Estimating State- and Industry-Specific Denominators for Calculating Workers' Compensation Claim Rates

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FOREWORD

Workers' compensation claims have been a useful and increasingly promising source of information on patterns and sources of injuries and illnesses in U.S. workplaces. NIOSH has therefore encouraged state health agencies to develop capacity to retrieve and analyze these data effectively. One key analysis task is calculating and comparing industry claim rates in order to help set prevention priorities. However, there have been challenges in determining the best ways to obtain or estimate denominators for these rates.

This document is the result of years of providing technical assistance to state agencies with regard to denominators. I trust that it will simplify the task of selecting methods for estimating denominators and serve as a basis for further development of denominator methods.

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LIST OF ACRONYMS, ABBREVIATIONS, AND SPECIAL TERMS

Term	Definition
ACS	American Community Survey. Conducted by the U.S. Census Bureau.
ACSv1	American Community Survey version 1. This refers to a version of the calculation of FTE/EE using ACS data. It is based on the method explained in Section 3 in which usual hours per week is divided by 40.
ACSv2	American Community Survey version 2. This refers to a version of the calculation of FTE/EE using ACS data. It is based on an alternative method in which usual hours per week is multiplied by weeks worked in the previous year and divided by 2,000 (the number of hours taken to represent full-year, full-time work).
ACS PUMS	American Community Survey Public Use Microdata Sample
BLS	U.S. Bureau of Labor Statistics
Census Bureau	U.S. Census Bureau
Census industry code	Industry codes used in population and household surveys such as ACS and CPS. Census industry codes correspond to NAICS codes as far as possible, but they do not classify industries in as much detail as NAICS codes.
CES	Current Employment Statistics. Based on a survey conducted by BLS.
CI	Confidence interval
Claim rate ACSv1	Claim rate calculated using FTE/EE based on ACSv1 to estimate the number of FTEs in the denominator.
Claim rate ACSv2	Claim rate calculated using FTE/EE based on ACSv2 to estimate the number of FTEs in the denominator.
Claim rate OPT	Claim rate calculated using FTE/EE based on OPT data to estimate the number of FTEs in the denominator.
COW	Class of Worker. Variable in ACS data that classifies workers into the following categories: employee of private for-profit business, employee of private nonprofit organization, federal government employee, state government employee, local government employee, self-employed in own incorporated business, self-employed in own unincorporated business, working without pay in family business or farm.
CPS	Current Population Survey. Co-sponsored by U.S. Bureau of Labor Statistics and U.S. Census Bureau. Conducted by U.S. Census Bureau.
Denom ACSv1	Number of FTE employees based on multiplying FTE/EE based on ACSv1 by number of employees from QCEW or other source.
Denom ACSv2	Number of FTE employees based on multiplying FTE/EE based on ACSv2 by number of employees from QCEW or other source.
Denom OPT	Number of FTE employees based on multiplying FTE/EE based on OPT data by number of employees from QCEW or other source.

Term	Definition
EE	Employees
EIN	Employer Identification Number. Also known as federal EIN (FEIN).
ESR	Employee Status Recode. In ACS data, classifies survey respondents as follows: civilian employed, at work; civilian employed, with a job but not at work; unemployed; armed forces, at work; armed forces, with a job but not at work; not in labor force.
Establishment	Generally, a single physical location where business is conducted, or services or industrial operations are performed. An employer or enterprise may consist of one or more locations. See the subsection on assigning NAICS codes to multi-establishment employers in Section 11, as well as Appendices A and Appendix I.
FEIN	Federal Employer Identification Number. Also known as Employer Identification Number (EIN) and Federal Tax Identification Number (FTIN).
FROI	First Report of Injury. Form submitted to initiate a workers' compensation claim.
FTE	Full-time equivalent employee or worker
FTE/EE	Number of FTEs per employee or worker
FTE/EE adjustment factor	Ratio used to adjust the number of employees (EE) to obtain the number of FTEs (FTE/EE * EE = FTEs)
LED extraction tool	Tool for extracting Longitudinal Employer-Household Dynamics data, including QWI data.
LPC data	Labor Productivity and Costs data. Data formerly produced by the Labor Productivity and Costs program of the Bureau of Labor Statistics. Now produced by the BLS Office of Productivity and Technology.
Master NAICS code	Summary NAICS code for an employer assigned within QCEW data.
MEEI code	A code used in QCEW data to indicate the part of an employer associated with a NAICS code.
MOE	Margin of Error. A measure of the error associated with an estimate. The estimate plus or minus the MOE defines the confidence interval around an estimate. The MOE is calculated by multiplying the standard error of the estimate by a factor that depends upon the desired probability that the estimate falls within the confidence interval (see Section 6).
MWR	Multiple Worksite Report. A report that employers with multiple locations are required to submit to provide data for the QCEW.
NAICS	North American Industry Code System
NAICSP	A data field in ACS data that records the NAICS code or codes that correspond to a given census industry code. Also indicates, where relevant, more detailed information about the relationship between the given census industry code and a specific NAICS code.
OEWS	Occupational Employment and Wages Statistics. A dataset based on a BLS survey.

Term	Definition
OBWC	Ohio Bureau of Workers' Compensation
OPT	Office of Productivity and Technology within the Bureau of Labor Statistics
OSHA	Occupational Safety and Health Administration
PI	Prevention Index. Index whose purpose is to identify industries in which prevention efforts are most needed. An average of an industry's rank by number of injuries and illnesses and its rank by claim rate.
PUMS	Public Use Microdata Sample. Used, for example, to refer to data from the ACS.
Primary job	Within ACS data, the job for which usual weekly hours is greatest.
PWGTP	Denotes Person Weight in ACS data.
QCEW	Quarterly Census of Employment and Wages
QWI	Quarterly Workforce Indicators
QWI Explorer	Tool for extracting QWI data.
RFEW	Report of Federal Employment and Wages. Used to gather information for the QCEW.
rMOE	relative Margin of Error. Margin of Error of an estimate as a proportion of the estimate (MOE/estimate).
Secondary job/ Second job	The job for which usual weekly hours is less than usual weekly hours of the primary job but more than for any additional jobs.
SOII	Survey of Occupational Injuries and Illnesses
UI	Unemployment Insurance
WC	Workers' Compensation
WKHP	In ACS data, usual hours worked per week in the past 12 months.
WKW	In ACS data, weeks worked during the past 12 months.

SUMMARY

This publication reports on a variety of analyses and investigations that have been conducted over several years with the goal of obtaining accurate denominator data to calculate rates of workers' compensation (WC) claims by industry. This research has been conducted because WC systems do not usually have the preferred kinds of denominators used in public health analyses. NIOSH therefore sought denominators among a variety of government data sources.

Although this technical report can provide practical suggestions on selection and estimation of denominators, it cannot always be definitive. Clearly, there is a continuing need to learn more about complex government statistical programs and surveys. There are also additional issues to consider with regard to joining the data from these programs and surveys to available WC claims data. Further investigations of the data sources focused on here, as well as additional data sources, would be beneficial and may lead to improved guidance in the future. This summary begins with a brief overview and then proceeds with a more detailed summary of each section of the report. It concludes with a brief note on potential future work and developments.

Overview

The goal of this report is to determine the best ways of obtaining full-time equivalent (FTE) denominators on the industry-state level for 3- and 4-digit industries as defined by the North American Industry Classification System (NAICS).[5] NIOSH proposes that FTEs be estimated by multiplying an employee count from the Quarterly Census of Employment and Wages (QCEW)[6] by an FTE per employee (FTE/EE) adjustment factor from another survey data source. Data from the Office of Productivity and Technology (OPT) of the U.S. Bureau of Labor Statistics (BLS)[7] and the America Community Survey (ACS)[8] of the U.S. Census Bureau (Census Bureau) are two key alternative sources for FTE/EE estimates. Key advantages and disadvantages of each include the following:

- OPT data on hours of work by industry are more accurate than ACS data for reasons explained in Sections 2 and 3 and Appendix C. Use of OPT data also requires fewer calculations, provides data for all NAICS 4-digit industries, and does not have calculable error associated with them. However, OPT data are available only on the national level.
- ACS data provide state- and industry-specific FTE/EE estimates that capture significant variation among states within industries, as explained in Section 2.

Using ACS data requires that a few issues be addressed:

- Census industry codes need to be mapped onto NAICS codes. This presents few problems on the NAICS 3-digit level but is not possible for many 4-digit NAICS codes. (See Section 4)
- ACS FTE/EE estimates are associated with some sampling error, making it good practice to calculate margin of error (MOE) for FTE/EE estimates and determine the resulting amount of error in estimates of claim rates. (See Section 6)
- Multiple years of ACS data may be combined to center the data on the desired year or to enable estimation of FTE/EE for smaller NAICS 4-digit industries and increase precision. (See Section 7)

ACS FTE/EE estimates, OPT FTE/EE estimates, and QCEW employee counts are all viable alternative denominators for ranking industries. Washington State data were used to compare rankings of

5 U.S. Census Bureau, North American Industry Classification System. https://www.census.gov/naics/

6 U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages. https://www.bls.gov/cew/

7 U.S. Bureau of Labor Statistics, Hours worked and employment measures (table). Washington, DC: https://www.bls.gov/productivity/tables/.

8 U.S. Census Bureau. American Community Survey. https://www.census.gov/programs-surveys/acs.html

industries by claim rate using these alternative denominators and results were quite similar. (See Section 8) However, note that these findings apply only to 2014 data from the State of Washington. It would be useful to conduct similar denominator comparisons with data from other states and years as well.

To calculate claim rates, claims need to be classified to NAICS codes and the number of insured employees in each NAICS code needs to be obtained. If, as is often the case, this information is not available or complete in WC data systems, employer records in WC data need to be linked to employer records in the QCEW. Section 11 of the report discusses the methods some states have used to address this challenge, as well as methods of obtaining summary NAICS codes for employers from QCEW data.

Section 1: Introduction

Section 1 outlines the advantages of using WC claims data to estimate rates of injuries and illnesses by industry. It also summarize the available data and general methods for estimating claim rate denominators.

Although the BLS, based on the Survey of Occupational Injuries and Illnesses (SOII), already publishes injury and illness incidence rates per 100 FTEs by industry for most states, WC datasets can be larger than those from the BLS SOII because WC datasets may cover all or a very large portion of insured employers in a state, whereas the BLS SOII is based on industry, size, and ownership-specific samples of employers in each state. This allows rate calculations on a more detailed industry level within individual states. In addition, WC claims data can be classified in more specific ways based on injury narratives, diagnosis, treatment, and more complete information on type and length of disability. Unlike SOII data, claims data can also provide estimates of injury cost and be used to calculate incidence rates for substate regions and individual employers.

Injury narratives provide detailed information on the circumstances of injuries and illnesses and are captured both in WC systems and in the injury and illness logs that the Occupational Safety and Health Administration (OSHA) requires employers to keep. These are used as the basis of the BLS SOII. OSHA has recently made injury narratives available for establishments that meet specific industry and employment size specifications.[9] However, WC claim narratives will still be especially valuable because they are linked to diagnosis, treatment, and cost information, and are available for past years.

WC data are not usually fully sufficient by themselves for calculating industry claim rates in terms of claims per employee or claims per FTE. WC systems use payroll dollars as the denominator in rate calculations, and they usually do not collect information on number of employees and FTEs from all employers. Therefore, data on number of employees and FTEs need to be obtained elsewhere. The principal sources of these types of data are government surveys and statistical programs of the U.S. Census Bureau and BLS. These include the ACS from the Census Bureau, the Current Population Survey (CPS) from the Census Bureau and BLS, the QCEW from BLS, Occupational Employment and Wages Statistics (OEWS) from BLS, and OPT data on employment and work hours data from the BLS.

However, the information on employees and FTEs in these data sources is classified by standard government industry codes, while WC claims are classified using "class codes" specific to WC systems, which vary by state.[10] The calculation of claim rates by industry requires reclassifying claims using standard government industry codes—either NAICS codes or census industry codes, which are a modification of NAICS codes. The task of reclassifying claims by NAICS code is discussed in Section 11, but the majority of this report focuses on the best way to obtain the number of employees and FTEs by state and NAICS code.

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9 Injury tracking application data: https://www.osha.gov/Establishment-Specific-Injury-and-Illness-Data

10 Class codes are typically four-digit numbers that insurance companies use to classify businesses by types of work activities and environments with distinctive levels of risk of costly claims. Some states have their own set of class codes, including some of the largest, but the majority of states use a class code system constructed by the National Council on Compensation Insurance (NCCI). Individual NCCI class code lookup tool: https://www.ncci.com/ServicesTools/Pages/CLASSLOOKUP.aspx. For codes for all states, see https://www.insurancexdate.com/class.

An authoritative source for obtaining the number of employees by state and NAICS code is the QCEW, which is built on a foundation of data from state unemployment insurance (UI) systems. Publicly available QCEW data provide employee counts by state and industry. These are sufficient for use as denominator data if the available WC claims data include all claims in a state. However, if only a subset of employers in a state is included in the available claims data, then a denominator that includes only a specific subset of employers is needed. To construct such a denominator, denominator information on the individual employer level is needed. Nonpublic QCEW data on the individual employer level can often be obtained, either directly or indirectly, through data sharing agreements with the appropriate state agencies. These employer-level QCEW data also serve as a critical source of accurate NAICS codes for employers and the claims of their employees.

Claim rate calculations, in terms of claims per employee using QCEW data, may usually be sufficient for identifying industries with the highest hazard levels, as the analysis in Section 8 indicates. However, claim rates in terms of claims per FTE are generally preferred because the number of claims per employee is a function not only of the hazard levels of work tasks but also the number of hours employees spend at work. The industries with the highest number of hours per employee have more than twice the number of hours per employee than the industries with the lowest number of hours per employee. Consequently, a fairer comparison of industries is provided by estimates of claims per FTE rather than by claims per employee.

A standard method of calculating the number of FTE employees is to divide the total annual number of hours worked in an industry by the number of hours that one full-time employee would work in a year. The BLS SOII uses an estimate of 2,000 hours per FTE (40 hours per week, * 50 weeks per year), and the same estimate is used in this report. WC claim rates can be expressed in terms of claims per 100 FTEs as follows:

Industry claim rate per 100 FTEs = (# injuries and illnesses)/(# hours worked in a year in industry)/ 2,000) * 100

To calculate claim rates in this way, data on hours of work by industry are needed. But these state-level data are not available from the QCEW data published by the BLS. Although a few states collect such work hours data in their WC or UI systems, most states need to rely on data from a national survey such as the ACS. But because the ACS and other surveys have sampling error, the best approach for estimating FTEs is to combine the authoritative industry employee counts from the QCEW with estimates of FTE/EE from the ACS or other survey source as follows. Note that state-level QCEW data are available from BLS, but that QCEW data on the employer level are only available from state workforce agencies that administer UI systems and provide data for the QCEW.[11]

Estimated FTEs	=	Employee Count	×	FTE employee per Employee ratio (FTE/EE)
		(QCEW data on industry level from BLS or on employer level from state workforce agency)		(calculated on industry level using data from a national or state survey)

In this report, the term on the right is referred to as an "adjustment factor." There are several data sources that might be used to estimate adjustment factors, including the following:

- ACS (Household survey) – substate, state, and national level
- CPS (Household survey) – state and national level
- Current Employment Statistics (CES) program (Employer establishment survey) – partial state and complete national level (hours paid)
- OPT (Based on CES, CPS, other sources) – national level data produced by BLS to support estimation of labor productivity and costs[12]

11 National Association of State Workforce Agencies: https://www.naswa.org/.

12 OPT industry data moved from an hours paid measure to an hours worked measure in 2015. See Appendix A and Jablonski M, Kunze K, Otto PF [1990]. Hours at work: a new base for BLS productivity statistics. Mon Labor Rev, February, https://www.bls.gov/opub/mlr/1990/02/art2full.pdf.

When a survey data source that includes detailed NAICS industry codes has a larger sample size, the accuracy of the estimates improves due to smaller relative margins of error (rMOEs). It is also desirable to have annual estimates to capture variation over time. Having estimates available at the substate level helps capture any geographic variation in claim rates. Additional data features are needed to allow workers not covered by state WC policies to be excluded, such as federal employees and the self-employed. More detailed discussion of the data options and features are in Section 1, and more in-depth descriptions of QCEW, ACS, and OPT data are in Appendix A.

Compared with CPS and CES, the ACS and OPT appear to provide the best overall sources of detailed industry data on hours worked and FTEs on the state and national levels, respectively. This technical report focuses primarily on using ACS and OPT data to estimate adjustment factors to apply to QCEW employee counts.

Section 2: Private sector FTE/EE: comparison of data sources and variation by industry, year, and state

Section 2 addresses the ways that FTE/EE varies by industry, year, and state, and compares how ACS and OPT data capture these variations. First, it compares the employment, FTE, and FTE/EE estimates of ACS and OPT data on the national level. Second, it examines patterns of variation in FTE/EE among industries and over time. Third, it assesses the relative importance of capturing variation over time and among industries. Fourth, it uses ACS and OPT data to examine how FTE/EE estimates vary among states. Fifth, Section 2 examines the relative merits of using ACS and OPT data, focusing particularly on the ability of ACS data to capture state differences in FTE/EE on the industry level.

ACS data yield lower employment estimates than OPT data but higher FTE and FTE/EE estimates. Overall, national FTE/EE is 16% higher as estimated with ACS data. Recent changes in OPT methodology would reduce the difference to a little over 12%. The remaining difference is due, at least in part, to ACS survey questions about work hours referring to all jobs together rather than a single job.

We see a high degree of correlation between ACS and OPT estimates of FTE/EE for individual industries. However, notable differences exist between ACS and OPT in relative FTE/EE estimates of industries, as shown in scatterplot graphs and in tables of the highest and lowest FTE/EE by industry.[13] OPT industry estimates show greater dispersion than ACS industry estimates. This is primarily because OPT provides estimates of hours for single jobs rather than of total hours for all jobs held by a worker, thus better capturing the lower work hours in industries with more part-time jobs.[14] While OPT data are unavailable at the state level, ACS data allow us to see how industries differ in the degree to which FTE/EE varies across states. Table 2.11 in Section 2 shows relatively little variation in FTE/EE among states in a variety of major service and manufacturing industries. We see greater variation in FTE/EE in several industries within the natural resource and transportation sectors.

The amount of variation in FTE/EE from year to year appears limited in most industries. Using 15 years of data for 2001–2015, the difference between the maximum and minimum FTE/EE was less than 0.2 in the great majority of industries (see Figure 2.13). Consequently, capturing year-to-year variation in FTE/EE appears less important than capturing industry variation. In some situations, there may be a trade-off between these two goals because capturing industry variation on a more detailed level may require pooling several years of data, preventing capture of year-to-year variation.

13 See Figures 2.8–2.11 and Tables 2.2–2.6 in Section 2.

14 See Appendix A for information on OPT employment and hours data.

For example, there may be a choice between the following two options:

(1) Calculate FTE/EE at the more-detailed 4-digit NAICS level rather than the less-detailed 3-digit level.[15]

(2) Capture year-to-year variation rather than using 5-year averages.

Calculations with OPT data clearly show that capturing FTE/EE at the 4-digit level enhances accuracy significantly more than does computing annual FTE/EE estimates (see Table 2.8).

The choice between OPT and ACS data is a choice between the greater accuracy and simplicity of FTE/EE national estimates using OPT data and the ability to obtain state-specific estimates using ACS data. The greater accuracy of OPT data comes from its larger national samples, more accurate industry coding, and survey questions that more precisely capture hours worked for a specific job in a specific industry. Appendix A, discusses the accuracy advantages of the OPT in more detail. The inaccuracy of ACS data is more fully discussed in Section 3 and Appendices C and D.

Although sampling errors in FTE/EE estimates from the national OPT are assumed to be small, sampling errors in FTE/EE estimates from ACS data for industries on the state level can sometimes be large. This raises the question whether, in general, the sampling errors of ACS estimates might be large enough to outweigh the advantage of capturing variation in FTE/EE among states. This appears not to be the case, however, at least when five years of data (2010–2014) are used for estimating FTE/EE of industries at the 3-digit NAICS level. Figure 2.16 shows that for about 50% of industries, the state-level ACS FTE/EE estimate was found to be statistically significantly different from the national estimate at the 95% confidence level, even though many industries in many states have FTE/EEs that are close to the national average.

Selecting OPT data as a source of FTE/EE estimates may be a reasonable choice. Evidence from Washington State (WA) data presented in Section 8 indicates that the choice between ACS and OPT data may have small enough impacts on industry claim rates that the ranking of industries by claim rate may be little affected. However, this report focuses more on ACS data than on OPT data because there are several technical issues that need to be addressed to calculate FTE/EE ratios with ACS data. These issues involve methods of estimating FTE/EE, industry coding, calculating margin of error (MOE) and confidence intervals (CI), and using multiple years of data (see Sections 3, 4, 6, and 7). Note particularly, that when using ACS data, MOEs can be calculated to check if large uncertainties are associated with particular industry claim rates.

Section 3: Calculating FTE/EE adjustment factors using ACS data

The following method is proposed for estimating FTE/EE adjustment factors using ACS data:

First, select respondents to include in the calculation using the Class of Worker (COW) variable.[16] The selection of respondents depends upon the population for which WC claims are available. For private sector workers select COW = 1 or 2, and for state and local public sector workers select COW = 3 or 4. One might also consider whether it is possible or necessary to include or exclude other more specific groups of workers to align with the groups included in the available claims data. Further, select only those working last week or with a job last week but not working (Employment Status Recode [ESR] = 1 or 2).

15 NAICS codes have a maximum of six digits. The first two digits of the code designate the sector, the third designates the subsector, the fourth digit designates the industry group, the fifth digit designates the NAICS industry, and the sixth digit designates an industry specific to the United States (not applicable to Canada or Mexico). This structure allows NAICS codes to be aggregated to the 2-, 3-, and 4-digit levels. Additional information: https://www.census.gov/naics/.

16 The COW variable indicates whether respondents worked for a private sector employer (profit or nonprofit), for a government employer (local, state, or federal), worked in the military, was self-employed (incorporated or unincorporated), or was an unpaid worker. Workers with multiple sources of employment were classified according to the work relationship where they spent the most time during the reference day or week.

Next, calculate the average number of FTEs represented by individual workers in each industry. Divide usual weekly hours during weeks worked over the past 12 months (WKHP) by 40 hours to obtain an FTE-equivalent for each respondent. Then calculate a weighted average FTE-equivalent for each industry. This is achieved by multiplying each respondent's FTE-equivalent by their person weight, summing these products for all respondents in the industry, and dividing by the total of the weights.

Section 3 explains this method's logic, where each respondent represents workers in their industry in a particular week. Because the ACS is administered throughout the year on a rolling basis, averaging across respondents in an industry should give an accurate estimate of both their average number during the year and the average number of hours they work per week over the year. This calculation aligns with the way that employment estimates from the QCEW and other sources are calculated, which is through averaging the number of workers in an industry over the months of the year. Some inaccuracies in the calculation due to the structure of ACS survey questions are noted and more fully explained in Appendix C.

Section 3 and associated Appendices D and E also explain why calculating FTE/EE on the basis of total, annual hours worked rather than hours worked per week is not recommended. To summarize, the annual hours worked depend on the number of weeks worked, which is not relevant to determining a worker's full-time equivalence during a particular week.

Section 4: Industry codes, crosswalks, and data availability at different code levels

The foundation of industry coding in the United States is NAICS. Census industry codes are a set of codes that align as much as possible with NAICS codes but are somewhat simplified and adapted for use in population surveys. Section 4 illustrates the number of NAICS codes at each level of industry detail (2-, 3-, and 4-digit codes) in each sector and their relationship to the detail available with standard 4-digit census industry codes.

ACS data use census industry codes, but also provide NAICSP codes, which are special "NAICS-based codes" that indicate the relationship of each census industry code to one or more NAICS codes when the mapping is not one-to-one. Because claim rate analysis generally aims to produce claim rates by NAICS code, attention needs to be paid to the translation between NAICS and census industry codes. If claim rate analysis is done at the 3-digit level of industry detail, this translation from census industry codes to NAICS codes presents few difficulties because most 3-digit census industry codes map to a single NAICS code.

Claim rates for 4-digit NAICS industries can be more useful for identifying workplaces that need injury prevention, but the mapping of census industry codes to NAICS codes is somewhat complex on that level. To help understand and use this mapping, Section 4 provides a detailed explanation, with examples, of the various types of relationships between NAICS, NAICSP, and census industry codes.

The ACS offers data at the 2-digit level for all industries in almost all states. For 2014, it provides data at the 3-digit level for 92 out of 99 NAICS industries in most states, with about 12 small states missing some additional 3-digit industries. However, at the 4-digit level, ACS provides data at the 4-digit level for only about half of the 4-digit NAICS industries. This means that alternative estimates of FTE/EE must be obtained to estimate some denominators for claim rates at the 4-digit level. As briefly explained in Section 4, and more fully explained in Appendix L, 3-digit FTE/EE estimates can be used for the 4-digit industries they contain with relatively modest impacts on the claim rates in most industries. An analysis of 2014 ACS data for all industries where both 3- and 4-digit data were used found that the median and mean differences between the 3- and 4-digit FTE/EE-based claim rates were 3.0% and 4.6%, respectively. It also found that 95% of the differences were less than 14%.

Section 5: Public sector employment and hours worked in OPT and ACS data

Irregularities exist in the coding of public sector workers in both ACS and OPT data. These irregularities limit the ability to estimate FTE/EE for public sector industries such as police and fire protection. They also bias FTE/EE estimates for industries that have a mix of public and private employers, such as education, healthcare, and transportation.

In the original NAICS system, industries are defined by the nature of their activities and can include both private and public employers. Many specific industries in the NAICS system are exclusively public in nature. However, although OPT data are generally classified by NAICS code, almost all public sector workers are lumped together in code 901. The ACS does include public sector workers in the NAICS codes where they normally belong. However, ACS groups the public sector workers who work in exclusively public sector industries into only a few, very broad categories that are not as useful for claim rate analysis. This means FTE/EE cannot be estimated, for example, for police or fire protection. It should also be noted that claims data for these industries are often not specifically coded to these industries either. Therefore, more specific, administrative data may need to be obtained for claim analysis of public sector workers.

Section 6: Calculating margin of error and confidence intervals for FTE/EE and FTE estimates based on ACS data

ACS estimates of FTE/EE are associated with sampling error. Computing the potential size of this error can be important for evaluating the resulting error in denominators and claim rates, and thus the degree of uncertainty in identification of the highest-rate industries. The Census Bureau offers two methods of calculating the standard error of estimates. The authors do not explain these methods here, but provide references to this Census Bureau guidance.

Given standard error estimates, Section 6 shows how MOEs and CIs for FTE/EE estimates can be computed at the desired confidence level (e.g., 90% or 95%). A useful metric for the accuracy of an estimate is rMOE, which is the MOE divided by the estimate. The rMOE is often expressed as a percentage of the estimate. The acceptable accuracy level depends on how the estimate is being used. Most important is to understand the level of uncertainty in the results.

Section 6 explains how CIs for FTE/EE can be translated into CIs for FTE estimates and claim rates. Appendix J provides example computations of MOE, rMOE, and CIs for FTE/EE and FTE estimates for three states.

Section 7: Combining ACS data across years

There are at least two reasons for pooling together more than one year of ACS data to estimate FTE/EE. One reason is the nature of the ACS question about work hours. Respondents' answers reflect hours worked over the previous year, rather than hours worked during the previous week in which they report their industry. As a result, data from a single survey year apply equally to the year of the survey data and the previous calendar year.

However, if work hours data that center on a specific year are desired, a dataset that aggregates data of two, consecutive survey years will serve this purpose. While such a 2-year dataset contains survey responses on hours worked that apply to three different years, the responses actually center specifically on the first of the two survey years in the dataset. A drawback to using such multi-year datasets is that none can be constructed that center on the most recent year of available data because such a dataset would require data from an even more recent year.

A second reason for aggregating more than one year of ACS data is that a larger dataset contains larger samples for each industry and thus offers more precise FTE/EE estimates. This may be useful if attempting to estimate FTE/EE on a more detailed industry level (e.g., 4-digit instead of 3-digit NAICS). This approach requires estimating average FTE/EE over multi-year periods rather than FTE/EE for

individual years. This results in some imprecision because it applies a multi-year FTE/EE estimate to individual years. One option to avoid this is to estimate claim rates for multi-year instead of single-year periods. Although this will miss year-to-year changes in claim rates, it may serve to obtain a better assessment of relative industry rates.

Figures in Section 7 show the rMOE of FTE/EE estimates by industry for three different-sized states (California [CA], Ohio [OH], and Massachusetts [MA]) based on 1-, 2-, and 5-year ACS datasets centered on 2014. Figures 7.1 and 7.2 illustrate the greater accuracy of estimates using 5-year data relative to estimates using 1-year data at the 3-digit NAICS level. In addition, a few industries in the 1-year data do not have a sufficient sample to estimate rMOE, and thus, FTE/EE: 2 of the 82 industries in Ohio and one in Massachusetts.

Figure 7.4 shows similar calculations for MA for the NAICS 4-digit industries available in ACS data. It shows the lower accuracy of estimates at the NAICS 4-digit level as compared to estimates at the 3-digit level (shown in Figure 7.3). It also shows differences in 4-digit rMOE estimates between 1-year and 5-year data. For example, comparing the number of industries for which rMOE is over 0.1, there were 27 such industries in the 1-year data, but 3 in the 5-year data. In addition, 13 industries had samples of insufficient size to estimate rMOE in the 1-year data, but there were only 3 such industries in the 5-year data. These results indicate that it is necessary to use a multi-year dataset to obtain sufficiently accurate or usable estimates of FTE/EE for a significant number of 4-digit industries.

Section 7 presents another set of tables and figures showing how much FTE/EE estimates based on 1-, 2-, and 5-year datasets differ from one another. These differences can be due both to real differences in values for individual years or groups of years and to sampling error. However, these magnitudes show how much results may be altered by selecting datasets with different numbers of years to estimate FTE/EE for a single year.

Table 7.1b examines the distribution of differences between 5-year and 1-year FTE/EE estimates for 82 3-digit NAICS industries in MA. Between the 5th and 95th percentiles, 5-year FTE/EE estimates are between 7% lower and 10% higher than the 1-year FTE/EE estimates. Figure 7.5 indicates that there are only four industries with differences over 11% in absolute magnitude, including two extreme outliers. The results in Table 7.2 are quite similar for the 143 4-digit NAICS industries available in ACS data for MA. Overall, the results suggest that using multi-year datasets instead of 1-year datasets will occasionally but not usually make a large difference in FTE/EE and FTE estimates.

Section 8: Comparison of results using alternative denominators

This section addresses whether differences in data source and method for estimating FTE/EE have a significant impact, not only on the estimated FTE denominators, but on industry claim rates and the ranking of industries by claim rate. This relative industry ranking is most important because it can play a large role in determining which industries to focus on for injury prevention.

Error in estimation of the FTE denominator will cause error in claim rates, but if variation among industries in the claim rate is large enough, a limited amount of error in the denominators might have little impact on industry rate rankings. Section 8 uses both claims and denominator data from Washington to examine this issue. FTE denominators, claim rates, and industry claim rate rankings are estimated using three sets of FTE/EE estimates: FTE/EE estimates based on (1) ACS data using the proposedmethod, (2) ACS data using an alternative method discussed in Section 3, and (3) OPT data. Each set of FTE/EE estimates is also used to compute a prevention index (PI) and a PI rank for each industry. The PI is another metric for identifying industries that most need improved injury prevention. It is computed by taking the average of an industry's ranks by claim number and claim rate.

Calculations show that the three sets of FTE/EE estimates produce similar results. The few exceptions tend to be for small industries or industries whose nature often differs across states. The top 10 industries by claim rate were the same when claim rates were estimated using proposed and alternative methods for estimating FTE/EE using ACS data. Eight of the 10 industries were also in the top 10 using FTE/EE

estimates from OPT data. There were only two large discrepancies of OPT claim rate ranks from ACS claim rate ranks. The 22nd ranked industry using ACS data (support activities for mining) was ranked 4th using OPT data.and the 4th ranked industry using ACS data (animal production and aquaculture) was ranked 12th using OPT data.

As explained in Section 1, although FTE denominators are preferred for calculating claim rates, a simple alternative is to estimate rates using the number of employees (employment) as the denominator. Using data from WA, the authors compared the two methods of calculating claim rates. The first used an FTE denominator based on the proposed ACS FTE/EE estimates, and the second used an employment denominator from the QCEW.

The results showed 8 of the top 10 industries by claim rate based on FTE denominators were also in the top 10 industries by claim rate based on employment denominators. Further, 22 of the top 25 industries by claim rate using FTE denominators were also in the top 25 industries by claim rate using only QCEW-employment denominators. This suggests that using employment rather than FTEs in the denominator is a viable option, although a few industries may be ranked rather differently using an employment denominator. For example, couriers and messengers have relatively low FTE/EE, so the FTE denominator resulted in a higher claim rate and a ranking of 6th instead of 12th, as was observed with the employment denominator. How closely results based on FTE and employment denominators align with each other could be usefully explored in the future with data from other states.

Section 9: Quarterly Workforce Indicators: A source of demographic denominator data by industry and state

A data source called Quarterly Workforce Indicators (QWI) can be used in place of the QCEW to obtain employment data by state and industry. It can also provide employment by demographic subgroup within specific industries. This national data source is compiled by the Census Bureau using UI data, the same data used as a foundation for QCEW, but it links these data on the individual worker level to demographic data from other federal sources. Like the QCEW, these data are assumed to have little error because they are based on reports from all employers rather than a survey sample. These data can be downloaded from the Local Employment Dynamics (LED) Extraction Tool at the following Census Bureau website: https://ledextract.ces.census.gov/static/data.html.

This website is best for downloading larger datasets that include data for multiple states or quarterly indicators and multiple types of subgroups within an employed population of interest. The same data are also available on the QWI Explorer website: https://qwiexplorer.ces.census.gov/static/explore.html#x=0&g=0. This website only provides data for one state and indicator at a time and for a more limited set of subgroup types at a time. However, unlike the LED extraction tool, it provides annual averages as well as aggregate and average values for custom-selected sets of industry subgroups and time frames.

Section 9 includes instructions for using the LED extraction tool and the QWI Explorer website for extracting employment data by industry within states. Instructions are also provided for extracting information on the demographic distributions of employees within industries for individual states. Information on demographic distributions involving more than one demographic variable is restricted to the two-variable combinations of sex and age, sex and education, or race and ethnicity.

Section 10: Estimating denominators for age groups

Because injury and illness risks are often different for workers of different ages, it is useful to estimate claim rates by age group. This section explains how ACS or QWI data can be used to estimate or obtain the fraction of an industry's employees within each age group. These fractions can then be multiplied by the total number of employees from the QCEW to obtain age-group denominators. ACS and QWI data can also be used to obtain denominators for sex-specific claim rates.

Section 11: Numerator issues

Although most of this report focuses on estimating denominators for industry claim rates, Section 11 looks at assigning NAICS codes to claims. This assignment should be done in a manner aligned with the way NAICS codes are used to define and estimate employment and FTE denominators. The basic principle to follow is that claims in the numerator must be associated with the same worker population represented by the denominator.

Some states consistently collect accurate NAICS codes for employers within their WC systems. However, other states find that NAICS information is not available, incomplete, or lacking in detail or reliability. If NAICS data are inadequate, the first step in assigning a NAICS code to a claim is to identify a link between the claimant's employer in the WC data and an employer record in the nonpublic QCEW data.

Linking claims to employers in the QCEW is usually made mainly with the federal Employer Identification Number (FEIN)[17] but may also use other employer information, such as employer name and address. With appropriate confidentiality protections, claimant social security numbers can also be used because they can be linked to UI records of claimant employers, which in turn are linked to QCEW data. Section 11 summarizes the variety of approaches to linking claims to employers in five states.

When employers have multiple establishments, the QCEW program independently assigns industry codes to each establishment. This means an employer's establishments do not necessarily share the same NAICS code. A summary NAICS code for each employer is also provided in nonpublic QCEW data, although it is not the code used by QCEW to classify workers by industry. Therefore, it may not always represent the activities of a large majority of an employer's workers.

Typically, the information provided to link each claim to a specific establishment is inadequate. So, it is necessary to select a single NAICS code that best summarizes the employer's activities. This may be the QCEW summary code for the employer or a code that a data user selects based on the NAICS codes and employment of individual establishments. Section 11 gives details on algorithms employed in Ohio and California that use QCEW data on individual establishments to determine the best summary NAICS code for the employer. The Ohio algorithm results were found to agree well with the summary codes assigned by QCEW.

Another set of issues in classifying claims to industry involves the basic alignment between coding and inclusion of claims in the numerator of an industry claim rate and the coding and inclusion of employee populations in the denominator of an industry claim rate. Misalignment might occur when claim records for certain employers represented in the denominator cannot be obtained or cannot be classified to an industry. This would yield a downward bias in the claim rate. Another uncommon and easily resolved misalignment issue involves using quarterly employment information in the detailed, nonpublic QCEW data. Sometimes employment data for an employer is missing for certain quarters within a year while claims are available for all quarters. Misalignment can be avoided by deleting claims in quarters when employment data are missing.

Another type of misalignment of numerator and denominator industry coding may occur if claims are assigned to summary NAICS codes for employers, but denominator employee counts are taken from aggregate, public QCEW data. These data classify all employees to NAICS industry on the individual establishment level. This misalignment may be avoided if denominators are estimated by using the same employer summary NAICS codes as are used to code claims. Access to the detailed, nonpublic QCEW data is necessary for this approach. Alternatively, claims may be coded to individual establishments if claims data contain enough detail to do this successfully. If neither of these approaches are feasible, some degree of misalignment of industry coding is unavoidable.

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17 An FEIN identifies a business entity. It is also referred to as a Federal Tax ID Number. Generally, all businesses need an FEIN. Many one-person businesses use their social security number as their EIN: https://www.irs.gov/businesses/small-businesses-self-employed/employer-id-numbers

The last part of Section 11 lists several additional claims data issues that are not directly related to industry coding of claims or to denominator estimates. However, they are useful to keep in mind when conducting claim rate analysis. Claim rate estimates may include or exclude denied or zero-costs claims, based on an analyst's judgment of whether these claims represent significant work-related injuries and illnesses. It is also important to be aware of claims data that may be missing or incomplete because this could bias claim rates as previously noted. In addition, because the status of individual claims can change over time, incomplete claims data make it harder to accurately classify claims into medical-only and lost-time categories or to determine whether claims have been accepted or denied.

Looking Ahead

This technical report focuses exclusively on denominators for state-level industry claim rates. But there may also be a need to analyze claim rates on a local level to identify prevention needs. Both the QCEW and ACS contain data on substate levels, and other data sources not addressed in this report do as well. Most notable are the County Business Patterns from the Census Bureau and the Occupational Employment and Wages Program at BLS. Exploring the use of these sources to estimate claim rates on substate levels could be useful..

Also of note, OSHA has begun to release data providing more specific information on injury and illness rates in large establishments in high injury-rate industries. See https://www.osha.gov/news/newsreleases/trade/04182024. These data contain less information on work disability, medical treatment, and cost than WC data, but provide information on the sub-employer, establishment level that is often not available in WC data. This underlines a broader need to explore how OSHA, SOII, and WC claims data compare and complement each other. This exploration, like that in the development of this technical report, and in future work on selecting appropriate denominators, is an ongoing process. NIOSH continues to learn about what each data source offers, how its data are generated, and what changes have been recently made or are anticipated

1. INTRODUCTION

Calculating injury and illness incidence rates by industry and employer using WC claims data is important in supporting occupational safety and health prevention activities. This technical report examines how WC claims data can be combined with estimates of FTE employees to calculate these rates.

The BLS already publishes injury and illness incidence rates per 100 FTEs, by state and NAICS industry code. These rates are based on the BLS Survey of Occupational Injury and Illness or SOII, which annually surveys a sample of employers in participating states. The SOII incidence rates have the advantage of being produced from a national survey, so incidence rates by industry can be compared among states.

However, WC datasets offer several advantages. In the United States, each state has its own state-regulated WC system. The state WC system pays for medical care and partial wage replacement for most private industry and state/local government workers who suffer injuries and illnesses due to work and file an accepted claim. Federal workers are covered under a similar separate system. WC datasets can be larger than those from BLS SOII, sometimes including data for all claims within a state, though sometimes they may not include claims from self-insured employers (those who provide insurance benefits for employees as required but do not purchase insurance). This allows for rate calculations that provide more specific guidance for prevention. For example, rates can be calculated for more specific industries. Rates may also be calculated for substate regions and individual employers.

In addition, WC claims data have the potential to be classified in more specific ways based on injury narratives, diagnosis, and treatment, as well as more complete information on the type and length of disability. Unlike SOII data, claims data can also provide estimates of injury cost.

Like WC systems, OSHA collects injury narratives that provide more details on the circumstances of injuries and illnesses. OSHA obtains these narratives from selected employers via the same forms (OSHA 300 and 301 Logs) that provide data for the SOII. Generally, there has been very limited access to these narratives for public health agencies and researchers outside OSHA due to confidentiality protections. However, with the new OSHA reporting requirements that went into effect beginning in 2024, OSHA narratives are being collected from establishments with 100 or more employees in industries with higher injury rates. They were recently made available after removing details that could identify individual workers.[18] These data were projected to cover about 30% of recordable work injuries.[19] Even with the availability of OSHA log narratives, WC claim narratives remain especially valuable because they are linked to diagnosis, treatment, and cost information. They are also available for all employers and include prior years.

18 See the following three websites: https://www.osha.gov/injuryreporting; https://www.osha.gov/news/newsreleases/trade/04182024; https://www.osha.gov/Establishment-Specific-Injury-and-Illness-Data

19 OSHA [2023]. OSHA fact sheet: Improve tracking of workplace injuries and illnesses. Electronic submission of OSHA form 300 and 301 data, https://www.osha.gov/sites/default/files/publications/OSHA_FS-4272_ITA_07-2023.pdf.

There is evidence that WC claims data do not capture all work-related injuries.[20] However, there is also increasing evidence that the SOII undercounts injuries to a significant extent.[21], [22] The pattern of undercounting is likely to be somewhat different in the SOII and WC. For example, the SOII includes injuries and illnesses that are "reportable" under OSHA rules, which may include different injuries and illnesses from those that result in WC claims.[23] However, the evidence does suggest that, overall, WC captures a greater share of work injuries than does the SOII.[24] Neither the SOII nor WC insurance claims are able to capture more than a small fraction of chronic illness cases associated with occupational exposures.[25]

ALTERNATIVE DENOMINATORS FOR CALCULATING CLAIM RATES BY INDUSTRY

To calculate industry rates of WC claims, we need to have claims data classified by industry, as well as denominator measures of industry size based on the same industry classification system. The WC insurance industry and its state regulators have data that meet these requirements but do not use the number of employees or FTEs as denominators. Instead, payroll dollars are used. WC insurers use the amount of past claim costs and number of claims per $100 of payroll to set insurance premiums for each industry and individual employer. Most insurers, therefore, do not collect information on number of employees or FTEs for all the employers they insure, although they often obtain such information for limited numbers of employers for other purposes such as auditing payroll or planning risk control services. Thus, if we wish to calculate claim rates on a per employee or per FTE basis, we need alternative denominator data sources. As we will see below, these alternative data sources use standard government industry classification systems. These differ from the "class code" systems used in WC, which sometimes are defined more by occupation than by industry and vary from state to state. If we need to use standard industry classification systems to estimate the number of employees or FTEs for the denominator, then we also need to classify claims in the numerator using the same classification systems.

Publicly available government data sources can provide the total number of employees or FTEs by industry on the state level. For example, the Current Population Survey (CPS) and the American Community

20 See complete citations to the following sources in the Reference section: Boden LI, Ozonoff A [2008a]. Capture-recapture estimates of nonfatal workplace injuries and illnesses; Boden LI, Ozonoff A, et al. [2008b]. Reporting workers' compensation injuries in California: How many are missed?; CDC [2010]. Proportion of workers who were work-injured and payment by workers' compensation systems—10 States, 2007; Biddle J, Roberts K [2003]. Claiming behavior in workers' compensation; Johnson WG [2004]. Back pain: acute injury or chronic disease?; Morse, et al. [1998]. The economic and social consequences of work-related musculoskeletal disorders: the Connecticut Upper-Extremity Surveillance Project (CUSP); Oregon Department of Consumer and Business Services [2008]. Workplace injuries and workers' compensation claim filing: results from the 2006 Oregon population survey; Won JU, Dembe AE [2006]. Services provided by family physicians for patients with occupational injuries and illnesses.

21 Ruser JW [2008]. Examining evidence on whether BLS undercounts workplace injuries and illnesses. Mon Labor Rev, August, https://www.bls.gov/opub/mlr/2008/08/art2full.pdf.

22 National Academies of Sciences, Engineering, and Medicine [2018]. A smarter national surveillance system for occupational safety and health in the 21st century. Washington, DC: The National Academies Press, pp. 84–85, https://doi.org/10.17226/24835.

23 OSHA definitions of a reportable case are can be found in the instructions for OSHA Log forms 300 and 301: OSHA [2004] Forms for reporting work-related injuries and illnesses. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration, Revised 4/2004, https://www.osha.gov/sites/default/files/OSHA-RK-Forms-Package.pdf.

24 Wurzelbacher S, et al. [2016]. Development of methods for using workers' compensation data for surveillance and prevention of occupational injuries among state-insured private employers in Ohio. Am J Ind Med *59*(12):1047–1182, https://doi.org/10.1002/ajim.22653.

25 Bushnell PT, Li J, Landen D [2011]. Group medical claims as a source of information on worker health and potentially work-related diseases. J Occup Environ Med *53*(12):1430–1441, https://doi.org/10.1097/JOM.0b013e3182363bbe; Leigh JP, Robbins JA [2004]. Occupational disease and workers' compensation: coverage, costs, and consequences. Milbank Q *82*(4):689–721, http://doi.org/10.1111/j.0887-378X.2004.00328.x.

Survey (ACS)[26] can be used to obtain information on number of employees and FTEs by industry. In addition, the BLS Occupational Employment and Wage Statistics (OEWS) and Quarterly Census of Employment and Wages (QCEW) provide data on number of employees by industry, but not FTEs. Of these four sources, the QCEW is the most accurate and provides the most industry detail because it is based on a near census of employers, rather than a sample-based survey. QCEW data are made available to the public by the federal government based on data collected from most employers by state unemployment insurance (UI) systems and supplementary QCEW surveys administered in a federal/state collaboration. See Section 11 and Appendix A for more details on the QCEW. The Census Bureau also makes these data available through its Quarterly Workforce Indicators (QWI), which combines UI data with other demographic data (see Section 9).

Although publicly available aggregate data from the QCEW and QWI may provide the best information on total employees by industry for denominators, it is also important to obtain employer-level QCEW data. Employer-level QCEW data are not publicly available but may be accessed through state workforce agencies using special data use agreements that ensure confidentiality. There are two basic purposes for obtaining these employer-level data. The first is accurately classifying claims to industry in the numerator. The QCEW data provide industry codes for each employer and the individual establishments it operates. Using QCEW data to assign industry codes to claims depends upon the ability to link each claim to an employer in the QCEW, a task which can be challenging. These challenges are discussed in Section 11.

The second purpose for obtaining employer-level QCEW data is adjusting the publicly available industry-level employee counts used in denominators to exclude employers who may be missing from the claims data in the numerator. For example, claims may not be available from workers at "self-insured" employers who provide WC insurance for their employees but do not purchase WC insurance from an insurer. Other omissions from the claims data may be due to claims from some employers not being reported or entered into the database, or an inability to code some employers to a specific industry. If such omissions are significant, denominators can be constructed by summing up the number of employees or FTEs only for those individual employers known to be included in the numerator claims data.

The key drawback to using QCEW data for industry denominators is that only employee counts are available, as they do not contain information on hours of work or FTEs. Although incidence rates calculated on a per employee basis can be useful for comparing industries, they are not ideal. The number of FTE employees is the preferred denominator because some industries employ more part-time workers than other industries, and exposure to the risk of injury at work is a function of the number of hours spent at work.

The average number of hours worked per worker varies significantly by industry. Using national Office of Productivity and Technology (OPT) data from BLS (described below in this section and in Appendix A), the number of FTEs per employee among 303 industries (NAICS 4-digit industries) ranged from 0.46 to 1.29 in 2014 and ranged from 0.66 in the 5th percentile industry to 1.09 in the 95th percentile industry (see Table 2.2).

Industries with the lowest average number of hours were often in the retail sector and entertainment sectors, while industries with the highest average number of hours were often in the manufacturing, agriculture, and transportation sectors (see Tables 2.5 and 2.6). Given this variation among industries, the use of FTE employee estimates in the denominator may more fairly compare injury rates across industries.[27] Thus, we want to obtain data on FTEs on the employer level.

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26 The CPS is sponsored jointly by the Census Bureau and BLS. The ACS is conducted by the Census Bureau.

27 For further discussion of this point in the context of fatality rates, see Ruser JW [1998]. Denominator choice in the calculation of workplace fatality rates. Am J Ind Med 3(2):151–156, https://doi.org/10.1002/(SICI)1097-0274(199802)33:2<151::AID-AJIM6>3.0.CO;2-0.

A few states do collect such data from employers. The state-run WC system operated by the Washington Department of Labor & Industries (WA L&I) collects hours of work data, so they can calculate FTE employee denominators by employer and by industry. There are also a few states that collect hours of work data through their UI systems, including Washington, Oregon, and Minnesota. However, most states do not collect such data from employers and must use alternative means for estimating employer-level FTEs, as is explained next.

HOW TO USE FTE/EE RATIOS (ADJUSTMENT FACTORS) TO ESTIMATE FTEs

A standard method of calculating the number of FTE employees is to divide the total annual number of hours worked in an industry by the number of hours that a full-time employee would work (e.g., 40 hours per week and 50 weeks per year, or a total of 2,000 hours). The BLS SOII uses this method to estimate injury and illness rates by industry, which they usually express as injuries and illnesses per 100 FTE employees:

Industry incidence rate per 100 FTEs =
(# injuries and illnesses)/(# hours worked in a year in industry/2,000) * 100

However, because hours worked reported by employers are not readily available for most states, an alternative method of calculating FTEs can be used. First, obtain employee counts by industry from QCEW data. Second,adjust the employee counts using survey data to estimate the number of FTEs, as follows. Note that state-level QCEW data are available from BLS. However, QCEW data on the employer level must be obtained from state workforce agencies that administer UI systems and provide data for the QCEW.[28]

Estimated FTEs	=	Employee Count	×	FTE employee per Employee ratio (FTE/EE)
		(QCEW data on industry level from BLS or on employer level from state workforce agency)		(calculated on industry level using data from a national or state survey)

In this report, the authors also refer to the FTE/EE calculated from survey data as an FTE adjustment factor. An adjustment factor of 1.0 implies that employees worked 40 hours per week on average, an adjustment factor of 0.75 implies an average of about 30 hours per week, and an adjustment factor of 1.05 implies an average of about 42 hours per week. Industries with high proportions of part-time employees, such as retail trade and fast food, will have relatively low adjustment factors.

For 2014, Table 1.1a provides an example of FTE/EE adjustment factor calculations for CA's agriculture, fishing, forestry, and hunting industry sector (NAICS 11) based on two alternative data sources: state-level data from the ACS and national OPT data from the productivity program of BLS. Later, more details on these data sources are provided.

The ACS adjustment factor of 1.07 implies that on average, employees in this sector work about 42.8 hours per week, and the OPT adjustment factor of 1.06 implies that employees worked, on average, about 42.6 hours per week. Table 1.1b applies these FTE/EE adjustment factors to the 2014 employee count from the California QCEW for NAICS 11, which was 415,444. After adjustment, the QCEW FTE employee estimates ranged from 442,117 (using OPT) to 444,595 (using ACS).

28 National Association of State Workforce Agencies: https://www.naswa.org/.

Table 1.1a Estimating FTE/EE adjustment factors using ACS and OPT data

Example: California Agriculture, Fishing, Forestry, and Hunting (NAICS 11), private sector only, 2014

Data Source	Geographic Region	Estimated EEs	Estimated FTEs	Estimated FTE/EE Adjustment Factor
ACS	CA	342,360	366,383	1.070169
OPT	U.S.	1,142,300	1,215,639	1.064203

Table 1.1b Estimating FTEs with QCEW employee counts using adjustment factors from ACS and OPT data

Example: California Agriculture, Fishing, Forestry, and Hunting (NAICS 11), private sector only, 2014

Estimated FTE/EE Adjustment Factor	CA QCEW	Estimated CA FTEs
1.070169 (ACS)	415,444	444,595
1.064203 (OPT)	415,444	442,117

SURVEY DATA SOURCES FOR CALCULATING FTE/EE ADJUSTMENT FACTORS AND CRITERIA FOR CHOOSING BETWEEN SOURCES

A number of different nationwide government surveys collect both hours worked (or paid) and employee counts by industry, including these:

- American Community Survey (ACS)[29] (Household survey) – substate, state, and national level
- Current Population Survey (CPS)[30] (Household survey) – state and national level
- Current Employment Statistics (CES)[31] (Employer establishment survey) – some broad industries at state level and detailed industries at national level (hours paid)
- Office of Productivity and Technology (OPT)[32] data (Based on CES, CPS, other sources) – national level
- Some industry-specific data are available from other sources, such as the Mine Safety and Health Administration (MSHA)[33]

Survey data with the following features are desirable:

- Data on hours worked and number of employees by detailed NAICS industry codes
- Data availability at the substate and state level
- Minimum rMOE of the estimates (thus, large sample size)

29 U.S. Census Bureau. American Community Survey. https://www.census.gov/programs-surveys/acs.html

30 U.S. Bureau of Labor Statistics, Current Population Survey. https://www.bls.gov/cps/

31 U.S. Bureau of Labor Statistics, Current Employment Statistics. https://www.bls.gov/ces

32 BLS [2024a]. Hours worked and employment measures (table). Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, https://www.bls.gov/productivity/tables/.

33 MSHA data can be found at the following two websites: Mine data retrieval system: https://www.msha.gov/data-and-reports/mine-data-retrieval-system; Mine employment and coal production: https://www.msha.gov/mine-employment-and-coal-production.

- Annual estimates to capture variation over time
- If additional workers not covered by state WC systems are included in the survey data, then researchers need to be able to exclude these additional workers, e.g., federal, self-employed and unpaid family workers, and armed forces
- Ability to separate ownership categories: private and public (federal, state, local)

The ACS, the first data source listed, has a large sample size and therefore can produce estimates for detailed industries on the state level. It is also the only source available at the substate level. The ACS uses industry codes from the census industry code system. These codes can be mapped to codes in the NAICS code system in many, but not all, cases. Industry coding in ACS data is discussed in Section 4 and Appendix G.

Data on employee counts and hours worked by industry are available in the ACS Public Use Microdata Sample files (PUMS). These files provide the full range of population and housing unit responses collected on individual ACS questionnaires for a subsample of housing units and people, including those living in group quarters.[34]

The PUMS files allow data users to conduct a custom analysis of the ACS data using a sample of actual responses to the ACS. PUMS files for an individual year, such as 2015, contain data on about 1% of the U.S. population. Therefore, PUMS files covering a five-year period, such as 2011–2015, contain data on about 5% of the U.S. population.[35] Additional information on the ACS and the ACS PUMS files is available in Appendix A.

National OPT data draw on the strengths of the CES (an establishment survey), CPS (a household survey), and other sources. OPT data on employee counts and hours worked are conveniently available for a consistent set of NAICS industry codes at the 4-digit level across many years (back to 1987) for private sector workers.[36] To calculate FTE using annual OPT hours worked, divide hours worked by 2,000 hours (50 weeks * 40 hours per week). Industry coding in the OPT may be more accurate than in household surveys such as the ACS and CPS (see discussion of this in Appendix A). To obtain comparability with the WC universe, BLS was able to provide special extracts of OPT data to NIOSH that contain only employees and exclude federal workers, the self-employed, and unpaid family workers. The BLS no longer provides these extracts, the most recent year being 2020. However, the publicly available data provide very similar FTE/EE estimates for most industries. NIOSH has been developing adjustments to the public data to account for differences between public and special extract data (see Appendix A).

Major drawbacks of OPT data include their availability at only the national level and their treatment of public sector workers. Following the CES data collection methodology, OPT data for public sector workers are not strictly classified by NAICS industry code. In the NAICS system, public sector workers are assigned to a variety of public administration and nonpublic administration codes depending upon the work their immediate employer does. However, in OPT data, these workers are all aggregated into a single, large government super-sector numbered "901" and are not classified on a more detailed NAICS level (see Section 5 for more details).

Annual CES data provide the finest level of industry detail available (including for many 6-digit NAICS codes), but only at the national level. As with the OPT data, industry coding in CES data may be more

34 Group quarters are where people live or stay in group living arrangements that are owned or managed by an entity or organization providing housing and/or services for the residents: https://www.census.gov/glossary/?term=Group+quarters+population.

35 Information about PUMS is available at the following Census Bureau website: U.S. Census Bureau [2022]. American Community Survey (ACE): public use microdata sample (PUMS). Washington, DC: U.S. Census Bureau, https://www.census.gov/programs-surveys/acs/microdata.html.

36 OPT data were previously produced by the Labor, Productivity, and Cost Program, but are currently produced by the Office of Productivity and Technology. These data are available at the following BLS website: BLS [2024a]. Hours worked and employment measures (table). Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, https://www.bls.gov/productivity/tables/.

accurate than in the ACS and CPS. At the state level, CES provides total employment for detailed industries, however hours paid is only available for 11 broad "supersectors."

The CPS provides annual data on number of employees and hours worked by detailed industry on the national and state levels. However, due to its small sample size (about 60,000 households nationwide), the CPS does not produce reliable estimates for most states by detailed industry. In CPS data, as in ACS data, industries are coded using census industry codes, not NAICS codes. Much of the discussion of the translation between census and NAICS codes for ACS data in Section 4 and Appendix G would apply to the CPS as well.

All four data sources discussed above allow calculation of FTE employees excluding categories of workers who are unlikely to be covered by WC insurance. It is essential to be able to filter the survey data in this way to align as closely as possible with the WC data universe. Filtering may need to be slightly adjusted depending on the state. For example, in many states, almost all employees in the private sector and state and local government employees are covered under WC insurance programs. As another example, in Tennessee (TN), agricultural workers and state government employees are exempt from WC coverage, and local government employees are not required to be covered.

We should also note an additional potential data source not listed above. BLS SOII collects information on hours worked from surveyed employers. However, although BLS publishes industry incidence rates and the numerator (the numbers of injuries and illnesses in each industry), it does not publish the denominator (the number of FTEs) or the corresponding number of employees in each industry by state.[37] In addition, due to small sample sizes, published information in many states does not include many industries. As a result, one of the other national level data sources need to be used to estimate the number of FTEs by employer and industry.

In the remainder of this technical report, the authors focus on using ACS and OPT data to estimate adjustment factors for employee counts taken from QCEW data. The ACS and OPT appear to provide the best overall sources of detailed industry data on hours worked and FTEs on the state and national levels, respectively. See Appendix A for basic descriptions of UI, QCEW, ACS, and OPT data.

37 Hours worked are now published at the national level by industry, but not at the state level. Visit https://www.bls.gov/iif/nonfatal-injuries-and-illnesses-tables.htm, and under injuries, illness, and fatalities data, see Table 3, "Number of hours worked and percent relative standard errors - detailed industry level."

2. PRIVATE SECTOR FTE/EE: COMPARISON OF DATA SOURCES AND VARIATION BY INDUSTRY, YEAR, AND STATE

This section begins by comparing ACS and OPT estimates of overall U.S. levels of employment, number of FTEs, and FTE/EE. The authors then compare these two data sources in terms of the degree of dispersion among industries in FTE/EE and the specific industries identified as having the highest and lowest FTE/EE. OPT data are used to examine the magnitude of changes over time in FTE/EE on the industry level. Having examined variation in FTE/EE by industry and by year, the authors then compare the importance of estimating FTE/EE on a detailed industry level versus the importance of estimating year-specific FTE/EE. This is a trade-off that may call for a decision because annual estimates of FTE/EE require using smaller annual datasets that do not allow as much industry detail. Following this, the authors use ACS data to examine the degree of variation among states in FTE/EE, both on the aggregate and individual industry level. Finally, the relative merits of using ACS versus OPT data are summarized, explaining the ability of the ACS to provide state-specific FTE/EE with acceptable industry detail. Note that short descriptions of ACS and OPT data were provided previously in Section 1, and more details on these data sources are in Appendix A.

AGGREGATE, PRIVATE-SECTOR FTE/EE ESTIMATES BASED ON ACS AND OPT DATA

Table 2.1 shows counts of employees (EE), full-time equivalent employees (FTE), and the FTE/EE ratio for the U.S. private sector during 2008–2015 based on ACS and OPT data. Employee counts from the QCEW are also shown for comparison. As noted, the QCEW does not provide data on FTEs. The information in Table 2.1 is displayed graphically in Figure 2.1 (EE), Figure 2.2 (FTE), and Figure 2.3 (FTE/EE ratio).

Across the years, OPT EE estimates were the highest, followed by QCEW and then the ACS. On average, during 2008–2015, OPT EE estimates were about 3 million workers higher annually than those of the QCEW, and the QCEW estimates were about 2.3 million workers higher than those of the ACS. On average, during 2008–2015, ACS FTE estimates were higher than OPT FTE estimates by about 10 million FTE employees. The higher FTE but lower employee estimates from the ACS data reflect that ACS FTE/EE ratios are higher than OPT FTE/EE ratios. ACS FTE/EE ratios averaged 0.971 during 2008–2015 and OPT FTE/EE ratios averaged 0.837.

Some of these differences between data sources can be explained. OPT EE counts are higher than QCEW EE counts because QCEW data are based on the administrative data collected for state-level UI systems, so do not include workers not covered by UI. OPT data are designed to be more inclusive and are drawn from a variety of sources (see Appendix A for more details). The principal source of OPT data is the CES survey. That survey estimates total nonfarm employment and benchmarks its employment estimates to the QCEW and other supplementary data sources each March. By itself, the QCEW represents about 97% of all nonfarm employees.[38]

38 Although CES is based on a survey with sampling error, the QCEW is based on a near census of employers. Therefore, the CES uses a benchmarking procedure to revise its employment estimates each year to align with employment levels reported in the QCEW. See descriptions of benchmarking of the CES to the QCEW and other data in the following three documents: (1) BLS [2023b]. CES national benchmark article: BLS establishment survey national estimates revised to incorporate March 2022 benchmarks. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, https://www.bls.gov/web/empsit/cesbmart.htm#Overview; (2) Mance S [2016]. How hard is it to count? Reconciling monthly survey and administrative data: Experiences from the CES program. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, Office of Survey Methods Research, https://www.bls.gov/osmr/research-papers/2016/st160060.htm; (3) Manning CD, Stewart JR [2017]. Benchmarking the Current Employment Statistics national estimates. Mon Labor Rev, October, https://doi.org/10.21916/mlr.2017.25.

