Quarterly Workforce Indicators: Basic Concepts

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Training Goals

- This first part of today's session will include:
  - Basics of LEHD infrastructure and data sources
  - Detailed definitions of all 32 Quarterly Workforce Indicators (QWI)
  - Appendix – Advanced Topics
- After covering Basic Concepts, we'll provide detailed, hands-on examples of using web-based tools to access the QWI.

Reference Materials

- QWI 101
  - Introduction to development and use of QWI
  - Excellent reference for new users
  - http://lehd.ces.census.gov/doc/QWI_101.pdf
- "The LEHD Infrastructure Files and the Creation of the Quarterly Workforce Indicators"
  - Detailed methodology, intended for advanced users
  - http://lehd.ces.census.gov/doc/technical_paper/tp-2006-01.pdf

Where to Find LED Data

- Census Website
  - Longitudinal Employer-Household Dynamics Program
  - http://lehd.ces.census.gov/data/
  - Variety of tools for accessing the data

Primary Unit of Analysis: Job

- Definition:
  - A “job” is an association of specific individual with specific employer and location in a given year/quarter
  - An individual may have multiple jobs within a quarter
    - The “primary job” (job with greatest earnings) is not defined separately in QWI, though it does appear in OnTheMap
- The job is the basic unit of analysis within the LEHD Infrastructure
  - In contrast, most other surveys and censuses are either household-based (ACS, CPS, Decennial Census) or employer-based (QCEW, Current Employment Statistics, etc)
  - Advantage of job-based frame – can produce tabulations by both worker **and** firm characteristics

Core Data Input: UI Earnings Records

- UI = Unemployment Insurance
- Record of individual earnings for covered jobs
  - These are the wage records, not UI claims data
- Collected for operation of state UI program
  - UI benefits are based on historical earnings
- Includes:
  - **Total** quarterly earnings for each job
  - Firm identified by State UI Account number (SEIN)
  - Worker identified by Protected Identification Key (PIK)
    - Census identifier based on SSN

Job Coverage in UI Earnings Data

- Most private sector jobs covered
  - For-profit and not-for-profit classified together (as per QCEW standard)
- State and local government also in system, though some reporting inconsistencies
- Federal data not available in QWI
  - Data based on Office of Personnel Management under development for QWI (have been incorporated into LODES)
- Self-employed not available
  - Data derived from tax records under development
- Massachusetts data not available yet

Additional Data Inputs

- UI wage records are linked to a variety of other data sources
- Sources of establishment information:
  - Quarterly Census of Employment and Wages (QCEW)
  - Business Dynamics Statistics (BDS)
- Sources of demographic information:
  - Decennial Census
  - Federal Tax Records
  - Social Security Administration Records
  - Other census and administrative records
- This additional information enables tabulations by detailed worker and firm characteristics

LEHD Processing: Merging Data

Quarterly Census of Employment and Wages (QCEW)

Employer and Establishment (Single/Multi-unit)

Geography
Industry
Ownership

UI Account Number (SEIN)

Unemployment Insurance Earnings Records

Employer-Worker
(most states)
OR
Establishment-Worker
(Minnesota only)

Earnings
Job history

Federal EIN

Business Dynamics Statistics (BDS)

Firm age and size

PIK (encoded SSN)

Census, Surveys, Other Administrative Records

Demographics
Place of Residence

QWI Measures

- The QWI public use data includes 32 measures
  - Employment
    - Counts of jobs (Individual)
    - Hiring and Separation counts and rates (Individual)
    - Job Creation and Destruction (Firm)
  - Earnings
    - Average earnings for selected job histories
    - Total earnings
  - Public use files and web-based applications are organized by state (national QWI are currently being developed)

QWI Aggregation Levels: Establishment

The QWI are tabulated by detailed geography, firm/ establishment characteristics, and worker demographics

- Establishment level characteristics:
  - Geography
    - State totals
    - County, Metro, Workforce Investment Board areas
  - Industry
    - All industries
    - NAICS Sectors, Sub-sectors (3-digit), Industry groups (4-digit)
  - Ownership
    - All (Public + private)
    - Private-only

- All crossings of these characteristics reported (with a few exceptions for firm age and firm size)

QWI Aggregation Levels: Firm

- Firm age and size are based on the characteristics of the national-level firm, sourced from Business Dynamics Statistics (BDS)
  - Firm Age (years)
    - 0-1, 2-3, 4-5, 6-10, 11+
  - Firm Size (employees)
    - 0-19, 20-49, 50-249, 250-499, 500+
  - Remember, these are based on national firm (so age and size for a Starbucks establishment is that of the national Starbucks corporation, not the individual location)

