SEO4OLAP – Search Engine Optimized Presentation of Statistical Linked Data

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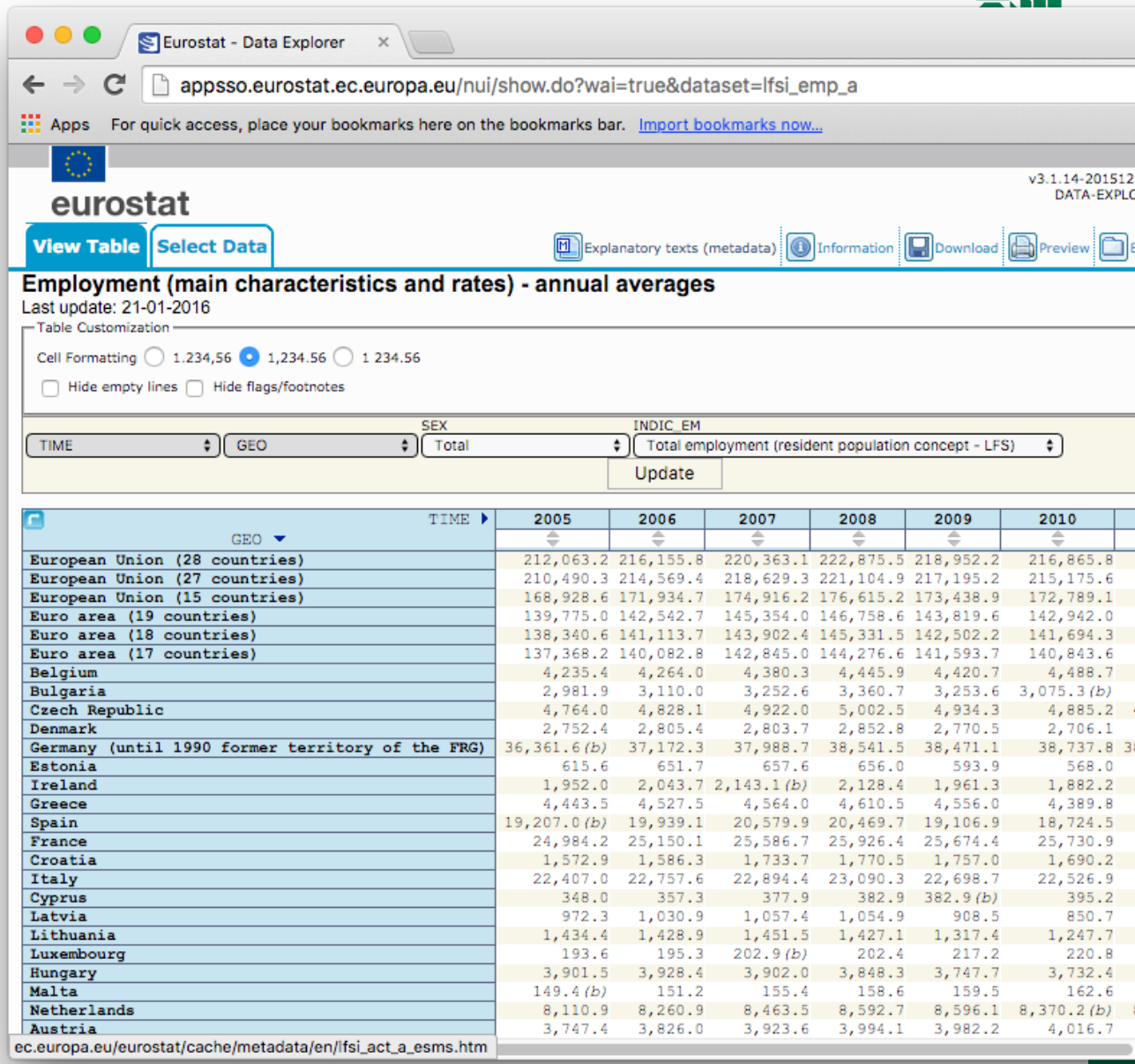
Motivation

- G8 Open Data Charter pushes open statistics
- Large amounts of numeric data already available
- In theory: Important information at your fingertips
  - Computations
  - Comparisons
  - …



