu/economics/papers/pap05_03.pdf (See p.5).

Some studies have discerned positive statistical relationships between public education expenditures and real estate performance. In their article published in the *New England Economic Review*, Katharine Bradbury, Karl Case, and Christopher Mayer (1998) investigated the impact of higher school funding policy on real estate values. They benefited from a natural experiment. Massachusetts' Proposition 2½ passed in the early 1990s, limiting the amount of taxes that can be levied by school districts. The authors observed a signification divergence in enrollment patterns as families disproportionately opted to move to localities less constrained by the tax limit.[34] In other words, they chose to move to areas associated with greater taxation.[35]

According to a comprehensive review of literature regarding public services and economic growth, Fisher (Center for Urban Studies) found that 12 out of 19 studies conducted through 1997 indicated a positive relationship between the level of investment in public education investment and local economic outcomes. Several of the studies that did not find a positive relationship simply were unable to produce any statistically significant findings.[36]

Of course, public school systems represent major employers in their own right. Higher educational spending naturally translates into higher local employment, all things being equal. In other words, the measured economic impact of the public school system can be substantial.

On behalf of the Oregon Education Association ("OEA"), Oregon School Boards Association ("OSBA"), and the Confederation of Oregon School Administrators ("COSA"), ECONorthwest conducted a comprehensive economic impact study to quantify the impact of Oregon's public school investment. The spending in K-12 schools injected more than $5.1 billion into the state economy during that school year including $3.3 billion for salary and payroll, $922 million for the purchase of supplies and materials, and $281 million in capital outlays.[37]

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[34] Bradbury, Katharine L., Karl E. Case, & Christopher J. Mayer. (1998). School Quality and Massachusetts Enrollment Shifts in the Context of Tax Limitations. *New England Economic Review* (July/August, 1998). Retrieved from https://www.bostonfed.org/economic/neer/neer1998/neer498a.pdf (See p.4 paragraph 5).
[35] Id., Bradbury, Katharine L., Karl E. Case, & Christopher J. Mayer. (1998).
[36] Fisher, Ronald C. (1997). The Effects of state and local public services on economic development. *New England Economic Review* (March/April, 1997). Retrieved from http://www.centerforurbanstudies.com/documents/electronic_library/buffalo_studies/effects_of_state_and_local_service_on_econ..pdf (See p.57-58).
[37] ECONorthwest. (June 2004). *K-12 Spending and the Oregon Economy*, Prepared for OEA, OSBA, COSA. Retrieved from http://www.osba.org/~/media/Files/Resources/Legislative/K-12%20spending%20and%20the%20Oregon%20Economy.pdf (See Executive Summary, p.2)

The Oregon K-12 system supported approximately 107,000 jobs, or 6.8 percent of statewide employment. These jobs include the system's 56,000 full-time employees, as well as 10,370 subcontractors, and 41,000 indirect (3,710 jobs) and induced jobs (37,040 jobs).[38] These jobs were associated with nearly $3.7 billion in wages and another $232 million in local business sales.[39]

Exhibit 13: Oregon K-12 System Economic Impact, based on the 2000-2001 School Year Expenditure of $5.1 billion, As presented in ECONorthwest Study (2004)

	Jobs	Wages ($million)	Business Income ($million)	Average Annual Wage
Direct	66,370 (56,000 FTE + 10,370)	$2,669.8	$60.3	$41,100
Indirect	3,710	111.3	22.4	$36,000
Induced	37,040	911.2	149.6	$28,600
Total:	107,120	$3,692.2	$232.3	$36,600

Source: ECONorthwest, in *K-12 Spending and the Oregon Economy* (Page 7)

In 2004, the National Educational Association (NEA) conducted a study estimating the employment impact of increasing education spending in all states. Specifically, the study considered a hypothetical 2.0 percent increase in educational spending for a period of 10 years and a corresponding increase in the consumption taxes.

This state-by-state analysis employed a set of state-specific dynamic computable general equilibrium (CGE) models, which incorporates detailed data on each state to explore the benefits of increases in public spending and the somewhat countervailing impact of fiscal change. Assuming that the 2.0 percent increase in public school funding is fully funded by a broad-based sales tax, state-specific models allow the analyst to capture the changes in spending patterns in response to a hypothetical tax increase, which likely offset at least a portion of the benefits. [40] The simulation model also incorporates a scenario for U.S. economic growth over the course of 10 years.[41]

The following exhibit presents the estimated net employment impact of a 2.0 percent increase in educational spending in each state relative to current levels. Net impacts were found to be positive for all 50 states and the District of Columbia for both the short-term (year 2010) and long-term (2020). In the aggregate, the total job impact for the year 2010 was estimated to be an additional 122,235 jobs, which would support nearly $6.6 billion in

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[38] Induced impacts are defined as additional spending or jobs created by the benefit created through direct and indirect impacts.

[39] ECONorthwest (June 2004), op. cit., p.2, 7.

[40] Sims, Richard G. (April 2004). *School Funding, Taxes, and Economic Growth: An Analysis of the 50 States* (National Educational Association). Retrieved from http://www.nea.org/assets/docs/HE/schoolfunding.pdf (See p.4 paragraph 2 & 3)

[41] Id. Sims, Richard G. (April 2004) (See p.4 paragraph 4).

additional personal income nationally. This estimate rises to 128,284 for 2020. For Maryland, the 2020 employment impact would exceed 2,400 positions.

