External Cost Adjustments for the Wyoming School Funding Model

Submitted to:

The Joint Appropriations Committee and
The Joint Education Committee

Submitted by:

Dr. Lori L. Taylor
Texas A&M University

August 2011

Executive Summary

In 2005, Lawrence O. Picus and Associates provided the Wyoming Legislature with a roadmap to educational adequacy. Their report used an evidence based approach to identify the personnel, instructional materials, and other real resources each school and district needed in order to provide "the basket" of educational goods and services every child in Wyoming should receive (Picus et al. 2005). Their report also advised the Legislature on the level of educational funding school districts needed to be able to purchase the specific mix of educational resources the consultants recommended.

One of the important recommendations of the 2005 report was that an external cost adjustment (ECA) "should be used to reflect the changing costs of resources in the interim years between full-model recalibrations" (Picus et al. 2005, p 164). ECAs are crucial to the long term viability of any cost-based funding recommendation. Without ECAs, inflation will erode the purchasing power of school districts, potentially leaving them unable to provide the necessary educational resources.

There are a number of existing price indices that could be used to measure year-to-year changes in the cost of education, but none of them reflect all of the inflationary pressures facing Wyoming school districts. Rather than applying one of the existing cost indices to the recommended funding level as a whole, Wyoming should consider adjusting each major resource component separately using the most appropriate cost index for each component.

If Wyoming chooses to adjust each major resource component separately, it will need to identify the most appropriate cost index for each component. Reasonable indices are available for the professional staff, nonprofessional staff, utilities, and educational materials components of the cost-based allocation model. This report identifies those indices and describes their recent patterns of growth.

All of the recommended indices indicate that the inflationary pressure on school districts has eased recently. However, they also indicate that inflationary pressures may be greater in Wyoming than in most other states. It is reasonable to anticipate that inflation will continue to impact the necessary funding allocations and plan accordingly.

On the other hand, it is important to note that ECAs serve only to maintain the status quo. Their use in the Wyoming funding model presumes that the model is based on accurate baseline measures of resource costs. If the baseline estimates overstate actual costs for one or more funding components, then applying an ECA to those funding components would simply perpetuate that overfunding, and the most appropriate policy response could be to forgo applying an ECA to those funding components until costs and funding converge. Similarly if a baseline estimate understates actual costs for a funding component, then applying an ECA to that baseline estimate would only perpetuate the underfunding, and further action would be needed to ensure that districts are able to provide the necessary resources.

Introduction

In 2005, Lawrence O. Picus and Associates provided the Wyoming Legislature with a roadmap to educational adequacy. Their report used an evidence based approach to identify the personnel, instructional materials, and other real resources each school and district requires in order to provide "the basket" of educational goods and services every child in Wyoming should receive (Picus et al. 2005). Their report also advised the Legislature on the level of educational funding school districts needed to be able to purchase the specific mix of educational resources the consultants recommended.

One of the important recommendations of the 2005 report was that an external cost adjustment (ECA) "should be used to reflect the changing costs of resources in the interim years between full-model recalibrations" (Picus et al. 2005, p 164). ECAs are crucial to the long term viability of any cost-based funding recommendation. Without ECAs, inflation will erode the purchasing power of school districts, potentially leaving them unable to provide the necessary educational resources.

There are a number of existing price indices that could be used to measure year-to-year changes in the cost of education, but none of them reflect all of the inflationary pressures facing Wyoming school districts. The Consumer Price Index (CPI) and the Wyoming Cost of Living Index (WCLI) measure changes in the price of the things that consumers buy, not the things that school districts buy.[1] The Employment Cost Index (ECI) measures nationwide changes in the price of labor, but not in the price of non-labor items that are important to school districts such as energy and school supplies.[2] The Comparable Wage index (CWI) measures changes in the price of college-educated labor in Wyoming, but again only measures changes in labor cost.[3] The U.S. Bureau of Economic Analysis (BEA) publishes an index of educational costs that reflects three major components of school district purchases—labor, energy and educational materials—but it is not available in a timely manner.[4]

Intuitively, the most appropriate ECA for Wyoming should reflect not only changes over time in the price of labor but also changes over time in the price of other important educational inputs. Rather than applying one of the existing price indices to the cost basis of the funding model as a whole, Wyoming should consider adjusting each major resource component separately using the most appropriate cost index for each type of resource.

---

[1] For more on the CPI, visit http://stats.bls.gov/cpi/ . For more on the WCLI, visit http://eadiv.state.wy.us/WCLI/Cost.html.

[2].For more on the ECI, visit http://stats.bls.gov/ncs/ect/.

[3] The CWI is not available from NCES for the years after 2005, but I have updated it through 2010 using the methodology I used to construct the NCES CWI. See Appendix A for details about the update. For more on the NCES CWI, visit http://nces.ed.gov/edfin/adjustments.asp

[4] The most recently available value for the BEA index comes from 2009. For more on the BEA index, visit http://www.bea.gov/industry/gpotables/gpo_list.cfm?anon=705541&registered=0

Identifying the Cost Components

As Table 1 illustrates, the Wyoming funding model supports four major types of school district spending—professional staff, nonprofessional staff, utilities, and educational materials. Two thirds of the educational resources provided through the funding model are dedicated to professional staff such as teachers, administrators and librarians. Another 15 percent of the resources are dedicated to nonprofessional staff such as secretaries, custodians and groundskeepers. Less than 4 percent of funding model resources is dedicated to utilities (the funding model category that includes energy costs). The remaining 15 percent of the model resources are dedicated to educational materials and other non-staff resources.

Table 1: The Major Components of Educational Cost in Wyoming, 2009-10

	Percent of Total Wyoming Funding Model Resources (less reimbursables & categoricals)
Professional staff resources	66.7%
Nonprofessional staff resources	14.6%
Utilities	3.4%
Educational materials and other non-staff resources	15.3%

Source: Wyoming Department of Education.

Arguably, each of these four resource components should have its own ECA. After all, there is little reason to believe that the inflationary pressure coming from energy prices will be the same as the inflationary pressures coming from labor costs. Applying a single cost adjustment to the entire cost-based allocation of resources necessarily overcorrects some resource components and under corrects others.

If Wyoming chooses to adjust each major resource component separately, it will need to identify the most appropriate cost index for each of these four components. A price index that measures changes in labor cost would be the obvious candidate for adjusting the staffing components. Year-to-year variations in utilities costs are largely driven by changes in the cost of energy, so a price index for energy costs would largely capture inflationary pressure on this model component. A price index similar to the BEA's educational materials index would capture inflationary pressures in the remaining component of school district spending.

Labor Cost Indices

There are a number of labor cost indices that Wyoming could use to adjust the staffing components of the resource allocation model. The two most promising are the ECI and the CWI.

The Bureau of Labor Statistics (BLS) designed the ECI to measures changes in labor cost over time. There are many ECIs tailored to specific industries or occupations. An ECI is available specifically for the elementary and secondary education industry, making it a particularly

attractive indicator from the school district perspective. Furthermore, there is an ECI for elementary and secondary education that reflects not only changes in wages, but also changes in benefit costs. On the other hand, the ECIs are only available at the national level. If wages are rising more rapidly in Wyoming than in the nation as a whole—as has been the case recently—then the national ECI will be a downwardly biased indicator of the inflationary pressures facing Wyoming school districts. Furthermore, ECIs for the education services industries may be unduly influenced by the policy choices of other state governments. For example if states like New York and California respond to their current fiscal crises by freezing teacher salaries, then growth in the education industry ECIs may be artificially suppressed.

The CWI can also be used to measure labor cost. Unlike the ECI, the CWI allows labor costs to rise more rapidly in some states than in others. The CWI for Wyoming reflects changes in the prevailing wage for college graduates in Wyoming, allowing it to capture changes in the price level that are specific to the state. By construction, the CWI reflects only growth in the wages of non-educators, so it is less likely to be biased by the policy decisions of other state governments than are the education sector ECIs.[5] However, the CWI reflects only changes in wages and salaries and not changes in benefit costs.