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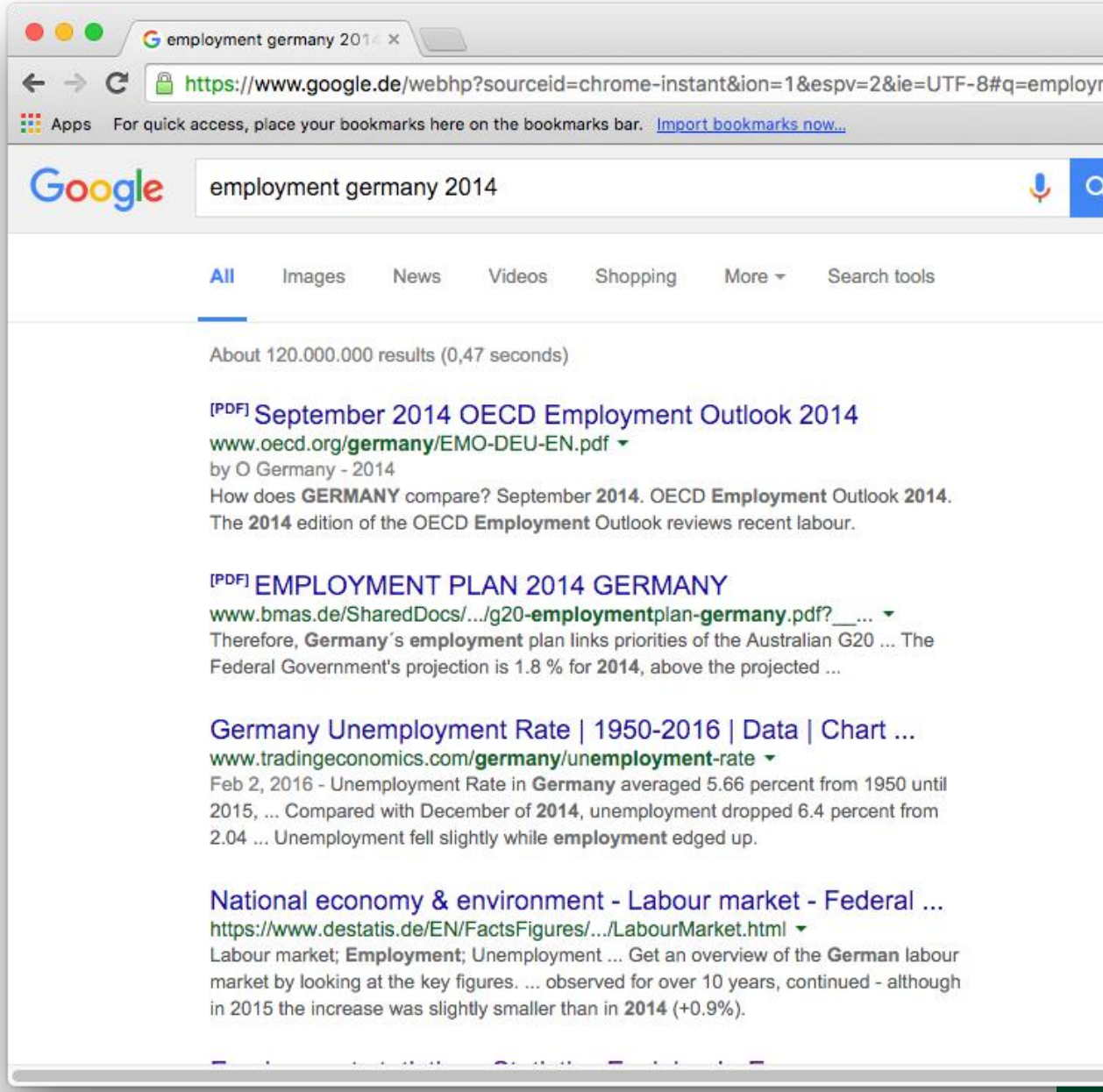
Problem

- How to find the right number for a specific question?
- Standard way = search engines
- Numeric data often not properly indexed
- Reasons
  - Deep web
  - CSV, SDMX…
  - JavaScript
  - …

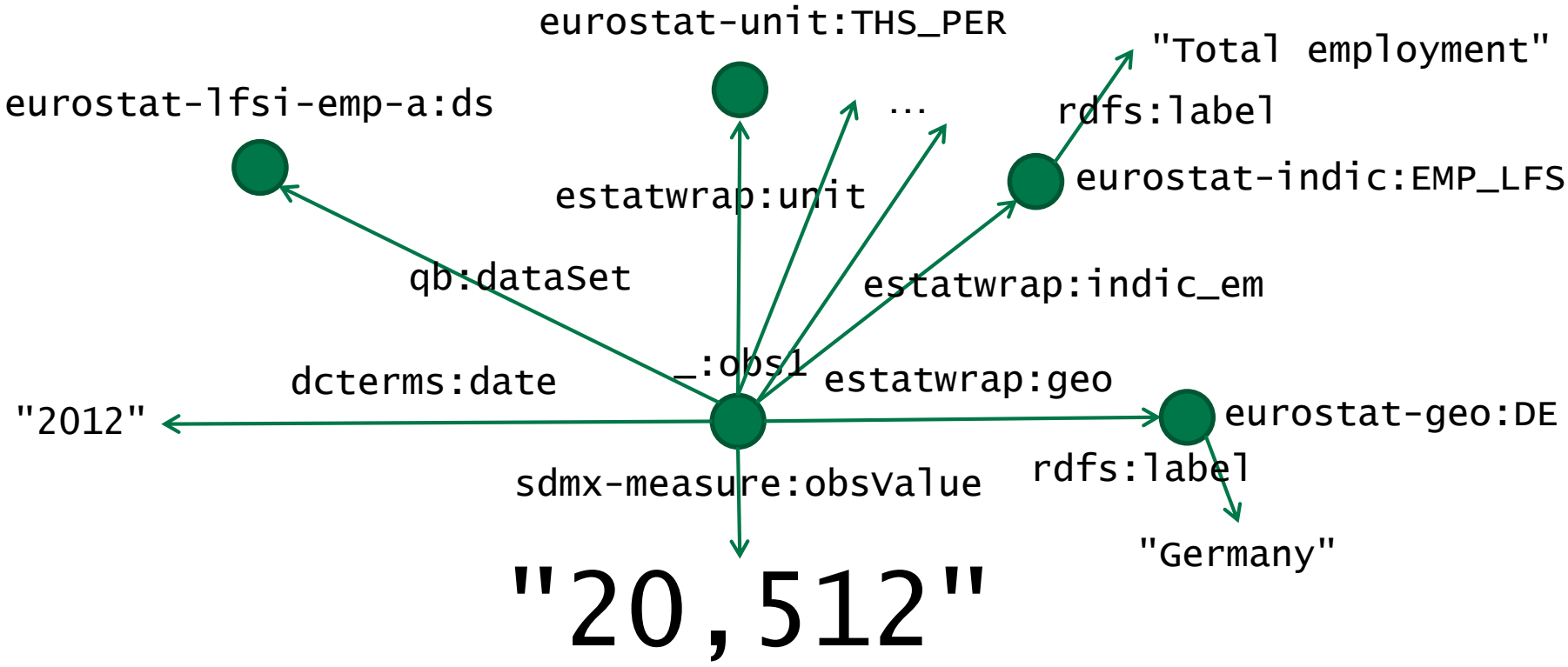


At the same time… Statistical Linked Data

How to publish numeric data on the Web?

