Quarterly Workforce Indicators 101

Local Employment Dynamics

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United States Census Bureau

The Quarterly Workforce Indicators (QWI)

This document provides a basic introduction to the construction and interpretation of the QWI. For a more complete discussion of the methodology, see *The LEHD Infrastructure Files and the Creation of the Quarterly Workforce Indicators*[1].

Overview

The Quarterly Workforce Indicators (QWI) provide local labor market statistics by industry, worker demographics, employer age and size. Unlike statistics tabulated from firm or person-level data, the QWI source data are unique job-level data that link workers to their employers. Because of this link, labor market data in the QWI is available by worker age, sex, educational attainment, and race/ethnicity. This allows for analysis by demographics of a particular local labor market or industry – for instance, identifying industries with aging workforces. Links between workers and firms also allow the QWI to identify worker flows – hires, separations, and turnover – as well as net employment growth. As most hiring activity is the consequence of worker turnover rather than employment growth, a focus on employment growth alone may misrepresent employment opportunity in the local labor market. Wages by industry and demographics as well as by whether the worker was newly hired are also available. QWI wages for new hires can be compared to wages for continuing workers, and wage growth for similar workers across industries can be compared to identify important local labor market trends.

The source data for the QWI is the Longitudinal Employer-Household Dynamics (LEHD) linked employer-employee microdata. The LEHD data is massive longitudinal database covering over 95% of U.S. private sector jobs. Much of this data is collected via a unique federal-state data sharing collaboration, the Local Employment Dynamics (LED) partnership. LED is a cooperative venture between the LEHD program at the U.S. Census Bureau and state agencies of all 50 states, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands[2]. Partner states voluntarily submit quarterly data files from existing administrative record systems, which are combined with a range of other data sources to generate public use products, including QWI and LODES (LEHD Origin-Destination Employment Statistics, presented in OnTheMap) and other new products in development. By integrating data used to administer public programs with existing census and surveys, a new national jobs database is generated at very low cost and with no additional respondent burden.

Data Sources

A wide variety of record sources contribute to the construction of the QWI, including the administrative records on employment collected by the states, Social Security data, Federal tax records, and other census and survey data. The following lists the main data inputs:

[1] Abowd, et. al., *The LEHD Infrastructure Files and the Creation of the Quarterly Workforce Indicators*, 2006 (https://lehd.ces.census.gov/doc/technical_paper/tp-2006-01.pdf).

[2] Data for Puerto Rico, and the US Virgin Islands are under development.

Unemployment Insurance Earnings Data (UI)

All employers that are covered by unemployment insurance submit quarterly earnings reports for all employees. These records are part of the administration of the state's UI system, used for purposes such as the calculation of UI benefits. This data provides employment and earnings data at the job level (a worker at a firm).

Quarterly Census of Employment and Wages (QCEW)

The QCEW is a firm-based data frame, collected at the state level. This provides detailed information about employers, such as industry, worksite locations, and ownership.

Business Dynamics Statistics (BDS)

Firm age and size is obtained from the BDS, which is a product of the Longitudinal Business Database maintained at the Census Bureau. Only private sector firms are included in the BDS.

Demographic Data Sources

Demographic information about the worker, such as age, sex, race, ethnicity, education, and place of residence, comes from a variety of sources, including the 2000 and 2010 Census, American Community Survey, Social Security administrative records and individual tax returns. These are linked to the UI earnings data using the Protected Identification Key (PIK), which is an encoded Social Security Number (SSN).

