BIG Data and OFFICIAL Statistics

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Michael W. Horrigan

Associate Commissioner

Office of Prices and Living Conditions

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Big Data and Official Statistics

- What are big data?
  - A few examples
  - Definition / scope
- How is BLS using big data?
- Examining big data through the lens of data quality frameworks
- What is the future of using big data by statistical agencies?

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What are 'Big Data'? A few examples

- Billion prices project
  - Daily CPIs in 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

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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

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What are 'Big Data'? A few examples

- 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.
- 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.

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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

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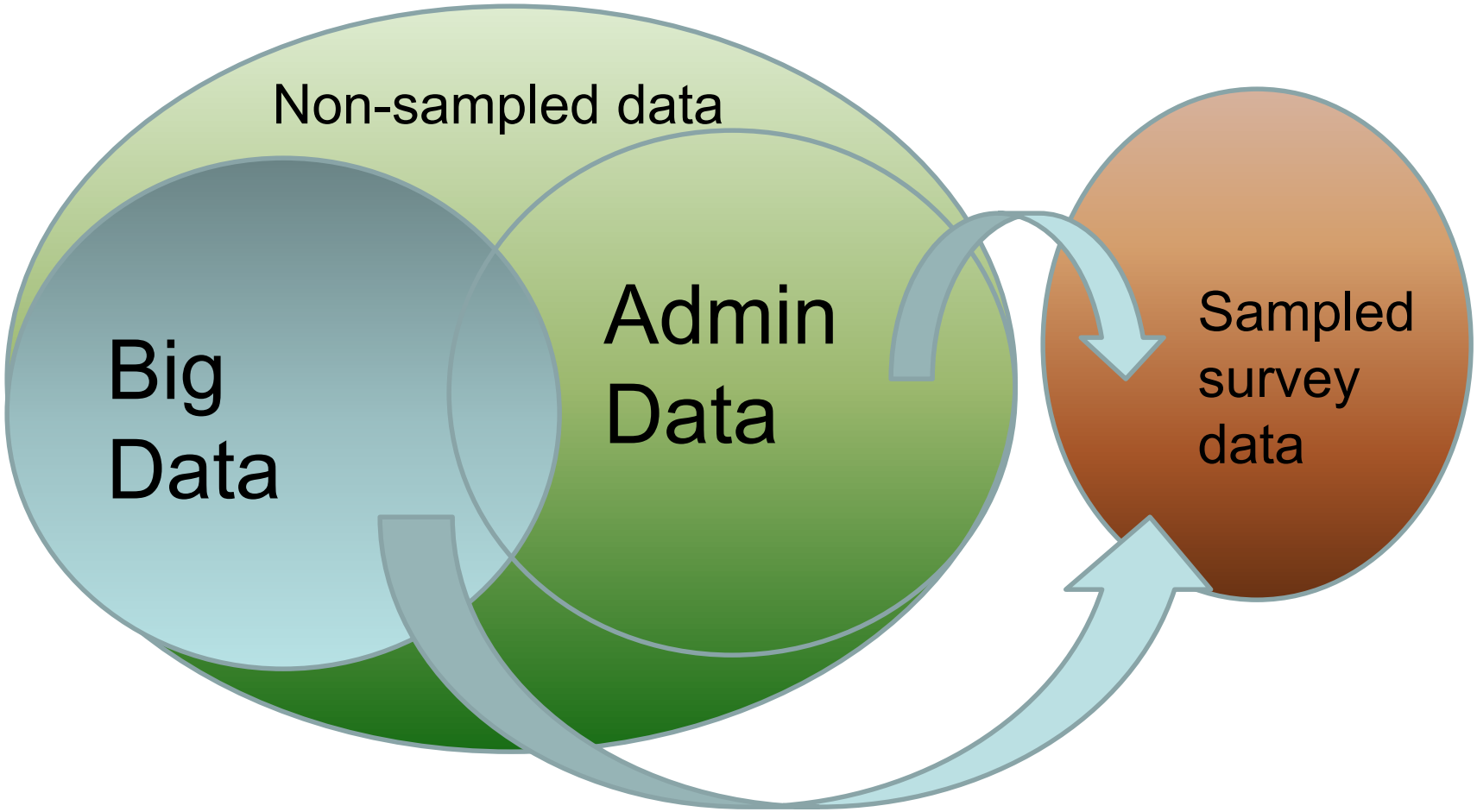

