Irving Fisher Committee on
Central Bank Statistics

BANK FOR INTERNATIONAL SETTLEMENTS

IFC – Bank Indonesia International Workshop and Seminar on *"Big Data for Central Bank Policies / Building Pathways for Policy Making with Big Data"*

Bali, Indonesia, 23-26 July 2018

Promise: measuring from inflation to discrimination[1]

Roberto Rigobon,

Massachusetts Institute of Technology (MIT)

[1] This presentation was prepared for the meeting. The views expressed are those of the author and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the meeting.

PROMISE:

Measuring From Inflation to Discrimination

July 2018

Roberto Rigobon

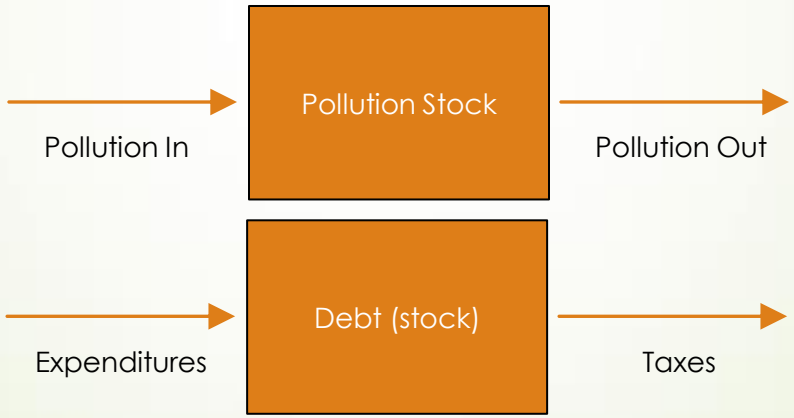
MIT, NBER, CNStat

Dimensions of Social Wellbeing

P	• Personal
R	• Relationships
O	• Organizations, Firms, and Jobs
M	• Markets and Economy
I	• Institutions
S	• Social and Political
E	• Environment

Principles

	P	R	O	M	I	S	E
Principles	Balance	Trust	Future Value	BB-NN	Consistency	SP	EE



Values

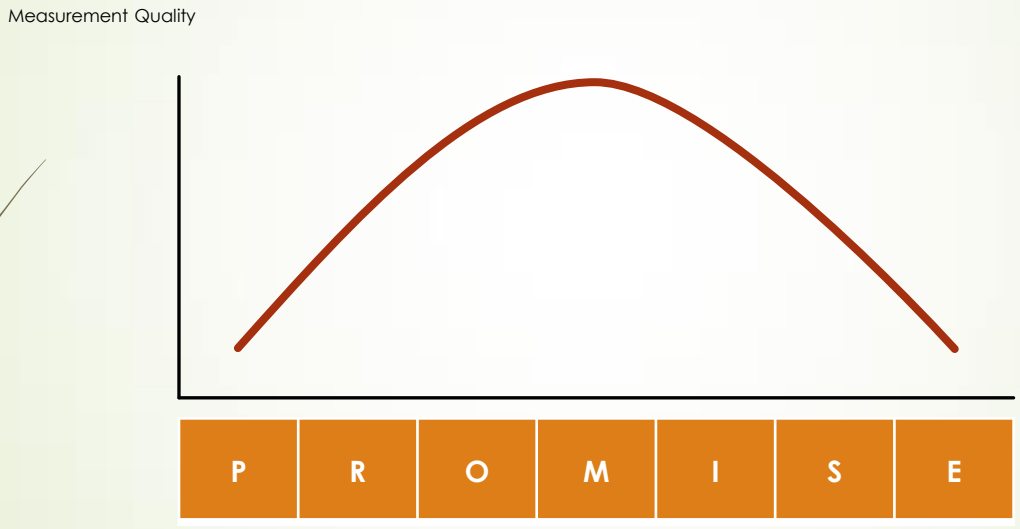
	P	R	O	M	I	S	E
Principles	Balance	Trust	Future Value	BB-NN	Consistency	SP	EE
Values	Weights on each dimension						

- How much do you care about each dimension?

Measurement

	P	R	O	M	I	S	E
Principles	Balance	Trust	Future Value	BB-NN	Consistency	SP	EE
Values	Weights on each dimension						
Measure	Quality of Measurement. How each "stock" is measured?						

