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A Comparable Wage Approach to Geographic Cost Adjustment

Research and Development Report

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Executive Summary

Introduction

Geographic cost differences present many complications when researchers attempt to make systematic comparisons of educational resources, and failure to address such differences can undermine the equity and adequacy goals of school finance formulas. Therefore, there is considerable interest in developing measures of the cost of education that can facilitate such comparisons and possibly may be used to adjust school finance formulas in some states. Geographic cost adjustment data for states, metropolitan areas, and school districts are frequently and widely requested by the public and school finance research community.[1]

Previous Cost Adjustments

Much of the geographic cost adjustment work published by NCES (Brazer and Anderson 1983; Chambers 1997) used sophisticated statistical modeling of data on teacher salaries and school district characteristics. Cost analyses based on education data are attractive because they are directly related to school district costs and can be used to make adjustments for a wide array of district-level cost factors, such as school district size or student demographics. However, they are also extremely complex, and there can be great uncertainty in classifying variables in the statistical model as controllable or uncontrollable by the school district (Fowler and Monk 2001). Such attempts may miss important differences in teacher quality (Goldhaber 1999), and the resulting estimates of higher costs may simply reflect inefficiency (Rothstein and Smith 1997; McMahon 1996). Finally, the main source of data for constructing nationwide estimates of geographic cost variation, the NCES School and Staffing Survey (SASS), is only available from NCES approximately every 4 years, making the adjustment untimely for educational researchers.

As an alternative, Goldhaber (1999) generated a comparable wage index at the state level using data on the earnings of college graduates from the Current Population Survey (CPS). However, Goldhaber's General Wage Index (GWI) could not identify intrastate variations in cost. Given that intrastate variations accounted for more than one-third of the total variation in other cost indexes, the lack of intrastate variation in the GWI limits its usefulness for the purpose of making geographic cost adjustments.

In this report, NCES extends the analysis of comparable wages to the labor market level using a Comparable Wage Index (CWI). The basic premise of a CWI is that all types of workers—including teachers—demand higher wages in areas with a higher cost of living (e.g., San Diego) or a lack of amenities (e.g., Detroit, which has a particularly high crime

[1] The National Center for Education Statistics (NCES) has had a long tradition of publishing work that reflects the latest research and development of education geographic cost adjustments. See, for example, Brazer and Anderson (1983), Chambers (1997), Fowler and Monk (2001), Goldhaber (1999), and Taylor and Keller (2003).

rate) (Federal Bureau of Investigation 2003). The CWI reflects systematic, regional variations in the salaries of college graduates who are not educators. Provided that these noneducators are similar to educators in terms of age, educational background, and tastes for local amenities, a CWI can be used to measure the uncontrollable component of variations in the wages paid to educators. Intuitively, if accountants in the Atlanta metro area are paid 5 percent more than the national average accounting wage, Atlanta engineers are paid 5 percent more than the national average engineering wage, Atlanta nurses are paid 5 percent more than the national average nursing wage, and so on, then the CWI predicts that Atlanta teachers should also be paid 5 percent more than the national average teacher wage.

This report develops a CWI by combining baseline estimates from the 2000 U.S. census with annual data from the Bureau of Labor Statistics (BLS). The Occupational Employment Statistics (OES) survey is a BLS database that contains average annual earnings by occupation for states and metropolitan areas from about 400,000 nonfarm businesses, and is available for years1997 to 2003.[2] Combining the census with the OES makes it possible to have yearly CWI estimates for states and local labor markets for each year after 1997. OES data are available each May and permit the construction of an up-to-date, annual CWI.

By matching each school district with the corresponding labor market, the research methodology can support CWI estimates for each school district in the United States. For urban school districts, this would be the CWI for the corresponding metropolitan area.[3] For rural districts, this would be the CWI for the corresponding census "place of work". A census place of work is a cluster of counties or census-defined places that contains at least 100,000 persons. All counties—and therefore all districts—in a census place of work area have the same CWI. For example, the 22 rural counties in the Texas Panhandle are clustered together into a single place-of-work area and therefore would be assigned the same CWI value. The CWI is available for all U.S. districts from 1997 through 2003.

Selected Findings

Geographically Different Wage Levels

The CWI helps confirm that college graduates command different wages in different parts of the country. The CWI for 1999 ranges from 0.70 to 1.24, indicating that the wage level for college graduates is 24 percent above the national average in New York City (the nation's most expensive labor market) and nearly 30 percent below the national average in several rural areas.

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[2] The OES is a firm-based survey rather than a household-based survey like the CPS. For a discussion of the advantages of using firm-based data for analysis of earnings, see Podgursky and Tongrut (2005).

[3] For this analysis, metropolitan areas were constructed by adding together whole places of work. Places of work that straddled more than one metropolitan area were treated as separate labor markets.

State-by-State Wage Levels

A state's CWI is a weighted average of the local wages within its borders. On average, the wage and salary of a typical college graduate in 1999 was 54 percent higher in New Jersey and Washington, DC (the states with the highest estimated wage level) than in Montana (the state with the lowest estimated wage level).

Within-State Wage Levels

In California, New York, Texas, West Virginia, Pennsylvania, Virginia, Illinois, and New Mexico, the education dollar can stretch at least 40 percent further in one part of the state than in another. With the exception of Hawaii, Rhode Island, and Washington, DC, all states face at least a 7 percent internal differential.

Conclusions

The CWI methodology offers many advantages over the previous NCES geographic cost adjustment methodologies, including relative simplicity, timeliness, and intrastate variations in labor costs that are undeniably outside school district control. However, the CWI is not designed to detect cost variations within labor markets. Thus, all the school districts in the Washington, DC metro area would have the same CWI cost index. Furthermore, as with other geographic cost indices, the CWI methodology does not address possible differences in the level of wages between college graduates outside the education sector and education sector employees. Nor does the report explore the use of these geographic cost adjustments as inflation adjustments (deflators.) These could be areas for fruitful new research on cost adjustments by NCES.

Foreword

The Research and Development (R&D) series of reports at NCES has been initiated to

- share studies and research that are developmental in nature. The results of such studies may be revised as the work continues and additional data become available;
- share the results of studies that are, to some extent, on the "cutting edge" of methodological developments. Emerging analytical approaches and new computer software development often permit new and sometimes controversial analyses to be done. By participating in "frontier research," we hope to contribute to the resolution of issues and improved analysis; and
- participate in discussions of emerging issues of interest to educational researchers, statisticians, and the federal statistical community in general. Such reports may document workshops and symposia sponsored by NCES that address methodological and analytical issues or may share and discuss issues regarding NCES practices, procedures, and standards.

The common theme in all three goals is that these reports present results or discussions that do not reach definitive conclusions at this point in time, either because the data are tentative, the methodology is new and developing, or the topic is one on which there are divergent views. Therefore, the techniques and inferences made from the data are tentative and subject to revision. To facilitate the process of closure on the issues, we invite comment, criticism, and alternatives to what we have done. Such responses should be directed to

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Introduction

Expenditures vary from school district to school district for two basic reasons—differences in the uncontrollable cost of education, and differences in the choices that school districts make (e.g., having small class sizes or hiring teachers who are better educated and have more experience). School districts that face high market prices for teachers will tend to spend more than other districts for reasons that are clearly beyond their control. School districts that serve a student population that is particularly challenging to teach may have to pay higher salaries to recruit and retain teachers. On the other hand, policy decisions that lead school districts to offer a particularly high level of educational services will also lead districts to have higher expenditures.

Separating uncontrollable causes of observed differences in spending from controllable causes is the fundamental challenge facing researchers and policymakers who are interested in comparing or equalizing the purchasing power of school districts. If the challenge is not met, high-spending districts may be misinterpreted as high-cost districts, policymakers may misallocate scarce educational resources, and researchers may be misled about the relationship between school resources and educational outcomes.

Given the widespread interest in this issue, the National Center for Education Statistics (NCES) has had a long tradition of publishing work that reflects the latest research and development of education geographic cost adjustments (e.g., Brazer and Anderson 1983; Chambers 1997; Fowler and Monk 2001; Goldhaber 1999; Taylor and Keller 2003). Much of that work has used sophisticated statistical modeling of teacher characteristics and salary, as well as school and school district characteristics (e.g., Brazer and Anderson 1983; Chambers 1997). However, Goldhaber (1999) generated a General Wage Index (GWI) at the state level using data from the Current Population Survey (CPS). Conceptually very similar to this analysis, Goldhaber's GWI measured state-by-state differences in the predicted wages of college graduates. Unfortunately, the data underlying Goldhaber's index were from a "state-based" study that was not designed for analysis of labor market areas within states (Bureau of Labor Statistics [BLS] and U.S. Census Bureau 2002). Therefore, Goldhaber's index could not identify intrastate variations in cost. Given that intrastate variations accounted for more than one-third of the total variation in previous cost indexes, the lack of intrastate variation in the GWI limited its usefulness for geographic cost adjustments.

In this report, NCES extends the analysis of comparable wages to the labor market level using a Comparable Wage Index (CWI). The basic premise of a CWI is that all types of workers demand higher wages in areas with a higher cost of living (e.g., San Diego) or a lack of amenities (e.g., Detroit, which has a particularly high crime rate) (Federal Bureau of Investigation 2003). A CWI reflects systematic, regional variations in the salaries of workers who are not educators. Provided that those noneducators are similar to educators in terms of age, educational background, and tastes for local amenities, a CWI can be used to measure uncontrollable variations in the wages paid to educators. Intuitively, if accountants in the Atlanta metro area are paid 5 percent more than the national average accounting wage, Atlanta engineers are paid 5 percent more than the national average engineering wage, Atlanta nurses are paid 5 percent more than the national average nursing wage, and so on, then the CWI predicts that Atlanta teachers should also be paid 5 percent more than the national average teacher wage.

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Geographic Cost Adjustments

As discussed in Fowler and Monk (2001) or Taylor and Keller (2003), there is a substantial amount of literature devoted to strategies for isolating uncontrollable cost variations. Taylor and Keller divide that literature into two broad categories—cost-of-living and cost-of-education approaches.

The cost-of-living approach rests on the premise that school districts in areas with a high cost of living or a lack of amenities will have to pay higher salaries to attract employees, thereby increasing the cost of education. The cost of living thus becomes a measure of the cost of education that cannot be directly influenced by school policy.

The cost-of-education approach uses data on education expenditures to estimate either the cost of providing a comparable level of educational services or the cost of producing comparable educational outcomes. The educational services approach generates an estimate of the amount each district would have to spend to purchase a typical set of educational inputs. Taylor, Chambers, and Robinson (2004) recently developed a geographic cost of education index (GCEI) for Alaska using a cost-of-services approach. The educational outcomes strategy generates an estimate of the amount each district would have to spend to achieve a certain level of educational achievement. Cost functional analyses are the most common source of educational outcomes indexes (see,

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[1] The OES is a firm-based survey rather than a household-based survey like the CPS. For a discussion of the advantages of using firm-based data for analysis of earnings, see Podgursky and Tongrut (2005).

for example, Duncombe, Ruggiero, and Yinger 1996; Imazeki and Reschovsky 1999; Gronberg et al. 2004).