Arguably, the wages of workers without a college degree may grow more slowly or more rapidly than do the wages of college graduates. If so, then it would be inappropriate to use the CWI to measure changes over time in the wages of nonprofessional staff. Instead, a more appropriate price index for non-professional staff would be a comparable wage index for high school graduates. As is discussed in Appendix B, I used the CWI methodology to estimate a comparable wage index for high school graduates who have not completed college (HS-CWI). The analysis is identical to that used in estimating the CWI, except that the baseline Census analysis uses data from individuals with a high school diploma but not a bachelor's degree.

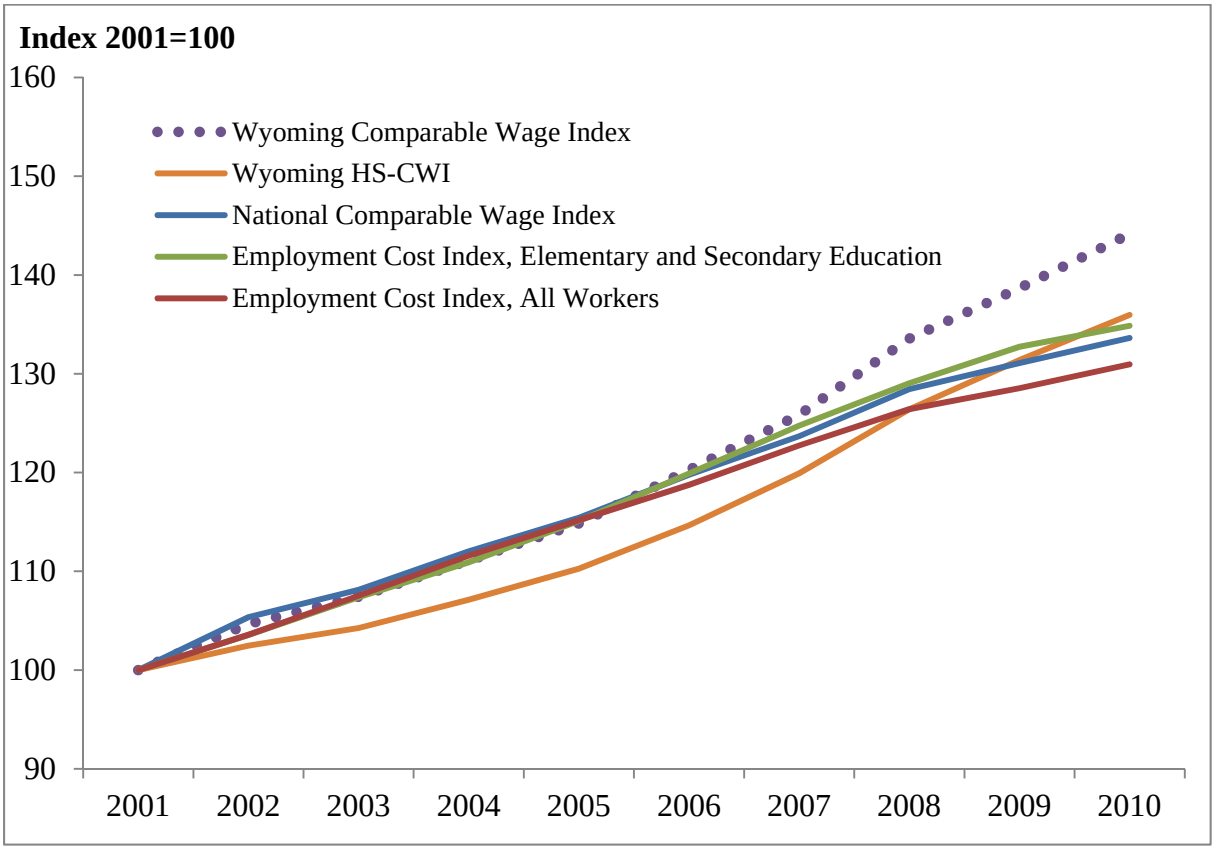
Figure 1 illustrates the relationship between the national ECI for total compensation of all civilian workers, the national ECI for total compensation in elementary and secondary education, the national CWI, the Wyoming CWI and the Wyoming HS-CWI. As the figure illustrates, the national CWI and the national ECI for elementary and secondary education track each other very closely over the entire decade. On average from 2001 through 2010, the national CWI increased 3.3 percent per year while the ECI for elementary and secondary education increased 3.4 percent per year. In other words, there is little difference between the CWI and the ECI for elementary and secondary education at the national level. Both are telling the same story about labor costs.

The Wyoming CWI was highly consistent with the national CWI and both the ECIs from 2001 through 2006, suggesting that the wage level for college graduates was growing at roughly the same rate in Wyoming as in the nation as a whole. However, after 2006, the wages for college

[5] Individuals who have a teaching or educational leadership occupation, and anyone who is employed in the elementary and secondary education industry has been excluded from all stages of the estimation for the CWI.

graduates started rising more rapidly in Wyoming than elsewhere in the nation. Since 2007, the national CWI and the ECI for elementary and secondary education have each grown 8 percent; the Wyoming CWI has grown nearly 15 percent. From 2009 to 2010, the ECI for elementary and secondary education indicates that wages were growing at a 1.6 percent annual rate, the national CWI indicates that wages were growing at a 1.9 percent annual rate, and the Wyoming CWI indicates that wages were growing at a 3.9 percent annual rate. The Wyoming CWI grew more rapidly than the CWI for any other state in 2010. Thus, the Wyoming CWI suggests that national indices understate the inflationary pressure currently facing Wyoming school districts.

Figure 1: The Labor Cost Indices



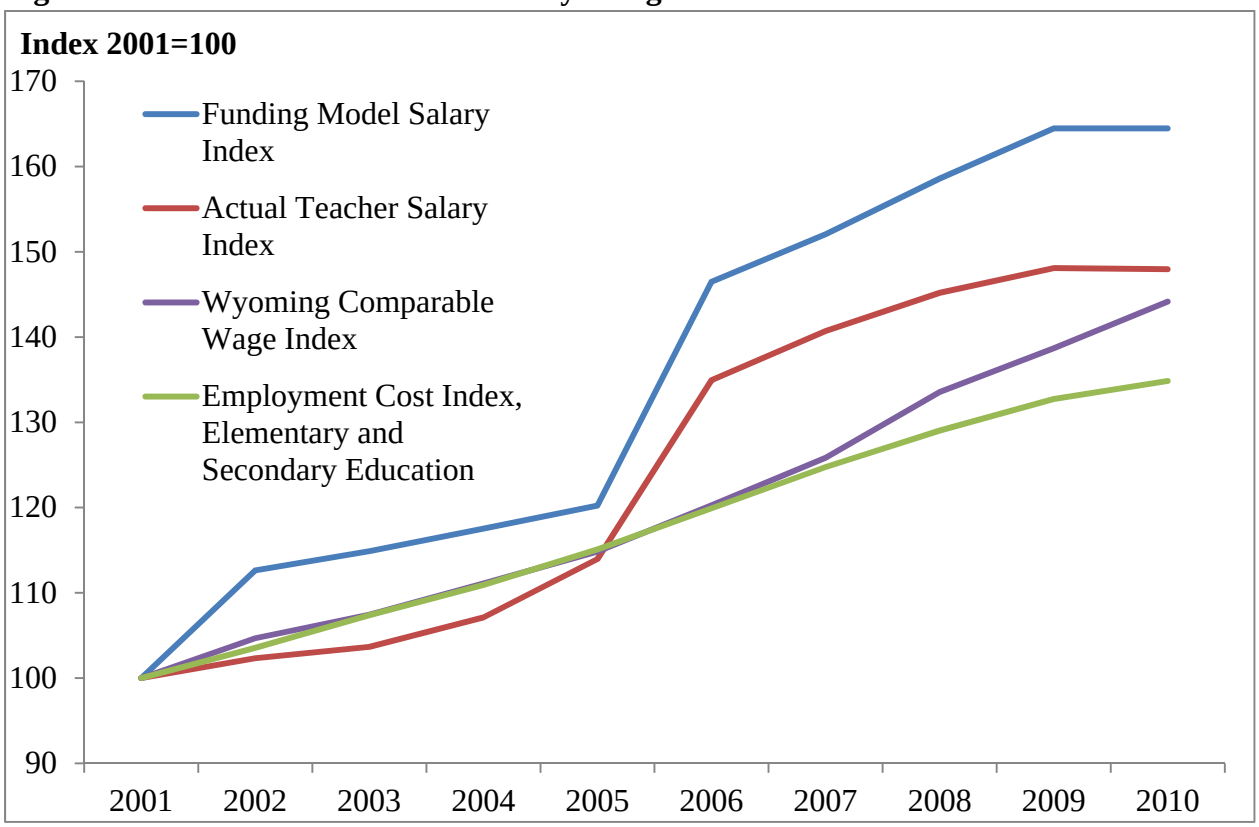
Sources: U.S. Bureau of Labor Statistics, National Center for Education Statistics and author's calculations.

