ADVISORY PANEL ON CONSUMER PRICES – STAKEHOLDER

RPI and CPI: a tale of two formulae

Purpose

1. This presentation discusses issues pertinent to the measurement of clothing price changes in consumer price inflation statistics, and also contributes to work on addressing the formula effect. It does not seek to pass any form of judgement on current ONS practices, nor does it make recommendations for (methodological) change.

Actions:

2. Members of the panel are invited to:
    a) comment on the research and its implications for consumer price statistics

Discussion

3. The measurement of clothing prices is of fundamental importance to the debate on the formula effect (the difference in measured inflation rates attributable to the use of different formulae for aggregating individual price quotes in the RPI and CPI). In terms of magnitude, **the formula effect increases the annual RPI inflation rate by about 1 percentage, relative to CPI inflation.**

4. Clothing accounts for over half of this formula effect. This reflects the very different measured RPI and CPI component inflation rates. **Clothing prices rose by either 15% or 80%** according to the CPI or RPI respectively between January 2010 and summer 2016, **based on the same source data.**

5. The difference between the RPI (Carli formula) and CPI (Jevons formula) results reflects, in essence, the difference between the arithmetic and geometric mean of a sample, which in turn is proportional to the variance of the sample.

6. The distribution in question here is that of the cumulative price change over a year, which is termed the price relative (i.e. relative to the January base price). Clothing data has a significantly **higher dispersion of price relatives** than many other basket items (hence the unusually large difference between measured RPI and CPI component inflation rates). There are two reasons for this:

    - The first, which is well documented, is that some of the January base prices embody sale prices while others don't. Thus the distribution of price relatives throughout the year contains some values which represent a post-sale recovery and others which represent a non-sale to non-sale price change.

    - The second, which generally does not feature so prominently in this debate, but which this research emphasises, is that **for clothing, many of the price relatives actually represent a comparison of prices of two different individual clothing items**.

7. High product turnover in clothing means that we are **increasingly unable to find matching products** throughout the year. In any given month, on average 25% of price quotes are flagged as a replacement, and by the end of the year, **only 15% of price relatives represent a comparison with**

the price of exactly the same item whose price was first observed in January. In other words, approximately 85% of clothing items will be replaced at some point during the year.

8. It is therefore of critical importance what portion of the price difference between two different clothing items represents inflation and what portion represents a difference in quality. In terms of the price index calculation procession, there is a binary distinction between whether the two different goods in this comparison are deemed comparable or non-comparable.

9. The comparable/non-comparable distinction matters because there are different methods used to calculate the base price and therefore the price relative in each case. Before 2010, 30-40% of such comparisons were classed as non-comparable. But since 2010, all such comparisons have been classed as comparable, even when the price of the replacement good is over five times that of the original.

10. I approached this situation from a perspective of robust estimation in the face of measurement error. Suppose we know that, in truth, some of these post-2010 replacements are actually non-comparable, but we don't know which ones exactly. This is also analogous to testing the sensitivity of the final result to an individual price collector's human judgement as to whether the replacement good is comparable or not.

11. The analysis therefore takes a Monte Carlo approach, based on the published microdata, in which a given proportion of those post-2010 price-relatives calculated using a replacement item are processed as if they were actually non-comparable. A baseline cross-check keeping all replacement items as non-comparable generates component inflation rates similar to the published RPI and CPI series.

12. I found:

    - Increasing the proportion of non-comparable replacements leads to lower average inflation rates, on both the CPI and RPI measures. While some of the price change currently recorded as inflation probably does reflect quality improvement, the main factor driving this observation is that individual quotes cease to be used immediately after having been on sale. That is, their transition to a sale price pulls the overall index down, but this is not counterbalanced by any subsequent price recovery. Precisely this phenomenon was also a source of the persistent downward bias for this item prior to the improvements to price collection practices in 2010.

    - Measured inflation rates can be very sensitive to the subjective judgements of price collectors. The geometric average is more robust to this than arithmetic average. This implies that confidence bands around RPI inflation would be (proportionally) greater.

Rupert de Vincent-Humphreys
January, 2017

List of Annexes

Annex A	RPI and CPI: a tale of two formulae - presentation

RPI and CPI:

A tale of two formulae

Unpicking the clothing formula effect with the CPI/RPI micro price data

Advisory Panels on Consumer Prices

January 2017

Rupert de Vincent-Humphreys

Notes:

This presentation comprises work previously presented at the Cardiff Business School Workshop on Price Microdata, July 2016.

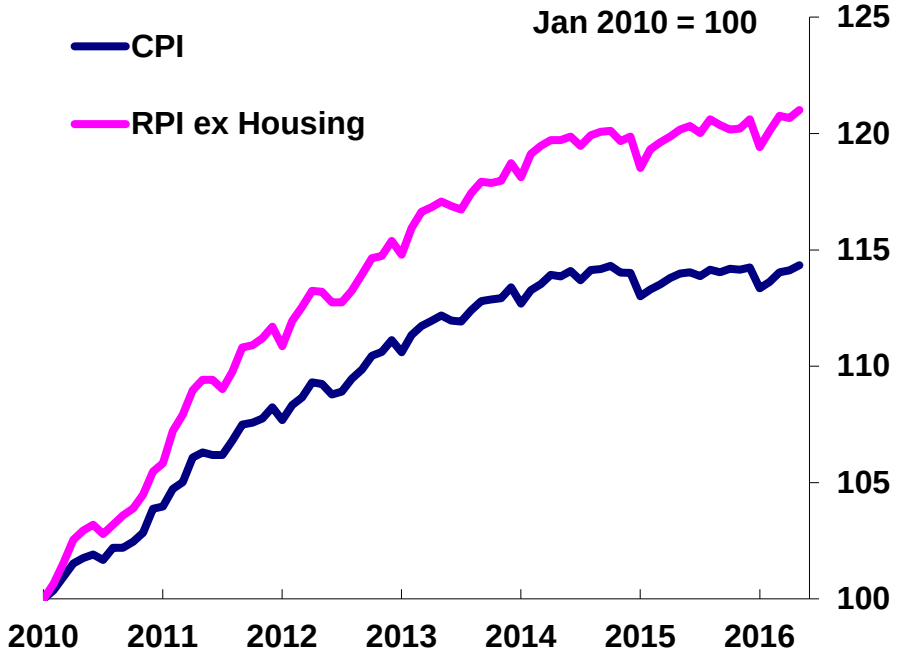
Any views expressed are my own and in no way attributable to my present/previous employer.

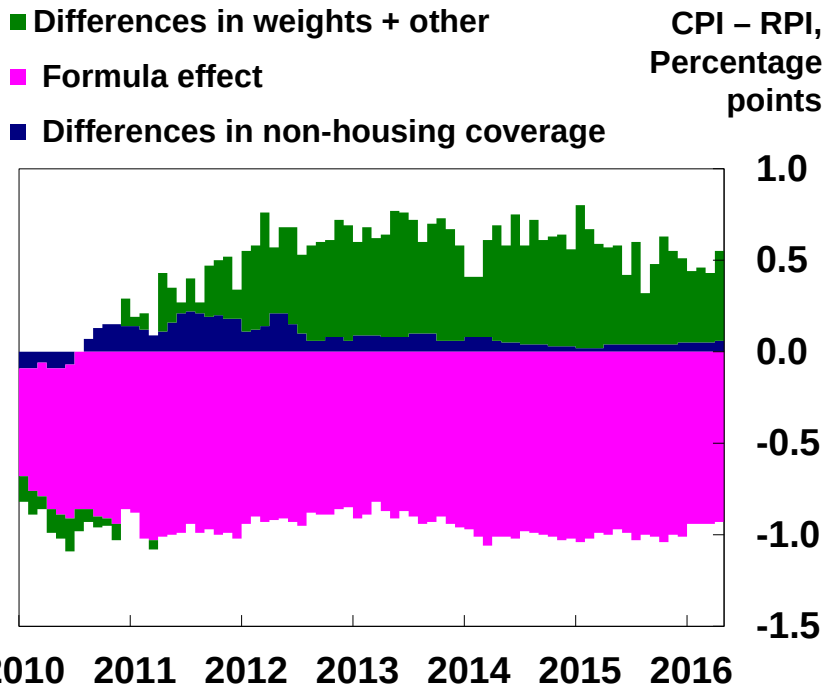
Headlines

- **Clothing central to the RPI/CPI formula debate.**
- **The challenge is the inevitable product replacement - the price comparison is no longer vs same product.**
- **In the face of uncertainty over genuine comparability, the geometric average (CPI) is more robust than the arithmetic average (RPI).**
- **This sector would benefit particularly from a much larger sample - perhaps new sources and methods.**

Motivation

Have prices risen 14% or 21% since 2010?