The advantages and disadvantages of each approach are discussed below.[2]

Methodology 1: Cost-of-Living Index

There are two mechanisms for estimating variations in the local cost of living. The first is to examine the cost of a specified collection of goods and services used by consumers in each community in a method called the "market-basket" strategy. Differences among communities in the cost of a "basket" of consumer goods and services capture differences in the cost of living. Because housing is such a large share of the typical consumer's budget, variations in housing costs explain most of the geographic variation in a market basket index.

The second mechanism is the CWI. As discussed above, the basic premise of a CWI is that all types of workers demand higher wages in areas with a higher cost of living or a lack of amenities. Therefore, one should be able to measure the cost of living (and thereby uncontrollable variations in educator pay) by observing systematic, regional variations in the earnings of comparable workers who are not educators.[3] Researchers exclude educators from the estimation of a CWI because educator salaries reflect not only general economic conditions but also industry specific factors such as the degree of unionization or the amount of competition among school districts. By excluding educators from the calculations, researchers can ensure that the CWI reflects only variations in the general attractiveness of a locale.

While similar in spirit to the market-basket strategy, the CWI offers a more complete picture of labor costs because it reflects not only differences in the price of haircuts and houses, but also any influence on wages due to differences in important community characteristics such as climate, crime rates, or cultural amenities. Thus, while a market-basket index may overestimate labor costs in areas with both a high cost of goods and services and a lot of amenities that make it a desirable place to work (Rothstein and Smith 1997; Stoddard 2005), a CWI will not. The CWI is also much less expensive to construct than a market-basket index because it can be generated from existing data.

There are a number of advantages to the cost-of-living approach. The clearest advantage is that the cost-of-living index measures costs that are beyond the control of school district administrators. Unlike analyses based on school district expenditures, there is no risk that a cost-of-living index confuses high-spending school districts with high-cost school districts. The cost-of-living approach is also quite straightforward. While there are many complex measurement issues involved (Rothstein and Smith 1997; Wynne and

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[2] See Taylor and Keller (2003) for an empirical analysis of the various methods applied to Texas.
[3] See for example, Rothstein and Smith (1997), Guthrie and Rothstein (1999), Goldhaber (1999), Alexander et al. (2000), Taylor et al. (2002), and Stoddard (2005).

Sigalla 1994; Alexander et al. 2000), cost-of-living indexes can be estimated and compared relatively easily, and need not employ the sophisticated statistical techniques and researcher judgment regarding which variables are under school district control that are required by cost of education indexes. Cost-of-living indexes are also appropriate regardless of the competitiveness of teacher labor markets. If a lack of competition in the teacher market distorts teacher compensation patterns, then cost indexes based on teacher compensation will be biased, but cost-of-living indexes will not (Hanushek 1999; Goldhaber 1999). Another advantage of the cost-of-living approach is its general applicability. Because the resulting cost index is based on systematic differences in consumer prices or the general wage level, it can be used to measure labor costs not only for public elementary and secondary education, but also for private schools, job training programs, and postsecondary institutions.

There are also a number of disadvantages to using a cost-of-living index to measure variations in school district costs. First, although it comprises more than 80 percent of current school district expenditures (U.S. Census Bureau 2004), labor cost is only part of the total cost of education. Other prices (e.g., energy costs) and other district characteristics (e.g., economies of scale, variations in the amount, characteristics and quality of school facilities, or variations in student need) also influence the cost of education. Any cost index based on variation in the price of labor represents only one dimension of the complete cost of education—albeit a very large dimension. It can be problematic to apply a labor cost index to school district expenditures that are largely unaffected by labor cost differentials, such as energy costs or capital outlays.

Second, any cost-of-living approach rests on comparability, which can break down. For example, if people in urban areas buy different items than people in rural areas, then the market-basket approach—which relies on comparing prices for a common set of items—may not accurately reflect the relative cost of living in the two locations. Similarly, if tastes for consumer products or local amenities differ according to worker types (perhaps college graduates are more susceptible to the lure of city lights than other workers), then variations in the wages of the general population of workers may not accurately reflect variations in the cost of hiring college graduates like teachers.

Third, cost-of-living differentials only reflect labor cost differentials when labor is mobile. If moving costs or the nonportability of retirement systems or other barriers to moving slow worker migration, then labor costs may temporarily diverge from what is expected given local amenities and the cost of living. Employers in fast-growing industries and school districts in fast-growing areas may need to pay a temporary premium to attract workers. Cost-of-living indexes cannot capture this effect.

Finally, by design, a cost-of-living index measures cost in a broad labor market like a metropolitan area. It does not capture variations in cost across school districts within a labor market, as does a cost-of-education index. In particular, it does not capture any variations in cost attributable to working conditions in specific school districts. Therefore, despite the substantial differences between them, an advantaged school district has the same cost-of-living index as its disadvantaged cross-town rival.

Methodology 2: Cost-of-Education Index

An alternative strategy for making adjustments to school funding is the cost-of-education approach, which NCES has employed in earlier studies of geographic cost adjustments. These cost-of-education approaches use complex statistical methodologies in an attempt to isolate uncontrollable variations in school district expenditures.[4]

The cost-of-education approach has a number of attractive features. Instead of using indirect proxies of education cost differences, as the cost-of-living approach does, it directly examines actual school district expenditures. The cost-of-education approach goes beyond the direct comparison of district expenditures, however, by using regression analysis to estimate the cost of providing equivalent levels of educational services to students or of achieving equivalent levels of student achievement. The ability to capture the effects of multiple cost factors means that the cost-of-education approach has the advantage of being able to take account of the effect of amenities like an attractive climate or low crime rates—factors that are reflected in the Comparable Wage Index (CWI) but not considered in market-basket indexes (Peternick et al. 1997). Because a cost-of-education index is based on school or school district data, it can detect cost variations at the school or district level rather than merely at the labor market level. Eleven percent of the variation in the geographic cost of education index (GCEI) that Chambers (1998) developed for NCES comes from differences across school districts within labor markets.[5] Finally, for states that already collect data on teacher salaries and district expenditures, it is much less expensive to construct a cost-of-education index than to apply a market-basket approach.

There are also a number of potential disadvantages to the cost-of-education approach. Cost indexes that are based on school expenditure data must rely on statistical technique and researcher judgment to separate controllable from uncontrollable costs. As such, cost-of-education indexes are vulnerable not only to generic statistical concerns but also to specific concerns about the measurement of school outcomes and inputs.[6] In addition, cost-of-education indexes have been criticized as based on data that are subject to school district manipulation (McMahon 1996), biased by the noncompetitive nature of teacher labor markets (Hanushek 1999), and liable to reward school districts for historic inefficiency (Rothstein and Smith 1997).

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[4] For an example of both cost-of-education methods applied to Texas, see Taylor et al. (2002).

[5] The GCEI is a cost-of-services index. This calculation of the share of variation with labor markets uses the same labor-market definitions as are used in this report.

[6] For example, Goldhaber (1999) points out that important differences in teacher quality may not be observable in the data. If unobservable teacher quality is correlated with observable characteristics, a cost-of-services index based on the pattern of teacher compensation could be biased. There is always the threat of an omitted variable in the analysis. In this regard, Goldhaber's GWI analysis at the state level, using the CPS, suggests that Chamber's methodology did not control for the effects of unionism.

The Comparable Wage Index

The inherent difficulty in separating controllable variations in school district expenditures from uncontrollable variations, the attractions of a cost index that is clearly outside school district control, and the greater timeliness of a CWI make it a particularly useful option for school finance researchers. Therefore, NCES has decided to produce and distribute a Comparable Wage Index.

A Census/OES-Based Comparable Wage Index

The 2000 census provides data that can be used for a baseline comparable wage analysis. The 5-Percent Individual Public Use Microdata Sample (IPUMS 5-Percent) contains information on the earnings, occupation, place of work, and demographic characteristics of individual workers throughout the United States. Given this rich dataset, one can estimate a demographically adjusted wage level for each place of work, thereby avoiding the conclusion that the wage level is low in an area simply because most of the workers are young and inexperienced. Furthermore, by restricting the analysis to college graduates, one can generate a wage index for noneducators who are in principle most comparable to teachers.

Regression analysis of the 2000 census yields the baseline estimates of the CWI.[7] The dependent variable is the log of annual wage and salary earnings for noneducators. The independent variables are age, gender, race, educational attainment, amount of time worked, occupation, and industry of each individual in the national sample.[8, 9] In addition, the estimation includes an indicator variable for each labor market area.[10] The labor

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[7] Census data for this analysis come from Ruggles et al. (2003). The estimator is restricted maximum likelihood.

[8] Some potentially important worker and employer characteristics (such as union participation and firm size) are not available in the IPUMS. To the extent that these characteristics vary systematically by occupation or industry, their influence on wages will be captured by the occupational and industrial indicators. However, to the extent that deviations from industry and occupational norms are location-specific, they could influence the wage level estimates. The extent of such influence is unknown.

[9] Arguably, hours worked and weeks worked could be endogenous. Estimating the model based on the log of hourly rather than annual wages and omitting the hours and weeks variables from the right-hand side of the estimation would address this concern, although it would also require researchers to assume that the wage impact of working more hours per week is equivalent to the wage impact of working additional weeks (an assumption that is not supported by the baseline estimation). Analysis based on this alternative specification indicates that the CWI would be unaffected by such a change. The correlation between the predicted wages (population marginal means) for labor market areas from the baseline estimation and the predicted wages for labor market areas from the alternative specification is 0.999.

[10] The model also includes random effects for states. Treating state effects as random rather than fixed ensures that the predicted wage is the same throughout a metropolitan area that crosses state lines (Kansas City, Kansas, and Kansas City, Missouri, for example) while allowing for a correlation in the errors among labor markets within any given state.

market indicators capture the effect on wages of all market-specific characteristics, including the price of housing, the crime rate, and the climate.[11] Because the CWI is an index of wage levels outside of education, it would not be appropriate to include in the model aggregate measures of school characteristics like school district size or student demographics. However, to the extent that those factors differ from one labor market to another, some of their effect on the prevailing wage level will be captured as a locational amenity by the labor market indicators.

All labor markets are based on "place-of-work areas" defined by the Census Bureau. 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.

Whenever possible, places of work have been aggregated into metropolitan areas using the Office of Management and Budget's 2003 definitions for Core-Based Statistical Areas (CBSAs) (U.S. Department of Education 2005, pp. 205–211).[12] Places of work that straddled more than one CBSA were treated as separate labor markets. After the aggregation, there were 800 CBSAs or place-of-work areas in the 2000 census. All parts of the United States are included in either a CBSA or a place-of-work area.

