Knocking at the College Door

Methodology Review

ACT

CollegeBoard

WICHE
Western Interstate Commission for Higher Education

This document summarizes the methodology review that WICHE conducted as part of the 8th edition of *Knocking at the College Door*.

Contents:

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Part 1. Results from Simulated Projections

Purpose

WICHE has been producing projections of high school graduates for the states individually and the nation as a whole going back over 30 years. These projections have routinely been viewed as the most useful forecasts of future postsecondary enrollment demand from recent high school graduates and even enrollment in K-12 schools by a wide and diverse array of audiences. In spite of its success, WICHE believed the time had come to undertake a review of the methodological approach it used to prepare its projections, a methodology that had not been rigorously examined at any point during the projections' series entire history. Advances in technology and predictive analytics suggested that such a review would, at a minimum, provide an enhanced level of confidence in the methodology, even if it did not suggest changes were needed. WICHE also felt the time was right to investigate other ways in which its expertise in projecting high school graduates could be deployed, such as by providing additional disaggregations of the national and state-level data or by releasing the projections in more interactive and useful ways to the various audiences.

These two goals composed the comprehensive methodological review WICHE undertook from 2010 to 2012. A major consideration in the work was that WICHE would resist making changes to the underlying methodology that might undermine the historical respect afforded its projection series unless the evidence from the review strongly indicated that it would lead to an improvement in the projections' accuracy and utility. Throughout the process WICHE's technical experts and others reminded us that one of the projections' core strengths are transparency in method and presentation, a major source of the substantial credibility the projections have among those who use or rely on them. As part of this process, WICHE commissioned a white paper from Hans Johnson and David Ezekiel from the Public Policy Institute of California (see Attachment 1), and convened two panels to examine the current methodology and other potential improvements to the *Knocking* series -- a technical review panel of experts and an end-user panel representing various constituencies who use *Knocking* (see Attachment 2 and Attachment 3). The purpose of the methodology review was to determine if another projection method was feasible and would yield more accurate projections of high school graduates.

Neither the white paper's authors nor the technical review panel felt that there would be substantial improvements from abandoning the current cohort survival ratio (CSR) approach in favor of a significantly different method. They felt that any improvements in accuracy would not likely be significant would be more than counterbalanced by tradeoffs in transparency and confidence in the publication; limits on the available data would impact the possibility for alternatives. They recommended that WICHE systematically review the current CSR method's accuracy and examine the impact of using different weights in the existing WICHE CSR model and of using single and double exponential smoothing methods, by running simulations with existing data. The end-user panelists also expressed confidence in the historical performance and transparency of WICHE's current CSR method and favored a single projection methodology for all states over varying the methodology for different states or under various circumstances, even such unusual circumstances as the hurricane in Louisiana.

The purpose of this paper is to summarize the results of WICHE's simulation of CSR alternatives and discuss how these findings provide evidence that WICHE's current methodology is sufficient and in some cases preferable for its projections of high school graduates.

Approach to Analysis

In order to determine the relative accuracy of alternative CSR methodologies for projecting high school graduates, we simulated projections using the current WICHE weighted average CSR method and the smoothing alternatives suggested by the technical panel: single exponential smoothing and double exponential smoothing. The methodological context and specific formulae for these methods are detailed in the white paper, which also discusses alternative methodologies that were deemed infeasible. In essence, the two alternative CSR methodologies simulated for this analysis allow for the continuation of past trends more than the current WICHE method. In practice, single exponential smoothing produces projected CSRs that are close to those produced by WICHE's weighted moving average approach. Both set a level and do not take the previous slope, or the direction and intensity of change, into account. The other simulation method, double exponential smoothing, allows previous historic changes to continue and the recent slope to inform the projection going forward. Both single and double exponential smoothing require more prior years of data than does the current WICHE method.

WICHE simulated projections for high school graduates for academic years 2002-03 to 2008-09, based on enrollment and graduate data for academic years

1992-93 to 2002-03.[1] We simulated projections for 43 states and the aggregate total of these 43 states ("U.S. total"), for public and private student totals and for each of the race/ethnicity categories.[2] For each level of aggregation, we investigated the standard deviation of the projected graduates compared to the actual graduates reported to the National Center for Education Statistics (NCES) and other statistics of fit (mean percent error, mean absolute error, mean absolute percent error, and mean square error), for the seven simulated years. The full range of category breakouts simulated is illustrated in the table in Appendix A.

Choosing the Best Overall Method

Our simulations indicate that the WICHE method generally produces projections as well as the alternative exponential smoothing methods do. While the simulations demonstrated that there may be certain states or racial/ethnic categories in which an exponential smoothing method produced a slightly more accurate or tailored result, the simulations also indicated that the gain in accuracy from switching to or varying the projections with a different method would typically not be very substantial. There also were no consistent patterns from the simulations that would help WICHE to predetermine which method would perform best for particular circumstances.

At the highest level, we determined how frequently each method makes the most accurate projections: in other words, how often a given method produces the lowest standard deviation. Table 1 shows that the WICHE method produced the lowest standard deviations for 37 percent of the projections by state and racial/ethnic category, making it "slightly best" overall in terms of the frequency of the lowest standard deviations. Furthermore, in 43 percent of the cases, the WICHE method produced the first or second most accurate projections of the three methods, followed by double exponential smoothing (30 percent) and single exponential smoothing (27 percent).

From the results in Table 1, double exponential smoothing would seem to be best for projecting the race/ethnicity total and White Non-Hispanic graduates, while single exponential would seem to be best for projecting Hispanic graduates. However, as seen from the charts in Figure 1 and Figure 2, each method has variable performance for different groups or totals, and the scale of difference between the methods is relatively small.

Figure 1 depicts the simulated projections for U.S. aggregate total public graduates and each race/ethnicity grouping. The method with the lowest standard deviation across all analysis years is labeled "best."[3] In our simulations the WICHE method was most accurate for public graduates at the U.S. aggregate level, with a standard deviation of 15,950 graduates and mean absolute percent error (MAPE) of 0.4. By comparison, the standard deviation for the double exponential smoothing projections was 27,717 and the MAPE was 0.9. The projections for White Non-Hispanic graduates, which show a distinct trend of declining white graduates, was the most notable instance in which the exponential smoothing method was more accurate than the WICHE method. Double exponential smoothing produced a standard deviation of 8,287 and MAPE of 0.3, compared to WICHE's standard deviation of 18,173 and MAPE of 0.8.

In these simulations the WICHE method produced the most accurate projections for Hispanic graduates, with a standard deviation of 5,694 and MAPE of 1.0,

Table 1. Frequency with which Each Method Produced the Lowest Standard Deviation

	Number of Times			Percent of Times			Average Diff. Between 1st & 2nd Most Accurate**
	WIC*	SES	DES	WIC	SES	DES	
Public Total	17	8	19	39%	18%	43%	0.70%
Total of Race/Ethnicities	15	5	24	34	11	55	0.46
American Indian/Alaskan Native	19	14	11	43	32	25	1.21
Asian/Pacific Islander/Hawaiian Native	15	14	15	34	32	34	0.81
Black Non-Hispanic	19	12	13	43	27	30	0.74
Hispanic	12	23	9	27	52	20	1.03
White Non-Hispanic	15	3	26	34	7	59	0.69
Private Total	22	11	11	50	25	25	1.03
Grand Total, Public & Private	11	27	6	25	61	14	1.15
TOTAL, All Categories	145	117	134	37%	30%	34%	

* WIC stands for WICHE; SES stands for single exponential smoothing; DES stands for double exponential smoothing.

** The difference between the first and second most accurate projections for each grouping, expressed as a percent of the mean graduates in the same grouping, e.g., the most accurate method minus the second most accurate method, divided by the number of graduates averaged over seven years.

followed by single exponential smoothing, with a standard deviation of 6,705 and MAPE of 1.1. Double exponential smoothing produced slightly more accurate projections for the U.S. aggregate totals for several categories (racial/ethnic total, Asians, and blacks), compared to the projections produced by the WICHE method in the simulations. But the projections from the double exponential smoothing method were only slightly more accurate and for all practical purposes the same as WICHE's (see Appendix B for detailed projections, standard deviations, and percent errors). In these simulations, single exponential smoothing produced the most accurate projections for the American Indian/Alaskan Native graduates category, which was also the category of graduates with the greatest error overall, due to their relatively small numbers. The standard error for single exponential smoothing was 824, and the MAPE was 2.4; the WICHE standard deviation was 1,060 and the MAPE was 3.2. The WICHE method was the most accurate in projecting nonpublic graduates. (Nonpublic graduates are not displayed here because there were only five years to compare and not seven, as for all other categories.)

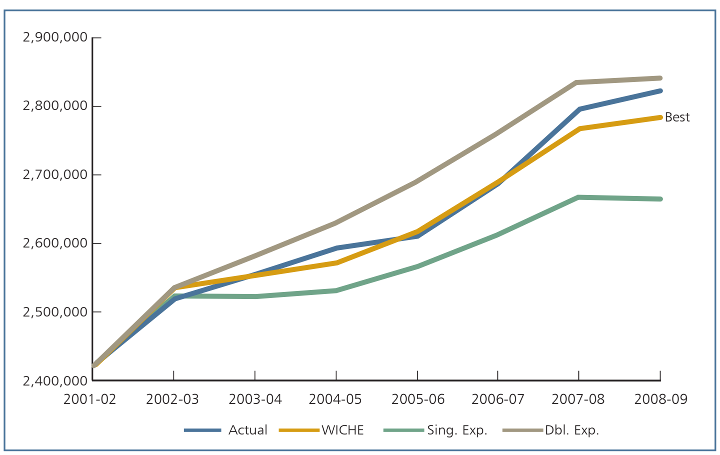
Different Methods Yield Only Small Differences

We also investigated whether the projections we simulated for each method were better or worse than each other in terms of accuracy, and to what degree. The simulated projections for the U.S. aggregate totals give a sense of the relatively small differences in percent terms and number of graduates. We also investigated this for states and ethnic populations that are growing or shrinking rapidly or for which the WICHE method produced the least accurate simulated projections. Figure 2's charts show actual graduates from 1996-97 to 2001-02 to demonstrate the historical trend going into the simulated projections and then projected graduates beginning with 2002-03. These charts give some sense of the projection methods' variable accounting for rapidly changing growth or decline in graduates. (Appendix C contains additional charts not shown in Figure 2).[4]

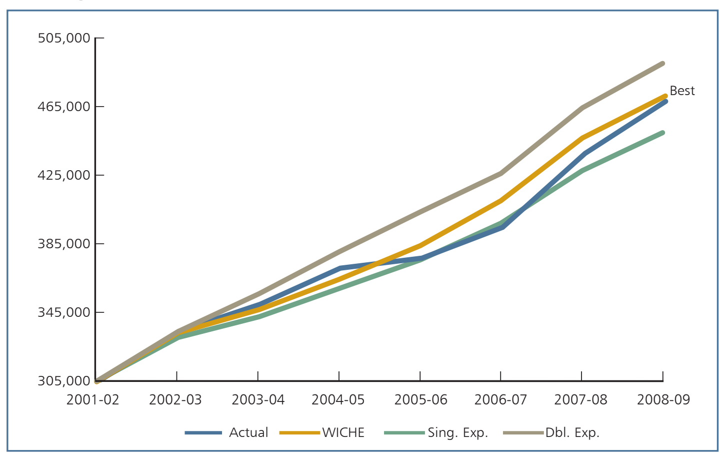
For two rapidly growing states, Florida and Nevada, exponential smoothing produced the lowest standard deviation in our simulations, to about the same extent as the WICHE method. The differences between the

Figure 1. Simulated Projections for U.S. Aggregate Totals (of 43 States Analyzed)

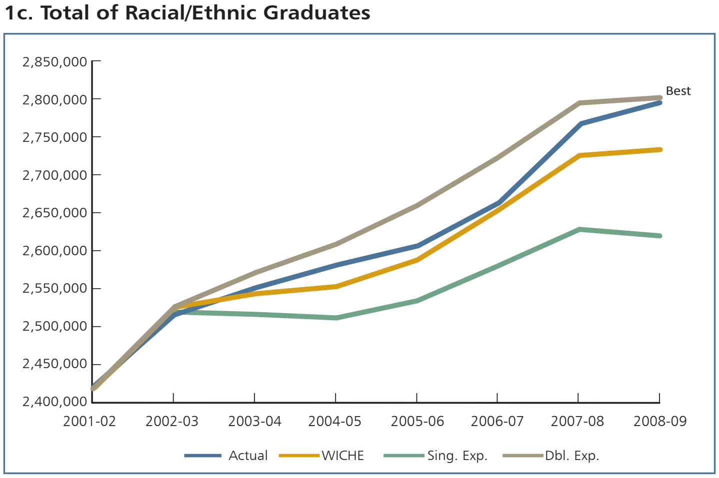
1a. Total Public Graduates



1b. Hispanic Graduates



1c. Total of Racial/Ethnic Graduates



1d. White Non-Hispanic Graduates

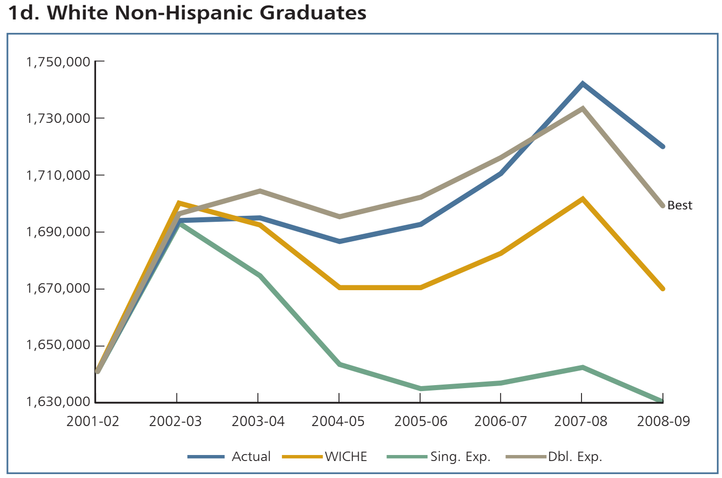
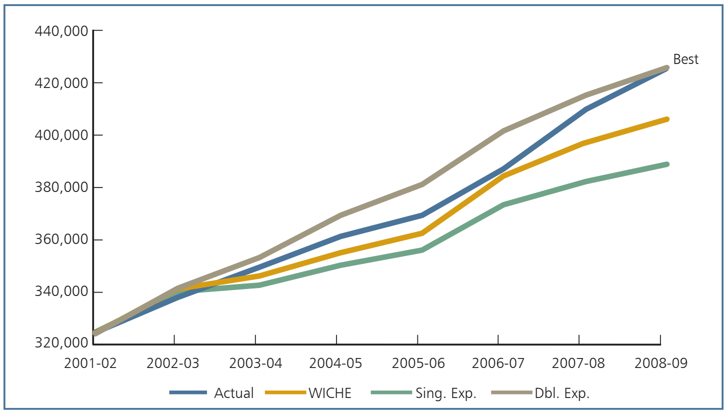


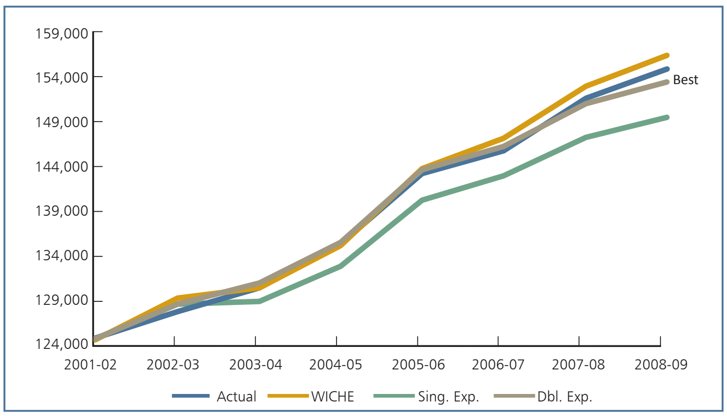
Figure 1 continued on next page

Figure 1. Continued

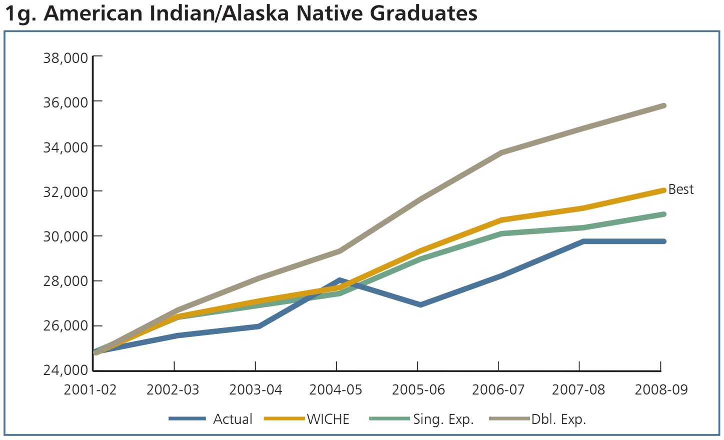
1e. Black Non-Hispanic Graduates



1f. Asian/Hawaiian Native/Pacific Islander Graduates



1g. American Indian/Alaska Native Graduates



projections methodologies were relatively small. In Florida, where the double exponential method produced the lowest standard deviation for White non-Hispanics, the double exponential projection was about 2 percent higher by the seventh and final year of simulated projections (1,450 graduates) and the WICHE projection about 4 percent lower (2,900 graduates) than actual White non-Hispanic graduates. There were relatively higher error rates in all instances for the simulated projections for Nevada, compared to those for most other states. It would appear that none of the methods would have accurately predicted the trends in Nevada because none could have predicted the change in trend between 2000 and 2003. Each of the projection methodologies overestimated graduates, but the single exponential method did so by slightly less than projections made with the WICHE method. The single exponential projection for total public graduates was about 12 percent higher (2,380 graduates) and the WICHE projection about 16 percent higher (3,170 graduates) than actual graduates by the seventh and final year of the simulations.

There was a similar outcome for the Virginia simulations, where each of the methods overestimated the growth in Hispanic graduates by as much 35 percent in the last year, though the single exponential method was slightly more accurate than the other two. In New York, however, each of the methods substantially underestimated graduates in our simulations, with WICHE underestimating public total graduates the least at 14 percent and White non-Hispanics by 7 percent (7,000 graduates), while the single exponential smoothing method underestimated Black non-Hispanics by 28 percent (8,600 graduates). As with Nevada, none of the standard methods used for these types of projections would have accounted for such an unexpected uptick in graduates, which might be explained by people moving, policy changes relating to higher graduation, or lower dropout rates than in the past.

Varying the exponential formulas does not significantly improve these projections.[5] To some extent this amount of overestimation or underestimation is probably related to the years covered in our simulations: the last year that actual graduate trends are reflected is 2001-02. Our overall analysis indicates that each of these methods would probably have tracked recent, distinct trends better if more recent academic years were included.

Indiana is another case where the single exponential smoothing method performed better for projecting smaller racial/ethnic groups in our simulations, but the differences between the methods were relatively small (see Appendix C). For the second largest racial/ethnic group, Black non-Hispanics, the single exponential projection was about 2 percent lower by the seventh and final year of simulated projections (although it was notably higher in earlier years), and the WICHE projection about 3 percent higher than actual reported graduates. The simulated projections for Michigan and Vermont (see Appendix C) and for White non-Hispanics in Kansas demonstrate similar variability between the methods in tracking specific trends (during the limited years of analysis, at least) and indicate that the WICHE method performs relatively well even when an exponential method is slightly more accurate overall. All three methods did about equally well in tracking the sustained growth in Texas, which is driven largely by

Hispanics, and each did slightly less well in tracking the ongoing reduction in White graduates.

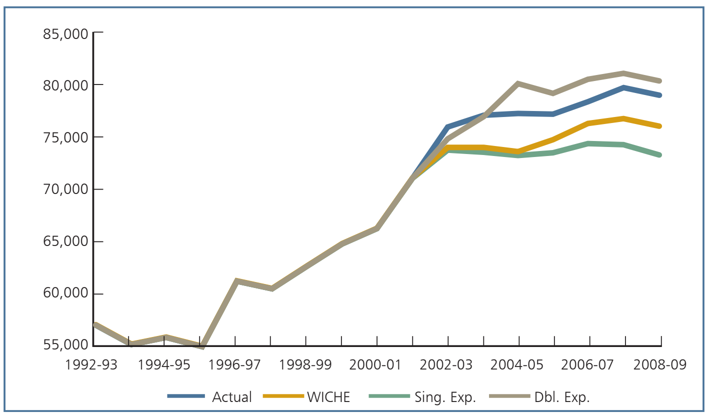
Conclusion

In summary, these results support continuing the use of the existing WICHE CSR method for the projections by state and race/ethnicity, rather than switching to an alternative exponential smoothing method or attempting to vary the projection methodology by state or circumstance. The current WICHE method was found to be sufficient for the vast majority of states and categories and was in some cases significantly better than the exponential smoothing alternatives.

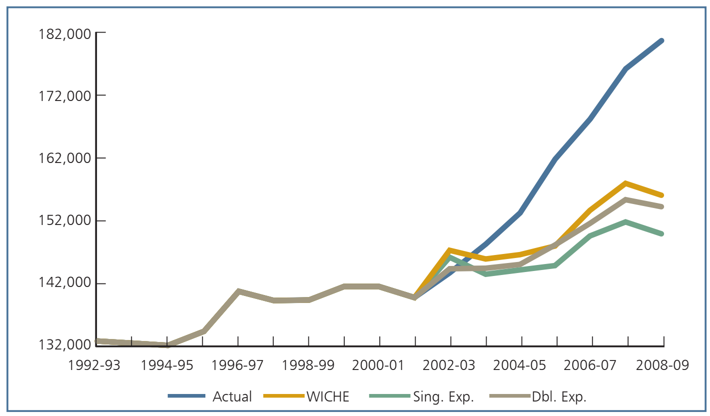
There are other factors that WICHE considers in its decision to retain or alter the methodology it has used for the past 30 years, in addition to the fundamental soundness and goodness of fit that the existing WICHE CSR method achieved in these simulations. *Knocking* is an established product that people trust, with a track record of consistency, transparency, and clarity of data and methods. Therefore, as a principle, and in keeping with the counsel we received from the technical and end-user reviews, it is WICHE's view that there must be a very compelling reason to change the methodology wholesale or to vary it for selected states or circumstances. While single and double exponential

Figure 2. Simulated Projections for Selected States

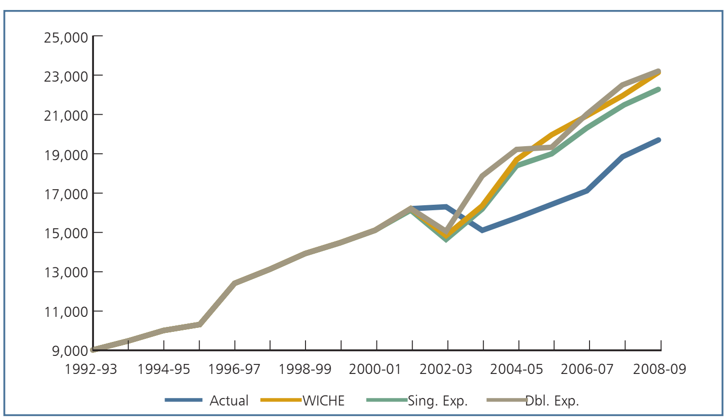
2a. FLORIDA – White Non-Hispanic Graduates



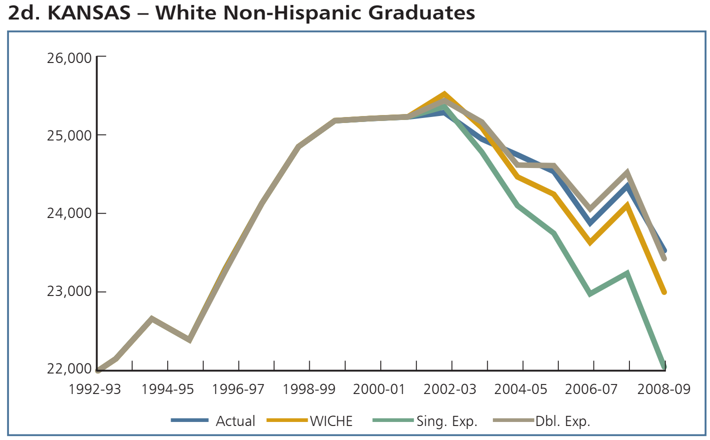
2b. NEW YORK – Total Public Graduates



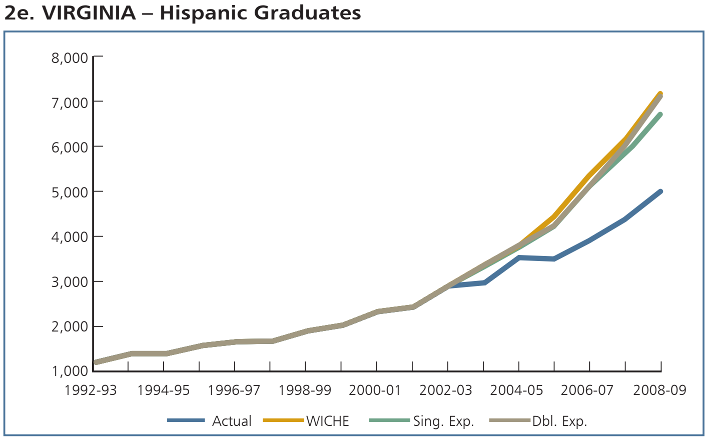
2c. NEVADA – Total Public Graduates



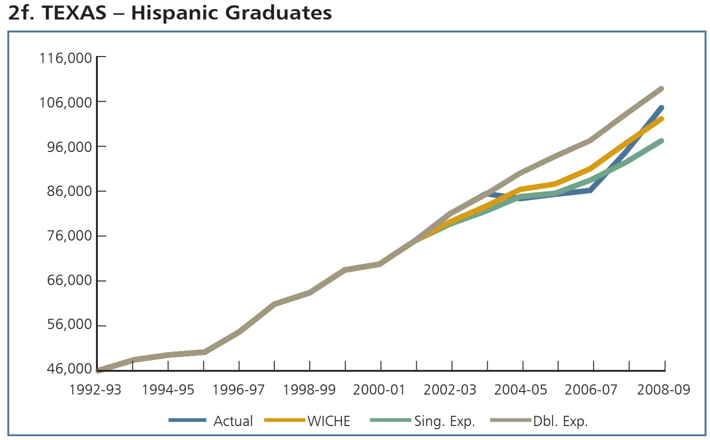
2d. KANSAS – White Non-Hispanic Graduates



2e. VIRGINIA – Hispanic Graduates



2f. TEXAS – Hispanic Graduates



smoothing are relatively well-known and accepted forecasting methods, they are mathematically complex enough to be less transparent for the broad range of *Knocking*'s users, whose confidence in the projections might be affected by WICHE's switching or selectively varying the methodology.