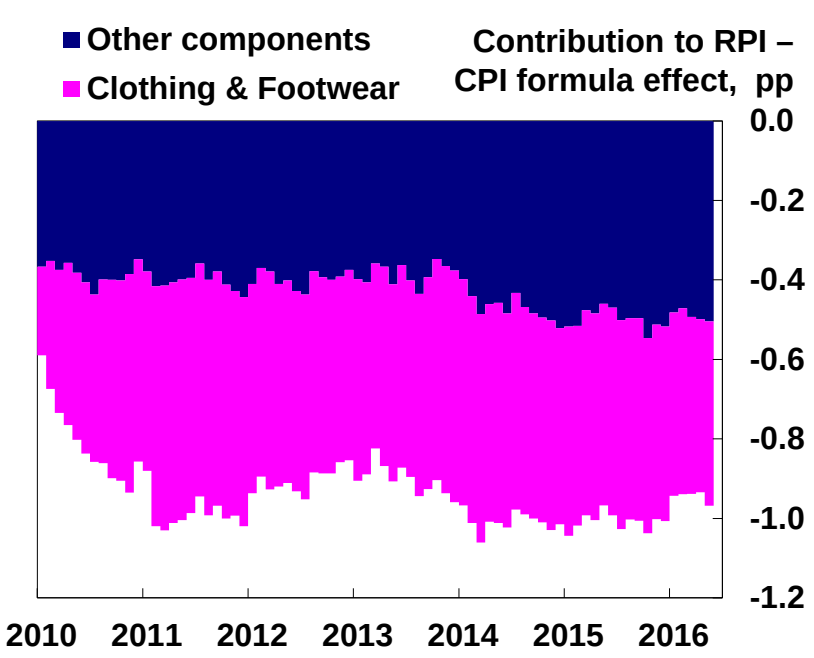


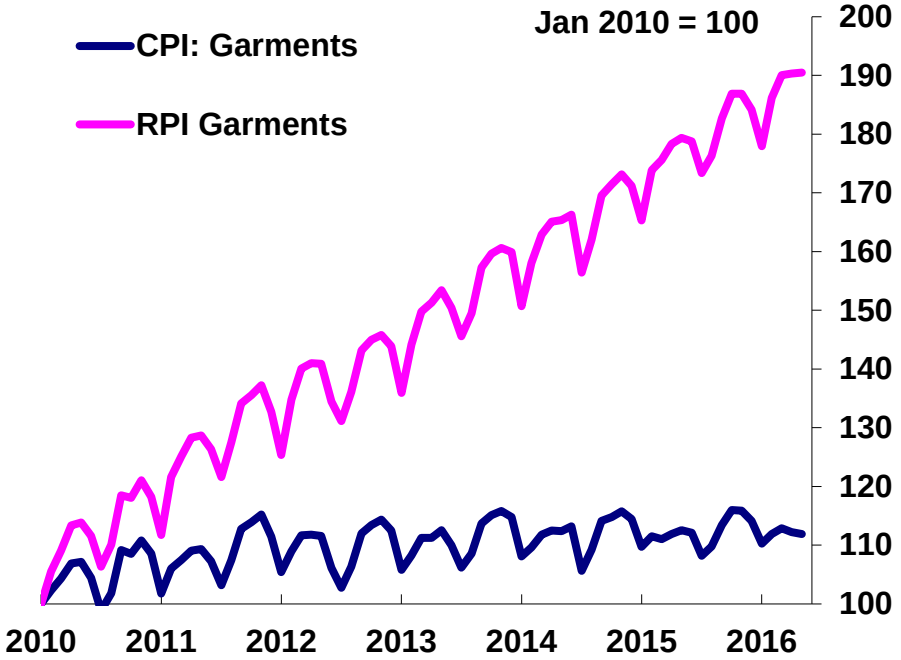


- **The formula for elementary aggregation in the RPI judged not to meet international standards.**
- **Nevertheless, the choice of formula still controversial.**

Motivation

Have clothing prices risen 15% or 80%?

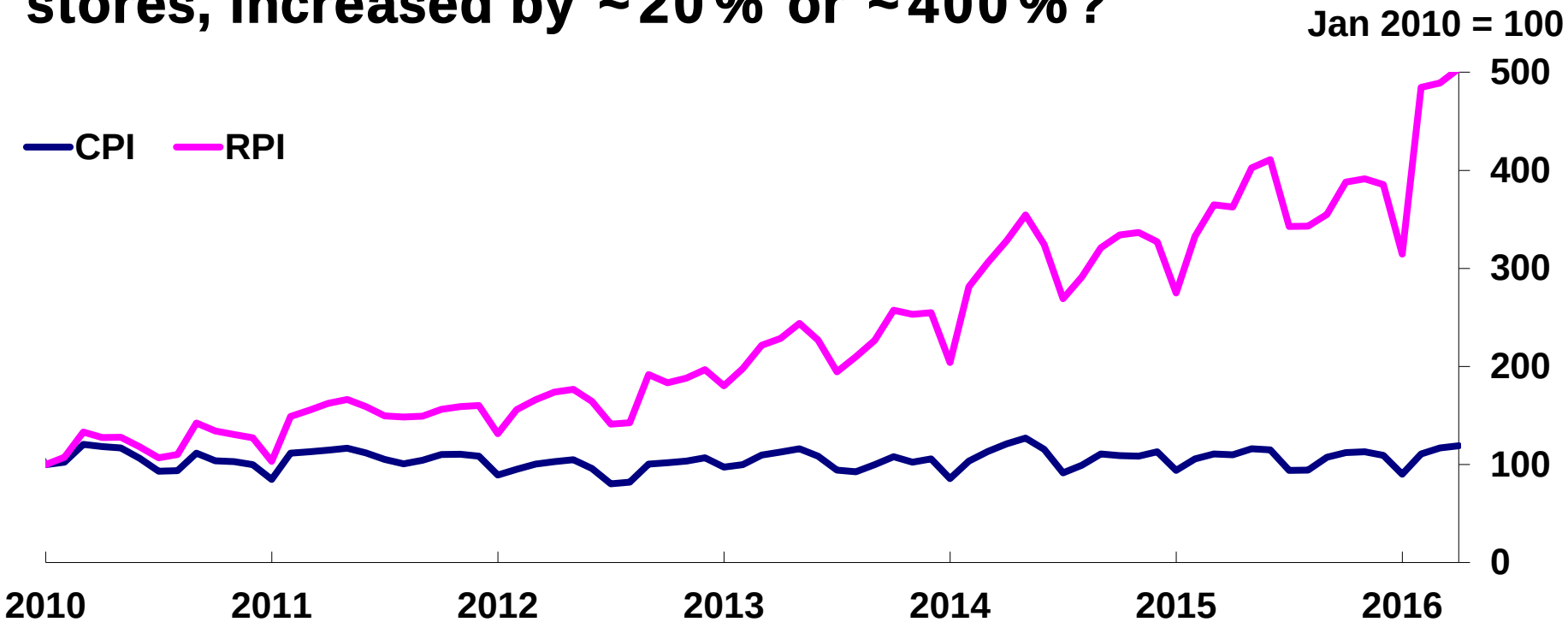




- **Clothing & Footwear account for about half the formula effect.**
- **Both indices produced from the same set of price data.**