Exhibit 14: Net Employment Impact of the Two-percent Increase in Educational Funding (after Subtracting the Matching Tax Increase)

	Employment, Net change in Jobs ('000)		Personal Income ($million, in nominal)			Employment, Net change in Jobs ('000)		Personal Income ($million, in nominal)	
	2010	2020	2010	2020		2010	2020	2010	2020
Alabama	1,830	2,266	$98	$152	Montana	670	708	$30	$44
Alaska	719	856	45	65	Nebraska	840	946	45	67
Arkansas	1,150	1,486	57	92	North Carolina	3,324	3,020	159	255
Arizona	1,453	1,750	83	142	North Dakota	337	346	14	19
California	10,050	11,150	743	1,142	Nevada	625	676	30	48
Colorado	1,612	1,798	79	114	New Hampshire	552	608	25	40
Connecticut	1,226	1,298	73	107	New Jersey	3,727	3,957	227	335
District of Columbia	138	148	5	6	New Mexico	1,279	1,219	44	70
Delaware	170	179	12	17	New York	8,130	8,993	603	869
Florida	6,624	7,295	411	776	Ohio	5,260	5,138	244	370
Georgia	3,139	3,466	187	281	Oklahoma	1,664	1,660	76	117
Hawaii	372	324	19	29	Oregon	2,313	2,360	107	158
Idaho	826	858	43	61	Pennsylvania	4,612	4,810	235	383
Illinois	4,192	4,638	257	385	Rhode Island	451	457	24	38
Indiana	2,816	2,942	130	190	South Carolina	2,190	2,270	103	156
Iowa	1,741	1,703	75	105	South Dakota	471	508	18	27
Kansas	2,421	2,340	58	88	Tennessee	1,590	1,956	102	164
Kentucky	2,721	2,768	89	133	Texas	10,281	10,371	524	814
Louisiana	2,128	2,207	108	166	Utah	1,361	1,379	57	78
Maine	568	657	29	45	Vermont	493	425	18	26
Maryland	*2,285*	*2,443*	*118*	*186*	Virginia	2,765	2,916	141	209
Massachusetts	1,939	2,107	120	170	Washington	3,348	3,577	187	274
Michigan	5,080	4,517	223	346	West Virginia	1,452	1,478	61	93
Minnesota	2,196	2,193	116	172	Wisconsin	2,998	2,891	140	216
Mississippi	1,318	1,534	64	104	Wyoming	498	494	22	29
Missouri	2,290	2,198	106	170	TOTAL:	122,235	128,284	$6,584	$10,143

Source: Sim, Richard. As presented in "School Funding, Taxes, and Economic Growth: An Analysis of the 50 States" (Appendix Table C).

More locally, the BEACON Institute at Salisbury University, which routinely partners with Sage on research projects, conducted an economic impact assessment of the investments made by Anne Arundel County Public Schools (AACPS). AACPS is the fifth largest public school system in Maryland, administering a total of 125 schools with nearly 78,500 students enrolled.

Given the size of the organization, it is not surprising that AACPS plays an important role in the local economy. The AACPS employs nearly 10,300 people, making it the second largest employer in the county. Its annual operating budget for FY2014 surpassed $1 billion. Importantly, the study estimated that approximately $0.93 of every dollar spent by the AACPS is retained within the Anne Arundel County economy (p.8).

The quality of public schools has also been one of the determining factors in shaping business relocations. For instance, a survey of small auto suppliers conducted as part of the research

project for the Tennessee Department of Economic Development revealed that school quality is among the most important factors in shaping business location decisions, not simply household location decisions. The finding appears to be rooted in employers' demands for high-quality workforces. A recent survey found that 95.1 percent of executives rate the availability of skilled labor as "very important" or "important" in their site selection decisions. This surpasses highway accessibility (93.5 percent) and labor costs (90.8 percent).[42]

Many international studies have also identified a positive relationship between educational quality and economic outcomes. In their review of available literature, Sianesi and Van Reenen (2002) found that simply increasing school enrollment rates by 1 percentage point produces an increase in per capita GDP growth of between one and three percentage points.[43] In their study of per capita GDP in 31 nations, Hanushek and Kimko (2000) found that a large proportion of the international discrepancy in per capita output is attributable to differences in student achievement. Specifically, they determined that the explained variance in per capita GDP expands from 33 percent to 73 percent when the quality of education is taken into account.[44] In his 2003 study, Wößmann, attempted a similar study with a sample of 132 countries and reached a similar conclusion.[45]

Sage's Hedonic Pricing Model for Howard County

Relevant Literature & Methods

What is Hedonic Modeling?

Hedonic pricing models represent a form of regression analysis used to estimate the value of various amenities or qualities that do not carry market prices on items that do.[46] These

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[42] Murray, Matthew N., Paula Dowell, & David T. Mayes. (August 1999). The location decision of automotive suppliers in Tennessee and the southeast (prepared for State of Tennessee Department of Economic and Community Development). Retrieved from http://cber.bus.utk.edu/pubs/mnm083.pdf , p. 7.

[43] Sianesi, Barbara & John Van Reenen. (2002). *The returns to education: A review of the empirical macro-economic literature* (Working Paper no.02/05, Institute for Fiscal Studies). Retrieved from http://www.econstor.eu/bitstream/10419/71555/1/345187784.pdf (See p.4).

[44] Hanushek, Eric A. & Dennis D. Kimko. (2000). Schooling, Labor-force Quality, and the Growth of Nations. *American Economic Review,* Vol.90(5), 1184-1208. Retrieved from http://econ2.econ.iastate.edu/classes/econ520/huffman/documents/SchoolingLaborForceQualityandtheGrowthofNations.pdf (See p.1185).

[45] Wößmann, Ludger. (2003). Schooling resources, educational institutions, and student performance: The international evidence. *Oxford Bulletin of Economics and Statistics,* 65(2),117-170.; As referenced in Erick A. Hanushek & Ludger Wößmann. (2007). The role of education quality in economic growth (Working paper, WPS4122). Retrieved from https://openknowledge.worldbank.org/bitstream/handle/10986/7154/wps4122.pdf?sequence=1 (See p.30)

[46] Rosen, Sherwin. (1974). Hedonic prices and implicit markets: Product differentiation in pure competition. *Journal of Political Economy,* Vol.82(1). p.34-65.

models uncover the value society places on these unpriced amenities by estimating their relationships with amenities for which prices are readily available (e.g., homes).