"20,512"

At the same time… Statistical Linked Data (2)



Dataset URI: http://estatwrap.ontologycentral.com/page/lfsi_emp_a
RDF Data Cube Vocabulary: *https://www.w3.org/TR/vocab-data-cube/*

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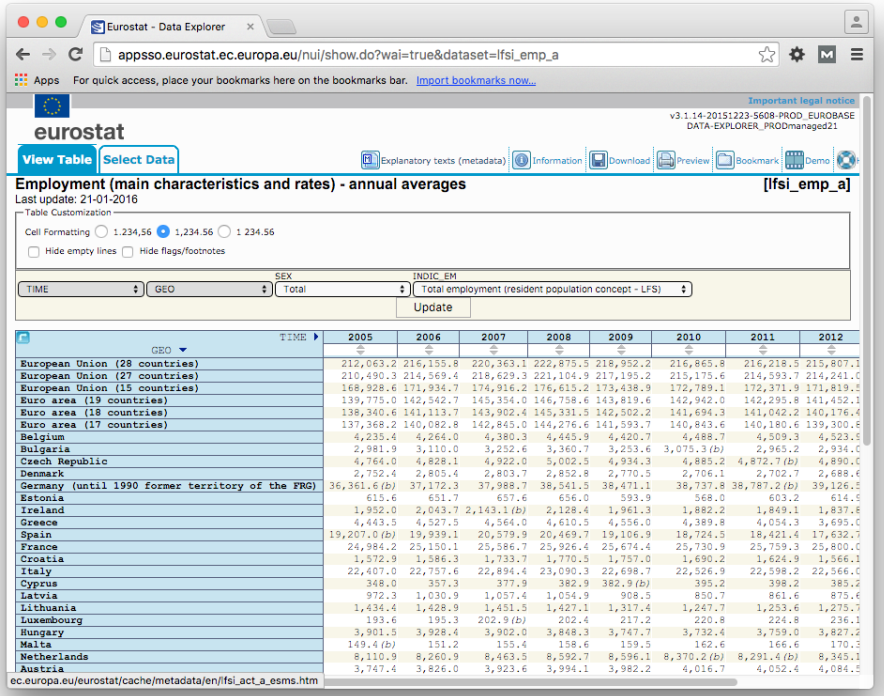
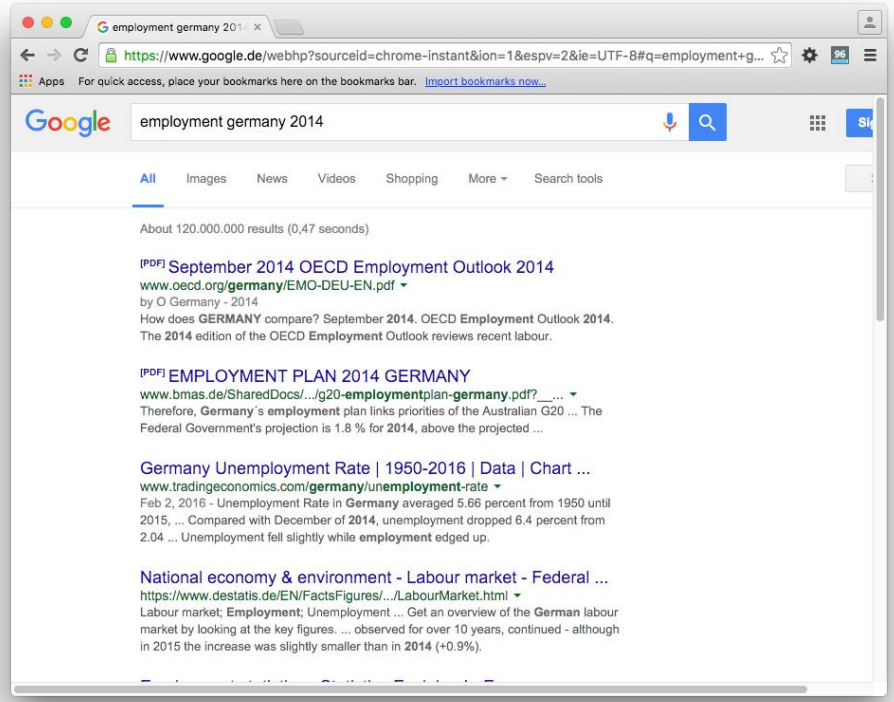
Problem





Research questions

- Can we semi-automatically built a version of arbitrary statistics on the web that is indexed by search engines?
- Is it true that the more specific a query, the better does our version in comparison to existing pages?

Outline

- Motivation/Problem
- **Related Work**
- Approach
- Evaluation
- Discussions
- Conclusions

Related Work

- We generate **search engine optimized pages**
  - Statistical Linked Data visualisation: CODE Query Wizard [Hoe13], CubeViz [SMM+12]
- We use **semantic annotations**
  - Automatic semantic annotation of documents: (automatic) annotation of websites with schema.org [VE13,Mik15]
- We do not do **off-page SEO** (e.g., promoting incoming links)
  - SEO: Web 2.0 techniques [Mal09], empirical evaluations of SEO techniques [SCC13]
- We make **transparent the sources** of numeric data
  - Commercial websites with numeric information: Wolfram Alpha, Tradingeconomics, Statista...