Furthermore, in relying on only five years of recent data, the WICHE method has an advantage over the exponential smoothing methods, which require more years of actual data as inputs into their formulas. This is a particular consideration for upcoming editions (at least for the next edition after 2012), which will be affected by recent changes to the race/ethnicity categorizations and for which there will be only a few years of newly categorized data available. Another consideration is that WICHE would need to know in advance which of either of the methods would provide a more accurate result for given racial/ethnic groups, graduating class sizes, or specific graduation trends. The results of the simulations do not provide decisive information to help WICHE predetermine which smoothing method would work best for specific cases.

WICHE consulted with the technical and end-user panels about how to best communicate technical details about the projection methodology and the accuracy of the projections. The panels discarded the idea of producing a range of estimates to depict the range of projections related to the methodologies' observed prediction accuracy, largely because end users could misinterpret or arbitrarily choose from a range of projections and because the panels were confident that most people who work with projections understand their inherent uncertainty. In fact, this analysis suggests that none of the projection methodologies would be able to accurately anticipate and account for particularly unpredictable trend changes within states, even through a range of projections. The panels suggested that WICHE publish a summary of the accuracy/error record from previous editions and provide a summary table or details for specific states or groups for which the chosen methodology provides the weakest projections.

WICHE also consulted with the technical and end-user panels about a related projection issue: whether to continue to project the totals at the state, regional, and national levels independently from state and race/ethnicity totals. By projecting the totals independently, the projections for smaller units do not sum up to the higher level, e.g., the numbers for the 50 states and District of Columbia do not sum exactly to the national total, and the race/ethnicity projections for any given state do not sum exactly to the state total of public graduates. For example, for 2022, the last year of projections for the 2008 edition of *Knocking*, the sum of WICHE's state projections was about 40,000 higher (1.2 percent) than the independent projection for the United States. Alternative approaches include calculating the smaller units and summing them to represent the higher-level projection or calculating the higher-level projections and then adjusting the lower-level projections to match exactly. The technical review panel did not offer a consensus recommendation on this issue. The end-user panel recommended that WICHE continue to make the projections separately in order to retain trends seen at the lower levels and simply be transparent about the reason for and magnitude of the resulting difference.

Endnotes

[1] We used Common Core of Data (CCD) and Private School Survey (PSS) data files for academic years 1992-93 to 2009-10, obtained from http://nces.ed.gov/surveys/SurveyGroups.asp?Group=1 in December 2011. These NCES data provided the most feasible accumulation of data for the 10 years needed to derive the projected ratios (five years for the WICHE method) and simulate seven years of projections.

[2] Only 43 states had a full complement of race/ethnicity data that required limited corrections and allowed us to draw comparisons between projected and actual figures.

[3] The U.S. aggregate total for this analysis comes from 43 states. Seven states (Idaho, Kentucky, New Hampshire, North Dakota, South Carolina, Utah, and Washington) and Washington, D.C., were not included because of data irregularities that were not easily resolved for this analysis. Most of the irregularities were in the earliest years of the CCD data, e.g., 1992-1996.

[4] Idaho and New Hampshire would have fallen into this outlier analysis, but they were among the seven states excluded due to data irregularities.

[5] For a discussion of varying formulas for best fit, see W.J. Hussar and T.M. Bailey, "Projections of Education Statistics to 2020," NCES 2011-026 (Washington, D.C.:U.S. Department of Education, National Center for Education Statistics, 2011). For this analysis WICHE followed the single exponential smoothing conventions that the NCES has historically used to project enrollment and high school graduates for public school students (but not private school students or projections by race/ethnicity), using a fixed smoothing constant. However, we note that for the first time, NCES varied the smoothing constants used in their smoothing formulas in producing their most recent set of projections.

Appendix A

Method that Produces the Lowest Standard Deviation, by State and Racial/Ethnic Grouping

	Times Lowest Std. Dev. (of 9 groupings each state)			Which Method Best Predicted Each Grouping?								
State	WICHE	SES	DES	Race/ Ethnicity Total	American Indian/ Alaska Native	Asian/ Pacific Islander/ Native Hawaiian	Hispanic	Black non-Hispanic	White non-Hispanic	Total Public	Nonpublic	Grand Total Public & Nonpublic
AK	5	4	0	WICHE	SES	SES	WICHE	SES	WICHE	WICHE	SES	WICHE
AL	1	4	4	DES	SES	DES	SES	WICHE	DES	DES	SES	SES
AR	2	1	6	DES	WICHE	SES	DES	WICHE	DES	DES	DES	DES
AZ	4	1	4	DES	SES	DES	WICHE	DES	DES	WICHE	WICHE	WICHE
CA	1	8	0	SES	SES	SES	SES	SES	SES	SES	WICHE	SES
CO	1	1	7	DES	WICHE	DES	SES	DES	DES	DES	DES	DES
CT	5	1	3	DES	WICHE	DES	WICHE	WICHE	WICHE	DES	WICHE	SES
DE	3	3	3	DES	DES	SES	SES	WICHE	DES	WICHE	WICHE	SES
FL	4	4	1	WICHE	SES	WICHE	SES	WICHE	DES	WICHE	SES	SES
GA	4	1	4	DES	WICHE	WICHE	SES	DES	DES	DES	WICHE	WICHE
HI	3	0	6	DES	WICHE	WICHE	DES	WICHE	DES	DES	DES	DES
IA	6	2	1	WICHE	SES	WICHE	SES	WICHE	WICHE	WICHE	WICHE	DES
IL	3	2	4	DES	WICHE	SES	WICHE	DES	DES	DES	WICHE	SES
IN	3	5	1	WICHE	SES	SES	SES	SES	WICHE	WICHE	DES	SES
KS	5	1	3	DES	SES	WICHE	WICHE	WICHE	DES	DES	WICHE	WICHE
LA	2	5	2	SES	WICHE	DES	SES	SES	WICHE	SES	DES	SES
MA	0	5	4	DES	SES	SES	DES	SES	DES	DES	SES	SES
MD	5	2	2	WICHE	WICHE	SES	DES	WICHE	DES	WICHE	WICHE	SES
ME	2	3	4	DES	WICHE	DES	SES	WICHE	DES	DES	SES	SES
MI	4	5	0	WICHE	WICHE	SES	SES	SES	WICHE	SES	WICHE	SES
MN	6	0	3	WICHE	WICHE	WICHE	DES	WICHE	WICHE	WICHE	DES	DES
MO	4	2	3	DES	WICHE	WICHE	SES	WICHE	DES	DES	WICHE	SES
MS	3	2	4	WICHE	DES	WICHE	SES	DES	WICHE	DES	DES	SES
MT	3	2	4	DES	DES	SES	SES	WICHE	DES	DES	WICHE	WICHE
NC	3	2	4	DES	DES	WICHE	SES	WICHE	DES	DES	SES	WICHE
NE	3	3	3	WICHE	DES	DES	SES	DES	WICHE	WICHE	SES	SES
NJ	2	6	1	SES	WICHE	DES	SES	WICHE	SES	SES	SES	SES
NM	4	3	2	WICHE	DES	WICHE	WICHE	DES	WICHE	SES	SES	SES
NV	1	7	1	SES	SES	DES	SES	SES	SES	SES	WICHE	SES
NY	8	1	0	WICHE	SES	WICHE	WICHE	WICHE	WICHE	WICHE	WICHE	WICHE
OH	2	2	5	DES	WICHE	SES	DES	DES	DES	WICHE	DES	SES
OK	5	1	3	DES	SES	WICHE	WICHE	WICHE	DES	DES	WICHE	WICHE
OR	3	0	6	DES	DES	WICHE	WICHE	DES	DES	DES	WICHE	DES
PA	5	1	3	WICHE	WICHE	DES	DES	WICHE	WICHE	WICHE	DES	SES
RI	1	5	3	DES	WICHE	SES	DES	SES	DES	SES	SES	SES
SD	3	3	3	WICHE	DES	SES	SES	DES	WICHE	WICHE	DES	SES
TN	5	1	3	DES	WICHE	DES	SES	WICHE	DES	WICHE	WICHE	WICHE
TX	5	2	2	WICHE	DES	WICHE	WICHE	SES	DES	WICHE	WICHE	SES
VA	2	6	1	SES	DES	SES	SES	SES	WICHE	SES	WICHE	SES
VT	2	3	4	DES	WICHE	DES	SES	SES	DES	DES	WICHE	SES
WI	1	1	7	DES	DES	DES	WICHE	DES	DES	DES	DES	SES
WV	1	3	5	DES	SES	DES	SES	DES	DES	DES	SES	WICHE
WY	7	1	1	WICHE	WICHE	WICHE	DES	SES	WICHE	WICHE	WICHE	WICHE

Note: WICHE is existing WICHE method; SES is single exponential smoothing; DES is double exponential smoothing. Only 43 states were analyzed.

Simulated Projections for U.S. Aggregate Totals (of 43 States Analyzed)

Public Graduates

Year	Actual	WICHE	Sing. Exp.	Dbl. Exp.	Abs. % Err. of Best
1992-93	2,064,047	2,064,047	2,064,047	2,064,047	
1993-94	2,044,207	2,044,207	2,044,207	2,044,207	
1994-95	2,093,137	2,093,137	2,093,137	2,093,137	
1995-96	2,094,647	2,094,647	2,094,647	2,094,647	
1996-97	2,171,499	2,171,499	2,171,499	2,171,499	
1997-98	2,248,846	2,248,846	2,248,846	2,248,846	
1998-99	2,292,065	2,292,065	2,292,065	2,292,065	
1999-00	2,355,999	2,355,999	2,355,999	2,355,999	
2000-01	2,376,612	2,376,612	2,376,612	2,376,612	
2001-02	2,425,871	2,425,871	2,425,871	2,425,871	
2002-03	2,519,887	2,536,169	2,521,930	2,535,389	-0.65
2003-04	2,557,566	2,551,878	2,522,810	2,583,971	0.22
2004-05	2,592,116	2,569,781	2,530,287	2,629,081	0.86
2005-06	2,611,287	2,620,311	2,565,775	2,688,683	-0.35
2006-07	2,686,964	2,689,940	2,612,017	2,757,692	-0.11
2007-08	2,795,003	2,769,015	2,666,748	2,836,063	0.93
2008-09	2,822,510	2,782,559	2,663,734	2,847,270	1.42
Std. Dev.		15,950	55,086	27,717	
MAPE		0.4	1.5	0.9	

Race/Ethnicity Total

Year	Actual	WICHE	Sing. Exp.	Dbl. Exp.	Abs. % Err. of Best
1992-93	2,067,874	2,067,874	2,067,874	2,067,874	
1993-94	2,044,173	2,044,173	2,044,173	2,044,173	
1994-95	2,075,429	2,075,429	2,075,429	2,075,429	
1995-96	2,096,594	2,096,764	2,096,764	2,096,764	
1996-97	2,179,385	2,179,475	2,179,475	2,179,475	
1997-98	2,252,647	2,252,647	2,252,647	2,252,647	
1998-99	2,290,720	2,290,720	2,290,720	2,290,720	
1999-00	2,371,062	2,371,062	2,371,062	2,371,062	
2000-01	2,403,317	2,403,317	2,403,317	2,403,317	
2001-02	2,422,166	2,422,166	2,422,166	2,422,166	
2002-03	2,515,503	2,529,839	2,519,619	2,526,591	-0.44
2003-04	2,551,479	2,544,004	2,516,948	2,572,532	-0.83
2004-05	2,582,974	2,552,811	2,513,337	2,609,860	-1.04
2005-06	2,609,196	2,590,028	2,536,807	2,662,176	-2.03
2006-07	2,665,472	2,655,081	2,581,352	2,724,507	-2.21
2007-08	2,771,025	2,728,824	2,630,097	2,797,074	-0.94
2008-09	2,797,326	2,735,589	2,621,241	2,802,272	-0.18
Std. Dev.		21,722	61,663	21,068	
MAPE		0.6	1.8	0.6	

American Indian/Alaska Native Graduates

Year	Actual	WICHE	Sing. Exp.	Dbl. Exp.	Abs. % Err. of Best
1992-93	18,167	18,167	18,167	18,167	
1993-94	19,308	19,308	19,308	19,308	
1994-95	19,600	19,600	19,600	19,600	
1995-96	19,215	19,215	19,215	19,215	
1996-97	20,009	20,009	20,009	20,009	
1997-98	21,117	21,117	21,117	21,117	
1998-99	21,686	21,686	21,686	21,686	
1999-00	23,010	23,010	23,010	23,010	
2000-01	24,318	24,318	24,318	24,318	
2001-02	24,762	24,762	24,762	24,762	
2002-03	25,518	26,347	26,313	26,583	-3.12
2003-04	25,927	27,081	26,912	28,089	-3.80
2004-05	28,036	27,664	27,420	29,300	2.20
2005-06	26,952	29,302	28,949	31,547	-7.41
2006-07	28,192	30,694	30,092	33,720	-6.74
2007-08	29,805	31,237	30,416	34,785	-2.05
2008-09	29,802	32,006	31,017	35,790	-4.08
Std. Dev.		1,060	824	2,435	
MAPE		3.2	2.4	7.5	

Asian/Pacific Islander/Native Hawaiian Graduates

Year	Actual	WICHE	Sing. Exp.	Dbl. Exp.	Abs. % Err. of Best
1992-93	89,968	89,968	89,968	89,968	
1993-94	94,412	94,412	94,412	94,412	
1994-95	87,261	87,261	87,261	87,261	
1995-96	94,061	94,232	94,232	94,232	
1996-97	98,729	98,819	98,819	98,819	
1997-98	105,539	105,539	105,539	105,539	
1998-99	109,483	109,483	109,483	109,483	
1999-00	117,996	117,996	117,996	117,996	
2000-01	123,212	123,212	123,212	123,212	
2001-02	124,883	124,883	124,883	124,883	
2002-03	127,823	129,263	128,657	128,765	-0.65
2003-04	130,419	130,437	128,994	130,946	1.09
2004-05	135,159	135,170	132,778	135,426	1.76
2005-06	143,098	143,637	140,153	143,799	2.06
2006-07	145,742	147,154	142,858	146,186	1.98
2007-08	151,645	152,801	147,146	150,873	2.97
2008-09	154,904	156,201	149,580	153,509	3.44
Std. Dev.		640	2,024	634	
MAPE		0.3	1.2	0.3	

Hispanic Graduates

Year	Actual	WICHE	Sing. Exp.	Dbl. Exp.	Abs. % Err. of Best
1992-93	195,472	195,472	195,472	195,472	
1993-94	202,840	202,840	202,840	202,840	
1994-95	207,949	207,949	207,949	207,949	
1995-96	213,233	213,233	213,233	213,233	
1996-97	227,830	227,830	227,830	227,830	
1997-98	246,178	246,178	246,178	246,178	
1998-99	261,822	261,822	261,822	261,822	
1999-00	276,064	276,064	276,064	276,064	
2000-01	288,668	288,668	288,668	288,668	
2001-02	305,968	305,968	305,968	305,968	
2002-03	329,995	332,669	330,643	333,177	-0.81
2003-04	350,205	347,558	343,029	356,012	0.76
2004-05	371,125	364,714	359,108	380,238	1.73
2005-06	377,055	384,208	376,379	403,598	-1.90
2006-07	394,219	409,570	396,807	426,868	-3.89
2007-08	437,880	446,135	427,699	463,566	-1.89
2008-09	468,352	471,220	449,309	488,775	-0.61
Std. Dev.		5,694	6,705	12,451	
MAPE		1.0	1.1	2.6	

Black non-Hispanic Graduates

Year	Actual	WICHE	Sing. Exp.	Dbl. Exp.	Abs. % Err. of Best
1992-93	275,619	275,619	275,619	275,619	
1993-94	272,325	272,325	272,325	272,325	
1994-95	268,749	268,749	268,749	268,749	
1995-96	274,421	274,421	274,421	274,421	
1996-97	289,450	289,450	289,450	289,450	
1997-98	298,802	298,802	298,802	298,802	
1998-99	301,206	301,206	301,206	301,206	
1999-00	313,644	313,644	313,644	313,644	
2000-01	317,103	317,103	317,103	317,103	
2001-02	324,366	324,366	324,366	324,366	
2002-03	337,753	341,306	340,245	341,529	-1.12
2003-04	349,987	346,202	342,849	352,852	-0.82
2004-05	361,428	354,898	350,231	369,325	-2.18
2005-06	369,092	362,287	355,864	380,862	-3.19
2006-07	386,268	384,565	373,857	401,114	-3.84
2007-08	409,191	396,739	382,101	414,447	-1.28
2008-09	425,563	405,521	389,009	425,214	0.08
Std. Dev.		6,643	12,287	5,176	
MAPE		1.2	2.3	1.0	

White non-Hispanic Graduates

Year	Actual	WICHE	Sing. Exp.	Dbl. Exp.	Abs. % Err. of Best
1992-93	1,488,648	1,488,648	1,488,648	1,488,648	
1993-94	1,455,288	1,455,288	1,455,288	1,455,288	
1994-95	1,491,872	1,491,872	1,491,872	1,491,872	
1995-96	1,495,664	1,495,664	1,495,664	1,495,664	
1996-97	1,543,367	1,543,367	1,543,367	1,543,367	
1997-98	1,581,012	1,581,012	1,581,012	1,581,012	
1998-99	1,596,523	1,596,523	1,596,523	1,596,523	
1999-00	1,640,348	1,640,348	1,640,348	1,640,348	
2000-01	1,650,016	1,650,016	1,650,016	1,650,016	
2001-02	1,642,186	1,642,186	1,642,186	1,642,186	
2002-03	1,694,414	1,700,254	1,693,761	1,696,537	-0.13
2003-04	1,694,942	1,692,726	1,675,165	1,704,633	-0.57
2004-05	1,687,226	1,670,364	1,643,800	1,695,571	-0.49
2005-06	1,693,000	1,670,594	1,635,462	1,702,370	-0.55
2006-07	1,711,051	1,683,097	1,637,738	1,716,619	-0.33
2007-08	1,742,505	1,701,912	1,642,734	1,733,403	0.52
2008-09	1,718,705	1,670,642	1,602,326	1,698,983	1.15
Std. Dev.		18,173	43,058	8,287	
MAPE		0.8	2.0	0.3	

Nonpublic Graduates

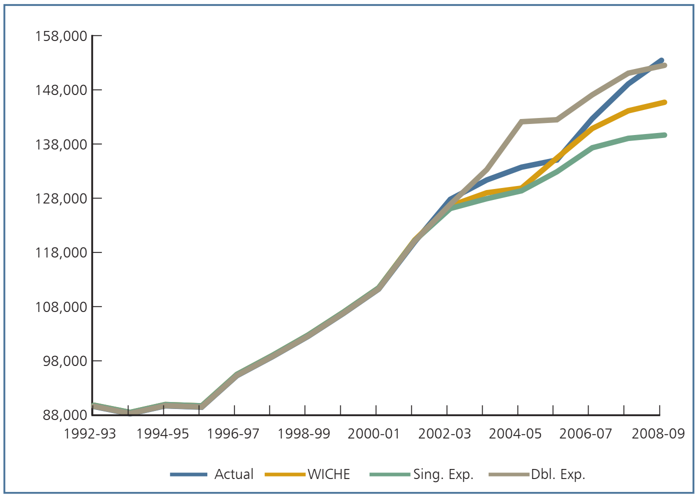
Year	Actual	WICHE	Sing. Exp.	Dbl. Exp.	Abs. % Err. of Best
1992-93	225,093	225,093	225,093	225,093	
1993-94	228,503	228,503	228,503	228,503	
1994-95	234,084	234,084	234,084	234,084	
1995-96	237,129	237,129	237,129	237,129	
1996-97	239,682	239,682	239,682	239,682	
1997-98	248,854	248,854	248,854	248,854	
1998-99	258,026	258,026	258,026	258,026	
1999-00	260,648	260,648	260,648	260,648	
2000-01	263,269	263,269	263,269	263,269	
2001-02	271,343	271,343	271,343	271,343	
2002-03	279,418	277,986	275,275	276,645	0.99
2003-04	284,824	282,751	277,658	277,589	2.54
2004-05	290,277	285,509	279,028	278,415	4.09
2005-06	289,188	287,740	279,415	279,530	3.34
2006-07	288,099	292,924	281,821	280,150	2.76
2007-08	0	292,968	279,584	276,533	N/A
2008-09	0	291,913	276,290	268,682	N/A
Std. Dev.		27,405	4,484	4,730	
MAPE		0.5	1.3	1.4	

Notes: Weighting, single exponential smoothing constant, and double exponential dampening factors were all set to 0.4 for these simulations. Std. Dev. is standard deviation of all years. MAPE is mean absolute percent error. Abs. % Err. of Best is the absolute percent error of the most accurate method.

