

Macroeconomics and On-Line Prices

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Micro Price Data in Macroeconomics

- Data Sources
 - Statistical Offices (CPI, PPI, IPI)
 - Scanner Data (Merchandizers or Supermarkets)
- Uses
 - Macroeconomics
 - Price Dynamics (Price Stickiness)
 - Real Rigidities
 - International Economics
 - Pass-through and Border Effects
 - Law of One Price and Purchasing Power Parity
 - Real Exchange Rates
- Online Data
 - Billion Prices Project

Advantages and Disadvantages

CPI

Advantages	Disadvantages
<ul style="list-style-type: none">• Representative• Long Time Series• Collection of Transaction Prices: "On-the-shelf" Prices.	<ul style="list-style-type: none">• Costly to collect• Unit Values• Difficult International Comparison

Advantages and Disadvantages

Scanner

Advantages	Disadvantages
<ul style="list-style-type: none">• Granularity• Frequency• Contains Information on Quantities and Costs	<ul style="list-style-type: none">• Non-Representative: Supermarkets, drugstores, and mass merchandisers• Imputed Prices or Unit Values• Extremely Difficult to Compare except within country (UPC)

Advantages and Disadvantages

On-Line

Advantages	Disadvantages
<ul style="list-style-type: none">• Granularity• Easy Comparison (better matching than UPC's)• Frequency• Posted Prices	<ul style="list-style-type: none">• Non-Representative: Online stores (or Information)• Cheap but Difficult to Collect• Weights

What is the Purpose of each Data?

CPI	Computation of Inflation Transaction Prices
Scanner	Marketing Strategy Accounting Standards
On-Line	Advertise Catalog Marketing and Sales

On-Line: Representativeness

- How representative On-Line Stores are?
 - Apple (in US) sells 50 percent On-Line
 - IKEA, H&M, Home Depot, Costco, etc. All have more than 10 percent sales On-Line
 - Walmart sells about 8 percent (non-perishable) through the On-Line store
- How representative are these?
Especially when compared to the stores we visit.

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 - How many Walmart's do you visit?
 - Walmart has 4759 stores in US, 624 Sam's Clubs, and 6288 International.

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 - How many Walmart's do you visit?
 - Walmart has 4759 stores in US, 624 Sam's Clubs, and 6288 International.
 - In the US, the median store is less than 0.02 percent.
So, the Online store is orders of magnitude larger than what you observe!

On-Line: Implications on Business

- Changes in Stores Behavior
 - Price Dispersion across On-Line Stores
 - Walgreens: 80+ percent of the Items have identical prices across zip codes
 - Large High-End retailers have 100 percent identical prices within a country.
 - Price Dispersion On-line versus Off-Line
 - High-End stores have identical prices.
 - Price Dispersion has collapsed in Clothing, Electronics, Hotels, Process Food, Household Products, and many other sectors, etc.
 - Price Dispersion remains in fresh food and services, or things we do not sell online (Gasoline)
 - Price Dispersion across Countries
 - Except within currency unions, it still remains extremely large.
 - On-Line Stores are still able to segment markets

On-Line: Answering Pricing Dynamics Questions

- Research
 - Price Stickiness, Distribution of Price Changes, Border Effects, Law of One Price, Cross country Price Levels, Hazard Functions (Price Change), etc.
- On-Line advantage:
 - No Unit Values:

CPI: Health, Education, Financial, Real Estate, Clothing, Electronics, Hotels, Transportation, Automobiles, are all collected as unit values, or price imputed from econometric models.

Scanner: Even daily prices suffer from unit values. You need every transaction (which is what Marketing tends to use).
 - Matching:

Store item code is much better to match products than UPC
 - Category Heterogeneity:

Stores are organized along categories that are relevant and meaningful to the customer.

What is the problem with Unit Values?

