Family and School Effects on the Cognitive Growth of Minority and Disadvantaged Elementary Students

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Abstract

This paper separates the effects of family environment and school on the cognitive growth of minority and disadvantaged elementary school students by examining differential achievement during the summer and school year. Hispanic, African American, economically disadvantaged students, and those with limited English proficiency start school far behind their peers. These same children suffer relative losses in skills in both math and reading during the summer, then gain skills at a faster rate during the school year. A large and persistent gap in cognitive skills remains. In addition, the non linear relationship between beginning and end of period test scores challenges one of the assumptions of prior research.

Introduction

As opportunities for unskilled workers shrink, minority and economically disadvantaged students are acquiring fewer of the cognitive skills essential for success in the labor market. (Murnane and Levy 1996) Whereas equality of opportunity in earlier decades meant removal of employment barriers, requiring civil rights legislation, the primary cause of inequality is shifting toward unequal cognitive skills. James Heckman (1998) concludes that " A careful reading of the entire body of available evidence confirms that most of the disparity in earnings between blacks and whites in the labor market of the 1990's is due to the differences in skills they bring to the market, and not to discrimination within the labor market." Heckman proposes that closing the economic gap will require "policies that promote skill formation, like improving family environments, schools and neighborhoods."

There is no consensus whether schools or families are causing this critical knowledge gap. Educators argue that much of what children are able to learn is determined by what they bring to school, including their health, attitudes and pre-school preparation to learn to read. Advocates of teachers and schools believe that America's schools are continuing to perform well but that families are no longer providing adequate learning environments. Others give schools lower grades. E. D. Hirsh (1996) believes that a lack of common curriculum, combined with romantic notions of equality of opportunity, have caused schools to evolve into ineffective and inefficient institutions. Eric Hanushek (1972) demonstrates that schools matter, but that pedagogical processes are inefficient. Chubb and Moe (1980), using an institutional focus, argue that the hierarchical structure of public schooling wrests control from those who produce the results; students, parents and teachers forcing schools to insulate themselves from political whim through highly structured and inflexible bureaucracies, making them inefficient and unresponsive.

This paper separates the influence of school and family by evaluating differences in cognitive growth during three summers and during two school years for students in the 4^{th} through 8^{th} grades. Gains or fallback during the summer reflect the influence of additional time spent with family, while school year gains or fallback are influenced by both the home environment and classroom instruction.

The paper begins by demonstrating that there is a cognitive skills gap; minority and low income Texas students are far behind their peers. The sample construction and selection are discussed, and the equivalence of test measures addressed. For a large school district, minority and disadvantaged students are shown to suffer relative fallback during the summer in both reading and math and to acquire cognitive skills at a faster rate during the school year. The effect of income on growth in cognitive skills is discussed. Exploratory regression analyses are used to study the effects of race/ethnicity, income, prior test scores, gender and age on seasonal gains. Finally, a brief summary outlines conclusions, points out policy alternatives and suggests further research directions.

Gaps in Cognitive Skills

The number of students attending Texas public schools has grown at a 10.7% annual rate during the past five years; there are now more than 3.8 million public school students in the state. A standardized test, the Texas Assessment of Academic Skills (TAAS), is administered annually to school children in grades 3-8, and in grade 10. The gap in cognitive skills for minority and economically disadvantaged students in Texas is reflected in lower scores, and lower passing rates, on all portions of the TAAS tests. (TEA 1997)

The first section of Table 1 displays statewide TAAS passing rates. Minority and disadvantaged children have been making steady, but slow progress, but gaps in passing rates continue to be large. Between 1994 and 1997 the gap in the percent of students passing TAAS reading in all grades relative to Anglo students narrowed from 17.2 % to 15.4% for African-American students, from 22.3% to 17.7% for Hispanic students, and from 24.3% to 18.7% for economically disavantaged students. Not too much should be made of this convergence, however, since it may be due to the ceiling effect, as Anglo passing rates for 1997 reached 92.4%.

Table 1. Passing Rates and Mean TAAS Reading Test Scores

Percent Passing

	1994	1995	1996	1997
All Students	76.2	78.4	80.4	84.0
African-American	60.2	63.0	66.8	73.2
Hispanic	64.9	67.9	70.3	74.3
Anglo	87.2	88.4	90.0	92.4
Economically Disadvantaged	62.9	66.1	68.4	73.7

Mean Score in Percent

	Grade 3 1994	Grade 4 1995	Grade 5 1996	Grade 6 1997
Asian-American	87.3	83.5	88.7	87.3
African-American	73.5	67.3	75.3	72.0
Hispanic	77.5	72.6	79.0	75.9
Anglo	84.5	80.7	86.3	84.1
Asian-American LEP	68.8	66.2	78.4	69.6
Hispanic LEP	62.3	58.0	67.8	59.9
Economically Disadvantaged	72.5	67.2	74.9	71.0

The second section of Table 1 gives the mean percent of reading questions answered correctly by race/ethnicity and for economically disadvantaged students for all Texas students in the 3rd through 6th grades in the 1993-94 through 1996-97 school years. The Texas Education Agency identifies five race/ethnic distinctions; Native American/Pacific Islander, Asian American, African American, Hispanic Origin, and Anglo. Throughout this paper, two additional race/ethnic categories are used to identify those Asian American and Hispanic students who were classified as limited English proficient (LEP) during 1994, 1995 or 1996. The distinction helps to facilitate identification of differential cognitive skills deficits and progress achieved by students for whom English is not the language spoken in the home, and who have either not yet, or have recently become, proficient in English usage. Due to the small number of Native American students, they are omitted from the analyses.

Table 1 shows that there are large and persistent gaps in test scores for non-Asian minority students. African-American students average 11.0% to 13.4% fewer correct answers than Anglo students, while Hispanic students average 7.0% to 8.2% fewer. Hispanic LEP students have the lowest reading scores, averaging 18.5% to 24.2% below Anglo students.

Economic disadvantage is defined as being eligible for free or reduced rate lunch. This implies a family income, adjusted for the number of family members, of less than 185% of the poverty level. Economically disadvantaged students have scores similar to those for African-American students, averaging between 11.4% and 13.5% below Anglo students. Asian students have higher average reading scores than Anglo students, while Asian LEP students score 7.9% to 15.7% lower than Anglo students, but make steady progress scoring 6.5%, 8.2%, 8.6% and 10.3% better than Hispanic LEP students.

The gap in cognitive skills, measured by reading comprehension scores, although showing some convergence, is clearly large and persistent for minority and economically disadvantaged students.

Summer Fallback

In order to assess the effect of school and family on cognitive skills, the differential progress made by students during the period including the summer will be contrasted with the school year period. Studies of summer fallback and school year gains are not a new phenomenon. Cooper et. al. (1996) unearthed 39 studies that test the effect of summer vacation, the first in 1906. Since 1975, 13 studies of cognitive growth during the school year and summer generally show some loss of cognitive skill during the summer, especially in reading.

The most thorough and probably most cited study of summer fallback was conducted by Barbara Heyns (1978). She investigated summer and school effects for a sample of 1,127 students in grades 5 through 6 and 567 students in grades 6 through 7 in Atlanta during the 1971-72 school year and summer. The study included family interviews, school marks, information about summer programs attended, and standardized test results. Heyns found evidence of differential summer fallback by income and between African-American and Anglo students. Summer school had a positive effect on higher income students, but no effect for minority and disadvantaged students.

The Beginning Schools Study, a sample of students drawn from twenty schools in Baltimore, selected for each school's degree of racial segregation, forms the basis for several assessments of summer fallback. An initial sample of 732 students in first grade in 1982-83, were tested in the spring and fall. Differential gains for math and reading were made by low income and minority students during the school year, but these children suffered larger setback during the summer. (Entwisle and Alexander 1992, 1994) A later analysis of the first five years of schooling concluded that "The generally higher level of test scores of the high socioeconomic status children thus accrues entirely from gains made in the summers." (Entwisle, Alexander and Olson 1997)

This study builds upon prior work by inclusion: African-American students will be joined by Asian and Hispanic minorities. The effects of limited English proficiency, special education, starting skills levels, and family income/race/ethnicity are examined. Like the prior studies, school year progress and summer fallback will be contrasted in order to shed light on the influence of family and school on cognitive growth.

Data and Sample Selection

The Texas Schools Micro-data Panel (TSMP) has been assembled by John Kain (Kain 1998) over the past five years. TSMP includes up to eight years of panel data for more than two million students and more than 350,000 teachers, as well as extensive data for nearly 6,000 campuses and more than 1,000 districts for the same eight year period. This student data is combined with data from a large Texas school district (District), to form the basis for the analyses in this study. Beginning with the 1989-90 school year, five cohorts of students are included in the TSMP. Following the convention that the 1989-90 school year is called 1990, the youngest of these cohorts were in pre-K and the oldest in the 3rd grade in 1990. The data base starts with 1990 because the Texas Education

Agency (TEA) implemented its Public Education Information Management System (PEIMS) in that year. TSMP also contains 26 years/grades of standardized test data for three different tests administered by TEA during this period. In all, the data base contains more than 80,000,000 records, many with more than 100 variables. Appendix A is a brief description of the Texas Schools Project and the TSMP.

One of Texas' largest school districts agreed to participate in this project by providing data in addition to that assembled by TEA. Data is for the 1987 through 1997 school years and includes three types of files: Student data consists of the assigned student ID, name, race/ethnicity, sex and home address. Test data includes the student's scores on the Iowa Test of Basic Skills (ITBS) administered in the fall of each year. Fortunately these data also indicate the District ID for the student's math, English and reading teacher, as well as the student's grade level. Teacher files include the teacher name and social security number in addition to the school at which the teacher was employed. The teacher, student, and test data for each District student is linked into a single record for each school year. Data from the TSMP, such as TAAS test scores, program participation and language proficiency is added, forming an enhanced panel data set.

Table 2 compares several characteristics of the District with those for the entire state, an inner city district, Inner City, and with a wealthy suburban district, Suburb. For most indicators, including race/ethnic makeup, percent of students who are economically disadvantage, and percent of students who are in bilingual or ESL programs, District averages more closely resemble the state wide averages than do the wealthy suburb or inner city district. The smaller Hispanic percentage than the state wide average illustrates the effect of large concentrations of Hispanic students in school districts near the Mexican border.