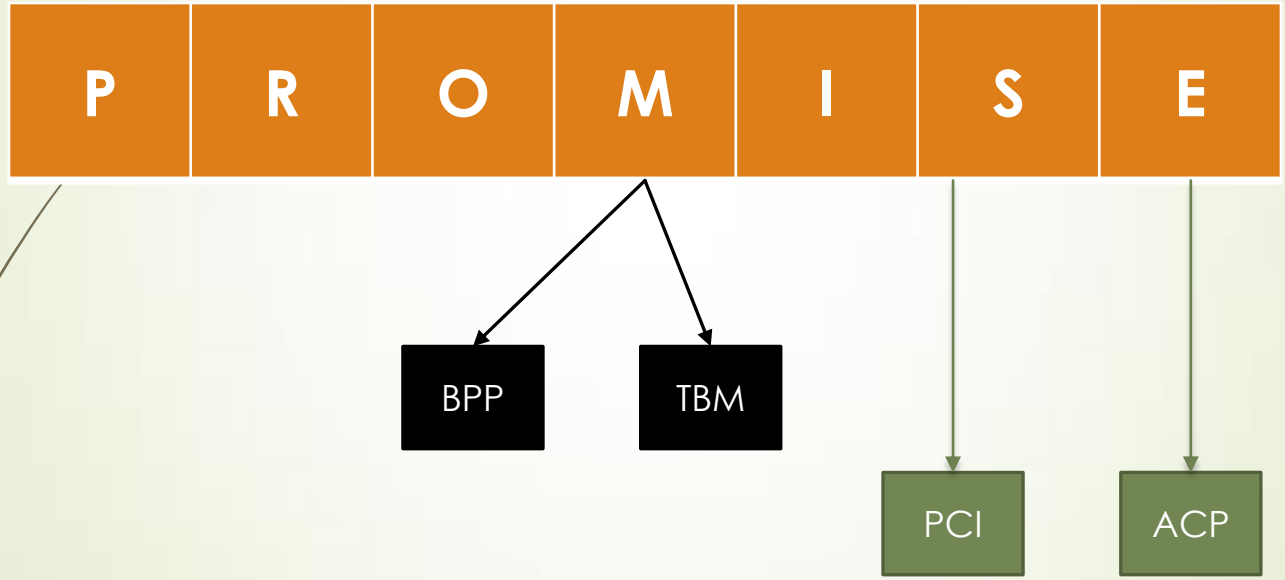
Measurement Quality



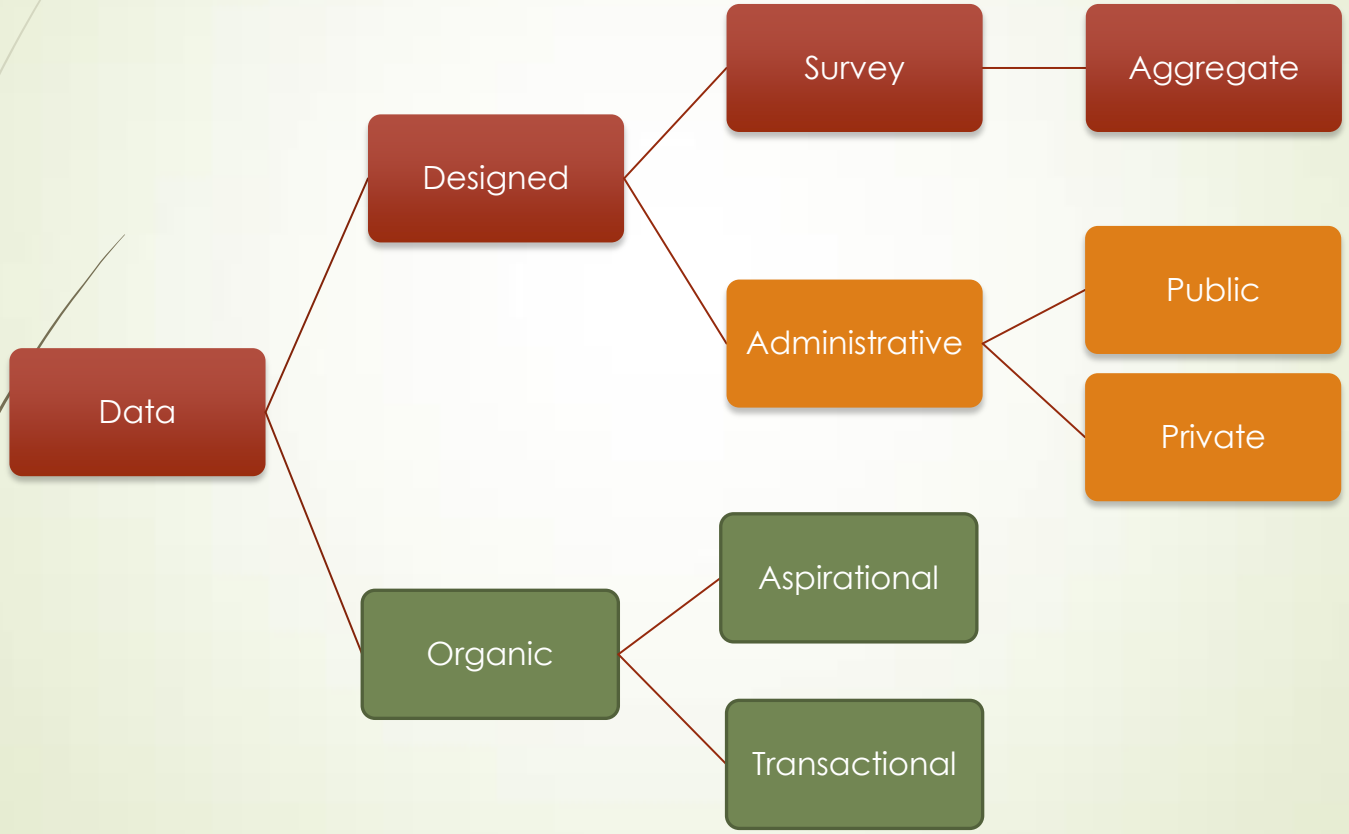
What you measure changes what you do!

- Incentives aligned with measurement
- Actions aligned with measurement

My Research



Evolution of Data Sources

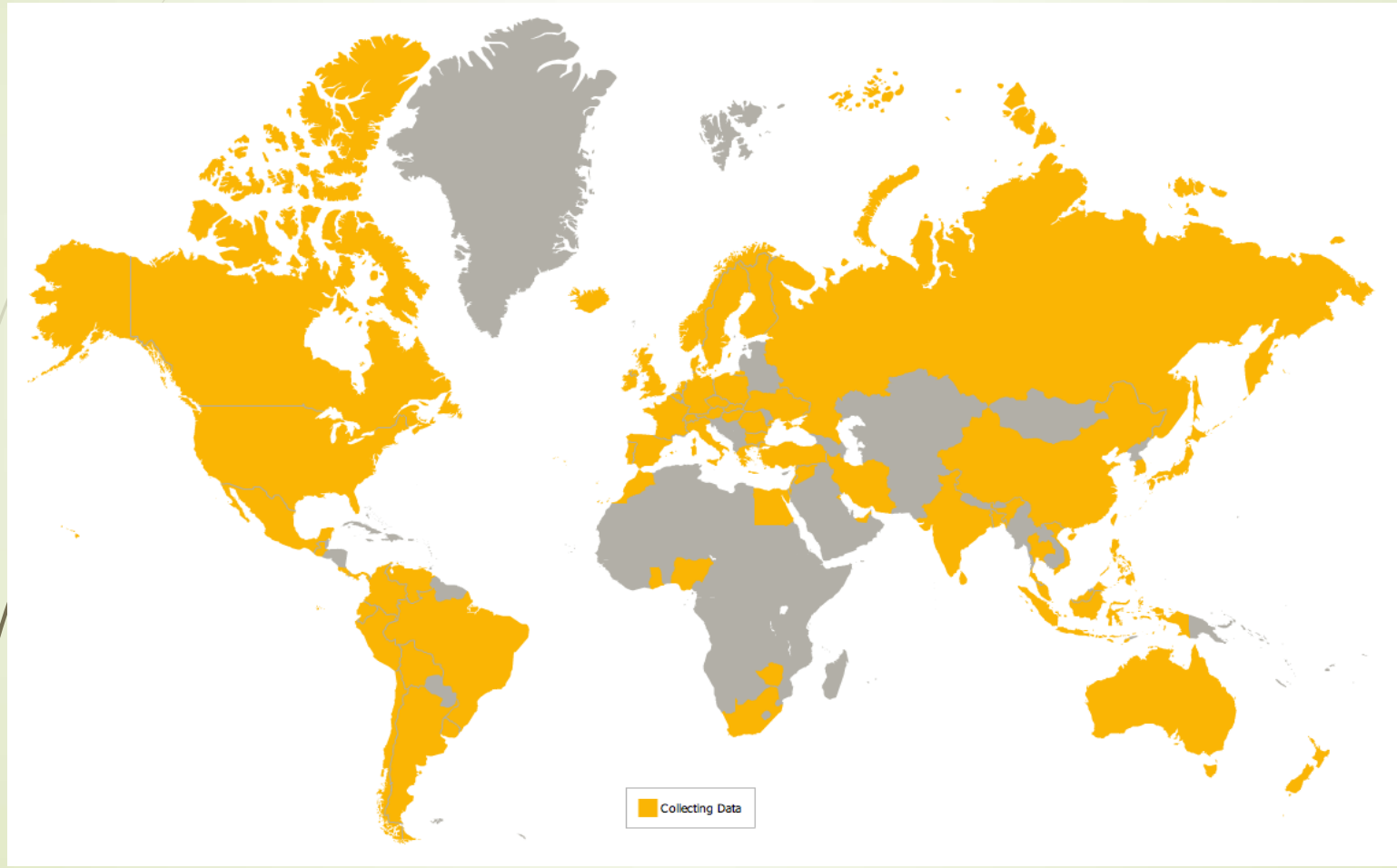


Advantages / Disadvantages

	Designed	Organic
Representative	Yes	No
Sample Selection	Response Rates Deteriorating	Extreme
Intrusive	Extremely Intrusive	Non-intrusive
Cost	Large	Small
Curation	Well-studied	Unclear
Structure	Geography and Socio-Economic	Behavior
Privacy	Well protected	Large Violations of Privacy

Hybrid approach to macro measurement

BPP: Countries covered



Online Information and Indexes

Our Approach to Daily Inflation Statistics

1. *Use scraping technology*
2. *Connect to thousands of online retailers every day*
3. *Find individual items*
4. *Store and process key item information in a database*
5. *Develop daily inflation statistics for ~20 countries*