Unit Values works as a non-classical Error-in-Variable problem

- From the 10 stylized facts...
 - (1) Price Stickiness
 - It is incorrectly measured.
 - Especially when measured as the probability of price change
 - Error-in-variables biases downward stickiness
 - (6) Distribution of Price Changes has large mass around zero
 - Unit values derived from random weighted prices imply uni-modal distributions.
 - (9) Simple hazard functions are non-increasing.
 - Unit Values and Heterogeneity imply that Hazard Functions are almost never increasing.
- From the international literature...
 - Border effects are overestimated
 - Law of One Price is underestimated

Some new results....

- Law of One Price
 - Better Matching Product ID's
 - Observe Prices at Product Introductions
- Distribution of Price Changes
 - No Unit-Values
 - Better treatment of Heterogeneity
- Border Effect
 - Better Matching
 - Granularity
 - No Unit-Values

Product Introductions, Currency Unions, and the Real Exchange Rate

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University of Chicago

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2013

What We Do

- ① Evaluate the LOP deviations
- ② Introduce large dataset of identical tradeable goods, sold by global retailers in three industries and **dozens of countries**.
- ③ **LOP generally holds within Currency Unions**, fails otherwise (including pegged regimes).
- ④ New decomposition shows **RER at time of introduction** is most important component of RER and moves closely with NER.

Price Data from Four Global Retailers

- Apple, IKEA, Zara, and H&M
- Among the largest global retailers (by sales) in technology, furniture, and apparel industries
- Headquartered in different countries, not jointly owned
- Prices “scraped” off the retailer websites
(eg. http://store.apple.com/us/shop_ipad/accessories/cases)

How Does "Scraping" Work?

The screenshot shows the Apple Store website's product page for iPad Smart Covers. The navigation bar at the top includes links for Store, Mac, iPod, iPhone, iPad, iTunes, Support, and a search icon. Below the navigation bar, the page title is "Apple Store" and there is a "Questions? Call 1-800-MY-APPLE" link. The breadcrumb trail indicates the path: Shop iPad > iPad Accessories > Cases. On the left, there are "Departments" (Shop Mac, Shop iPad, Shop iPhone, Shop iPod) and "Narrow by" filters (iPad (1st generation) through iPad mini, Smart Case, Smart Cover, Sleeve, Stand). The main content area displays a list of products under the heading "Cases". The first product is "iPad Smart Cover (PRODUCT) Red". Below it, a list of products is shown with columns for product name, description, rating, and price. The products listed are: iPad mini Smart Cover - Dark Gray (\$39.00), iPad mini Smart Cover - (PRODUCT) RED (\$39.00), and iPad Smart Case - Polyurethane - Dark Gray (\$49.00).

Product Name	Description	Rating	Price
iPad mini Smart Cover - Dark Gray	Redesigned for iPad mini, the iPad mini Smart Cover is designed to be its perfect match: a thin, durable cover...	★★★★☆ Based on 81 reviews	\$39.00 In Stock
iPad mini Smart Cover - (PRODUCT) RED	Redesigned for iPad mini, the iPad mini Smart Cover is designed to be its perfect match: a thin, durable cover...	★★★★☆ Based on 69 reviews	\$39.00 In Stock
iPad Smart Case - Polyurethane - Dark Gray	The iPad Smart Case covers your iPad — both front and back — yet still retains the thin, light design of iPad...	★★★★☆ Based on 173 reviews	\$49.00 In Stock Free Shipping

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<!-- START product -->
```

```
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```

```
<p class="productname">Ipad Mini Smart Cover – Dark Grey</p>
```

```
<td class="Price">$39.00</td>
```