Note that the District has achieved higher passing rates in every category of the Texas Assessment of Academic Skills (TAAS) than either the Central City district or the state wide averages. The District has developed a stable and highly competent administration, has a good reputation and a good working relationship between administrators and teachers.

The District also includes an expanding minority population. The Director of Testing and Evaluation has told us that almost all of the District growth is due to the increasing number of Hispanic students. Conclusions drawn from District data may well be applicable to the rest of Texas and to other areas of the country where non-African-American minority populations are growing.

	Number of Students	5 Year Change	% African American	% Hispanic	% Anglo	% Other	% Econ. Dis-advantaged	% Special Education	% Bilingual/ ESL
State of Texas	3,740,260	10.7	14.0	37.0	46.0	3.0	46.9	11.0	11.0
Inner City	148,839	10.0	43.0	43.0	12.0	2.0	73.0	9.0	26.0
District	**43,553**	**14.7**	**14.0**	**20.0**	**60.0**	**6.0**	**31.9**	**11.0**	**8.0**
Suburb	38,429	26.1	5.0	7.0	79.0	9.0	9.0	10.0	4.0

All Grades % Passing

	All Tests Taken	Reading	Writing	Math	African American	Hispanic	Anglo	Other	Econ. Dis-advantaged
State of Texas	67.1	80.4	82.9	74.2	46.9	54.2	79.8	81.5	52.5
Inner City	50.8	66.7	73.1	59.8	42.5	53.4	73.8	68.8	45.7
District	**79.2**	**88.2**	**91.0**	**84.4**	**60.3**	**65.3**	**86.4**	**81.5**	**64.0**
Suburb	86.0								

of first and second grade scores are also shown, as these will be used to assess starting cognitive skill levels and the effect of the skills which children bring to school on subsequent growth in cognitive skills. The same table for math tests is given in

Table 3: Number of TAAS and ITBS Reading Scores
Students in District By Grade and Year

		1989		1990		1991		1992		1993		1994		1995		19
		Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
Grade 1	ITBS		**2,910**		**3,074**		**3,091**									
	TAAS															
Grade 2	ITBS				**3,024**		**3,079**		**3,330**							
	TAAS															
Grade 3	ITBS															
	TAAS											**3,292**				
Grade 4	ITBS												**3,418**			
	TAAS											**3,075**		**3,103**		
Grade 5	ITBS												**3,261**		**3,236**	
	TAAS											**3,035**		**3,159**		**3,290**
Grade 6	ITBS												**3,194**		**3,243**	
	TAAS													**3,074**		**3,189**
Grade 7	ITBS														**3,203**	
	TAAS															**3,127**
Grade 8	ITBS															
	TAAS															

Appendix Table B-1. The numbers of valid math test scores are similar to those for reading. Notice, however, that there are no second grade math scores. The math portion of ITBS was not administered in second grade during the 1989 through 1991 school years. Also, during 1992-1993, ITBS was administered only to students in the first and second grades. Fortunately this policy was reversed; for 1994 forward, grades 1 through 8 were tested in both reading and math. The arrows in the table indicate how the data was pooled for regression analysis.

ITBS tests were administered by the District in the fall of each year. The test dates varied from year to year and were in October during 1994 and 1996. In 1995, ITBS was given in mid-November, a full 13 weeks into the school year. Heyns (1987) finds that the further into the school year that the test is administered, the more difficult it is to separate summer effects from school year effects. She cites late fall testing as a reason for findings of insignificant summer fallback in several studies. In this study the summer season encompasses both the time when school was not in session and the first 8-13 weeks of school in the fall.

Test Scores and Equivalence

One of the major difficulties of non-experimental analyses is the inability to control the treatment and testing which are used. This analysis suffers from two different instruments being used to assess cognitive skills. As noted above, TAAS, a criterion referenced test, is administered in the spring, and ITBS, a norm referenced national test, is given in the fall.

In order to compare the results across tests, the raw reading scores for each test are first converted to z scores. For each student on each test the reading z score is the difference between the student's score from the mean score for all District students with valid scores, divided by the standard deviation for District students. Comparison of mean scores for individual students or groups of students (such as by race/ethnicity) gives the relative performance of that individual or group compared to every other District student who took the test. Unlike the absolute measures of change used in prior summer fallback research, using z scores detects relative changes. This measure can be used to assess seasonal differences, even when there may be absolute gains for all students. Z scores are particularly useful here because the fall tests were administered well into the school year.

Comparison between tests is more problematic. Do the z scores on one test measure the same thing as these scores on the other test? Are there systematic differences for groups of students? These questions cannot be answered with complete assurance. In this case, however, two statistical comparisons give some comfort that the tests may be measuring similar skill attainment.

Table 4 gives the Pearson correlation coefficients for the reading z scores for Cohort 1 which includes Grade 3 in Spring, 1994 through Grade 6 in Fall, 1996. The correlations range from .59 to .76, indicating that scores on the test are strongly positively related.

Table 4: Reading Test Z Scores Correlations

For Students Taking All Six Tests

Cohort 1 (N = 2137)

			Grade 3	Grade 4		Grade 5		Grade 6
	Test Date		Spring 1994	Fall 1994	Spring 1995	Fall 1995	Spring 1996	Fall 1996
		Test Type	TAAS	ITBS	TAAS	ITBS	TAAS	ITBS
Grade 3	Spring 1994	TAAS	1.00					
Grade 4	Fall 1994	ITBS	0.57	1.00				
	Spring 1995	TAAS	0.64	0.60	1.00			
Grade 5	Fall 1995	ITBS	0.55	0.65	0.58	1.00		
	Spring 1996	TAAS	0.61	0.55	0.69	0.54	1.00	
Grade 6	Fall 1996	ITBS	0.55	0.67	0.62	0.69	0.58	1.00

Mean Reading Z Scores and Paired Difference Test

Grade 4 District Students Taking TAAS and NAPT

Spring, 1993

	NAPT	**TAAS**	**t Statistic**	**Prob. t>|t|**	**N**
Native American	-0.40	-0.23	-0.96	0.35	22
Asian American	0.25	0.26	-0.24	0.81	95
African American	-0.54	-0.46	-1.63	0.10	208
Hispanic	-0.19	-0.22	0.59	0.55	267
Anglo	0.21	0.19	0.84	0.40	1,719
Asian EverLEP	-0.95	-0.84	-0.44	0.67	13
Hispanic EverLEP	-1.50	-1.48	-0.25	0.80	99
All	0.00	0.00	0	1	2,503

Appendix Table B-2 displays the other two cohort reading correlations and math correlations for all three cohorts. Notice that the math correlations are even higher; for Cohort 3 they ranging from .71 to a high of .83.

The second comparison, reflected in the bottom part of Table 4, takes advantage of two tests which are part of the TSMP. TAAS and an ITBS test (the Norm-referenced Assessment Program for Texas, or NAPT) were both administered to fourth grade students during May, 1993. If the two tests measure cognitive skills, and if the distributions are similar, there should not be statistically significant differences between the mean scores for the defined race/ethnic groups.

The paired difference tests for District students taking both tests, shown in the lower section of Table 4, indicate that none of the seven race/ethnic group means are statistically different (.10 two tailed test) on the two tests.[1]

If statistically significant differences in summer fallback or school year gains are found for the race/ethnic groups in the sample, we can have at least some confidence that these differences are not caused by differences in the tests.

Descriptive Analysis

Figure 1 plots the reading z scores by race/ethnicity for students in Cohort 1 who were not classified as Special Education during any one of the three years. The lowest 1993 scores are those of students who have limited English proficiency. Asian LEP students make progress moving from -.23 to .08 over the six tests.

English proficient Asian students start and end as the best performers. Their cognitive skills advantage starts at .58 and progresses to .67 standard deviations above the mean. There is little change for Anglo students who start at .48 and end at .49 above the mean and remain in the .42 to .51 range throughout the duration of this study.

The pattern of scores is much different for African-American, Hispanic and Hispanic LEP students. During the summer, English proficient Hispanic students lose .19, .26 and

[1] The distribution of TAAS reading scores is skewed to the right. Apparently the reading portion of TAAS is not difficult enough for some students. The censoring effects are, however, quite small. For example, the adjusted mean z score for TAAS Grade 3, 1994 would rise by only .03 standard deviations.

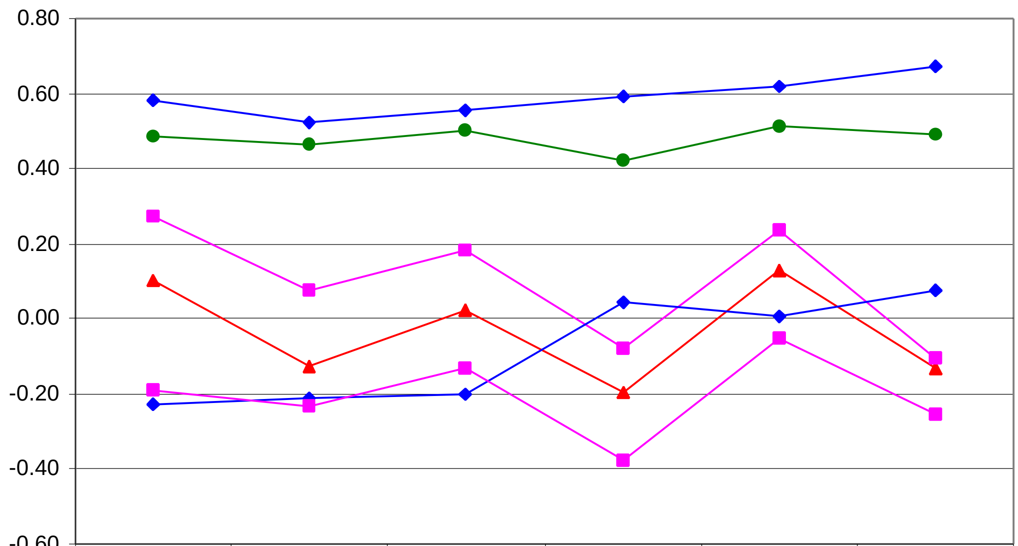
.35 standard deviations. LEP Hispanic students lose .04, .24 and .30 standard deviations. African-American students lose .22, .21 and .26 standard deviations. This summer fallback is offset by gains of .10, and .32 for both Hispanic and Hispanic LEP students, and .14 and .32 for African-American students during the school year. Looking from

Figure 1

Summer Fallback

District Students Taking All Tests

Not Ever Special Education



	spring 94	fall 94	spring 95	fall 95	spring 96	fall 96
Asian American	0.58	0.52	0.56	0.59	0.62	0.67
African American	0.10	-0.12	0.02	-0.19	0.13	-0.13
Hispanic	0.27	0.08	0.18	-0.08	0.24	-0.11
Anglo	0.48	0.47	0.50	0.42	0.51	0.49
Asian EverLEP	-0.23	-0.21	-0.20	0.04	0.01	0.08
Hispanic EverLEP	-0.19	-0.23	-0.13	-0.37	-0.05	-0.25

spring 94 to spring 96, Hispanic students lose .03 standard deviations, Hispanic LEP students gain .14, while African-American students gain .03 standard deviations. From fall 95 to fall 96 Hispanic students lose .19, Hispanic LEP students lose .02, while African-American students lose .01 standard deviations.