Data Linkages

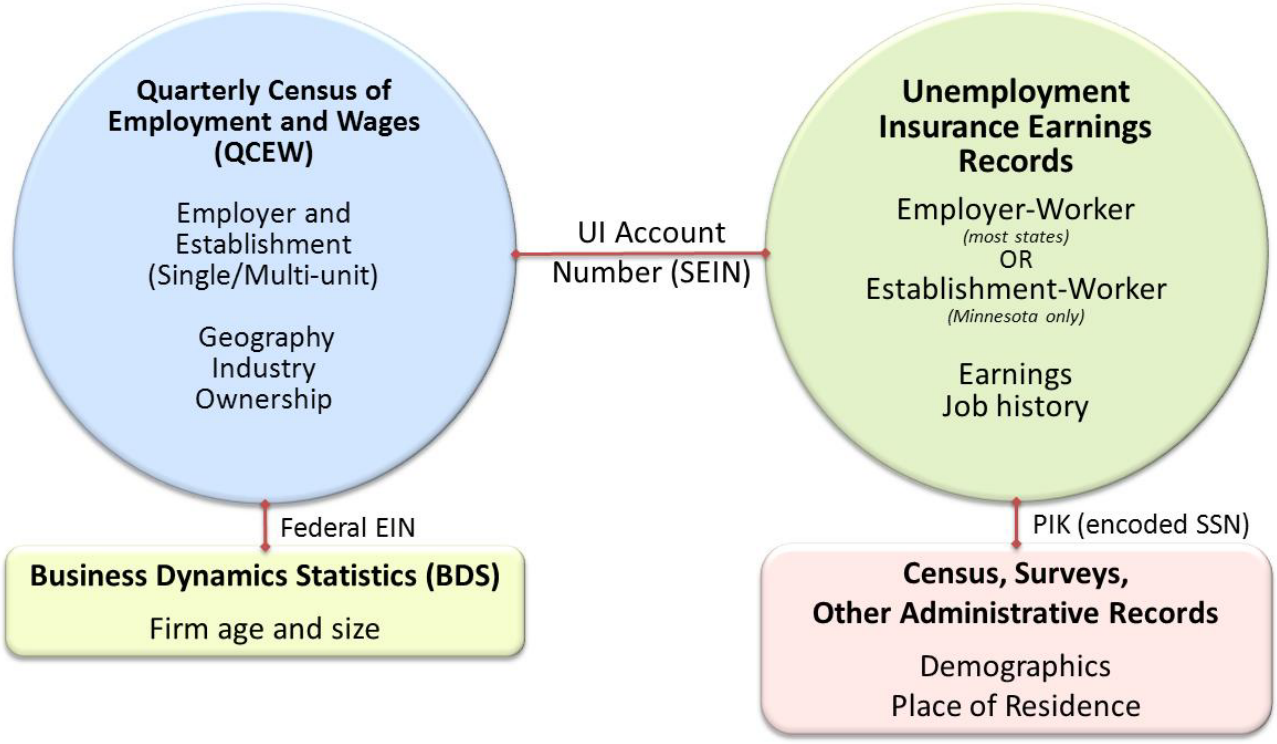
Basic QWI Concepts

The QWI are constructed from job level data, linking an individual to an employer at a point in time. The following table describes the key concepts that are used to define the job.

Concept	Description
Employer	A single account in a given state's unemployment wage reporting system, referred to as State Employer Identification Number (SEIN). State-based Employers may be linked across states to a national firm, via the Federal Employer Identification Number (EIN).
Establishment	A physical place of work within an employer (SEINUNIT). A single employer may have one or many establishments (single-unit employer or multi-unit employer)
Employee	A single worker, identified by Social Security Number (SSN), encoded to Protected Identification Key (PIK)
Dates	Earnings for each PIK are reported on a quarterly basis, on the calendar year (January-March=Q1, April-June=Q2, etc.).
Job	The association of an individual PIK with an establishment in a given year and quarter. An individual PIK may have multiple jobs within a single quarter. The entire job history for an individual, including all jobs across all years and quarters, can be referenced in the calculation of QWI measures.

Data Diagram

The numerous input data sources are linked using a set of common identifiers. The following diagram displays the important relationships between the data sources.



Data Frame and Coverage

Job Frame

The QWI use a job based frame, where every job is the relationship of an individual with a firm. A job exists when a firm reports that the individual received earnings in a calendar quarter. Individuals may hold more than one job in any quarter – for example, a person may have both a day and a night job, or work for one employer in the first month of the quarter, and a second employer in the rest of the quarter. The job frame is comparable to that for the QCEW[3], though employment counts may vary due to a variety of reason related to definitions, data sources, methodology, and other factors.

Covered Employment

UI-covered employment represents 96% of wage and salary civilian jobs in the United States[4], counting private, state and local, and federal government employment. At this time, however, Federal employment has not been integrated into the regular releases of the QWI. Limited beta releases of QWI data containing federal employment have been made available for selected states. Examples of jobs that are not covered by UI include some agricultural jobs, railroad employment, self-employment, and other exceptions that vary from state to state.

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[3]Bureau of Labor Statistics, Quarterly Census of Employment and Wages, Overview, https://www.bls.gov/cew/cewover.htm
[4]BLS Handbook of Methods, Quarterly Census of Employment and Wages, https://www.bls.gov/opub/hom/cew/pdf/cew.pdf.

QWI Aggregation Categories[5]

The QWI are aggregated from the job level to establishments, and then to a number of higher level categories for public release. These categories are interacted in various combinations on the public release files. Within the public release files, totals for each category are included along with detailed components.

Demographic Categories

The demographic categories available on the QWI include age, sex, race, ethnicity, and educational attainment. The interactions selected for publication include:

- Sex by Age *[sa]*
- Race by Ethnicity *[rh]*
- Sex by Education *[se]*
    - Educational attainment is reported only for workers who are age 25 and up.

Detail: Demographic Categories

The demographic categories reported in the QWI follow:

Sex	Male
	Female
Age	14-18
	19-21
	22-24
	25-34
	35-44
	45-54
	55-64
	65-99
Race	White Alone
	Black or African American Alone
	American Indian or Alaska Native Alone
	Asian Alone
	Native Hawaiian or Other Pacific Islander Alone
	Two or More Race Groups
Ethnicity	Not Hispanic or Latino
	Hispanic or Latino
Education	Less than high school
	High school or equivalent, no college
	Some college or Associate degree
	Bachelor's degree or advanced degree
	Educational attainment not available (workers aged 24 or younger)

[5]The abbreviations used to reference each category on the full public release file are included in brackets. For more details on the data schema, see https://lehd.ces.census.gov/data/schema/latest/lehd_public_use_schema.html.