Application of Hedonic Modeling in Public Educational Contexts

One of the first studies linking educational quality to real estate values was published in 1969 by then-Princeton University professor Wallace Oates. He analyzed the impact of expenditure per pupil on home values in New Jersey using multivariate regression analysis.[47] One of the findings in the Oates study was that a $100 increase in per student expenditures would translate into a $1,200 increase in home values.[48]

Many noteworthy hedonic pricing studies emerged during the 1990s. These studies consistently indicate positive correlations between elevated school quality indicators and local housing values. For instance, in their 1997 study, Bogart and Cromwell compared multiple school districts with low and high property taxes revenues collected in support of local public schools. Using hedonic modeling, the authors concluded that localities associated with greater investment in schools experienced apartment rents that were $36 per month higher on average.[49]

A 1999 study by Sandra Black, which has emerged as one of the discipline's most influential studies, analyzed the relationship between elementary school test scores and home sales prices. Using a sample of housing transactional data sampled from Ohio, the study found that homebuyers are willing to pay 2.1 percent more for a home in exchange for a 5 percent increase in test scores.[50]

Measures of School Quality

Broadly, there are two types of measures – output and input. Output measures reflect outcomes such as test scores and graduation rates. Input measures relate to school spending, which include teacher salaries, school infrastructure (e.g., libraries, labs), and per pupil expenditures. Input measures can also be nonfinancial in nature, encompassing

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[47] Oates, Wallace. (1969). The effects of property taxes and local public spending on property values: an empirical study of tax capitalization and the Tiebout hypothesis. *Journal of Political Economy,* Vol.77(6). 957-971 (p.962, paragraph 2).

[48] Id., Oates, Wallace (1969), p.966, paragraph 2; Using the sampled data in the study, the result of the study indicates an increase from $350 to $450 per pupil.

[49] Bogart, William T. & Brian A. Cromwell. (1997). How much more is a good school district worth?. *National Tax Journal*, Vol.50(2). Retrieved from http://ntj.tax.org/wwtax/ntjrec.nsf/notesview/A1267750E3E3F58D85256863004A5952/$file/v50n2215.pdf (See p.215)

[50] Black, Sandra E. (1999). Do better schools matter? Parental Valuation of Elementary Education. *Quarterly Journal of Economics,* Vol.114(2). 577-599. (See p.578, paragraph 2).

items such as student body mix, parental resources, and the measurable quality of administration.[51]

Earlier research largely focused on input measures, including the Oates (1969) study, presumably because less output data were available at the time. That has changed. With high-stakes testing now in place, the volume of output measures has expanded dramatically.[52]

Of course, even those who use output measures to assess the economic impact of improved educational outcomes differ markedly in terms of their equation specifications and data utilization. For instance, Black's (1999) study utilizes ninth grade test scores while others, including Chiodo et al. (2010) utilize fourth grade test scores.[53] There does not seem to be any general agreement regarding which output measures are superior, with many researchers simply choosing to work with those data that are most plentiful.

However, while the economics community has not expressed a strong preference, educational researchers have often emphasized the importance of fourth grade academic achievement. According to Sanacore and Plumbo (2009), a lack of preparation by the fourth grade translates into lingering underperformance in later years as students are exposed to increasingly complex material, including reading material.[54]

In a longitudinal experimental study conducted by Chall and Jacob in 1990, the progress of students in the second, fourth, and sixth grades were monitored over a period of two years. The scholars noted that "low-income children in grades 2 and 3 achieved as well as children in the normative population, while some of the students' scores started to decelerate around fourth grade."[55]

Based on its review of educational literature, Sage has chosen to use fourth grade test results as a basis of its hedonic pricing modeling. With assistance from the Howard

[51] Black, Sandra E. (1998). Measuring the value of better schools. *Federal Reserve Bank of New York Economic Policy Review.* (March 1998). Retrieved from
http://www.nyfedeconomists.org/research/epr/98v04n1/9803blac.pdf
[52] Brashington, David M. (1999). Which measures of school quality does the housing market value?. *Journal of Real Estate Research,* Vol.18. 395-413.
[53] Chiodo, Abbigail J., Rubén Hernández-Murillo, & Michael T. Owyang. (2010) Nonlinear Effects of School Quality on House Prices. *Federal Reserve Bank of St. Louis Review,* 92(3), May/June 2010, 185-204. (See p.195). Retrieved from http://research.stlouisfed.org/publications/review/10/05/Chiodo.pdf
[54] Sanacore, Joseph & Anthony Palumbo. (2009). Understanding the fourth-grade slump: Our point of view. *The Educational Forum,* Vol.73. 67-74. Retrieved from
http://ww.kdp.org/publications/theeducationalforum/pdf/sanacore.pdf, p. 68.
[55] Chall, Jeanne S. & Vicki A. Jacobs. (2003). The Classic Study on Poor Children's Fourth-Grade Slump. *American Educator* (Spring 2003). Retrieved from http://www.colorincolorado.org/article/13995/, paragraph 6.

County Public School System, Sage was able to acquire test scores and other data needed for the analysis.

Controlling for Neighborhood Effects

Skeptics of these types of studies often point to omitted variable bias. The issue is that omitting home price explanatory variables may result in biased estimates of the impact of educational outcomes. Hedonic pricing models are particularly susceptible to such criticism because of the presence of unaccounted neighborhood characteristics that impact residential values, including items such as the presence of sidewalks, elegant tree canopies, or attractive architecture.[56]

In order to circumvent the issue, economist Sandra Black advocates the use of a "boundary fixed-effects approach," which involves a vector of variables indicating boundaries along school attendance areas. In her 1999 study, the author strategically limits the sample of homes to those located near the boundaries of attendance areas, thereby controlling for a host of neighborhood characteristics. In other words, these areas are essentially identical except that students attend different schools depending upon the relative position vis-à-vis districting boundaries.

The legitimacy of the boundary fixed-effect approach has been questioned by other researchers, however, and not simply in educational contexts. First, the method is based upon the "somewhat questionable assumption"[57] that homes along boundaries are not significantly different.[58] Also, the redistricting process means that boundaries can sometimes shift.[59] Some researchers have even found that such an approach can lead to estimates that have the wrong sign (positive versus negative).