8.9% of the test takers correctly answered all 36 questions. See the censored distribution discussion in

During the summer season (the period between the spring TAAS test administration and fall ITBS test), the gap in cognitive skills, in this example between African-American, Hispanic and Hispanic LEP students and all other students widens, as family and neighborhood influences effect these children. During the school year, these gaps narrow. The reading skills gap between the spring third and sixth grades shows little change; these students start out and remain .4 to .6 standard deviations behind Anglo students.

Both summer fallback and school year gains are given in Table 5. The t statistics are for paired differences test for each race/ethnic group by school year or summer. Probabilities are for a two tailed test of significance. Figures in bold type indicate statistical significance at the .10 or higher level.

Table 5. Reading Z Score Differences
District Students Taking All Tests Not Special Education
By Race/Ethnicity and Period

		Summer 1994	School Year 1995	Summer 1995	School Year 1996	Summer 1996
Asian American	Difference of Means	-0.06	0.03	0.04	0.03	0.05
N = 49	t Statistic	-0.59	0.31	0.40	0.25	0.57
	Prob. t > |t|	0.561	0.759	0.694	0.806	0.573
African American	Difference of Means	**-0.23**	**0.14**	**-0.22**	**0.32**	**-0.26**
N = 235	t Statistic	**-4.08**	**2.56**	**-4.16**	**6.66**	**-5.39**
	Prob. t > |t|	**0.000**	**0.011**	**0.000**	**0.000**	**0.000**
Hispanic	Difference of Means	**-0.19**	0.10	**-0.26**	**0.32**	**-0.34**
N = 138	t Statistic	**-2.78**	1.51	**-4.50**	**5.26**	**-5.64**
	Prob. t > |t|	**0.006**	0.135	**0.000**	**0.000**	**0.000**
Anglo	Difference of Means	-0.02	**0.04**	**-0.08**	**0.09**	-0.02
N = 1285	t Statistic	-0.92	**1.83**	**-3.75**	**4.23**	-1.15
	Prob. t > |t|	0.356	**0.067**	**0.000**	**0.000**	0.250
Asian LEP	Difference of Means	0.02	0.01	0.24	-0.04	0.07
N = 36	t Statistic	0.15	0.06	2.06	-0.29	0.71
	Prob. t > |t|	0.885	0.956	0.047	0.772	0.485
Hispanic LEP	Difference of Means	-0.04	0.10	**-0.24**	**0.32**	-0.20
N = 62	t Statistic	-0.39	0.94	**-2.21**	**2.67**	-1.59
	Prob. t > |t|	0.700	0.351	**0.031**	**0.010**	0.118

Greene (1997: 959-962)

For African-American students, all five of the differences are significant, while four of five, including all three summers, are significant for Hispanic students. For Anglo students, schools produce gains relative to all other students during both years. For one summer, Anglo students suffer fallback which is significant, but their fallback is less than half the magnitude of the fallback for African-American or Hispanic students. The fallback for Hispanic LEP students is much different. Fallback is zero for the summer between 4th and 5th grade and school year gains are made during the 5th grade. All of the other summer fallback or school year gains are statistically insignificant.

The significance and magnitude of the summer fallback for African-American and Hispanic students contrasts with the baseline test of TAAS and NAPT. There appear to be large and regular seasonal differences in learning between these minority and Anglo students.

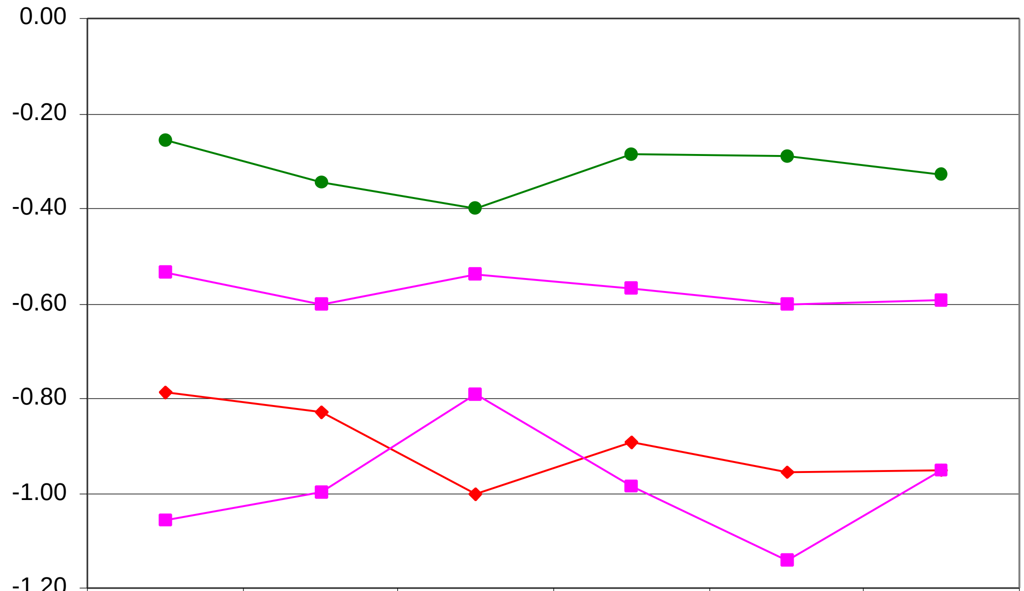
<u>Special Education Students</u>

Two earlier analyses using TSDB data, Kain and O'Brien (1998a) and Hanushek, Rivkin and Kain (1998) demonstrate that special education students require separate analysis from mainstream students due to the additional needs of these students, and programs which are provided by school districts. Figure 2 shows summer fallback and school year gains for special education students in the sample who took all six tests.
Only two District Asian-American LEP students and two English proficient Asian-American students who took all six test are classified as special education, so they are not included in the diagram. Of the remaining 314 special education students, 205 are Anglo, 53 are African-American, 34 are Hispanic and 22 are Hispanic LEP students.

Special education students have lower scores and smaller and less consistent summer fallback. Hispanic and Anglo students fall back during two of the three summers, while African-American and Hispanic LEP students fall back during one of three. None of the gains or losses are larger than .17 standard deviations.

Part of the explanation for the general lack of summer fallback may be the availability of year round programs for special education students. Some of these students are taught in non-school settings; others have specially designed year round schooling. The sample

Figure 2
Summer Fallback
District Students Taking All Tests
Ever Special Education



	spring 94	fall 95	spring 95	fall 95	spring 96	fall 97
African American	-0.79	-0.83	-1.00	-0.89	-0.96	-0.95
Hispanic	-0.54	-0.60	-0.54	-0.57	-0.60	-0.60
Anglo	-0.26	-0.35	-0.40	-0.28	-0.29	-0.33
Hispanic EverLEP	-1.06	-1.00	-0.79	-0.98	-1.14	-0.95

size may also effect the regularity of gains and losses. There are 2,137 regular classroom students, but only 318 special education students. Only one seasonal difference, the gain of .12 standard deviations for Anglo students during the summer of 1995 is statistically significant (at the .08 level using a two-tailed test).

The Effect of Income

On average, minority families also tend to have lower income and fewer financial assets than Anglo families. Perhaps summer fallback and school year gains are, at least in part, caused by differences in family financial resources. The measure of income available on the TSMP is eligibility for free or reduced rate lunch. For this study, being eligible in any one of the years in which the student took the TAAS test is used to identify low income students (Everecon). All other students are classified as high income. This measure is somewhat crude in two ways. First, there may be measurement error due to students not wanting to be classified as receiving lunch assistance, particularly in the higher grades. Second, there may be large income related effects within each of these income categories, particularly within high income, which extends from 185% of the poverty level to the highest income brackets. Despite these drawbacks, Everecon has a strong influence on cognitive skills within each race/ethnic group.