Examples of nonfarm employee categories included in the CES (and therefore the OPT data) but not the QCEW include student workers on the payroll of the college or university they attend; hospital interns; elected government officials; railroad workers; employees of religious organizations, such as parochial school teachers; and, in some states, certain officers of corporations. OPT data also include the self-employed and unpaid family workers, but these workers are excluded in the OPT data extract used here because they are not thought typically to be covered by WC insurance (see Appendix A).

There are several reasons why ACS might yield higher estimates of FTE/EE than OPT. In general, household surveys indicate higher hours of work than establishment surveys.[39] Frazis and Stewart [2010] provide a good starting point to explore this pattern. Although overreporting hours on household surveys has long been considered a possibility, they found that respondents to the CPS did not overreport hours as compared with respondents to the American Time Use Survey,[40] which provides a detailed and accurate accounting for time spent in all activities.

Frazis and Stewart also explored several reasons for the difference between hours reported in the CPS, a population survey, and the CES program, which is based on establishment surveys. They identify three main reasons for the difference. One of these applies when comparing ACS and OPT data. ACS respondents are asked to report the total number of hours worked across all jobs, rather than just the hours for a single, primary job. This primary job is the focus of the ACS question about industry of employment. This contrasts with the OPT, which uses data from the CES that reflects hours from a single job.

A second potential reason for the higher FTE/EE ratios observed in ACS data is that responses to ACS questions about work hours may include more off-the-clock, unpaid hours than OPT data. OPT methods are based on the assumption that work hours of nonsupervisory and hourly workers are fully reflected in paid hours reported by employers. This may not be entirely true. Current OPT methods, first incorporated in data released in late 2022, make explicit adjustments to estimated work hours for full-time, salaried workers to account for off-the-clock hours using CPS data. These adjustments were found to more fully include off-the-clock hours than were previous OPT adjustment methods that were in use when the data for the present analysis were obtained. The revised method yielded work hour estimates that were 3.3% higher than those of the previous method. This implies that a replication of the present analysis with a current release of OPT data may find ACS FTE/EE estimates a little over 12% higher than OPT estimates rather than 16% higher (see Appendix A for discussion of OPT methods).

Another potential reason for the difference in FTE/EE between ACS and OPT is that respondents to the ACS are asked to report their "usual weekly hours" rather than their "average weekly hours." If they do this correctly, they will disregard weeks in which they worked an unusual amount of overtime or took time off. If the magnitude and frequency of downward deviations from usual weekly hours tend to be greater than the magnitude and frequency of upward deviations, this would make usual weekly hours an overestimate of average weekly hours. Also note that "usual weekly hours" implicitly includes paid time off, while OPT data have been adjusted to exclude paid time off.[41]

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39 For a discussion of differences in employment levels, see Abraham KG, Haltiwanger JC, Sandusky K, Spletzer J [2013]. Exploring differences in employment between household and establishment data. Working paper. National Bureau of Economic Research, No. w14805, http://doi.org/10.3386/w14805.

40 The American Time Use Survey (ATUS), sponsored by BLS and conducted by the Census Bureau, is a time-use survey that provides measures of the amounts of time people spend on various activities, including working, leisure, childcare, and household activities, https://www.bls.gov/tus/.

41 Other reasons why ACS estimates of FTE/EE are higher than OPT estimates are less likely, but could be explored. Some ACS respondents with informal, or cash-based jobs are probably not covered by WC insurance and would not likely be included as employees in the OPT, but they may report they are employees in the ACS. However, this would not contribute to higher FTE/EE in the ACS than the OPT, unless these workers work more hours than formal employees, which seems unlikely. A possibility exists that some ACS respondents include commute time when they report hours of work.

Table 2.1 Private sector U.S. employment, FTEs, and FTE/EE Ratio, ACS, OPT, and QCEW data, 2008–2015

Employee Count (EE)			
	ACS	OPT	QCEW†
2008	110,392,875	115,294,700	113,188,643
2009	105,584,411	109,370,000	106,947,104
2010	103,915,881	108,557,900	106,201,232
2011	105,672,300	110,578,300	108,184,795
2012	108,250,147	113,057,700	110,645,869
2013	110,853,344	115,325,200	112,958,334
2014	113,169,054	117,838,100	115,568,686
2015	115,582,916	120,649,600	118,307,717

Full-time Equivalent Employee Count (FTE)		
	ACS	OPT
2008	108,513,502	96,761,527
2009	102,202,568	90,596,121
2010	100,258,136	90,575,841
2011	102,173,427	92,783,421
2012	104,867,524	94,996,861
2013	107,507,536	96,683,858
2014	109,962,474	98,869,588
2015	112,577,148	101,059,675

Full-time Equivalent to Employee Ratio (FTE/EE)		
	ACS	OPT
2008	0.9830	0.8393
2009	0.9680	0.8283
2010	0.9648	0.8344
2011	0.9669	0.8391
2012	0.9688	0.8403
2013	0.9698	0.8384
2014	0.9717	0.8390
2015	0.9740	0.8376

† The QCEW does not provide data on hours of work or FTEs.

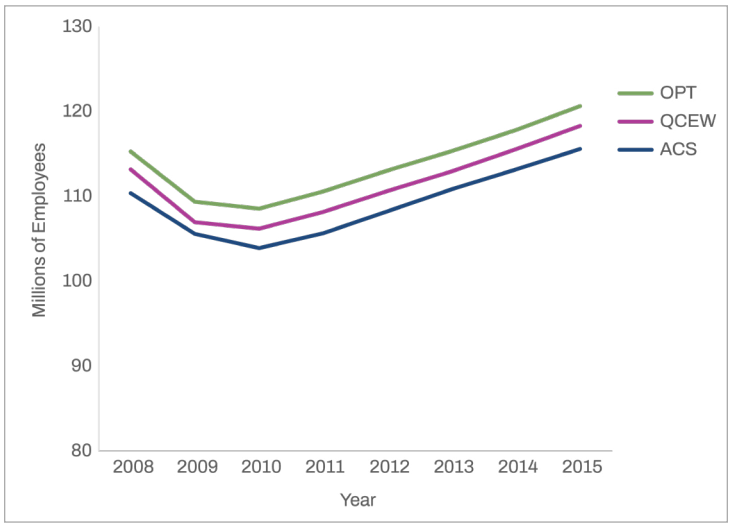


Figure 2.1 Private sector employee estimates, ACS, OPT, and QCEW data, 2008–2015

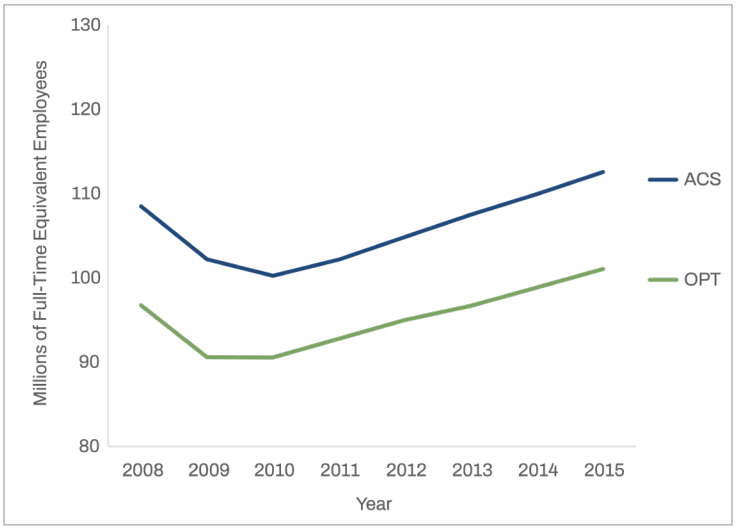


Figure 2.2 Full-time equivalent employee estimates, ACS and OPT data, 2008–2015

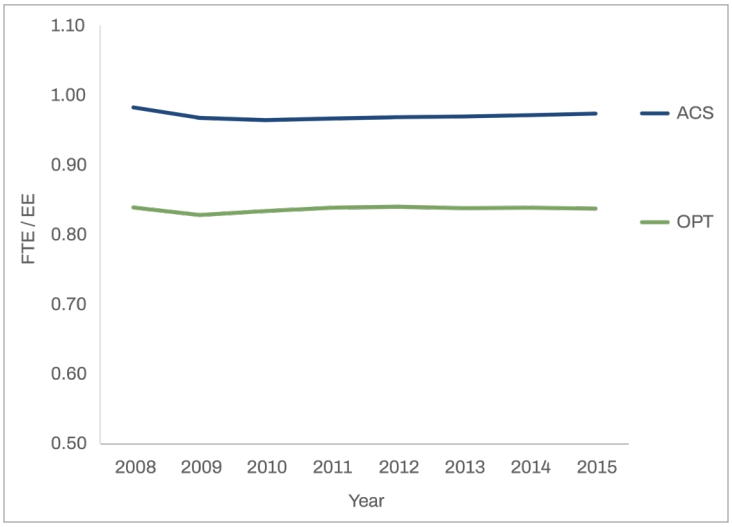


Figure 2.3 Private sector FTE/EE ratios, ACS and OPT data, 2008–2015

VARIATION IN FTE/EE AMONG INDUSTRIES USING ACS AND OPT DATA

The differences between FTE/EE calculated with ACS and OPT data can also be seen on the individual industry level. In the overwhelming majority of 3-digit NAICS industries, the 2014 ACS FTE/EE estimates were higher than the OPT estimates (see Figure 2.4). Of the four exceptions, three OPT estimates were only slightly higher: NAICS 112, 315, and 316 (see Appendix K for 3-digit NAICS codes and their titles). The OPT FTE/EE estimate for NAICS 814 (private households) was markedly higher than the ACS estimate. Figure 2.5 shows the difference between the ACS FTE/EE estimate and the OPT FTE/EE estimate (by NAICS) for codes that could be directly compared in the two datasets. Section 4 discusses the lack of a perfect correspondence between NAICS industry codes and the industry codes used in the ACS.

The ACS and OPT surveys also yield different rankings of industries in terms of FTE/EE. As has already been implied by the data in Figures 2.4 and 2.5, ACS FTE/EE estimates give a fairly different ranking of industries by FTE/EE, although the rankings are strongly positively correlated. It is difficult to identify reasons why the ACS and OPT would tend to rank industries differently. Scatter plots showing the relationship between industry FTE/EE ratios based on ACS and OPT data and between percentile ranks of industry FTE/EE ratios from the two data sources are shown in Figures 2.6 and 2.7, respectively.

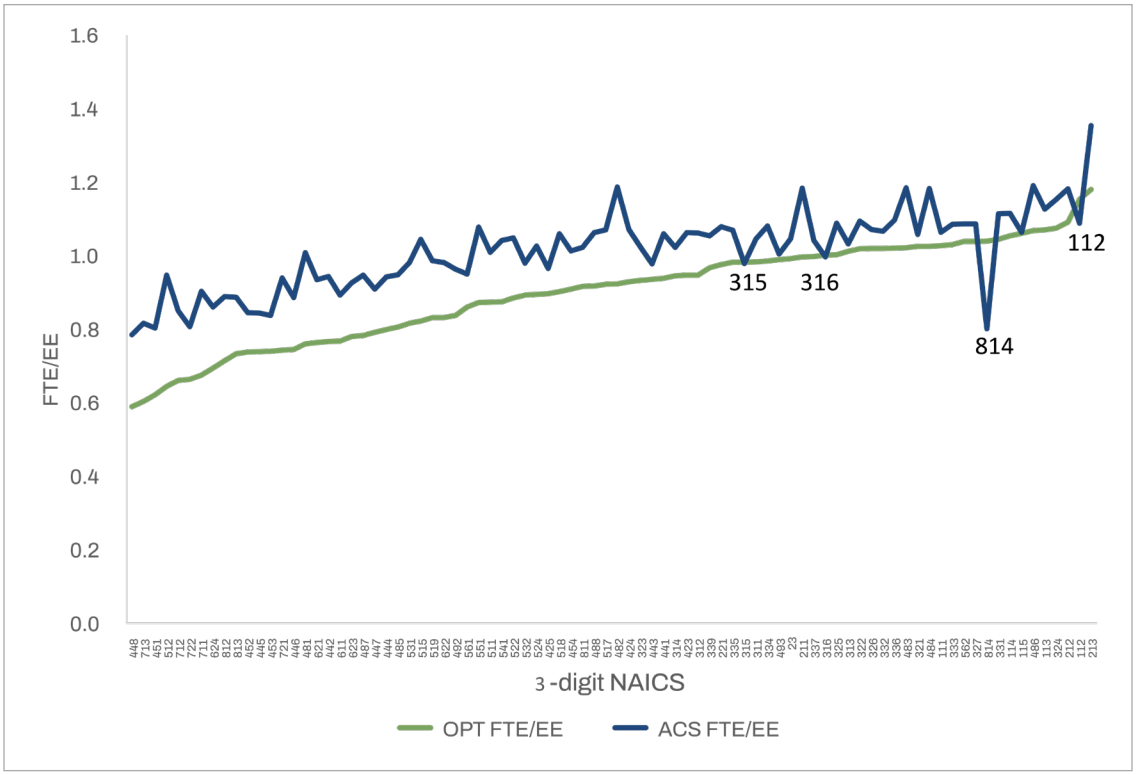


Figure 2.4 2014 FTE/EE by industry, ACS and OPT data, sorted by OPT FTE/EE

Note: A complete list of 3-digit 2012 NAICS codes and their titles is in Appendix K, Table K.1, which presents estimates for WA associated with Section 8.

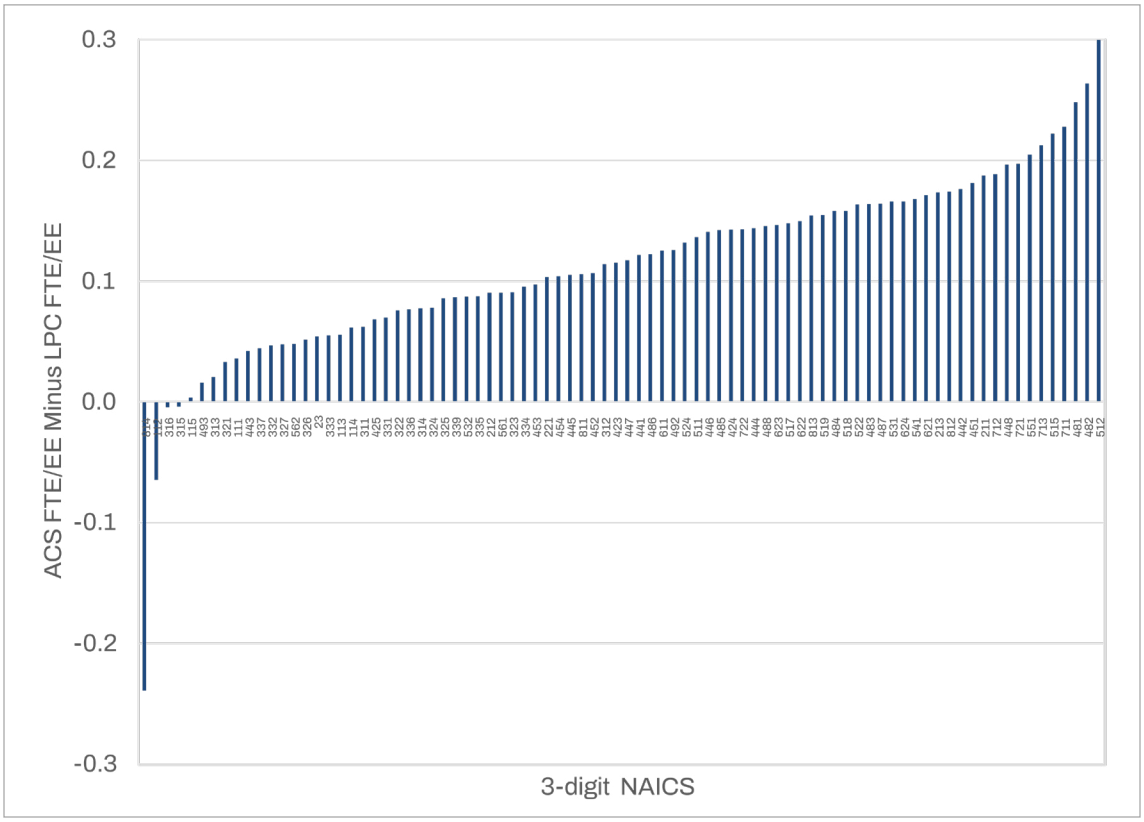
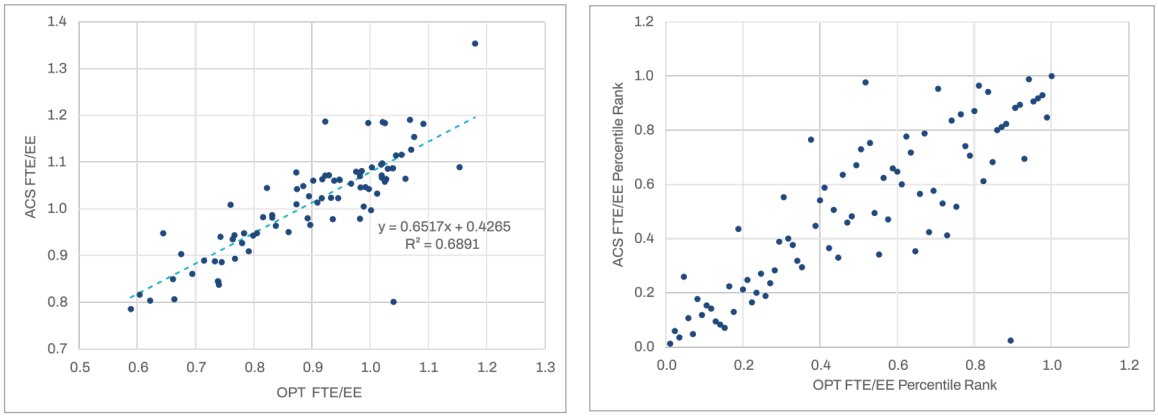


Figure 2.5 Difference in 2014 FTE/EE by industry, ACS FTE/EE minus OPT FTE/EE

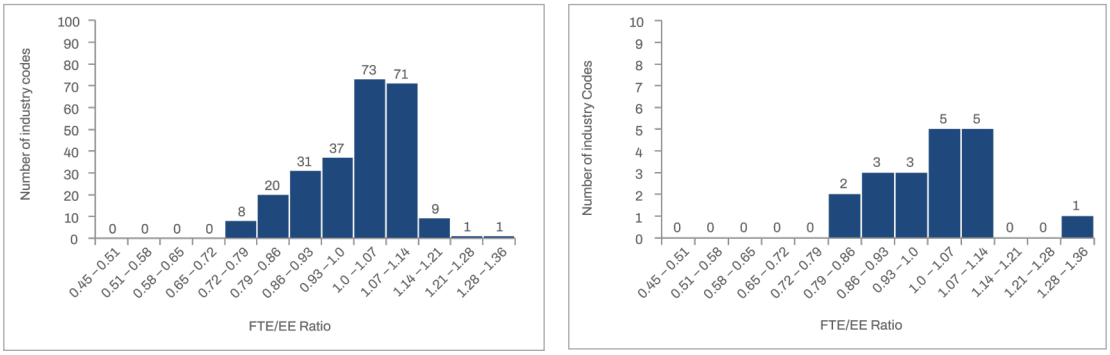
Note: 3-digit NAICSP industry in the ACS data is usually the same as 3-digit NAICS in the OPT data.[42] See the discussion of NAICSP in Section 4. A list of 3-digit NAICS codes and their titles is in Appendix K, Table K.1, which presents estimates for WA associated with Section 8.



Figures 2.6 and 2.7 Comparison of estimates from 2014 ACS and OPT data: FTE/EE and FTE/EE percentile rank

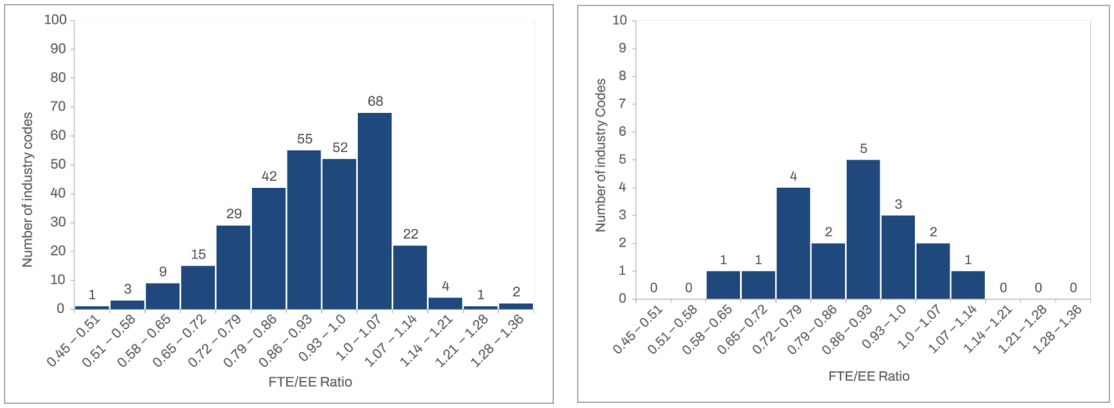
42 In PUMS data, NAICSP is the field that records the NAICS code corresponding to the census industry code when the relationship is one-to-one. It can also indicate another relationship, such as the census industry code representing only a portion of a single NAICS code, or the census industry code representing multiple NAICS codes within a more general NAICS code.

Figures 2.4, 2.6, and 2.7 have already shown the distribution of FTE/EE ratios across industries. Figures 2.8 and 2.9 offer additional views of this distribution, using histograms based on 2014 ACS data. These figures give the distribution of FTE/EE using both detailed census industry codes and broad industry codes (2-digit NAICS codes). Comparable histograms using OPT data display more dispersion than the ACS figures, as well as generally lower FTE/EE ratios (see Figures 2.10 and 2.11). These differences between ACS and OPT data in the overall level and industry dispersion of FTE/EE ratios can also be seen in the statistics reported in Table 2.2. At least one reason for these differences is that OPT data rely on employer surveys and represent hours worked per job, whereas the ACS data are based on a population survey and represent total hours worked per worker, including all jobs held by each worker.



Figures 2.8 and 2.9 Distribution of FTE/EE by industry: ACS 2014 data

Note: Figure 2.8: 251 Census industry codes, Figure 2.9: 19 2-digit NAICS codes



Figures 2.10 and 2.11 Distribution of FTE/EE by industry: OPT 2014 data

Note: Figure 2.10: 303 4-digit NAICS Industry codes, Figure 2.11: 19 2-digit industry codes

Table 2.2 FTE/EE variation by industry—ACS 2014 and OPT 2014

ACS FTE/EE - 251 Industries	
Minimum (NAICSP 45322, 51912)	0.736
Maximum (NAICSP 213)	1.354
Range	0.618
Median	1.035
5th percentile	0.805
95th percentile	1.128
95th percentile minus 5th percentile	0.324
Average	1.007
Standard Deviation	0.102

OPT FTE/EE - 303 Industries	
Minimum (NAICS 8134)	0.455
Maximum (NAICS 1123)	1.286
Range	0.831
Median	0.927
5th percentile	0.660
95th percentile	1.091
95th percentile minus 5th percentile	0.431
Average	0.913
Standard Deviation	0.138

Variation in FTE/EE ratios across private sector industries are further described in Tables 2.3 and 2.4 using 2014 ACS data and in Tables 2.5 and 2.6 using 2014 OPT data. These tables list the industries with the highest and lowest FTE/EE ratios. In general, for both datasets, the lowest FTE/EE ratios were found in the retail trade, information, and services industries. The highest FTE/EE ratios were in agriculture, mining, manufacturing, and transportation.

Table 2.3 ACS 2014—Industries with the lowest FTE/EE ratios (sorted by census industry code)

Census Code	Census Industry 2012 Description	ACS FTE/EE	NAICS Equivalent	ACS NAICSP†
5170	Clothing stores	0.767	4481	4481
5180	Shoe stores	0.797	4482	4482
5280	Sewing, needlework, and piece goods stores	0.753	45113	45113
5370	Book stores and news dealers	0.774	45121	45121
5470	Retail florists	0.796	4531	4531
5570	Gift, novelty, and souvenir shops	0.736	45322	45322
6770	Libraries and archives	0.736	51912	51912
7890	Other school and instruction and educational support services	0.772	6116, 6117	611M
8390	Vocational rehabilitation services	0.789	6243	6243
8580	Bowling centers	0.741	71395	71395
8680	Restaurants and other food services	0.807	722 excl. 7224	722Z
8690	Drinking places, alcoholic beverages	0.799	7224	7224
9290	Private households	0.801	814	814

† See discussion of NAICSP in Section 4.

Table 2.4 ACS 2014—Industries with the highest FTE/EE ratios (sorted by census industry code)

Census Code	Census Industry 2012 Description	ACS FTE/EE	NAICS Equivalent	ACS NAICSP†
0270	Logging	1.138	1133	1133
0370	Oil and gas extraction	1.184	211	211
0380	Coal mining	1.22	2121	2121
0390	Metal ore mining	1.149	2122	2122
0470	Nonmetallic mineral mining and quarrying	1.161	2123	2123
0490	Support activities for mining	1.354	213	213
2070	Petroleum refining	1.163	32411	32411
2670	Iron and steel mills and steel product manufacturing	1.122	3311, 3312	331M
4490	Petroleum and petroleum products merchant wholesalers	1.146	4247	4247
6080	Rail transportation	1.187	482	482
6090	Water transportation	1.185	483	483
6170	Truck transportation	1.183	484	484
6270	Pipeline transportation	1.191	486	486

† See discussion of NAICSP in Section 4.

Table 2.5 OPT 2014—Industries with the lowest FTE/EE ratios (sorted by NAICS)

NAICS	ACS NAICSP†	Industry	FTE/EE
4481	4481	Clothing stores	0.544
4511	4511	Sporting goods and musical instrument stores	0.623
4512	4512	Book stores and news dealers	0.619
4854	485M	School and employee bus transportation	0.628
5121	5121	Motion picture and video industries	0.640
5259	52M2	Other investment pools and funds	0.620
7111	711	Performing arts companies	0.625
7113	711	Promoters of performing arts and sports	0.596
7114	711	Agents and managers for public figures	0.596
7139	713Z + 71395	Other amusement and recreation industries	0.556
7224	7224	Drinking places, alcoholic beverages	0.563
8121	8121	Personal care services	0.626
8134	813M	Civic and social organizations	0.455

† See discussion of NAICSP in Section 4.

Table 2.6 OPT 2014—Industries with the highest FTE/EE ratios (sorted by NAICS)

NAICS	ACS NAICSP†	Industry	OPT FTE/EE
1111	111	Oilseed and grain farming	1.235
1121	112	Cattle ranching and farming	1.109
1122	112	Hog and pig farming	1.202
1123	112	Poultry and egg production	1.286
1125	112	Aquaculture	1.170
1129	112	Other animal production	1.281
2121	2121	Coal mining	1.131
2131	213	Support activities for mining	1.180
2379	23	Other heavy construction	1.106
3255	3255	Paint, coating, and adhesive manufacturing	1.110
3324	332M	Boiler, tank, and shipping container manufacturing	1.149
4851	485M	Urban transit systems	1.135
4852	485M	Interurban and rural bus transportation	1.110

† See discussion of NAICSP in Section 4.

VARIATION IN FTE/EE BY YEAR

In Figures 2.1–2.3, all data sources clearly show the effects of the Great Recession of 2007-2009.[43] Employee and FTE estimates dropped significantly from 2008 through 2009, dropped again through 2010, and then started to recover in 2011. Employee and FTE estimates did not recover to 2008 levels until 2013 or 2014 in all data sources. However, because the numbers of employees and FTE employees largely moved together, there was only modest change in the overall FTE/EE ratio.

Despite little change in FTE/EE in the aggregate, there may still be large changes in FTE/EE within individual industries. However, in Figure 2.12 and Table 2.7, based on national OPT data for 2009–2011, we do not see many industries exhibiting large year-to-year changes in FTE/EE. The great majority of industries saw one-year changes in FTE/EE of less than 5%. In Figure 2.13, which shows the distribution of industries by change in FTE/EE over a much longer time period, 2001–2015, most industries still showed limited variation. The difference between the maximum FTE/EE and minimum FTE/EE over this 15-year period was usually less than 0.2.

43 Cunningham E [2018]. Great Recession, great recovery? Trends from the Current Population Survey. Mon Labor Rev, April, https://doi.org/10.21916/mlr.2018.10

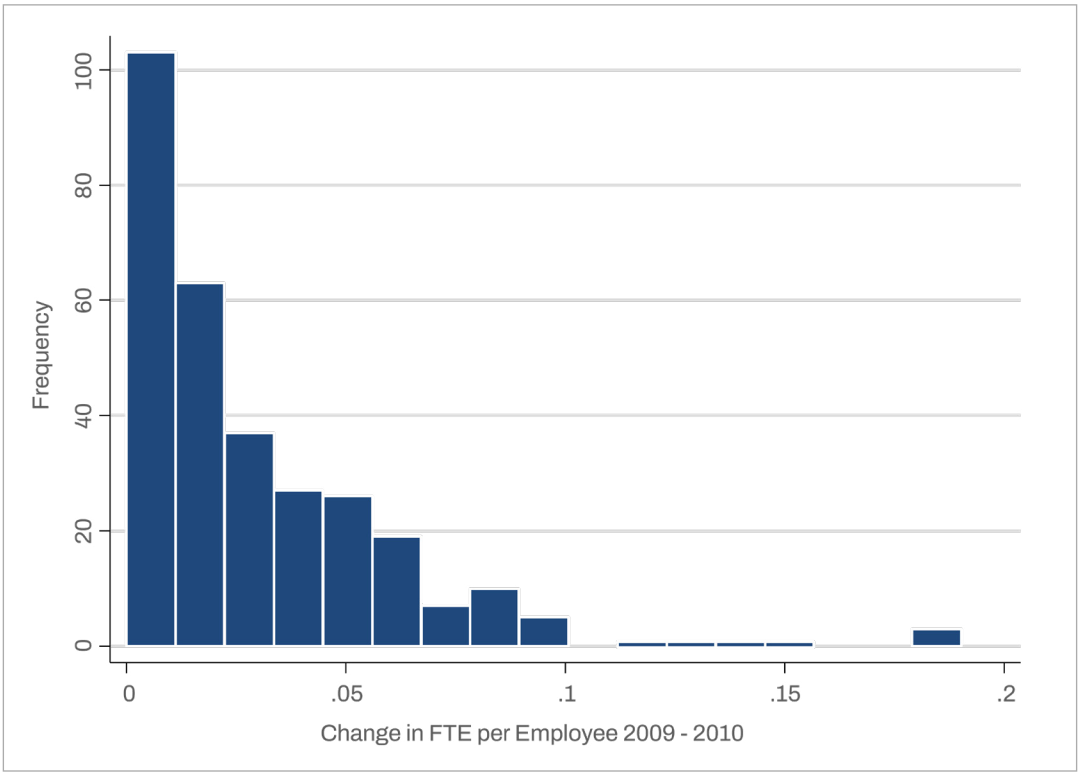


Figure 2.12 Distribution of industries by 1-year change in FTE/EE

304 4-digit NAICS industries, OPT data, 2009–2010

Table 2.7 Distribution of industries by 1-year change in FTE/EE

304 4-digit NAICS industries, OPT data, 2009–2011

	Percentage of industries with FTE/EE changing < 5%	Percentage of industries with FTE/EE changing > 10%
2009–2010	80.1%	2.3%
2010–2011	89.1%	1.0%

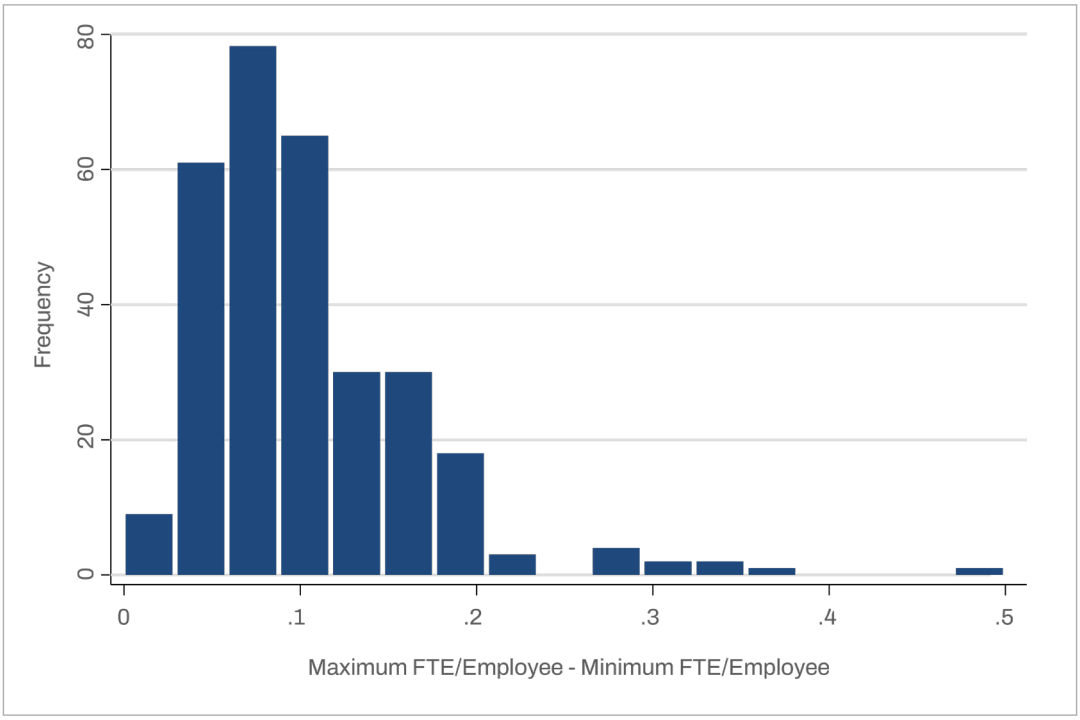


Figure 2.13 Distribution of industries by 15-year variation in FTE/EE, 2001–2015

Maximum ratio—Minimum ratio, 304 4-digit NAICS industries, OPT data

COMPARING THE IMPORTANCE OF CAPTURING VARIATION IN FTE/EE OVER TIME AND AMONG INDUSTRIES

Table 2.8 is an attempt to compare the importance of capturing industry variation in FTE/EE versus year-to-year variation in FTE/EE. This comparison could assist in making decisions about whether to pool data from multiple years. Pooling data from multiple years reduces the ability to capture changes in FTE/EE over time. However, it increases the size of individual industry samples, allowing for calculation of FTE/EE for more specific industries.

In the Table 2.8 analysis, a potential increase in the capture of industry variation is measured by the difference between 4-digit FTE/EEs and the FTE/EEs for the 3-digit NAICS industries to which they belong. A potential increase in the capture of year-to-year variation is measured by the difference between FTE/EE using 1-year data and FTE/EE using 5-year data.

The results show that the additional variation captured by estimating FTE/EE on a more detailed industry level is generally greater than the additional variation captured by calculating FTE/EE on an annual rather than a 5-year basis. See Section 7 for a discussion of combining ACS data across years. Note that there is no reason to combine OPT data across years because OPT data only exist on the national level and are already available annually for detailed 4-digit NAICS industries.

Table 2.8 Relative importance of FTE/EE variation by year and by industry, OPT data, 2009

Comparison	Percentage of 4-digit NAICS Industries in 2009		
	< 5% Difference†	5%–10% Difference†	> 10% Difference†
3-digit FTE/EE vs. 4-digit FTE/EE	70.1%	17.1%	12.8%
2007–2011 Average FTE/EE vs. 2009 FTE/EE (4-digit NAICS)	90.5%	7.9%	1.6%

† Difference between 4-digit FTE/EE and 3-digit FTE/EE or between 1-year FTE/EE and 5-year FTE/EE

VARIATION IN FTE/EE AMONG STATES

Variation in Total Private Sector FTE/EE Ratios Based on ACS Data

OPT data exist only on the national level, but variation in FTE/EE among states can be examined with ACS data. Using ACS 2015 data for the private sector based on state of residence, Table 2.9 provides basic summary statistics for FTE/EE ratios by state (including Washington, DC). These state-based ratios ranged from a minimum of 0.942 (Rhode Island) to a maximum of 1.036 (Alaska), while the U.S. average was 0.974, and the average among the 50 states and Washington, DC, was 0.975. Variation in the ratios by state are measured by the range (0.094), the 95th percentile minus the 5th percentile (0.071), and the standard deviation (0.021). Figure 2.14 shows FTE/EE by state with the U.S. average. Table 2.10 shows the 2015 ACS private sector FTE/EE ratios for each state. The states' FTE/EE ratios are first sorted from the highest (rank of 1) to the lowest (rank of 51). These same results are then sorted alphabetically by state abbreviation.

Table 2.9 Summary statistics for the distribution of average FTE/EE by state, ACS 2015, U.S. private sector

Category	ACS
Minimum	0.942
Maximum	1.036
Range	0.094
Median	0.97
5th percentile	0.944
95th percentile	1.015
95th minus 5th percentile	0.071
Average	0.975
Standard deviation	0.021

* 50 states and D.C.

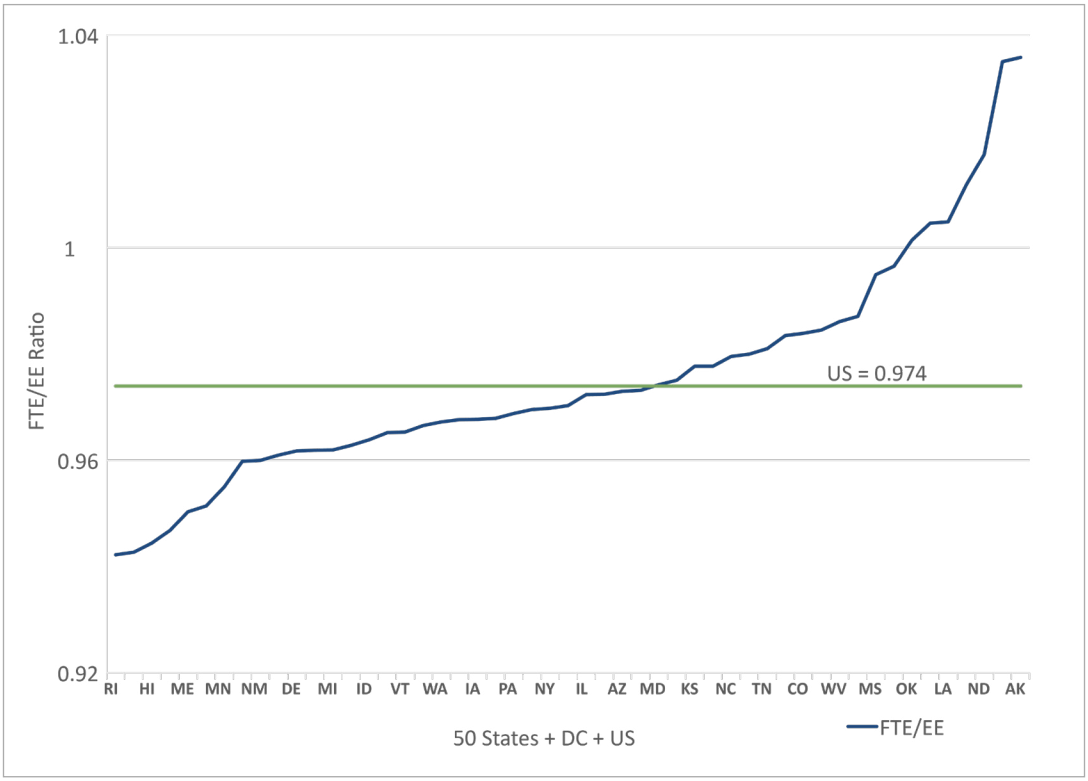


Figure 2.14 FTE/EE by state & U.S. average, ACS 2015

Table 2.10 State FTE/EE estimates, ACS 2015, U.S. private sector

States Ranked by FTE/EE			States in Alphabetical Order		
FTE/EE Rank	State	FTE/EE	State	FTE/EE	FTE/EE Rank
	US	0.974			
1	AK	1.036	AK	1.036	1
2	WY	1.035	AL	0.987	10
3	ND	1.018	AR	0.997	8
4	TX	1.012	AZ	0.973	23
5	LA	1.005	CA	0.963	38
6	DC	1.005	CO	0.984	13
7	OK	1.001	CT	0.965	36
8	AR	0.997	DC	1.005	6
9	MS	0.995	DE	0.962	41
10	AL	0.987	FL	0.968	32
11	WV	0.986	GA	0.985	12
12	GA	0.985	HI	0.944	49
13	CO	0.984	IA	0.968	31
14	KY	0.983	ID	0.964	37
15	TN	0.981	IL	0.972	25
16	SD	0.980	IN	0.973	22
17	NC	0.980	KS	0.978	18
18	KS	0.978	KY	0.983	14
19	NE	0.978	LA	1.005	5
20	SC	0.975	MA	0.951	46
21	MD	0.974	MD	0.974	21
22	IN	0.973	ME	0.950	47
23	AZ	0.973	MI	0.962	39
24	VA	0.972	MN	0.955	45
25	IL	0.972	MO	0.970	28
26	NJ	0.970	MS	0.995	9
27	NY	0.970	MT	0.961	42
28	MO	0.970	NC	0.980	17
29	PA	0.969	ND	1.018	3
30	OH	0.968	NE	0.978	19
31	IA	0.968	NH	0.962	40
32	FL	0.968	NJ	0.970	26
33	WA	0.967	NM	0.960	43
34	NV	0.967	NV	0.967	34

States Ranked by FTE/EE			States in Alphabetical Order		
FTE/EE Rank	State	FTE/EE	State	FTE/EE	FTE/EE Rank
35	VT	0.965	NY	0.970	27
36	CT	0.965	OH	0.968	30
37	ID	0.964	OK	1.001	7
38	CA	0.963	OR	0.947	48
39	MI	0.962	PA	0.969	29
40	NH	0.962	RI	0.942	51
41	DE	0.962	SC	0.975	20
42	MT	0.961	SD	0.980	16
43	NM	0.960	TN	0.981	15
44	WI	0.960	TX	1.012	4
45	MN	0.955	UT	0.943	50
46	MA	0.951	VA	0.972	24
47	ME	0.950	VT	0.965	35
48	OR	0.947	WA	0.967	33
49	HI	0.944	WI	0.960	44
50	UT	0.943	WV	0.986	11
51	RI	0.942	WY	1.035	2

Variation in Industry-level FTE/EE Ratios Among States Based on ACS Data

Using ACS 5-year data (2010–2014), Table 2.11 shows FTE/EE variation of individual 3-digit NAICSP industries among 50 states, listing the industries with the least and the most variation among states. A 3-digit NAICSP is the same as a 3-digit NAICS in most cases (see the discussion of NAICSP in Section 4). Instead of 1- or 2-year data, 5-year data were used because they provide a somewhat better measure of differences between states and industries (see the discussion of FTE/EE variation by year above in this section).

The main measure of variation used here is the difference between the 95th and 5th percentile values of FTE/EE. This measure omits extreme outliers, but other measures such as the standard deviation or the range (maximum minus the minimum) would show similar results.

The 3-digit industry with the least variation in its ACS FTE/EE ratio among states was NAICSP 524, "Insurance carriers and related activities," with a minimum ratio of 0.981, a maximum of 1.072, and a range of 0.091. The difference between the 95th and the 5th percentile ratio was 0.058. At the other extreme, the 3-digit industry with the most variation was NAICSP 487, "Scenic and sightseeing transportation," with a minimum ratio of 0.127, a maximum of 1.405, and a range of 1.278. The difference between the 95th and the 5th percentile ratio was 0.968. In data not shown here, it appears that many of the more extreme values of FTE/EE are found in small states that may have a small and relatively atypical set of employers or establishments in some industries.

Appendix B includes a complete listing of industries with measures of variation of FTE/EE among states: 3-digit industries ranked by the difference between the 95th and 5th percentile values of their FTE/EE ratios among states using 5-year, 2010–2014 ACS data.

Table 2.11 Industries with the least and most variation among states in FTE/EE, ACS 2010–2014

3-digit NAICSP† variation measured by the range between the 95th percentile value of FTE/EE and the 5th percentile value

NAICSP Code	NAICS Title	Median	Min	Max	Range	Std dev	Average	SORT BY: 95th minus 5th	# States
Private		0.966	0.930	1.067	0.137	0.023	0.969	0.079	50
13 Industries With the Least Variation State-to-State in FTE/EE									
524	Insurance carriers and related activities	1.025	0.981	1.072	0.091	0.017	1.024	0.058	50
517	Telecommunications	1.064	1.026	1.102	0.076	0.018	1.061	0.061	50
221	Utilities	1.076	1.040	1.119	0.079	0.019	1.077	0.067	50
561	Administrative and support services	0.944	0.894	1.108	0.214	0.031	0.944	0.073	50
622	Hospitals	0.974	0.925	1.007	0.082	0.020	0.970	0.074	50
441	Motor vehicle and parts dealers	1.060	1.028	1.111	0.083	0.022	1.065	0.075	50
339	Miscellaneous manufacturing	1.045	0.925	1.088	0.163	0.025	1.045	0.077	50
541	Professional, scientific, and technical services	1.024	0.971	1.120	0.148	0.026	1.027	0.078	50
423	Merchant wholesalers, durable goods	1.065	0.986	1.121	0.134	0.023	1.062	0.083	50
621	Ambulatory health care services	0.936	0.873	0.985	0.111	0.024	0.937	0.085	50
13 Industries With the Largest Variation State-to-State in FTE/EE									
425	Wholesale electronic markets and agents and brokers	0.995	0.651	1.234	0.583	0.096	0.979	0.350	48
212	Mining (except oil and gas)	1.149	1.049	1.652	0.603	0.104	1.177	0.352	50
519	Other information services	0.916	0.509	1.106	0.597	0.107	0.904	0.361	50
112	Animal production and aquaculture	1.071	0.819	1.272	0.453	0.096	1.077	0.365	50
512	Motion picture and sound recording industries	0.816	0.407	1.066	0.659	0.125	0.806	0.443	50
115	Support activities for agriculture and forestry	1.036	0.601	1.218	0.617	0.127	1.025	0.500	50
113	Forestry and logging	1.090	0.500	1.272	0.772	0.143	1.061	0.526	48
213	Support activities for mining	1.331	0.991	1.763	0.773	0.185	1.366	0.610	50
483	Water transportation	1.250	0.500	1.740	1.240	0.220	1.248	0.761	49
491	Postal service	0.964	0.392	1.625	1.233	0.197	0.950	0.813	49

Source: ACS, 3-digit NAICS, 5-year data 2010–2014, excluding the District of Columbia and special codes 22S, 31M, 33MS, 3MS, 42S, 4MS, 52M, and 53M.

† 3-digit NAICSP is usually the same as 3-digit NAICS. See the discussion of NAICSP in Section 4.

Note: Some industries are not present in every state or are not represented in all state samples.

CHOOSING BETWEEN ACS AND OPT DATA

In Section 2, the authors compare results of FTE/EE calculations using ACS and OPT data and explore variation of FTE/EE by industry, year, and state. The goal, in part, is to provide information that assists in choosing between ACS and OPT data. Each data source has advantages and disadvantages. This subsection discusses considerations that lead us to focus mostly on ACS data in subsequent sections.

On the national level, OPT data offer more accuracy in calculation of FTE/EE. Partly, this is because it is based on data that cover a larger share of the U.S. workforce. More importantly, OPT is based largely on CES and CPS data, which more accurately capture information about hours worked by industry. This is due in part to survey questions in the OPT that focus specifically on current hours worked in a specific job versus questions in the ACS that ask about hours over the previous year including all jobs. Section 3 and Appendices C and D explain biases associated with the ACS survey questions on hours. This helps to explain why estimates based on OPT data indicate a greater number of industries with relatively low FTE/EE than do estimates based on ACS data (see Figures 2.8–2.11). Despite these biases, it appears that, with some exceptions, the ACS still provides reasonable FTE/EE estimates based on the strong correlation we saw in Figure 2.6 between FTE/EE calculated with the ACS and FTE/EE calculated with OPT data.

Another reason that OPT may offer more accuracy in the calculation of FTE/EE is greater accuracy in classification of employees to industry. OPT data obtain information on industry from CES data, which in turn employ industry codes from the QCEW, an employer survey described in more detail in Sections 9 and 11 and Appendix A. As explained in Appendix A, frequent discrepancies between ACS and QCEW industry codes assigned to individual workers have been found, and employers may provide better characterization of their industry than their employees. Further, there are several features of the QCEW program that suggest information gathered on industry is more detailed and that there are more mechanisms for review and correction of industry codes.

Despite the concerns just stated, a key advantage of the ACS is that it offers the ability to support detailed industry FTE/EE estimates that are state-specific. On the aggregate, all-industry level, Figure 2.14 and Tables 2.9 and 2.10 showed a modest variation among states in FTE/EE, but on the individual industry level, there was much more state variation (see Table 2.11 and Appendix B). A drawback to using state-specific ACS data is that samples are much smaller on the industry-state level, so that MOEs and CIs can sometimes be wide.

This leads to the question of whether state-level FTE/EE estimates based on ACS data might be exhibiting variation among states due largely to imprecision in estimates, rather than to real variation among states. Note, however, that although we should expect smaller samples to exhibit more variation due to sampling error, it is also true that any small, state-level subsets of a national industry are not likely to be representative of the national industry. This is only partially due to the influence of location on the nature of work activities and schedules.

In addition, when we examine the standard errors and CIs associated with the industry-state-level estimates, we observe that they often indicate high statistical probability of real difference of state-level FTE/EE from the national average FTE/EE. This is illustrated in Figure 2.15, which gives state-level estimates based on ACS 2010–2014 data for a single industry (111 crop production). This figure shows that many relatively imprecise, state-level estimates of FTE/EE are likely to be better estimates for the state than the national average FTE/EE. The national average is represented by the vertical line in the middle of Figure 2.15. CIs that don't span the vertical line are statistically significantly different from the national average.

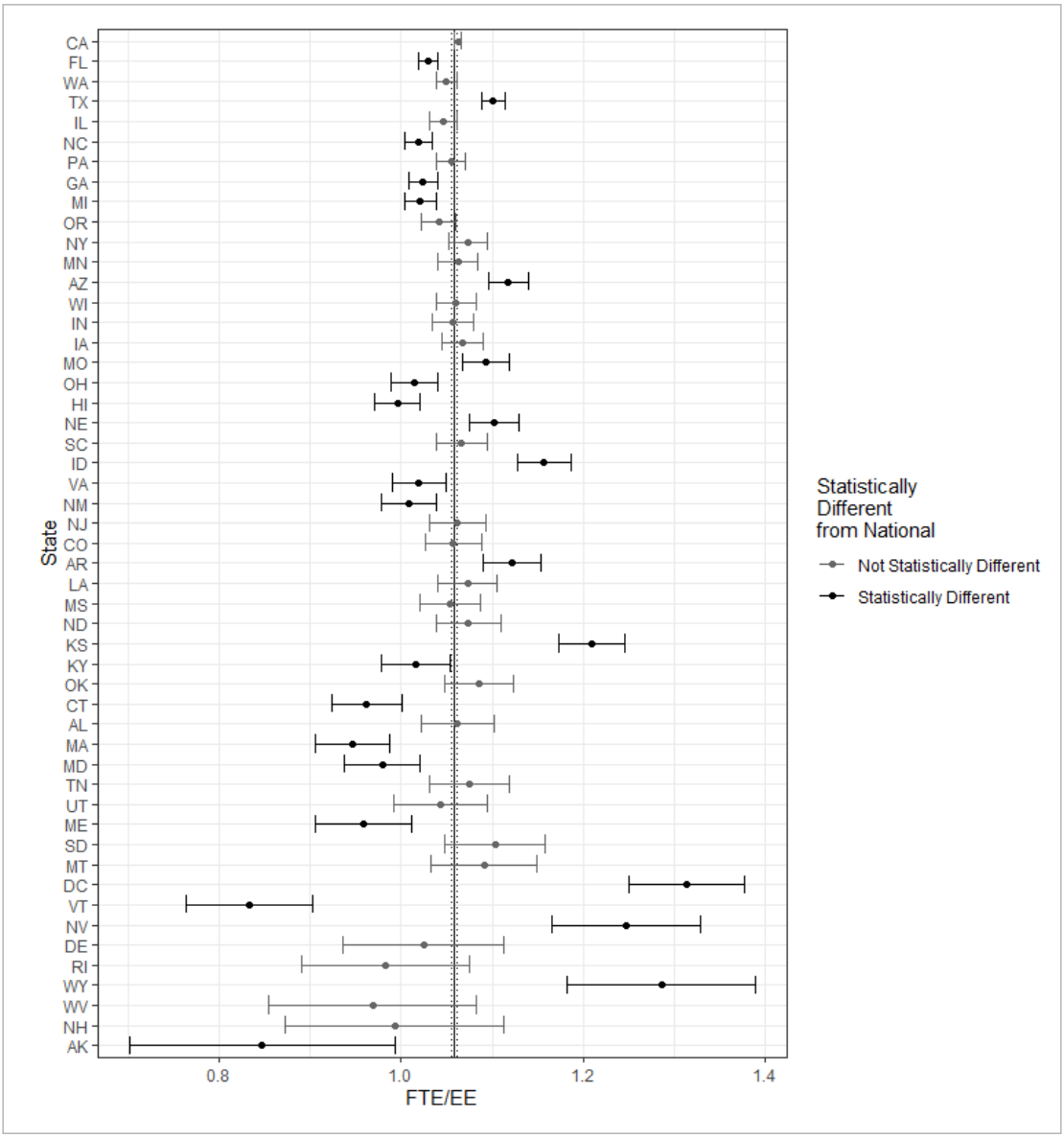


Figure 2.15 ACS FTE/EE by state, with 95% confidence intervals, and ACS national average FTE/EE for crop production (NAICS 111), ACS 2010–2014 data

Note: The vertical solid line in the middle of the graph represents the national ratio, and the vertical dashed lines next to it represent the national ratio's confidence interval.

Figure 2.16 illustrates the more general pattern for all industries. It shows the percentage of state-level FTE/EE estimates with a statistically significant difference from the national FTE/EE and how this percentage varies with the standard error of the estimate. This percentage ranges from 75% for the quintile of estimates with the lowest standard errors to a still substantial 39% for the quintile estimates with the largest standard errors.

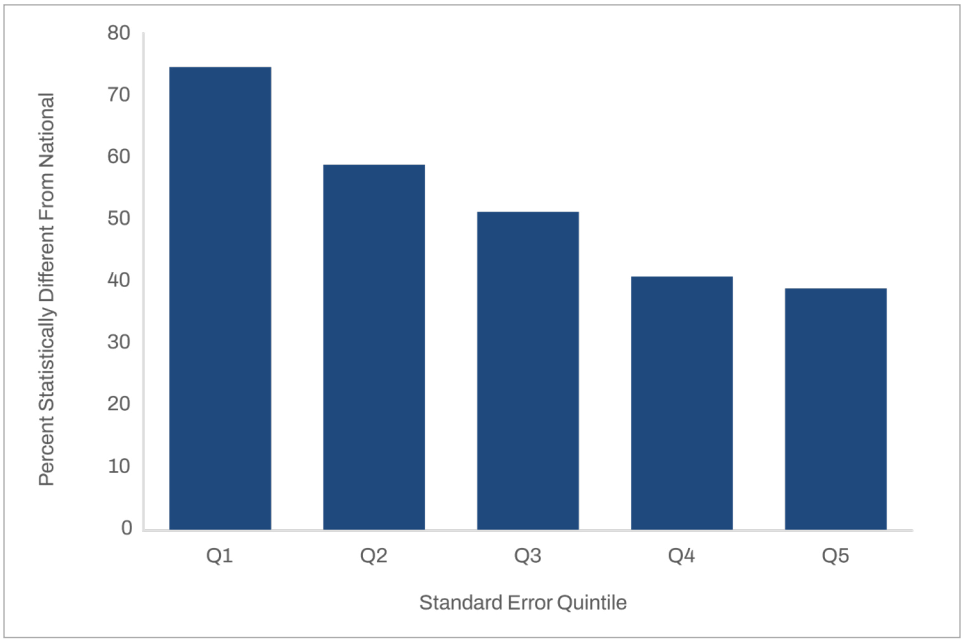


Figure 2.16 ACS state-level industry FTE/EE estimates, 2010–2014 data: percentage with statistically significant difference from ACS national average FTE/EE, by standard error quintile (95% confidence level)

Although state-level data are needed to represent a state's portion of a national industry, in Section 8 below, analyses of Washington data suggest that the choice between ACS and OPT data may actually have a modest impact on the ranking of industries by claim rate. This may be true for two reasons. First, even though a state's portion of an industry can be quite different from the industry on a national level, the range of FTE/EE among states within an industry is usually considerably less than the variation among industries. This can be seen in Table B.1 in Appendix B. This implies that national FTE/EE values are still somewhat indicative of differences among industries on the state level. Second, the findings in Section 8 imply that the variation in the actual claim rate is much greater than, and dominates, the variation among alternative estimates of FTE/EE and FTE denominators.

While national-level OPT FTE/EE estimates may yield claim rate estimates that provide reasonably accurate rankings of industry claim rates, subsequent sections of this report focus mostly on the ACS. This is because only the ACS can capture state-specific, industry FTE/EE ratios, and because several technical issues need to be addressed when calculating FTE/EE ratios with ACS data. These issues involve selecting methods of estimating FTE/EE, assigning industry codes, calculating MOE and CI, and using data from multiple years (see Sections 3, 4, 6, and 7).

By comparison, using FTE/EE derived from OPT data is straightforward for several reasons. First, it requires only dividing the provided total number of industry hours by the provided number of employees and converting the result into FTEs. Second, unlike ACS data, OPT data are classified by NAICS code at the 4-digit level. Third, there is no need to calculate standard errors. BLS does not provide a method for this, and sampling error is minimal due to CES's large sample size, which is the main data source for OPT data (see Appendix A). Fourth, a large sample size provides accurate annual estimates, eliminating the need to consider aggregating data for multiple years as is appropriate with ACS data.

Note that if ACS is selected as the main data source to estimate FTE/EE, it is prudent to calculate MOE and CIs to determine how much uncertainty exists in the estimates. In that case, claim rates can be calculated using alternative denominators near either end of the CIs to see if they result in significant differences in relative industry claim rates. See Section 6 on MOE and CI for further details. As referenced in Section 6, Table J.1 in Appendix J provides industry-level FTE/EEs with standard errors and CIs for three states of different sizes. Table J.2 also shows how FTE/EE CIs translate into FTE denominator CIs that can be used to calculate claim rate CIs.

3. CALCULATING FTE/EE ADJUSTMENT FACTORS USING ACS DATA

Although there are advantages to using OPT data for estimating industry FTE/EE ratios, the variation in FTE/EEs among states may warrant reliance on the ACS, as discussed in Section 2. The proposed method for estimating FTE/EE using ACS data, along with explanations for its selection, are outlined here. Several ACS PUMS variables are referred to in this section. Details on relevant ACS survey questions, labels for ACS variables, and values for question responses are provided in Appendix H.

METHOD FOR CALCULATING FTE/EE ADJUSTMENT FACTORS

Select Respondents to Include:

- If calculating claim rates only for private sector workers, include only class of worker (COW) = 1, 2 (employee who worked for a for-profit business or a nonprofit organization). If including public sector workers in the claim rate calculations, also include COW = 3, 4 (worked for state or local government).
- Include only those working last week or with a job last week but not working (ESR = 1, 2).

Calculate FTE/EE by Industry:

- Divide WKHP (usual hours worked per week in the past 12 months) by 40 hours to obtain the number of FTEs that each survey respondent represents.
- Calculate the mean FTE/EE within each industry using "person weight" (PWGTP).[44] Multiply the number of FTEs for each respondent by the respondent's person weight. Then, within each industry, sum this product over all respondents and divide by the sum of the weights in the industry.

RATIONALE FOR THE METHOD

Inclusion and exclusion of worker groups

The first step in the method above is selecting respondents to include in the calculation. The COWs included are private sector workers and possibly state and local government workers as well. Note that federal government workers are not included because they are covered by a separate, federal WC system. Self-employed workers are not included because purchase of WC insurance is typically optional for them.[45] Data are lacking on the percentage of self-employed people who purchase it, but it was assumed that the majority do not. However, if evidence is found that the majority of self-employed people do purchase insurance for themselves, then they can also be included. COW 6 is self-employed with unincorporated businesses and COW 7 is self-employed with incorporated businesses. The latter may be more likely to purchase insurance. Some self-employed workers are "independent contractors," although the ACS does not include a question that asks respondents specifically whether they fit this description. While most independent contractors are likely to correctly report being self-employed (most likely with an unincorporated business), some of these workers report being employees in population surveys and will be mistakenly included.[46]

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44 Each person in the ACS survey sample represents a certain number of people in the population from which the sample is drawn. This number of people is the person weight. Note that in ACS data published at IPUMS.org, these weights have the variable name PERWT.

45 Coverage in the majority of states is not required for sole proprietorships or individuals engaged in business who do not have employees. Also, employers who hire independent contractors are not required to cover independent contractors in most states. See Tables 1 and 2 in Rothkin K [2025] Workers' compensation laws as of January 1, 2025. Workers' Compensation Research Institute. Pub. WC-25-19. https://assets.noviams.com/novi-file-uploads/iaiabc/WCRI-IAIABC_WC_Laws/WCRI-IAIABC_WC-Laws_2025.pdf. Workers' compensation insurance requirements for self-employed individuals are summarized on many insurer and law firm websites, such the following: https://www.progressivecommercial.com/business-insurance/workers-compensation-insurance/self-employed-independent-contractors/

46 Abraham KG, Haltiwanger JC, Sandusky K, Spletzer J [2013]. Exploring differences in employment between household and establishment data. J Labor Econ 31(S1):S129–S172, https://www.journals.uchicago.edu/doi/10.1086/669062.

The general principle is to select respondents who are likely to be covered by a WC insurance policy purchased by their employer, because these workers are eligible to file a claim. The vast majority of employers are required by state law to purchase a policy that covers all of their employees (except in Texas).[47] Some of the most common exemptions from covering some or all employees are in the agricultural sector. It may be possible to tailor the criteria for selecting which agricultural workers to include by consulting agricultural coverage laws and options, which vary widely by state.[48] Some states also have exemptions for very small businesses, domestic workers, nonprofit organizations, certain industries, or other employers or categories of workers.[49] It is good to check whether the inclusion criteria for selection of ACS respondents might be tailored for any such exemptions. However, for some exemptions, such as those defined by size of business, information that could be used to exclude respondents whose employer is exempted is unavailable in the ACS.