Notably, after relatively sluggish growth during the first half of the decade, the Wyoming HS-CWI has been growing nearly as fast as the Wyoming CWI. Both comparable wage indices indicate that wages have been growing more rapidly in Wyoming than in any other state during 2010.

Figure 2 illustrates the relationship between the ECI for elementary and secondary education, the CWI and indices based on actual and funding model salaries in Wyoming. Table 2 presents the same information in table form. The actual salary index reflects the full-time-equivalent total salary for teachers, adjusted for differences in teacher demographics and work assignments. (See Appendix C for more information about these adjustments.) The funding model salary index is

the base salary for each year, divided by the base salary for 2001. An index value of 164 in 2010 indicates that funding model salaries in 2010 were 64 percent higher than the funding model salaries in 2001. As table 2 illustrates, if the funding model salary index is higher than the actual salary index, it does not mean that funding model salaries are higher than actual salaries. It simply means that funding model salaries have grown more rapidly than actual salaries since 2001.

Figure 2: The Labor Cost Indices and Wyoming Teacher Salaries



Sources: Wyoming Department of Education, U.S. Bureau of Labor Statistics, National Center for Education Statistics and author's calculations.

As the figure and table illustrate, actual wages and funding model salaries have grown more rapidly than the CWI since 2001. Both actual salaries and funding model salaries took a big step forward in 2006. From 2006 through 2009, funding model salaries nearly kept pace with the growth in the CWI and outpaced the growth in the ECI. Actual teacher salaries grew at roughly the same rate as the ECI for elementary and secondary education between 2006 and 2009. In 2010, funding model salaries held constant, actual salaries slipped slightly, and the other indices continued to grow. However, the level of funding model salaries remain well above the long-term trajectory for either cost index.

Table 2: Comparing Teacher Salaries with the Labor Cost Indices

Year	Actual Teacher Salary	Actual Teacher Salary Index	Funding Model Base Salary	Funding Model Salary Index	Wyoming CWI	ECI Elementary and Secondary Education
2001-02	$37,667	100	$22,507	100	100	100
2002-03	$38,543	102	$25,349	113	105	104
2003-04	$39,048	104	$25,856	115	107	107
2004-05	$40,349	107	$26,451	118	111	111
2005-06	$42,931	114	$27,059	120	115	115
2006-07	$50,831	135	$32,971	146	120	120
2007-08	$53,001	141	$34,224	152	126	125
2008-09	$54,694	145	$35,696	159	134	129
2009-10	$55,777	148	$37,017	164	139	133
2010-11	$55,731	148	$37,017	164	144	135

Note: The actual salary index reflects the full-time-equivalent total salary for Wyoming teachers, adjusted for differences in teacher demographics and work assignments. See Appendix C for information on the adjustments. The Wyoming CWI and the ECI for Elementary and Secondary Education have been rebased so that 2001=100. Sources: Wyoming Department of Education, U.S. Bureau of Labor Statistics, National Center for Education Statistics and author's calculations.

Cost Indices for Energy and Educational Materials

While labor costs can be heavily influenced by local conditions, the prices for energy and educational materials are largely determined at the national level. Therefore, national cost indices would be the most appropriate to use for those cost components. The BEA's cost indices for Educational Energy and Educational Materials would seem the most appropriate candidates. Unfortunately, the BEA's cost indices for educational materials and energy are not available in a timely manner, so alternative indices must be found.

As Table 3 illustrates, the BLS has a producer price index (PPI) for office supplies and accessories which closely tracks the BEA's cost index for educational materials, making it a reasonable choice of cost index for the educational materials cost component.[6] Similarly, a composite index that is a weighted average of the PPIs for commercial electricity and natural gas

[6] The BEA index for educational sector materials is available from 1997 through 2009. Over that time period, the Pearson correlation between the BEA index and the PPI for office supplies and accessories is 0.9543.

tracks the BEA cost index for education sector energy very well.[7] Therefore, it is a credible choice of cost index for the utilities cost component.[8]

Table 3: Comparing Alternative Price Indices for Energy and Educational Materials

Year	BEA Cost Index for Materials Inputs by Industry, educational services	PPI Office supplies and accessories	BEA Cost Index for Energy Inputs by Industry, educational services	Producer Price Index Commercial Electric Power	Producer Price Index Commercial Natural Gas	Composite Energy Index
1997	100.06	95.69	84.96	94.34	65.24	78.07
1998	97.79	95.84	82.02	93.41	63.22	76.53
1999	97.74	94.59	81.18	92.48	64.23	76.69
2000	99.09	97.74	89.92	94.20	80.04	86.28
2001	100.00	100.00	100.00	100.00	100.00	100.00
2002	99.20	99.12	90.93	98.50	80.21	88.28
2003	102.23	100.37	106.41	100.93	103.15	102.17
2004	104.57	100.51	114.81	102.29	115.81	109.85
2005	107.18	104.53	132.34	107.31	138.15	124.55
2006	108.88	106.79	137.33	115.54	142.54	130.64
2007	111.42	110.30	138.96	118.48	139.99	130.50
2008	115.70	115.63	153.17	124.14	161.68	145.12
2009	111.06	116.07	132.74	127.94	125.91	126.80
2010	n/a	116.80	n/a	130.73	123.59	126.74