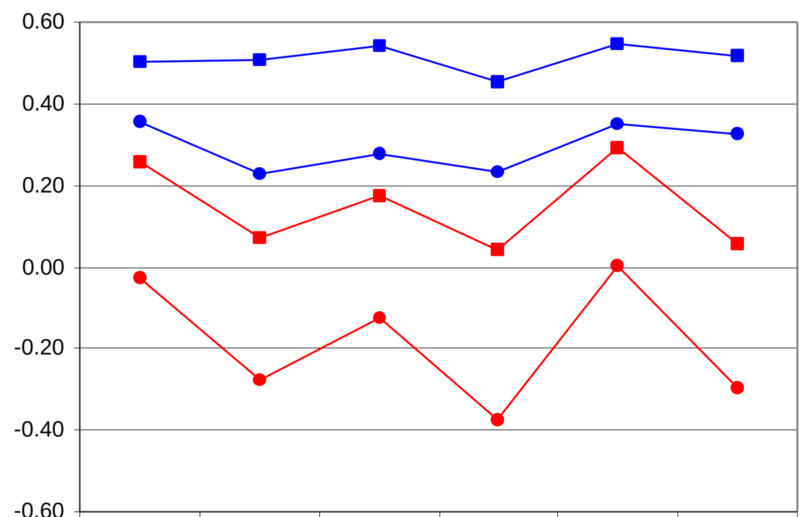
Table 6: Mean Z Scores
By Race/Ethnicity and Income for Cohort 1

	Asian		African-American		Hispanic		Anglo		Asian LEP		Hispanic LEP	
	high	low	high	low	high	low	high	low	high	low	high	low
Reading												
Number of Students	34	15	108	131	68	70	1,088	205	20	16	9	53
Spring, 1994 Grade 3	0.66	0.39	0.26	-0.03	0.34	0.20	0.50	0.36	-0.02	-0.50	-0.14	-0.20
Fall, 1994 Grade 4	0.69	0.15	0.07	-0.28	0.27	-0.11	0.51	0.23	0.03	-0.51	-0.35	-0.21
Spring, 1995 Grade 4	0.67	0.29	0.17	-0.12	0.23	0.13	0.54	0.28	-0.13	-0.29	-0.32	-0.10
Fall, 1995 Grade 5	0.66	0.44	0.04	-0.38	0.05	-0.20	0.45	0.23	0.10	-0.04	-0.23	-0.40
Spring, 1995 Grade 5	0.74	0.35	0.29	0.00	0.40	0.08	0.54	0.35	-0.01	0.02	0.08	-0.07
Fall, 1996 Grade 6	0.71	0.58	0.06	-0.30	0.02	-0.23	0.52	0.33	0.08	0.07	0.01	-0.30
Math												
Number of Students	36	14	111	122	66	75	1,061	203	17	16	9	52
Spring, 1994 Grade 3	0.79	0.30	0.12	-0.15	0.41	0.06	0.57	0.32	0.09	-0.43	-0.10	-0.25
Fall, 1994 Grade 4	0.92	0.33	0.07	-0.24	0.31	-0.26	0.56	0.26	0.13	-0.03	-0.44	-0.23
Spring, 1995 Grade 4	0.76	0.48	0.25	-0.09	0.41	0.10	0.56	0.34	0.28	0.29	-0.43	-0.11
Fall, 1995 Grade 5	0.79	0.52	0.04	-0.30	0.31	-0.12	0.51	0.21	0.39	0.05	-0.58	-0.19
Spring, 1995 Grade 5	0.80	0.68	0.19	-0.10	0.47	0.02	0.58	0.37	0.47	0.36	-0.13	0.04
Fall, 1996 Grade 6	0.88	0.41	0.03	-0.28	0.30	-0.23	0.57	0.34	0.38	0.12	-0.34	-0.32

Table 6 shows the mean reading and math scores by race/ethnicity and income for students in Cohort 1. A cursory inspection of Table 6 reveals a pattern of Z score differences by income. For example, for English proficient Hispanic students low income results in a gap of between .10 and .38 standard deviations for reading and .27 to .34 standard deviations for math. In the entire table, with 72 pairs of scores, there are only 8 sign reversals, where the high income group has lower scores than the low income group. Seven of these are for Hispanic LEP students, where the high income group consists of 9 students, and the other for Asian LEP students, which has only 16 low income students.

Scores for the remaining cohorts are given in Appendix Table B-3. Of the 108 reading and 108 math z scores means, there are 12 reading and 20 math sign reversals. None of these are for African American or Anglo students, and only 3 of the 36 mean z scores for high income Asian and 5 for high income Hispanic students are smaller than those for low income students. Within race/ethnic groups, low income students consistently score lower than high income students.

Figure 3
Anglo and African American Reading Z Scores
By Income for Cohort 1



	Spring 94	Fall 94	Spring 95	Fall 95	Spring 96	Fall 96
African American High	0.26	0.07	0.17	0.04	0.29	0.06
African American Low	-0.03	-0.28	-0.12	-0.38	0.00	-0.30
Anglo High	0.50	0.51	0.54	0.45	0.54	0.52
Anglo Low	0.36	0.23	0.28	0.23	0.35	0.33

The effect of income on summer fallback for African American and Anglo students is illustrated in Figure 3.   High income Anglo students have the highest mean reading z scores on each test, followed by low income Anglo students, High income African American students and finally low income African American students. The pattern of summer fallback and school year gains is consistent across race/ethnic and income groups. High income Anglo students show almost no seasonal variation, while the distinct pattern of summer fallback and school year gains is most pronounced for low income African American students. Appendix Figure B-1 illustrates that the same relationship holds for math scores.[2]

Several recent studies employ the TSMP data to demonstrate the effect of poverty on elementary school student cognitive growth. Table 7 shows the income effects from Kain and O'Brien (1998a). Value added equations are used to assess the income/race/ethnicity

Table 7. Estimated Effects of Family Income on Test Scores

By Race/Ethnicity

	Grade 4	Grade 5	Grade 6	Grade 7
Asian- High	0.03	0.03	-0.03	0.00
Asian- Low	-0.10	-0.01	-0.12	-0.01
Asian-Very Low	-0.09	-0.01	-0.15	-0.05
Black-High	-0.34	-0.13	-0.21	-0.08
Black-Low	-0.41	-0.15	-0.25	-0.13
Black-Very Low	-0.48	-0.23	-0.29	-0.16
Hisp-High	-0.19	-0.06	-0.14	-0.05
Hisp-Low	-0.27	-0.11	-0.17	-0.07
Hisp-Very Low	-0.33	-0.13	-0.23	-0.11
Anglo-Low	-0.11	-0.05	-0.08	-0.05
Anglo-Very Low	-0.18	-0.08	-0.13	-0.06

[2] These patterns are consistent across both subject and cohort. The patterns also persist when comparing medians instead of means. Tables of means and medians for each subject and cohort are available from the author.

effect from one year to the next. Students are in grade 4 in 1993 and are evaluated through grade 7 in 1996. The regressions control for individual characteristics including gender, special education, limited English proficiency, and retention or double promotion, as well as the probability of taking the test if the student was ever classified as limited English proficient or special education. Campus fixed effects were used to remove systematic correlation of schools such as neighborhood income levels and teacher quality. The equations explained between 51% and 59% of the variation in test scores.

The coefficients of the income/race/ethnicity variables are highly regular. The missing category against which the coefficients are compared is high income Anglo students. Only three of the 44 coefficients are positive. Each of the positive coefficients is for high income Asian-American students. All are small in magnitude, and one is statistically insignificant. The remaining 41 coefficients are each statistically significant and reveal a clear and simple pattern.

Both the entire TSMP and the sample which includes District students clearly illustrate that students within each race/ethnic group from low income families score below those from high income families. Summer fallback and school year gains are more pronounced for economically disadvantaged minority students.

Starting Scores

Summer fallback appears to indicate that for economically disadvantaged minority students, family environment is an important contributor to cognitive skills. Further evidence of the influence of family is available by examining differential preparation to begin school, here measured by ITBS tests administered in the first grade. First grade ITBS test scores are available for reading and math for students in each of the three cohorts being studied. Table 8 shows reading and math mean first grade z scores for each race/ethnic and income group for students in each cohort.

Table 8: First Grade Reading and Math Z Scores
By Race/Ethnicity/Income and Year

	Asian High	Asian Low	African American High	African American Low	Hispanic High	Hispanic Low	Anglo High	Anglo Low	Asian LEP High	Asian LEP Low	Hispanic LEP High	Hispanic LEP Low
Reading												
Grade 1, 1989	0.46	-0.27	0.19	-0.22	0.05	-0.07	0.47	0.24	-0.83	-0.33	-0.64	-0.74
N = 1,221	36	17	70	41	67	74	788	83	4	4	3	34
Grade 1, 1990	0.71	0.47	0.41	0.13	0.34	0.19	0.53	0.31	-0.10	-0.55	-0.81	-1.10
N = 1,343	32	7	67	61	47	69	850	112	11	3	6	78
Grade 1, 1991	0.79	0.02	0.28	-0.26	0.08	-0.33	0.47	0.13	0.17	-0.22	0.11	-0.60
N = 1,431	30	12	81	86	47	51	921	135	18	6	8	36
Math												
Grade 1, 1989	0.14	-0.17	0.01	-0.41	-0.14	-0.16	0.55	0.36	-1.27	-1.01	-0.39	-0.75
N = 1,209	36	16	68	38	67	74	783	82	4	4	3	34
Grade 1, 1990	0.40	0.51	0.17	-0.16	0.00	-0.15	0.55	0.35	-0.26	-0.15	-0.59	-1.01
N = 1,322	31	7	66	61	45	67	839	111	11	3	6	75
Grade 1, 1991	0.54	0.04	-0.01	-0.11	-0.01	-0.32	0.49	0.34	-0.52	-0.57	0.19	-0.75
N = 1,413	30	12	79	85	44	51	908	136	18	6	8	36

Looking at Hispanic students, for each test the mean z score for low income students is lower than for students from high income families. The gap ranges from .12 standard deviations for first grade, 1989 reading z scores to .33 standard deviations for math z scores in 1991. For all three cohorts, there is only one reading Z score sign reversal, for Asian LEP students in 1989, and only three for math, one for Asian students in 1990, and two for Asian LEP students in 1989 and 1990. In the remaining 32 race/ethnic income categories, high income z score means are higher than low income. The first grade z score income gaps are quite large, ranging from .15 to .34 standard deviations for Anglo students, from .12 to .54 standard deviations for African American students and from .12 to .33 standard deviations for Hispanic students.

It appears that economically disadvantaged minority students start grade school far behind. They then fall back during each summer, and make progress during each school year. But large gaps in cognitive skills remain throughout the elementary grades.

Value Added Regressions

In order to further assess the influence of family income/race/ethnicity, gender and age on the growth in cognitive skills during the school year and summer, a series of fixed-effects regressions are performed. Fixed effects refers to subtracting the mean characteristics for each group, in this case students at a single school and grade, from the student's characteristics before performing the regression calculation. The result is that the systematic correlation of common treatments or characteristics for members of the group are controlled. For the summer periods, effects are fixed for the campus attended by the student during the prior school year; for the school year, the campus at which the test was taken is used. Campus fixed effects helps to eliminate some of the influence of school administrative practices , funding differences, and characteristics of the student's peers, such as skill levels and mobility, and the influence of living in the neighborhood served by the school.