This method includes almost all workers covered by WC insurance, encompassing part-time employees and those in short-term or contingent jobs.[50] It also includes workers employed by a temporary staffing agency. Note that complications arise regarding how these workers are classified to industry in ACS data. When temporary staffing agency employees are asked in the ACS to give the name of the employer they work for, they might choose to name either the temporary staffing agency or the "host" employer who uses their services. If they respond with the name of the temporary staffing agency, they could be coded to the employment services industry (ACS industry code 7580, NAICS code 5613). Subsequent ACS questions ask about work activities at the workplace, which would refer to the host employer's workplace. Consequently, respondent answers may result in coding industry according to activities at the host employer. Note that, in contrast to the ACS, temporary staffing agency employees are consistently counted in QCEW, UI, and OPT data as employees of the staffing agencies.

Rationale for including only people working or with a job last week

To understand the method of calculating the average number of FTE-equivalents by industry, begin by recalling that the FTE/EE ratio derived from the ACS is multiplied by an employee count to obtain the total number of FTEs. Thus, we have FTE/EE * Total EEs = Total FTEs. For this calculation to be valid, the EE in the denominator of FTE/EE should be expressed in the same units as the EE count in the second term of the equation. These Total EE counts are generally obtained from another source such as UI or QCEW data. In the UI system, employers are asked monthly to report the number of employees on the payroll for the payroll period that includes the 12th of the month.[51] Payroll periods are usually biweekly or semimonthly, with most of the rest being weekly.[52] The 12 monthly EE counts are averaged to produce

47 Texas Department of Insurance: https://www.tdi.texas.gov/wc/employer/index.html.

48 McEowen R [2015]. Workers' compensation and the exemption for agricultural labor. Ames, IA: Iowa State University, Center for Agricultural Law and Taxation, https://www.calt.iastate.edu/article/workers%E2%80%99-compensation-and-exemption-agricultural-labor.

49 See brief summaries of exemptions from WC coverage requirements at the following webpage of the National Federation of Independent Business, entitled "Workers' compensation laws: state by state comparison" (June 7, 2017), https://www.nfib.com/content/legal-compliance/legal/workers-compensation-laws-state-by-state-comparison-57181/.

50 See technical definitions of contingent workers in: BLS [2018]. Contingent and alternative employment arrangements—May 2017. News release. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, Publication No. USDL-18-0942, https://www.bls.gov/news.release/pdf/conemp.pdf.

51 Federal data sources other than the QCEW also report employee counts for industries that are averages of employee counts for a series of pay periods throughout the year. For example, the CES program asks employers to report the number of employees for the pay period that includes the 12th of the reference month. These monthly figures are averaged to yield employment figures for the year by industry. These figures in turn are used by the BLS Office of Productivity and Technology which provides statistics on number of employees and hours worked by industry at the national level. As another example, the CPS asks individual respondents about their industry of employment during the calendar week that includes the 12th of the reference month.

52 BLS [2023c]. Length of pay periods in the Current Employment Statistics survey. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, https://www.bls.gov/ces/publications/length-pay-period.htm.

the annual EE counts from UI or QCEW. These counts represent the average, point-in-time number of employees in an industry, rather than the total number of people who ever worked in an industry at any time during the year. If there is any amount of industry turnover (workers entering or leaving the industry), the total number of employees who work in an industry over a 1-year period will always be greater than the average number of people working in a single payroll period during the year.

If total employee counts obtained from UI or QCEW data represent averages over points in time during the year, then FTE/EE should also be an average over points in time during the year. The proposed method given above identifies a representative sample of workers in each industry in which each respondent represents a worker for a single, one-week period. This is why only persons who had a job "last week" (ESR = 1, 2) are included in the calculation, and those who worked within the previous 12 months but had no job "last week" are excluded (ESR = 3, 6).

The ACS is administered on a continuous basis throughout the year, so those working in all weeks of the year have an equal probability of being selected. Rises and falls in the number of workers in an industry are reflected in this pool of respondents. For example, in a seasonal industry, there will be fewer respondents in the low season and more respondents in the high season. This accurately reflects the distribution of workers in the industry.

This method takes each ACS respondent as representative of workers in the respondent's industry in the week they are known to have worked in that industry ("last week"). Because the method's purpose is to count FTEs, the desired information is the number of FTEs the respondent represented during that week. This is determined by the number of hours worked during that week. If 1 FTE = 40 hours, then hours worked divided by 40 equals the FTE of the respondent. The FTEs of the respondents in each industry are averaged using the appropriate person weights.

Unfortunately, the actual FTE of each respondent in the last week is not available in the ACS because there is no survey question about hours worked in the last week. The ACS only asks about usual weekly hours over the last 12 months, in all jobs combined. The authors therefore use the answer to this question as an approximation to hours worked last week. Appendix C details biases resulting from use of the usual weekly hours question in this way.

The number of FTEs in an industry can exceed the number of employees because a single worker working more than 40 hours per week will count as more than one FTE. An alternative method sometimes considered is to count each worker as no more than one FTE, no matter how many hours they work, while still counting workers who work less than 40 hours per week as a fraction of an FTE. Appendix F provides a discussion of the rationale for this method and reasons why the authors do not suggest using it.

The ACS can be used to calculate total work hours over the previous 12 months by combining usual weekly hours with the number of weeks worked during the previous 12 months, as reported by the respondent. Total hours worked in the previous 12 months can be compared with 2,000, which is the number of annual hours generally taken to represent 1 full-year FTE.

However, the number of weeks the respondent worked during the year does not bear upon the number of FTEs represented by the respondent "last week." Use of the weeks worked variable (WKW) to determine FTEs in the ACS could therefore lead to error. For example, any respondent working 40 hours per week, but less than 50 weeks, would be erroneously counted as working less than full time. However, many such workers did work full time during the reference week.

Remember that the goal is to determine how many FTEs each worker represents at a point in time, not what proportion of the year they worked. See Appendix D for hypothetical examples that illustrate why the proposed method should provide more accurate estimates than a method using WKW. Appendix E provides more details on the method using WKW and compares FTE and FTE/EE estimates based on the proposed method ("version 1" [v1]) with estimates based on the method using weeks worked ("version 2" [v2]). Section 8 and Appendix K also include alternative estimates based on the version 2 method using WKW.

4. INDUSTRY CODES, CROSSWALKS, AND DATA AVAILABILITY AT DIFFERENT CODE LEVELS

WC claim rate analysis within WC systems employs industry coding systems specific to WC. But claim rate analysis for public health is more often based on coding employers and claims using standard government coding systems. The foundational industry coding system in the U.S. is the NAICS, which is mostly common between Canada, Mexico, and the U.S. This coding system is used when data are gathered from employers. However, a modified set of codes, called census industry codes, is used when survey data are gathered from individual workers and households. This is because it is sometimes more difficult to obtain specific industry information from respondents to the ACS and other population surveys than from employers. Census industry codes are somewhat less specific than NAICS codes, but they are constructed to align as much as possible with NAICS codes. A discussion of industry codes in population surveys versus employer surveys is in Appendix A.

2012 CENSUS AND NAICS INDUSTRY CODING—LEVEL OF DETAIL

NAICS industry codes are revised every 5 years. They were revised in 2017 and 2022, but most of the 2012 industry codes are still in use. As reported in Table 4.1, there are 269 4-digit census industry codes (2013). Of these, 15 are for public administration (code 92), including 7 for the active-duty military. By comparison, there are 312 4-digit NAICS codes (2012). Of these, 8 are for public administration (92), including one for active-duty military. These 4-digit codes are grouped into 99 3-digit NAICS codes, which in turn are grouped into 20 2-digit codes. Eight of the 3-digit codes and one of the 2-digit codes are for public administration.

Table 4.1 also reports the number of 3-digit NAICS codes and 4-digit NAICS codes included in each 2-digit NAICS code, as well as the number of 4-digit census industry codes corresponding to each 2-digit NAICS code. In most 2-digit industries, NAICS provides more detail at the 4-digit level than census industry codes. There are more 4-digit NAICS than census industry codes. Exceptions include NAICS 21, 22, 42, 44–45, 54, 81, and 92. In NAICS 51, there is an equal number of 4-digit census and NAICS codes. NAICS 55 has only one code in both code lists.

Table 4.1 2012 NAICS and 2013 census industry codes

	2-digit Industry Description	2-digit NAICS Code	3-digit NAICS Count	4-digit NAICS Count	4-digit CENSUS Code Count
1	Agriculture, fishing, forestry, and hunting	11	5	19	6
2	Mining, quarrying, and oil and gas extraction	21	3	5	6
3	Utilities	22	1	3	6
4	Construction	23	3	10	1
5	Manufacturing	31–33	21	86	81
6	Wholesale trade	42	3	19	21
7	Retail trade	44–45	12	27	36
8	Transportation and warehousing	48–49	11	29	12
9	Information	51	6	12	12
10	Finance and Insurance	52	5	11	5
11	Real estate and rental and leasing	53	3	8	5
12	Professional, scientific, and technical Services	54	1	9	10
13	Management of companies and enterprises	55	1	1	1
14	Administrative and support and waste management and remediation services	56	2	11	8
15	Educational services	61	1	7	4
16	Healthcare and social assistance	62	4	18	15
17	Arts, entertainment, and recreation	71	3	9	4
18	Accommodation and Food Services	72	2	6	4
19	Other services (except public administration)	81	4	14	17
20	Public administration†	92	8	8	15
		Total	**99**	**312**	**269**

Note: The census industry code 9920 is excluded from this table because it represents people without a job (unemployed, last worked 5 years ago or earlier, or never worked).

† For all branches of the active-duty military, the NAICS code is 928110, which is part of public administration.

NAICS CODES IN THE ACS PUMS EXTRACTS

Responses to ACS industry questions are coded by the Census Bureau using only the census industry codes, not NAICS codes. However, the NAICS code that most closely corresponds to the assigned census industry code is provided in the ACS PUMS field labeled "NAICSP."[53] In many cases, there is a 1-to-1 mapping between a census industry code and a NAICS code. If so, NAICSP is just a standard, 4-digit NAICS code. However, census industry codes do not map one-to-one to NAICS codes in all cases, especially at the 4-digit level. If there is no 1-to-1 mapping, a special "NAICS-based" code is given in the "NAICSP" field. A NAICS-based code consists of a NAICS code and a letter suffix that indicates the type of relationship between the NAICS code and the census industry code.

The letter suffixes of NAICS-based codes are defined as follows. Census Bureau definitions are given in bold[54] and additional explanations are provided in brackets.:

- **M = Multiple NAICS codes** [Indicates that the census industry code represents more than one, but not all of the more detailed NAICS codes within the specified NAICS code. In a few cases, there may be two or more census industry codes representing different groups of detailed NAICS codes within the specified general NAICS code. When this occurs, the suffix is given as "M1" or "M2," etc.]
- **P = Part of a NAICS code; NAICS code split between two or more census industry codes**
- **S = Not specified Industry in NAICS sector; specific to census industry codes only**
- [Indicates that the survey response was only classified to a general industry represented by a 2- or 3-digit NAICS code. The more specific industry is unknown.]
- **Z = Exception to NAICS code; Part of NAICS industry has its own census industry code** [The census industry code corresponds to the NAICS code, except that one or more detailed codes within the NAICS code correspond to a different census industry code. The meaning of Z appears similar to the meaning of M.]

Information on the correspondence between census, NAICS, and NAICS-based codes for 2018 data is provided in a crosswalk entitled "2018 ACS PUMS and 2018 SIPP Public Use Industry Code List" at https://www.census.gov/topics/employment/industry-occupation/guidance/code-lists.html.[55] The previous, 2013 version of this crosswalk corresponds with the most recent data used for the tables and figures in this report and is reproduced in Appendix G. Note that NAICS codes are updated every 5 years, and ACS PUMS "NAICSP" codes change accordingly. For example, ACS "NAICSP" codes for 2018–2022 were based on 2017 NAICS codes. Similarly, NAICSP 2013–2017 codes were based on 2012 NAICS codes.

In general, ACS PUMS data at the 2- and 3-digit NAICS levels can be used with relatively few complications. Most 2- and 3-digit ACS "NAICSP" codes are standard NAICS codes that map exactly to a single census industry code or to a group of census industry codes. A few 3-digit NAICS codes are not available in the NAICSP set of codes. However, some workaround solutions are available:

- In 2014 data, NAICS code 221 is not available, but there are six more specific NAICSP codes that contain parts of 221. These can be grouped together to obtain a sample of respondents in 221. Note that 221 is the only 3-digit code within NAICS 22. The six codes are 2211P, 2212P, 221MP, 2213M, 22132, and 22S.
- NAICS code 522 is also not available, but can be represented by NAICSP codes 522M, 5221M, and 52M. Although 52M contains some workers in 521, most are in 522 (this can be seen in QCEW data).

53 See additional information on the ACS and ACS PUMS data in the Introduction and Appendix A.

54 See, for example, the file "2022 ACS 1-year PUMS Code Lists" on the PUMS documentation webpage of the U.S. Census Bureau: https://www.census.gov/programs-surveys/acs/technical-documentation/pums/documentation.html.

55 For historical data up through 2012, see the crosswalk between census industry codes and NAICS codes in the file "1990–2012 Census Industry Codes with Crosswalk" on the U.S. Census Bureau Industry and occupation code lists & crosswalks webpage: https://www.census.gov/topics/employment/industry-occupation/guidance/code-lists.html.

- Although NAICS code 532 is not available, it can be represented by 5321, 53223, and 532M. Note that 53M should not be included because most of the employment in NAICS 53 is in NAICS 531.
- None of the 3-digit NAICS codes within NAICS 23 (construction) are available, but in this case, it is reasonable to use data for NAICS 23 for an FTE/EE estimate that can be applied to the 3-digit codes in construction.

There are some ACS respondents who could only be classified at a 2-digit level, so they could not be included in counts of workers at more detailed industry levels. These respondents were classified into the following special NAICSP codes: 22S, 31M, 33M, 3MS, 42S, 4MS, 52M, 53M, and 92M.[56] These codes should not be used when calculating FTE/EE at the 3-digit level because they contain respondents who belong in a variety of 3-digit codes. Omission of most of these codes is of little concern, because they represent only a small percentage of workers in their industry sectors. Two exceptions exist: one is special code 52M, which includes about half of the employees and hours worked in finance and insurance (52); the other is 92M, which includes more than 60% of the employees and hours worked in public administration (92). All of the codes with two digits and a suffix can be included in calculations of FTE/EE at the 2-digit NAICS level.

At the 4-digit level, many "NAICSP" special codes appear, indicating lack of perfect correspondence between census and NAICS codes. If computing claim rates at the 4-digit level, it can be helpful to understand these codes in more detail. Table 4.2a illustrates ten examples of common patterns and uses of special NAICS-based "NAICSP" codes and Table 4.2b provides detailed explanations of the examples in Table 4.2a.

56 Note that codes 3MS and 4MS actually refer to 2-digit sectors 31–33 (manufacturing) and 44–45 (retail).

Table 4.2a Crosswalk: Ten examples of relationships among census, NAICS and NAICSP industry codes in ACS

Example	2012 Census	2012 Industry Description	2012 NAICS Code	2013 ACS NAICS-Based "NAICSP" Code
1	0170	Crop production	1111, 1112, 1113, 1114, 1119	111
2	0190	Forestry except logging	1131 (Timber tract operations) 1132 (Forest nurseries and gathering of forest products)	113M
	0270	Logging	1133	1133
3	0770	Construction	2361, 2362, 2371, 2372, 2373, 2379, 2381, 2382, 2383, 2389	23
4	0570	Electric power generation, transmission, and distribution	2211	2211P
	0580	Natural gas distribution	2212	2212P
	0590	Electric and gas, and other combinations	Parts of 2211, 2212	221MP
5	0670	Water, steam, air-conditioning and irrigation systems	22131 (Water supply and irrigation systems) 22133 (Steam and air-conditioning supply)	2213M
	0680	Sewage treatment facilities	22132 (Sewage treatment facilities)	22132
6	0690	Not specified utilities	Part of 22	22S
7	3290	Not specified machinery manufacturing	Part of 333	333S
8	3990	Not specified manufacturing	Part of 31, 32, 33	3MS
9	4590	Not specified wholesale trade	Part of 42	42S
10	6680	Wired telecommunications carriers	5171	5171
	6690	Telecommunications, except wired communications carriers	517, excluding 5171	517Z

Table 4.2b Explanations of Examples in Table 4.2a

Example(s)	Explanation
1	Crop production (NAICS 111) has five different 2012 NAICS codes at the 4-digit level. However, there is only one census industry code for crop production (0170), so the most detailed ACS PUMS data will be at the 3-digit level using "NAICSP."
2	Forestry except logging, census industry code 0190, combines two 4-digit NAICS codes (1131 and 1132) into "NAICSP" code 113M, but then logging alone is available as a 4-digit code in "NAICSP."
3	Construction has only one census industry code (0770) and one 2-digit ACS "NAICSP" code (23) but has ten 4-digit NAICS codes. Constructing FTE/EE ratios at a detailed 3- or 4-digit industry level for construction is not possible with ACS data. However, applying 2-digit ACS FTE/EEs to the 3- or 4-digit NAICS employee counts from the QCEW is a possible work-around.
4	Two 4-digit NAICS (2211, 2212) can be split between three census industry codes. The "NAICSP" codes 2211P and 2212P show that only part of these two NAICS codes are included. The "NAICSP" code 221MP then aggregates the remaining parts of 2211 and 2212.
5	Example 5 is similar to Example 2, except that the NAICS codes are at the 5-digit level as opposed to the 4-digit level in Example 2.
6,7,8,9	These examples all include "S" codes that represent "not specified industry" in a NAICS sector. The "S" codes can probably be ignored for purposes of calculating FTE/EE ratios.
10	Example 10 shows how a 4-digit NAICS code (5171) corresponding to census 6680 is carved out of 3-digit NAICS industry 517 (telecommunications). This leaves 517Z, corresponding to census 6690, to represent the remainder of 517.

ACS PUMS EXTRACTS: DIFFERENCES AMONG STATES IN AVAILABILITY OF DATA FOR PRIVATE INDUSTRIES

ACS PUMS data availability for the private sector is excellent at the 2-digit NAICS level. For example, only Wyoming was missing a code (NAICS 55) in 2014.

Generally, 3-digit NAICS codes are available in the 3-digit ACS PUMS extract for the private sector, with the following exceptions in 2014:

- Seven 3-digit codes are missing in all states. These include all three of the 3-digit codes for construction (236, 237, 238), as well as codes 521, 523, 525, and 533. Code 551 may also appear to be missing, but because it is the only 3-digit code in NAICS 55 (management of companies and enterprises), data for NAICS 55 represent NAICS 551.
- Additional 3-digit codes are missing from the ACS extract in the following small states: AK, DC, DE, ID, MT, ND, NH, RI, SD, VT, WV, and WY. Three other states, HI, LA, and NM, are only missing selected special codes such as 31M and 33M.

NAICS codes at the 4-digit level are generally available for about half of the 304 possible private sector 4-digit NAICS codes without resorting to using the special "NAICSP" codes with suffixes M, P, S, and Z. However, this availability varies by state. For a low-population state like AK, data for only 96 4-digit codes are provided in the 2014 ACS PUMS. But for CA, estimates are provided for 149 4-digit codes.

ESTIMATES OF FTE/EE FOR 4-DIGIT NAICS INDUSTRIES WHEN STATE-LEVEL ACS DATA ARE NOT AVAILABLE

When data for 4-digit NAICS codes are not available in the ACS on the state level, other options for obtaining reasonable FTE/EE estimates are needed. These options include state-level 3-digit ACS data, national-level 4-digit ACS data, and national-level 4-digit OPT data.

As explained in Appendix L, state-level 3-digit FTE/EE ACS data are probably the best choice overall. These state-level, 3-digit estimates and national-level, 4-digit ACS estimates are almost equally close to state-level 4-digit ACS estimates. The 3-digit estimates are closer to state-level 4-digit estimates than estimates based on national-level OPT data.

Focusing only on state-level industries with available ACS data at the 4-digit level, calculations in Appendix L show that substituting 3-digit FTE/EE estimates for 4-digit FTE/EE estimates results in a median change of 3% in calculated claim rates. Claim rates are changed by 14% or less in 95% of cases.

Although using state-level 3-digit data can sometimes result in large differences in estimated claim rates, the inaccuracy associated with using these alternative FTE/EE estimates needs to be weighed against the value of obtaining 4-digit level claim rates. Claim rate estimation at the 4-digit level rather than the 3-digit level can provide considerably more precise information on where higher rates of injuries are occurring. Errors in the denominator may still allow a reasonably accurate ranking of industries by claim rate (see Section 8 for more discussion and analysis of this issue).

5. PUBLIC SECTOR EMPLOYMENT AND HOURS WORKED IN OPT AND ACS DATA

OPT data are generally coded to NAICS but a notable exception is the classification of workers in the public sector. In OPT data, most public employees are aggregated in NAICS sector 901. The armed forces are excluded. The aggregation of public employees in sector 901 means that the OPT data reported by NAICS code for industries that typically include both public and private workers reflect only private sector workers. This is notable in industries such as education, healthcare and social assistance, construction, utilities, and transportation. For example, public school teachers are included in OPT sector 901, so the published OPT education industry data (NAICS 611) are for private school teachers only. One exception is liquor stores (NAICS 4453) as state workers are double counted because they are ncluded in NAICS 4453 as well as in the aggregated sector 901. A second exception is federal postal employees (NAICS 491) as they are reported separately in NAICS 491 and not in the aggregated sector 901 data.

For sector 901, OPT data only measure hours paid and do not reflect an hours-paid-to-hours-worked adjustment as they do for private sector industries. For most industries within 901, OPT data use average weekly hour data from the CPS to estimate total annual hours. For industries without CPS data, OPT assumes a 40-hour work week. BLS does not provide a detailed breakdown of OPT public sector data in sector 901. However, BLS may be able to remove federal employees upon request, as was done for the OPT data used in this report.

In contrast to OPT data, the ACS PUMS classifies private and public sector workers together in the same industry where appropriate. However, all workers are also classified by the COW variable as private, local, state, or federal, so statistics for private and public portions of an industry can be calculated separately. State and local government data in the ACS are also published for several census industry code classifications that are defined exclusively as public administration sectors in the NAICS system. However, a majority of the employees in these classifications correspond to very broad, special "NAICSP" codes such as 92M1, 92M2, and 92MP.

A couple of the specific industry codes mentioned in the context of OPT data can also create confusion in ACS data. Some states have only private sector retail stores in NAICS 4453 (liquor stores, census industry code 4490), while others have private and public sector liquor stores. Some states have private as well as public sector employees in the postal service NAICS 491 (census industry code 6370) because there are private contractors to the USPS. Prior to 2014, private sector postal workers in NAICS 491/census 6370 were classified as federal workers (COW = 5) but are subsequently identified as private workers (COW = 1, 2).[57]

Ideally, claim rates for high-hazard, public sector industries such as police and fire should be calculated, but there are issues in obtaining the numerator and the denominator. For the numerator, these claims are often covered under insurance policies of state and local governments that include employees in other industries and occupations. The identification of police and fire claims must be accomplished using more specific administrative data. For the denominator, total, statewide employee counts for police protection (NAICS 922120) and fire protection (NAICS 922160) are available from QCEW data. However, it is not possible to calculate FTE/EE adjustment factors for these industries using OPT data for the reasons previously explained. In ACS data, detailed counts of police and fire workers are available by occupation, but police and fire cannot be broken out by industry code. Police and fire are included in a more general classification that includes police, fire, and other categories of employees: NAICSP code 92MP (justice, public order, and safety activities), which includes NAICS 922 and part of 92115.

57 Louie K [2023]. Email message to Martha WM Jones, June 5 (from California Department of Finance). The Census Bureau referenced this kind of change to the ACS in the following note: U.S. Census Bureau [2021]. Changes to the occupation, industry, and class of worker editing procedures. Washington, DC: U.S. Census Bureau, https://www.census.gov/programs-surveys/acs/technical-documentation/user-notes/2015-01.html.

6. CALCULATING MARGIN OF ERROR AND CONFIDENCE INTERVALS FOR FTE/EE AND FTE ESTIMATES BASED ON ACS DATA

ACS PUMS data are based on a sample and subject to sampling variability. The degree of uncertainty for an estimate arising from sampling variability is represented with margin of error (MOE) and confidence interval (CI) estimates, which require calculation of the standard error. The Census Bureau offers two methods of calculating standard errors. One is based on design factor formulas, which are specific to the type of statistic being estimated. Because the method of estimating FTE/EE as previously explained in Section 3 is a matter of calculating a weighted mean of weekly hours expressed as a fraction of a 40-hour work week, the appropriate design factor formulas are the ones used for the standard error of means.[58] Design factor formula parameters vary by state and characteristics, such as industry. The second method for calculating standard errors uses replicate weights and is considered more accurate by the Census Bureau but is more computationally intensive. This is the method the authors used.[59]

The lower and upper bounds of the CI around an FTE/EE estimate are defined by the estimate minus the MOE and the estimate plus the MOE. Researchers can choose between different levels of confidence when computing the MOE and CI. A 90% level of confidence is used by the Census Bureau, and a 95% level of confidence is used in most research publications.

A CI of 95% or higher may be most reasonable in the context of evaluating evidence for a theory or scientific conclusion. Confidence levels lower than 95% may be more reasonable in the context of using data for descriptive and decision-making purposes. A 90% MOE and CI can be interpreted roughly as providing a 90% probability that the CI contains the true value. A 90% MOE is calculated by multiplying the standard error of the estimate by 1.645. In a normal distribution, 90% of the values lie within 1.645 standard deviations of the mean. The relative MOE (rMOE) is defined as the MOE divided by the estimate itself, and may serve as a measure of the quality of the estimate:

- Margin of Error (80%) = standard error * 1.285
- Margin of Error (90%) = standard error * 1.645
- Margin of Error (95%) = standard error * 1.96
- Relative Margin of Error = MOE/estimate

The Census Bureau does not provide universally applicable guidelines on acceptable levels of the rMOE. The acceptability of rMOE levels depends upon how precise estimates need to be to adequately serve their purpose.

58 See pp. 21–22, 24–25 in: U.S. Census Bureau [no date]. Public use microdata sample (PUMS): Accuracy of the data (2012–2016), https://www2.census.gov/programs-surveys/acs/tech_docs/pums/accuracy/2012_2016AccuracyPUMS.pdf.

59 See pp. 25–26 in: U.S. Census Bureau [2009]. A compass for understanding and using American Community Survey data: What PUMS data users need to know, https://www.census.gov/library/publications/2009/acs/pums.html; More details on both methods are available in Chapter 12 (variance estimation) in: U.S. Census Bureau [2014]. ACS 2014 design and methodology report, https://www.census.gov/library/publications/2010/acs/archive.html. An updated version of this document is also available: https://www.census.gov/programs-surveys/acs/methodology/design-and-methodology.html.

Table 6.1 Calculation of margin of error and confidence interval for FTE/EE (ACS data) Crop production industry (NAICS 111) in Ohio, 2012

	90% Confidence Level	95% Confidence Level
FTE/EE estimate	1.0141	1.0141
Standard error (SE)	0.0188	0.0188
Factor (90% or 95% confidence level)	1.645	1.96
MOE (SE * factor)	0.031	0.037
rMOE [MOE / (FTE/EE)]	3.0%	3.6%
Confidence interval		
Lower bound FTE/EE (FTE/EE minus MOE)	0.983	0.977
Upper bound FTE/EE (FTE/EE plus MOE)	1.045	1.051

Table 6.1 gives an example calculation of the MOE and CI for an FTE/EE estimate for a single industry (crop production). Table 6.2 shows how the lower and upper bound FTE/EE estimates for the same industry can be multiplied by the number of employees obtained from the QCEW to yield a CI for the number of FTEs, as well as the MOE for the FTE estimate. This calculation is simple, because QCEW data on number of employees is based on reports from every individual employer and is not subject to sampling error. See Appendix A for more information on the QCEW.

Table 6.2 Calculation of FTE estimate with margin of error and confidence interval: Crop production industry (NAICS 111) in OH, 2012

	90% Confidence Level	95% Confidence Level
EE (Number of Employees, QCEW)	7,324	7,324
FTE/EE[60]	1.014	1.014
FTE (EE * FTE/EE)	7,427	7,427
Confidence interval		
Lower bound FTE (EE * Lower bound FTE/EE)	7,201	7,158
Upper bound FTE (EE * Upper bound FTE/EE)	7,653	7696
FTE MOE (FTE minus lower bound FTE estimate)[61]	226	269
FTE rMOE: (FTE MOE)/FTE	3.0%	3.6%

For examples of MOE and CI calculations for FTE/EE and FTE estimates for all 3-digit NAICS industries in differently sized states (CA, OH, and MA), see Tables J.1a—J.1c and J.2a—J.2c in Appendix J. MOEs are smaller and CIs are narrower for larger states with larger ACS samples. Note that Tables J.2a—J.2c only provide figures for the 90% confidence level.

60 FTE/EE estimates were calculated using 5-year ACS data, 2010–2014.

61 Note: the FTE MOE can be calculated in two ways: (1) the FTE estimate minus the lower bound FTE; and (2) the upper bound FTE minus the FTE estimate.

CALCULATING CIS FOR CLAIM RATES

The CIs for FTE estimates can easily be used to calculate CIs for claim rates. The number of claims in the numerator of a claim rate is usually known with certainty. The only uncertainty associated with claim rates is associated with the denominator. To calculate the CI for a claim rate, simply calculate alternative claim rates using the alternative FTE estimates at the lower and upper bounds of the FTE CI.

Claim rates are typically calculated to focus prevention efforts on the industries with the highest rates. For example, attention might be placed on the top 3, 10, or 25 industries. Alternatively, focus may be on industries with claim rates above some other chosen claim-rate level that seems to separate a group of industries with high rates from other industries. Wherever the line between the highest-rate industries and other industries is drawn, the degree of uncertainty associated with claim rate estimates should be recognized.

It is prudent to consider what claim rates would be if estimated using the lower and upper bounds of the FTE CI to determine whether certain industries that appear below that line might actually be above it, and vice versa. This would especially apply to industries with a large MOE associated with the FTE/EE estimate and a claim rate near the line between the highest-rate industries and other industries. In some cases, a finding of significant uncertainty in claim rates might be used with other evidence or considerations to help select industries for heightened focus on prevention.

Some ACS industry samples may be too small to support accurate estimates of the CI. However, no clear, general criteria exist for determining when a sample is too small to estimate an accurate CI for the mean. In the extreme case when the sample only contains one observation, the standard error and MOE will be zero because the sample does not allow any variation to be observed.

When samples are very small, an accurate CI cannot be estimated. However, it is possible to check how the calculated claim rate varies when reasonable alternative estimates of FTE/EE are used, such as the national-level FTE/EE estimate or low and high FTE/EE estimates for the same industry from other states. If using national FTE/EE estimates in this way, it is better to use ACS data rather than OPT data. ACS data typically yield higher estimates than OPT data, and any national FTE/EE estimates used should be consistent with other FTE/EE estimates based on state-level ACS data.

NON-SAMPLING ERROR IN FTE/EE AND CLAIM RATE ESTIMATES

TTNon-sampling error in ACS-based estimates of FTE/EE may be caused by errors in survey responses and by biases due to lack of alignment between the nature of survey questions in the ACS and the objective of estimating FTE/EE. The latter issue is described in Section 3 and Appendices C and D.

Another source of non-sampling error in claim rate estimates is the potential mismatch between the set of employers covered by the data source used to estimate FTE/EE and the set for whom claims data are available. ACS data are based on a random sample of housing units and provide a reasonably representative sample of employees of each industry's employers in a state. However, claims data may only be available for a subset of employers and it is only those employers whose employees are counted in the denominator. If there is a difference in average hours of work per employee between the employees of employers included in the claims dataset and the employees who work for other employers in the industry, some inaccuracy will result (Section 11 discusses obtaining QCEW information on number of employees for a subset of employers in an industry). In addition, if claim rates are computed on the individual employer level, FTE/EE estimates based on ACS or OPT data do not necessarily apply to any individual employer.

7. COMBINING ACS DATA ACROSS YEARS

REASONS FOR COMBINING MULTIPLE YEARS OF ACS DATA TO ESTIMATE FTE/EE

There are at least two reasons why one may choose to pool ACS data from multiple years. The first has to do with the nature of the ACS survey question about usual weekly hours of work. This question asks the respondent to consider the past 12 months rather than just the previous week. Because the ACS is administered throughout the year, the answers will pertain equally to hours during the year of the survey (call this year X) and the previous year (call this year X – 1). In the same way, responses to the following year's survey will pertain equally to year X + 1 and year X. Thus, dataset that pools the data from years X and X + 1 will be centered on year X, which is desirable if we are estimating a denominator for year X.

Using data from a single year may still be reasonable and more practical depending upon how respondents' answers are interpreted. Respondents may base their answers primarily on experience in recent weeks and months. If so, hours of work in year X are better represented by survey responses from year X than by survey responses in year X + 1. This makes the single-year data of year X a reasonable choice.

On the other hand, if respondents report hours of work that truly represent the previous year or a longer period, then a 2-year dataset including years X and X + 1 would be better centered on year X. If survey responses are biased toward recent weeks, they would better support the proposed FTE/EE estimation method. This method uses responses to represent hours per week in the previous week, which is the week in which respondents report their industry (see Section 3 and Appendix C). Another practical consideration in selecting a dataset is that ACS data may not yet be available for the year following the most recent year of available claims data. In other words, if the most recent year of claims data is X, ACS data may not yet be available for year X + 1.

Another reason for pooling ACS data from multiple years is to increase sample size and FTE/EE-estimate precision. In other words, larger sample size increases reliability as reflected in lower rMOEs (See Section 6 for a discussion of rMOE of FTE/EE estimates). In some cases, a lower rMOE may permit denominator estimates on a more detailed industry level (e.g., 4-digit NAICS rather than 3-digit NAICS). Denominator and claim rate estimates at the NAICS 4-digit level more specifically identify workplaces where injury prevention is most needed.

Despite the increased reliability of estimates using pooled data, the findings in this section show that 1 or 2 years of ACS data is generally adequate for FTE/EE estimates at the 3-digit NAICS level. At the NAICS 4-digit level, 1 or 2 years of ACS data is still usually adequate, although combining 5 years of data would likely make a noticeable difference in the precision of estimates for some industries.

The more precise FTE/EE estimates that come from combining 5 years of data may be used to calculate either annual rates or 5-year average rates. To calculate annual rates, the 5-year FTE/EE estimates are multiplied by employee counts of individual years to calculate denominators and claim rates for individual years. If this method is used, the most recent 5-year datasets will be centered on earlier years than the most recent single and 2-year datasets. It is ideal for the claims data and denominator data to be centered on the same years, so this could be a drawback of using 5-year ACS datasetsa.

Consider the schedule the Census Bureau follows when releasing ACS PUMS data for a given year. For example, for 2014, 1-year 2014 PUMS data were released in Fall 2015, and 5-year 2010–2014 PUMS data were released in Winter 2016. In Spring 2016, if a researcher wanted to use the most recent ACS PUMS data, the available datasets would be: 1-year data: 2014 1-year PUMS; 2-year data: 2013 and 2014 PUMS, which are centered on 2013; and 5-year data: 2010–2014 PUMS, which are centered on 2012. The year 2012 is the central year in this set of years and answers to questions in the 2012 survey about hours of work over the previous year pertain to 2011 and 2012. Alternative aggregations of years like 2-year data need to be assembled by the researcher. The Census Bureau no longer publishes 3-year datasets.

An alternative way of using FTE/EE estimates based on 5 years of pooled data is to shift the goal from producing claim rates for individual years to producing average claim rates for 5-year periods. This strategy would avoid using a 5-year FTE/EE estimate that may be quite different from the FTE/EE for an individual year. Further below, the authors show how 5-year FTE/EE estimates can sometimes greatly differ from 1- or 2-year FTE/EE estimates.

A 5-year rate would be computed by dividing the total number of claims over a 5-year period by the sum of FTEs for each of the 5 years. Each year's FTE estimate could be computed by multiplying the number of employees for that year by the 5-year FTE/EE estimate. While 5-year claim rates would not give detailed information on trends over time, they would provide information on relative claim rates of industries, which is usually the most important goal. The drawback is that some industries may be undergoing rapid change in working conditions, causing rapid changes in claim rates that might be missed.

EFFECT OF COMBINING ACS DATA FROM MULTIPLE YEARS ON RELATIVE MARGINS OF ERROR (RMOE)

Using ACS data, Figures 7.1–7.4 provide examples of how rMOEs of FTE/EE estimates can vary across the following dimensions:

- Data aggregation across years: 5-year data vs. 2-year data vs. 1-year data.
- Large population states vs. small population states: The authors present data for four geographical areas: the U.S. (2016 population: 323.1 million), California (39.25 million), Ohio (11.6 million) and MA (6.8 million). Data aggregation across years can provide larger ACS sample sizes, which is more beneficial for states with smaller populations and samples.
- 3-digit NAICS codes vs. 4-digit NAICS codes available in the NAICSP field of the ACS data: Note that most 3-digit NAICS codes are available but a little less than half of the 4-digit NAICS codes are available.

A 90% level of confidence was used in all margin-of-error calculations.

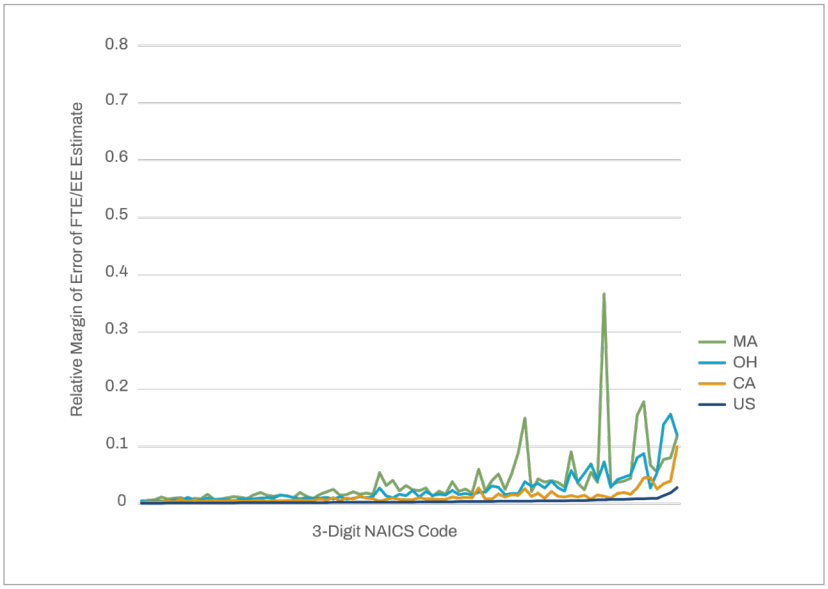

Figure 7.1 Relative margin of error of FTE/EE for 3-digit NAICS industries (82 codes) for the U.S., CA, OH, and MA: 5-year ACS data, 2012–2016. NAICS codes sorted by U.S. rMOE (90% confidence level)

Note: The Following 3-digit NAICS code was deleted in Figure 7.1: 491

Figure 7.1 uses 5-year ACS 2012–2016 data for the U.S., CA, OH, and MA, and sorts the rMOEs for 82 3-digit NAICS industry codes by the U.S. rMOE. These are all of the private sector 3-digit codes available in all four of these jurisdictions in the ACS data, with the exception of the code for the postal service.[62] Note that these codes represent most of the private sector 3-digit codes in the NAICS system, with the exception of the three codes within construction (NAICS 236, 237, 238), and five codes within the finance, real estate and management sectors (521, 523, 525, 533, 551) (see Section 4). We can compare the precision of the estimates for the U.S., CA, OH, and MA in a simple way by counting the number of industries with rMOE over an arbitrary level, such as 0.10. For the smallest state, MA, five industries in the 5-year data have a rMOE above 0.10, while Ohio has three such industries, California has one, and the U.S. has none.

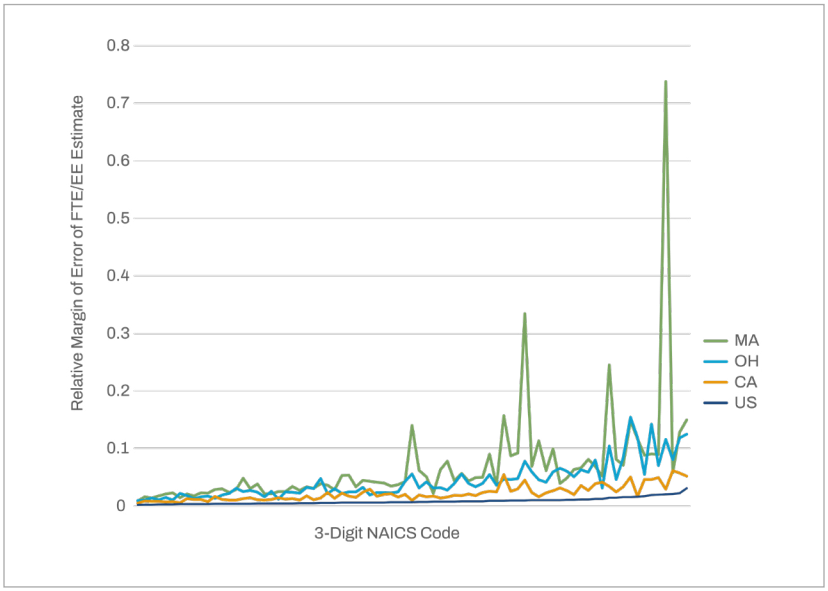

Figure 7.2 Relative margin of error of FTE/EE for 3-digit NAICS industries (79 codes) for the U.S., CA, OH, and MA: 1-year ACS data, 2014. NAICS codes sorted by U.S. rMOE (90% confidence level)

Note: The following 3-digit NAICS codes were deleted in Figure 7.2: 491, 113, 114, and 487.

Figure 7.2 shows rMOEs using 2014, 1-year ACS data for 79 3-digit NAICS codes for the U.S., CA, OH, and MA. The smaller, 1-year data set required us to drop three industries due to missing or unusably small samples (two industries in Ohio and one in Massachusetts). Very small samples may generate an inaccurate rMOE estimate of zero, indicating an unreliable FTE/EE estimate. The 1-year rMOEs in Figure 7.2 are generally higher than the 5-year estimates in Figure 7.1, indicating lower precision. Accordingly, the number of industries with rMOE estimates above 0.10 is somewhat greater. For MA, a total of 10 industries have rMOE greater than 0.10, while Ohio has seven, and California and the U.S. have none.

62 Some private contractor employees are included in NAICS 491 (U.S. Post Office), so 491 is a code that might be used for WC claim analysis. But 491 is not included in these figures because private sector information was only collected starting in 2014, in the middle of the 5-year data sample (2012–2016).

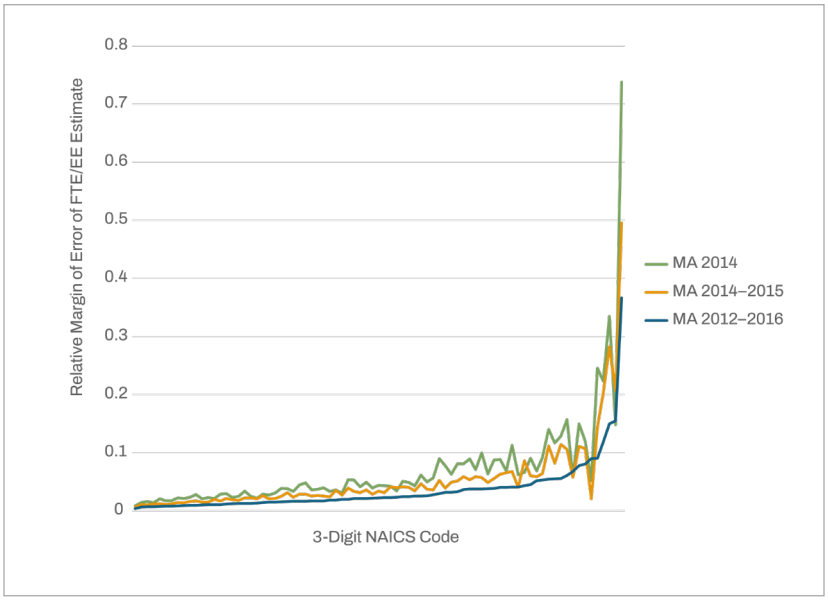

Figure 7.3 Relative margin of error of FTE/EE for 3-digit NAICS industries (81 codes) for MA: ACS data, 5-year, 2-year, 1-year. NAICS codes sorted by 5-year rMOE (90% confidence level)

Note: The following 3-digit NAICS codes were deleted in Figure 7.3: 491, 113.

Figure 7.3 focuses only on MA and displays rMOEs for 5-year, 2-year (2014-2015), and 1-year data together so that the results can be more easily compared across datasets for a single state. This figure reproduces the results for MA shown in Figures 7.1 and 7.2 for the 5-year and 1-year datasets, along with results for the 2-year dataset. In the 2-year data, the rMOE values are generally between those for the 5-year and 1-year data.

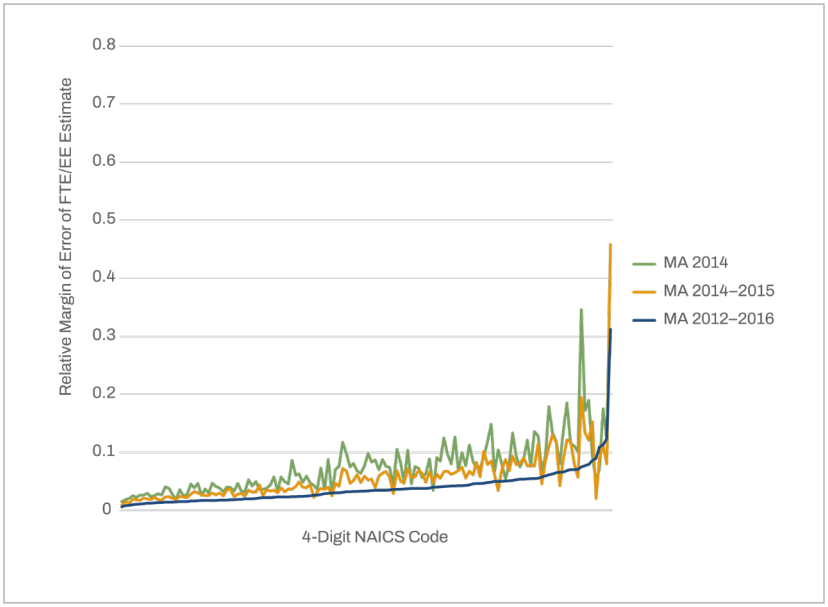

Figure 7.4 Relative margin of error of FTE/EE for 4-digit NAICS industries (136 codes) for MA: ACS data, 5-year, 2-year, 1-year. NAICS codes sorted by 5-year rMOE (90% confidence level)

Note: The following 4-digit NAICS codes were deleted in Figure 7.4. Missing samples: 1133, 2122, 3122, 3131,3141, 3159. rMOE = 0: 2121,3211, 3212, 3253, 3369, 4235, 4245.

Figure 7.4 is analogous to Figure 7.3 but focuses on 4-digit rather than 3-digit NAICS codes. About half of the NAICS 4-digit codes (149 codes) are available at the national level in ACS data, 136 of which have samples of sufficient size to produce nonzero estimates of rMOE in the 1-year data for MA and thus be included in the figure. The Figure 7.4 rMOE estimates are generally higher than those in Figure 7.3 because 4-digit samples are smaller than 3-digit samples, but the results show that most industries have rMOE below 0.10, even in 1-year and 2-year data. In the 5-year data, three industries have a rMOE estimate over 0.10. This compares to 13 such industries in the 2-year data and 27 such industries in the 1-year data. There are also notable differences in the number of industries that have missing samples or samples so small that their calculated rMOE is zero. There are three such industries in the 5-year data, but nine such industries in the 2-year data and 13 such industries in the 1-year data. These results indicate that it is necessary to use a multi-year dataset to obtain sufficiently accurate or usable estimates of FTE/EE for a significant number of 4-digit industries.

EFFECT OF COMBINING ACS DATA ACROSS YEARS ON 3-DIGIT NAICS INDUSTRY FTE/EE ESTIMATES

This section compares the magnitude of FTE/EE estimates using 5-year, 2-year, and 1-year data rather than rMOE. Differences in these magnitudes are due both to sampling error and differences between time periods in FTE/EE. This information shows how much FTE estimates may change if a different number of years are included in the ACS data. This offers perspective on how much estimated claim rates may change with choice of ACS dataset.

These comparisons were done for a relatively low population state, MA (population 6.8 million), and for the U.S. as a whole. Table 7.1a presents the method of calculating percentage difference between FTE/EE estimates based on 5-year, 2-year, and 1-year datasets for individual industries. An example of a calculation for NAICS 115 (support activities for agriculture and forestry) in MA is included.

Table 7.1b shows the minimums, maximums, and ranges for the percentage differences between estimates from the three datasets among 82 3-digit NAICS. It also includes percentage differences at the 5th and 95th percentiles, which are useful measures of variation because they are not affected by extreme outliers. The results for MA indicate that 5-year FTE/EE estimates are generally between 7% lower and 10% higher than the 1-year FTE/EE estimates. For the U.S., the 5-year FTE/EE estimates are generally between 1.4% lower and 2.1% higher than the 1-year estimates.

Table 7.1a Calculating the percentage difference between FTE/EE estimates from 5-year, 2-year, and 1-year ACS datasets

Calculate the percentage difference between estimates:		
Datasets	Calculation formulas†	Example calculation MA, NAICS 115, 5yr minus 1yr
A = 5 year = 2012–2016	5yr minus 1yr = [(A–C)/((A+C)/2)] * 100	[(0.593–0.393)/((0.593+0.393)/2)]*100=40.5% (NAICS 115 has the highest % difference among MA 3-digit industries)
B = 2 year = 2014–2015	5yr minus 2yr = [(A–B)/((A+B)/2)] * 100	
C = 1 year = 2014	2yr minus 1yr = [(B–C)/((B+C)/2)] * 100	

† The formula uses the average of the two estimates that are being compared in the denominator so that the magnitude of calculated percentage difference will be the same regardless of which estimate is the highest or lowest.

Table 7.1b Percentage differences between FTE/EE estimates from 5-year, 2-year, and 1-year ACS datasets, 3-digit NAICS codes, 2012–2016, 2014–2015, and 2014 data

Percentage Difference	Massachusetts, 82 NAICS Industry Codes			United States, 82 NAICS Industry Codes		
	5yr minus 1yr	5yr minus 2yr	2yr minus 1yr	5yr minus 1yr	5yr minus 2yr	2yr minus 1yr
min	–24.7%	–12.2%	–12.7%	–2.1%	–1.8%	–1.2%
max	40.5%	14.3%	31.7%	3.3%	1.8%	2.7%
range	65.2	26.4	44.3	5.4	3.6	3.9
5th	–7.0%	–6.9%	–6.6%	–1.4%	–0.8%	–0.8%
95th	9.7%	6.4%	8.8%	2.1%	1.1%	1.8%
range	16.6	13.3	15.4	3.4	1.9	2.6

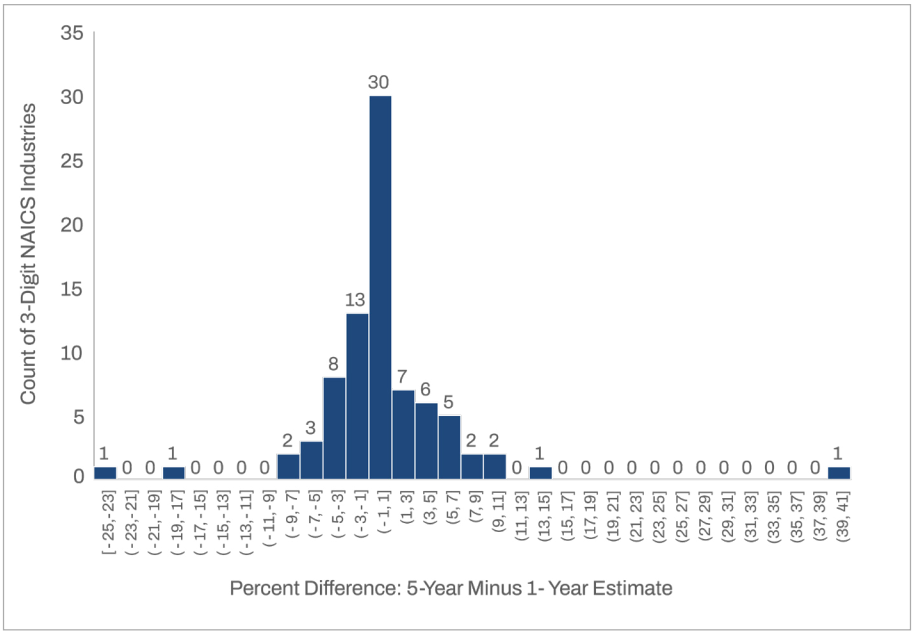

Figure 7.5 MA: Percentage Difference in FTE/EE estimates between 5-year (2012–2016) and 1-year (2014) ACS datasets, 3-digit NAICS codes

Figure 7.5 presents a more complete view of how percentage differences between 5-year and 1-year FTE/EE estimates are distributed for MA based on ACS data. This figure indicates that estimate differences are greater than 11% (in absolute value) for only four industries. The results suggest that using multi-year datasets instead of 1-year datasets will occasionally but not usually make a large difference in FTE/EE and FTE estimates.

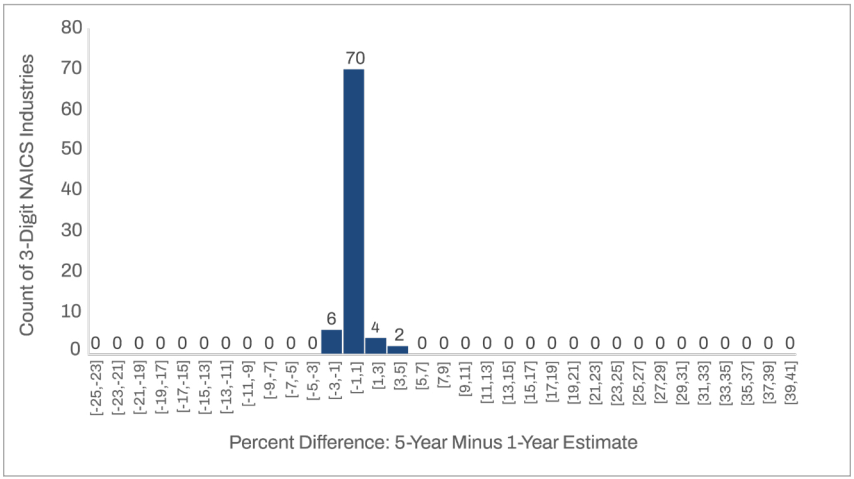

Figure 7.6 U.S.: Percentage difference in FTE/EE estimates between 5-year (2012–2016) and 1-year (2014) ACS datasets, 3-digit NAICS codes, using same bins as MA

When estimate differences based on U.S. data were plotted on the same scale as estimate differences based on MA data, the entire U.S. distribution fits in only four percentage ranges (see Figure 7.6). The much smaller differences between 5-year and 1-year estimates at the national level could be due to less annual variation in FTE/EE or to less sampling error due to larger 1-year samples. But since the magnitude of differences between 5-year and 1-year estimates seems unlikely to be so much less for the U.S. than for MA, this suggests that the observed differences between the 5-year and 1-year estimates in MA may be due more to sampling error associated with 1-year data than real differences among years in FTE/EE.

EFFECT OF COMBINING ACS DATA ACROSS YEARS ON 4-DIGIT NAICS INDUSTRY FTE/EE ESTIMATES

Table 7.2 reports the percentage differences in FTE/EE estimates for the 143 4-digit NAICS available in ACS data and is analogous to Table 7.1b. The results for MA show that 5-year FTE/EE estimates are generally between 6% lower and 9% higher than the 1-year FTE/EE estimates, similar to the results for 3-digit NAICS industries. For the U.S., the 5-year FTE/EE estimates are generally between 1.1% lower and 1.1% higher than the 1-year estimates.

Table 7.2 Percentage differences between FTE/EE estimates from 5-year, 2-year, and 1-year ACS datasets, 4-digit NAICS codes, 2012–2016, 2014–2015, and 2014 data

Percentage Difference	Massachusetts, 143 NAICS Industry Codes†			United States, 149 NAICS Industry Codes		
	5yr minus 1yr	5yr minus 2yr	2yr minus 1yr	5yr minus 1yr	5yr minus 2yr	2yr minus 1yr
min	–11.7%	–23.0%	–11.6%	–1.6%	–2.2%	–1.9%
max	18.7%	25.2%	21.4%	2.9%	3.3%	2.3%
range	30.4	48.2	33.0	4.5	5.4	4.2
5th	–6.2%	–7.5%	–6.8%	–1.1%	–1.5%	–1.1%
95th	8.6%	13.1%	9.3%	1.1%	1.7%	1.2%
range	14.9	20.6	16.0	2.2	3.2	2.3

† The six NAICS codes with missing samples not included.

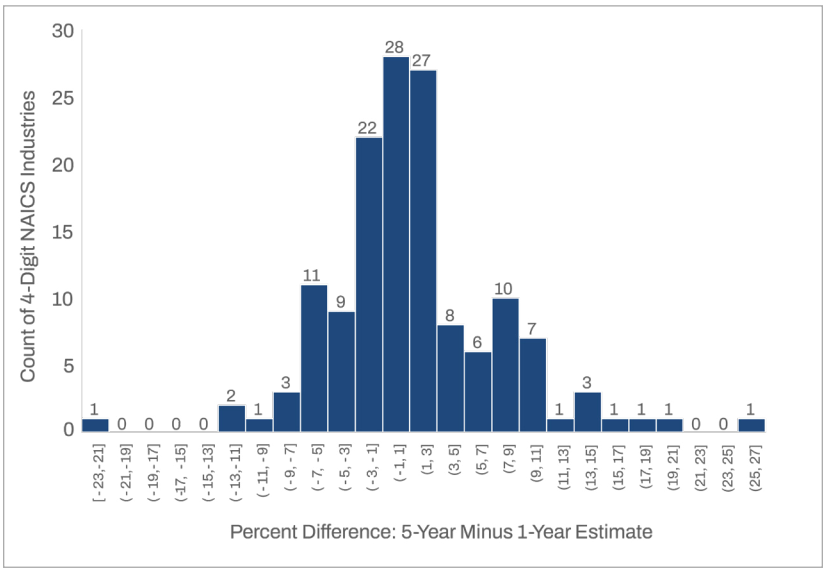

Figure 7.7 MA: Percentage difference in FTE/EE estimates between 5-year (2012–2016) and 1-year (2014) ACS datasets, 4-digit NAICS codes

Figure 7.7 shows the distribution of percentage differences between 5-year and 1-year FTE/EE estimates for Massachusetts' 4-digit NAICS industries using ACS data. In this figure, estimate differences are greater than 11% (in absolute value) for 11 of the 143 industries, and greater than 19% for 3 industries.

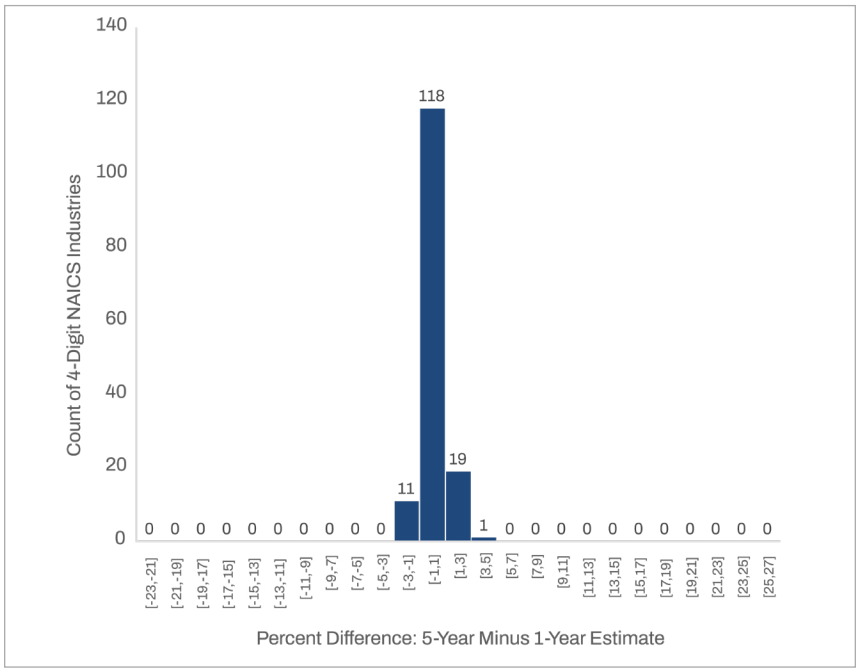

Figure 7.8 U.S.: Percentage difference in FTE/EE estimates between 5-year (2012–2016) and 1-year (2014) ACS datasets, 4-digit NAICS codes, using same bins as MA

In Figure 7.8, as in Figure 7.6 for 3-digit NAICS industries, if 4-digit estimate differences based on U.S. data are plotted on the same scale as estimate differences based on MA data, the entire U.S. distribution fits in only four percentage ranges.

8. COMPARISON OF RESULTS USING ALTERNATIVE DENOMINATORS

COMPARISON OF RESULTS USING ALTERNATIVE METHODS OF CONVERTING QCEW EMPLOYEE COUNTS TO FTES

This section addresses whether the variations in method and data source make a significant difference in estimated FTE denominators, industry claim rates, and the ranking of industries by claim rate. Industry ranking is of greatest importance because it can play a large role in setting priorities for prevention.

Error in estimates of the FTE denominator will cause error in claim rates. However, if variation among industries in the claim rate is large enough, it is possible that this variation would overwhelm and dominate the error in the denominator. If so, the error in the denominator might have little to no impact on industry rate rankings.

In this section, the authors examine how alternative estimates of industry FTE denominators affect estimates of industry claim rates and claim rate rankings. All data are from Washington. (The abbreviation WA is used hereafter in this section for convenience) The degree of variation in claim rates among WA industries is not likely to be unusual so the data are useful for examining the general question of impacts of denominator choice.

First, the authors present the differences among denominators in claim rates and claim rate rankings. The authors then examine resulting differences in industry ranks based on the prevention index (PI), which averages claim rate ranking with claim count ranking. The PI was developed by the Washington State Department of Labor & Industries (WA L&I) and is widely applied to help prioritize industries for prevention efforts.[63] Review of the differences between alternative approaches provides information on the implications of choosing one method versus another for estimating FTE/EE, or choosing ACS versus OPT as the data source for FTE/EE.

