

# **Big Data in Economic Measurement:**

## **What a Billion Prices say about Inflation and Exchange Rates?**

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Big Distance!

Data

Information


Knowledge



The world is not lacking  
of Data

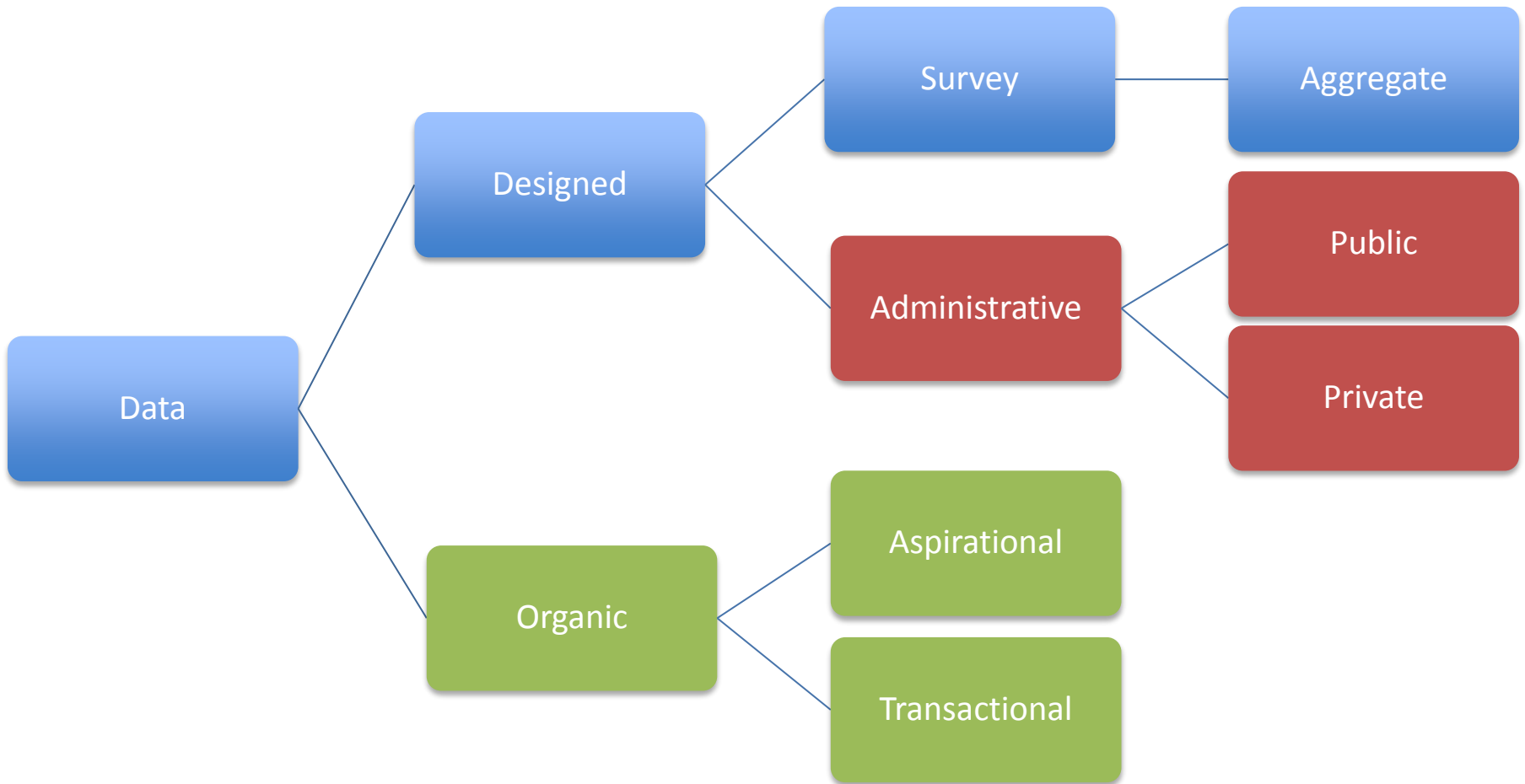


It is lacking of Careful  
Empirical Analysis



It is lacking of  
Managerial Data  
Analysis

# Different Types of Data



# Types of Data

Designed Data	Organic Data
Representative	Non-representative
Scope is limited	Volume, Velocity, Variety
Costly	Cheap
Difficult Access	Open
Intrusive	Non-intrusive

# Problems

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

# Problems

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

# The Possibilities!

- Inflation
  - Measuring CPI
  - Measuring Core
- Exchange Rates
  - Real Exchange Rate
  - Nominal Exchange Rate
- Economic Activity
  - Scarcity
  - Natural Disasters