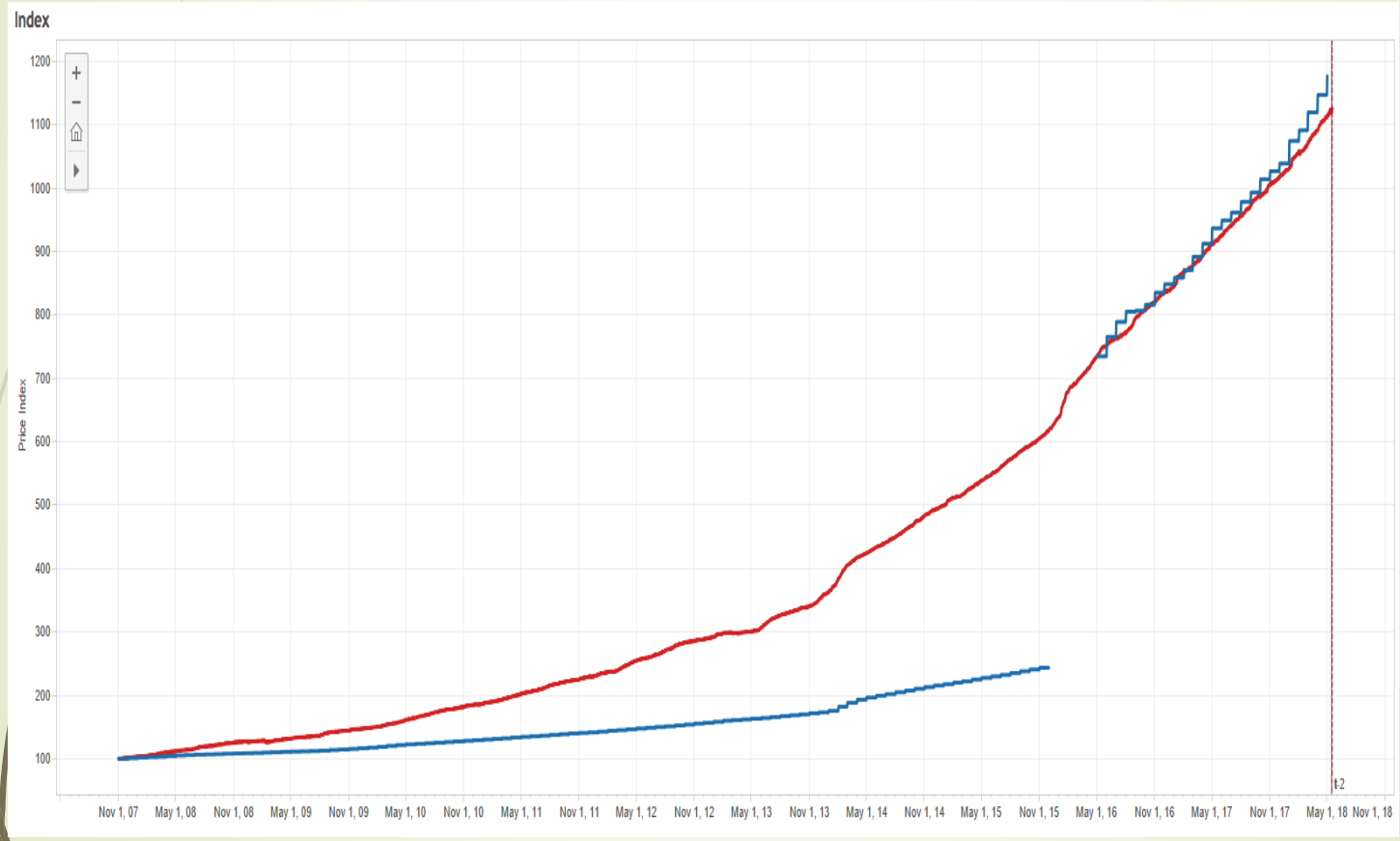
- *Date*
- *Item*
- *Price*
- *Description*

Online versus Offline?

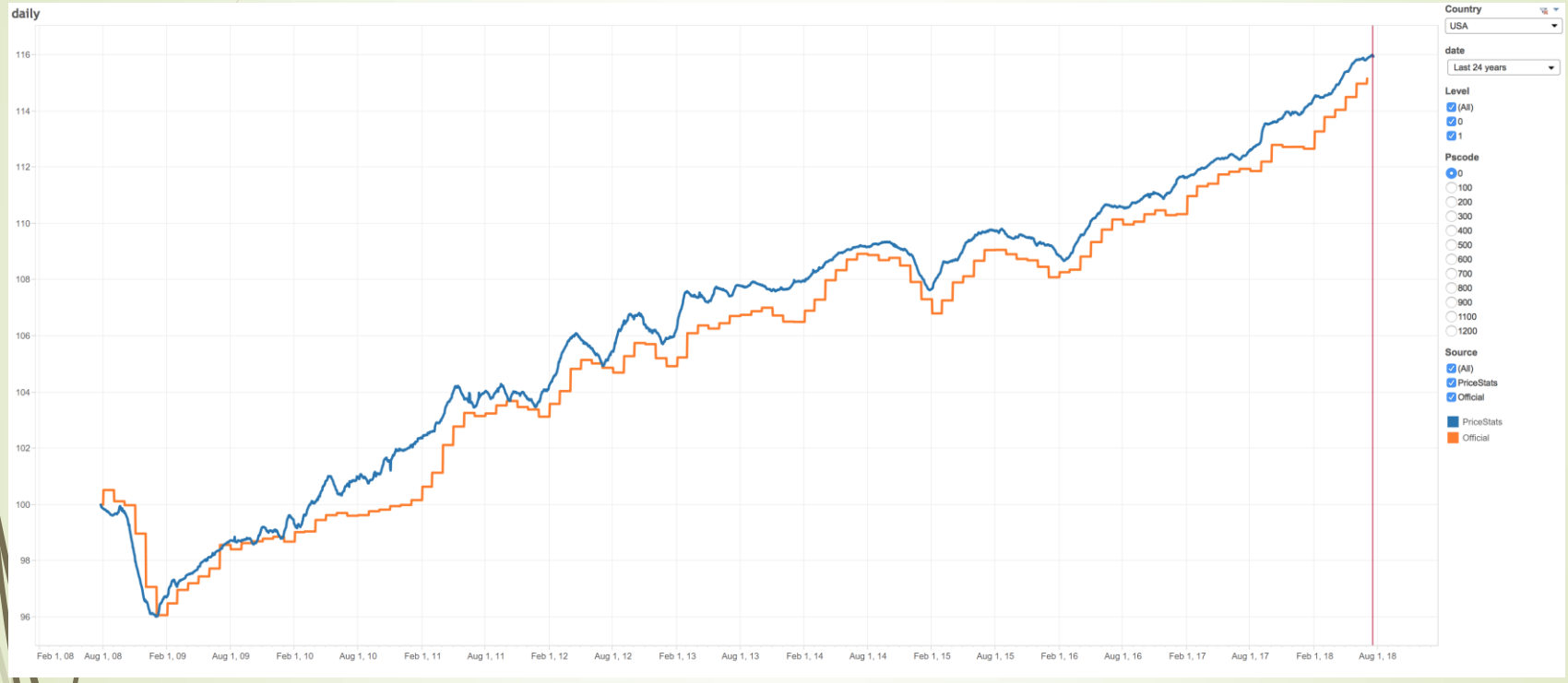
Preference to buy online versus in-store

Online		In-store
60%	Books, music, movies & video games	28%
39%	Toys	37%
43%	Consumer electronics & computers	51%
36%	Sports equipment/outdoor	44%
37%	Health & beauty (cosmetics)	47%
40%	Clothing & footwear	51%
32%	Jewelery/watches	49%
33%	Household appliances	56%
30%	DIY/home improvements	52%
30%	Furniture & homeware	59%
23%	Grocery	70%