Ownership

Ownership distinguishes between private sector and public sector employment. These are reported in the QWI as two separate categories:

- All *[oslp]*
  - includes state and local government employment, as well as private employment
- All Private *[op]*
  - Includes only private sector employment

Geography

Geography is based on the place of work, using TIGER/Line Census geographies (see https://lehd.ces.census.gov/data/schema/latest/lehd_public_use_schema.html#_geography for information on the current vintage of geographies in the QWI). Regions are reported at four different levels:

- State *[gs]*
- County or County equivalent *[gc]*
- Metropolitan/Micropolitan Area *[gm]*
  - State part of each metropolitan/micropolitan area (CBSA - Core Based Statistical Area)
  - Non-CBSA employment assigned to a statewide residual category
- Workforce Investment Area *[gw]*
  - State-established regions, as defined under the Workforce Investment Act of 1998

Industry

For all quarters, industry is reported using NAICS codes (see https://lehd.ces.census.gov/data/schema/latest/lehd_public_use_schema.html#_industry for information on the current vintage of NAICS in the QWI). NAICS5 and NAICS6 are not reported for sub-state geographic levels. The following detailed levels are released:

- Total, all industries
- NAICS Sectors *[ns]*
- NAICS Subsectors *[n3]*
- NAICS Industry Groups *[n4]*
- NAICS Industries *[n5]*
- NAICS National Industries *[n6]*

Firm Age and Size

Firm age and size are defined at the national level, rather than the state level. A national firm may frequently be larger or older than the part of that firm found in any one state. Note that firm size refers to the national employment size of the firm on March 12th of the previous year. For new firms, firm size is measured as the current year's March employment (or the employment in the first month of positive employment if born after March). Firm age and size are reported only for private sector firms and are not interacted with each other. Industry detail is also limited, as NAICS3 and NAICS4 are not reported for sub-state geographic levels.

- Firm Age *[fa]*

- Firm Size *[fs]*
- Firm Age and Size not included *[f]*

Detail: Firm Age and Size

The firm age and size categories reported in the QWI follow:

Firm Age	0-1 Years
	2-3 Years
	4-5 Years
	6-10 Years
	11+ Years
Firm Size	0-19 Employees
	20-49 Employees
	50-249 Employees
	250-499 Employees
	500+ Employees

The QWI Time Series

Data Availability

Time is reported on the QWI by specifying a year and calendar quarter (Jan-Mar, Apr-Jun, Jul-Sep, Oct-Nov). The extent of the time series available will vary by state, based on the availability of historical data when joining the partnership. The earliest state time series begin in 1990. As each state is processed independently, the latest available data across states may also vary at any point in time. Not all measures will be present in all quarters, as most require leading or lagging data for calculation. In addition, the most recent data available for firm age and size tabulations will be one quarter behind other tabulations because of additional input data requirements.

QWI Data Releases

The QWI are produced on a quarterly schedule. The latest available data is three quarters behind the production quarter. For example, the QWI data released in the fourth quarter of 2013 will contain QWI up to the first quarter of 2013. States are released separately on a rolling basis throughout the calendar quarter, with production expected to be completed by the last day of the quarter. In the event that data submission or data quality issues are encountered, QWI production for a state may be skipped for one or several quarters, until the issue can be resolved.

Updates and Revisions

The complete QWI time series is recalculated with every release, so numbers may change in any quarter. These changes are due to a number of factors, including:

- Updates to input files (primarily UI and QCEW)
  - States typically make a second submission of the previous quarter's data in every quarter, to improve completeness of data reporting. Historical files may be resubmitted to improve data quality.
  - Other input data sources are also periodically updated.
- Modifications to algorithms to develop estimates

- The data quality of the QWI is continuously reviewed, and the algorithms are periodically modified to improve the results. These modifications may affect measures throughout the time series.

- Stochastic changes to imputations used to complete missing information
  - Random draws are used to generate data that are missing. These draws may change between production runs, though longitudinal consistency is generally maintained within a data release.

We recommend that users do not combine data from different QWI releases. Metadata indicating the data release is provided along with QWI data files. This metadata file will specify both the release quarter as well as the quarters of data included in the tables.

The Longitudinal Job History

	-5	-4	-3	-2	-1	*t*	+1	+2	+3	+4	+5
Measure			●	●		$	✕				

All QWI are based on longitudinal job histories linking an individual with an employer over time. The earnings histories are developed from quarterly reports of individual earnings, which are reported by the employer as part of the unemployment insurance system. Most measures count the number of individuals in each quarter with a specified job history. The above hypothetical measure requires the following to be true in an employee's job history with a given employer:

	The employee received earnings from the employer in quarters *t-1* and *t*
●	The employee received earnings in at least one of *t-3* and *t-2*, though not necessarily both quarters
✕	The employee did not receive earnings in t+1
	Other quarters are not considered in the computation of this measure
$	A dollar sign ($) indicates which quarter in the job history is referenced to calculate average or total earnings.

If the employee's job history with the given employer matches the pattern specified in quarter *t*, the job will be counted towards the calculation of the measure in the reference quarter *t*. A single worker may have jobs at many employers in the same calendar quarter, and each job is counted separately.

The following subscripts are used in the technical definitions of the QWI:
i = employee *(PIK)*
j = specific establishment within an employer *(SEINUNIT)*
t =reference quarter *[i.e., (t-1)=previous quarter, (t+1)=following quarter]*

Other QWI Terms

The following additional terms and concepts are commonly used in the descriptions of QWI measures:

Stable (or Full-Quarter) Employment – When an individual receives earnings from the same employer for three consecutive quarters, it is inferred that the individual was employed for the whole of the middle quarter. Many QWI measures are provided with stable and non-stable versions.