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<!-- END product -->
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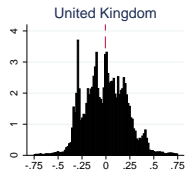
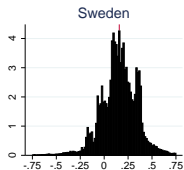
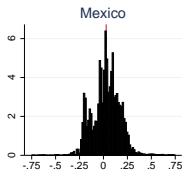
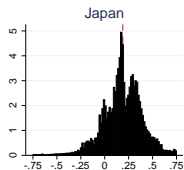
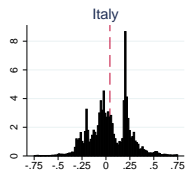
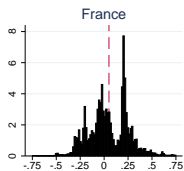
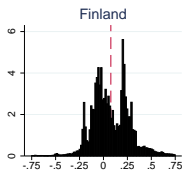
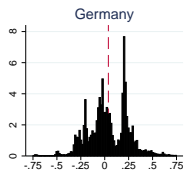
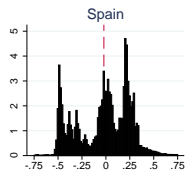
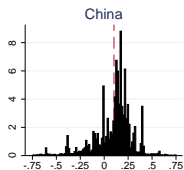
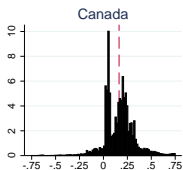
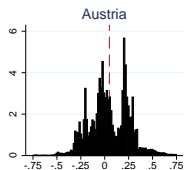
Good-level RER Definition

- $p_i(z, t)$ is log price of z in country i in week t
- $e_{ij}(t)$ is log exchange rate (units of currency i per unit of j 's)
- $q_{ij}(z, t)$ is the log of the good-level RER:

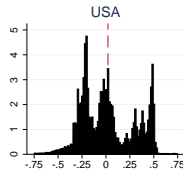
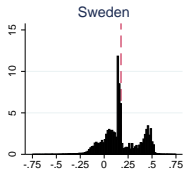
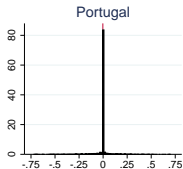
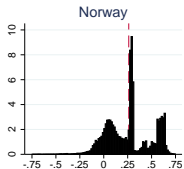
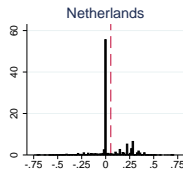
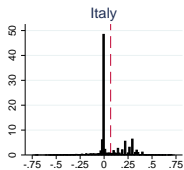
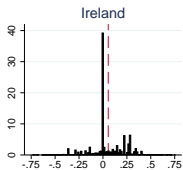
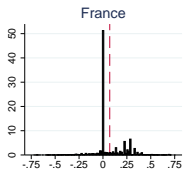
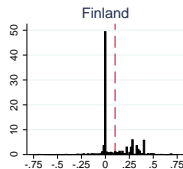
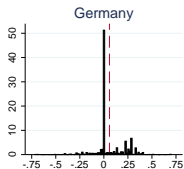
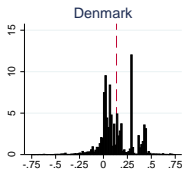
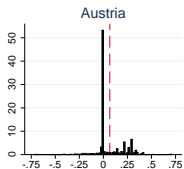
$$q_{ij}(z, t) = p_i(z, t) - e_{ij}(t) - p_j(z, t)$$

- $q_{ij}(z, t) = 0$ when the LOP holds

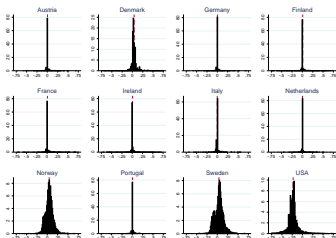
Good-level RERs q_{ij} for $j = \text{United States}$



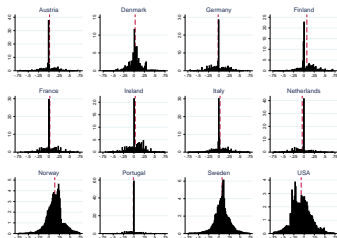
Good-level RERs q_{ij} for $j = \text{Spain}$