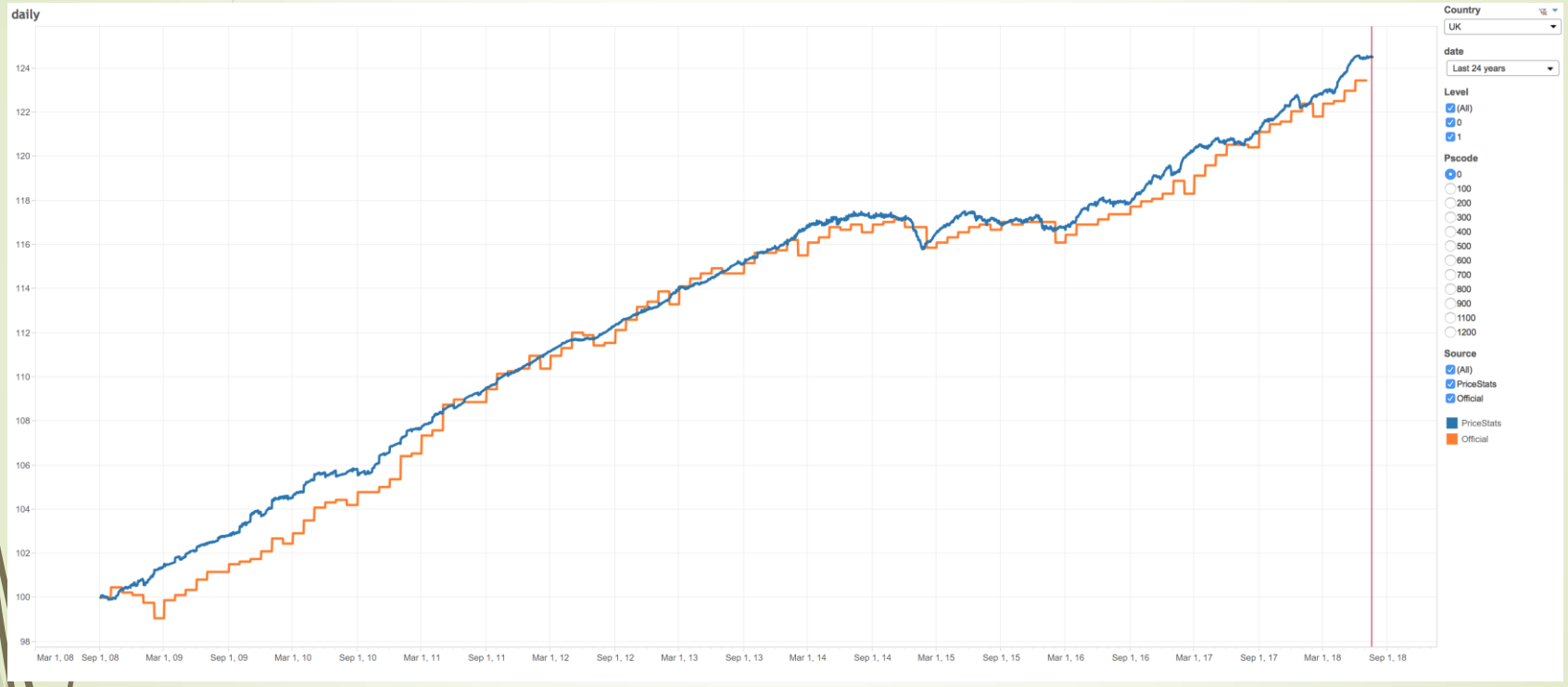
Argentina


Index
Price Index
1200
1100
1000
900
800
700
600
500
400
300
200
100
Nov 1, 07
May 1, 08
Nov 1, 08
May 1, 09
Nov 1, 09
May 1, 10
Nov 1, 10
May 1, 11
Nov 1, 11
May 1, 12
Nov 1, 12
May 1, 13
Nov 1, 13
May 1, 14
Nov 1, 14
May 1, 15
Nov 1, 15
May 1, 16
Nov 1, 16
May 1, 17
Nov 1, 17
May 1, 18
Nov 1, 18

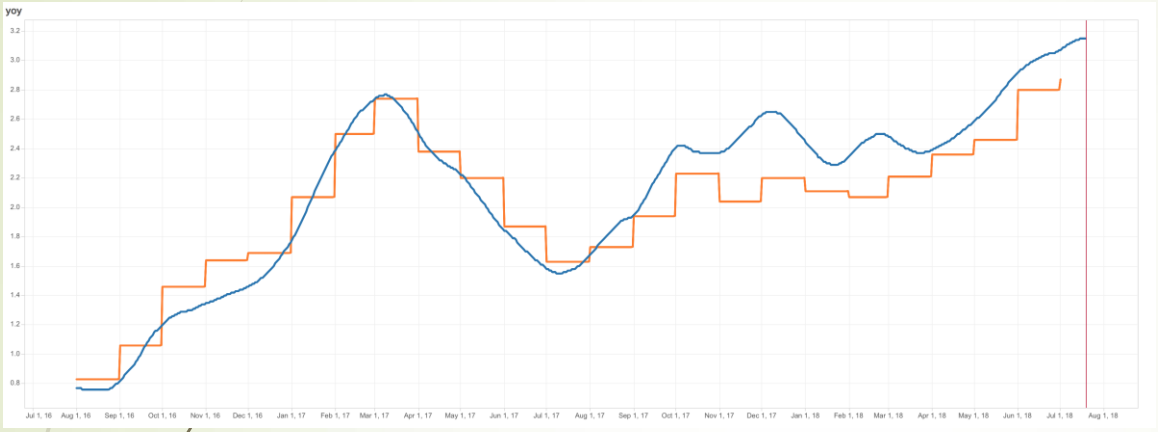
USA


daily
116
114
112
110
108
106
104
102
100
98
96
Feb 1, 08
Aug 1, 08
Feb 1, 09
Aug 1, 09
Feb 1, 10
Aug 1, 10
Feb 1, 11
Aug 1, 11
Feb 1, 12
Aug 1, 12
Feb 1, 13
Aug 1, 13
Feb 1, 14
Aug 1, 14
Feb 1, 15
Aug 1, 15
Feb 1, 16
Aug 1, 16
Feb 1, 17
Aug 1, 17
Feb 1, 18
Aug 1, 18
Country
USA
date
Last 24 years
Level
(All)
0
1
Pscode
0
100
200
300
400
500
600
700
800
900
1100
1200
Source
(All)
PriceStats
Official
PriceStats
Official

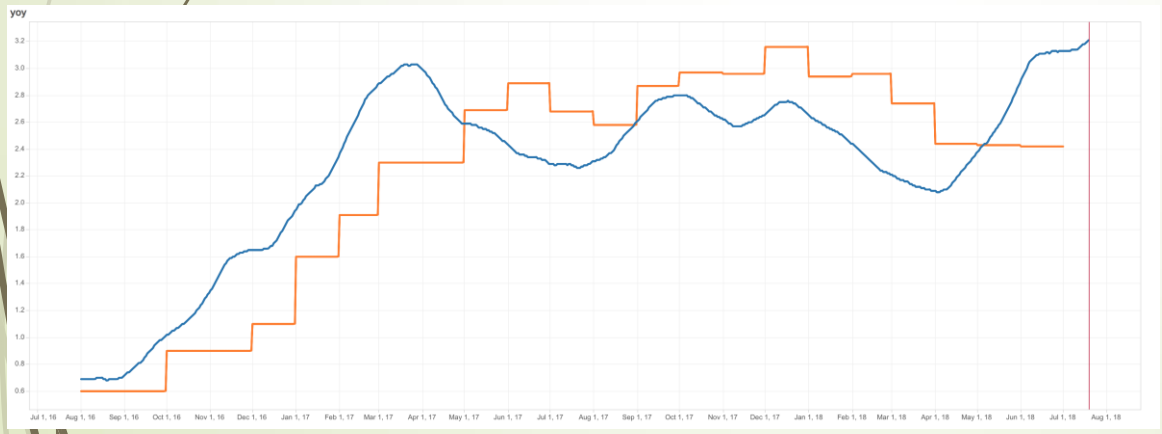
UK


daily
124
122
120
118
116
114
112
110
108
106
104
102
100
98
Mar 1, 08
Sep 1, 08
Mar 1, 09
Sep 1, 09
Mar 1, 10
Sep 1, 10
Mar 1, 11
Sep 1, 11
Mar 1, 12
Sep 1, 12
Mar 1, 13
Sep 1, 13
Mar 1, 14
Sep 1, 14
Mar 1, 15
Sep 1, 15
Mar 1, 16
Sep 1, 16
Mar 1, 17
Sep 1, 17
Mar 1, 18
Sep 1, 18
Country
UK
date
Last 24 years
Level
(All)
0
1
Pscode
0
100
200
300
400
500
600
700
800
900
1100
1200
Source
(All)
PriceStats
Official
PriceStats
Official

