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U.S. DEPARTMENT OF EDUCATION

Education Demographic and Geographic Estimates (EDGE) Program

American Community Survey Comparable Wage Index for Teachers (ACS-CWIFT)

ies NATIONAL CENTER FOR EDUCATION STATISTICS
Institute of Education Sciences

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1.0 Introduction to the American Community Survey Comparable Wage Index for Teachers (ACS-CWIFT)

The Comparable Wage Index (CWI) is an index that was initially created by the National Center for Education Statistics (NCES) to facilitate comparison of educational expenditures across locales (principally school districts, or local educational agencies—LEAs) or states (state educational agencies—SEAs).[1] The CWI is a measure of the systematic, regional variations in the wages and salaries of college graduates who are not PK-12 educators as determined by reported occupational category. It can be used by researchers to adjust district-level finance data at different levels in order to make better comparisons across geographic areas.

This documentation describes the creation of a CWI for teachers based primarily on the American Community Survey (ACS). The ACS, an ongoing survey conducted by the U.S. Census Bureau, has replaced the decennial census as the primary source of detailed demographic information about the U.S. population. It provides information about the earnings, age, occupation, industry, and other demographic characteristics for millions of U.S. workers. The ACS-CWIFT (called CWIFT throughout the rest of this document) measures wage and salary differences for college graduates, using an analysis that is modeled after the baseline analysis used to construct the original CWI released by NCES in 2006.

The remainder of this documentation includes background information, detailed information about the CWIFT, a user guide, and a glossary of terms.

1.1 Background

Geographic cost data for states, metropolitan areas, and school districts are frequently and widely requested by policymakers, the public, practitioners, and school finance research community. In response, the National Center for Education Statistics (NCES) has engaged in a long tradition of publishing research and analysis on geographic cost indices.[2] This report documents the newly developed American Community Survey Comparable Wage Index for Teachers (CWIFT).

The goal of any geographic cost index is to measure uncontrollable differences in the purchasing power of school districts so that comparisons among districts or across time can be based on real educational resources. Where costs are high, districts are unable to purchase as many real resources for each dollar of expenditure; where costs are low, districts have greater purchasing power and are able to provide more real resources for similar levels of spending. In other words, school districts in high cost environments must spend more than school districts in low cost environments just to provide the same level of educational services. A geographic cost index attempts to describe how much more. The cost of labor, in particular the wages paid to teachers, is one of the largest costs for school districts. For this reason, NCES has focused on measuring the variation in labor costs by geographic location.

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[1] The CWI was initially developed by Dr. Lori L. Taylor at the Bush School of Government and Public Service, Texas A&M University and William J. Fowler, Jr. at NCES. Dr. Taylor's research was supported by a contract with the NCES. The complete description of the research is provided in the NCES Research and Development report "A Comparable Wage Approach to Geographic Cost Adjustment" (NCES 2006-321). Dr. Alan F. Karr and Dr. Satkartar K. Kinney at the National Institute for Statistical Sciences (NISS) also provided valuable assistance and guidance to NCES about geographic adjustment factors. Their technical reviews and supplemental analysis directly informed and benefited the development of the CWIFT.

[2] For example, see Brazer and Anderson (1983), Barrow (1994), Chambers (1998), Fowler and Monk (2001), Goldhaber (1999), Taylor and Keller (2003), and Taylor and Fowler (2006).

The CWIFT is designed to identify geographic variation in wages for college-educated workers outside of the education field after controlling for job-related and demographic characteristics.[3] The basic premise of any CWI is that all types of workers demand higher wages in areas where the cost of living is high or desirable local amenities (such as good climate, low crime rates, or access to beaches, museums, and fancy restaurants) are lacking. As a result, it should be possible to measure most of the geographic variation in the cost of hiring teachers and other PK-12 educators by observing systematic, regional variations in the wages of comparable workers who are not PK-12 educators.[4]

In theory, if accountants, nurses, and computer programmers, for example, all earn 5 percent more than the national average for their professions in Houston, then it is reasonable to expect that the cost of hiring teachers in Houston would also be 5 percent more than the national average for teachers.

The CWIFT has been developed as a special tabulation of restricted-use data from the three most recent years of the ACS. The CWIFT measures local differences in the prevailing wage for college graduates in all jobs.

The CWIFT updates the baseline analysis used to estimate the initial CWI developed by NCES (Taylor and Fowler 2006). The initial CWI developed by NCES was based on public-use data from the 2000 Census. The initial CWI based labor market definitions on Public Use Microdata Areas (PUMAs) which are "special non-overlapping areas that partition each state into congruous geographic units containing no fewer than 100,000 people each."[5] In constructing the CWIFT, Census Bureau researchers have access to the restricted-use files and are therefore able to base local labor market definitions on counties, which are the units of analysis most commonly used by the US Bureau of Labor Statistics (BLS) to define labor markets.[6] As a result, in stark contrast to the initial CWI released by NCES which provided labor cost estimates for 800 labor market areas, the CWIFT provides labor cost estimates for 1,570 local labor market areas.

