**3rd Meeting of the Country Operational
Guidelines and Procedures Task Force**

**September 27, 2018
World Bank, 1818 H St. NW, Washington, DC
MC 10-100**

Consumer Prices Spatial Adjustment Factors

& Regional Price Levels / UK regional parities

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CONSUMER PRICES SPATIAL ADJUSTMENT FACTORS AND REGIONAL PRICE LEVELS

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September 2018

Consumer prices

DATA COLLECTION OF CONSUMER GOODS AND SERVICES FOR USE IN CALCULATION OF REGIONAL PPPS AND SPATIAL ADJUSTMENT FACTORS

The main aim of the paper is to provide practical guidance for countries wishing to undertake data collection for the calculation of regional purchasing power parities (PPPs) and spatial adjustment factors (SAFs). It aims to cover all levels of experience and/or knowledge from very limited experience (or indeed none) to countries that have some level of understanding on how to undertake an effective and efficient successful data collection process. The main aim is to concentrate primarily on data collection for regional PPPs and SAFS although it will touch lightly on data collection for the Consumer Price Index (CPIs) as there are close synergies between PPPs and CPIs.

Although the paper will primarily concentrate on the data collection process it will also present practical guidance on how to clean the data file and discuss the stages of the validation process and how to undertake them. The paper will also briefly present synergies between CPI and PPPs and integration of the two although this will be covered in more detail in the integration of CPI-ICP component of the Task force.

The final section will look at future developments, specifically in the UK, that will be undertaken as part of a wider initiative within ONS to introduce new ways of capturing data via for example web scrapping and scanner data   and explore how these new data sources could be used to strengthen price data used in SAFs and PPPs in general.

SECTION ONE - DATA COLLECTION

This section will aim to discuss the theory, sources and methods and practicalities of the actual data collection for calculating average prices for use in SAFS and Regional indices. The aim of this section is to provide practical guidance for regions/countries who want to conduct successful data collection for use in PPP generally, specifically SAFs and regional price levels. Areas covered will include;

1.1 Sampling of items (covering how many items to include in sub sample, which items to include in sub sample, treatment of representative and non-representative items, use of proxy items in the absence of not being able to collect certain items).

One serious consideration for any SAF project is to ask the question 'do we need to conduct a full SAF project data collection for all elements of consumer spend, with the nationalisation and globalisation of the market with many key retailers and service providers dominating the market. Additionally, the way in which consumers purchase goods and services is changing and therefore the approach to the price collection should reflect this every changing market.

1.2 Sampling of locations/regions (covering method used to sample locations and how many locations to sample to ensure adequate coverage, to ensure each country that makes up the UK was represented accordingly)

1.3 Pre-enumeration prior for survey (practical guidance of how to conduct pre-enumeration and its importance in the whole process, including item descriptions)

1.4 Method of data collection (to cover areas such as paper collection, hand held devises (as used by UK), use of IT to collect data such as web scrapping and scanner data)

1.5 Data collection - sources

1.1 SAMPLING OF ITEMS

There is very little guidance provided by Eurostat on the calculation of spatial adjustment factors including the processes from sample design of items and retailers and service providers through to validation and actual calculation of the SAFs. Therefore, to some extent, at least as far as the data collection is concerned, a similar format was followed as for the regular PPP consumer surveys.

1.1.1. Sampling of items – how many to sample

The UK took responsibility for sampling of the items for the SAF basket of Goods and Services. The starting point was the regular PPP survey item lists with consideration being given to representative items, non representative items and the use of Proxy items (these are covered in more detail below). It was not feasible or practical from a financial and/or resource perspective to collect the complete PPP item list. Therefore, the process used was to create a sub sample of the total items that were both representative and non representative (and indeed proxy items).

> Design of the sub sample of the total PPP item list required two questions to be asked. Firstly, how MANY items to be sampled and secondly WHICH items to sample.

