

# Improving Real-Time Employment Estimates Combining Multiple Vintages and Multiple Surveys

Tara M. Sinclair and Matthew Zahn  
The George Washington University

25<sup>th</sup> Annual Symposium  
Society for Nonlinear Dynamics and Economics  
Paris, France  
March 30, 2017

# Challenges of Real-Time US Employment Estimates

- US Bureau of Labor Statistics (BLS) collects data each month from 2 separate surveys:
  - Current Population Survey (CPS): Households
    - Source of the official US unemployment rate data
  - Current Employment Statistics (CES) survey: Establishments
    - Source of the official US payroll employment data
- Two orthogonal sources of information on monthly US employment, but with:
  - Different definitions of employment
  - Different statistical properties
  - Different data collection issues

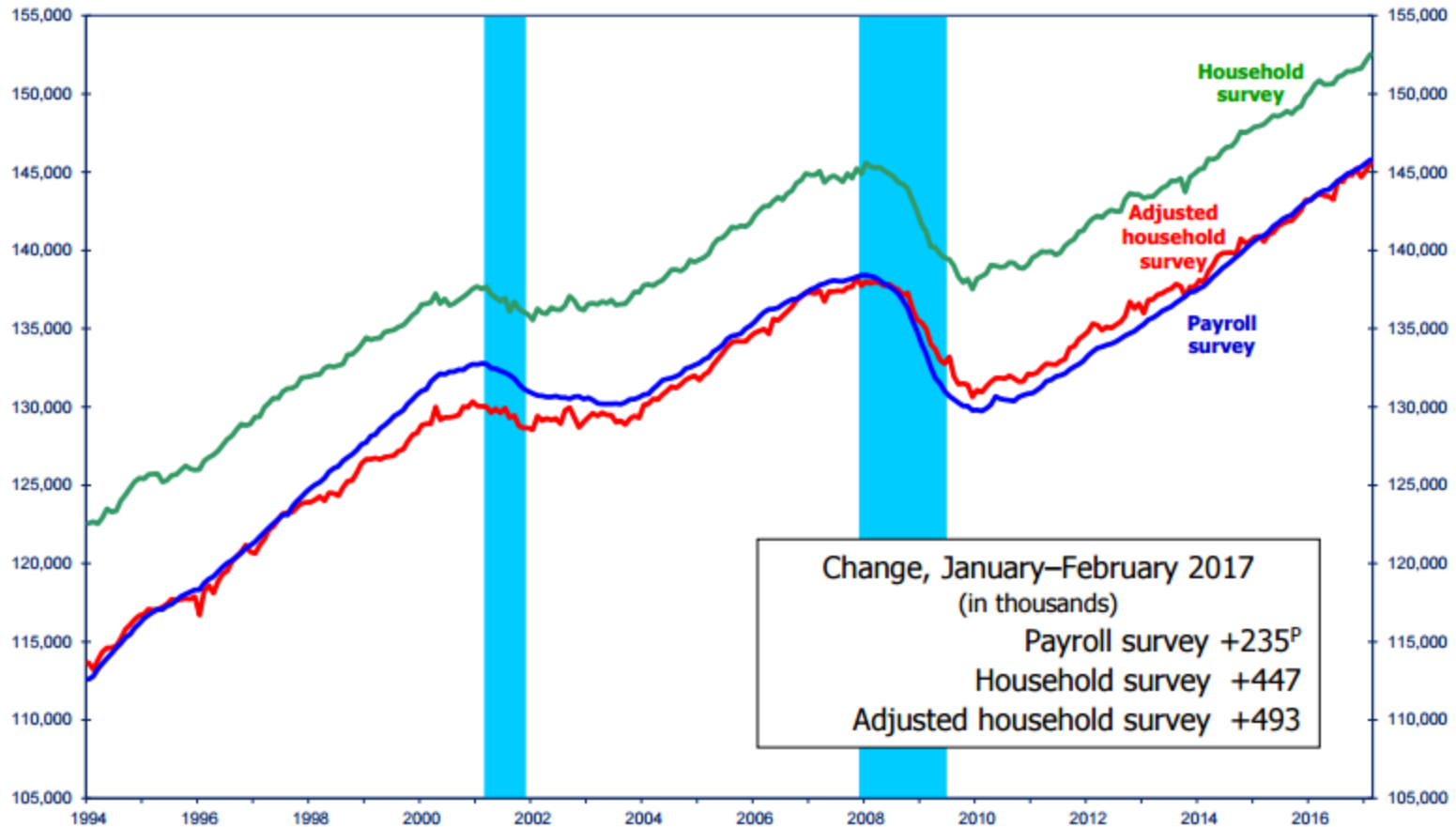
# Comparison of survey concepts, definitions and methodologies (source: BLS)