# 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*

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

5

*Develop daily inflation statistics for ~20 countries*

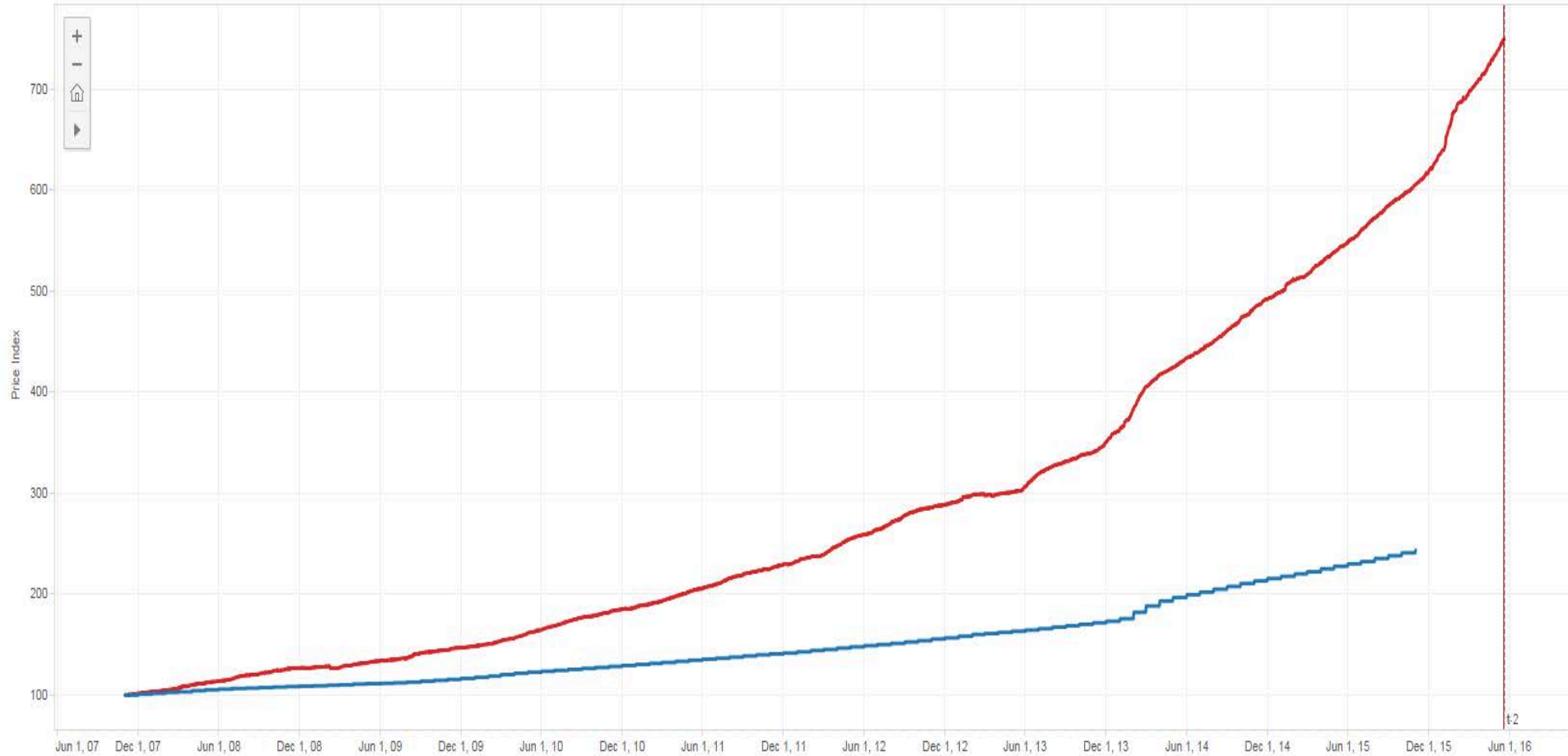






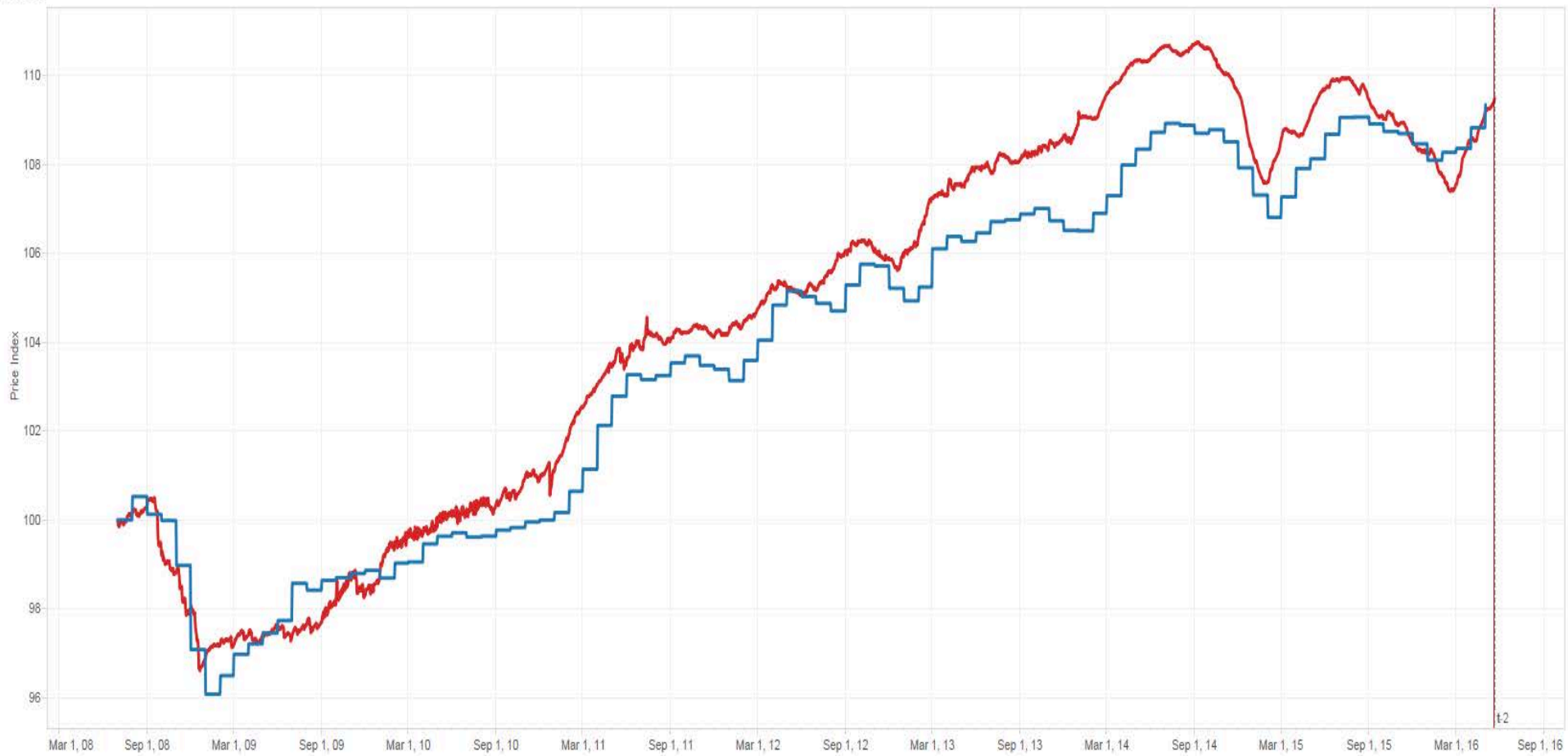
# Argentina <http://www.inflacionverdadera.com>

Index



# USA (<http://bpp.mit.edu/usa/>)

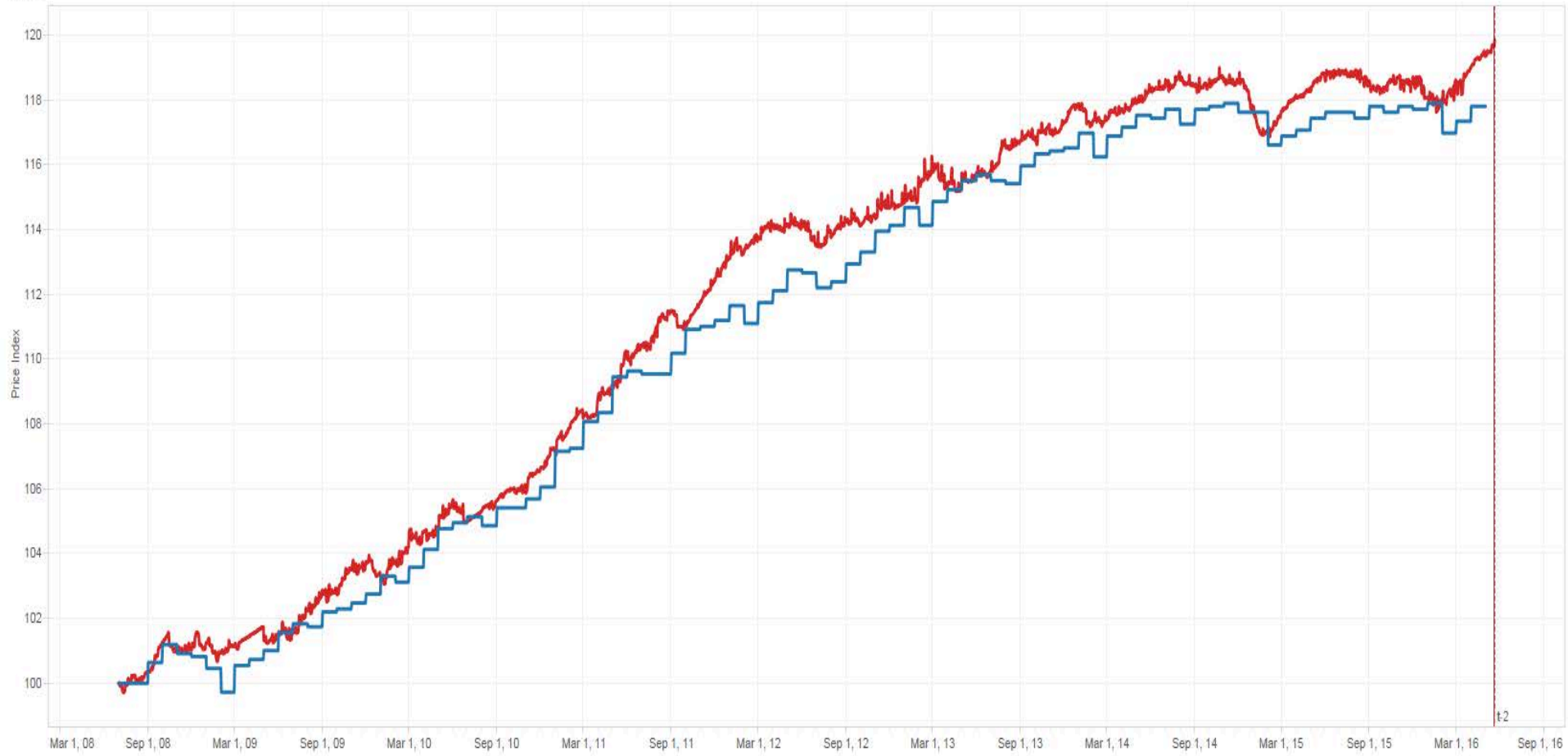
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# UK