To ensure that the sample represents noneducators who are directly comparable to teachers, the estimation excludes a number of worker classifications. Because the sample is restricted to noneducators, anyone who has a teaching occupation or who is employed in the elementary and secondary education industry is excluded. Workers without a college degree are excluded because they are not directly comparable with teachers. Self-employed workers are excluded because their reported earnings may not represent the market value of their time. Workers who work less than half-time or for less than $5,000 per year are excluded because such part-time employees are not directly comparable to teachers. Finally, individuals employed outside the United States are excluded because their earnings may represent compensation for foreign travel or other working conditions not faced by domestic workers. After these exclusions, the IPUMS 5-Percent retains 1,053,184 employed, college graduates drawn from 460 occupations and 256 industries.

Arguably, some of the 460 occupations included in the analysis are more directly comparable to teaching than others. For example, Allegretto, Corcoran, and Mishel (2004) identify 16 occupations that are particularly similar to teaching based on the skills required to do the job. One might consider restricting the CWI sample to a carefully selected subset of the occupations held by college graduates. However, the CWI reflects

[11] The labor market indicators, which are also known as labor market fixed effects, capture both measurable and unmeasurable characteristics of labor markets. It is statistically impossible to include direct measures of labor market characteristics in a cross-sectional model with labor market fixed effects.

[12] There are two types of CBSAs—metropolitan areas and micropolitan areas. Only metropolitan areas are large enough to contain more than one place of work.

only systematic regional differences from the national wage, controlling for worker demographics, industries, and occupations. Because it is based on pay differentials within each occupation, the CWI is not influenced by differences in pay levels from one occupation to another.[13] Therefore, it is not sensitive to differences in job characteristics across occupations. Furthermore, reducing the sample size greatly reduces the precision of any regional wage estimate. Without evidence that differences in job description imply differences in tastes for consumer products and local amenities, there would be little gain to restricting the sample to a subset of occupations.[14]

Table 1 presents selected coefficient estimates and descriptive statistics from the census model of comparable wages. The coefficient estimates indicate the impact on wage and salary income of a small change in each explanatory variable, holding constant all of the other variables in the model. The standard errors indicate the precision with which the coefficients are estimated. Coefficients that are statistically different from zero at the 5-percent level are marked with an asterisk.

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[13] Occupational means are captured by occupational indicator variables; so, all other variables can be described as being estimated from the observation-by-observation differences between reported earnings and the mean earnings by occupation.

[14] A similar logic applies to any suggestion that the sample be limited to a subset of industries.

Table 1. Maximum likelihood estimates of selected independent variables from the census model of log annual wage and salary income: 1999

Explanatory variable	*Estimate*	*Standard error*
Usual hours worked per week (log)	0.7249*	0.0028
Weeks worked last year (log)	1.0219*	0.0058
Age	0.0685*	0.0003
Age, squared	-0.0007*	0.0000
White	0.0000	
Black	-0.0879*	0.0022
American Indian/Alaska Native	-0.1096*	0.0085
Chinese	-0.1177*	0.0037
Japanese	-0.0029	0.0068
Other Asian or Pacific Islander	-0.1093*	0.0026
Other race, not elsewhere classified	-0.1642*	0.0045
Two or more major races	-0.1216*	0.0042
Male	0.0000	
Female	-0.1703*	0.0012
Professional degree	0.0000	
Bachelor’s degree	-0.0781*	0.0028
Master’s degree	-0.0007	0.0029
Doctorate	0.1163*	0.0037

NOTE: The * indicates a coefficient that is significantly different from zero at the 5-percent level. The model also includes 460 occupational fixed effects, 256 industry fixed effects, 800 labor market fixed effects, and random effects for state. There are 1,053,184 observations, and the -2 residual log likelihood is 1616489. The R-squared for this model is 0.45.
SOURCE: Ruggles et al. (2003) and authors’ calculations.

The estimated 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 advanced degrees earn systematically more than persons with bachelor’s degrees. 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.

Using the model, one can predict the wages that a nationally representative person would earn in each labor market area.[15] A nationally representative person has average demographic characteristics and works the average number of hours per week and the average number of weeks per year in a nationally 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 everyone in the dataset lived in that market.

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[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 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.

The national average predicted wage, which is an employment-weighted average of local area predicted wages, is $47,836 per year in 1999 dollars. Dividing each local wage prediction by this national average yields the CWI.

The resulting distribution of index values generally corresponds to reasonable expectations. Almost without exception, the labor markets with the lowest CWI are located in rural areas. The labor markets with the highest CWI are generally in major urban areas. The wage level in New York City (the market with the highest CWI) is 77 percent higher than the wage level in rural Idaho (the market with the lowest CWI).

Interestingly, variations within states are an important part of the cost variations detected by the CWI. Nearly half of the total variation in the baseline CWI (44 percent) comes from variations within states. More of the variation in the CWI comes from within-state variation than in Chambers' GCEI (38 percent), even though the GCEI varies within labor markets while the CWI does not.

The large amount of within-state variation suggests that the CWI is a helpful extension of Goldhaber's state-level index. Many studies of educational adequacy have relied on Chambers' GCEI to make within-state adjustments for cost differentials (Baker, Taylor, and Vedlitz 2004). Since the CWI also varies significantly within states, it may prove a particularly useful tool for analyses of school finance adequacy and equity. For example, Taylor (forthcoming) uses the CWI to demonstrate that cost adjustment reduces the measured inequality of the U.S. school finance system, but raises the measured inequality of current educational expenditures in most states.

One potential criticism of the CWI is that it reflects wage and salary earnings rather than total compensation. (The IPUMS 5-Percent provides no information on employee benefits.) To the extent that benefits differ systematically across industries or occupations, they will be captured by regression fixed effects and have no impact on the CWI. However, systematic differences in benefits across states—that might arise because workers desire to take more of their compensation in the form of benefits in states with income tax than they do in states without income tax—will be indistinguishable from cost-of-living differentials.

It is difficult to gauge the magnitude of potential bias from excluding benefits because few researchers have published work on the geographic variation in employee benefits. However, two recent reports using the 2004 Current Population Survey (CPS) indicate that there is considerable geographic variation in employer-provided benefits. Copeland (2004) finds that the share of full-time, full-year workers participating in an employer-provided retirement plan ranged from 46.7 percent in Florida to 67 percent in North Dakota. Gould (2004) finds that that the share of at-least-part-time, private-sector workers covered by employer-provided health insurance ranged from 43.7 percent in New Mexico to 69.6 percent in Hawaii. The pension participation rates and the CWI are not correlated (the Pearson correlation is 0.0498), but there is a statistically significant relationship between health insurance coverage rates and the CWI (the Pearson correlation is 0.3837). States with higher CWIs also had higher shares of the working population covered by employer-provided health insurance.

Because neither report on benefit variations adjusts the estimated benefit rates to reflect differences in the demographic, occupational, and industrial composition of the states, or restricts the analysis to college graduates (who are likely to have higher and more uniform participation rates than other workers), neither rate is directly comparable to the CWI. Furthermore, the health benefits estimate makes no distinction between part-time and full-time workers. Therefore, the apparent correlation between health insurance coverage rates and the CWI could be spurious. However, if high-wage states are also generally high-benefit states, the CWI would understate the geographic differential in the cost of hiring teachers. As such, the CWI may be a conservative estimate of differences in the cost of education.

Extending the Baseline CWI

While the baseline CWI makes it possible to compare district purchasing power across space, Occupational Employment Statistics (OES) data make it possible to extend the CWI in noncensus years, resulting in a CWI for 1997 on.

The OES is a Bureau of Labor Statistics (BLS) database that contains average annual earnings by occupation for states and metropolitan areas. Each year, the BLS samples and contacts approximately 400,000 civilian, nonfarm establishments for the OES survey.[16] Survey respondents in the 2003 OES dataset employed 72 percent of civilian, nonfarm workers in the United States.

Unfortunately, while the OES survey categorizes workers into 770 detailed occupations, it does not provide any demographic information about them (BLS 2003). Therefore, the OES would not be an appropriate dataset for construction of a baseline CWI. However, it ought to be possible to use OES-based estimates of wage growth to adjust the census-based estimates of wage levels. For example, if the OES indicates that the wage level in Houston increased by 5 percent between 1999 and 2001, then the baseline CWI for Houston can be revised upward by 5 percent to generate an estimate of the Houston CWI in 2001. Such annual estimates can be generated for 1997 on.

As long as the demographic profiles of states and metropolitan areas are relatively stable from one year to the next, the lack of demographic data in the OES should not lead to systematic biases in the estimated growth rates. Areas where the population is young and inexperienced will have systematically lower wages in 1999, but they will also have systematically lower wages in 2000 and 2001. Therefore, while changes in demographics may affect the estimated growth rates, the levels of the demographic characteristics should not.[17]

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[16] Details on the OES survey come from BLS (2003).

[17] The obvious exception is the distribution of educational attainment. To the extent that the returns to education are rising over time, average wages will also be rising in areas with a disproportionately educated population. Much of the effect of rising returns to education should be reflected in rising returns to occupations (like engineering or medicine) that disproportionately employ college graduates, and therefore captured by the occupational effects in the OES analysis. However, to the extent that the returns to

The evidence suggests that demographic profiles are remarkably stable over time, so any bias in the growth rates induced by demographic shifts should be modest. Among metropolitan areas included in the census's American Community Survey (ACS), there is a 0.968 correlation between the share of the adult population with a bachelor's degree in 2002 and the share with a bachelor's degree in 2004. Even across the decade between censuses, there is a 0.959 correlation between the share of the adult population with a bachelor's degree in a metropolitan area in 1990 and the same indicator in 2000. Similarly, there is a 0.942 correlation between share of the working-age population that is under 30 in 1990 and the share under 30 in 2000.

Although the bias arising from a lack of demographic information in the OES data should be modest, it will tend to cumulate over time. Therefore, we have more confidence in the estimates within a few years on either side of the 1999 census than we have in estimates further away in time. As the Bureau of the Census expands the coverage of the ACS it may be desirable to use it to update the CWI rather than the OES. The ACS is an annual version of the long-form census questionnaire, and starting in the summer of 2006, the public use data from the ACS will provide individual data with much the same degree of demographic and geographic detail provided by the IPUMS from the 2000 census (U.S. Census Bureau 2006).

As an alternative to updating using the OES, one could consider extending the CWI using the CPS. Because it is a household-based rather than an establishment-based survey, the CPS contains demographic information. Thus, a CPS index would be able to control for demographically driven wage shifts that could influence year-to-year changes in an OES index. On the other hand, the CPS provides much less occupational detail than does the OES; thus, an OES index is likely to do a better job of controlling for wage shifts driven by changes in the occupational mix. Moreover, the OES provides much better geographic coverage than does the CPS. The OES is designed to generate wage estimates for metropolitan areas as well as states. The CPS is a "state-based" study that is not designed for analysis of labor market areas within states (BLS and U.S. Census Bureau 2002).[18] Therefore, while either series could be used to extend the CWI for states, only the OES is well suited for extending the CWI for metropolitan areas. Given the magnitude of within-state differences in the CWI, it is particularly important to extend the index for metropolitan areas.