Comparison of:	Household Survey (CPS)	Payroll Survey (CES)
Scope	Civilian noninstitutional population age 16 and over	Nonfarm wage and salary jobs
Data source	Monthly sample survey of approximately 60,000 eligible households	Monthly sample survey of approximately 147,000 businesses and government agencies, representing about 634,000 individual worksites
Major outputs	Labor force, employment, unemployment, and associated rates with demographic detail	Employment, hours, and earnings with industry and geographic detail
Reference period	Generally the calendar week that includes the 12th of the month (see <a href="#">note below</a> )	Employer pay period that includes the 12th of the month (could be weekly, biweekly, monthly, or other)
Employment concept	Estimate of employed people (multiple jobholders are counted only once).  Includes people on unpaid leave from their jobs.	Estimate of jobs (multiple jobholders are counted for each nonfarm payroll job).  Includes only people who received pay for the reference pay period.
Employment inclusions and exclusions	Includes the unincorporated self-employed, unpaid family workers in family businesses, agriculture and related workers, workers in private households, and workers on unpaid leave.  Excludes workers on furlough for the entire reference week, even if they receive pay for the furlough period (they are considered unemployed, on temporary layoff).	Excludes all of the groups listed at left, except for the logging component of agriculture and related industries.  Includes furloughed workers if they receive pay for any portion of the pay period that includes the furlough.
Approximate size of over-the-month change in employment required for statistical significance at the 90-percent confidence level	± 500,000	± 120,000
Benchmark adjustments to survey results	No direct benchmark for employment.  Adjustments to underlying population base made annually using intercensal population estimates, and every 10 years using the decennial census.	Employment benchmarked annually to universe employment counts derived primarily from unemployment insurance (UI) tax records.