Motivation

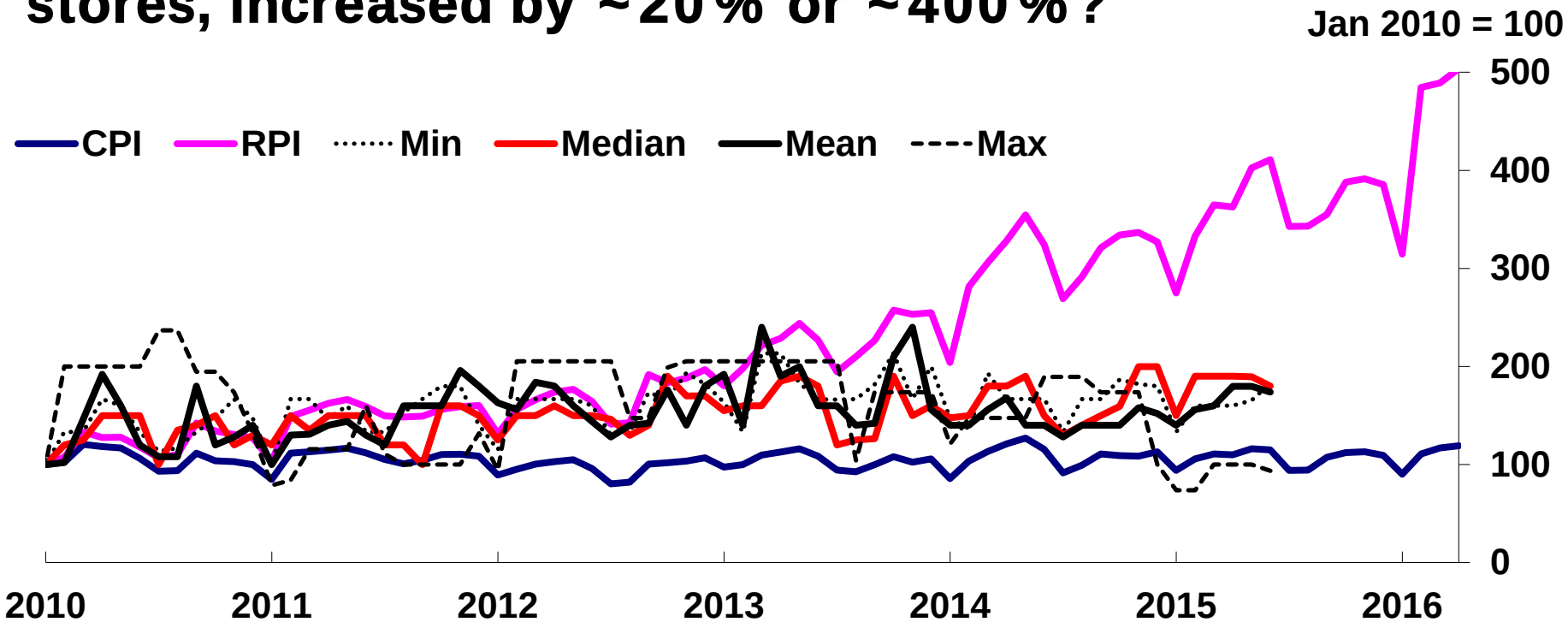
Have women's vests/strappy tops, from independent stores, increased by ~20% or ~400%?



- **Both RPI and CPI series produced from the same set of price data.**

Motivation

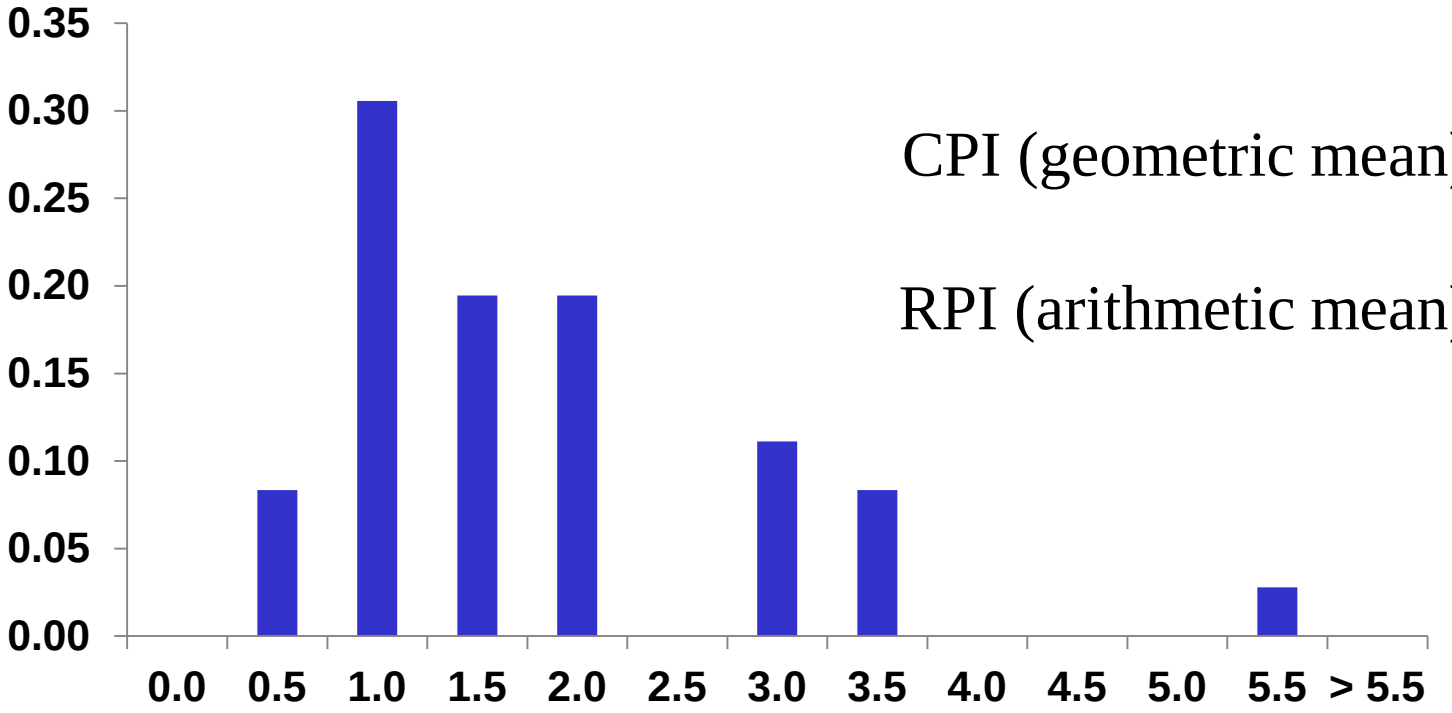
Have women's vests/strappy tops, from independent stores, increased by ~20% or ~400%?