Point-in-Time Employment – Because earnings are reported quarterly, there is no direct information as to whether an individual is employed on a given day. So, when an individual receives earnings from the same

employer in consecutive quarters, that individual is interpreted as having had an active job on the boundary between the quarters.

Hire (or Accession) – A hire is indicated when an individual reports earnings for an employer in one quarter, but did not report earnings in the previous quarter. There are a number of measures related to hires contained in the QWI, with variations in the duration of employment and previous job history.

Separation –A separation is indicated when a job is present in one quarter, but is not present in the following quarter. The QWI include a number of different measures with variations in timing and duration. Voluntary separations (retirement, new job) and involuntary separations (layoff, firing) cannot be separately identified.

Average Monthly Earnings – For measures that are reported as averages, earnings are aggregated across all individuals who match the job history required, and the mean is calculated. The mean is then divided by three, to generate the monthly average.

Full-Quarter Earnings – Most average earnings measures are based on stable jobs. The number of hours worked is not available, so an hourly or weekly wage figure cannot be calculated. However, using stable jobs suggests that an employee had an ongoing relationship with the employer throughout the quarter. Therefore, earnings are representative of how much this universe of individuals earned through a combination of full and part-time work.

Point-in-Time Earnings – This earnings measure calculates average earnings for all individuals employed at a firm at a point-in-time. This will tend to be lower than the full-quarter measure, since it will include individuals who began or ended their jobs midway through the quarter.

Noise Infusion – Confidentiality of the data is protected using a system of multiplicative noise infusion, whereby all released data are "fuzzed." [6]

[6] See Abowd, et. al., *Confidentiality Protection in the Census Bureau's Quarterly Workforce Indicators,* (https://lehd.ces.census.gov/doc/technical_paper/tp-2006-02.pdf.)

QWI Measure Descriptions

The public use file contains 32 QWI measures, which may be divided into the following categories:

Category	Count	Comments
Employment	5	The employment measures are built directly from individual employment histories, aggregating total counts. The primary measure of employment is a point-in-time measure, but additional measures are also available, unique to the QWI system.
Employment Change, Individual	13	These measures look at the dynamics of employment at the individual level. This grouping includes three rate calculations.
Employment Change, Firm	8	Firm-based dynamics measures are calculated using employment counts that have been aggregated to the establishment level. The diagrams associated with these measures reference the components that are used. This grouping includes one rate calculation.
Earnings	6	Earnings from individuals with specified job histories are tabulated.

The following tables list all measures available on the public release file. Before each group of measures, the graphic illustrates which quarters from the longitudinal job history are referenced in constructing the measure. For measures that are composites (ratios and firm-based measures), relevant components are listed. Additionally, a number of measures are computed directly from other measures that have been released, rather than being developed from confidential microdata. The formulae used to calculate these measures are provided.

Associated with each indicator, references to relevant sections of the *LEHD Infrastructure* document[7] may also be included, as per this sample:

Beginning-of-Quarter Employment: Counts Emp A.1.7 A.2.2 (A.2) A.2.3 (A.39)	Beginning-of-Quarter Employment – label for variable *(Alternative description may be italicized)* Counts – type of calculation made **Emp** –variable name in QWI public use file A.1.7 – Reference to relevant subsection in appendix of infrastructure document A.2.2 – Individual-level calculation reference (formula in parentheses) A.2.3 – Establishment-level calculation reference

Employment

Measures	-5	-4	-3	-2	-1	***t***	+1	+2	+3	+4	+5
Beginning-of-Quarter					■	■					
End-of-Quarter						■	■				
Full-Quarter					■	■	■				
Full-Quarter, *Previous Quarter*				■	■	■					

[7] Abowd, et. al., *The LEHD Infrastructure Files and the Creation of the Quarterly Workforce Indicators, Appendix A,* https://lehd.ces.census.gov/doc/technical_paper/tp-2006-01.pdf.

Reference Quarter											

Indicator: **Employment**	**Description**	**Technical Definition or Formula**	**Questions**
Beginning-of-Quarter Employment: Counts Emp A.1.7 A.2.2 (A.2) A.2.3 (A.39)	Estimate of the total number of jobs on the first day of the reference quarter. Beginning-of-quarter employment counts are similar to point-in-time employment measures, such as the QCEW (see: www.bls.gov/cew/).	A worker *i* is beginning-of-quarter employed with employer *j* in *t* if worker has positive earnings at *j* in *t-1* and *t*.	•Top area industries? •Who is filling what jobs? Who are the top employers of young, older, or female workers? •Where are similar local economies?
End-of-Quarter Employment: Counts EmpEnd A.1.7 A.2.2 (A.3) A.2.3 (A.40)	Estimate of the number of jobs on the last day of the quarter.	A worker *i* is end-of-quarter employed with employer *j* in *t* if worker has positive earnings at *j* in *t* and *t+1*.	Same as for beginning-of-quarter employment, but about workers employed on the last day of the quarter.
Full-Quarter Employment (Stable): Counts EmpS A.1.8 A.2.2 (A.6) A.2.3 (A.42)	Estimate of stable jobs, *i*.e., the number of jobs that are held on both the first and last day of the quarter with the same employer. This is often, but not necessarily, the same as being employed for a full quarter (e.g., an on-call substitute teacher may have earnings in each of three consecutive quarters, but intermittently).	A worker *i* is full-quarter employed with employer *j* in *t* if worker has positive earnings at *j* in *t-1*, *t*, and *t+1*.	Same as for employment measures above, with emphasis on workers in more stable jobs.
Full-Quarter Employment in the Previous Quarter: Counts EmpSpv A.1.8 A.2.2 (A.6) A.2.3 (A.42)	Estimate of stable jobs in the quarter *before* the reference quarter. This measure is provided for certain special-purpose analyses.	A worker *i* is full-quarter employed in the previous with employer *j* in *t* if worker has positive earnings at *j* in *t-2*, *t-1*, and *t*.	Used in calculation of full-quarter employment growth.
Employment - Reference Quarter: Counts EmpTotal A.1.1 – A.1.6 A.2.2 (A.1) A.2.3 (A.41)	This is a count of people employed in a firm at any time during the quarter. It is not a count of jobs. This measure may also be referred to as "flow" employment.	A worker *i* is flow-employed with employer *j* in *t* if worker has positive earnings at *j* in *t*.	This measure is provided for informational purposes for state partners. For total employment we recommend using Beginning-of-Quarter employment.