In this Sage study, neighborhood impacts are addressed through the inclusion of neighborhood demographic characteristics rather than through the utilization of the fixed-effect boundary method. Sage used a web-based online tool provided by the Maryland Data Center (http://census.maryland.gov/censusIMap.shtml) and the Census Bureau's TigerWeb application (http://tigerweb.geo.census.gov/TIGERweb2010/) to assign Howard County addresses to the appropriate Census designation.

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[56] Woodridge, Jefferey. (2002). *Introductory Econometrics: A Modern Approach*. (South Western, Cengage Learning: Mason OH), p.87.
[57] Brasington, David M. (2004). Educational outcomes and house values: A test of the value-added approach. (Department of Economics Working Paper Series: Louisiana State University, Baton Rouge, LA), p.9
[58] Id.
[59] Clapp, John M., Anupam Nanda, Stephen L. Ross. (2007). Which School Attributes Matter? The Influence of School District Performance and Demographic Composition on Property Values. Working paper by University of Connecticut & National Association of home Builders. (See p.4, paragraph 2).

In keeping with the econometric techniques of many others, the Sage study team randomly selected properties currently on sale or recently sold to establish home prices. Our dataset excludes foreclosed homes. Fortunately, foreclosure levels in Howard County are not elevated. This would have the effect of creating additional unwanted variation in observed home prices. The study team relied upon attendance area maps for the most recent school year (2013-2014).[60]

Furthermore, the study team refrained from the use of middle school test results due to complication relating to the recent school redistricting among HCPSS attendance area redistricting. HCPSS recently underwent a redistricting process for public middle schools, which takes effect for the 2014-2015 school year. Elementary and high school attendance areas were unchanged. To include middle school test results, the study team would have either had to select historic or prospective district boundaries. Questions would emerge from the rendering of either selection.

Model Specification

The model is implemented using a dataset consisting of information related to 1,719 homes. The study team regressed the value of these sampled homes on variables that are presumed to impact home prices. The model is specified as follows:

$$\ln(V_{ij}) = \alpha_0 + X_{ij}\beta + \gamma(TEST_j) + e_{ij} \dots (1)$$

where V_{ij} is the value of the ith home in the jth attendance area; X_{ij} indicates a series of variables reflecting attributes of a given home and its community characteristics of the attendance area, including the number of bedrooms, baths, stories, etc., general educational levels, and age distribution of the community population; $TEST_j$ indicates the average MSA test scores from the jth Howard County elementary school; α_o is an intercept or constant term; and e_{ij} indicates model residuals. Each variable on the right hand side is associated with coefficients β or γ. The coefficient γ is of interest to this analysis since it reflects the magnitude of consumers' willingness-to-pay for the quality of schools, which is proxied by a combination of math and reading scores.

Because the dependent variable, V_{ij}, is in logarithmic form, coefficients indicate the magnitude of percentage changes in home values for each unit increase in the variable, holding all other variables in the specification constant. In implementing this model, the Sage study team utilized a standard statistical computer software package -- SAS version 9.2.

Variable Description and Data Source

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[60] Data on the newly opened Ducketts Lane Elementary are not reflected in the analysis.

Dependent Variable: 'V$_{ij}$' in Equation (1)

The values of homes (*"V$_{ij}$"* in Equation (1)) are collected from a web-based property database, *Real Property Search* made available by the State Department of Assessment and Taxation (SDAT). All home values reflect the phase-in value of the assessed property as of July 1st, 2014.[61]

Independent Variables: 'X$_{ij}$'s' and 'TEST$_j$' in Equation (1)

There are three sets of independent variables: housing and neighborhood characteristics (*"X$_{ij}$s"* in Equation 1), and test scores emerging from Howard County elementary schools (*"TEST$_j$"* in Equation 1).

Housing characteristics: Eight different variables are included in the regression model. Data associated with 7 of these variables are collected from SDAT's *Real Property Search*. Information regarding the number of bedroom is collected from the home search website, *Zillow.com* (http://www.zillow.com/). Variables characterizing sampled homes include:

- Size of the building in square feet
- Lot size in square feet
- Age of homes*
- Number of stories
- Number of full bathroom
- Number of half bathroom
- Vehicle storage**
- Number of bedrooms (from Zillow.com)

(NOTE: *Computed based on the year in which the primary structure of the home is built; **Dichotomy variable where '1' indicates that the house has some form of storage space for vehicle(s), either attached or detached, and '0' indicates otherwise.)

Neighborhood Characteristics

The analysis also employs 8 different indicators that characterize neighborhoods. These include:

- Percentage of population under age 9 (BG level, 2010 data)
- Percentage of population between age 10 and 20 (BG level, 2010 data)
- Cultural diversity of population (BG level, 2010 data)
- Percentage of population older than age 65 (BG level, 2010 data)

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[61] State Department of Taxation and Assessment. (n.d.) *A homeowner's guide to property taxes and assessments*. Retrieved from http://www.dat.state.md.us/sdatweb/hog.html

- Home ownership (BG level, 2010 data)
- Median household income (Census Tract Level, 2012 data)
- Percentage of households headed by female (Census Tract Level, 2012 data)
- Percentage of adult population aged 25 and older with a bachelor's degree (Census Tract Level, 2012 data)

Data were gathered from the Census Bureau. With the exception of median income, percentage of female-headed households, and proportion of bachelor's degree holders, all data are presented at the Census block group (BG) level, the most granular geographic definition utilized by the Bureau. Three remaining variables, median income, percentage of adults holding bachelor's degree, and percentage of female-headed households are available at the Census Tract level, the next smallest geographic classification. All BG level data are based on results of the 2010 Decennial Census while Census Tract level data were obtained through the 2012 American Community Survey.[62] There are 154 BGs and 55 Census Tracts in Howard County.[63]

<u>Test scores from Howard County elementary schools</u>: This analysis relied upon Howard County elementary school results from the 2013 Maryland School Assessment (MSA). These data were obtained with the assistance of HCPSS. Math and reading scores were averaged together for each elementary school and this composite represents the independent variable of greatest interest.[64] Based on rationales offered above, the analysis uses results for the fourth grade.