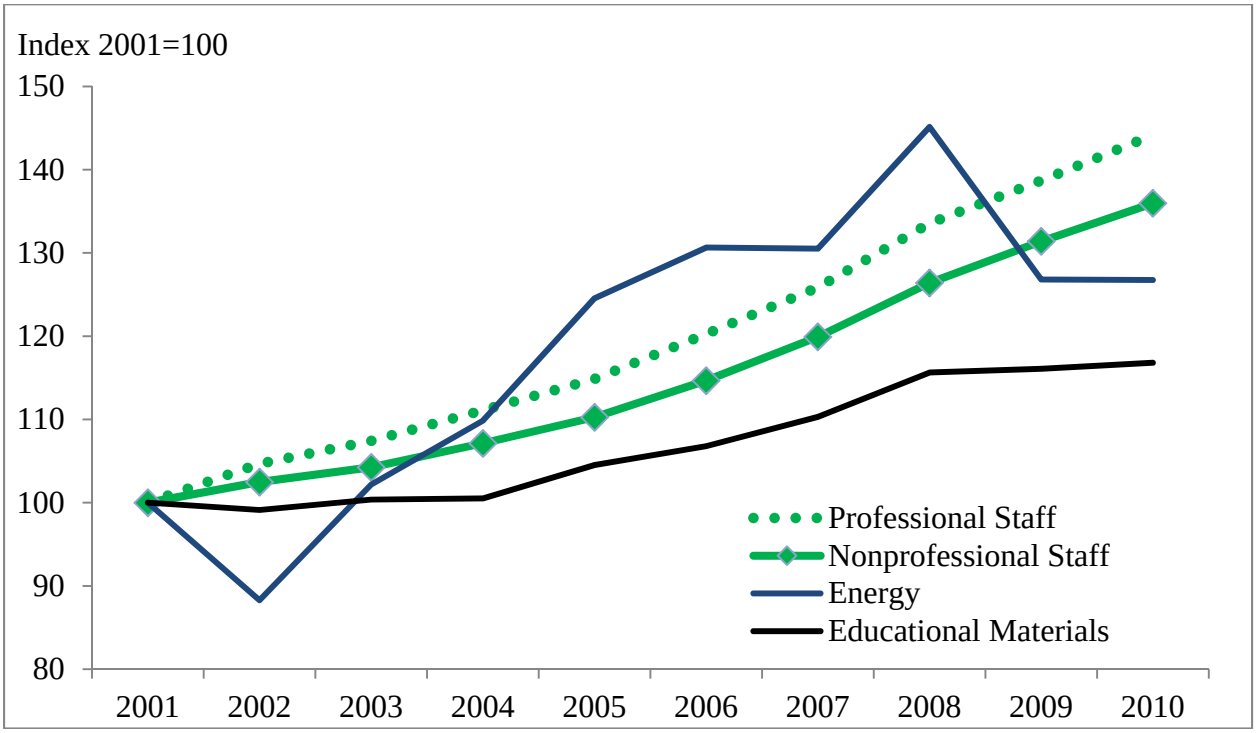
Note: The Composite Energy Index is a weighted average of the producer price indices for commercial electricity and natural gas, where the weights are 0.441 and 0.559, respectively. The weights were chosen to maximize the correlation between the composite energy index and the BEA cost index for energy inputs in the education sector. All of the indexes have been rebased to 2001=100.
Sources: U.S. Bureau of Economic Analysis and U.S. Bureau of Labor Statistics.

Because wages have been rising faster in Wyoming than in the nation as a whole, using the CWI and the HS-CWI as the cost indices for professional staff resources and nonprofessional staff resources, respectively, is recommended. Using the PPI for office supplies as the cost index for educational materials, and the composite energy index as the cost index for utilities is also recommended. Figure 3 illustrates the relationship among these recommended cost indices.

[7] The composite index is a weighted average of the PPIs for commercial electric power and commercial natural gas, where the regression-based weights are 0.441 and 0.559, respectively. The BEA index for educational sector energy is available from 1997 through 2009. Over that time period, the Pearson correlation between the BEA index and the composite energy index is 0.9968.

[8] The CPI for energy is not as well correlated with the BEA's price index for energy inputs as is the weighted average of the PPIs, but it would be a reasonable alternative. The CPI for energy is available for the nation as a whole and for selected cities in the west, including the Denver metropolitan area.

Figure 3: Recommended Cost Indices for the Four Major Funding-Model Components



Sources: U.S. Bureau of Labor Statistics, National Center for Education Statistics and author's calculations

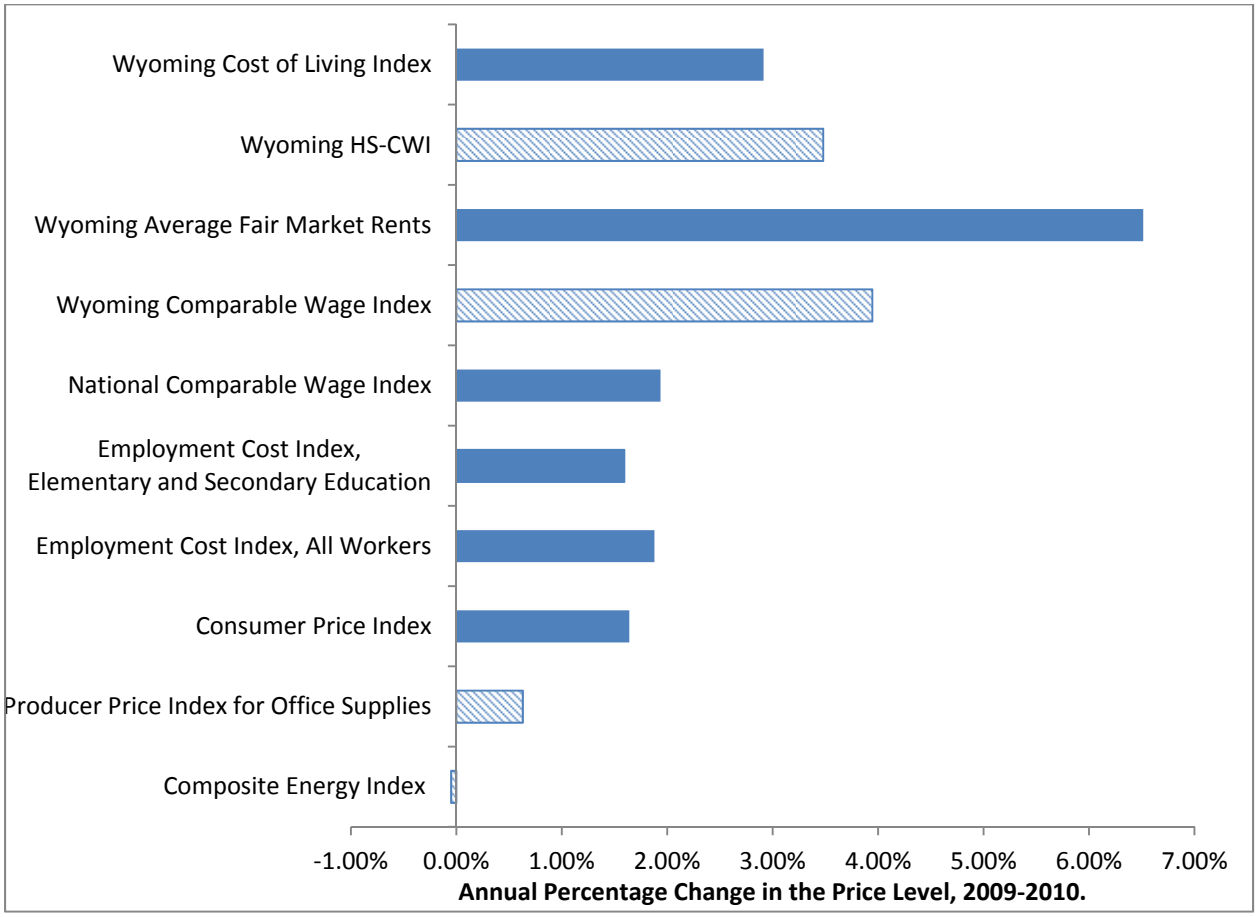
As the figure illustrates, labor costs in Wyoming have been rising steadily, with somewhat more growth in professional wages than in nonprofessional wages. The educational materials index has grown more slowly than either labor cost index. The energy index has been the most volatile of the four, which is consistent with recent swings in the price of energy.

Intriguingly, all four recommended indicators suggest that inflationary pressures may be easing. The two non-labor indices are essentially flat for 2010, and the labor cost indicators are growing more slowly than in recent years. On average, wages for college graduates in Wyoming increased 4.6 percent per year over the five-year period from 2005 to 2010, but over the most recent year (from 2009 to 2010) wages increased by only 3.9 percent. Similarly, wages for high school graduates in Wyoming increased 4.3 percent per year over the five-year period from 2005 to 2010, but only 3.5 percent between 2009 and 2010.