The CWIFT incorporates the recommendations of an expert panel on the CWI convened by NCES in January 2012. The expert panel recommended that NCES annually produce and release geographic adjustment factors for educational expenditures.[7] The panel recommended that the factors be based on

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[3] The ACS asks respondents questions related to income in the past twelve months. If the respondent reports receiving income in "[w]ages, salary, commissions, bonuses, or tips from all jobs," they are asked to "[r]eport amount before deductions for taxes, bonds, dues, or other items" for the 12 months prior to the response date. Any future reference to "wage(s)' or "wage(s) and salary(ies)" in this documentation includes all the items contained in the question. Any future references of "log wage(s)" includes the log of wage(s) and salary(ies).

[4] For example, see Rothstein and Smith (1997), Guthrie and Rothstein (1999), Goldhaber (1999), Alexander et al. (2000), Taylor et al. (2002), Stoddard (2005), Taylor (2006), and Taylor (2015).

[5] PUMA definition is available on the Census Bureau's website about ACS PUMS.

[6] The BLS provides wage and employment data for counties, metropolitan areas and nonmetropolitan areas. Metropolitan areas "consist of one or more counties (or towns and cities in New England) and contain a core area with a substantial population that has a high degree of economic and social integration with the surrounding areas." Source: BLS Wage Data Overview website.

[7] The NISS/NCES Technical Expert Panel made the following recommendations (Karr and Kinney 2012):

1. NCES annually produce and release geographical adjustment factors for educational expenditures (referred to [ ] as GAFEEs).
2. GAFEEs should: a. Support both cross-sectional and temporal comparisons; b. Be accompanied by detailed documentation of the data sources, methodology and statistical uncertainties in their values.
3. GAFEEs be based on one-year restricted-access data files produced by the American Community Survey (ACS), and be reported as rapidly as possible once data become available.

one-year restricted-access data files produced by the American Community Survey (ACS), but recognized that it may be desirable to base the estimation on multiple years. The CWIFT uses three years of restricted-access data in order to contain sufficient sample in optimally-sized local labor markets for high data quality.

1.2 Strengths and Weaknesses of the Comparable Wage Approach

A CWI offers many advantages over other geographic cost adjustment methodologies.[8] A CWI can be estimated from existing data, making it more cost-effective to estimate and update than other approaches.

A CWI clearly measures costs that are beyond the control of school district administrators. Unlike cost adjustments that are based on analyses of school district expenditures (as in Chambers 1998 or Taylor, Chambers, and Robinson 2004) there is no risk that a CWI confuses high-spending school districts with high-cost school districts and no need to rely on statistical technique and researcher judgment to separate controllable from uncontrollable costs.

A CWI is 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 a CWI will not (Hanushek 1999; Goldhaber 1999).

A CWI reflects differences in amenities as well as the cost of living. As such, it is a more complete price index than the cost of living indices used for regional cost adjustments in the Colorado and Wyoming school funding formulas (Taylor 2015). Cost of living indices like the Wyoming Cost of Living Index have been criticized for over-estimating labor costs in locations where attractive amenities make it a desirable place to live and work (Rothstein & Smith 1997; Stoddard 2005; Taylor 2015).

Another advantage of the comparable wage approach is its general applicability. Because the resulting cost index is based on systematic differences in 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 limitations to using a CWI to measure variations in the cost of education. First, the CWI is a labor cost index, and labor cost is only part of the total cost of education—albeit a very large part. It could be problematic to apply a labor cost index such as the initial CWI or CWIFT to school district expenditures that are not affected by labor cost differentials, such as energy costs (Smith et al. 2003).

Second, the labor cost model underlying any CWI presumes that workers are mobile. If moving costs or other barriers to moving slow worker migration, then "labor cost may temporarily diverge from what would be expected given local amenities and the local 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. [A] CWI cannot capture this effect." (Taylor 2006, p. 352).

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4. GAFEEs be calculated using a modification of the current CWI base year methodology that: a. Accounts properly for the state-level random effects, and estimates these effects correctly; b. Does not exclude industry and occupation classifications related to education; c. Includes the ACS field of degree variable as a predictor; d. Properly includes weights in the mixed model as well as in mean calculations across geography.
5. GAFEEs be reported to no more than two decimal places (x.yy).

[8] For a more detailed discussion of the advantages and disadvantages of the CWI, see Taylor and Fowler (2006) or Taylor (2015).

Third, a CWI is constructed assuming that educators and the non-educator population under analysis are comparable with respect to their tastes for amenities and the cost of living. If comparability breaks down, then a CWI becomes a poor proxy for the cost of educator labor.