- Firm Age and Firm Size are available only for private ownership
- Reduced detail on geography/industry tabulations (3- and 4- digit NAICS are only available for state-level totals)

QWI Aggregation Levels: Employee Age/Sex

- Employee level characteristics
  - Age (years)
    - 14-18, 19-21, 22-24, 25-34, 35-44, 45-54, 55-64, 65-99
  - Sex
    - Male, Female
- We use the age categories specified in the Workforce Investment Act (WIA)
- Data comes from a variety of sources (Decennial Census, surveys and administrative records)

QWI Aggregation Levels: Employee Education

- Education
  - Less than a High School Diploma
  - High School Diploma, No College
  - Some College or Associate's Degree
  - Bachelor's Degree or Above
  - Educational Attainment Not Available (workers aged 24 or younger)
- Valid only for individuals age 25 and up
  - Reflects person's maximum education level
- Crossed by Sex in QWI tabulations
- Sourced from decennial census where available; otherwise, imputed using multinomial logit model

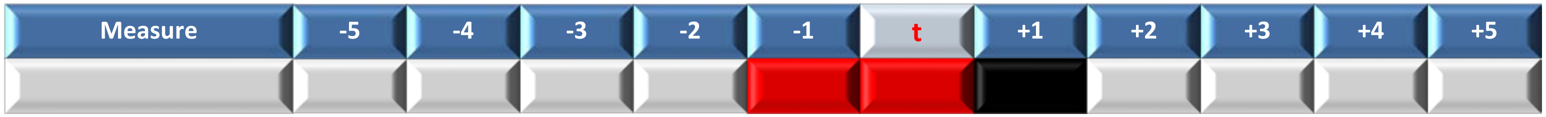
QWI Aggregation Levels: Employee Race/Ethnicity

- Race and Ethnicity are tabulated according to categories defined by the Office of Management and Budget:
  - Race
    - White alone
    - African-American or Black alone
    - Asian or Pacific alone
    - Native Hawaiian or Other Pacific Islander alone
    - American Indian or Alaska Native alone
    - Two or More Races
  - Ethnicity
    - Hispanic or Latino
    - Not Hispanic or Latino
  - Race and Ethnicity are cross-tabulated in public QWI data
  - Use data from Decennial Census where available; otherwise, impute using Census file provided from Social Security Administration (SSA)

Next: Detailed Definitions of QWI Measures

Employment History

- Jobs are linked across time to develop an individual's employment history with a firm
- We use diagrams to help visualize the measures:



- The reference quarter is noted at t
  - Earlier quarters are negative, later positive
- For calculation of measures,
  - RED indicates positive earnings in quarter
  - BLACK indicates zero earnings in quarter
  - GREY indicates time period not referenced
  - So in the figure above, the worker received earnings from this employer in t-1 and t, but did not receive earnings in t+1

QWI Measures: Employment

Measure	-5	-4	-3	-2	-1	t	+1	+2	+3	+4	+5
Count of Jobs (Flow Employment)											
M (EmpTotal)											
Beginning-of-quarter Employment											
B (Emp)											
End-of-quarter Employment											
E (EmpEnd)											
Full-quarter (Stable) Employment											
F (EmpS)											
Full-quarter (Stable) Employment, previous quarter											
Fpv (EmpSpv)											

Details: Employment Measures

- **Flow employment (EmpTotal)**
  - Anyone who receives positive earnings from a particular employer in the quarter
  - Drawbacks to this measure:
    - May double count people transiting between jobs
    - Many very short jobs

Measure	-5	-4	-3	-2	-1	t	+1	+2	+3	+4	+5
Count of Jobs (Flow Employment)											
M (EmpTotal)											

