Federal Forecasters Conference
The role of ‘big’ data in forecasting

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Outline

- What are ‘big’ data?
- A framework for thinking about ‘big’ data in forecasting
- How does BLS use ‘big’ data?
- Final thoughts on data gaps
What are ‘big’ data?

A view from outside the statistical system
What are ‘Big Data’?
A few examples

• Billion prices project
  □ Daily CPIs in over 20 countries
  □ Webscraping technology

• Google
  □ Tools to create large data files that combine publicly available data on social and economic activity stratified by geography, and social-demographic characteristics
What are ‘Big Data’?
A few examples

Google

- Modeling form combines Google search index data in the current period with past values of an economic measure from the statistical system to predict a future value of the same concept

\[ Y_t = f(\text{Search}_{t-1 \text{ to } t}, Y_{t-1}, t-2, \ldots) \]

- Example: Initial claims
What are ‘Big Data’?
A few examples

- Tweets University of Michigan Study database
  - Case study of job loss related tweets that examines the correlation with unemployment data to predict initial claims
- Intuit
  - Quicken payroll accounts - Time series of employment, compensation, hours worked, hourly rates of pay, % full time, new hire rate
  - Stratified by size, industries
What are ‘Big Data’?

A few examples

- **ADP Payroll**
  - Over the month change in payroll employment

- **UPS**
  - Using telematic sensors in over 46,000 vehicles, big data on route selection, speed, and direction
  - Estimated savings of 8.4 million gallons of fuel by cutting off 85 million miles of route driven in 2011
What are ‘Big Data’?
A few examples

- GE
  - Use of real time monitoring of machines with big data analytic techniques to improve productivity of electricity generating machines, aviation, rail transportation, and health care
  - Power of 1% and the industrial internet
  - 1% savings in fuel consumption in aviation would generate savings of $30 billion
  - 1% efficiency improvement in GE’s global gas fire plant fleet would produce an estimated savings of $66 billion in 15 years
Big Data – Definitions/Scope

- Wikipedia
  - Big data is term for the collection of data sets so large and complex that it becomes difficult to process using hands-on data base management tools or traditional data base processing applications

- 3V definition
  - Volume, Velocity, Variety
  - SAS Institute – Variety not volume

- Transactional data
A framework for thinking about ‘big’ data in forecasting
Big Data and Official Statistics

- Big Data
- Admin Data
- Non-sampled data
- Sampled survey data
Bureau of Economic Analysis

Big Data

Non-sampled data

Admin Data

Sampled survey data

GDP
‘Big’ data and forecasting

● Forecasting
  ■ Time: out of sample forecasts
    – Forecasts with error properties
    – BLS projections example: natural rate of unemployment
  ■ Place
    – Model subdomain detail
    – Geography
    – Strata subgroups

● Modelling
  ■ Causation versus correlation
  ■ Focus on inputs to improve forecasts
‘Big’ data and forecasting

- Quality measures
  - Reduction of survey error
  - Coherence checks
  - Transparency of methods

- Big data methods
  - Replace
  - Blend
  - Model / Use of ‘big’ data to ratio allocate to subdomains
    - Acceptable levels of Mean Squared Error
  - Validate
Uses of alternative ‘big’ data at BLS
Types of alternative data and BLS uses

- Webscraped data
- Federal administrative data
  - Linking data sets
- Private Vendor data
- Modelling
- Corporate data
- Autocoding and text analysis
Webscraping

- Determine whether or not we need permission to scrape web sites.
- Examining the most promising areas for webscraping:
  - Food prices
  - Cable TV prices
  - Airline prices
  - Courier services
BLS uses of Federal Administrative Data

• Sampling frames
• Production of statistics.
  □ Quarterly Data on employment and payrolls at nearly every establishment in the U.S.
  □ Employment at startups, growing and contracting establishments
BLS uses of Federal Administrative Data

- Uses of Administrative data for direct estimation
  - Energy Information Agency --- Import Energy Price indexes
  - Department of Transportation baggages fees – Producer Price indexes
  - CMS – Medicare reimbursements for hospital and physician treatments – Producer Price Indexes
BLS uses of Federal Administrative Data

- Linking: Quarterly Census of Employment and Wages (QCEW) to:
  - Non profit data (IRS)
  - Hurricane maps (National Hurricane Program)
  - Foreign Direct Investment (BEA)
  - Occupational Employment Statistics Survey (OES)
  - Survey of Occupational Illnesses and Injuries (SOI) and OES
Private Vendor data: BLS uses

- Stock Exchange Security Trades – Producer Price Indexes
- JD Power – Consumer Price Indexes
- Scanner Data
  - Homescale, Nielsen – Consumer Price Index research
Acquiring alternative data sets for use in estimation: future opportunities

- Supplement JOLTS data on vacancies with job openings data from private vendors (Snagajob, Burning Glass, Career Builder)
- Truven Health Analytics data for health care productivity measures
- Use of Compustat data to develop State level productivity estimates
- Use of credit card data collected by BEA to potentially use to create travel and tourism price indexes
Modelling

- Occupational Employment Statistics Program
  - Creation of time series data for the Occupational Employment Statistics program and imputing occupational staffing patterns to the universe of establishments
  - Develop estimates of annual changes in occupational employment and wages down to the state and possibly MSA level
  - Develop short-term forecasts / extrapolations
Modelling

- Job Opening and Labor Turnover (JOLTS)
  - Development of state based modelled estimates of vacancies, hires, quits, layoffs, and other separations
  - Potential future use of Unemployment Insurance wage records to model JOLTS data to finer levels of geography
Corporate data: BLS uses

- The Current Employment Statistics Survey (CES) collects data from 88 corporations at their Electronic Data Interchange facility in Chicago, IL
  - Accounts for nearly 10% of total weighted employment
  - Respondents submit electronic files in BLS formats
- The Occupational Employment Statistics (OES) Survey collects electronic data files from large firms that are also in the sample for the National Compensation Survey
Electronic data collection

- A large share of collected information in our establishment surveys comes from a small share of total establishments owing to the size concentration of economic activity.
- In 2012, of the known value of U.S. exports that could be matched to specific companies:
  - the top 50 companies contributed nearly 31% of known value
  - the top 100 nearly 40%
  - the top 250 just over half
  - and the top 2000 nearly 78%
Electronic data collection: The future

- Allow firms to report using their formats and databases
- Using autocoding learning models, or computational linguistics to convert firm based data and classifications to BLS concepts
Autocoding

- The Survey of Occupational Injuries and Illnesses is currently autocoding text fields on types of injuries into their classification system on injuries.
- We are planning on introducing autocoding to classify job titles into the Standard Occupational Classification (SOC) system in the Occupational Employment Statistics (OES) Survey.
- We are researching using text analysis in many other areas across BLS.
FINAL THOUGHTS ON DATA GAPS
Data Gaps

● What kinds of workers are used to produce goods or provide services?
  □ The May 2017 Contingent Worker Survey (and the Katz/Kreuger study) are from the individual worker perspective
  □ Need establishment data

● How much training is provided by firms?

● What other margins of adjustment are used such as domestic and foreign outsourcing?

● Industry of placement of temporary help agency workers

● Consistency of classification systems
Employment in temporary help services is considered a leading indicator for total nonfarm employment. However, one of the largest gaps in our data is not knowing the industry placement for workers in this industry.
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