Employment Change, Individual

Measures	-5	-4	-3	-2	-1	***t***	+1	+2	+3	+4	+5
Hires All					✕						
Hires New		✕	✕	✕	✕						
Hires Recalls		●	●	●	✕						
All Hires, End-of-Quarter Employed					✕						
Separations, Beginning-of-Quarter Employed							✕				
Separations							✕				
Hires All (Stable)				✕							
Hires New (Stable)	✕	✕	✕	✕							
Separations (Stable)							✕				
Separations (Stable), *Next Quarter*								✕			

Indicator: Employment Change, Individual	**Description**	**Technical Definition or Formula**	**Questions**
Hires All: Counts *(Accessions)* HirA A.1.9 A.2.2 (A.4) A.2.3 (A.57)	Estimated number of workers who started a new job in the specified quarter. It is the sum of "Hires New" and "Hires Recalls."	A worker *i* is defined as acceding to employer *j* in *t* if the worker has positive earnings at *j* in *t* but no earnings from *j* in *t-1*.	•What industries are hiring the most workers and in what geographic areas? •Which industries are hiring older workers? Younger workers?
Hires New: Counts HirN A.1.11 A.2.2 (A.7) A.2.3 (A.61)	Estimated number of workers who started a new job. More specifically, total hires that, while they worked for an employer in the specified quarter, were not employed by that employer in any of the previous four quarters.	A worker *i* is defined as a new hire for employer *j* in *t* if has positive earnings at *j* in *t* but no earnings from *j* in *t-1*, *t-2*, *t-3*, *t-4*.	Same as above but refers to newly hired workers.
Hires Recalls: Counts HirR A.1.11 A.2.2 (A.8) A.2.3 (A.63)	Estimated number of workers who returned to the same employer where they had worked within the previous year (*i.e.*, total hires that are not new hires).	A worker *i* is defined as a recall for employer *j* in *t* if the worker has positive earnings at *j* in *t* but no earnings from *j* in *t-1*, and positive earnings at *j* in one or more of the quarters *t-2*, *t-3*, or *t-4*.	•What industries are most likely to rehire or recall workers? •Of those rehired, are younger or older workers more likely to be rehired? Men or women?
Separations: Counts Sep A.1.9 A.2.2 (A.5) A.2.3 (A.59)	Estimated number of workers whose job with a given employer ended in the specified quarter.	A worker *i* is defined as separating from employer *j* in *t* if the worker has positive earnings at *j* in *t* but no earnings from *j* in *t+1*.	•What types of workers are leaving jobs? •What types of industries are workers leaving?

Indicator: **Employment Change, Individual**	**Description**	**Technical Definition or Formula**	**Questions**
End-of-Quarter Hires[8] `HirAEnd` A.2.2 (A.9)	Estimated number of workers who started a new job in the specified quarter, which continued into next quarter.	A worker *i* is defined as an end-of-quarter hire to employer *j* in *t* if the worker has positive earnings at *j* in *t* and *t+1* but no earnings from *j* in *t-1*.	•Measure used in calculation of hiring rate.
End-of-Quarter Hiring rate `HirAEndR`	Hires as a percent of average employment.	$\frac{2 \times HirAEnd_t}{(Emp_t + EmpEnd_t)}$	•What fraction of the workforce are starting or returning to new jobs?
Beginning-of-Quarter Separations[9] `SepBeg` A.2.2 (A.15)	Estimated number of workers whose job in the previous quarter continued and ended in the given quarter.	A worker *i* is defined as a beginning-of-quarter separation from employer *j* in *t* if the worker has positive earnings at *j* in *t-1* and *t* but no earnings from *j* in *t+1*.	•Measure used in calculation of separation rate.
Beginning-of-Quarter Separation Rate `SepBegR`	Separations as a percent of average employment.	$\frac{2 \times SepBeg_t}{(Emp_t + EmpEnd_t)}$	•What fraction of the workforce are leaving their jobs?
Hires All (Stable): Counts *(Flow into Full-Quarter Employment)* `HirAS` A.1.10 A.2.2 (A.10) A.2.3 (A.64)	Estimated number of workers that started a job that lasted at least one full quarter with a given employer. *Jobs are counted as a stable hire in the first quarter of Full-quarter employment, rather than the first quarter of employment.*	A worker *i* is defined as a flow into full-quarter employment with employer *j* in *t* if the worker has positive earnings at *j* in *t*, *t-1* and *t+1* but no earnings from *j* in *t-2*.	•Which industries are hiring stable workers?