The overall conclusion is that alternative approaches to calculating the three sets of FTE/EE estimates produce similar results. There are just a few exceptions that tend to be for small industries or for industries whose production processes and conditions often differ among states.

In this section, the authors use FTE denominator data from three combinations of data sources and methods and label them as follows:

1. Denom ACSv1: WA QCEW data adjusted with FTE/EE ratios based on ACS data, using the proposed method. This method (v1) is described in Section 3 and divides usual weekly hours by 40 to obtain FTEs.
2. Denom ACSv2: WA QCEW data adjusted with FTE/EE ratios based on ACS data, using an alternative method (v2) described in Appendices D and E. This method multiplies usual weekly hours by number of weeks worked in the previous 12 months, and divides by 2,000. Note that this alternative method is not recommended as stated in Section 3. Results based on this version are presented here only to show the difference between this method and the proposed method.
3. Denom OPT: WA QCEW data adjusted with FTE/EE ratios based on OPT data (see Appendix A).

63 Silverstein B, Viikari-Juntura E, Kalat J [2002]. Use of a prevention index to identify industries at high risk for work-related musculoskeletal disorders of the neck, back, and upper extremity in Washington State, 1990–1998. Am J Ind Med *41*(3):149–169, https://doi.org/10.1002/ajim.10054. See also: Anderson NJ, Bonauto DK, Adams D [2014]. Prioritizing industries for occupational injury prevention and research in the services sector in Washington State, 2002–2010. J Occup Med Toxicol *9*(37), http://doi.org/10.1186/s12995-014-0037-2.

The claims data used in Section 8 are from the WA L&I for 2014. Washington has a single payer WC insurance system. Employers within the state are mandated to purchase WC insurance through the WA L&I State Fund unless they meet the statutory and financial requirements to self-insure or are covered by other WC systems (e.g., the federal government). Some exceptions, such as work performed by tribe-owned companies on tribal land, are not covered by state WC laws. Elective WC coverage is available to the self-employed, employers of one household worker, or other minor occupational groups exempt from mandatory coverage.[64, 65] Approximately 70% of workers under L&I jurisdiction are covered by State Fund employers, and 30% work for a self-insured employer. The self-insured typically represent Washington's largest employers.

In WA L&I data, there is a discrepancy between claims and denominator data in methods of industry code assignment. The claims in the numerator are assigned NAICS codes by L&I at the employer or "account" level, and the denominator data are assigned to NAICS codes at the establishment level by QCEW. This will cause some error in estimated claim rates. However, this error is present in all calculations, so the results in this section still provide information on differences in results due to differences in denominators.

Comparison of FTE Denominators

As shown in Table 8.1, the three FTE denominators are highly correlated. Four industries with zero QCEW employee counts and one with only 7 employees were omitted, as well as postal service employees NAICS 491, leaving 83 3-digit NAICS industries.[66]

Table 8.1 Correlation matrix, FTE Denominators, 83 industries, WA 2014

	Denom ACSv1	Denom ACSv2	Denom OPT
Denom ACSv1	1		
Denom ACSv2	0.9988	1	
Denom OPT	0.9974	0.9957	1

64 Washington State Legislature [no date]. Title 51.12RCW Employments and occupations covered. Revised Code of Washington, Industrial insurance, https://app.leg.wa.gov/RCW/default.aspx?cite=51.12. Date accessed: October 15, 2024.

65 Washington State Legislature [no date]. Title 51.14RCW Self-Insurers. Revised Code of Washington, Industrial insurance, http://apps.leg.wa.gov/RCW/default.aspx?cite=51.14. Date accessed: October 15, 2024.

66 NAICS 482, 486, 521, and 525 have zero private sector employees in the 2014 QCEW. NAICS 211 has only seven employees. NAICS 491 was excluded due to coding issues. See Section 4.

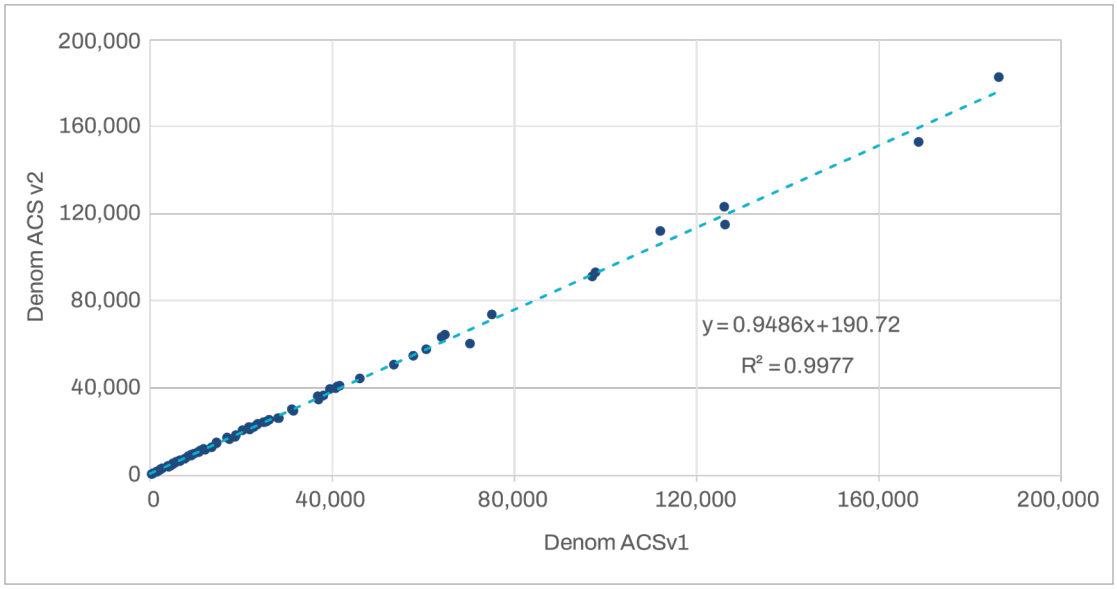

Figure 8.1 Compare FTE denominators, Industry Denom ACSv1 and Industry Denom ACSv2, WA 2014

Figure 8.1 compares the two ACS-based FTE denominators, Denom ACSv1 and Denom ACSv2. These estimates are very close.

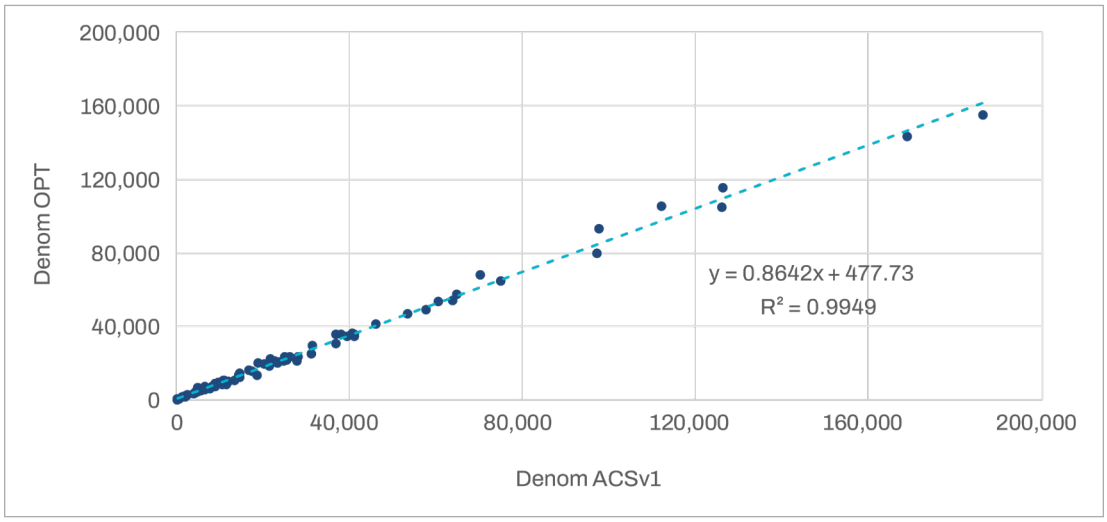

Figure 8.2 Compare FTE denominators, Industry Denom ACSv1 and Industry Denom OPT, WA 2014

Figure 8.2 compares Denom ACSv1 with Denom OPT. These estimates are also quite close. Complete numerical denominator estimates are reported in Appendix K, Table K.1.

Comparison of Claim Rates

Table 8.2 gives the correlations of claim rates using FTE denominators calculated using WA QCEW data adjusted with ACSv1, ACSv2, and OPT data. Complete claim rate results by 3-digit NAICS are included in Appendix K, Table K.2.

Table 8.2 Correlation matrix, claim rates, 83 industries, WA 2014

	Claim Rate ACSv1	Claim Rate ACSv2	Claim Rate OPT
Claim Rate ACSv1	1		
Claim Rate ACSv2	0.9925	1	
Claim Rate OPT	0.9822	0.9751	1

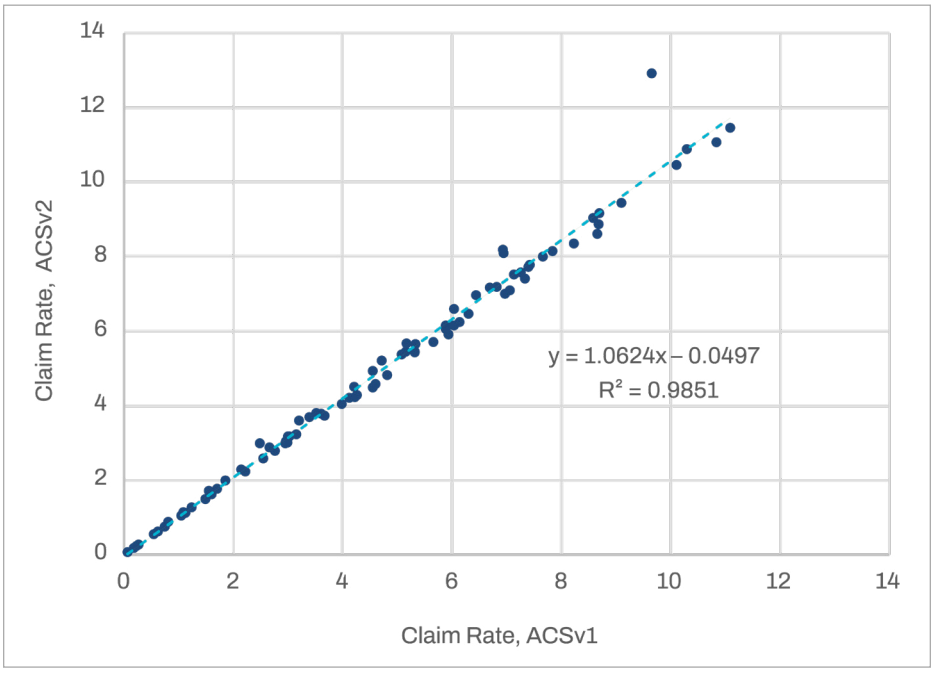

Figure 8.3 Compare claim rates, ACSv1 and ACSv2, WA 2014

Figure 8.3 compares WA 2014 claim rate calculations using ACSv1 denominators with WA 2014 claim rates using ACSv2 denominators. The rates estimated with these methods are generally similar. The outlier in Figure 8.3 is NAICS 313 (textile mills), with a claim rate of 9.65 using ACSv1 and 12.92 using ACSv2 for adjustment factors.

ACSv2 appears to estimate FTEs with a downward bias, thus biasing claim rate estimates upward, as discussed in Appendices D and E. This bias seems particularly pronounced in the textile mill industry, one of the smallest industries in the QCEW dataset, with 369 employees in WA in 2014.

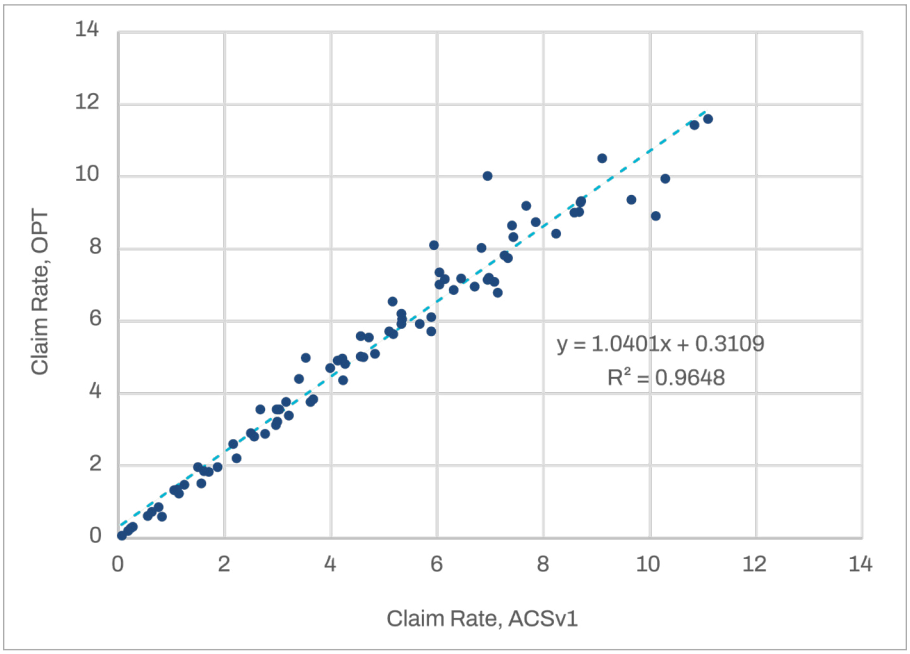

Figure 8.4 Compare claim rates, ACSv1 and OPT, WA 2014

Figure 8.4 compares WA 2014 claim rate calculations using ACSv1 denominators with WA 2014 claim rates using OPT denominators. The most extreme outlier is NAICS 213 (support activities for mining, although this industry actually contains more oil and gas activity than mining), with a claim rate of 6.93 using ACSv1 and 10.02 using OPT. This difference for NAICS 213 could exist for a variety of reasons. Because it is the smallest industry in the dataset, its denominator is estimated with more error. Also, geological and environmental conditions vary widely among states. Because OPT data are national data, they may not represent the WA population of workers in NAICS 213.

The purpose of calculating claim rates is to identify industries with the highest rates so they might be emphasized in prevention efforts. It is most important that claim rates be accurate for industries with relatively high claim rates. Table 8.3 lists the WA 2014 claim rates of the industries with the highest rates, based on claim rate calculations using Denom ACSv1. Claim rates using Denom ACSv2 and Denom OPT are reported for comparison.

Table 8.3 Industries with the highest claim rates based on ACSv1, with rates based on ACSv2 and OPT, WA 2014

Rank by Claim Rate ACSv1†	NAICS	Industry Title	Claim Rates		
			ACSv1	ACSv2	OPT
1	113	Forestry and logging	11.09	11.47	11.60
2	331	Primary metal manufacturing	10.83	11.08	11.44
3	115	Agriculture and forestry support activities	10.29	10.89	9.95
4	112	Animal production and aquaculture	10.10	10.47	8.92
5	313	Textile mills	9.65	12.92	9.37
6	492	Couriers and messengers	9.09	9.46	10.51
7	236	Construction of buildings	8.69	9.17	9.32
8	321	Wood product manufacturing	8.69	8.88	9.28
9	332	Fabricated metal product manufacturing	8.66	8.62	9.04
10	238	Specialty trade contractors	8.58	9.04	9.01
11	312	Beverage and tobacco product manufacturing	8.23	8.36	8.42
12	484	Truck transportation	7.84	8.16	8.75
13	485	Transit and ground passenger transportation	7.66	8.00	9.21
14	424	Merchant wholesalers, nondurable goods	7.43	7.79	8.34
15	444	Building material and garden supply stores	7.40	7.72	8.65
16	337	Furniture and related product manufacturing	7.33	7.41	7.75
17	811	Repair and maintenance	7.26	7.57	7.83
18	237	Heavy and civil engineering construction	7.14	7.52	6.80
19	562	Waste management and remediation services	7.06	7.10	7.09
20	327	Nonmetallic mineral product manufacturing	6.97	7.00	7.21
21	111	Crop production	6.94	8.11	7.14
22	213	Support activities for mining	6.93	8.19	10.02
23	623	Nursing and residential care facilities	6.82	7.20	8.03
24	311	Food manufacturing	6.69	7.17	6.96
25	453	Miscellaneous store retailers	6.44	6.97	7.18

† A total of 83 industries were ranked.

Comparison of Claim Rate Rankings

In general, WA 2014 claim rate ranks are highly correlated across the three sets of denominator estimates. See Table 8.4 and Figures 8.5 and 8.6. Complete, detailed results for WA 2014 claim rate ranks by 3-digit NAICS can be found in Appendix K, Table K.3.

Table 8.4 Correlation matrix, claim rate ranks, 83 industries, WA 2014

	Claim Rate Rank ACSv1	Claim Rate Rank ACSv2	Claim Rate Rank OPT
Claim Rate Rank ACSv1	1		
Claim Rate Rank ACSv2	0.9964	1	
Claim Rate Rank OPT	0.9861	0.9880	1

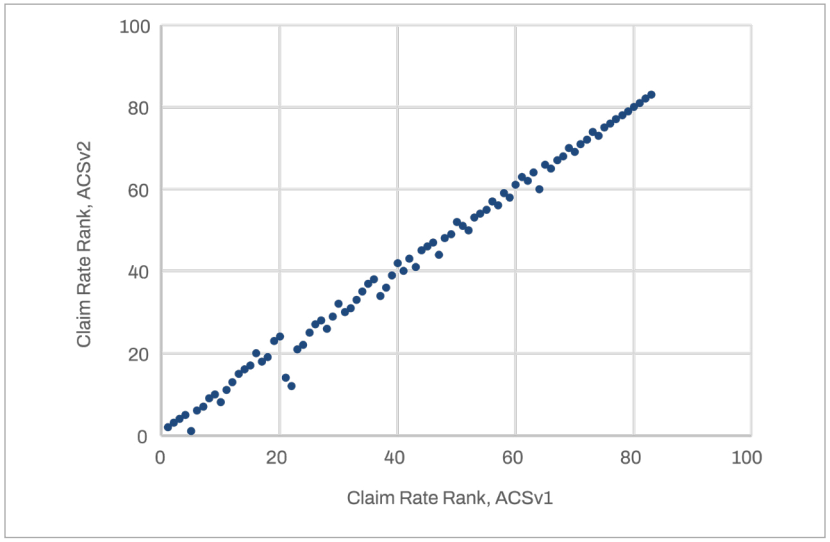

Figure 8.5 Compare claim rate ranks, ACSv1 and ACSv2, WA 2014

Figure 8.5 compares WA 2014 claim rate ranks based on ACSv1 and ACSv2. The largest rank discrepancies between ACSv1 and ACSv2 were for NAICS 111 (crop production), ranked 21 with ACSv1 and 14 with ACSv2, and NAICS 213 (support activities for mining), ranked 22 with ACSv1 and 12 with ACSv2.

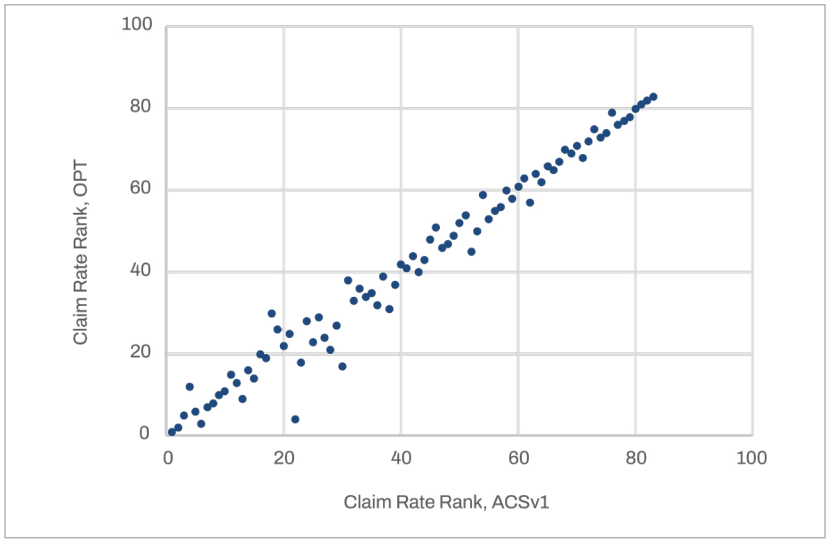

Figure 8.6 Compare claim rate ranks, ACSv1 and OPT, WA 2014

Figure 8.6 compares WA 2014 claim rate ranks based on ACSv1 and OPT. The largest rank discrepancies between ACSv1 and OPT were for NAICS 237 (heavy and civil engineering construction), NAICS 481 (air transportation)and NAICS 213 (support activities for mining).

Table 8.5 lists the WA 2014 claim rate ranks of the 25 industries with the highest claim rate ranks based on claim rate calculations using Denom ACSv1. Examining this table, we ask whether different denominators yield the same list of high priority industries. For example, do they identify the same list of top ten industries? For ACSv2, the answer is yes. The rank order of these top ten industries is also similar, with one notable exception. The textile mills industry ranked 5th with ACSv1 but ranked 1st with ACSv2. The OPT list identified eight of the top ten industries identified with ACSv1. One of the other two industries in the top ten OPT list, NAICS 485, ranking 9th, was ranked 13th by ACSv1 and 15th by ACSv2, indicating a relatively modest discrepancy. However, NAICS 213 (support activities for mining), previously mentioned, was ranked 4th by OPT but only 22nd by ACSv1.

Table 8.5 Industries with highest claim rate ranks based on ACSv1, with ranks based on ACSv2 and OPT, WA 2014

NAICS	Industry Title	Claim Rate Rank†			Rank Difference	
		ACSv1	ACSv2	OPT	ACSv1 minus ACSv2	ACSv1 minus OPT
113	Forestry and logging	1	2	1	–1	0
331	Primary metal manufacturing	2	3	2	–1	0
115	Agriculture and forestry support activities	3	4	5	–1	–2
112	Animal production and aquaculture	4	5	12	–1	–8
313	Textile mills	5	1	6	4	–1
492	Couriers and messengers	6	6	3	0	3
236	Construction of buildings	7	7	7	0	0
321	Wood product manufacturing	8	9	8	–1	0
332	Fabricated metal product manufacturing	9	10	10	–1	–1
238	Specialty trade contractors	10	8	11	2	–1
312	Beverage and tobacco product manufacturing	11	11	15	0	–4
484	Truck transportation	12	13	13	–1	–1
485	Transit and ground passenger transportation	13	15	9	–2	4
424	Merchant wholesalers, nondurable goods	14	16	16	–2	–2
444	Building material and garden supply stores	15	17	14	–2	1
337	Furniture and related product manufacturing	16	20	20	–4	–4
811	Repair and maintenance	17	18	19	–1	–2
237	Heavy and civil engineering construction	18	19	30	–1	–12
562	Waste management and remediation services	19	23	26	–4	–7
327	Nonmetallic mineral product manufacturing	20	24	22	–4	–2
111	Crop production	21	14	25	7	–4

NAICS	Industry Title	Claim Rate Rank†			Rank Difference	
		ACSv1	ACSv2	OPT	ACSv1 minus ACSv2	ACSv1 minus OPT
213	Support activities for mining	22	12	4	10	18
623	Nursing and residential care facilities	23	21	18	2	5
311	Food manufacturing	24	22	28	2	–4
453	Miscellaneous store retailers	25	25	23	0	2

† A total of 83 industries were ranked.

Comparison of Prevention Indices and Prevention Index Rankings

Prevention Indices

The PI of an industry is the average of its rank by claim count and its rank by claim rate [(Count Rank + Claim Rate Rank)/2], where industries with the highest claim count and the highest claim rate have ranks of 1.[67] The original PI was based only on lost-time claims involving indemnity payments to compensate for lost earnings on missed work days. But here we use all claims, including those requiring only payment for medical care. The main PI results are presented here. See complete PI results in Appendix K, Table K.4 and Table K.5. The high correlation of PI across the three alternative denominators is shown in Table 8.6 and illustrated in Figures 8.7 and 8.8.

Table 8.6 Correlation matrix, prevention indices, 83 industries, WA 2014

	PI ACSv1	PI ACSv2	PI OPT
PI ACSv1	1		
PI ACSv2	0.9988	1	
PI OPT	0.9954	0.9960	1

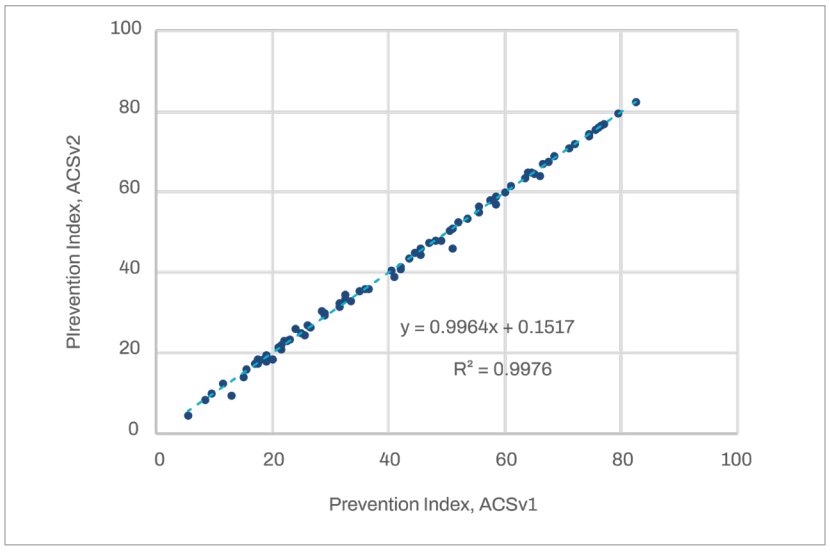

Figure 8.7 Compare prevention Indices, ACSv1 and ACSv2, WA 2014

67 Anderson NJ, Bonauto DK, Adams D [2014]. Prioritizing industries for occupational injury prevention and research in the services sector in Washington State, 2002–2010. J Occup Med Toxicol *9*(37), http://doi.org/10.1186/s12995-014-0037-2.

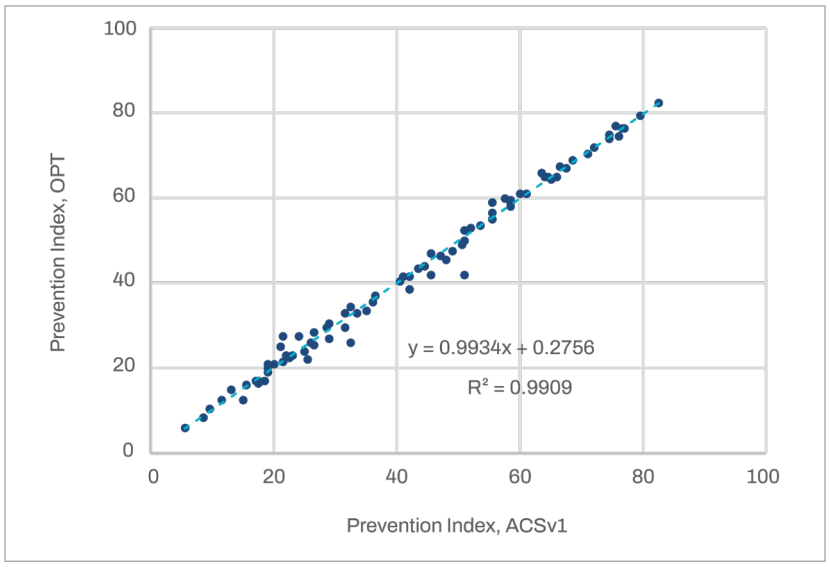

Figure 8.8 Compare prevention indices, ACSv1 and OPT, WA 2014

The following table gives the numerical PI estimates for the industries with the highest PIs as calculated using ACSv1.

Table 8.7 Industries with the highest prevention index estimates based on ACSv1, with prevention index estimates based on ACSv2 and OPT, WA 2014

Rank by PI ACSv1†	NAICS	Industry Title	PI ACSv1	PI ACSv2	PI OPT
1	238	Specialty trade contractors	5.5	4.5	6
2	236	Construction of buildings	8.5	8.5	8.5
3	115	Agriculture and forestry support activities	9.5	10	10.5
4	424	Merchant wholesalers, nondurable goods	11.5	12.5	12.5
5	111	Crop production	13	9.5	15
6	623	Nursing and residential care facilities	15	14	12.5
7	332	Fabricated metal product manufacturing	15.5	16	16
8	484	Truck transportation	15.5	16	16
9	321	Wood product manufacturing	17	17.5	17
10	444	Building material and garden supply stores	17.5	18.5	17
11	622	Hospitals	17.5	17.5	16.5
12	492	Couriers and messengers	18.5	18.5	17
13	311	Food manufacturing	19	18	21
14	331	Primary metal manufacturing	19	19.5	19
15	811	Repair and maintenance	19	19.5	20
16	561	Administrative and support services	20	18.5	21
17	112	Animal production and aquaculture	21	21.5	25

Rank by PI ACSv1†	NAICS	Industry Title	PI ACSv1	PI ACSv2	PI OPT
18	237	Heavy and civil engineering construction	21.5	22	27.5
19	722	Food services and drinking places	21.5	21	21.5
20	336	Transportation equipment manufacturing	22	23	23
21	113	Forestry and logging	22.5	23	22.5
22	445	Food and beverage stores	23	23.5	23
23	562	Waste management and remediation services	24	26	27.5
24	452	General merchandise stores	25	25	24
25	721	Accommodation	25.5	24.5	22

† A total of 83 industries were ranked.

PREVENTION INDEX RANK

Given the high correlation of PIs across denominator estimates, it is unsurprising that PI ranks are also highly correlated (see Table 8.8 and Figures 8.9 and 8.10).

Table 8.8 Correlation matrix, prevention index ranks, 83 industries, WA 2014

	PI Rank ACSv1	PI Rank ACSv2	PI Rank OPT
PI ACSv1 Rank	1		
PI ACSv2 Rank	0.9987	1	
PI OPT Rank	0.9938	0.9951	1

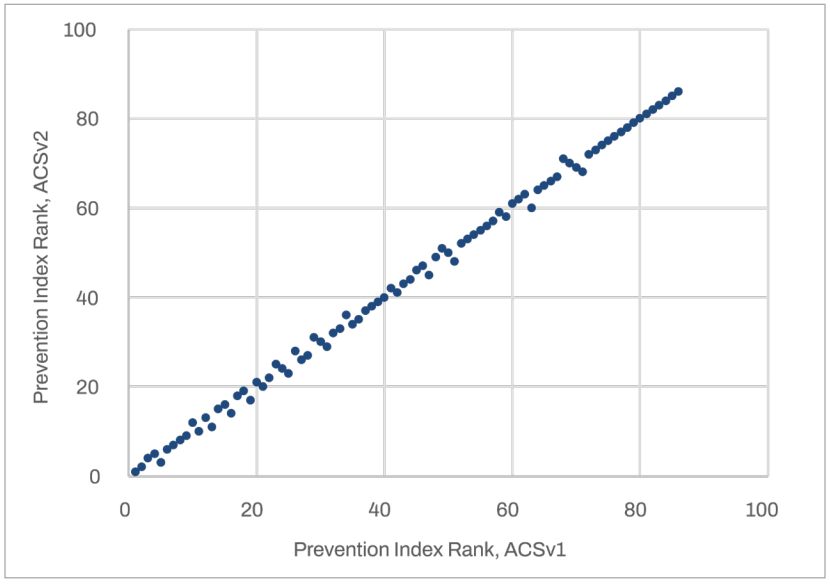

Figure 8.9 Compare prevention index ranks, ACSv1 and ACSv2, WA 2014

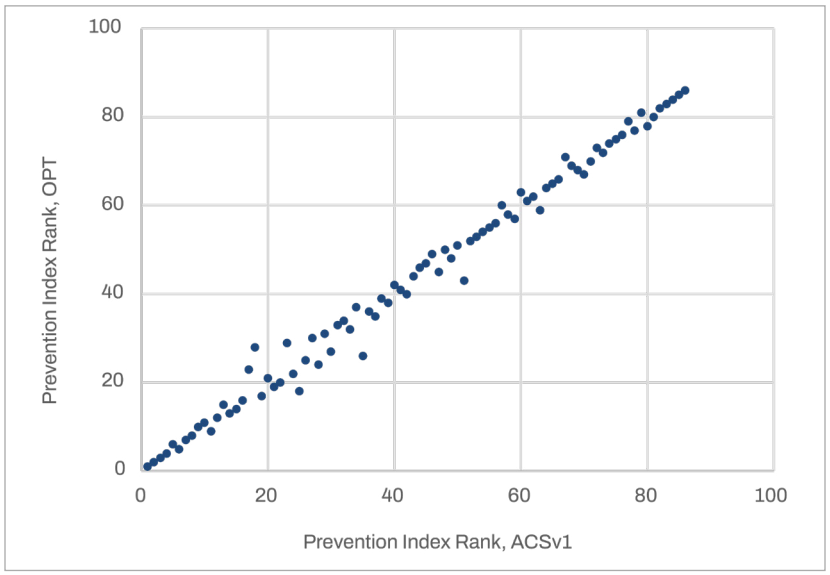

Figure 8.10 Compare prevention index ranks, ACSv1 and OPT, WA 2014

Table 8.9 lists the 25 industries with the highest PI ranks as computed using ACSv1. The PI rankings based on the three FTE denominator types are much more similar than the claim rate rankings. This is expected because one of the components of the PI (the rank order of the claim counts) is not affected by denominator estimates. The top 15 industries identified with ACSv2 were almost the same as those identified with ACSv1. The top 15 industries identified with OPT denominators were exactly the same as those identified with ACSv1.

Table 8.9 Industries with highest prevention index ranks based on ACSv1, with prevention index ranks based on ACSv2 and OPT, WA 2014

Industry Title	Prevention Index Rank†			Rank Difference	
	ACSv1	ACSv2	OPT	ACSv1 minus ACSv2	ACSv1 minus OPT
Specialty trade contractors	1	1	1	–1	–1
Construction of buildings	2	2	2	–2	–2
Agriculture and forestry support activities	3	4	3	–4	–3
Merchant wholesalers, nondurable goods	4	5	4	–5	–4
Crop production	5	3	6	–3	–6
Nursing and residential care facilities	6	6	5	–6	–5
Fabricated metal product manufacturing	7	7	7	–7	–7
Truck transportation	8	8	8	–8	–8
Wood product manufacturing	9	9	10	–9	–10
Building material and garden supply stores	10	12	11	–12	–11
Hospitals	11	10	9	–10	–9

Industry Title	Prevention Index Rank†			Rank Difference	
	ACSv1	ACSv2	OPT	ACSv1 minus ACSv2	ACSv1 minus OPT
Couriers and messengers	12	13	12	–13	–12
Food manufacturing	13	11	15	–11	–15
Primary metal manufacturing	14	15	13	–15	–13
Repair and maintenance	15	16	14	–16	–14
Administrative and support services	16	14	16	–14	–16
Animal production and aquaculture	17	18	23	–18	–23
Heavy and civil engineering construction	18	19	28	–19	–28
Food services and drinking places	19	17	17	–17	–17
Transportation equipment manufacturing	20	21	20	–21	–20
Forestry and logging	21	20	19	–20	–19
Food and beverage stores	22	22	21	–22	–21
Waste management and remediation services	23	25	29	–25	–29
General merchandise stores	24	24	22	–24	–22
Accommodation	25	23	18	–23	–18

† A total of 83 industries were ranked.

COMPARISON OF RESULTS USING QCEW-BASED ESTIMATES OF FTES WITH RESULTS USING QCEW EMPLOYEE COUNTS

The preferred denominator is the number of FTEs because it is generally the best metric for exposure to injury risk when comparing industries. It is also the standard denominator type used by BLS. However, information on number of employees (employee count) is more available and associated with less uncertainty.

The general pattern observed in the results is that differences in claim rates and claim rate ranks are usually modest. This is largely because FTE/EE for most industries is close to 1. These results are similar to those of Ruser [1998][68] who found that, although an hours-based denominator is preferable, the correlation of employment-based and hours-based occupational fatality rates for 222 occupations was very high. However, our results are on the 3-digit NAICS level, and variation in FTE/EE is greater at the more detailed 4-digit level. Table 8.10 shows the high correlation between FTE and employee count denominators.

68 Ruser JW [1998]. Denominator choice in the calculation of workplace fatality rates. Am J Ind Med *3*(2):151–156, https://doi.org/10.1002/(SICI)1097-0274(199802)33:2<151::AID-AJIM6>3.0.CO;2-0.

Table 8.10 Correlation matrix, FTE (ACSv1) and employee count (QCEW) denominators, 83 industries, WA 2014

FTE (ACSv1) and Employee Count (QCEW) Denominators	Correlation
Denominator	0.9892
Claim Rate	0.9746
Claim Rate Rank	0.9843
Prevention Index	0.9908
Prevention Index Rank	0.9933

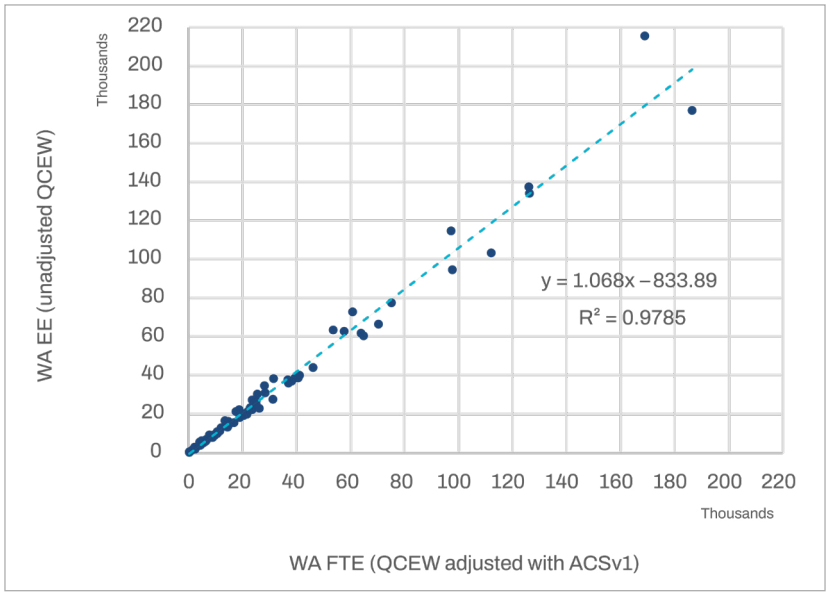

Figure 8.11 Compare FTE (ACSv1) and employee count (QCEW) denominators, WA 2014

Figure 8.11 illustrates the same correlation but also shows differences for some industries. The greatest discrepancy is for NAICS 722, Food services and drinking places with 168,802 FTEs vs. 215,537 employees. This difference is likely due to a high percentage of part-time workers in this industry.

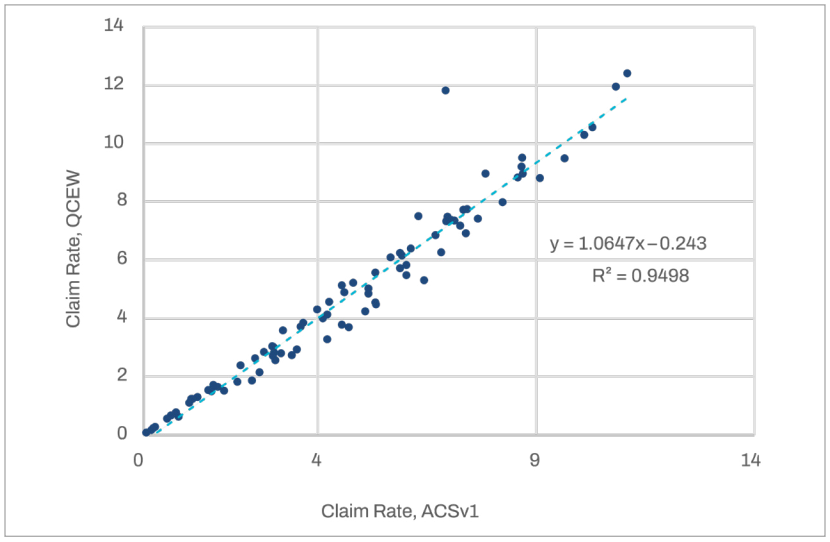

Figure 8.12 Compare claim rates based on FTE (ACSv1) and employee count (QCEW) denominators

Figure 8.12 compares claim rates based on FTE and employee count denominators. It shows that the differences are generally modest.

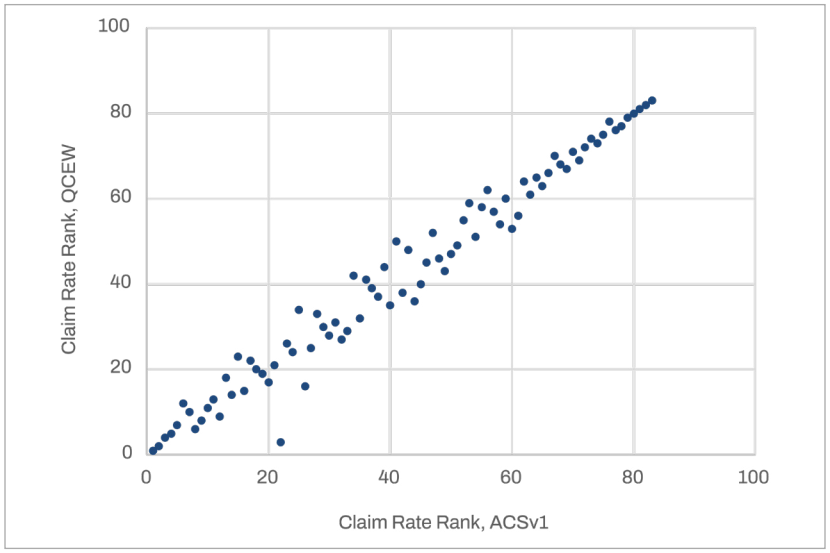

Figure 8.13 Compare claim rate ranks based on FTE (ACSv1) and employee count (QCEW) denominators, WA 2014

Figure 8.13, which compares WA 2014 claim rate ranks based on FTE and employee count denominators, displays a similar pattern. Again, the largest difference is for NAICS 213 (rank of 22nd for ACSv1 vs. 3rd for QCEW).

Table 8.11 focuses specifically on comparing claim rates among the 25 industries with the highest rates. The outlier in both Figure 8.12 and Table 8.11 is NAICS 213, support activities for mining, for which the ACSv1 claim rate is much lower than the QCEW claim rate. NAICS 213 has an unusually high average ACS value of FTE/EE on the national level (see Appendix B) and particularly in Washington State. This value considerably exceeds 1, thus raising the FTE estimate far above the QCEW employee count and lowering the ACS claim rate estimate.

Table 8.11 Industries with the highest claim rates based on ACSv1, with rates based on QCEW, WA 2014

Rank by Claim Rate ACSv1†	NAICS	Industry Title	Claim Rates	
			ACSv1	QCEW
1	113	Forestry and logging	11.09	12.42
2	331	Primary metal manufacturing	10.83	11.94
3	115	Agriculture and forestry support activities	10.29	10.56
4	112	Animal production and aquaculture	10.10	10.29
5	313	Textile mills	9.65	9.49
6	492	Couriers and messengers	9.09	8.81
7	236	Construction of buildings	8.69	8.96
8	321	Wood product manufacturing	8.69	9.52
9	332	Fabricated metal product manufacturing	8.66	9.22
10	238	Specialty trade contractors	8.58	8.84
11	312	Beverage and tobacco product manufacturing	8.23	7.98
12	484	Truck transportation	7.84	8.97
13	485	Transit and ground passenger transportation	7.66	7.42
14	424	Merchant wholesalers, nondurable goods	7.43	7.75
15	444	Building material and garden supply stores	7.40	6.91
16	337	Furniture and related product manufacturing	7.33	7.73
17	811	Repair and maintenance	7.26	7.17
18	237	Heavy and civil engineering construction	7.14	7.36
19	562	Waste management and remediation services	7.06	7.37
20	327	Nonmetallic mineral product manufacturing	6.97	7.49
21	111	Crop production	6.94	7.34
22	213	Support activities for mining	6.93	11.83
23	623	Nursing and residential care facilities	6.82	6.26
24	311	Food manufacturing	6.69	6.85
25	453	Miscellaneous store retailers	6.44	5.32

† A total of 83 industries were ranked.

Table 8.12 shows some notable differences in rank for three industries in addition to NAICS 213: NAICS 492 (6th for ACSv1 vs. 12th for QCEW), NAICS 444 (15th for ACSv1 vs. 23rd for QCEW), and NAICS 453 (25th for ACSv1 and 34th for QCEW). However, we saw in Table 8.11 that these differences in rank are not based on large differences in rate.

Table 8.12 Industries with the highest claim rate ranks based on ACSv1, with ranks based on QCEW, WA 2014

NAICS	Industry Title	Claim Rate Rank†		Rank Difference
		ACSv1	QCEW	ACSv1 minus QCEW
113	Forestry and logging	1	1	0
331	Primary metal manufacturing	2	2	0
115	Agriculture and forestry support activities	3	4	–1
112	Animal production and aquaculture	4	5	–1
313	Textile mills	5	7	–2
492	Couriers and messengers	6	12	–6
236	Construction of buildings	7	10	–3
321	Wood product manufacturing	8	6	2
332	Fabricated metal product manufacturing	9	8	1
238	Specialty trade contractors	10	11	–1
312	Beverage and tobacco product manufacturing	11	13	–2
484	Truck transportation	12	9	3
485	Transit and ground passenger transportation	13	18	–5
424	Merchant wholesalers, nondurable goods	14	14	0
444	Building material and garden supply stores	15	23	–8
337	Furniture and related product manufacturing	16	15	1
811	Repair and maintenance	17	22	–5
237	Heavy and civil engineering construction	18	20	–2
562	Waste management and remediation services	19	19	0
327	Nonmetallic mineral product manufacturing	20	17	3
111	Crop production	21	21	0
213	Support activities for mining	22	3	19
623	Nursing and residential care facilities	23	26	–3
311	Food manufacturing	24	24	0
453	Miscellaneous store retailers	25	34	–9

† A total of 83 industries were ranked.

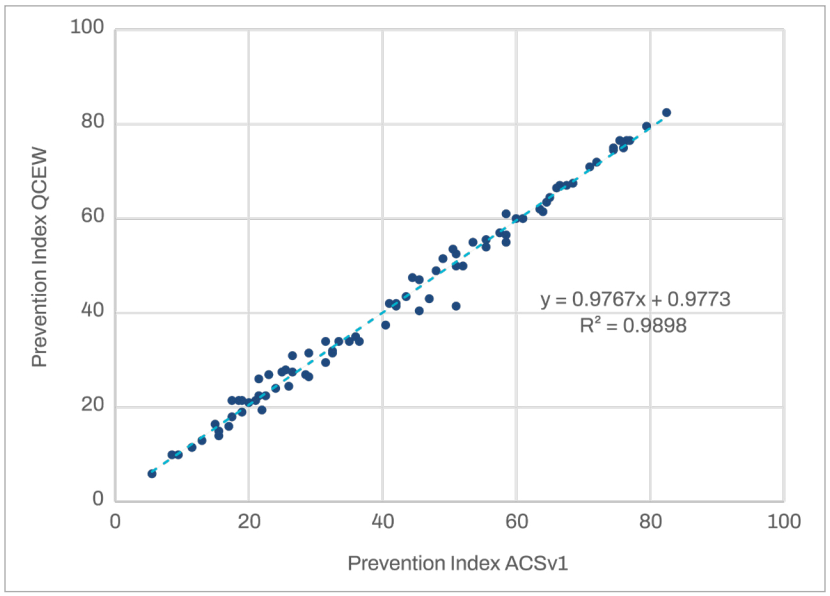

Figure 8.14 Compare prevention indices based on ACSv1 and QCEW denominators, WA 2014

Figures 8.14 and 8.15 and Tables 8.13 and 8.14 compare PIs and their ranks based on FTE and employee count denominators. Continuing the pattern we saw previously in this section, PI and PI rank are more highly correlated than are claim rates and claim rate ranks. Recall that industries with the highest average of claim count rank and claim rate rank have PI ranks of 1.

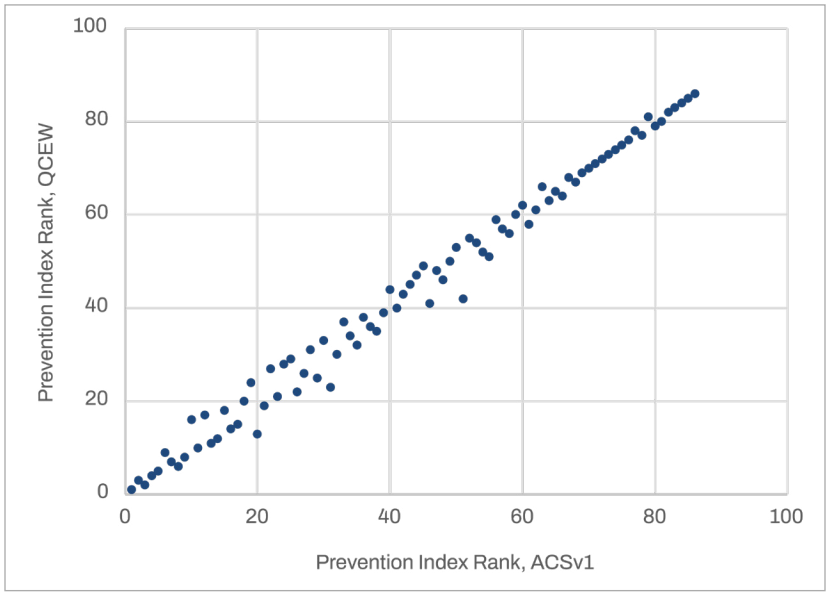

Figure 8.15 Compare prevention index ranks based on ACSv1 and QCEW denominators, WA 2014

Table 8.13 Industries with the highest prevention indices estimates based on ACSv1, with prevention index estimates based on QCEW, WA 2014

Rank by PI ACSv1†	NAICS	Industry Title	PI ACSv1	PI QCEW
1	238	Specialty trade contractors	5.5	6
2	236	Construction of buildings	8.5	10
3	115	Agriculture and forestry support activities	9.5	10
4	424	Merchant wholesalers, nondurable goods	11.5	11.5
5	111	Crop production	13	13
6	623	Nursing and residential care facilities	15	16.5
7	332	Fabricated metal product manufacturing	15.5	15
8	484	Truck transportation	15.5	14
9	321	Wood product manufacturing	17	16
10	444	Building material and garden supply stores	17.5	21.5
11	622	Hospitals	17.5	18
12	492	Couriers and messengers	18.5	21.5
13	311	Food manufacturing	19	19
14	331	Primary metal manufacturing	19	19
15	811	Repair and maintenance	19	21.5
16	561	Administrative and support services	20	21
17	112	Animal production and aquaculture	21	21.5
18	237	Heavy and civil engineering construction	21.5	22.5
19	722	Food services and drinking places	21.5	26
20	336	Transportation equipment manufacturing	22	19.5
21	113	Forestry and logging	22.5	22.5
22	445	Food and beverage stores	23	27
23	562	Waste management and remediation services	24	24
24	452	General merchandise stores	25	27.5
25	721	Accommodation	25.5	28

† A total of 83 industries were ranked.

Table 8.14 Industries with the highest prevention index ranks based on ACSv1, with ranks based on QCEW denominators, WA 2014

NAICS	Industry Title	Prevention Index Rank†		Rank Difference
		ACSv1	QCEW	ACSv1 minus QCEW
238	Specialty trade contractors	1	1	0
236	Construction of buildings	2	3	–1
115	Agriculture and forestry support activities	3	2	1
424	Merchant wholesalers, nondurable goods	4	4	0
111	Crop production	5	5	0
623	Nursing and residential care facilities	6	9	–3
332	Fabricated metal product manufacturing	7	7	0
484	Truck transportation	8	6	2
321	Wood product manufacturing	9	8	1
444	Building material and garden supply stores	10	16	–6
622	Hospitals	11	10	1
492	Couriers and messengers	12	17	–5
311	Food manufacturing	13	11	2
331	Primary metal manufacturing	14	12	2
811	Repair and maintenance	15	18	–3
561	Administrative and support services	16	14	2
112	Animal production and aquaculture	17	15	2
237	Heavy and civil engineering construction	18	20	–2
722	Food services and drinking places	19	23	–4
336	Transportation equipment manufacturing	20	13	7
113	Forestry and logging	21	19	2
445	Food and beverage stores	22	26	–4
562	Waste management and remediation services	23	21	2
452	General merchandise stores	24	28	–4
721	Accommodation	25	29	–4

† A total of 83 industries were ranked.

9. QUARTERLY WORKFORCE INDICATORS: A SOURCE OF DEMOGRAPHIC DENOMINATOR DATA BY INDUSTRY AND STATE

QWI data can be used to get employee counts in demographic subgroups within specific industries. This national data source is compiled using UI data, the same data used as a foundation for the QCEW, but QWI links these data on the individual worker level to demographic data from other federal sources. QWI data can be downloaded from two sources:

- LED Extraction Tool at this Census Bureau website: https://ledextract.ces.census.gov/static/data.html. The LED website is best for downloading larger datasets that include data for multiple states or indicators and multiple types of subgroups in an employed population of interest.
- QWI Explorer website: https://qwiexplorer.ces.census.gov/static/explore.html#x=0&g=0. This website only provides data for one state and indicator at a time, and for a more limited set of subgroup types at a time. However, it does allow reporting of annual averages, as well as aggregate and average values for custom-selected sets of subgroups. QWI Explorer also generates line and bar charts.

More information about QWI is available on the Longitudinal Employer-Household Dynamics webpage of the Census Bureau: https://lehd.ces.census.gov/data/#qwi. These data can be used in place of the QCEW or the ACS to obtain basic employee-count, industry denominator data. Note that both QCEW and QWI provide data on number of jobs rather than number of workers. Some workers have jobs at more than one employer and are therefore counted more than once. In contrast, ACS provides data on number of workers, with each worker counted once in the industry of their main job.

- QWI can also be used to obtain employee counts for a variety of subgroups within each industry. Demographic subgroups are likely to be of most interest. Three types of employee distribution across demographic groups are available: sex and age, sex and education, and race and ethnicity. The data extraction tools do not allow other combinations of demographic categories.

One drawback of QWI is that data for federal employees cannot be specifically excluded. Federal employees and workers covered by the Longshore and Harbor Workers' Compensation Act are not included in available claims data, so these groups should ideally be excluded. However, QWI data can be retrieved only for all privately-owned employers or for all private and public employers. This means that federal employees cannot be removed without removing all public sector employees. Because local and state government employees are more numerous than federal employees, the best choice for WC data analysis is generally to include public sector employees. Note that the default choice for firm ownership on the QWI Explorer website is "All Private Ownership," which is displayed under "Filters/Aggregations." To change the firm ownership category, click on the blue text. Similarly, "all private ownership" is the default choice in the LED extraction tool, but this can be changed to "All Ownership" under "Firm Characteristics."

OBTAINING EMPLOYEE COUNTS BY INDUSTRY

Average annual employee counts are found by selecting the appropriate "indicators" from among those offered. Employee counts are available for the beginning and end of each quarter at three levels of industry detail: NAICS sector, NAICS 3-digit code, and NAICS 4-digit code. The beginning-of-quarter counts are labeled "Emp," and the end-of-quarter counts are labeled "Empend." To obtain an average count for a quarter, take the mean of Emp and Empend. For annual figures, take the mean of all four quarters or just average all the quarterly Emp and Empend values. Note that the counts for the end of a quarter don't match the counts for the beginning of the following quarter exactly, for a few technical reasons. These reasons include quarterly adjustment of employer establishment weights, noise infusion for confidentiality protection, and reclassification of employers. Also note that small differences exist between quarterly employment figures in the QCEW and QWI. One reason is that the QCEW measures employment in the pay period that includes the 12th day of the month, as opposed to measuring employment at the beginning and end of each quarter.

To obtain employee counts by industry in QWI Explorer,

- Select a state.
- Select Emp.
- Select "yearly averages" under "X-Axis" in the middle of the page (not under "Filters/Aggregations")
- Under "Group" on the right, select NAICS industry sector, NAICS 3-digit industries, or NAICS 4-digit industries. The program automatically selects all available years, but this sometimes results in a message that the file is too large for QWI Explorer. If so, limit the number of years selected under "X-Axis."
- A chart and table will appear. Although the chart can only display a portion of the data at a time, the table includes all of the requested data. The table data can be downloaded in Excel or csv format.
- Repeat the steps above to download the Empend indicator. Note that in QWI Explorer, the variable Empend does not appear in the default menu, which shows only 8 of the 32 available quarterly indicators. To see Empend and the rest of the indicators,
  - click on "Adv. Settings" to the right in the dark ribbon at the top of the webpage.
  - Select "Show All Indictors."
  - Reload QWI Explorer. All indicators will appear in the indicator menu.
- Merge the two downloaded files
- Average Emp and Empend for each industry and year.

To obtain employee counts by industry in the LED Extraction Tool,

- Select "All QWI Measures."
- Select a state by first selecting "United States" under geography and then selecting the desired state in the middle panel.
- Under "Firm Characteristics," select NAICS industry sector, NAICS 3-digit industries, or NAICS 4-digit industries.
- Under "Indicators" select both Emp and Empend
- Select the desired quarters under "Quarters."
- Click "Submit Request" under "Summary and Export" and download the data.
  - Averages for individual years can be computed by averaging the eight Emp and Empend values for each year-industry combination.

OBTAINING EMPLOYEE COUNTS OF DEMOGRAPHIC SUBGROUPS WITHIN INDUSTRIES

In QWI Explorer, parameters can be set to extract employee counts by industry for a single year, broken down by a single selected demographic variable: sex, age, education, race, or ethnicity. Here is how to do to that:

- Select a state and employee count indicator (either Emp or Empend).
- Under "X-Axis" select industry NAICS sectors, 3-digit industries, or 4-digit industries
- Under "Group" select the type of demographic subgroup of interest (sex, age, education, race, or ethnicity).
- Select the quarters to be included under "Filters/Aggregations." Because an annual average is wanted for a single year, select all four quarters for the desired year. This will cause the program to report averages over the four selected quarters.
  - Note that the average reported employment will be an average over all quarters selected, regardless of whether the quarters represent partial or multiple years. Do not apply any other filters. Note that a filter will restrict the requested data to certain selected subgroups, and reported employee counts will be aggregate counts that include all of the selected subgroups. No values for any of the individual, selected subgroups are then reported.
- Follow the above steps twice, once to download Emp and again to download Empend.
- Average Emp and Empend to obtain the desired results.

Alternatively, parameters can be set in QWI Explorer to extract the employee counts for only a single industry for a single year, but broken down in a more detailed manner by a combination of sex and age, sex and education, or race and ethnicity. Follow these steps:

- Under "X-Axis" select sex.
- Under "Group" select age or education (or vice versa).
- Under "X-Axis" select race and under "Group" select ethnicity (or vice versa) if a race and ethnicity breakdown is desired,.
- Return to filter the data to include only a single selected industry as well as the quarters of a single selected year.
  - Note that if an attempt is made to apply the filter before "X-axis" and "Group" selections are made, the software may not allow selection of the desired filter, depending upon the current or default selections under "X-axis" and "Group."
- Follow the above steps twice, once to obtain Emp and a second time to obtain Empend.
- Average Emp and Empend for the desired results.

Extraction of demographic subgroup employee counts by industry is more straightforward with the LED Extraction Tool. Queries can be constructed by selecting industries, demographic subgroups, and quarters. The query will return a dataset that includes counts for all possible combinations of the industries, demographic subgroups, and quarters selected. Demographic breakdowns are still restricted, however, to combinations of sex and age, sex and education, or race and ethnicity. Unlike QWI Explorer, a single data extract can include any number of states and/or indicators. Annual averages have to be computed by the user after download.

10. ESTIMATING DENOMINATORS FOR AGE GROUPS

Sometimes it is important to compute claim rates by age group to determine if younger or older workers are particularly subject to the risks and burden of work-related injuries.[69] So there may be a need to estimate FTE denominators for specific age groups. There are two basic steps described below.

1. Estimating counts of workers by age group within each industry

We can start by assuming that the total count of employees in each industry is available and has been used to calculate a claim rate for the entire industry. This number could have been obtained from QCEW industry-level data, or from information on the number of employees for each individual employer from unemployment compensation or QCEW data. The first task is to estimate the number of employees in each age group. WC and QCEW data usually do not contain this information. However, information on the age distribution of employees within each industry can be obtained from the ACS or from QWI. This age distribution can be used to allocate the total employee count in each industry among age groups.

If the ACS is used, divide the number of employees in each age group by the total number of employees in the industry in the ACS to obtain the share of total industry employees within each age group. Note that, if the age groups within an industry are small, the age distribution may need to be estimated using a larger ACS data sample that may be constructed by including more years or more states.

If the QWI is used, the number of employees in each age group within each industry can be retrieved through the appropriate query, thus allowing each age group's share of total employees to be computed. The following age groups are available in the QWI: 14–18, 19–21, 22–24, 25–34, 35–44, 45–54, 55–64, 65–99.

Regardless of whether the ACS or QWI is used, the computed fraction of an industry's workers within an age group is multiplied by the previously known total number of workers in the industry to obtain the estimated number of workers within each age group.

2. Compute age group-specific FTE/EE ratios to convert age group employee counts into age-group FTEs

An FTE/EE ratio can be computed with ACS data for each age group within an industry, just as it is for the industry as a whole. Note again, that if age groups within an industry are small, the age distribution may need to be estimated using a larger ACS data sample that may be constructed by including more years, more states, or a more broadly defined industry. The computed FTE/EE ratio is multiplied by the employee count to obtain the number of FTEs.

69 For an example of the method below, see Kaur H, Wurzelbacher SJ, Bushnell PT, Grosch JW, Tseng C-Y, Scholl JC, Meyers AR, Lampl M [2021]. Workers' compensation claim rates and costs for musculoskeletal disorders related to overexertion among construction workers—Ohio, 2007–2017. MMWR *70*(16):577–582, https://doi.org/10.15585/mmwr.mm7016a1.

11. NUMERATOR ISSUES

One of the basic requirements for calculating claim rates by industry is to assign industry codes to each claim. The total number of claims in an industry is the numerator in an industry claim rate. However, the way in which claims are assigned to an industry has implications for determining the number of employees and FTEs in the denominator. The principle is that the employer-level industry code assigned to the claims of an employer's employees should also be assigned to the employer's employees in the denominator. In this way, the number of claims in the numerator and the number of employees or FTEs in the denominator refer to the same population of workers.