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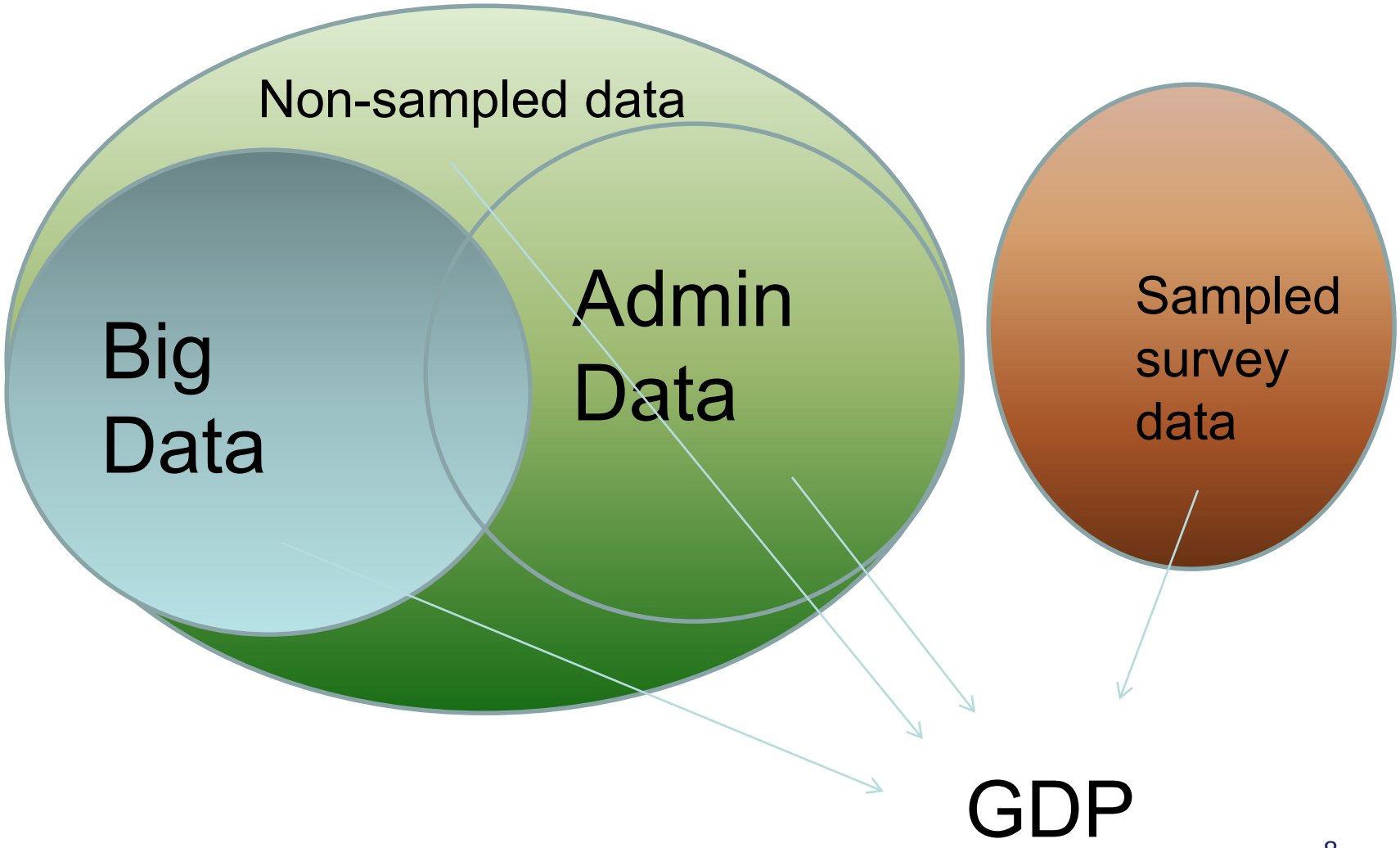
Bureau of Economic Analysis



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How are Big Data being used?