Figure 4 helps put the four recommended cost indices in context by comparing their estimates of the cost increases between 2009 and 2010 with estimates coming from other sources. Those other sources include national cost indices (e.g. the U.S. Consumer Price Index) and Wyoming-specific cost indices (the average increase in Fair Market Rents for the state of Wyoming,[9] and the Wyoming Cost of Living Index[10]).

[9] Fair market rents for each county in Wyoming are calculated by the U.S. Department of Housing and Urban Development. I calculated the state average rent each year as the population weighted average of the county rents

Figure 4: Other Indicators of Cost Increases



Note: The shading indicates a cost index recommended for use in Wyoming's external cost adjustments.
Sources: Wyoming Department of Administration & Information, U.S. Bureau of Labor Statistics, U.S. Department of Housing and Urban Development, and author's calculations.

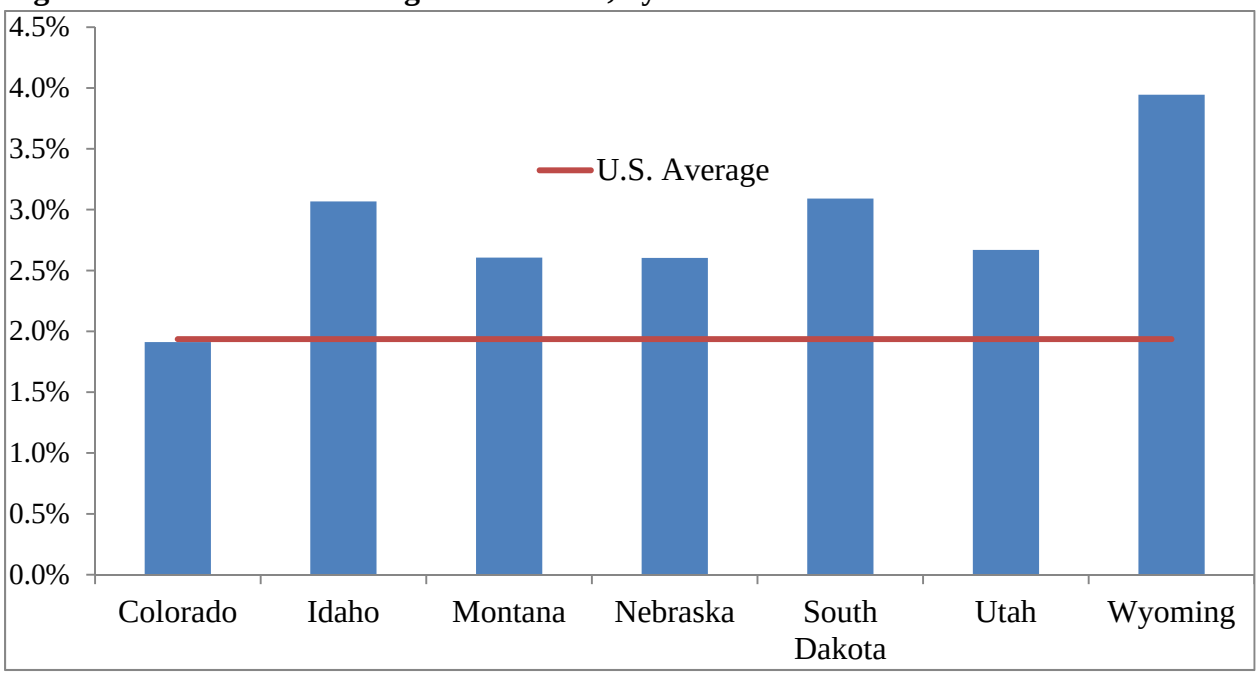
As the figure illustrates, there are systematic differences between cost indices that are Wyoming-based, and cost indices for the nation as a whole. All of the national cost indices indicate that costs are increasing by no more than 2.0 percent per year. All of the Wyoming indices indicate that costs are increasing by more than 2.9 percent per year. For example, the CPI indicates that the inflation rate in 2010 was 1.6 percent, but the WCLI, which is a Wyoming version of the CPI, indicates that the inflation rate was 2.9 percent. This provides further evidence that, despite the apparent deceleration in inflationary pressures, costs are rising more rapidly in Wyoming than in the nation as a whole.

for a two-bedroom apartment. For more on the fair market rents, visit http://www.huduser.org/portal/datasets/fmr.html .

[10] The Wyoming Cost of Living Index is produced bi-annually by the Wyoming Department of Administration & Information's Economic Analysis Division. These data are Fourth Quarter Estimates. For more on the Wyoming Cost of Living Index, visit http://eadiv.state.wy.us/WCLI/Cost.html

Figure 5 provides further context for the inflationary pressuring facing Wyoming school districts by comparing the annual rate of change in the CWI for Wyoming with the annual rates of change for surrounding states. As the figure illustrates, wages are rising more rapidly than the national average in every state in the region, except Colorado, where the wage growth is indistinguishable from the national average. Therefore, higher wage growth in Wyoming appears part of a regional phenomenon rather than a purely local effect.

Figure 5: Year-to-Year Changes in the CWI, by state



Source: Author's calculations using OES and Census data.

Conclusions

The Wyoming school funding model is based on a series of recommendations about real resources. In 2005, consultants advised the Legislature about the number and type of school personnel, educational materials and other resources that would be required to achieve the state's performance goals, and about the level of funding required to purchase those educational resources.

Their funding recommendations were based on real resource needs and the best available estimates of the prices for those resources. Those resource needs have been generally stable over time and should remain so in the future, but there is no reason to believe that the prices will also remain unchanged. Rising prices for energy or school personnel mean that school districts will need additional funding just to maintain the status quo.

ECAs act as automatic stabilizers, holding school districts steady in the face of inflation. Inadequate ECAs lead to unintended cuts in school district resources, yet inappropriately large

cost adjustments shift resources into education that are better used elsewhere in the state budget. Therefore, it is particularly important that the state choose its ECAs wisely.

Labor cost indices like the ECI and cost of living indices like the WCLI give an incomplete picture of changes in educational cost. A better strategy would be to adjust each component of the resource allocation model separately using the most appropriate cost index for that component. Reasonable indices are available for the professional staff, nonprofessional staff, utilities, and educational materials components of the funding model, and presented in Table 5. It is recommended that the Legislature plan to use these indices for external cost adjustments going forward.

Table 5: The Recommended Cost Indices for Funding Model Components

Year	Professional Staff Cost Index	Nonprofessional Staff Cost Index	Energy Cost Index	Educational Materials Cost Index
2005-06	115	110	125	105
2006-07	120	115	131	107
2007-08	126	120	131	110
2008-09	134	126	145	116
2009-10	139	131	127	116
2010-11	144	136	127	117

Note: The Professional Staff Cost Index is the updated Wyoming CWI (see Appendix A). The Nonprofessional Staff Index is the Wyoming High School CWI (see Appendix B). The Energy Cost Index is a weighted average of the PPIs for commercial electricity and natural gas, where the weights are 0.441 and 0.559, respectively. The Educational Materials Cost Index is the PPI for office supplies. All indices have been rebased so that 2001=100.
Sources: Wyoming Department of Education, U.S. Bureau of Labor Statistics, National Center for Education Statistics and author's calculations.

All of the recommended indices indicate that the inflationary pressure on school districts has eased recently. However, they also indicate that inflationary pressures may be greater in Wyoming than in most other states. It is reasonable to anticipate that inflation will continue to impact the necessary funding allocations and plan accordingly.

On the other hand, it is important to note that ECAs serve only to maintain the status quo. Their use in the Wyoming funding model presumes that the model is based on accurate baseline measures of resource costs. If the baseline estimates overstate actual costs for one or more of the funding components, then applying an ECA to those funding components would simply perpetuate that overfunding, and the most appropriate policy response could be to forgo applying an ECA to those funding components until costs and funding converge. Similarly if a baseline estimate understates actual costs for a funding component, then applying an ECA to that baseline estimate would only perpetuate the underfunding, and further action would be needed to ensure that districts are able to provide the necessary resources.