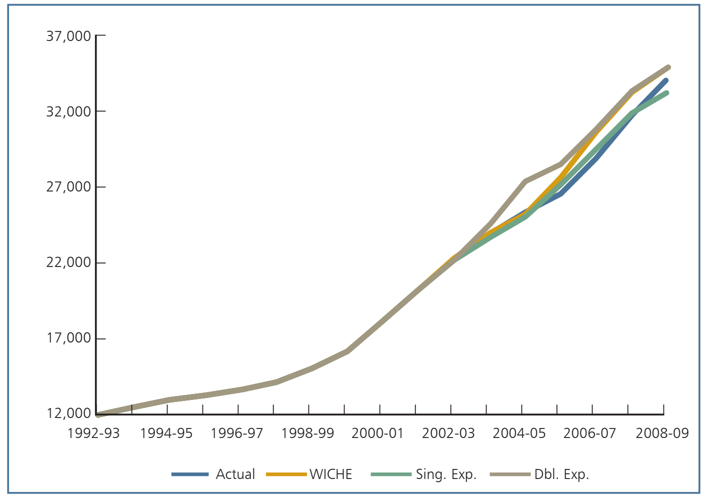
Selected Simulated Projections

Figure C-1. FLORIDA

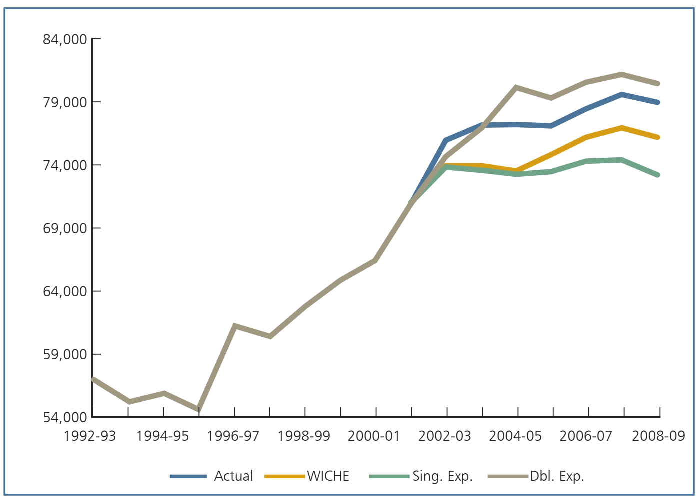
C-1a. Total Public



C-1b. Hispanic



C-1c. White non-Hispanic



C-1d. American Indian/Alaska Native

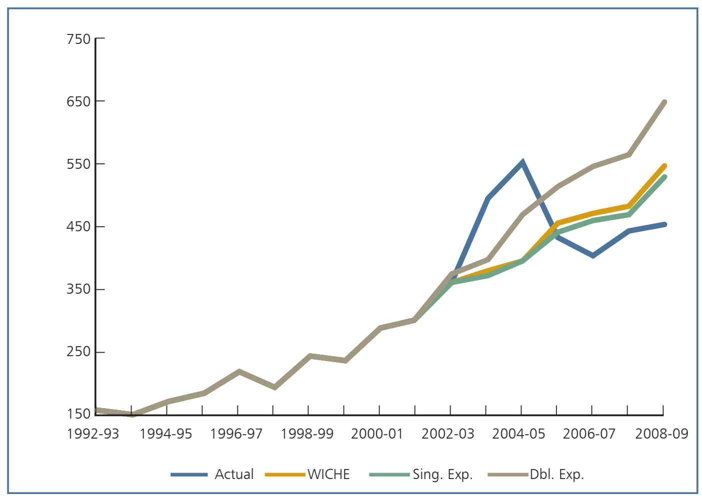
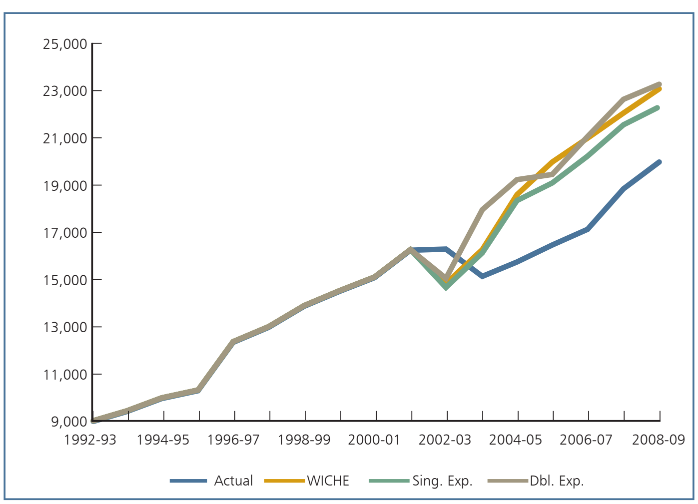
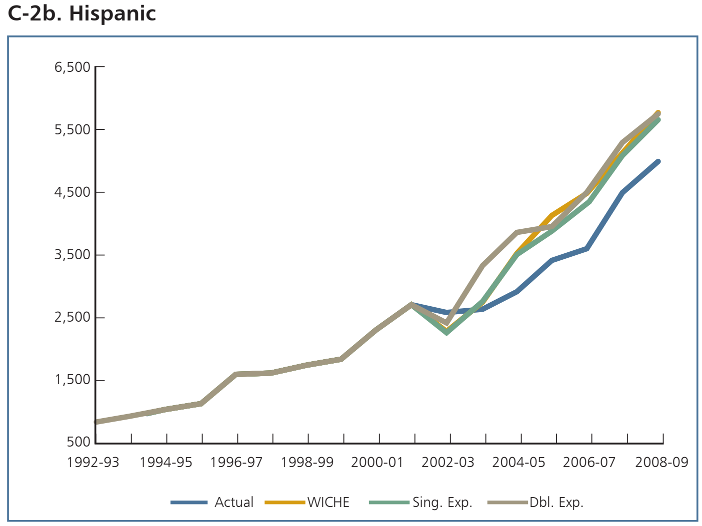


Figure C-2. NEVADA

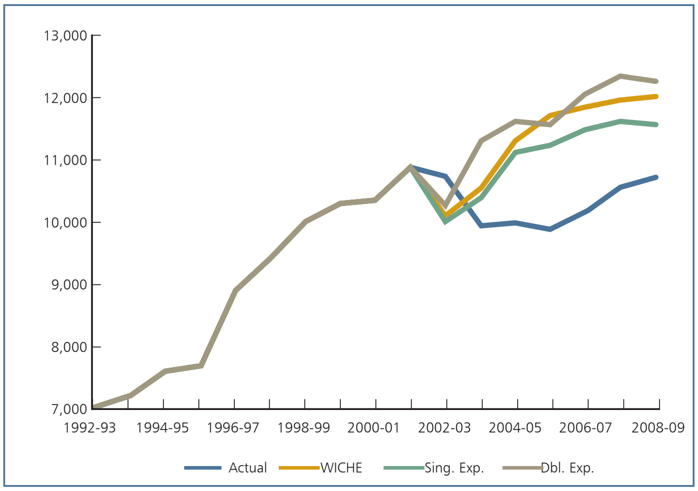
C-2a. Total Public



C-2b. Hispanic



C-2c. White non-Hispanic



C-2d. Black non-Hispanic

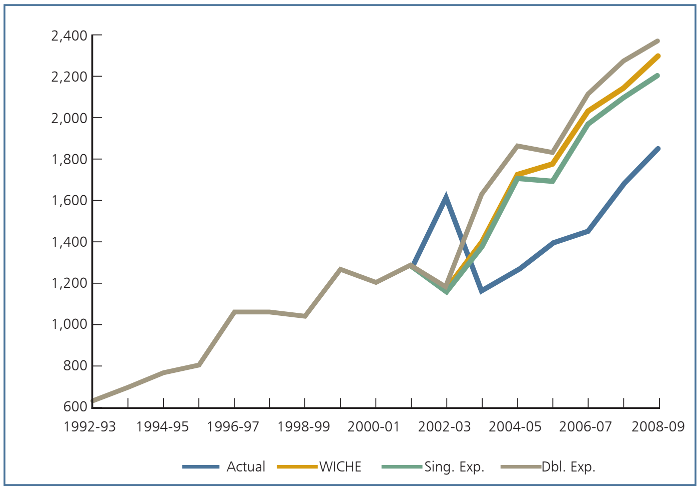
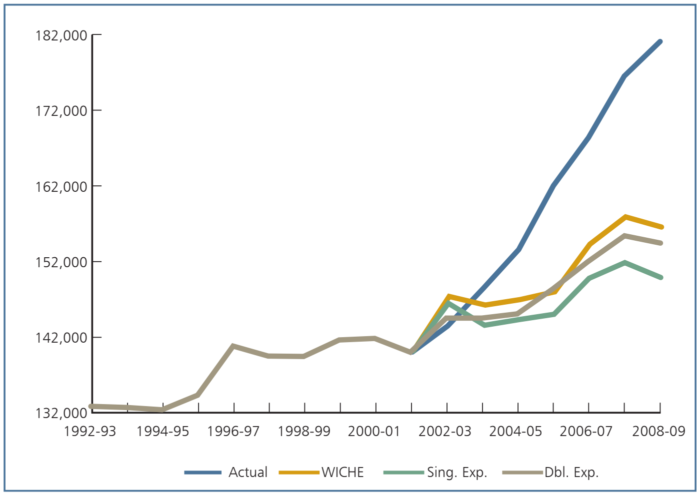
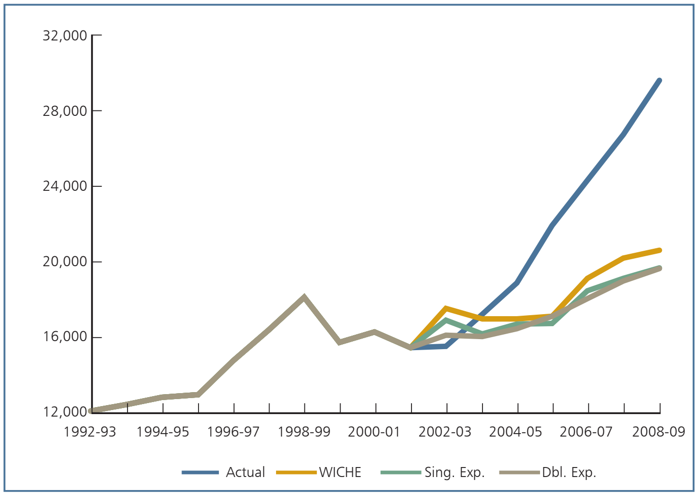


Figure C-3. NEW YORK

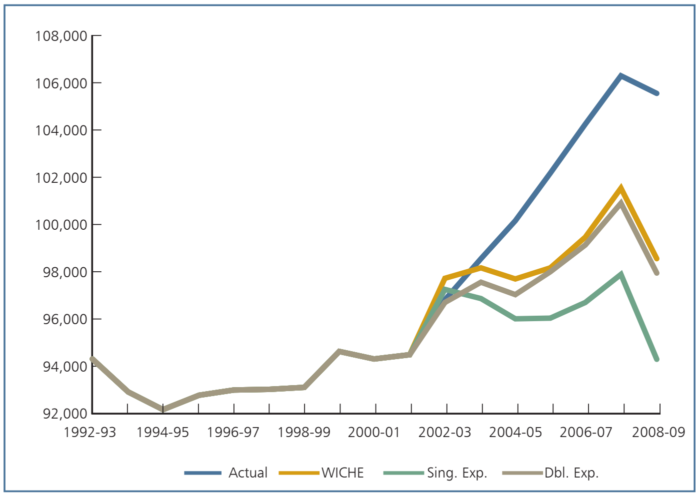
C-3a. Total Public



C-3b. Hispanic



C-3c. White non-Hispanic



C-3d. Black non-Hispanic

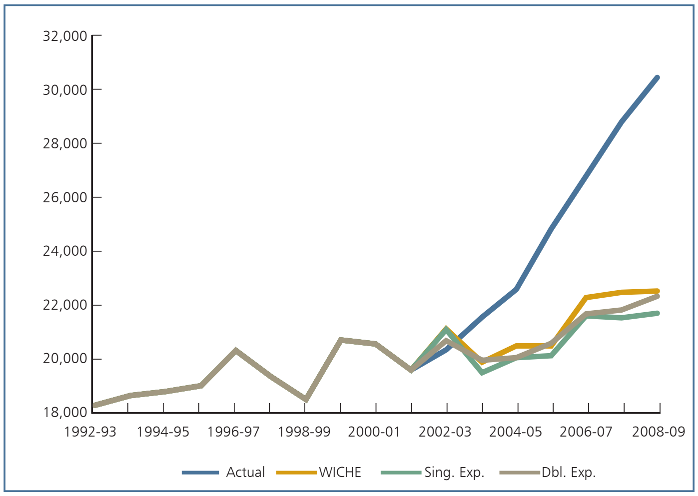
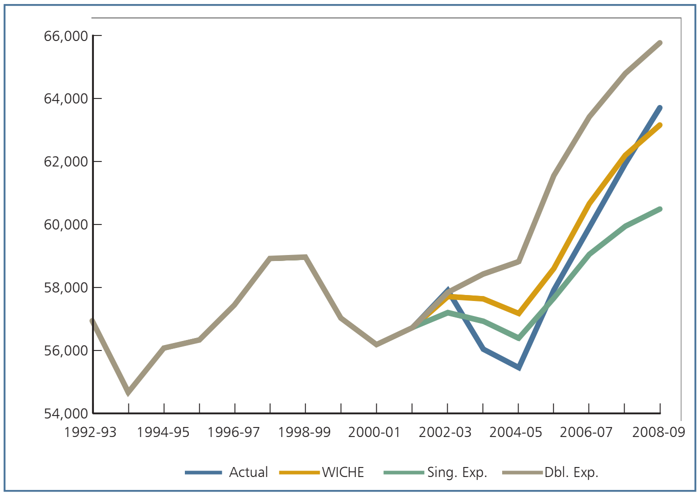
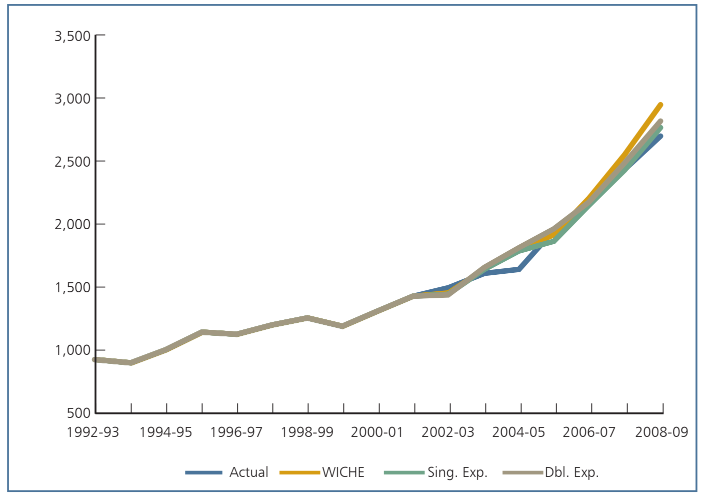


Figure C-4. INDIANA

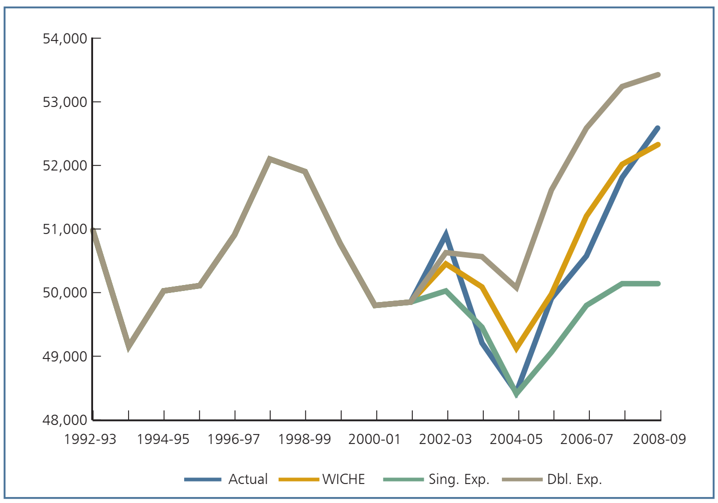
C-4a. Total Public



C-4b. Hispanic



C-4c. White non-Hispanic



C-4d. Black non-Hispanic

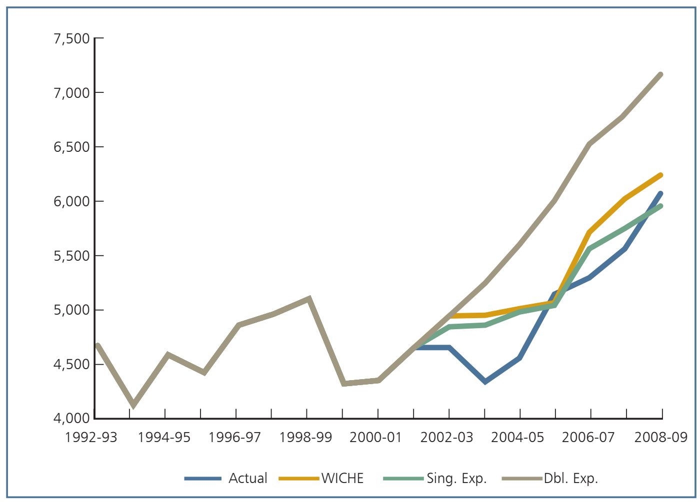
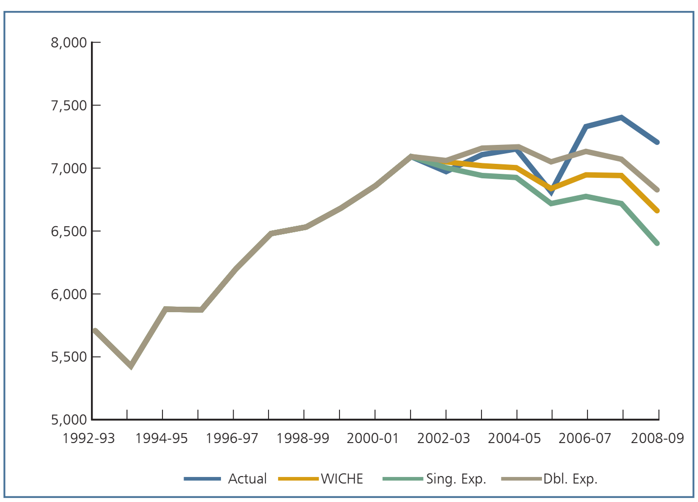
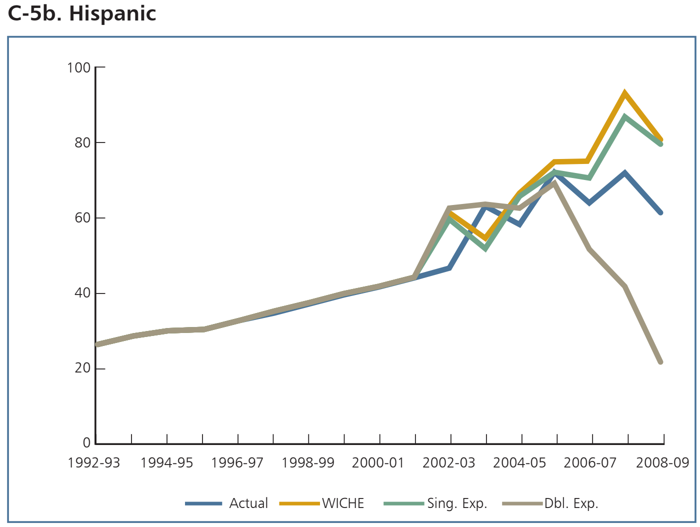


Figure C-5. VERMONT

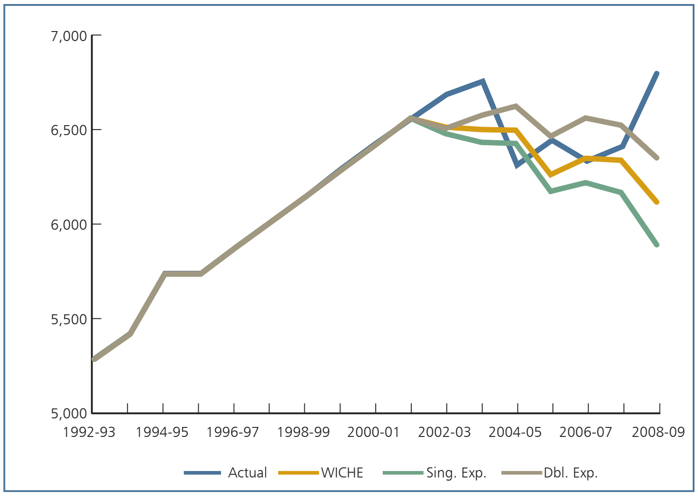
C-5a. Total Public



C-5b. Hispanic



C-5c. White Non-Hispanic



C-5d. Black non-Hispanic

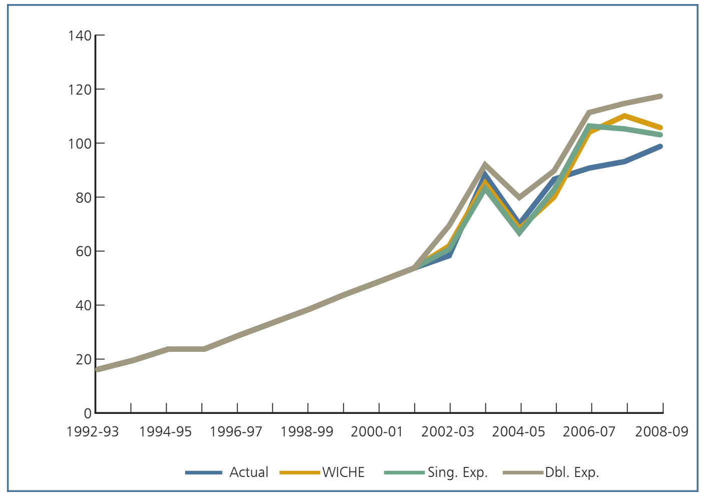
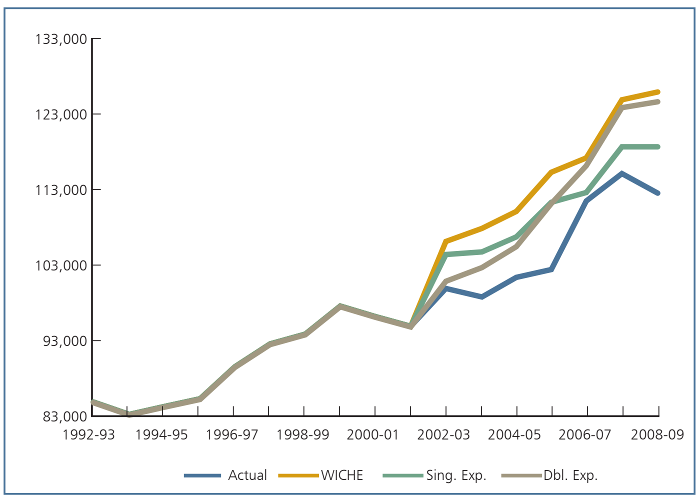
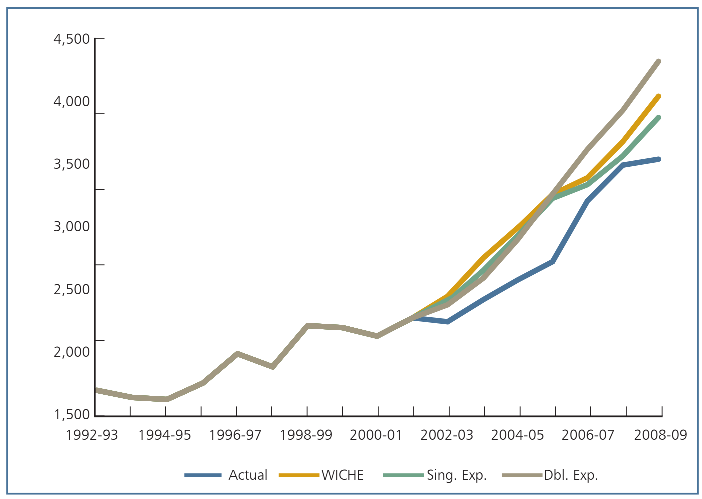


Figure C-6. MICHIGAN

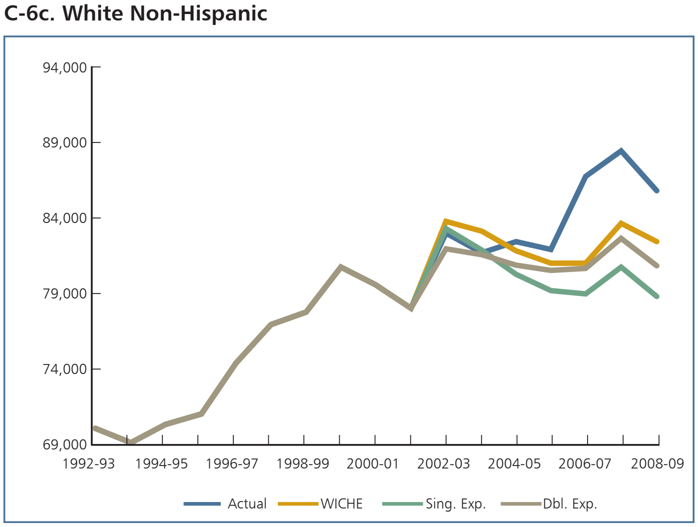
C-6a. Total Public



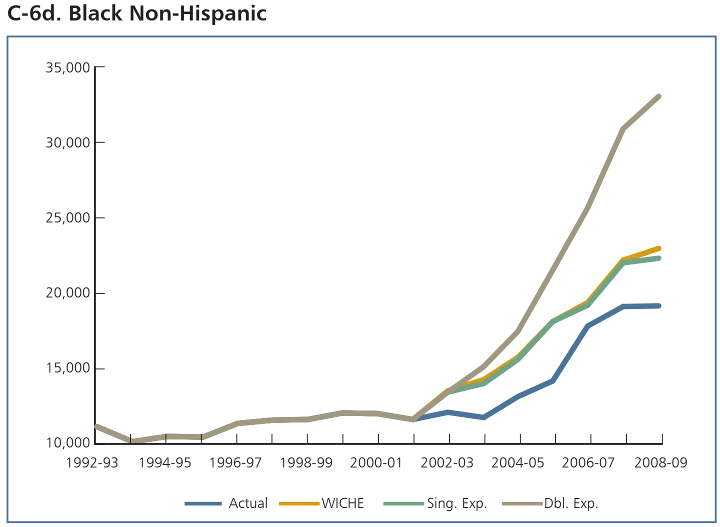
C-6b. Hispanic



C-6c. White Non-Hispanic



C-6d. Black Non-Hispanic



Part 2. Improving Projections of High School Graduates

By Hans Johnson and David Ezekiel

Summary

WICHE's projections of high school graduates are informative and widely used. Institutions, researchers, and policy officials across the United States use the projections for planning and to forecast higher education enrollments. WICHE has produced the high school graduate projections for over 30 years and has established a strong track record of consistency, transparency, and clarity in its data and methods. The basic approach used by WICHE has not changed appreciably in that time, although the projections have expanded in scope to include all 50 states and multiple racial/ethnic groups. In this paper we review WICHE's methodology and evaluate whether the projections could be made more useful by incorporating additional characteristics of high school graduates beyond race and ethnicity.