[8] The technical definition describes the identification of End-of-Quarter Hires at the job level. In public release files, this measure is calculated by combining other measures, using the formula `HirAEnd=EmpEnd-EmpS`.

[9] The technical definition describes the identification of Beginning-of-Quarter Separations at the job level. In public release files, this measure is calculated by combining other measures, using the formula `SepBeg=Emp-EmpS`.

Indicator: **Employment Change, Individual**	**Description**	**Technical Definition or Formula**	**Questions**
Hires New (Stable): Counts *(New Hires to Full-Quarter Status)* HirNS A.1.12 A.2.2 (A.12) A.2.3 (A.65)	Estimated number of workers who started a job that they had not held within the past year and the job turned into a job that lasted at least a full quarter with a given employer. *Jobs are counted as a stable hire in the first quarter of full-quarter employment, rather than the first quarter of employment.*	A worker *i* is defined as a full-quarter new hire with employer *j* in *t* if the worker has positive earnings at *j* in *t*, *t-1* and *t+1* but no earnings from *j* in *t-2*, *t-3*, *t-4*, and *t-5*.	Same as Flow into Full-Quarter Employment, but with emphasis on new hires.
Separations (Stable): Counts *(Flow out of Full-Quarter Employment)* SepS A.1.10 A.2.2 (A.16) A.2.3 (A.67)	Estimated number of workers who had a job for at least a full quarter and then the job ended. *Jobs are counted as a stable separation in the last quarter of employment.*	A worker *i* is defined as a flow out of full-quarter employment with employer *j* in *t* if the worker has positive earnings at *j* in *t*, *t-1* and *t-2* but no earnings from *j* in *t+1*.	•What industries are stable workers leaving?
Separations (Stable), Next Quarter: Counts *(Flow out of Full-Quarter Employment)* SepSnx	Estimated number of workers in the next quarter who had a job for at least a full quarter and then the job ended. *Jobs which are stable separations in the next quarter will be full-quarter employed in the reference quarter.*	A worker *i* is defined as a flow out of full-quarter employment with employer *j* in *t* if the worker has positive earnings at *j* in *t-1, t*, and *t+1* but no earnings from *j* in *t+2*.	•Used in calculation of turnover measure.
Turnover (Stable) TurnOvrS A.2.6	The rate at which stable jobs begin and end. It is calculated by summing the number of stable hires in the reference quarter and stable separations in the next quarter, and dividing by the average full-quarter employment.	$\frac{HirAS_t + SepSnx_t}{2 \times EmpS_t}$	•What industries have the most employment churning? The least? •What industries have the lowest and highest rates of employment churning for older and for younger workers? For men compared with women?

Employment Change, Firm

Components	-5	-4	-3	-2	-1	***t***	+1	+2	+3	+4	+5
Beginning-of-Quarter Employment											
End-of-Quarter Employment											
All Hires, End-of-Quarter Employed					✕						
Full-Quarter Employment											
Full-Quarter Employment, *Previous Quarter*											

Indicator: Employment Change, Firm	**Description**	**Technical Definition or Formula**	**Questions**
Firm Job Gains: Counts *(Job Creation)* FrmJbGn A.1.13 A.2.3 (A.46)	Estimated number of jobs gained at firms throughout the quarter. This measure counts total employment increase at firms that grew over the course of the quarter.	End-of-quarter employment in *t* minus Beginning-of-quarter employment in *t*, or 0, whichever is larger	•Regions with most new jobs? •Industries most likely to create jobs? •Which industries are most likely to create jobs that younger workers gain?
Firm Job Loss: Counts *(Job Destruction)* FrmJbLs A.1.13 A.2.3 (A.48)	Estimated number of jobs lost at firms throughout the quarter. This measure counts employment decrease at firms that shrank over the course of the quarter.	End-of-quarter employment in *t* minus beginning-of-quarter employment in *t*, or 0, whichever is smaller, (reported in absolute value).	•Regions where job loss is highest? •Industries most likely to reduce employment? •In industries with net job losses, are older workers more likely to be job losers than younger workers?
Firm Job Change: Net Change FrmJbC A.1.14 A.2.3 (A.43)	Difference between firm job gain and firm job loss.	End-of-quarter employment in *t* minus beginning-of-quarter employment in *t*	•Regions where employment growth is fastest? •Top expanding industries?
Replacement Hires: Counts[10] HirAEndRepl	Hires into continuous quarter employment in excess of job creation.	$HirAEnd_t - FrmJbGn_t$	•How many hires are replacing others who are leaving?
Replacement Hiring Rate[11] HirAEndReplR	Replacement hires as a percent of the average of beginning- and end-of-quarter employment.	$\frac{2 \times HirAEndRepl_t}{(Emp_t + EmpEnd_t)}$	•What fraction of the workforce is being replaced?

[10] Though this calculation is theoretically bounded on the lower end at zero, a small number of negative values may be observed as a result of noise infusion.

[11] This rate is bounded by zero and one for most values. Some values greater than 1 will be observed in very small cells, resulting from noise infusion and rounding. Negative rates will also appear in a small number of cells.