Bibliography

Bureau of Labor Statistics. (2011). Technical Notes for the May 2010 OES Estimates. Retrieved July 13, 2010, from http://stats.bls.gov/oes/current/oes_tec.htm.

Chambers, J.G. (1998). Geographic Variations in Public Schools' Costs (NCES 98-04). U.S. Department of Education. Wyoming, DC: National Center for Education Statistics Working Paper.

Chambers, J.G. (1997). Volume III—The Measurement of School Input Price Differences: A Technical Report on Geographic and Inflationary Differences in the Prices of Public School Inputs. U.S. Department of Education, National Center for Education Statistics. Wyoming, DC: U.S. Government Printing Office.

Goldhaber, D.D. (1999). An Alternative Measure of Inflation in Teacher Salaries. In W.J. Fowler, Jr. (Ed.), Selected Papers in School Finance, 1997–99 (NCES 1999-334) (pp. 29–54). U.S. Department of Education. Wyoming, DC: National Center for Education Statistics.

Picus, Lawrence O. et al. 2005. An Evidence-Based Approach to Recalibrating Wyoming's Block Grant School Funding Formula. Retrieved August 1, 2011 from http://legisweb.state.wy.us/2009/interim/schoolfinance/WYRecalibration.pdf

Ruggles, S., Sobek, M., Alexander, T., Fitch, C., Goeken, R., Hall, P., King, M., and Ronnander, C. (2003). Integrated Public Use Microdata Series: Version 3.0 (machine-readable database). Minneapolis, MN: Minnesota Population Center. Retrieved October 29, 2004, from http://www.ipums.org.

Taylor, L.L. 2010. An Analysis of Wyoming Cost Adjustments. A report prepared for the Select Committee on School Finance Recalibration

Taylor, L.L. 2011. A Comparable Wage Analysis of Wyoming Teacher Salaries. A report prepared for the Select Committee on School Finance Recalibration

Taylor L.L. 2008. Washington Wages: An Analysis of Educator and Comparable Non-educator Wages in the State of Washington, A report to the Joint Task Force on Basic Education Finance. Retrieved December 1, 2010 from http://www.leg.wa.gov/JointCommittees/BEF/Documents/Mtg11-10_11-08/WAWagesDraftRpt.pdf

Taylor, L.L. 2008. Comparing Teacher Salaries: Insights from the U.S. Census. *Economics of Education Review*, 27(1): 48-57.

Taylor, L.L. 2006. Comparable Wages, Inflation and School Finance Equity. *Education Finance and Policy*. 1(3): 349-71.

Taylor, L.L., and W.J. Fowler, Jr... 2006. A Comparable Wage Approach to Geographic Cost Adjustment NCES 2006–321. Wyoming, D.C.: National Center for Education Statistics.

Appendix A: Updating the NCES Comparable Wage Index

The NCES CWI measures the prevailing wage for college graduates for each state and for 800 U.S. Labor markets. The baseline estimates (for 1999) come from a regression analysis of the individual earnings data from the 2000 U.S. Census. Annual updates to that baseline come from regression analyses of occupational earnings data provided by the U.S. Bureau of Labor Statistics (BLS).[11]

The 800 labor markets in the NCES CWI are based on "place-of-work areas" as defined by the Census Bureau for the 2000 Census. Census place-of-work areas are geographic regions designed to contain at least 100,000 persons. The place-of-work areas do not cross state boundaries and generally follow the boundaries of county groups, single counties, or census-defined places (Ruggles et al. 2003). Counties in sparsely-populated parts of a state are clustered together into a single Census place-of-work area. Each labor market in the NCES CWI is either a single place of work, or a cluster of the places-of-work that comprise a metropolitan area. There are four NCES CWI labor markets in the state of Wyoming—Western Wyoming (Park, Teton, Sublette, Sweetwater, Lincoln and Uinta counties), Central Wyoming (Fremont, Natrona and Carbon counties), Eastern Wyoming (Big Horn, Hot Springs, Washakie, Sheridan, Johnson, Campbell, Crook, Converse, Niobrara, Platte, Goshen and Weston counties) and the Cheyenne and Laramie metropolitan areas (Albany and Laramie counties).

Taylor and Fowler (2006) used data from the Bureau of Labor Statistics' Occupational Employment Survey (OES) to extend the baseline estimates of the NCES CWI and provide annual index values for 1997 through 2005. The OES is a BLS database that contains average annual earnings by occupation for states and metropolitan areas (MSAs). Each year, the BLS samples and contacts approximately 400,000 civilian, nonfarm establishments for the OES survey.[12] Survey respondents in the 2010 OES dataset employed 74.4 percent of the civilian, nonfarm workers in the United States.

The first step in extending the CWI is generating OES-based estimates of the annual wage level in each labor market. Because metropolitan areas span state lines, combining the state and metropolitan data into a single model would be inappropriate. Therefore, the wage levels for states and metropolitan areas are estimated separately. To allow for both occupation-specific and location-specific shifts in wage levels over time, each year is also analyzed separately. Thus, each model is an annual regression of the average annual earnings (in logs) on indicator variables for occupation and location (either state or MSA) weighted by total employment in the occupation/location cell. Weighting by employment yields the same coefficient estimates as would arise from a data set comprised of individual workers each earning the average annual pay for his or her occupation and location. As such, it serves to makes the OES regressions parallel

[11] The methodological discussion in this appendix borrows heavily from Taylor and Fowler (2006). For more on the estimation of the NCES CWI, see Taylor and Fowler (2006).

[12] Technical details come from BLS (2011).

to the census regressions, and ensures that location effects are estimated as deviations from a nationally representative occupational wage.

Each model yields a predicted wage for each occupation in each location. The local wage level is a weighted average of the local predicted wages by occupation, where the weights are each occupation's share of total employment among the national sample of college graduates in the census database. Thus, occupations that are held only rarely by college graduates are given little weight in the construction of the OES wage levels, while occupations that employ college graduates intensively are given greater weight. Occupations that could not be matched to the census files for college graduates or that are present in only some of the OES years are assigned a zero weight in the construction of the local wage level. Thus, while there are between 435 and 463 occupations included in the OES regressions each year, the estimate of the local wage level is based on the 348 of them that can be matched to the census occupation codes and are observed in at least one state and metropolitan area each year. Because the distribution of employment across occupations mirrors the census, changes in the OES wage estimates over time reflect systematic changes in average wages across occupations, not changes in the occupational mix.

When extending the baseline CWI, Taylor and Fowler used the OES data to estimate an occupationally adjusted wage in each labor market area, and then adjusted the baseline NCES CWI to reflect the annual growth in those wage estimates in each location.[13] For example, if their analysis of the OES data indicated that the wage level in Cheyenne increased by 5 percent between 1999 and 2001, they revised the baseline CWI for Cheyenne upward by 5 percent to generate an estimate of the Cheyenne CWI in 2001.

Approximately 346 of the 800 labor markets from the baseline analysis (CBSAs and places-of-work) can be matched to OES labor markets. For rural areas and many smaller metropolitan areas, there is no direct estimate of the change in wage levels. If state average wages and the average wages in all major metropolitan areas within the state are both up 10 percent, it is clear that wages elsewhere in the state must also be up 10 percent, on average. When the major metropolitan areas and the state as a whole are growing at different rates, then the growth rate for the remainder of the state is imputed such that an employment-weighted average of the rural and metropolitan growth rates equals the state average growth rate. The growth rates for two Wyoming labor markets (Central Wyoming and Cheyenne and Laramie) are estimated directly using the OES data for wages in Casper and Cheyenne, respectively. The growth rates for the other two Wyoming labor markets (Eastern Wyoming and Western Wyoming) are imputed.