In order to increase the sample size, particularly for minority groups, students in grades 4, 5, 6 and 7 in adjacent cohorts were pooled. This nearly doubles the number of students in each regression, from approximately 1,800 to about 3,600.

Table 9 shows the reading regressions for the summer after 4th grade, 5th grade school year and summer after 5th grade periods. Additional reading regression results for the summer after 5th grade, 6th grade school year and the summer after 6th grade, as well as math regressions for both sub-samples are included in Appendix tables B-4 through B-6. Coefficients with t-scores greater than 2.0 are shown in bold type.

The regressions explain approximately half of the variation in the post-test scores with R^2 in the tight .49 to .50 range, and .50 to .52 in the 5th-6th grade reading regressions. The math estimates explain substantially more with R^2 between .61 and .67. There were 39 campuses serving 4th grade students in 1994, an additional campus was added for the 1995 school year. When the students reach 6th grade, they change schools, there are 13

	Coef.	t-score	Coef.	t-score	Coef.	t-score
Pretest	**-0.61**	**-6.2**	**1.32**	**16.7**	**-0.93**	**-8.9**
Pretest squared	**0.16**	**12.3**	**-0.12**	**-12.3**	**0.21**	**15.3**
First Grade Score	**0.14**	**8.4**	**0.10**	**7.9**	**0.22**	**13.0**
Gender	**-0.04**	**-2.0**	**-0.06**	**-3.3**	**0.05**	**2.2**
Age	-0.06	-1.9	**-0.11**	**-4.7**	**-0.17**	**-5.9**
Asian Low	**0.31**	**2.3**	-0.11	-1.1	0.24	1.8
Asian High	-0.02	-0.2	0.01	0.2	0.02	0.2
African Amercian Low	**-0.23**	**-4.8**	**-0.18**			

variable is the student's previous test z score. For the summer, it is the spring TAAS reading z score, and for the school year, it is the fall ITBS reading comprehension z score.

The square of the pre-test score is included to test for non-linearity. Since there are many Z scores which are negative, the constant value 4 was added to each pre-test score prior to the regression. This made each Z score and its square a positive value.

In the estimate for each period, both the test score and its square are highly statistically significant. Also notice that the sign for the test score is positive during the school year and negative during the summer. The sign of the squared test score is the opposite, negative for the school year and positive for the summer. The relationship between the pre-test and post-test is significant, non-linear and changes shape from the summer through the school year. As Appendix Tables B4-B6 demonstrate, this pattern is repeated for both math and reading regressions for each 5^{th}, 6^{th} and 7^{th} grade pooled sample. The math regression for the summer after the 4^{th} grade is the only exception; the sign of the pre-test score is positive, but the coefficient is not statistically significant.

For the first grade scores, the actual score was included in the regression if it was available. Separate regressions were run to estimate first grade scores for each student for whom the first grade score was missing. For both the summer and school years, first grade scores are statistically significant and positive. The same result is true for all of the regressions in Appendix Tables B4-B6. The student's preparation for school is an important predictor of later success.

The student's gender does not exhibit a consistently large or significant contribution to growth in cognitive skills in reading or math. Older students tend to have smaller gains during both the summers and school years. In all 12 regressions, the sign is negative, and in 10 of 12, is statistically significant. This may reflect student retention in one of the first three grades.

The Effect of Race/Ethnicity/Income

The omitted category for family income/race/ethnicity is high income Anglo students. Of the 33 estimates, 17 have t scores less than 2.0. A lack of significance indicates scores which are not significantly different from those for Anglo high income students or for which there are very small sample sizes. In the 5^{th} grade, controlling for prior test results, gender, age and first grade test scores, both Asian and Hispanic students had test scores similar to high income Anglo students.

The scores for African American students, and all LEP students, however, were from .09 to .54 standard deviations below those for high income Anglo students. Low income students also had lower scores. The income gap was .09 standard deviations for African American students, .14 standard deviations for Asian LEP students, and .24 standard deviations for Hispanic LEP students. For the six reading and six math regressions, all 12 of the African American scores are negative relative to high income Anglo students, and are lower for low income then high income students. For Hispanic students, both scores are significant in 3 of the 12 regressions. The income gaps are between .07 and .08 standard deviations in each of these cases.

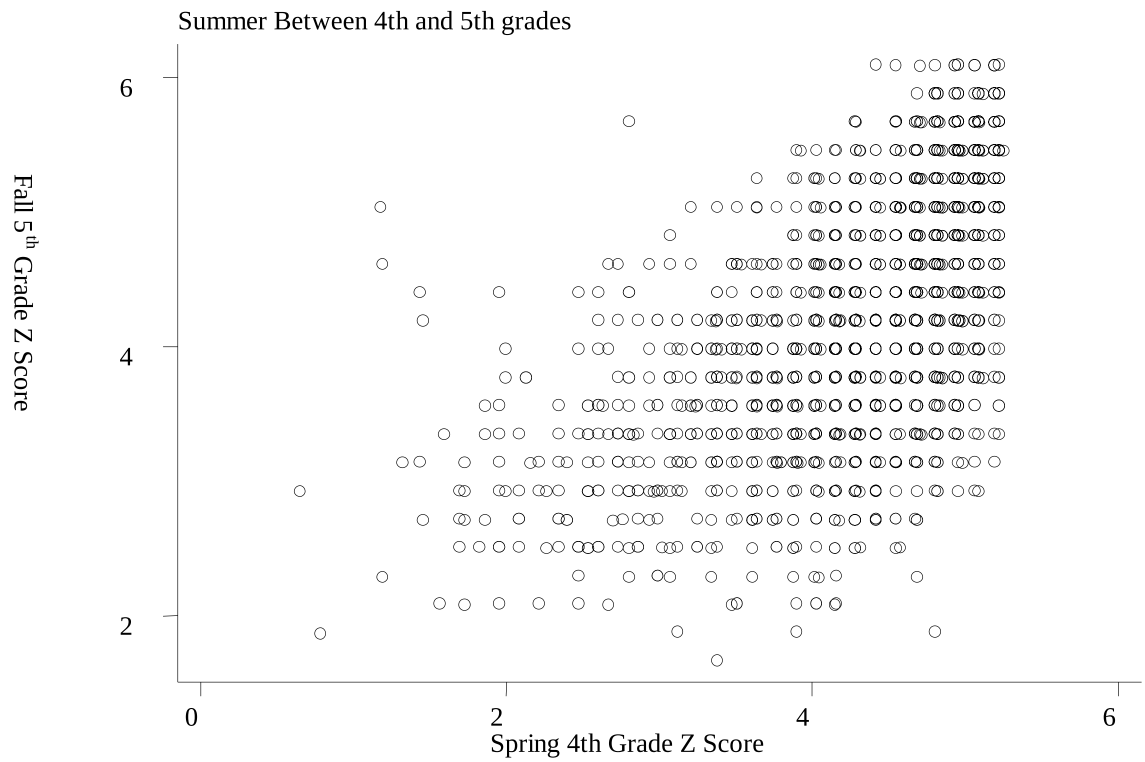
With this more limited sample size, there is less significance than the Kain and O'Brien results shown in Table 7, but predominance of negatively signed coefficients for non-Asian minorities supports prior findings that there is a persistent gap in test scores for minority students, even when prior test scores and classroom characteristics are controlled. The gap in scores persists at the end of each summer season and school year.

The Effect of Prior Scores

What, then causes summer fallback? The size and signs of the race/ethnicity/income, student age, gender are similar between the summer and school years. However, both the preparation for school and score on the pre-test are very different between summer and school year.

The positive sign and statistical significance of the first grade score coefficient means that higher first grade scores result in higher post-test scores for both the summer and school years. However, the size of the first grade score effect is larger during each summer than during each school year. In Table 8, for example, a one standard deviation increase in first grade score results in a .14 standard deviation increase in the 5th grade fall score and a .22 standard deviation increase in the 5th grade fall score. During the summer period, a one standard deviation increase results in only a .10 standard deviation change in the 5th grade spring score. The summer coefficient averages .12, while the school year coefficient averages .17. About .05 standard deviations of the difference in summer fallback and school year gains appears to depend on preparation for school.

Figure 4. Actual and Predicted Pre-test and Post-test Scores



The effect of the prior test score also differs between summer and school year. Both the pre-test score and its squared value are significant in 11 of 12 regressions, indicating a non linear relationship. These summer and school year relationships for the reading regressions shown in Table 8 are depicted in Figures 5 and 6, which plot the values of the pre-test and post-test as well as the predicted values of post-test for the summer after 4th grade and the 5th grade school year, respectively. The graphs are similar for each of the other school year and summer period regressions.

As the graphs indicate, the impact of an increase in score depends on the starting score level. During the summer, a one standard deviation increase in pre-test score yields a .29 standard deviation increase in post-test score for a student with a –1.0 z score, but yields a .93 standard deviation change in post-test score for a student with a 1.0 z score. There is an increasing rate of return for pre-test gains.

Figure 5. Actual and Predicted Pre-test and Post-test Scores

5th Grade School Year

Spring 5th Grade Z Score

2

Fall 5th Grade Z Score

During the school year, a pre-test gain of one standard deviation yields a post-test increase of .1.56 standard deviations for a student with a z score of –1.0, but only a gain of 1.08 standard deviations for a student with a pre-test z score of 1.0. The model predicts a diminishing rate of post-test gains for pre-test gains.

Because minority and disadvantaged students have lower pre-test scores, their post-test scores at the end of summer are relatively lower in the fall, while lower scores at the beginning of the school year result in faster relative gains during the school year.

Summary and Conclusions

This paper supports the findings of Doris Entwisle and Karl Alexander as well as those of Barbara Heyns that minority and disadvantaged elementary school students suffer differential fallback in cognitive skills during the summer months when the influence of family is the strongest. These same children gain cognitive skills at a faster rate than other students while school is in session. Schools help low performing students the most. The findings are robust across subjects, grades and cohorts, and generally apply to Hispanic students with and without English proficiency. The findings are most powerful and consistent for African American students.