- Webscraping – BLS CPI
  - Create data base of product characteristics for use in quality adjustment hedonic models
    - Televisions
    - Camcorders
    - Camera
    - Washing Machines
  - Research to expand use to collect prices for cable TV plans and airline prices

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How are Big Data being used?

- Scanner data: Homescan, Nielson
  - Actual sales transactions
  - Comparison of national distribution of selected products with results from CPI disaggregation process
- JD Power
  - Used car frame for CPI
  - Researching use for CPI production of new car price indexes

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How are Big Data being used?

- Medicare part B
  - PPI and CPI use reimbursements to doctors by procedure code in indexes
- Claims data
  - Validation of MEPS and CPI inflation rates
  - Note: CPI constructs experimental disease based price indexes using annual weights from the MEPS household survey data

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How are Big Data being used?

- Stock Exchange Security Trades
  - PPI receives a monthly census of all bid and ask prices and trading volume for all traded securities as of market close for 3 selected days of the month.
  - These data are used for index estimation
- Ratio allocation
  - CPI cost allocation weights and gasoline data from EIA

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How are Big Data being used?

- Company provided data – Corp X
  - Research by CPI to use company provided data on all register transactions for sampled outlets
  - Challenges:
    - Can the matched model requirement be satisfied
    - Accounting for substitutes
    - IT production requirements
    - Risk of losing access
  - Opportunity:
    - Use of corporate data in direct estimation

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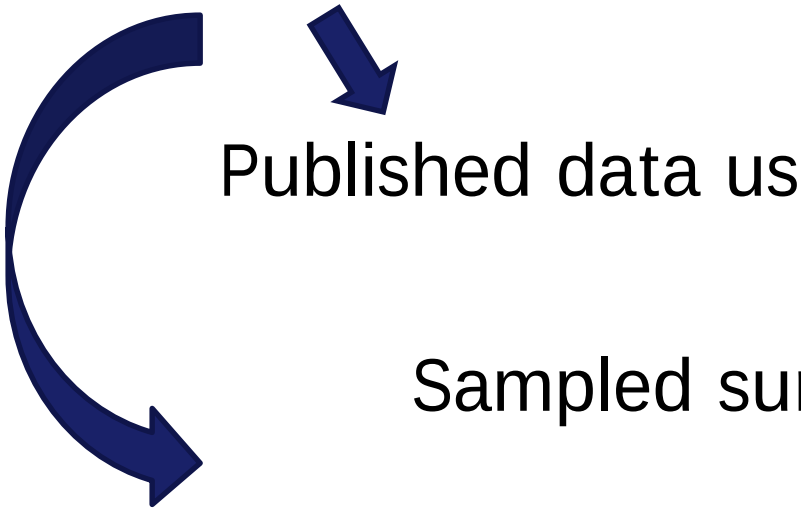
How are Big Data being used?



How are Big Data being used?

- BLS Quarterly Census of Employment and Wages: Some examples of uses:
  - BLS sampling: PPI, NCS, CES, OES, OSH, JOLTS, Green Jobs
  - Imputation: State based estimates use QCEW data to impute for key non-respondents
  - Use of QCEW data to develop forecasts that are used in the CES birth death model

How are Big Data being used?

Administrative data

Used directly in estimation

- IPP uses EIA data on crude petroleum for their import indexes
- PPI uses Department of Transportation data on baggage fees
- CPI uses SABRE data for airline prices

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How are Big Data being used?