Fourth, a CWI is an estimate from a sample survey and is subject to the usual criticisms of sample-based research, including sampling error.[9] As a result, data users will need to account for this variability when making claims about differences between estimated means. The CWIFT estimates are reported along with standard errors to facilitate this review.

Finally, a CWI is based on local labor markets, not school districts. It is not designed to capture variations in cost across school districts within a single labor market, such as those cost differences that might be attributable to working conditions in specific school districts. It is also not designed to map perfectly onto school district boundaries. When school districts operate in multiple labor markets (as may be the case when districts cross county lines), researchers must develop strategies for matching index values to school districts. Such strategies may introduce measurement error.

2.0 The CWIFT Methodology

The CWIFT is derived from a regression analysis of individual wage data. The data for the analysis come from the three ACS survey years because the sample is larger and yields more precise estimates of wages by location than could be generated using only a single year of ACS data. The larger sample also permits a much finer geographic breakdown than would be possible in an analysis based on a single year of the ACS.

The ACS asks respondents about employment characteristics, including location of workplace. Geography contributes to, and is involved in, ACS sampling, data collection, weighting, and data tabulation activities. The place of work geographies are derived from the respondents' answers to the survey and are not based on where the surveys are sent, which helps reduce the possibility of disclosure. The place of work geographies for this tabulation are counties.

The ACS collects respondents' total wages, not wages by job. Respondents with more than one job are identified by their primary occupation and industry, while the wages and hours worked may be based on more than one job. To the extent that hourly earnings differ between the primary and secondary job, this introduces a possible source of measurement error because the CWIFT regression model attributes all wages to the primary occupation and industry.[10] The estimated coefficients for specific occupations or industries in which multiple job holding is more common, such as firefighters, emergency medical technicians, and dental hygienists, may be particularly affected. (Teachers are another occupation with relatively high rates of multiple job holding, but they are excluded from the estimation of the CWIFT.)

2.1 The Sample

The estimation sample has been constructed to ensure that the non-educator population is comparable to teachers with respect to their sensitivity to housing costs and local amenities.

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[9] The CWIFT is also subject to nonsampling error such as nonresponse error, coverage error, measurement error, and processing error. For more information on ACS methodology, see the Census Bureau's ACS website.

[10] Hirsch, Husain and Winters (2016) "guestimate" that the difference in wages between primary and secondary jobs is approximately 6 percent. However, their estimates include all levels of educational attainment and include teachers, who are among the most common types of workers to hold secondary jobs. We have no data on the extent of wage differentials among college graduates who are not educators (the CWI population).

The sample consists of people who:

1. Are employed in private for-profit, private not-for-profit, or government industries (excludes unemployed and self-employed/unpaid family workers)
2. Are between the ages of 18 and 80
3. Work at least 20 but fewer than 90 hours per week
4. Worked between 27 and 52 weeks in the past 12 months
5. Have at least a bachelor's degree
6. Have annual wage and salary earnings above $5,000
7. Work in one of the 50 states or D.C.
8. Do not work in the elementary/secondary education industry and are not education administrators, teachers, librarians, teaching assistants, or miscellaneous other education workers.

(See Taylor and Fowler 2006).

Self-employed workers are excluded because their reported wage and salary earnings may not represent the market value of their time. Individuals who report working less than half time or for more than 90 hours a week are excluded, as are workers under the age of 18 and over the age of 80 and workers without a bachelor's degree, because they are unlikely to be comparable to teachers. Individuals who report earning less than $5,000 in the past year (despite working at least half time) are excluded because their responses are implausible. Workers for whom the Census Bureau imputes key attributes of their job (wages, occupation, industry, or hours worked) from donor sample cases are excluded. Finally, individuals employed outside the United States are excluded because their wages may represent compensation for foreign travel or other working conditions not faced by domestic workers.

The estimation sample does not include anyone who has a teaching or educational administration occupation or who is employed in the elementary and secondary education industry.[11] Such persons are excluded from the analysis because it is conceptually important that the wages and salaries reflected in the CWIFT be outside of school district control (i.e., be independent of school district hiring practices or the influences of unionization). Including PK-12 educators in the estimation sample would undermine one of the key advantages of the CWI approach to educational cost adjustment.

All other occupations and industries have been included in the analysis. Retaining all non-educator occupations and industries greatly increases the sample size and reduces the noise in the estimates of local wage levels. Furthermore, as discussed in Taylor and Fowler (2006), a CWI is not influenced by differences in pay levels or job characteristics from one occupation or industry to another because it is based on demographically-adjusted pay differentials within each occupation or industry. Without evidence that differences in job description imply differences in tastes for housing or local amenities, there would be no gain from restricting the sample to a subset of occupations or industries.

[11] The expert panel on the initial CWI released by NCES recommended that the geographic cost adjustment factors should not exclude industry and occupation classifications related to education, arguing that the original CWI was not very sensitive to the occupational and industry exclusions and that including the education sector would increase the sample size. However, the fact that the CWI reflects wage differences outside of education is crucially important conceptually and one of the major reasons why this approach appeals to researchers. Including educators in the estimation sample would fundamentally change the nature of the wage index.