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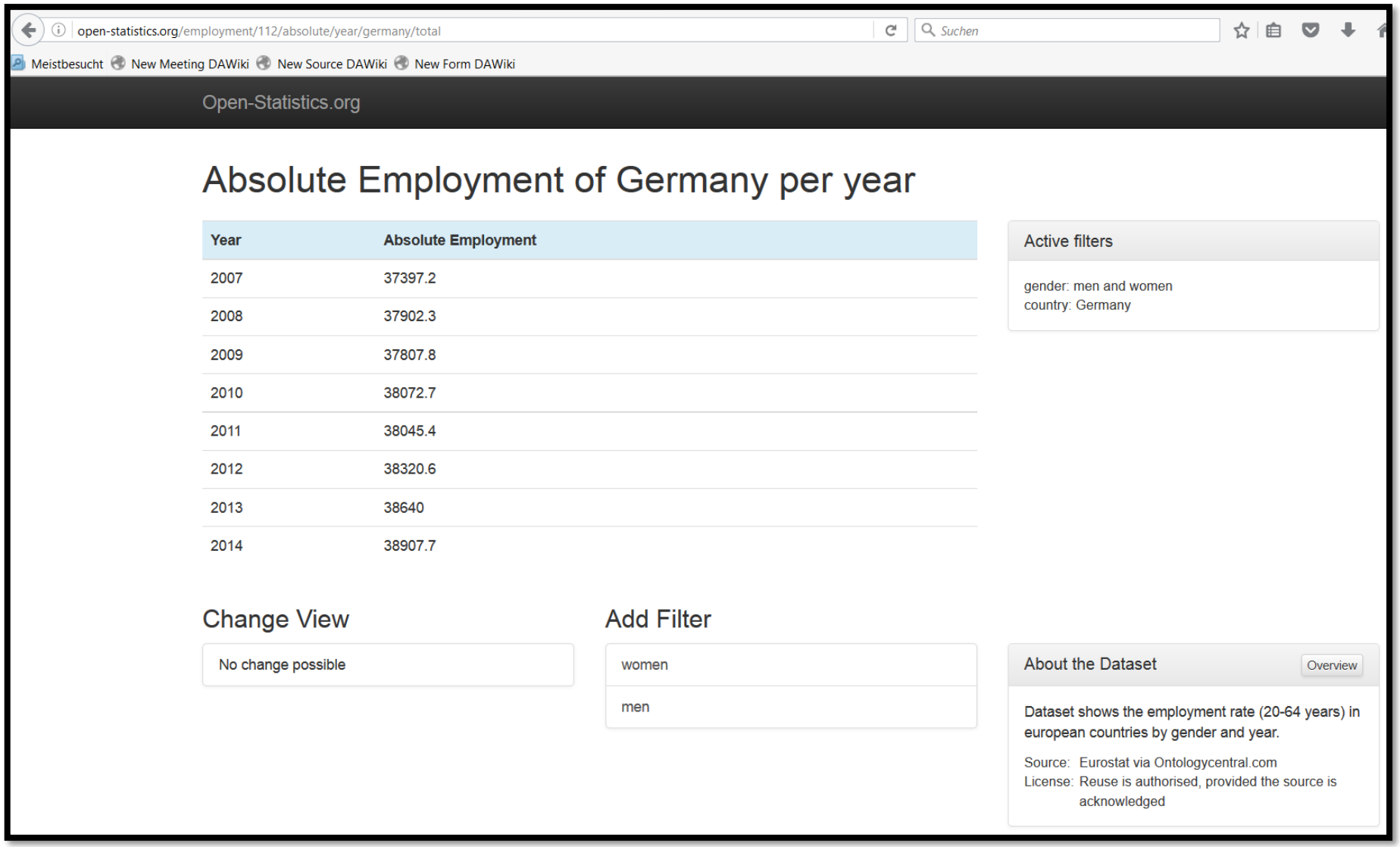
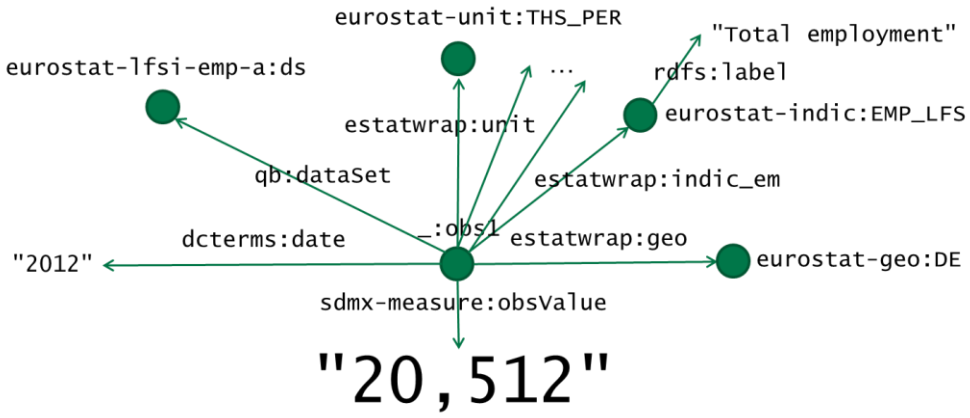
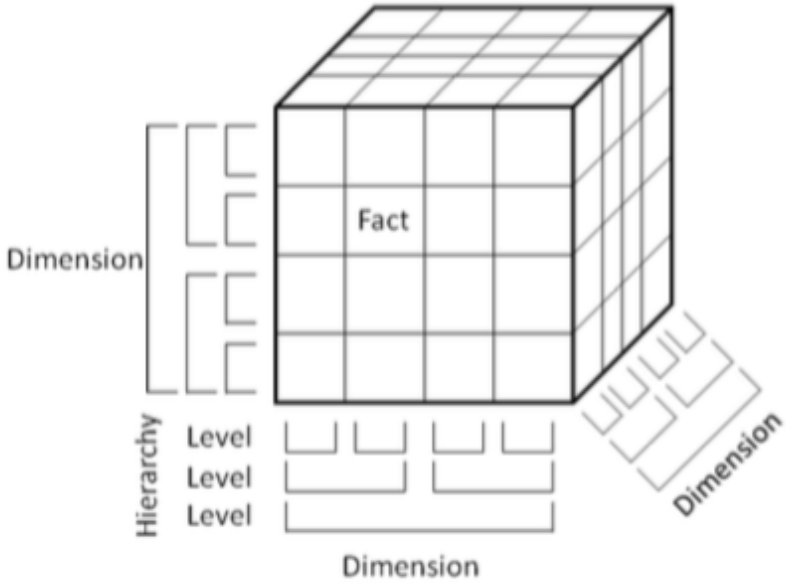
Approach: For every possible "QB view" a search engine optimized landing page



QB View?