Administrative data

Linking

- Census Bureau's Longitudinal Establishment….
- BLS Business Employment Dynamics
- Linking within agencies
- Sharing across agencies: CIPSEA

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Assessing Big Data through the lens of Quality frameworks

- Statistical agencies use a variety of quality dimensions to judge the efficacy of their direct data collection programs.
- It is reasonable to ask how the use of Big Data by Billion Prices, Google, Intuit and others fare along the same dimensions
- The use of external data sets (Big, Administrative, Other surveys) by statistical agencies to produce 'blended' estimates should come under the same scrutiny

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Quality as a three-level concept

Product Quality

- Timeliness
- Relevance
- Objectivity
  - Clear, unbiased
- Accuracy – sampling errors
  - Calculated, published, used in analysis
- Accuracy – non sampling errors
  - Coverage
    - Primary challenge to statistical systems
    - Often an advantage of Big Data

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Product Quality

- Accuracy – non sampling errors
  - Non response bias
    - Significant concern of statistical systems about their own data and for Big Data
  - Classification/specification
    - Lack of cross walks across different classification systems across statistical systems, administrative data, firm data, big data
- Metadata/transparency/interpretability
- Coherence / comparability

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Leveraging Big Data and the Future of the U.S. statistical system

- Budgets for the U.S. statistical system are flat or declining in real terms

- Faced with budget cuts, such as through the sequester, most agencies cut programs
  - For example, in FY 2013, BLS eliminated the International Comparisons Program, the Mass Layoff Survey Program, and the Green Jobs Employment Program

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Leveraging Big Data and the Future of the U.S. statistical system

- Big Data
  - Potential for large volumes of data that, except for up front ($) investment in infrastructure and skill enhancement needed for handling big data, potentially relatively less expensive than direct data collection.
  - Replace, enhance, expand or validate

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Leveraging Big Data and the Future of the U.S. statistical system

- Replace
  - Replace directly collected data with big data estimates
    - Administrative data less subject to selection bias
      - Use of DOT baggage fees, ask/bid prices on securities
    - Self selection bias from social media sources very problematic for top side estimates
      - Use reliable survey methods for control totals and ratio allocate biased 'proportions' to sub categories
      - Replace the goal of unbiased estimation for detailed estimates that minimize Mean Square Error
    - Bias is not always an issue – QA model example

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Leveraging Big Data and the Future of the U.S. statistical system

- Enhance
  - Use direct survey (or high quality blended) estimates for periodic repeated cross-sectional or time series estimates (monthly, quarterly, semi-annual, annual) and redefine the relevance and mission of the statistical system by publishing (noisier and blended) data on a more frequent basis (weekly, daily)
    - EIA weekly gasoline prices
    - CPI's three pricing periods

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Leveraging Big Data and the Future of the U.S. statistical system

- Expand
  - Use big data, especially administrative data and corporate data, to expand coverage of the economy.
  - As of March 2013, 4.3% percent of businesses were of size 50 or more, accounting for just under 60% of employment.
  - Could IRS administrative records for the remaining 95.7% be used as a substitute for expensive direct data collection from small firms and greatly increase their coverage?

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Leveraging Big Data and the Future of the U.S. statistical system

- Expand
  - In the first quarter of 2013, there were just under 16,000 firms with 250 or more employees, accounting for 17% of total employment in the US
  - Explicit strategies to gain access to corporate records from the 16,000 firms could again reduce the direct data collection burden from such large firms.
  - Corporate records have the potential of greatly increasing the quantity, quality and timeliness of data we collect.

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Leveraging Big Data and the Future of the U.S. statistical system

- Expand
  - Two largest gaps in our coverage of the economy is in the service providing sector and in global production processes.
  - Could corporate data record keeping systems, especially firms with global production processes, be leveraged to fill in these gaps?

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Leveraging Big Data and the Future of the U.S. statistical system

- Validate
  - Use of big data as a check on findings from direct survey collection such as validating the CPI market basket for select items against scanner data
  - Development of control/treatment groups
    - Machine learning by Google
    - Experimental design for social interventions

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Contact Information

Michael Horrigan
Associate Commissioner
Office of Prices and Living Conditions
www.bls.gov
202-691-6960
horrigan.michael@bls.gov

What are “Big Data”?