2.2 The Variables

The dependent variable is the log of reported wage and salary earnings in the past year. Ideally, the dependent variables would reflect total compensation and include not only wages and salaries, but also fringe benefits. Unfortunately, survey respondents are not asked about the value of their fringe benefits[12] (if any) so more complete data on worker compensation are not available.[13]

The independent variables describe the workers and the jobs they held. The worker characteristics include continuous variables for age, age squared, and the number of hours worked per week; categorical variable for weeks worked per year; and indicator variables for gender, race, English-speaking ability, educational attainment, and undergraduate field of degree.[14] The model includes the interaction between sex and age, to allow for the possibility that men and women have different career paths, and therefore different age-earnings profiles.[15] The job characteristics include indicator variables for occupation and industry for each year. This specification allows wages to rise (or fall) more slowly in some occupations or industries than it does in others. Such flexibility is particularly important because the analysis period includes the period immediately after the "Great Recession," and some industries and occupations are recovering more slowly than others.

Finally, the regression includes indicator variables for each local labor market area. The local labor market indicators[16] capture the effect on wages of all location-specific characteristics, including the price of housing, the crime rate, and the climate.[17]

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[12] The only question about fringe benefits included in the ACS was a yes or no question that did not differentiate between health insurance tied to the respondent's current job and health insurance tied to a family member's job or to the respondent's previous job. The question asks, "Is this person covered by any of the following types of health insurance or health coverage plans: Insurance through a current or former employer or union (of this person or another family member?)."

[13] To the extent that fringe benefits differ systematically across industries or occupations, they will be captured by regression fixed effects and have no impact on the CWIFT. However, as discussed in Taylor and Fowler (2006) systematic differences in benefits across states—such as those that might arise if workers take more of their compensation in the form of benefits in states with income tax than they do in states without income tax—could bias the CWIFT.

[14] The degree fields are aggregated to the two-digit level, and include: agricultural sciences; environmental sciences; architecture; area ethnic and civilization studies; communications; communication technologies; computer and information sciences; cosmetology and culinary arts; education; engineering; engineering technologies; languages; family and consumer sciences; pre-law and legal studies; literature; liberal arts and humanities; library science; biological sciences; mathematics and statistics; military technologies; multidisciplinary studies; physical fitness, parks, recreation, and leisure; philosophy and religious studies; theology; physical and related sciences; applied biotechnology; psychology; criminal justice and fire protection; public administration, public policy and social work; social science; construction services; electrical and mechanical repairs and technologies; precision production; transportation sciences and technologies; visual and performing arts; healthcare; business; and history.

[15] This is a change from Taylor and Fowler (2006), and represents an enhancement in the modeling. The estimation suggests that the age-earnings profiles of men and women are different in statistically and analytically meaningful ways.

[16] The local labor market indicators, which are also known as labor market fixed effects, capture both measurable and unmeasurable characteristics of local labor markets.

[17] In contrast to the current CWIFT, the baseline model for the original CWI also included random effects for states. Although the Technical Expert Panel recommended that the predicted wages used to generate the CWI incorporate the average state-level random effects, this would have been be particularly consequential for index values in metropolitan areas that straddle state lines (such as Kansas City or New York City). The CWIFT local labor markets do not cross state lines, which removes the need for any state-level random effects.

The regression model is produced using ACS person data collected over three survey years. The models are produced for "local labor market" geographic areas. The first production of CWIFT used data from 2013-2015 and is referred to as the 2015 CWIFT. It contained 1,570 local labor markets in the United States. The 1,570 local labor market areas are based on counties or county equivalents and an individual's reported place of work, not place of residence. As such, it is possible for an individual to live in one county but work in another. Each individual's compensation contributes to the estimate of the prevailing wage in their place of work, regardless of their place of residence.

NCES requested a minimum number of sample cases to help improve data quality and to keep local labor market geographies stable over time. Each local labor market must contain at least 100 unweighted universe cases per county of work from data collected in 2013 through 2015. Those that do not meet the minimum are successively combined with the neighboring county within the same state that has the fewest cases until every local labor market has at least 100 unweighted universe cases. The neighboring counties are determined by a county adjacency file that was created from the U.S. Census Bureau's 2015 TIGER geographic shapefiles. Counties must share a least one mile of border to be considered "neighboring." The local labor markets are created with at least 100 unweighted universe cases to allow for fluctuations in sample count in subsequent years and still provide sufficient sample size for estimation (at least 50 cases). Local labor markets will be redefined with new ACS data when (1) county boundaries change and cross the local labor markets boundaries and/or (2) local labor markets do not contain a sufficient number of sample cases to produce reliable estimates. The user notes associated with each file will identify the year that the local labor markets were defined.