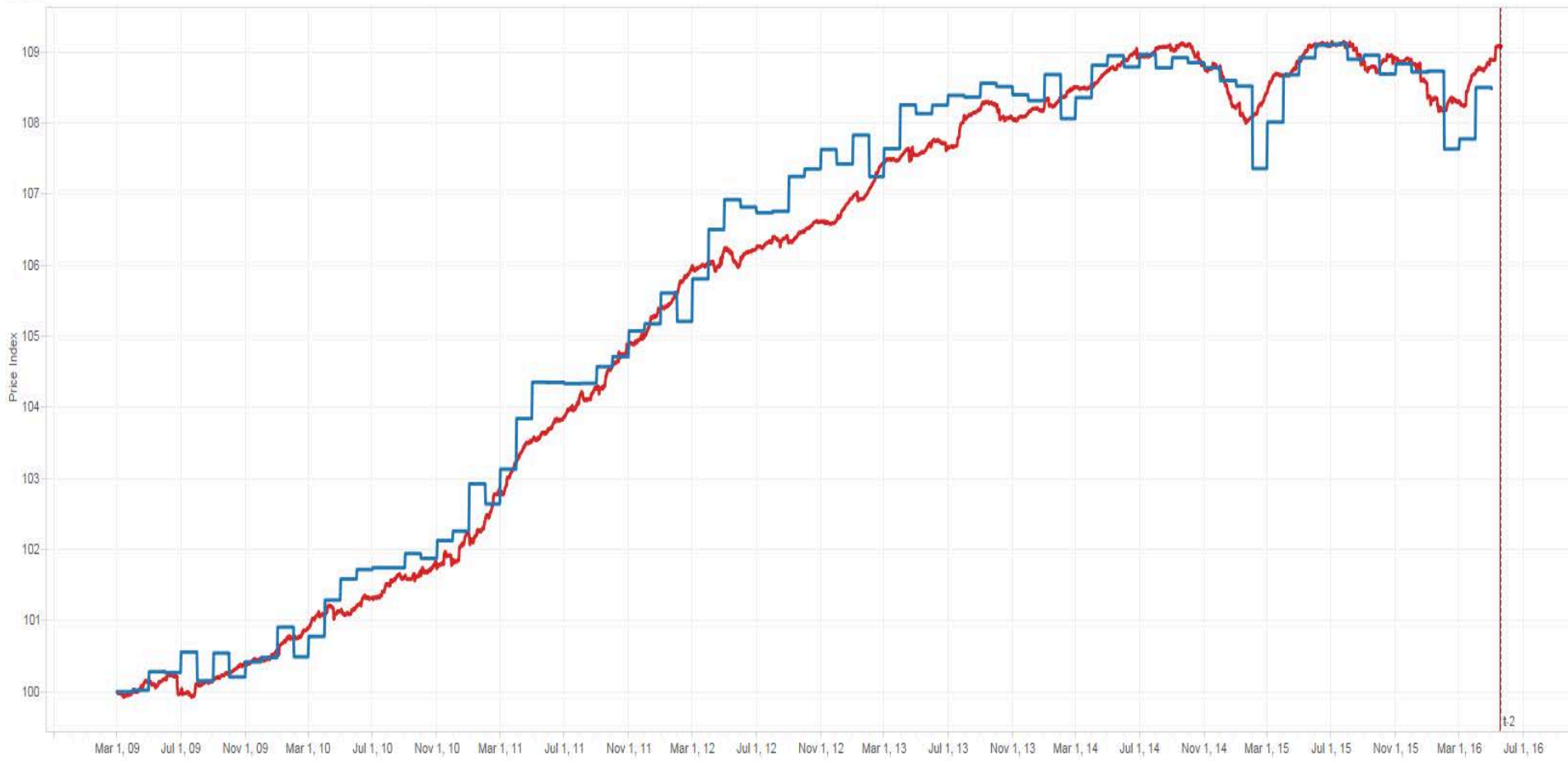
Index



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# EuroZone

Index



# Alternative Measures

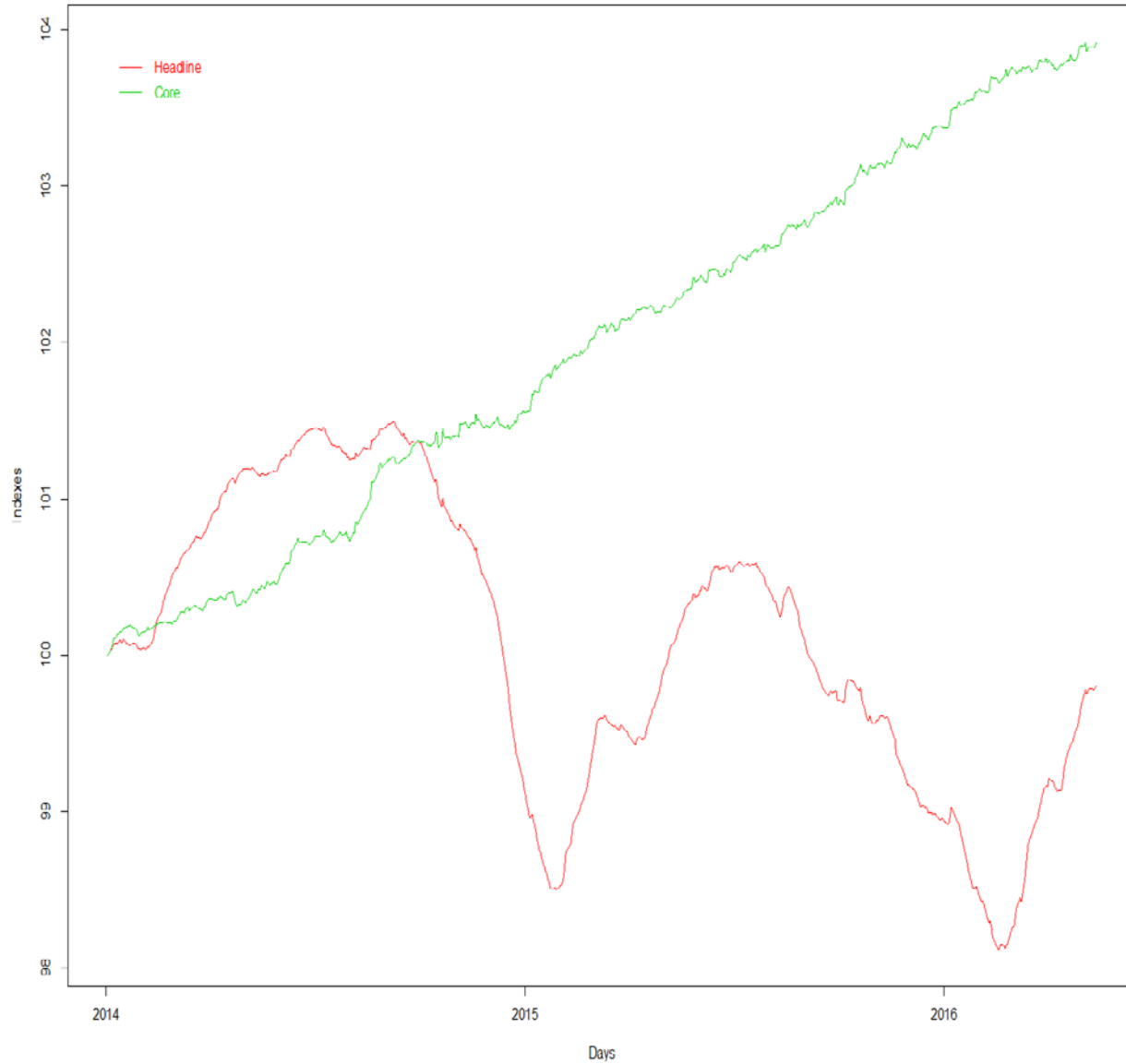
- Purpose of Core Inflation
  - Take out the effect of shocks that are not controlled by the monetary authority
    - Food prices
    - Oil prices
    - Taxes
    - Exchange Rates

# Two effects

- Direct effect: exclusion procedure
  - Food, gasoline, taxes, etc. are part of the consumption basket.
  - The direct effect is eliminated by exclusion
- Indirect effect: pass-through procedure
  - Oil has an impact on gasoline, transportation, imported items, cost of energy, etc.
  - Exchange Rate has an impact on imported items, pricing of domestic competitors, and intermediate goods.
  - The indirect effect cannot be computed by exclusion procedures