Indicator: Employment Change, Firm	Description	Technical Definition or Formula	Questions
Firm Job Gains (Stable): Counts FrmJbGnS A.1.15 A.2.3 (A.53)	Estimated number of full-quarter jobs gained at firms.	Full-quarter employment in *t* minus full-quarter employment in *t-1*, or 0, whichever is larger.	Same as for Firm Job Gains, but the focus is on jobs that lasted a Full-quarter.
Firm Job Loss (Stable): Counts FrmJbLsS A.1.15 A.2.3 (A.55)	Estimated number of full-quarter jobs lost at firms.	Full-quarter employment in *t* minus full-quarter employment in *t-1*, or 0, whichever is smaller (reported in absolute value).	Same as for Firm Job Loss, but the focus is on jobs that lasted a Full-quarter with a given employer.
Job Change (Stable): Net Change FrmJbCS A.1.15 A.2.3 (A.50)	Net growth in jobs that last a full quarter. Change in net estimate of full-quarter jobs at firms.	Full-quarter employment in *t* minus full-quarter employment in *t-1*.	Similar to Firm Job Change, but the focus is on jobs lasting a full quarter.

Earnings

Measures	-5	-4	-3	-2	-1	*t*	+1	+2	+3	+4	+5
Full-Quarter Employees: Average						$					
Beginning-of-Quarter Employees: Average						$					
Hires All (Stable): Average				X		$					
Hires New (Stable): Average	X	X	X	X		$					
Separations (Stable): Average						$		X			
Total Quarterly Payroll: Sum						$					

$	Indicates the quarter from which earnings are referenced in the calculation of the average or sum.

Indicator: Earnings	Description	Technical Definition or Formula	Questions
Full-Quarter Employment (Stable): Average Monthly Earnings EarnS A.1.17 A.2.2 (A.22) A.2.3 (A.89)	Average monthly earnings of employees with stable jobs (*i.e.*, worked with the same firm throughout the quarter).	Add all quarterly earnings at *j* in *t* for all *i* who are full-quarter employees. Divide this by the number of full-quarter employees at j. Then divide that by three (number of months in a quarter).	•Highest and lowest paying industries in an area? •Average earnings for employees in a particular industry?

Indicator: Earnings	Description	Technical Definition or Formula	Questions
Beginning-of-Quarter Employment: Average Monthly Earnings EarnBeg	Average monthly earnings of employees who worked on the first day of the reference quarter.	Add all quarterly earnings at j in *t* for all *i* who are beginning-of-quarter employees. Divide this by the number of beginning-of-quarter employees at j. Then divide that by three.	Similar to average earnings in stable jobs but includes jobs that lasted less than the entire quarter. Because this includes people who did not work the entire quarter, average earnings tend to be lower than for full-quarter workers.
Hires All (Stable): Average Monthly Earnings EarnHirAS A.1.18 A.2.2 (A.26) A.2.3 (A.92)	Average monthly earnings for workers who started a job that turned into a job lasting a full quarter. That is, average monthly earnings of full-quarter employees who started working with a firm in the previous quarter.	Add all quarterly earnings at j in *t* for all *i* who are hires (all) to full-quarter status employees. Divide this by the number of hires (all) to full-quarter status at j in *t*. Divide that by three.	•What are average starting wages for different types of workers in a particular industry?
Hires New (Stable): Average Monthly Earnings EarnHirNS A.1.19 A.2.2 (A.27) A.2.3 (A.93)	Average monthly earnings of newly stable employees (*i.e.*, full-quarter employees who were new hires with a firm in the previous quarter).	Add all quarterly earnings at j in *t* for all *i* who are full-quarter new hires. Divide this by the number of full-quarter new hires at j in *t*. Divide that by three.	•What are the best paying industries for new hires? In what regions can new hires get the best pay, on average?
Separations (Stable): Average Monthly Earnings EarnSepS A.1.20 A.2.2 (A.31) A.2.3 (A.100)	Average monthly earnings of separations from full-quarter status at an establishment.	Add all quarterly earnings at j in *t* for all *i* who are separations from full-quarter status in *t+1*. Divide this by the number of separations from full-quarter status at j in *t+1*. Divide that by three.	•What were averages wages for workers that separated from specific industries in different regions?
Total Quarterly Payroll: Sum Payroll A.2.2 (A.17) A.2.2 (A.71)	Total quarterly payroll for all jobs.	Sum of all earnings for all jobs in a quarter.	•What are the largest industries in my geographic area in terms of total payroll?

QWI Identities

There are a number of identities that serve to relate the various QWI measures to each other that hold at the establishment level. We provide several of the basic identities below, using the short variable names listed above. A more complete list of relationships is available in the *LEHD Infrastructure* document, section A.2.4.