Inflation y-o-y



USA



UK

Thousands Big Mac's Project

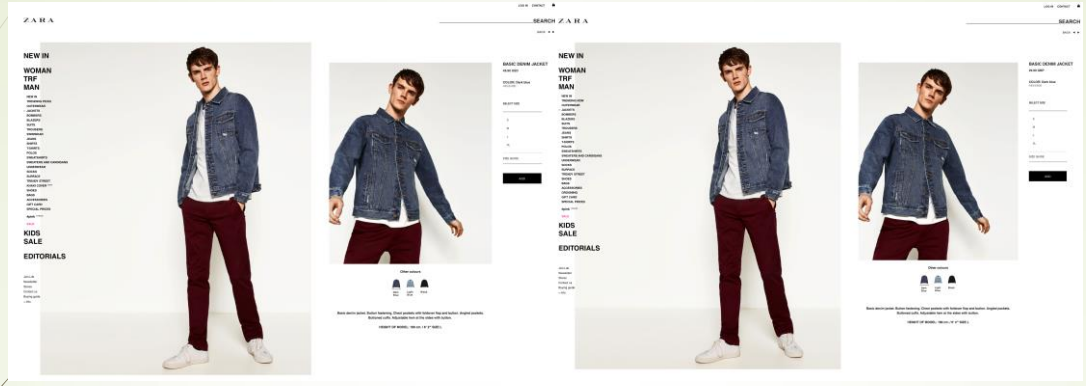
Compare prices for a bottle of Coke across countries

Apply similar approach to hundreds of products on a daily basis

PPP Indices

- Online prices represent an effective tool to measure PPP fluctuations
  - Identical items sold around the world
  - Detailed descriptions to achieve a nearly perfect matching
  - Daily Prices
- PPP indices:
  - More than 300 narrow product categories
  - With thousands individually matched items
  - In food, fuel, and electronics: we are missing clothing, personal care, household products.
  - Cars we will never match