# US Core Price Index

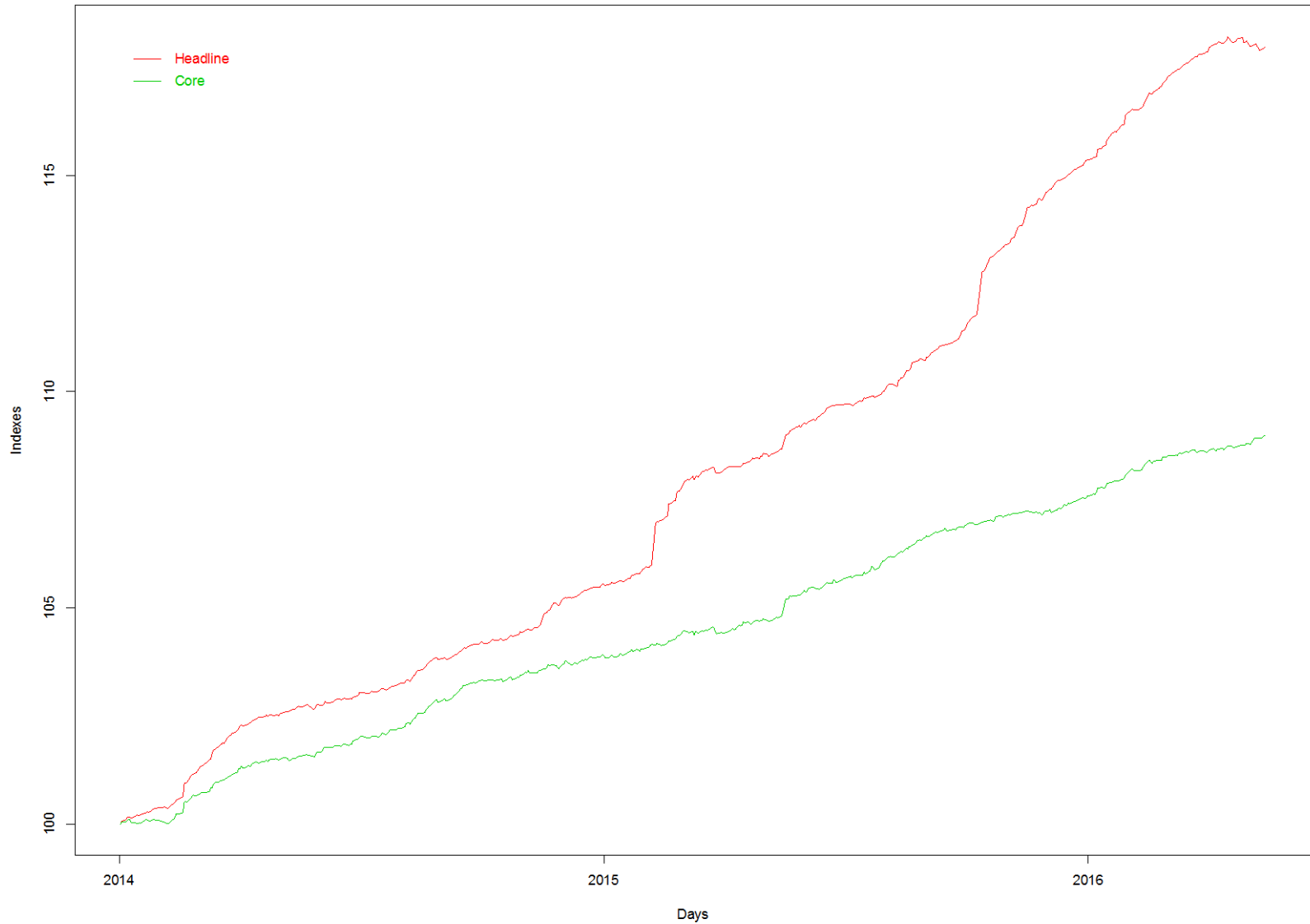
USA: Core Inflation: 2014-01-01





# Brazil Core Price Index

Brasil: Core Inflation: 2014-01-01



# Purchasing Power Parity


Thousand BigMac Indexes

# The International Comparison Program

- The International Comparison Program (ICP) is the world's largest statistical initiative.
  - Established in 1968
  - It is now the largest international data collection exercise involving five regions and 107 countries.
  - The results will be combined with the OECD/Eurostat PPP program for 43 countries, bringing the total to about 150 benchmark countries.
- Measure disequilibrium two ways:
  - Compare the purchasing power across nations for similar goods or basket of goods
  - Compare the time series or international relative prices for similar goods or basket of goods

# Thousands Big Mac's Project

Compare prices for a bottle of Coke  
across countries

- 
- 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

# Methodology

1

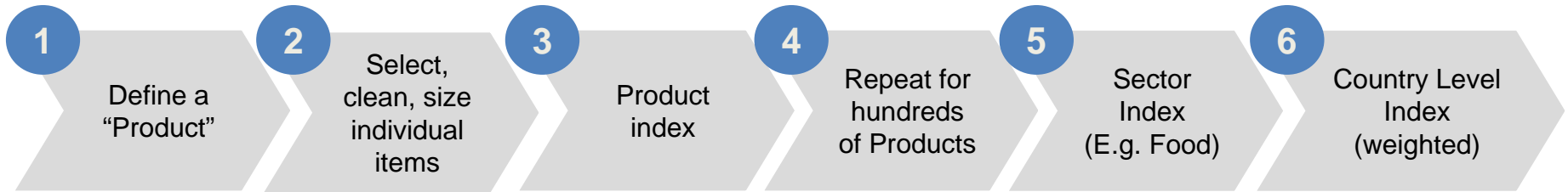
Define a  
“Product”

- Very narrow product definition
- Must be available in multiple countries
- Branded and Unbranded categories

## EXAMPLES OF PRODUCT CATEGORIES

FOOD	ELECTRONICS
Coffee_Illy_Ground (excluding decaf)	Television_Samsung_LED 32inch basic
Coffee_Regular_Ground (excluding decaf)	Television_Samsung_LED 32inch All Other (including Full HD, Smart, 3D)
Coffee_Regular_Beans (excluding decaf)	Television_Samsung_LED 40-43inch basic
Coffee_Decaf	Television_Samsung_LED 40-43inch All Other (including Full HD, Smart, 3D)
Coffee_All Other	Television_Sony_LED 32inch basic
Ketchup_Heinz_Regular	Television_Sony_LED 32inch All Other (including Full HD, Smart, 3D)
Ketchup_Heinz_Low Sodium, no salt	Television_Sony_LED 40-43inch basic
Ketchup_Heinz_All Other (e.g., flavored)	Television_Sony_LED 40-43inch All Other (including Full HD, Smart, 3D)
Ketchup_All Other_Regular	Television_Sony_LED 44-47inch All Other (including Full HD, Smart, 3D)
Ketchup_All Other_All Other (e.g., flavored)	Television_LG_LED 32inch basic
Soy Sauce_All Other_Regular	Television_LG_LED 32inch All Other (including Full HD, Smart, 3D)
Soy Sauce_All Other_Low Sodium, no salt, light	Television_LG_LED 40-43inch basic
.....	.....

# Methodology



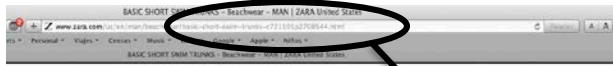
- Very narrow product definition
- Must be available in multiple countries
- Branded and Unbranded categories

- Dozens of items per "product" in each country
- Different retailers, brands, and sizes

- Product availability varies across countries and time
- If a good is not available in the US, it will not appear in our series

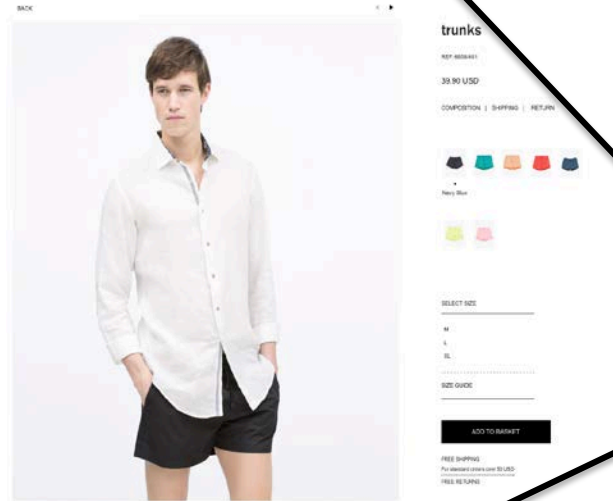
- Some sectors are cheaper, others more expensive

- Use to compare Eppp and E

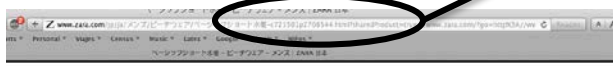
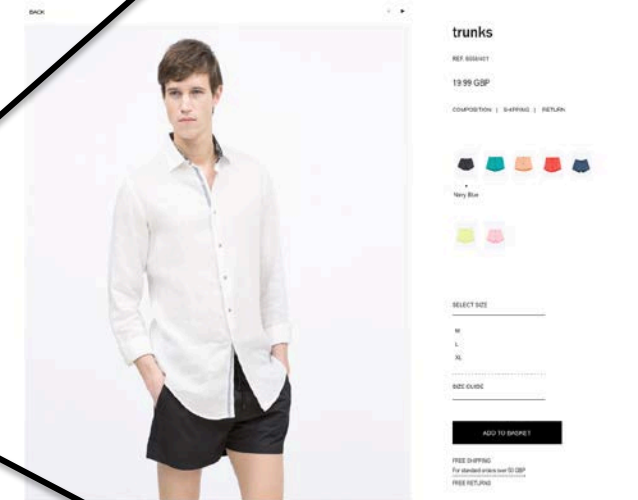


US

UK

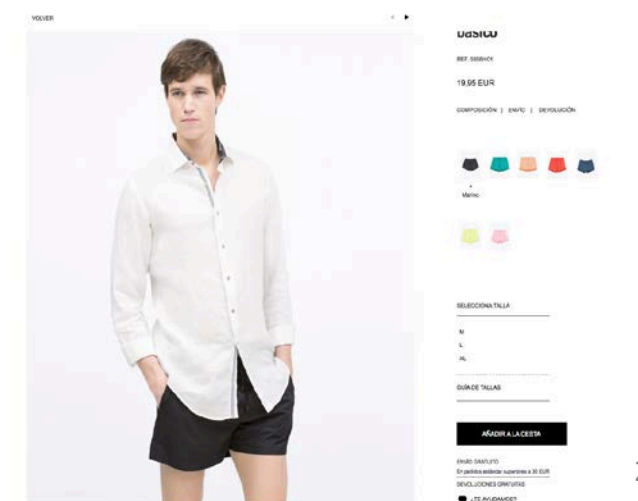
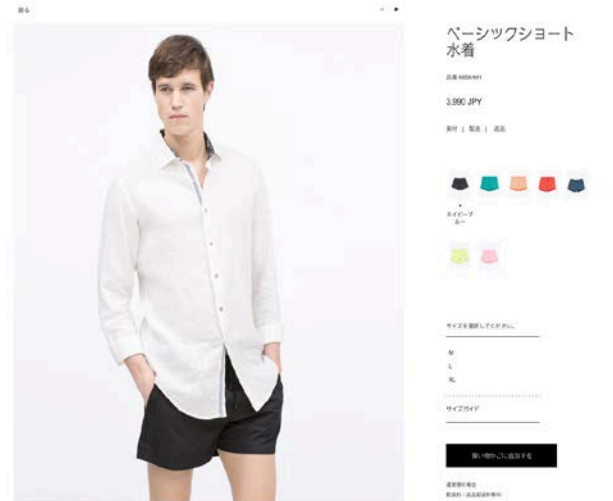
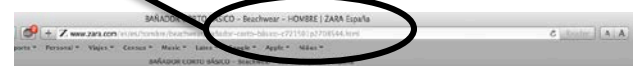