# Household and payroll survey employment

## Seasonally adjusted, 1994–2017

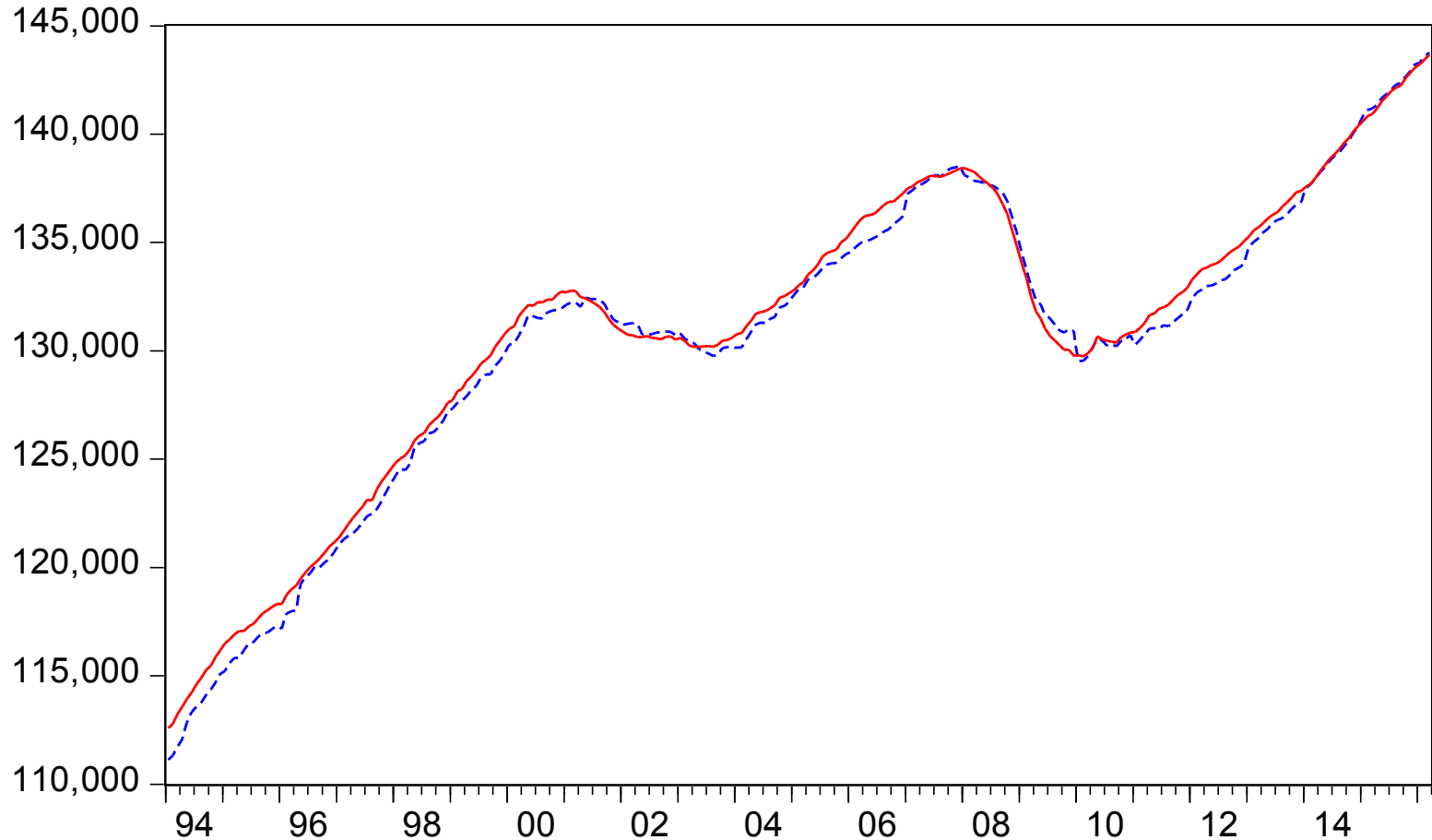
Numbers in thousands



Note: The historical household survey data shown here are a research series that has been smoothed for population control adjustments. The adjusted household survey data are a research series that has been adjusted to an employment concept more like the payroll survey's and smoothed for population control adjustments. More information about these research series is available at [www.bls.gov/web/empsit/ces\\_cps\\_trends.htm#appendix](http://www.bls.gov/web/empsit/ces_cps_trends.htm#appendix). Shaded areas represent recessions as determined by the National Bureau of Economic Research (NBER). P = preliminary.

Source: Bureau of Labor Statistics, March 10, 2017.

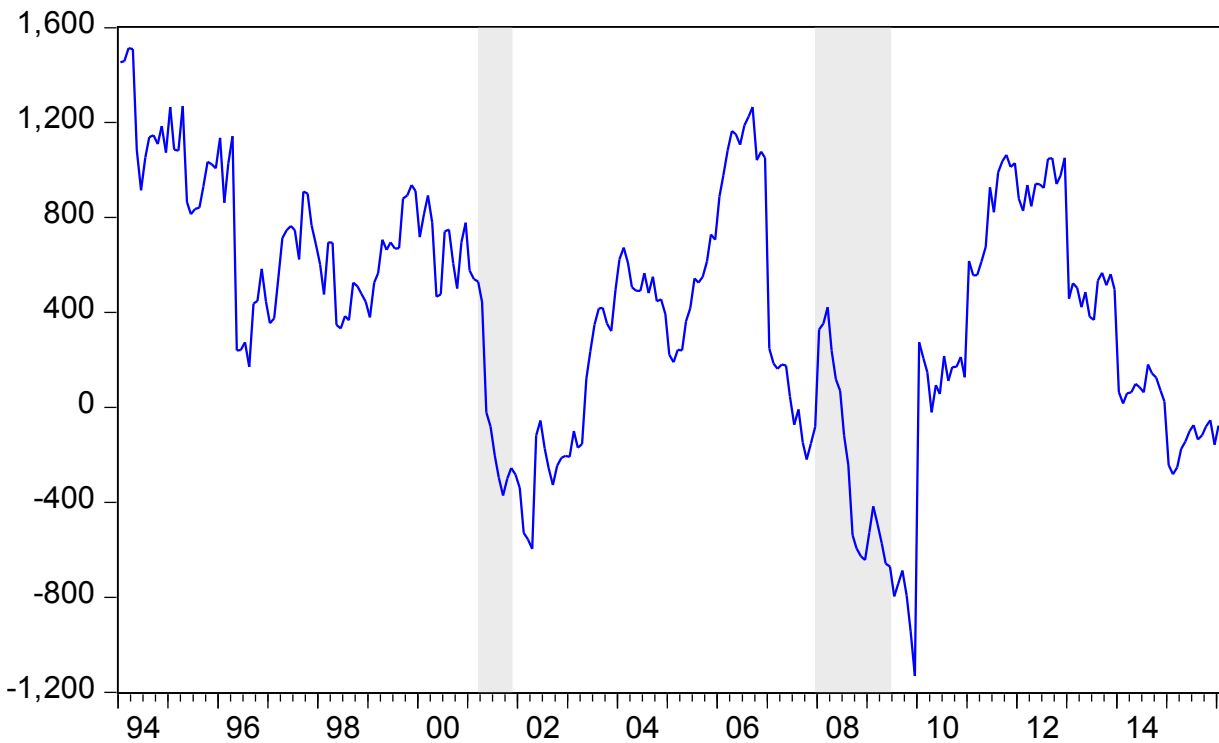
# Total Nonfarm Payroll Employment initial estimate and benchmark totals (in thousands)