Exhibit 15 reflects test scores for each elementary school in Howard County. It is important to note that Sage's assessment of the impact of school quality on home prices takes place in the context of Howard County communities. Data from other jurisdictions is not included in the model. This allowed the study team to control for many variables, including property tax rates. Howard County has no incorporated municipalities, which also simplifies the analysis. The school with the highest average test score is Centennial Lane at 459.7. This is roughly 54 points above the school with the lowest average.

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[62] During the most recent decennial census conducted in 2010, the Census Bureau discontinued the long form questionnaires. As a result, detailed demographic data related to socioeconomic status are imputation. Furthermore, these imputed data are part of the American Community Survey (ACS) and are not available at block group level. The ACS data are available annually. The most recent survey results for Howard County were released in 2012.

[63] Census Bureau. *American Community Survey*. Data downloadable from
http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t

[64] In Black (1999), an example where actual test scores are used as the proxy for school quality, the author utilized the sum of test scores in math, reading, and science averaged over three years (See p.583, paragraph 3).

Exhibit 15: Average Test Scores for HCPSS Elementary Schools, Math and Reading in the 4th Grade, 2013

	Math 2013	Reading 2013	Average		Math 2013	Reading 2013	Average
Atholton	452.0	436.6	444.3	Laurel Woods	428.1	414.6	421.3
Bellows Spring	449.2	433.4	441.3	Lisbon	440.5	435.8	438.1
Bollman Bridge	410.8	409.1	410.0	Longfellow	425.3	411.3	418.3
Bryant Woods	407.7	403.2	405.5	Manor Woods	451.6	439.1	445.3
Bushy Park	441.6	429.2	435.4	Northfield	461.5	453.1	457.3
Centennial Lane	465.7	453.6	459.7	Phelps Luck	432.1	418.1	425.1
Clarksville	465.9	448.0	457.0	Pointers Run	451.8	433.4	442.6
Clemens Crossing	460.0	442.3	451.2	Rockburn	447.5	425.4	436.4
Cradlerock	419.6	416.1	417.9	Running Brook	423.4	421.1	422.3
Dayton Oaks	446.4	429.4	437.9	St. John's Lane	455.6	454.1	454.8
Deep Run	449.1	427.6	438.4	Stevens Forest	429.5	410.7	420.1
Elkridge	428.4	415.3	421.8	Swansfield	426.6	415.6	421.1
Forest Ridge	434.5	422.5	428.5	Talbott Springs	420.0	413.0	416.5
Fulton	448.7	440.5	444.6	Thunder Hill	433.1	422.1	427.6
Gorman Crossing	444.2	430.1	437.1	Triadelphia Ridge	449.0	436.7	442.8
Guilford	422.4	407.3	414.8	Veterans	441.0	426.8	433.9
Hammond	448.0	430.4	439.2	Waterloo	442.1	423.2	432.6
Hollifield Station	445.4	424.7	435.0	Waverly	452.9	435.9	444.4
Ilchester	432.5	426.7	429.6	West Friendship	433.7	423.2	428.4
Jeffers Hill	438.7	424.3	431.5	Worthington	448.6	435.5	442.1

Source: HCPSS

Summary Statistics

Exhibit 16 summarizes statistics for the more than 1,700 homes used to drive the analysis. The diverse nature of housing is made apparent by the fact that the most expensive home in the dataset has an assessed value nearly 19 times the value of the least expensive home. The average home value is $429,005. The average home is roughly 30 years old and encompasses 2,300 square feet. Roughly three-quarters of homes come with some form of vehicle storage (attached, detached, or in the form of a carport).

Exhibit 16: Summary Statistics of Variables Appearing in Sage's Hedonic Model

Detail	Label	Mean	Standard Deviation	Minimum	Maximum
Home Value – Dependent Variable)					
Home value (from SDAT)	VALUE	429,005	199,208	87,500	1,629,000
in Logarithmic Form	LOGVALUE	12.88	0.41	11.38	14.30
Housing Characteristics – Independent Variable					
Age of the homes	AGE	30.04	19.53	0	284.00
Size of the building in square feet	BLDSQ	2,360.56	1,187.85	672.00	9,515.00
Lot size in square feet	LOT	33,814.75	51,391.97	1,132.00	601,563.6
Number of stories	STORY	1.82	0.46	1	4
Number of bedroom	BED	3.88	0.90	1	9
Number of full bathroom	FULLB	2.36	0.89	1	9
Number of half bathroom	HALFB	1.04	0.41	0	3
Vehicle storage (dichotomous)	CAR	0.75	0.43	0	1
Neighborhood Characteristics – Independent Variable					
Diversity of Population	PropMinority	0.29	0.12	0.05	0.67
Percentage of population under age 9	AGE9	0.13	0.03	0.04	0.20
Percentage of population between age 10 and 20	AGE1020	0.16	0.04	0.06	0.25
Percentage of population older than age 65	AGE65	0.12	0.07	0.01	0.45
Home ownership	OWNER	0.85	0.16	0.10	0.99
Median household income	MEDINC	124,405	38,069	64,844	210,889
Percentage of households headed by female	FEMHH	0.05	0.03	0	0.15
Percentage of adult population aged 25 and older with bachelor's degree	BAS	0.61	0.10	0.35	0.82

Source: Census Bureau, State Department of Assessment & Taxation, Zillow.com

Analytical Results

Sage's analysis generated statistical significance for key variables. The model's *R*-squared coefficient is 0.91, suggesting that the model does a good job explaining sources of variability in home prices.[65]

The coefficient of greatest interest is the one associated with the variable *TEST*. The variable is statistically significant and has a coefficient of +0.00242. This means that for each one point advance in average test score at the elementary school level, consumers are willing to pay 0.242 percent more for a home. Given the sample average value of $429,005, this means that a one point increase in test scores will raise the price of a home

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[65] Woodridge, Jeffery, M. (2005). op. cit., p.119, paragraph 2.

by $1,038.19.[66] This implies a per home difference in value of $56,270[67] between homes in the top performing school district and bottom performing school district because of higher average test scores just in the 4th grade. It is quite possible that other school attributes not measured here also impact home values in Howard County, including the perceived safety of schools, technology offered, and capacity of area high schools to promote college readiness.