The UK made the decision to create a sub sample of items; two important factors were _WHICH_ items and how _MANY_ items to include in the basket. From a practical level, there was a debate on this as some members of the Project Board (which was the main decision-making body of the SAF project) had mixed opinions. A decision was made to design and replicate the sampling methodology used by Eurostat-OECD for the European Comparison Programme (ECP). The number of items or products priced for each basic heading was very much dependent on the heterogeneity of items covered by the item and the importance of the basic heading. For each basic heading, the number of representative items selected was commensurate (proportionate) with the price variation within the basic heading and its expenditure at the basic heading level. This information was taken from the latest UK National Accounts data; where the expenditure is greater this is where resources should be invested. Additionally, if historically we knew that there were basic headings with a lot of variation in the dataset resources were also directed here. In

order to establish this, we looked at the variation coefficient of the CPI data and also knowledge and metadata from the PPP regular surveys and price collectors to identify those items with high levels of variance.

Example – Table 1 Shares of household expenditure

GDP expenditure weights [millions of national currencies]				
Code	**Description**	**YEAR**		
		2014	**2015**	**2016**
GDP	**Gross Domestic Product**	1837062	1888737	1961125
A	**Individual consumption expenditure by households**	1143919	1181868	1233323
A.03	**Clothing and footwear**	61815	65064	67697
A.03.1	**Clothing**	52653	54842	56334
A.03.1.1	*Clothing materials*	*728*	*721*	*676*
A.03.1.1.0	Clothing materials	728	721	676
A.03.1.2	*Garments*	*47305*	*49739*	*51078*
A.03.1.2.1	Garments for men	13245	13927	14302
A.03.1.2.2	Garments for women	24599	25864	26560
A.03.1.2.3	Garments for infants (0 to 2 years) and children (3 to 13 years)	9461	9948	10216
A.03.1.3	*Other articles of clothing and clothing accessories*	*3610*	*3510*	*3687*
A.03.1.3.0	Other articles of clothing and clothing accessories	3610	3510	3687
A.03.1.4	*Cleaning, repair and hire of clothing*	*1010*	*872*	*893*
A.03.1.4.0	Cleaning, repair and hire of clothing	1010	872	893
A.03.2	**Footwear**	**9162**	**10222**	**11363**
A.03.2.1	*Shoes and other footwear*	*9107*	*10168*	*11311*
A.03.2.1.1	Footwear for men	3252	3631	4039
A.03.2.1.2	Footwear for women	4283	4781	5319
A.03.2.1.3	Footwear for infants and children	1572	1756	1953
A.03.2.2	*Repair and hire of footwear*	*55*	*54*	*52*
A.03.2.2.0	Repair and hire of footwear	55	54	52

As you can see the share of individual household consumption of GDP is approx. 63%. Of the household consumption, the division of Clothing and Footwear of £67,697m accounts for approx. 5.5% the biggest share of which is attributed by the aggregate of Garments for Women which accounts for nearly 50% of the total Clothing aggregate. With this is mind more resource was dedicated to Clothing and specifically Clothing for Women. This is a difficult aggregate as not only is the division an important one in terms of expenditure but also notoriously difficult due to high variation and therefore required more prices to be collected.

Individual household expenditure and high levels of variation in prices are key factors in determining how many prices to collect for each item. **ONE** in **FOUR** (25%) of items from the total PPP list was sampled.

Returning to the subject of the actual number of items to collect, the UK decided, based on resources, to select a fixed proportion of items from the PPP item list; Selecting, in the main, the same proportion of items from each basic heading. However, there were some exceptions. The sub sample contained a minimum of **ONE** in **FOUR** or 25% of the items under each basic heading in the PPP items list. However, there were some exception and CPI data was used extensively, particularly for food items where the specification for both PPPs and CPI were very comparable and therefore more than 25% of PPPs items were sampled. This ensured a more robust dataset particularly for the COICOP division of Food, Beverages and Tobacco.

Breakdown of items

The sub sample for the SAF calculations consisted of **565 PPP items** across 167 basic headings.

A total of 565 PPP items were included in the sub sample covering the following COICOP aggregates;

    i.   House and Garden
    ii.   Personal Appearance
    iii.   Services
    iv.   Transport, Recreation, Hotels and Restaurants
    v.   Food, Beverages and Tobacco
    vi.   Health and Furniture

- Overall the UK sampled 333 items out of a total sub sample of 565 for the third party sub contractor, TNS UK Ltd to collect out in the shops or outlets covering all aspects of consumer spend.