The first step in extending the CWI is generating OES-based estimates of the annual wage level in each labor market. The OES provides estimates of average annual earnings and employment by occupation for states and metropolitan areas from 1997 through 2003. To allow for both occupation-specific and location-specific shifts in wage levels over time, each year is also analyzed separately. In each year, the wage model is an

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education are independent of occupation, rising returns to education will bias wage growth upward in local areas with a relatively educated population.

[18] Other currently available datasets, such as the ACS, also lack data for labor market areas within states, and therefore cannot be used to extend the CWI.

annual regression of the average wages (in logs) on indicator variables for occupation and location (either state or metropolitan area) weighted by total employment in the occupation/location cell.[19, 20]

The second step is to calculate the growth rate for wages in each state and metropolitan area from the OES-based estimates of wage levels, and to adjust the baseline CWI accordingly. (See Appendix A for detail.)

One advantage to extending the baseline CWI with the OES is that it generates a very timely index of school-district labor cost. The annual OES estimates are generated with only a 1-year lag. Thus, researchers can generate a CWI for 2003 in the spring of 2004. In contrast, the most recent NCES data released in spring of 2005 from the Schools and Staffing Survey (the primary data source for Chambers' Geographic Cost of Education Index) cover the 1999–2000 school year, and the most recent national data on school-district expenditures cover the 2002–03 school year.

Together, census and OES data can be used to support a viable CWI, which is the dataset employed in this study that NCES will release for use by the public and education finance researchers as a geographically based, cost-of-living adjustment. The resulting panel of index values measures the wage level for college graduates in all parts of the United States for the years 1997 through 2003. The CWI dataset will be available from NCES at http://nces.ed.gov/edfin/, along with a user's guide and documentation.

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[19] As with the census analysis, teaching and teaching-related occupations have been excluded from the estimation database.

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

Selected Findings

Geographically Different Wage Levels

The CWI helps confirm that college graduates command different wages in different parts of the country. The CWI is constructed as the local wage level divided by the national average in 1999. The CWI for 1999 ranges from 0.70 to 1.24, indicating that the wage level for college graduates is 24 percent above the national average in New York City (the nation's most expensive labor market) and nearly 30 percent below the national average in several rural areas.

The labor markets with the highest CWI are generally in major urban areas (figure 1). In 1999, wages for college graduates were more than 15 percent above the national average in New York City; San Jose, California; San Francisco; and Bridgeport, Connecticut.

The CWI reveals variation in wages not only between urban and rural America, but also among America's largest cities (figure 2). In 1999, wages in New York City were 12 percent higher than wages in Dallas, Texas, which in turn were 15 percent higher than wages in Phoenix, Arizona. College graduates in Phoenix earned 4 percent less than the national average.

Not only are there considerable geographic differences in the wages of college graduates, but the CWI also indicates that the price of college-graduate labor has been rising rapidly. Over the course of the 6 years between 1997 and 2003, wage levels increased by at least 18 percent in all local labor markets. The wage level grew by 39 percent in San Jose, leading it to overtake New York City as the highest paid market for college graduates in the United States. Among the 10 largest local labor markets, wage growth was fastest in Riverside-San Bernardino, California, and slowest in Phoenix, Arizona.

The geographic pattern of wages was largely unaffected by the growth differentials, however. For example, figure 3 plots the CWI for the 10 largest local labor markets. As the figure illustrates, the pattern of relative wages is dominated by the common trend and the baseline differentials. Among the 800 CBSAs and census places-of-work areas, the correlation between the CWI for 1997 and the CWI for 2003 was .966. The correlation between the CWI and previous geographic cost indexes—including Chambers' GCEI and Goldhaber's GWI—is also quite high. (See appendix B.)

State-by-State Wage Levels

A state's CWI is a weighted average of the local wages within its borders. As figure 4 shows, state-by-state comparisons also reveal considerable variation in comparable wage levels. On average, the wage and salary of a typical college graduate in 1999 was 54 percent higher in New Jersey and Washington, DC (the states with the highest estimated wage level) than in Montana (the state with the lowest estimated wage level). As one might expect, the CWI was highest in New York, New Jersey, and Washington, DC, and lowest in the Great Plains states. Because the states with the highest CWI are also among the most populous, most states have a CWI below 1.00.

Within-State Wage Levels

Not only are there considerable differences in wage levels across states, there are also considerable differences within a single state (table 2). The difference in CWIs within the state of California is as great as the difference between New Jersey and Montana. In New York, Texas, West Virginia, Pennsylvania, Virginia, Illinois, and New Mexico, the education dollar can stretch at least 40 percent farther in one part of the state than in another. With the exception of Hawaii, Rhode Island, and Washington, DC, all states face at least a 7 percent internal differential.

Beginning Teacher Salaries

The considerable differences in hiring cost revealed by the CWI suggest that it is very important to take purchasing power into consideration when making financial comparisons across school districts. To illustrate how geographic cost adjustment transforms widely reported data, consider its effect on beginning teacher salaries.[21] In 1999–2000, only five states had higher beginning teacher salaries than New Jersey. However, New Jersey also had particularly high wages for college graduates, on average (table 3). Adjusted for geographic variations in hiring costs, beginning teacher salaries in New Jersey were not the sixth highest in the nation, but instead the seventh lowest—just behind Mississippi.

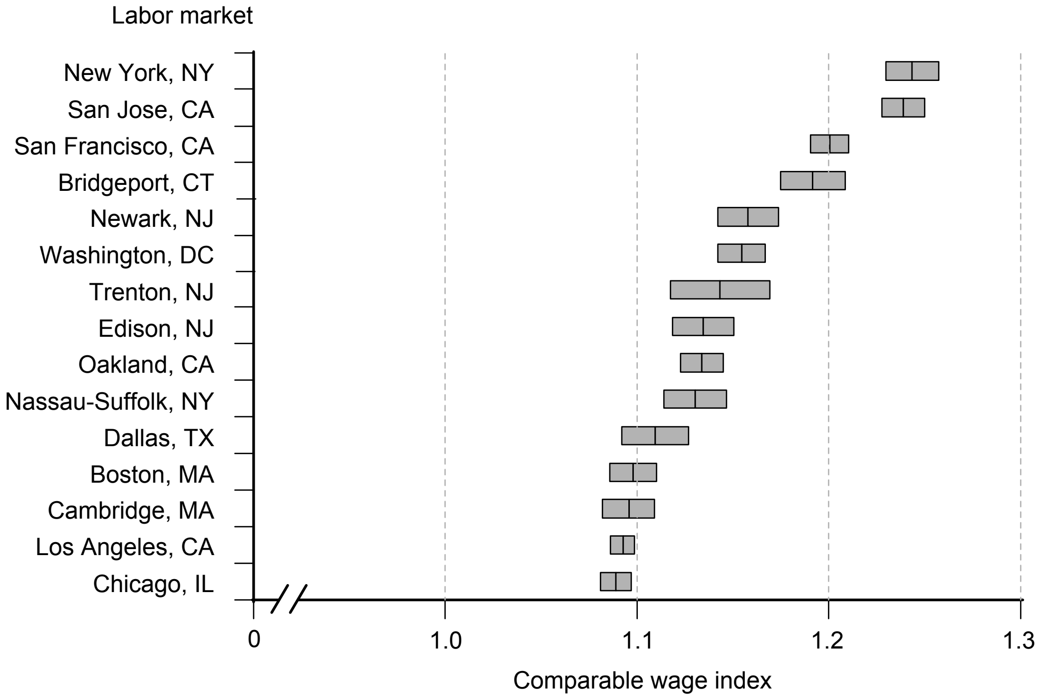
[21] "Beginning teachers" are elementary and secondary school teachers with 3 or fewer years of experience (U.S. Department of Education 2003, p. 59).

Conclusions

The differences in labor costs measured by the CWI may be considered by some to be both substantial and relevant for education policymaking and analysis. The CWI indicates that there are large and persistent within-state differences in labor cost, such that it may be appropriate to make adjustments for them not only when analyzing school finances but also when constructing school finance formulas.

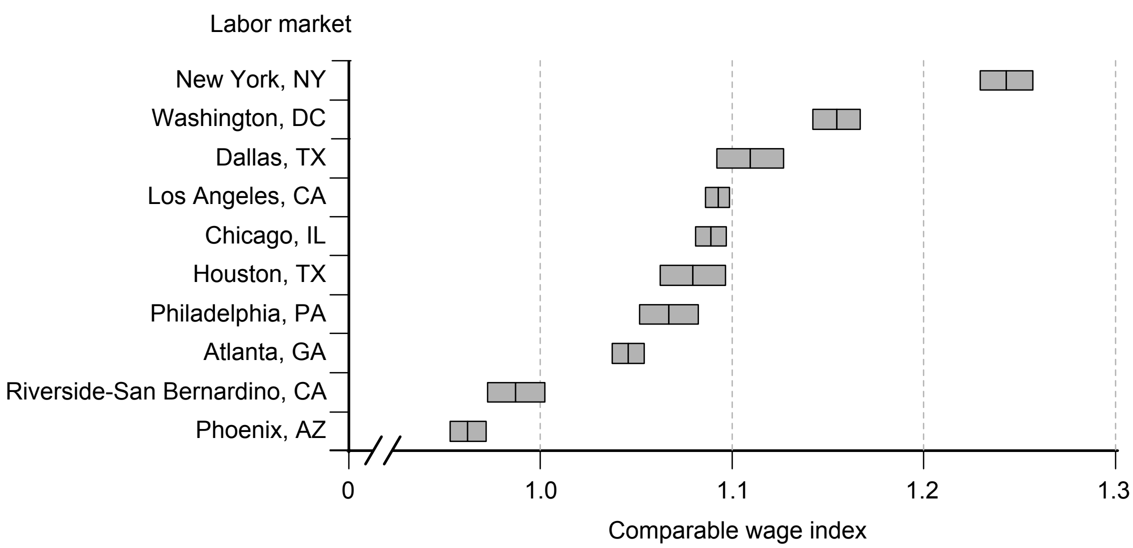
The CWI methodology for geographic cost adjustment offers many advantages over the previous NCES methodologies, including relative simplicity, timeliness, and intrastate variations in labor costs that are undeniably outside school district control. However, the CWI is not designed to detect cost variations within labor markets. Thus, all the school districts in the Washington, DC metro area would have the same CWI cost index. In addition, this report also does not address possible differences in the level of wages between college graduates outside the education sector and education-sector employees. Nor does the report explore the use of these geographic cost adjustments as inflation adjustments (deflators.) These are areas for future fruitful new research on cost adjustments by NCES.