QB view = OLAP subcube query [KOH12] = Diced X Sliced X Freed





Statistical Linked Data

Data Cube

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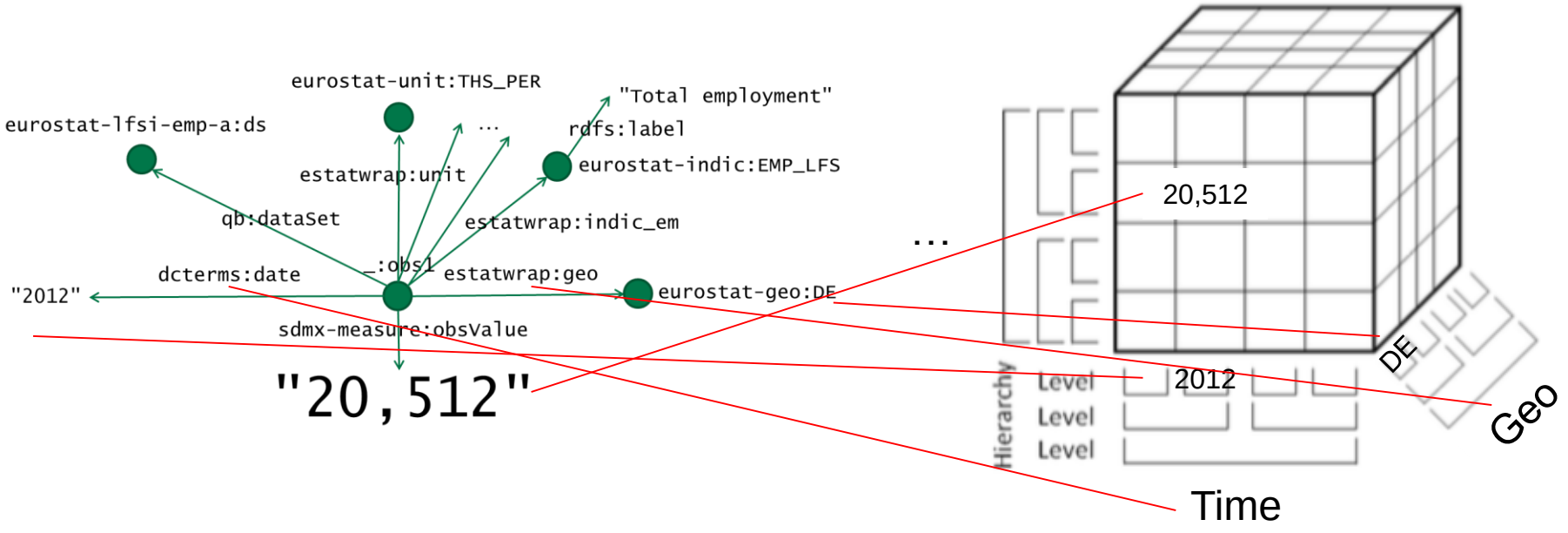

Statistical Linked Data

Data Cube

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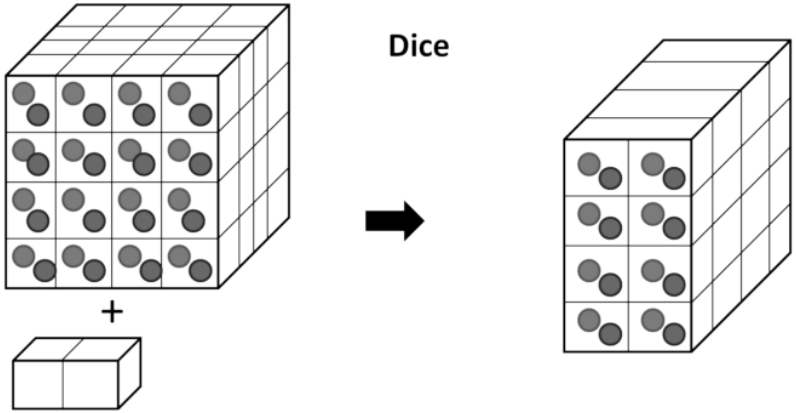
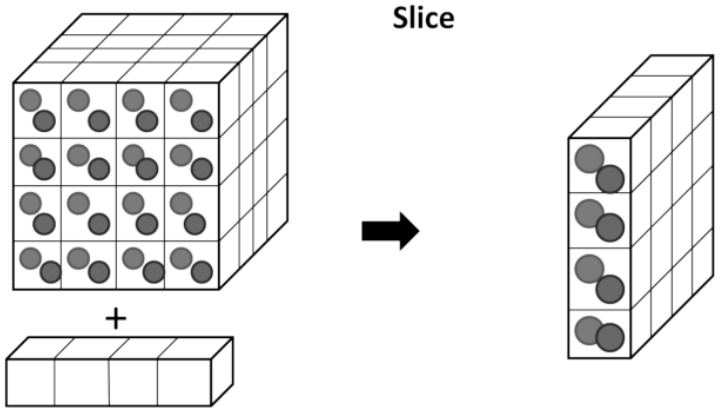
QB View? (2)

Dice	Slice
Filter for one (or more) dimension values	Remove and aggregate over one dimension





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QB View? (3)

- OLAP subcube query [KOH12]: `Diced X Sliced X Freed`
- Example: `({(Unit,THS_PER),(Indicator,Total employment),…}, {Sex,Geo}, {Time})`

Dice	Slice	Free
Unit = Thousand persons Indicator = Total employment Age = 15-64 years Geo = DE	Sex = ALL	Time

Time	Value
2007	37,397
2008	37,902
…	…

Numeric data on the landing page

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For every possible "QB view"?

