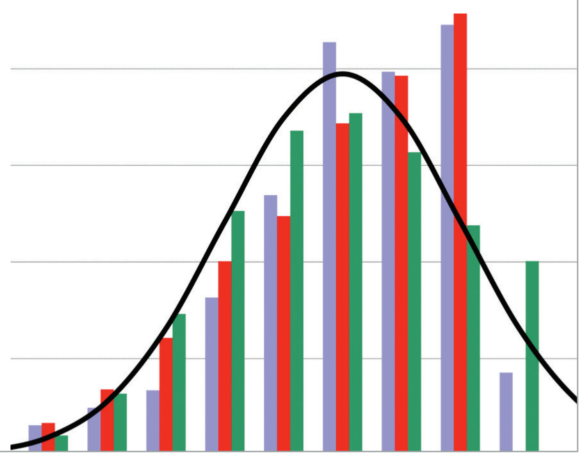
ACT Research Report Series

2013 (3)



High School Grade Inflation from 2004 to 2011

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Abstract

This study explores inflation in high school grade point average (HSGPA), defined as trend over time in the conditional average of HSGPA, given ACT® Composite score. The time period considered is 2004 to 2011. Using hierarchical linear modeling, the study updates a previous analysis of Woodruff and Ziomek (2004). The study also investigates variation in grade inflation across high schools and how this variation is related to school demographic characteristics. Although researchers have demonstrated the existence of high school grade inflation before 2001, results from this study show little evidence of overall grade inflation in recent years. There is, however, significant variation in grade inflation/deflation among high schools. This variation was not found to be related to different levels of school poverty or minority enrollment.

High School Grade Inflation from 2004 to 2011

Introduction

High school grade point average (HSGPA) is one of the key variables used to make college admission decisions. Admissions officers seek to maximize academic success and accurately identify potentially successful applicants. As such, they generally use comprehensive academic achievement measures that can accurately identify students with the highest probability to succeed in college (Sawyer, 2010). The measures used in college admissions remain largely consistent, and the most important ones are grades in college-preparatory courses, strength of high school curriculum, standardized admission test scores, and overall HSGPA (Clinedinst, Hurley, & Hawkins, 2011).

That said, prior research shows that high school grades have increased over time. This may suggest the phenomenon of grade inflation, where there is an increase in grades without a concomitant increase in students' academic achievement, as measured by test scores (Bejar & Blew, 1981). An increase in HSGPA without an accompanying increase in test scores may also be observed if there were changes in the scholastic behavior pattern (e.g. turning in assignments) or grading practices (e.g. incorporation of participation into course grades) that are unrelated to student content knowledge. Grade inflation is undesirable because it weakens the predictive validity of HSGPA and makes it increasingly hard for college admission officers to compare students and make admission decisions (Godfrey, 2011).

Longitudinal studies have demonstrated strong evidence of grade inflation (ACT, 2005; Ziomek & Svec, 1995; Camara, Kimmel, Scheuneman, & Sawtell, 2003; Godfrey, 2011). Although grade inflation requires longitudinal examination and comparison between grades and test scores, many empirical research studies regard grade increases over time as grade inflation. Researchers have found that HSGPA has increased over the time period they examined, whereas standardized test scores (ACT or SAT scores) remained stable. Woodruff and Ziomek (2004) extended the grade inflation research by comparing self-reported average HSGPAs conditioned on ACT Test scores from 1991 to 2003, and discovered an increase of conditional average HSGPA for American public high schools over the 13 years.

Camara, Kimmel, Scheuneman, and Sawtell (2003) investigated grade inflation by using self-reported grade data and SAT scores for eight cohorts of college-bound students. The trend of average HSGPA over time was examined to investigate grade inflation. The authors found that 2002 high school grade point average “far exceeded” the grades students reported in 1976, whereas the SAT-V and SAT-M scores remained relatively unchanged. In addition, they found that the differences in average grade point average across parental education levels and race/ethnicity groups were greater for the 2002 cohorts than those for the 1981 cohorts, and that students from families with higher education levels and higher grade levels showed the greatest increases in HSGPA.