Figure 1. Labor markets in selected cities with the highest Comparable Wage Index: 1999



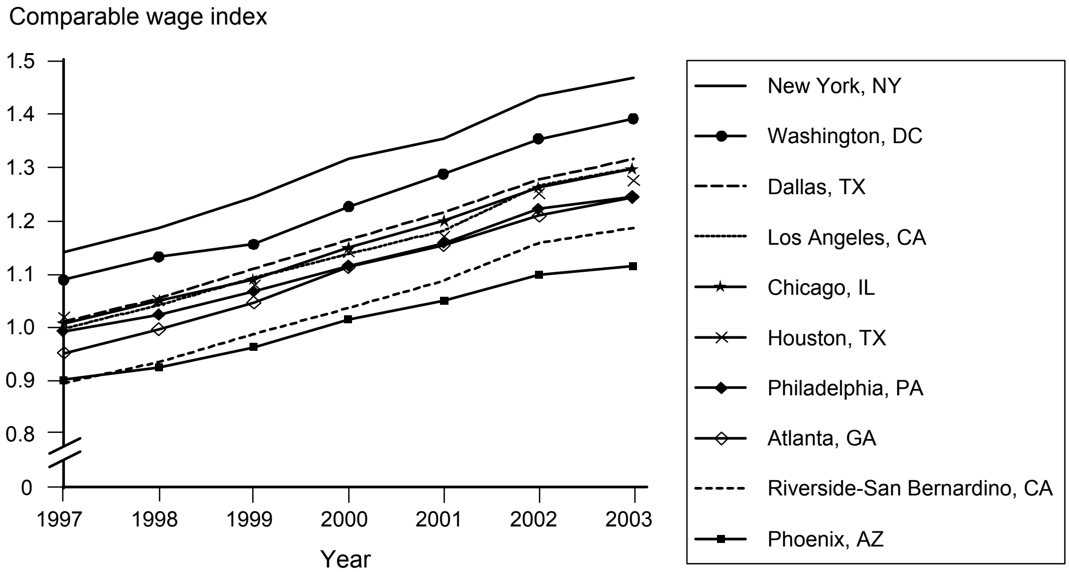
NOTE: Figure includes mean and two standard error confidence bands.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Comparable Wage Index data file, 2006.

Figure 2. Comparable Wage Index in the 10 most populous labor markets: 1999



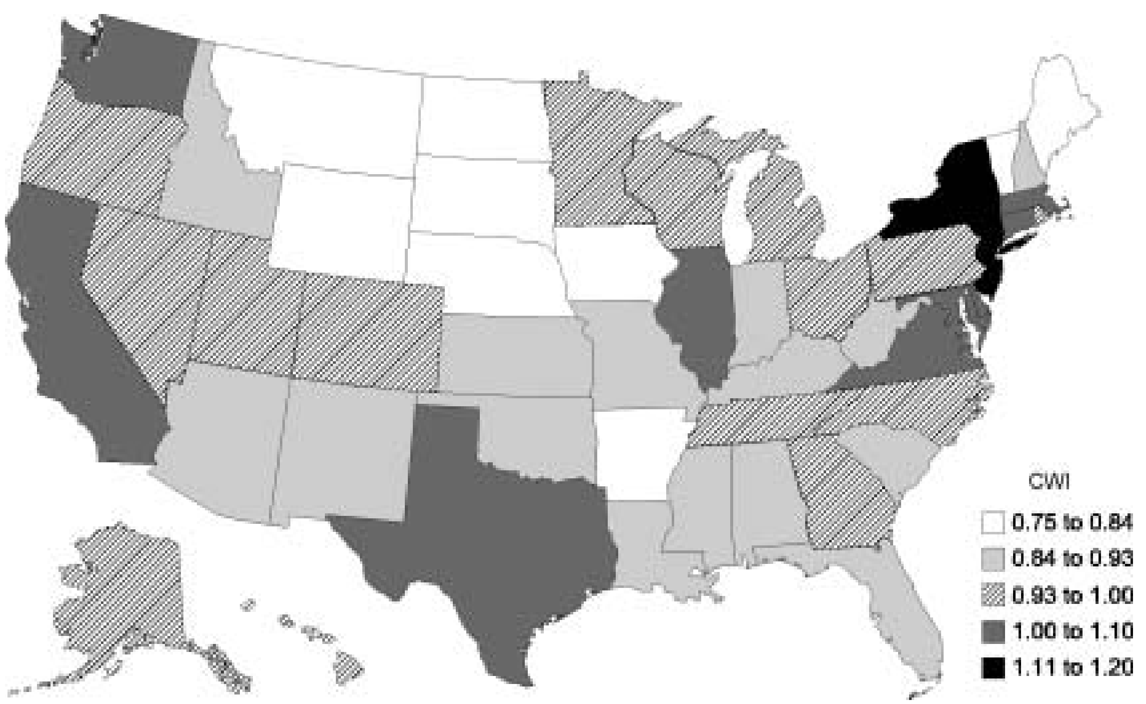
NOTE: Figure includes mean and two standard error confidence bands.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Comparable Wage Index data file, 2006.

Figure 3. Comparable Wage Index in the 10 most populous labor markets: 1997–2003



SOURCE: U.S. Department of Education, National Center for Education Statistics, Comparable Wage Index data file, 2006.

Figure 4. Comparable Wage Index, by state: 1999



SOURCE: U.S. Department of Education, National Center for Education Statistics, Comparable Wage Index data file, 2006.

Table 2. The range of Comparable Wage Index values for school districts, by state: 1999

	Minimum CWI	*Maximum CWI*		*Minimum CWI*	*Maximum CWI*
United States	0.703	1.244	Missouri	0.715	0.959
Alabama	0.770	0.938	Montana	0.709	0.792
Alaska	0.939	1.011	Nebraska	0.712	0.912
Arizona	0.777	0.962	Nevada	0.928	1.016
Arkansas	0.731	1.022	New Hampshire	0.818	0.969
California	0.801	1.239	New Jersey	0.984	1.244
Colorado	0.720	0.981	New Mexico	0.714	1.001
Connecticut	0.932	1.191	New York	0.816	1.244
Delaware	0.861	1.034	North Carolina	0.766	1.037
District of Columbia	1.155	1.155	North Dakota	0.740	0.846
Florida	0.731	0.971	Ohio	0.791	1.008
Georgia	0.791	1.045	Oklahoma	0.737	0.915
Hawaii	0.968	0.968	Oregon	0.808	1.001
Idaho	0.703	0.886	Pennsylvania	0.793	1.158
Illinois	0.776	1.089	Rhode Island	0.988	0.988
Indiana	0.774	1.008	South Carolina	0.858	1.037
Iowa	0.733	0.927	South Dakota	0.711	0.850
Kansas	0.727	0.950	Tennessee	0.735	1.022
Kentucky	0.744	1.008	Texas	0.738	1.109
Louisiana	0.756	0.994	Utah	0.817	0.957
Maine	0.734	0.869	Vermont	0.800	0.866
Maryland	0.829	1.155	Virginia	0.814	1.155
Massachusetts	0.836	1.098	Washington	0.853	1.062
Michigan	0.823	1.073	West Virginia	0.776	1.155
Minnesota	0.785	1.032	Wisconsin	0.804	1.076
Mississippi	0.774	1.022	Wyoming	0.772	0.861

SOURCE: U.S. Department of Education, National Center for Education Statistics, Comparable Wage Index data file, 2006.

Table 3. Minimum (beginning) teacher salaries, cost-adjusted and actual, by state: 1999–2000

	Minimum (beginning) teacher salaries			
	Cost-adjusted	***Actual***	***CWI***	***CWI standard error***
United States	$27,989	$27,989	1.000	0.0039
Alaska	34,402	33,676	0.979	0.0119
Alabama	33,600	29,790	0.887	0.0042
Oregon	31,503	29,733	0.944	0.0070
Pennsylvania	31,125	30,185	0.970	0.0063
Vermont	30,999	25,791	0.832	0.0107
Delaware	30,874	30,945	1.002	0.0088
Georgia	30,644	30,402	0.992	0.0035
Hawaii	30,160	29,204	0.968	0.0080
Iowa	30,150	25,275	0.838	0.0052
Wyoming	30,067	24,168	0.804	0.0135
Indiana	29,671	26,553	0.895	0.0042
Kansas	29,528	25,252	0.855	0.0050
California	29,481	32,190	1.092	0.0018
Illinois	29,256	30,151	1.031	0.0034
North Carolina	29,240	27,968	0.956	0.0058
Tennessee	29,003	27,228	0.939	0.0072
Missouri	28,899	25,977	0.899	0.0047
Nevada	28,870	28,734	0.995	0.0083
Massachusetts	28,708	30,330	1.057	0.0047
Michigan	28,703	28,545	0.994	0.0047
Louisiana	28,614	25,738	0.900	0.0053
New Mexico	28,561	25,042	0.877	0.0077
New York	28,440	31,910	1.122	0.0060
Connecticut	28,207	30,466	1.080	0.0044
Oklahoma	28,073	24,025	0.856	0.0069
West Virginia	28,054	23,829	0.849	0.0096
South Dakota	28,038	21,889	0.781	0.0102
Montana	28,037	20,969	0.748	0.0081
Texas	27,964	28,400	1.016	0.0072
Maine	27,913	22,942	0.822	0.0074
Arizona	27,762	25,613	0.923	0.0037
Nebraska	27,641	22,923	0.829	0.0068
Rhode Island	27,606	27,286	0.988	0.0091
Florida	27,590	25,132	0.911	0.0026
Kentucky	27,558	24,753	0.898	0.0051
South Carolina	27,437	25,215	0.919	0.0072
Maryland	27,393	28,612	1.044	0.0049
New Hampshire	27,169	24,650	0.907	0.0078
Wisconsin	26,993	25,344	0.939	0.0082
Arkansas	26,961	22,599	0.838	0.0059
District of Columbia	26,722	30,850	1.155	0.0062
Colorado	26,610	24,875	0.935	0.0034
Minnesota	26,556	25,666	0.966	0.0051
Mississippi	26,538	23,040	0.868	0.0069
New Jersey	26,440	30,480	1.153	0.0063
Washington	26,140	26,514	1.014	0.0083
North Dakota	25,982	20,422	0.786	0.0102
Virginia	25,927	26,783	1.033	0.0067
Utah	24,976	23,273	0.932	0.0086
Idaho	24,893	20,915	0.840	0.0079
Ohio	24,524	23,597	0.962	0.0059

NOTE: CWI=Comparable Wage Index. States sorted by cost-adjusted minimum salary. Beginning teachers are those with 3 or fewer years of experience (U.S. Department of Education 2003, p. 59).
SOURCE: Snyder and Hoffman (2002), and U.S. Department of Education, National Center for Education Statistics, Comparable Wage Index data file, 2006.