- # QB view = $\prod_{i=1}^{n}(d_i + 2)$
- with
  - n : number of dimensions
  - d_i : number of values of dimension i
  - 2 : additional values per dimension for "Sliced" and "Freed"
- Example:
  - 6 dimensions (time, geo, age, unit, sex, indicator)
  - 10 values for time, 42 (geo), 2 (age), 2 (unit), 2 (sex), 2 (indicator)
  - 12 x 44 x 4 x 4 x 4 x 4 = 135,168

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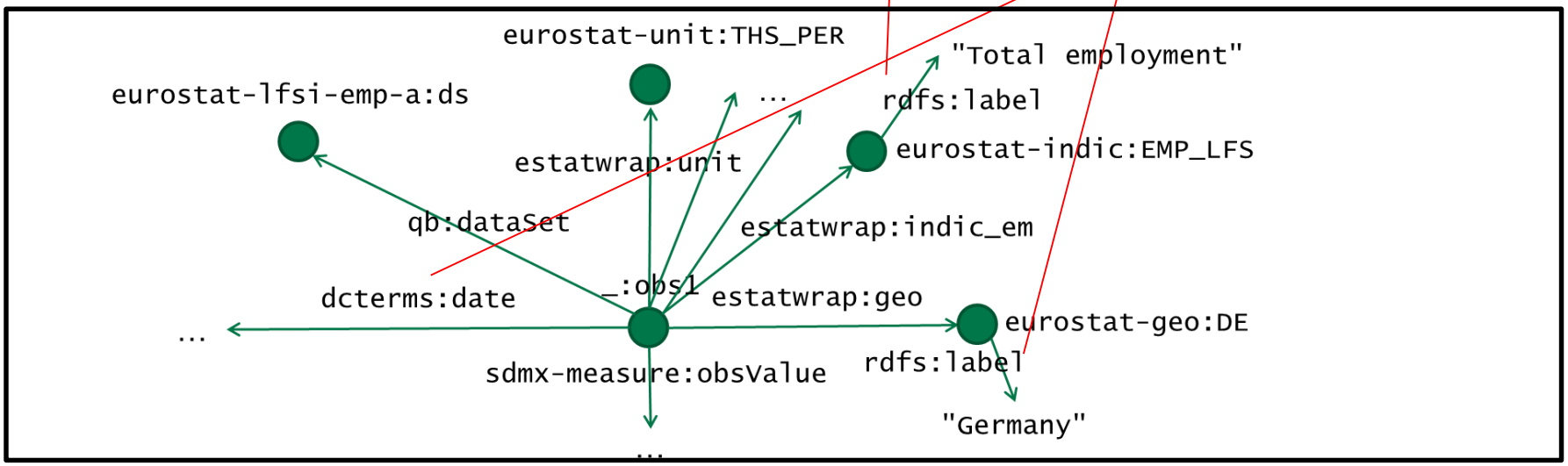
Search engine optimized landing page?

Verbalisation (using templates)

<title> … </title>
<h1>{{diced}}{{freed}}</h1>
…

<title> … </title>
<h1>Employment of Germany per year</h1>
…

HTML



Statistical Linked Data

Search engine optimized landing page? (2)

- URI schema
  - `({(Unit,THS_PER),(Indicator,Total employment),…},{Sex,Geo},{Time})`
  - HTTP Request
    http://baseUri/endpoint?dataset=id1&freed=id2&diced=id3...
  - URL Scheme
    http://baseUri/id1/pattern/id1/id2/id3/... (pattern defines how many freed dimensions)
  - Bsp:
    http://example.org/lfsi-emp-a/1/date/total_employment/germany
- No off-page optimisation (e.g., promoting incoming links)

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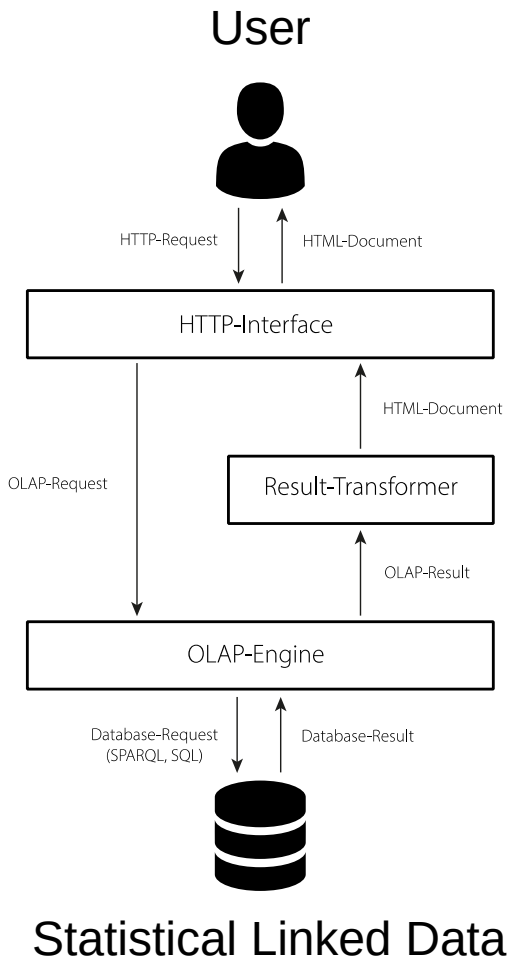
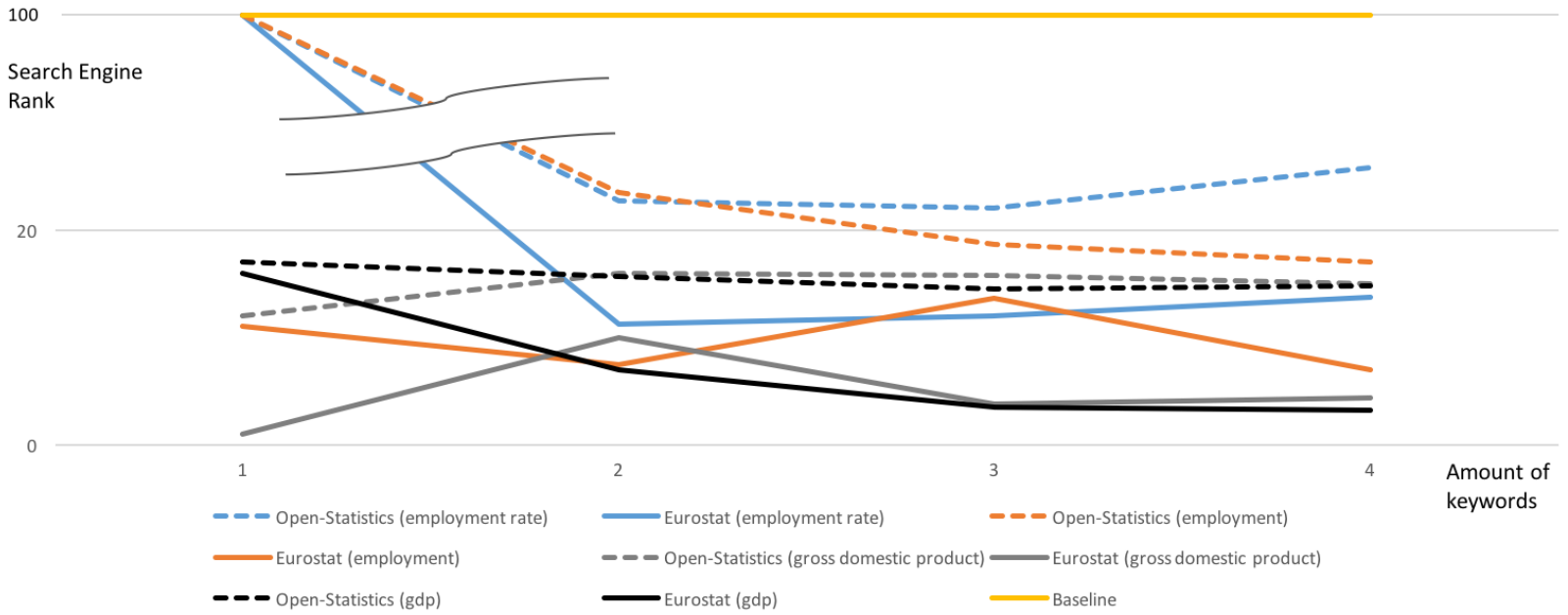
Evaluation