The U.S. Department of Education (1994) compared the test scores in reading and math with students’ grades and the percentage of students receiving free or reduced price lunch. A large difference in grades was discovered for schools by poverty level; students receiving A’s in high poverty schools had the same average NELS:88 Reading and Math test scores as students receiving C’s and D’s in more affluent schools.

Although researchers have found evidence for the existence of high school grade inflation, there are limitations to previous studies. First, much of the research only captured the average level of grade inflation in the population, but did not evaluate variation in grade inflation across high schools. Second, the statistical models used by these studies often did not take into account the hierarchical structure of the data.

This study uses hierarchical linear modeling (HLM) to extend Woodruff and Ziomek's (2004) study on grade inflation to explore grade inflation using ACT Test scores and self-reported grade point averages from 2004 to 2011. Also, this study investigates the variation of grade inflation across schools by school demographic characteristics; namely, the proportion of students receiving free or reduced price lunch and the proportion of minority students in the school.

The following three research questions are addressed by this study:

1. Is there evidence of high school grade inflation between 2004 and 2011?
2. Does grade inflation (or deflation) vary across high schools?
3. Can grade inflation be explained by school demographic characteristics, such as the proportion of students eligible for free or reduced price lunch and the proportion of minority students?

Data

The data for this study included public high school graduates from 2004 to 2011 who took the ACT Test in the eleventh or twelfth grade of high school as a part of national testing or a statewide adoption program.[1] High schools were included in the analysis if they had at least 100 ACT-tested students across the 8 years examined. If a student took the ACT Test more than once, the most recent test record was used. High school grades in up to 23 courses

[1] Students attending private schools were excluded to facilitate generalizability to US public schools and to allow comparability with Woodruff and Ziomek (2004). This excluded about 11% of ACT-tested students for any given year in the time period examined.

were self-reported by students when they registered to take the ACT Test.[2] Overall HSGPA was calculated based on these grades.

Student-level data were aggregated at the school level for the purpose of exploring school-level grade inflation. Conditional average HSGPAs were calculated by ACT Composite score for each high school and each year. Within this structure, the school was the unit of analysis.

The proportion of students eligible for free or reduced price lunch and the proportion of minority students (Black, Hispanic, and American Indian/Alaska native) are school demographic characteristics hypothesized to affect grade inflation. These two variables were extracted from the 2009 National Center for Education Statistics (NCES) Common Core of Data (NCES, 2011), centered by their grand means for ease of parameter interpretation, and matched with high schools.

The proportion of students taking the ACT Test in a state was also included to help account for differences in the tested population in each state. Some states have implemented the ACT Test as part of a statewide testing program; in other states most students self-select to take the ACT Test. Within statewide adoption states, there is greater heterogeneity of students with regard to demographics and achievement relative to the largely self-selected, college-bound population in non-statewide adoption states. Estimated proportion tested was calculated by dividing the number of test records for a given state by the Western Interstate Commission for Higher Education (WICHE) estimates of public high school graduates for that state (Prescott, 2008).

[2] The 23 courses include English 9, English 10, English 11, English 12, Speech, Algebra 1, Algebra 2, Geometry, Trigonometry, Calculus, Advanced Math, Computer Science, General Science, Biology, Chemistry, Physics, US History, World History, Other History, US Government, Economics, Geography, and Psychology.

Table 1 shows the number of high schools by year from 2004 to 2011, as well as the average, over high schools, of mean high school GPA and demographic variables. State-tested population percentage also increased by approximately 10 percentage points during that time period. This is partially a result of additional states incorporating the ACT Test into its statewide high school assessment program. The average HSGPA and average ACT Composite (ACTC) score for schools were similar across years suggesting that grade inflation may not be seen in the time period from 2004 to 2011. The average free/reduced-price lunch eligible percentage and the racial/ethnic minority percentage were also consistent across the eight years examined.[3]