Details: Employment Measures

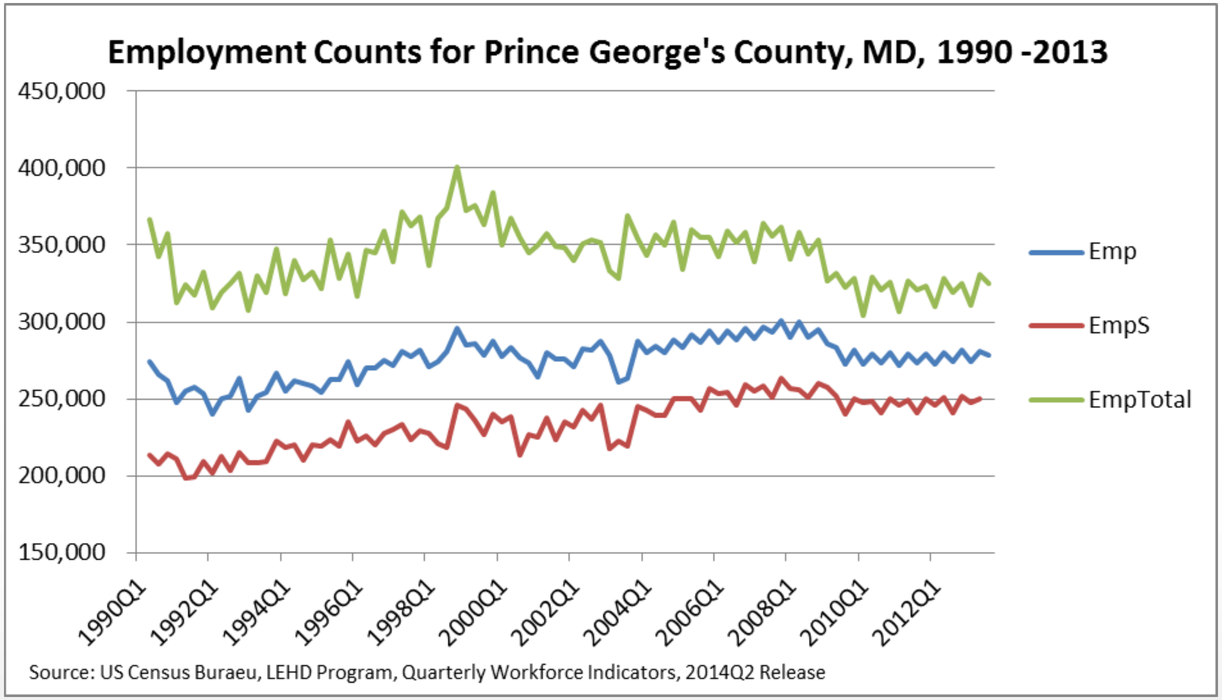
- **Beginning-of-quarter employment (Emp)**
  - Primary measure of employment for QWI and OnTheMap
  - Defined when job is present in both previous and current quarter
  - If earnings are received in consecutive quarters, individual is considered to be employed on the first day of quarter t
    - Point-in-time employment measure
  - Conceptually and empirically similar to QCEW Month 1 employment
    - Precise definitions, data sources, and methodology result in differences
- **End-of-quarter (EmpEnd)**
  - Symmetric concept to Beginning-of-quarter
  - Job is present in both current and next quarter

Details: Employment Measures

- **Full-quarter (EmpS)**
  - Defined when a job is present in previous, current and next quarter
  - Reflects stable, ongoing employment
  - Used as reference for calculating earnings measures
- **Full-quarter, Previous quarter (EmpSpv)**
  - Reported for particular estimates related to full quarter job growth

Measure	-5	-4	-3	-2	-1	t	+1	+2	+3	+4	+5
Full-quarter (Stable) Employment											
F (EmpS)											
Full-quarter (Stable) Employment, previous quarter											
Fpv (EmpSpv)											

Demonstration: Comparing Employment Measures in Los Angeles Metro Area



- **EmpTotal** is greater than **Emp**; both are greater than **EmpS**
- All three measures trended up during the first part of the time series, but are now lower than their pre-recession highs
- **EmpTotal** has the most seasonal variation (typically lowest in Q1)

QWI Measures: Earnings for Employment Counts

Measure	-5	-4	-3	-2	-1	t	+1	+2	+3	+4	+5
Average Monthly Earnings for Beginning-of-quarter Jobs											
EarnBeg						$					
Average Monthly Earnings for Full-quarter Jobs											
EarnS						$					
Total Reported Earnings											
Payroll						$					

Dollar sign ($) indicates reference quarter for earnings

Details: Earnings for Employment Counts

- Three earnings measures based on employment counts:
  - **Average Monthly Earnings for Beginning-of-Quarter Jobs (EarnBeg)**
  - **Average Monthly Earnings for Full-Quarter Jobs (EarnS)**
  - **Total Quarterly Payroll (Payroll)**
- Include all income amounts reported for UI wages
- Include a mix of full-time and part-time jobs (not adjusted for hours)
- We often prefer **Full Quarter Employment Earnings (EarnS)**, since it will be less biased by jobs that began or ended part-way through the quarter
- Average earnings are based on quarterly wage record, divided by 3 (monthly estimate)

Measure	-5	-4	-3	-2	-1	t	+1	+2	+3	+4	+5
Average Monthly Earnings for Beginning-of-quarter Jobs											
EarnBeg						$					
Average Monthly Earnings for Full-quarter Jobs											
EarnS						$					
Total Reported Earnings											
Payroll						$					