2.3 The Estimation

Table 1 presents selected coefficients from generalized least squares estimation of the CWIFT wage model from the initial production year. The estimation sample for the first production of CWIFT contained 1,391,896 survey respondents and the regression is weighted using the person weights provided by the Census Bureau. Replicate weights are used to incorporate known sampling error into adjusted standard errors for the coefficients.[18] The ACS employs the Successive Differences Replication (SDR) method […] to produce variance estimates. It has been the method used to calculate ACS estimates of variances since the start of the survey" (ACS Design and Methodology, 2014 – Chapter 12, Page 1). ACS replicate weights were applied to the CWI model using SAS PROC SURVEYREG to help account for known sampling error.[19]

As the table illustrates, the estimated model is consistent with reasonable expectations about labor markets. Wages and salaries increase with the amount of time worked per week and the number of weeks worked per year. Wages and salaries also rise as workers get older, but the increase is more rapid for men than for women (perhaps because age is not as good an indicator of experience for women as it is for men). Workers with advanced degrees earn systematically more than workers with a bachelor's degree. Non-Hispanic whites earn systematically more than comparable individuals from other racial or

[18] Replicate weights were used to adjust the standard errors of the CWI for survey error in addition to model error. The use of replicate weights has no effect on the CWI values themselves. For more information on ACS design and methodology see the Census Bureau's ACS Design and Methodology Report. Information on replicate weights and variance estimation can be found in Chapters 11 and 12. For additional discussion of ACS variance estimation, see Chapter 12 of the ACS Design and Methodology report.

[19] The model incorporated ACS replicate weights to estimate sampling errors of the estimators using SAS PROC SURVEYREG. Additional information of the SAS SURVEYREG procedure is available here on the SAS support page overview of SURVEYREG procedure.

ethnic groups. Workers who do not speak English earn substantially less than other college-educated workers, all other things being equal.

Table 1. Selected coefficient estimates from the ACS model of log annual wage and salary income: 2013, 2014, and 2015

	ESTIMATE	STANDARD ERROR	
Usual Hrs. Worked Per Week (in logs)	0.9166	0.0030	**
50 To 52 Weeks Worked	0.5545	0.0045	**
48 To 49 Weeks Worked	0.4486	0.0063	**
40 To 47 Weeks Worked	0.3045	0.0058	**
27 To 39 Weeks Worked	0.0000	0.0000	
Female	0.3105	0.0137	**
Male	0.0000	0.0000	
Age	0.0847	0.0005	**
Age, Squared	-0.7861	0.0056	**
Female*Age	-0.0161	0.0007	**
Female*Age, Squared	0.1275	0.0074	**
Not An English Speaker	-0.5075	0.0242	**
Bachelor's Degree	-0.2696	0.0028	**
Master's Degree	-0.1561	0.0027	**
Professional Degree	-0.0519	0.0038	**
Doctoral Degree	0.0000	0.0000	
Hispanic	-0.1077	0.0022	**
White, Alone	0.0617	0.0039	**
Black Or African American, Alone	-0.0734	0.0043	**
American Indian and Alaska Native, Alone	-0.0195	0.0089	*
Asian, Alone	-0.0390	0.0041	**
Native Hawaiian and Other Pacific Islander, Alone	-0.0395	0.0209	
Some other race, Alone	-0.0111	0.0079	
Two Or More Races	0.0000	0.0000	
Undergraduate Degree Field Indicators?	Yes		
Industry*Year Indicators?	Yes		
Occupation * Year Indicators?	Yes		
Local labor Market Indicators?	Yes		
Number Of Observations	1,391,896		

Source: U.S. Census Bureau special tabulation.
Note: ** indicates that the coefficient is significantly different from zero at the 1-percent level while * indicates a coefficient that is significantly different from zero at the 5-percent level.
Note: Due to OMB guidelines, respondents are asked separately about race and Hispanic origin. Respondents who identify as Hispanic will also have a race identified. For these data, 73% of Hispanic respondents identified as White, 15% identified as Some Other Race, 5% identified as Two Or More Races, 3% identified as Asian, 3% identified as Black or African American, and the remainder identified as American Indian, Alaska Native, or Native Hawaiian and Other Pacific Islander.

2.4 The Construction of Market-level and County-level Index Values

The predicted wage level in each local labor market area captures systematic variations in labor earnings while controlling for demographics, industrial and occupational mix, and amount of time worked. The coefficient estimates from the regression analysis were used to predict the log wage and salary that a

person with average characteristics would earn in each location..[20] Using those local predictions, the predicted log of wage and salary was calculated for each state and for the nation as a whole.[21] The predicted wage level for each location is the exponent of the corresponding predicted log of wage and salary. In turn, the CWIFT for each location is the predicted wage level for that location divided by the national average predicted wage, which was $62,655 for the 2015 CWIFT. The 2015 CWIFT ranged from 0.649 in rural Montana to 1.377 in New York County (Manhattan), New York.