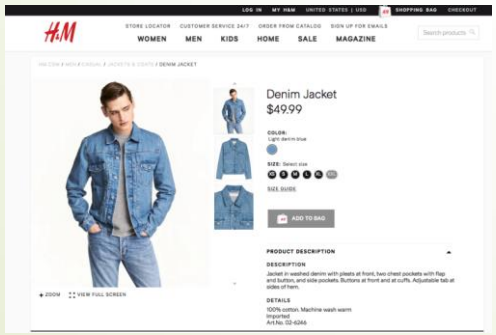
Relative Prices

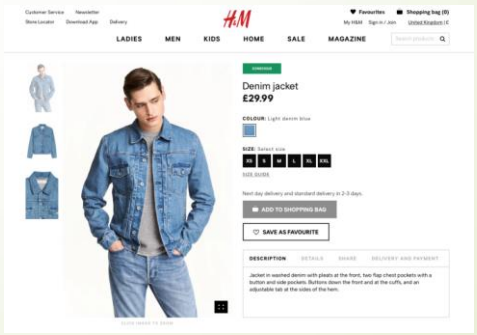


Price: 49.90
Product: 4081762

Price: 29.99
Product: 4081762

$\frac{49.90}{29.99}=1.664$



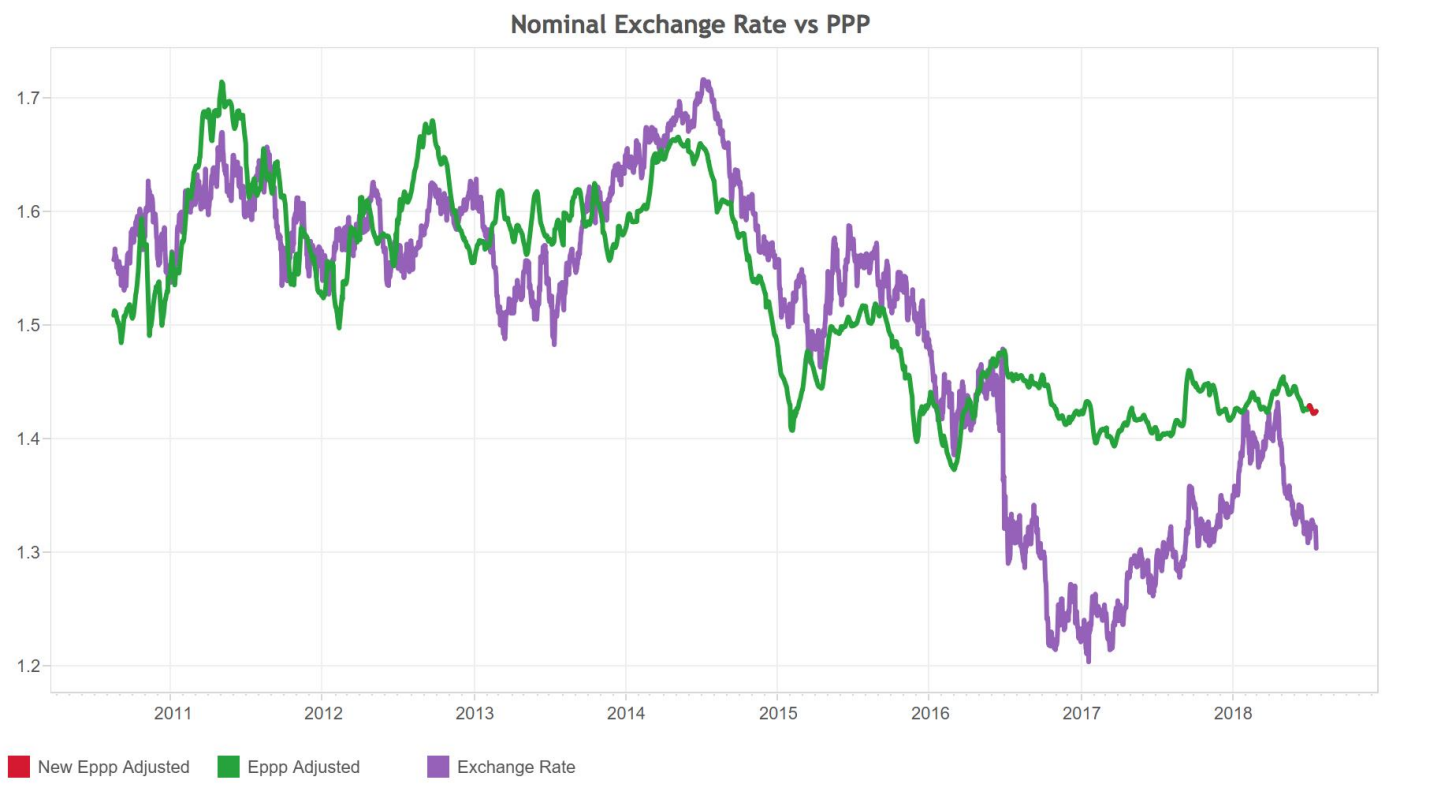


Price: 49.99
Product: 70136

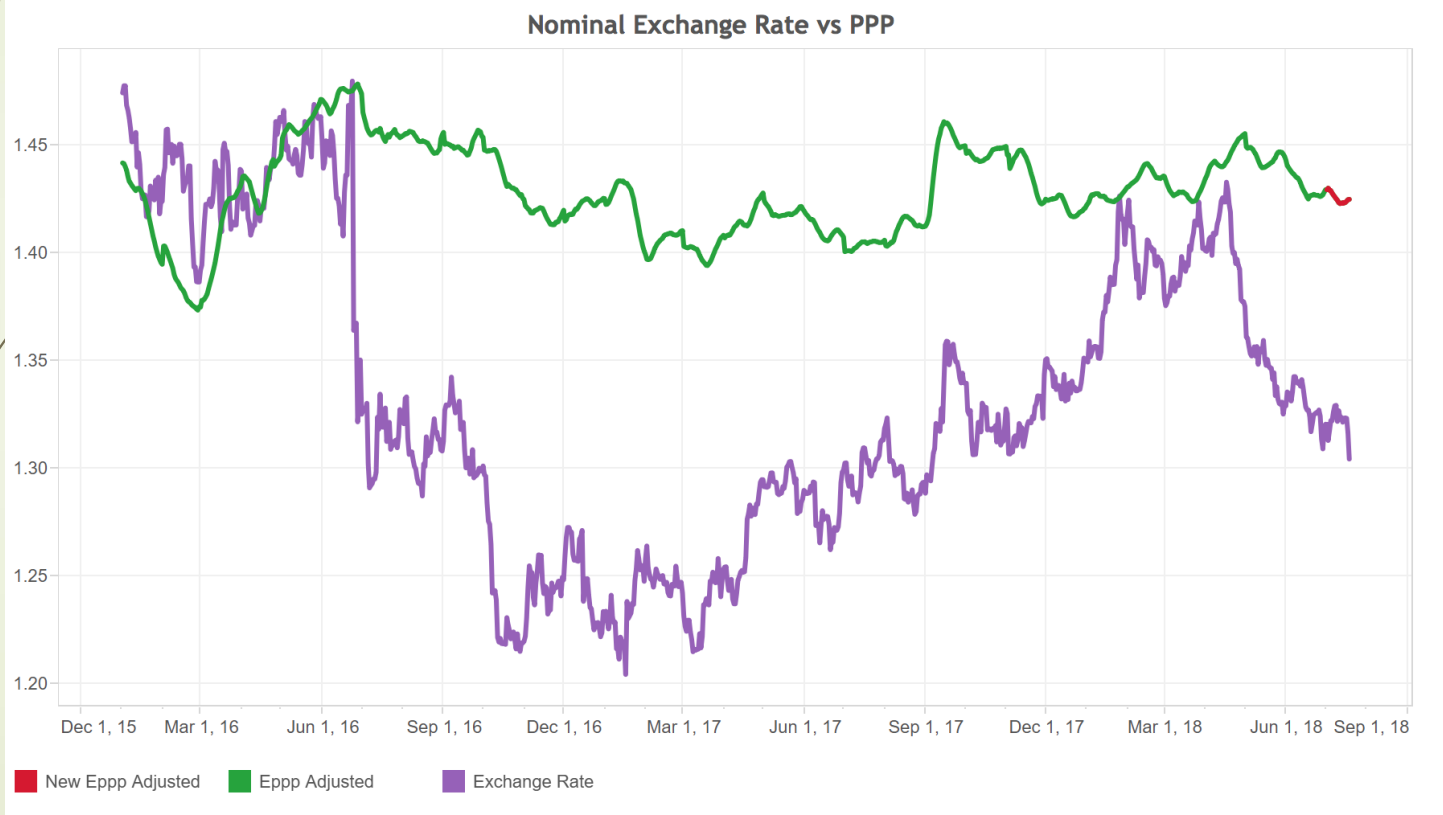
Price: 29.99
Product: 70136

$\frac{49.99}{29.99}=1.667$

UK


Nominal Exchange Rate vs PPP
1.7
1.6
1.5
1.4
1.3
1.2
2011
2012
2013
2014
2015
2016
2017
2018
New Eppp Adjusted
Eppp Adjusted
Exchange Rate

UK (3 years)


Nominal Exchange Rate vs PPP
1.45
1.40
1.35
1.30
1.25
1.20
Dec 1, 15
Mar 1, 16
Jun 1, 16
Sep 1, 16
Dec 1, 16
Mar 1, 17
Jun 1, 17
Sep 1, 17
Dec 1, 17
Mar 1, 18
Jun 1, 18
Sep 1, 18
New Eppp Adjusted
Eppp Adjusted
Exchange Rate