--- Initial Release Payroll Employment  
— Feb 3 2017 Benchmark

# The gap may look small, but...

BENCHMARK\_MINUS\_INITIAL

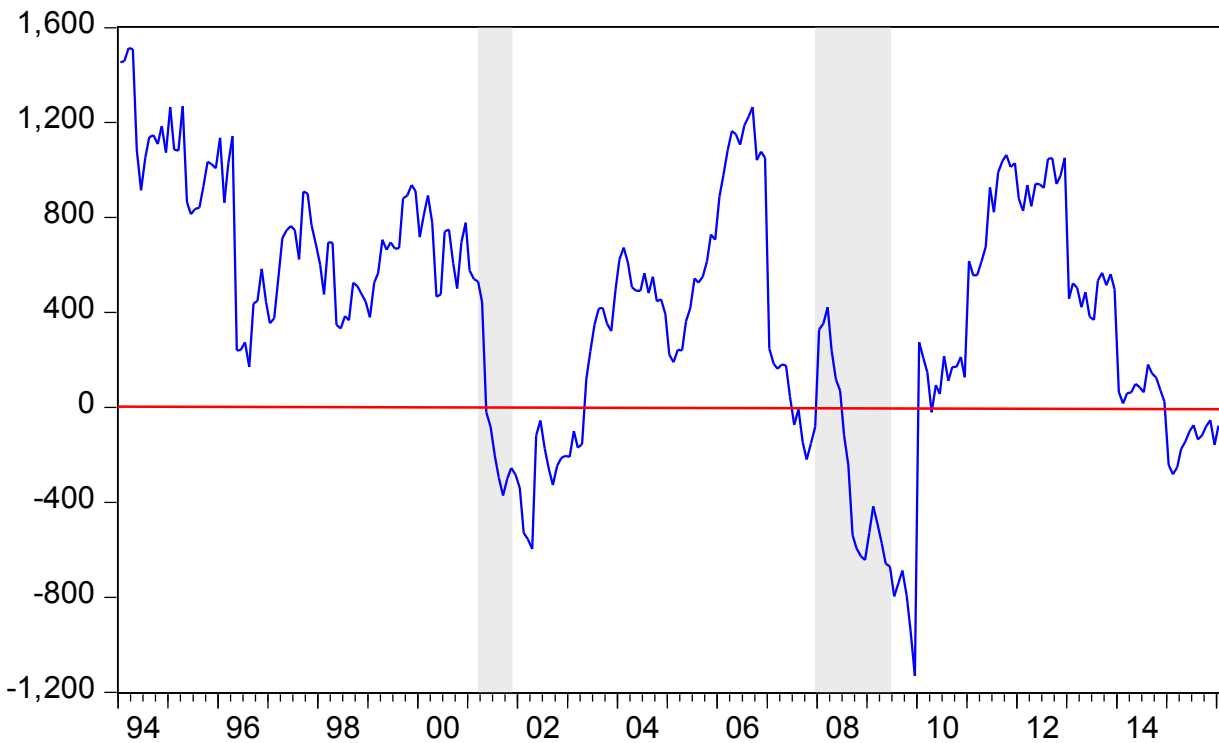


Series: BENCHMARK\_MINUS\_INITIAL  
Sample 1994M 01 2016M 03  
Observations 267

Mean	398.5730
Median	455.0000
Maximum	1514.000
Minimum	-1132.000
Std. Dev.	519.3211
Skewness	-0.315806
Kurtosis	2.596424