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Appendix A: Extending the Baseline With the OES

While the baseline CWI makes it possible to compare district purchasing power across locations, the OES data make it possible to extend the CWI in noncensus years.

The OES is a Bureau of Labor Statistics (BLS) database that contains average annual earnings by occupation for states and metropolitan areas each year from 1997 through 2003. Each year, the BLS samples and contacts approximately 400,000 civilian, nonfarm establishments for the OES survey.[1] Every firm in the United States with at least 250 employees is included in the sample with near-certainty each year. Smaller firms are sampled proportionally. The rate of response to the survey is typically quite high. Nearly 80 percent of the establishments contacted for the May 2003 survey responded. Survey respondents in the 2003 OES dataset employed 72 percent of civilian, nonfarm workers in the United States.[2]

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 to the census regressions, and ensures that location effects are estimated as deviations from a nationally representative occupational wage. Table A-1 presents descriptive statistics for the fourteen OES regression models.

As the table illustrates, the models fit the OES data quite closely, and much more closely than the baseline estimation fits the census. The OES models are able to explain more of the variation in earnings largely because the OES data have less variation in earnings that needs to be explained. The OES data represent average earnings by occupation while the census data represent the earnings of individual workers in that occupation. Thus, for example, the average metropolitan area wage for financial analysts in 1999 ranges from $29,000 to $106,000 in the OES but from $5,000 to $354,000 in the census estimation sample.

[1] Details on the OES survey come from BLS (2003).

[2] The OES is constructed as a 3-year moving average. Thus, the estimates for 2002 are drawn from surveys in 2000, 2001, and 2002. Because the 2003 survey straddles the shift from the Standard Industrial Classification (SIC) system to the North American Industry Classification System (NAICS), "May 2003 data were combined with samples from November 2002, 2001, 2000, and a subset of certainty units collected in 1999" (BLS 2003).

Table A-1. Number of occupations, labor markets, and goodness-of-fit characteristics for OES wage regressions, by metropolitan area and state analyses: 1997–2003

	Metropolitan area analysis				*State analysis*			
Year	*Number of occupations*	*Number of labor markets*	*Number of observations*	*R-square*	*Number of occupations*	*Number of labor markets*	*Number of observations*	*R-square*
1997	458	306	85,921	0.934	463	51	28,501	0.946
1998	459	306	96,333	0.939	463	51	30,302	0.950
1999	435	309	64,986	0.937	440	51	24,055	0.946
2000	439	309	90,593	0.932	441	51	27,946	0.944
2001	440	309	95,658	0.936	442	51	28,496	0.946
2002	438	309	95,589	0.943	442	51	28,001	0.951
2003	438	309	94,457	0.942	441	51	27,868	0.951

NOTE: OES=Occupational Employment Statistics.
SOURCE: Bureau of Labor Statistics (2003) and authors' calculations.

The OES regression models differ from the baseline census regression model in three key respects. First, the OES database contains information on average earnings for workers in each occupation, but no information on worker demographics or industry. Therefore, the OES regressions cannot include any explanatory variables other than occupation and labor market area indicators. The OES regression model for metropolitan areas in 1997 is made up of 458 occupational indicator variables and 306 market indicator variables, for example. The baseline census regression includes not only occupation and location indicators, but also demographic characteristics, hours worked, and industry indicators.

Second, the list of occupational indicators is not the same between the OES database and the census. The OES does not use consistent coding for occupations in all years between 1997 and 2003, and in no year is the OES coding completely consistent with the 2000 census. Therefore, OES occupations were matched to their census equivalents using a crosswalk provided by the National Crosswalk Service Center, http://www.xwalkcenter.org/xw_ackx.html#SOCOES. Occupations that could not be matched using the crosswalk were included in the OES estimation using their original coding. Wherever the OES provided more occupational detail than the census—such as occurs when both the census and the 1997 OES group all physicians together in a single occupation, but the 2003 OES decomposes the category into subgroups such as internists, pediatricians and obstetricians—the data were recoded to match the census codes. Therefore, there can be more than one observation per occupation in a market each year.

Finally, the labor market areas with data in the OES database represent only a subset of the labor market areas available for analysis using the census. Therefore, the OES regression models also include fewer labor market indicators than does the census regression model.

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 (see table A-2). 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.

The census asked respondents to report their wages in 1999. Therefore, the OES wage estimates for 1999 form the basis for comparison of changes in local wage levels. If the OES estimated wage level for Dallas in 2000 was 2 percent higher than the OES estimated wage level for Dallas in 1999, then the CWI for Dallas in 2000 was 2 percent higher than the baseline CWI. Similarly, if the average OES wage for Texas increased by 10 percent between 1999 and 2002, then the CWI for the state of Texas in 2002 was 10 percent higher than the baseline CWI.

Approximately 346 of the 800 labor markets from the baseline analysis (CBSAs and places-of-work) can be matched to OES labor markets.[3] 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 employment weights used in calculating growth rates for areas that cannot be directly estimated from the OES come from the total employment records of the 2000 census. The employment weights reflect workers with all levels of educational attainment because the OES data do not separate out the college graduates within occupations, and data on all occupations are used to estimate the labor market differentials.[4] Note that when metropolitan areas spill over state boundaries, it is not necessarily true that the

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[3] OES has not updated its geographic boundaries since 1990; thus, a handful of OES labor markets cannot be matched successfully to a CBSA.

[4] Predicted wage levels in any labor market reflect local variations around a nationwide constant. The nationwide constant is based solely on the occupations held by college graduates in the 2000 census, but the local wage level is the nationwide constant plus the estimated labor market fixed effect. Thus, differences in growth rates across labor market areas are solely a function of changes in labor market fixed effects. The fixed effects are estimated using all of the OES data; thus, imputing fixed effects to the unobserved regions of a state requires information on total employment.

state’s growth rate is a weighted average of the growth rate of its metropolitan areas and its rural places of work. Therefore, this imputation strategy is less precise in states that share a metropolitan area with another state.

Table A-2. Occupational frequencies used in the OES local wage predictions

Occupation Code	Occupation title	Frequency Share (percent)
4	Advertising and Promotions Managers	0.25
5	Marketing and Sales Managers	3.30
6	Public Relations Managers	0.22
12	Financial Managers	2.80
13	Human Resources Managers	1.07
14	Industrial Production Managers	0.66
15	Purchasing Managers	0.53
16	Transportation, Storage, and Distribution Managers	0.28
20	Farm, Ranch, and Other Agricultural Managers	0.13
22	Construction Managers	0.65
32	Funeral Directors	0.06
35	Medical and Health Services Managers	1.21
40	Postmasters and Mail Superintendents	0.05
41	Property, Real Estate, and Community Association Managers	0.53
51	Purchasing Agents and Buyers, Farm Products	0.02
52	Wholesale and Retail Buyers, Except Farm Products	0.30
53	Purchasing Agents, Except Wholesale, Retail, and Farm Products	0.46
54	Claims Adjusters, Appraisers, Examiners, and Investigators	0.62
60	Cost Estimators	0.15
62	Human Resources, Training, and Labor Relations Specialists	1.99
71	Management Analysts	1.35
80	Accountants and Auditors	5.61
81	Appraisers and Assessors of Real Estate	0.15
82	Budget Analysts	0.15
83	Credit Analysts	0.08
84	Financial Analysts	0.20
86	Insurance Underwriters	0.20
91	Loan Counselors and Officers	0.73
93	Tax Examiners, Collectors, and Revenue Agents	0.17
94	Tax Preparers	0.10
101	Computer Programmers	1.98
106	Database Administrators	0.25
120	Actuaries	0.10
122	Operations Research Analysts	0.34
124	Miscellaneous Mathematical Science Occupations, Including Mathematicians and Statisticians	0.13
130	Architects, Except Naval	0.63
131	Surveyors, Cartographers, and Photogrammetrists	0.12
132	Aerospace Engineers	0.48
135	Chemical Engineers	0.30
136	Civil Engineers	1.10
143	Industrial Engineers, Including Health and Safety	0.62
144	Marine Engineers	0.04
145	Materials Engineers	0.13
146	Mechanical Engineers	0.98
151	Nuclear Engineers	0.04
152	Petroleum, Mining and Geological Engineers, Including Mining Safety Engineers	0.09
153	Miscellaneous Engineers, Including Agricultural and Biomedical	1.24
154	Drafters	0.19
155	Engineering Technicians, Except Drafters	0.33
156	Surveying and Mapping Technicians	0.02

Occupation Code	Occupation title	Frequency Share (percent)
161	Biological Scientists	0.42
165	Medical Scientists	0.40
170	Astronomers and Physicists	0.10
171	Atmospheric and Space Scientists	0.04
172	Chemists and Materials Scientists	0.50
174	Environmental Scientists and Geoscientists	0.38
182	Psychologists	0.37
184	Urban and Regional Planners	0.11
186	Miscellaneous Social Scientists, Including Sociologists	0.14
193	Geological and Petroleum Technicians	0.02
196	Miscellaneous Life, Physical, and Social Science Technicians, Including Social Science Research Assistants and Nuclear Technicians	0.23
200	Counselors	1.20
201	Social Workers	2.34
204	Clergy	1.64
205	Directors, Religious Activities and Education	0.14
210	Lawyers	2.82
211	Judges, Magistrates, and Other Judicial Workers	0.26
214	Paralegals and Legal Assistants	0.53
215	Miscellaneous Legal Support Workers	0.29
220	Postsecondary Teachers	4.47
260	Artists and Related Workers	0.25
263	Designers	1.12
274	Dancers and Choreographers	0.01
275	Musicians, Singers, and Related Workers	0.16
280	Announcers	0.07
281	News Analysts, Reporters, and Correspondents	0.32
282	Public Relations Specialists	0.42
290	Broadcast and Sound Engineering Technicians and Radio Operators and Other Media and Communication Equipment Workers	0.11
291	Photographers	0.10
292	Television, Video, and Motion Picture Camera Operators and Editors	0.04
300	Chiropractors	0.05
301	Dentists	0.21
303	Dietitians and Nutritionists	0.22
304	Optometrists	0.06
305	Pharmacists	0.93
306	Physicians and Surgeons	2.52
311	Physician Assistants	0.16
312	Podiatrists	0.02
313	Registered Nurses	5.79
315	Occupational Therapists	0.21
316	Physical Therapists	0.49
320	Radiation Therapists	0.02
321	Recreational Therapists	0.06
322	Respiratory Therapists	0.12
325	Veterinarians	0.17
330	Clinical Laboratory Technologists and Technicians	0.83
331	Dental Hygienists	0.16
332	Diagnostic Related Technologists and Technicians	0.23
340	Emergency Medical Technicians and Paramedics	0.07
341	Health Diagnosing and Treating Practitioner Support Technicians	0.17

