ADVISORY PANEL ON CONSUMER PRICE STATISTICS – STAKEHOLDER

Context of Consumer Prices

Purpose

1. The paper outlines the context of consumer prices in the UK at present and is designed as training material for the advisory panels.

Recommendations

2. Members of the Panel are invited to:
   a) read the slides provided in annex A. These provide an introduction to Consumer Price Statistics in the UK and details the processes involved in producing Consumer Price Statistics
   b) prepare any questions they have regarding the presentation. There will be a very brief opportunity to ask any urgent questions of clarification at the first joint meeting of the panels. Other questions should be directed to the secretariat for each panel (Richard Campbell for the stakeholder panel, Ainslie Woods for the technical panel) via cpi@ons.gsi.gov.uk

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Prices Division, Office for National Statistics
November, 2015

List of Annexes

Annex A	APCP-S(15)01 Annex A: Consumer Prices presentation

Office for National Statistics

Consumer Price Statistics

Training material for the Advisory Panels on Consumer Prices

Overview

- PART 1: Introduction to consumer price inflation statistics (CPI, CPIH, RPI & RPIJ)
- PART 2: Producing consumer price inflation statistics

Office for National Statistics

PART 1

Introduction to consumer price inflation statistics

The Inflation Figures

- **CPI** - Consumer Prices Index
- **CPIH** - measure of consumer price inflation including owner occupiers' housing costs (OOH)
  - CPIH uses an approach called rental equivalence to measure OOH. Rental equivalence uses the rent paid for an equivalent house in the private sector as a proxy for the costs faced by an owner occupier.
- **RPI** - Retail Prices Index
- **RPIJ** - a variant of the RPI which is calculated using formulae that meet international standards

CPI & CPIH

CPI

- First introduced in 1996 as the Harmonised Index of Consumer Prices (HICP)
- Standards of construction and continuous improvement via European legislation
- Rapidly established its position of prominence

CPIH

- Established 2013 following many years of developing OOH
- Independent measure of inflation but constructed in the same way as the CPI
- National Statistics Status cancelled in 2014 and subsequent revisions in early 2015
- National Statistics re-assessment is in progress

RPI & RPIJ

RPI

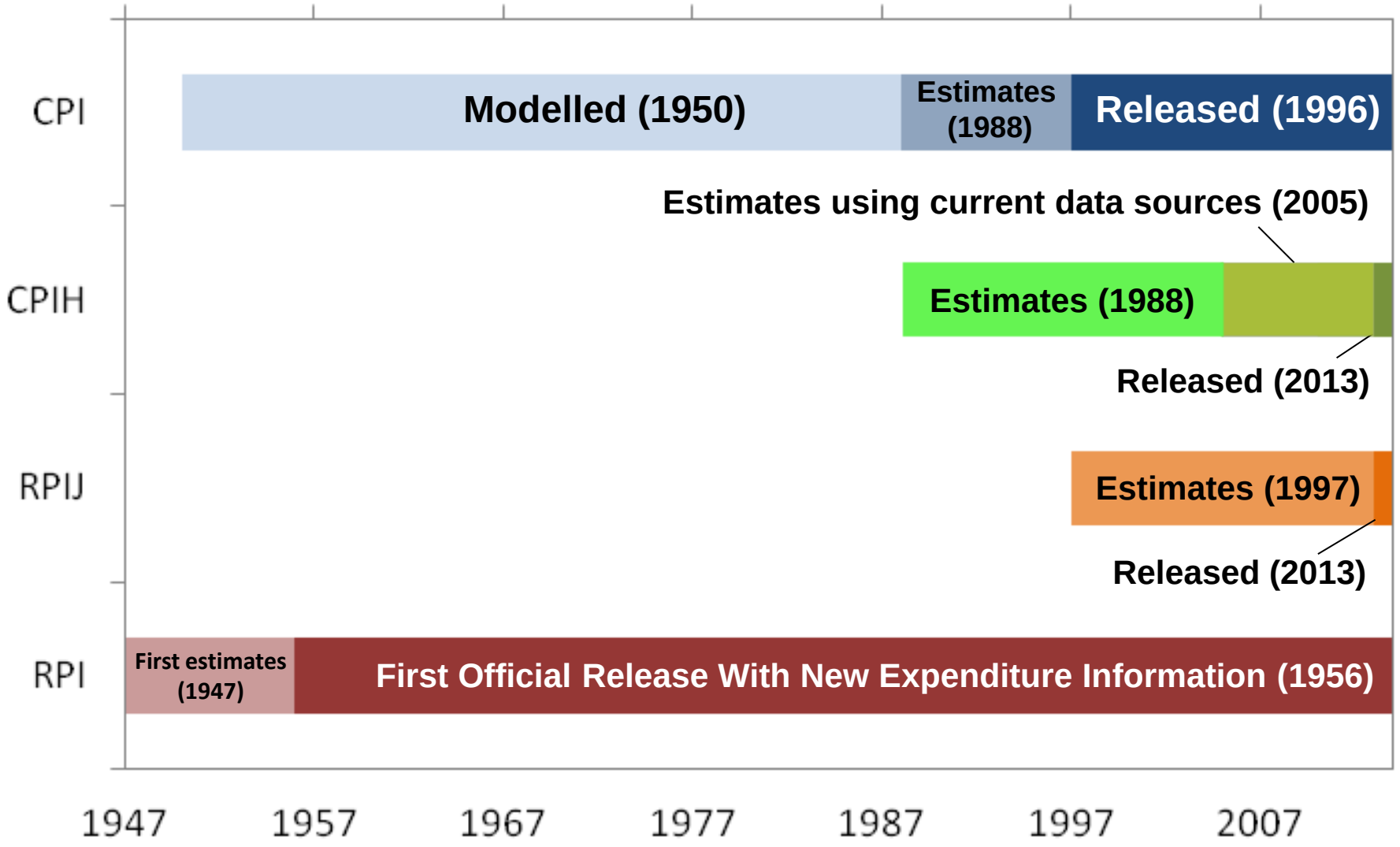
- Established June 1947[1] on an interim basis with first full RPI published in January 1956
- Uses include:
  - Index linked gilts
  - National Savings and Investments Index-linked savings certificates
  - Regulate charges e.g. rail, water and sewerage
  - (some) Private sector pensions funds
- National Statistics status cancelled in March 2013