Our primary findings are that WICHE should continue to use the Cohort Survival Ratio (CSR) method for projecting high school graduates, for at least two reasons. First, the method relies on data that are timely and readily available for all 50 states. Second, the underlying determinants of CSRs, including demographic forces such as migration and educational outcomes such as retention, are not accurately measured historically for most states, if they exist at all. Developing projections from unstable or uncertain historical data series is, of course, not a good idea.

However, the advent of the American Community Survey (ACS) does offer some new opportunities for enhancing WICHE's projections. The large sample size of the ACS makes it a useful tool, for examining trends in socioeconomic characteristics of high school students, especially in larger states. WICHE could choose to develop projections of some of those characteristics or could simply highlight recent trends.

Introduction

WICHE has been developing projections of high school graduates since 1979.[1] Over time the series has become more comprehensive, both geographically and in terms of content. The 7th edition of the series was published in 2008 and is supplemented with detailed online datasets. The projections provide numbers of graduates by race/ethnicity for all 50 states and the District of Columbia. WICHE's projections, including both public and private high school graduates, are widely used and cited. For WICHE's primary constituency, higher education institutions and state higher education officials, the projections provide essential information that can be used both technically (for example, for enrollment planning) and more generally (for example, to understand the changing demographic composition of high school graduates). WICHE's transparency in its discussion of the methods, sources, and data used to develop the projections is a hallmark of the series, adding to its credibility and usefulness.

As WICHE prepares to develop a new set of projections, it is an appropriate time to consider new methods, new data challenges, and new opportunities. In this paper we provide a review of WICHE's projections of high school graduates. We evaluate WICHE's methodological approach, discuss new and ongoing challenges to developing accurate projections, identify new data opportunities, and offer suggestions for enhancing the projections.

Review of Methodology: The Cohort Survival Ratio Model

WICHE uses cohort survival ratios, also known as grade progression ratios, to project school enrollment and the number of high school graduates. The ratio is simply the number of students in grade p in year t divided by the number of students in grade p-1 in year t-1:

$$Y_{p,t} = E_{p,t}/E_{p-1,t-1}$$

where $Y_{p,t}$ is the cohort survival ratio (CSR) from grade p-1 to grade p from year t-1 to year t, and E is enrollment. As shown below WICHE uses CSRs over the five most recent years of actual data to develop its projections. It is worth noting that the CSR is not really composed of a true cohort of students "surviving" through an education system across time: for example, the students in grade p in year t include some who were in grade p-1 the previous year but also include new entrants (through in-migration). CSRs tend to congregate around 1.0 or just below 1.0 but in theory could range from 0 to extremely high values.

WICHE calculates CSRs separately by state and race/ethnicity and for both public and private schools. Ratios are also calculated for births to first grade enrollment and for 12th grade enrollment to graduation. To project a CSR, WICHE uses a weighted moving average of CSRs over the past five years, with greater weights given to the most recent year. Specifically, the last year represents 40 percent of the projected CSR and the previous second through fifth years are equally weighted to each represent 15 percent of the projected CSR:

$$Y_{p,t} = w\ Y_{p,t-1} + (1 - w)\ (\Sigma_{i=2}^{5} Y_{p,t-1} / 4)$$

where $Y_{p,t}$ is the CSR for grade p at year t, and w is the smoothing weight (set equal to 0.4).

To estimate CSRs WICHE uses data provided by the National Center for Education Statistics (the Common Core of Data (CCD) for public schools and the Private School Survey (PSS) for nonpublics) or data provided by the state in the event that CCD or PSS data is unavailable. Prior to its 2008 series, WICHE collected data from each state individually. To calculate the CSR for births to first grade, WICHE uses birth data from the National Center for Health Statistics. In addition to checking each state for availability, WICHE performs quality checks on the available data and makes adjustments to CCD and PSS data where necessary.

WICHE has evaluated the accuracy of past projections. In general, the projections are most accurate in the short run versus the long run and for larger states versus smaller states. States with more stable past trends in CSRs tended to have more accurate projections than states with volatile CSRs. WICHE's evaluation of its 2003 series shows mean absolute percentage errors of 4.1 percent for a seven-year horizon. Error rates were lower for regional and nationwide projections; similarly, projections were more accurate for large racial/ethnic groups.[2] NCES's recent analyses of their projections show that their national public school graduate projections had mean absolute errors of 1.0 percent for a five-year horizon and 3.8 percent for a 10-year horizon.[3] For a five-year horizon, NCES projections had mean absolute errors that ranged from 1.4 percent for Maryland to 16.5 percent for the District of Colombia; for a 10-year horizon, error rates ranged from 1.5 percent for Massachusetts to 17.8 percent for South Dakota.

The CSR method has many advantages: CSRs are easy to calculate, which means that the approach is transparent to public policymakers and others; they are derived from administrative data that are readily available on an annual and timely basis for every state; and they are widely known and accepted. Moreover, the CSR is a good summary measure of numerous, complex underlying trends for which information is difficult to find.

The CSR method has disadvantages as well, the key concern being that CSRs obscure or even ignore underlying trends that could potentially be used to develop a deeper and more accurate understanding of the forces that lead to the observed ratios. These factors include demographic events, such as migration, and school outcomes, such as dropout. Moreover, each of those factors could and do vary by student demographics, including gender, race/ethnicity, nativity (meaning U.S.-born or foreign-born), and parent's education, among others. Education policies, such as retention practices, and state policies, such as exit exams, further complicate matters and require due diligence in evaluating the appropriateness of using historical trends in developing projections.[4]

In this report we identify these underlying forces and attempt to measure their effect on projections of high school graduates. We consider both empirical data and previous research regarding these underlying factors, but the absence of data (e.g., retention rates by grade – the rate at which students of a given grade will be held back) makes it difficult to precisely measure the size of their effects. To use these factors in developing projections of high school graduates would require comprehensive and timely data. For WICHE's purposes this means the data should be available annually for each state and racial/ethnic group. The development of longitudinal student databases in many states is a step in the right direction, but for the most part the data required to use the determinants of the CSR to project high school graduates are not sufficiently available.

Deconstructing the Cohort Survival Ratio

As shown in the first equation (on p. 17), CSRs are determined by grade enrollment in successive grades in successive years. Any event that affects enrollment in successive grades across time will affect CSRs. These events can be characterized as either demographic or based on student outcomes, the latter of which can be affected by policy or practice. Specifically, the CSR is a function of grade completion and progression, grade retention (and skipping), dropout, migration (including movement into and out of private schools), and mortality.

Migration. Migration is one of the demographic processes with the greatest potential to affect the cohort survival ratio. The direction of migration into and out of the country as well as between states within the country, if large enough, could alter the CSR in a way that does not necessarily reflect the educational progress of students in any given state. Positive net migration will increase CSRs (more students are added to next year's class increasing enrollment), and negative migration will decrease CSRs (students in last year's class have moved away). If all children progressed one grade each year without dropout, then CSRs would be completely determined by net migration flows.

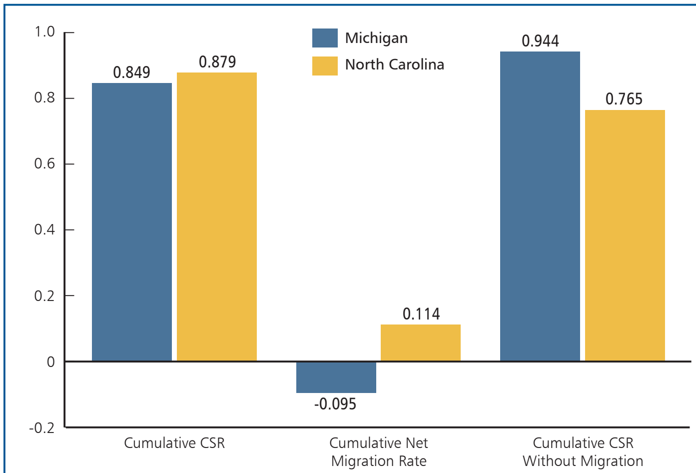
Determination of the role that migration plays in the level and trends in CSRs requires annual data on migration. Unfortunately, accurate information on migration of school-aged children is not available for all states. Single-grade migration information for students is a recent development for the American Community

Survey (ACS), available only since 2008, so a time series is not yet possible. However, for the years that are available, the ACS provides information on state, race, and migration status. This information is only available for domestic migration within the United States and international immigration to the United States but does not include emigration from the United States. Moreover, because interstate migration is not common among families with children, the number of survey respondents that report moving across state lines is quite low for many states and for single grades. Low sample sizes lead to imprecise estimates of migration, making such estimates an unreliable foundation for projections.

The ACS data show that migration is highly variable between states. In 2009, among school-aged children, Hawaii experienced the largest net migration losses and Delaware experienced the largest net migration gains. Hawai'i lost 3 percent of its K-12 aged population due to domestic out-migration in 2009, whereas Delaware experienced an increase in its K-12 population by 3 percent due to in-migration.[5] Our empirical analysis shows that although net migration does not generally appear to be a large factor in the determination of the CSR for any one grade, the cumulative effects of net migration flows can play a large role in affecting trends and patterns in CSRs over the entire course of elementary and secondary grades. For example, Michigan has suffered net migration losses for many decades. The loss of students from one grade to the next is relatively small and does not dramatically affect the single-grade CSR, but sustained losses over many years and many grades can have a substantial effect on the cumulative CSR (defined as the CSR for all grades combined). Moreover, differences in CSRs between states could be solely due to migration and rather than dropout rates or other factors. For example, Michigan tends to have lower CSRs than North Carolina. While Michigan has sustained large domestic migration losses, North Carolina has experienced strong gains in population due to migration. The lower CSRs in Michigan, compared to North Carolina, can be completely explained by migration. Indeed, were it not for its migration losses, Michigan would have had higher CSRs than North Carolina (Figure 1).

For individual grade CSRs, migration is not particularly important. This is illustrated by a comparison of Michigan with Texas (like North Carolina, a state with large net migration gains). Differences in grade-specific CSRs between Michigan and Texas are not due to migration (Figure 2). Specifically, in 2009 Texas had a net migration rate for grades K to 12 of .0035 (or a net gain of 3.5 per thousand students), whereas Michigan had a net migration rate for the same age-group of negative .0086 (a net loss of 8.6 students per thousand). Throughout the second through 12th

Figure 1. CSRs and Net Migration Rates for 2009, Michigan and North Carolina

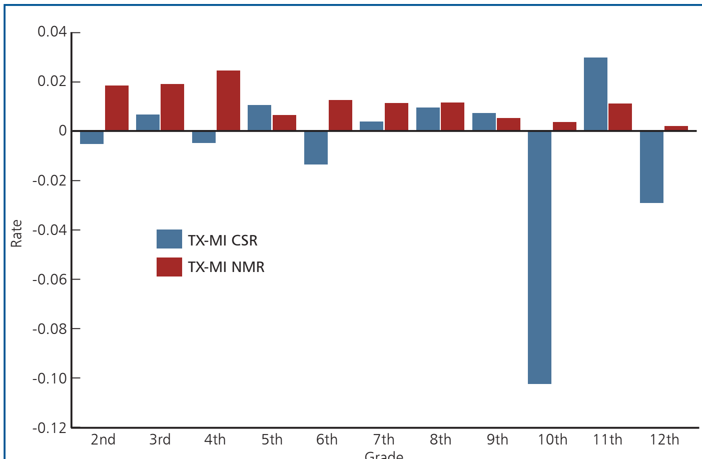


Sources: Authors' calculations, based on the U.S. Census Bureau 2009 American Community Survey, accessed on 24 July 2012 from <www.census.gov/acs/www/data_documentation/data_main>; NCES Common Core of Data State Nonfiscal Public Elementary/Secondary Education Survey Data: 2009-10, accessed on 24 July 2012 from <http://nces.ed.gov/ccd/stnfis.asp>; and Steven Ruggles, J. Trent Alexander, Katie Genadek, Ronald Goeken, Matthew B. Schroeder, and Matthew Sobek, *Integrated Public Use Microdata Series: Version 5.0* (Minneapolis: University of Minnesota, 2010).

Note: Cumulative CSRs are the product of individual grade CSRs; cumulative NMRs are the sum of individual grade NMRs.

grades, Texas consistently had a higher migration rate than Michigan (red bars in Figure 2), but CSRs are not appreciably different between the two states (blue bars in Figure 2). Indeed, Michigan has a much higher grade progression ratio at tenth grade despite having a lower net migration rate than Texas, a difference not possibly explained by migration rates. For reasons other than migration, Texas has very low CSRs from ninth to 10th grade.

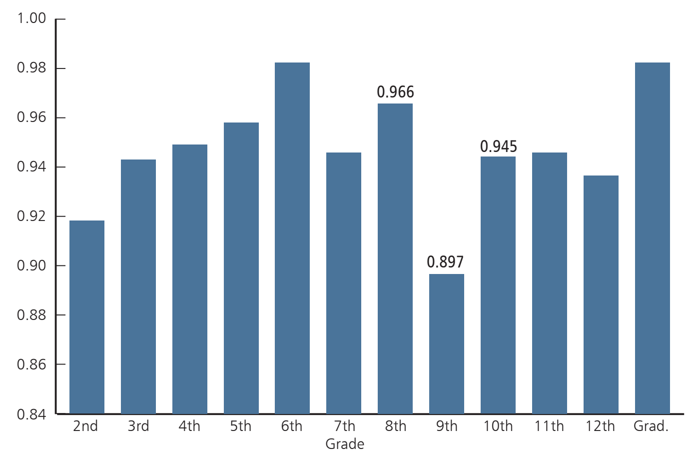
Figure 2. Differences in CSRs and Net Migration Rates for 2009, Michigan and Texas



Source: Authors' calculations based on the Census's 2009 American Community Survey; the NCES Common Core of Data, 2009-10; and Ruggles et al., *Integrated Public Use Microdata Series*.

Another kind of migration that can affect CSRs (when CSRs are broken down by school type) is movement between public and private schools. Data on this kind of movement are not systematically and comprehensively available. Indeed, rather than using data on the movement between public and private schools to deconstruct CSRs, CSRs are perhaps the best source of information on the movement between public and private schools. For example, the low CSR from eighth to ninth grade for private school students, as recorded by WICHE in its 2008 projection series, suggests that many private middle school students attend public high schools (Figure 3).

Figure 3. CSRs for Non-Public Schools, U.S., 2001-02



Source: Author's calculations using Western Interstate Commission for Higher Education, *Knocking at the College Door: Projections of High School Graduates by State and Race/Ethnicity, 1992-2022* (Boulder, CO: WICHE, 2008) Data files available from www.wiche.edu

In sum, migration is a key underlying factor that can and does influence CSRs, but it is not well-recorded. Even with the advent of the ACS, sample sizes for migration data for a single year of age for young children are simply too small to be used in WICHE's projections. Moreover, migration between public and private schools is not systematically collected, and emigration out of the United States is not available at all.

Mortality. Deaths are not an influential force on student progression ratios. Mortality after the first year of life is so small that it makes little difference in CSRs. For example, for the most at-risk non-infant group in our analysis, 15-19 year old black males in Washington, D.C., the crude mortality rate is just over 0.2 percent (Table 1). Even this relatively high mortality rate plays little role in explaining the low CSRs this population experienced during the corresponding high school years. The crude death rate's inability to account for variation in the CSR is reinforced by the very low levels that crude death rates can reach for less at-risk groups. The lowest mortality rate in the U.S. for the study period is eight in 100,000 for white females age five to nine in New York State. Not only is mortality a minor factor in CSRs, the mortality data that is available are difficult to apply to the WICHE projections. Single-year mortality is available at the national level without any connection to grade or school enrollment. For states and demographic groups, the available data is limited to five-year age groups, which cannot be reliably split up to apply to the single-grade cohort survival ratios WICHE produces.

Table 1. Death Rates for Selected Demographic Groups, 2007

Mortality Rates	Age Group	Gender	Race	Hispanic Origin	State	Deaths/ 100,000
Highest						
	<1	Female	Black	No	D.C.	2,307
	1-4	Female	Black	No	So. Carolina	75
	5-9	Male	Black	No	No. Carolina	27
	10-14	Male	Black	No	So. Carolina	44
	15-19	Male	Black	No	D.C.	203
Lowest						
	<1	Male	White	Yes	Georgia	255
	1-4	Female	White	No	Michigan	13
	5-9	Female	White	No	New York	8
	10-14	Female	White	No	Ohio	9
	15-19	Female	White	No	New Jersey	20

Source: Authors' calculations, based on data from the National Vital Statistics System, Deaths by Single Years of Age, Race, and Sex: United States, 2007 (Atlanta: Centers for Disease Control and Prevention: National Center for Health Statistics), accessed on 24 July 2012 from <www.cdc.gov/nchs/data/dvs/MortFinal2007_Worktable310.pdf>.

Grade retention and grade acceleration. Apart from demographic forces, CSRs are also determined by student outcomes. These include grade retention (repeating a grade) and grade acceleration (also known as grade skipping and whole grade advancement). Data on each of these events is hard to come by. In general, such data are either not collected at all or are not well-reported. National longitudinal surveys do not contain a sufficiently large sample to estimate trends in these factors and often are focused only on a subset of child populations. For example, none of the National Longitudinal Survey of Youth (NLSY), the National Educational Longitudinal Study (NELS), or the Educational Longitudinal Study (ELS) includes elementary school students. The NELS base-year (1988) sample includes about 25,000 eighth graders, and the ELS base-year (2002) sample includes just over 16,000 10th graders. State sample sizes are much smaller; indeed, the ELS does not even include a state geographic variable. Moreover, these surveys are not available on a consistent temporal basis, following only certain cohorts many years apart. Nonetheless, data from these surveys and other sources do provide some national measures of the overall magnitude of some of these determinants of CSRs.

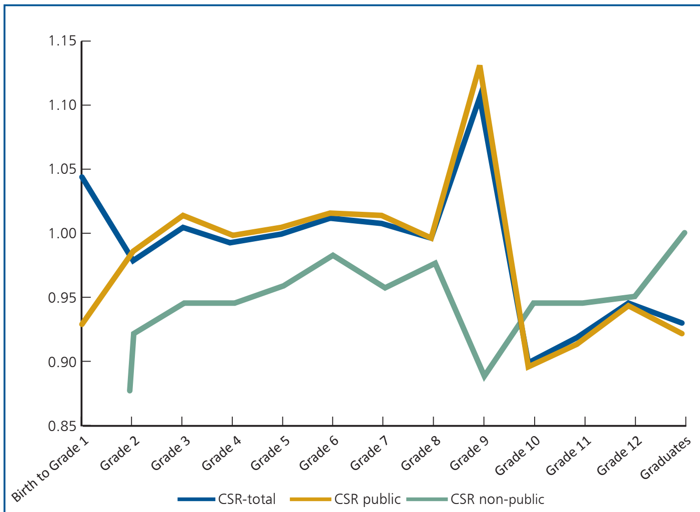
Grade acceleration is not well-recorded but is almost certainly a relatively uncommon event. A recent study found that 1.4 percent of the NELS cohort of eighth graders had skipped at least one grade prior to eighth grade and 0.6 percent of the ELS cohort of 10th graders had skipped a grade prior to 10th grade, with the determination of grade acceleration based on birth date and grade enrolled[6], a somewhat problematic approach given different age cut-offs for school enrollment by state. In theory, the ACS could be used to develop a similar measure for each year and for each state. Since 2006 the ACS has included information on single year of age and birth quarter (three-month groupings); and since 2008 it has provided information on specific grade (rather than grade groupings). However, because the ACS is based on an independent sample for each month of the calendar year and no information is provided on the month of the survey, it is not possible to precisely identify students that are young for their grade and therefore grade accelerated. For example, a nonadvanced student age seven with a birth date in the first quarter of the year would be either in second grade or third grade depending on the month of interview. Since we do not know the month, we cannot precisely ascertain if the student has been accelerated.

Grade retention appears to be far more common than grade advancement. Estimates of grade retention vary and depend on the source of data. In general, retention rates are low but not inconsequential. Researchers have used a number of data sources to estimate retention rates, including the surveys noted above, the October school enrollment supplements to the Current Population Survey (CPS), the National Household Education Surveys (NHES) Program, longitudinal data from school districts, and the Common Core of Data (CCD). The approach to estimating retention rates varies with the source. For example, the NHES asks parent respondents if their children have ever been retained. Researchers using the October CPS compare a child's age with his or her grade level to identify students that are old for their grade, equating this to retention. The most accurate measures of dropout are derived from longitudinal data such as the ELS.

How common is retention? According to parent responses to the "Parent and Family Involvement in Education" component of the 2007 NHES, about 10 percent of students had been retained by the time of the survey. The NHES asks parents directly if their student has ever been retained. The results indicate that, prior to high school, students are most likely to be retained in kindergarten or first grade. Retention rates as reported in the NHES have not varied much since at least 1996[7]. A recent examination of retention rates based on longitudinal student data in early grades in the Los Angeles Unified School District found that 7.5 percent of students were retained at least once prior to third grade.[8]

Other data show relatively high rates of retention for ninth graders. One clear pattern that emerges from an examination of CSRs is the large number of students in ninth grade. Nationwide, for both public and private schools combined, WICHE's 2008 report shows about 10 percent more students in ninth grade than there were in eighth grade a year earlier, a CSR far higher than for any other grade sequence (Figure 4).[9] This is not due to a large influx of ninth graders from abroad but is instead attributable to high retention rates in

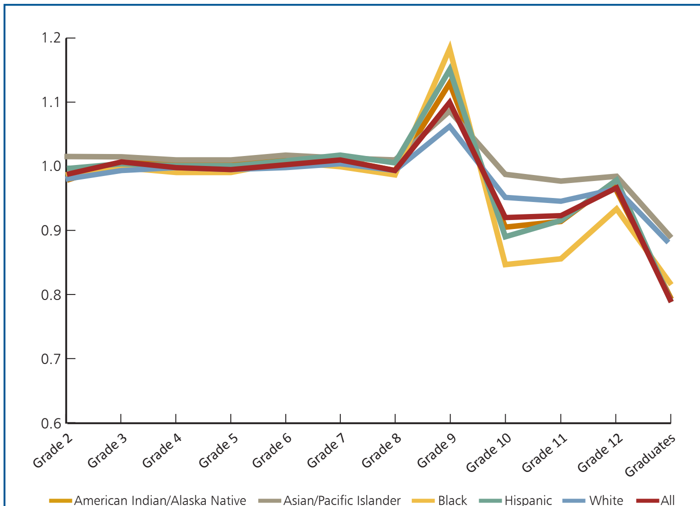
Figure 4. CSRs in the United States, 2003-04



Source: WICHE, *Knocking at the College Door, 1992-2022.*

ninth grade. The number of 10th graders is about 20 percent lower than the number of ninth graders one year earlier. In other words, a substantial number of ninth graders are repeating that grade. The pattern is consistent across states and ethnic groups, with African American students having the highest CSRs for ninth graders (Figure 5). Using CCD data along with state administrative data, a study of 2008 high school graduates in six states finds that 16 percent of all ninth grade students repeated ninth grade, with retention rates ranging from about 10 percent in Massachusetts to 30 percent in South Carolina.[10] However, in the 2007 collection year of the NHES, only 11 percent of parents nationally reported that their child had repeated a grade; one in nine stated the grade was ninth grade.