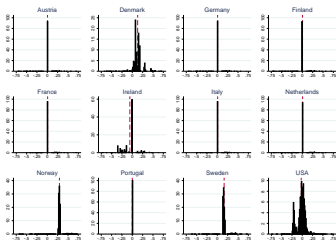
Good-level RERs q_{ij} for $j = \text{Spain}$, by Store



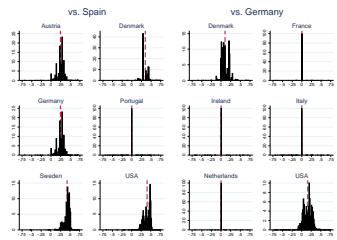
(a) Apple



(b) IKEA

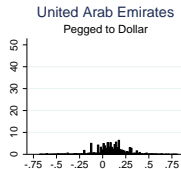
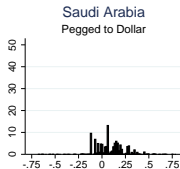
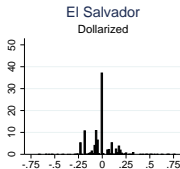
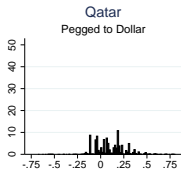
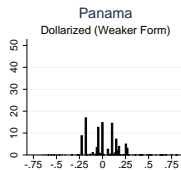
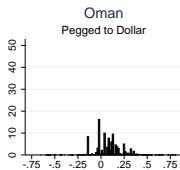
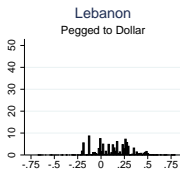
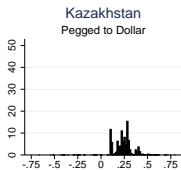
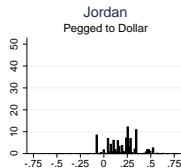
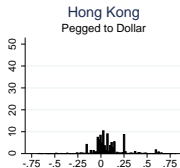
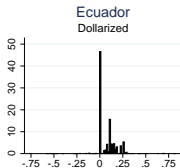
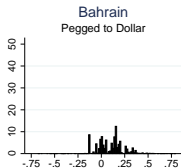


(c) H&M



(d) Zara

Currency Unions or the Euro Zone?



Quantitative Results

		All Stores	Apple	IKEA	H&M	Zara
<i>Panel A: Average Absolute Values of Log Good-level RERs</i>						
All Data	Currency Unions	0.076	0.023	0.129	0.020	0.102
All Data	NER Pegs	0.116	0.085	0.145	0.119	0.115
All Data	Floats	0.187	0.143	0.216	0.145	0.207
$(p_i + p_j) > \$400$	Currency Unions	0.043	0.022	0.086	0.013	0.097
$(p_i + p_j) > \$400$	NER Pegs	0.096	0.078	0.094	0.125	0.118
$(p_i + p_j) > \$400$	Floats	0.171	0.151	0.170	0.141	0.270
<i>Panel B: Share of Absolute Value of Log Good-level RERs Less Than 1 Percent</i>						
	Currency Unions	0.610	0.681	0.307	0.911	0.548
	NER Pegs	0.069	0.140	0.081	0.069	0.064
	Floats	0.045	0.049	0.033	0.062	0.040

Are Results Representative? Additional Stores (Less Data)

	Additional Stores	Adidas	Dell	Mango	Nike	
(i)	Currency Unions	0.086	0.087	0.054	0.112	0.053
(ii)	NER Pegs	0.154	0.172	0.130	0.158	0.103
(iii)	Floats	0.201	0.207	0.139	0.203	0.210

Does This Show Up in “Aggregated” Data?