[13] The local wage level is a weighted average of the local predicted wages by occupation, where the weights are each occupation's share of total employment among the national sample of college graduates in the census database. Thus, occupations that are held only rarely by college graduates are given little weight in the construction of the OES wage levels, while occupations that employ college graduates intensively are given greater weight. See Appendix A of Taylor and Fowler (2006) for details.

Following the same methodology as in that earlier work, I have updated the NCES CWI through 2010. Thus, I have used OES data for 2006, 2007, 2008, 2009 and 2010 to estimate the occupationally adjusted wage level in each state and major metropolitan area in the United States. Using those estimates, I have also calculated the implied average wage level in the non-metropolitan remainder of each state. I then calculated the annual rate of change in the OES wage estimates and adjusted the baseline CWI accordingly.

Table A.1 presents the updated values of the NCES CWI for the 4 labor market areas in Wyoming. As the table illustrates, the wage differences among Wyoming labor market areas have remained remarkably stable over the last six years. For example, wages in Cheyenne and Laramie were 2.4 percent lower than the state average in 2005 and 2.2 percent lower than the state average in 2010. Similarly, wages in Western Wyoming were 7 percent higher than the state average in 2005 and 6.5 percent higher than the state average in 2010.

Table A.1: Comparable Wage Index Values

	NCES CWI 2005	Updated CWI 2006	Updated CWI 2007	Updated CWI 2008	Updated CWI 2009	Updated CWI 2010
Cheyenne and Laramie	0.999	1.035	1.086	1.155	1.196	1.257
Eastern Wyoming	0.983	1.023	1.069	1.134	1.183	1.228
Central Wyoming	1.010	1.080	1.135	1.202	1.238	1.279
Western Wyoming	1.096	1.141	1.191	1.265	1.319	1.369
State average	1.024	1.072	1.122	1.191	1.237	1.285
National average	1.265	1.313	1.355	1.408	1.437	1.464

The updated CWI also indicates substantial increases in the cost of college educated labor between 2005 and 2010. On average, wages for college graduates in Wyoming increased 4.6 percent per year over the five-year period. However, wage growth appears to be slowing. Over the most recent year (from 2009 to 2010) wages increased by only 3.9 percent.

Meanwhile, the difference between Wyoming and the national average has narrowed substantially. In 2005, the prevailing wage for college graduates in Wyoming was 81 percent of the national average; in 2010, it was 88 percent. This narrowing is strong evidence that wages have been growing more rapidly in Wyoming than in the rest of the country, and therefore that a national wage index may understate labor cost inflation in Wyoming.

Appendix B: Estimating a CWI for High School Graduates

Following the methodology used for the NCES CWI, I estimated a baseline comparable wage index for high school graduates (HS-CWI) using the Individual Public Use Microdata Sample (IPUMS 5-Percent) from the 2000 U.S. Census.[14] As with the NCES CWI, I extended the HS-CWI to non-census years using OES data.

Table B.1 presents the regression results from the baseline analysis of wages for individuals who have complete high school or received a G.E.D. degree, but have not completed a bachelor's degree. The dependent variable is the log of annual wage and salary earnings. The independent variables are age, gender, race, English language proficiency, educational attainment, amount of time worked, occupation and industry of each individual in the national sample. In addition, the estimation includes an indicator variable for each labor market area. This analysis uses the same definition of labor markets as in the NCES CWI.

Workers with a bachelor's degree (or more) and those without a high school diploma (or G.E.D.) have been excluded from the analysis, as has anyone who has a teaching occupation or who is employed in the elementary and secondary education industry. Self-employed workers were excluded because their reported earnings may not represent the market value of their time. Individuals who work less than half time were excluded because such part-time employees are not directly comparable to non-certified school personnel. Workers who reported earnings and hours that implied an hourly wage of less than $3.00 per hour were also excluded, as were workers for whom the Census Bureau imputed their employment data. Finally, individuals employed outside the United States were excluded because their earnings may represent compensation for foreign travel or other working conditions not faced by domestic workers. After these exclusions, the estimation sample retained 1,810,105 employed, high school graduates drawn from 452 occupations and 256 industries.

The HS-CWI is estimated from nationwide data because the national sample is much larger and yields much more precise estimates of wages by industry and occupation than could be generated using only the IPUMS data for the state of Wyoming.

[14] The methodological discussion in this appendix borrows heavily from Taylor (2008a).

Table B.1: The Comparable Wage Model for High School Graduates

Explanatory Variables	Estimate	Standard Error	p-value
Usual hours worked per week (log)	0.9126	0.0018	<.0001
Weeks worked last year (log)	1.0018	0.0030	<.0001
Associate degree, occupational program	0.0335	0.0009	<.0001
High school graduate, or GED	-0.0542	0.0007	<.0001
Some college, no degree	0.0000		.
Female	-0.1830	0.0008	<.0001
Male	0.0000		.
Age	0.0503	0.0002	<.0001
Age, squared	-0.0005	0.0000	<.0001
American Indian	-0.0493	0.0033	<.0001
African American	-0.0646	0.0011	<.0001
Chinese	-0.1754	0.0049	<.0001
Japanese	0.0135	0.0065	0.0383
Other Asian or Pacific	-0.1181	0.0024	<.0001
Other race, nec	-0.0363	0.0021	<.0001
Two or more major races	-0.0621	0.0023	<.0001
White	0.0000		.
Hispanic	-0.0719	0.0015	<.0001

NOTE: The model also includes 452 occupational fixed effects, 256 industry fixed effects, 800 labor market fixed effects, and random effects for state. There are 1,810,105 observations, and the -2 residual log likelihood is 1,756,401.

Source: Authors calculations using IPUMS data from Ruggles et al. (2003)

As Table B.1 illustrates, the model conforms to reasonable expectations about labor markets. Wage and salary earnings increase with the amount of time worked and the age of the worker (a rough proxy for experience). Persons with some collegiate experience earn systematically more than persons with no college, and workers with an associate's degree earn more than workers with some college experience but no degree to show for it. Women earn less than men of comparable age and educational attainment, possibly because age is a better indicator of experience for men than for women. Whites earn systematically more than apparently comparable individuals from most other racial groups. Hispanic workers earn systematically less than non-Hispanic workers with the same demographic profile.

Using the model, one can predict the wages that the typical high school graduate would earn in each labor market area.[15] The typical high school graduate has average demographic

[15] Formally, the predicted wage level in each labor market area is the least-squares mean for the market fixed effect. The least-squares mean (or population marginal mean) is defined as the value of the mean for each effect (in this

characteristics and works the average number of hours per week and the average number of weeks per year in a representative mix of occupations and industries. Equivalently, the predicted wage in each labor market area is the average wage one would expect to observe if every non-college graduate in the country lived in that market. The HS-CWI for each labor market is the predicted local wage divided by the national average predicted wage. The HS-CWI for each school district is the HS-CWI for the corresponding labor market area.

As with the NCES CWI, I extended the HS-CWI to non-census years using OES-based estimates of state and metropolitan area wage growth. Again, if the OES estimated wage level for high school graduates in Cheyenne in 2000 is 2 percent higher than the OES estimated wage level for high school graduates in Cheyenne in 1999, then the HS-CWI for Cheyenne in 2000 is 2 percent higher than the HS-CWI baseline.[16] I estimated an extended HS-CWI for each year from 1997-2010. Table B.2 presents index values for 2005-2010.