Table 1

Public High School Demographic Variables

	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Number of high schools	11,608	11,718	11,820	11,923	11,983	12,048	12,092	12,092
Average HSGPA	3.28	3.29	3.30	3.30	3.29	3.28	3.29	3.29
Average ACT Composite score	20.83	20.89	20.97	21.08	21.04	21.01	21.11	21.15
State-tested population percentage	44.05	44.35	44.13	46.18	48.19	49.82	52.09	54.62
Racial/ethnic minority percentage	27.75	27.81	27.99	28.19	28.33	28.44	28.49	28.46
American Indian	1.94	1.93	1.92	1.90	1.89	1.88	1.88	1.81
African American	13.61	13.63	13.71	13.77	13.82	13.85	13.86	13.81
Hispanic	12.53	12.59	12.69	12.84	12.93	13.02	13.05	13.01
Free/reduced-price lunch eligible percentage	39.74	39.68	39.68	39.63	39.60	39.58	39.55	39.49
Free lunch	31.86	31.81	31.81	31.77	31.74	31.73	31.70	31.64
Reduced-priced lunch	8.04	8.04	8.04	8.03	8.01	8.01	8.00	7.93

[3] Because only 2009 NCES Common Core of Data was used, annual variations in these averages were due to different schools being represented in each year.

Method

In the present study a two stage analysis approach was undertaken. First, a descriptive analysis utilizing the methodology employed by Woodruff and Ziomek (2004) was conducted. This preliminary analysis was done in an attempt to replicate the previous study with the current years being investigated. Subsequently, hierarchical linear modeling was used to explore grade inflation/deflation at the school level. This methodological extension allows the incorporation of the nested structure of the data being examined as well as the incorporation of additional factors that may contribute to grade inflation/deflation.

Descriptive Analysis

For each year, raw conditional average HSGPA was calculated for students with the same ACTC score. ACTC score was limited to a range of 13 to 32 because relatively few students scored outside this range. It was assumed that students with the same ACTC score had the same level of content knowledge across years. Thus, the increase or decrease in conditional average HSGPA over time would indicate grade inflation or deflation.

Hierarchical Linear Modeling

Hierarchical linear modeling (HLM) was used to measure annual grade change and its variation across high schools. The data consisted of raw conditional mean HSGPAs, given the ACTC scores observed at a high school. Within each school, these conditional mean HSGPAs were pooled across the graduating class years 2004 to 2011.

The data consist of raw conditional mean values of HSGPA, given ACT Composite score and graduating class year, nested within high schools. We modeled the conditional mean HSGPA at each high school as a function of ACT Composite score, graduating class year, and a random effect associated with the school:

$$HSGPA_{ij} = \beta_{0j} + \beta_{1j}ACTC_{ij} + \beta_{2j}ACTC_{ij}^2 + \beta_{3j}YEAR_{ij} + r_j$$

where

$HSGPA_{ij}$ is the i^{th} modeled conditional mean HSGPA at high school *j*, given ACTC score and graduating class year;

$ACTC_{ij}$ is the ACTC score corresponding to the i^{th} raw conditional mean *HSGPA* at high school *j*;

$YEAR_{ij}$ is the graduating class year corresponding to the i^{th} raw conditional mean *HSGPA* at high school *j*;

β_{0j} is a constant associated with high school *j;*

β_{1j} is the expected change associated with a one unit increase in $ACTC_{ij}$;

β_{2j} is the expected change associated with a one unit increase in $ACTC_{ij}^2$;

β_{3j} is the expected change associated with a one-year increase in time for high school j; and

r_j is the random residual error associated with high school *j*.

The level 2 model was:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}Proportion\ tested_{0j} + u_{0j};$$

$$\beta_{1j} = \gamma_{10};$$

$$\beta_{2j} = \gamma_{20};\text{ and}$$

$$\beta_{3j} = \gamma_{30} + u_{3j}.$$

where

γ_{00} is a constant;

γ_{01} is the slope for $Proportion\ tested_{0j}$, the proportion of students tested in the state;

γ_{10} is the slope for the linear term $ACTC_{ij}$;

γ_{20} is the slope for the quadratic term $ACTC_{ij}^2$;

γ_{30} is the expected slope for a one year increase;

u_{0j} is the random increment to the intercept associated with high school j; and

u_{3j} is the random increment to the slope for a one year increase in time associated with high school j.