RPIJ

- Established March 2013 following a consultation on options for changing the RPI
- Calculated using formulae that meet international standards
- Gives users a better alternative to the RPI and allows uses to see the impact of using different formulae
- National Statistic status awarded December 2013

[1] Before this calculated a Cost of Living Index 1914-1947

Time Series


CPI
Modelled (1950)
Estimates (1988)
Released (1996)
Estimates using current data sources (2005)
CPIH
Estimates (1988)
Released (2013)
RPIJ
Estimates (1997)
Released (2013)
RPI
First estimates (1947)
First Official Release With New Expenditure Information (1956)
1947
1957
1967
1977
1987
1997
2007

Common attributes

- Fixed basket price indices
  - Reviewed and updated annually, additions in 2015 included: E-Cigarettes, Music Streaming Subscriptions, Speciality Beer/Ale
  - Annual chainlink
- Monthly price collection
  - Some products measured less frequently
- Same basic price data
- Common exclusions from the baskets
  - Savings & investment, cash gifts, gambling & prostitution
- Plutocratic weights
  - household contributes to the weights proportionally to its expenditure

Fixed basket (base weighted) price indices

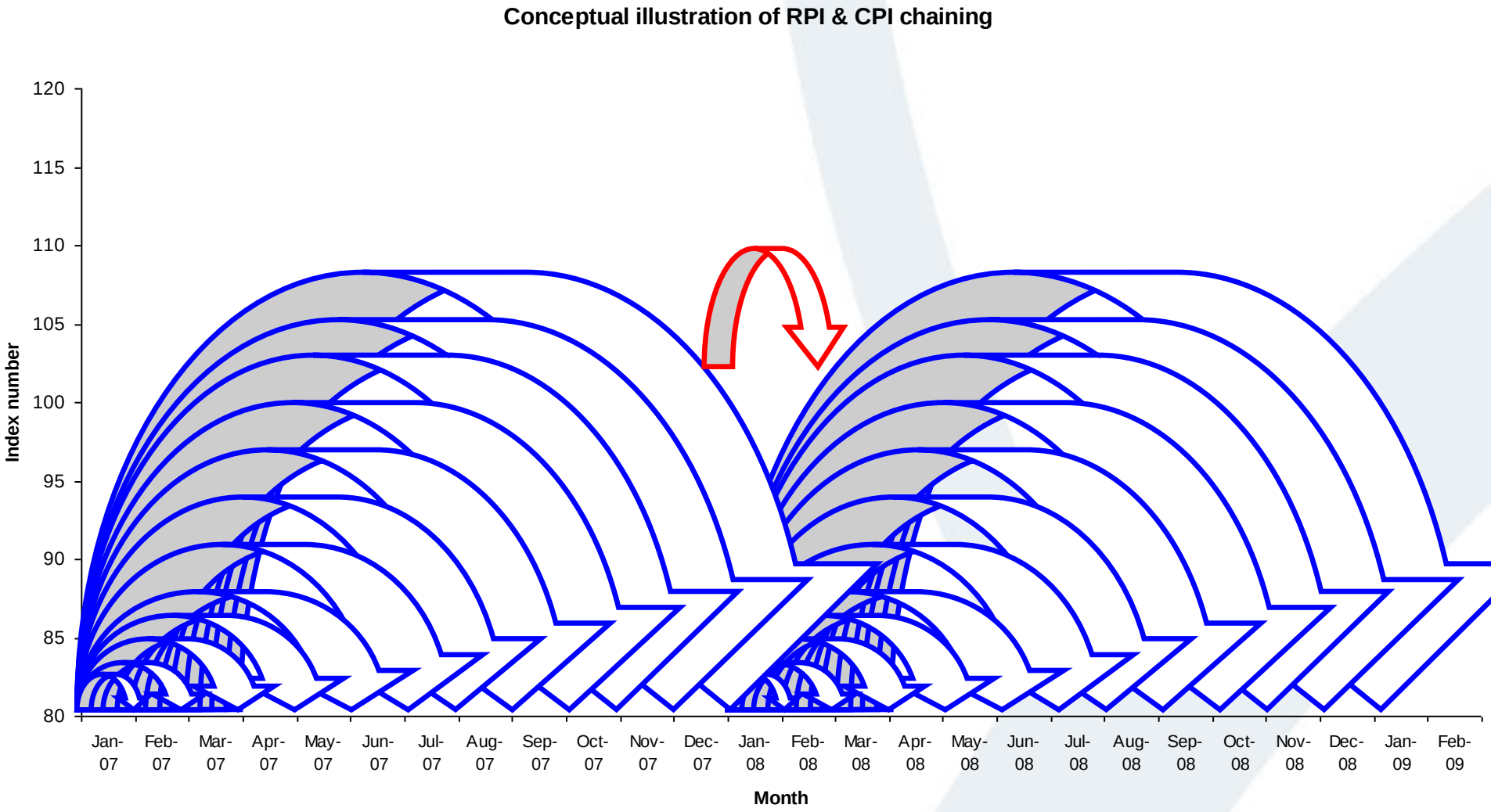
$$I_{Lowe}^{0:t} = \frac{\sum_{i=1}^{n} p_i^t q_i^b}{\sum_{i=1}^{n} p_i^0 q_i^b} \times 100$$