Aggregate Confusion

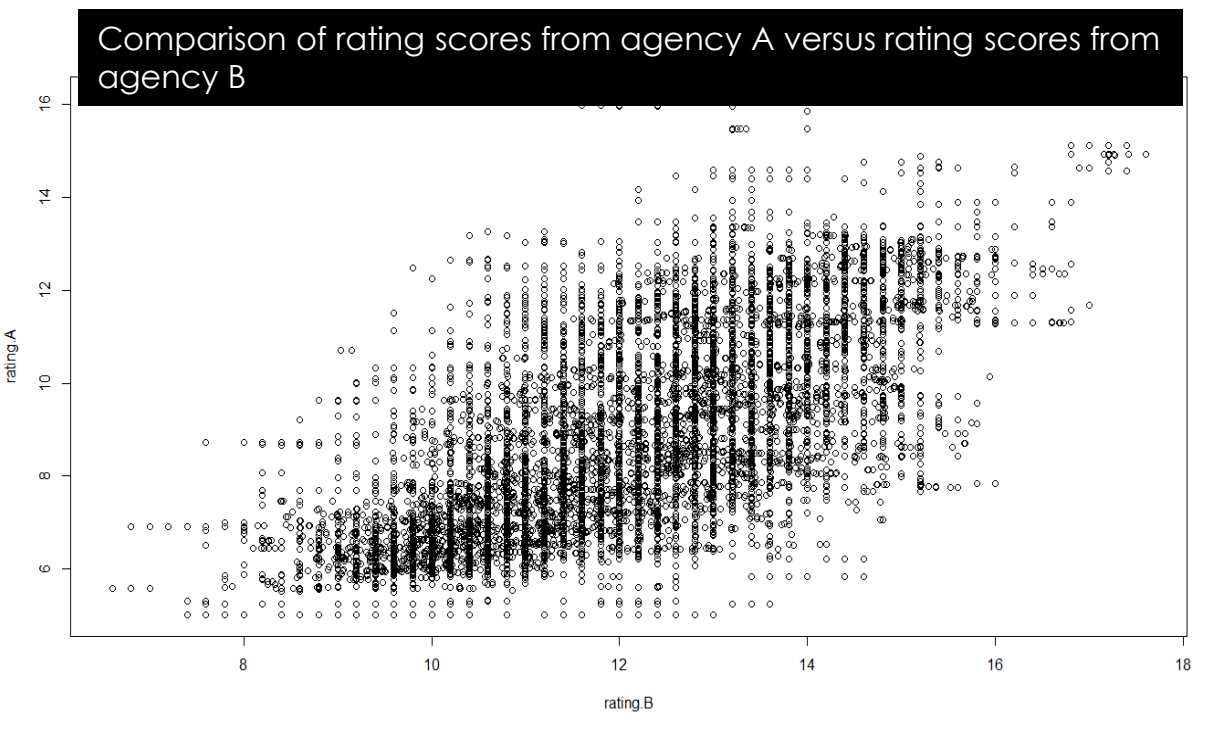
Solving the confusion of ESG ratings

Julian Koelbel, Florian Berg, Roberto Rigobon

MIT MANAGEMENT SLOAN SCHOOL

July, 2017

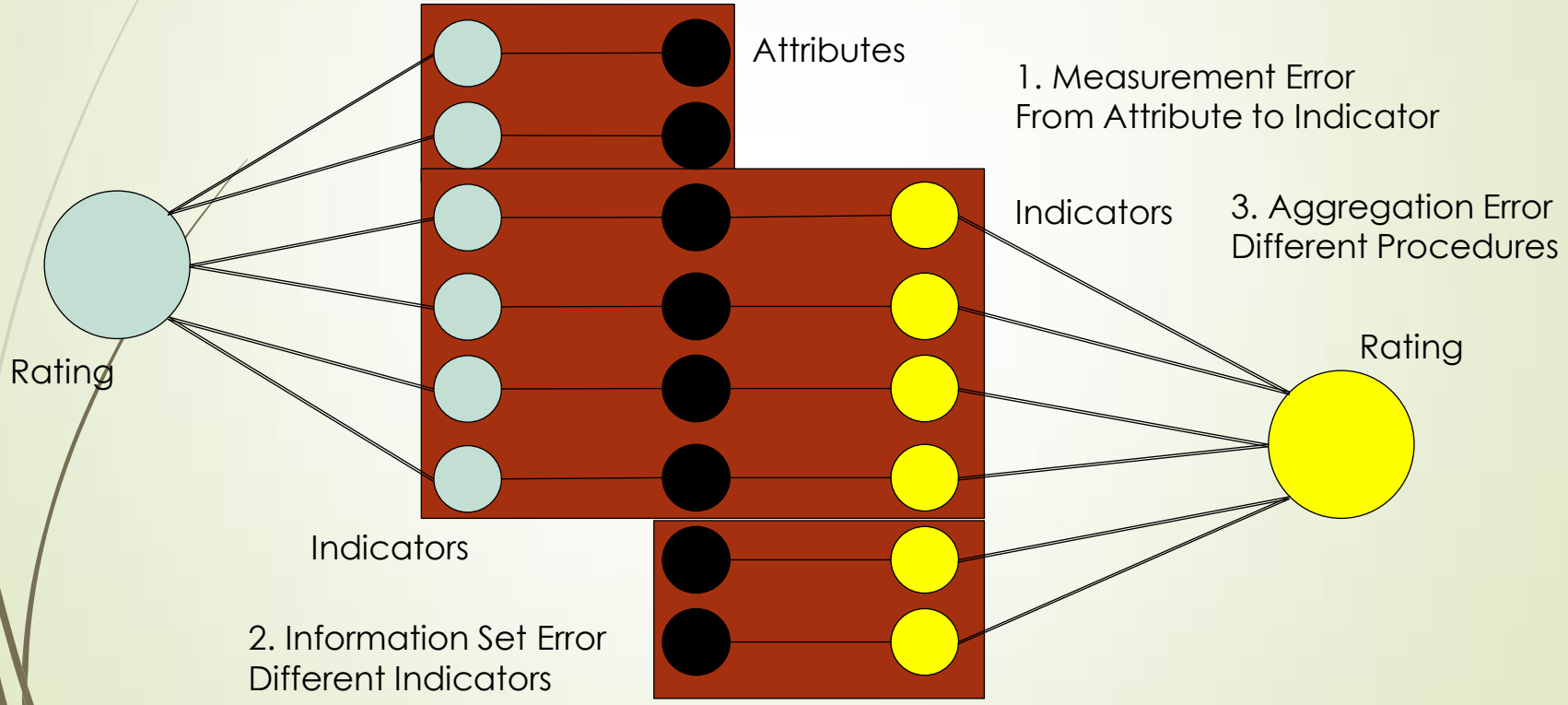
ESG Rating Agencies' Scores diverge



Things that are more correlated than the ratings!

- The number of people that downed every year in swimming pools in the US is correlated with the number of Nicholas Cage movies: 66 percent
- 72 percent of people who dislike licorice understand HTML
- 75 percent of people who can't type without looking at the keyboard prefer thin-crust pizza to deep-dish
- Per capita consumption of mozzarella and PhD's in civil engineering are correlated in 96 percent

Sources of errors



Preliminary Results

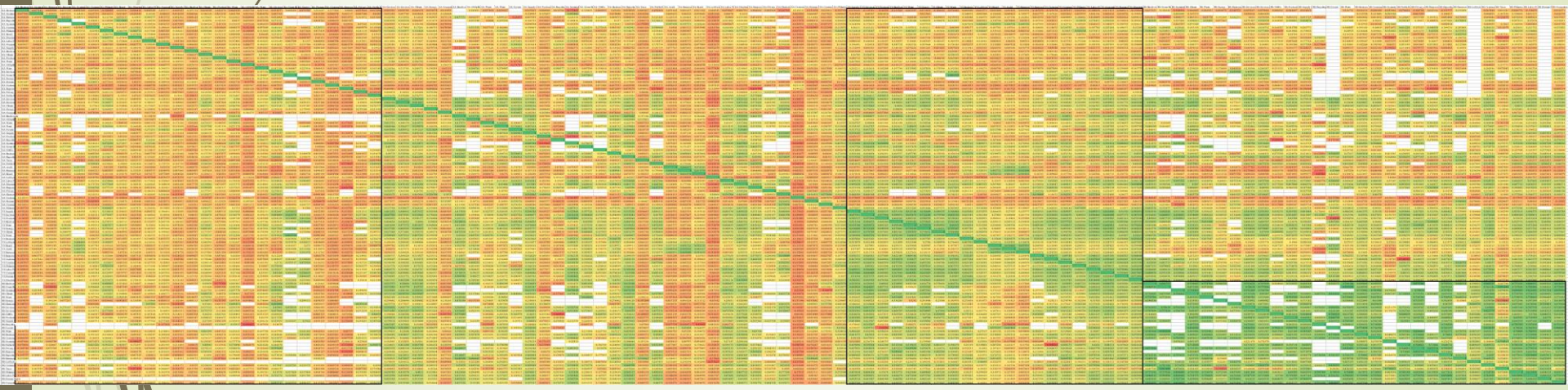
	Discrepancy			
	Aggregation	Measurement	Information and Unmeasured	Straight Explanation
		VI		
MSCI/KLD	3.3%	48.6%	48.1%	19.47%
RS	1.7%	87.7%	10.6%	49.14%
SA	3.8%	22.5%	73.7%	50.38%
		RS		
MSCI/KLD	0.0%	54.9%	45.1%	18.71%
VI	0.3%	82.0%	17.7%	49.14%
SA	3.5%	34.3%	62.1%	43.52%
		SA		
MSCI/KLD	1.5%	29.8%	68.7%	22.89%
VI	6.9%	56.3%	36.8%	50.38%
RS	5.4%	76.3%	18.3%	43.52%
		MSCI/KLD		
VI	0.0%	73.1%	26.9%	19.47%
RS	0.0%	84.1%	15.8%	18.71%
SA	1.5%	43.3%	55.2%	22.89%
		58%	40%	

Preliminary results

- Reverse Engineering implies quasi-linear rules
  - Get more than 98+ percent explanatory power within sample
- Variance Decomposition of Discrepancy
  - 58 percent is measurement
  - 40 percent is information set
  - 2 percent is from aggregation rules

Attribute measurement errors

- At the attribute level things are worse!
  - Some attributes are negatively correlated across rating agencies!
    - Lobbying
    - Responsible Marketing Policies