The slope estimate for year was the key indicator of annual grade change (inflation or deflation). The fixed-effect estimate for year showed the average level of annual grade change across all public high schools. The model allowed the intercept and year effect to randomly vary for each high school. The random effect associated with year reflects the variation among schools in their annual change in mean HSGPA.[4]

In estimating the model parameters, we weighted the calculations by the number of students in a school per given ACTC score. The weighted estimates take into account that the variance of the i^{th} raw conditional mean *HSGPA* at high school j depends on the number of scores on which it is based.

In two additional models, the proportion of students eligible for free or reduced price lunch or the proportion of minority students were also included as predictors of the intercept and the slope of year. The inclusion of these factors as predictors of the slope of year measured the association between annual grade change, as indicated by γ_{30}, and school demographic variables.

[4] Alternatively, this could have been modeled as students nested within high schools with year as a crossed level 2 effect.

Results

Descriptive Analysis

The curves in Figure 1 show simple averages, over high schools, of the conditional mean HSGPAs, given ACTC score. There is a separate curve for each year. Note that HSGPA is positively associated with ACTC score for all 8 years. The slight flattening at the upper end of the curves shows a ceiling effect for conditional average HSGPA.

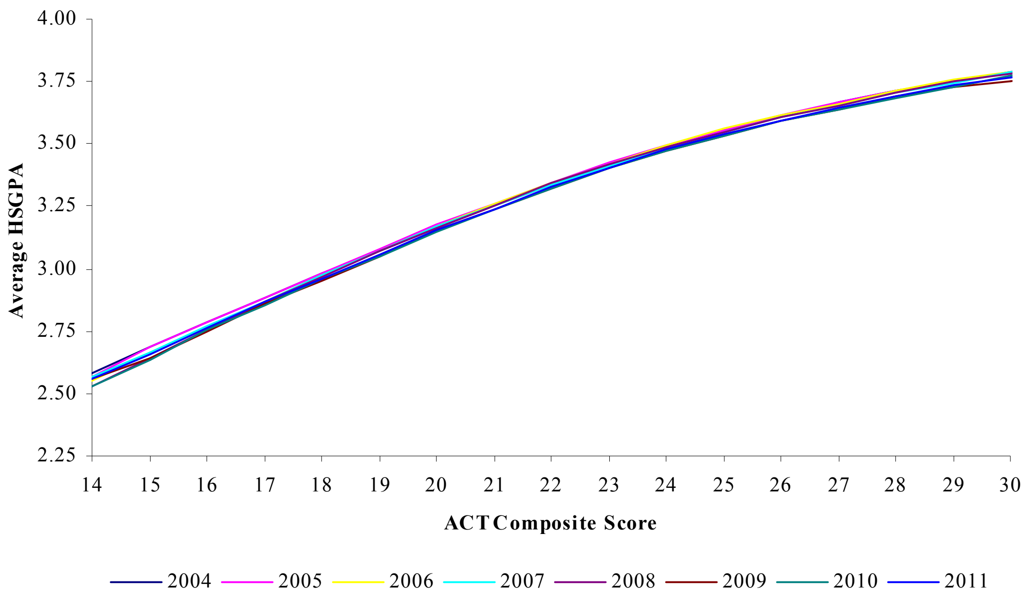

Figure 1. Plot of conditional high school GPA by ACT Composite score for the years of 2004 to 2011

The vertical layering of the curves indicates grade inflation or deflation across years. This graph shows that the 8 curves lie on top of each other with no definite pattern of annual grade change. Although no discernible evidence of systematic grade inflation can be identified, there are differences across years at different levels of ACTC score. For example, there was greater variability in annual grade change at the lower and upper ends of the ACTC score scale. This variation did not, however, demonstrate systematic inflation or deflation across years.