- Eurostat “Product Level Indices” (PLI)
- Pick the 8 non-overlapping tradable mfg sectors similar to ours (i.e. excludes “restaurants and hotels” and “meat”):

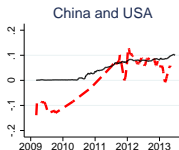
	Audio Equip	Clothes	Elect Equip	Metal Prods	Shoes	Furniture	Software	Transp Equip
Euro	0.067	0.091	0.069	0.067	0.114	0.095	0.112	0.079
Pegs	0.103	0.167	0.082	0.115	0.174	0.375	0.109	0.120
Floats	0.123	0.198	0.091	0.101	0.200	0.296	0.133	0.121

- Also true in disaggregated (confidential) data from Eurostat

Product Introductions

- Result 1 : LOP holds well within currency unions ($q \approx 0$)
- Result 2: We now propose an RER decomposition that emphasizes evolution of RER for newly introduced goods
 - Significant recent attention to “intro prices”, given exclusion from matched-model price indices
 - Baxter and Landry (2012) only other paper with actual measurements of this

Good-level RERs at Introduction vs. NER, Lowess



--- RER at Introduction — Log Exchange Rate

The Distribution of the Size of Price Changes

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Motivation

- Fact from CPI and Scanner Data research: Distribution of Price Changes has a large mass around zero. Large mass between -2 and 2 percent!
- This result can be the outcome of Unit Values being collected as opposed to Regular Prices exhibiting small price changes.
- Formal test of unimodality within narrow windows of price changes
 - Hartigan
 - Silverman
 - Proportional Mass

What we do

- Data
 - Study daily price changes from hundreds of retailers
 - Compute three tests for unimodality in different parts of the distribution.
- Results
 - Unimodality is rejected in most retailers
 - Rejections occur in narrow window (-5 to 5 %)
 - Rejections increase when window is increased:
Possibly due to “Sales”
 - Hartigan and Silverman’s tests are rejected in all retailers
 - Proportional Mass rejects about 2/3 of the retailers
 - Supermarkets are more unimodal than clothing and electronics