- **Both RPI and CPI series produced from the same set of price data.**
- **Observed prices increased more than CPI; much less than RPI.**

The *price relative* distribution

Women's strappy tops, independent stores, Dec 2014



- **Distribution very wide and (destined to be) asymmetric.**

Issues with clothing

January Base Price

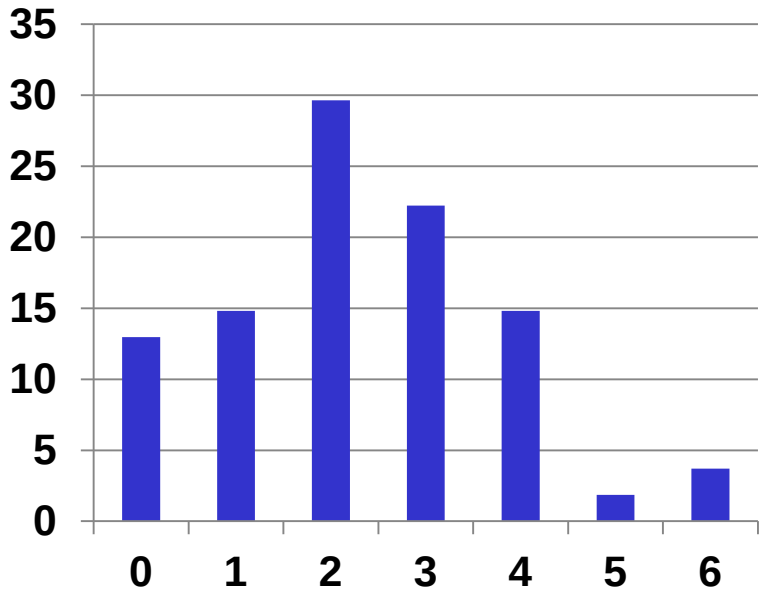
Set of measured price change since January very disperse, depending on whether product was on sale then. More so than for many other basket items.

High product turnover

Generally cannot calculate matched observation price change over the year:

Clothing items typically change 2-3 times a year.

Whether a replacement is judged to be comparable or not is of critical importance.

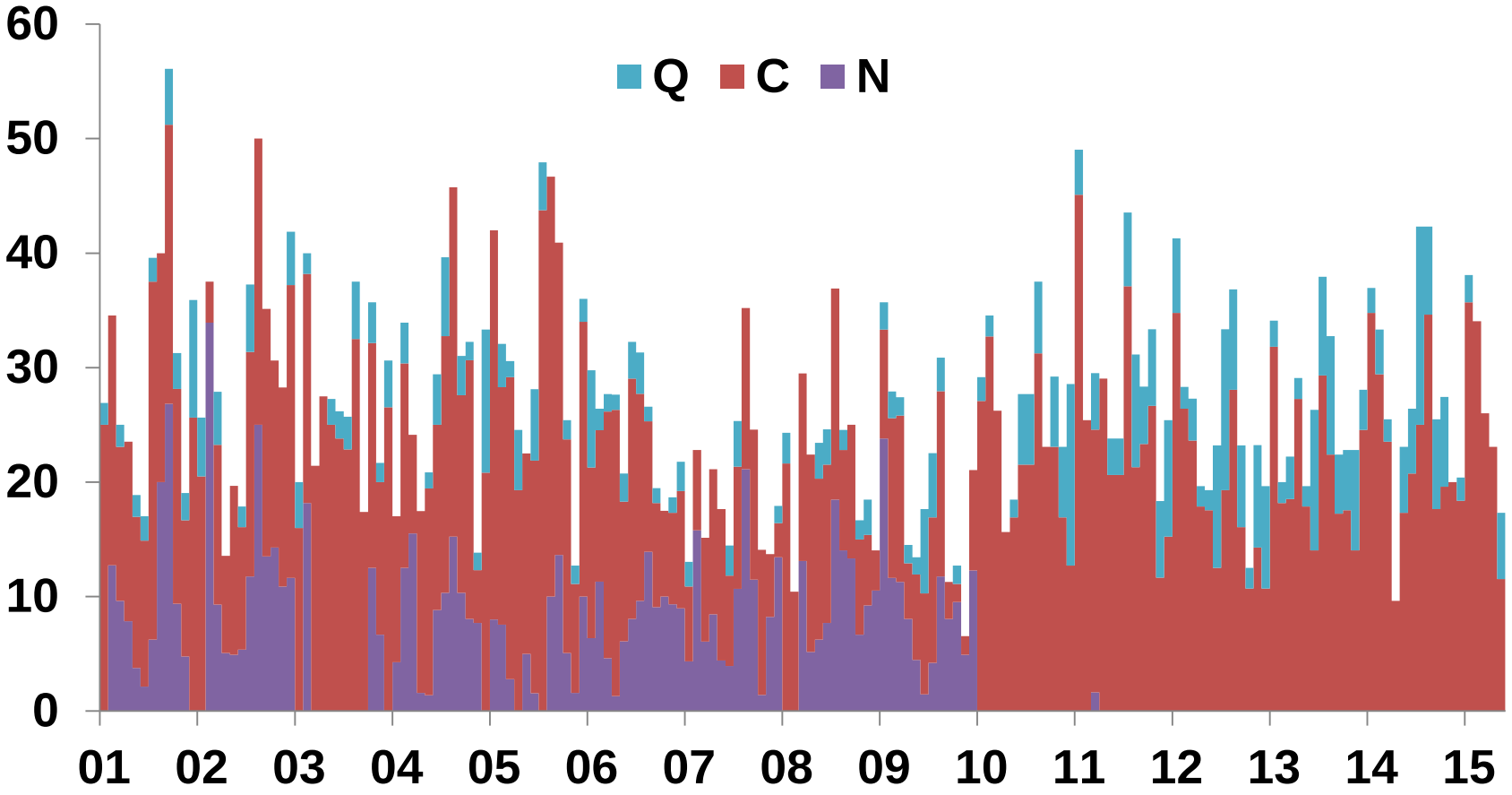


Some prices (510244_2, 2014)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
10.00	**10.00**	**10.00**	**10.00**	**10.00**	**10.00**	**10.00**	**10.00**	**10.00**	**10.00**	**10.00**	**10.00**
10.00	12.00	12.00	12.00	12.00	12.00	12.00					
24.00	140.00	140.00	140.00	140.00	180.00	180.00	180.00	165.00	165.00	165.00	75.00
8.40	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	
35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00
					69.00	69.00	69.00	**45.00**			
59.00	59.00	59.00	59.00	59.00	59.00	59.00	25.00		25.00	25.00	25.00
2.9	9.90	9.90	9.90	9.90	9.90	9.90	9.90	9.90	9.90	9.90	9.90
9.5	19.00	19.00	19.00	19.00	12.99	12.99	16.99	**8.50**	29.99	29.99	29.99
79.00	**79.00**	**79.00**	**79.00**	**79.00**	**79.00**	**79.00**	**79.00**	**79.00**	**79.00**	**79.00**	
19.00	19.00	25.00	25.00	25.00	25.00	**15.00**	**21.00**	25.00	25.00	25.00	25.00
32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	**10.50**	10.00	10.00
35.00	35.00	35.00	35.00	35.00	**29.00**	30.00	30.00	30.00	30.00	**25.00**	30.00
			12.00	12.00	12.00	5.00	5.00	5.00	5.00	5.00	5.00
5.25	**5.25**			22.50	5.99	5.99	15.00	28.00	28.00	28.00	28.00
49.00	**39.00**	135.00	**135.00**	135.00	115.00	**29.00**	**55.00**	95.00	95.00	95.00	95.00
6.00	6.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	16.00	16.00
		18.00	18.00	18.00	**15.00**	**12.00**	**10.00**	**8.00**			
32.00	**32.00**	**32.00**	**32.00**	**32.00**	**32.00**	**32.00**	**32.00**	**32.00**	**32.00**	**32.00**	**32.00**
19.99	**19.99**	**19.99**	**19.99**	**19.99**	**19.99**	**19.99**	**19.99**			**19.99**	**19.99**

- **Price change associated with a sale or a change in the item.**
- **<u>ALL of these replacements treated as comparable.</u>**

Indicator flags (510244_2)



- **On average, a quarter of quotes are replacements.**
- **Up to 2010, about 30-40 % of those classed as non-comparable.**

Calculation structure

t = 0 — **Jan base price**

t = 1:12 — **In-year price**

N.B.: If insufficient quotes to compute EA, carry over item change

Is in-year price a replacement?

Y

Is replacement comparable?

N

Y

N

$$price\_rel^t_{shop} = \frac{price^t_{shop}}{Imputed\ base\ price_{shop}}$$

$$price\_rel^t_{shop} = \frac{price^t_{shop}}{Jan\ base\ price_{shop}}$$

$$ln(EA^t_{CPI}) = \sum_{shop=1}^{n} w_{shop} * ln(price\_rel_{shop})$$

$$EA^t_{CPI} = \sum_{shop=1}^{n} w_{shop} * price\_rel_{shop}$$

Calculation structure

t = 0 — **Jan base price**

t = 1:12 — **In-year price**

This is randomly assigned in simulation

Is in-year price a replacement?