The finding that summer fallback is the sole cause of cognitive skill gaps for minority and disadvantaged children is not supported. For each cohort, representing grades 3-6, 4-7 and 5-8, relative summer losses in cognitive skills during the summer is completely offset by gains during the school year. The large gaps in cognitive skills in the early grades remain large for Hispanic, Hispanic LEP and African American students. Asian LEP students, however, achieve noticeable relative gains from year to year.

Differences in income affect cognitive skills. Low income Anglo students also suffer some summer fallback, and some progress relative to other students during the school year. The magnitude of these changes is small compared to those for African American and Hispanic students. For Hispanic and African American students the regular pattern of school year gains and summer fallback is similar for high and low income students. Low income students of all race/ethnic groups have lower test scores than high income students.

The findings described in this paper demonstrate that the relationship between pre-test and post-test scores over the summer and school years is significantly non-linear. An increase in the pre-test score for low pre-test students results in a smaller gain during the summer, and a larger gain during the school year than the gain for high pre-test students. Prior studies treat pre-test to post-test scores as a linear relationship, and with difference and difference-of-difference analyses, as linear and having a coefficient of one. These analyses also overlook the large seasonal variations demonstrated here and in prior studies of summer fallback. Both non linearity and seasonal differences should be considered in future studies.

The results of this analysis have been presented and discussed with the research and testing supervisors from several Texas school districts. Although they share some of the concerns about the equivalence of test scores noted earlier, their initial reaction is that something ought to be done in order to minimize summer fallback. The options discussed include summer school, year round schools and extending the school year.

Prior research indicates that summer school programs must be highly structured and focused on academic improvement in order to be effective. I know of no evidence which indicates that year round school, which offers the same number of instructional days as the current school year, makes any difference in cognitive skill gaps. Comparison of the length of the school year across countries does indicate that extending the school year could help minority and disadvantaged students. The fiscal, political and social obstacles to greatly increasing the length of the school year may render this option moot.

The District offered voluntary summer programs for low scoring students for the past two summers. District administrators have recently agreed to share data on program results.

These programs were academically oriented; the analysis may provide new evidence that summer programs can help to reduce summer fallback.

Another large district is starting to test student reading skills by administering a norm referenced test in both the spring and fall as part of a reading improvement initiative. These tests will initially be given in pre-K through 2nd grade, but will be extended to higher grades as the students progress. The Green Center will participate in the evaluation and will analyze summer fallback and school year gains for these students. This new study will overcome any problems caused by different test instruments, and will extend the analysis to the earliest grades.

Families and schools have large and opposing effects for minority and disadvantaged children. These students begin school with lower cognitive skills, make relative gains during the school year, and lose this ground during each summer. There are no easy, obvious or available solutions. However, preventing summer fallback would greatly increase the chances that the gap in cognitive skills for minority and disadvantaged students could be eliminated. Equality of cognitive skills would help to make the goal of equal opportunity possible.

Appendix A

Description of the UTD Texas Schools Project

The UTD Texas Schools Project is a multiyear research project whose goals are to obtain a better understanding of the determinants of student performance with the long-term objective of providing a knowledge/research base to improve the performance of public schools.

John F. Kain, Cecil and Ida Green Chair for the Study of Science and Society at UTD, initiated the Harvard/UTD Texas Schools Project in 1992 when he was a Visiting Professor at UTD. Prior to accepting a permanent UTD appointment in spring 1997, Professor Kain was the Henry Lee Professor of Economics and Professor of Afro-American Studies at Harvard, where the project was previously housed. It is now housed at UTD's Cecil and Ida Green Center for the Study of Science and Society.

The project's primary focus to date has been the creation of the Texas Schools Microdata Panel (TSMP). This database already includes eight years of linked micro data for more than two million students attending Texas public schools. These data will be used for research on a large number of important questions that are either poorly understood or for which there has been, heretofore, little or no research or even systematic information.

TSMP currently includes individual student, teacher, district and campus data for the eight-year period 1990-1997.[3] The student data include enrollment, attendance and standardized test records for more than two million students belonging to five cohorts. As Table 1 reveals, the members of the youngest cohort were in Pre-K during the 1989-90 school year while members of the oldest were in third grade in the same year. TSMP begins in the 1990-91 school year because TEA implemented its PEIMS (Public Education Information Management System) in that year. In each subsequent year, TEA has improved the quality and extent of these data. The letter and number designations in the columns labeled Test/Grade in Table 1 identify particular standardized tests by grade and type of test NAPT (Norm-referenced Assessment Program for Texas) and TAAS (Texas Assessment of Academic Skills). Thus, N-5 under Cohort 1 refers to the fifth grade NAPT, while T-7 under Cohort 1 refers to the eighth grade TAAS.

In addition to student data, TSMP includes individual data for all Texas public school teachers for the same eight-year period. Currently we are able to link these teacher data to individual students at the campus, grade and program (bilingual, ESL (English as a Second Language), special education, gifted and talented) level. In the future, we hope to obtain data that will permit us to link individual students to their specific teachers.

[3] PEIMS is a yearly relational data base and TEA makes no effort to link these data across years. To construct TSMP, we had to combine annual PEIMS teacher and student data with TAAS, NAPT, and various teacher certification tests that are not part of PEIMS, and link these data across years. As Appendix Table A-1 reveals, to create TSMP we had to combine data from more than 140 individual student files and more than 110 individual teacher files, as well as campus level data from TEA's AEIS files, block group data from the 1990 Census and district level data from the School District Data Book CD ROMs. The number of individual records included in TSMP exceeds 102 million.

Table 1. Total Students and Standardized Tests Included in the Texas Schools Data Base by Cohort, Grade and Test

Year	Total Students (Enrollment)	Sem	Cohort 1		Cohort 2		Cohort 3		Cohort 4		Cohort 5	
			Gr	Test/ Grade	Gr	Test/Gr ade	Gr	Test/Gr ade	Gr	Test/Gr ade	Gr	Test/Gr ade
89-90		F	3		2		1		K		PK	
89-90	1,161,358	S	3		2		1		K		PK	
90-91	1,505,551	F	4		3	T-3	2		1		K	
90-91	1,391,735	S	4		3		2		1		K	
91-92	1,420,295	F	5		4		3	T-3	2		1	
91-92		S	5	N-5	4	N-4	3	N-3	2		1	
92-93	1,415,593	F	6		5		4		3	T-3	2	
92-93		S	6	N-6	5	N-5	4	N-4 & T-4	3	N-3	2	
93-94	1,428,908	F	7		6		5		4		3	
93-94		S	7	T-7	6	T-6	5	T-5	4	T-4	3	T-3
94-95	1,438,632	F	8		7		6		5		4	
94-95		S	8	T-8	7	T-7	6	T-6	5	T-5	4	T-4
95-96	1,459,220	F	9		8		7		6		5	
95-96		S	9		8	T-8	7	T-7	6	T-6	5	T-5
96-97		F	10		9		8		7		6	
96-97		S	10	T-10	9		8	T-8	7	T-7	6	T-6

Even without this valuable extension, we are able to complete educational histories for individual students as long as they attend Texas public schools. Skillful use of these data should enable us to more accurately and effectively assess the performance of Texas schools than can be done with the fragmentary data that are currently available. These data should also allow us to develop a better understanding of the causes of low student performance. If the required funding can be obtained, we will continue to follow individual students belonging to the current five cohorts until they have completed high school or dropped out, as well as add additional cohorts. The availability of data for more recent cohorts will enable us to assess the effectiveness of various ongoing school reform efforts, such as TEA's accountability system and Governor Bush's reading initiative.

While the TEA data are of unprecedented quality and extent, important gaps remain. Therefore, as time and funding permit, we plan to add information obtained from individual school districts to TSMP. Among the highest priorities in terms of data base enhancements are: earlier (first and second grade) tests for students already included in our data base, information that will enable us to link individual students to individual teachers, and additional family background variables. We have already held discussions with officials in 12 districts in the Dallas, Fort Worth and Corpus Christi PMSAs. Three of them have already provided us with supplementary data and three others have agreed to participate. We are continuing our discussions with the remaining nine districts and plan to meet with others as time allows.

We plan to use TSMP to examine a number of specific educational issues. As we add years and cohorts to the database and enrich it by adding district specific data, its analytical usefulness and power will greatly increase. We are already committed to completing research on three important areas, the impact of increased minority access to suburban schools on the performance of minority children, on special education and on bilingual education.

The Spencer Foundation, which has provided nearly $400,000 of funding for this work, supported the collection of data for the first five cohorts and eight years of data, as well as the difficult and time consuming effort of creating TSMP from TEA's disparate and unlinked annual data. Spencer also funded the project's first substantive focus, an investigation of the impact of increased minority access to suburban schools on the academic performance of minority, and especially African-American, children.

In fall 1996 the Smith-Richardson Foundation provided an additional $200,000 in funding for what we anticipate will be the first of several studies that will use data from the TSMP for research on a variety of educational policy issues. In this study, Eric A. Hanushek (Rochester University) and Stephen Rivkin (Amherst College) will join Professor Kain in an analysis of special education programs in Texas. Special education, which is the most rapidly growing segment of public education, has been subject to very little systematic research.

Other high-priority analyses include research on TEA's accountability system, on alternative instructional strategies for reading and their effects, on the determinants of teacher supply, on the impact of mobility on student performance, and on the extent of student turnover/flux in Texas schools and its effect on individual student achievement.

Support of Ph D Dissertations

Two UTD graduate students are currently completing Ph.D. dissertations as part of the Texas Schools Project. They are receiving financial support from the Green Center and their research combines TSMP data with supplementary data obtained from one or more school districts.

Daniel M. O'Brien is examining two areas. They are the effects of summer fallback on the achievement of low income and minority students and the effects of early tests on student achievement. Summer fallback refers to the summer achievement declines that appear to occur for low-income children during a period when middle and high income children continue to experience gains. O'Brien's research on the effects of early tests will be useful in assessing the biases that arise in the Harvard/UTD Texas

School Project from the fact that the earliest tests in the larger data base is given in the third grade.