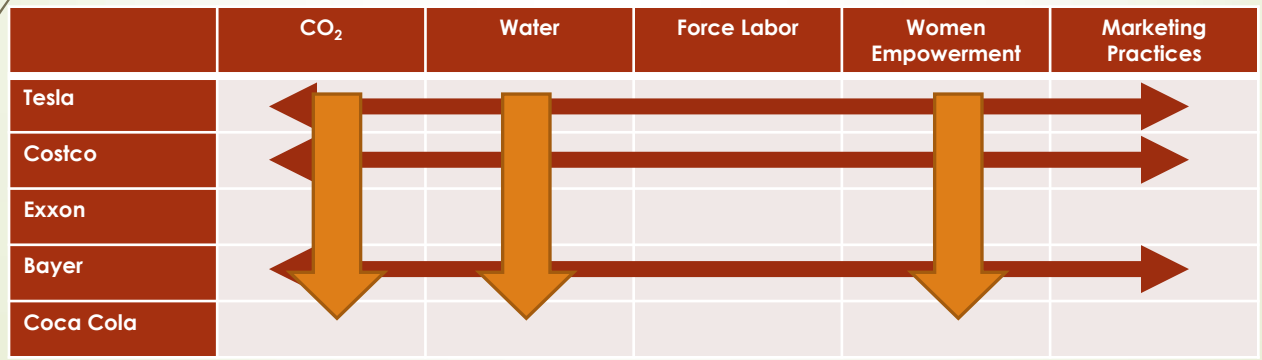


Three Domains for Improvement

- Organizational Structure
- Aggregation Procedure
- Data Source

Organizational Bias

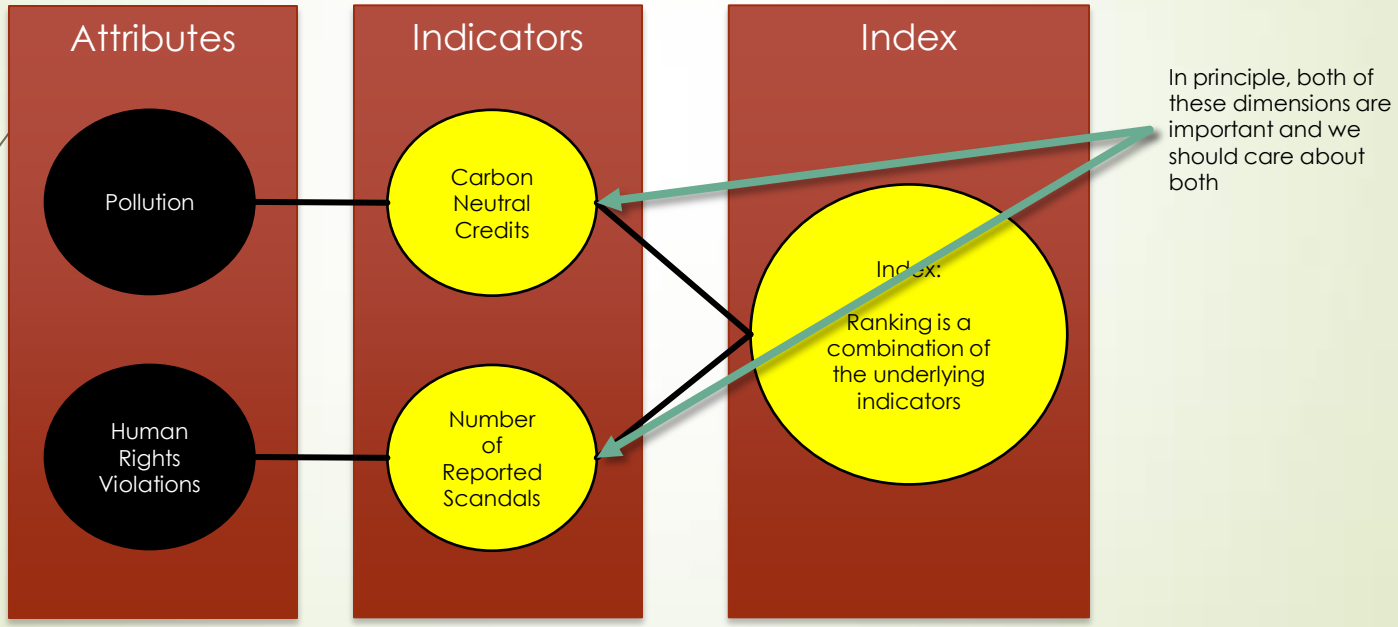
- Organizational Structure
  - Analysts are organized through firms and not across attributes (rows as opposed to columns)
  - Bias is firm (analyst) specific



  - Florian's research (still preliminary)

Quasi-linear Rules

- Ranking Implies that Dimensions that should NOT be substitutable become substitutes



Data Source Bias

- Data mostly comes from Three sources
  - **Statements**: Self-reported or non-mandatory surveys
  - **Outcomes**: Extreme Events
    - Accidents or scandals measured in public documents, courts, or regulator's reports
  - **Perception** : Reporting on extreme events
    - Accidents or scandals as reported by the media
  - Taxonomy might need another dimension

New Measures

- How to measure?
  - Women empowerment
  - Household Stress
  - Mansplaining and Hidden Networks (Team Chemistry and/or Attribution Problem)
  - Human Trafficking
  - Opioid Crises
  - Job Quality and Job Satisfaction
  - Water management practices

Example

- Women Empowerment
  - How we measure today?
    - Counting — Only relevant at the extremes
    - Scandals — Only relevant if media agrees
    - Wage gap — Discrimination on regressors
  - Characteristics?
    - Too late
    - Too concentrated on extreme events
    - Too infrequent
    - Too based on perception (news outlets)
    - Too fixated in the wrong statistic
  - How are we evaluating materiality?

Pillars of the new measures

1. Continuous Measurement of process
   - Timely measures
2. Non-intrusive
   - Can't rely on surveys – needs electronic forms of data collection
3. Open source
   - Many could adopt the methodologies
4. Privacy protecting
   - Violations of privacy can be significantly harmful, especially when estimating hidden behavior that is morally questionable
5. Imperfect Measurement
   - To guarantee the previous 4 characteristics the measures need to be noisy.

Example

- Women Empowerment
  - Measure interruptions
    - How frequently men interrupt women and other men?
    - Airtime: how long each one talks?
    - Mansplaining: assertiveness and apologies
    - Culture, hierarchy, language, media matter – but why gender and minority status would?

How much of the unconscious biases are unmeasured biases?

Data sources of organic data

- Digital documentation of transactions with a service or manufacturing process
  - Credit card transaction, retail sales scanner data
- Data from social network communication
  - Facebook, Twitter, Instagram
- Data transmitted from software agents within mobile devices
  - GPS
- Data from the internet of things
  - e-commerce: Web pages, price aggregators
  - Utility meter data, sensor data for traffic, air, water, soil quality
- Biometric data
  - DNA
- Human communication digital data
  - Emails, blogs, text
- Digital video data

Weaknesses depend on use

	Survey	Estimation	Forecasting	Measurement
Representativeness				✓
Selection Bias		✓		✓
Reliability and Consistency	✓		✓	✓
Transparency on Data Collection and Treatment	✓	✓		✓
Errors-in-variables		✓	✓	✓
Aspirational (Transactional)	✓	✓		✓
Private (as opposed to public)	✓		✓	✓
Model Uncertainty and Behavioral Changes			✓	✓

Warnings

- The Promiscuous Pursuit of Data
  - Big Data reduces variance of the estimates, not their bias
  - Little sample uncertainty but Large model uncertainty
  - Do not fall in love with the Data: Transactional versus Aspirational
- The Human Element of the Data
  - Problem of identification
    - Who drowns more regularly at sea?
    - Happiness Index: Correlation and Causation
  - Measurement not Forecasting
- The Potential for Irrelevance
  - Problem of representativeness
    - Restaurant Reviews: Sampling Bias
    - Parental Guidance through Facebook
- Privacy is a First Order Problem
  - Aggregation does not solve the problem of privacy

The future of NSI's and CB's Data Collection

- Hybrid Approach: Change in National Statistics
  - Relevance and Timeliness
    - Demand driven (not supply driven)
  - Cost, Granularity, and Reducing Response Rates
    - Organic Data based indicators
  - Privacy
    - Aggregation is not enough
  - Organizational Paradigm
    - Geographical and Socio-economically organized; versus network and behaviorally organized.