A standard error for each predicted log of wage and salary was created and it incorporated both model and survey error. The standard error for the CWIFT in each geographic area is calculated by dividing one standard error of the predicted wage by the national average predicted wage.[22] Among the 1,570 local labor market areas in the United States, the standard error for the 2015 CWIFT ranged from 0.004 in Los Angeles County, California to 0.160 in rural Colorado.

County-level index values are simply the index and standard error values of their corresponding local labor market. For example, Stafford County, Kansas is in a local labor market area made up of eight neighboring counties. All eight counties, including Stafford County, received that market's index value of 0.737.

2.5 The Construction of LEA-level Index Values

As a general rule, the CWIFT for a local education agency (LEA) is the CWIFT for the corresponding county. However, some LEAs span multiple counties. In those cases, the CWIFT for the LEA is a population-weighted average of the CWIFTs for each county in the LEA. The weights reflect the shares of school-aged children in each LEA who live in each county.[23] For example, Abernathy Independent School District (ISD) straddles the border between Hale County, Texas and Lubbock County, Texas. For the 2015 CWIFT production, the U.S. Census Bureau estimated that 71 percent of Abernathy ISD's students live in Hale County and the remaining 29 percent live in Lubbock County using the FY15 Title I database with 2013/14 school district boundaries. Therefore, because the 2015 CWIFT for Hale County is 0.813 while the 2015 CWIFT for Lubbock County is 0.866, the 2015 CWIFT for Abernathy ISD is 0.828 (0.71*0.813+ 0.29*0.866).

2.6 Changes from the Initial CWI

Although the CWIFT is modeled after the baseline specification used to estimate the initial CWI, there are key differences beyond simple updating. Some of the differences arise from differences between the decennial census and the ACS. Others arise from the differences between restricted-use and public-use data files. Still other differences arise from enhancements in the modeling technique.

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[20] Formally, the predicted log wage level in each local labor market area (i.e. the least-squares mean or population marginal mean) is the mean wage level that would be expected from a balanced design holding all continuous variables at their means and all indicator variables at their population frequencies.

[21] At the state and national levels, the predicted log wage is a weighted average of the local predicted log wages, where the weights are the local employment shares for the estimated population based on the sample definition in section 2.1.

[22] In other words, for the 2015 CWIFT data, the dollar value of one standard error of the predicted wage divided by $62,655 is the CWIFT standard error. The dollar value of one standard error of the predicted wage is calculated by adding one standard error of the predicted log wage to the log wage, taking the exponent, and then subtracting the predicted wage.

[23] Data on the population aged 5-17 come from the U.S. Census Bureau's Small Area Income and Poverty Estimates (SAIPE). Of the estimates available for county pieces of school districts, the shares of the population aged 5-17 are most correlated with the shares of teachers.

The most obvious difference is the geography: the first CWIFT provided labor cost estimates for 1,570 local labor market areas based on counties and clusters of sparsely populated counties. In stark contrast, the initial CWI was based on 800 Census-defined place of work areas or metropolitan area aggregates of place of work areas. The increased geographic detail in the CWIFT—which is only possible with the restricted-use data—provides better representations of local labor market conditions than were possible with the initial CWI.

The enhanced geography of the CWIFT also facilitates the construction of more finely-grained index values for LEAs. With the initial CWI, school districts were matched to the labor market areas according to the county of record. Thus, an LEA that spanned more than one county had the CWI of the county where the head office (typically) was located. In contrast, the CWIFT for an LEA is a population-weighted average of the CWIFTs for each county in the LEA. Because LEAs may cross county lines, this change means that it is no longer necessarily the case that all of the LEAs in a local labor market have the same index values. In addition, changes from one year to the next in the CWIFT for a specific LEA could now arise from changes in the population weights as well as changes in the wage levels.

Differences in the survey questions between the decennial census and the ACS have led to changes in the specification of the hedonic wage model. The ACS measure of weeks-worked-per-year is categorical rather than continuous (as was the case with the decennial census) so the wage model changed accordingly. The ACS also contains data on the undergraduate field of degree that were not available with the decennial census. As was recommended by the expert review panel convened by NCES on the initial CWI, indicators for degree fields have been incorporated into the ACS hedonic wage model. Finally, the ACS collects data on occupations and industries that are based on more recent coding schemes than those used in the 2000 Census; those updated codes are used in the estimation of the ACS hedonic wage model.

Additional changes in the specification represent enhancements in modeling technique. The revised model includes the interaction between sex and age, to allow for age-earnings profile differences between men and women. It also includes indicators for whether or not the worker is Hispanic or does not speak English. Because the ACS model incorporates data from multiple years, it also incorporates the interaction between year indicators and the occupation or industry fixed effects. Whereas the initial hedonic wage model included random effects for states in the estimation, but did not include those random effects in the construction of the wage predictions, the ACS model does not include random effects at either stage (estimation or prediction), making the wage predictions more consistent with the underlying model. Unlike the initial model, the ACS model also incorporates replicate weights, which is consistent with the recommendations of the expert review panel on the initial CWI.