Figure 5. CSRs by Race/Ethnicity, United States, 2009



Source: Authors' calculations, based on the NCES Common Core of Data, 2009-10.

As discussed later in this report, state policies on graduation requirements can affect CSRs, particularly for 12th grade to graduation.

The lack of systemic data across states on grade retention and acceleration means that they cannot be used to project school enrollment.

Dropout rates. CSRs are also implicitly influenced by dropout rates. Indeed, dropout is the primary reason that CSRs are less than one for high school students. Moreover, dropout is one of the most important school outcome measures to policymakers and education officials, subject to intense policy concern and focus. Even so, accurate and comprehensive measures of dropout rates are not widely available. Estimates of dropout rates are controversial and subject to uncertainty. In California, for example, a recent review of graduation and dropout rates concluded that, using the same data source, three different reports showed different levels and trends.[11] The National Center for Education Statistics (NCES) notes that current measures "are, at best, proxies for the true cohort indicator,"[12] with the true cohort indicator requiring data that is not available across all or even most states. Nationwide, NCES has estimated "averaged freshman graduation rates" and "event dropout rates" using the Common Core of Data. These rates are published for each state and by racial/ethnic group.[13] The freshman graduation rate is a measure of on-time graduation, while event dropout rates are estimates of the share of students that drop out in a single year or grade. NCES develops the on-time graduation rates by comparing estimates of first-time 9th graders with counts of high school graduates three years later. These rates are not adjusted for retention, acceleration, migration, or movement into and out of private schools.[14] NCES uses the October CPS to estimate national event dropout rates for public and private schools and uses the CCD to estimate state event dropout rates for public high school students. As shown in Figure 6, these two measures of high school completions are not consistently aligned across states. For example, based on the 2008-09 CCD, Illinois had a relatively high freshman graduation rate, 77.7 percent – better than most states. But the state also reported a very high share of students dropping out (about 63,000 dropouts compared to 130,000 graduates), the highest rate in the nation. Clearly, these two estimates are inconsistent. Either Illinois school districts are over reporting dropouts to NCES or the NCES freshman graduation rate method misses large numbers of dropouts; or the data's been affected by some combination of the two.

As with other determinants of CSRs, estimates of dropout rates are too inconsistent and not sufficiently measured to use in projections of high school graduates.

Summary of Determinants of CSRs

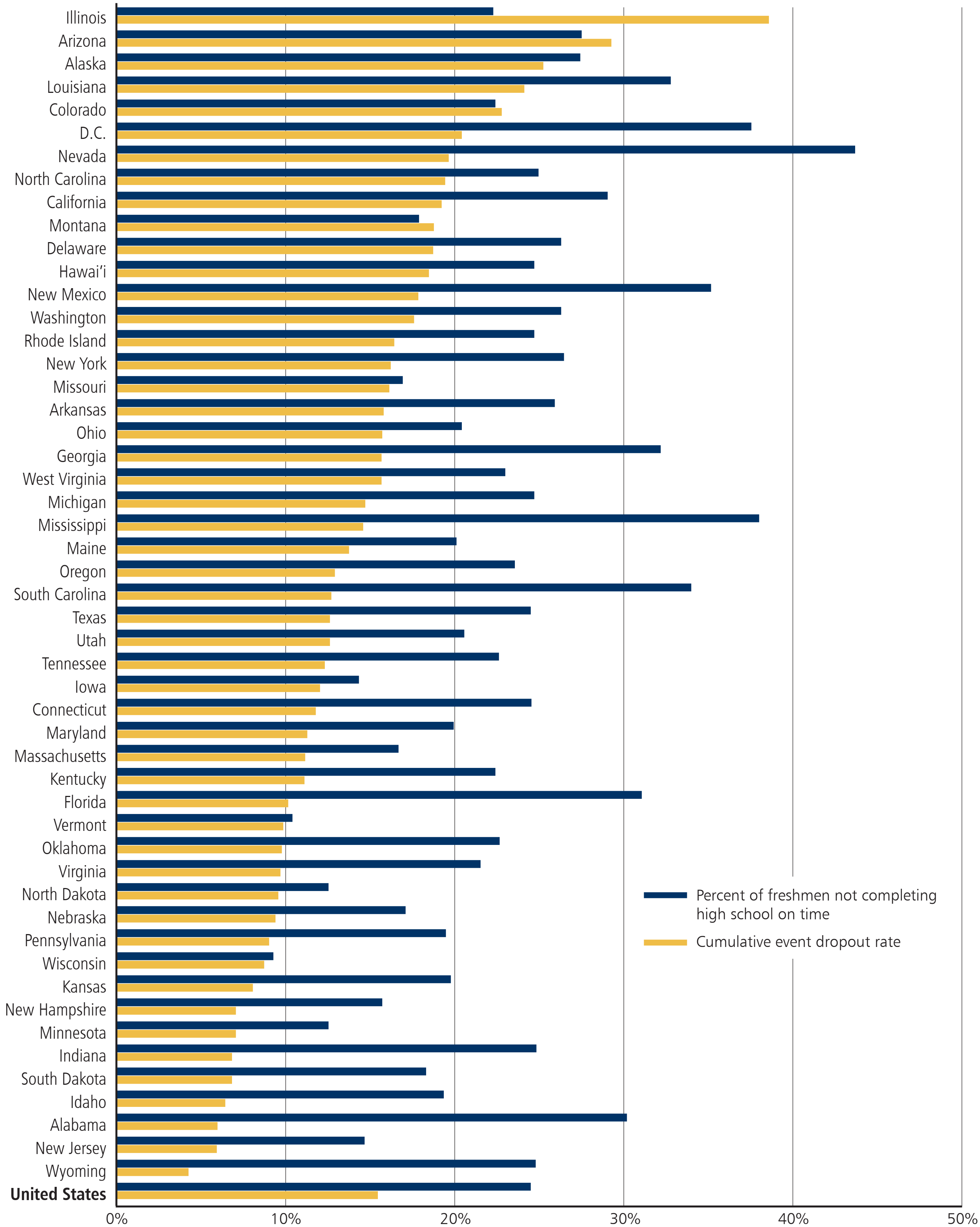
Having accurate data on the determinants of CSRs would not only provide for more nuanced projections of school enrollments and high school graduates, it would also greatly enhance our understanding of the forces that shape and determine student success. Unfortunately, data on the underlying demographic factors and student outcomes are simply not sufficient to develop robust projections. The development of student longitudinal databases in many states is a step in the right direction, but their inaccessibility and the fact that all states do not yet have them make them a poor alternative to the CSR model.[15]

Alternative Approaches

Projections and forecasts of times series data are developed for many purposes across a wide range of fields. Some models are well-defined and restricted to relatively narrow applications, such as cohort component models for population projections, while others are broad and include many variations, such as times series models. Chen identifies and provides a summary of nine types of models used for higher education enrollment projections: subjective judgment (such as the Delphi model, based on expert consensus), the ratio model, the CSR model, the Markov transition model, neural network models, simulation methods, time series analysis (including autoregressive integrated moving average, or ARIMA, models), fuzzy time series analysis, and regression analysis.[16] Some of these models could be categorized together; that is, they are not necessarily exclusive. For example, subjective judgment is used in many of the model types identified by Chen. The CSR model is really a type of ratio model. In general, there is a trade-off between complexity and transparency. Some models provide statistical confidence intervals and involve relatively little subjective decision making by the modeler, but most require some set of subjective assumptions. Table 2 provides a summary of the advantages and disadvantages of enrollment projection models, using classifications derived from Chen's approach (but modified to avoid repetition).

The key point for WICHE is that the more statistically sophisticated models (event probability models and regression methods) require data that are simply not available. Even if those approaches could yield more accurate projections, the inputs for those models do not exist. For example, in a simulation (or regression) model, current CSRs could be modeled as a function of both direct determinants (such as migration, deaths, and retention) and indirect determinants (including student characteristics, parent's education, and state education policies). Because the data required to run such a model do not exist across states, regression

Figure 6. Measures of High School Completion, 2008-09



Source: Authors' calculations, based on R. Stillwell, J. Sable, C. Plotts, and A. M. Noel, *NCES Common Core of Data State Dropout and Completion Data File: School Year 2008–09*, NCES 2011-313 and NCES 2010-365 revised (Washington, D.C.: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, 2011), accessed on 24 July 2012 at <http://nces.ed.gov/ccd/drpcompstatelvl.asp>.

Note: The percent of freshmen not completing high school on time is calculated by dividing the average of the number of eighth, ninth, and 10th graders in academic year 2005-2006 (to create an estimate of first-time ninth graders) by the number of high school graduates in academic year 2008-2009. The cumulative event dropout rate is calculated as: CEDR = 1 – ((1-EDR9) * (1-EDR 10) * (1-EDR11) * (1-EDR 12)), where EDR = dropout in grade x / enrollment in grade x. It is the cumulative probability that a student will dropout before graduating. Dropouts are identified by states in their reporting on the CCD.

Table 2. Summary of Projection Models

Model type	Example	Advantages	Disadvantages
Subjective judgment	Delphi method (experts debate and discuss)	Requires little historical data; takes advantage of expert knowledge	Expert judgment is often wrong; does not rely on empirical data; lacks transparency
Ratio models	CSR model	Uses known and readily available historical data; transparent and easily understood	Does not identify or forecast the underlying forces that shape the observed ratios; assumes a linear relationship
Event probability models	Markov transition model, simulation model	Projects the specific events that lead to the projected outcomes (e.g., underlying determinants of the CSR)	Specific event data is often not available; historic trends in underlying determinants can be highly variable; models can be complex but not necessarily more accurate
Regression methods	Time series analysis (ARIMA)	Allows the data to speak; can incorporate trends in related determinants; produces confidence intervals	Requires a large and extensive historical database (30+ years) with accurate and consistent measures of all variables; assumes past trends will not change in the future; is complex

models are not a viable option. Simulation models would be possible but would require a number of speculative assumptions regarding the inputs. The large number of assumptions which would have to be made in the absence of empirical evidence would render the results highly suspect.

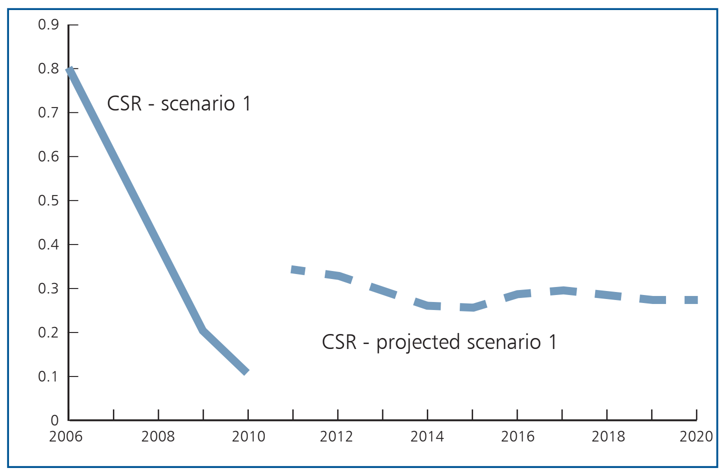
The lack of data required for other approaches means that, in practice, K-12 enrollment and high school graduate projections are primarily developed through the CSR model. For example, many large states, including California, New York, Illinois, and Pennsylvania, use CSR models, as does NCES, but they do not all use the same approach in projecting CSRs. A key question is whether some model other than one that relies on CSRs should be used. Given the data constraints, as outlined earlier in this report, we do not recommend using an alternative to the CSR model as the basis for projecting enrollments and high school graduates. However, WICHE could consider using a different approach to projecting CSRs.

WICHE's CSR model currently uses a weighted moving average approach to project future CSRs, determining the weight and number of past years to be included subjectively. The weighted moving average approach leads to a nearly constant projection once we are a few years into the projection period. The implicit assumption is that the levels of CSRs of the recent past are a good predictor of the level of future CSRs but that the trend is not predictive. A few hypothetical scenarios illustrate the point (Figure 7). In the case of scenario 1, CSRs are sharply and consistently declining. WICHE's projection method weights the most recent historical observation most heavily but also incorporates CSRs from earlier years. The resultant projected CSRs do not continue the trend, and the level is set at substantially higher than in the most recent historical observation. Scenarios 2 and 3 highlight the potentially problematic nature of WICHE's approach. In scenario 2 CSRs are sharply and consistently increasing, with a clear positive trend. In scenario 3 CSRs are relatively stable and flat, with little change over the five years preceding the projection period. Despite these very different historical patterns, WICHE's projected CSRs would be nearly identical. If past trends are a good predictor of future trends, then WICHE's approach to projecting CSRs is problematic.

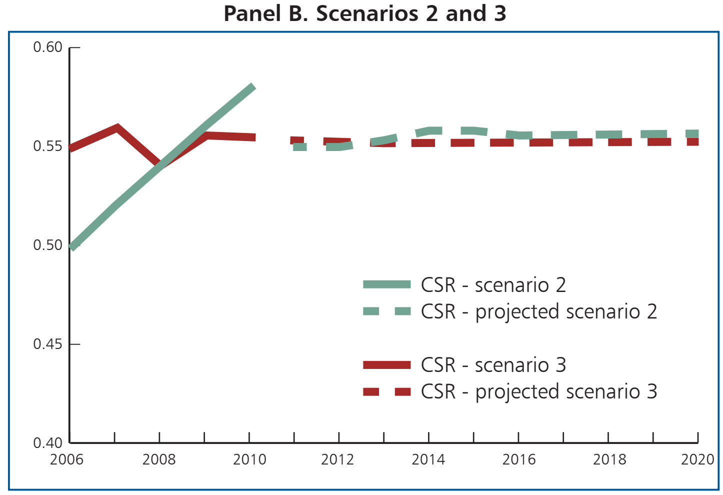
In considering alternative approaches to forecasting CSRs, it is useful to consider practices used by other forecasters. First, we consider NCES projections and then those of a few large states.

Figure 7. Hypothetical CSR Projections using WICHE's Method: Three Scenarios

Panel A. Scenario 1



Panel B. Scenarios 2 and 3



Note: The scenarios are hypothetical and are intended for illustrative purposes only.

NCES Projections

NCES has been projecting K-12 enrollment and high school graduates since 1964. In 2011 NCES issued its 38th edition of its projections.[17] This most recent edition is the first to include projections by race/ethnicity. The projections are available nationally and for each state. However, the NCES state projections do not include private high school students or graduates, whereas their national projections do include private high school students. The NCES uses the PSS, as does WICHE, to estimate and project private high school graduates. NCES's projection methods are similar to those of WICHE: it uses past CSRs (which it calls "grade progression ratios") and projects them to the first year of its projection period using single exponential smoothing by recursively evaluating:

$$Y_{p,t+1} = w\,Y_{p,t} + (1\text{-}w)\,Y_{p,t-1}$$

where $Y_{p,t}$ is the CSR for grade p at year t and w is the smoothing weight (set equal to 0.4). The first historical year to be considered in this recursive process is not identified by NCES.

Projections beyond the first period are held constant to the projection for the first period:

$$Y_{p,t+2} = Y_{p,t+1}\,.$$

Specifically, NCES's single exponential smoothing approach can be accomplished through the following steps:

- Step 1: Calculate the CSR for at least 10 years prior to the first projection period.
- Step 2: Assign each year a number corresponding to the number of years it is before the projection period commences, starting with the most recent available year at 0.
- Step 3: Subtract your alpha-weight from 1 for each year. Raise the resulting number to the number assigned in the previous step.
- Step 4: Multiply the number derived in the previous step by the CSR for the corresponding year.
- Step 5: Add all the numbers from step 4. The resulting sum is the CSR assumed for all projection years.

In practice, single exponential smoothing produces projected CSRs that are close to those produced by WICHE's weighted moving average approach. Both weight the last year of observed CSRs at 0.4, but NCES places more weight on the second prior year and less weight on the fourth and fifth prior years (Figure 8). NCES's weighting approach appears to be somewhat more elegant than the approach used by WICHE, as it gradually places less and less emphasis on earlier CSRs, whereas the WICHE method has discrete jumps that beg for an explanation: for example, why should the sixth year prior to the projection period not be considered at all and the fifth year be given the same weight as the second year? One advantage of the WICHE approach is that it is easy to explain and requires only limited prior year data. In Figure 9 the WICHE and NCES projection approaches are applied to a hypothetical set of CSRs. Differences in the projections are observed, arising from the different weighting schemes, but the differences are not large.

Figure 8. Comparison of WICHE and NCES Weights Applied to CSRs for Projections

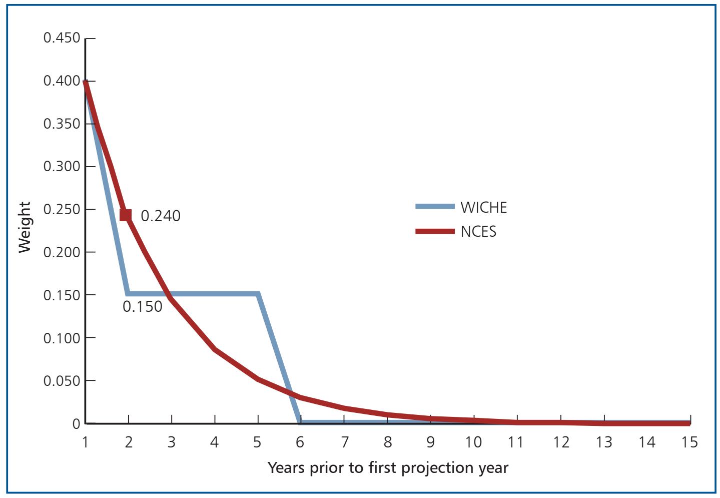
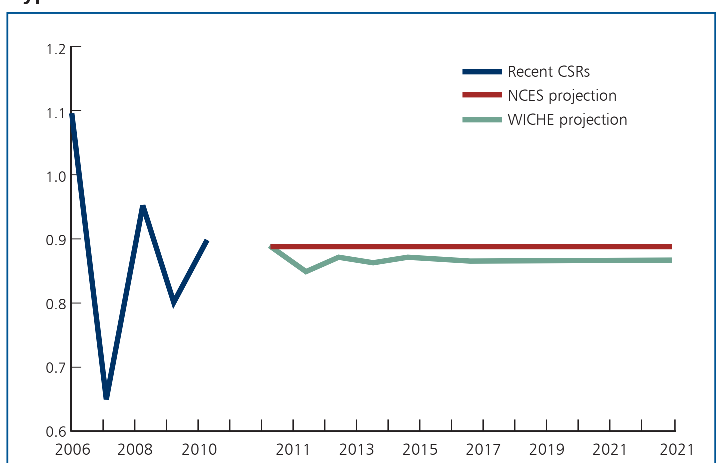


Figure 9. WICHE and NCES Projection Models Applied to Hypothetical CSRs



Source: Authors' simulations.

In general, the NCES approach, like WICHE's approach, works well for time series in which there is no clear trend. In projections of other education series, such as the number of doctorates awarded by higher education institutions, NCES uses double exponential smoothing, allowing for a continuation of the observed trend but at a dampened rate of change.

Double exponential smoothing can be accomplished through the following steps:

- Step 1: Take the average annual change in CSRs over the historical period.
- Step 2: Assign a dampening factor; we chose 0.9 for each
- Step 3: For each projected year, starting with 1, raise the dampening factor to the number of years into the projection period.
- Step 4: Multiply the average historical change by the dampening factor raised to the year.
- Step 5: Add the previous year's CSR and the product of the operation in the previous step.
- Step 6: Take the weighted average of the number derived in the previous step with a weight of .4 and the previous year's CSR with a weight of .6

Double exponential smoothing works best when past changes in CSRs are expected to continue into the future. For example, if we believe Texas has strong in-migration and policies that are increasingly successful at moving students along from one grade to the next with fewer dropouts and we believe those trends will continue into the future, then double exponential smoothing would produce the best projections.

State Projections

Of the 10 largest states, five have websites where school enrollment projections can be readily obtained (California, New York, Illinois, Pennsylvania, and Texas). All of these states except Texas develop projections of high school graduates and provide some description of their methods. Each of these four remaining states uses a CSR method, but the approach used to project CSRs varies. New York uses a methodological approach very similar to WICHE's, with a couple caveats. First, New York includes racial/ethnic detail for private school graduates as well as for public school graduates. Second, New York considers models that allow for declines in high school dropout rates. Illinois's somewhat dated (2004) projections use the average CSR (retaining rates) for the four prior years to project future rates but also use a hard-to-decipher approach to apparently allow for trends in secondary enrollment, stating:

> The retaining rate cannot reflect the rapid rise of the secondary enrollment. Therefore, the moving average rate on the retaining growth is applied. For year 2004-05 through year 2007-08, the average of the growth rate of students (by grade) for the prior four years was added to the prior year retaining rate and then multiplied the enrollment for the next lowest grade of the prior year.[18]

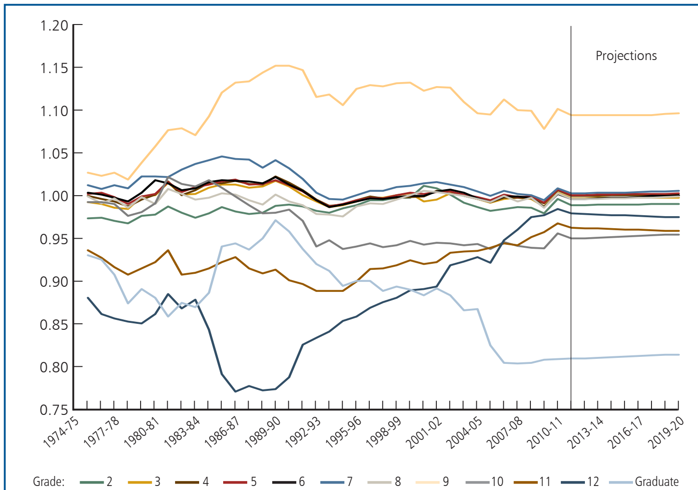
To project future CSRs, Pennsylvania averages CSRs over the past five years but also evaluates trends "to determine if a pattern is discernible." If it is, "the pattern is continued in making the projections." Outliers, or "unusual" retention rates, are discarded. It is not clear from the documentation exactly how the pattern is continued.

Similarly, California uses CSRs to project enrollment and high school graduates and modifies the projections in light of past trends:

> The most likely progression model is chosen based upon analysis of historical trends; knowledge of migration trends and demographic characteristics of each county including the most recent population estimates; and survey results from selected school districts... The best fitting progression ratios are chosen independently for the projection of each grade including high school graduates.

Again, it is not clear exactly how the best fit is identified. As shown in Figure 10, California's projected CSRs (called "grade progression ratios" by the state) are mostly level, but upward and downward slopes are evident. For example, the projected CSR for graduates (12th grade to graduation) shows a slight increase throughout the projection horizon, suggesting lower dropout rates in the future among 12th graders. In contrast, the projections show slight declines in CSRs to 11th and 12th grades, suggesting higher dropout rates among those students. In contrast, the CSR for 10th grade increases in the projection period. It is not at all clear why we might expect such inconsistent dropout patterns in the future between specific high school grades. This inconsistency highlights one of the dangers of treating CSRs independently of one another.[19]

Figure 10. Historical and Projected Grade Progression Rates for California



Source: Authors' calculations, based on California Public K-12 Graded Enrollment and High School Graduate Projections by County, February 2011 series, accessed on 25 July 2012 at <www.dof.ca.gov/research/demographic/reports/projections/k-12/view.php>.

Although we do not recommend adopting an entirely new method to developing enrollment and high school graduate projections, we do suggest that WICHE consider revising how it forecasts CSRs. We now turn more explicitly to alternative means of forecasting the CSRs and other issues that WICHE will need to consider in its future forecasts.