- Hypotheses
  - We can built a version of arbitrary Statistical Linked Data that is indexed by search engines
  - The more specific a query, the better does our version in comparison to existing pages
- Implementation
  - Website: http://open-statistics.org/
  - HTTP-Interface+Result-Transformer: https://github.com/dbreucker/seo4olap-evaluation/
  - Statistical Linked Data: Estatwrap: http://estatwrap.ontologycentral.com/
  - OLAP-Engine: OLAP4LD [KH14]
- Evaluation
  - 2 datasets: Employment in the EU - annual averages, Gross Domestic Product (GDP)
  - Restricted number of pages: max. 2x free dimensions, max. 2x diced dimensions
  - Time: 614 pages generated in 30min



Evaluation (3)



- Comparing Google rank of 3x page types using CuteRank tool
  - Baseline = Eurostat Pivot Pages
  - Eurostat = Landing pages of Eurostat (without actual numbers)
  - Open-Statistics = Our landing pages

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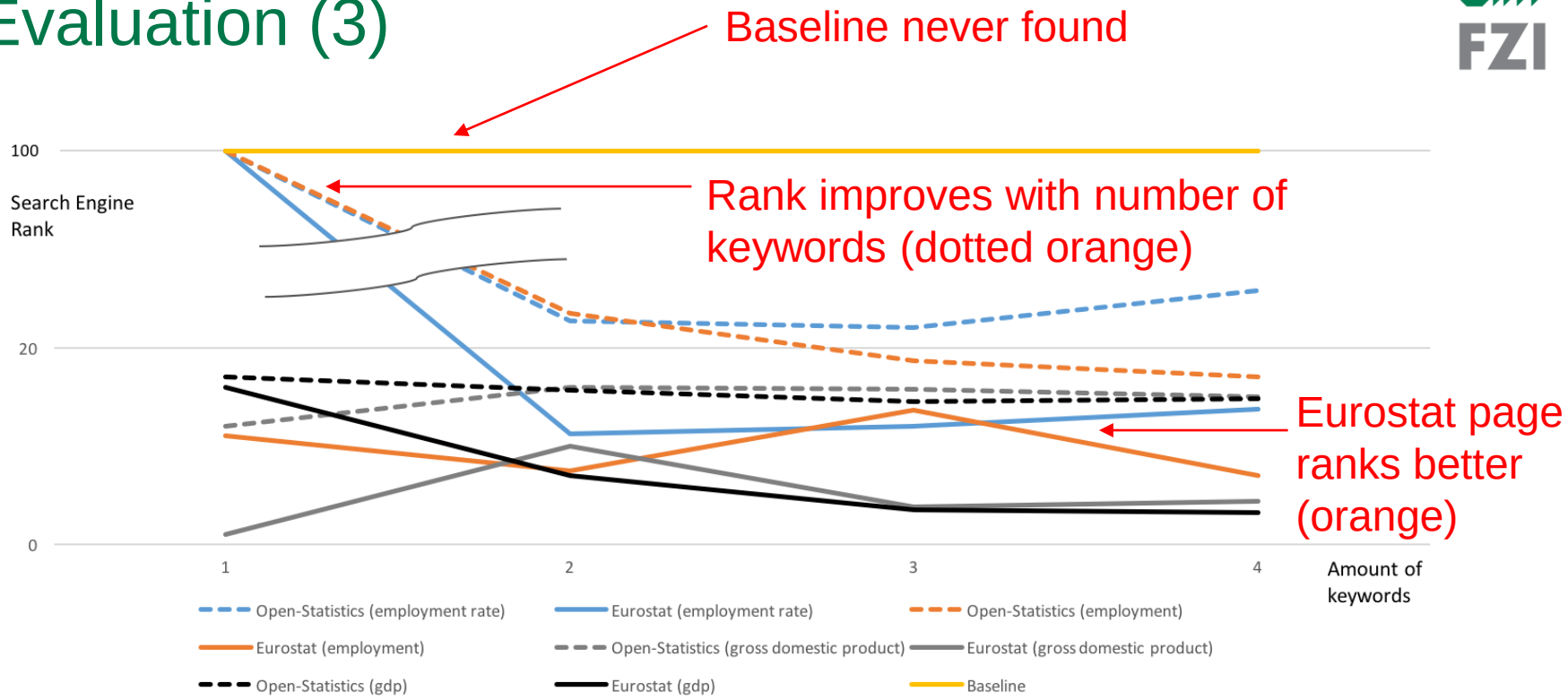
Evaluation (3)