# The gap may look small, but...

BENCHMARK\_MINUS\_INITIAL



Series: BENCHMARK\_MINUS\_INITIAL  
Sample 1994M 01 2016M 03  
Observations 267

Mean	398.5730
Median	455.0000
Maximum	1514.000
Minimum	-1132.000
Std. Dev.	519.3211
Skewness	-0.315806
Kurtosis	2.596424

# The media react to the initial estimate



**Ben White** ✓  
@morningmoneyben



Following

Jobs day Twitter is the best Twitter we have.

← Reply ↻ Retweeted ★ Favorite ⋮ More

RETWEETS  
8

FAVORITES  
12



7:39 AM - 4 Apr 2014

Reply to @morningmoneyben



**Jason Richardson** @\_editengine · Apr 4

@morningmoneyben woo hoo I totally forgot it was jobs day! \*straightens pens and cranks up the spreadsheet\*

Details

← Reply ↻ Retweet ★ Favorite ⋮ More



**Jared Small** @jaredsmall · Apr 4

They are always "resounding success" AND "catastrophic consequence"  
"@morningmoneyben: Jobs day Twitter is the best Twitter we have."

Details

← Reply ↻ Retweet ★ Favorite ⋮ More





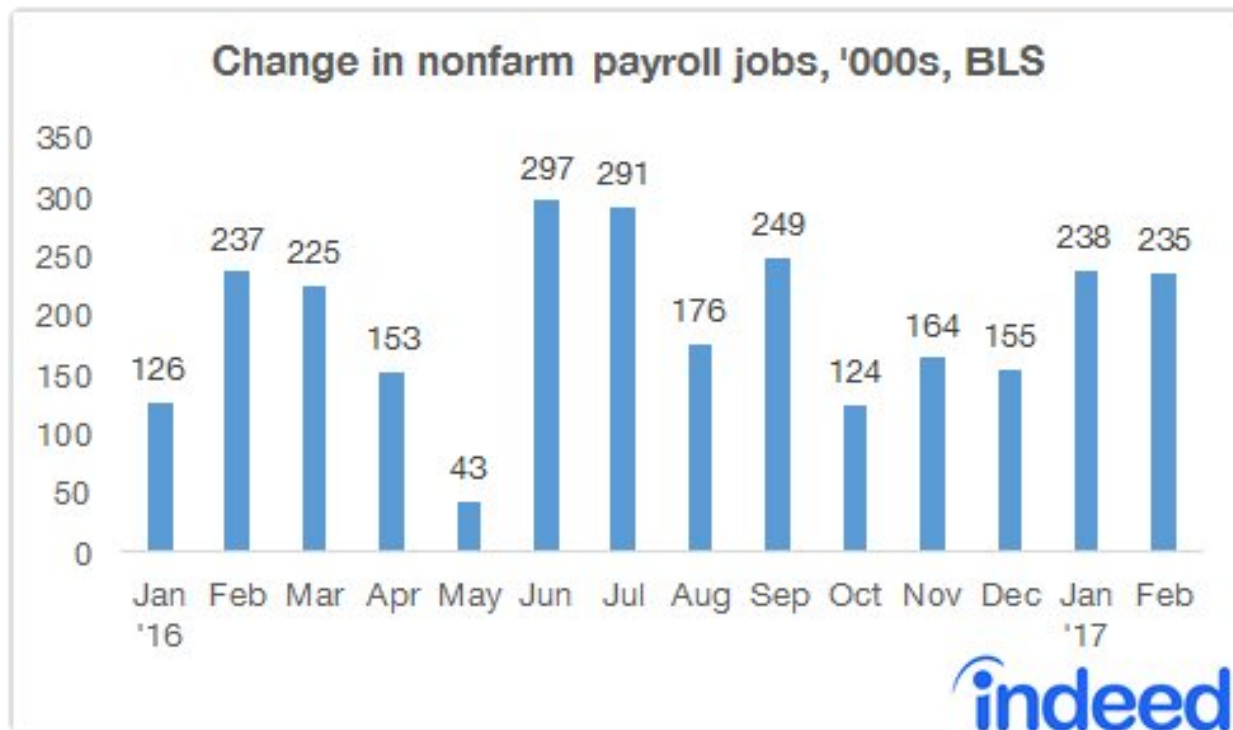
Indeed   
@indeed

Following



Our [@TaraSinc](#) says another strong month of job gains makes a Fed rate hike more likely.