- Laspeyres type price index
  - Not strictly Laspeyres, since price reference period is usually January of the current year, where the expenditure data (and hence quantities) come from two years earlier
  - Index updated for February 2015 uses expenditure data from 2013

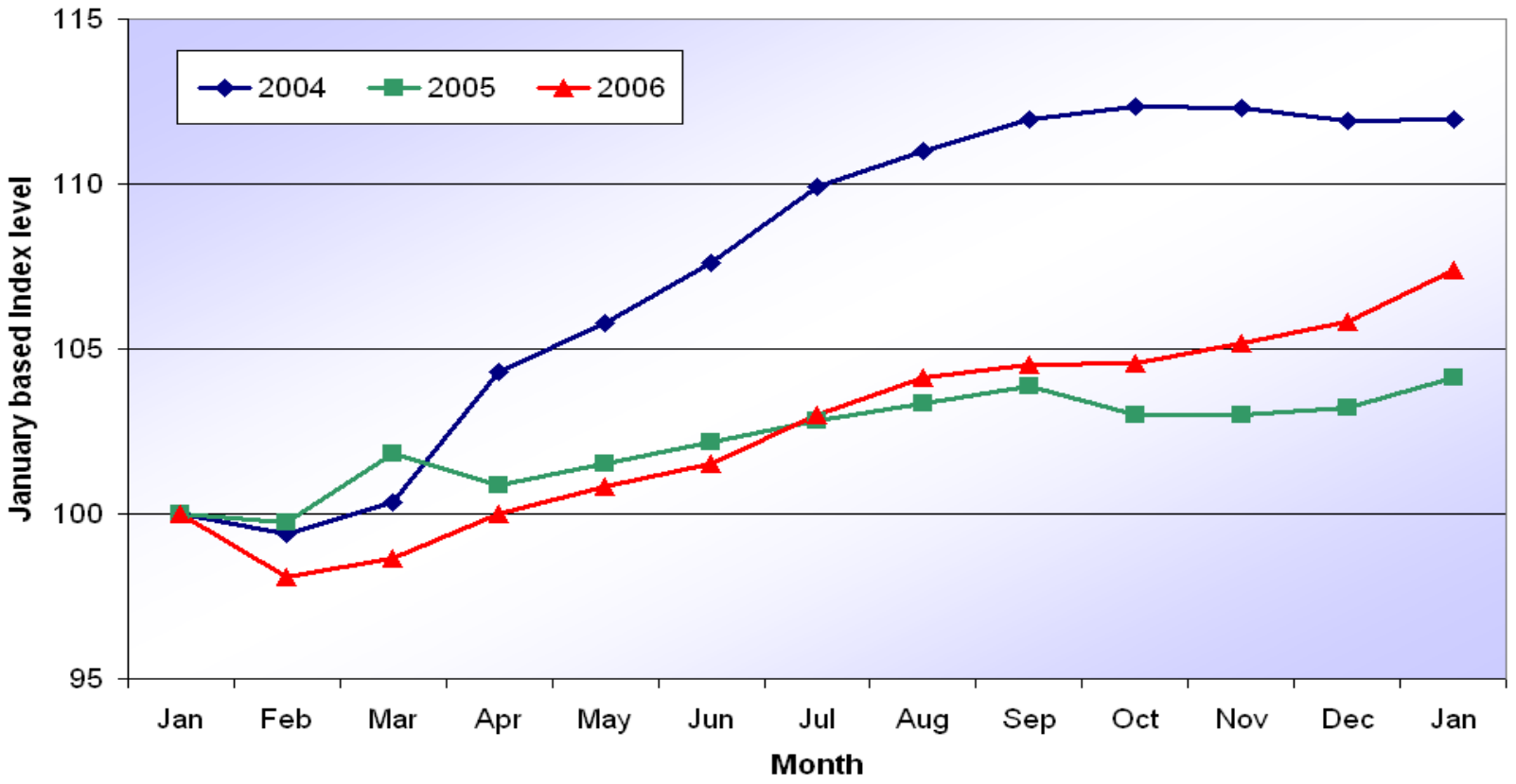
Annual chain link

- Indices linked each year to provide long term measure of price change
  - 12 direct “within year” indices, linked each January

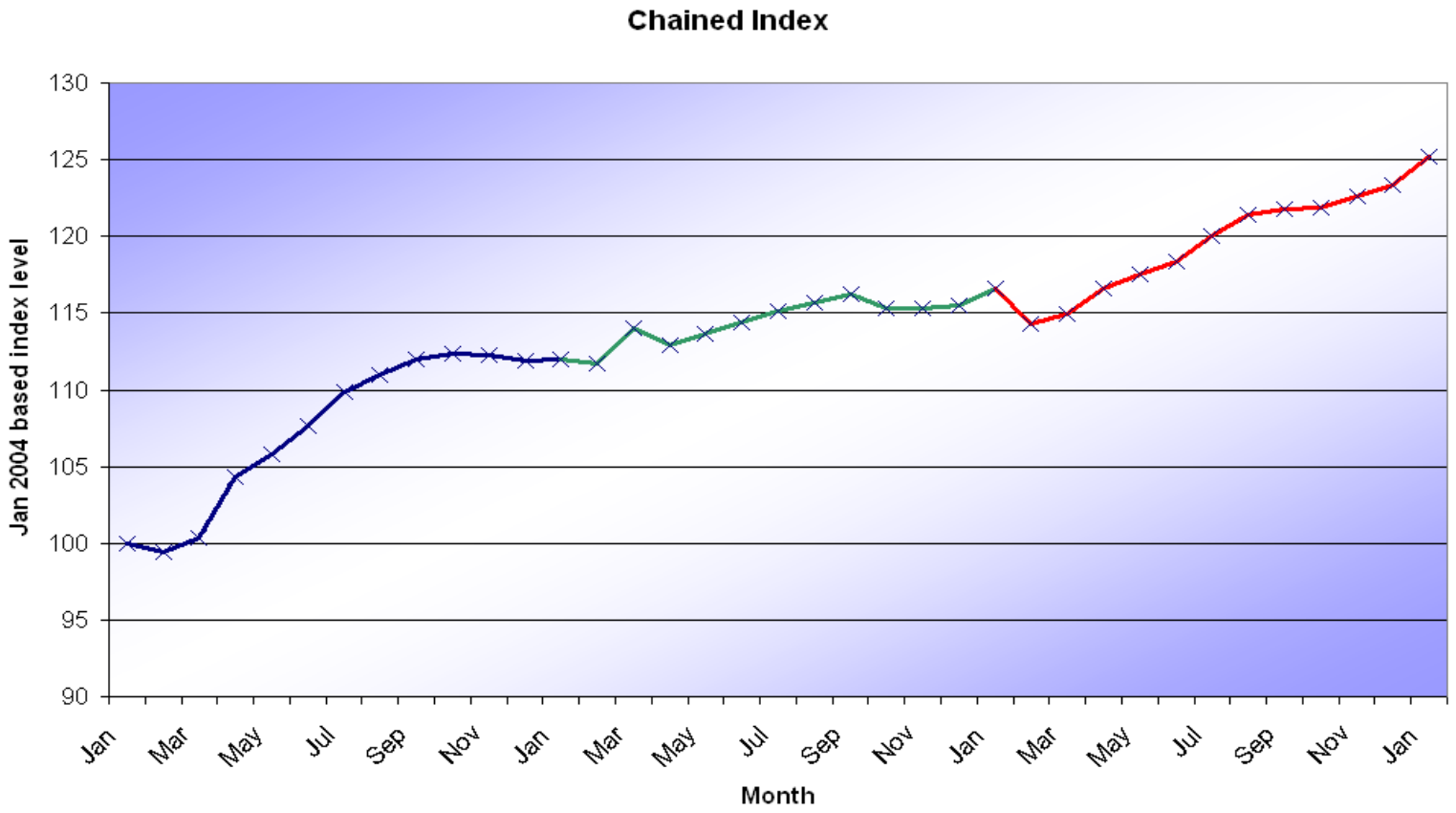
Chaining in the RPI & CPI



Chain linking – within year indices



Chain linking – linked index



Annual updating of the baskets

- Update expenditure data used for weighting
- Allows introduction of new goods & services
  - 2015 – Speciality Beer/Ale
  - 2014 – Video streaming services (such as LoveFilm or Netflix)
  - 2013 – eBooks
- Ensures price sample and weighting pattern remains representative of consumption activity
  - Outlets
  - Goods and services consumed
  - Relative levels of expenditure