Y

Is replacement comparable?

N

N

Y

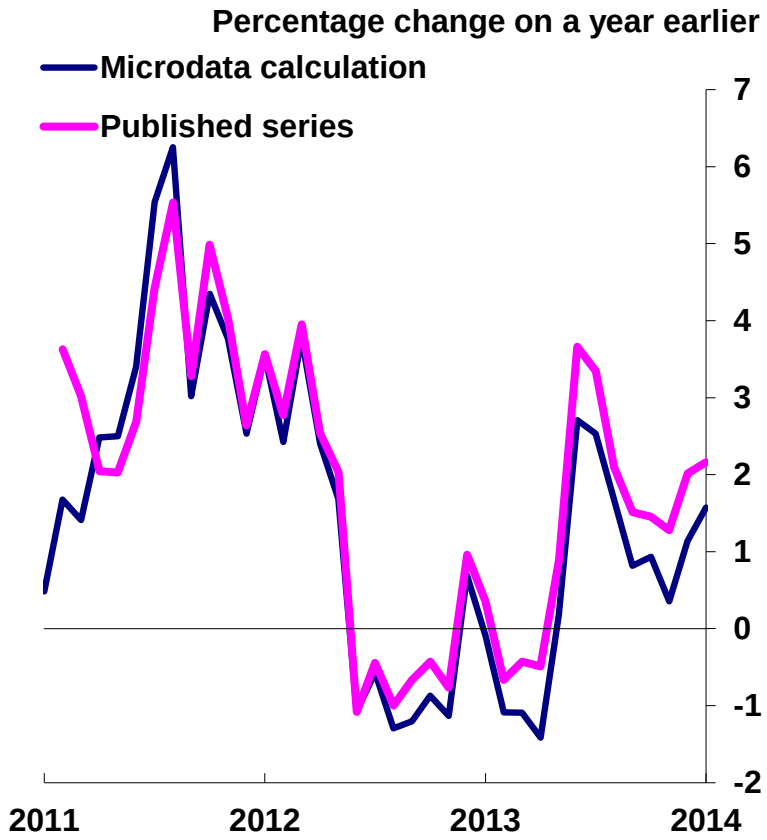
$$price\_rel^{t}_{shop} = \frac{price^{t}_{shop}}{Imputed\ base\ price_{shop}}$$

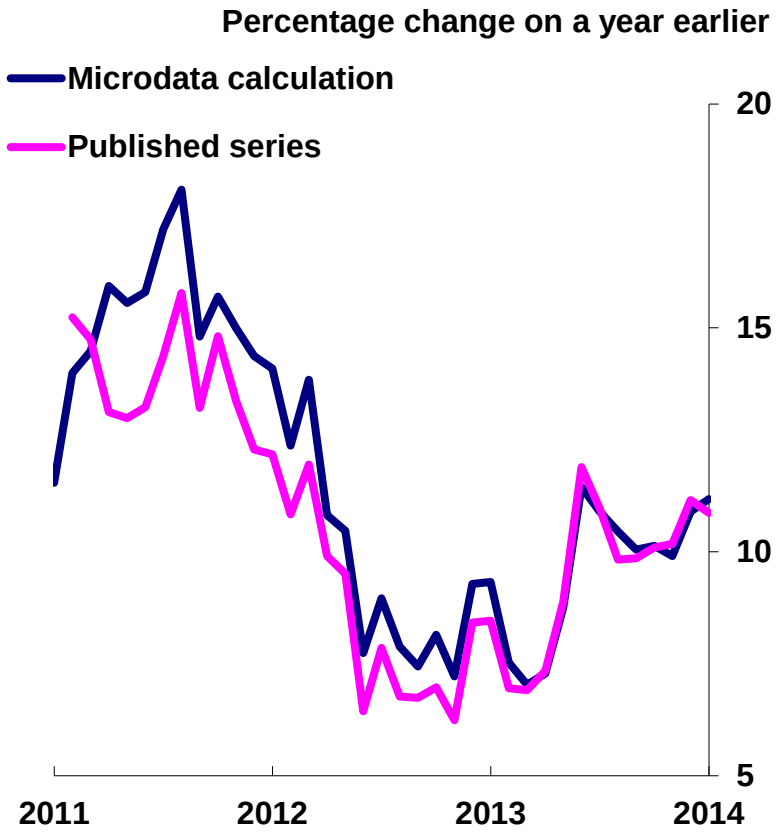
$$price\_rel^{t}_{shop} = \frac{price^{t}_{shop}}{Jan\ base\ price_{shop}}$$