Occupation Code	Occupation title	Frequency Share (percent)
350	Licensed Practical and Licensed Vocational Nurses	0.26
351	Medical Records and Health Information Technicians	0.06
352	Opticians, Dispensing	0.03
353	Miscellaneous Health Technologists and Technicians	0.09
360	Nursing, Psychiatric, and Home Health Aides	0.46
361	Occupational Therapist Assistants and Aides	0.00
362	Physical Therapist Assistants and Aides	0.04
364	Dental Assistants	0.07
365	Medical Assistants and Other Healthcare Support Occupations	0.25
371	First-Line Supervisors/Managers of Police and Detectives	0.21
372	First-Line Supervisors/Managers of Fire Fighting and Preventions Workers	0.06
374	Fire Fighters	0.18
375	Fire Inspectors	0.02
380	Bailiffs, Correctional Officers, and Jailers	0.25
382	Detectives and Criminal Investigators	0.31
384	Miscellaneous Law Enforcement Workers	0.02
385	Police Officers	0.91
392	Security Guards and Gaming Surveillance Officers	0.37
394	Crossing Guards	0.00
402	Cooks	0.17
404	Bartenders	0.15
405	Combined Food Preparation and Serving Workers, Including Fast Food	0.03
406	Counter Attendants, Cafeteria, Food Concession, and Coffee Shop	0.01
411	Waiters and Waitresses	0.45
412	Food Servers, Nonrestaurant	0.02
413	Dining Room and Cafeteria Attendants, Bartender Helpers, and Miscellaneous Food Preparation and Serving Related Workers	0.02
415	Hosts and Hostesses, Restaurant, Lounge, and Coffee Shop	0.03
420	First-Line Supervisors/Managers of Housekeeping and Janitorial Workers	0.06
421	First-Line Supervisors/Managers of Landscaping, Lawn Service, and Groundskeeping Workers	0.07
422	Janitors and Building Cleaners	0.21
423	Maids and Housekeeping Cleaners	0.08
424	Pest Control Workers	0.02
425	Grounds Maintenance Workers	0.15
434	Animal Trainers	0.01
441	Motion Picture Projectionists	0.00
442	Ushers, Lobby Attendants, and Ticket Takers	0.01
443	Miscellaneous Entertainment Attendants and Related Workers	0.05
446	Funeral Service Workers	0.01
450	Barbers	0.01
452	Miscellaneous Personal Appearance Workers	0.03
453	Baggage Porters, Bellhops, and Concierges	0.03
454	Tour and Travel Guides	0.03
455	Transportation Attendants	0.15
460	Child Care Workers	0.23
461	Personal and Home Care Aides	0.07
462	Recreation and Fitness Workers	0.30
464	Residential Advisors	0.05
470	First-Line Supervisors/Managers of Retail Sales Workers	2.34
471	First-Line Supervisors/Managers of Non-Retail Sales Workers	1.48
474	Counter and Rental Clerks	0.04

Occupation Code	*Occupation title*	*Frequency Share (percent)*
475	Parts Salespersons	0.04
476	Retail Salespersons	2.13
480	Advertising Sales Agents	0.45
481	Insurance Sales Agents	0.75
482	Securities, Commodities, and Financial Services Sales Agents	1.04
483	Travel Agents	0.14
485	Sales Representatives, Wholesale and Manufacturing	2.67
490	Models, Demonstrators, and Product Promoters	0.02
492	Real Estate Brokers and Sales Agents	0.66
493	Sales Engineers	0.12
500	First-Line Supervisors/Managers of Office and Administrative Support Workers	2.16
501	Switchboard Operators, Including Answering Service	0.02
502	Telephone Operators	0.03
510	Bill and Account Collectors	0.14
511	Billing and Posting Clerks and Machine Operators	0.23
512	Bookkeeping, Accounting, and Auditing Clerks	0.89
514	Payroll and Timekeeping Clerks	0.12
515	Procurement Clerks	0.04
516	Tellers	0.15
520	Brokerage Clerks	0.01
522	Court, Municipal, and License Clerks	0.06
523	Credit Authorizers, Checkers, and Clerks	0.05
525	Eligibility Interviewers, Government Programs	0.13
526	File Clerks	0.13
530	Hotel, Motel, and Resort Desk Clerks	0.05
531	Interviewers, Except Eligibility and Loan	0.13
533	Loan Interviewers and Clerks	0.11
534	New Accounts Clerks	0.01
535	Correspondence Clerks and Order Clerks	0.08
536	Human Resources Assistants, Except Payroll and Timekeeping	0.05
540	Receptionists and Information Clerks	0.38
541	Reservation and Transportation Ticket Agents and Travel Clerks	0.17
550	Cargo and Freight Agents	0.01
551	Couriers and Messengers	0.08
552	Dispatchers	0.12
553	Meter readers, Utilities	0.01
555	Postal Service Mail Carriers	0.25
560	Production, Planning and Expediting Clerks	0.45
561	Shipping, Receiving, and Traffic Clerks	0.15
562	Stock Clerks and Order Filers	0.28
563	Weighers, Measurers, Checkers, and Samplers, Record keeping	0.03
570	Secretaries and Administrative Assistants	2.16
580	Computer Operators	0.24
581	Data Entry Keyers	0.29
582	Word Processors and Typists	0.08
583	Desktop Publishers	0.02
584	Insurance Claims and Policy Processing Clerks	0.21
585	Mail Clerks and Mail Machine Operators, Except Postal Service	0.04
586	Office Clerks, General	0.68
590	Office Machine Operators, Except Computer	0.02
591	Proofreaders and Copy Markers	0.03
592	Statistical Assistants	0.03

Occupation Code	*Occupation title*	*Frequency Share (percent)*
604	Graders and Sorters, Agricultural Products	0.01
605	Miscellaneous Agricultural Workers, Including Animal Breeders	0.14
613	Logging Workers	0.01
620	First-Line Supervisors/Managers of Construction Trades and Extraction Workers	0.32
621	Boilermakers	0.00
622	Brickmasons, Blockmasons, and Stonemasons	0.01
624	Carpet, Floor, and Tile Installers and Finishers	0.02
626	Construction Laborers	0.12
630	Paving, Surfacing, and Tamping Equipment Operators	0.00
632	Miscellaneous Construction Equipment Operators	0.04
633	Drywall Installers, Ceiling Tile Installers, and Tapers	0.01
636	Glaziers	0.01
644	Pipelayers, Plumbers, Pipefitters, and Steamfitters	0.08
646	Plasterers and Stucco Masons	0.00
651	Roofers	0.01
652	Sheet Metal Workers	0.02
653	Iron and Steel Workers	0.01
660	Helpers, Construction Trades	0.01
666	Construction and Building Inspectors	0.08
670	Elevator Installers and Repairers	0.01
671	Fence Erectors	0.00
672	Hazardous Materials	0.01
673	Highway Maintenance Workers	0.01
675	Septic Tank Servicers and Sewer Pipe Cleaners	0.00
680	Derrick, Rotary Drill, and Service Unit Operators, and Roustabouts, Oil, Gas, and Mining	0.00
682	Earth Drillers, Except Oil and Gas	0.00
683	Explosives Workers, Ordnance Handling Experts, and Blasters	0.00
694	Miscellaneous Extraction Workers, Including Roof Bolters and Helpers	0.00
700	First-Line Supervisors/Managers of Mechanics, Installers, and Repairers	0.23
701	Computer, Automated Teller, and Office Machine Repairers	0.20
702	Radio and Telecommunications Equipment Installers and Repairers	0.11
710	Electrical and Electronics Repairers, Industrial, Utility, and Transportation Equipment	0.01
712	Electronic Home Entertainment Equipment Installers and Repairers	0.01
714	Aircraft Mechanics and Service Technicians	0.07
720	Automotive Service Technicians and Mechanics	0.11
721	Bus and Truck Mechanics and Diesel Engine Specialists	0.03
722	Heavy Vehicle and Mobile Equipment Service Technicians and Mechanics	0.03
724	Small Engine Mechanics	0.01
726	Miscellaneous Vehicle and Mobile Equipment Mechanics, Installers, and Repairers	0.01
730	Control and Valve Installers and Repairers	0.01
731	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	0.04
732	Home Appliance Repairers	0.01
733	Industrial and Refractory Machinery Mechanics	0.09
734	Maintenance and Repair Workers, General	0.11
735	Maintenance Workers, Machinery	0.00
736	Millwrights	0.01
741	Electrical Power-Line Installers and Repairers	0.02
742	Telecommunications Line Installers and Repairers	0.05
743	Precision Instrument and Equipment Repairers	0.04
751	Coin, Vending, and Amusement Machine Servicers and Repairers	0.01
754	Locksmiths and Safe Repairers	0.01
756	Riggers	0.00

Occupation Code	Occupation title	Frequency Share (percent)
761	Helpers--Installation, Maintenance, and Repair Workers	0.00
770	First-Line Supervisors/Managers of Production and Operating Workers	0.94
771	Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	0.00
772	Electrical, Electronics, and Electromechanical Assemblers	0.06
773	Engine and Other Machine Assemblers	0.01
774	Structural Metal Fabricators and Fitters	0.00
775	Miscellaneous Assemblers and Fabricators	0.20
780	Bakers	0.03
781	Butchers and Other Meat, Poultry, and Fish Processing Workers	0.03
783	Food and Tobacco Roasting, Baking, and Drying Machine Operators and Tenders	0.00
784	Food Batchmakers	0.01
790	Computer Control Programmers and Operators	0.01
792	Extruding and Drawing Machine Setters, Operators, and Tenders, Metal and Plastic	0.00
793	Forging Machine Setters, Operators, and Tenders, Metal and Plastic	0.00
794	Rolling Machine Setters, Operators, and Tenders, Metal and Plastic	0.00
795	Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	0.01
796	Drilling and Boring Machine Tool Setters, Operators, and Tenders, Metal and Plastic	0.00
800	Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic	0.01
801	Lathe and Turning Machine Tool Setters, Operators, and Tenders, Metal and Plastic	0.00
803	Machinists	0.08
804	Metal Furnace and Kiln Operators and Tenders	0.01
806	Model Makers and Patternmakers, Metal and Plastic	0.01
810	Molders and Molding Machine Setters, Operators, and Tenders, Metal and Plastic	0.01
813	Tool and Die Makers	0.03
814	Welding, Soldering, and Brazing Workers	0.05
815	Heat Treating Equipment Setters, Operators, and Tenders, Metal and Plastic	0.00
816	Lay-Out Workers, Metal and Plastic	0.00
820	Plating and Coating Machine Setters, Operators, and Tenders, Metal and Plastic	0.00
821	Tool Grinders, Filers, and Sharpeners	0.00
822	Other Metal Workers and Plastic Workers, Including Milling, Planing, and Machine Tool Operators	0.09
823	Bookbinders and Bindery Workers	0.01
824	Job Printers	0.02
825	Prepress Technicians and Workers	0.05
826	Printing Machine Operators	0.05
830	Laundry and Dry-Cleaning Workers	0.02
831	Pressers, Textile, Garment, and Related Materials	0.01
832	Sewing Machine Operators	0.03
834	Shoe Machine Operators and Tenders	0.00
835	Tailors, Dressmakers, and Sewers	0.02
836	Textile Bleaching and Dyeing Machine Operators and Tenders	0.00
842	Textile Winding, Twisting, and Drawing Out Machine Setters, Operators, and Tenders	0.00
845	Upholsterers	0.00
846	Miscellaneous Textile, Apparel, and Furnishings Workers, Except Upholsterers	0.01
850	Cabinetmakers and Bench Carpenters	0.02
851	Furniture Finishers	0.01
853	Sawing Machine Setters, Operators, and Tenders, Wood	0.01
854	Woodworking Machine Setters, Operators, and Tenders, Except Sawing	0.01
855	Miscellaneous Woodworkers, Including Model Makers and Patternmakers	0.01
860	Power Plant Operators, Distributors, and Dispatchers	0.03
861	Stationary Engineers and Boiler Operators	0.05