Analytical Results of Sage's Hedonic Pricing Model for Howard County

$$Ln\,(V) = \quad 11.05 \quad + \quad \underline{\mathbf{0.0024TEST}} \quad - \quad 0.002AGE \quad + \quad 0.00018BLDSQ \quad + \quad 0.0000002LOT$$

| (72.28) | (7.23) | (-9.56) | (33.41) | (2.35) |

$$- \quad 0.055STORY \quad + \quad 0.026BED \quad + \quad 0.04FULLB \quad - \quad 0.0032HALFB \quad + \quad 0.17CAR$$

| (-5.49) | (5.08) | (7.03) | (-0.36) | (16.64) |

$$- \quad 0.175\,PropMinority \quad - \quad 0.40AGE9 \quad - \quad 0.028AGE1020 \quad + \quad 0.084AGE65 \quad - \quad 0.04OWNER$$

| (-3.79) | (-2.20) | (-0.17) | (0.97) | (-1.32) |

$$+ \quad 0.000002MEDINC \quad + \quad 0.63FEMHH \quad + \quad 0.16BAS$$

| (8.72) | (4.26) | (2.89) |

$R^2 = 0.9119$
$N = 1,719$

NOTE: The figures in parentheses are t-statistics. *Values greater than 1.96 indicates the coefficients are statistically significant at 95-percent confidence level.

In Summary

Sage's model indicates that the quality of Howard County schools significantly and positively impacts home values. There are many economic implications attached to this finding, including the fact that the Howard County government benefits tremendously from enhanced income. The typical homeowner also enjoys augmented home equity due to these positive impacts on residential values.

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[66] = $429,005 × 0.24% (from the analytical result).

[67] Calculated by multiplying the test score differential by $1,038.19 (i.e. the estimated increase in home value in response to a point-advance in average test scores in the school district *ceteris paribus*). According to the data supplied by the HCPSS, there is estimated difference of 54.2 points in average scores between the best and the worst performing school districts.

Measuring Economic Impact of Howard County School System

<u>Toward a More Complete Understanding of Economic Impact</u>

The preceding sections supplied overwhelming evidence of a statistically significant relationship between the quality of Howard County's public schools and home values. This section translates those results in total community-wide economic impacts. The economic impact of the Howard County school system takes the following three forms:

- *Wealth effects*: an increase in homeowners' spending power due to higher home values;
- *Income effects*: the equilibrium level of incomes is higher because home prices are higher; and
- *Operational effects*: impacts directly derived from the operations of the Howard County Public School System.

<u>Assessing the Incremental Dollar Impact on Home Values</u>

The foregoing section found that a one point increase in test scores for Howard County schools is associated with a 0.24 percent increase in home values *ceteris paribus*. This means that it is possible to discretely quantify the portion of home price differential between Howard County and the balance of Maryland attributed to school quality alone.
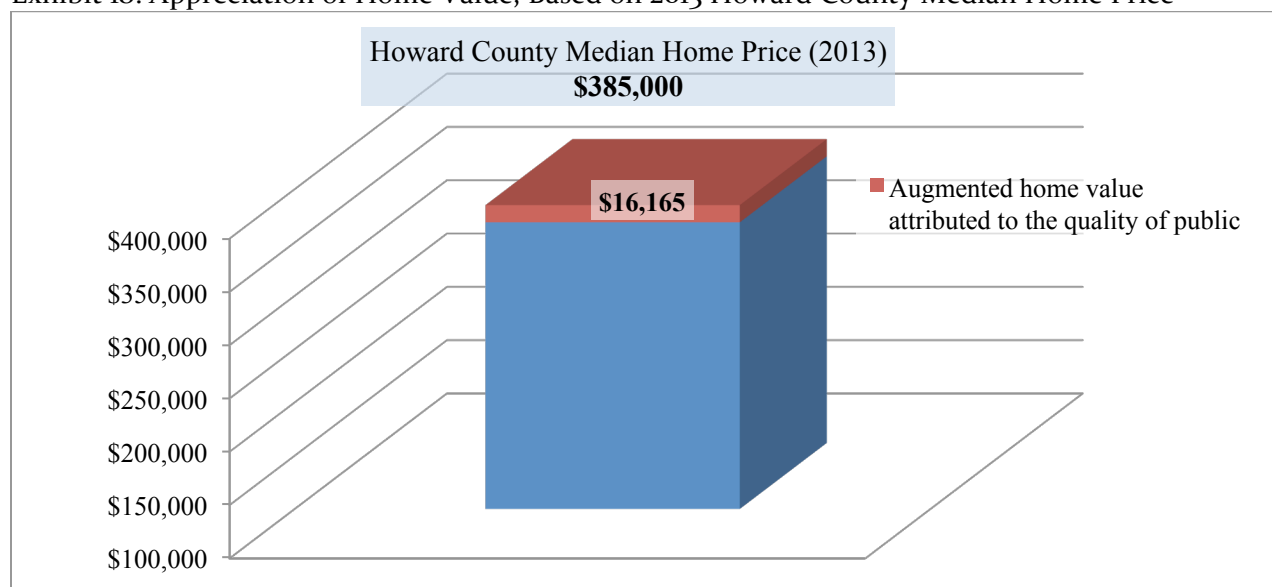
According to results of the 2013 Maryland State Assessment, the difference in median test scores in reading and math was 18 (428.6 for the State v. 446.6 for Howard County) and 16.7 (415 for the State v. 431.7 for Howard County), respectively. Averaging these two scores produces an average difference of 17.35. Using the previous 0.24 figure, this means that Howard County homes gain 4.2 percent in home value relative to the balance of the state because of superior school performance. It's important to note that a number of large Maryland school systems are deemed to be high performance school systems, including Montgomery County's, the state's largest school system, and Baltimore County's, the largest in the Baltimore metropolitan area. Based on the 2013 median home price in Howard County, this 4.2 percent differential translates into $16,165.