Methodological Considerations and Recommendations

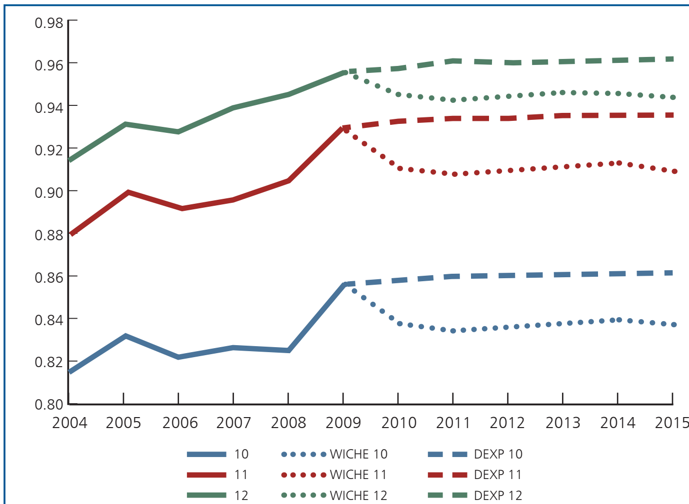
In developing a new set of enrollment and graduation projections, WICHE will need to make choices on a number of methodological issues. These issues include technical forecasting considerations, such as whether and how to trend the CSR projections, new data issues, and even how or whether to incorporate changes in state policies.

Trending the ratios/alternative projections. A key consideration in developing projections is whether future rates should be held constant or allowed to change based on the historical record. As already discussed, several states do allow for increasing or decreasing trends in CSRs in their projection approach. NCES holds CSRs constant in its K-12 enrollment and high school graduate projections but does allow for changing rates in some of its other projections of education statistics. WICHE's current approach implicitly assumes that past levels of CSRs are a good predictor of future CSRs but that past changes in CSRs are not good predictors of future changes. On its face this approach seems inconsistent. To be consistent we should either believe the historical data have some predictive power or not. Ignoring past changes in CSRs is problematic unless those changes are the result of noise or randomness. However, a danger in continuing a past change is that projected future CSRs could become unreasonably high or low. That is, it is seldom the case that increases or decreases in CSRs will continue to occur in a monotonic fashion for many years.

A case study provides a good illustration of the differences between using changes in past CSRs versus only considering the levels. Figure 11 shows CSRs for high school students in Texas (as calculated by the authors, using the CCD). CSRs appear to have been clearly trending upwards for 11th and 12th grades, most likely due to a decline in dropouts or increasing migration to Texas. WICHE's projection method does not continue the recent trend in CSRs for those grades; in fact, it reverses the trend for the first year or so of the projections and settles on rates that are lower than those most recently observed. In contrast, double exponential smoothing continues but abates the trends, so that future increases in CSRs are of lower and lower magnitude.[20] For those grades double exponential smoothing seems to be a more accurate reflection of the historical record. However, the pattern for 10th grade might give us some pause as we consider how much stock we want to put in past changes in CSRs. Specifically, from 2004 through 2008, 10th grade CSRs were fairly level in Texas, with no clear change in direction. The 2009 CSR for 10th grade, however, showed a strong increase from prior years. The WICHE projections method discounts this most recent CSR, treating it as a bit of an outlier. The WICHE projected CSRs for 10th graders settle at a level that is higher than the historical series but lower than the most recent historical data point. In contrast, the double exponential method places substantial confidence in that latest observed data point and projects continued increases in CSRs. In this case, absent other information, we might conclude that the WICHE approach is a more accurate reflection of the bulk of the historical evidence for 10th grade CSRs.

The choice of which method to use to project CSRs is truly a subjective one, but it is not inconsequential. In the Texas high school CSR example, the differences between the projection series are notable and will lead to projections of high school graduates that are significantly higher in the double exponential model than in the WICHE model. If WICHE does choose to use a method that allows for a continuation of past trends, consideration will have to be made as to which approach to take. Methods could include linear regression or extrapolation, ARIMA modeling, exponential smoothing, or some other approach. If the goal is to continue past changes in CSRs, we like double exponential smoothing (compared to regression and other models) because there is some track record for its selection (it has been used by NCES); it is well-

Figure 11. Recent and Projected CSRs for Texas, Using WICHE Methods and Double Exponential Smoothing (DEXP)



Source: Authors' calculations, using NCES CCD State Nonfiscal Public Elementary/Secondary Education Survey Data files for the years shown.

Note: The data smoothing factor and trend smoothing factor were both set equal to 0.4 in the double exponential smoothing projections.

defined; and it is somewhat flexible in that smoothing factors can be chosen that will lead to either greater or lesser dampening. Perhaps the best approach would be a hybrid approach, with single exponential smoothing as the default and double exponential smoothing used only when a set of rules is met (e.g., only if changes in four of the five previous years are in the same direction).

WICHE could produce alternative series of projections or a high and low series to bound a middle series of projections. Creating the additional series would not necessarily entail a great deal of additional work but would dramatically increase the volume of output. A high and low series could be created by using alternative historic periods to set future CSRs (or changing the weight in the single exponential model) or by using different projection techniques (double exponential smoothing in one series, single exponential smoothing in another). Before embarking on this path, WICHE would want to confirm that such alternative series would be useful to its audience. In general, users often find alternative series to be confusing. On the other hand, because WICHE does not update the projections annually, higher education officials might want to consider an alternative series if after a few years WICHE's middle series is not tracking accurately. Moreover, producing alternative series could provide users with a better sense of the uncertainty in the projections.[21]

New racial/ethnic categories. The 2000 United States Census was the first to allow individuals to identify as of more than one race. The Office of Budget and Management, which recommends and sets standards for racial and ethnic reporting, advised federal data collection agencies to adhere to new categories that include reporting of multiracial identity. WICHE's 2008 projections used the five categories available at that time:

- American Indian/Alaska Native
- Asian/Pacific Islander
- Black non-Hispanic
- Hispanic
- White non-Hispanic

The two new categories now available for some states are:

- More than one race
- Pacific Islander (separate from Asian)

In the CCD, collected by NCES and used by WICHE and NCES to develop CSRs, 14 states now use seven racial/ethnic categories (Table 3), while the other states continue to use five racial/ethnic categories.

Table 3. CCD Data on Race/Ethnicity by State

States that switched to 7 racial/ethnic categories starting in 2008	States that switched to 7 racial/ethnic categories starting in 2009
Alaska	Arkansas
California	Georgia
Massachusetts	Iowa
Mississippi	Kansas
New Jersey	New Hampshire
Vermont	New Mexico
	West Virginia
	Wyoming

Source: NCES Common Core of Data, State Nonfiscal Public Elementary/Secondary Education Survey Data: 2008-09 and 2009-10.

Note: All other states use five categories for reporting racial/ethnic data.

Because most states have not yet switched to the seven category reporting (and because the switch has only been very recent, meaning that it will not be possible to generate an analysis of recent trends for the new racial/ethnic groups), we recommend that WICHE adhere to its past approach of developing projections for five racial/ethnic groups. For states that have adopted seven categories, WICHE can combine the Pacific Islander group with the Asian group to create a temporally consistent group. It should also allocate multiracial residents to other race groups based on their share of the combined total among the four race groups (American Indian/Alaska Native, Asian and Pacific Islander, Black non-Hispanic, and White non-Hispanic). Alternatively, WICHE could produce projections for seven racial/ethnic groups for the states that now report those categories. The historical analysis will still require collapsing groups, but the projections could be parsed out by distributing the combined total into the distinct categories based on recent shifting shares of the combined total. Once most states have adopted the full set of racial/ethnic categories, WICHE will want to convert its projections to that set. WICHE could also develop separate projections for specific subethnic groups for key states (e.g., Cubans in Florida or Vietnamese in California).[22]

Independent versus controlled. WICHE currently develops national and regional projections independently of state projections. That is, the state projections do not sum to the regional projections, and neither the state nor regional projections sum to the national projections. Similarly, projections are developed independently by racial/ethnic group and for all groups combined, and those projections do not sum to the state or national projections. WICHE chooses this approach partly because smaller sizes of some population groups lead to greater uncertainty in the projections.[23] Moreover, some states provide data on racial/ethnic groups that WICHE has not projected, and thus the sum of the racial/ethnic projections will not match the total enrolled population. Specifically, for many states, the sum of the racial/ethnic enrollments is less than the total enrollment reported in the CCD.

The lack of consistency between WICHE's projection series is problematic. We recommend that WICHE make its projections consistent, to the extent possible. Because the differences between the sum of the independent projections by state and region are very close to the national projections for WICHE's 2008 series, aligning the projections using an adjustment factor would not have appreciably changed any of the projections. Nationwide, for example, the sum of WICHE's state projections of high school graduates for 2022 was about 40,000 greater than the independent projection for the United States, a difference of only 1.2 percent (Table 4).

Table 4. WICHE's Projections of High School Graduates in 2022

	High school graduates
U.S.	3,361,696
Sum of regions	3,356,080
Sum of states	3,402,467

Source: Authors' calculations, based on WICHE, Knocking at the College Door, 2008.

We recommend that WICHE develop its new projection series independently, as it has done in the past, but then apply an adjustment factor to the independent projections to make them align with the preferred set (for the 2008 series, that would have meant reducing the state projections by 1.2 percent to make their sum consistent with the U.S. series or increasing the U.S. series by 1.2 percent to make it consistent with the sum of states projections). For states in which the sum of the racial/ethnic groups equals total enrollment in the CCD, a similar approach should be used. A recent analysis of school district projections found that projections with all races combined were more accurate than those that summed separate projections by race/ethnicity, but the greater precision was mostly due to lack of precision for small districts.[24]

Extending the projections. WICHE currently relies on birth data from the National Center for Health Statistics (NCHS) to develop its projections, the births data being used to develop ratios of the number of children born that go into first grades. Thus, the projections are restricted to a 17-year period beyond the last available birth data, the approximate number of years that the individuals represented in the most recent available births would be graduating from high school. For example, WICHE's 2008 projections extended to 2021-22, 17 years past the last available year of birth data, which was 2004. Currently, NCHS has birth data available through 2008, meaning WICHE could develop projections of high school graduates to 2025.[25]

To extend the projections horizon beyond this year, WICHE would have to rely on projections of births. The Census Bureau develops projections of the population of each state, including projections of births by race/ethnicity. Unfortunately, the most complete set of projections – those that include births by race/ethnicity – are quite old, released in 1996 and based on 1990 Census data.[26] Unless the bureau releases new population and birth projections, we do not recommend extending WICHE's projections beyond 2025.[27]

Homeschooling. Homeschooled students are not included in the CCD, nor do most states collect data on them. Neither NCES nor WICHE projections include homeschooled students. Nonetheless, homeschooling appears to be increasingly common in the United States. The federal Institute of Education Sciences (IES) estimates the number of homeschooled students was approximately 2.9 percent of the total school-aged population in the United States in 2007. The estimate is drawn from the National Household Education Survey (NHES) and is based on a sample of almost 11,000 parents of students aged 5 to 17. The point estimate is 1,508,000, with the 95 percent confidence interval extending from 1,277,000 to 1,739,000 (IES 2008). IES estimates that both the number and share of homeschooled students has increased dramatically, from about 850,000 in 1999 (1.7 percent of the school-age population) to 1.1 million in 2003 (2.2 percent) and 1.5 million in 2007 (2.9 percent).[28] Some of these students are also enrolled in a public school (about 18 percent) and are therefore likely to be included in the CCD data. Homeschooling is most common among the first through third grades (3.4 percent).[29] State-level information is not available from the NHES.[30] According to the Homeschooling Legal Defense Association, about half the states (including large states like California, Texas, and Illinois) have little or no regulation of homeschools.[31] Because of the dearth of data, WICHE should not incorporate homeschooled students into its projections.

Incorporating changes in state policies. Past trends in CSRs can be affected by state policies. Many states have added competency tests or exit exams to their requirements for high school graduation. Those exams could have a measurable impact on high school graduation, although the effects will vary by state, depending on how difficult the exams are and whether students can be exempted from them.

Just over half of the states in the U.S. require students take a minimum competency test for a high school diploma, according to the NCES (Table 5).

Table 5. States that Require Competency Tests for Graduation

State	First graduating class with these requirements, if available
Alabama	
Alaska	2004
Arizona	2002
Arkansas	2010
California	2004
Florida	2003
Georgia	
Idaho	
Indiana	
Louisiana	
Maryland	2007
Massachusetts	2003
Minnesota	
Mississippi	2002
Nevada	
New Jersey	2004
New Mexico	
New York	
North Carolina	2005
Ohio	2005
Oklahoma	2012
South Carolina	
Tennessee	
Texas	
Virginia	2004
Washington	2008

* Oklahoma has not yet implemented its testing standard but has scheduled testing requirements to begin in 2012.

Sources: National Center for Education Statistics, Digest of Education Statistics, Table 176 and Table 153, accessed on 25 July 2012 at <http://nces.ed.gov/programs/digest/d10/tables/dt10_176.asp> and <http://nces.ed.gov/programs/digest/d01/dt153.asp>.

In identifying patterns in CSRs, WICHE will want to take into account whether there's a change in CSRs, especially those for 12th grade to graduation, for the first high school graduating class required to pass the exam.[32] It is not possible, of course, for WICHE to project future policy changes.

Enhancements to WICHE's Projections

WICHE's projections could be enhanced by providing more detail about high school graduates. Nativity, some measure of income, and parents' education would all be excellent additions, leading to even more use by policymakers and higher education officials. Providing additional information about high school graduates could further distinguish WICHE's projections from those developed by NCES.

Data limitations, however, restrict the degree to which additional characteristics of students could be added to the projections. Alternatives to explicitly attaching more information to the projections of high school graduates should be considered. For example, WICHE could highlight recent trends in the changing socioeconomic characteristics of high school graduates without incorporating those characteristics into a full set of projections. Alternatively, WICHE could choose to project certain characteristics for states (or groups of states) with more robust data (i.e., those with large numbers of high school graduates). In general, the CCD does not provide information on many of the characteristics that would be of most interest to users of WICHE's projections. However, the fairly recent development and full implementation of the American Community Survey does afford some new opportunities.

With the advent of the fully operational American Community Survey, WICHE has the ability to exploit a large and detailed source of data on K-12 students. Sample sizes are large: overall, 2.5 percent of the population is included in the ACS, so even for sparsely populated state, the total number of individuals in the sample is great (Table 6). For example, Wyoming, the smallest state by population, has over 10,000 individuals in the 2009 ACS full sample and 5,538 individuals in the 2009 public use microdata sample (including 875 K-12 students).

One of the challenges in using the ACS is that it is too new to provide a historical series for developing new projections. Not until 2008 did the ACS provide information on the exact grade a student attended; in earlier years (and in the 2000 Census) grades were not precisely identified: only grade groupings (e.g., fifth to eighth grade) were available. It would be possible to infer a grade based on single year of age data, but this is imprecise.

Beginning in 2005 the ACS provided birth quarter, which would allow for some increased precision in attaching a specific grade to a student. In the 2009 ACS, for example, 13-year-olds were about evenly split between seventh and eighth grade; those born in the fourth quarter (October through December) were more likely to be in the seventh grade, whereas those born in the second quarter (April through June) were more likely to be in the eighth grade. Still, there is quite a bit of uncertainty, rendering the assignment of grade based on age and birth quarter somewhat suspect.

The ACS includes a rich set of social, economic, and demographic characteristics about individuals, their families, and their households. Geographic detail varies, including substate areas that are fairly large in size for individual years of the ACS. By aggregating the ACS across years or across grades (or both), larger sample sizes can be developed, even for subgroups and substate regions.

A potential problem with the ACS is that the data are self-reported (generally by one respondent per household, providing information on all household members); and although participation is mandatory,

Table 6. ACS Public-use Microdata Sample Sizes, 2009

State	K-12 students	High school students	12th graders
1. Alabama	8,070	2,599	657
2. Alaska	1,390	455	114
4. Arizona	10,962	3,565	950
5. Arkansas	4,685	1,521	391
6. California	64,143	22,009	6,467
8. Colorado	8,443	2,616	671
9. Connecticut	6,159	2,056	532
10. Delaware	1,316	420	121
11. District of Columbia	662	231	53
12. Florida	27,611	8,872	2,424
13. Georgia	17,266	5,470	1,432
15. Hawai'i	2,182	774	215
16. Idaho	3,080	937	232
17. Illinois	22,159	7,207	1,848
18. Indiana	11,472	3,665	947
19. Iowa	4,943	1,617	411
20. Kansas	4,953	1,602	406
21. Kentucky	7,420	2,306	622
22. Louisiana	7,601	2,439	652
23. Maine	1,882	645	153
24. Maryland	9,213	3,202	898
25. Massachusetts	10,210	3,391	910
26. Michigan	17,373	5,916	1,576
27. Minnesota	9,214	3,126	834
28. Mississippi	4,873	1,558	415
29. Missouri	10,228	3,332	915
30. Montana	1,447	474	111
31. Nebraska	3,061	966	248
32. Nevada	4,373	1,423	364
33. New Hampshire	2,211	784	211
34. New Jersey	14,855	4,858	1,287
35. New Mexico	3,242	1,059	299
36. New York	31,440	10,774	2,764
37. North Carolina	15,464	4,917	1,289
38. North Dakota	1,044	362	74
39. Ohio	19,944	6,648	1,751
40. Oklahoma	6,298	2,005	513
41. Oregon	6,071	2,036	567
42. Pennsylvania	19,709	6,711	1,708
44. Rhode Island	1,630	553	144
45. South Carolina	7,455	2,332	598
46. South Dakota	1,494	501	115
47. Tennessee	10,322	3,321	877
48. Texas	45,255	13,995	3,650
49. Utah	5,936	1,752	477
50. Vermont	975	323	80
51. Virginia	12,811	4,139	1,070
53. Washington	11,125	3,667	955
54. West Virginia	2,584	861	225
55. Wisconsin	10,210	3,428	913
56. Wyoming	875	279	75
U.S. Total	**517,341**	**169,699**	**45,211**

Source: ACS Public-use Microdata Sample Sizes, 2009

not all households participate. Comparisons of ACS data with administrative data on school enrollments shows strong agreement, but there are notable differences. Nationwide, the ACS in 2006 and 2007 showed strong agreement with NCES published data (based on the CCD) on school enrollments for high school students. But it also showed not insignificant differences for younger students, especially those in lower primary grades (Table 7). These differences could be due to incorrect ACS weights; incorrect responses of ACS participants (e.g., perhaps parents were less likely to report their child to be in school if they were surveyed during the summer; or maybe parents with children in charter schools misidentified those schools as private); or overstatement of enrollments in the CCD. For WICHE's purposes, the strong agreement at the secondary grades is encouraging.[33]

Table 7. Number of Students Enrolled in School by Grade, 2006 (Thousands)

Grade	2006			2007		
	NCES	ACS	Percent Diff.	NCES	ACS	Percent Diff.
Kindergarten	3,631	3,465	-4.6	3,609	3,478	-3.6
1st to 4th	14,605	13,971	-4.3	14,737	14,010	-4.9
5th to 8th	14,744	14,624	-0.8	14,639	14,477	-1.1
9th to 12th	14,971	15,181	1.4	14,995	15,133	0.9
Elementary Ungraded	170			139		
Secondary Ungraded	110			92		
Total Secondary	15,081	15,181	0.7	15,087	15,133	0.3
Total	**48,231**	**47,240**	**-2.1**	**48,211**	**47,098**	**-2.3**

Source: William J. Hussar and Tabitha M. Bailey, *Projections of Education Statistics to 2019*, 38th edition (Washington, D.C.: National Center for Education Statistics, 2011), accessed on 24 July 2012 from <nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2011017>; and authors' calculations, based on the U.S. Census Bureau 2006 and 2007 American Community Survey.

At the state level, agreement between the ACS and NCES depends to a large degree on the size of the state. As expected, states with larger enrollments (and larger ACS samples) showed stronger agreement than those with smaller populations and enrollments (Table 8). Among the 10 largest states, differences in secondary enrollments were less than 3 percent for all but Ohio and Georgia.

Our recommendation is that WICHE use the ACS to provide more detailed information about characteristics of high school graduates. Below, we discuss some specific characteristics that should be considered.

Income. In its 2003 series, WICHE developed projections of high school graduates by family income. At the time the series was developed, WICHE noted that "no comprehensive and regularly collected data are available that would permit direct knowledge of the family income of individual high school graduates".[34] In the absence of such data, WICHE developed projections of high school graduates by income based on the distribution of family income for school districts. WICHE's approach exploits variation in CSRs and income by district but is clearly less than ideal. A particular weakness, identified by WICHE, is the reliance on a single year of income data from the 2000 Census.

With the advent of the ACS, new information can be generated on the family income of students. The data comes close to the ideal identified by WICHE in its 2003 report: "student-level data that included family income values…available for every enrolled student by

Table 8. Grade 9 to Grade 12 Public Enrollments (in thousands)

State	NCES 2007	ACS 2007	Percent Difference
California	2,015	2,031	0.8
Texas	1,300	1,282	-1.4
New York	909	935	2.8
Florida	811	792	-2.4
Illinois	640	642	0.3
Pennsylvania	597	592	-0.8
Ohio	586	568	-3.1
Michigan	556	545	-1.9
Georgia	471	494	4.8
New Jersey	428	420	-1.8
North Carolina	417	432	3.6
Virginia	380	381	0.3
Washington	333	330	-0.8
Indiana	317	309	-2.4
Arizona	316	323	2.1
Massachusetts	296	292	-1.4
Wisconsin	289	280	-3.2
Missouri	285	284	-0.5
Tennessee	283	284	0.2
Minnesota	279	274	-1.8
Maryland	269	274	1.9
Colorado	236	234	-0.7
Alabama	218	217	-0.6
South Carolina	208	216	3.7
Kentucky	197	207	5.3
Oregon	182	183	0.4
Louisiana	181	195	7.6
Oklahoma	179	180	0.7
Connecticut	177	177	0.1
Utah	166	157	-5.6
Iowa	156	156	-0.2
Kansas	142	147	3.7
Mississippi	141	155	9.8
Arkansas	139	139	0.3
Nevada	122	131	7.1
New Mexico	99	112	12.6
Nebraska	91	92	1.2
West Virginia	84	87	3.2
Idaho	81	80	-1.3
Maine	66	62	-5.9
New Hampshire	66	66	-0.3
Hawai'i	54	52	-4.3
Rhode Island	48	48	-0.2
Montana	46	49	6.6
Alaska	42	48	14.6
Delaware	38	37	-1.6
South Dakota	38	40	4.5

Source: Hussar and Bailey, *Projections of Education Statistics*; and authors' calculations, based on the U.S. Census Bureau 2007 American Community Survey.

state and year over a series of years".[35] With the ACS we have direct data on family income available for a sample of students by state for every year (starting with the full implementation of the ACS in 2006).[36]

Given the availability of this data, the key question becomes if and how it should be used to generate high school graduates projections based on family income. Three issues must be considered: sample sizes, the type of income to be considered, and the method to use in projecting family income for high school graduates.

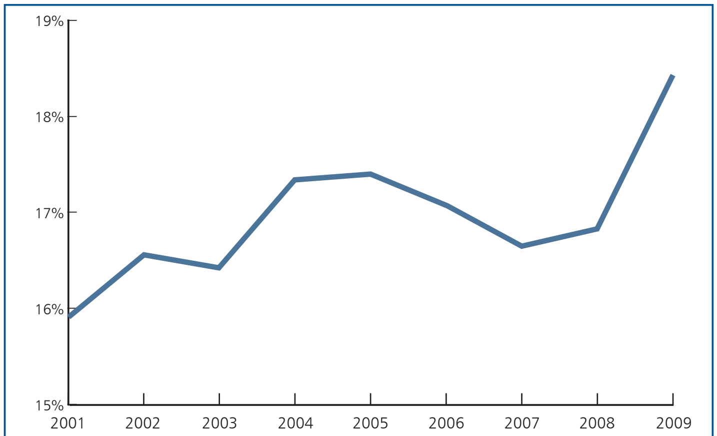
Sample sizes are a problem in many states (see Table 6). Focusing on students and family income will require use of the public use microdata files, which are composed of a sample of 1 percent of a state's households. Sample sizes for 12th graders are over 1,000 in only 12 states, but are over 1,000 for all high school students in 36 states. Combining years of the ACS is another strategy to increase sample sizes, as the survey is drawn independently from one month to the next. For example, combining data across the last three ACS years (2007, 2008, and 2009) provides samples of at least 1,000 high school graduates for over 30 states. At a minimum WICHE should be able to develop recent trends in family income for high school students in the largest states and the nation.