Demonstration: Monthly Earnings (Stable) by Worker Age in QWI Explorer

QWI Explorer (Beta) LEHD Home Help and Documentation

State

Maryland

Indicator

EarnS - Full Quarter Employment (Stable): Aver

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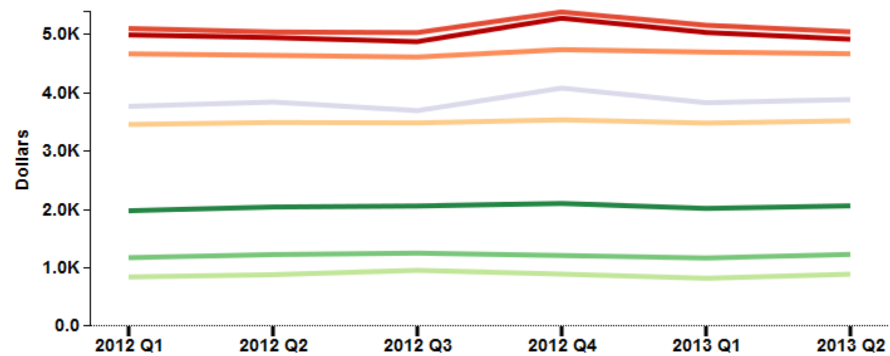
Filters/Aggregations

Quarters: X-Axis
Counties: Prince Georges
Industries: None
Firm Ownership: All Ownership
Firm Age/Size: None
Worker Characteristics: None



X-Axis

Year/Quarter

Six Year/Quarters Selected

Group

Age

Eight Age Groups Selected

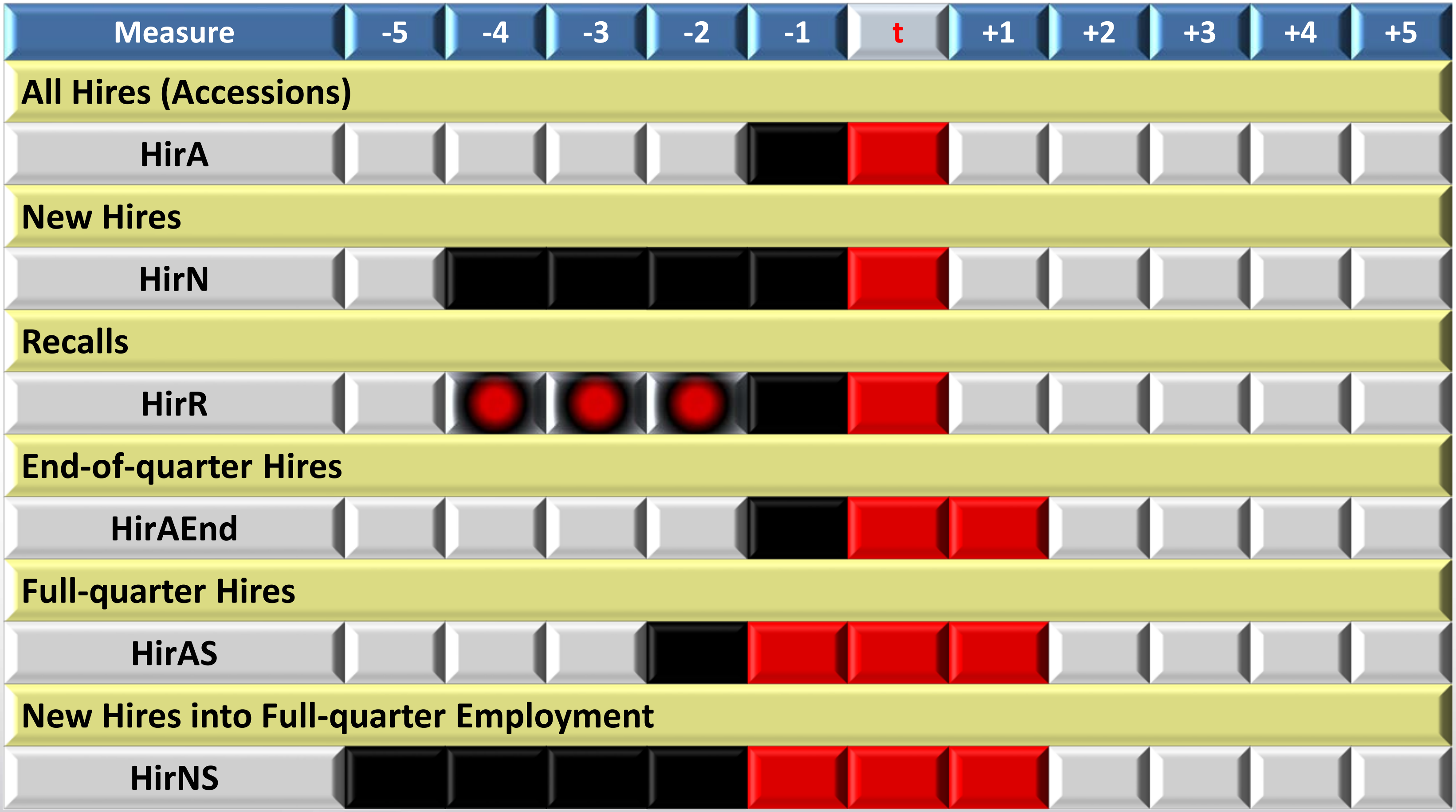
	14-18	19-21	22-24	25-34	35-44	45-54	55-64	65-99
2012 Q1	845	1,176	1,980	3,459	4,670	5,105	4,995	3,770
2012 Q2	884	1,229	2,045	3,494	4,644	5,045	4,949	3,844
2012 Q3	958	1,253	2,062	3,487	4,616	5,034	4,879	3,696
2012 Q4	894	1,213	2,105	3,538	4,742	5,386	5,281	4,082
2013 Q1	823	1,170	2,020	3,484	4,700	5,160	5,036	3,833
2013 Q2	892	1,232	2,064	3,523	4,672	5,048	4,922	3,886