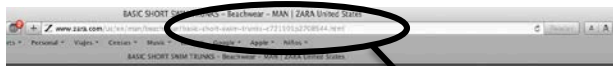
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Japan

Spain



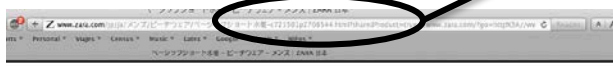


US

UK

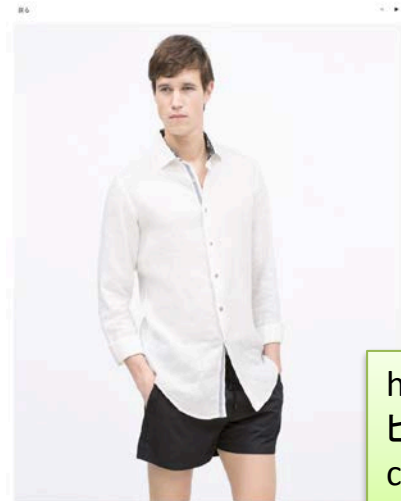
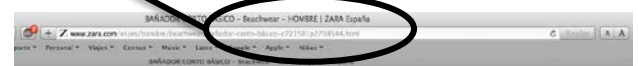


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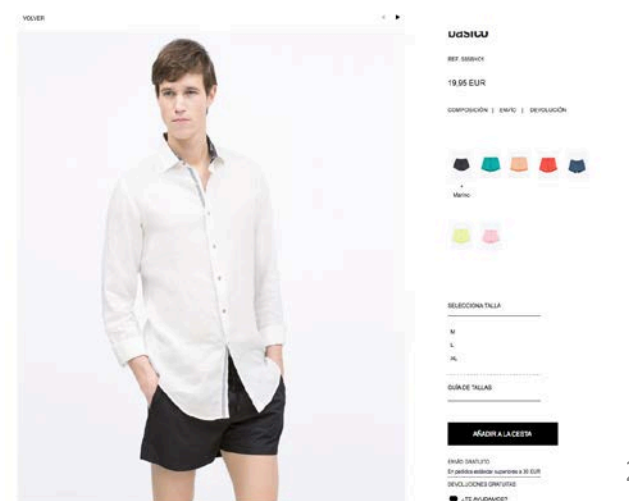


Japan

Spain



<http://www.zara.com/jp/ja/メンズ/ビーチウェア/ベーシックショート水着-c721501p2708544.html>





# Two exchange rates

- E: Nominal Exchange Rate
  - Determined in financial markets
    - Uncovered and covered interest rate parity
    - Order Flows
- E<sub>PPP</sub>: Implied Exchange Rate
  - Computed from retailer's relative prices

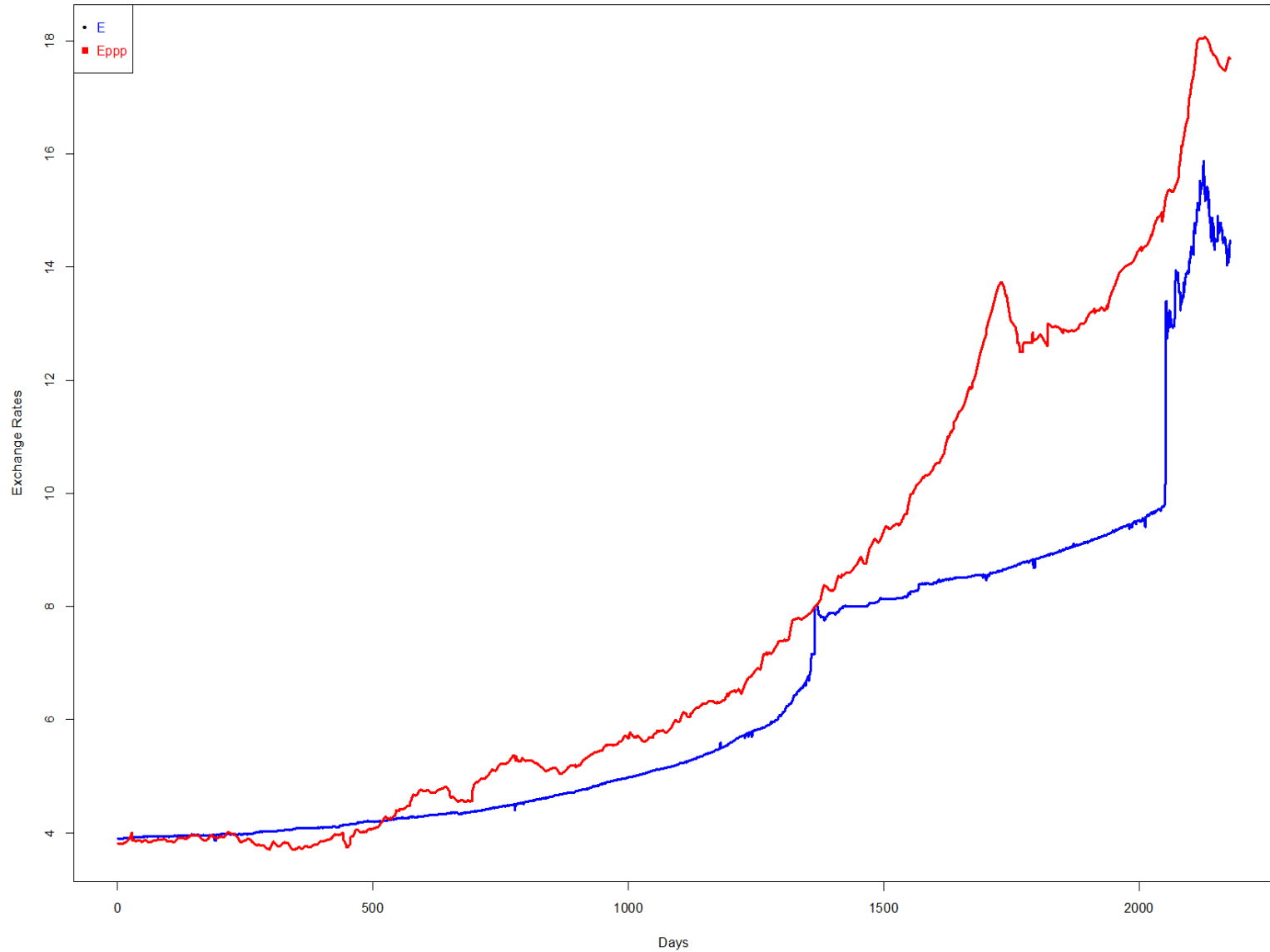
$$E_{PPP} = \sum \frac{P_{Brazil,i}}{P_{USA,i}} w_i$$

# From Eppp to E?

- Why are the two related?
  - From E to Eppp
    - Theory of Pass-through
  - From Eppp to E?
    - Can we learn something about the nominal exchange rate by paying attention to relative retail prices?
      - Demand for tradeables / importables
      - Hedging demand
- Eliminating average level differences...
  - Differences in
    - Taxation
    - Degree of competition
    - Levels of development