$$ln(EA^{t}_{CPI}) = \sum_{shop=1}^{n} w_{shop} * ln(price\_rel_{shop})$$

$$EA^{t}_{CPI} = \sum_{shop=1}^{n} w_{shop} * price\_rel_{shop}$$

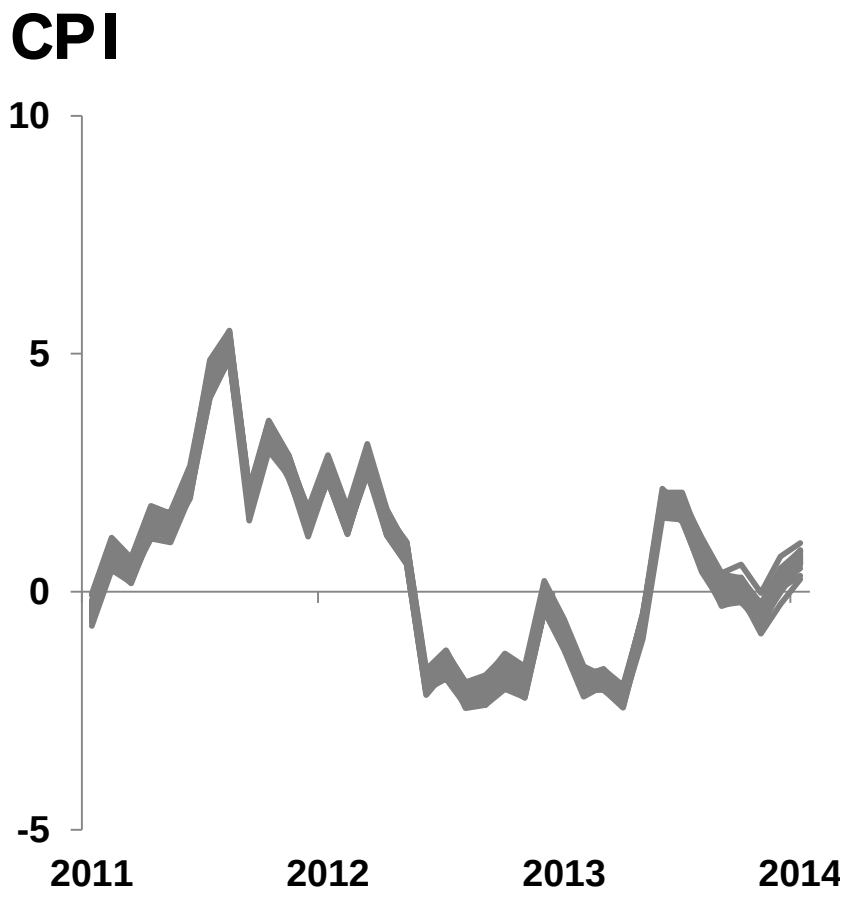
Baseline check: *p(N) = 0*

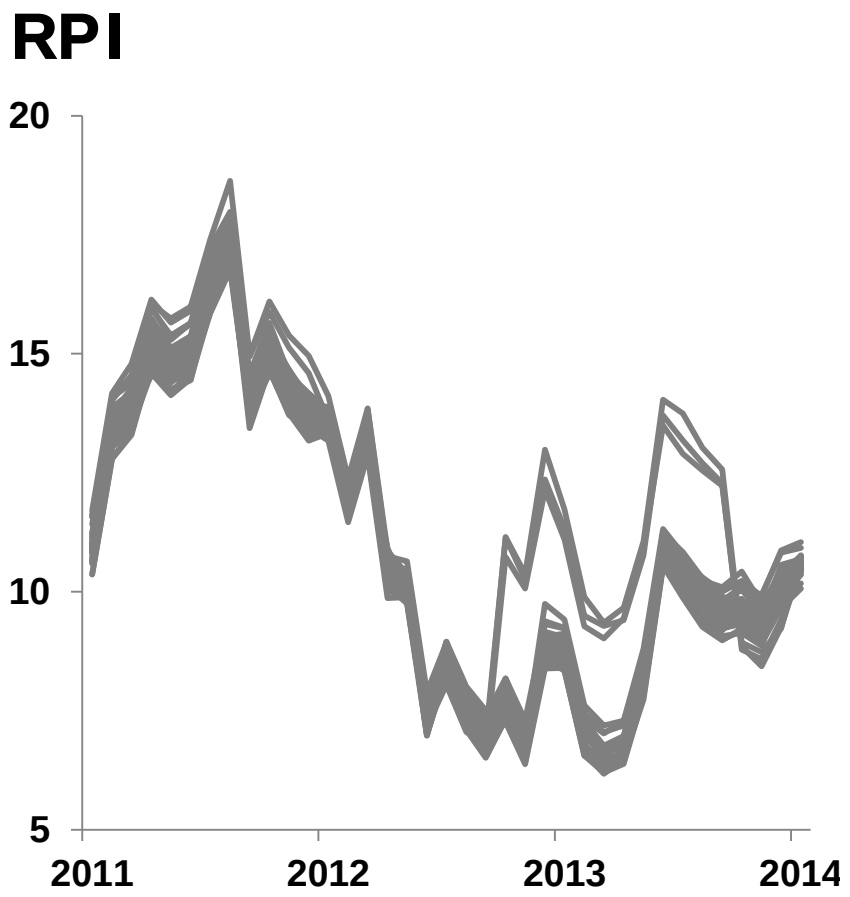




- **Close enough.**
- **(No seasonal items, CPI imputation & some missing quotes.)**