3.0 User Guide

There are CWIFT estimates for three different geographic levels:

1. The school district CWIFTs are created for each local education agency (LEA) in the Title I Database.[24] The CWIFT for each LEA is either the CWIFT for the corresponding county, or a school age child population weighted average of the CWIFTs for the corresponding counties

[24] User notes about the files will include information about which Title I database was used to weight LEAs that cross county lines.

when the LEA straddles county lines. The LEA boundaries are based on the U.S. Census Bureau's School District Review Program.[25]

2. The county CWIFTs are created for each county or county equivalent in the United States. The local labor market areas used to construct the CWIFT are based on counties or county equivalents. The CWIFT ratio is created by dividing the exponent of the log wage of the local labor market area by the national average wage and each county receives its local labor market index value and standard error. The local labor market code is included to identify the counties in each market.
3. The state CWIFTs are based on the average predicted log wage for each state (including Washington, DC). The state average predicted log wage is a weighted average of the county-level predicted log wages, where the weights are the local employment shares for the estimated population based on the sample definition in section 2.1. The state's CWIFT ratio is the exponent of the state's average predicted log wage divided by the national average wage.

3.1 LEA CWIFT File Description

The LEA-level CWIFT file is named CWIFT<yyyy>_LEA<schyr>.txt, where <yyyy> indicates the final year from the ACS sample (i.e., 2015) and <schyr> indicates the school year of the LEA boundaries (i.e., 1314 for the 2013/14 school year). It includes the following data elements.

- ***LEAID*** - The LEAID code uniquely identifies each local education agency (LEA) in the CCD database. It consists of seven characters: the two-digit state FIPS code (see Table 2) followed by a five-digit number that is unique to each agency within the state.
- ***LEA_NAME*** - Local Education Agency Name.
- ***ST_NAME*** - State name.
- ***LEA_CWIFTEST*** – CWIFT estimate for each LEA.
- ***LEA_CWIFTSE*** – CWIFT standard error for each LEA.

3.2 County CWIFT File Description

The Country-level CWIFT file is named CWIFT<yyyy>_County.txt, where <yyyy> indicates the final year from the ACS sample (i.e., 2015). It includes the following data elements.

- ***CNTY_FIPS*** – The county code uniquely identifies each county. It consists of five characters: the two-digit state FIPS code followed by a three-digit Federal Information Processing Standard (FIPS) code for each county or county equivalent.
- ***CNTY_*NAME** - County name.
- ***ST_NAME*** – State name.
- ***MKT<mktyr>*** – The local labor market code identifies the local labor market that corresponds to the county. All counties that make-up a local labor market will have the same local labor market code. Some local labor markets are only made up of one county. *<mktyr>* identifies the final year of the ACS data used to define the markets.

[25] For more information, see the Census Bureau's School District Review Program website. The school year is identified in the LEA file name.

- ***CNTY_CWIFTEST*** – CWIFT estimate for each county.
- ***CNTY_CWIFTSE*** – CWIFT standard error for each county.

3.3 State CWIFT File Description

The State CWIFT file is named CWIFT<yyyy>_State.txt, where <yyyy> indicates the final year from the ACS sample (i.e., 2015). It includes the following data elements.

- ***ST_FIPS*** – Two-digit Federal Information Processing Standard (FIPS) code for the state.
- ***ST_NAME*** – State name.
- ***ST_CWIFTEST*** – CWIFT estimate for each state.
- ***ST_CWIFTSE*** – CWIFT standard error for each state.

3.4 Using the Index to Make Geographic Adjustments

One important reason for the development of the CWIFT is to enable more meaningful comparisons across school districts. To normalize dollar amounts and make them comparable, divide the dollar amounts by the district-level CWIFT, which are already normalized to the national average wage. For example, suppose one wished to make an adjustment to expenditure data from the Elementary and Secondary Information (ELSI) system for the 2013-14 school year. The 2015 CWIFT for Los Angeles Unified School District 1.129. So the $6,137 total current expenditures on salary per pupil in Los Angeles Unified for 2013-14,[26] when normalized, are equal to $5,436 ($6,137 / 1.129). The 2013-14 total current expenditures on salary per pupil[27] by Palm Beach County School District (in Florida) were $5,433. Normalized to reflect the lower cost of hiring in this area, they are the equivalent of $5,677 ($5,433 / 0.957). In other words, even though Los Angeles Unified School District spent more than Palm Beach County School District in nominal terms, once the two dollar figures were adjusted for the difference in purchasing power between the two districts, Palm Beach County School District effectively spent $241 more per pupil than did Los Angeles Unified School District.[28]

3.5 Geographic Adjustment Applied to State Aid

Because one of the great virtues of the CWIFT is that it is outside of school district control, another application of the CWIFT is to adjust state aid to a school district for differences in wages. For example, consider a program intended to provide an additional $100 per pupil, but adjusted for geographic

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[26] U.S. Department of Education, National Center for Education Statistics, Common Core of Data (CCD), "Local Education Agency (School District) Universe Survey Directory Data", 2014-15 v.1a; "School District Finance Survey (F-33)", 2013-14 (FY 2014) v.1a.