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Discussions

- About generation of pages…
  - **Measure dimension:** some dimensions refer to the indicator and should not be sliced since aggregation would be meaningless
  - **Slice member:** some dimensions contain special type members "total" that should not be included in aggregations
  - **Alternative labels** based on simple rules ("female" => "women")
  - **Unit** not always available in a machine readable format (e.g., ambiguous "ratio or thousand" simply in the textual documentation)
  - Some datasets only mention their **indicator** neither as a specific measure nor in a dimension but only in the title
  - **Schema.org** so far does not provide a way to annotate arbitrary numeric facts for search engines
- About the evaluation…
  - We can built a version of arbitrary Statistical Linked Data that is indexed by search engines – **Confirmed.**
  - The more specific a query, the better does our version in comparison to existing pages – **Valid for some pages but cannot be generally shown.**

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Conclusions

Summary

- We can automatically generate SEO landing pages for arbitrary statistics on the web using Statistical Linked Data
- Although we cannot compete with more prominent off-page optimized websites, some of our pages may eventually prove to be a useful source of specific numeric information for search engines and users

Open work

- So far only two datasets published
  - What to do if we want to publish all 5,000 datasets of Eurostat and of other available Statistical Data sources?
- Is it possible to automatically provide additional information besides the specific numbers such as
  - definitions of indicators from DBpedia/Wikipedia
  - news articles mentioning the numbers
  - highlighting anomalies
  - showing related numbers (for comparisons)
- Is it possible to allow arbitrary combinations (e.g., derived number "GDP per capita")…
- …and comparisons of numbers from the "Global Cube" of all available Statistical Linked Data on the web?

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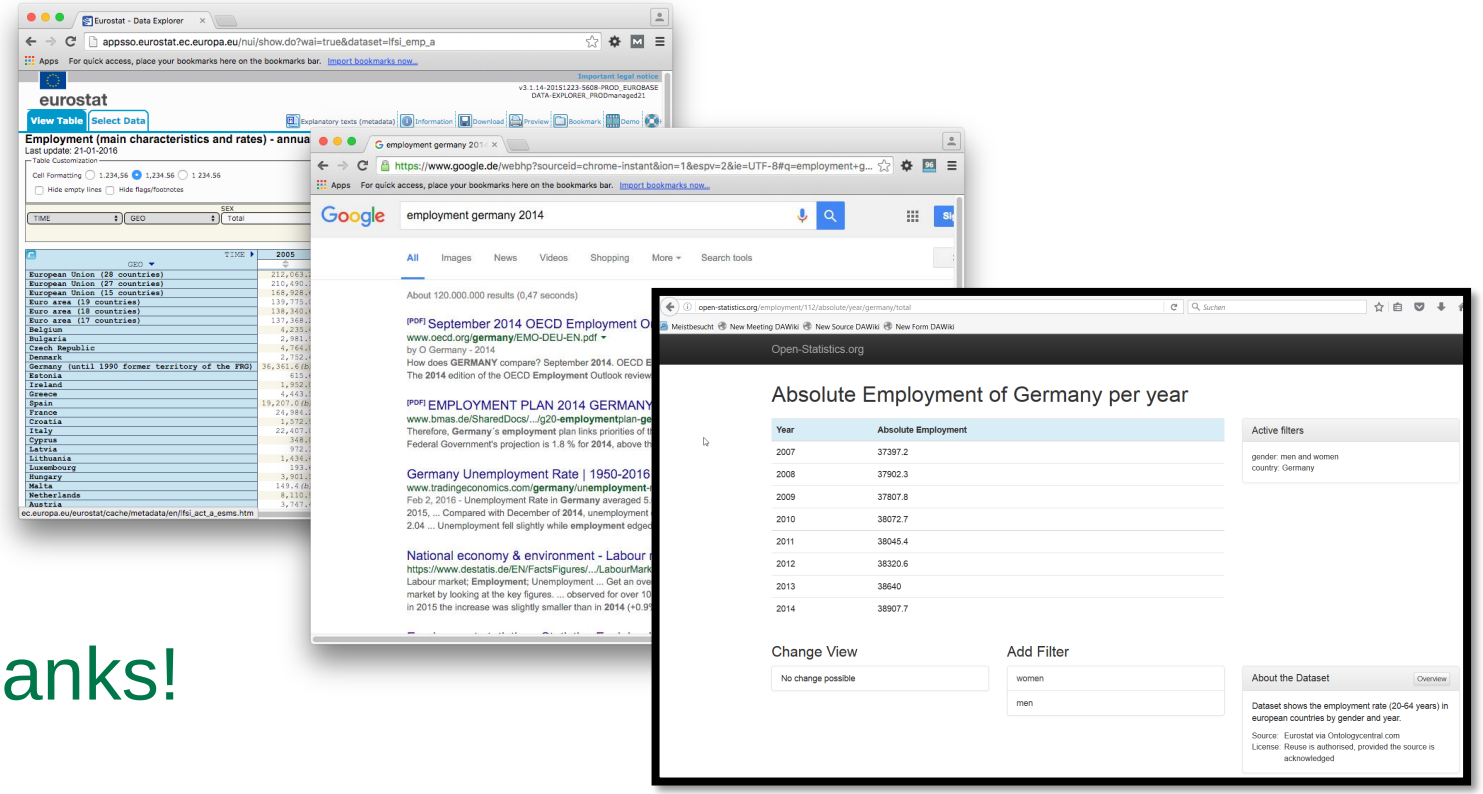

Thanks!

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