- Of the 565 PPP items, data from the UK national Consumer Price Index (CPI) was used for 120 items.

- The UK, statistical office, ONS (primarily Prices division where the UK PPP team and UK National CPI team was situated) collected prices for the remaining 112 items. These were either collected using internet and telephone or collectors went out to locations locally to collect for those items that the third party subcontractors had difficulty pricing.
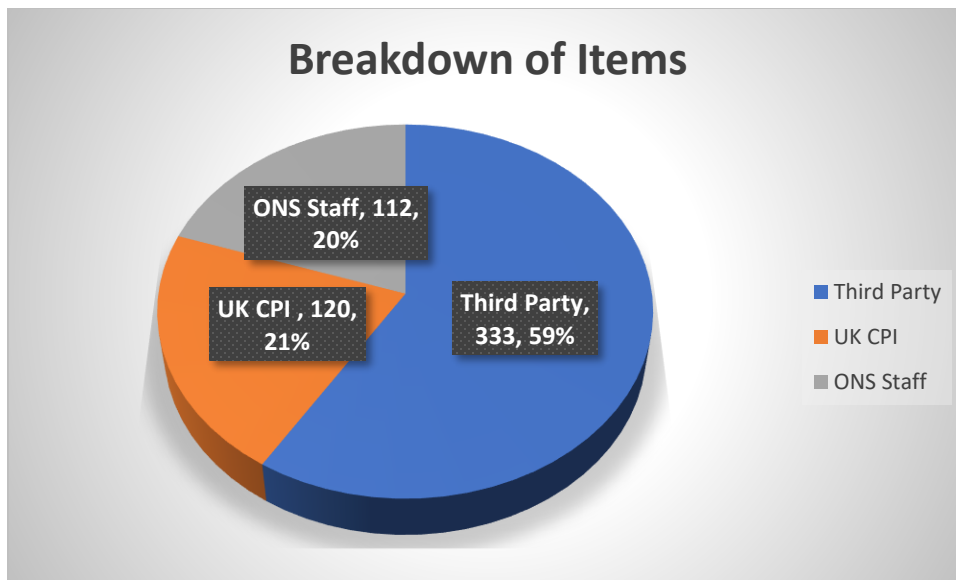
Once we decided on how MANY items to include the next key question was WHAT items to include.

1.1.2 Sampling of items – which items to include in sub sample

Once the number of items has been established the next challenge was to establish which items to include in the sub sample of 565.

Items were selected purposively from the PPP item list. Firstly, items were selected if they had a direct specification match with the CPI item with the intention that CPI items could be used instead of having to collect prices for that particular item. Initially the intention was to produce some coding that would allow for matching of the specifications but this proved to be a challenge. Unfortunately, the final matching undertaken was done manually as this was the only method where it could be certain that it was an absolute match. (For future SAF projects it is hoped that coding that the UK PPP team are developing in Python will be used for matching purposes, therefore saving resources at this stage of the process).

If more items were needed to make up the required sample size, items were initially randomly selected so that there were sufficient coverage of items across all the basic headings.

1.1.3. Treatment of representative and non representative items

When considering the sample, it was important to consider both representative and non representative items.

What are representative items?

Representative items are those which are important in terms of relative total expenditure within a basic heading or in other terms among the most important items purchased in the national market. However, for many countries, including the UK it is sometimes difficult to ascertain which ones are important (or not) as

there is no national accounts expenditure below the basic heading. Therefore, the UK relied on several criteria to determine if an item was representative or not. They include (but not exhaustive);

a. The amount of shelf space that an item occupied. The larger the amount of shelf space relative to similar products, it could be assumed the more important the item was

b. The experience of the price collectors who had practical experience of working with CPI and were very knowledgeable of both the regional and the national market.

c. The use of the UK national CPI. Items that were in the CPI sampled are deemed as being representative of the UK market and therefore could be marked as such for the SAFs.

d. Reports from research companies such as Mintel, research papers and publications such as The Grocer (a monthly publication detailing trend's, items in the UK retail and service market)

What are non representative items?