- Average monthly earnings (for full-quarter employees) in Prince George's County, MD is highest for workers in the 45-54 age category, exceeding $5,000
- Potential analysis: Compare Prince George's County to the state of Maryland as a whole. Or, compare to other counties (Montgomery, Fairfax, etc.)

QWI Measures: Worker Flows

- Worker Flows measures use longitudinal job history to identify changes in employment status
- Average earnings are calculated for some full-quarter measures
- Turnover is as a composite measure based on aggregates of flow measures
- We'll discuss: Accessions (Hires), Separations, and Average Earnings associated with these transitions

QWI Measures:
Worker Flows - Accessions



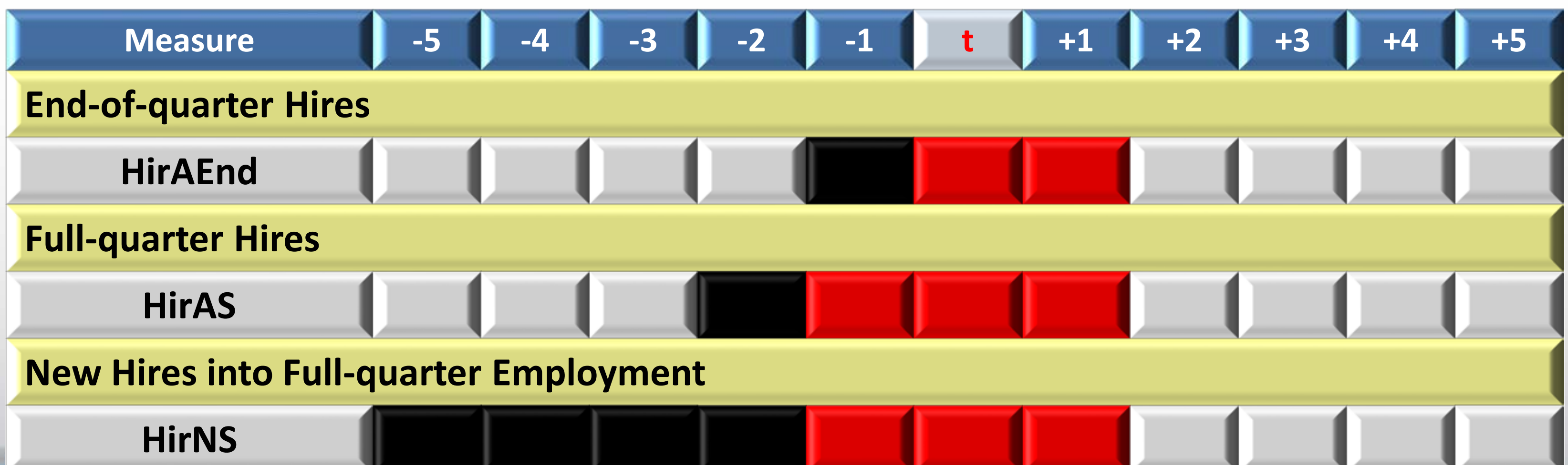
Details: Worker Flows - Accessions

- An **Accession (HirA)** occurs when an individual has positive earnings from a particular employer in the current and not in the previous quarter.
- Two types of accessions:
  - **New Hire (HirN)**: Accession with no earnings from the employer during the previous four quarters
  - **Recall Hire (HirR)**: Accession, and also received earnings from the employer during one of the last three quarters