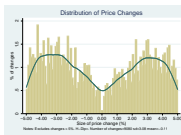
Distribution of Price Changes



(a) ARG-1



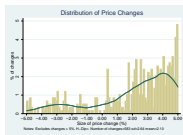
(b) ARG-2



(c) AUS-1



(d) AUS-2



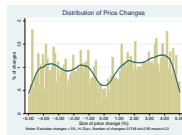
(e) AUS-3



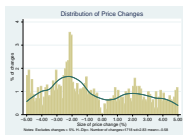
(f) AU-4



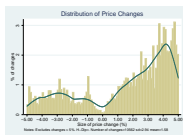
(g) BRA-1



(h) CHI-1



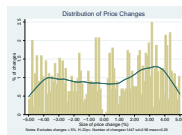
(i) CHN-1



(j) CHN-2

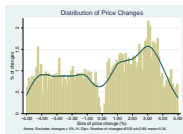


(k) COL-1

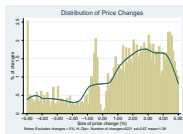


(l) ECU-1

Distribution of Price Changes



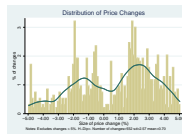
(a) FRA-1



(b) FRA-2



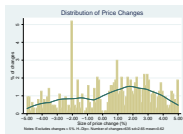
(c) FRA-3



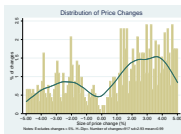
(d) HK-1



(e) IRE-1



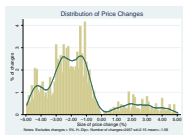
(f) ITA-1



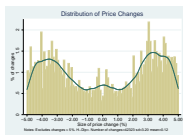
(g) ITA-2



(h) MEX-1



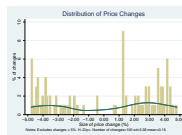
(i) NE-1



(j) NZ-1

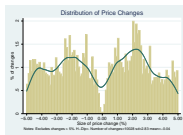


(k) RUS-1

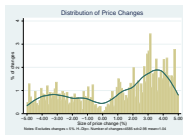


(l) SIN-1

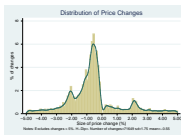
Distribution of Price Changes



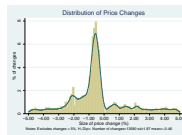
(a) ES-1



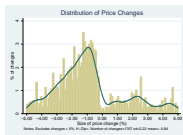
(b) TUR-1



(c) UK-1



(d) UK-2



(e) UK-3



(f) UK-4



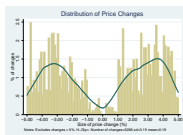
(g) UK-5



(h) URU-1



(i) US-1



(j) US-2



(k) US-3



(l) VEN-1

Comparison with Scanner and CPI sampling methods

Compute the average weekly price (only for the Supermarkets in our data). We assume equal weights.

	Daily Data	Weekly Average
Mean Dip (Hartigan)	0.035	0.019
Mean Critical Bandwidth (Silverman)	1.351	0.799
Mean PM Score	-0.143	0.145

Unimodal distributions have lower Dips, lower CBs and positive PMs.