Table B.2: The Comparable Wage Index for High School Graduates

	HS-CWI 2005	HS-CWI 2006	HS-CWI 2007	HS-CWI 2008	HS-CWI 2009	HS-CWI 2010
Cheyenne and Laramie	1.068	1.098	1.152	1.217	1.261	1.320
Eastern Wyoming	1.018	1.053	1.098	1.158	1.209	1.249
Central Wyoming	1.030	1.095	1.149	1.209	1.247	1.282
Western Wyoming	1.189	1.230	1.283	1.352	1.412	1.459
State average	1.074	1.116	1.168	1.231	1.279	1.324

Like the updated CWI, the HS-CWI also indicates substantial increases in the cost of labor between 2005 and 2010. On average, wages for high school graduates in Wyoming increased 4.3 percent per year over the five-year period. Again, the evidence suggests that wage growth has been slowing recently. Between 2009 and 2010, wages for high school graduates in Wyoming increased by 3.5 percent, on average.

context, each market) that would be expected from a balanced design holding all covariates at their mean values and all classification variables (e.g., occupation or gender) at their population frequencies.

[16] The local wage level is a weighted average of the local predicted wages by occupation, where the weights are each occupation's share of total employment among the national sample of high school graduates in the census database. Thus, occupations that are held only rarely by high school graduates are given little weight in the construction of the OES wage levels, while occupations that employ high school graduates intensively are given greater weight.

Appendix C: Constructing the Teacher Salary Index

Average teacher salaries are a poor basis for comparisons across districts, locations and school years. Average salaries can increase over time as teachers move up the salary scale, even if the scale itself remains unchanged. Average salaries can be high in a district that chooses to hire only experienced teachers with advanced degrees, and low in a district that can only afford to hire beginning teachers. Such differences do not tell us whether or not a teacher with the same qualifications would receive a higher wage offer from one district than from another, nor can they tell us if salary levels are rising.

A hedonic wage model uses regression analysis to decompose the observed variation in wages into that which is attributable to worker characteristics, that which is attributable to working conditions and that which is attributable to locational characteristics.[17] I use the same technique to estimate the prevailing salary for teachers in Wyoming school districts. The hedonic salary model for Wyoming teachers describes each teacher's salary as a function of his or her personal characteristics, job assignments, and the school district in which he or she works. I use this model to predict the average full-time-equivalent salary each year, holding constant the influence of demographic and job characteristics. Those predictions indicate the prevailing salaries in the state over time.

Data for this part of the analysis were provided by the Wyoming Department of Education (WDE). Data on earnings, teacher characteristics and job assignments were drawn from the WDE602 fall data collection files for the ten school years from 2001-2002 through 2010-2011. All individuals who taught at least half time for a Wyoming public school district during that 10-year period are included in the analysis.

The teacher and job characteristics used to adjust teacher salaries are outlined in Table 1. Most are self-explanatory, but a few require a bit of additional explanation. The teaching assignments are a series of indicators for whether or not the teacher was assigned to the specific subject matter. Any teacher could have one or more teaching assignments. Similarly, the non-teaching assignments are a series of indicators for whether or not the teacher was assigned to the specific non-teaching activity. Again, any teacher could have one or more non-teaching assignments. Because all of the teachers under analysis were, by definition, assigned to the teaching activity at least half time, there is no need for an indicator for teaching assignment. Instead, the analysis includes a measure of the percent time spent in teaching. The model also includes individual fixed effects to capture any unobserved differences in teacher qualifications across school districts.

[17] For more on the use of hedonic wage models in education, see Chambers (1998), Goldhaber (1999), or Taylor (2011, 2010, 2008a and 2008b).

Table C.1: Explanatory Factors from the Hedonic Wage Model for Wyoming Teachers

Individual Characteristics	
Years of experience in the school district	Highest degree held (BA, MA, PhD)
Years of experience, total	Percent FTE in teaching
Years of experience unknown	Individual fixed effects
First-year teacher indicator	
Teaching Assignments	
English	Social Science
Math	Health and P.E.
Foreign Language	Vocational Education
Bilingual/ESL	Fine Art
Science	Special Education
Elementary Education	
Non-Teaching Assignments	
Advisor/Sponsor	Head teacher
Assistant principal	Principal
Assistant coach	Support staff position
Coach	Certified Teacher Tutor Professional
Classified staff position	Other administrator

To estimate the prevailing teacher salary each year, I applied the hedonic salary model described in Table 1 to all available data on the earnings of Wyoming teachers from fall 2001 through fall 2010. Complete data were available for 11,823 individual teachers from 48 school districts. [18] Appendix Table C.2 presents the coefficient estimates and standard errors from the salary model. The dependent variable is the log of each individual's full-time-equivalent total salary, excluding coaching stipends, and the analysis also includes district-by-year fixed effects. The prevailing salary in each district is the predicted salary for a teacher with state average characteristics for 2010. Appendix Table C.3 indicates the demographic and job characteristics of this average Wyoming teacher in 2010.

[18] Due to data quality concerns, teacher records with full-time-equivalent (FTE) total salaries greater than $120,000 or less than $12,000 were excluded from the analysis, as were individuals with a reported FTE greater than 1.1 or a FTE in teaching greater than 110 percent of the individual's total FTE. A teacher's FTE total salary is his or her total salary divided by his or her FTE.

Table C.2: The Hedonic Salary Model for Wyoming Teachers, 2001-2002 through 2010-11

	Coefficient	Standard Error	
Percent time teaching	0.103	0.006	***
MA	0.062	0.001	***
PhD	0.039	0.006	***
Years of district experience (log)	0.020	0.001	***
Years of total experience (log)	0.146	0.001	***
Experience missing indicator	0.347	0.005	***
First-year teacher indicator	0.090	0.002	***
Non-teaching assignments			
Other administrator	0.026	0.002	***
Advisor/sponsor	0.026	0.001	***
Assistant principal	0.176	0.019	***
Assistant coach	-0.005	0.001	***
Classified staff position	0.008	0.003	***
Coach	-0.004	0.001	***
Head teacher	0.043	0.004	***
Principal	0.170	0.012	***
Support staff position	0.030	0.002	***
Professional tutor	0.030	0.003	***
Teaching assignments			
Fine Arts	-0.017	0.005	***
Elementary education	-0.002	0.002	
English	-0.001	0.002	
Bilingual/ESL	0.014	0.006	***
Foreign Language	-0.002	0.005	
Health and Physical Education	0.006	0.003	
Mathematics	0.000	0.002	
Science	-0.001	0.002	
Special Education	0.002	0.002	
Social Science	0.000	0.002	
Vocational/technical	-0.004	0.003	
Adjusted R-squared		0.9693	
Number of observations		68,965	
Number of individual teachers		11,823	

Note: The model also includes individual teacher fixed effects and school district-by-year- fixed effects. The asterisks indicate a coefficient that is significant at the 1-percent (***) or 5-percent (**) level.

Table C.3: The Characteristics of the Average Wyoming Teacher, 2010-11

	Mean	Standard Deviation
FTE Total Salary	56945.580	9126.892
Percent time teaching	0.993	0.053
BA	0.389	0.487
MA	0.003	0.059
PhD	2.048	1.011
Years of district experience (log)	2.376	0.936
Years of total experience (log)	0.008	0.088
Experience missing indicator	0.036	0.186
First-year teacher indicator	0.036	0.186
Non-teaching assignments		
Other administrator	0.022	0.145
Advisor	0.189	0.392
Assistant principal	0.000	0.000
Assistant coach	0.120	0.325
Classified staff position	0.005	0.071
Coach	0.067	0.249
Head teacher	0.003	0.051
Principal	0.001	0.033
Support staff position	0.019	0.136
Professional tutor	0.015	0.120
Teaching assignments		
Fine Arts	0.075	0.264
Elementary education	0.366	0.482
English	0.094	0.292
Bilingual/ESL	0.008	0.089
Foreign Language	0.024	0.152
Health and Physical Education	0.067	0.250
Mathematics	0.069	0.254
Science	0.059	0.236
Special Education	0.135	0.342
Social Science	0.056	0.230
Vocational/technical	0.064	0.245