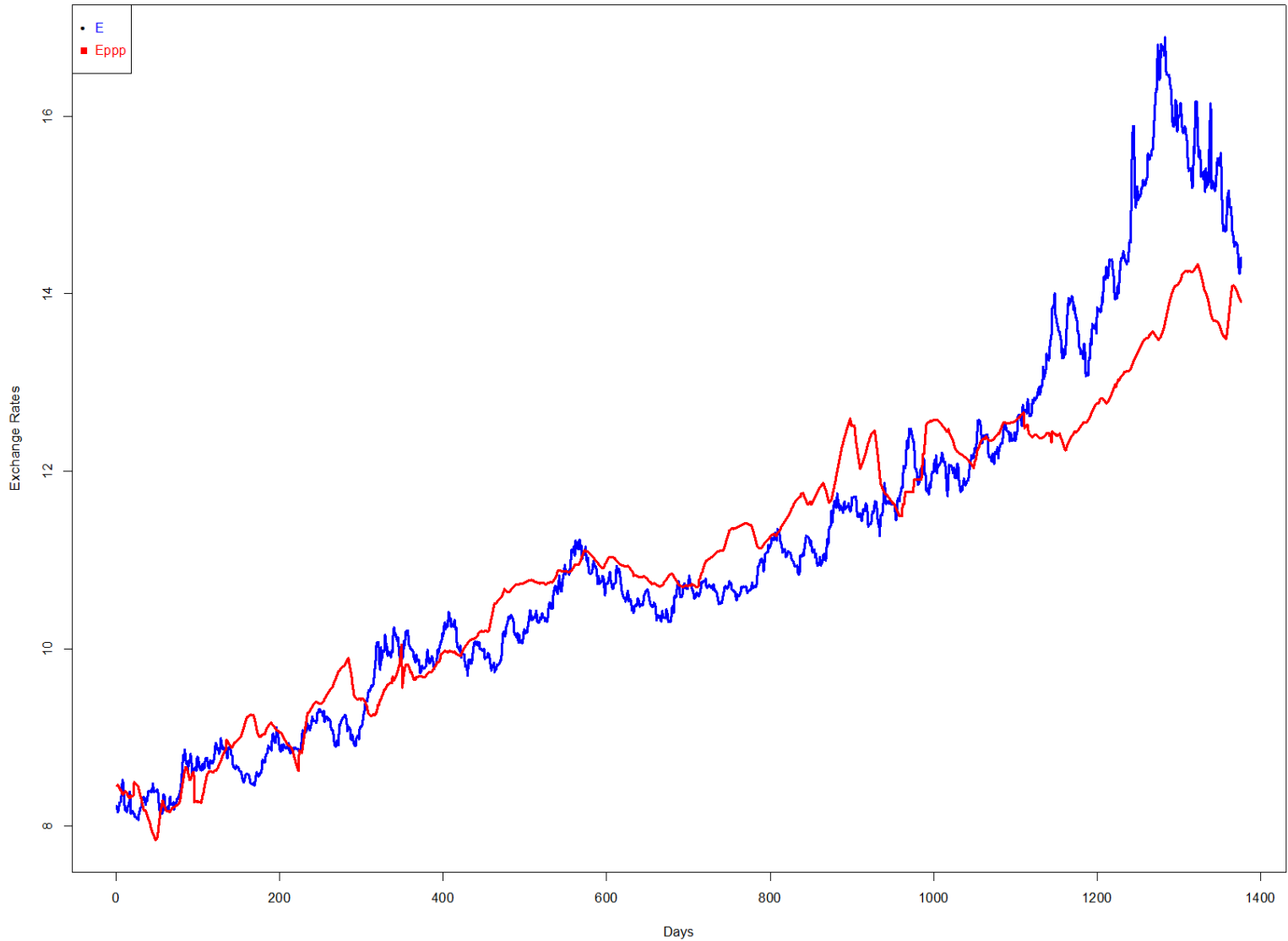
# Argentina

Argentina: Market and Implied Exchange Rates



# South Africa

South Africa: Market and Implied Exchange Rates

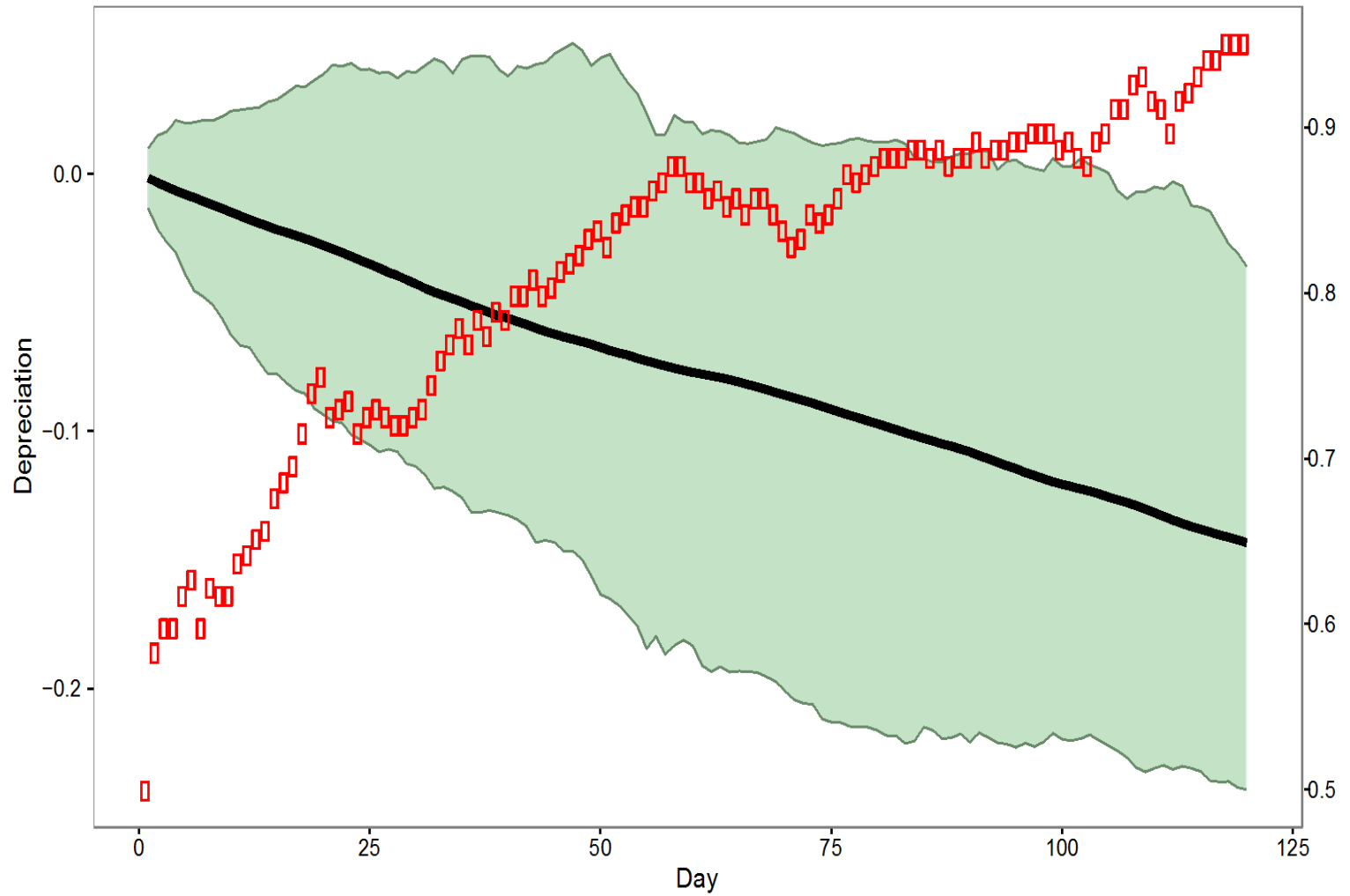


# Predictive Model

- Generate Depreciations and Appreciations signals
  - Machine Learning – Random Forest
  - Training set
    - Predict the change in the nominal exchange rate the next (60 or 120) business days
    - Use past information on the nominal exchange rate ( $E$ ) and the implied exchange rate ( $E_{ppp}$ ) (typically 1000 observations)
    - Re-estimate the model everyday
  - Signal
    - Create a signal out of sample (the day after the training set)
    - Prediction is either appreciation (up) or depreciation (down)
  - Evaluate using an event study
    - Align all the “devaluation signals” and track the actual exchange rate for 120 days
    - Compute the 90 and 10 percent bands of the actual events
    - Compute the probability of depreciation or the probability of appreciation