The general finding of no discernible pattern of grade inflation is in contrast to the findings of Woodruff and Ziomek (2004). To further explore the differences in results between the present and former study, Figure 2 shows the change in HSGPA for selected ACTC scores. This figure is based on public high school graduates between 1991 and 2011 who took the ACT Test as part of national or state testing, tested during the eleventh or twelfth grade, and scored between a 14 and 31. This graph examines the time period investigated in the Woodruff and Ziomek study (1991 - 2003) as well as the present research (2004-2011). As this graph illustrates, from 1991 to 2001 there was an increase in conditional HSGPA for the selected ACTC scores. After 2003, there was comparatively little change in the conditional HSGPA scores. This pattern held regardless of ACTC score.

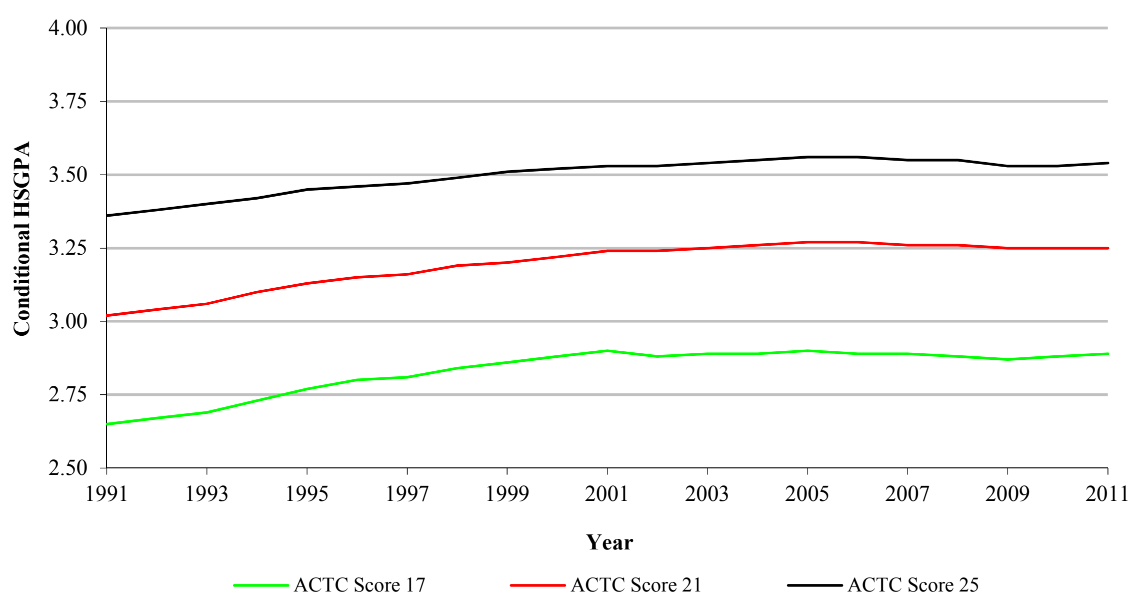

Figure 2. Plot of conditional high school GPA between 1991 and 2011 for selected ACT Composite scores

HLM Base Model

As seen in Table 2, the slope coefficient for year was 0.0010 ($p<0.01$). As the slope accounts for annual grade change after controlling for ACTC score (and other factors), this coefficient reflects that the conditional average HSGPA in the population "inflates" slightly per year.[5] Although the positive and statistically significant estimate indicates grade inflation, its absolute value is very close to zero. The estimate suggests that on average, HSGPA was inflated by 0.008 units (0.0010 * 8) on the 0.0 – 4.0 HSGPA scale.

Table 2

Solution for Fixed Effects: Base Model

Effect	Estimate	Standard Error	p
Intercept	0.3892	0.0067	< 0.01
Year	0.0010	0.0002	< 0.01
ACT Composite	0.1910	0.0006	< 0.01
ACT Composite Squared	-0.0025	0.0000	< 0.01
Proportion of students tested in state	-0.2352	0.0040	< 0.01

The school-specific coefficients were determined by the estimation of random effects in the HLM model. The estimated variance of the intercept and year were 0.0313 and 0.0004, respectively. The variance of slopes were statistically significantly different from zero ($p<.01$), indicating that there was significant variation in annual grade inflation (or deflation) among all high schools. A histogram of school-level annual grade change is shown in Figure 3. The predicted annual grade change ranges from a minimum deflation of about -0.08 to a maximum inflation of about 0.08 in HSGPA. Therefore, although the overall average annual

[5] A quadratic term for year was evaluated and found significant (coefficient = 0.0003); however, its inclusion did not alter the conclusions. For ease of interpretation this quadratic term was not included.