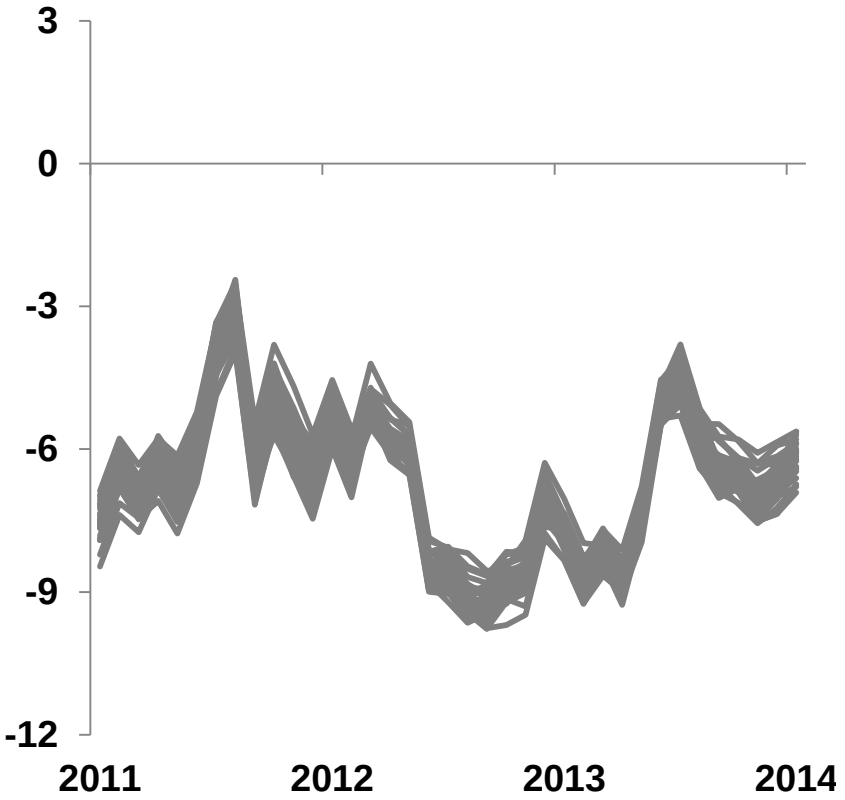
Simulation: *p(N) = 0.05*



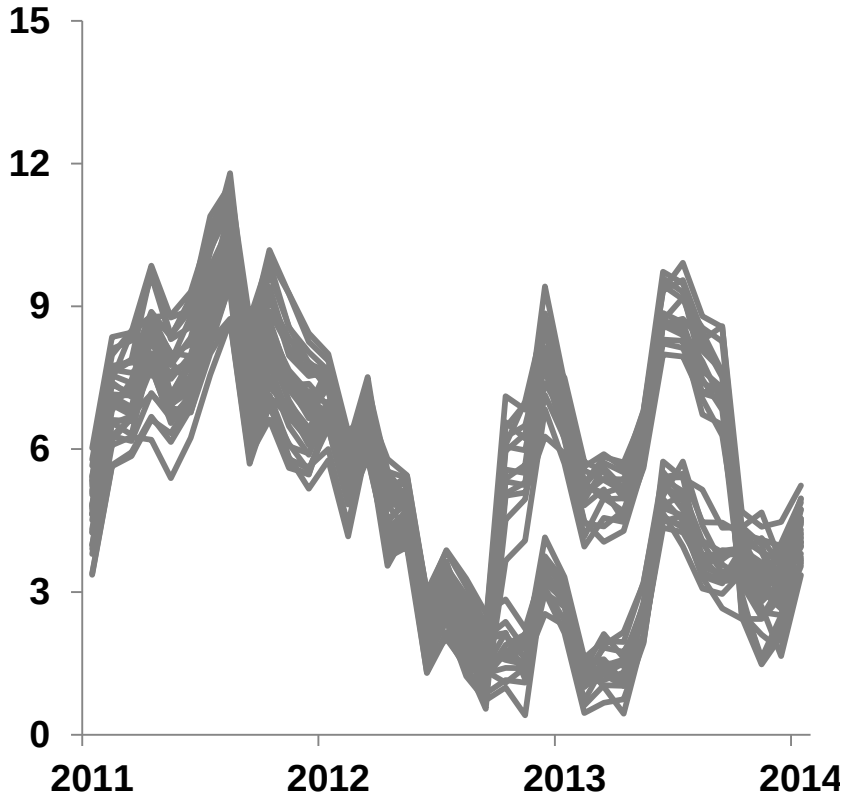


Simulation: *p(N) = 0.40*

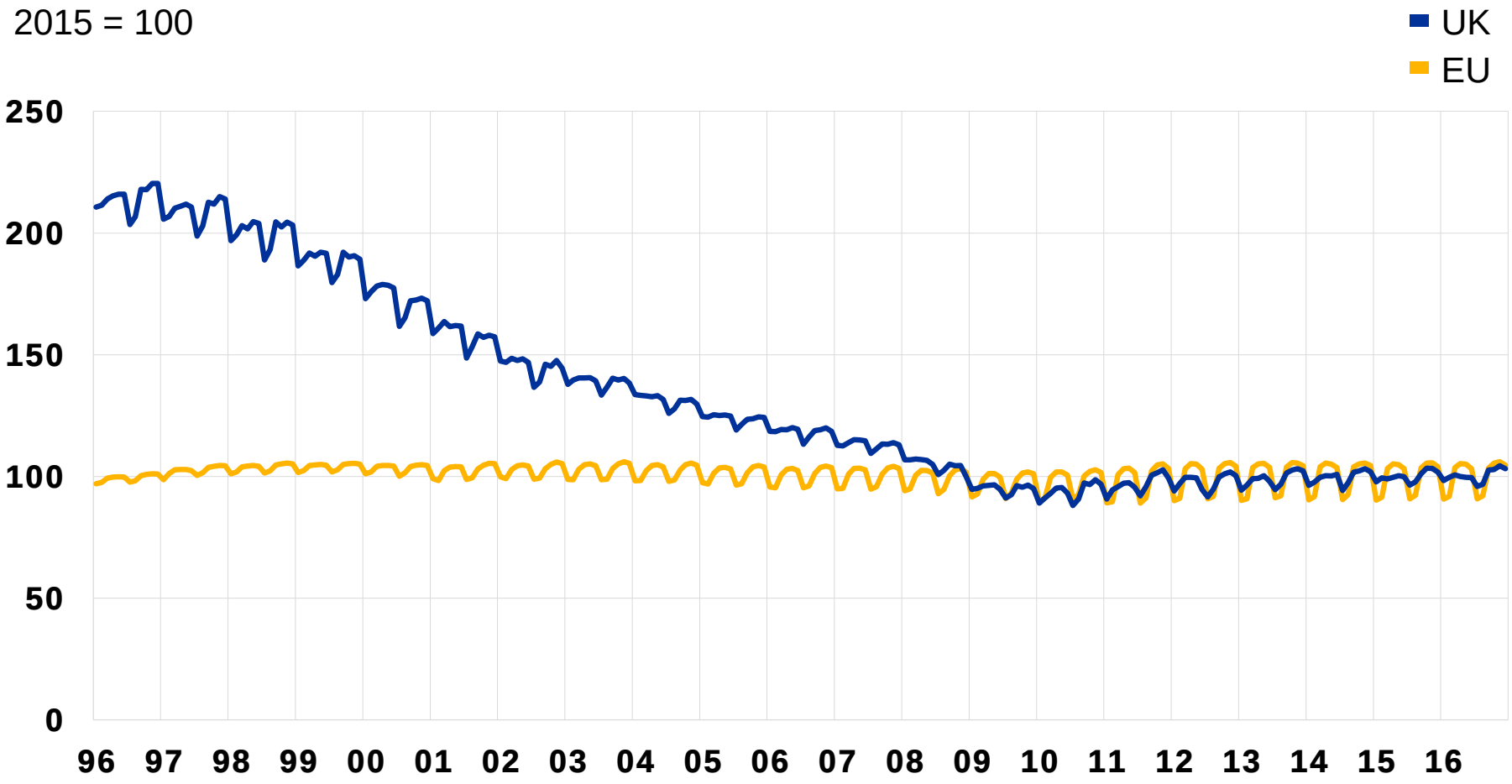
CPI



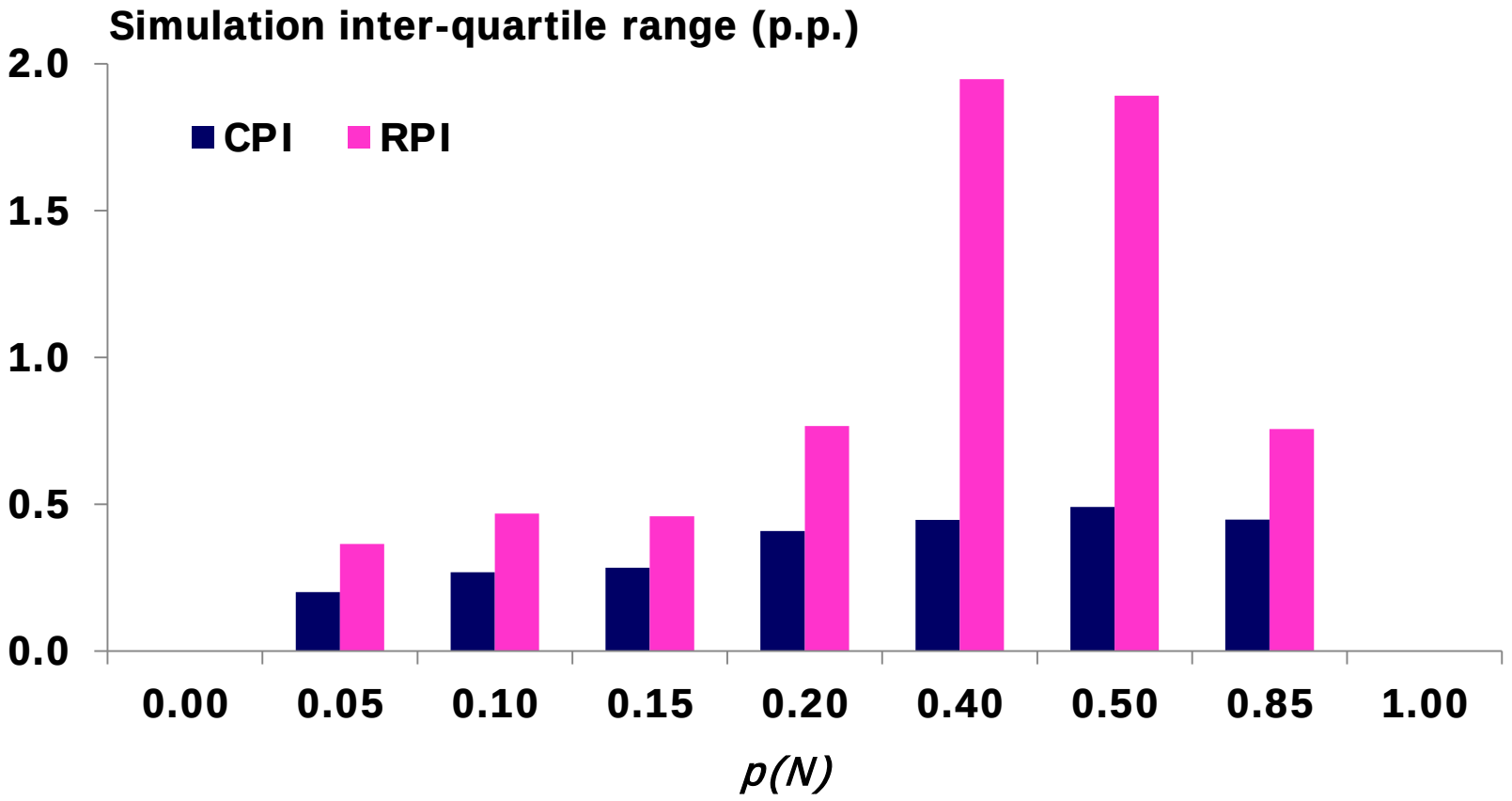
RPI



UK and EU HICP Garments



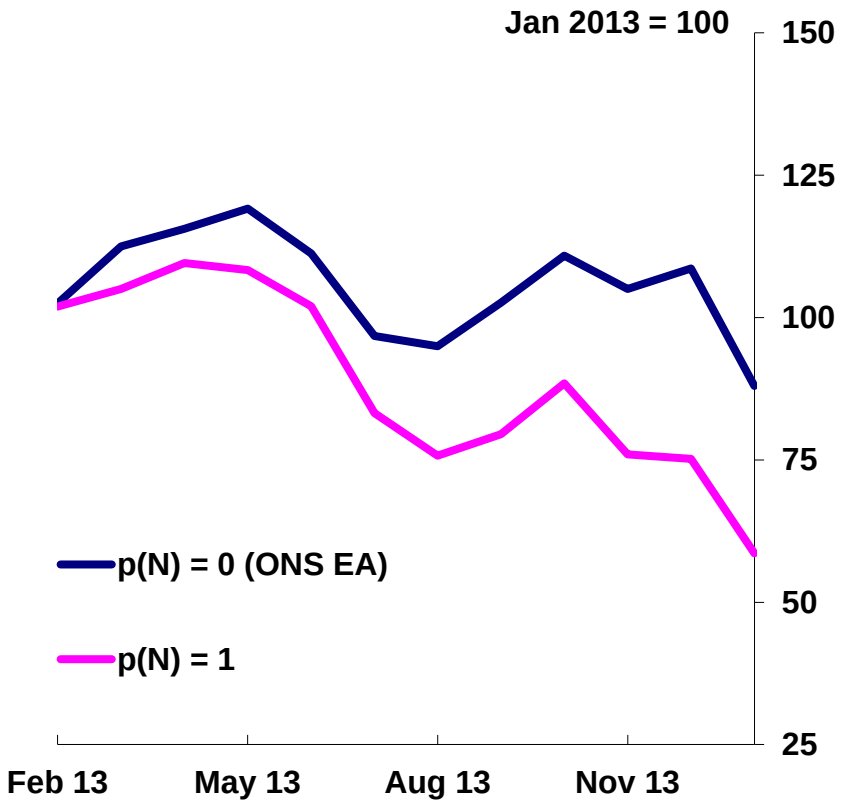
Summary of inter-quartile ranges



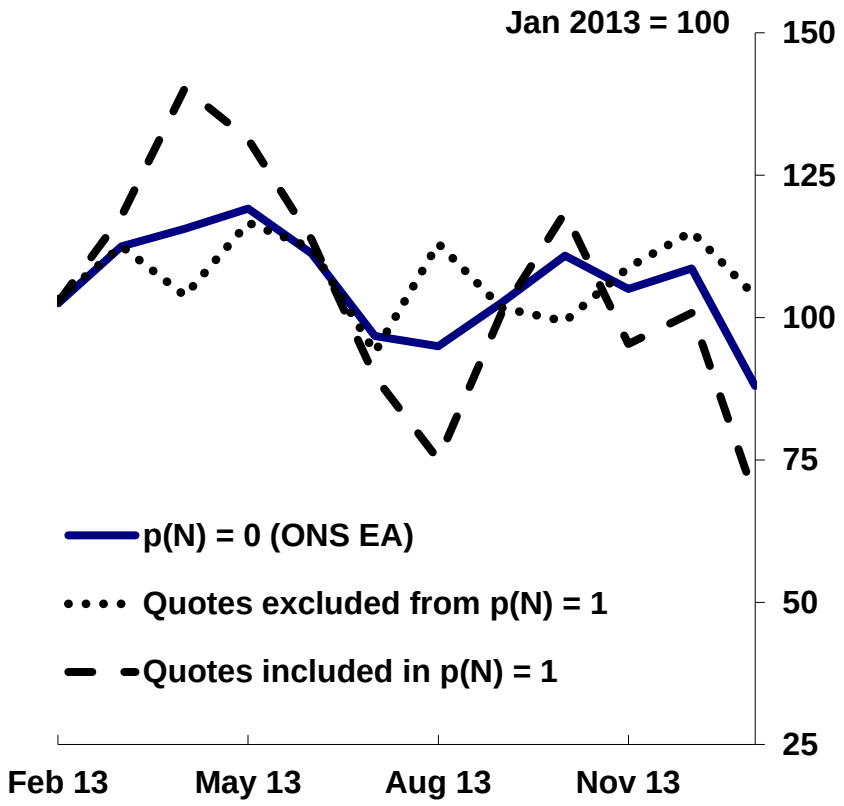
- **Absolute spread of RPI simulations wider than CPI.**
- **Bifurcation in RPI results prominent.**

Inflation decreasing with p(N)?

In-year indices, 510244_2

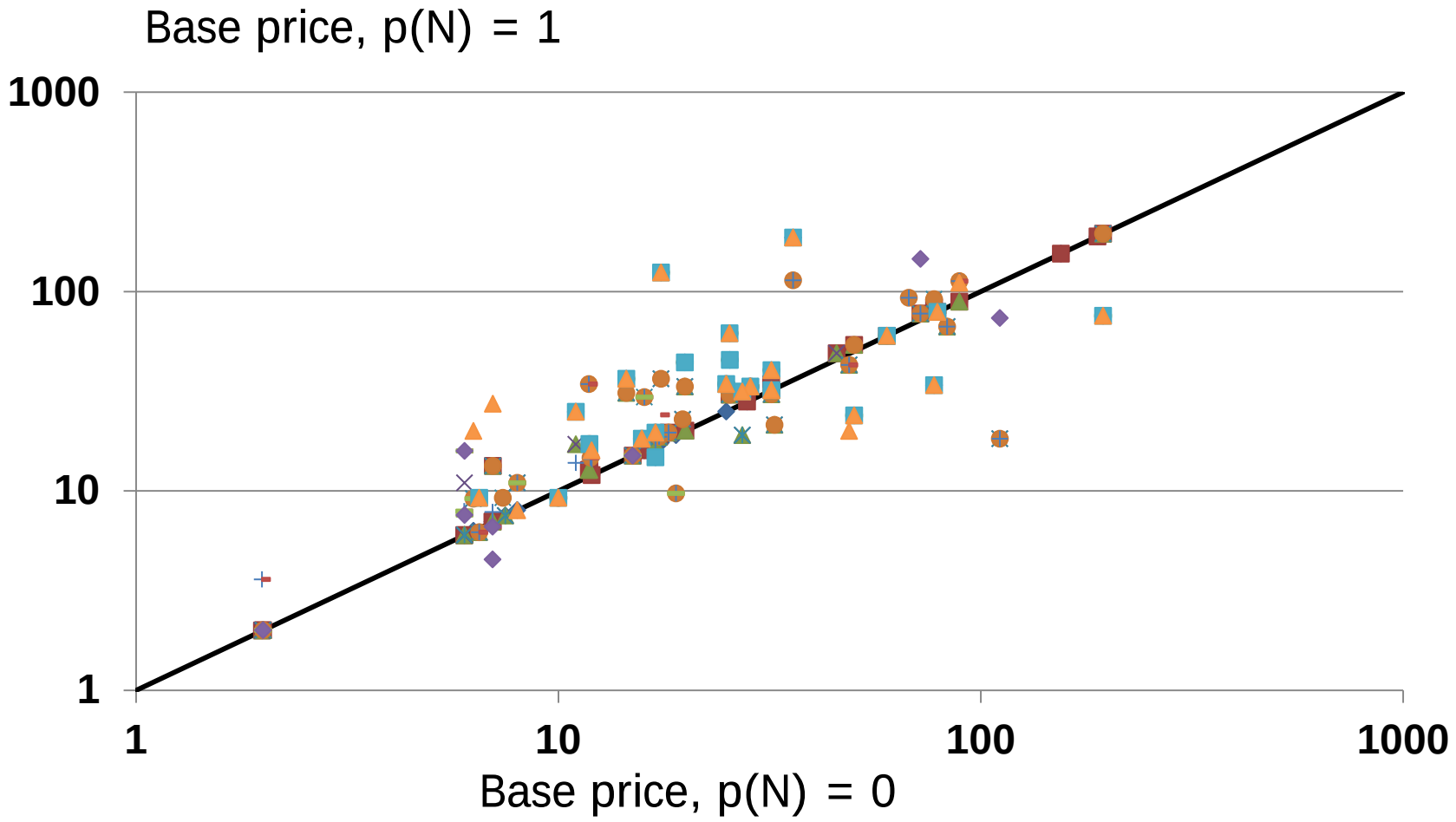


Compositional effect



- **Approximately 2/3 of quotes no longer used.**

Inflation decreasing with p(N)?



- **For quotes common to p(N)=0 and p(N)=1 calculations, base price tends to be increased: lower price relatives.**

Headlines

- **Clothing central to the RPI/CPI formula debate.**
- **The challenge is the inevitable product replacement - the price comparison is no longer vs same product.**
- **In the face of uncertainty over genuine comparability, the geometric average (CPI) is more robust than the arithmetic average (RPI).**
- **This sector would benefit particularly from a much larger sample - perhaps new sources and methods.**