[27] Current expenditures for salary are comprised of expenditures for the day-to-day operation of schools and school districts for public elementary and secondary education. General administration expenditures and school administration expenditures are included in current expenditures. Expenditures associated with repaying debts and capital outlays (e.g., purchases of land, school construction, and equipment) are excluded from current expenditures. Programs outside the scope of public prekindergarten through grade 12 education, such as community services and adult education are not included in current expenditures. Payments to private schools and payments to charter schools outside of the school district are also excluded from current expenditures.

[28] The Los Angeles Unified School District CWIFT SE is 0.004 resulting in an adjusted SE value of ±$25, The Palm Beach County School District CWIFT SE is 0.007 resulting in an adjusted SE value of ±$38. The comparison of adjusted values $5,436 and $5,677 is significant at the 95% confidence level.

variations in the cost of education. The 2015 CWIFT for New Rochelle, NY in 2015 is 1.163, or 16.3 percent higher than the national average; the 2015 CWIFT for Buffalo, NY is 0.902, or approximately 10 percent lower than the national average. Therefore, to receive the same increase in purchasing power as a $100 increase in Buffalo City School District, New Rochelle City School District would need to receive $128.94 ($100*(1.163 / 0.902)).[29]

3.6 Standard Errors

The standard error of each predicted wage level indicates the precision with which it was measured. Dividing one standard error of each predicted wage by the national average wage yields the standard error of the CWIFT, which ranges from 0.004 in Los Angeles County, California to 0.160 in rural Colorado for the 2015 CWIFT.

4.0 Glossary

American Community Survey (ACS) An ongoing survey conducted by the U.S. Census Bureau. It has replaced the decennial census as the primary source of detailed demographic information about the U.S. population.

Elementary/Secondary Education Programs providing instruction, or assisting in providing instruction, for students in grades preK–12 and ungraded programs.

Fiscal Year (FY) The 12-month period to which the annual operating budget applies. At the end of the fiscal year, the agency determines its financial condition and the results of its operations.

Local Labor Market A labor market is an economically integrated area within which individuals can reside and find employment within a reasonable distance or can readily change jobs without changing their place of residence (as defined by the U.S. Bureau of Labor Statistics on the Local Area Unemployment Statistics website). Local labor markets are the units of analysis for the Comparable Wage Index study. They are geographic regions (either individual counties or groupings of neighboring counties) that have the same value for a comparable wage index.

Local Education Agency (LEA) Often called a school district; primary responsibility is to operate public schools or to contract for public school services.

[29] The New Rochelle City School District CWIFT SE is 0.01 and the adjusted SE value of the ratio is 0.48. The comparison of a $128.94 increase to a $100 increase is significant at the 95% confidence level.

Table 2. Federal Information Processing Standards State Codes, by state abbreviation and state name

State abbreviation	State name	FIPS State code
AL	Alabama	01
AK	Alaska	02
AZ	Arizona	04
AR	Arkansas	05
CA	California	06
CO	Colorado	08
CT	Connecticut	09
DE	Delaware	10
DC	District of Columbia	11
FL	Florida	12
GA	Georgia	13
HI	Hawaii	15
ID	Idaho	16
IL	Illinois	17
IN	Indiana	18
IA	Iowa	19
KS	Kansas	20
KY	Kentucky	21
LA	Louisiana	22
ME	Maine	23
MD	Maryland	24
MA	Massachusetts	25
MI	Michigan	26
MN	Minnesota	27
MS	Mississippi	28
MO	Missouri	29
MT	Montana	30
NE	Nebraska	31
NV	Nevada	32
NH	New Hampshire	33
NJ	New Jersey	34
NM	New Mexico	35
NY	New York	36
NC	North Carolina	37
ND	North Dakota	38
OH	Ohio	39
OK	Oklahoma	40
OR	Oregon	41
PA	Pennsylvania	42
RI	Rhode Island	44
SC	South Carolina	45
SD	South Dakota	46
TN	Tennessee	47
TX	Texas	48
UT	Utah	49
VT	Vermont	50
VA	Virginia	51
WA	Washington	53
WV	West Virginia	54
WI	Wisconsin	55
WY	Wyoming	56

SOURCE: U.S. Department of Commerce, National Institute of Standards and Technology, Computer Systems Laboratory. *Federal Information Processing Standards Publication 5-2, Codes for the Identification of the States*, *The District of Columbia and the Outlying Areas of the United States, and Associated Areas.* Gaithersburg, MD: 1970.

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