Differences - Population base

RPI & RPIJ	CPI & CPIH
• Including UK private households • Excluding top 4% of highest income households • Excluding pensioner households that receive more than three quarters of their income through state benefits	• Including all UK private & institutional households • Including foreign visitors to the UK

Differences - Commodity coverage

RPI & RPIJ	CPI
• Including owner occupiers' housing costs (mortgage interest payments, depreciation, buildings insurance and council tax) • Excluding university accommodation fees, foreign students' university tuition fees, unit trust & stockbrokers' charges	• Including university accommodation fees, foreign students' university tuition fees, unit trust & stockbrokers' charges

- CPI – excludes owner occupiers' housing costs
- CPIH – includes owner occupiers' housing costs measured using the rental equivalence approach

Differences - Classification Structure

- CPI & CPIH use COICOP
  - Classification of Individual Consumption According to Purpose
  - Adapted by the EU for the HICP
  - Based on UN classification
  - Compliant with ESA10

- RPI & RPIJ use an in-house product classification derived in part from Living Costs and Food Survey (LCF)

CPI Aggregation Structure

All Items CPI	
Division	e.g. Furniture, Household Equipment and Maintenance
Group	e.g. Furniture, Furnishings and Carpets
Class	e.g. Carpets and Other Floor Coverings
Item	e.g. Carpet per square metre
Stratum	e.g. Item in south-east
Matched pair (quote and base price)	Price of item in particular location & shop

RPI Aggregation Structure

All Items RPI	
Group	e.g. Household goods
Section	e.g. Furnishings
Item	e.g. Carpet per square metre
Stratum	e.g. Item in south-east
Matched pair (quote and base price)	Price of item in particular location & shop

Differences - Transaction coverage

- CPI & CPIH aims to measure prices throughout the month
  - At least a week, more broadly for some items
    - Petrol
    - Pilot currently ongoing for fresh fruit & vegetables
- RPI & RPIJ measures prices on “index day”
  - Generally second Tuesday

Differences – Expenditure/Weighting data

- RPI & RPIJ use expenditure data from the Living Costs and Food Survey
  - Updated for the Jan-to-Feb price index each year

- CPI & CPIH use data from the UK national accounts
  - Household Final Monetary Consumption Expenditure
  - Updated for the Dec-to-Jan price index each year (Eurostat regulation)
  - This data is used because the expenditure information is comprehensive, and balanced against data collected in other sectors of the economy

Differences - Index Reference Period

- CPI & CPIH = 100 for the average of the 2005 calendar year
  - Will be rebased to 2015 = 100 in January 2016

- RPI & RPIJ = 100 at January 1987

Differences - Elementary aggregate formulae

- Elementary aggregate - lowest level of aggregation
- Adequate expenditure (or quantity) data not available within the elementary aggregates
  - E.g. No weighting information to combine prices collected for item ‘Lager, 4 bottle’
- Construct elementary aggregate price index using some equally weighted average, of prices, or price relatives
- Many possible solutions to this issue

Dutot..

- ..or Ratio of Average (RA) price index
- Ratio of average prices from the current and base periods
- Require products to be homogeneous ***in price***
  - e.g. inappropriate for musical instruments
    - average of the price of a recorder and a grand piano?

Dutot

$$I_{RA}^{0:t} = \frac{\frac{1}{n}\sum_{i=1}^{n} p_i^t}{\frac{1}{n}\sum_{i=1}^{n} p_i^0} \times 100$$

Carli..

- ..or Average of Relatives (AR) price index
- Average of price relatives for all items in the price basket
- Upward bias when chain linked in the presence of price bouncing
  - Chain drift

Carli

$$I_{AR}^{0:t} = \frac{1}{n} \sum_{i=1}^{n} \frac{p_i^t}{p_i^0} \times 100$$

Jevons..

- ..or Geometric Mean (GM) price index
- Geometric mean of price relatives for all items in the price basket …

  … and simultaneously …

- … the Ratio geometric mean of current period prices to geometric mean of base period prices
- Not suitable if zero prices possible! (but there are ways to work around)

Jevons

$$I_{GM}^{0:t} = \left(\prod_{i=1}^{n} \frac{p_i^t}{p_i^0} \right)^{\frac{1}{n}} \times 100$$

$$= \frac{\left(\prod_{i=1}^{n} p_i^t \right)^{\frac{1}{n}}}{\left(\prod_{i=1}^{n} p_i^0 \right)^{\frac{1}{n}}} \times 100$$

Relationships between equal weighted indices

- All indices give same result if all prices change by the same proportional amount
- Carli (AR) and Dutot (RA) give the same result if all base period prices are the same
- Carli (AR) ***always*** greater than or equal to Jevons (GM)
- Dutot (RA) and Jevons (GM) are transitive
  - Chained and direct indices give the same result