In contrast, non representative items are those items that are not considered important in terms of total expenditure within a basic heading and is not among the more important items purchased in the market.

> For the 2016 SAF project the UK took a different approach to the treatment of non representative items in the sample design. For previous rounds (2004 and 2010) the UK priced higher proportion of non representative items. For 2016 the proportion was reduced.

For SAF projects or rounds previous to 2016, namely 2004 and 2010 both representative and non representative items were sampled. The reasoning behind this approach at the time was that the UK was adhering to Eurostat guidelines as for the regular PPP surveys where it was instructed that both representative and non representative items were sampled and priced to ensure that there were adequate prices to allow for comparison between countries. However, this approach caused major challenges in 2010 for the UK price collectors out in the shops in the regions as time was spent looking for items that were not freely available the UK cross all the regions. This was a major lesson learnt for future SAF projects. In fact, this was one of the key lessons learnt. Consequently, a decision was made ahead of the 2016 SAF project to ensure that the non representative items were freely available on the UK market to ensure efficient use of resources. There was concern by the UK that the latest edition of the Eurostat/OECD Methodological Manual on Purchasing Power Parities states that, and I quote "representative items usually have a lower price level than unrepresentative items'. That said, however, since the SAFS will only be used to adjust the PPP prices collected in the capital city of London this would not be a major issue. However, that said, it was also felt that it was important to include some non representative items in the sub sample to avoid biasing the SAFs and importantly to remain compliant with Eurostat-OECD PPP methodology.

For the 2010 SAF project the number of non representative items in the sub sample was approximately equivalent to the proportion of non representative items under each basic heading of the PPP item list. However, for the 2016 SAF project, this approach changed to include a lower proportion of non representative items to ensure adequate resource was available.

Use of proxy items in the item sample

The use of PROXY ITEMS was a significant development in the calculation of Spatial Adjustment Factors for the UK during the 2016 round. Previous SAF calculations for the UK did not include the use of PROXY ITEMS. This allowed for optimum use of resources both financially and in terms of time.

During the SAF process, the UK experienced issues with the fact that for there were some basic headings, where the UK either had difficulty pricing, particularly in the case of items which had a service element or we did not have the necessary resources or. Alternatively, the proxy items could be one that was representative and widely available in the UK but was not collected as part of the regular PPP surveys, i.e. on the PPP item list. This was discussed with Eurostat at the time of the UK SAF project and was confirmed as a viable approach in ensuring comparability across regions/locations with the aim of calculating SAFs across the regions of the UK the use of proxy items is definitely a viable option. In these instances, a decision was made to use other similar type items in the same basic heading where we could make use of CPI data. This was important as it limited the resources required and ensured that maximum use was made of the hundreds of thousands of prices that had been collected for the UK national CPI. Items within the same basic heading with have an element of homogeneity and if there is no reason to assume or to perceive that prices for a particular item would not behave in the same way as others within the same basic heading then it is acceptable to use other items as a proxy.

For the UK one such example was the inclusion of a new item relating to basic heading Recreation and Sporting Services A.09.4.1.0, namely Latin Classes. This is not a PPP item but closely correlates to the established PPP item of Salsa classes for beginners, 1 lesson. In this instance, we used the data from CPI

A variation on the PROXY ITEMS is to change the specification of an existing item to allow for greater coverage of items during the collection period. Such examples included;

Regular PPP survey item specification for TABLE SALT

Brand	Well Known
Reference Qty	1000g
Minimum Qty	500g
Maximum Qty	1200g
Type	Fine table Salt

Package Type	Simple box, bag, *without pourer*
Exclude	special salts, with pourer

Spatial Adjustment Factor PPP specification

As above but with one significant adjustment to the '*Package Type*', and '*Exclusion*' criteria namely;

Package Type	Simple box, bag, *with pourer*
Exclude	special salts, ~~with pourer~~

Being able to collect the salt with a pourer meant that coverage was excellent; the pourer was most popular within the UK and was not a price determining factor. What is important in determining true price difference is comparability.