The first step in classifying claims by industry involves linking each claim to the claimant's employer or employer establishment. The next step is determining the industry code for the employer so it can be assigned to the claim. The first subsection below discusses methods of linking claims to employers. The second subsection discusses the problem of assigning a summary NAICS code to an employer when the employer has multiple establishments that do not all share the same code. The third subsection explains how the assignment of industry codes to claims can give rise to problems with alignment of industry coding in numerator and denominator and how those problems might be resolved. Following this are two short subsections that call attention to special problems in industry coding of public sector claims and to issues concerning which claims are available for claim rate analysis and which type of claims should be included and excluded.

Before beginning the discussion of classifying claims by industry, it is useful to review some of the basic features of the data on which this process has relied. The most useful data for this process are individual employer data on industry and number of employees from the QCEW. The QCEW is a federal/state cooperative program whose primary data source is administrative data from state unemployment insurance (UI) programs, supplemented by two BLS surveys. (See descriptions of these surveys and more details on QCEW data in Appendix A.) Although aggregate QCEW data by industry and state are published by the federal BLS, disaggregate QCEW and UI data for the employees of individual employers must be obtained from state workforce agencies[70] under confidentiality protection agreements. UI data contain records of earnings of individual workers at each employer for which they work. The QCEW program adds additional information to the UI data on the number of employees at each individual establishment when employers have more than one establishment, as well as the NAICS industry code of each establishment.

LINKING CLAIMS TO EMPLOYERS

This subsection deals with methods used by states to link individual claims to employer or establishment records in UI data and the QCEW so that the employer's NAICS code can be assigned to them. In some states, NAICS codes are submitted by claims administrators or employers on the first report of injury (FROI) or are otherwise available in WC data, but these NAICS codes may not be detailed enough (at 2-digit level only) and may be incomplete, and/or inaccurate. In addition, although the older standard industrial classification (SIC) codes have largely been replaced by NAICS codes, SIC codes are still sometimes found on claim records. Thus, it may be necessary to link individual claim records to UI and QCEW employer records to obtain NAICS industry codes.

Examples of different methods used are given below for California (CA), Massachusetts (MA), Michigan (MI), Ohio (OH), and Tennessee (TN).[71] These states received grants from NIOSH to construct and report industry claim rates. Table 11.1 gives information on which data years and private sector claims were analyzed by each state.

70 See list of state workforce agencies and their labor market information offices on BLS webpage entitled State Labor Market Information Contact List: https://www.bls.gov/bls/ofolist.htm.

71 See the following final reports from states on analyses supported by the NIOSH grants. Complete citations appear in the Reference section. California Department of Public Health and California Department of Industrial Relations [2019]; Massachusetts Department of Industrial Accidents (DIA), Massachusetts Department of Public Health (DPH), and Massachusetts Department of Labor Standards (DLS) [2019]; Ohio Bureau of Worker's Compensation [2019]; Rosenman KD, Reilly MJ [2020]; and University of Tennessee [2019].

Table 11.1 Private sector claims linked to employers and establishments in UI and QCEW data: Five states

State	Study Dates	Claim Types Included	Number of Claims
CA	2015-2017	Lost-time and medical-only	1.56 million
MA	2014-2016	Lost-time	94,869
MI	2014-2017	Lost-time	70,622
OH	2001-2011	Lost-time and medical-only	1.3 million
TN	2014-2016	Lost time and medical-only	197,306

California

California's analysis of lost-time and medical-only claims included both accepted and denied claims. California matched claims to an employer in the QCEW using an indirect method, because the federal Employer Identification Number (EIN) data reported to their Workers' Compensation Information System (WCIS) were not always reliable or available.

In the first step, private sector WC claims were submitted to the California Employment Development Department's Labor Market Information Division (LMID) programmers, and Social Security Number (SSN) was used to match claims to employment records in the unemployment insurance Base Wage File (BWF) in the quarter of injury. The BWF is a database that records individual worker earnings for each employer and associates each employer with an EIN. Of the 1.56 million private sector claims, 91% were matched to one or more employers in the BWF.

In the second step, EINs for the employers of injured workers were linked to detailed employer records containing NAICS codes from the QCEW in a second file from LMID. Almost all employers in the BWF were matched to an employer in the QCEW file. However, for the 20% of claims that matched to more than one employer, it was not always possible to identify the specific employer where the injury occurred due to absence of an EIN or an industry code on the claim. In some cases, this was not a problem, because there was sufficient industry information on the claim to assign an industry code without QCEW data, or because the multiple employers in the QCEW data shared the same NAICS code.

Massachusetts

In Massachusetts the study dataset of all filed, lost-time claims was directly linked with the QCEW file for private sector establishments using employer information common to both datasets (name, address, EIN). The linkage was carried out under a Memorandum of Understanding among three departments: Unemployment Assistance (DUA), Industrial Accidents (DIA) and Public Health (DPH). DIA performed the linkage with guidance from DPH. This process involved checking a series of over 100 potential deterministic linkages and extensive manual review of linked WC-UI records for firms with multiple establishments and multiple NAICS codes. The match rate of claims to a QCEW establishment was 88.7%. All matched claims were assigned a NAICS code. Researchers examined concordance between NAICS codes provided by insurers through electronic data interchange (EDI) and those assigned by linkage with QCEW. They found concordance was low, only 49% at the 4-digit level, and concluded that insurer-provided NAICS codes were useful in deciding whether to accept UI-WC matches but cannot be relied on for surveillance purposes. They also concluded that characterizing the types and distribution of NAICS-assignment errors by insurers could provide useful insight about the potential for improvement. An additional challenge in MA was that employee counts by establishment were not provided to the researchers by their UI/QCEW agency. Instead, establishment size class was provided.

Michigan

Michigan researchers obtained partial federal EINs from state WC claims data under strict confidentiality requirements from their Workers' Disability Compensation Agency (WDCA). For paid, lost-time claims, the last four digits of the employer EIN were provided. These were used by a contractor to match claims to employer records in the QCEW database. The last four digits of the EIN were not sufficient to create a unique match. Therefore, the contractor (Kunz, Leigh & Associates) developed an approach using both the Levenshtein (LEV) and Soundex algorithms to perform the match using combinations of federal EIN, employer name, street address, city, state, and zip code.[72] The LEV and SOUNDEX programs were able to identify matches for 90% to 100% of claims in each year. To ensure accuracy of the matches, a manual review was conducted for all matches in 2014 and all new matches in subsequent years. In cases where a match to a QCEW employer was unsuccessful, an internet search for NAICS code and number of employees was conducted, accounting for about 5% of total employers included in the analysis. Out of 70,622 claims over a four-year period, only 42 companies, representing 66 claims remained unmatched.

Ohio

Ohio's Bureau of Workers' Compensation (OBWC), as the sole insurer in Ohio, has complete linkage of claims to employer WC policies. Ohio requires each employer, as identified by a federal EIN, to have only a single policy, regardless of the number of locations. OBWC's data warehouse links data on each policy with data for all claims filed by employees of the policy holder, including information from the FROI form and data on diagnoses, treatments, and costs.[73] Although the Ohio FROI form asks for specific location of injury, this information is often missing or inadequate. Therefore, the industry code assigned to each claim must be the code assigned to the employer as a whole, not one that is specific to any of its individual locations. Because OBWC does not have NAICS codes and employee counts for employers, they linked records of OBWC-insured, private employers to QCEW employer records from the Ohio Department of Jobs and Family Services using EINs common to both databases. About 90% of employers could be matched in this way. Attempts to match additional employers using employer name only did not increase the match rate significantly and risked introducing error, so this method was not used to increase the match rate.

Tennessee

Claims data from the Tennessee Bureau of Workers' Compensation were provided directly to the University of Tennessee at Knoxville's Boyd Center for Business and Economic Research, custodians of the Tennessee Longitudinal Data System, due to their experience working with sensitive state data and existing security protocols. Both accepted (183,249) and denied (14,057) claims were included but analyzed separately. The Boyd Center deterministically matched EIN fields from claims and QCEW data to ascertain the employer's six-digit NAICS code and employment levels during the quarter of the reported injury. Tennessee did not report the match rate of claims to employers for private sector claims. Among compensable, medical-only and lost-time claims in the private, state and local sectors combined, the claim match rate to both employer and industry was 78.3%.

Once claims have been linked to employers, NAICS codes are easily retrieved, but there are two issues that may be encountered. One is that NAICS codes are revised every 5 years (including 2017 and

72 See Rosenman KD, Reilly MJ [2020]. Use of Michigan workers' compensation data for surveillance of work-related injuries and illnesses. Final cooperative agreement report. Funded by NIOSH Grant No. 5 U60OH010892. East Lansing, MI: Michigan State University, U60-OH-010892, https://oem.msu.edu/images/resources/Works%20Comp/FinalReport2020.pdf.

73 Wurzelbacher S, Al-Tarawneh IS, Meyers AR, Bushnell PT, Lampl MP, Robins DC, Tseng C-Y, Wei C, Bertke SJ, Raudabaugh JA, Haviland TM, Schnorr TM [2016]. Development of methods for using workers' compensation data for surveillance and prevention of occupational injuries among state-insured private employers in Ohio. Am J Ind Med 59(12):1047–1182, https://doi.org/10.1002/ajim.22653.

2022). It is possible that data sources that supply NAICS codes for employers could contain codes from more than one version of the NAICS code set. If so, available crosswalks between NAICS code sets may need to be applied. The second issue that may arise is that many employers have more than one NAICS code as explained below.

ASSIGNING NAICS CODES TO MULTI-ESTABLISHMENT FIRMS OPERATING IN MULTIPLE INDUSTRIES

Industry codes are assigned to claims by determining the industry code assigned to the claimant's employer. If an employer has a single establishment, assigning an industry code to the claim is straightforward, because the industry code for the establishment is the same as the code for the employer. The only problem that may arise is inconsistent industry codes for the establishment across quarters, but this happens infrequently.[74]

However, there is a special problem that arises when selecting a single code to represent the industry of a multiple-establishment employer whose establishments are in more than one industry. Note that each separate physical location is considered a separate establishment, and in some cases, a single location in which distinct economic activities are conducted encompasses more than one establishment. NAICS, the foundational industry coding system of the federal government, is primarily designed to be applied at the establishment level. Typically, however, WC claim analysis requires coding at the employer level, because it is difficult to link each claim to a specific establishment.

QCEW data show that the vast majority of U.S. employers have a single establishment, but that employers with multiple establishments employ a large share of employees. Table 11.2 presents national QCEW data from the 1st quarter of 2019. Only about 1.4% of employers had multiple establishments, but they accounted for about 17% of U.S. establishments and 41% of employment.

Table 11.2 Multiple-establishment employers: National share of employers, establishments, and employment, QCEW data, 1st Quarter 2019†

	Percentage of National Total
Percentage of employers	1.4%
Percentage of U.S. establishments	17.3%
Percentage of U.S. employment	41.03%

† Note that the QCEW program only gathers establishment-level data from employers with multiple establishments if they have more than 10 employees in locations other than their main location. In addition, some multiple-establishment employers fail to report, or are unable to report separately for all individual establishments. See more details on QCEW data in Appendix A. Source: BLS [2023a]. BLS Handbook of Methods, Quarterly Census of Employment and Wages, History, https://www.bls.gov/opub/hom/cew/history.htm.

For multi-establishment employers, detailed QCEW data contain a NAICS industry code for each individual establishment, as well as a summary NAICS code for the employer as a whole (see Appendix A for an explanation of how these codes appear in the data). For many of these employers, all establishments have the same NAICS code, but in other cases, the NAICS codes for some establishments are different from the NAICS code assigned to the employer as a whole.

74 In a previous analysis of Ohio WC data published in 2016, the same NAICS code was usually reported (> 99% of the time) for a given employer across the quarters within a given calendar year. When this did not occur, the most frequently reported NAICS code across the quarters was selected. If there was a tie, the NAICS of the final quarter was selected. See Wurzelbacher et al. [2016] as cited in the preceding footnote.

This leads us to the question of how the master NAICS code is assigned in the QCEW, and how much this might vary among states who are primarily responsible for code assignment.[75] The information that is available to states for this task includes (1) information provided on QCEW forms by employers describing their main activities and giving the distribution of their sales and revenues by product or service at the establishment level, (2) the NAICS codes that have been assigned to individual establishments and the number of employees in each, and (3) publicly available information on an employer's products, services, and activities. General QCEW guidance on industry code assignment indicates that more than one type of information may be used, depending upon circumstances:

> *"If an establishment performs more than one activity, the industry should be assigned based on the establishment's principal product or group of products produced or distributed, or services rendered. Ideally, the principal good or service should be determined by its relative share of current production costs and capital investment at the establishment. In practice, however, it might be necessary to use other variables such as revenue, shipments, or employment as proxies for measuring significance."*[76]

Also note that on the data collection forms of the QCEW used to assign industry codes to individual establishments, the "main business activity" is defined as follows:

> *"We need detailed information to assign the correct North American Industry Classification System (NAICS) code to this business. In the space provided below, describe your business activities, goods, products, or services in this State, as though you were telling a prospective employee what you do. Please describe the activities and provide the approximate percentage of sales or revenues resulting from each activity. Percentages should total 100%."*[77]

A percentage-of-sales criterion would not align as well as an employment criterion with the purposes of WC claim analysis. See Appendix A for an illustration of multi-establishment employer coding based on these alternatives.

There are at least two ways to handle multi-establishment firms with different NAICS codes assigned to different establishments or sub-units.

1. Ignore the NAICS data for the sub-units and use the NAICS code provided for the employer as a whole. Note that in QCEW data, the master record for the employer is designated by MEEI code 2, and sub-unit records are designated by MEEI code 3 or 5 (see details on MEEI codes in Appendix A[78]). The advantage of this approach is that it's less complicated than the algorithms below, but the disadvantage is that it may be based on sales/revenue rather than employee counts.
2. Design an algorithm using the sub-units' NAICS and employment data to choose a single NAICS code for each multi-establishment employer. Each such algorithm begins by subtotaling the employee

75 This section discusses the assignment of NAICS codes at the employer level within the QCEW. Note that at the federal level, assignment of NAICS codes varies by agency, and there is no central authority for determining the NAICS codes for employers or establishments. BLS urges states to make NAICS code assignments consistent across BLS statistical programs, with QCEW being the lead program for assigning industry codes. See Section 2.2 in: OIRA [2011]. QCEW operating manual. Washington, DC: Executive Office of the President, Office of Management and Budget, Office of Information and Regulatory Affairs, http://www.reginfo.gov/public/do/DownloadDocument?objectID=48010401; A more recent version of the QCEW operating manual is available, but it is less convenient to use because it lacks a table of contents and index: OIRA [2019]. QCEW operating manual 2020, OMB Publication No. 1220-0012, https://omb.report/icr/202101-1220-001/doc/107532601.

76 See pp. 2–8 in OIRA [2007]. QCEW operating manual, as cited in the preceding footnote. The specific survey referred to is the Annual Refiling Survey.

77 See the Annual Refiling Survey forms (Industry verification forms BLS 3023-NVM) at this BLS website: https://www.bls.gov/respondents/ars/forms.htm.

78 The authors would like to thank Rebecca Jackson, formerly of the California Department of Public Health, for first alerting us to the role and importance of multi-establishment employers and MEEI codes (a MEEI code is used in QCEW data to indicate the part of an employer associated with a NAICS code).

counts (listed for each sub-unit) by NAICS code. There are many details to such algorithms, but here is the outline of algorithms used in Ohio and California :

a. Ohio algorithm (used in analyses with NIOSH)—the employer is assigned a 6-digit NAICS code if there is a code that represents at least 75% of the employees in the master record. Alternatively, if there is a 3-digit code that represents at least 75% of the workforce, then just assign a 3-digit code to the employer. If there is no code representing 75% of the workforce, then omit that employer from the analysis.
b. California algorithm—the employer is assigned a master NAICS code if there is a code that has at least 80% of the employees. Employment at establishments coded 551114 ("Corporate, Subsidiary, and Regional Managing Offices") are excluded from this calculation, because it is thought that this code does not actually reflect the industry of the employer or the claimant employees. However, some multi-establishment employers are assigned NAICS 5511 because at least 80% of their employees are recorded under this code. If there is no single code representing 80% of employees, then assign a non-specific industry code (for example: "999999"). This keeps the employer (and workers) in the study and lumps all these cases into one bucket.

IDENTIFICATION AND INDUSTRY CODING OF MULTI-ESTABLISHMENT EMPLOYERS: OHIO RESULTS

The linking of OBWC's policies from 2006–2011 to QCEW records showed that 98% of state-insured, private sector policies were for single-location employers, but these policies covered only 78% of private sector employees. In contrast, only 2% of private sector policies were for multi-location employers, but these employers accounted for 22% of private sector employees (see Table 11.3a). In the public sector, 73% of policies were for single-location employers, accounting for 17% of public sector employees, while 27% of policies were for multi-location employers, accounting for 83% of public sector employees (see Table 11.3b).[79] Note that self-insured employers who are relatively large are not included in these data. This decreases the percentage of employers with multiple establishments and the percentage of employees they represent.

Table 11.3a Percentage and number of private sector employers and employees located in single versus multiple establishment firms, OBWC data

Private Sector	Single-establishment Employers		Multiple-establishment Employers	
Policies (Employers)	98%	1,024,040	2%	19,422
Employees	78%	11,947,192	22%	3,428,944

79 See Table 1 in Wurzelbacher S, Al-Tarawneh IS, Meyers AR, Bushnell PT, Lampl MP, Robins DC, Tseng C-Y, Wei C, Bertke SJ, Raudabaugh JA, Haviland TM, Schnorr TM [2016]. Development of methods for using workers' compensation data for surveillance and prevention of occupational injuries among state-insured private employers in Ohio. Am J Ind Med *59*(12):1047–1182, https://doi.org/10.1002/ajim.22653.

Table 11.3b Percentage and number of public sector employers and employees located in single versus multiple establishment firms, OBWC data

Public Sector	Single-establishment Employers		Multiple-establishment Employers	
Policies (Employers)	73%	14,858	27%	5,631
Employees	17%	585,951	83%	2,878,403

When the Ohio algorithm was applied to multi-establishment, private-sector, Ohio employer policies from 2006–2011, the results were as follows:

Step #1: Determine the 6-digit NAICS code with at least 75% of the employees for a given employer across locations (84.6% of policies representing 84.7% of claims).

Step #2: If #1 fails, then determine the 3-digit NAICS code with at least 75% of the employees for a given employer across locations (4.0% of policies representing 4.8% of claims).

Step #3: If #2 fails, then determine the NAICS code with the most employees for a given employer (11.3% of policies representing 10.6% of claims). Employers assigned a NAICS code with this step were not included in analysis of industry claim rates.

Step #4: If #3 fails, then do not select a NAICS code for this employer (0.01% of policies, 0.0% of claims).

Comparison of NAICS Code Selected by the Ohio Algorithm With the Assigned NAICS Master Code in QCEW Data

A separate analysis using four quarters of 2011 QCEW Ohio data was used to determine the frequency with which the selection method above assigned a NAICS code that matches the master NAICS code for the employer (MEEI code 2) in the QCEW data.[80] This analysis focused on multi-location, private-sector employers. After applying Ohio's algorithm (Steps 1–4) for the multi-location policies, the 6-digit NAICS code was the same as the master code in about 94% of the cases and the 3-digit NAICS code was the same in 99% of the cases (see Table 11.4).[81] This implies that over 80% of the employers for whom the 6-digit code did not match were assigned a 3-digit code that did match.[82]

Table 11.4 NAICS code assignment using Ohio's algorithm compared with the QCEW master code, 2011 OBWC data

Year	Quarter	Match 6-digit	Match 3-digit
2011	1	94.89%	99.41%
2011	2	94.61%	99.20%
2011	3	94.20%	98.69%
2011	4	93.93%	98.45%

80 Robins D [2017a,b]. Email messages to Tim Bushnell, Aug. 17–Sept. 15 (from the Ohio Bureau of Workers' Compensation).

81 Note that the percentage of workers who work in an employer with a NAICS code representing over 75% of the workforce might be lower than these results suggest as the selection of a nonmatching NAICS code may happen more often when the employer is larger. This concern is lessened somewhat, however, because this analysis only included multi-location employers, and so did not include the very large number of small employers.

82 Some policies were only assigned a 3-digit code based on Step #2, but all policies that were assigned a 6-digit code were also implicitly assigned a 3-digit code given by the first 3 digits of the 6-digit code.

Note that codes chosen based on Step #3 matched the master NAICS in the QCEW data in most cases, even though they represented less than 75% of the workforce. The previous analysis indicated that 11.3% of multi-location employers were assigned a NAICS code based on this step. This leads to an important point to keep in mind if choosing to use the master NAICS code given in the QCEW data: It is important to check the percentage of employees working in locations with the master NAICS to make sure it is not too low (below 75% or some other threshold).

ALIGNMENT OF INDUSTRY CODING IN NUMERATOR AND DENOMINATOR

Ideally, there should be complete alignment between the numerator and denominator in NAICS code assignments. Alignment is achieved when the same NAICS code is assigned to an employer's claims in the numerator and its employees in the denominator. Alignment means that the converse is also true. If an employer's claims are not included in an industry numerator, then its employees are not included in the industry's denominator either. In practice, however, it may be difficult to achieve complete alignment of industry coding between numerator and denominator. There are four potential alignment issues. The first is caused by a systematic failure to link claims to certain individual employers. Such a failure could stem from a failure of insurers or claims administrators to report the claims of certain employers. Or the failure could stem from an inability to link these employers to the reported claims of their employees due to inaccurate or missing EIN or other data elements. However it occurs, the absence of claims for certain employers can sometimes be difficult to distinguish from a true zero claim rate. Thus, it can be unclear when individual employers should be excluded from the denominator. Note that if failure to link claims to employers occurs at random for individual claims, rather than systematically for all claims of certain employers, this would not require that any employer's employees be excluded from the denominator.

A second alignment issue is closely related to the first, occurs when an employer is linked to the claims of its employees, but the employer's industry cannot be summarized by a single industry code. Because the claims cannot be assigned to an industry and included in any industry numerator, neither should the employees be included in any industry denominator.

A third alignment issue occurs when employment data for an employer are missing for one or more quarters. This can happen for various reasons such as reporting or data errors, fluctuations in business, or employers beginning or ending operations in the middle of a year. However, this occurs relatively infrequently. In a 2016 Ohio analysis, values for employee counts were reported for all quarters in the year over 99% of the time. When quarters were missing, claim rates were computed only for the quarters in which employee counts were available and were expressed as an annual rate of claims per full-year FTE. Thus, to obtain alignment between numerator and denominator, neither claims nor employment for quarters with missing employment numbers were included in claim rate calculations.[83]

The fourth issue occurs when claims are assigned a summary NAICS code at the employer level, but the industry denominators are taken from aggregate QCEW data which provide total number of employees by industry based on establishment-level NAICS coding. Industry coding on the establishment level yields more accurate counts of employees by industry. However, in any rate calculation, the numerator and denominator should always refer to the same population of workers. Thus, if claims are coded at the employer level, so should the worker populations in the denominators.

Misalignment of numerator and denominator industry coding can be avoided if there is access to employer-level QCEW data. With this microdata, industry denominators can be generated by summing individual, employer-level employee counts for employers who have been classified as a whole to certain NAICS codes. This is the procedure that Ohio followed. Massachusetts reduced misalignment in a different way by linking each claim to an individual establishment in the detailed QCEW data. This

83 Wurzelbacher et al. [2016]. As cited above.

allowed them to code claims at the establishment level and so align with the establishment-level coding that is the basis of the publicly available QCEW industry employee counts.

When there is limited access to QCEW microdata, it may not be possible to generate industry denominators by selectively summing the employment of industry-coded employers or to link claims to individual establishments and their industry codes. In that case, it may be necessary to use the publicly available, aggregate QCEW data for the denominator, and therefore to allow some misalignment of industry coding between numerator and denominator.

A NOTE ON CLASSIFYING PUBLIC SECTOR CLAIMS AND EMPLOYEES BY NAICS CODE

As discussed in Section 5, public sector employees are often classified in broad categories that are not very useful for claim rate analysis. The same is true for claims of public sector workers. Claims are typically associated with general government entities that span a wide variety of activities that belong in different public sector NAICS codes. Thus, it may be necessary to work with government administrative data to identify claims of workers in fire and police protection and other specific, public sector worker populations.

ADDITIONAL NUMERATOR ISSUES CONCERNING COMPLETENESS OF CLAIMS DATA AND CHOICE OF CLAIM TYPES TO INCLUDE IN CLAIM RATE ANALYSIS

WC claims data are not always complete, and there are some claim types that may be best to exclude or to analyze separately. Only some of these issues have potential implications for construction of denominators, but they are all briefly listed here for reference.

- In some states, reporting of claims by claims administrators and self-insured employers to the state's database is not complete. Incomplete reporting of FROIs (first report of injury) may be more prevalent in states without financial penalties for incomplete reporting.
- Ideally, claim rates can be calculated for medical-only and indemnity (lost-time) claims, both separately and together. Claims data available in some states such as Ohio allow this, but in some other states, this is not the case. For example, Massachusetts does not require data on medical-only claims to be reported to the State, so rates can only be calculated for indemnity claims.
- Some states have incomplete reporting by claims administrators for their Subsequent Reports of Injury (SROI data), so for many claims, they do not have enough information to determine whether they are medical-only or indemnity claims. In this case, total claim rates might be calculated, but separate calculation of rates of medical-only or indemnity claims will not include all claims, and relative industry claim rates will be biased if industries have different patterns of missing SROIs.
- A more general point is that claims data are dynamic because the status, type, and costs of individual claims often change over time. Thus, claim information that is gathered a longer time following the year of injury will be more accurate. Over time, a claim's accepted-versus-denied status can change. Sometimes, claims are filed for injuries that turn out not to require either medical care or time off work.
- Claim rate analyses may include all reported claims, or may be confined to accepted claims only, depending upon the extent to which denied claims are considered indicative of work-related injuries and illnesses. If all claims are analyzed, denied claims may or may not be analyzed separately from accepted claims. Note that information on acceptance or denial is not always reported, and that in some states, denied claims are not always flagged as denied in the available claims database.
- Some claims result in zero dollars in benefit payments. This raises the question whether such claims generally represent work injuries and illnesses, and if so, whether they are of sufficient severity that they should be included.

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APPENDIX A – QCEW, ACS, AND OPT DATA

Appendix A provides detailed descriptions of the QCEW program of the BLS as well as OPT data, also from the BLS, and the ACS of the Census Bureau. The focus is on data relevant to estimation of denominators for calculation of WC claim rates and other rates of occupational injuries and illnesses.

QCEW EMPLOYEE COUNT DATA BY INDUSTRY

The QCEW, formerly known as the ES-202 program, produces data on the number of establishments, monthly and quarterly employment, and total quarterly wages by industry for workers covered by state UI laws and federal workers covered by the Unemployment Compensation for Federal Employees (UCFE) program. The primary source for the QCEW is administrative data from state UI programs, supplemented by data from federally-sponsored QCEW employer surveys. These data are highly accurate and detailed, because they are based on a census of employers, rather than a survey sample. However, note that although there is no sampling error, errors in industry coding and employment estimates can occur and could be relatively large in very small industries. More detailed information on QCEW data can be accessed online at www.bls.gov/cew.

The QCEW covers more than 95% of U.S. jobs. It is available at the county, Metropolitan Statistical Area (MSA), state, and national level, by detailed industry. These data are aggregated to many different NAICS industry levels, from the 6-digit level and proceeding upward through NAICS industry groups, sectors, and supersectors. Note that the sums of published employee counts at a given level of NAICS code detail do not always add up to the published totals at the next higher level. This may be due to suppression of more detailed data to protect disclosure of information on individual employers. For example, sums of employee counts at the 4-digit NAICS level within a given 3-digit code can be slightly less than the published 3-digit level count.

At the national level, the QCEW program publishes establishment count, employment, and wage data for nearly every NAICS industry. The same kind of data are also published at the state, county, and MSA level in as much detail as possible, including the 6-digit NAICS industry level if disclosure restrictions are met. Establishment counts and wage data are available quarterly and annually. Employment data are available monthly, quarterly, and annually. In addition, the QCEW program produces data on establishments, employment, and wages stratified by size of establishment for the first quarter of each year. Quarterly QCEW employment data represent an average of three monthly employee counts. Employers are instructed to report the number of employees they have during the pay periods that include the 12th of each month. The QCEW data field "avg_emp" represents, for the relevant quarter, the average of the three months that are in that quarter.

In QCEW data, the fundamental economic unit is the "establishment." An establishment is commonly understood as a single economic unit, such as a farm, a mine, a factory, or a store, that produces goods or services. Establishments are typically at one physical location and engaged in one, or predominantly in one type of economic activity to which a single industrial classification may be applied. In some cases, if distinct types of economic activity are conducted at one physical location and separate records are kept, it is possible for a single location to be divided into more than one establishment. An employer may be a business, a nonprofit organization, or government unit, and may consist of one or more establishments. Therefore, each establishment may participate in a different predominant economic activity.[84] QCEW employment and wage statistics by industry are based on industry coding on the establishment level, not the employer level.

84 See the FAQ entitled "What is the difference between a company, a firm and an establishment in QCEW data?" No. 23 on this QCEW website: https://www.bls.gov/cew/questions-and-answers.htm.

In each state, QCEW microdata at the employer level are fundamentally a byproduct of the state's UI accounting system. Each state receives Quarterly Contributions Reports (QCRs) from all private sector employers, as well as from state and local governments covered under the UI program. Federal government employers provide similar statistical reports via the Report of Federal Employment and Wages (RFEW). These reports contain employment and wage data for each employer within each state. The wage data represent total employee earnings. Hourly wage data are not collected.

These data are supplemented by data from two BLS surveys: the Annual Refiling Survey (ARS) and the Multiple Worksite Report (MWR), both administered under cooperative agreements by state workforce agencies.[85] All employers, with few exceptions, are requested and—in many states, required[86]—to complete these surveys. The surveys are conducted on a 3-year cycle, with approximately one-third of all business establishments sampled each year.

The ARS uses separate forms for single- and multiple-worksite employers. The MWR is sent only to employers with multiple establishments and more than ten employees at locations other than their primary worksite. The primary location is the one with the most employment. Note that "worksite" is synonymous with establishment.

Survey forms are prepared by BLS and are similar among states. However, there are a few exceptions, such as the return address of the state-based labor department office, the individual state government codes regarding UI, and modifications to align the MWR form with other state-based forms.

The ARS requests multiple worksite employers (on "industry verification" form BLS 3023-NVM) to provide the following information for each individual worksite (establishment): (1) business name, (2) physical location address, (3) number of employees, (4) county, (5) main business activity, and if more than one main activity, (6) a list of activities and the percentage of sales associated with each.

The MWR asks for the main business mailing address and the following for each worksite: (1) the physical location address, (2) the number of employees in each month, and (3) the quarterly wages subject to UI laws. National and state QCEW staff have regular processes for checking, cleaning, and correcting reported data.

Unlike published QCEW data at the industry level, QCEW microdata at the employer level are not publicly available. To access the microdata, state WC divisions enter into interagency data use agreements with their state's labor agency. In these detailed data, Multi-Establishment Employment Indicator (MEEI) codes designate the organizational unit associated with each record, each of which contains a NAICS industry code. The MEEI codes are listed and defined in Table A.1.[87] Thus, each NAICS code appearing in the data is associated with an MEEI code that indicates the entity to which the NAICS code refers, whether that be a sub-unit of an employer or an entire employer.

85 See the Data Sources/Surveys section in: BLS [2023a]. BLS Handbook of Methods, Quarterly Census of Employment and Wages. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, https://www.bls.gov/opub/hom/cew/.

86 See the Data Sources/Authorization and Participation section in: BLS Handbook of Methods, Quarterly Census of Employment and Wages, as cited above.

87 See Chap. 3, Section 2 (pp. 3–6 and 3–7) in: OIRA [2007]. QCEW operating manual. Washington, DC: Executive Office of the President, Office of Management and Budget, Office of Information and Regulatory Affairs, http://https.omb.report/icr/201103-1220-007.

Table A.1 Multi-establishment employment indicator (MEEI) codes in QCEW data

MEEI Code	Unit Type	Description
1	Single Establishment Employer	Employer with only a single establishment
2	Multi-unit Master Record	An entire multi-establishment employer for which NAICS codes have also been reported for individual establishments
3	Sub-unit records of a Multi-unit Employer	Establishment of a multi-establishment employer who has reported codes for its sub-units on the MWR or RFEW
4	Multi-unit reporting as Single (lack of data)	Multi-establishment employer reporting as a single unit because the employer refuses to complete the MWR or RFEW
5	Sub-unit representing several establishments	Sub-unit of a multi-establishment employer that includes more than one establishment for reporting purposes
6	Multi-unit reporting as single (due to size)	Multi-establishment employer reporting as a single unit because it does not meet the minimum criteria for filing the MWR or RFEW

Source: U.S. Department of Labor, Bureau of Labor Statistics; See pp. 3–6 and 3–7 in: OIRA [2007]. QCEW operating manual, http://https.omb.report/icr/201103-1220-007. (Date accessed: November 23, 2024)

NAICS codes associated with MEEI code 2 represent a master industry NAICS code that identifies the main industry of a multi-establishment employer. NAICS codes associated with MEEI code 3 (sub-unit record of a multi-unit employer) represent the industry of a single establishment within a multi-unit master record (MEEI code 2). NAICS codes associated with MEEI code 5 represent the industry of an employer sub-unit that includes more than one establishment. This code is used when an employer cannot report or fails to report separately on each establishment within a group of establishments. For many employers, the same NAICS code is listed for all establishments or sub-units, and this code will match the NAICS code listed in the master record. This means that all NAICS codes associated with MEEI code 3 and/or MEEI code 5 are the same as the NAICS code associated with MEEI code 2. In these cases, the choice of industry code on the employer level is clear. However, in some cases, the NAICS codes listed for some of the sub-units will differ from the master record's NAICS code.

The assignment of a summary NAICS code to multi-establishment employers (NAICS for MEEI code 2) may be based on different types of available information as described in Section 11, principally information on distribution of sales revenues and employees. Specific hypothetical coding scenarios next illustrate how these criteria could operate and the possible difference between them. Table A.2 shows five possible scenarios for the assignment of a master NAICS code to a hypothetical employer X that has 5 locations (establishments 1,2,3,4 and 5). There are five scenarios. In each one, the establishments have different dollar amounts of sales and numbers of employees, as well as different NAICS code assignments ("abcdef," "ghijkl," or "mnopqr"). Note that these three NAICS codes are assumed to be different at the 3-digit, 4-digit, and 6-digit levels.

Table A.2 Illustrative example: Assigning master NAICS codes to a multi-location employer

Employer X	Sales ($)	Employee Count (EEs)	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
QCEW Master code (highest sales)			abcdef	abcdef	abcdef	abcdef	mnopqr
Establishment 1	$400,000	500	abcdef	abcdef	abcdef	abcdef	abcdef
Establishment 2	$400,000	300	abcdef		abcdef	abcdef	mnopqr
Establishment 3	$100,000	120	abcdef		abcdef	ghijkl	mnopqr
Establishment 4	$50,000	40	abcdef		ghijkl	ghijkl	ghijkl
Establishment 5	$50,000	40	abcdef		mnopqr	mnopqr	ghijkl
Total	**$1,000,000**	**1,000**					

Table A.3, Part A, shows how the master NAICS code is assigned in each of the five scenarios, based on highest percentage of sales revenue. This criterion results in an assignment of "abcdef" in Scenarios #1–4, but "mnopqr" in Scenario #5.

Alternatively, Table A.3, Part B, shows how the master NAICS code is assigned in each of the five scenarios if the highest percentage of employees is the criterion for choosing a master NAICS code. This criterion results in the assignment of "abcdef" in Scenarios #1–5.

Table A.3 Summary—Master NAICS code assignment

PART A	Total sales				
	#1	#2	#3	#4	#5
abcdef	$1,000,000	$1,000,000	$900,000	$800,000	$400,000
ghijkl	$0	$0	$50,000	$150,000	$100,000
mnopqr	$0	$0	$50,000	$50,000	$500,000

PART B	Total EEs				
	#1	#2	#3	#4	#5
abcdef	1,000	1,000	920	800	500
ghijkl	0	0	40	160	80
mnopqr	0	0	40	40	420

Detailed comments on each scenario are listed below:

1. In Scenario #1, each of the five establishments have the same NAICS code, so that code is assigned as the master code for employer X.
2. In Scenario #2, NAICS "abcdef " was reported for all establishments as a single group (using MEEI code 5). No establishment had a separately reported NAICS code. Therefore, "abcdef" is assigned as the master code for employer X.
3. In Scenario #3, 90% of sales and 92% of employees are in establishments with code "abcdef."
4. In Scenario #4, 80% of sales and 80% of employees are in establishments with code "abcdef."
5. Scenario #5 provides an example where a master code assignment based on the highest sales ("mnopqr") results in a different NAICS than an assignment based on employee counts ("abcdef"). However, neither Ohio nor California would assign a specific NAICS code to the employer in this scenario, because even at the 3-digit level, less than 75% of employees are in one NAICS code.

ACS PUMS DATA ON EMPLOYMENT AND HOURS BY INDUSTRY

The Census Bureau conducts the ACS, which replaced the former decennial census long form and offered the advantage of producing data between decennial census years. The survey is administered on a rolling basis and samples a percentage of the population in households and group quarters every month. The ACS has a large sample size; therefore, its estimates have lower margins of error than other household surveys such as the CPS. This is valuable when estimates are needed on the state as well as the national level. In 2014, for example, 2.3 million U.S. households were surveyed, including 217,111 in California and 90,191 in Ohio. Standard ACS tabulations are available online at https://data.census.gov/cedsci.

The ACS asks about the industry of the respondent's primary job, but not any additional jobs. Answers to this question pertain either to the job held in the previous week or to the last job held, whichever is applicable. The ACS uses Census industry codes (not NAICS) to initially code a respondent's industry of work. A crosswalk is then applied to create "NAICSP" codes (as discussed in Section 4), which are as close as possible to NAICS codes. Most NAICSP codes at the 3-digit level correspond directly to a NAICS code, but there are often significant differences between NAICSP and NAICS codes at more detailed code levels. Although ACS collects data on employee counts and hours worked for both private and public sector employees, in the public administration sector (NAICS 92), most data are not disaggregated by detailed industry.

The ACS asks about "usual" hours of work per week in all jobs in the previous 12 months. There is no question about hours of work specifically on the primary job, or hours of work in the last week, which is the reference period for the question about industry. (See Section 3 and Appendix C for discussion of the implications of the limitations of the ACS hours-of-work question.) Note that because the hours-of-work question refers to the previous 12 months (as do many other questions in the ACS), most responses refer to parts of two calendar years. This means that question responses pertaining to a given calendar year would actually be found equally in the survey for that calendar year and the survey of the following calendar year. See more details on this in the first subsection of Section 7.

The PUMS files from the ACS include all of the population and housing unit responses collected on individual ACS questionnaires and allow users to create customized tabulations. The ACS PUMS files are used in this report to cross-tabulate hours worked and employee counts by detailed industry. Two types of PUMS files are available. The 1-year PUMS files include records for about 1% of the total population and the 5-year files contain records for about 5%. Geographies available include region, division, state, and Public Use Microdata Areas (PUMAs), which are non-overlapping areas that partition each state into areas containing about 100,000 residents.

More information on ACS and ACS PUMS data can be found online:

- https://www.census.gov/programs-surveys/acs/about.html
- https://www.census.gov/programs-surveys/acs/microdata/access.html

OPT DATA ON EMPLOYMENT AND HOURS BY INDUSTRY

The BLS Division of Industry Productivity Studies in the Office of Productivity and Technology publishes indices and levels of annual hours and employment by industry that reflect the total labor input used in producing industry output during the year. Data are available from 1987 onward for 3- and 4-digit NAICS industries, for 2-digit NAICS industries that are equivalent to 3-digit industries, and for other NAICS industries with published productivity measures including many 5- and 6-digit industries.

These data are available on the BLS Office of Productivity and Technology website at https://www.bls.gov/productivity/tables/. Data for 1987–2022 became available in April 2023. (See BLS table "Hours

Worked and Employment Measures"). A general data description is available at the following BLS website: https://www.bls.gov/productivity/technical-notes/industry-hours-and-employment.htm.

The OPT employment and hours estimates are based primarily on data on employment and paid hours from the BLS CES survey, a monthly establishment survey that provides data on total employment and average paid weekly hours of workers in nonagricultural establishments. CES estimates are benchmarked annually to the March employee counts of the QCEW, which provides a full count of all employees covered by state UI systems. Other sources of data are used to add counts of employees not covered by UI. The CES survey counts jobs, not workers. This means that persons employed by two or more establishments are counted more than once (once at each place of employment). Persons are considered employed if they receive pay for any part of the specified pay period, which is the period that includes the 12th of each month.[88] Although the CES data are available on a monthly as well as annual basis, the OPT data are annual only.

Because the objective of the CES is to count all nonagricultural employees, data on employees who are not covered by a regular, state-level, unemployment system and therefore not included in the QCEW, are obtained from a variety of other sources. Unemployment insurance laws vary from state to state, and therefore BLS relies on State Workforce Agencies to identify industries where a substantial number of such jobs may exist. Examples of workers not included in the QCEW include student workers on the payroll of the college or university they attend; hospital interns; elected government officials; railroad workers; employees of religious organizations, such as parochial school teachers; and, in some states, certain officers of corporations.

Railroad workers are covered by an alternate system of UI, and CES obtains a count of these jobs from the Railroad Retirement Board. For other industries, CES derives noncovered employment estimates primarily from County Business Patterns (CBP) and the Annual Survey of Public Employment and Payroll (ASPEP), two Census Bureau programs. CBP derives employment counts using administrative data such as Social Security filings, while the ASPEP is based on a sample of state, local, and federal government entities. Both include employment not covered by regular UI.[89]

Although the CES provides data on employment levels in the great majority of industries, alternative data sources are required for some industries. These industries include agriculture, line-haul railroads, air transportation, and paid employees in private households. OPT data also need to include the self-employed and unpaid workers because the objective is to estimate the total amount of labor contributed to the production of goods and services in the U.S. data on self-employed workers (sole proprietors and partners). Unpaid family workers are obtained from the CPS, a monthly household survey conducted by the Census Bureau for BLS, as well as from nonemployer and small-firm data from the Census Bureau.[90]

The estimation of hours worked in the OPT data is based mainly on CES data on average paid weekly hours. Data on paid hours are drawn from alternative data sources for some industries, including agriculture, mining, line-haul railroads, air transportation, the U.S. Postal Service, and paid household workers.[91] The purpose of the OPT statistics is to support the measurement of labor productivity by measuring the amount of time individuals contribute to the production of domestic goods and services. However, total hours paid includes some paid hours for which an employee is absent from a job (e.g., paid holidays, sick leave, and vacation time). Because this time is not available for the production of a good or performance of a service, BLS wants to exclude it. Therefore, ratios of paid hours at work to

88 Garner C [2017]. Email message to Bushnell PT, March 17 (from U.S. Bureau of Labor Statistics, Industry Productivity Studies).

89 Mance S [2016]. How hard is it to count? Reconciling monthly survey and administrative data: Experiences from the CES program. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, Office of Survey Methods Research, https://www.bls.gov/osmr/research-papers/2016/st160060.htm.

90 BLS [2024b]. Industry hours and employment. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, https://www.bls.gov/productivity/technical-notes/industry-hours-and-employment.htm.

91 BLS [2024] Industry hours and employment. As cited above.

total hours paid, based on employer-reported hours of employee leave in the National Compensation Survey (NCS),[92] are multiplied by the total number of paid hours to derive estimates of total paid hours at work, by industry.[93]

An adjustment is made to the above paid work hours estimates to account for additional hours of work off-the-clock. For this purpose, a ratio of actual, total work hours to paid hours at work is estimated using data from the CPS. When estimated paid work hours are multiplied by the ratio of total work hours to paid work hours, the result is estimates of work hours that include both paid work hours and off-the-clock work hours. To estimate these off-the-clock ratios for each industry, workers are divided into hourly (including all part-time) and salaried, full-time groups. Hourly and part-time workers are assumed not to work any hours off the clock, while off-the-clock hours of salaried, full-time workers are estimated by the difference between reported actual hours of work and 40 hours. This is the number of hours that employers generally report for their salaried employees in the CES and other data sources. Note that some salaried workers report usual hours of work at less than 40, so for them, off-the-clock hours are considered those in excess of usual hours.[94] See additional details of the estimation methods in a 2022 publication by Eldridge et al.[95] and on this BLS webpage: https://www.bls.gov/productivity/technical-notes/labor-productivity-hours-worked-method-using-ces-all-employee-hours-nov-2022.htm.

The method just described was used to produce the data released by BLS beginning in November 2022. Data currently being released incorporate this new method for earlier years, because each year's data release includes data for the years 1987 onward and reflects revisions of data for previous years so as to make the data comparable across years. However, data released prior to November 2022 employed a somewhat different method based on a distinction between production employees and nonproduction or supervisory employees, rather than a distinction between hourly and salaried employees.

This previous method was used to produce the data analyzed in Section 2. In this method, the ratio of paid hours worked to total hours paid was calculated separately for production and nonproduction employees using NCS data. In the next step, data from the CPS were used to obtain ratios of nonproduction and supervisory employee average weekly hours to production and nonsupervisory employee average weekly hours. These ratios were then multiplied by production and nonsupervisory worker average weekly hours to estimate nonproduction or supervisory worker average weekly hours by industry.[96] For each industry, total hours worked was computed by summing hours worked by supervisory workers and hours worked by production or nonsupervisory workers. BLS has published an article that explores how the old and new methods compare and the difference this makes to estimates of hours worked.[97]

CES and OPT data generally classify industry using NAICS codes, with the exception of their treatment of workers in the public sector. In NAICS, any employer that engages in the activities or production processes of an industry is classified to that industry, regardless of whether it is public or private. However, in both CES and OPT data, public sector employers and employees are separated from private sector employers and employees and assigned to different industry codes (for all industries except liquor stores). OPT data have aggregated most public employees into sector 901; CES data have aggregated them into the government super sector 9093. Both data sources exclude data on the armed forces.

92 See information on the NCS at the following BLS websites: http://www.bls.gov/ncs/, https://www.bls.gov/opub/hom/ncs/.

93 Eldridge et al. [2022] as cited above.

94 Eldridge et al. [2022] as cited above.

95 Eldridge et al. [2022] as cited above.

96 See BLS [2005]. Construction of average weekly hours for supervisory and nonproduction wage and salary workers in detailed industries, https://www.bls.gov/productivity/technical-notes/average-weekly-hours-method-detailed-industry.pdf.

97 Eldridge et al. [2022] as cited above.

Currently, BLS does not calculate standard errors or margins of error for OPT data due to the complexities posed by combining multiple data sources. However, OPT employment totals for most industries are largely based on data from the CES, which are benchmarked annually to the QCEW, so OPT margins of error are expected to be relatively small. Margins of error for CES data are publicly available.

Special Extract of OPT Data

OPT employment and hours data include information on wage and salary, self-employed, and unpaid family workers. However, in most states, workers covered by WC programs exclude federal employees, and probably do not include the majority of the self-employed, or unpaid family workers. To make OPT data more aligned with the WC claims data used in calculating injury and illness incidence rates, a special extract of OPT data was requested from BLS. The authors used this special extract to generate the tables and figures in this report by taking the following steps:

- Self-employed and unpaid family workers were excluded.
- Federal government employees were excluded by dividing sector 901 into more detailed industries: 911 (Federal government); 92, 93 (State and local government); and 919130 (Other federal government). Only state and local government employees were retained in sector 901.
- Postal employees (NAICS 491) were excluded.
- State employees were excluded from liquor stores (NAICS 4453) and moved to sector 901.

In 2024, BLS informed NIOSH it no longer had the ability to supply special data extracts. The last year for which NIOSH received a special extract was 2020. This raises the question whether the publicly available OPT data might be used instead for years after 2020. For most industries, FTE/EE based on public data is close to FTE/EE based on extract data. This is largely because the federal, self-employed, and unpaid family business workers left out of the special extract usually represent a small share of workers.

Federal workers have been excluded from almost all industries in the public data since they are placed in a separate public sector code as previously noted. In addition, self-employed and unpaid workers sometimes do not work a number of hours very different from workers who are employees. However, there are some industries where public FTE/EE differs substantially from extract FTE/EE. These include most agricultural industries where FTE/EE is far higher in the extract because employees are a minority of workers, and they work many more hours than self-employed workers. Therefore, NIOSH is investigating the use of public OPT data for 2021, but with adjustments based partly on ratios of extract FTE/EE to public FTE/EE that were observed before 2021. Contact NIOSH for further details.

Accuracy of Industry Coding in ACS and QCEW Data

Industry coding involves some error, and there is some question about the relative accuracy of industry coding in the ACS versus employer-based data sources such as the QCEW. There have been few comparative analyses of industry coding accuracy. However, the Census Bureau reported on a 2013 analysis by Isenberg et al. showing that industry codes in ACS data often do not match the industry codes reported by the respondent's employer in the QCEW.[98] Respondents to the ACS were matched to the earnings records for their main job in UI records, which are linked to employer information on industry in the QCEW. Industry sector (2-digit) codes from the two data sources matched in 75% of cases, and 4-digit NAICS codes matched in only 61% of cases. These results suggest a significant amount of error, but the authors state that it is difficult to assess the shares of error attributable to the ACS versus the QCEW.

98 Isenberg E, Landivar LC, Mezey E [2013]. A comparison of person-reported industry to employer-reported industry in survey and administrative data. Working paper. Washington, DC: U.S. Census Bureau, No. CES-13-47, https://www.census.gov/library/working-papers/2013/adrm/ces-wp-13-47.html.

These results may overstate the rate of mismatch for a couple of reasons. First, some respondents could not be matched with certainty to a single job and earnings record in the UI data, so some of the mismatches are due to inaccurate data linkage rather than any error in coding. About 13% of respondents were linked to more than one job in the same time period in the UI data and could therefore have been classified to the industry of a secondary job rather than the main job they refer to in their ACS response. It is likely, though, that the majority of these workers were accurately linked to their main job.

Second, employees in the QCEW were coded to industry on the employer level because they could not be linked to a specific establishment within their multi-establishment employers. Yet the industry of individual establishments is not always the same as the main industry of the employer. This could result in an industry code mismatch that is not due to an industry coding error in the ACS or QCEW. A significant number of employees work in establishments whose industry does not match the main industry of the employer. Interestingly, the rate of industry code matching between the ACS and the QCEW was actually slightly higher for ACS respondents who worked in multi-establishment employers. This presents a puzzle, because it is hard to explain why employer-level coding in the QCEW would align better with industry coding in the ACS, because in the ACS, answers given to questions about industry are supposed to refer to the establishment where the respondent works. Overall, it appears that only a modest portion of the high rate of mismatch of industry codes appears to be explained by imperfections in the method of comparison.

Although Isenberg et al. [2013] say it is difficult to assess the relative accuracy of industry coding in the ACS versus the QCEW, they also mention several QCEW features that suggest industry coding in the QCEW may be more accurate. One is that employers have a broader and therefore more accurate view of the nature of the industry than individual workers. In addition, every 3–5 years, the ARS of the QCEW is administered to verify or revise the industry code. This adds a layer of quality control, although if an establishment's industry changes over time, the QCEW code could be out of date. Furthermore, when states have inadequate information for industry coding, they mail a form to employers to gather additional data. QCEW industry coding accuracy might also be enhanced because QCEW program personnel draw on local knowledge of the employer. Also, the QCEW program assigns codes at the 6-digit level, which would demand a more detailed knowledge of the nature of the employer's business.

More recent research has also assessed industry coding in the QCEW as more accurate than the CPS, which is another population survey that obtains industry code information in a similar way to the ACS. Haltiwanger et al. [2022] merged CPS data with data from the Longitudinal Employer-Household Dynamics database, which incorporates QCEW data on industry.[99] The authors coded the industry of individual respondents using the industry codes from QCEW rather than the CPS due to the strengths of QCEW industry coding methods. They found this choice greatly affected their findings regarding the increasing dispersion in earnings levels among 4-digit NAICS industries.

99 Haltiwanger J, Hyatt H, Spletzer J [2022]. Industries, mega firms, and increasing inequality. Working paper. Cambridge, MA: National Bureau of Economic Research (NBER), No. w29920, https://doi.org/10.3386/w29920.

APPENDIX B – FTE/EE VARIATION AMONG STATES ON THE 3-DIGIT INDUSTRY LEVEL

Table B.1 shows how much FTE/EE varies by state within individual industries. Since OPT data are only available on the national level, a state-level data source like the ACS must be used to capture this variation. Some industries show only modest variation by state. As Table B.1 shows, these include insurance carriers, telecommunications, utilities, administrative services, and hospitals where the difference between FTE/EE in the 5th and 95th percentile states is only 0.06 to 0.075.

There are other industries whose FTE/EE varies far more. These industries, many of them in the natural resource and agricultural sectors, tend to be small in many states and often vary according to the natural environment. There are 22 out of 85 industries whose FTE/EE varies by more than 0.20 between the 5th and 95th percentile states.

As the results in Section 8 show, use of national OPT data for FTE/EE estimates may result in a ranking of industries by claim rate that is very similar to a ranking produced using ACS state-level data. And as Section 8 points out, this may be because industry claim rates vary so much that errors in denominator estimates do not greatly alter industry rankings.

Table B.1 FTE/EE variation among states by 3-digit Industry code, ACS 2010–2014

Industries listed in order of difference between 95th and 5th percentile FTE/EE

	Industry	2012 NAICS U.S. Title	Minimum	Maximum	Range	Standard Deviation	Mean	Median	5th Percentile	95th Percentile	SORT BY: 95th Percentile minus 5th Percentile	Number of States
	Private Sector		0.930	1.067	0.137	0.023	0.969	0.966	0.939	1.019	0.079	50
1	524	Insurance Carriers and Related Activities	0.981	1.072	0.091	0.017	1.024	1.025	0.992	1.050	0.058	50
2	517	Telecommunications	1.026	1.102	0.076	0.018	1.061	1.064	1.028	1.089	0.061	50
3	221	Utilities	1.040	1.119	0.079	0.019	1.077	1.076	1.043	1.110	0.067	50
4	561	Administrative and Support Services	0.894	1.108	0.214	0.031	0.944	0.944	0.902	0.975	0.073	50
5	622	Hospitals	0.925	1.007	0.082	0.020	0.970	0.974	0.931	1.004	0.074	50
6	441	Motor Vehicle and Parts Dealers	1.028	1.111	0.083	0.022	1.065	1.060	1.030	1.105	0.075	50
7	339	Miscellaneous Manufacturing	0.925	1.088	0.163	0.025	1.045	1.045	1.002	1.079	0.077	50
8	541	Professional, Scientific, and Technical Services	0.971	1.120	0.148	0.026	1.027	1.024	0.987	1.065	0.078	50

	Industry	2012 NAICS U.S. Title	Minimum	Maximum	Range	Standard Deviation	Mean	Median	5th Percentile	95th Percentile	SORT BY: 95th Percentile minus 5th Percentile	Number of States
9	423	Merchant Wholesalers, Durable Goods	0.986	1.121	0.134	0.023	1.062	1.065	1.016	1.099	0.083	50
10	621	Ambulatory Health Care Services	0.873	0.985	0.111	0.024	0.937	0.936	0.888	0.972	0.085	50
11	424	Merchant Wholesalers, Nondurable Goods	1.012	1.132	0.120	0.024	1.076	1.080	1.033	1.118	0.086	50
12	325	Chemical Manufacturing	0.956	1.360	0.403	0.048	1.081	1.080	1.026	1.117	0.091	50
13	332	Fabricated Metal Product Manufacturing	1.013	1.177	0.163	0.029	1.062	1.061	1.021	1.112	0.091	50
14	446	Health and Personal Care Stores	0.819	0.963	0.145	0.027	0.891	0.892	0.843	0.938	0.095	50
15	444	Building Material and Garden Equipment and Supplies Dealers	0.902	1.029	0.128	0.029	0.954	0.955	0.908	1.005	0.097	50
16	453	Miscellaneous Store Retailers	0.747	0.898	0.150	0.030	0.840	0.847	0.788	0.884	0.097	50
17	531	Real Estate	0.898	1.045	0.147	0.029	0.965	0.968	0.907	1.008	0.101	50
18	624	Social Assistance	0.757	0.945	0.189	0.031	0.854	0.851	0.807	0.909	0.102	50
19	336	Transportation Equipment Manufacturing	0.961	1.356	0.395	0.047	1.088	1.080	1.036	1.141	0.105	50
20	326	Plastics and Rubber Products Manufacturing	0.997	1.209	0.212	0.034	1.059	1.061	1.004	1.110	0.107	50
21	813	Religious, Grantmaking, Civic, Professional, and Similar Organizations	0.785	0.969	0.184	0.032	0.890	0.884	0.845	0.954	0.108	50
22	334	Computer and Electronic Product Manufacturing	1.004	1.173	0.169	0.030	1.072	1.073	1.009	1.118	0.109	50
23	452	General Merchandise Stores	0.779	0.969	0.189	0.034	0.848	0.851	0.791	0.906	0.115	50
24	448	Clothing and Clothing Accessories Stores	0.699	0.877	0.178	0.035	0.767	0.764	0.712	0.830	0.118	50
25	323	Printing and Related Support Activities	0.918	1.069	0.151	0.032	1.005	1.014	0.928	1.047	0.119	50
26	623	Nursing and Residential Care Facilities	0.836	0.990	0.154	0.036	0.922	0.925	0.861	0.980	0.119	50
27	333	Machinery Manufacturing	1.012	1.225	0.213	0.033	1.080	1.078	1.026	1.146	0.119	50
28	811	Repair and Maintenance	0.944	1.135	0.191	0.033	1.021	1.018	0.978	1.099	0.121	50
29	611	Educational Services	0.780	0.944	0.165	0.036	0.884	0.888	0.816	0.938	0.121	50
30	492	Couriers and Messengers	0.879	1.099	0.220	0.037	0.969	0.963	0.923	1.046	0.122	50

	Industry	2012 NAICS U.S. Title	Minimum	Maximum	Range	Standard Deviation	Mean	Median	5th Percentile	95th Percentile	SORT BY: 95th Percentile minus 5th Percentile	Number of States
31	311	Food Manufacturing	0.968	1.654	0.686	0.093	1.042	1.031	0.973	1.096	0.123	50
32	23	Construction	0.989	1.163	0.173	0.034	1.042	1.038	0.997	1.123	0.125	50
33	722	Food Services and Drinking Places	0.721	0.876	0.155	0.035	0.795	0.794	0.737	0.864	0.127	50
34	515	Broadcasting (except Internet)	0.945	1.102	0.157	0.033	1.043	1.050	0.968	1.095	0.127	50
35	522	Credit Intermediation and Related Activities	0.954	1.117	0.163	0.031	1.032	1.032	0.965	1.096	0.131	50
36	812	Personal and Laundry Services	0.790	0.960	0.170	0.038	0.872	0.869	0.801	0.936	0.135	50
37	321	Wood Product Manufacturing	0.923	1.221	0.298	0.042	1.039	1.036	0.970	1.107	0.137	50
38	442	Furniture and Home Furnishings Stores	0.812	1.032	0.220	0.040	0.945	0.945	0.880	1.018	0.138	50
39	335	Electrical Equipment, Appliance, and Component Manufacturing	0.959	1.151	0.192	0.035	1.064	1.065	0.992	1.130	0.138	50
40	327	Nonmetallic Mineral Product Manufacturing	0.994	1.211	0.217	0.037	1.071	1.071	1.010	1.152	0.142	50
41	451	Sporting Goods, Hobby, Musical Instrument, and Book Stores	0.720	0.910	0.190	0.039	0.808	0.799	0.743	0.885	0.142	50
42	721	Accommodation	0.795	1.005	0.210	0.041	0.914	0.920	0.840	0.984	0.144	50
43	443	Electronics and Appliance Stores	0.828	1.075	0.248	0.041	0.970	0.970	0.882	1.027	0.145	50
44	445	Food and Beverage Stores	0.720	0.920	0.200	0.045	0.843	0.850	0.760	0.908	0.148	50
45	337	Furniture and Related Product Manufacturing	0.937	1.097	0.160	0.038	1.020	1.022	0.940	1.089	0.149	50
46	322	Paper Manufacturing	1.000	1.180	0.180	0.035	1.088	1.086	1.024	1.175	0.151	49
47	55	Management of Companies and Enterprises	0.960	1.138	0.178	0.044	1.074	1.079	0.976	1.129	0.153	49
48	314	Textile Product Mills	0.799	1.750	0.951	0.115	1.011	1.007	0.915	1.074	0.160	50
49	532	Rental and Leasing Services	0.856	1.060	0.204	0.046	0.975	0.982	0.880	1.042	0.162	50
50	447	Gasoline Stations	0.775	1.016	0.241	0.047	0.913	0.916	0.834	1.000	0.166	50
51	331	Primary Metal Manufacturing	1.000	1.262	0.262	0.047	1.094	1.087	1.014	1.184	0.169	50
52	493	Warehousing and Storage	0.868	1.140	0.272	0.042	1.005	1.011	0.903	1.075	0.171	50
53	454	Nonstore Retailers	0.833	1.090	0.257	0.049	0.996	1.001	0.908	1.087	0.179	50
54	713	Amusement, Gambling, and Recreation Industries	0.729	0.955	0.226	0.049	0.813	0.807	0.736	0.916	0.180	50
55	484	Truck Transportation	1.001	1.339	0.338	0.057	1.187	1.197	1.099	1.282	0.183	50

	Industry	2012 NAICS U.S. Title	Minimum	Maximum	Range	Standard Deviation	Mean	Median	5th Percentile	95th Percentile	SORT BY: 95th Percentile minus 5th Percentile	Number of States
56	511	Publishing Industries (except Internet)	0.773	1.036	0.263	0.053	0.961	0.969	0.829	1.026	0.197	50
57	562	Waste Management and Remediation Services	0.932	1.242	0.309	0.051	1.082	1.083	0.973	1.179	0.206	50
58	481	Air Transportation	0.906	1.166	0.260	0.055	1.019	1.009	0.925	1.147	0.223	50
59	312	Beverage and Tobacco Product Manufacturing	0.810	1.238	0.429	0.070	1.073	1.080	0.939	1.166	0.227	50
60	712	Museums, Historical Sites, and Similar Institutions	0.681	0.986	0.305	0.059	0.845	0.852	0.716	0.943	0.227	50
61	315	Apparel Manufacturing	0.719	1.061	0.342	0.065	0.973	0.983	0.827	1.060	0.234	49
62	518	Data Processing, Hosting, and Related Services	0.598	1.111	0.513	0.084	1.025	1.048	0.859	1.099	0.240	50
63	324	Petroleum and Coal Products Manufacturing	0.994	1.416	0.422	0.068	1.148	1.144	1.055	1.297	0.243	50
64	485	Transit and Ground Passenger Transportation	0.752	1.175	0.423	0.087	0.921	0.913	0.787	1.041	0.254	50
65	482	Rail Transportation	0.937	1.407	0.470	0.077	1.158	1.158	1.015	1.274	0.259	50
66	814	Private Households	0.551	0.900	0.349	0.074	0.750	0.766	0.594	0.858	0.264	50
67	488	Support Activities for Transportation	0.927	1.257	0.330	0.067	1.066	1.046	0.976	1.252	0.276	50
68	316	Leather and Allied Product Manufacturing	0.500	1.189	0.689	0.102	1.000	1.003	0.872	1.164	0.292	45
69	313	Textile Mills	0.293	1.293	1.000	0.128	1.016	1.024	0.873	1.191	0.318	49
70	111	Crop Production	0.833	1.286	0.453	0.078	1.050	1.055	0.902	1.226	0.325	50
71	711	Performing Arts, Spectator Sports, and Related Industries	0.659	1.165	0.506	0.091	0.880	0.878	0.730	1.067	0.337	50
72	486	Pipeline Transportation	0.936	1.654	0.718	0.110	1.169	1.158	1.000	1.342	0.342	49
73	425	Wholesale Electronic Markets and Agents and Brokers	0.651	1.234	0.583	0.096	0.979	0.995	0.740	1.089	0.350	48
74	212	Mining (except Oil and Gas)	1.049	1.652	0.603	0.104	1.177	1.149	1.053	1.405	0.352	50
75	519	Other Information Services	0.509	1.106	0.597	0.107	0.904	0.916	0.700	1.061	0.361	50
76	112	Animal Production and Aquaculture	0.819	1.272	0.453	0.096	1.077	1.071	0.880	1.244	0.365	50
77	512	Motion Picture and Sound Recording Industries	0.407	1.066	0.659	0.125	0.806	0.816	0.583	1.026	0.443	50

	Industry	2012 NAICS U.S. Title	Minimum	Maximum	Range	Standard Deviation	Mean	Median	5th Percentile	95th Percentile	SORT BY: 95th Percentile minus 5th Percentile	Number of States
78	115	Support Activities for Agriculture and Forestry	0.601	1.218	0.617	0.127	1.025	1.036	0.697	1.197	0.500	50
79	113	Forestry and Logging	0.500	1.272	0.772	0.143	1.061	1.090	0.730	1.256	0.526	48
80	213	Support Activities for Mining	0.991	1.763	0.773	0.185	1.366	1.331	1.082	1.692	0.610	50
81	483	Water Transportation	0.500	1.740	1.240	0.220	1.248	1.250	0.897	1.659	0.761	49
82	491	Postal Service	0.392	1.625	1.233	0.197	0.950	0.964	0.511	1.324	0.813	49
83	114	Fishing, Hunting and Trapping	0.776	1.875	1.099	0.222	1.116	1.067	0.812	1.667	0.855	49
84	211	Oil and Gas Extraction	0.738	2.125	1.388	0.221	1.268	1.234	0.954	1.827	0.873	48
85	487	Scenic and Sightseeing Transportation	0.127	1.405	1.278	0.226	0.902	0.946	0.263	1.231	0.968	49

Note: Table B.1 includes 2-digit codes that represent the maximum level of detail available in their sectors (23 and 55). Special NAICSP codes that do not correspond with 3-digit NAICS codes are not included: 3MS, 4MS, 22S, 31M, 33M, 42S, 52M, and 53M.