Example of different formulae

	Price (£)				Price index (Jan=100.0)		
Month	Item 1	Item 2	Item 3	Item 4	RA	AR	GM
Jan	1.00	1.35	1.25	3.18	100.0	100.0	100.0
Feb	1.05	1.35	1.50	3.25	105.5	106.8	106.5
Mar	1.07	1.28	1.50	3.33	105.9	106.6	106.3
Apr	1.15	1.35	1.50	3.65	112.8	112.4	112.2
May	1.29	1.40	1.95	4.10	128.9	129.4	128.1

Differences - Elementary aggregate formulae

	RPI	RPIJ	CPI & CPIH
Carli	27%	0%	0%
Dutot	29%	29%	5%
Jevons	0%	27%	63%
Other/weighted formula	43%[1]	43%	33%

- For a given elementary aggregate:

$$RPI \geq CPI$$

The use of these different formulae causes the 'formula effect' between the CPI and RPI

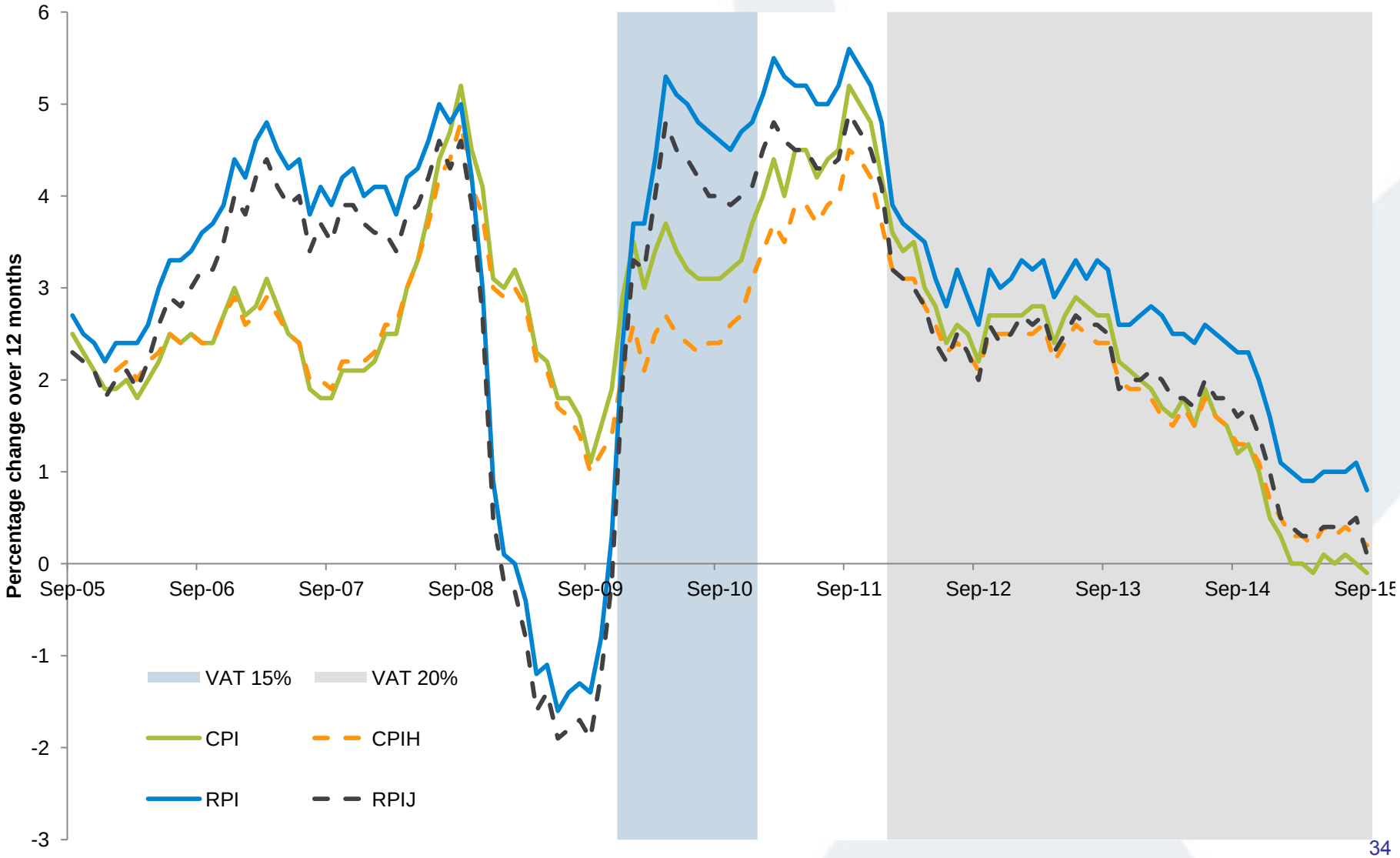
[1] The main reason for the higher figure in RPI and RPIJ is the formula used in calculating Mortgage Interest Payments (MIPS) and Housing Depreciation.