A second consideration is which measure of income to use. WICHE used family income in its 2003 report, and colleges certainly want and collect that information from prospective students. However, family income as a percentage of the poverty level – which is defined on the basis of family income and composition, including size – might be a better measure of family resources, since colleges consider family size when evaluating income. Poverty levels, determined for both individuals and families, cover a range of incomes, with the top level including those who earn 500 percent of the base level. The data is readily accessible and controls for inflation.

The third consideration is whether and how to project income (including poverty) data for high school graduates. One problem is that income and poverty rates vary from year to year and are especially sensitive to business cycles (Figure 12 and Table 9). A student who lives in poverty this year might not be in poverty next year. Given the variation in income across time, developing CSRs based on income is especially tricky and could be misleading. During a period of strong economic growth, CSRs will appear large for higher-income families as more and more students join their ranks, due to increases in family incomes, not due to increases in grade progressions); conversely, during a period of economic decline, incomes will fall and CSRs for low-income families will increase as more students become poor.

Attempting to forecast business cycles would be ill-advised. Instead, WICHE could choose an option in which recently observed income or poverty levels are held constant by grade cohorts, race/ethnicity, and state. As students progress and the composition of the high school graduate population changes, the projections of income will vary. One problem with this approach is that family income might reasonably be expected to change as students age. More detailed empirical analyses of the life cycle of income for children as they age could be done to evaluate how problematic this would be for a simple projections approach. A more sophisticated approach would be one in which CSRs are projected separately for students by income (as well as by cohort, race/ethnicity, and state), but this approach would require some way to accurately abstract the ratios from business cycle effects. Regression models could be utilized, but this would be a complex and messy procedure at best.[37] Given these problems in forecasting income, providing information on recent trends is probably the best option for WICHE. If WICHE is intent on developing income projections, then we would suggest focusing on poverty levels, holding those levels constant based on some historic average, and allowing future rates to vary based on changes in the composition of high school graduates.[38]

Figure 12. Poverty Rate of U.S. Students Enrolled in Grades K-12, 2001-2004



Source: Authors' tabulations, based on American Community Survey Public Use Microdata Sample (PUMS) data for the United States (restricted to students enrolled in K-12 grades, not in group quarters).

Table 9. U.S. Family Income as a Percentage of the Poverty Level for K-12 Students, 2001-2009

Year	1-100%	101-200%	201-300%	301-400%	401-500%	501+%
2001	15.9	21.2	19.6	15.0	9.8	18.5
2002	16.6	20.5	19.1	14.9	10.2	18.8
2003	16.4	21.1	19.2	14.5	10.0	18.8
2004	17.3	21.0	18.5	14.4	9.6	19.1
2005	17.4	20.9	18.2	14.3	9.8	19.4
2006	17.1	20.9	18.5	14.1	9.9	19.5
2007	16.7	20.8	18.3	14.2	10.0	20.0
2008	16.8	20.7	18.4	14.1	9.8	20.2
2009	18.4	21.3	18.0	13.4	9.4	19.3

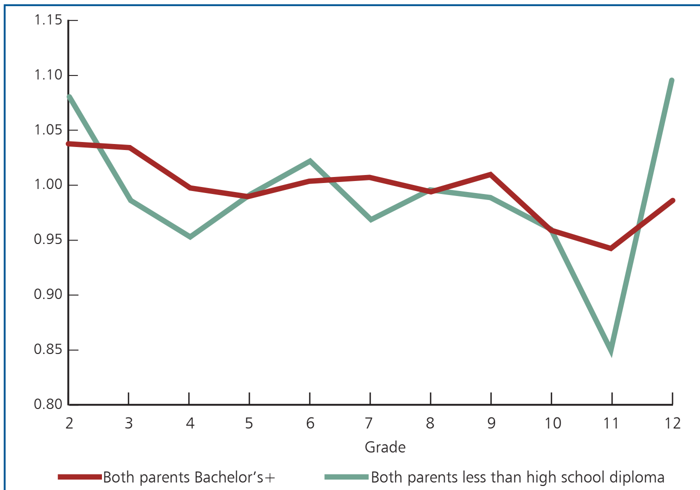
Source: Authors' tabulations, based on American Community Survey PUMS data for the United States, restricted to students enrolled in K-12 grades, not in group quarters.

Note: In 2009 the poverty level for a family of four (two adults and two children) was $21,756. For this same family in 2009, 200 percent of the poverty level was $43,506, 300 percent was $65,259, 400 percent was $87,012, and 500 percent was $108,765.

Parents' education. One of the strongest determinants of a child's educational attainment is the educational attainment of his or her parents. Parental educational attainment is also a consideration used by some colleges in admission decisions, with students who would be the first in their family to attend college given special consideration. Compared to income, parental education has the added attractiveness of being relatively static. That is, for most parents, educational attainment does not change over the course of their children's education.

The ACS provides data on the educational attainment of parents who live with their children. Using two years of ACS data, it is possible to calculate CSRs for students based on their parents' education. Figure 13 shows that grade progression ratios vary between students with highly educated parents and those with less educated parents – but not always in the expected direction. In general, and as expected, grade progressions are higher for students with highly educated parents, but there are some odd results: for instance, there is a higher progression to twelfth grade among students with parents who haven't earned a high school diploma. This might be the result of the student's repeating 12th grade.[39] Immigration could also play a role, but is unlikely to be of sufficient size to explain this pattern.

Figure 13. CSRs for U.S. Students, Based on Parents' Education, 2008-2009

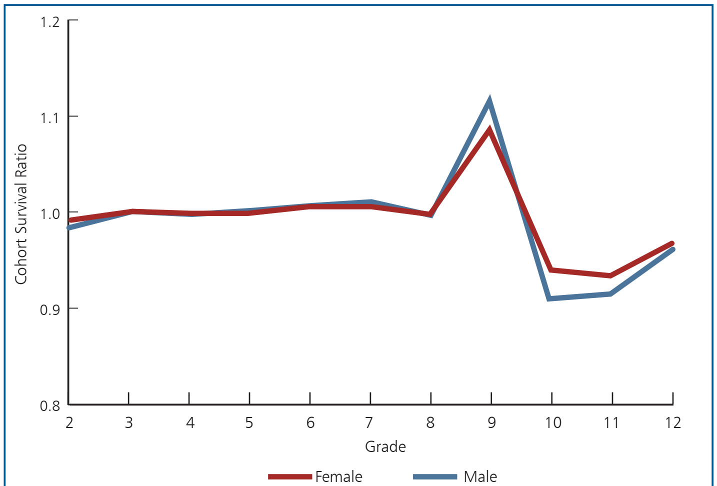


Source: Authors' calculations, based on U.S. Census Bureau 2008 and 2009 American Community Survey data.

Nativity. Among adults educational outcomes vary tremendously by nativity. Foreign-born residents of the United States are much more likely to have either very little education (less than a high school degree) or a lot (college graduate), relative to U.S.-born residents. However, we know of no comprehensive set of data on CSRs for students that is broken down by nativity. No variables for nativity are present in the CCD survey. Up until 2008 there was a variable for migrant students, but it wasn't broken down by grade. Starting with the 2008-09 school year survey, the migrant variable was dropped. The CCD glossary also mentions English Language Learner variables, but they are not populated in the dataset for any of the years in our data universe. The ACS does include information on nativity; and for children who live with their parents, it is possible to identify the parents' nativity as well. As with other characteristics available from the ACS, the sample size is not sufficient to calculate CSRs for all states and demographic groups, but it could be used to identify overall differences between groups according to nativity status for states with large numbers of immigrants.

Gender. Neither WICHE nor NCES currently provides projections of high school graduates by gender. However, the CCD does provide school enrollment data by sex. For the nation as a whole and across ethnicities, cohort survival ratios differ most between the sexes during the high school years. Males tend to have higher CSRs in ninth grade and lower CSRs from that point on (Figure 14). This would indicate higher retention rates for males during ninth grade and higher dropout rates compared to females from then on. The sex difference is much more pronounced for Black non-Hispanics and Hispanics than it is for Asian/Pacific Islanders and White non-Hispanics, so separate projections by sex could likely produce more reliable results, especially when broken down by ethnicity.[40]

Figure 14. U.S. CSRs by Gender, United States, 2009



Source: Authors' calculations, based on NCES CCD State Nonfiscal Public Elementary/Secondary Education Survey Data, 2009-10.

Because females are making up larger and larger shares of new college students, including gender to WICHE'S projections of high school graduates would be a valuable addition to the series.

Metropolitan areas. For many colleges, the vast majority of their students are from high schools within the same metropolitan area as the college. Indeed, metropolitan areas are defined by the U.S. government on the basis of population and commuting patterns, and can be thought of as unified labor markets. Moreover, because they are defined on the basis of county boundaries, they are easily identified.41 However, neither WICHE nor NCES currently provide projections of high school graduates by metropolitan area. Developing projections by metropolitan area would not be methodologically difficult, but would be data intensive. The CCD contains geographic identifiers that can be used to develop CSRs for metropolitan areas. Similarly, the ACS's Public Use Microdata Sample (PUMS) files of the ACS provide geographic identifiers that can be used to generate metropolitan area statistics. As with states, projections for smaller metropolitan areas are likely to be less precise than those for larger areas.

Recommendations

A key consideration in revising WICHE's methodology is the intended audience for the projections. In theory, estimates and forecasts of the underlying determinants of CSRs could provide a highly valuable tool, not only for understanding and tracking trends in K-12 enrollment and high school graduation but also for providing consistent measurements of the determinants themselves. These underlying determinants are the subject of quite a bit of policy focus and interest. For example, establishing consistent measures of dropout rates across time, grades, racial/ethnic groups, and states would help decision makers to evaluate policies designed to reduce those rates. WICHE could become a central and credible source of such information. Unfortunately, in practice, the paucity and lack of consistency of the data across all the groups that WICHE forecasts would require numerous assumptions to create such a detailed database, thereby invalidating some or even all of the potential benefits. More to the point, WICHE's primary goal is to estimate and project the number of high school graduates, with a particular focus on their use by higher education institutions. In that context WICHE could enhance the projections without revising its projections methods.

In this report we have evaluated WICHE's methodological approach to developing projections of high school graduates, considered alternative methods, and identified ways that the WICHE projections might be enhanced. We offer the following recommendations for WICHE's consideration as the commission develops a new series of projections. Our major recommendations fall into two categories: methodological and enhancements.

Methodological recommendations:

- WICHE should continue to use the CSR method but modify the methods used to project future rates. Specifically, WICHE should consider adopting a hybrid approach in which some CSRs are forecast through double exponential smoothing and others are forecast through exponential smoothing.[42] Past projections could be revised using a hybrid approach to determine if such an approach results in greater accuracy.[43] Alternative approaches could be evaluated to determine whether WICHE wants to use them to provide some sense of the range of the projections' accuracy.

- WICHE should continue to use five racial/ethnic categories and adjust recent data for states that use seven racial/ethnic categories to ensure consistency across time.
- WICHE should ensure that its projections are consistent with each other; for example, that the state series numbers sum to those of the national series.

Enhancements:

- WICHE should add gender to its projections. The data are readily available from the CCD, and there are notable differences in CSRs between males and females.[44]
- WICHE should consider adding projections for metropolitan areas. The data is readily available and would almost certainly be of great interest to many college officials.
- For some states or for regions, WICHE should consider incorporating data from the ACS on other student characteristics to generate projections that provide more socioeconomic detail. Characteristics to consider include income (or poverty), parents' education, and nativity. Short of incorporating these characteristics into new projections, WICHE could develop a series of reports on recent trends related to these characteristics.

Incorporating some or all of these recommendations will make WICHE's projections more valuable, and will help set them apart from NCES's projections. Regardless of which, if any, of these recommendations WICHE adopts, the commission will want to ensure that its reports continue to provide clarity and transparency in the methods and data used to generate the projections. WICHE's technical advisors and end users should play an important role in determining which of these recommendations are pursued.

Endnotes

[1] For a detailed history of WICHE, including its high school graduate projections, see Frank C. Abbott, *A History of the Western Interstate Commission for Higher Education* (Boulder, CO: WICHE, 2004), accessed on 6 July 2012 at <www.wiche.edu/pub/11654>.

[2] Unpublished analysis of the accuracy of the 2003 series, provided by Brian Prescott of WICHE. Analysis conducted by Dustin Weeden, a 2011 summer WICHE policy intern.

[3] William J. Hussar and Tabitha M. Bailey, *Projections of Education Statistics to 2019*, 38th edition (Washington, D.C.: National Center for Education Statistics, 2011), accessed on 24 July 2012 from <nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2011017>.

[4] Singular events not likely to be repeated, such as Hurricane Katrina, could have a notable effect on CSRs and render them unstable for forecasting purposes. Indeed, in the 2008 version of *Knocking at the College Door*, WICHE acknowledged problems with Louisiana's state projections caused by Hurricane Katrina and its aftermath. See Western Interstate Commission for Higher Education, *Knocking at the College Door: Projections of High School Graduates by State and Race/Ethnicity, 1992-2022* (Boulder, CO: Western Interstate Commission for Higher Education, 2008), accessed on 25 July 2012 at www.wiche.edu/pub/11556 >, page 51.

[5] Relatively small sample sizes make these estimates imprecise.

[6] Ryan Wells, David Lohman and Maureen Marron, "What Factors Are Associated With Grade Acceleration? An Analysis and Comparison of Two U.S. Databases," *Journal of Advanced Academics*, 20:2:248-273, 2009.

[7] M. Planty, W. Hussar, T. Snyder, G. Kena, A. KewalRamani, J. Kemp, K. Bianco, and R. Dinkes, *The Condition of Education 2009* (Washington, D.C.: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, 2009), as reported by Thomas C. West, *Still a Freshman: Examining the Prevalence and Characteristics of Ninth-Grade Retention Across Six States* (Baltimore, MD: Johns Hopkins University Center for Social Organization of Schools, 2009).

[8] Jill S. Cannon and Stephen Lipscomb, "Early Grade Retention and Student Success: Evidence from Los Angeles"(San Francisco, CA: Public Policy Institute of California, 2011), accessed on 25 July 2012 at <www.ppic.org/content/pubs/report/R_311JCR.pdf>.

[9] WICHE, *Knocking at the College Door*. There appears to be some migration from private schools to public schools in the transition from middle school to high school. Private school CSRs for eighth to ninth grade show a dip, almost certainly due to some migration to public schools.

[10] West, *Still a Freshman*.

[11] Kathryn Baron, *Grad Rates Trending Up – or Down*, posted on 8 July 2011, accessed 25 July 2012 at <http://toped.svefoundation.org/2011/06/08/graduation-rates-trending-up-or-maybe-down>.

[12] M. Seastrom, C. Chapman, R. Stillwell, D. McGrath, P. Peltola, R. Dinkes, and Z. Xu, *User's Guide to Computing High School Graduation Rates, Volume 1: Review of Current and Proposed Graduation Indicators*, NCES 2006-604 (Washington, D.C.: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, 2006), 3. See also M. Seastrom, C. Chapman, R. Stillwell, D. McGrath, P. Peltola, R. Dinkes, and Z. Xu, *User's Guide to Computing High School Graduation Rates, Volume 2: Technical Evaluation of Proxy Graduation Indicators*, NCES 2006-605 (Washington, D.C.: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, 2006).

[13] R. Stillwell, J. Sable, C. Plotts, and A. M. Noel, *NCES Common Core of Data State Dropout and Completion Data File: School Year 2008–09*, NCES 2011-313 and NCES 2010-365 revised (Washington, D.C.: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, 2011), accessed on 25 July 2012 at <http://nces.ed.gov/ccd/drpcompstatelvl.asp>.

[14] J.R. Warren, "State-level High School Completion Rates: Concepts, Measures, and Trends," *Education Policy Analysis Archives 13*, no. 51, 2005,. Retrieved [12-28-2005] from http://apaa.asu.edu/epaa/v13n51. Warren does attempt to adjust completion rates for migration, but his measure of migration is indirect, relying on school enrollment changes.

[15] State longitudinal data systems will need common elements for grade-by-grade enrollment and graduation for them to be meaningful for a national projection series.

[16] C. Chen, J. Sable, L. Mitchell, and F. Liu, *NCES Common Core of Data Public Elementary/Secondary School Universe Survey: School Year 2009–10*, NCES 2011-348 (Washington, D.C.: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, 2011), accessed on 25 July 2012 at <http://nces.ed.gov/ccd/pubschuniv.asp>.

[17] Hussar and Bailey, *Projections of Education Statistics*.

[18] For example, Jesse H. Ruiz, Illinois Public School Enrollment Projections: 2004-05 to 2012-13 (Illinois: Illinois State Board of Education, 2004), <http://www.isbe.state.il.us/research/pdfs/public_school_enrollment.pdf>.

[19] By "independent" we mean that the projection of a CSR for one grade is developed separately from the CSR for another grade. One option that would prevent inconsistency in projections would be to establish a rule that would restrict how much the projected CSR could change for one grade relative to the surrounding grades. Of course, there might be a very good reason that 11th grade dropout rates are increasing and 12th grade dropout rates are declining; and therefore it is not clear whether such a rule is necessary. Flagging potential inconsistencies and then subjectively considering them might be the best alternative.

[20] We developed double exponential smoothing projections for Texas by first calculating the average annual change in the CSR for the recent past. Using six years of recent data for 10th grade CSRs in Texas, this equals .0080312. Specifically, 10th grade CSRs increased from .8157182 in 2004 to .8558742 in 2009: .0080312=(.8558472-.8157182)/5. Next, we applied the dampening factor to the average annual change calculated in step 1 for subsequent projection years. For example, for year 1 of the projection, the change in the CSR for Texas (using a dampening factor of 0.4) is 0.4 * .008312=.0032125. For year 2 it is .4 * .4 *.008312. (And so on for subsequent projected years). We created a series of projected CSRs by adding the annual change calculated in step 2 to the previous year's CSR. This gives the single smoothed series. For Texas, for year 1 of the projection, this is .8560867 (the sum of .8558742 and .0032125). The final double smoothed series is a weighted average of the single series CSR in the current year times the CSR for the previous year. Using a weighting factor of 0.4 gives a projected first-year CSR for Texas of .8578017 (which is equal to .6*.8558742+.4*.8590867).

[21] Developing statistical confidence intervals is not realistic, given the limitations of the historic data. Specifically, an ARIMA time series model would be necessary, and there is insufficient historic data to develop a robust model. Producing narrower but subjective bounds rather than statistical confidence intervals is possible with "high" and "low" alternative series.

[22] If WICHE does develop projections for subgroups, it should control those projections to those for a larger ethic group. For example, in Florida WICHE will project graduates for all Latinos and could develop subgroup projections for Cubans and non-Cuban Latinos (which together would be controlled to sum to the projections for all Latinos). The ACS provides detailed ethnicity information for students by grade and age (again, sample sizes could be an issue, requiring an aggregation across years or age groups).

[23] WICHE, *Knocking at the College Door*.

[24] Richard S. Grip, "Does Projecting Enrollments by Race Produce More Accurate Results in New Jersey School Districts?" *Population Research and Policy Review 28*, no. 6 (2009), 747-771.

[25] The latest birth data from the National Center for Health Statistics can be accessed at <www.cdc.gov/nchs/births.htm>.

[26] The complete series with birth projections by race/ethnicity can be accessed at <www.census.gov/population/projections/state/stpj_layout.txt>. The bureau's most recent state population projections, released in 2004, are termed "interim" and do not include racial/ethnic detail; they can be accessed at <www.census.gov/population/www/projections/projectionsagesex.html>.

[27] Alternatively, WICHE could develop its own birth projections to extend the series. This would require developing a new set of population projections for every state by race/ethnicity, a cumbersome process.

[28] Stacey Bielick, "1.5 Million Homeschooled Students in the United States in 2007," issue brief (Washington D.C.: Institute of Education Sciences, 2008), accessed on 23 July 2012 at <http://nces.ed.gov/pubs2009/2009030.pdf>.

[29] U.S. Census Bureau, *Statistical Abstract of the United States: 2011*, Table 236, accessed on 25 July 2012 at <www.census.gov/compendia/statab/2011/tables/11s0236.pdf>.

[30] IES will eventually provide new national estimates for 2011-12, but that survey and its results will not be available for some time.

[31] Homeschooling Legal Defense Association, homepage, accessed on 25 July 2012 at <www.hslda.org/laws/default.asp>.

[32] A recent analysis of California's exit exam requirement indicates that only about 1 percent of students were denied diplomas because they could not pass an exit exam. The vast majority of students who drop out appear to do so for other reasons. See D. E. Becker, L. Wise Lauress, and Christa Watters (eds.), *Independent Evaluation of the California High School Exit Examination: 2010 Biennial Report*, accessed on 25 July 2012 at<www.cde.ca.gov/ta/tg/hs/documents/cahsee10biennlrpt.pdf>.

[33] It is not possible to determine whether homeschooling accounts for some of the differences between the ACS and NCES enrollment data. It is possible that some parents report that their homeschooled students are not enrolled in public schools, even if those children are partially enrolled.

[34] WICHE, *Knocking at the College Door: Projections of High School Graduates by State, Income, and Race/Ethnicity, 1988 to 2018* (Boulder, CO: Western Interstate Commission for Higher Education, 2003),25.

[35] Ibid., 82.

[36] The ACS allows for the direct measurement of family income, a better measure than the indirect approach used by WICHE in the past. In 2005 the ACS sample was increased dramatically, but it was not until 2006 that the ACS included individuals in group quarters.

[37] For example, a regression model could predict family income as a function of child's age, race/ethnicity, nativity; of parental characteristics, including education; and of the time period and the overall unemployment rate.

[38] For example, WICHE could assume that poverty levels over the forecast period will remain at the same levels observed in state x for the past t years for each racial/ethnic group (or could trend the rates based on the historic pattern). Then, as the racial/ethnic composition changes, so too would overall poverty levels.

[39] Sample sizes are not likely to be a problem. ACS samples of 12th graders, for example, exceed 45,000 for 2009 and 50,000 for 2008.

[40] The main data constraint is that graduation figures are not broken down by sex in the CCD, so that CSRs can only be calculated through 12th grade. WICHE would have to make assumptions about CSRs for 12th grade to graduation based on patterns observed at other grades or based on other sources of data.

[41] After each decennial census, the Office of Management and Budget redesignates metropolitan areas in the United States. This process usually takes several years. Currently, there are over 300 metropolitan areas in the United States, with about 100 having more than 500,000 residents.

[42] One approach would be to use double exponential smoothing if CSRs over the past five years are either monotonically increasing or decreasing.

[43] Specifically, WICHE could look back at prior projections, calculate CSRs both ways, and see which approach would have been closer to the actual data. This could be done by state or by race/ethnicity within a state.

[44] Gender is not available for CSRs for 12th grade to graduation. WICHE could estimate those CSRs by assuming the same ratio of male to female CSRS for 12th grade to graduation as observed for 11th to 12th grade. For example, if the 11th to 12th grade CSR was .95 overall, .94 for males, and .96 for females, and the observed 12th grade to graduation CSR was .92, then the male estimated CSR to graduation would be .94/.95*.92. and the female estimated CSR would be .96/.95*.92.

Appendix A

Detailed Data and Projected CSRs

In developing this report, we have generated CSRs by state, by race/ethnicity and by gender. The CSRs are available for all 50 states and the District of Columbia for every grade from first through high school graduation for five race/ethnic group and for first to 12th grade by race/ethnicity and by sex. The CSRs cover the historical period from 2003 to 2009 for first through 12th grades and from 2005 to 2008 for graduates. Projected CSRs extend to 2025. One set uses WICHE's current methods; another set uses NCES's methods; and a third set uses double exponential smoothing.

The following link provides additional and detailed data on school enrollments and CSRs:

Link forthcoming

Part 3. Technical Review Panel Summary

As part of the *Knocking at the College Door* methods review process, a technical review panel was convened in Boulder, CO, on September 7, 2011, to address the following questions:

- What is the best methodology that balances accuracy and transparency? Specifically, how should WICHE:
  - Use other statistical approaches to replace or enhance the current methodology.
  - Integrate additional breakout categories,
  - Account for different circumstances and manage "shocks", and
  - Anticipate the impact of statewide longitudinal data systems and the richer, more detailed level of data they may provide.
- Is it appropriate to incorporate data from the American Community Survey (into this analysis and if so what is the best way to do it?
- What changes should be made to the content and delivery/dissemination of the report?

The primary purpose of this panel was to review the technical aspects of the report; a user review panel addressed user's content and functional needs.

Prior to this meeting, WICHE commissioned a paper by Hans Johnson and David Ezekiel from the Public Policy Institute of California to examine the current methodology of the report and provide recommendations for changes and improvements. This paper was provided to technical panel participants prior to the discussion. Its content and recommendations were presented at the meeting and served as a starting point for discussion.