APPENDIX C – BIASES ASSOCIATED WITH USE OF THE USUAL WEEKLY HOURS QUESTION (ACS QUESTION 40) TO REPRESENT WORK HOURS IN THE PAST WEEK IN THE PRIMARY JOB INDUSTRY

Respondents to the ACS are only asked about the industry and occupation of their current or most recent, primary job (ACS Questions 41–46). In contrast, the questions about usual weekly hours and weeks worked refer to all jobs that the respondent held over the previous year. In other words, both second (and third) jobs, as well as previous jobs, are included in the estimates of usual weekly hours and weeks worked, even though those jobs may be in different industries. The coverage of the usual weekly hours and weeks worked questions is illustrated below.

← 12 months →	
Previous primary job	Current primary job
Previous second job	Current second job

Appendix H provides a copy of 2014 ACS questionnaire items relevant to industry, hours worked, and weeks worked, as well as code values of key ACS variables from the 2014 ACS PUMS data dictionary. This discussion of biases will focus on the usual weekly hours question (ACS Question 40).

For the jobs in each industry, the authors have proposed estimating average weekly hours by taking an average of usual weekly hours of all respondents whose primary job is in that industry. Because usual weekly hours include hours in second jobs, this estimated average will be biased upward. At the same time, the computed average will not include workers who have second jobs in the industry and a primary job at another employer in another industry. Because people work fewer hours in their second job, the exclusion of these second-job workers from the calculation of the average weekly hours for the industry also results in an upward bias. Higher weekly hours imply a higher FTE/EE ratio, and this upward bias applies to all industries. However, the bias will be greater for some industries than others, resulting in a distortion of relative hours worked in different industries.

For example, if an industry has mostly full- time workers without second jobs, the upward bias will be small. But if an industry has many part- time workers who also have other jobs, there will be a greater upward bias in reported usual weekly hours and thus in FTE/EE. Note that the ACS sample of workers in such an industry will have a greater percentage of workers who report weekly hours that include hours in other jobs. In addition, it will exclude many workers who work few hours, because many of them have primary jobs in other industries where all their work hours will be counted.

Because reports of usual weekly hours refer to the past 12 months, they will not necessarily be equal to hours in the past week. This may or may not result in significant bias. If the number of usual weekly hours is changing over the year due to regular, seasonal variation, this should result in little bias. Respondent answers should reflect an entire year of seasons and should therefore accurately reflect the average hours over the year. In this case, despite usual hours not representing current hours, the calculated average hours per week in the industry should still represent the average of actual, current hours over the year.

However, bias could arise if usual weekly hours have been changing over the past 12 months as part of a long-term trend, perhaps because the industry is rapidly shrinking or growing. If usual weekly hours have been declining over the past year, then survey responses will consistently overestimate current hours; if hours have been increasing, responses will underestimate current hours.

Note that because the question about usual weekly hours in the last 12 months includes previous jobs, some survey responses will also be affected by work in other, unknown industries. This leads to error, but by itself, does not lead to systematic bias because previous jobs would not be expected to have either more or fewer weekly hours.

Questions about the past 12 months also raise general concerns about recall bias. Usual hours per week may be difficult to estimate over a whole year if there were changes in work schedule. As a consequence, answers might be biased toward the present. However, they might also be biased toward the past if perceptions of "usual" work schedule are influenced by schedules worked in previous years. Biases toward the present or toward previous years may be different for respondents who have changed jobs more frequently as compared with those with steady jobs.

Severe employment disruptions with spells of unemployment and changing of jobs, such as happened during the COVID-19 pandemic, may make it particularly difficult to accurately report usual weekly hours over the course of the previous year. But in that case, answers about usual weekly hours seem likely to focus more on recent and current circumstances. Because the ACS question on industry of employment focuses on the current or most recent job, this might actually encourage better alignment of reported hours with reported industry, although job changes will still inevitably result in some misalignment of reported hours with reported industry.

Additional potential biases are due to the difference between "usual weekly hours" and "average weekly hours." A question about "usual" hours worked per week encourages a respondent to report the most typical number of hours worked, rather than the average hours worked. Average hours worked might be higher or lower than typical hours, depending upon the size and frequency of downward and upward variation in hours from the typical number.

For example, a worker might normally work 40 hours per week, except when they work overtime; or they might work 40 hours per week, except when business is slow and they go home early; or they may work 40 hours per week, except during a slow season when weather limits activities. In all these cases, a respondent might report that they usually work 40 hours per week. Industries with different scheduling patterns may therefore appear to have weekly hours that are more similar or different than they are in reality. In general, weekly hours in industries with less stable work schedules will be measured less accurately.

APPENDIX D – BIASES ASSOCIATED WITH COMPUTING FTE EQUIVALENT ON AN ANNUAL BASIS USING THE WEEKS WORKED VARIABLE (ACS QUESTION 39)

In the ACS, the annual sample of workers in an industry should appropriately represent workers in each month of the year according to the relative number of workers in each month, as explained in Section 3 on calculating FTE/EE using ACS data. In the proposed method, each respondent is taken to represent some number of FTEs (usually one or somewhat less than or greater than one) during the week they report working in the industry. However, if the number of FTEs for each respondent is based not only on usual weekly hours but also on number of weeks worked in the previous year, then the estimated number of FTEs can be much lower for those workers who worked only part of the year. This leads to error as illustrated in the calculation scenarios below.

COMPARISON OF FTE CALCULATIONS WITH AND WITHOUT WEEKS WORKED: SEASONAL EMPLOYMENT AND HIGH TURNOVER SCENARIOS

Basic assumptions:

- For simplicity, assume 1 year = 50 weeks
- Full- time = 40 hours/week
- ACS samples workers at random, with equal chance of selection per unit time employed, because we focus only on respondents who were employed in the reference week.
- Assumption: When respondents are asked about their "usual weekly hours" over the last year during the weeks they worked, their answers apply equally to their current and previous jobs in all industries.

1. Seasonal employment scenario (e.g., construction) in which employees are employed for only a part of the year:

Scenario assumptions:

50 year- round employees work full time, and 50 additional employees work 6 months full- time

The 6- month employees are unemployed during the other 6 months of the year.

Mean employee count over the year = 75

Total FTEs for the year = 75

FTE/EE = 1

Calculation with weeks worked:

The 6- month employees will be counted as working 1,000 hours each

[40 hours/week * 25 weeks]/2,000 = 0.5 FTEs

The 12-month employees will have worked 2,000 hours over the year and will each be counted as 1.0 FTE.

Because they are employed twice as many weeks per year, the full- year employees will be sampled twice as often as the half- year employees. So, there will be 2 full-year workers for every half-year worker

in the ACS sample. Averaging the number of FTEs across 2 full-year workers and 1 part-year worker gives us an estimate of 0.833 FTEs per worker: [(2 * 1) + (1 * 0.5)]/3 = 0.8333

This ratio will be applied to the estimated count of employees, which is 75 in this scenario.
The result will be 0.83333 * 75 = 62.5 FTEs, which differs from the correct estimate of 75 FTEs for the year.

(Note that the lower FTE/EE estimate will result in a lower claim rate denominator and thus a higher estimated claim rate.)

Calculation without weeks worked:

All employees sampled are counted as 1 FTE, because all of them report that they usually worked 40 hours per week.

FTE/EE = 1. This ratio is applied to the estimated employee count of 75, resulting in a correct estimate of 75 FTEs for the year.

2. High turnover scenario with workers not employed for part of the year:

Scenario assumptions:

A total of 500 employees work at some time during the year in the industry.

Each employee works full-time, but only for 10 weeks in the industry (one fifth of the year).

These employees are employed for a total of 6 months per year, including jobs in other industries.

Because employees work in the industry only one fifth of the year, they are captured in the survey as industry employees only one fifth as frequently as they would be if they worked in the industry all year round.

Estimated employee count is 100.

FTE/EE = 1

Total FTEs = 100

Calculation with weeks worked:

All employees are counted as 0.5 FTEs, because they work for half a year and report they usually worked 40 hours per week.

FTE/EE = 0.5

This ratio is applied to the estimated employee count of 100.

FTE estimate is 0.5 * 100 = 50

Calculation without weeks worked:

All employees are counted as 1 FTE because they report they usually worked 40 hours per week.

FTE/EE = 1 is applied to the estimated employee count of 100.

FTE estimate is 100.

Conclusion:

Using the ACS question about weeks worked during the past year produces estimates of FTE/EE and total FTEs that are biased downward. If an employee is not employed for part of a year, they will be counted as less than a full-time worker, even if they were a full-time worker during their time of employment in the industry, and even if their position was filled during the entire year with a full-time employee.

These examples were constructed to illustrate the potential for large downward bias in individual instances. In practice, a large share of workers who are seasonal or hold a part-time job were employed for most or all of the previous year, so the downward bias will not be so dramatic.

APPENDIX E – ACSv1 VERSUS ACSv2 AND OPT DATA

The ACS FTE counts used in this report were estimated by dividing the number of usual weekly hours by 40 for each respondent. These counts are referred to as version 1 (v1) in this appendix. FTEs can also be calculated by focusing on the number of full-year FTEs represented by each respondent instead. To do this, multiply the usual weekly hours by weeks worked during the previous 12 months. Divide this number by 2,000 hours, which is the number of annual hours taken by BLS to represent 1 full-year FTE. This alternative type of FTE estimate is referred to as version 2 (v2). Note that, for reasons explained in Section 3, ACS respondents who did not have a job last week are excluded in v2, just as they are in v1.[100]

During 2008–2018, the WKW variable recorded only the range within which the respondent's answer fell. The number of weeks worked used to calculate ACSv2 FTE in this appendix is the midpoint of each range (see Table E.1).[101] Note that a person who usually works 40 hours per week and works all year is estimated to work 2,040 hours (40 hours * 51 weeks). This represents 1.02 FTEs, which is greater than 1.0 FTE as estimated under v1. Thus, there is an upward bias in this method in relation to v1. Because the midpoint method adopted here is only approximate and involves other unknown biases, and because this upward bias is relatively small, the authors have not adjusted the v2 estimates downward to account for this bias.

The figures and tables in Appendix E expand on the analyses in Section 2 by providing ACS FTEs and FTE/EE ratios using the alternative FTE calculation method (v2) described in Section 3 and Appendix D. For the U.S., Table E.2 indicates that during 2008–2015, ACSv2 FTE employee estimates are about 4 million persons lower than the ACSv1 FTE estimates used throughout this report. The ACSv2 FTE/EE estimates are correspondingly lower, and they would be lower still without the upward bias previously explained.

Figures E.1–E.3 provide graphs of employee count, FTEs, and FTE/EE for the same time period. Also included are OPT estimates and estimates based on BLS SOII for reference. Figure E.4 shows the relationship between ACSv1 and ACSv2 estimates of FTE/EE on the 3-digit industry level. Table E.3 reports comparisons of ACSv1 and ACSv2 FTE/EE estimates for the industries with the greatest difference in FTE/EE between the two methods. Comparison of Figure E.6 with Figure E.5 shows that ACSv2 estimates are lower. The nature of the industries in Table E.3 suggests that ACSv2 tends to produce especially low estimates of FTE/EE when industries have a greater proportion of seasonal jobs, as in agricultural or entertainment sectors. This is as expected as explained in Appendix D. Also, as expected, for reasons explained in Section 2, Figure E.7 shows that OPT FTE/EE estimates are lower than ACS estimates.

The last sets of figures and tables in this appendix provide additional perspectives on differences between ACSv1 and ACSv2 estimates. Table E.4 shows how the distributions of industry FTE/EEs differ between v1 and v2. Tables E.5 and E.6 report industries with the highest and lowest FTE/EE estimates. Tables E.7 and E.8 show differences between v1 and v2 in estimates of aggregate FTE/EE among states.

100 Differences between v1 and v2 would be greater if those without a job last week but reporting work in the previous 12 months had been included.

101 In 2019, the WKW variable that records answers in ranges of weeks was replaced by the variable WKWN that records the number of weeks. See p. 17 in: U.S. Census Bureau [2020]. American Community Survey: 2019 ACS 1-year PUMS files: Readme. Washington, DC: U.S. Census Bureau, https://www2.census.gov/programs-surveys/acs/tech_docs/pums/ACS2019_PUMS_README.pdf.

Table E.1 Coding for weeks worked (WKW) in ACS FTE estimates, ACSv2

Weeks Worked During the Past 12 Months (Survey Response)	Number of Weeks Used in Calculation of ACSv2 FTE
50 to 52 weeks worked	51
48 to 49 weeks worked	48.5
40 to 47 weeks worked	43.5
27 to 39 weeks worked	33
14 to 26 weeks worked	20
less than 14 weeks worked	7

Table E.2 U.S. private sector FTE employee and FTE/EE estimates, ACSv1, ACSv2, and OPT, 2008–2015

	ACSv1 FTE	ACSv2 FTE	OPT FTE
2008	108,513,502	104,412,417	96,761,527
2009	102,202,568	98,569,256	90,596,121
2010	100,258,136	96,050,027	90,575,841
2011	102,173,427	97,812,839	92,783,421
2012	104,867,524	100,645,175	94,996,861
2013	107,507,536	103,276,647	96,683,858
2014	109,962,474	105,767,018	98,869,588
2015	112,577,148	108,520,298	101,059,675

	ACSv1 FTE/EE	ACSv2 FTE/EE	OPT FTE/EE
2008	0.9830	0.9458	0.8393
2009	0.9680	0.9336	0.8283
2010	0.9648	0.9243	0.8344
2011	0.9669	0.9256	0.8391
2012	0.9688	0.9298	0.8403
2013	0.9698	0.9317	0.8384
2014	0.9717	0.9346	0.8390
2015	0.9740	0.9389	0.8376

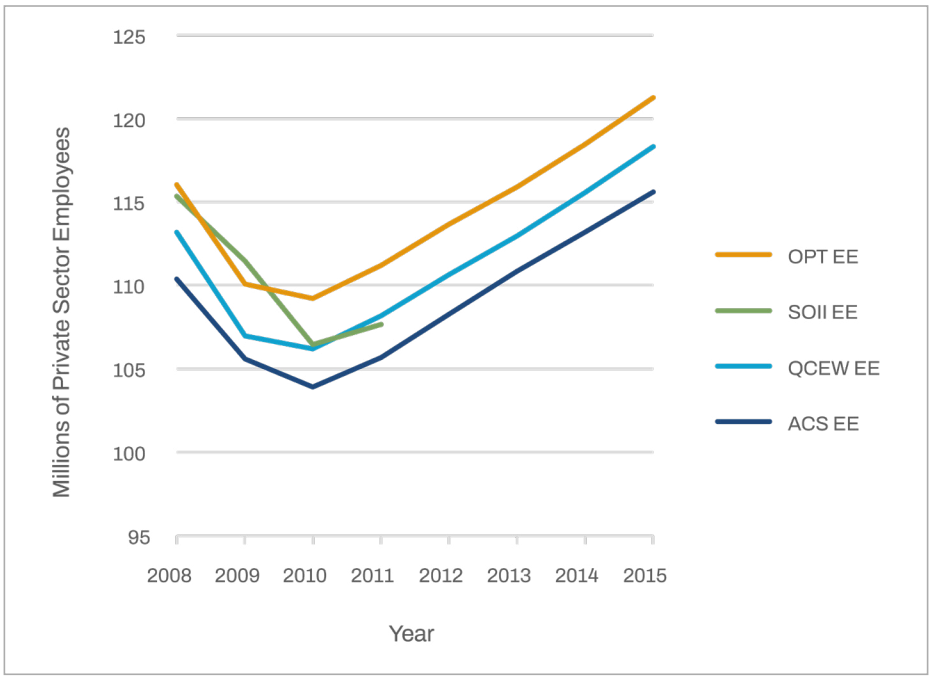

Figure E.1 Employee estimates, ACS, OPT, and BLS SOII, 2008–2015

Note: SOII figures were not published before 2019. These are derived by dividing the reported number of injuries by the reported rate of injuries per 100 FTEs and then multiplying by 100.

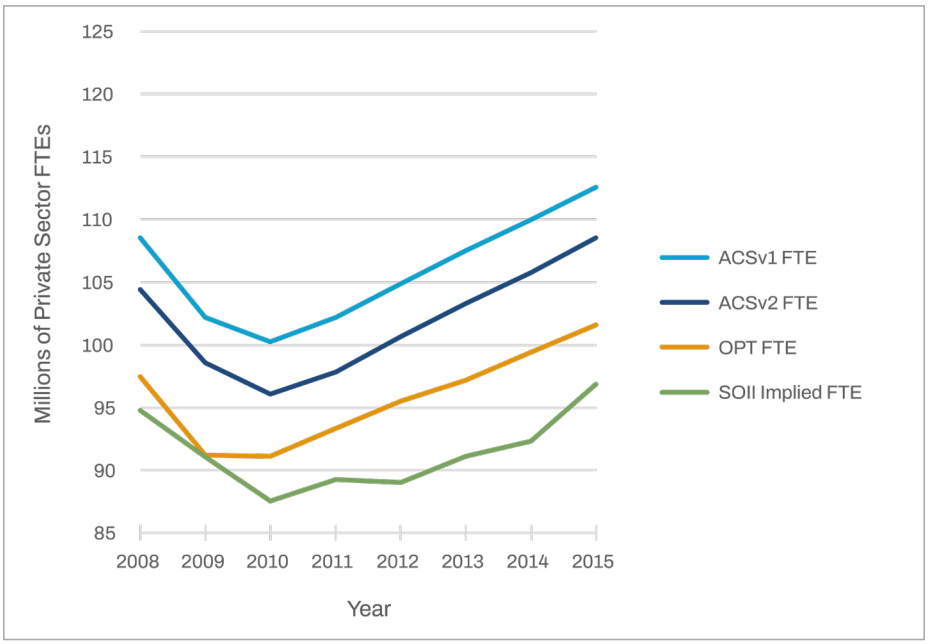

Figure E.2 Full-time equivalent employee estimates, ACSv1, ACSv2, OPT, and BLS SOII, 2008–2015

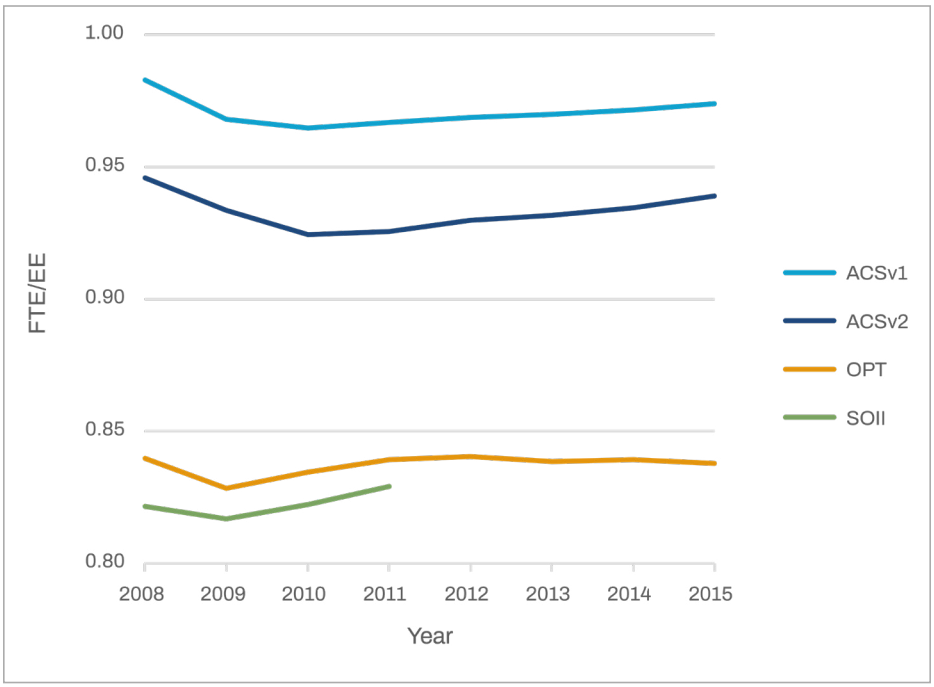

Figure E.3 Private sector FTE/EE ratios, ACSv1, ACSv2, OPT, and BLS SOII, 2008–2015

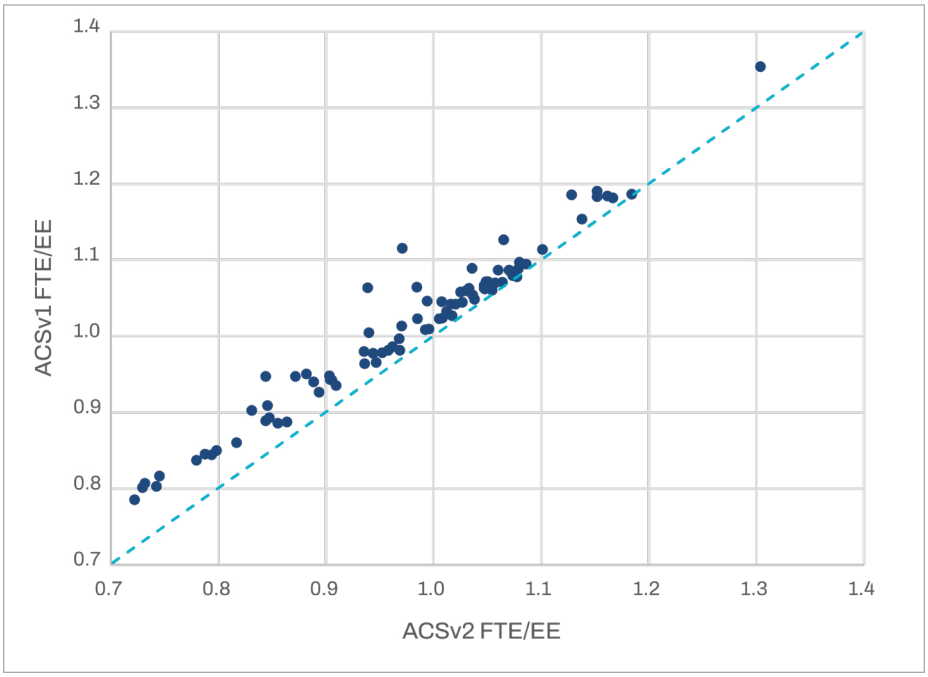

Figure E.4 Comparison of FTE/EE ACSv1 and ACSv2, 2014 ACS data, 3-digit NAICS

Table E.3 The ten 3-digit NAICS codes with the largest difference in FTE/EE between ACSv1 and ACSv2, 2014 ACS data

NAICS	Industry Description	v1	v2	Difference v1 Minus v2
114	Fishing, hunting, and trapping	1.1155	0.9708	0.1447
111	Crop production	1.0635	0.9386	0.1249
487	Scenic and sightseeing transportation	0.9475	0.8442	0.1033
115	Agriculture and forestry support activities	1.0642	0.9845	0.0797
512	Motion picture and sound recording industries	0.9474	0.8717	0.0757
722	Food services and drinking places	0.8067	0.7319	0.0748
711	Performing arts and spectator sports	0.9030	0.8310	0.0721
814	Private households	0.8010	0.7297	0.0714
713	Amusements, gambling, and recreation	0.8163	0.7452	0.0710
561	Administrative and support services	0.9503	0.8821	0.0682

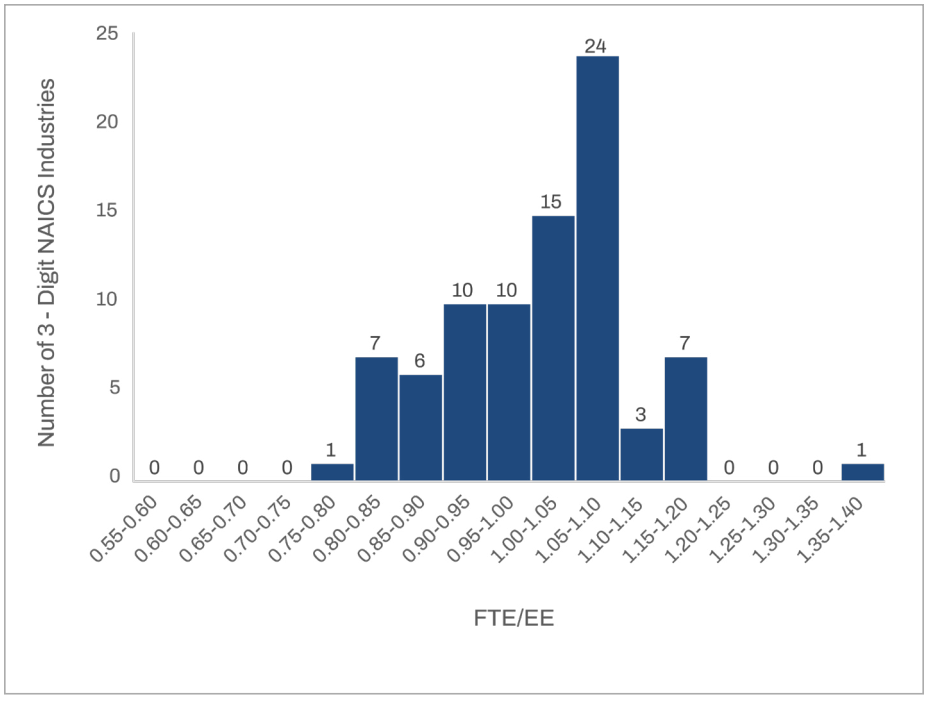

Figure E.5 FTE/EE, ACSv1, 2014 ACS data, 3-digit NAICS (84 codes)

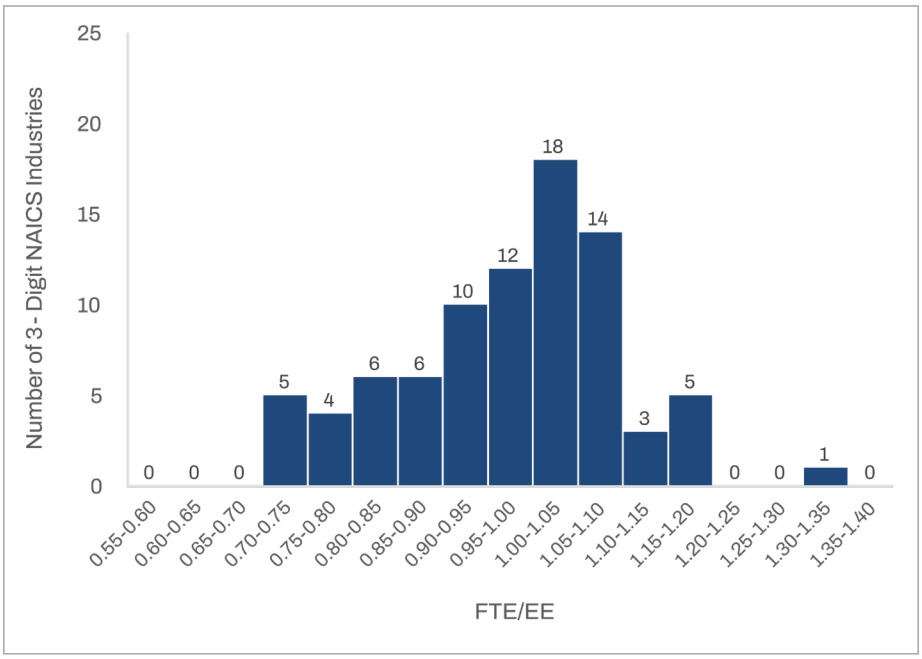

Figure E.6 FTE/EE, ACSv2, 2014 ACS data, 3-digit NAICS (84 codes)

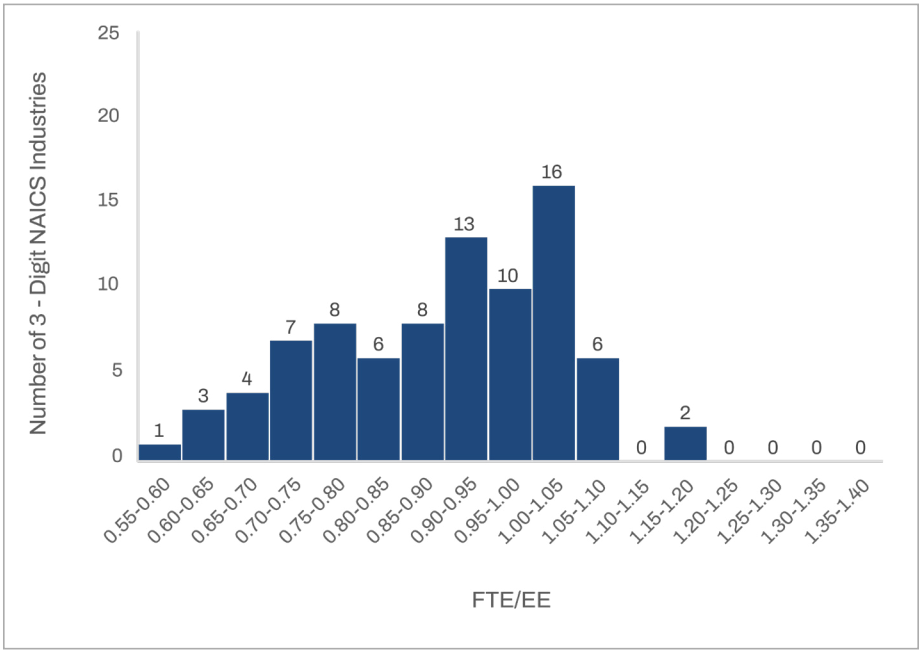

Figure E.7 FTE/EE, 2014 OPT data, 3-digit NAICS (84 codes)

Table E.4 FTE/EE variation among private industries, ACSv1 and ACSv2, and OPT data, 3-digit NAICS, 2014

Category	ACSv1	ACSv2	OPT
Minimum	0.736	0.670	0.455
Maximum	1.354	1.304	1.286
Range	0.618	0.633	0.831
Median	1.035	1.003	0.927
5th percentile	0.805	0.744	0.660
95th percentile	1.128	1.109	1.091
95th minus 5th percentile	0.324	0.366	0.431
Average	1.007	0.975	0.913
Standard Deviation	0.102	0.116	0.138

Table E.5 Summary of lowest FTE/EE ratios among industries, ACSv1 and ACSv2, 2014

Census Code	NAICS Equivalent	ACS NAICSP	Census Industry 2012 Description	v1 FTE/EE	v2 FTE/EE
5170	4481	4481	Clothing stores	0.767	0.701
5180	4482	4482	Shoe stores	0.797	0.73
5275	45111, 45112	4511M	Sporting goods, and hobby and toy stores	–	0.746
5280	45113	45113	Sewing, needlework, and piece goods stores	0.753	0.688
5370	45121	45121	Book stores and news dealers	0.774	0.721
5470	4531	4531	Retail florists	0.796	–
5490	4533	4533	Used merchandise stores	–	0.74
5570	45322	45322	Gift, novelty, and souvenir shops	0.736	0.678
6770	51912	51912	Libraries and archives	0.736	0.709
7890	6116, 6117	611M	Other school and instruction and educational support services	0.772	0.715
8390	6243	6243	Vocational rehabilitation services	0.789	–
8580	71395	71395	Bowling centers	0.741	0.686
8670	7212, 7213	721M	Recreational vehicle parks & camps, and rooming and boarding houses	–	0.67
8680	722 excl. 7224	722Z	Restaurants and other food services	0.807	0.731
8690	7224	7224	Drinking places, alcoholic beverages	0.799	–
9290	814	814	Private households	0.801	0.73

Table E.6 Summary of highest FTE/EE ratios across industries, census industry codes, ACSv1 and ACSv2, 2014

Census Code	NAICS Equivalent	ACS NAICSP	Census Industry 2012 Description	v1 FTE/EE	v2 FTE/EE
0270	1133	1133	Logging	1.138	–
0370	211	211	Oil and gas extraction	1.184	1.161
0380	2121	2121	Coal mining	1.22	1.209
0390	2122	2122	Metal ore mining	1.149	1.143
0470	2123	2123	Nonmetallic mineral mining and quarrying	1.161	1.136
0490	213	213	Support activities for mining	1.354	1.304
2070	32411	32411	Petroleum refining	1.163	1.146
2670	3311, 3312	331M	Iron and steel mills and steel product manufacturing	1.122	1.109
4490	4247	4247	Petroleum and petroleum products merchant wholesalers	1.146	1.141
6080	482	482	Rail transportation	1.187	1.184
6090	483	483	Water transportation	1.185	1.128
6170	484	484	Truck transportation	1.183	1.152
6270	486	486	Pipeline transportation	1.191	1.152
6490	5112	5112	Software publishers		1.11

Table E.7 Summary statistics for distribution of average FTE/EE by state, ACSv1 and ACSv2, 2015

Category	ACSv1	ACSv2
Minimum	0.942	0.898
Maximum	1.036	0.993
Range	0.094	0.095
Median	0.970	0.937
5th percentile	0.944	0.905
95th percentile	1.015	0.972
95th minus 5th percentile	0.071	0.068
Average	0.975	0.939
Standard Deviation	0.021	0.019

Table E.8 Variation among states in FTE/EE ratios, ACSv1 and ACSv2, Private Sector, 2015

SORT 1: BY FTE/EE					SORT 2: Alphabetical Order					
	v1: Without WKS (weeks worked)		v2: Using WKS (weeks worked)			v1: Without WKS (weeks worked)		v2: Using WKS (weeks worked)		
Rank	State	FTAE/ EE	State	FTE/ EE	State	FTE/ EE	Rank	FTE/ EE	Rank	Difference in Rank: v1 minus v2
1	AK	1.036	WY	0.993	AK	1.036	51	0.950	39	12
2	WY	1.035	TX	0.976	AL	0.987	42	0.947	36	6
3	ND	1.018	ND	0.976	AR	0.997	44	0.954	43	1
4	TX	1.012	LA	0.968	AZ	0.973	29	0.933	20	9
5	LA	1.005	DC	0.967	CA	0.963	14	0.925	11	3
6	DC	1.005	OK	0.967	CO	0.984	39	0.951	41	–2
7	OK	1.001	SD	0.959	CT	0.965	16	0.928	15	1
8	AR	0.997	MS	0.956	DC	1.005	46	0.967	47	–1
9	MS	0.995	AR	0.954	DE	0.962	11	0.927	14	–3
10	AL	0.987	NE	0.953	FL	0.968	20	0.935	22	–2
11	WV	0.986	CO	0.951	GA	0.985	40	0.949	38	2
12	GA	0.985	WV	0.950	HI	0.944	3	0.917	5	–2
13	CO	0.984	AK	0.950	IA	0.968	21	0.935	21	0
14	KY	0.983	GA	0.949	ID	0.964	15	0.919	7	8
15	TN	0.981	KY	0.949	IL	0.972	27	0.941	30	–3
16	SD	0.980	AL	0.947	IN	0.973	30	0.940	29	1
17	NC	0.980	KS	0.947	KS	0.978	33	0.947	35	–2
18	KS	0.978	TN	0.946	KY	0.983	38	0.949	37	1
19	NE	0.978	MD	0.942	LA	1.005	47	0.968	48	–1
20	SC	0.975	SC	0.942	MA	0.951	6	0.918	6	0
21	MD	0.974	NC	0.942	MD	0.974	31	0.942	33	–2
22	IN	0.973	IL	0.941	ME	0.950	5	0.908	4	1
23	AZ	0.973	IN	0.940	MI	0.962	13	0.924	10	3
24	VA	0.972	VA	0.939	MN	0.955	7	0.923	9	–2
25	IL	0.972	MO	0.937	MO	0.970	24	0.937	27	–3
26	NJ	0.970	PA	0.937	MS	0.995	43	0.956	44	–1
27	NY	0.970	NJ	0.937	MT	0.961	10	0.931	19	–9
28	MO	0.970	NY	0.937	NC	0.980	35	0.942	31	4
29	PA	0.969	FL	0.935	ND	1.018	49	0.976	49	0

SORT 1: BY FTE/EE					SORT 2: Alphabetical Order					
	v1: Without WKS (weeks worked)		v2: Using WKS (weeks worked)		v1: Without WKS (weeks worked)		v2: Using WKS (weeks worked)			
Rank	State	FTAE/ EE	State	FTE/ EE	State	FTE/ EE	Rank	FTE/ EE	Rank	Difference in Rank: v1 minus v2
30	OH	0.968	OH	0.935	NE	0.978	34	0.953	42	–8
31	IA	0.968	IA	0.935	NH	0.962	12	0.927	13	–1
32	FL	0.968	AZ	0.933	NJ	0.970	26	0.937	24	2
33	WA	0.967	MT	0.931	NM	0.960	9	0.920	8	1
34	NV	0.967	WI	0.931	NV	0.967	18	0.925	12	6
35	VT	0.965	VT	0.930	NY	0.970	25	0.937	25	0
36	CT	0.965	WA	0.929	OH	0.968	22	0.935	23	–1
37	ID	0.964	CT	0.928	OK	1.001	45	0.967	46	–1
38	CA	0.963	DE	0.927	OR	0.947	4	0.905	3	1
39	MI	0.962	NH	0.927	PA	0.969	23	0.937	26	–3
40	NH	0.962	NV	0.925	RI	0.942	1	0.905	2	–1
41	DE	0.962	CA	0.925	SC	0.975	32	0.942	32	0
42	MT	0.961	MI	0.924	SD	0.980	36	0.959	45	–9
43	NM	0.960	MN	0.923	TN	0.981	37	0.946	34	3
44	WI	0.960	NM	0.920	TX	1.012	48	0.976	50	–2
45	MN	0.955	ID	0.919	UT	0.943	2	0.898	1	1
46	MA	0.951	MA	0.918	VA	0.972	28	0.939	28	0
47	ME	0.950	HI	0.917	VT	0.965	17	0.930	17	0
48	OR	0.947	ME	0.908	WA	0.967	19	0.929	16	3
49	HI	0.944	OR	0.905	WI	0.960	8	0.931	18	–10
50	UT	0.943	RI	0.905	WV	0.986	41	0.950	40	1
51	RI	0.942	UT	0.898	WY	1.035	50	0.993	51	–1

APPENDIX F – NOTE ON AN ALTERNATIVE METHOD OF COMPUTING FTE/EE

Under the methods described in Section 3, the number of FTEs in an industry can exceed the number of employees because a single individual working more than 40 hours per week will count as more than one FTE. One alternative, mixed method, which has sometimes been considered, is to count each worker as no more than one FTE, no matter how many hours they work, while still counting workers who work less than 40 hours per week as a fraction of an FTE. A rationale for this is that allowing one worker to represent more than a single FTE yields a higher estimated number of FTEs, and thus a lower estimated number of claims per FTE. This might be regarded as understating the overall risk of the job for long-hour workers. Because these workers tend to have more claims due to longer hours of work, it might seem desirable to have this reflected in the claim rate. Part-time workers are counted as only a fraction of an FTE because if they were counted as a whole FTE, their claim rates would be lower. This is regarded as undesirable as it would downplay risks in part-time jobs, despite those jobs potentially increasing overall, work-related risks for workers with more than one job.

This proposed mixed method deviates from the concept of consistently measuring risk per unit of time on the job. As a result, some of the resulting claim rate comparisons by industry would reflect not just differences in injury risk per unit time worked, but differences in number of hours worked per worker.[102] This is not usually desirable because, for analysis, it is useful to separate the impact of job hazards on risk of injury from the impact of the amount of time exposed to those hazards.

Given a measurement of risk per unit of time, we can proceed from there, if we wish, to determine how risks to individual workers vary by total time exposed. Longer time exposed to a given hazard tends to increase injuries due simply to the additive effect of exposure for more hours. Longer hours may also have impacts on the level of risk per unit time, as when physical and mental fatigue increase. Calculating claim rates as claims per worker (in whole or in part) makes it more difficult to distinguish between risks due to underlying job hazards and risks due to long hours of work. It also makes it harder to separate the additive effect of longer exposure (in hours) from the possible impact of fatigue on risk per hour.

Using 40-hour-per-week units as a consistent basis for estimating FTEs thus facilitates analysis of job risks. Further, this method is consistent with how FTEs and injury rates are calculated in the BLS SOII. BLS reports injury rates as number of injuries per 100 FTEs, based on number of work hours reported by employers in the survey, and setting 1 FTE = 2,000 hours per year. The proposed method is also broadly aligned with the way that payroll dollar denominators are used in the WC insurance industry to compute claim rates and claim cost rates. Although payroll dollars per hour is different across employers and industries, it is largely proportional to hours worked.

102 To take a simplified example, consider two industries, A and B. Industry A has 50% more claims per worker than Industry B, but workers work an average of 60 hours per week in Industry A, rather than 40 hours per week as in Industry B. Under the proposed alternative method, Industry A would have a claim rate 50% higher than the claim rate in Industry A. But this is not due to any difference in the inherent hazard level of the work. If we instead compute claim rates on an FTE basis, we obtain equal claim rates in Industries A and B. However, we can still recognize that long hours lead to a greater number of injury claims for those workers who work longer than 40 hours per week, as is most frequently the case in Industry A.

APPENDIX G – CENSUS, NAICS AND ACS PUMS NAICS-BASED [NAICSP] CROSSWALK

The table below is an extract of the file "2013 ACS 1-year and 2014 SIPP PUMS Industry Code List.xlsx" on this Census Bureau website: https://www.census.gov/topics/employment/industry-occupation/guidance/code-lists.html. (See crosswalk tab.) In this file, 2013 census industry codes are matched to 2012 NAICS codes and 2012 NAICS-based (NAICSP) codes. These 2013 codes are reproduced here, because they are the most recent codes used in this report. The previous 2012 census industry codes were based on the older 2007 NAICS codes.

Note that a more recent version of this crosswalk is available at the same website: "2018 ACS PUMS and 2018 SIPP Public Use Industry Code List."

Letter suffixes of NAICS-based [NAICSP] codes are defined at the end of Table G.1 and discussed in Section 4.

Table G.1 Crosswalk: 2013 Census, 2012 NAICS, and 2012 ACS PUMS NAICS-Based [NAICSP] Codes

2013 Census Industry Description (ACS PUMS)	2013 Census Code	2012 NAICS Code	2012 NAICS-Based [NAICSP] Code
Agriculture, Forestry, Fishing and Hunting, and Mining	0170–0490	11–21	11–21
Agriculture, Forestry, Fishing, and Hunting	**0170–0290**	**11**	**11**
Crop production	0170	111	111
Animal production and aquaculture	0180	112	112
Forestry except logging	0190	1131, 1132	113M
Logging	0270	1133	1133
Fishing, hunting, and trapping	0280	114	114
Support activities for agriculture and forestry	0290	115	115
Mining, Quarrying, and Oil and Gas Extraction	**0370–0490**	**21**	**21**
Oil and gas extraction	0370	211	211
Coal mining	0380	2121	2121
Metal ore mining	0390	2122	2122
Nonmetallic mineral mining and quarrying	0470	2123	2123
Support activities for mining	0490	213	213
Construction	0770	23	23
Construction (the cleaning of buildings and dwellings is incidental during construction and immediately after construction)	0770	23	23
Manufacturing	1070–3990	31–33	31–33
Animal food, grain and oilseed milling	1070	3111, 3112	311M1
Sugar and confectionery products	1080	3113	3113

2013 Census Industry Description (ACS PUMS)	2013 Census Code	2012 NAICS Code	2012 NAICS-Based [NAICSP] Code
Fruit and vegetable preserving and specialty food manufacturing	1090	3114	3114
Dairy product manufacturing	1170	3115	3115
Animal slaughtering and processing	1180	3116	3116
Retail bakeries	1190	311811	311811
Bakeries and tortilla manufacturing, except retail bakeries	1270	3118 excl. 311811	3118Z
Seafood and other miscellaneous foods, n.e.c.	1280	3117, 3119	311M2
Not specified food industries	1290	Part of 311	311S
Beverage manufacturing	1370	3121	3121
Tobacco manufacturing	1390	3122	3122
Fiber, yarn, and thread mills	1470	3131	3131
Fabric mills, except knitting mills	1480	3132 excl. 31324	3132Z
Textile and fabric finishing and coating mills	1490	3133	3133
Carpet and rug mills	1570	31411	31411
Textile product mills, except carpets and rugs	1590	314 excl. 31411	314Z
Knitting fabric mills, and apparel knitting mills	1670	31324, 3151	31M
Cut and sew apparel manufacturing	1680	3152	3152
Apparel accessories and other apparel manufacturing	1690	3159	3159
Footwear manufacturing	1770	3162	3162
Leather tanning and finishing, and other allied products manufacturing	1790	3161, 3169	316M
Pulp, paper, and paperboard mills	1870	3221	3221
Paperboard container manufacturing	1880	32221	32221
Miscellaneous paper and pulp products	1890	32222, 32223, 32229	3222M
Printing and related support activities	1990	3231	3231
Petroleum refining	2070	32411	32411
Miscellaneous petroleum and coal products	2090	32412, 32419	3241M
Resin, synthetic rubber, and fibers and filaments manufacturing	2170	3252	3252
Agricultural chemical manufacturing	2180	3253	3253
Pharmaceutical and medicine manufacturing	2190	3254	3254
Paint, coating, and adhesive manufacturing	2270	3255	3255
Soap, cleaning compound, and cosmetics manufacturing	2280	3256	3256
Industrial and miscellaneous chemicals	2290	3251, 3259	325M
Plastics product manufacturing	2370	3261	3261

2013 Census Industry Description (ACS PUMS)	2013 Census Code	2012 NAICS Code	2012 NAICS-Based [NAICSP] Code
Tire manufacturing	2380	32621	32621
Rubber products, except tires, manufacturing	2390	32622, 32629	3262M
Pottery, ceramics, and plumbing fixture manufacturing	2470	32711	32711
Clay building material and refractories manufacturing	2480	327120	327120
Glass and glass product manufacturing	2490	3272	3272
Cement, concrete, lime, and gypsum product manufacturing	2570	3273, 3274	327M
Miscellaneous nonmetallic mineral product manufacturing	2590	3279	3279
Iron and steel mills and steel product manufacturing	2670	3311, 3312	331M
Aluminum production and processing	2680	3313	3313
Nonferrous metal (except aluminum) production and processing	2690	3314	3314
Foundries	2770	3315	3315
Metal forgings and stampings	2780	3321	3321
Cutlery and hand tool manufacturing	2790	3322	3322
Structural metals, and boiler, tank, and shipping container manufacturing	2870	3323, 3324	332M
Machine shops; turned product; screw, nut and bolt manufacturing	2880	3327	3327
Coating, engraving, heat treating and allied activities	2890	3328	3328
Ordnance	2970	332992, 332993, 332994, 332995	33299M
Miscellaneous fabricated metal products manufacturing	2980	3325, 3326, 3329 excl. 332992, 332993, 332994, 332995	332MZ
Not specified metal industries	2990	Part of 331 and 332	33MS
Agricultural implement manufacturing	3070	33311	33311
Construction, and mining and oil and gas field machinery manufacturing	3080	33312, 33313	3331M
Commercial and service industry machinery manufacturing	3095	3333	3333
Metalworking machinery manufacturing	3170	3335	3335
Engine, turbine, and power transmission equipment manufacturing	3180	3336	3336
Machinery manufacturing, n.e.c. or not specified	3190	3332, 3334, 3339	333MS

2013 Census Industry Description (ACS PUMS)	2013 Census Code	2012 NAICS Code	2012 NAICS-Based [NAICSP] Code
Combines:			
Machinery manufacturing, n.e.c.	3190	3332, 3334, 3339	333M
Not specified machinery manufacturing	3290	Part of 333	333S
Computer and peripheral equipment manufacturing	3365	3341	3341
Communications, and audio and video equipment manufacturing	3370	3342, 3343	334M1
Navigational, measuring, electromedical, and control instruments manufacturing	3380	3345	3345
Electronic component and product manufacturing, n.e.c.	3390	3344, 3346	334M2
Household appliance manufacturing	3470	3352	3352
Electric lighting and electrical equipment manufacturing, and other electrical component manufacturing, n.e.c.	3490	3351, 3353, 3359	335M
Motor vehicles and motor vehicle equipment manufacturing	3570	3361, 3362, 3363	336M
Aircraft and parts manufacturing	3580	336411, 336412, 336413	33641M1
Aerospace products and parts manufacturing	3590	336414, 336415, 336419	33641M2
Railroad rolling stock manufacturing	3670	3365	3365
Ship and boat building	3680	3366	3366
Other transportation equipment manufacturing	3690	3369	3369
Sawmills and wood preservation	3770	3211	3211
Veneer, plywood, and engineered wood products	3780	3212	3212
Prefabricated wood buildings and mobile homes	3790	321991, 321992	32199M
Miscellaneous wood products	3875	3219 excl. 321991, 321992	3219ZM
Furniture and related product manufacturing	3895	337	337
Medical equipment and supplies manufacturing	3960	3391	3391
Sporting and athletic goods, and doll, toy and game manufacturing	3970	33992, 33993	3399M
Miscellaneous manufacturing, n.e.c.	3980	3399 excl. 33992, 33993	3399ZM
Not specified manufacturing industries	3990	Part of 31, 32, 33	3MS
Wholesale Trade	4070–4590	42	42
Motor vehicle and motor vehicle parts and supplies merchant wholesalers	4070	4231	4231
Furniture and home furnishing merchant wholesalers	4080	4232	4232
Lumber and other construction materials merchant wholesalers	4090	4233	4233

2013 Census Industry Description (ACS PUMS)	2013 Census Code	2012 NAICS Code	2012 NAICS-Based [NAICSP] Code
Professional and commercial equipment and supplies merchant wholesalers	4170	4234	4234
Metals and minerals (except petroleum) merchant wholesalers	4180	4235	4235
Household appliances and electrical and electronic goods merchant wholesalers	4195	4236	4236
Hardware, and plumbing and heating equipment, and supplies merchant wholesalers	4265	4237	4237
Machinery, equipment, and supplies merchant wholesalers	4270	4238	4238
Recyclable material merchant wholesalers	4280	42393	42393
Miscellaneous durable goods merchant wholesalers	4290	4239 excl. 42393	4239Z
Paper and paper products merchant wholesalers	4370	4241	4241
Drugs, sundries, and chemical and allied products merchant wholesalers	4380	4242, 4246	424M
Apparel, piece goods, and notions merchant wholesalers	4390	4243	4243
Grocery and related product merchant wholesalers	4470	4244	4244
Farm product raw material merchant wholesalers	4480	4245	4245
Petroleum and petroleum products merchant wholesalers	4490	4247	4247
Alcoholic beverages merchant wholesalers	4560	4248	4248
Farm supplies merchant wholesalers	4570	42491	42491
Miscellaneous nondurable goods merchant wholesalers	4580	4249 excl. 42491	4249Z
Wholesale electronic markets and agents and brokers	4585	4251	4251
Not specified wholesale trade	4590	Part of 42	42S
Retail Trade	4670–5790	44–45	44–45
Automobile dealers	4670	4411	4411
Other motor vehicle dealers	4680	4412	4412
Automotive parts, accessories, and tire stores	4690	4413	4413
Furniture and home furnishings stores	4770	442	442
Household appliance stores	4780	443141	443141
Electronics stores	4795	443142	443142
Building material and supplies dealers	4870	4441 excl. 44413	4441Z
Hardware stores	4880	44413	44413
Lawn and garden equipment and supplies stores	4890	4442	4442
Grocery stores	4970	4451	4451
Specialty food stores	4980	4452	4452

2013 Census Industry Description (ACS PUMS)	2013 Census Code	2012 NAICS Code	2012 NAICS-Based [NAICSP] Code
Beer, wine, and liquor stores	4990	4453	4453
Pharmacies and drug stores	5070	44611	44611
Health and personal care, except drug, stores	5080	446 excl. 44611	446Z
Gasoline stations	5090	447	447
Clothing stores	5170	4481	4481
Shoe stores	5180	44821	44821
Jewelry, luggage, and leather goods stores	5190	4483	4483
Sporting goods, and hobby and toy stores	5275	45111, 45112	4511M
Sewing, needlework, and piece goods stores	5280	45113	45113
Musical instrument and supplies stores	5295	45114	45114
Book stores and news dealers	5370	45121	45121
Department stores and discount stores	5380	45211	45211
Miscellaneous general merchandise stores	5390	4529	4529
Retail florists	5470	4531	4531
Office supplies and stationery stores	5480	45321	45321
Used merchandise stores	5490	4533	4533
Gift, novelty, and souvenir shops	5570	45322	45322
Miscellaneous retail stores	5580	4539	4539
Electronic shopping	5590	454111	454111
Electronic auctions	5591	454112	454112
Mail-order houses	5592	454113	454113
Vending machine operators	5670	4542	4542
Fuel dealers	5680	454310	454310
Other direct selling establishments	5690	45439	45439
Not specified retail trade	5790	Part of 44, 45	4MS
Transportation and Warehousing, and Utilities	6070–6390, 0570–0690	48–49, 22	48–49, 22
Transportation and Warehousing	6070–6390	48–49	48–49
Air transportation	6070	481	481
Rail transportation	6080	482	482
Water transportation	6090	483	483
Truck transportation	6170	484	484
Bus service and urban transit	6180	4851, 4852, 4854, 4855, 4859	485M
Taxi and limousine service	6190	4853	4853
Pipeline transportation	6270	486	486

2013 Census Industry Description (ACS PUMS)	2013 Census Code	2012 NAICS Code	2012 NAICS-Based [NAICSP] Code
Scenic and sightseeing transportation	6280	487	487
Services incidental to transportation	6290	488	488
Postal Service	6370	491	491
Couriers and messengers	6380	492	492
Warehousing and storage	6390	493	493
Utilities	0570–0690	22	22
Electric power generation, transmission and distribution	0570	2211	2211P
Natural gas distribution	0580	2212	2212P
Electric and gas, and other combinations	0590	Pts. 2211, 2212	221MP
Water, steam, air-conditioning, and irrigation systems	0670	22131, 22133	2213M
Sewage treatment facilities	0680	22132	22132
Not specified utilities	0690	Part of 22	22S
Information	6470–6780	51	51
Newspaper publishers	6470	51111	51111
Periodical, book, and directory publishers	6480	5111 excl. 51111	5111Z
Software publishing	6490	5112	5112
Motion pictures and video industries	6570	5121	5121
Sound recording industries	6590	5122	5122
Broadcasting (except internet)	6670	515	515
Internet publishing and broadcasting and web search portals	6672	51913	51913
Wired telecommunications carriers	6680	5171	5171
Telecommunications, except wired telecommunications carriers	6690	517 excl. 5171	517Z
Data processing, hosting, and related services	6695	5182	5182
Libraries and archives	6770	51912	51912
Other information services, except libraries and archives, and internet publishing and broadcasting and web search portals	6780	5191 excl. 51912, 51913	5191ZM
Finance and Insurance, and Real Estate and Rental and Leasing	6870–7190	52–53	52–53
Finance and Insurance	6870–6990	52	52
Banking and related activities	6870	521, 52211,52219	52M1
Savings institutions, including credit unions	6880	52212, 52213	5221M
Nondepository credit and related activities	6890	5222, 5223	522M
Securities, commodities, funds, trusts, and other financial investments	6970	523, 525	52M2

2013 Census Industry Description (ACS PUMS)	2013 Census Code	2012 NAICS Code	2012 NAICS-Based [NAICSP] Code
Insurance carriers and related activities	6990	524	524
Real Estate and Rental and Leasing	7070–7190	53	53
Real estate	7070	531	531
Automotive equipment rental and leasing	7080	5321	5321
Video tape and disk rental	7170	53223	53223
Other consumer goods rental	7180	53221, 53222, 53229, 5323	532M
Commercial, industrial, and other intangible assets rental and leasing	7190	5324, 533	53M
Professional, Scientific, and Management, and Administrative, and Waste Management Services	7270–7790	54–56	54–56
Professional, Scientific, and Technical Services	7270–7490	54	54
Legal services	7270	5411	5411
Accounting, tax preparation, bookkeeping, and payroll services	7280	5412	5412
Architectural, engineering, and related services	7290	5413	5413
Specialized design services	7370	5414	5414
Computer systems design and related services	7380	5415	5415
Management, scientific, and technical consulting services	7390	5416	5416
Scientific research and development services	7460	5417	5417
Advertising, public relations, and related services	7470	5418	5418
Veterinary services	7480	54194	54194
Other professional, scientific, and technical services	7490	5419 excl. 54194	5419Z
Management of companies and enterprises	7570	55	55
Management of companies and enterprises	7570	55	55
Administrative and support and waste management services	7580–7790	56	56
Employment services	7580	5613	5613
Business support services	7590	5614	5614
Travel arrangements and reservation services	7670	5615	5615
Investigation and security services	7680	5616	5616
Services to buildings and dwellings (except cleaning during construction and immediately after construction)	7690	5617 excl. 56173	5617Z
Landscaping services	7770	56173	56173

2013 Census Industry Description (ACS PUMS)	2013 Census Code	2012 NAICS Code	2012 NAICS-Based [NAICSP] Code
Other administrative and other support services	7780	5611, 5612, 5619	561M
Waste management and remediation services	7790	562	562
Educational Services, and Health Care and Social Assistance	7860–8470	61–62	61–62
Educational Services	**7860–7890**	**61**	**61**
Elementary and secondary schools	7860	6111	6111
Colleges, universities, and professional schools, including junior colleges	7870	6112, 6113	611M1
Business, technical, and trade schools and training	7880	6114, 6115	611M2
Other schools and instruction, and educational support services	7890	6116, 6117	611M3
Health Care and Social Assistance	**7970–8470**	**62**	**62**
Offices of physicians	7970	6211	6211
Offices of dentists	7980	6212	6212
Offices of chiropractors	7990	62131	62131
Offices of optometrists	8070	62132	62132
Offices of other health practitioners	8080	6213 excl. 62131, 62132	6213ZM
Outpatient care centers	8090	6214	6214
Home health care services	8170	6216	6216
Other health care services	8180	6215, 6219	621M
Hospitals	8190	622	622
Nursing care facilities (skilled nursing facilities)	8270	6231	6231
Residential care facilities, except skilled nursing facilities	8290	6232, 6233, 6239	623M
Individual and family services	8370	6241	6241
Community food and housing, and emergency services	8380	6242	6242
Vocational rehabilitation services	8390	6243	6243
Child day care services	8470	6244	6244
Arts, Entertainment, and Recreation, and Accommodation and Food Services	8560–8690	71–72	71–72
Arts, Entertainment, and Recreation	**8560–8590**	**71**	**71**
Performing arts, spectator sports, and related industries	8560	711	711
Museums, art galleries, historical sites, and similar institutions	8570	712	712
Bowling centers	8580	71395	71395
Other amusement, gambling, and recreation industries	8590	713 excl. 71395	713Z

2013 Census Industry Description (ACS PUMS)	2013 Census Code	2012 NAICS Code	2012 NAICS-Based [NAICSP] Code
Accommodation and Food Services	**8660–8690**	**72**	**72**
Traveler accommodation	8660	7211	7211
Recreational vehicle parks and camps, and rooming and boarding houses	8670	7212, 7213	721M
Restaurants and other food services	8680	722 excl. 7224	722Z
Drinking places, alcoholic beverages	8690	7224	7224
Other Services, Except Public Administration	8770–9290	81	81
Automotive repair and maintenance	8770	8111 excl. 811192	8111Z
Car washes	8780	811192	811192
Electronic and precision equipment repair and maintenance	8790	8112	8112
Commercial and industrial machinery and equipment repair and maintenance	8870	8113	8113
Personal and household goods repair and maintenance	8880	8114	8114
Combines:			
Personal and household goods repair and maintenance	8880	8114	8114
Footwear and leather goods repair	8890	81143	81143
Barber shops	8970	812111	812111
Beauty salons	8980	812112	812112
Nail salons and other personal care services	8990	812113, 81219	8121M
Drycleaning and laundry services	9070	8123	8123
Funeral homes, and cemeteries and crematories	9080	8122	8122
Other personal services	9090	8129	8129
Religious organizations	9160	8131	8131
Civic, social, advocacy organizations, and grant-making and giving services	9170	8132, 8133, 8134	813M
Labor unions	9180	81393	81393
Business, professional, political, and similar organizations	9190	8139 excl. 81393	8139Z
Private households	9290	814	814
Public Administration	9370–9590	92	92
Executive offices and legislative bodies	9370	92111, 92112, 92114, pt. 92115	9211MP
Public finance activities	9380	92113	92113
Other general government and support	9390	92119	92119
Justice, public order, and safety activities	9470	922, pt. 92115	92MP
Administration of human resource programs	9480	923	923

2013 Census Industry Description (ACS PUMS)	2013 Census Code	2012 NAICS Code	2012 NAICS-Based [NAICSP] Code
Administration of environmental quality and housing programs	9490	924, 925	92M1
Administration of economic programs and space research	9570	926, 927	92M2
National security and international affairs	9590	928	928P
Active-Duty Military	9670–9870	928110	928110
U. S. Army	9670	928110	928110P1
U. S. Air Force	9680	928110	928110P2
U. S. Navy	9690	928110	928110P3
U. S. Marines	9770	928110	928110P4
U. S Coast Guard	9780	928110	928110P5
U. S. Armed Forces, Branch Not Specified	9790	928110	928110P6
Military Reserves or National Guard	9870	928110	928110P7
Unemployed, last worked 5 years ago or earlier or never worked	9920		999920

M = Multiple NAICS codes

P = Part of a NAICS code - NAICS code split between two or more census codes

S = Not specified industry in NAICS sector - specific to census codes only

Z = Exception to NAICS code - Part of NAICS industry has own census code

Part or pt. should be indicated where there are splits between code categories

n.e.c. = not elsewhere classified

APPENDIX H – ACS SURVEY QUESTIONS AND PUMS CODE DEFINITIONS: QUESTIONS AND VARIABLES RELATING TO EMPLOYMENT STATUS, HOURS WORKED, AND INDUSTRY

Except where noted, the material below is extracted from the 2014 ACS PUMS data dictionary, available online at the following Census Bureau website: https://www2.census.gov/programs-surveys/acs/tech_docs/pums/data_dict/PUMSDataDict14.pdf.