Differences – Other

- Treatment of insurance
  - CPI & CPIH: Expenditure on insurance premiums is distributed among other expenditure categories according to the nature of the claim. Only the service charge is allocated to the relevant insurance heading.
  - RPI & RPIJ: All expenditure on insurance is considered to belong to the relevant insurance heading (e.g. housing or motor insurance premiums).

- Rounding
  - CPI & CPIH: Rates of change calculated using unrounded indices
  - RPI & RPIJ: Rates of change calculated using rounded indices

Annual rates of change – last 10 years



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PART 2

Producing consumer price inflation statistics

How do we produce the 4 indices?

- Common price collection
- Re-use of price ***samples*** wherever possible
- Same elementary aggregate **price sample** produces different elementary aggregate (“item level”) ***price indices***
- Common sample collection, quality adjustment, sample maintenance, imputation
  - For the most part

An immediate hurdle – annual update!

- RPI & RPIJ updates weights in February
- CPI & CPIH updates weights in January
- Common “basket of goods and services” updated in February
- CPI & CPIH requires “double chain link”
  - COICOP class level and above in January
  - Elementary aggregates in February
    - Implemented to comply with EU regulation

Sample design – mechanism for managing price collection

- Stratification can be by
  - region
  - shop type (multiple/independent)
  - region and shop type
  - None (national)
- Varies by group of product
  - “Airfares” different from “loaves of bread”
- Consequential impact on weights of EAs to higher level aggregates
  - If an item sells more in the NE than in the SW, price changes for that item in the NE will have a greater effect on the index than similar price changes in the SW

The monthly price sample

- 180,000 individual price transactions observed per month
  - Prices collected on 2nd or 3rd Tuesday of month
  - Published within 3 weeks of end of month of collection (usually 3rd Tuesday)
- Joint strategy
  - Local price collection (100,000 prices)
  - Central price collection (80,000 prices)
- Need to ensure same rules and procedures are used throughout

Local price collection – in the field

- External (3rd party) contractor collects prices throughout UK
  - 141 locations
    - And then outlets within each location, and products within outlets
  - Locations “back-checked” at random by ONS auditors
  - Vast number of shops including both multiple and independent type

- Collection done using handheld computers
  - Data punched in the field, some edit checks applied, facility to record metadata

Central collection – ONS office staff

- **Central shops** collection
  - certain large stores operate central pricing policy
  - one price is replicated throughout country
  - tend to be from large chains

- Other central collection
  - ONS staff collect prices via the internet; e-mail; and telephone:
    - services e.g. utility prices, air fares; and
    - goods e.g. computers, digital cameras

Comparable items

- When an item is no longer available, a comparable item is sought
  - not significantly different from original item
  - maybe a colour change
  - so similar that there is no perceived quality change
  - should **never** be chosen because of a similar price
- A comparable item retains the original item's base price as it is sufficiently similar

How to choose a comparable item

- Aside from price and indicator codes, collectors record three lines of description on items
- Includes material, colour, country of origin, distinguishing features, etc.
- Necessary to allow re-pricing of an identical item next month…
  - …or select a comparable item if it again changes

Non-comparable items

- A non-comparable item is selected only where both the original item and a comparable item are unavailable
  - this item does not continue the price series of the item it replaces
    - “series break” for the individual product
  - nevertheless it should be as close to the previous item as possible
    - And representative of expenditure within the elementary aggregate

Non-comparable items

- So how does the new item enter the index?
- A new base price needs to be constructed for the new (incoming) item…
  - … because there is a perceived **quality difference** between this item and the one it replaces
- Marking an item as ***non-comparable*** is saying there has been a ***quality change***
- The issue is now one of ***quality adjustment***
  - And in practice, quality adjustment involves determining the base period price for the incoming item

Types of quality adjustment

- Implicit
  - No quality change
    - Note that marking a replacement item as “Comparable” is literally saying “quality change is zero, all variation is due to price”
  - “Class mean” family of imputation
- Explicit
  - Quantity adjustment (“Packet size change”)
  - Option cost
  - Hedonics

Class mean imputation

- "The market knows best"
- Impute the base price of the incoming item based on the movement of the rest of the sample since the base period
  - Any difference from the base price of the outgoing item is then the implicit quality change

Class mean imputation: example

Month	Base price (£)	Current period price (£)	Price index for entire EA (valid prices)
Jan	7.50	7.50	**100.0**
Feb	7.50	7.50	**100.4**
Mar	7.50	7.65	**100.9**
Apr	7.50	7.90	**102.1**
May	7.50	7.80	**103.0**
Jun	7.50		**103.2**
Jul	?	11.45	**103.6**

In July a non-comparable replacement needs to be made. We therefore need to impute a base price:

$$I^{Jan:Jul} = 103.6$$

$$p_i^{Jul} = 11.45$$

$$\hat{p}_i^{Jan} = p_i^{Jul} \times \frac{100.0}{I^{Jan:Jul}}$$

$$= 11.45 \times \frac{100.0}{103.6}$$

$$= 11.05$$

- Imputed base price for incoming item of 11.05
  - ***Implied quality change*** of 11.05-7.50=3.55
- 11.05 is base price for July onwards

Example - quantity adjustment

- Linear relationship
  - Between quantities for OLD and NEW quantities

- Assume ratios between NEW and OLD quantities gives difference in period 0 prices

$$g = \frac{u_{NEW}}{u_{OLD}}$$

$$\hat{p}^{0}_{NEW} = g \times p^{0}_{OLD}$$

$$= \frac{u^{NEW}}{u^{OLD}} \times p^{0}_{OLD}$$

Example - Mars Bars!