Sharon Wrobel, who has just begun her thesis research, is studying bilingual education in one of the states largest districts and will help that district assess its efforts to strengthen its bilingual programs. Like O'Brien, Wrobel has been able to supplement TSMP data with data obtained from the district she is studying. These data include the scores obtained by Limited English Proficient (LEP) students on the English proficiency tests that are used in determining whether they should be assigned to bilingual, ESL or regular programs. A test of this kind is given to all LEP students attending public schools, but the scores are not supplied to TEA. Thus, they are not included in TSMP.

Publications and Working Papers

John F. Kain and Kraig Singleton. "Equality of Educational Opportunity Revisited." New England Economic Review. (May/June), 1996.

John F. Kain and Daniel M. O'Brien, "How Much Has Moving to the Suburbs Increased African American Educational Opportunities," Paper prepared for the meetings of the American Economics Association, Chicago, Illinois, January 5, 1998.

Steven G. Rivkin, Eric A. Hanushek and John F. Kain, "Teachers, Schools and Academic Achievement," Paper prepared for the meetings of the Econometric Society, Chicago, Illinois, January 4, 1998 (Revised July 1998).

John F. Kain, "Using TEA Annual Data to Develop a Multi-Year Panel Data Base: Lessons Learned and Suggested Additions and Improvements to TEA's Data Collection," Prepared for the 12th Annual Texas Assessment Conference, February 15-18, 1998. Renaissance Austin Hotel, Austin, TX.

John F. Kain and Daniel M. O'Brien, "Minority Suburbanization in Texas Metropolitan Areas and Its Implications for Educational Opportunity," Presented at Conference on Suburban Racial Change, Harvard University, March 28, 1998.

John F. Kain and Daniel M. O'Brien, "A Longitudinal Assessment of Reading Achievement: Evidence from the Harvard/UTD Texas Schools Project," Presented at the

Daniel M. O'Brien, "Do Low Income Children Suffer Summer Fallback in Achievement," Presented at Institute for Research on Poverty Summer Workshop, "Problems of the Low-Income Population," June 15-18, 1998.

Eric A. Hanushek, John F. Kain and Steven G. Rivkin, "Does Special Education Raise Academic Achievement for Students with Disabilities," June 1998.

Eric A. Hanushek, John F. Kain and Steven G. Rivkin, "The Effects of Differences in Teacher Salaries," July 1998.

Table A-1. Data and Files Included in the Texas Schools Microdata Panel (TSMP)
(Data for the 1990-97 School Years, Eight Years of Data)

File Types	Years	Files	Total Records
Student			
PEIMS Demographic	5	5	7,948,609
PEIMS Enrollment	8	8	11,147,832
PEIMS Chapter I Enrollment	8	8	5,330,209
PEIMS Special Ed Enrollment	8	8	1,465,578
PEIMS Voced Enrollment	4	4	986,627
PEIMS Gifted Enrollment	6	6	392,462
PEIMS Summer Demographic	5	5	7,948,609
PEIMS Basic Attendance	4	24	33,017,628
PEIMS Special Ed Attendance	4	24	6,984,950
PEIMS Voced Attendance	4	24	986,627
TAAS	7	22	6,259,435
NAPT	2	7	1,683,009
TEAMS	1	1	286,982
Total Student Files/Records			84,438,557
Teacher			
PEIMS Staff	8	8	2,421,138
PEIMS Employment	8	8	2,421,138
PEIMS Payroll	8	8	4,013,119
PEIMS Class	8	8	7,788,629
PEIMS Nonclass	8	8	366,579
PEIMS Permit	8	8	82,021
TECAT	5	1	145,711
ExCET	5	64	292,696
TOPT	5	1	4,894
PPST	5	1	54,125
TASP	5	1	32,032
Total Teacher Files/Records		116	17,622,082

Table B1: Number of TAAS and ITBS Math Scores

Students in District By Grade and Year

		1989		1990		1991		1994		1995		1996	
		Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
Math													
Grade 1	ITBS	3011		3055		3050							
	TAAS												
Grade 3	ITBS												
	TAAS							3,294					
Grade 4	ITBS								3,400				
	TAAS							3,086		3,102			
Grade 5	ITBS								3,238		3,204		
	TAAS							3,036		3,150		3,296	
Grade 6	ITBS								3,192		3,193		3,299
	TAAS									3,083		3,195	
Grade 7	ITBS										3,198		3,208
	TAAS											3,123	
Grade 8	ITBS												3,071
	TAAS												

Table B-2: Test Score Correlations

Students Taking All Tests

Cohort 1			TAAS	ITBS	TAAS	ITBS	TAAS	ITBS
			Spring, 1994	Fall, 1994	Spring, 1995	Fall, 1995	Spring, 1995	Fall, 1996
	Math		Grade 3	Grade 4	Grade 4	Grade 5	Grade 5	Grade 6
TAAS	Spring, 1994	Grade 3	1					
ITBS	Fall, 1994	Grade 4	0.67	1				
TAAS	Spring, 1995	Grade 4	0.69	0.67	1			
ITBS	Fall, 1995	Grade 5	0.66	0.71	0.70	1		
TAAS	Spring, 1995	Grade 5	0.66	0.66	0.74	0.73	1	
ITBS	Fall, 1996	Grade 6	0.64	0.72	0.67	0.73	0.69	1

Cohort 2			TAAS	ITBS	TAAS	ITBS	TAAS	ITBS
			Spring, 1994	Fall, 1994	Spring, 1995	Fall, 1995	Spring, 1995	Fall, 1996
	Reading		Grade 4	Grade 5	Grade 5	Grade 6	Grade 6	Grade 7
TAAS	Spring, 1994	Grade 4	1					
ITBS	Fall, 1994	Grade 5	0.66	1				
TAAS	Spring, 1995	Grade 5	0.75	0.66	1			
ITBS	Fall, 1995	Grade 6	0.64	0.68	0.63	1		
TAAS	Spring, 1995	Grade 6	0.71	0.65	0.75	0.64	1	
ITBS	Fall, 1996	Grade 7	0.63	0.70	0.62	0.73	0.64	1
	Math							
TAAS	Spring, 1994	Grade 4	1					
ITBS	Fall, 1994	Grade 5	0.75	1				
TAAS	Spring, 1995	Grade 5	0.77	0.73	1			
ITBS	Fall, 1995	Grade 6	0.67	0.77	0.69	1		
TAAS	Spring, 1995	Grade 6	0.73	0.71	0.78	0.70	1	
ITBS	Fall, 1996	Grade 7	0.69	0.77	0.71	0.80	0.74	1

Cohort 3			TAAS	ITBS	TAAS	ITBS	TAAS	ITBS
			Spring, 1994	Fall, 1994	Spring, 1995	Fall, 1995	Spring, 1995	Fall, 1996
	Reading		Grade 5	Grade 6	Grade 6	Grade 7	Grade 7	Grade 8
TAAS	Spring, 1994	Grade 5	1					
ITBS	Fall, 1994	Grade 6	0.64	1				
TAAS	Spring, 1995	Grade 6	0.71	0.66	1			
ITBS	Fall, 1995	Grade 7	0.65	0.72	0.69	1		
TAAS	Spring, 1995	Grade 7	0.66	0.56	0.70	0.62	1	
ITBS	Fall, 1996	Grade 8	0.55	0.65	0.59	0.67	0.50	1
	Math							
TAAS	Spring, 1994	Grade 5	1					
ITBS	Fall, 1994	Grade 6	0.70	1				
TAAS	Spring, 1995	Grade 6	0.79	0.74	1			
ITBS	Fall, 1995	Grade 7	0.72	0.77	0.78	1		
TAAS	Spring, 1995	Grade 7	0.75	0.71	0.83	0.76	1	
ITBS	Fall, 1996	Grade 8	0.71	0.75	0.78	0.81	0.78	1

Table B-3: Mean Reading and Math Z Scores

By Race/Ethnicity and Income for Cohorts 2 and 3

	Asian		African-American		Hispanic		Anglo		Asian LEP		Hispanic LEP	
	high	low	high	low	high	low	high	low	high	low	high	low
Cohort 2												
Reading												
Number of Students	50	12	112	120	67	102	1071	179	14	12	8	146
Spring, 1994 Grade 4	0.55	0.35	0.19	-0.11	0.30	0.18	0.50	0.31	0.08	-0.41	-0.85	-1.26
Fall, 1994 Grade 5	0.46	0.67	0.08	-0.26	0.10	-0.19	0.49	0.22	0.06	-0.30	-0.65	-0.93
Spring, 1995 Grade 5	0.62	0.55	0.30	-0.03	0.35	0.26	0.54	0.32	0.40	-0.28	-0.48	-0.95
Fall, 1995 Grade 6	0.61	0.54	0.13	-0.28	0.22	-0.19	0.51	0.25	0.38	-0.10	-0.93	-0.92
Spring, 1995 Grade 6	0.70	0.50	0.32	-0.11	0.31	0.16	0.56	0.24	0.48	-0.12	-0.54	-0.83
Fall, 1996 Grade 7	0.77	0.41	0.05	-0.39	0.22	-0.11	0.50	0.19	0.40	-0.24	-1.17	-0.78
Math												
Number of Students	50	13	112	110	61	99	1057	181	14	12	7	136
Spring, 1994 Grade 4	0.66	0.68	0.26	-0.15	0.45	0.31	0.56	0.32	0.44	-0.30	-1.09	-1.04
Fall, 1994 Grade 5	0.74	0.49	0.04	-0.27	0.27	0.13	0.51	0.24	0.45	-0.06	-1.21	-0.87
Spring, 1995 Grade 5	0.73	0.61	0.22	-0.14	0.46	0.40	0.56	0.32	0.64	0.18	-0.73	-0.66
Fall, 1995 Grade 6	0.85	0.71	0.12	-0.24	0.19	0.08	0.51	0.23	0.58	0.17	-0.93	-0.59
Spring, 1995 Grade 6	0.67	0.56	0.25	-0.16	0.40	0.16	0.55	0.28	0.66	0.19	-0.78	-0.49
Fall, 1996 Grade 7	0.85	0.49	0.12	-0.36	0.21	0.00	0.57	0.18	0.51	0.13	-0.85	-0.71
Cohort 3												
Reading												
Number of Students	55	27	103	100	90	111	1050	156	5	9	3	76
Spring, 1994 Grade 5	0.69	0.57	0.23	-0.21	0.27	0.19	0.52	0.29	-0.47	-0.66	0.10	-1.02
Fall, 1994 Grade 6	0.51	0.30	0.08	-0.39	0.16	0.10	0.50	0.28	-0.85	-0.56	-0.04	-0.83
Spring, 1995 Grade 6	0.65	0.46	0.25	-0.33	0.19	0.21	0.56	0.35	-0.32	-0.39	0.70	-0.66
Fall, 1995 Grade 7	0.55	0.40	0.08	-0.44	0.26	0.06	0.54	0.27	-0.72	-0.87	-0.22	-0.79
Spring, 1995 Grade 7	0.64	0.46	0.28	-0.11	0.26	0.34	0.53	0.47	-0.24	0.07	0.52	-0.56
Fall, 1996 Grade 8	0.64	0.36	-0.08	-0.50	0.15	-0.04	0.46	0.22	-0.02	-0.13	-0.53	-0.57
Math												
Number of Students	54	27	103	96	87	116	1055	164	5	10	3	79
Spring, 1994 Grade 5	0.81	0.76	0.26	-0.23	0.23	0.25	0.58	0.42	0.12	-0.20	0.46	-0.70
Fall, 1994 Grade 6	0.73	0.71	0.08	-0.37	0.09	0.09	0.52	0.34	-0.42	-0.35	0.05	-0.81
Spring, 1995 Grade 6	0.72	0.69	0.30	-0.29	0.16	0.20	0.60	0.42	-0.29	-0.18	0.32	-0.52
Fall, 1995 Grade 7	0.70	0.54	0.10	-0.43	0.13	0.02	0.59	0.35	-0.38	-0.22	0.26	-0.64
Spring, 1995 Grade 7	0.74	0.66	0.29	-0.17	0.25	0.29	0.61	0.46	-0.02	0.07	0.66	-0.41
Fall, 1996 Grade 8	0.70	0.51	-0.01	-0.50	0.05	0.01	0.57	0.28	-0.69	-0.22	0.16	-0.68