More recent, as well as earlier data dictionaries are available at https://www2.census.gov/programs-surveys/acs/tech_docs/pums/data_dict/.

2014 ACS QUESTIONNAIRE

29a. LAST WEEK, did this person work for pay at a job (or business)?

- Yes (skip to question 30)
- No, did not work (or retired)

29b. LAST WEEK, did this person do ANY work for pay, even for as little as one hour?

- Yes
- No (skip to question 35a)

35a. LAST WEEK, was this person on layoff from a job?

- Yes (skip to question 35c)
- No

35b. LAST WEEK, was this person TEMPORARILY absent from a job or business?

- Yes, on vacation, temporary illness, maternity leave, other family/personal reasons, bad weather, etc. (skip to question 38)
- No (skip to question 36)

35c. Has this person been informed that he or she will be recalled to work within the next 6 months OR been given a date to return to work?

- Yes (skip to question 37)
- No

36. During the LAST 4 WEEKS, has this person been ACTIVELY looking for work?

- Yes
- No (skip to question 38)

37. LAST WEEK, could this person have started a job if offered one, or returned to work if recalled?

- Yes, could have gone to work
- No because of own temporary illness
- No, because of all other reasons (in school, etc.)

39a. During the PAST 12 MONTHS (52 weeks), did this person work 50 or more weeks? Count paid time off as work.

- Yes (skip to question 40)
- No

39b. How many weeks DID this person work, even for a few hours, including paid vacation, paid sick leave, and military service?[103]

- o 50 to 52 weeks
- o 48 to 49 weeks
- o 40 to 47 weeks
- o 27 to 39 weeks
- o 14 to 26 weeks
- o 13 weeks or less

40. During the PAST 12 MONTHS, in the WEEKS WORKED, how many hours did this person usually work each WEEK? Usual hours worked each WEEK _____

Answer questions 41–46 if this person worked in the past 5 years. Otherwise, SKIP to question 47.

41-46 Current or most recent job activity. *Describe clearly this person's chief job activity or business last week. If this person had more than one job, describe the one at which this person worked the most hours. If this person had no job or business last week, give information for his/her last job or business.*

41. Was this person (Mark one box)

- o An employee of a private for-profit company or business, or of an individual, for wages, salary or commissions?
- o An employee of a private not-for-profit company or business, or of an individual, for wages, salary or commissions?
- o A local government employee (city, county, etc.)?
- o A state government employee?
- o A federal government employee?
- o Self-employed in own not incorporated business, professional practice, or farm?
- o Self-employed in own incorporated business, professional practice, or farm?
- o Working without pay in family business or farm?

42. For whom did the person work?

If now on active duty in the Armed Forces, mark (X) this box ____

Name of company, business, or other employer _____

43. What kind of business or industry was this?

Describe the activity at the location where employed. _____

44. Is this mainly (Mark one box)

- o Manufacturing?
- o Wholesale trade?
- o Retail trade?
- o Other (agriculture, construction, service, government, etc.)?

45. What kind of work was this person doing? (For example: registered nurse, personnel manager, supervisor of order department, secretary, accountant) _____

103 This question was changed in the 2019 ACS to ask respondents the exact number of weeks they worked in the previous 12 months (WKWN).

46. What were this person's most important activities or duties? (For example: patient care, directing hiring policies, supervising order clerks, typing and filing, reconciling financial records) _____

2014 ACS PUMS RECODE VARIABLE DEFINITIONS: VARIABLES RELATING TO WEEKS AND HOURS WORKED, INDUSTRY, AND EMPLOYMENT STATUS

Recode variables are distinguished from variables that directly represent the original coded responses to survey questions. They classify the original responses in alternative ways and/or represent combinations of responses to multiple survey questions.

Weeks worked (WKW) – derived from response to ACS #39

WKW - Weeks worked during past 12 months

b	N/A (less than 16 years old/did not work during the past 12 months)
1	50 to 52 weeks worked during past 12 months
2	48 to 49 weeks worked during past 12 months
3	40 to 47 weeks worked during past 12 months
4	27 to 39 weeks worked during past 12 months
5	14 to 26 weeks worked during past 12 months
6	less than 14 weeks worked during past 12 months

Hours Worked (WKHP) – derived from response to ACS #40

WKHP - Usual hours worked per week past 12 months

b	N/A (less than 16 years old/did not work during the past 12 months)
01..98	1 to 98 usual hours
99	99 or more usual hours

Class of worker (COW) – derived from response to ACS #41

COW	Class of worker
b	N/A (less than 16 years old/NILF [not in labor force] who last worked more than 5 years ago or never worked)
1	Employee of a private for-profit company or business, or of an individual, for wages, salary, or commissions
2	Employee of a private not-for-profit, tax-exempt, or charitable organization
3	Local government employee (city, county, etc.)
4	State government employee
5	Federal government employee
6	Self-employed in own not incorporated business, professional practice, or farm
7	Self-employed in own incorporated business, professional practice or farm

8 Working without pay in family business or farm

9 Unemployed and last worked 5 years ago or earlier or never worked

NAICSP – derived from responses to ACS #42–46

NAICS Industry recode for 2013 and later based on 2012 NAICS codes

b N/A (less than 16 years old/NILF who last worked more than 5 years ago or never worked)

111 AGR-CROP PRODUCTION

112 AGR-ANIMAL PRODUCTION AND AQUACULTURE

...

Etc.

Employment status recode (ESR) – derived from responses to ACS #29, #35–#37

ESR Employment status recode

b N/A (less than 16 years old)

1 Civilian employed, at work

2 Civilian employed, with a job but not at work

3 Unemployed

4 Armed forces, at work

5 Armed forces, with a job but not at work

6 Not in labor force

More details on ESR from the 2014 ACS documentation on subject definitions:

> "The data on employment status were derived from Questions 29 and 35–37 in the 2014 American Community Survey (ACS)... The questions were asked of all people 15 years old and over. The series of questions on employment status was designed to identify, in this sequence, (1) people who worked at any time during the reference week, (2) people on temporary layoff who were available for work, (3) people who did not work during the reference week but who had jobs or businesses from which they were temporarily absent (excluding layoff), (4) people who did not work during the reference week, but who were looking for work during the last four weeks and were available for work during the reference week, and (5) people not in the labor force... The employment status data shown in ACS tabulations relate to people 16 years old and over."[104]

In response to a question about how layoffs are handled in the ESR variable, the authors received the following answer from the Census Bureau.[105] The short answer is that the ESR of a respondent who reports being on layoff depends on the other answers he/she provides. Respondents who indicate that they are on layoff can go down one of five possible paths:

1. If they have been informed that they will be recalled to work within the next 6 months or been given a date to return to work (#35a), then they are considered *unemployed.*

104 See p. 62 in U.S. Census Bureau [2017]. American Community Survey and Puerto Rico Community Survey: 2014 subject definitions, https://www2.census.gov/programs-surveys/acs/tech_docs/subject_definitions/2014_ACSSubjectDefinitions.pdf?#.

105 Smith A [2017]. Email message to Jones MWM, May 5 (from U.S. Census Bureau, Social, Economic, and Housing Statistics Division, FED).

2. If they have not been informed that they will be recalled to work within the next 6 months or been given a date to return to work (#35a), have been actively looking for work in the past 4 weeks (#36), and were available to work last week (#37), then they are considered *unemployed*
3. If they have not been informed that they will be recalled to work within the next 6 months or been given a date to return to work (#35a), have been actively looking for work in the past 4 weeks (#36), but were not available to work last week (#37) due to illness, then they are considered *unemployed.*
4. If they have not been informed that they will be recalled to work within the next 6 months or been given a date to return to work (#35a), have been actively looking for work in the past 4 weeks (#36), but were not available to work last week (#37) for any other reason, then they are considered *not in labor force.*
5. If they have not been informed that they will be recalled to work within the next 6 months or been given a date to return to work (#35a), and have not been actively looking for work in the past 4 weeks (#36), then they are considered *not in labor force.*

APPENDIX I – SELECTED CENSUS FAQ INFORMATION ON NAICS CODING FROM THE U.S. CENSUS BUREAU

All information below is reproduced from the following website: https://www.census.gov/naics/ (see Menu, FAQs).

What is NAICS and how is it used?
The North American Industry Classification System (NAICS) was developed under the direction and guidance of the Office of Management and Budget (OMB) as the standard for use by Federal statistical agencies in classifying business establishments for the collection, tabulation, presentation, and analysis of statistical data describing the U.S. economy. Use of the standard provides uniformity and comparability in the presentation of these statistical data. NAICS is based on a production-oriented concept, meaning that it groups establishments into industries according to similarity in the processes used to produce goods or services. NAICS replaced the Standard Industrial Classification (SIC) system in 1997.

NAICS in the U.S. was designed for statistical purposes. However, NAICS is frequently used for various administrative, regulatory, contracting, taxation, and other non-statistical purposes. [Additional text omitted.]

For statistical purposes, a business establishment is assigned one NAICS code, based on its primary business activity. [Additional text omitted.]

What is an establishment?
An establishment is generally a single physical location where business is conducted or where services or industrial operations are performed (e.g., factory, mill, store, hotel, movie theater, mine, farm, airline terminal, sales office, warehouse, or central administrative office). An enterprise, on the other hand, may consist of one or more locations that are more than 50% owned by the same entity performing the same or different types of economic activities. Each establishment of that enterprise is assigned a NAICS code, based on its own primary business activity.

What is a "primary business activity?"
Ideally, the primary business activity of an establishment is determined by relative share of production costs and/or capital investment. In practice, other variables, such as revenue, value of shipments, or employment, are used as proxies. The U.S. Census Bureau generally uses revenue or value of shipments to determine an establishment's primary business activity.

Who assigns NAICS codes to businesses and how?
There is no central government agency with the role of assigning, monitoring, or approving NAICS codes for establishments. Individual establishments are assigned NAICS codes by various agencies for various purposes using a variety of methods. The U.S. Census Bureau has no formal role as an arbitrator of NAICS classification.

The U.S. Census Bureau assigns one NAICS code to each establishment based on its primary activity (generally the activity that generates the most revenue for the establishment) to collect, tabulate, analyze, and disseminate statistical data describing the economy of the U.S. Generally, the U.S. Census Bureau's NAICS classification codes are derived from information that the business establishment provided on surveys, census forms, or administrative records.

Various other government agencies, trade associations, and regulation boards adopted the NAICS classification system to assign codes to their own lists of establishments for their own programmatic needs. If you question the NAICS code contained on a form received from an agency other than the U.S. Census Bureau, you should contact that agency directly.

How can I have my company's NAICS code changed?
There is no "official" way to have a company's NAICS code changed and there is no central register that represents the "official" NAICS classification for business establishments. Various Federal government agencies maintain their own directories of business establishments, and assign classification codes based on their own needs. Generally, the classification codes are derived from information that the business establishment has provided on surveys, forms, or administrative records. For this reason, we recommend that you contact the agency that has assigned the code that you believe should be changed. For example, if you question the NAICS code contained on a form received from the Occupational Safety and Health Administration (OSHA), you should contact the Department of Labor. For access to a list of Federal government agencies' websites, visit www.usa.gov/Agencies/Federal/All_Agencies/index.shtml.

Can a business have more than one NAICS code?
In the process of collecting, tabulating, analyzing, and disseminating statistical data, the U.S. Census Bureau assigns and maintains only one NAICS code for each establishment based on its primary activity (generally the activity that generates the most revenue for the establishment). Since other agencies and organizations have adopted NAICS for use in programs that are not statistical (e.g., regulatory activities and procurement), it is possible that they allow for more than one NAICS code per establishment. For instance, the System for Award Management (SAM), where businesses register to become federal contractors, will accept multiple classification codes per establishment. You will need to contact these other agencies to find out what their policies are, and what NAICS codes are appropriate for your business relative to their programs. For access to a list of Federal government agencies, visit www.usa.gov/Agencies/Federal/All_Agencies/index.shtml.

APPENDIX J – UNCERTAINTY IN INDUSTRY ESTIMATES OF FTE/EE IN CALIFORNIA, OHIO, AND MASSACHUSETTS, SECTION 6

This appendix presents examples of the rMOE and CI calculations described in Section 6. Tables J.1a–J.1c presents MOE and CI for FTE/EE estimates for NAICS 3-digit industries in three states (CA, OH, MA). Tables J.2a–J.2c presents MOE and CI for FTE estimates for the same industries and states.

Table J.1a Margins of error and confidence intervals for estimates of FTE/EE for CA industries, 2010–2014 ACS data

				90% Confidence Level				95% Confidence Level			
NAICS Code	Industry Title	FTE/EE	Standard Error (SE)	Margin of Error MOE = SE*1.645	Relative Margin of Error rMOE = MOE/FTE/EE	CI Lower Bound FTE/EE – MOE	CI Upper Bound FTE/EE + MOE	Margin of Error MOE = SE*1.96	Relative Margin of Error rMOE = MOE/FTE/EE	CI Lower Bound FTE/EE – MOE	CI Upper Bound FTE/EE + MOE
111	Crop production	1.0628	0.0029	0.005	0.4%	1.058	1.068	0.006	0.5%	1.057	1.068
112	Animal production and aquaculture	1.1321	0.0102	0.017	1.5%	1.115	1.149	0.020	1.8%	1.112	1.152
113	Forestry and logging	1.0777	0.0215	0.035	3.3%	1.042	1.113	0.042	3.9%	1.036	1.120
114	Fishing, hunting and trapping	1.0403	0.0542	0.089	8.6%	0.951	1.129	0.106	10.2%	0.934	1.146
115	Agriculture and forestry support activities	1.0548	0.0078	0.013	1.2%	1.042	1.068	0.015	1.4%	1.040	1.070
211	Oil and gas extraction	1.1631	0.0205	0.034	2.9%	1.129	1.197	0.040	3.4%	1.123	1.203
212	Mining, except oil and gas	1.1034	0.0195	0.032	2.9%	1.071	1.135	0.038	3.5%	1.065	1.142
213	Support activities for mining	1.2343	0.0171	0.028	2.3%	1.206	1.262	0.033	2.7%	1.201	1.268
221	Utilities	1.0680	0.0042	0.007	0.6%	1.061	1.075	0.008	0.8%	1.060	1.076
23	Construction	0.9891	0.0014	0.002	0.2%	0.987	0.991	0.003	0.3%	0.986	0.992
311	Food manufacturing	1.0175	0.0041	0.007	0.7%	1.011	1.024	0.008	0.8%	1.009	1.026
312	Beverage and tobacco product manufacturing	1.0455	0.0061	0.010	1.0%	1.035	1.056	0.012	1.1%	1.034	1.057
313	Textile mills	1.0061	0.0115	0.019	1.9%	0.987	1.025	0.023	2.2%	0.983	1.029
314	Textile product mills	1.0163	0.0112	0.018	1.8%	0.998	1.035	0.022	2.2%	0.994	1.038
315	Apparel manufacturing	0.9730	0.0046	0.008	0.8%	0.965	0.981	0.009	0.9%	0.964	0.982
316	Leather and allied product manufacturing	1.0020	0.0130	0.021	2.1%	0.981	1.023	0.025	2.5%	0.977	1.027
321	Wood product manufacturing	1.0266	0.0070	0.011	1.1%	1.015	1.038	0.014	1.3%	1.013	1.040

NAICS Code	Industry Title	FTE/EE	Standard Error (SE)	90% Confidence Level				95% Confidence Level			
				Margin of Error MOE = SE*1.645	Relative Margin of Error rMOE = MOE/FTE/EE	CI Lower Bound FTE/EE – MOE	CI Upper Bound FTE/EE + MOE	Margin of Error MOE = SE*1.96	Relative Margin of Error rMOE = MOE/FTE/EE	CI Lower Bound FTE/EE – MOE	CI Upper Bound FTE/EE + MOE
322	Paper manufacturing	1.0584	0.0079	0.013	1.2%	1.045	1.071	0.015	1.5%	1.043	1.074
323	Printing and related support activities	0.9954	0.0055	0.009	0.9%	0.986	1.004	0.011	1.1%	0.985	1.006
324	Petroleum and coal products manufacturing	1.1112	0.0099	0.016	1.5%	1.095	1.128	0.019	1.7%	1.092	1.131
325	Chemical manufacturing	1.0592	0.0033	0.005	0.5%	1.054	1.065	0.006	0.6%	1.053	1.066
326	Plastics and rubber products manufacturing	1.0345	0.0055	0.009	0.9%	1.025	1.043	0.011	1.0%	1.024	1.045
327	Nonmetallic mineral product manufacturing	1.0373	0.0055	0.009	0.9%	1.028	1.046	0.011	1.0%	1.027	1.048
331	Primary metal manufacturing	1.0517	0.0073	0.012	1.1%	1.040	1.064	0.014	1.4%	1.037	1.066
332	Fabricated metal product manufacturing	1.0239	0.0044	0.007	0.7%	1.017	1.031	0.009	0.8%	1.015	1.032
333	Machinery manufacturing	1.0550	0.0037	0.006	0.6%	1.049	1.061	0.007	0.7%	1.048	1.062
334	Computer and electronic product mfg.	1.0823	0.0019	0.003	0.3%	1.079	1.085	0.004	0.3%	1.079	1.086
335	Electrical equipment and appliance mfg.	1.0490	0.0053	0.009	0.8%	1.040	1.058	0.010	1.0%	1.039	1.059
336	Transportation equipment manufacturing	1.0622	0.0022	0.004	0.3%	1.059	1.066	0.004	0.4%	1.058	1.067
337	Furniture and related product manufacturing	0.9833	0.0053	0.009	0.9%	0.974	0.992	0.010	1.1%	0.973	0.994
339	Miscellaneous manufacturing	1.0517	0.0026	0.004	0.4%	1.047	1.056	0.005	0.5%	1.047	1.057
423	Merchant wholesalers, durable goods	1.0338	0.0031	0.005	0.5%	1.029	1.039	0.006	0.6%	1.028	1.040
424	Merchant wholesalers, nondurable goods	1.0350	0.0026	0.004	0.4%	1.031	1.039	0.005	0.5%	1.030	1.040
425	Electronic markets and agents and brokers	0.9886	0.0130	0.021	2.2%	0.967	1.010	0.025	2.6%	0.963	1.014
441	Motor vehicle and parts dealers	1.0414	0.0036	0.006	0.6%	1.036	1.047	0.007	0.7%	1.034	1.048

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442	Furniture and home furnishings stores	0.9073	0.0073	0.012	1.3%	0.895	0.919	0.014	1.6%	0.893	0.922
443	Electronics and appliance stores	0.9640	0.0047	0.008	0.8%	0.956	0.972	0.009	0.9%	0.955	0.973
444	Building material and garden supply stores	0.9172	0.0052	0.009	0.9%	0.909	0.926	0.010	1.1%	0.907	0.927
445	Food and beverage stores	0.8927	0.0024	0.004	0.4%	0.889	0.897	0.005	0.5%	0.888	0.897
446	Health and personal care stores	0.8957	0.0042	0.007	0.8%	0.889	0.903	0.008	0.9%	0.888	0.904
447	Gasoline stations	0.9362	0.0084	0.014	1.5%	0.922	0.950	0.017	1.8%	0.920	0.953
448	Clothing and clothing accessories stores	0.7802	0.0049	0.008	1.0%	0.772	0.788	0.010	1.2%	0.771	0.790
451	Sporting goods, hobby, book and music stores	0.7855	0.0074	0.012	1.6%	0.773	0.798	0.015	1.9%	0.771	0.800
452	General merchandise stores	0.8072	0.0031	0.005	0.6%	0.802	0.812	0.006	0.8%	0.801	0.813
453	Miscellaneous store retailers	0.8309	0.0065	0.011	1.3%	0.820	0.842	0.013	1.5%	0.818	0.844
454	Nonstore retailers	1.0007	0.0077	0.013	1.3%	0.988	1.013	0.015	1.5%	0.986	1.016
481	Air transportation	0.9758	0.0070	0.011	1.2%	0.964	0.987	0.014	1.4%	0.962	0.990
482	Rail transportation	1.0979	0.0140	0.023	2.1%	1.075	1.121	0.027	2.5%	1.071	1.125
483	Water transportation	1.0676	0.0148	0.024	2.3%	1.043	1.092	0.029	2.7%	1.039	1.097
484	Truck transportation	1.1118	0.0053	0.009	0.8%	1.103	1.121	0.010	0.9%	1.101	1.122
485	Transit and ground passenger transportation	0.9908	0.0077	0.013	1.3%	0.978	1.003	0.015	1.5%	0.976	1.006
486	Pipeline transportation	1.1650	0.0351	0.058	4.9%	1.107	1.223	0.069	5.9%	1.096	1.234
487	Scenic and sightseeing transportation	0.9568	0.0274	0.045	4.7%	0.912	1.002	0.054	5.6%	0.903	1.010
488	Support activities for transportation	1.0198	0.0053	0.009	0.8%	1.011	1.028	0.010	1.0%	1.009	1.030
492	Couriers and messengers	0.9514	0.0064	0.010	1.1%	0.941	0.962	0.012	1.3%	0.939	0.964

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493	Warehousing and storage	0.9805	0.0056	0.009	0.9%	0.971	0.990	0.011	1.1%	0.970	0.991
511	Publishing industries, except internet	1.0229	0.0053	0.009	0.9%	1.014	1.032	0.010	1.0%	1.013	1.033
512	Motion picture and sound recording industries	1.0676	0.0061	0.010	0.9%	1.058	1.078	0.012	1.1%	1.056	1.079
515	Broadcasting, except internet	1.0617	0.0047	0.008	0.7%	1.054	1.069	0.009	0.9%	1.053	1.071
517	Telecommunications	1.0650	0.0037	0.006	0.6%	1.059	1.071	0.007	0.7%	1.058	1.072
518	Data processing, hosting and related services	1.0977	0.0134	0.022	2.0%	1.076	1.120	0.026	2.4%	1.071	1.124
519	Other information services	1.0791	0.0078	0.013	1.2%	1.066	1.092	0.015	1.4%	1.064	1.094
522	Credit intermediation and related activities	1.0389	0.0033	0.005	0.5%	1.034	1.044	0.006	0.6%	1.033	1.045
524	Insurance carriers and related activities	1.0202	0.0026	0.004	0.4%	1.016	1.024	0.005	0.5%	1.015	1.025
531	Real estate	0.9674	0.0030	0.005	0.5%	0.962	0.972	0.006	0.6%	0.961	0.973
532	Rental and leasing services	0.9768	0.0079	0.013	1.3%	0.964	0.990	0.015	1.6%	0.961	0.992
541	Professional and technical services	1.0420	0.0016	0.003	0.2%	1.039	1.045	0.003	0.3%	1.039	1.045
551	Management of companies and enterprises	1.0784	0.0116	0.019	1.8%	1.059	1.097	0.023	2.1%	1.056	1.101
561	Administrative and support services	0.9382	0.0020	0.003	0.4%	0.935	0.942	0.004	0.4%	0.934	0.942
562	Waste management and remediation services	1.0600	0.0056	0.009	0.9%	1.051	1.069	0.011	1.0%	1.049	1.071
611	Educational services	0.8533	0.0032	0.005	0.6%	0.848	0.859	0.006	0.7%	0.847	0.860
621	Ambulatory healthcare services	0.9359	0.0021	0.003	0.4%	0.932	0.939	0.004	0.4%	0.932	0.940
622	Hospitals	0.9744	0.0021	0.003	0.4%	0.971	0.978	0.004	0.4%	0.970	0.979
623	Nursing and residential care facilities	0.9391	0.0035	0.006	0.6%	0.933	0.945	0.007	0.7%	0.932	0.946

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624	Social assistance	0.8590	0.0031	0.005	0.6%	0.854	0.864	0.006	0.7%	0.853	0.865
711	Performing arts and spectator sports	0.9279	0.0098	0.016	1.7%	0.912	0.944	0.019	2.1%	0.909	0.947
712	Museums, historical sites, zoos, and parks	0.8614	0.0119	0.019	2.3%	0.842	0.881	0.023	2.7%	0.838	0.885
713	Amusements, gambling, and recreation	0.8315	0.0038	0.006	0.7%	0.825	0.838	0.007	0.9%	0.824	0.839
721	Accommodation	0.9390	0.0036	0.006	0.6%	0.933	0.945	0.007	0.8%	0.932	0.946
722	Food services and drinking places	0.8001	0.0017	0.003	0.4%	0.797	0.803	0.003	0.4%	0.797	0.804
811	Repair and maintenance	0.9833	0.0031	0.005	0.5%	0.978	0.988	0.006	0.6%	0.977	0.989
812	Personal and laundry services	0.8742	0.0042	0.007	0.8%	0.867	0.881	0.008	0.9%	0.866	0.882
813	Membership associations and organizations	0.9014	0.0045	0.007	0.8%	0.894	0.909	0.009	1.0%	0.893	0.910
814	Private households	0.7789	0.0085	0.014	1.8%	0.765	0.793	0.017	2.1%	0.762	0.796

Table J.1b Margins of error and confidence intervals for estimates of FTE/EE for OH industries, 2010–2014 ACS data

				90% Confidence Level				95% Confidence Level			
NAICS Code	Industry Title	FTE/EE	Standard Error (SE)	Margin of Error MOE = SE*1.645	Relative Margin of Error rMOE = MOE/FTE/EE	CI Lower Bound FTE/EE – MOE	CI Upper Bound FTE/EE + MOE	Margin of Error MOE = SE*1.96	Relative Margin of Error rMOE = MOE/FTE/EE	CI Lower Bound FTE/EE – MOE	CI Upper Bound FTE/EE + MOE
111	Crop production	1.0141	0.0188	0.031	3.0%	0.983	1.045	0.037	3.6%	0.977	1.051
112	Animal production and aquaculture	0.9923	0.0351	0.058	5.8%	0.935	1.050	0.069	6.9%	0.924	1.061
113	Forestry and logging	0.9752	0.0640	0.105	10.8%	0.870	1.080	0.125	12.9%	0.850	1.101
114	Fishing, hunting, and trapping	1.1847	0.0684	0.112	9.5%	1.072	1.297	0.134	11.3%	1.051	1.319
115	Agriculture and forestry support activities	1.0148	0.0451	0.074	7.3%	0.941	1.089	0.088	8.7%	0.926	1.103
211	Oil and gas extraction	1.1721	0.0585	0.096	8.2%	1.076	1.268	0.115	9.8%	1.057	1.287
212	Mining, except oil and gas	1.2052	0.0148	0.024	2.0%	1.181	1.230	0.029	2.4%	1.176	1.234
213	Support activities for mining	1.2816	0.0253	0.042	3.2%	1.240	1.323	0.049	3.9%	1.232	1.331
221	Utilities	1.0823	0.0064	0.011	1.0%	1.072	1.093	0.013	1.2%	1.070	1.095
23	Construction	1.0426	0.0029	0.005	0.5%	1.038	1.047	0.006	0.5%	1.037	1.048
311	Food manufacturing	1.0387	0.0062	0.010	1.0%	1.029	1.049	0.012	1.2%	1.027	1.051
312	Beverage and tobacco product manufacturing	1.0828	0.0184	0.030	2.8%	1.053	1.113	0.036	3.3%	1.047	1.119
313	Textile mills	1.0561	0.0233	0.038	3.6%	1.018	1.094	0.046	4.3%	1.010	1.102
314	Textile product mills	1.0246	0.0142	0.023	2.3%	1.001	1.048	0.028	2.7%	0.997	1.052
315	Apparel manufacturing	1.0187	0.0187	0.031	3.0%	0.988	1.049	0.037	3.6%	0.982	1.055
316	Leather and allied product manufacturing	0.9754	0.0322	0.053	5.4%	0.922	1.028	0.063	6.5%	0.912	1.039
321	Wood product manufacturing	1.0660	0.0086	0.014	1.3%	1.052	1.080	0.017	1.6%	1.049	1.083
322	Paper manufacturing	1.0859	0.0076	0.012	1.1%	1.073	1.098	0.015	1.4%	1.071	1.101
323	Printing and related support activities	1.0182	0.0084	0.014	1.4%	1.004	1.032	0.017	1.6%	1.002	1.035
324	Petroleum and coal products manufacturing	1.1190	0.0144	0.024	2.1%	1.095	1.143	0.028	2.5%	1.091	1.147
325	Chemical manufacturing	1.0968	0.0046	0.008	0.7%	1.089	1.104	0.009	0.8%	1.088	1.106

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326	Plastics and rubber products manufacturing	1.0675	0.0058	0.009	0.9%	1.058	1.077	0.011	1.1%	1.056	1.079
327	Nonmetallic mineral product manufacturing	1.0803	0.0062	0.010	0.9%	1.070	1.090	0.012	1.1%	1.068	1.092
331	Primary metal manufacturing	1.1069	0.0049	0.008	0.7%	1.099	1.115	0.010	0.9%	1.097	1.116
332	Fabricated metal product manufacturing	1.0783	0.0038	0.006	0.6%	1.072	1.084	0.007	0.7%	1.071	1.086
333	Machinery manufacturing	1.0940	0.0036	0.006	0.5%	1.088	1.100	0.007	0.6%	1.087	1.101
334	Computer and electronic product manufacturing	1.0756	0.0088	0.014	1.3%	1.061	1.090	0.017	1.6%	1.058	1.093
335	Electrical equipment and appliance mfg.	1.0682	0.0066	0.011	1.0%	1.057	1.079	0.013	1.2%	1.055	1.081
336	Transportation equipment manufacturing	1.0901	0.0028	0.005	0.4%	1.085	1.095	0.005	0.5%	1.085	1.096
337	Furniture and related product manufacturing	1.0488	0.0091	0.015	1.4%	1.034	1.064	0.018	1.7%	1.031	1.067
339	Miscellaneous manufacturing	1.0481	0.0055	0.009	0.9%	1.039	1.057	0.011	1.0%	1.037	1.059
423	Merchant wholesalers, durable goods	1.0660	0.0057	0.009	0.9%	1.057	1.075	0.011	1.0%	1.055	1.077
424	Merchant wholesalers, nondurable goods	1.0608	0.0056	0.009	0.9%	1.052	1.070	0.011	1.0%	1.050	1.072
425	Electronic markets and agents and brokers	1.0109	0.0405	0.067	6.6%	0.944	1.077	0.079	7.9%	0.931	1.090
441	Motor vehicle and parts dealers	1.0435	0.0065	0.011	1.0%	1.033	1.054	0.013	1.2%	1.031	1.056
442	Furniture and home furnishings stores	0.9557	0.0125	0.021	2.2%	0.935	0.976	0.025	2.6%	0.931	0.980
443	Electronics and appliance stores	0.9839	0.0122	0.020	2.0%	0.964	1.004	0.024	2.4%	0.960	1.008
444	Building material and garden supply stores	0.9325	0.0060	0.010	1.1%	0.923	0.942	0.012	1.3%	0.921	0.944

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445	Food and beverage stores	0.8398	0.0054	0.009	1.1%	0.831	0.849	0.011	1.3%	0.829	0.850
446	Health and personal care stores	0.8918	0.0066	0.011	1.2%	0.881	0.903	0.013	1.4%	0.879	0.905
447	Gasoline stations	0.8874	0.0107	0.018	2.0%	0.870	0.905	0.021	2.4%	0.867	0.908
448	Clothing and clothing accessories stores	0.8169	0.0078	0.013	1.6%	0.804	0.830	0.015	1.9%	0.802	0.832
451	Sporting goods, hobby, book, and music stores	0.8070	0.0165	0.027	3.4%	0.780	0.834	0.032	4.0%	0.775	0.839
452	General merchandise stores	0.8307	0.0050	0.008	1.0%	0.823	0.839	0.010	1.2%	0.821	0.840
453	Miscellaneous store retailers	0.8294	0.0092	0.015	1.8%	0.814	0.844	0.018	2.2%	0.811	0.847
454	Nonstore retailers	0.9679	0.0095	0.016	1.6%	0.952	0.983	0.019	1.9%	0.949	0.986
481	Air transportation	1.0132	0.0133	0.022	2.2%	0.991	1.035	0.026	2.6%	0.987	1.039
482	Rail transportation	1.1713	0.0216	0.036	3.0%	1.136	1.207	0.042	3.6%	1.129	1.214
483	Water transportation	1.3677	0.0888	0.146	10.7%	1.222	1.514	0.174	12.7%	1.194	1.542
484	Truck transportation	1.2145	0.0082	0.013	1.1%	1.201	1.228	0.016	1.3%	1.198	1.231
485	Transit and ground passenger transportation	0.8989	0.0169	0.028	3.1%	0.871	0.927	0.033	3.7%	0.866	0.932
486	Pipeline transportation	1.1337	0.0234	0.038	3.4%	1.095	1.172	0.046	4.0%	1.088	1.180
487	Scenic and sightseeing transportation	0.8903	0.1171	0.193	21.6%	0.698	1.083	0.230	25.8%	0.661	1.120
488	Support activities for transportation	1.0311	0.0137	0.022	2.2%	1.009	1.054	0.027	2.6%	1.004	1.058
492	Couriers and messengers	0.9665	0.0108	0.018	1.8%	0.949	0.984	0.021	2.2%	0.945	0.988
493	Warehousing and storage	0.9927	0.0092	0.015	1.5%	0.978	1.008	0.018	1.8%	0.975	1.011
511	Publishing industries, except internet	0.9622	0.0089	0.015	1.5%	0.948	0.977	0.017	1.8%	0.945	0.980
512	Motion picture and sound recording industries	0.7840	0.0324	0.053	6.8%	0.731	0.837	0.064	8.1%	0.720	0.848

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515	Broadcasting, except internet	1.0229	0.0114	0.019	1.8%	1.004	1.042	0.022	2.2%	1.001	1.045
517	Telecommunications	1.0661	0.0096	0.016	1.5%	1.050	1.082	0.019	1.8%	1.047	1.085
518	Data processing, hosting and related services	1.0452	0.0193	0.032	3.0%	1.013	1.077	0.038	3.6%	1.007	1.083
519	Other information services	0.8717	0.0143	0.023	2.7%	0.848	0.895	0.028	3.2%	0.844	0.900
522	Credit intermediation and related activities	1.0238	0.0069	0.011	1.1%	1.013	1.035	0.013	1.3%	1.010	1.037
524	Insurance carriers and related activities	1.0243	0.0034	0.006	0.5%	1.019	1.030	0.007	0.6%	1.018	1.031
531	Real estate	0.9656	0.0086	0.014	1.5%	0.952	0.980	0.017	1.7%	0.949	0.982
532	Rental and leasing services	0.9815	0.0194	0.032	3.2%	0.950	1.013	0.038	3.9%	0.943	1.019
541	Professional and technical services	1.0205	0.0031	0.005	0.5%	1.015	1.026	0.006	0.6%	1.014	1.027
551	Management of companies and enterprises	1.0817	0.0139	0.023	2.1%	1.059	1.104	0.027	2.5%	1.055	1.109
561	Administrative and support services	0.9340	0.0039	0.006	0.7%	0.928	0.940	0.008	0.8%	0.926	0.942
562	Waste management and remediation services	1.0713	0.0125	0.021	1.9%	1.051	1.092	0.025	2.3%	1.047	1.096
611	Educational services	0.8712	0.0045	0.007	0.9%	0.864	0.879	0.009	1.0%	0.862	0.880
621	Ambulatory healthcare services	0.9241	0.0033	0.005	0.6%	0.919	0.929	0.006	0.7%	0.918	0.930
622	Hospitals	0.9700	0.0024	0.004	0.4%	0.966	0.974	0.005	0.5%	0.965	0.975
623	Nursing and residential care facilities	0.8931	0.0042	0.007	0.8%	0.886	0.900	0.008	0.9%	0.885	0.901
624	Social assistance	0.8368	0.0056	0.009	1.1%	0.828	0.846	0.011	1.3%	0.826	0.848
711	Performing arts and spectator sports	0.8749	0.0234	0.038	4.4%	0.836	0.913	0.046	5.2%	0.829	0.921
712	Museums, historical sites, zoos, and parks	0.8452	0.0197	0.032	3.8%	0.813	0.878	0.039	4.6%	0.807	0.884

NAICS Code	Industry Title	FTE/EE	Standard Error (SE)	90% Confidence Level				95% Confidence Level			
				Margin of Error MOE = SE*1.645	Relative Margin of Error rMOE = MOE/FTE/EE	CI Lower Bound FTE/EE – MOE	CI Upper Bound FTE/EE + MOE	Margin of Error MOE = SE*1.96	Relative Margin of Error rMOE = MOE/FTE/EE	CI Lower Bound FTE/EE – MOE	CI Upper Bound FTE/EE + MOE
713	Amusements, gambling, and recreation	0.7432	0.0088	0.014	1.9%	0.729	0.758	0.017	2.3%	0.726	0.760
721	Accommodation	0.8902	0.0101	0.017	1.9%	0.874	0.907	0.020	2.2%	0.870	0.910
722	Food services and drinking places	0.7557	0.0034	0.006	0.7%	0.750	0.761	0.007	0.9%	0.749	0.762
811	Repair and maintenance	1.0151	0.0073	0.012	1.2%	1.003	1.027	0.014	1.4%	1.001	1.029
812	Personal and laundry services	0.8505	0.0076	0.012	1.5%	0.838	0.863	0.015	1.7%	0.836	0.865
813	Membership associations and organizations	0.8655	0.0063	0.010	1.2%	0.855	0.876	0.012	1.4%	0.853	0.878
814	Private households	0.7661	0.0237	0.039	5.1%	0.727	0.805	0.046	6.1%	0.720	0.813

Table J.1c Margins of error and confidence intervals for estimates of FTE/EE for MA industries, 2010–2014 ACS data

				90% Confidence Level				95% Confidence Level			
NAICS Code	Industry Title	FTE/EE	Standard Error (SE)	Margin of Error MOE = SE*1.645	Relative Margin of Error rMOE = MOE/FTE/EE	CI Lower Bound FTE/EE – MOE	CI Upper Bound FTE/EE + MOE	Margin of Error MOE = SE*1.96	Relative Margin of Error rMOE = MOE/FTE/EE	CI Lower Bound FTE/EE – MOE	CI Upper Bound FTE/EE + MOE
111	Crop production	0.9470	0.0315	0.052	5.5%	0.895	0.999	0.062	6.5%	0.885	1.009
112	Animal production and aquaculture	0.9047	0.0592	0.097	10.8%	0.807	1.002	0.116	12.8%	0.789	1.021
113	Forestry and logging	0.8947	0.0798	0.131	14.7%	0.763	1.026	0.156	17.5%	0.738	1.051
114	Fishing, hunting, and trapping	1.0784	0.0905	0.149	13.8%	0.930	1.227	0.177	16.5%	0.901	1.256
115	Agriculture and forestry support activities	0.5988	0.1072	0.176	29.4%	0.422	0.775	0.210	35.1%	0.389	0.809
211	Oil and gas extraction	1.1164	0.1003	0.165	14.8%	0.951	1.281	0.197	17.6%	0.920	1.313
212	Mining, except oil and gas	1.1827	0.0580	0.095	8.1%	1.087	1.278	0.114	9.6%	1.069	1.296
213	Support activities for mining	1.2758	0.0815	0.134	10.5%	1.142	1.410	0.160	12.5%	1.116	1.436
221	Utilities	1.0727	0.0074	0.012	1.1%	1.061	1.085	0.014	1.3%	1.058	1.087
23	Construction	1.0266	0.0037	0.006	0.6%	1.021	1.033	0.007	0.7%	1.019	1.034
311	Food manufacturing	0.9785	0.0141	0.023	2.4%	0.955	1.002	0.028	2.8%	0.951	1.006
312	Beverage and tobacco product manufacturing	1.0699	0.0230	0.038	3.5%	1.032	1.108	0.045	4.2%	1.025	1.115
313	Textile mills	1.0589	0.0192	0.032	3.0%	1.027	1.091	0.038	3.6%	1.021	1.097
314	Textile product mills	0.9828	0.0226	0.037	3.8%	0.946	1.020	0.044	4.5%	0.938	1.027
315	Apparel manufacturing	1.0040	0.0310	0.051	5.1%	0.953	1.055	0.061	6.1%	0.943	1.065
316	Leather and allied product manufacturing	1.0025	0.0273	0.045	4.5%	0.958	1.047	0.054	5.3%	0.949	1.056
321	Wood product manufacturing	1.0373	0.0240	0.039	3.8%	0.998	1.077	0.047	4.5%	0.990	1.084
322	Paper manufacturing	1.0763	0.0125	0.020	1.9%	1.056	1.097	0.024	2.3%	1.052	1.101
323	Printing and related support activities	1.0100	0.0093	0.015	1.5%	0.995	1.025	0.018	1.8%	0.992	1.028
324	Petroleum and coal products manufacturing	0.9904	0.0598	0.098	9.9%	0.892	1.089	0.117	11.8%	0.873	1.108
325	Chemical manufacturing	1.0798	0.0052	0.009	0.8%	1.071	1.088	0.010	0.9%	1.070	1.090

NAICS Code	Industry Title	FTE/EE	Standard Error (SE)	90% Confidence Level				95% Confidence Level			
				Margin of Error MOE = SE*1.645	Relative Margin of Error rMOE = MOE/FTE/EE	CI Lower Bound FTE/EE – MOE	CI Upper Bound FTE/EE + MOE	Margin of Error MOE = SE*1.96	Relative Margin of Error rMOE = MOE/FTE/EE	CI Lower Bound FTE/EE – MOE	CI Upper Bound FTE/EE + MOE
326	Plastics and rubber products manufacturing	1.0595	0.0116	0.019	1.8%	1.041	1.079	0.023	2.1%	1.037	1.082
327	Nonmetallic mineral product manufacturing	1.0442	0.0146	0.024	2.3%	1.020	1.068	0.029	2.7%	1.016	1.073
331	Primary metal manufacturing	1.0753	0.0207	0.034	3.2%	1.041	1.109	0.041	3.8%	1.035	1.116
332	Fabricated metal product manufacturing	1.0367	0.0060	0.010	0.9%	1.027	1.046	0.012	1.1%	1.025	1.048
333	Machinery manufacturing	1.0695	0.0078	0.013	1.2%	1.057	1.082	0.015	1.4%	1.054	1.085
334	Computer and electronic product manufacturing	1.0908	0.0040	0.007	0.6%	1.084	1.097	0.008	0.7%	1.083	1.099
335	Electrical equipment and appliance manufacturing	1.0740	0.0117	0.019	1.8%	1.055	1.093	0.023	2.1%	1.051	1.097
336	Transportation equipment manufacturing	1.0991	0.0083	0.014	1.2%	1.085	1.113	0.016	1.5%	1.083	1.115
337	Furniture and related product manufacturing	1.0006	0.0217	0.036	3.6%	0.965	1.036	0.042	4.2%	0.958	1.043
339	Miscellaneous manufacturing	1.0658	0.0060	0.010	0.9%	1.056	1.076	0.012	1.1%	1.054	1.077
423	Merchant wholesalers, durable goods	1.0686	0.0076	0.012	1.2%	1.056	1.081	0.015	1.4%	1.054	1.083
424	Merchant wholesalers, nondurable goods	1.0672	0.0074	0.012	1.1%	1.055	1.079	0.014	1.4%	1.053	1.082
425	Electronic markets and agents and brokers	0.9733	0.0342	0.056	5.8%	0.917	1.030	0.067	6.9%	0.906	1.040
441	Motor vehicle and parts dealers	1.0497	0.0100	0.016	1.6%	1.033	1.066	0.020	1.9%	1.030	1.069
442	Furniture and home furnishings stores	0.9049	0.0173	0.028	3.1%	0.876	0.933	0.034	3.7%	0.871	0.939
443	Electronics and appliance stores	1.0048	0.0142	0.023	2.3%	0.981	1.028	0.028	2.8%	0.977	1.033
444	Building material and garden supply stores	0.9241	0.0100	0.016	1.8%	0.908	0.940	0.020	2.1%	0.905	0.944

NAICS Code	Industry Title	FTE/EE	Standard Error (SE)	90% Confidence Level				95% Confidence Level			
				Margin of Error MOE = SE*1.645	Relative Margin of Error rMOE = MOE/FTE/EE	CI Lower Bound FTE/EE – MOE	CI Upper Bound FTE/EE + MOE	Margin of Error MOE = SE*1.96	Relative Margin of Error rMOE = MOE/FTE/EE	CI Lower Bound FTE/EE – MOE	CI Upper Bound FTE/EE + MOE
445	Food and beverage stores	0.7591	0.0064	0.011	1.4%	0.749	0.770	0.013	1.7%	0.747	0.772
446	Health and personal care stores	0.8348	0.0107	0.018	2.1%	0.817	0.852	0.021	2.5%	0.814	0.856
447	Gasoline stations	0.8979	0.0264	0.043	4.8%	0.854	0.941	0.052	5.8%	0.846	0.950
448	Clothing and clothing accessories stores	0.7638	0.0104	0.017	2.2%	0.747	0.781	0.020	2.7%	0.743	0.784
451	Sporting goods, hobby, book, and music stores	0.7297	0.0219	0.036	4.9%	0.694	0.766	0.043	5.9%	0.687	0.773
452	General merchandise stores	0.7994	0.0075	0.012	1.5%	0.787	0.812	0.015	1.8%	0.785	0.814
453	Miscellaneous store retailers	0.8749	0.0127	0.021	2.4%	0.854	0.896	0.025	2.8%	0.850	0.900
454	Nonstore retailers	1.0201	0.0099	0.016	1.6%	1.004	1.036	0.019	1.9%	1.001	1.039
481	Air transportation	0.9885	0.0243	0.040	4.0%	0.949	1.028	0.048	4.8%	0.941	1.036
483	Water transportation	1.0483	0.0559	0.092	8.8%	0.956	1.140	0.110	10.5%	0.939	1.158
484	Truck transportation	1.0855	0.0136	0.022	2.1%	1.063	1.108	0.027	2.5%	1.059	1.112
485	Transit and ground passenger transportation	0.8385	0.0133	0.022	2.6%	0.817	0.860	0.026	3.1%	0.812	0.865
486	Pipeline transportation	1.1258	0.0533	0.088	7.8%	1.038	1.213	0.104	9.3%	1.021	1.230
487	Scenic and sightseeing transportation	0.8965	0.0550	0.091	10.1%	0.806	0.987	0.108	12.0%	0.789	1.004
488	Support activities for transportation	1.0175	0.0167	0.027	2.7%	0.990	1.045	0.033	3.2%	0.985	1.050
492	Couriers and messengers	0.9796	0.0176	0.029	2.9%	0.951	1.009	0.034	3.5%	0.945	1.014
493	Warehousing and storage	1.0221	0.0208	0.034	3.3%	0.988	1.056	0.041	4.0%	0.981	1.063
511	Publishing industries, except internet	1.0198	0.0076	0.012	1.2%	1.007	1.032	0.015	1.5%	1.005	1.035
512	Motion picture and sound recording industries	0.8651	0.0239	0.039	4.5%	0.826	0.904	0.047	5.4%	0.818	0.912

NAICS Code	Industry Title	FTE/EE	Standard Error (SE)	90% Confidence Level				95% Confidence Level			
				Margin of Error MOE = SE*1.645	Relative Margin of Error rMOE = MOE/FTE/EE	CI Lower Bound FTE/EE – MOE	CI Upper Bound FTE/EE + MOE	Margin of Error MOE = SE*1.96	Relative Margin of Error rMOE = MOE/FTE/EE	CI Lower Bound FTE/EE – MOE	CI Upper Bound FTE/EE + MOE
515	Broadcasting, except internet	1.0230	0.0112	0.018	1.8%	1.005	1.041	0.022	2.1%	1.001	1.045
517	Telecommunications	1.0752	0.0081	0.013	1.2%	1.062	1.089	0.016	1.5%	1.059	1.091
518	Data processing, hosting and related services	1.0796	0.0188	0.031	2.9%	1.049	1.110	0.037	3.4%	1.043	1.116
519	Other information services	0.9329	0.0224	0.037	3.9%	0.896	0.970	0.044	4.7%	0.889	0.977
522	Credit intermediation and related activities	1.0527	0.0086	0.014	1.3%	1.039	1.067	0.017	1.6%	1.036	1.069
524	Insurance carriers and related activities	1.0393	0.0044	0.007	0.7%	1.032	1.047	0.009	0.8%	1.031	1.048
531	Real estate	0.9883	0.0092	0.015	1.5%	0.973	1.003	0.018	1.8%	0.970	1.006
532	Rental and leasing services	1.0251	0.0203	0.033	3.3%	0.992	1.058	0.040	3.9%	0.985	1.065
541	Professional and technical services	1.0598	0.0026	0.004	0.4%	1.056	1.064	0.005	0.5%	1.055	1.065
551	Management of companies and enterprises	1.0838	0.0213	0.035	3.2%	1.049	1.119	0.042	3.8%	1.042	1.125
561	Administrative and support services	0.9397	0.0057	0.009	1.0%	0.930	0.949	0.011	1.2%	0.929	0.951
562	Waste management and remediation services	1.0691	0.0149	0.024	2.3%	1.045	1.094	0.029	2.7%	1.040	1.098
611	Educational services	0.8836	0.0044	0.007	0.8%	0.876	0.891	0.009	1.0%	0.875	0.892
621	Ambulatory healthcare services	0.9139	0.0038	0.006	0.7%	0.908	0.920	0.007	0.8%	0.906	0.921
622	Hospitals	0.9716	0.0041	0.007	0.7%	0.965	0.978	0.008	0.8%	0.963	0.980
623	Nursing and residential care facilities	0.8850	0.0052	0.009	1.0%	0.876	0.894	0.010	1.2%	0.875	0.895
624	Social assistance	0.8408	0.0054	0.009	1.0%	0.832	0.850	0.011	1.2%	0.830	0.851
711	Performing arts and spectator sports	0.8739	0.0211	0.035	4.0%	0.839	0.909	0.041	4.7%	0.833	0.915
712	Museums, historical sites, zoos, and parks	0.8305	0.0208	0.034	4.1%	0.796	0.865	0.041	4.9%	0.790	0.871

NAICS Code	Industry Title	FTE/EE	Standard Error (SE)	90% Confidence Level				95% Confidence Level			
				Margin of Error MOE = SE*1.645	Relative Margin of Error rMOE = MOE/FTE/EE	CI Lower Bound FTE/EE – MOE	CI Upper Bound FTE/EE + MOE	Margin of Error MOE = SE*1.96	Relative Margin of Error rMOE = MOE/FTE/EE	CI Lower Bound FTE/EE – MOE	CI Upper Bound FTE/EE + MOE
713	Amusements, gambling, and recreation	0.7395	0.0119	0.020	2.7%	0.720	0.759	0.023	3.2%	0.716	0.763
721	Accommodation	0.9316	0.0085	0.014	1.5%	0.918	0.946	0.017	1.8%	0.915	0.948
722	Food services and drinking places	0.7849	0.0045	0.007	0.9%	0.777	0.792	0.009	1.1%	0.776	0.794
811	Repair and maintenance	1.0055	0.0087	0.014	1.4%	0.991	1.020	0.017	1.7%	0.988	1.023
812	Personal and laundry services	0.8344	0.0109	0.018	2.1%	0.816	0.852	0.021	2.6%	0.813	0.856
813	Membership associations and organizations	0.8690	0.0088	0.014	1.7%	0.855	0.883	0.017	2.0%	0.852	0.886
814	Private households	0.7709	0.0219	0.036	4.7%	0.735	0.807	0.043	5.6%	0.728	0.814

Table J.2a Margins of error and confidence intervals for estimates of FTE for CA industries, 2010–2014 ACS data

NAICS Code	Industry Title	EE Number of Employees (QCEW EE)	FTE/EE	FTE EE * FTE/EE	90% Confidence Level			
					Lower Bound FTE Estimate EE *(FTE/EE minus MOE)	Upper Bound FTE Estimate EE * (FTE/EE plus MOE)	FTE MOE FTE – Lower Bound FTE Estimate†	FTE rMOE (FTE MOE) /FTE
111	Crop production	171,501	1.0628	182,268	181,453	183,083	815	0.447%
112	Animal production and aquaculture	28,987	1.1321	32,815	32,329	33,302	486	1.482%
113	Forestry and logging	2,747	1.0777	2,960	2,863	3,057	97	3.276%
114	Fishing, hunting, and trapping	460	1.0403	479	438	520	41	8.566%
115	Agriculture and forestry support activities	195,225	1.0548	205,923	203,422	208,425	2,502	1.215%
211	Oil and gas extraction	9,748	1.1631	11,338	11,010	11,666	328	2.894%
212	Mining, except oil and gas	5,246	1.1034	5,788	5,621	5,956	168	2.900%
213	Support activities for mining	13,072	1.2343	16,135	15,768	16,502	367	2.274%
221	Utilities	59,094	1.0680	63,110	62,707	63,513	403	0.639%
23	Construction	586,645	0.9891	580,274	578,894	581,654	1,380	0.238%
311	Food manufacturing	149,106	1.0175	151,717	150,704	152,730	1,013	0.668%
312	Beverage and tobacco product manufacturing	44,491	1.0455	46,514	46,067	46,962	447	0.961%
313	Textile mills	8,682	1.0061	8,735	8,570	8,899	165	1.885%
314	Textile product mills	8,299	1.0163	8,434	8,281	8,587	153	1.811%
315	Apparel manufacturing	56,542	0.9730	55,018	54,591	55,445	427	0.776%
316	Leather and allied product manufacturing	3,469	1.0020	3,476	3,402	3,550	74	2.129%
321	Wood product manufacturing	19,745	1.0266	20,271	20,045	20,497	226	1.114%
322	Paper manufacturing	21,308	1.0584	22,552	22,276	22,827	276	1.222%
323	Printing and related support activities	42,071	0.9954	41,876	41,497	42,255	379	0.906%
324	Petroleum and coal products manufacturing	14,648	1.1112	16,277	16,038	16,516	239	1.469%
325	Chemical manufacturing	75,822	1.0592	80,308	79,896	80,721	413	0.514%
326	Plastics and rubber products manufacturing	44,293	1.0345	45,819	45,422	46,217	398	0.868%
327	Nonmetallic mineral product manufacturing	28,167	1.0373	29,218	28,963	29,473	255	0.872%

NAICS Code	Industry Title	EE Number of Employees (QCEW EE)	FTE/EE	FTE EE * FTE/EE	90% Confidence Level			
					Lower Bound FTE Estimate EE *(FTE/EE minus MOE)	Upper Bound FTE Estimate EE * (FTE/EE plus MOE)	FTE MOE FTE – Lower Bound FTE Estimate†	FTE rMOE (FTE MOE) /FTE
331	Primary metal manufacturing	19,778	1.0517	20,801	20,565	21,038	237	1.137%
332	Fabricated metal product manufacturing	123,392	1.0239	126,345	125,462	127,228	883	0.699%
333	Machinery manufacturing	71,634	1.0550	75,570	75,137	76,004	434	0.574%
334	Computer and electronic product manufacturing	269,399	1.0823	291,579	290,750	292,407	829	0.284%
335	Electrical equipment and appliance manufacturing	29,016	1.0490	30,438	30,187	30,689	251	0.825%
336	Transportation equipment manufacturing	101,899	1.0622	108,240	107,865	108,616	375	0.347%
337	Furniture and related product manufacturing	31,146	0.9833	30,624	30,352	30,897	273	0.890%
339	Miscellaneous manufacturing	82,866	1.0517	87,149	86,795	87,504	354	0.407%
423	Merchant wholesalers, durable goods	319,408	1.0338	330,204	328,591	331,817	1,613	0.489%
424	Merchant wholesalers, nondurable goods	250,974	1.0350	259,756	258,682	260,829	1,073	0.413%
425	Electronic markets and agents and brokers	103,385	0.9886	102,206	99,997	104,416	2,209	2.161%
441	Motor vehicle and parts dealers	167,643	1.0414	174,580	173,598	175,562	982	0.562%
442	Furniture and home furnishings stores	49,955	0.9073	45,324	44,727	45,922	597	1.318%
443	Electronics and appliance stores	65,085	0.9640	62,742	62,242	63,242	500	0.797%
444	Building material and garden supply stores	114,425	0.9172	104,952	103,967	105,936	984	0.938%
445	Food and beverage stores	335,036	0.8927	299,070	297,747	300,393	1,323	0.442%
446	Health and personal care stores	106,300	0.8957	95,215	94,484	95,946	731	0.768%
447	Gasoline stations	51,323	0.9362	48,050	47,338	48,761	712	1.481%
448	Clothing and clothing accessories stores	180,263	0.7802	140,636	139,195	142,077	1,441	1.025%
451	Sporting goods, hobby, book, and music stores	67,752	0.7855	53,220	52,392	54,048	828	1.556%
452	General merchandise stores	297,593	0.8072	240,226	238,704	241,748	1,522	0.634%
453	Miscellaneous store retailers	88,110	0.8309	73,209	72,262	74,155	946	1.293%

NAICS Code	Industry Title	EE Number of Employees (QCEW EE)	FTE/EE	FTE EE * FTE/EE	90% Confidence Level			
					Lower Bound FTE Estimate EE *(FTE/EE minus MOE)	Upper Bound FTE Estimate EE * (FTE/EE plus MOE)	FTE MOE FTE – Lower Bound FTE Estimate†	FTE rMOE (FTE MOE) /FTE
454	Nonstore retailers	38,982	1.0007	39,011	38,517	39,505	494	1.266%
481	Air transportation	42,725	0.9758	41,693	41,203	42,183	490	1.175%
482	Rail transportation	147	1.0979	161	158	165	3	2.090%
483	Water transportation	5,285	1.0676	5,642	5,513	5,771	129	2.282%
484	Truck transportation	108,899	1.1118	121,073	120,116	122,029	957	0.790%
485	Transit and ground passenger transportation	39,100	0.9908	38,741	38,247	39,235	494	1.275%
486	Pipeline transportation	2,831	1.1650	3,298	3,135	3,461	163	4.949%
487	Scenic and sightseeing transportation	3,942	0.9568	3,772	3,594	3,949	178	4.708%
488	Support activities for transportation	78,824	1.0198	80,385	79,703	81,067	682	0.848%
492	Couriers and messengers	57,624	0.9514	54,826	54,224	55,428	602	1.098%
493	Warehousing and storage	69,697	0.9805	68,340	67,703	68,977	637	0.933%
511	Publishing industries, except internet	85,731	1.0229	87,696	86,950	88,442	746	0.851%
512	Motion picture and sound recording industries	141,505	1.0676	151,064	149,646	152,481	1,418	0.938%
515	Broadcasting, except internet	43,708	1.0617	46,407	46,071	46,742	336	0.724%
517	Telecommunications	89,019	1.0650	94,803	94,268	95,337	534	0.564%
518	Data processing, hosting and related services	20,402	1.0977	22,396	21,945	22,847	451	2.013%
519	Other information services	48,199	1.0791	52,012	51,394	52,629	618	1.188%
522	Credit intermediation and related activities	250,756	1.0389	260,520	259,176	261,865	1,345	0.516%
524	Insurance carriers and related activities	181,940	1.0202	185,613	184,832	186,395	781	0.421%
531	Real estate	189,948	0.9674	183,750	182,806	184,694	944	0.514%
532	Rental and leasing services	57,394	0.9768	56,062	55,320	56,805	742	1.324%
541	Professional and technical services	1,101,458	1.0420	1,147,708	1,144,864	1,150,553	2,845	0.248%
55	Management of companies and enterprises	202,528	1.0784	218,402	214,551	222,253	3,851	1.763%
561	Administrative and support services	885,364	0.9382	830,675	827,733	833,617	2,942	0.354%

NAICS Code	Industry Title	EE Number of Employees (QCEW EE)	FTE/EE	FTE EE * FTE/EE	90% Confidence Level			
					Lower Bound FTE Estimate EE *(FTE/EE minus MOE)	Upper Bound FTE Estimate EE * (FTE/EE plus MOE)	FTE MOE FTE – Lower Bound FTE Estimate†	FTE rMOE (FTE MOE) /FTE
562	Waste management and remediation services	42,147	1.0600	44,674	44,284	45,064	390	0.872%
611	Educational services	307,296	0.8533	262,203	260,586	263,821	1,618	0.617%
621	Ambulatory healthcare services	677,737	0.9359	634,287	631,968	636,606	2,319	0.366%
622	Hospitals	372,673	0.9744	363,144	361,844	364,443	1,300	0.358%
623	Nursing and residential care facilities	257,485	0.9391	241,796	240,297	243,296	1,499	0.620%
624	Social assistance	226,517	0.8590	194,580	193,410	195,750	1,170	0.601%
711	Performing arts and spectator sports	63,597	0.9279	59,014	57,992	60,036	1,022	1.732%
712	Museums, historical sites, zoos, and parks	16,111	0.8614	13,879	13,565	14,193	314	2.263%
713	Amusements, gambling, and recreation	175,459	0.8315	145,899	144,811	146,988	1,088	0.746%
721	Accommodation	200,260	0.9390	188,040	186,848	189,233	1,193	0.634%
722	Food services and drinking places	1,133,266	0.8001	906,771	903,565	909,978	3,206	0.354%
811	Repair and maintenance	139,956	0.9833	137,623	136,905	138,341	718	0.522%
812	Personal and laundry services	148,110	0.8742	129,478	128,454	130,501	1,023	0.790%
813	Membership associations and organizations	151,269	0.9014	136,348	135,238	137,458	1,110	0.814%
814	Private households	365,007	0.7789	284,293	279,189	289,397	5,104	1.795%

† Alternatively, the FTE MOE can be calculated by subtracting the FTE estimate from the upper bound FTE estimate.