Employment at Beginning of Period *t* Equals Employment at End of Period *t-1*

$$Emp_{jt} = EmpEnd_{jt-1}$$

Evolution of Continuous-Quarter Employment

$$EmpEnd_{jt} = Emp_{jt} + HirAEnd_{jt} - SepBeg_{jt}$$

Job Flow Identity

$$FrmJbC_{jt} = FrmJbGn_{jt} - FrmJbLs_{jt}$$

Creation-Destruction Identity

$$EmpEnd_{jt} = Emp_{jt} + FrmJbGn_{jt} - FrmJbLs_{jt}$$

Creation-Destruction/Accession-Separation Identity

$$HirA_{jt} - Sep_{jt} = FrmJbGn_{jt} - FrmJbLs_{jt}$$

New Hires/Recalls Identity

$$HirA_{jt} = HirN_{jt} + HirR_{jt}$$

Evolution of Full-Quarter Employment

$$EmpS_{jt} = EmpSpv_{jt} + HirAS_{jt} - SepS_{jt}$$

Full-Quarter Job Flow Identity

$$FrmJbCS_{jt} = FrmJbGnS_{jt} - FrmJbLsS_{jt}$$

Full-Quarter Creation-Destruction/Accession-Separation Identity

$$HirAS_{jt} - SepS_{jt} = FrmJbGnS_{jt} - FrmJbLsS_{jt}$$

QWI Identities in the Aggregated Data

While QWI identities hold at the establishment level, they do not always hold at higher aggregation levels released to the public. Sometimes identities will be off by very small margins due to rounding. Though the released counts are integers, they are built up from non-integer values, which include weighting and noise infusion. However, some identities will have greater deviations in the aggregated data. There are three primary causes of the differences: weighting, noise infusion, and changes in job characteristics over time.

Weighting

LEHD measures are weighted so the QWI employment counts trend with the Quarterly Census of Employment and Wages counts at higher levels of aggregation, allowing short-term differences in counts. Weights can vary by measure in order to improve longitudinal consistency in the QWI series. Because these weights are applied independently on each QWI series, summing QWI counts from a detailed tabulation may not match published aggregates (see https://lehd.ces.census.gov/doc/QWI-Weight-Adjustment-R2021Q2.pdf for more details on past and present QWI weighting methodology).

Noise infusion

The noise infusion for the set of job flow measures (e.g., job creation or destruction) is handled slightly differently than noise infusion for other measures (e.g., employment, accessions, or separations). This may cause deviations in identities that mix these measures, such as the Creation-Destruction Identity.

Changes in Job Characteristics

As described earlier, all QWI measures are calculated by referencing the longitudinal job history, the linkage of a person with a firm over time. Though a job may persist for a long period of time, characteristics of that job may change from time to time. For example:

- the firm may relocate the establishment across a county border;
- the primary line of business (NAICS code) for an establishment may change;
- in firm age tables, the firm ages from 5 years to 6 years, causing it to switch to an older category;
- in firm size tables, the firm grows from 15 to 20 employees, causing it to switch to a larger category;
- in age tables, the worker ages from 24 to 25 years old, causing the job to switch to an older category.

When any of these transitions occur, the employment count of the affected jobs will shift from one cell to another in the aggregated data, which will cause end-of-quarter employment to diverge from beginning-of-quarter employment in the next quarter. Job flows measures will also not tie the quarters together, because these are calculated from the difference between beginning- and end-of-quarter employment in the reference quarter. In addition, there will be no accessions or separations recorded, because the link between the worker and the firm was not broken. Note, changes in job characteristics will not affect identities in grand totals for a state.

Aggregating QWI Across Categories

Users may be interested in combining measures across tabulation categories in order to create multi-county regions, larger industries, broader age categories, etc. This is often possible, though not all measures can be treated the same, as explained below. In all cases, users should also be aware of data suppressions that have been applied. Combining suppressed items with non-suppressed items may induce bias in results.

Employment and Employment Change, Individual Measures

Measures of employment, hires, accessions and the like may be freely aggregated across categories.

Employment Change, Firm Measures

Measures of job creation and destruction may be aggregated across establishment categories, such as industry, geography, firm age, and firm size. However, they may not be aggregated across the demographic categories of sex, age, race, ethnicity, and education. When the composition of the workforce within an establishment shifts, job creation is reported in some demographic categories and job destruction in others. For example, if a woman leaves the firm and a man is hired, you will see job destruction for women and job creation for men. However, if the overall employment count at the firm does not change, there is no job creation or job destruction at the establishment level or higher levels of aggregation.

Average Earnings Measures

Average earnings measures may be combined across tabulation categories. It is recommended that users compute weighted averages, using the denominator specified in the calculation of the measure.

Aggregating Over Time

QWI should generally not be combined over time, since they are point-in-time measures or inherently quarterly concepts. For example, if a firm grows in one quarter, shrinks in the next quarter, and grows again in the following one, aggregating job creation will double count the measure across the quarters. Users may take the arithmetic mean of any measure across quarters to generate an average quarterly measure. Performing this calculation over four quarters will tend to reduce the variations in the data resulting from seasonal employment patterns.

Status Flags

Every estimate in the QWI has an associated status flag. These flags provide information about why items are missing, or whether the item has an elevated level of noise infused for confidentiality protection. The status flags reported are as follows:

```
-2,no data available in this category for this quarter
-1,data not available to compute this estimate
 1,OK
 5,Value suppressed because it does not meet US Census Bureau publication standards.
 6,Value calculated from other released measures - no significant distortion
 7,Value calculated from other released measures - some of which have significantly distorted
data
 9,Data significantly distorted - fuzzed value released
 10,Aggregate of cells - no significant distortion
 11,Aggregate of cells not released because component cells do not meet U.S. Census Bureau
publication standards
 12,Aggregate of cells - some of which have significantly distorted data
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Questions or comments may be sent to CES.QWI.Feedback@census.gov.