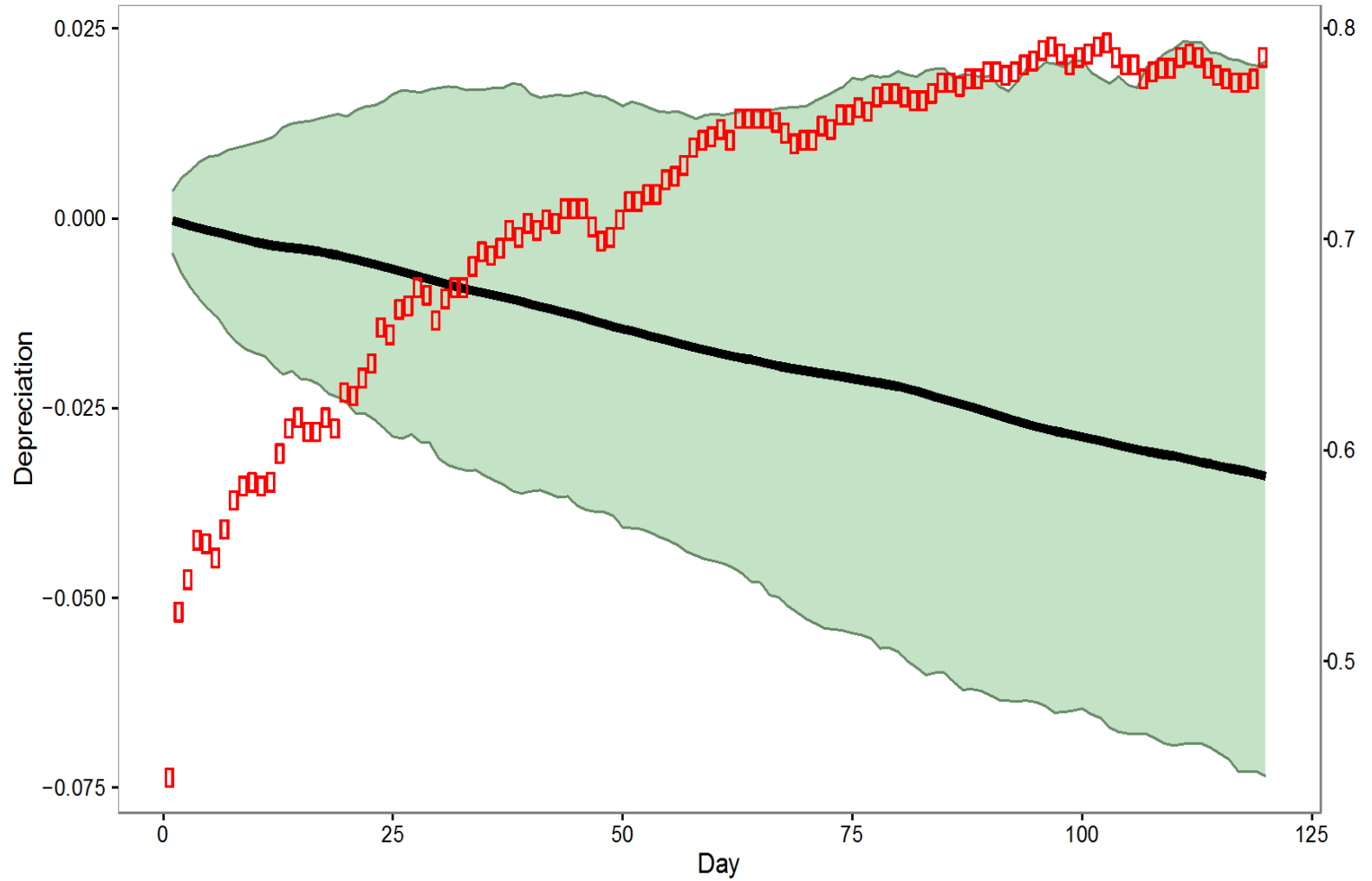
# Brazil

Brazil: Event Study: Devaluation



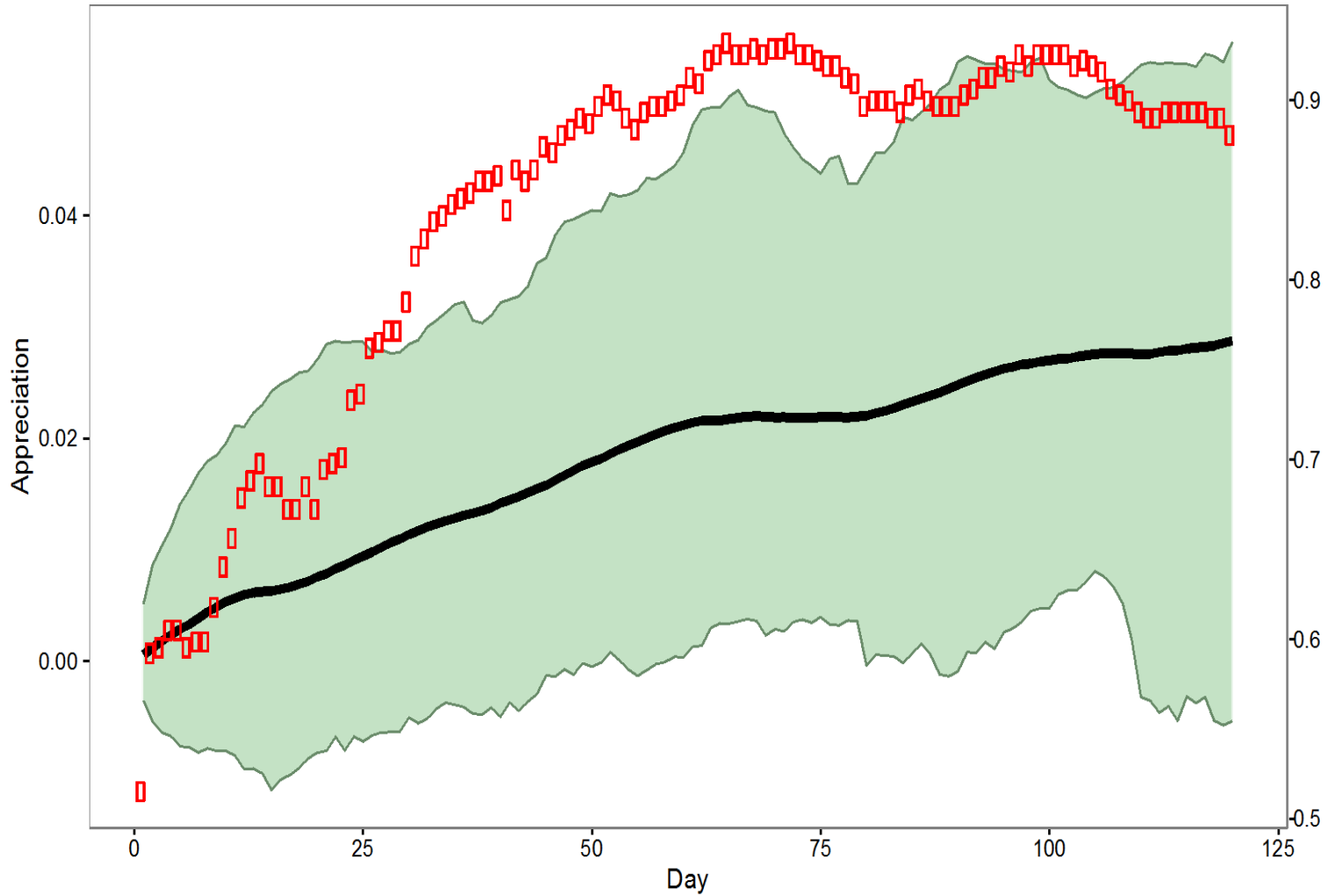
# UK

UK: Event Study: Devaluation



# Appreciations

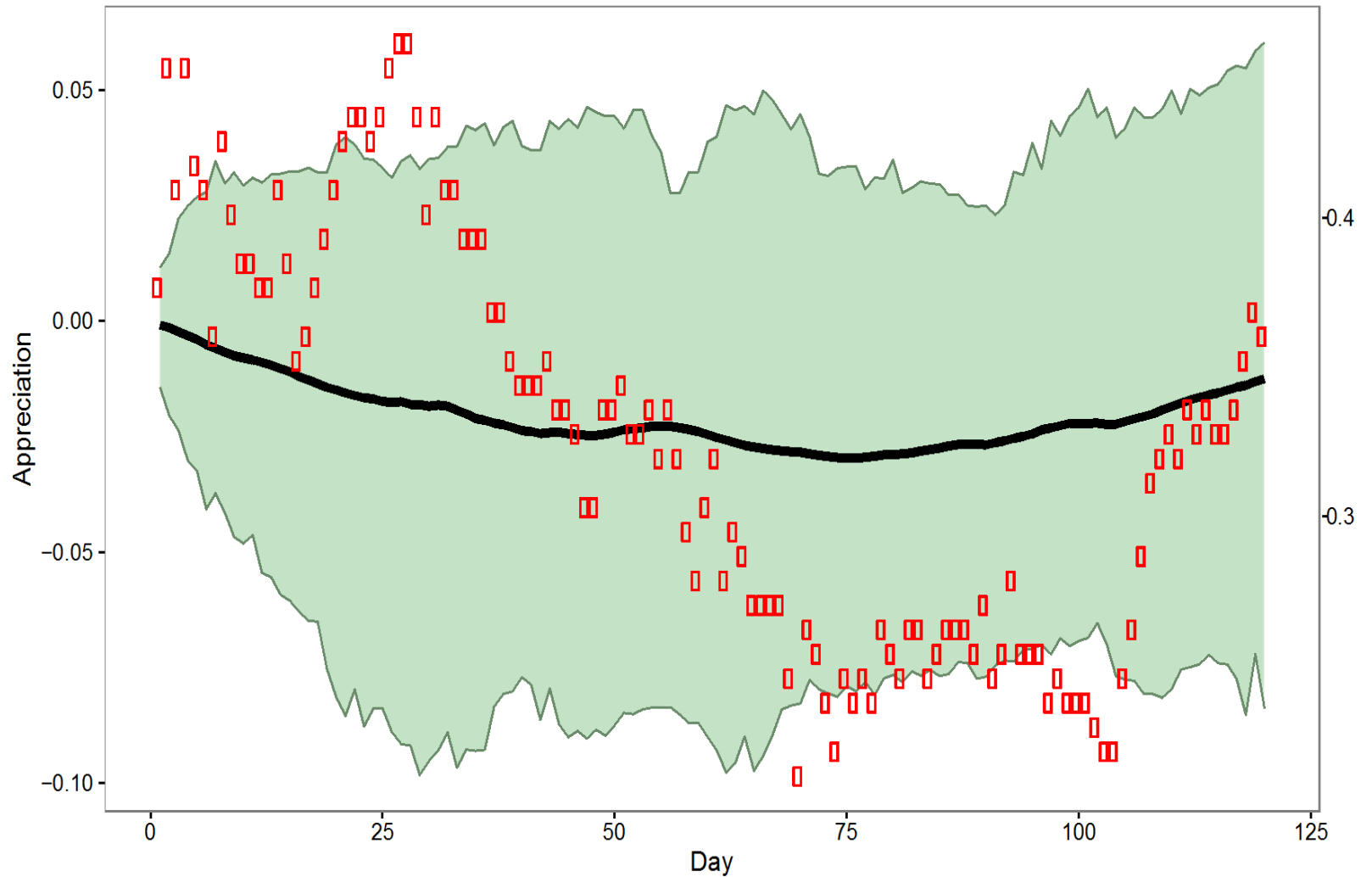
UK: Event Study: Appreciation





# Appreciations

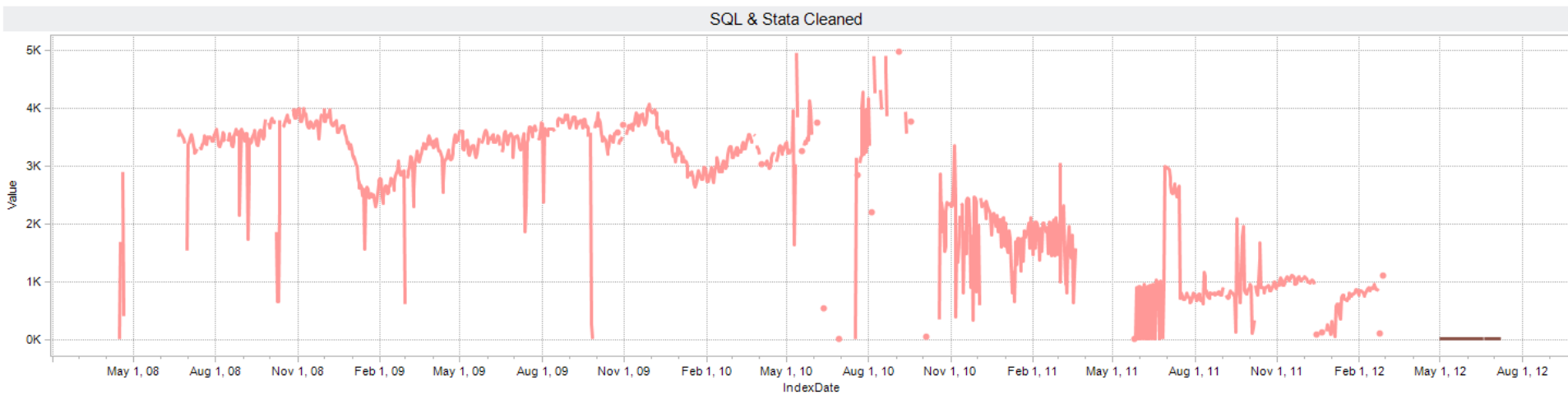
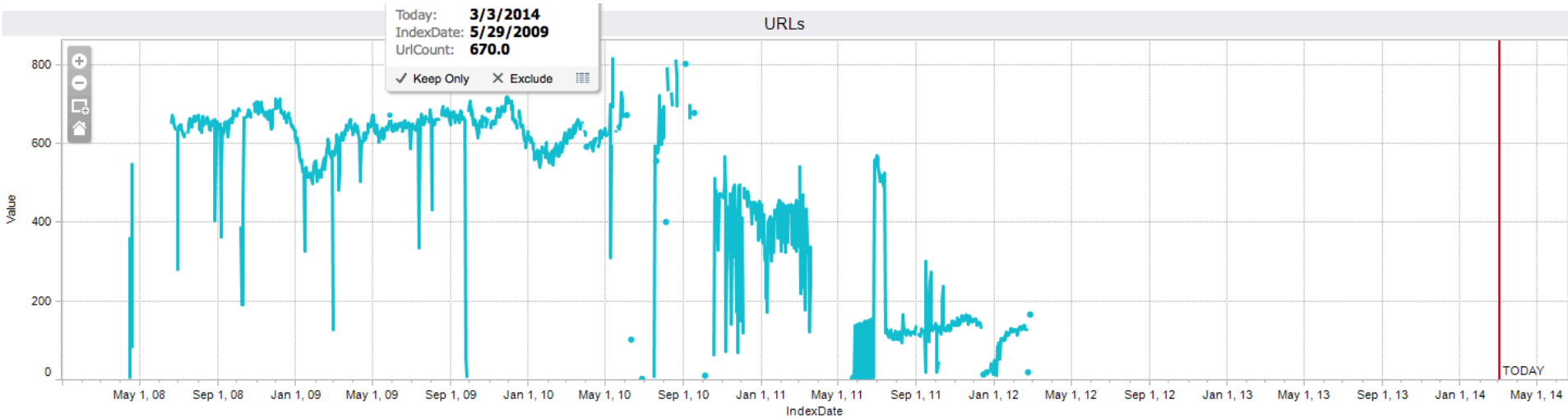
Brazil: Event Study: Appreciation



# What is next?

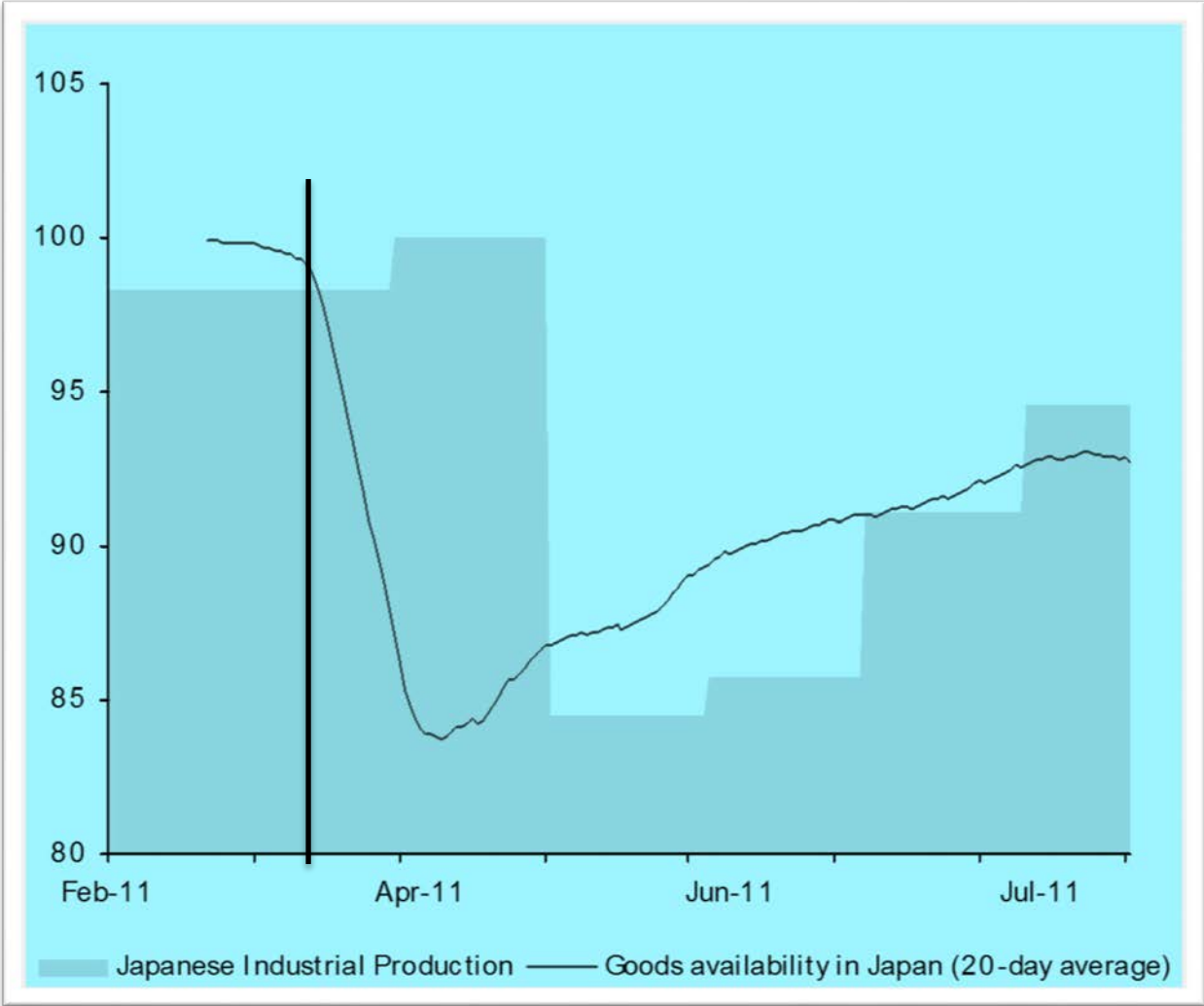
- Economic Activity
- Labor Market Conditions
- Real Estate

# Scarcity in Venezuela



# Japan

Gauging shortages in Japanese goods



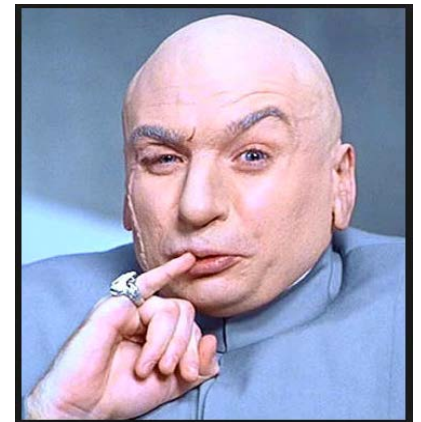
# What is my (our?) objective?

- Change the way statistical offices measure economic indicators
  - Price is the first step
  - Scarcity and PPP is the second one
  - International Trade, Economic activity, Labor Markets, Consumer Confidence, Real Estate... and GDP....
  - Well, I just need... one billion prices... Well, actually...

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*One trillion things!!!!*



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