- Aug-08 Mars Bar weighed 62.5 grams
- Sep-08 Mars Bar weighed 58 grams
- Jan-08 (period 0) price for 62.5 gram bar was £0.40
- Jan-08 price for 58 gram bar was £0.37

$$u_{OLD} = 62.5 \ grams$$

$$u_{NEW} = 58 \ grams$$

$$g = \frac{u_{NEW}}{u_{OLD}}$$

$$= \frac{58}{62.5}$$

$$p_{OLD}^{Jan-08} = £0.40$$

$$\hat{p}_{NEW}^{Jan-08} = g \times p_{OLD}^{Jan-08}$$

$$= \frac{u_{NEW}}{u_{OLD}} \times p_{OLD}^{Jan-08}$$

$$= \frac{58}{62.5} \times £0.40$$

$$= £0.37$$

Example - Hedonic quality adjustment

- Very diverse field, many different mechanisms for application, with different interpretations of results
- ONS approach is that the hedonic regression is purely an **empirical tool**
  - summarising the different value that consumers place on the combination of different characteristics in a complex good
- Applied for PCs, laptops, smartphones & Tablet PCs
- Used for digital cameras and PAYG mobile phones until 2013

Validation Processes

- To check for incorrect prices, various data checks are carried out
- Checks at point of recording price
- Min/max price levels for each item
  - picks out some miskeyed prices, ie where an extra “0” has been entered
- Analysis of price movements
  - range of valid price changes set for each group of items

Validation Processes

- Tukey algorithm
  - outlier detection process
- Dispersion prints
  - lists counts of price ratios in different ranges
- “Q” codes examination

Validation

- “Howler hunt” [final check]
  - all extreme indices checked
  - all price quotes within these indices checked
- Prices failing these checks and not subsequently validated by ONS staff are excluded from the index
  - Price relative effectively imputed as class mean

Public perceptions

- Perception that the inflation rate should be higher/lower
- Some argue that consumer price inflation statistics do not reflect the movement of prices in ***their*** shopping basket
  - e.g. a pensioner with state pension as main income may spend relatively more on food and heating costs
- The basket is an average
  - And like many averages, differs from each individual
    - Who uses Coal, Wood, Electricity ***and*** Gas for heating?

Legislation

- By law The UK Statistics Authority must produce the RPI
- It is a Eurostat requirement to produce the CPI
  - If deemed to be non compliant, liable for significant fines (in the hundreds of thousands) for each day, until compliance is restored

Cost of living indices

- CPI, CPIH, RPI and RPIJ are not cost of living indices
- Measure change in price for a fixed basket of goods and services
- “Cost of living” indices
  - In popular usage is ill defined
  - Some use it to mean a measure of the cost of maintaining some minimum standard of living
  - Economic definition is a measure of the minimum cost to obtain the same level of utility in the base period

Revisions

- The RPI series is never revised
- Potentially the CPI could be revised
- CPIH was revised in 2015 as a result of improvements to the rental equivalence measure of OOH

Alternative measures

- CPIY & CPIHY: Excludes indirect taxes
- CPI-CT: Constant taxes
- RPIX: excludes mortgage interest payments (MIPS)
- RPIY: excludes MIPS and indirect taxes
- TPI: Tax and Price index
- Pensioners Price Indices: Based on RPI indices but weighted using spending patterns of households dependant on state pension
- Rossi Index: Formerly used to uprate income related state benefits

Relevant links

- Website home page

  www.ons.gov.uk

- Technical Manual

http://www.ons.gov.uk/ons/rel/cpi/consumer-price-indices---technical-manual/2014/index.html

- UK Consumer Price Statistics: A Review (Johnson, 2015)

http://www.statisticsauthority.gov.uk/reports---correspondence/current-reviews/range-of-prices-statistics.html

Recent consultations

- Measuring Consumer Prices: the options for change

http://www.statisticsauthority.gov.uk/reports---correspondence/consultations/index.html

- National Statistician's consultation on options for improving the Retail Prices Index

http://www.ons.gov.uk/ons/rel/cpi/consumer-price-indices/improvements-to-the-measurement-of-owner-occupiers--housing-costs-and-private-housing-rental-prices/index.html

- Consultation on the recommended method of reflecting owner occupiers' housing costs in a new additional measure of consumer price inflation, and the strategy for Consumer Price statistics

http://www.ons.gov.uk/ons/about-ons/get-involved/consultations-and-user-surveys/archived-consultations/2012/owner-occupiers-housing-costs/index.html