HSGPA change is small, school-specific grade inflation or deflation is apparent between 2004 and 2011. This is most apparent in the distribution at schools with an inflation/deflation factor outside the first and third quartiles (i.e. above approximately 0.01 and below approximately -0.01).

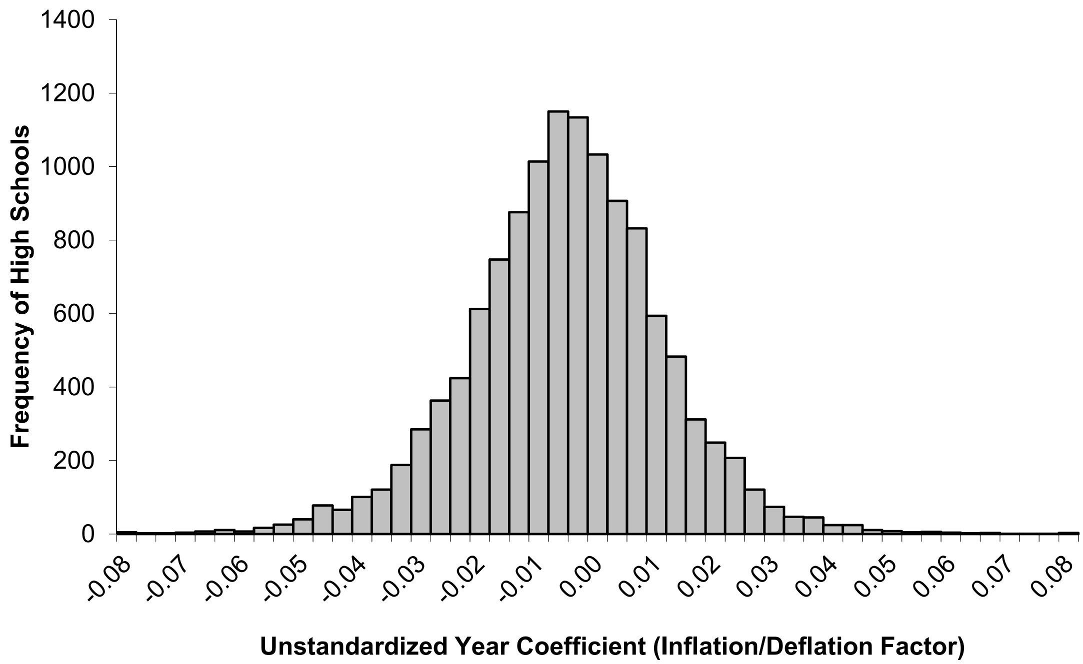

Figure 3. Histogram of estimated annual HSGPA change per year

HLM Models Including Predictors of the Year Effect

The regression models including the proportion of students eligible for free or reduced price lunch or the proportion of minority students as predictors of the slope of year, are shown in Tables 3 and 4, respectively.

Table 3

Solution for Fixed Effects (Proportion of Free/Reduced Lunch Recipients as a Predictor of Slope Effect)

Effect	Estimate	Standard Error	Significance
Intercept	0.3782	0.0067	< 0.01
Year	0.0013	0.0002	< 0.01
Proportion free/reduced lunch	0.2468	0.0073	< 0.01
Year * proportion free/reduced lunch recipients	-0.0003	0.0010	0.80
ACT Composite	0.1915	0.0006	< 0.01
ACT Composite Squared	-0.0025	0.0000	< 0.01
Proportion of Students tested in state	-0.2517	0.0039	< 0.01

Table 4

Solution for Fixed Effects (Proportion of Minority Students as a Predictor of Slope Effect)