The Billion Prices Project

Alberto Cavallo

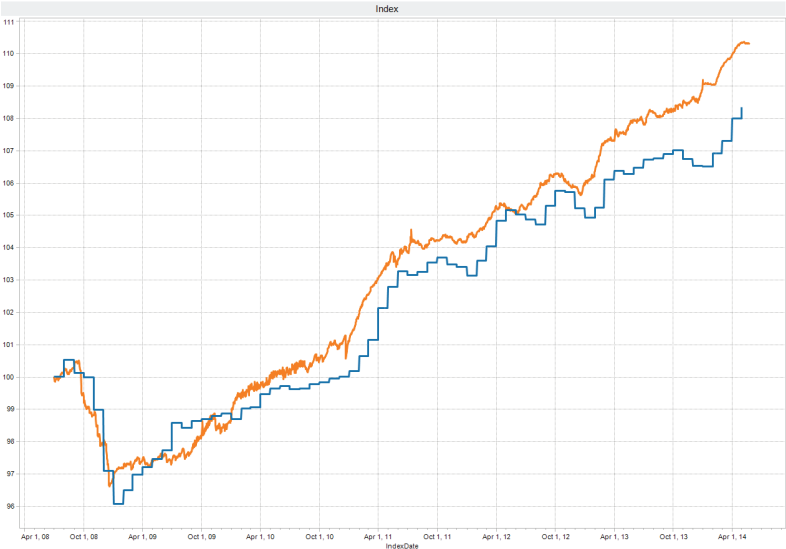
MIT

Roberto Rigobon

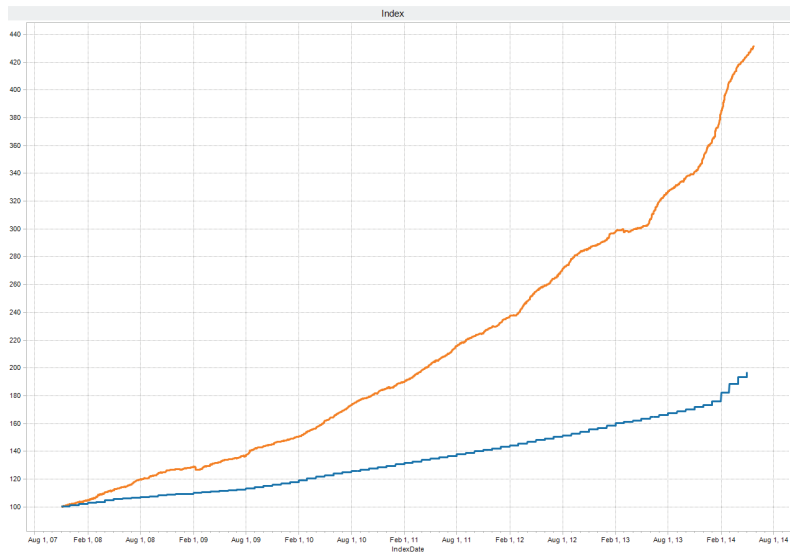
MIT

2014

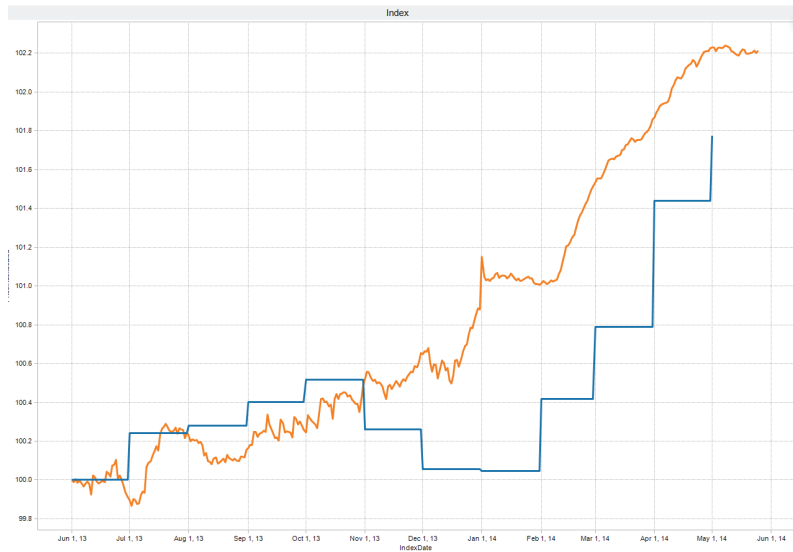
Inflation in USA



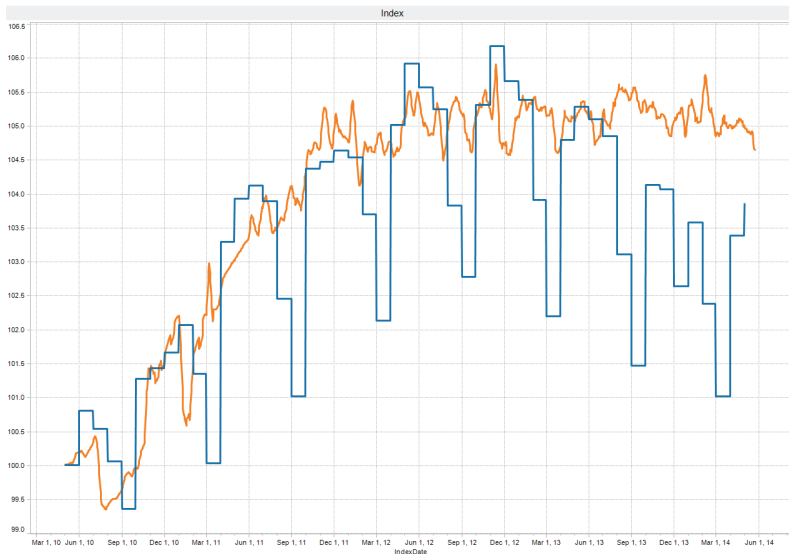
Inflation in Argentina



Inflation in USA (Winter Shock)



Inflation in Greece (Different Seasonality)



Final Remarks

- Micro Price Data has become a very important resource for macroeconomics and international economics research.
- Some new research using OnLine Prices is challenging the consensus.
 - Distribution of Price Changes, Explanations of LOP deviations, Border effects, Hazard Functions, and Price Level Differences.
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- At the Billion Prices Project we have been collecting data for 6 years. We are working on making that available to all – very soon.