[#hiringlab](#) [#jobsreport](#) [#BLSdata](#)



RETWEETS

2

LIKE

1

Bauch  
control  
solutions



11:08 AM - 10 Mar 2017

# What we propose to do

- In this project we combine the information in the two surveys into a single estimated of monthly real time employment.
  - Objective: create a better real time measure of US payroll employment using information provided from BLS each month within minutes of the update.
  - Measure of success: smaller RMSE than initial release payroll employment data for the data that has been revised to match the “universe counts of employment” (“benchmarked employment”).
- Features:
  - Incorporate the data revisions from the establishment survey
  - Optimally combine the information from the two surveys

## Economic News Release

### Employment Situation Summary

Transmission of material in this release is embargoed until  
8:30 a.m. (EST) Friday, March 10, 2017

USDL-17-0300

#### Technical information:

Household data: (202) 691-6378 \* [cpsinfo@bls.gov](mailto:cpsinfo@bls.gov) \* [www.bls.gov/cps](http://www.bls.gov/cps)  
Establishment data: (202) 691-6555 \* [cesinfo@bls.gov](mailto:cesinfo@bls.gov) \* [www.bls.gov/ces](http://www.bls.gov/ces)

Media contact: (202) 691-5902 \* [PressOffice@bls.gov](mailto:PressOffice@bls.gov)

#### THE EMPLOYMENT SITUATION -- FEBRUARY 2017

Total nonfarm payroll employment increased by 235,000 in February, and the unemployment rate was little changed at 4.7 percent, the U.S. Bureau of Labor Statistics reported today. Employment gains occurred in construction, private educational services, manufacturing, health care, and mining.

• • •

The change in total nonfarm payroll employment for December was revised down from +157,000 to +155,000, and the change for January was revised up from +227,000 to +238,000. With these revisions, employment gains in December and January combined were 9,000 more than previously reported. Monthly revisions result from additional reports received from businesses since the last published estimates and from the recalculation of seasonal factors. Over the past 3 months, job gains have averaged 209,000 per month.

## Economic News Release

### Employment Situation Summary

Transmission of material in this release is embargoed until  
8:30 a.m. (EST) Friday, March 10, 2017

USDL-17-0300

#### Technical information:

Household data: (202) 691-6378 \* [cpsinfo@bls.gov](mailto:cpsinfo@bls.gov) \* [www.bls.gov/cps](http://www.bls.gov/cps)  
Establishment data: (202) 691-6555 \* [cesinfo@bls.gov](mailto:cesinfo@bls.gov) \* [www.bls.gov/ces](http://www.bls.gov/ces)

Media contact: (202) 691-5902 \* [PressOffice@bls.gov](mailto:PressOffice@bls.gov)

#### THE EMPLOYMENT SITUATION -- FEBRUARY 2017

Total nonfarm payroll employment increased by 235,000 in February, and the unemployment rate was little changed at 4.7 percent, the U.S. Bureau of Labor Statistics reported today. Employment gains occurred in construction, private educational services, manufacturing, health care, and mining.

• • •

The change in total nonfarm payroll employment for December was revised down from +157,000 to +155,000, and the change for January was revised up from +227,000 to +238,000. With these revisions, employment gains in December and January combined were 9,000 more than previously reported. Monthly revisions result from additional reports received from businesses since the last published estimates and from the recalculation of seasonal factors. Over the past 3 months, job gains have averaged 209,000 per month.

## Economic News Release

### Employment Situation Summary

Transmission of material in this release is embargoed until  
8:30 a.m. (EST) Friday, March 10, 2017

USDL-17-0300

#### Technical information:

Household data: (202) 691-6378 \* [cpsinfo@bls.gov](mailto:cpsinfo@bls.gov) \* [www.bls.gov/cps](http://www.bls.gov/cps)  
Establishment data: (202) 691-6555 \* [cesinfo@bls.gov](mailto:cesinfo@bls.gov) \* [www.bls.gov/ces](http://www.bls.gov/ces)

Media contact: (202) 691-5902 \* [PressOffice@bls.gov](mailto:PressOffice@bls.gov)

#### THE EMPLOYMENT SITUATION -- FEBRUARY 2017

Total nonfarm payroll employment increased by 235,000 in February, and the unemployment rate was little changed at 4.7 percent, the U.S. Bureau of Labor Statistics reported today. Employment gains occurred in construction, private educational services, manufacturing, health care, and mining.