Effect	Estimate	Standard Error	Significance
Intercept	0.3857	0.006731	< 0.01
Year	0.000834	0.000236	< 0.01
Proportion minority	0.03273	0.00583	< 0.01
Year * proportion minority	0.003063	0.000768	< 0.01
ACT Composite	0.1913	0.000606	< 0.01
ACT Composite Squared	-0.00249	0.000014	< 0.01
Proportion of Students tested in state	-0.2311	0.004025	< 0.01

There was an association between annual grade change and the proportion of minority students in a school (coefficient =-0.0031, p=< 0.01). However, the absolute value of the coefficient was too small to be considered practically significant, illustrating that the proportion of minority students in a school was not strongly related to annual grade change.

The proportion of students eligible for free or reduced price lunch was not significantly related to grade inflation or deflation (coefficient=0.0003, p=0.80), such that high-poverty schools do not differ in grade inflation or deflation from low-poverty schools. Thus, school-level variation in grade inflation or deflation is not practically associated with either of the two school demographic factors examined.

A large percentage of ACT-tested graduates of 2004 – 2011 did not report high school grade data, resulting in missing data for HSGPA. For example, in 2005, 2006, and 2007, more than 20% of the students were missing HSGPA. We imputed the missing data. The imputation did not change the practical significance of the regression coefficients in the models. That is to say, the implementation of imputation did not alter the conclusion that on average, there is no annual grade change for all public high schools from 2004 to 2011, and that school-level variation in grade inflation or deflation is not practically associated with either of the two school demographic factors

Conclusions

This study examined high school grade inflation from 2004 to 2011. Compared with the significant high school grade inflation from 1991 to 2003 (Woodruff & Ziomek, 2004), more recent data showed no pattern of overall grade inflation or deflation across the eight years. One possible explanation for this finding is that the national push for raising academic standards and strengthening school accountability has equalized forces that caused grade inflation in earlier years. Potential inflationary forces in earlier years include credential inflation (which could facilitate high school diploma attainment and competitiveness in admission to college) and differential grading practices (where different schools assign different grades for the same level of student achievement). Since 2004, it is also possible that more students are taking more upper-level high school courses (e.g., mathematics courses beyond Algebra II), which could result in a downward shift in HSGPA, again equalizing the forces that cause inflation. This issue could be addressed with additional research.

Although little evidence of overall grade inflation at US public high schools was found, school-level variation in conditional HSGPA change was evident across the 8 years. This variation cannot, however, be attributed to the school's proportion of students eligible for free/reduced lunch or the proportion of minority students. No practically significant association was found between the school characteristics examined and grade inflation.

Future research must identify the sources of variation of grade inflation across high schools. The present study did not account for the differing political pressures that individual schools and states face. It is possible that an examination of the types of pressures schools are under may lead to a better understanding of where this variation comes from. Additionally, the current study was limited by the use of self-reported grades. While evidence exists that these self-reported grades can be utilized as effective proxies for transcript data (Sawyer, Laing, & Houston, 1988), it is possible that the use of transcript data would allow a more accurate identification of HSGPA and the sources of its variation.[6]

This study concerned itself with school level variability in annual average HSGPA and therefore did not incorporate student level variability in the statistical model chosen. Alternative mathematical models could be employed which would incorporate student level variability. The use of these alternative models in future research may produce different

[6] While prior ACT (1991) research suggests that self-reported student grades are slightly inflated when compared to transcript data, this research also suggests that self-reported grades are of sufficient accuracy to facilitate research involving groups of students.

conclusions in regards to school level variability of HSGPA over time given ACT Composite scores.

The results of this study provide both positive and concerning messages to high schools and postsecondary institutions. That no evidence of grade inflation was found at the national level suggests that average HSGPA has stabilized, alleviating some concerns about the validity decay of HSGPA for measuring students' preparedness for college or the workforce. This is not to say, however, that grade inflation and deflation do not exist. The significant variation across schools identified in this study demonstrates that HSGPA inflation or deflation continues to exist at some high schools.

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