Table B-4: Value Added Reading Regressions
Pooled 5th-6th and 6th-7th Grades

	Grade 5-6 Summer		Grade 6 School Year		Grade 6-7 Summer	
	Coef.	t-score	Coef.	t-score	Coef.	t-score
Pretest	**-0.73**	**-7.6**	**0.66**	**7.6**	**-0.77**	**-8.9**
Pretest squared	**0.18**	**14.5**	**-0.03**	**-2.8**	**0.18**	**16.3**
First Grade Score	**0.14**	**8.3**	**0.11**	**7.7**	**0.15**	**9.4**
Gender	0.01	0.6	-0.02	-0.8	**-0.05**	**-2.4**
Age	**-0.08**	**-2.8**	**-0.13**	**-5.5**	**-0.11**	**-3.9**
Asian Low	-0.05	-0.5	0.04	0.5	0.04	0.3
Asian High	-0.03	-0.5	0.07	1.2	0.04	0.6
African Amercian Low	**-0.24**	**-4.7**	**-0.29**	**-6.9**	**-0.32**	**-7.0**
African Amercian High	**-0.14**	**-2.9**	-0.06	-1.5	**-0.21**	**-4.4**
Hispanic Low	**-0.17**	**-3.4**	-0.03	-0.8	**-0.17**	**-3.1**
Hispanic High	-0.06	-1.0	**-0.15**	**-3.2**	0.01	0.2
Anglo Low	0.01	0.2	**-0.10**	**-2.9**	-0.05	-1.2
Hispanic LEP Low	0.09	0.6	**-0.32**	**-2.5**	**-0.31**	**-2.0**
Hispanic LEP High	-0.05	-0.3	-0.01	-0.1	-0.09	-0.6
Asian LEP Low	**-0.30**	**-5.0**	**-0.52**	**-11.0**	**-0.24**	**-4.8**
Asian LEP High	-0.30	-1.4	0.04	0.2	**-0.66**	**-3.0**
Constant	**0.81**	**2.0**	**-0.22**	**-0.6**	**1.49**	**3.6**
R-squared	0.50		0.52		0.51	
N	3,601		3,642		3,642	
Number of Campuses	39		13		13	

Table B-5: Value Added Math Regressions
Pooled 4th-5th and 5th-6th Grades

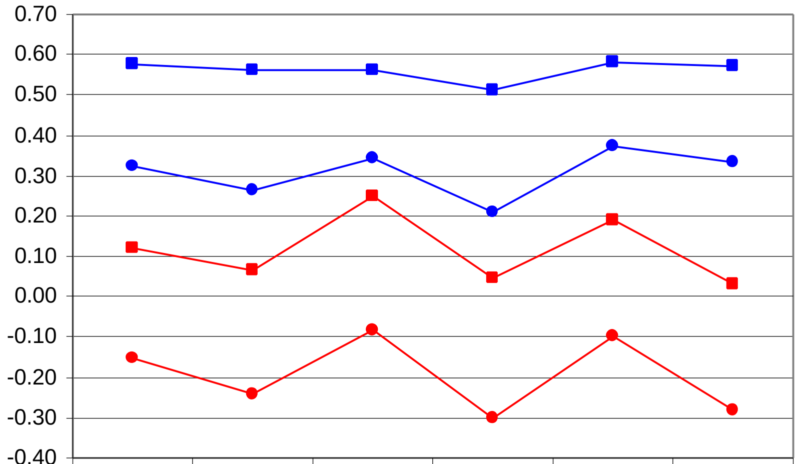
	Grade 4-5 Summer		Grade 5 School Year		Grade 5-6 Summer	
	Coef.	**t-score**	**Coef.**	**t-score**	**Coef.**	**t-score**
Pretest	0.12	1.4	**1.71**	**26.5**	**-0.75**	**-8.0**
Pretest squared	**0.07**	**6.6**	**-0.15**	**-18.6**	**0.19**	**15.5**
First Grade Score	**0.20**	**13.9**	**0.13**	**10.3**	**0.22**	**13.5**
Gender	**0.09**	**5.4**	**-0.07**	**-4.6**	**0.14**	**7.3**
Age	**-0.11**	**-4.7**	**-0.08**	**-4.4**	**-0.09**	**-3.4**
Asian Low	0.05	0.5	0.14	1.6	0.10	0.9
Asian High	**0.16**	**2.7**	0.08	1.8	**0.18**	**2.8**
African Amercian Low	**-0.18**	**-4.6**	**-0.14**	**-4.4**	**-0.14**	**-3.3**
African Amercian High	**-0.13**	**-3.5**	**-0.06**	**-2.0**	**-0.09**	**-2.2**
Hispanic Low	-0.03	-0.6	0.01	0.3	-0.09	-1.9
Hispanic High	0.03	0.7	0.07	1.8	-0.05	-1.0
Anglo Low	-0.04	-1.4	-0.03	-1.1	0.02	0.8
Hispanic LEP Low	0.10	1.0	0.13	1.6	0.15	1.3
Hispanic LEP High	**0.22**	**2.3**	0.13	1.7	0.14	1.3
Asian LEP Low	-0.02	-0.5	**-0.11**	**-2.8**	-0.03	-0.5
Asian LEP High	**-0.31**	**-2.4**	-0.05	-0.5	-0.22	-1.6
Constant	**-0.53**	**-1.7**	**-3.15**	**-12.0**	**0.74**	**2.1**
R-squared	0.62		0.63		0.60	
N	3,549		3,612		3,612	
Number of Campuses	39		40		40	

Table B-6: Value Added Math Regressions

Pooled 5th-6th and 6th-7th Grades

	Grade 5-6 Summer		Grade 6 School Year		Grade 6-7 Summer	
	Coef.	t-score	Coef.	t-score	Coef.	t-score
Pretest	**-0.72**	**-7.9**	**1.65**	**23.0**	**-0.82**	**-8.8**
Pretest squared	**0.18**	**15.9**	**-0.13**	**-16.1**	**0.20**	**17.4**
First Grade Score	**0.17**	**12.4**	**0.13**	**10.1**	**0.14**	**8.1**
Gender	**0.13**	**7.3**	**-0.07**	**-4.1**	**-0.11**	**-4.9**
Age	**-0.13**	**-5.8**	**-0.13**	**-6.2**	-0.13	-1.6
Asian Low	-0.04	-0.5	0.11	1.4	0.02	0.4
Asian High	0.09	1.8	0.06	1.1	**-0.32**	**-8.0**
African Amercian Low	**-0.23**	**-5.8**	**-0.23**	**-6.0**	**-0.24**	**-6.2**
African Amercian High	**-0.17**	**-4.4**	-0.02	-0.5	**-0.20**	**-5.1**
Hispanic Low	**-0.09**	**-2.3**	-0.05	-1.5	**-0.14**	**-3.2**
Hispanic High	-0.06	-1.3	-0.04	-1.1	**-0.07**	**-2.4**
Anglo Low	-0.05	-1.8	**-0.08**	**-2.7**	-0.13	-1.2
Hispanic LEP Low	0.04	0.4	0.02	0.2	-0.19	-1.6
Hispanic LEP High	-0.01	-0.1	0.16	1.4	**-0.41**	**-10.2**
Asian LEP Low	**-0.22**	**-5.1**	**-0.16**	**-3.9**	-0.18	-1.1
Asian LEP High	-0.05	-0.3	-0.08	-0.5	**1.27**	**3.6**
Constant	**1.40**	**4.1**	**-2.54**	**-8.3**	**0.74**	**2.1**
R-squared	0.6725		0.61		0.66	
N	3,615		3,615		3,615	
Number of Campuses	13		13		13	

Figure B-1
Anglo and African American Math Z Scores
By Income
Cohort 1



	Spring 94	Fall 94	Spring 95	Fall 95	Spring 96	Fall 96
African American High	0.12	0.07	0.25	0.04	0.19	0.03
African American Low	-0.15	-0.24	-0.09	-0.30	-0.10	-0.28
Anglo High	0.57	0.56	0.56	0.51	0.58	0.57
Anglo Low	0.32	0.26	0.34	0.21	0.37	0.34

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