Overall Report Methodology

The panel discussed methodological approaches, including Monte Carlo simulations, autoregressive integrated moving average (ARIMA) models, and cohort survival ratios using single or double differential smoothing. There are benefits to using the current methodology: cohort survival ratio. It is transparent, easy to understand, relatively accurate, and widely accepted. Still, the methodology could be enhanced with modifications addressing factors the model overlooks and better communicate the prediction errors. Finally, though the commissioned paper provided some insight into the impact of methodological changes, panelists needed more data to make final recommendations; they suggested WICHE mine its existing data before making a final decision.

There was discussion about the current use of birth data to drive graduation rate projections for age groups not yet enrolled in school. Using birth in combination with the enrollment data from the Common Core of Data (CCD) means the model misses students who migrate, die, or are not moved forward into school between 0 and 6. American Community Survey (ACS) age counts may help provide an alternative source of "knowable data" to address this concern. Still, this data would need to be adjusted because it is calendar year rather than academic year data, and there are potential problems with "age heaping" in ACS. When deciding whether to use age counts, it is important to understand how much this approach will improve the accuracy and utility of the report.

Despite broad agreement that the CSR model provides a strong foundation for *Knocking*, the group discussed the impact and utility of complex statistical approaches. ARIMA models and Monte Carlo simulations are not as transparent as CSR, and they are not always more accurate; but they do provide an opportunity to communicate error. It may be helpful to consider using these methods to report past errors, and improve the accuracy of data impacted by disasters and other shocks (such Hurricane Katrina in Louisiana and WHAT? Nevada).

There was a discussion about the best way to produce the regional and national totals. The current approach produces state, regional and national projections independently. It also projects race and ethnic groups separately. The resulting projections for smaller units (such as states) do not, when added together, equal the national projections. Alternative approaches include calculating the smaller units and summing them to produce the aggregated totals or calculating the aggregated totals and "fudging" the lower-level data. The benefits of the current approach include the ability to minimize error. However, the fact that state-level data do not sum up to national totals can be confusing to readers. The technical review panel did not offer a consensus recommendation on this issue.

Finally, the recent change in the race and ethnicity categories collected by the National Center for Education Statistics has an impact on the methodology. The U.S. Census implemented the new categories some time ago, so this group suggested reviewing the literature for what others have done to bridge the old and new categories. Many in education are mapping the new categories to the old categories, which may be appropriate in this case because of the timing of the report and the challenges of doing breakouts for different populations. This is an important decision, and there may be an opportunity to produce some specialized reports for certain populations. There was some discussion of how to address Hispanic breakouts and the variable capacity for states to accurately report on different groups.

Recommendations. The panel suggested WICHE consider the following actions.

Examine the impact of different statistical methods (such as using different weights in the existing model, exponential smoothing, and double exponential smoothing) on the accuracy and consistency of the model by running simulations on the existing data set.

1. Consider the impact of different weighting approaches on the current model.
2. Use a CSR model and keep the methodology simple, even if WICHE chooses to integrate new weights, so that it continues to meet the needs of the existing audience.
3. Consider using ACS age count data for students between 0 and 6 rather than the current approach of using birthrate and skipping six years of knowable data between birth and first grade.
4. Examine more complex models that offer the benefit of communicating the potential for error in the model, such as error bars (high, medium, low) and "error cones" or hurricane charts using a method like root square error.
5. Maintain the base utility of the report; special analysis and more detailed statistical information about the accuracy of projections should be directed to appropriate audiences, as should any complex modeling used for any reason.
6. Realize there are benefits to both approaches to aggregating the projections to produce national and regional totals (since there are few questions about the current methodology, this group did not have specific recommendations to change the current approach).
7. Use what others are doing with the race and ethnicity categories (which are causing challenges to many organizations) to guide WICHE's approach. Consider the following solutions:
   - Collapse the new categories into the original five until the change to the new categories is more widespread in higher education.
   - Complement the core report with a few special reports with deeper race breakdowns to address the needs of specific groups (such as Pacific Islanders in Hawaii and California).
   - Refrain from splitting out Hispanic groups, which is generally not helpful from a policy perspective. All Hispanic groups are important and policymakers often already know the breakout of these groups within a region. Keeping them together is the better option.
   - Make sure whatever method WICHE uses for *Knocking* is transparent and communicates to stakeholders the impact it may have on the stability of the projections.

Integrating Additional Graduate Categories

The panel also discussed the categories utilized to break out data in the report. Previous reports have disaggregated the data based on income, and there has been interest in providing projections based on gender and geography. In general, the group seemed to feel that it is important to keep things simple, in order to best serve the primary audiences of the report. Therefore, the analysis should stay relatively straightforward, and WICHE could complement it with special reports for targeted populations.

Adding gender comparisons to the report is relatively straightforward and should probably be done. However, there was considerably more discussion around adding MSA breakouts. There are advantages to adding MSA breakouts, since it allows data to be broken out for metropolitan areas that extend across state lines and provides for a better understanding of rural areas. MSA projections will be impacted by migration and by their expansion or contraction in the years to come. Still, the group felt that MSA analysis could add value and was straightforward enough to be included in the core of the report.

Recommendations. WICHE should consider the following.

1. Add gender and additional geographic (MSA) breakouts to the core publication. They will enhance the report; they are straightforward, and the data is available.
2. If WICHE adds MSA breakouts, be aware that they may be less accurate than other breakouts and that WICHE will need to consider the size and volatility of MSAs when choosing which ones to include.

Accounting for Shocks and Other Circumstances

State competency tests and adoption of the Common Core State Standards might factor into dropout rates, which impact the accuracy of projections. The group cautioned against incorporating policy changes into the core *Knocking* report, which should serve as a neutral foundation of information, for example WICHE's role in providing unbiased estimates through *Knocking* is similar to that of the Congressional Budget Office. Members of the panel suggested that, for *Knocking*, the key impact of state policy relates to its effect on dropout rates (which, as just noted, affect, the accuracy of the projections). In some ways the model takes this into account by weighting for the most recent year, but it is difficult to fully address.

Other shocks and major events, both sudden and long-term like Hurricane Katrina and the economic downturn, can also impact the accuracy of projections. The group discussed two ways to address shocks: one is to acknowledge them and the impact they have on the projections; and the other is to correct for them in the model. When unexpected changes appear in the projections due to imprecise data, they should probably be left alone to encourage better data in the future; but adjusting for shocks based on circumstances is more of a judgment call. The group did not have specific recommendations other than that WICHE should be transparent about the decisions it makes in this area. Additionally, they cautioned that correcting for shocks in one state can have implications on the comparability of that data to other states.

Recommendations. The group suggested WICHE consider the following.

1. The core of the WICHE report is the unbiased projection of high school graduation rates. There may be an opportunity to analyze the impact of state-level policies after the fact, but such analyses would best be included in complementary material, not the core model or report.
2. Inconsistencies due to inaccurate data should not be corrected.
3. External shocks to the data, such as economic changes and natural disasters, should be considered on a case-by-case basis.

In addition to the topics above, other issues were discussed briefly. These included: how WICHE might better address home-schooled and private school students; how statewide longitudinal data systems may impact the methodology; and how GED and nontraditional students should be factored in.

Integrating the American Community Survey

The American Community Survey offers WICHE a rich data source to potentially exploit for the purpose of extending the projections series in useful new directions or adding contextual information. The panel discussed at length the possibility of integrating these data. Beyond the 0-6 age data already described, there was extensive discussion around how ACS could be used to improve *Knocking*'s presentation of topics such as income. On the whole participants felt that too much additional analysis might undercut the core strength of the report's straightforward high school graduation projections.

In 2003 WICHE used school-district-level income data from the Census for its projections. Some of the panel members were concerned with the previous methodology because it assumed that the average income for students and their families was the same as the average income for all residents in a district. In addition, the data were relatively old and did not account for changes. Income data present a number of challenges because they change with business cycles and warrant more complex economic analysis.

The ACS has data on parents' level of education, which linked to socioeconomic status and is more stable than income data; this may be a better measure. Characterizing the projections in light of poverty levels or socioeconomic characteristics may also help improve the validity of the projections and provide context to readers. However, it should be presented separately so it does not distract from the core of the report.

Recommendations. WICHE might consider the following.

1. The ACS could provide valuable data sets to help inform supplemental analyses that complement the core report and provide context, but it should not be integrated into the projections or the core report.
2. Parental education, poverty, and nontraditional students all provide good topics for relevant supplemental analysis, and data on these areas is relatively easy to access.
3. Any attempts to project graduates by income should rely on one or more of the following:
   - A more frequently updated data source than the Census and ideally one that ties more directly to students rather than relying on averages.
   - Higher-level economic forecasting approaches that take into account the impact of business cycles, unemployment rates, and other factors.
   - Parents' education level or poverty level, because they are more stable proxies for income.
   - An approach that examines trends in income distribution rather than projecting trends for an actual number of students.

Timeline for Report

Throughout the meeting a number of opportunities relating to the reporting timeline and content were discussed. Consistent with other areas, there seemed to be agreement that the core approach to creating and publishing *Knocking at the College Door* on a regular timeline, and in print, was one of the report's strengths. There was also a sense that there is an opportunity to do more with *Knocking*'s data.

Recommendations. The panel suggested that WICHE should:

1. Consider releasing the projections or at least additional analyses that complement the report more often to help address some of the shocks and ensure ongoing activity, though this should be balanced with the benefits the panel recognized of printing a consistent, paper-based report at regular intervals. WICHE should consider carefully how to reconcile any updates to the projections and any supplemental analyses with the regular published report.
2. Consider ways to allow users to interact with and access the data set, such as online tools, and WICHE to provide additional context.
3. Consider making the data sets that WICHE cleans and constructs available to other researchers and possibly the public.

Conclusions

In brief, the panel had the following major recommendations.

- The current approach, cohort survival ratio (CSR), makes *Knocking at the College Door* transparent and easy to understand, which allows it to be widely used by multiple audiences. Neither the background paper's authors nor the technical review panel found that abandoning the CSR as the core methodology for producing the projections in favor of another approach would lead to substantial improvements. Improvements in accuracy, if any, would be more than counterbalanced by tradeoffs in transparency, data availability, and other virtues. Relatively simple adjustments to the CSR approach built off of a systematic review of the projections' accuracy would provide WICHE with the best approach to improving accuracy.
- The core of the WICHE report is the unbiased projections of high school graduation. WICHE should add gender and additional geographic (metropolitan statistical area, or MSA) breakdowns to the core publication but make more complex analysis supplemental.
- WICHE should focus its projections on high school graduates but could add valuable contextual information by using data available from the American Communities Survey to do additional analysis on topics such as parental education, poverty, and trends in nontraditional students.
- Interspersing additional and extended analyses of data on high school graduates between the publication of each new edition of *Knocking* (which appears on a four- to five-year cycle) would likely meet a need and could improve the quality and utility of its reports. Additionally, such interim reports could address adjustments to the projections made necessary by the impact of short- and long-term shocks, like Hurricane Katrina.
- Using more advanced statistical approaches to examine and report the level of error in the report's projections may help improve its value to researchers.

This summary of the meeting was prepared by Katie Zaback, a policy analyst at the State Higher Education Executive Officers (SHEEO).

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Part 4. End User Review Panel Summary

As part of the *Knocking at the College Door* methods review process, WICHE convened panelists representing various constituencies of WICHE's high school graduation projections, on February 22 and 23, 2012, in Boulder, CO. This group of panelists considered several high school graduate methodological topics from an end-user perspective, as well as report format and components and potential enhancements. Previously, in September 2011, a technical review panel (TRP) had considered technical methodological aspects of similar topics; prior to the February meeting, panelists reviewed the white paper WICHE commissioned to examine the current methodology and potential improvements and the TRP's recommendations. The white paper's authors, Hans Johnson and David Ezekiel from the Public Policy Institute of California, were also present for the meeting. Recommendations provided at the end-user meeting and through a follow-up survey are summarized below.

Produce projections using one method. Hans Johnson summarized the aspects of the underlying methodology that he and the TRP recommended be reviewed; the two alternatives to be compared; and why various other projection methodologies are not feasible alternatives. Peace Bransberger, a WICHE policy analyst, presented examples of the alternative methodologies. Panelists said that WICHE's credibility and transparency were paramount and that users understand well enough that there are different expectations for error and accuracy with retrospective research than with predictive. Overwhelmingly, one methodology was the preferred approach.

- Panelists preferred that the method not be varied or tailored state by state, or according to circumstance, or across editions. In particular, the methodology across states and from edition to edition should be the same for comparability.
- Simplicity and transparency are best. Most users want to know whether the alternative methodologies are "roughly comparable" and do not need a lot of detail. They understand that one cannot predict or exactly model the impacts, subtle or dramatic, of so many multifaceted factors.
- Nuances between the methodologies can be discerned retrospectively, but it may not be possible to predict which will work best for the future.
- The direction of a trend, and whether the methodology accounts for it, is as important or more so than pinpoint accuracy. Panelists were generally comfortable with the relatively low level of error, especially when viewed in light of the total numbers spread out over categories and states.
- Whether WICHE would choose to continue with the current model for its overall suitability or use another, it should be fully transparent and disclose situations or states where the chosen model is not the best fit. This could be done in a table online as a technical series, or a supplement to the publication in the state profiles, as relevant.

Continue to generate aggregated projections independently from the subgroups but explain the nonequivalence more clearly. The panelists recommended continuing to generate the national and regional projections independent of the states and the state totals independent of the racial/ethnic categories, despite the nonequivalence this generates. They also suggested what WICHE should address in explaining the process more clearly to end-users.

- The nonequivalence is most likely to affect end users who compare data across levels, which executives and associations might do more frequently. Many end-users are only focused on a single state or category.
- The nonequivalence needs to be mentioned in presentations. However, according to panelists, "users of these types of reports understand things such as 'figures do not sum due to rounding' as standard practice." In addition, "these are projections, and they do not inherently have to all add up."
- It would be more problematic to smooth out actual trends at a state level than to accept the dissonance from nonequivalence.
- Clearer explanation of this nonequivalence should: summarize the amount of difference (as the white paper did); describe the nature of the projections and WICHE's reasoning; provide salient examples of the tradeoffs for either approach; and make sure the tables notes are clear.

A presentation of historical error is the way to be transparent about the projections' (un)certainty. Hans Johnson explained that it is not possible to get statistical confidence levels on these projections, as with other types of statistical reports, and explored the feasibility of other ways for WICHE to describe the (un)certainty and (in)accuracy of the projections. The panelists encouraged a simple approach that emphasizes transparency and reliability and discouraged giving too much attention to this. The panelists said their constituencies understand that projections are inherently less than 100 percent precise and were concerned that placing undue emphasis on the accuracy issue would cause end users to doubt their accuracy; on the other hand, presenting "projected bounds," one alternative discussed, would convey false precision.

- Panelists widely recommended a summary of historical errors (an average, in percentage terms), such as was done in the 2003 edition, as a way to describe what can be expected, based on our previous performance. This would also help to communicate to users that each of the cells has a different expectation of error, e.g., by virtue of its smaller graduating classes, Wyoming is "noisier" than California. One specific suggestion was that WICHE include a high-level summary in the text, as well as illustrations for the nation, the region, and large states, where there is inherently lower error, and a detailed appendix table with the errors for advanced users.
- As regards accuracy or uncertainty related to particular circumstances (e.g., extremes from the average errors, observed shocks, data irregularities, or particular characteristics for a given state or grouping), WICHE could provide specific explanation in a sidebar or the state profile.

It is not necessary to adjust for shocks in the projections, but there are options for putting them in context. The panelists discussed how to handle "shocks," such as a major displacement resulting from a natural disaster or an economic slump, and anomalies that arise from data irregularities. They advised against trying to anticipate or adjust for them but provided ideas for putting them in context.

- Rather than try to figure out or correct for these things internally, panelists suggested involving states with irregularities to address them; or forming an advisory group or tapping into constituencies/associations to vet the initial findings and provide some contextual information about anomalies or unexpected trends.
- Panelists discussed "naturally" occurring anomalies that probably should not be corrected for but would perhaps warrant some discussion in the narrative, e.g., a sidebar about the "top 3" factors that appear to affect trends in the graduate projections. Immigration effects, either from economic conditions or state laws, might cause blips that are not constant over time. High school completion initiatives, dropout law changes, military requirements, dual enrollment, laws about GED requirements, Common Core State Standards, and even retention practices at a local level (metropolitan statistical areas, or MSAs) will affect projections initially but may start a trend line that will dissipate over time. It was noted, however, that even in these circumstances, WICHE would be describing a past policy or trend that came into play during the data time period. It may not be as useful to give that much attention to past events.
- At a minimum, WICHE should acknowledge that shocks and other extenuating circumstances cause greater uncertainty.
- Irregularities and other special circumstances are good material for state profiles or periodic special analyses.
- Shocks and other irregularities provide another argument against making the aggregated and subgroup projections dependent on each other (see above).

Retain the existing race/ethnicity categories and provide additional information. Hans Johnson summarized the infeasibility of producing projections for the two racial/ethnic categories that are being phased into federal education data collections (Hawaiians/Pacific Islanders and the "two or more races" category), due to insufficient data. The panelists discussed options, the unreliability of further dissecting the race/ethnicity projections in some cases, and the limited usefulness of projections at finer levels of detail in some cases.

- The panelists concurred with the TRP's recommendations to retain the existing race/ethnicity categories for the 2012 edition but provide additional contextual information about subpopulations where possible. They suggested that the state profiles and sidebars in the report could provide detail about selected racial/ethnic subpopulations, such as Hispanic breakouts for the 18 and under population from the American Community Survey or California's approach to multiple Asian categories. Panelists also felt that there may be limited usefulness in providing additional racial/ethnic analysis without income or other socioeconomic information. (See recommendations regarding income below). As one panelist explained, "Racial/ethnic projections depict diversity, but income, language spoken at home, and immigration are more characteristic of students' needs even if they overlap or transcend racial/ethnic categories."
- The panelists recommended that WICHE explicitly discuss the implications of the changing racial/ethnic categories for future projections. For example, WICHE should discuss the fact that the numbers of non-Hispanic and racially distinct students will inevitably decline as the mutually exclusive Hispanic category and the "two races" category increase and examine how this could affect trend-based projections, referring readers to NCES's or other resources on this topic.

Projections by income are not feasible, but WICHE should accompany the primary projections with selected contextual information. The panelists acknowledged the possible infeasibility and limitations of projecting by income but described the utility of having more income-contextualized information included along with the projections. They also posited that, ultimately, income and socioeconomic information is needed to really interpret and use the projections by race/ethnicity and even further disaggregated gender projections. Suggestions for things to highlight in the report, in state profiles or a separate research report included:

- Quartiles or quintiles of family income for those under 18 or family income by race/ethnicity from the 2010 Census and American Community Survey (ACS).
- Recent historical trends for families with youth of high school age, perhaps indexed to poverty, and high school graduates' income and poverty over the preceding five to 10 years, for families with younger children versus families with older children for smaller sample sizes.
- Median family income for families with high school graduates by race/ethnicity categories from the ACS.
- Current trends for the U.S. overall, compared to trends in states and possibly MSAs.
- Present income by quartiles/quintiles or in the same groupings as projections.

Provide projections by gender and race/ethnicity. There was general consensus that projections by gender are a somewhat higher priority than MSA projections and are ultimately most useful when also broken out by race/ethnicity because gender disparities are most apparent in certain race/ethnicities. Acknowledging that projections by gender and by race/ethnicity will increase the report size, panelists offered several reporting alternatives.

- Present only national projections by gender and race/ethnicity in the print publication.
- Present gender splits for each state in the book, and then present data by race/ethnicity in a supplement, perhaps published only on the website. Putting the new categories of projections in a supplement or on the web is a reasonable idea since this will be a pilot feature.
- Present three consecutive tables or tabs for each state: total, female, and male.

Panelists also mentioned some circumstances in which gender projections may be less useful. For example, in states with small racial/ethnic populations, gender projections probably do not warrant state policy attention. This also raises the issue that projecting by gender will reduce small subpopulations by half; WICHE should set a threshold for disaggregation, (e.g., greater than or equal to10 percent of the state's population). In addition, projections by gender will surface a "performance" aspect that would need to be addressed in the narrative.

MSA projections would be useful, but are somewhat lower priority than projections by gender. Panelists said that there would be substantial interest in metro-area projections, particularly from foundations; urban areas that are moving away from state interventions and toward more focused urban-center interventions; and school districts and community college districts.

- However, there are notable issues with defining metro areas. MSAs are rapidly changing; even federal agencies (such as the Labor and Energy departments and Health and Human Services) with similar focuses have different ways of thinking of MSAs.
- The panelists emphasized the need to address MSA projections in a way that is sensitive to the urban-rural political divide that it could exacerbate.
- Because the usefulness of either cross-state MSAs or MSAs based on size would vary by state and circumstance, the panelists suggested ranking the two types by size; making projections for a certain number of MSAs in each category (e.g., the top 25 cross-state, largest, and possibly smallest MSAs); and then make sure no particularly important MSA is missed by that prioritization.

Retain the historical "core" *Knocking* format and components, but consider additional supplements and enhancements as more periodic "series" components. There was general consensus that the *Knocking* publication and its historical components should continue to stay focused on the areas for which they are best-known. The new levels/types of projections endorsed above are timely and helpful, but even some of those new components might best be piloted as supplements and not added to the core publication in this edition. WICHE might consider doing some special analyses or reports or adding focused interim projections or supplements that are relevant for *Knocking* audiences, but most panelists recommended against these as additions to the core report. Panelists cautioned against going too far afield because others are already focusing on some related work (e.g., Carnevale's labor and education analyses); because of the cost of dedicating additional limited resources, versus the benefit; and because it may not be helpful to repeat information or data that is commonly available elsewhere.

- While not recommending they be included in the core report, panelists expressed varying levels of interest in topics such as: workforce preparedness, education-labor market outcomes, college preparedness of high school graduates, and the contribution of nontraditional and older populations to workforce and education.
- Ways that WICHE could help provide context and make *Knocking* more useful include:
    - Provide discussion prompts or guides (e.g., "Here's how to plug our data into a human capital model" or "Here's how to use the data to achieve attainment rates" or "Here are the tough questions to ask, and conclusions/relationships that can be drawn when looking at the projections through a workforce lens" or "What do these data mean for "X" policy or goal?"
    - Expand the utility of the website by posting slides or presentations, linking to work that others have done using the projections, and linking to related resources.
    - While the methods review does not require extensive treatment in the core report, post it to the website for those who are interested and so that it can be referred to in later years.
- The narrative report and appendices were generally described as "about right" in length and depth of treatment. None were recommended for removal or reduction.
- The printed report is still useful enough to justify printing it again, although possibly for streamlined distribution. But it is not a bad idea to use this edition as the last printed edition and transition to the next web-only edition. Given the widespread transition to downloading documents from websites, most people would be just fine with web-only components
- Most panelists felt that there is typically barely enough change in graduation trends to warrant more frequent full-scale projections. However, it might be useful to issue selected interim projections in off-years in order to adjust for shocks or irregularities (that self-adjust in one or two years) or for special analyses.

Enhance the website so it is a self-service access point. The panelists recommended a variety of items for the *Knocking* website and were strongly in favor of increasing its self-serviceability and interactivity, as outlined below and throughout the foregoing recommendations. But panelists recommended against one option discussed, WICHE developing an interactive tool for users to test hypothetical scenarios.

- The data tables should continue to be posted. Adding the cleaned data files and even files of the ratios would be very useful.
- There was widespread interest in a simpler dashboard-like tool that would allow users to select particular data or even images or charts for varying levels and comparisons (for example, to select a given state's data, charts, or profile and compare it with selected states). One panelist mentioned a dashboard builder from Sharepoint and Google Tools.
- Other ideas for intermediate-level interactive tools included a tool that gives states the opportunity to input their data if it differs from the federal data used for the projections (e.g., newer or less irregular data from data cleaning or reflecting adjustments from shocks) and have the WICHE methodology regenerate their projections.
- Panelists recommended against making an interactive tool for testing or building hypothetical scenarios publicly available because users might use it to misinterpret or misapply WICHE's official data and because not enough is known about the factors and algorithms for the scenarios. There was some concern that there is risk that such providing such a tool could imply policy and causality. However, several panelists suggested limited ways in which WICHE could pursue some of this modeling for selected constituents, perhaps as a fee-based product.

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