Occupation Code	*Occupation title*	*Frequency Share (percent)*
862	Water and Liquid Waste Treatment Plant and System Operators	0.04
863	Miscellaneous Plant and System Operators	0.02
864	Chemical Processing Machine Setters, Operators, and Tenders	0.04
865	Crushing, Grinding, Polishing, Mixing, and Blending Workers	0.02
871	Cutting Workers	0.01
872	Extruding, Forming, Pressing, and Compacting Machine Setters, Operators, and Tenders	0.01
873	Furnace, Kiln, Oven, Drier, and Kettle Operators and Tenders	0.00
874	Inspectors, Testers, Sorters, Samplers, and Weighers	0.47
875	Jewelers and Precious Stone and Metal Workers	0.02
876	Medical, Dental, and Ophthalmic Laboratory Technicians	0.04
880	Packaging and Filing Machine Operators and Tenders	0.03
881	Painting Workers	0.02
883	Photographic Process Workers and Processing Machine Operators	0.05
885	Cementing and Gluing Machine Operators and Tenders	0.00
891	Etchers and Engravers	0.00
892	Molders, Shapers, and Casters, Except Metal and Plastic	0.01
893	Paper Goods Machine Setters, Operators, and Tenders	0.01
896	Other Production Workers, Including Semiconductor Processors and Cooling and Freezing Equipment Operators	0.26
900	Supervisors, Transportation and Material Moving Workers	0.17
903	Aircraft Pilots and Flight Engineers	0.41
904	Air Traffic Controllers and Airfield Operations Specialists	0.06
912	Bus Drivers	0.08
913	Driver/Sales Workers and Truck Drivers	0.54
914	Taxi Drivers and Chauffeurs	0.08
915	Miscellaneous Motor Vehicle Operators, Including Ambulance Drivers and Attendants	0.00
920	Locomotive Engineers and Operators	0.03
930	Sailors and Marine Oilers	0.01
931	Ship and Boat Captains and Operators	0.02
933	Ship Engineers	0.01
935	Parking Lot Attendants	0.01
936	Service Station Attendants	0.02
941	Transportation Inspectors	0.03
942	Miscellaneous Transportation Workers, Including Bridge and Lock Tenders and Traffic Technicians	0.01
951	Crane and Tower Operators	0.01
952	Dredge, Excavating, and Loading Machine Operators	0.00
956	Hoist and Winch Operators	0.00
960	Industrial Truck and Tractor Operators	0.05
961	Cleaners of Vehicles and Equipment	0.02
962	Laborers and Freight, Stock, and Material Movers, Hand	0.26
963	Machine Feeders and Offbearers	0.01
964	Packers and Packagers, Hand	0.05
965	Pumping Station Operators	0.01
972	Refuse and Recyclable Material Collectors	0.01
975	Miscellaneous Material Moving Workers; Including Conveyor Operators and Tenders; Shuttle Car Operators; and Tank Car, Truck, and Ship Loaders	0.01

SOURCE: Ruggles et al. (2003) and authors' calculations.

Appendix B—Comparisons With Other Cost Adjustment Strategies

The issue of regional cost adjustment is not new. There have been a number of previous attempts to measure geographic variations in the cost of education. Two nationwide indexes are particularly noteworthy—Chambers' Geographic Cost of Education Index (GCEI) and Goldhaber's General Wage Index (GWI).

The GCEI is a district-specific cost-of-education index. It is a weighted average of price indexes for three types of school district inputs—certified personnel, noncertified personnel, and nonpersonnel inputs—where the weights reflect the share of the typical school district budget devoted to each type of expense (Chambers 1998). The certified personnel index is based on a hedonic wage regression of teacher salaries from the NCES School and Staffing Survey, while the noncertified personnel index is based on a similar analysis of selected occupations from the Current Population Survey (CPS). In both cases, the personnel indexes measure the variations in self-reported wages that can be attributed to cost factors outside of school district control such as student demographics, crime rates or housing costs. The nonpersonnel inputs index reflects the cost of hiring contractual personnel (which was estimated from the personnel indexes) and "some limited geographic variations in energy prices" (Chambers 1998, page 7).

The GWI is a state-level version of a Comparable Wage Index (CWI). Goldhaber generated the GWI using CPS data on the earnings of college graduates who are not teachers.

Table B-1 presents the correlations between these two indexes and the annual CWIs for each school district. As the table indicates, despite the 3-year gap between the earliest estimate of the CWI and the latest estimate for the other indexes, the CWI is highly correlated with the GCEI. The correlation between the CWI and GCEI is never lower than 0.798. At a maximum of 0.423, the correlations between the CWIs and GWI are substantially lower, reflecting at least in part the fact that the GWI does not vary within states as do the other indexes.

As table B-2 illustrates, when the average index values are compared across states, the correlations between the GWI and CWIs greatly increase. Once the data are aggregated to the state level, the GWI and the GCEI are equally well correlated with the CWIs.[1]

[1] The correlations between the CWIs and the GWI are not significantly different at the 5-percent level from the corresponding correlations between the CWIs and the GCEI.

Table B-1. District-level correlations among CWI, GCEI, and GWI, by index and year: 1994–2003

	CWI							GCEI	GWI
Index	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*1994*	*1994*
CWI									
1997	1.0000								
1998	0.9976	1.0000							
1999	0.9784	0.9807	1.0000						
2000	0.9817	0.9839	0.9931	1.0000					
2001	0.9840	0.9884	0.9865	0.9943	1.0000				
2002	0.9850	0.9898	0.9772	0.9874	0.9970	1.0000			
2003	0.9809	0.9863	0.9814	0.9913	0.9978	0.9976	1.0000		
GCEI									
1994	0.8002	0.7978	0.8121	0.8113	0.8074	0.8008	0.8062	1.0000	
GWI									
1994	0.3891	0.3891	0.4233	0.4178	0.3987	0.3846	0.3972	0.4209	1.0000

NOTE: CWI=Comparable Wage Index; GCEI=Geographic Cost of Education Index; and GWI=General Wage Index.
SOURCE: Goldhaber (1999), Chambers (1998), and U.S. Department of Education, National Center for Education Statistics, Comparable Wage Index data file, 2006.

Table B-2. State-level correlations among CWI, GCEI, and GWI, by index and year: 1994–2003

	CWI							GCEI	GWI
Index	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*1994*	*1994*
CWI									
1997	1.0000								
1998	0.9981	1.0000							
1999	0.9883	0.9924	1.0000						
2000	0.9828	0.9878	0.9967	1.0000					
2001	0.9792	0.9854	0.9936	0.9983	1.0000				
2002	0.9777	0.9847	0.9925	0.9972	0.9991	1.0000			
2003	0.9720	0.9799	0.9877	0.9945	0.9977	0.9991	1.0000		
GCEI									
1994	0.7465	0.7411	0.7435	0.7450	0.7465	0.7421	0.7400	1.0000	
GWI									
1994	0.8327	0.8293	0.8305	0.8283	0.8231	0.8187	0.8160	0.8385	1.0000

NOTE: CWI=Comparable Wage Index; GCEI=Geographic Cost of Education Index; and GWI=General Wage Index.
SOURCE: Goldhaber (1999), Chambers (1998), and U.S. Department of Education, National Center for Education Statistics, Comparable Wage Index data file, 2006.

In addition to such nationwide estimates of geographic cost variations, there are a number of state-specific estimates of education cost. For example, Florida uses a market-basket estimate of the cost of living to adjust its school-finance formula for geographic cost differentials. Texas uses a teacher cost index for similar purposes. As table B-3 illustrates, the CWI is also reasonably well-correlated with the cost indexes used in the Texas and Florida school finance formulas for the 2003–04 school year.

The CWI is even more highly correlated with recent updates to the Texas Cost of Education Index (CEI). The cost index used in the Texas school finance formula has not been updated since its adoption in 1991; thus, it reflects the pattern of teacher compensation in 1989. Taylor (2004) estimates a new teacher cost index based on personnel records from the 2000 through 2003 school years and using individual teacher fixed effects to control for variations in teacher characteristics. The correlations between this updated cost index and the CWI are also presented in table B-3.

In addition, New York has proposed adjusting its finance formula using a Regional Cost Index (RCI) based on median wages among 63 professional, noneducation occupations. This wage estimate is philosophically very similar to the CWI—as evidenced by the high correlation between the RCI and CWI—but differs in a number of key respects. The New York RCI is less detailed geographically, dividing New York state into 9 regions while the CWI divides the state into 27 regions. The RCI is based exclusively on OES data for 2001, and therefore cannot incorporate any adjustment for differences in worker demographics across regions. Finally, the CWI uses the national variation in wages to estimate average wages for occupations and applies a much larger set of occupations, both of which should lead to more precise controls for occupational mix.

Table B-3. Within-state correlations between CWI and the Florida PLI, Texas CEI, and New York RCI, by year: 1997–2003

CWI year	*Florida PLI*	*Texas CEI*	*Updated Texas CEI*	*New York RCI*
1997	0.6501	0.4651	0.6375	0.8295
1998	0.6247	0.4639	0.6395	0.8268
1999	0.6283	0.4383	0.6339	0.8423
2000	0.6166	0.442	0.6458	0.8350
2001	0.5755	0.4391	0.6429	0.8461
2002	0.6062	0.4503	0.6466	0.8432
2003	0.6212	0.4423	0.6444	0.8501

NOTE: CWI=Comparable Wage Index; PLI=Price Level Index; CEI=Cost of Education Index; and RCI=Regional Cost Index. The Florida PLI and the updated Texas CEI are both based on a 3-year average of data ending in 2003. The Texas CEI is based on 1989 data, and the New York RCI is based on 2001 data.
SOURCE: University of Florida and Florida Department of Education (2004), Alexander et al. (2000), New York State Department of Education (2003), Taylor (2004), and U.S. Department of Education, National Center for Education Statistics, Comparable Wage Index data file, 2006.