Measure	-5	-4	-3	-2	-1	t	+1	+2	+3	+4	+5
All Hires (Accessions)											
HirA											
New Hires											
HirN											
Recalls											
HirR											

Details: Worker Flows - Accessions

- Three additional accession measures capture hires to longer-duration jobs:
  - **End-of-Quarter Hire (HirAEnd):** Occurs when a worker is hired in quarter t, and also receives earnings from that job in quarter t+1
  - **Full-Quarter Hire (HirAS)**: Occurs when a worker is hired and receives earnings from that employer for three consecutive quarters. Reference period is the first quarter of full-quarter status.
  - **New Full-Quarter Hire (HirNS)**: Full-Quarter hire to a firm that did not employ that worker in previous 4 quarters



QWI Measures:
Worker Flows - Separations

Measure	-5	-4	-3	-2	-1	t	+1	+2	+3	+4	+5
Separations											
Sep											
Beginning-of-quarter Separations											
SepBeg											
Separations from Full-quarter Employment											
SepS											
Separations from Full-quarter Employment, next quarter											
SepSnx											

Details: Worker Flows - Separations

- A **Separation (Sep)** occurs when an individual has positive earnings from a particular employer in the current quarter, but not in the subsequent quarter.
- An **Beginning-of-Quarter Separation (SepBeg)** occurs when an individual separates from a job from which they received earnings for at least two consecutive quarters.
- A **Full-Quarter Separation (SepS)** occurs when an individual is separated from a job from which they received earnings from at least three consecutive quarters.
- A **Separation from Full-Quarter Employment, next quarter (SepSnx)** is a full-quarter separation, where separation occurs in the next quarter (used to calculate turnover)

Measure	-5	-4	-3	-2	-1	t	+1	+2	+3	+4	+5
Separations											
Sep											
Beginning-of-quarter Separations											
SepBeg											
Separations from Full-quarter Employment											
SepS											
Separations from Full-quarter Employment, next quarter											
SepSnx											

Earnings for Worker Flow Measures

Measure	-5	-4	-3	-2	-1	t	+1	+2	+3	+4	+5
Average Monthly Earnings for Hires to Full-Quarter Employment											
EarnHirAS						$					
Average Monthly Earnings for New Hires to Full-Quarter Employment											
EarnHirNS						$					
Average Monthly Earnings for Separations from Full-Quarter Employment											
EarnSepS						$					

Dollar sign ($) indicates reference quarter for earnings

Details: Earnings for Worker Flow Measures

- Three earnings measures based on worker flows:
  - **Avg Monthly Earnings for Hires to Full-Quarter Employment (EarnHirAS)**
  - **Avg Monthly Earnings for New Hires to Full-Quarter Employment (EarnHirNS)**
  - **Avg Monthly Earnings for Separations from Full-Quarter Employment (EarnSepS)**
- All are based full-quarter counts, which are less biased by jobs that began or ended part-way through the quarter
- Average earnings are based on quarterly wage record, divided by 3 (monthly estimate)

Measure	-5	-4	-3	-2	-1	t	+1	+2	+3	+4	+5
Average Monthly Earnings for Hires to Full-Quarter Employment											
EarnHirAS						$					
Average Monthly Earnings for New Hires to Full-Quarter Employment											
EarnHirNS						$					
Average Monthly Earnings for Separations from Full-Quarter Employment											
EarnSepS						$					

Hiring and Separation Rates

- Both rates are divided by the average of Beginning-of-Quarter and End-of-Quarter employment
  - Hiring Rate

$$\text{HirAEndR}_t = \frac{\text{HirAEnd}_t}{\frac{1}{2}(\text{Emp}_t + \text{EmpEnd}_t)}$$

  - Separation Rate

$$\text{SepBegR}_t = \frac{\text{SepBeg}_t}{\frac{1}{2}(\text{Emp}_t + \text{EmpEnd}_t)}$$

  - Both rates are bounded by 0% and 200%

Turnover Rate

- Turnover (TurnOvrS) is calculated after final aggregations are produced
  - Combines three job flow measures in formula:

$$\frac{(HirAS_t + SepSnx_t)}{2 \times EmpS_t}$$

- Simple intuition:
  - If a firm of 100 individuals has 10 separations, and replaces them with 10 hires => 10% turnover

Measure	-5	-4	-3	-2	-1	t	+1	+2	+3	+4	+5
HirAS											
SepSnx											
EmpS											

Firm-Based Measures: Flows, Creations, Destructions

Measure	Description
FrmJbGn	Job Creation
FrmJbLs	Job Destruction
FrmJbC	Net Job Flows
FrmJbGnS	Full-quarter Job Creation
FrmJbLsS	Full-quarter Job Destruction
FrmJbCS	Net Full-quarter Job Flows
HirAEndRepl	Replacement Hires
HirAEndReplR	Replacement Hire Rate