Exhibit 17: Median Scale Score for 2013 MSA for Grade 4, Maryland v. Howard

Math by Section	Howard	Maryland	Reading by Section	Howard	Maryland
Algebra, Patterns, or Functions	455	429	*General Reading Processes*	431	413
Geometry and Measurement	437	421	*Comprehension of Informational Text*	436	420
Statistics and Probability	450	433	*Comprehension of Literary Text*	428	412
Number and Relationship Computation	447	429	**Median:**	**431.7**	**415**
Processes of Mathematics	444	431	**Difference: Maryland v. Howard**		**16.7**
Median:	**446.6**	**428.6**	**Average score difference between Math and Reading Subjects**		**17.35**
Difference: Maryland v. Howard		**18.0**			

Source: MSDE

Exhibit 18: Appreciation of Home Value, Based on 2013 Howard County Median Home Price

Howard County Median Home Price (2013)
$385,000

$16,165

Augmented home value attributed to the quality of public

$400,000
$350,000
$300,000
$250,000
$200,000
$150,000
$100,000

Source: Maryland Association of the Realtors

Wealth effects

Academics have spent considerable time analyzing wealth effects. According to Shiller et al., studies on the subject have generally identified a positive relationship between consumption and changes in wealth.[68] An empirical study of major metropolitan areas in the U.S. between 2005 and 2007 conducted by Jiang et al. determined that for every 10

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[68] Case, Karl E., John M. Quigley, & Robert J. Shiller. Wealth Effects Revisited: 1975 – 2012. Retrieved from http://www.nber.org/papers/w18667, p.2-3.

percent increase in home prices, non-durable consumption increases by 4.1 percent.[69] (i.e. 0.41 percent for each percentage point increase in home prices). If one uses this ratio, the implication is that the higher value of homes attributable to the outperformance of Howard County schools lifts per household spending by 1.72 percent.

Exhibit 19: Estimated Wealth Effect of School Quality

Test score differential: *Howard County v. State*	% Appreciation in Home Values *ceteris paribus*... (1)	Elasticity of Spending to Wealth (% increase in spending for each percentage appreciation of home value) ... (2)	**Wealth effect of the school quality ... (1)×(2)**
17.35[1] point difference	4.2% (0.24% per score× 17.35 point difference)	0.41% (Based on the study by Jiang et al.)	**1.72%**

Source: 1. Maryland Report Card (MSDE)

According to the *consumer expenditure survey* for FY2013 from the Bureau of Labor Statistics, on average, Americans spent 79.1 percent of their before-tax income on consumer expenditures.[70] As reflected in Exhibit 20 below, using this parameter means that Howard County's collective annual household spending is boosted by $141.57 million per year, though not all of that money is spent in the county itself, of course.

Exhibit 20: Increment in Household Spending due to Wealth Effect

Average Household Income[1] (2013 1-yr estimate)	Number of homeowners (occupied homes) in County[1]	Aggregated Income ($million)	Aggregated Spending ($million) $79.1\%_2$ of pre-tax income ... (3)	**Monetized wealth effect of school quality** ($million) (1.72% of (3))
$131,886	78,877 units	$10,402.8	$8,223.8	**$141.57**

Source: 1. 2013 American Community Survey, 1-year estimate (Census Bureau). The figure is equivalent to 'owner-occupied housing units'; 2. 1. Proportion of income spent on consumer expenditure, estimation reported in 2013 *Consumer Expenditure Survey* (Bureau of Labor Statistics). Calculation by Sage.

Income effects

Greater income is required to afford a home in Howard County. The inducement to pay more for a Howard County home has much to do with the high quality of Howard County schools. Based on standard mortgage assumptions, the study team estimates that $16,165

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[69]Jiang, Shenyi, Wei Sun, & Anthony Webb. (2011). Did the housing boom increase household spending? *Center for Retirement Research of Boston College*, July 2011, No.11-10. Retrieved from http://crr.bc.edu/wp-content/uploads/2011/08/IB_11-10_508.pdf

[70] Bureau of Labor Statistics. (May 23, 2014) *Consumer Expenditure Survey: Midyear Update – July 2012 through June 2013 Average.* Retrieved from http://www.bls.gov/news.release/cesmy.nr0.htm

in additional home value translates into an additional monthly mortgage payment of $78.11.[71] According to the Census Bureau's 2013 1-year estimate, total housing cost of a typical homeowner in Howard County represents approximately 22 percent of their household income.[72] Household income is therefore $4,261 higher than it otherwise would be in Howard County due to school-related bolstered home values.

Exhibit 21: Estimation of Additional Household Income to Support the Appreciation in Home Value, per Household and Aggregated Level, Howard County

Increase in home value due to quality of schools ($4.2\% \times \$385,000_1$)	Additional annual mortgage payment ... (4)	Proportion of the annual income spent on housing$_2$ ... (5)	Additional income per household that owns their home ... (4)÷(5)
$16,165	$937.32 ($78.11 additional per month)	22.0% (based on Census Bureau)	$4,260.55

Source: 1. Howard County median home price in 2013 (Maryland Association of Realtors); 2. Based on the 2012 American Community Survey, 2013 1-year estimate (Census Bureau)

Due to the positive income effects derived from higher school quality, Howard County's households are associated with $3,368 in additional spending per annum, though again not all of this money is spent in the county itself. If one considers the county's 78,877 resident owners, the aggregated income effect is estimated at $265.7 million.[73] Exhibit 22 summarizes.