Table J.2b Margins of error and confidence intervals for estimates of FTE for OH industries, 2010–2014 ACS data

NAICS Code	Industry Title	EE Number of Employees (QCEW EE)	FTE/EE	FTE EE * FTE/EE	90% Confidence Level			
					Lower Bound FTE Estimate EE *(FTE/EE minus MOE)	Upper Bound FTE Estimate EE * (FTE/EE plus MOE)	FTE MOE FTE – Lower Bound FTE Estimate†	FTE rMOE (FTE MOE) /FTE
111	Crop production	7,324	1.014	7,427	7,201	7,653	226	3.0%
112	Animal production and aquaculture	4,811	0.992	4,774	4,497	5,051	277	5.8%
113	Forestry and logging	364	0.975	355	317	393	38	10.8%
114	Fishing, hunting, and trapping	29	1.185	34	31	38	3	9.5%
115	Agriculture and forestry support activities	1,716	1.015	1,741	1,614	1,869	127	7.3%
211	Oil and gas extraction	3,086	1.172	3,617	3,320	3,914	297	8.2%
212	Mining, except oil and gas	5,765	1.205	6,948	6,807	7,088	141	2.0%
213	Support activities for mining	3,389	1.282	4,343	4,203	4,484	141	3.2%
221	Utilities	19,085	1.082	20,656	20,455	20,856	201	1.0%
23	Construction	180,919	1.043	188,621	187,770	189,472	851	0.5%
311	Food manufacturing	56,233	1.039	58,408	57,838	58,978	570	1.0%
312	Beverage and tobacco product manufacturing	6,553	1.083	7,096	6,897	7,294	198	2.8%
313	Textile mills	2,100	1.056	2,218	2,137	2,298	81	3.6%
314	Textile product mills	3,059	1.025	3,134	3,063	3,206	71	2.3%
315	Apparel manufacturing	1,498	1.019	1,526	1,480	1,572	46	3.0%
316	Leather and allied product manufacturing	495	0.975	483	457	509	26	5.4%
321	Wood product manufacturing	11,203	1.066	11,943	11,784	12,102	159	1.3%
322	Paper manufacturing	19,199	1.086	20,848	20,609	21,087	239	1.1%
323	Printing and related support activities	21,795	1.018	22,191	21,889	22,493	302	1.4%
324	Petroleum and coal products manufacturing	4,524	1.119	5,062	4,955	5,170	107	2.1%
325	Chemical manufacturing	44,081	1.097	48,350	48,018	48,681	331	0.7%
326	Plastics and rubber products manufacturing	52,972	1.068	56,548	56,045	57,050	503	0.9%
327	Nonmetallic mineral product manufacturing	25,362	1.080	27,399	27,141	27,657	258	0.9%

NAICS Code	Industry Title	EE Number of Employees (QCEW EE)	FTE/EE	FTE EE * FTE/EE	90% Confidence Level			
					Lower Bound FTE Estimate EE *(FTE/EE minus MOE)	Upper Bound FTE Estimate EE * (FTE/EE plus MOE)	FTE MOE FTE – Lower Bound FTE Estimate†	FTE rMOE (FTE MOE) /FTE
331	Primary metal manufacturing	39,739	1.107	43,988	43,670	44,306	318	0.7%
332	Fabricated metal product manufacturing	103,443	1.078	111,538	110,897	112,180	642	0.6%
333	Machinery manufacturing	73,991	1.094	80,943	80,509	81,378	435	0.5%
334	Computer and electronic product manufacturing	20,517	1.076	22,067	21,771	22,364	297	1.3%
335	Electrical equipment and appliance manufacturing	27,634	1.068	29,518	29,216	29,819	301	1.0%
336	Transportation equipment manufacturing	105,818	1.090	115,348	114,862	115,834	486	0.4%
337	Furniture and related product manufacturing	13,792	1.049	14,465	14,258	14,673	207	1.4%
339	Miscellaneous manufacturing	22,318	1.048	23,390	23,190	23,590	200	0.9%
423	Merchant wholesalers, durable goods	122,827	1.066	130,931	129,777	132,085	1,154	0.9%
424	Merchant wholesalers, nondurable goods	67,995	1.061	72,130	71,507	72,753	623	0.9%
425	Electronic markets and agents and brokers	33,029	1.011	33,387	31,187	35,588	2,200	6.6%
441	Motor vehicle and parts dealers	70,872	1.043	73,951	73,197	74,706	754	1.0%
442	Furniture and home furnishings stores	13,349	0.956	12,757	12,482	13,032	275	2.2%
443	Electronics and appliance stores	17,629	0.984	17,345	16,991	17,700	355	2.0%
444	Building material and garden supply stores	46,864	0.933	43,701	43,240	44,162	461	1.1%
445	Food and beverage stores	105,744	0.840	88,800	87,865	89,734	934	1.1%
446	Health and personal care stores	35,989	0.892	32,096	31,707	32,485	389	1.2%
447	Gasoline stations	33,673	0.887	29,881	29,291	30,471	590	2.0%
448	Clothing and clothing accessories stores	42,517	0.817	34,732	34,189	35,275	543	1.6%
451	Sporting goods, hobby, book and music stores	19,933	0.807	16,086	15,546	16,625	540	3.4%
452	General merchandise stores	119,235	0.831	99,045	98,074	100,016	971	1.0%
453	Miscellaneous store retailers	30,118	0.829	24,979	24,525	25,433	454	1.8%

NAICS Code	Industry Title	EE Number of Employees (QCEW EE)	FTE/EE	FTE EE * FTE/EE	90% Confidence Level			
					Lower Bound FTE Estimate EE *(FTE/EE minus MOE)	Upper Bound FTE Estimate EE * (FTE/EE plus MOE)	FTE MOE FTE – Lower Bound FTE Estimate†	FTE rMOE (FTE MOE) /FTE
454	Nonstore retailers	23,865	0.968	23,099	22,728	23,470	371	1.6%
481	Air transportation	10,690	1.013	10,831	10,596	11,065	234	2.2%
483	Water transportation	630	1.368	862	770	954	92	10.7%
484	Truck transportation	65,789	1.215	79,901	79,013	80,788	887	1.1%
485	Transit and ground passenger transportation	8,981	0.899	8,073	7,824	8,322	249	3.1%
486	Pipeline transportation	1,035	1.134	1,173	1,134	1,213	40	3.4%
487	Scenic and sightseeing transportation	239	0.890	213	167	259	46	21.6%
488	Support activities for transportation	17,773	1.031	18,326	17,927	18,725	399	2.2%
492	Couriers and messengers	19,965	0.966	19,295	18,941	19,649	354	1.8%
493	Warehousing and storage	36,979	0.993	36,711	36,148	37,273	562	1.5%
511	Publishing industries, except internet	26,079	0.962	25,093	24,710	25,476	383	1.5%
512	Motion picture and sound recording industries	5,001	0.784	3,921	3,654	4,188	267	6.8%
515	Broadcasting, except internet	6,656	1.023	6,808	6,683	6,933	125	1.8%
517	Telecommunications	26,465	1.066	28,214	27,794	28,634	420	1.5%
518	Data processing, hosting and related services	4,794	1.045	5,011	4,858	5,163	153	3.0%
519	Other information services	5,482	0.872	4,778	4,650	4,907	129	2.7%
522	Credit intermediation and related activities	94,556	1.024	96,810	95,743	97,877	1,067	1.1%
524	Insurance carriers and related activities	95,481	1.024	97,804	97,275	98,333	529	0.5%
531	Real estate	40,195	0.966	38,812	38,246	39,378	566	1.5%
532	Rental and leasing services	17,193	0.981	16,875	16,326	17,423	548	3.2%
541	Professional and technical services	241,754	1.021	246,712	245,491	247,933	1,221	0.5%
55	Management of companies and enterprises	127,678	1.082	138,108	135,199	141,017	2,909	2.1%
561	Administrative and support services	289,030	0.934	269,948	268,099	271,798	1,850	0.7%
562	Waste management and remediation services	13,878	1.071	14,868	14,582	15,154	286	1.9%

NAICS Code	Industry Title	EE Number of Employees (QCEW EE)	FTE/EE	FTE EE * FTE/EE	90% Confidence Level			
					Lower Bound FTE Estimate EE *(FTE/EE minus MOE)	Upper Bound FTE Estimate EE * (FTE/EE plus MOE)	FTE MOE FTE – Lower Bound FTE Estimate†	FTE rMOE (FTE MOE) /FTE
611	Educational services	93,742	0.871	81,666	80,966	82,366	700	0.9%
621	Ambulatory healthcare services	249,646	0.924	230,685	229,347	232,024	1,339	0.6%
622	Hospitals	239,776	0.970	232,592	231,646	233,539	947	0.4%
623	Nursing and residential care facilities	168,078	0.893	150,102	148,946	151,258	1,156	0.8%
624	Social assistance	90,468	0.837	75,705	74,872	76,539	833	1.1%
711	Performing arts and spectator sports	13,008	0.875	11,381	10,881	11,881	500	4.4%
712	Museums, historical sites, zoos, and parks	6,089	0.845	5,146	4,950	5,343	197	3.8%
713	Amusements, gambling, and recreation	48,572	0.743	36,098	35,397	36,798	701	1.9%
721	Accommodation	33,466	0.890	29,791	29,233	30,348	558	1.9%
722	Food services and drinking places	398,965	0.756	301,482	299,257	303,707	2,225	0.7%
811	Repair and maintenance	42,939	1.015	43,589	43,076	44,102	513	1.2%
812	Personal and laundry services	54,306	0.850	46,186	45,511	46,860	674	1.5%
813	Membership associations and organizations	48,638	0.866	42,098	41,591	42,605	507	1.2%
814	Private households	5,516	0.766	4,226	4,011	4,441	215	5.1%

† Alternatively, the FTE MOE can be calculated by subtracting the FTE estimate from the upper bound FTE estimate.

Table J.2c Margins of error and confidence intervals for estimates of FTE for MA industries, 2010–2014 ACS data

NAICS Code	Industry Title	EE Number of Employees (QCEW EE)	FTE/EE	FTE EE * FTE/EE	90% Confidence Level			
					Lower Bound FTE Estimate EE *(FTE/EE minus MOE)	Upper Bound FTE Estimate EE * (FTE/EE plus MOE)	FTE MOE FTE – Lower Bound FTE Estimate†	FTE rMOE (FTE MOE) /FTE
111	Crop production	3,466	0.9470	3,282	3,103	3,462	180	5.2%
112	Animal production and aquaculture	1,569	0.9047	1,419	1,267	1,572	153	9.7%
113	Forestry and logging	107	0.8947	96	82	110	14	13.1%
114	Fishing, hunting, and trapping	1,477	1.0784	1,593	1,373	1,813	220	14.9%
115	Agriculture and forestry support activities	548	0.5988	328	232	425	97	17.6%
211	Oil and gas extraction	11	1.1164	12	10	14	2	16.5%
212	Mining, except oil and gas	779	1.1827	921	847	996	74	9.5%
213	Support activities for mining	76	1.2758	97	87	107	10	13.4%
221	Utilities	10,259	1.0727	11,005	10,881	11,129	124	1.2%
23	Construction	115,565	1.0266	118,637	117,943	119,331	694	0.6%
311	Food manufacturing	24,017	0.9785	23,500	22,944	24,056	556	2.3%
312	Beverage and tobacco product manufacturing	2,777	1.0699	2,971	2,866	3,076	105	3.8%
313	Textile mills	3,594	1.0589	3,806	3,692	3,919	114	3.2%
314	Textile product mills	1,992	0.9828	1,958	1,884	2,032	74	3.7%
315	Apparel manufacturing	2,122	1.0040	2,131	2,022	2,239	108	5.1%
316	Leather and allied product manufacturing	2,107	1.0025	2,112	2,018	2,207	95	4.5%
321	Wood product manufacturing	2,254	1.0373	2,338	2,249	2,427	89	3.9%
322	Paper manufacturing	8,815	1.0763	9,488	9,307	9,669	181	2.0%
323	Printing and related support activities	11,698	1.0100	11,815	11,636	11,994	179	1.5%
324	Petroleum and coal products manufacturing	761	0.9904	754	679	829	75	9.8%
325	Chemical manufacturing	16,738	1.0798	18,074	17,931	18,218	144	0.9%
326	Plastics and rubber products manufacturing	12,071	1.0595	12,790	12,560	13,019	230	1.9%
327	Nonmetallic mineral product manufacturing	5,336	1.0442	5,572	5,444	5,700	128	2.4%

NAICS Code	Industry Title	EE Number of Employees (QCEW EE)	FTE/EE	FTE EE * FTE/EE	90% Confidence Level			
					Lower Bound FTE Estimate EE *(FTE/EE minus MOE)	Upper Bound FTE Estimate EE * (FTE/EE plus MOE)	FTE MOE FTE – Lower Bound FTE Estimate†	FTE rMOE (FTE MOE) /FTE
331	Primary metal manufacturing	3,439	1.0753	3,698	3,580	3,815	117	3.4%
332	Fabricated metal product manufacturing	32,221	1.0367	33,404	33,088	33,719	315	1.0%
333	Machinery manufacturing	17,781	1.0695	19,016	18,789	19,244	228	1.3%
334	Computer and electronic product manufacturing	57,191	1.0908	62,383	62,004	62,763	379	0.7%
335	Electrical equipment and appliance manufacturing	9,459	1.0740	10,159	9,976	10,341	183	1.9%
336	Transportation equipment manufacturing	13,205	1.0991	14,513	14,333	14,693	180	1.4%
337	Furniture and related product manufacturing	3,982	1.0006	3,984	3,842	4,126	142	3.6%
339	Miscellaneous manufacturing	20,390	1.0658	21,732	21,532	21,932	200	1.0%
423	Merchant wholesalers, durable goods	52,488	1.0686	56,090	55,437	56,742	653	1.2%
424	Merchant wholesalers, nondurable goods	41,736	1.0672	44,539	44,033	45,044	505	1.2%
425	Electronic markets and agents and brokers	27,595	0.9733	26,859	25,306	28,413	1,553	5.6%
441	Motor vehicle and parts dealers	33,786	1.0497	35,463	34,908	36,019	555	1.6%
442	Furniture and home furnishings stores	9,751	0.9049	8,823	8,547	9,100	277	2.8%
443	Electronics and appliance stores	9,567	1.0048	9,613	9,389	9,837	224	2.3%
444	Building material and garden supply stores	24,864	0.9241	22,976	22,569	23,383	407	1.6%
445	Food and beverage stores	97,546	0.7591	74,050	73,023	75,077	1,027	1.1%
446	Health and personal care stores	26,834	0.8348	22,402	21,930	22,873	472	1.8%
447	Gasoline stations	12,027	0.8979	10,799	10,276	11,322	523	4.3%
448	Clothing and clothing accessories stores	35,141	0.7638	26,841	26,238	27,444	603	1.7%
451	Sporting goods, hobby, book, and music stores	15,145	0.7297	11,052	10,506	11,597	545	3.6%
452	General merchandise stores	50,973	0.7994	40,748	40,120	41,376	628	1.2%
453	Miscellaneous store retailers	18,032	0.8749	15,776	15,399	16,153	377	2.1%

NAICS Code	Industry Title	EE Number of Employees (QCEW EE)	FTE/EE	FTE EE * FTE/EE	90% Confidence Level			
					Lower Bound FTE Estimate EE *(FTE/EE minus MOE)	Upper Bound FTE Estimate EE * (FTE/EE plus MOE)	FTE MOE FTE – Lower Bound FTE Estimate†	FTE rMOE (FTE MOE) /FTE
454	Nonstore retailers	11,999	1.0201	12,240	12,044	12,435	196	1.6%
481	Air transportation	7,277	0.9885	7,193	6,903	7,484	290	4.0%
483	Water transportation	832	1.0483	872	796	949	77	9.2%
484	Truck transportation	14,402	1.0855	15,633	15,311	15,955	322	2.2%
485	Transit and ground passenger transportation	20,567	0.8385	17,245	16,794	17,696	451	2.2%
486	Pipeline transportation	148	1.1258	167	154	180	13	8.8%
487	Scenic and sightseeing transportation	1,185	0.8965	1,062	955	1,170	107	9.1%
488	Support activities for transportation	6,706	1.0175	6,823	6,639	7,008	184	2.7%
492	Couriers and messengers	10,812	0.9796	10,592	10,280	10,904	312	2.9%
493	Warehousing and storage	8,939	1.0221	9,136	8,831	9,442	306	3.4%
511	Publishing industries, except internet	41,461	1.0198	42,282	41,766	42,797	516	1.2%
512	Motion picture and sound recording industries	5,949	0.8651	5,146	4,913	5,380	234	3.9%
515	Broadcasting, except internet	4,862	1.0230	4,974	4,885	5,063	89	1.8%
517	Telecommunications	18,745	1.0752	20,154	19,903	20,405	251	1.3%
518	Data processing, hosting, and related services	6,735	1.0796	7,271	7,063	7,479	208	3.1%
519	Other information services	8,956	0.9329	8,355	8,026	8,684	329	3.7%
522	Credit intermediation and related activities	56,502	1.0527	59,477	58,681	60,272	796	1.4%
524	Insurance carriers and related activities	63,512	1.0393	66,006	65,542	66,470	464	0.7%
531	Real estate	30,082	0.9883	29,729	29,273	30,186	457	1.5%
532	Rental and leasing services	10,212	1.0251	10,468	10,127	10,808	340	3.3%
541	Professional and technical services	265,946	1.0598	281,855	280,726	282,984	1,129	0.4%
55	Management of companies and enterprises	63,272	1.0838	68,571	66,356	70,786	2,215	3.5%
561	Administrative and support services	152,939	0.9397	143,718	142,282	145,155	1,437	0.9%
562	Waste management and remediation services	10,449	1.0691	11,171	10,915	11,427	256	2.4%

NAICS Code	Industry Title	EE Number of Employees (QCEW EE)	FTE/EE	FTE EE * FTE/EE	90% Confidence Level			
					Lower Bound FTE Estimate EE *(FTE/EE minus MOE)	Upper Bound FTE Estimate EE * (FTE/EE plus MOE)	FTE MOE FTE – Lower Bound FTE Estimate†	FTE rMOE (FTE MOE) /FTE
611	Educational services	131,490	0.8836	116,190	115,236	117,144	954	0.7%
621	Ambulatory healthcare services	159,554	0.9139	145,810	144,823	146,797	987	0.6%
622	Hospitals	183,867	0.9716	178,645	177,393	179,897	1,252	0.7%
623	Nursing and residential care facilities	100,935	0.8850	89,325	88,455	90,195	870	0.9%
624	Social assistance	75,876	0.8408	63,794	63,125	64,463	669	0.9%
711	Performing arts and spectator sports	10,433	0.8739	9,117	8,756	9,479	362	3.5%
712	Museums, historical sites, zoos, and parks	5,270	0.8305	4,377	4,196	4,557	181	3.4%
713	Amusements, gambling, and recreation	34,837	0.7395	25,762	25,079	26,446	684	2.0%
721	Accommodation	33,232	0.9316	30,958	30,493	31,422	464	1.4%
722	Food services and drinking places	242,021	0.7849	189,950	188,151	191,750	1,800	0.7%
811	Repair and maintenance	24,446	1.0055	24,581	24,232	24,930	349	1.4%
812	Personal and laundry services	38,517	0.8344	32,140	31,449	32,830	691	1.8%
813	Membership associations and organizations	39,341	0.8690	34,187	33,617	34,757	570	1.4%
814	Private households	38,557	0.7709	29,725	28,335	31,115	1,390	3.6%

† Alternatively, the FTE MOE can be calculated by subtracting the FTE estimate from the upper bound FTE estimate.

APPENDIX K –
DETAILED TABLES FOR WASHINGTON STATE ESTIMATES IN SECTION 8

Appendix K presents detailed numerical results corresponding to figures in Section 8. It compares calculations of FTEs, claim rates, claim rate ranks, PIs, and prevention index ranks using different data sources (ACS, OPT, and QCEW) and different methods of calculating FTE/EE with ACS data (v1, which is proposed, and an alternative, v2). Calculations are based on 2014 data for 3-digit NAICS industries in Washington State. Tables K.1–K.5 focus, in order, on FTEs, claim rates, claim rate ranks, PIs, and PI ranks. Note that ACS and OPT results are derived by multiplying employment figures from QCEW by FTE/EE estimates from ACS and OPT data. Further details on calculations and data are discussed in the introduction to Section 8.

Table K.1 Denominators, WA 2014

	NAICS	Industry Title	FTE ACSv1†	FTE ACSv2†	FTE OTP	EE QCEW
0	**Total**	**Total private sector**	**2,432,484.1**	**2,330,768.5**	**2,114,026.2**	**2,518,960**
1	111	Crop production	70,254.6	60,105.1	68,216.5	66,380
2	112	Animal production and aquaculture	6,644.6	6,409.2	7,523.9	6,523
3	113	Forestry and logging	4,571.3	4,419.1	4,371.3	4,083
4	114	Fishing, hunting, and trapping	1,594.4	1,412.0	1,499.7	1,423
5	115	Agriculture and forestry support activities	21,813.8	20,601.5	22,543.1	21,256
6	211	Oil and gas extraction	7.9	8.0	7.0	7
7	212	Mining, except oil and gas	2,379.5	2,317.3	2,182.0	1,999
8	213	Support activities for mining	317.4	268.6	219.5	186
9	221	Utilities	5,064.7	5,090.2	4,655.1	4,770
10	236	Construction of buildings	38,099.4	36,131.3	35,523.8	36,952
11	237	Heavy and civil engineering construction	18,918.7	17,941.5	19,848.1	18,349
12	238	Specialty trade contractors	97,729.1	92,680.8	93,031.4	94,786
13	311	Food manufacturing	36,945.6	34,461.6	35,507.6	36,104
14	312	Beverage and tobacco product mfg.	6,356.3	6,258.0	6,208.9	6,551
15	313	Textile mills	362.7	270.9	373.4	369
16	314	Textile product mills	2,157.1	2,152.5	2,084.1	2,205
17	315	Apparel manufacturing	1,476.0	1,338.4	1,505.4	1,532
18	316	Leather and allied product mfg.	374.1	357.0	384.5	384
19	321	Wood product manufacturing	14,576.6	14,259.6	13,637.2	13,303
20	322	Paper manufacturing	9,039.0	9,149.5	8,171.3	8,019
21	323	Printing and related support activities	5,522.8	5,453.7	4,993.5	5,354
22	324	Petroleum and coal products mfg.	2,656.1	2,647.9	2,651.0	2,465
23	325	Chemical manufacturing.	6,551.4	6,438.3	6,249.3	6,231
24	326	Plastics and rubber products mfg.	9,031.7	8,750.5	8,681.6	8,513

	NAICS	Industry Title	FTE ACSv1†	FTE ACSv2†	FTE OTP	EE QCEW
25	327	Nonmetallic mineral product mfg.	9,675.9	9,625.9	9,351.4	8,999
26	331	Primary metal manufacturing.	6,341.6	6,200.6	6,007.7	5,753
27	332	Fabricated metal product mfg.	20,355.8	20,449.2	19,510.5	19,128
28	333	Machinery manufacturing	16,931.3	16,744.8	16,171.7	15,695
29	334	Computer and electronic product mfg.	21,710.3	21,708.9	19,619.3	19,908
30	335	Electrical equipment and appliance mfg.	5,002.3	4,958.8	4,776.3	4,861
31	336	Transportation equipment mfg.	112,066.9	111,897.4	105,522.4	103,378
32	337	Furniture and related product mfg.	6,168.8	6,099.8	5,834.9	5,848
33	339	Miscellaneous manufacturing	11,070.9	10,934.8	10,404.7	10,756
34	423	Merchant wholesalers, durable goods	64,772.9	64,331.8	57,170.0	60,351
35	424	Merchant wholesalers, nondurable goods	46,059.4	43,904.3	41,025.8	44,152
36	425	Electronic markets and agents and brokers	22,796.0	21,861.5	20,968.2	23,375
37	441	Motor vehicle and parts dealers	40,655.4	39,630.3	36,379.4	38,773
38	442	Furniture and home furnishings stores	9,106.2	8,590.8	7,165.8	9,342
39	443	Electronics and appliance stores	9,013.9	8,940.0	8,314.0	8,885
40	444	Building material and garden supply stores	24,919.8	23,858.0	21,311.7	26,671
41	445	Food and beverage stores	53,537.1	50,367.9	47,010.5	63,575
42	446	Health and personal care stores	14,613.9	14,241.1	12,201.0	16,376
43	447	Gasoline stations	12,148.9	11,423.3	10,187.6	12,870
44	448	Clothing and clothing accessories stores	18,701.0	17,256.1	13,167.5	22,356
45	451	Sporting goods, hobby, book, and music stores	13,489.8	12,385.1	10,362.4	16,658
46	452	General merchandise stores	60,635.1	57,291.6	53,770.1	72,828
47	453	Miscellaneous store retailers	17,483.6	16,147.8	15,674.1	21,173
48	454	Nonstore retailers	31,191.5	29,921.5	25,098.6	27,595
49	481	Air transportation	11,684.8	11,698.6	8,548.3	11,243
50	482	Rail transportation	N	N	N	N
51	483	Water transportation	4,500.3	4,086.2	3,809.3	3,729
52	484	Truck transportation	26,204.2	25,183.0	23,479.4	22,898
53	485	Transit and ground passenger transportation	6,575.9	6,300.0	5,473.8	6,794
54	486	Pipeline transportation	N	N	N	N
55	487	Scenic and sightseeing transportation	740.8	737.4	557.0	711
56	488	Support activities for transportation	21,499.8	21,105.6	18,179.0	19,808
57	492	Couriers and messengers	10,512.9	10,108.5	9,094.3	10,854
58	493	Warehousing and storage	10,959.9	10,418.3	10,479.3	10,596

	NAICS	Industry Title	FTE ACSv1†	FTE ACSv2†	FTE OTP	EE QCEW
59	511	Publishing industries, except internet	63,966.2	62,894.1	54,069.6	61,903
60	512	Motion picture and sound recording industries	4,140.8	3,439.0	3,546.5	5,503
61	515	Broadcasting, except internet	4,015.0	3,996.1	3,139.9	3,817
62	517	Telecommunications	23,621.6	23,368.5	20,457.5	22,166
63	518	Data processing, hosting, and related services	5,776.9	5,739.4	4,902.8	5,435
64	519	Other information services	10,698.8	10,225.3	8,358.4	10,049
65	521	Monetary authorities - central bank	N	N	N	N
66	522	Credit intermediation and related activities	41,671.9	40,819.5	35,550.8	40,171
67	523	Securities, commodity contracts, investments	NA	NA	10,493.2	11,865
68	524	Insurance carriers and related activities	39,484.6	39,365.1	34,620.7	38,682
69	525	Funds, trusts, and other financial vehicles	N	N	N	N
70	531	Real estate	36,864.0	35,983.8	30,892.4	37,855
71	532	Rental and leasing services	8,378.7	8,222.8	7,167.8	8,031
72	533	Lessors of nonfinancial intangible assets	NA	NA	191.3	206
73	541	Professional and technical services	186,389.0	182,364.4	154,952.8	177,218
74	551	Management of companies and enterprises	41,156.1	40,367.7	34,849.8	39,919
75	561	Administrative and support services	126,294.0	114,907.7	115,545.9	134,351
76	562	Waste management and remediation services	14,616.7	14,541.9	14,546.7	14,007
77	611	Educational services	31,557.0	29,225.6	29,542.8	38,472
78	621	Ambulatory health care services	126,096.7	123,020.8	105,040.9	137,498
79	622	Hospitals	75,056.8	73,383.5	64,433.6	77,466
80	623	Nursing and residential care facilities	57,726.5	54,670.7	49,022.0	62,850
81	624	Social assistance	97,167.0	90,896.3	79,705.7	114,742
82	711	Performing arts and spectator sports	7,759.1	7,161.0	6,300.1	9,329
83	712	Museums, historical sites, zoos, and parks	2,113.4	1,974.2	1,790.7	2,708
84	713	Amusements, gambling, and recreation	28,036.6	25,799.1	20,911.8	34,625
85	721	Accommodation	28,274.1	25,843.1	23,155.8	31,167
86	722	Food services and drinking places	168,802.1	152,727.4	143,073.9	215,537
87	811	Repair and maintenance	25,122.4	24,067.0	23,294.9	25,408
88	812	Personal and laundry services	25,554.2	24,366.4	21,620.4	30,247
89	813	Membership associations and organizations	23,542.1	22,976.0	20,149.4	27,481
90	814	Private households	4,945.2	4,506.8	6,555.7	6,303

Notes: NAICS 491 omitted. See Section 4 and Appendix A; ACS data were not reported for codes 523 and 533 in 2014 for Washington State; NA = Not available; N indicates nondisclosure screening, which is run so that individual company data are not revealed or discernible in published data—N pertains to codes 482, 486, 521, and 525.

† 2014 ACS-based adjustment factors (FTE/EE for ACSv1 and ACSv2) are calculated using 2014 and 2015 data so that the survey responses are centered on the year 2014. See first subsection of Section 7.

Table K.2 Private sector claim rates, WA 2014

	NAICS	Industry Title	ACSv1†	ACSv2†	OTP	QCEW
0	**Total**	**Total Private Sector**	**4.41**	**4.60**	**5.08**	**4.26**
1	111	Crop production	6.94	8.11	7.14	7.34
2	112	Animal production and aquaculture	10.10	10.47	8.92	10.29
3	113	Forestry and logging	11.09	11.47	11.60	12.42
4	114	Fishing, hunting, and trapping	3.20	3.61	3.40	3.58
5	115	Agriculture and forestry support activities	10.29	10.89	9.95	10.56
6	212	Mining, except oil and gas	6.30	6.47	6.87	7.50
7	213	Support activities for mining	6.93	8.19	10.02	11.83
8	221	Utilities	4.60	4.58	5.01	4.88
9	236	Construction of buildings	8.69	9.17	9.32	8.96
10	237	Heavy and civil engineering construction	7.14	7.52	6.80	7.36
11	238	Specialty trade contractors	8.58	9.04	9.01	8.84
12	311	Food manufacturing	6.69	7.17	6.96	6.85
13	312	Beverage and tobacco product mfg.	8.23	8.36	8.42	7.98
14	313	Textile mills	9.65	12.92	9.37	9.49
15	314	Textile product mills	4.22	4.23	4.37	4.13
16	315	Apparel manufacturing	1.56	1.72	1.53	1.50
17	316	Leather and allied product mfg.	5.88	6.16	5.72	5.73
18	321	Wood product manufacturing	8.69	8.88	9.28	9.52
19	322	Paper manufacturing	4.55	4.49	5.03	5.13
20	323	Printing and related support activities	2.55	2.59	2.82	2.63
21	324	Petroleum and coal products mfg.	2.22	2.23	2.23	2.39
22	325	Chemical manufacturing	3.66	3.73	3.84	3.85
23	326	Plastics and rubber products mfg.	5.88	6.07	6.12	6.24
24	327	Nonmetallic mineral product mfg.	6.97	7.00	7.21	7.49
25	331	Primary metal manufacturing	10.83	11.08	11.44	11.94
26	332	Fabricated metal product mfg.	8.66	8.62	9.04	9.22
27	333	Machinery manufacturing	5.66	5.72	5.92	6.10
28	334	Computer and electronic product mfg.	1.13	1.13	1.25	1.23
29	335	Electrical equipment and appliance mfg.	2.76	2.78	2.89	2.84
30	336	Transportation equipment mfg.	4.81	4.82	5.11	5.22
31	337	Furniture and related product mfg.	7.33	7.41	7.75	7.73

	NAICS	Industry Title	ACSv1†	ACSv2†	OTP	QCEW
32	339	Miscellaneous manufacturing	2.95	2.99	3.14	3.04
33	423	Merchant wholesalers, durable goods	4.25	4.28	4.82	4.57
34	424	Merchant wholesalers, nondurable goods	7.43	7.79	8.34	7.75
35	425	Electronic markets and agents and brokers	1.70	1.77	1.85	1.66
36	441	Motor vehicle and parts dealers	5.32	5.45	5.94	5.57
37	442	Furniture and home furnishings stores	5.15	5.46	6.55	5.02
38	443	Electronics and appliance stores	2.98	3.01	3.24	3.03
39	444	Building material and garden supply stores	7.40	7.72	8.65	6.91
40	445	Food and beverage stores	5.33	5.66	6.06	4.48
41	446	Health and personal care stores	3.15	3.24	3.78	2.82
42	447	Gasoline stations	3.00	3.19	3.57	2.83
43	448	Clothing and clothing accessories stores	3.52	3.81	5.00	2.94
44	451	Sporting goods, hobby, book, and music stores	3.40	3.70	4.42	2.75
45	452	General merchandise stores	5.08	5.38	5.73	4.23
46	453	Miscellaneous store retailers	6.44	6.97	7.18	5.32
47	454	Nonstore retailers	1.09	1.14	1.35	1.23
48	481	Air transportation	5.93	5.92	8.11	6.16
49	483	Water transportation	0.07	0.07	0.08	0.08
50	484	Truck transportation	7.84	8.16	8.75	8.97
51	485	Transit and ground passenger transportation	7.66	8.00	9.21	7.42
52	487	Scenic and sightseeing transportation	1.48	1.49	1.97	1.55
53	488	Support activities for transportation	3.98	4.05	4.70	4.32
54	492	Couriers and messengers	9.09	9.46	10.51	8.81
55	493	Warehousing and storage	3.60	3.79	3.77	3.73
56	511	Publishing industries, except internet	0.26	0.27	0.31	0.27
57	512	Motion picture and sound recording industries	2.49	3.00	2.90	1.87
58	515	Broadcasting, except internet	1.05	1.05	1.34	1.10
59	517	Telecommunications	1.60	1.62	1.85	1.71
60	518	Data processing, hosting and related services	0.62	0.63	0.73	0.66
61	519	Other information services	0.22	0.23	0.29	0.24
62	522	Credit intermediation and related activities	0.74	0.76	0.87	0.77
63	524	Insurance carriers and related activities	0.54	0.54	0.62	0.55
64	531	Real estate	4.12	4.22	4.91	4.01
65	532	Rental and leasing services	6.13	6.25	7.17	6.40

	NAICS	Industry Title	ACSv1†	ACSv2†	OTP	QCEW
66	541	Professional and technical services	1.24	1.27	1.49	1.30
67	551	Management of companies and enterprises	0.17	0.18	0.21	0.18
68	561	Administrative and support services	5.16	5.67	5.64	4.85
69	562	Waste management and remediation services	7.06	7.10	7.09	7.37
70	611	Educational services	1.85	2.00	1.98	1.52
71	621	Ambulatory health care services	2.97	3.04	3.56	2.72
72	622	Hospitals	6.03	6.17	7.02	5.84
73	623	Nursing and residential care facilities	6.82	7.20	8.03	6.26
74	624	Social assistance	2.15	2.30	2.62	1.82
75	711	Performing arts and spectator sports	4.55	4.93	5.60	3.78
76	712	Museums, historical sites, zoos, and parks	4.21	4.51	4.97	3.29
77	713	Amusements, gambling, and recreation	2.66	2.89	3.56	2.15
78	721	Accommodation	6.03	6.60	7.37	5.47
79	722	Food services and drinking places	4.71	5.21	5.56	3.69
80	811	Repair and maintenance	7.26	7.57	7.83	7.17
81	812	Personal and laundry services	3.02	3.17	3.58	2.56
82	813	Membership associations and organizations	5.31	5.44	6.21	4.55
83	814	Private households	0.81	0.89	0.61	0.63

Notes: NAICS 211 estimates not reported. The QCEW count for 211 is extremely low and therefore a small error in the count can lead to a large error in the claim rate estimate. The computed claim rate is implausibly high. See Section 8; NAICS 482, 486, 491, 521, 523, 525, and 533 were omitted. See notes to Table K.1.

† 2014 ACS-based adjustment factors (FTE/EE for ACSv1 and ACSv2) are calculated using 2014 and 2015 data so that the survey responses are centered on the year 2014. See first subsection of Section 7.

Table K.3 Claim rate ranks, WA 2014

(1 = highest claim rate; 85 = lowest claim rate)

	NAICS	Industry Title	ACSv1†	ACSv2†	OTP	QCEW
1	111	Crop production	21	14	25	21
2	112	Animal production and aquaculture	4	5	12	5
3	113	Forestry and logging	1	2	1	1
4	114	Fishing, hunting, and trapping	54	54	59	51
5	115	Agriculture and forestry support activities	3	4	5	4
6	212	Mining, except oil and gas	26	27	29	16
7	213	Support activities for mining	22	12	4	3
8	221	Utilities	42	43	44	38
9	236	Construction of buildings	7	7	7	10
10	237	Heavy and civil engineering construction	18	19	30	20
11	238	Specialty trade contractors	10	8	11	11
12	311	Food manufacturing (mfg.)	24	22	28	24
13	312	Beverage and tobacco product mfg.	11	11	15	13
14	313	Textile mills	5	1	6	7
15	314	Textile product mills	46	47	51	45
16	315	Apparel manufacturing	70	69	71	71
17	316	Leather and allied product mfg.	31	30	38	31
18	321	Wood product manufacturing	8	9	8	6
19	322	Paper manufacturing	44	45	43	36
20	323	Printing and related support activities	63	64	64	61
21	324	Petroleum and coal products mfg.	65	66	66	63
22	325	Chemical manufacturing	50	52	52	47
23	326	Plastics and rubber products mfg.	32	31	33	27
24	327	Nonmetallic mineral product mfg.	20	24	22	17
25	331	Primary metal manufacturing	2	3	2	2
26	332	Fabricated metal product mfg.	9	10	10	8
27	333	Machinery manufacturing	33	33	36	29
28	334	Computer and electronic product mfg.	73	74	75	74
29	335	Electrical equipment and appliance mfg.	61	63	63	56
30	336	Transportation equipment mfg.	40	42	42	35
31	337	Furniture and related product mfg.	16	20	20	15

	NAICS	Industry Title	ACSv1†	ACSv2†	OTP	QCEW
32	339	Miscellaneous manufacturing	60	61	61	53
33	423	Merchant wholesalers, durable goods	45	46	48	40
34	424	Merchant wholesalers, nondurable goods	14	16	16	14
35	425	Electronic markets and agents and brokers	68	68	70	68
36	441	Motor vehicle and parts dealers	35	37	35	32
37	442	Furniture and home furnishings stores	38	36	31	37
38	443	Electronics and appliance stores	58	59	60	54
39	444	Building material and garden supply stores	15	17	14	23
40	445	Food and beverage stores	34	35	34	42
41	446	Health and personal care stores	55	55	53	58
42	447	Gasoline stations	57	56	56	57
43	448	Clothing and clothing accessories stores	52	50	45	55
44	451	Sporting goods, hobby, book, and music stores	53	53	50	59
45	452	General merchandise stores	39	39	37	44
46	453	Miscellaneous store retailers	25	25	23	34
47	454	Nonstore retailers	74	73	73	73
48	481	Air transportation	30	32	17	28
49	483	Water transportation	83	83	83	83
50	484	Truck transportation	12	13	13	9
51	485	Transit and ground passenger transportation	13	15	9	18
52	487	Scenic and sightseeing transportation	71	71	68	69
53	488	Support activities for transportation	49	49	49	43
54	492	Couriers and messengers	6	6	3	12
55	493	Warehousing and storage	51	51	54	49
56	511	Publishing industries, except internet	80	80	80	80
57	512	Motion picture and sound recording industries	64	60	62	65
58	515	Broadcasting, except internet	75	75	74	75
59	517	Telecommunications	69	70	69	67
60	518	Data processing, hosting, and related services	78	78	77	77
61	519	Other information services	81	81	81	81
62	522	Credit intermediation and related activities	77	77	76	76
63	524	Insurance carriers and related activities	79	79	78	79
64	531	Real estate	48	48	47	46
65	532	Rental and leasing services	27	28	24	25

	NAICS	Industry Title	ACSv1†	ACSv2†	OTP	QCEW
66	541	Professional and technical services	72	72	72	72
67	551	Management of companies and enterprises	82	82	82	82
68	561	Administrative and support services	37	34	39	39
69	562	Waste management and remediation services	19	23	26	19
70	611	Educational services	67	67	67	70
71	621	Ambulatory health care services	59	58	58	60
72	622	Hospitals	29	29	27	30
73	623	Nursing and residential care facilities	23	21	18	26
74	624	Social assistance	66	65	65	66
75	711	Performing arts and spectator sports	43	41	40	48
76	712	Museums, historical sites, zoos, and parks	47	44	46	52
77	713	Amusements, gambling, and recreation	62	62	57	64
78	721	Accommodation	28	26	21	33
79	722	Food services and drinking places	41	40	41	50
80	811	Repair and maintenance	17	18	19	22
81	812	Personal and laundry services	56	57	55	62
82	813	Membership associations and organizations	36	38	32	41
83	814	Private households	76	76	79	78

Notes: NAICS 211, 482,486,491, 521,523,525,533 were omitted. See notes to Tables K.1 and K.2.

† 2014 ACS-based adjustment factors (FTE/EE for ACSv1 and ACSv2) are calculated using 2014 and 2015 data so that the survey responses are centered on the year 2014. See first subsection of Section 7.

Table K.4 Prevention indices, WA 2014

Low PI suggests a high number of claims and high claim rate

	NAICS	Industry Title	ACSv1†	ACSv2†	OTP	QCEW
1	111	Crop production	13	9.5	15	13
2	112	Animal production and aquaculture	21	21.5	25	21.5
3	113	Forestry and logging	22.5	23	22.5	22.5
4	114	Fishing, hunting, and trapping	63.5	63.5	66	62
5	115	Agriculture and forestry support activities	9.5	10	10.5	10
6	212	Mining, except oil and gas	45.5	46	47	40.5
7	213	Support activities for mining	51	46	42	41.5
8	221	Utilities	52	52.5	53	50
9	236	Construction of buildings	8.5	8.5	8.5	10
10	237	Heavy and civil engineering construction	21.5	22	27.5	22.5
11	238	Specialty trade contractors	5.5	4.5	6	6
12	311	Food manufacturing (mfg.)	19	18	21	19
13	312	Beverage and tobacco product mfg.	26.5	26.5	28.5	27.5
14	313	Textile mills	41	39	41.5	42
15	314	Textile product mills	57.5	58	60	57
16	315	Apparel manufacturing	74.5	74	75	75
17	316	Leather and allied product mfg.	55.5	55	59	55.5
18	321	Wood product manufacturing	17	17.5	17	16
19	322	Paper manufacturing	47	47.5	46.5	43
20	323	Printing and related support activities	64.5	65	65	63.5
21	324	Petroleum and coal products mfg.	68.5	69	69	67.5
22	325	Chemical manufacturing	55.5	56.5	56.5	54
23	326	Plastics and rubber products mfg.	36.5	36	37	34
24	327	Nonmetallic mineral product mfg.	28.5	30.5	29.5	27
25	331	Primary metal manufacturing	19	19.5	19	19
26	332	Fabricated metal product mfg.	15.5	16	16	15
27	333	Machinery manufacturing	31.5	31.5	33	29.5
28	334	Computer and electronic product mfg.	66.5	67	67.5	67
29	335	Electrical equipment and appliance mfg.	64	65	65	61.5
30	336	Transportation equipment mfg.	22	23	23	19.5
31	337	Furniture and related product mfg.	32.5	34.5	34.5	32

	NAICS	Industry Title	ACSv1†	ACSv2†	OTP	QCEW
32	339	Miscellaneous manufacturing	58.5	59	59	55
33	423	Merchant wholesalers, durable goods	29	29.5	30.5	26.5
34	424	Merchant wholesalers, nondurable goods	11.5	12.5	12.5	11.5
35	425	Electronic markets and agents and brokers	60	60	61	60
36	441	Motor vehicle and parts dealers	26	27	26	24.5
37	442	Furniture and home furnishings stores	42	41	38.5	41.5
38	443	Electronics and appliance stores	58.5	59	59.5	56.5
39	444	Building material and garden supply stores	17.5	18.5	17	21.5
40	445	Food and beverage stores	23	23.5	23	27
41	446	Health and personal care stores	51	51	50	52.5
42	447	Gasoline stations	55.5	55	55	55.5
43	448	Clothing and clothing accessories stores	45.5	44.5	42	47
44	451	Sporting goods, hobby, book, and music stores	50.5	50.5	49	53.5
45	452	General merchandise stores	25	25	24	27.5
46	453	Miscellaneous store retailers	26.5	26.5	25.5	31
47	454	Nonstore retailers	65	64.5	64.5	64.5
48	481	Air transportation	32.5	33.5	26	31.5
49	483	Water transportation	82.5	82.5	82.5	82.5
50	484	Truck transportation	15.5	16	16	14
51	485	Transit and ground passenger transportation	29	30	27	31.5
52	487	Scenic and sightseeing transportation	76	76	74.5	75
53	488	Support activities for transportation	40.5	40.5	40.5	37.5
54	492	Couriers and messengers	18.5	18.5	17	21.5
55	493	Warehousing and storage	51	51	52.5	50
56	511	Publishing industries, except internet	72	72	72	72
57	512	Motion picture and sound recording industries	66	64	65	66.5
58	515	Broadcasting, except internet	74.5	74.5	74	74.5
59	517	Telecommunications	61	61.5	61	60
60	518	Data processing, hosting and related services	77	77	76.5	76.5
61	519	Other information services	79.5	79.5	79.5	79.5
62	522	Credit intermediation and related activities	67.5	67.5	67	67
63	524	Insurance carriers and related activities	71	71	70.5	71
64	531	Real estate	36	36	35.5	35
65	532	Rental and leasing services	35	35.5	33.5	34

	NAICS	Industry Title	ACSv1†	ACSv2†	OTP	QCEW
66	541	Professional and technical services	43.5	43.5	43.5	43.5
67	551	Management of companies and enterprises	76.5	76.5	76.5	76.5
68	561	Administrative and support services	20	18.5	21	21
69	562	Waste management and remediation services	24	26	27.5	24
70	611	Educational services	53.5	53.5	53.5	55
71	621	Ambulatory health care services	33.5	33	33	34
72	622	Hospitals	17.5	17.5	16.5	18
73	623	Nursing and residential care facilities	15	14	12.5	16.5
74	624	Social assistance	42	41.5	41.5	42
75	711	Performing arts and spectator sports	49	48	47.5	51.5
76	712	Museums, historical sites, zoos, and parks	58.5	57	58	61
77	713	Amusements, gambling, and recreation	48	48	45.5	49
78	721	Accommodation	25.5	24.5	22	28
79	722	Food services and drinking places	21.5	21	21.5	26
80	811	Repair and maintenance	19	19.5	20	21.5
81	812	Personal and laundry services	44.5	45	44	47.5
82	813	Membership associations and organizations	31.5	32.5	29.5	34
83	814	Private households	75.5	75.5	77	76.5

Notes: NAICS 211, 482, 486, 491, 521, 523, 525, and 533 were omitted. See notes to Tables K.1 and K.2.

† 2014 ACS-based adjustment factors (FTE/EE for ACSv1 and ACSv2) are calculated using 2014 and 2015 data so that the survey responses are centered on the year 2014. See first subsection of Section 7.

Table K.5 Prevention index ranks, WA 2014

	NAICS	Industry Title	ACSv1†	ACSv2†	OTP	QCEW
1	111	Crop production	5	3	5	4
2	112	Animal production and aquaculture	13	13	17	13
3	113	Forestry and logging	16	15	14	14
4	114	Fishing, hunting, and trapping	49	53	54	49
5	115	Agriculture and forestry support activities	3	4	3	2
6	212	Mining, except oil and gas	36	39	38	29
7	213	Support activities for mining	41	39	33	30
8	221	Utilities	42	44	43	37
9	236	Construction of buildings	2	2	2	2
10	237	Heavy and civil engineering construction	14	14	21	14
11	238	Specialty trade contractors	1	1	1	1
12	311	Food manufacturing	11	9	11	10
13	312	Beverage and tobacco product mfg.	22	20	22	20
14	313	Textile mills	32	32	32	31
15	314	Textile product mills	45	49	50	45
16	315	Apparel manufacturing	59	62	62	58
17	316	Leather and allied product mfg.	44	46	48	43
18	321	Wood product mfg.	8	8	8	7
19	322	Paper manufacturing	37	40	37	32
20	323	Printing and related support activities	51	56	53	50
21	324	Petroleum and coal products mfg.	56	59	57	54
22	325	Chemical manufacturing	44	47	46	41
23	326	Plastics and rubber products mfg.	30	31	29	26
24	327	Nonmetallic mineral product mfg.	23	24	23	19
25	331	Primary metal manufacturing	11	11	9	10
26	332	Fabricated metal product mfg.	7	7	6	6
27	333	Machinery manufacturing	25	25	25	22
28	334	Computer and electronic product mfg.	54	57	56	53
29	335	Electrical equipment and appliance mfg.	50	56	53	48
30	336	Transportation equipment mfg.	15	15	15	11
31	337	Furniture and related product mfg.	26	29	27	25

	NAICS	Industry Title	ACSv1†	ACSv2†	OTP	QCEW
32	339	Miscellaneous manufacturing	46	50	48	42
33	423	Merchant wholesalers, durable goods	24	22	24	18
34	424	Merchant wholesalers, nondurable goods	4	5	4	3
35	425	Electronic markets and agents and brokers	47	51	51	46
36	441	Motor vehicle and parts dealers	21	21	19	16
37	442	Furniture and home furnishings stores	33	34	30	30
38	443	Electronics and appliance stores	46	50	49	44
39	444	Building material and garden supply stores	9	10	8	13
40	445	Food and beverage stores	17	16	15	19
41	446	Health and personal care stores	41	43	41	39
42	447	Gasoline stations	44	46	45	43
43	448	Clothing and clothing accessories stores	36	37	33	34
44	451	Sporting goods, hobby, book, and music stores	40	42	40	40
45	452	General merchandise stores	19	18	16	20
46	453	Miscellaneous store retailers	22	20	18	23
47	454	Nonstore retailers	52	55	52	51
48	481	Air transportation	26	28	19	24
49	483	Water transportation	65	69	66	61
50	484	Truck transportation	7	7	6	5
51	485	Transit and ground passenger transportation	24	23	20	24
52	487	Scenic and sightseeing transportation	61	65	61	58
53	488	Support activities for transportation	31	33	31	28
54	492	Couriers and messengers	10	10	8	13
55	493	Warehousing and storage	41	43	42	37
56	511	Publishing industries, except internet	58	61	59	56
57	512	Motion picture and sound recording industries	53	54	53	52
58	515	Broadcasting, except internet	59	63	60	57
59	517	Telecommunications	48	52	51	46
60	518	Data processing, hosting, and related services	63	67	63	59
61	519	Other information services	64	68	65	60
62	522	Credit intermediation and related activities	55	58	55	53
63	524	Insurance carriers and related activities	57	60	58	55
64	531	Real estate	29	31	28	27
65	532	Rental and leasing services	28	30	26	26

	NAICS	Industry Title	ACSv1†	ACSv2†	OTP	QCEW
66	541	Professional and technical services	34	36	34	33
67	551	Management of companies and enterprises	62	66	63	59
68	561	Administrative and support services	12	10	11	12
69	562	Waste management and remediation services	18	19	21	15
70	611	Educational services	43	45	44	42
71	621	Ambulatory health care services	27	27	25	26
72	622	Hospitals	9	8	7	9
73	623	Nursing and residential care facilities	6	6	4	8
74	624	Social assistance	33	35	32	31
75	711	Performing arts and spectator sports	39	41	39	38
76	712	Museums, historical sites, zoos, and parks	46	48	47	47
77	713	Amusements, gambling, and recreation	38	41	36	36
78	721	Accommodation	20	17	13	21
79	722	Food services and drinking places	14	12	12	17
80	811	Repair and maintenance	11	11	10	13
81	812	Personal and laundry services	35	38	35	35
82	813	Membership associations and organizations	25	26	23	26
83	814	Private households	60	64	64	59

Notes: NAICS 211, 482, 486, 491, 521, 523, 525, and 533 were omitted. See notes to Tables K.1 and K.2.

† 2014 ACS-based adjustment factors (FTE/EE for ACSv1 and ACSv2) are calculated using 2014 and 2015 data so the survey responses are centered on the year 2014. See first subsection of Section 7.

APPENDIX L – ESTIMATES OF FTE/EE FOR 4-DIGIT NAICS INDUSTRIES WHEN STATE-LEVEL ACS DATA ARE NOT AVAILABLE

This appendix provides details of the analysis summarized at the end of Section 4. The purpose of that analysis is to evaluate options to address the lack of data for many 4-digit industries in state-level ACS data. This problem is mainly due to ACS use of the census industry coding system that only includes counterparts for about half of the 4-digit NAICS codes. It is also due to confidentiality protections and smaller samples sizes on the state level that do not allow production of usable statistics for some 4-digit NAICS industries. If it is desired to calculate claim rates for 4-digit industries, other options for obtaining reasonable FTE/EE estimates must be considered.

Three options are illustrated in Table L.1 for the food manufacturing sector in TN. Food manufacturing is NAICS code 311, and it contains nine 4-digit codes for more specific food manufacturing industries. In TN, ACS data provide FTE/EE estimates for five of these industries, but not for the other four. One option for obtaining FTE/EE estimates for these four industries is to use the corresponding 3-digit FTE/EE ratio instead. See Option #1 in Table L.1. However, this entails inaccuracies, particularly for dairy product manufacturing (3115), but also for bakeries and tortilla manufacturing. More generally, as seen in Section 2, Table 2.8, 12.8% of 4-digit FTE/EEs at the national level were more than 10% different from the FTE/EE for the corresponding 3-digit industry.

A second option is to use FTE/EE estimates from national ACS data. This is because they include data for some 4-digit industries for which ACS data are not always available at the state level, particularly for smaller states. However, in the case of Tennessee food manufacturing, this is not the case. Tennessee data actually provide FTE/EE estimates for all five 4-digit NAICS codes available at the national level. See option #2 in Table L.1.

Examining Tennessee food manufacturing industries where state-level FTE/EE estimates are available, we can see that national-level ACS estimates are fairly close to those at the state level. The exception is dairy product manufacturing, which is quite high at the state level but much lower at the national level. This illustrates the general point that using national-level 4-digit estimates of FTE/EE is not ideal because state-level FTE/EE ratios for any individual industry differ among states. See Appendix B, which shows variation among states within industries.

A third option is to use an adjusted 4-digit NAICS FTE/EE estimate from national OPT data. This has the drawback of ignoring variation among states. However, it has the advantage of providing FTE/EE estimates for all 4-digit NAICS industries, including those unavailable in ACS data at any level. Because OPT estimates are generally lower than ACS estimates, an adjustment is needed to make OPT FTE/EE estimates comparable with the ACS estimates already available for other industries.[106] The overall ACS/OPT ratio of FTE/EE estimates [(ACS FTE/EE)/(OPT FTE/EE)] might be used as an adjustment factor as follows:

ACS/OPT ratio * OPT 4-digit industry FTE/EE estimate = Adjusted OPT 4-digit estimate.

However, the difference between ACS FTE/EE and OPT FTE/EE varies by industry. Consequently, it is better to use ACS/OPT ratios of FTE/EE at the specific 3-digit industry level as adjustment factors. See Option #3 in Table L.1 for an example of results using this method. Adjusted OPT estimates in Table L.1 are reasonably close to state-level 4-digit ACS estimates, except for dairy product manufacturing.

106 See Section 2 and Appendix E about the comparison of ACS and OPT estimates. See Figure 2.3 for a comparison of the overall, annual ACS and OPT FTE/EE ratios. Figures 2.4 and 2.5 illustrate industry differences at the 3-digit level.

Table L.1 Three alternative estimates of FTE/EE when state-level 4-digit-industry ACS data are not available

Example of food manufacturing in Tennessee (NAICS 311)

		Option #1		Option #2	Option #3	
NAICS Code	Industry Title	FTE/EE TN 4-digit ACS	FTE/EE TN 3-digit ACS	FTE/EE U.S. 4-digit ACS	FTE/EE U.S. 4-digit Adjustment OPT	TN Employees
311	Food manufacturing		1.0626			32,659
3111	Animal food manufacturing	NA	1.0626	NA	1.1282	498
3112	Grain and oilseed milling	NA	1.0626	NA	1.1359	1,868
3113	Sugar & confectionery product manufacturing	1.0611	1.0626	1.0317	1.0917	2,538
3114	Fruit & vegetable preserving & specialty	1.0426	1.0626	1.0778	1.0699	3,730
3115	Dairy product manufacturing	1.2477	1.0626	1.0885	1.0691	2,196
3116	Animal slaughtering and processing	1.0594	1.0626	1.0446	1.0649	11,131
3117	Seafood product preparation and packaging	NA	1.0626	NA	0.9582	NA
3118	Bakeries and tortilla manufacturing	0.9898	1.0626	0.9654	0.9804	6,171
3119	Other food manufacturing	NA	1.0626	NA	1.0056	4,527

The example in Table L.1 indicates that both the national ACS data and the national OPT data provided somewhat better approximations to estimates based on state-level 4-digit data than did state-level 3-digit ACS data. But the important question is, which source provides better approximations to estimates based on state-level 4-digit data on average across all industries and states?

This can be investigated by focusing on all industries in all states for which we have a good state-level 4-digit ACS estimate. We can compare these estimates to the estimates from the three alternative data sources, just as in Table L.1. Using 2014 ACS data, we identified 5,149 4-digit, state-level estimates available in the ACS that were reasonably accurate (rMOE greater than zero and less than 0.15). This total excluded industries for which rMOE is zero because that indicates very small samples. The total also excluded industries for which QCEW employment estimates were zero or not available as that also indicates very small samples or a possibility of industry miscoding.

For each method, the absolute values of the differences between the alternative estimate and the state-level 4-digit ACS estimate were totaled. The results indicated that the sum of differences was very similar for state-level 3-digit and national 4-digit ACS estimates, but substantially greater for the adjusted national 4-digit OPT estimates. It is also algebraically possible to translate these denominator differences into relative differences in claim rate estimates. The relative difference in claim rate is the difference in the claim rate due to a difference in the denominator estimate, divided by the claim rate based on the state-level 4-digit ACS denominator.[107] Results of this calculation were similar to the results for the sum of absolute differences in FTE/EE. The state-level 3-digit estimates and national 4-digit ACS estimates yielded about the same total amount of difference from the estimates based on state-level 4-digit ACS data, but the adjusted OPT 4-digit estimates yielded about 31% more difference than did the state-level 3-digit estimates. As a third comparative metric, the relative differences in claim rates were squared and summed to place more weight on larger errors. The results again showed similar levels of difference for the state-level 3-digit ACS and the national 4-digit ACS, but greater difference for OPT data.

The calculations above also provided information on the distribution of differences from the preferred, state-level 4-digit ACS estimates. The median relative difference in the claim rate caused by using the state-level 3-digit ACS estimate was 3%. The mean was 4.6%, and 95% of the relative differences in claim rate were less than 14%. Extreme differences between 30% and 56% were obtained in 0.43% of cases. These differences in claim rate due to use of 3-digit ACS data are not the total amount of claim rate error, because there is also error associated with uncertainty in the state-level 4-digit estimates. However, not all of these differences represent error that adds to the sampling error. Although these differences sometimes represent an additional magnitude of difference from the true value, they sometimes cancel out part or all of the sampling error associated with the 4-digit estimate.[108]

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107 The relative difference in the claim rate due to using an alternative FTE estimate can be expressed as follows, where C represents number of claims, FTE represents an FTE estimate based on the preferred, state-level 4-digit ACS estimate of FTE/EE, and EstFTE represents an alternative FTE estimate such as one based on the state-level 3-digit ACS estimate of FTE/EE:

$$\left[\frac{C}{FTE\left(\frac{EstFTE}{FTE}\right)} - \frac{C}{FTE}\right] \div \frac{C}{FTE}$$

Multiplying top and bottom by FTE/C, we get $\frac{1}{\frac{EstFTE}{FTE}} - 1$ or $\frac{FTE}{EstFTE} - 1$

Note that the value of this last expression can be calculated by substituting a ratio of FTE/EE estimates for the ratio of FTE estimates. That is, instead of using FTE, use FTE/EE based on state-level 3-digit data, and instead of using EstFTE, use FTE/EE based on one of the alternative FTE/EE estimates. This provides the correct value because the ratio of FTE estimates is always equal to the corresponding ratio of FTE/EE estimates. This can be seen by dividing the top and bottom of $\frac{FTE}{EstFTE}$ by the number of employees obtained from the QCEW, yielding the ratio of FTE/EE estimates.

108 For example, if a sampling error causes an estimate to exceed the true value, the alternative state-level 3-digit estimate may be still higher, thereby adding to the total amount of error. However, the 3-digit estimate may be lower than the 4-digit estimate. This would cancel out some or all of the sampling error. Although, if the estimate is low enough, it could still result in a total error of greater magnitude than the sampling error.

The conclusion is that using the state-level 3-digit FTE/EE when the state-level 4-digit FTE/EE is unavailable is probably the best choice overall. First, it appears to be as similar to state-level 4-digit FTE/EE, on average, as the national 4-digit ACS FTE/EE and notably more similar to state-level 4-digit FTE/EE on average than the adjusted national 4-digit OPT FTE/EE. Second, the state-level 3-digit FTE/EE is convenient to use because there is no need to make use of national data as well as state data.

Given that there will sometimes be some substantial inaccuracy due to using a 3-digit rather than a 4-digit FTE/EE, there may be some hesitancy to rely upon the 3-digit FTE/EE. However, the potential inaccuracy should be kept in perspective. A state-level 3-digit FTE/EE or national-level 4-digit FTE/EE may not differ from the true state-level value by enough to alter how industries are ranked by claim rate for the setting of prevention priorities. See Section 8 that compares results using ACS state-level data with results using national OPT data (for 3-digit industries).

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