Measuring Firm-Level Worker Flows

- Firm job flows display dynamics at the establishment level
  - Job creation
    - Establishments that grow over the quarter
    - Establishment births
  - Job destruction
    - Establishments that shrink over the quarter
    - Establishment deaths
  - Net Job Change = Job Creation – Job Destruction

Firm Job Flow Measures

- Calculated at establishment level
  - Job Creation *(FrmJbGn)*
    - Difference between End-of-quarter and Beginning-of-quarter employment *(EmpEnd – Emp)*
      - zero if negative
  - Job Destruction *(FrmJbLs)*
    - Difference between Beginning-of-quarter and End-of-quarter employment *(Emp – EmpEnd)*
      - zero if negative
  - Net Job Flows *(FrmJbC)*
    - Difference between End-of-quarter and Beginning-of-quarter employment *(EmpEnd – Emp)*
      - Can be positive (net job creation) or negative (net job destruction)

	-5	-4	-3	-2	-1	t	+1	+2	+3	+4	+5
B (Emp)											
E (EmpEnd)											

Firm Job Flow Measures

- Full-Quarter measures are defined similarly:
  - Full-Quarter Job Creation *(FrmJbGnS)*
    - Difference between Full-Quarter employment *(EmpS – EmpSpv)*
      - zero if negative
  - Full-Quarter Job Destruction *(FrmJbLsS)*
    - Difference between Full-Quarter employment *(EmpSpv – EmpS)*
      - zero if negative
  - Full-Quarter Net Job Flows *(FrmJbCS)*
    - Difference between Full-Quarter employment *(EmpS – EmpSpv)*
      - Can be positive (net job growth) or negative (net job destruction)

	-5	-4	-3	-2	-1	t	+1	+2	+3	+4	+5
EmpSpv											
EmpS											

Replacement Hiring

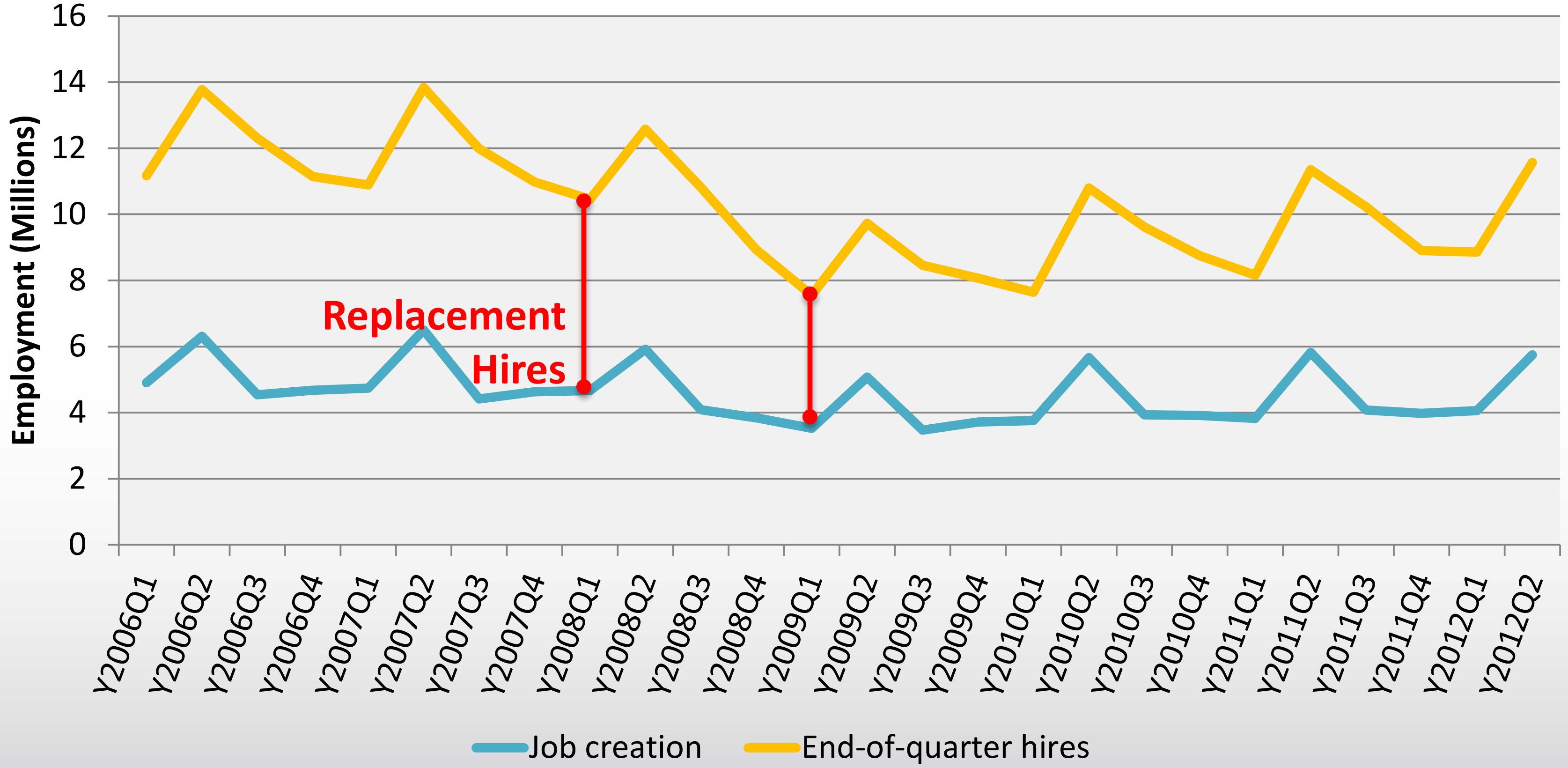
- Hiring and Job Creation are not necessarily equal:
  - Job Creation means more end-of-quarter employment than beginning-of-quarter employment at a firm
    - But – there may be high levels of "churn" at firms, even without net employment growth
- To capture this, we define replacement hires:
  - **Replacement Hires (HirAEndRepl)** are hires in excess of job creation:

$$\text{HirAEndRepl} = \text{HirAEnd} - \text{FrmJbGn}$$

  - The **Replacement Hiring Rate (HirAEndReplR)** is replacement hires as a percentage of average employment:

$$\text{HirAEndReplR} = \frac{\text{HirAEndRepl}_t}{\frac{1}{2}(\text{Emp}_t + \text{EmpEnd}_t)}$$

QWI Estimates:
Source of Replacement Hires



Data: QWI pooled across all available states

Summary

- The QWI provide 32 measures of employment counts, employment flows, and earnings
- By linking to a variety of data sources, the QWI can be tabulated by detailed geography, firm characteristics and worker demographics
- The LEHD program has developed multiple web-based tools for accessing the QWI. These will be demonstrated in the next session.

- Contact us: ces.qwi.feedback@census.gov

Appendix: Advanced Topics

Firm Job Flows: Be Careful about Aggregation

- Note that for worker demographic categories (such as age and sex), the published net job flows for the subcategories will sum to the margin
- But for gross Job Creation and gross Job Destruction, this is not true
- (Job Creation for men) + (Job Creation for women) does not equal (total Job Creation)
  - Why? Consider this example: A job could be created at a firm and filled by a woman, while another job at the same firm is destroyed, previously filled by a man
  - Job Creation and Job Destruction should be 0, since these are defined at the firm level. Summing across characteristics would produce the wrong totals.
- QWI Explorer has built-in rules to prevent these incorrect aggregations

	Men	Women	Incorrect Total (sum across characteristics)	Correct Total
Job Creation	0	1	1	0
Job Destruction	1	0	1	0
Net Job Flows	-1	+1	0	0

Noise Infusion (“Fuzzing”)

- Why infuse noise into data?
  - Reduce the amount of cell suppression while preserving confidentiality and analytic validity
- Properties of noise
  - Every data item is distorted by a minimum amount
  - For a given workplace, data are always distorted in the same direction, by the same percentage in every period and release of QWIs
  - When aggregated, the effects of the distortion cancel out for the vast majority of the estimates
- QWI statistics are flagged when the value is significantly distorted
- See infrastructure document, section 6, for more details

QWI Status Flags

Each data item in the QWI is assigned a status flag.

Status flags indicate why data items are missing, or whether they are significantly distorted:

- -2 No data available in this category for this quarter
- -1 Data not available to compute this estimate
- 1 OK, fuzzed value released
- 5 Value suppressed because it does not meet US Census Bureau publication standards
- 9 Data significantly distorted, distorted value released
- 10 Aggregate of cells, no significant distortion
- 11 Aggregate of cells not released because component cells do not meet US Census Bureau publication standards
- 12 Aggregate of cells, some of which have significantly distorted data

*Note that suppression does not mean zero

LEHD Processing: Weighting

- QWI Beginning-of-Quarter Employment is benchmarked against QCEW Mon1 employment
- Firm-level weights (within bounds) are applied to adjust employment towards Mon1 employment
- Secondary weights are applied to match statewide private-only employment
- Weights are calculated at ECF stage, applied at QWI