Exhibit 22: Summary of Income Effect

Additional spending per household in response to increase in income level ($4,260.55 \times 79.1\%_1$)	Aggregated Income Effect ($3,368.13 \times 78,877$ home owners$_2$)
$3,368.13	$265,667,984

1. Proportion of income spent on consumer expenditure, estimation reported in 2013 *Consumer Expenditure Survey* (Bureau of Labor Statistics); 2. Number of owner-occupied housing units (Census Bureau). Calculation by Sage

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[71] The monthly mortgage payment is estimated using standard amortization schedule calculations and assumes an annual interest rate of 4.1 percent with a fixed rate structure and 30-year payment period. These assumptions likely bias estimated income effects lower.

[72] Census Bureau, American Community Survey. *Median selected monthly owner costs as a percentage of household income in the past 12 months* (Table B25092). Retrieved from http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_12_1YR_B25092&prodType=table

[73] Census Bureau, American Community Survey. *Selected housing characteristics* (Table DP04). Retrieved from http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_12_1YR_DP04&prodType=table

Operational effects of HCPSS

HCPSS is a significant economic actor. According to its FY2015 operating budget, the System employs 8,136 people, including 4,737 teachers.[74] The organizational general fund budget approaches $760 million. Over the past 5 years, approximately 85 percent of the system's general fund expenditure (64 percent of all funds) went towards salaries and benefits for the employees of HCPSS.[75]

Exhibit 23: Operational Budget Layout, FY2011 – FY2015

	FY 2011	FY 2012	FY 2013	FY 2014 *	FY 2015*	5-year avg.
Organizational employment**	7,840	7,874	7,958	8,084	8,136	7,978
General Fund	$666,356,369	$683,462,429	$697,156,007	$725,280,030	$758,765,350	$706,204,037
Salaries	451,393,786	456,714,311	471,706,276	487,034,020	505,593,870	474,488,453
Benefits	113,889,890	116,544,689	125,637,275	136,465,250	143,493,870	$127,206,195
All Other Funds	210,082,472	215,387,087	251,096,230	244,002,620	253,193,207	234,752,323
	210,082,472	215,387,087	251,096,230	244,002,620	253,193,207	234,752,323
(Capital outlays*)	(63,267,567)	(70,311,178)	(96,636,496)	(83,502,000)	(76,084,000)	(77,960,248)
Total	$871,013,652	$897,684,512	$948,252,237	$973,096,110	$1,011,958,557	$940,401,014

Source: HCPSS; *FY2014 and FY2015 information is based on approved budgets. Data for all other years are actuals. (See http://www.hcpss.org/f/aboutus/2015-approved-budget.pdf, see page 25&29) **Id., p. 36. Figures reflect full- and part-time jobs converted into full-time equivalent positions.

Total Economic Impact in Howard County

Using standard econometric modeling, the three effects detailed above can be translated into total economic impact. As noted above, wealth and income effects are experienced by Howard County households, but not all the associated spending takes place in the county. Sage developed a model to account for this. The same is true for the school system, but not to the same extent.

Exhibit 24 reflects the results of the economic impact analysis. Together, wealth and income effects support an additional 2,035 induced jobs (jobs created through augmented consumer spending) in the county. These jobs are associated with $73.6 million in wages and salaries. The impact on local business sales from combined wealth and income effects is estimated to total $276.3 million.

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[74] HCPSS. (2014). *Approved Fiscal 2015 Operating Budget*. Retrieved from, http://www.hcpss.org/f/aboutus/2015-approved-budget.pdf p.8
[75] HCPSS. (2014) *op. cit.*, p.25.

HCPSS operations support a total of 12,418 local jobs when multiplier effects are considered. Of this total, 7,978 positions are considered direct jobs. These 12,418 jobs are associated with $464.8 million in employee compensation, which includes the value of benefits. Local business sales are augmented by an estimated $1.57 billion.

In total, HCPSS provides support for 14,453 jobs, or 12,846 jobs measured in full-time equivalents. These jobs are associated with more than $550 million in annual employee compensation. The system also supports $1.85 billion in local business sales. In other words, the economic impact of HCPSS on Howard County's economy is equivalent to approximately 8 percent of total county output.

Exhibit 24: Economic Impact of HCPSS and Howard County Schools

Location and type of impact	Change in Spending ($millions)	Full & Part-Time Jobs	Full-time Equivalent Jobs	Employee Compensation ($millions)	Employee Wages & Salaries ($millions)	Business Sales ($millions)
Wealth effects*	$141.6**	709	626	$30.8	$25.7	$96.3
Income effects*	$265.7**	1,326	1,170	$57.5	$48.0	$180.0
Wealth + Income effects		2,035	1,796	$88.2	$73.6	$276.3
Operational effects	$940.4	12,418	11,050	$464.8	$391.9	$1,574.5
Direct:	(7,978 jobs)	7,978	7,080	$277.2	$234.0	$940.4
Indirect:		2,550	2,301	$105.5	$89.3	$377.0
Induced		1,890	1,669	$82.1	$68.6	$257.1
Total Economic Impact:		14,453	12,846	$553.1	$465.5	$1,850.8
Direct:		7,978	7,080	$277.2	$234.0	$940.4
Indirect:		2,550	2,301	$105.5	$89.3	$377.0
Induced		3,925	3,465	$170.4	$142.2	$533.4

*In IMPLAN, economic impacts generated by augmented consumer outlays are considered induced impacts.
**Based on estimate of marginal propensity to spend for various income strata.

Conclusion

The superior performance of Howard County's public school system generates both positive wealth and income effects for the county's economy. These effects have been estimated through regression analysis that makes use of standardized test scores. When combined with the impacts associated with HCPSS operations, total economic impact totals $1.85 billion per annum. This activity supports nearly 14,500 jobs countywide, or 12,846 measured in full-time equivalents. These jobs are associated with more than $550 million in employee compensation per year. In other words, the economic impact of HCPSS on Howard County's economy is equivalent to approximately 8 percent of total annual county output.