• • •

The change in total nonfarm payroll employment for December was revised down from +157,000 to +155,000, and the change for January was revised up from +227,000 to +238,000. With these revisions, employment gains in December and January combined were 9,000 more than previously reported. Monthly revisions result from additional reports received from businesses since the last published estimates and from the recalculation of seasonal factors. Over the past 3 months, job gains have averaged 209,000 per month.



**Justin Wolfers**

@JustinWolfers

Following



Household survey is very strong, showing employment growth of +447k. Using my 80/20 formula, says jobs growth was an impressive +277k.

RETWEETS

16

LIKES

20



8:34 AM - 10 Mar 2017



2



16



20



Reply to @JustinWolfers



**Jason Furman** @jasonfurman · Mar 10



@JustinWolfers Or using the Obama CEA 100/9 formula that is a pretty good 235,000 [obamawhitehouse.archives.gov/sites/default/...](http://obamawhitehouse.archives.gov/sites/default/...)



1



1



4



**Jay C. Shambaugh** @JayCShambaugh · Mar 10



@jasonfurman @JustinWolfers I think the state space model to extract signal is the compromise: 92/8 >> 250k



1



3

# Quick Literature Overview

- Multiple Vintages:
  - Clements and Galvão (2012): VAR models of multiple data vintages for improved real time estimates of output and inflation gaps.
  - Koenig and Kishor (2012): Address the apples and oranges problem of the heavily revised earlier data and less revised more recent data.
  - Jacobs and van Norden (2011): Economic data revisions modeled in a state-space framework.
- Multiple Surveys:
  - Auroba et. al (2012 and 2016): Combine information from different national accounting approaches to improve the measurement of output
  - CEA Brief (January 2017): “employment growth itself is best measured entirely using the payroll survey while disregarding changes in the household-survey measure of employment.”
- Real time issues with payroll employment:
  - Owyang and Vermann (2014): procyclical revisions
  - Aruoba (2008): payroll employment is one of many macro variables where the initial is a biased estimate of the final.

# Our Data

- Data for the RHS:
  - Monthly change of initial payroll employment
  - First two revisions of payroll employment
  - Monthly change of household employment
  - Monthly change of adjusted household employment (available since 1994)
  - February 1994 to March 2016
  - All data are seasonally adjusted
  - Real time data sourced from St. Louis Fed's ALFRED database
    - We're currently treating the HH data as unrevised, but that's not quite right...
- Target data (LHS): benchmarked total nonfarm payroll employment released on February 3, 2017.
- Plan for the model: produce real-time estimates each month, update model parameter estimates each February upon release of the newest benchmarks.



# (*Very Preliminary*) Results

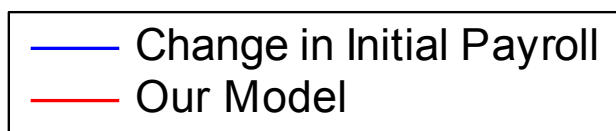
Model	In Sample RMSE
Change in Initial Payroll	92.45
80/20 Initial Payroll and Household	107.37
80/20 Initial Payroll and Adjusted Household	110.71
<b>Our model with Initial Payroll, Adjusted Household and the lagged first revision</b>	<b>91.33</b>

# Out of Sample Predictions

- We currently have real time data for April 2016-February 2017 and do not yet have the benchmarked data.
- How different are the out-of-sample predictions of our model versus using initial payroll?

# Out of Sample Results

	<b>Initial Payroll</b>	<b>Our Model</b>
<b>Mean Apr 2016 – Feb 2017</b>	182	192
<b>Feb 2017</b>	235	253



# Next Steps

- Additional features to add to the model:
  - Time varying parameters (particularly on the weight of the household survey, at least addressing the January trend breaks due to new population controls)
  - Nonlinear features to capture the cyclical patterns
  - Stochastic volatility
  - Addressing seasonal adjustment biases (Phillips and Nordlund, 2012)
  - Additional information available quarterly from QCEW (Philadelphia Fed, 2014)
  - Additional variables available in real time (e.g. unemployment claims)