> The exact item must be collected within the same time frame to allow for true spatial comparisons. This was one of the major challenges of the price collection.

In delivering the SAFs the concept of COMPARABILITY is key and all items collected across the regions within the UK must be comparable to allow for that spatial comparison. The pricing of comparable items (identical or if not identical, then equivalent) ensures that the difference in prices across the regions or locations for a good or service reflect actual price differences between those regions or locations and is not influenced in differences in quality of the product. This was a key concept which was impressed upon to the price collectors. Specifically, the company that conducted the UK price collection out in the locations. The exact item had to be collected within the same time frame to allow for true spatial comparisons. This was one of the major challenges of the price collection and on many occasions the UK had to discuss with the company undertaking the price collection they this concept was imperative to a successful collection and must not be confused with the collection of items for the UK national CPI. The same company collected for both the CPI and PPP and it took a change in mind set for some of the price collectors to adopt this concept. However, overall the company were successful in their price collection for the SAFs.

1.2 Sampling of locations/regions (covering method used to sample locations and how many locations to sample to ensure adequate coverage, to ensure each country that makes up the UK was represented accordingly)

The sampling or selection of locations was the responsibility of ONS and not the third party contacted to undertake the external price collection.

> A different approach was used for the more recent spatial adjustment factor and regional price levels surveys from that of previous surveys. A new technique called 'Hotspot analysis' was introduced.

A list of locations for price collection was determined using Hotspot analysis technique to identify clusters of shopping centres in the UK and Retail Sales data. There was however, one exception to this, as one location that had been sampled as part of this process, namely Swindon, was replaced by Bristol. The reason was that feedback from the collector involved in the 2010 survey expressed concern of the lack of outlets for Furniture and Clothing items. Each of the locations required the same amount of data to be collected.

The price collection was split into seven broad regions within the UK, with three locations within each of the seven regions, totalling 21 locations in all. The locations and regions are listed in Table 2 – Regions and Locations.

A decision was made to use the same methodology that was used for the 2010 project and retain three locations per region. This would ensure an adequate number of price quotes per item; most of the actual locations are the same as 2010 with the exception of Bristol which has already been covered above and more notably the locations for London. In 2010 the three sampled locations were West End, Knightsbridge and Baker Street. For 2016 the three London locations sampled were West End, Croydon and Bromley, all of which are sampled for the UK CPI. Two of three locations namely Croydon and West End are sampled locations for the regular PPP survey for Consumer Goods and Services. Bromley is within close proximity of a number of the PPP locations.

Table 2 – Regions and locations used in SAF 2016

Northern	Midlands	Southern	London	Wales	Scotland	Northern Ireland
Leeds	Birmingham	Norwich	West End	Cardiff	Aberdeen	Belfast
Manchester	Leicester	Bristol	Croydon	Swansea	Edinburgh	Londonderry
Newcastle	Nottingham	Reading	Bromley	Torfaen	Glasgow	Coleraine

The locations selected for the SAF project were a sub-sample of those locations currently used in the 2016 UK CPI collection. TNS visits 141 locations each month, collecting prices for use in the CPI. From this list of 141, locations were selected using purposive sampling, where locations with the largest retail turnover in each region were selected (Hot spot analysis). To ensure sufficient coverage, the 12 Government Office Regions (GORs) across the UK contained at least one location each. The eight GORs within England (excluding London) were combined to produce three larger regions. Each of these regions contained three locations. Prices were collected in three locations in Wales, Scotland and Northern Ireland.

Three locations were selected for London, the reference location. Two of the selected locations feature in the ongoing PPP survey programme, namely West End and Croydon. The third location sampled for London was Bromley.

1.3 Pre-enumeration prior for survey (practical guidance of how to conduct pre-enumeration and its importance in the whole process, including item descriptions)

In previous SAFS projects, the UK did not undertake any pre-enumeration work. This was included in a 'Lessons Learnt' document from the previous survey in 2010 that pre-enumeration was a valuable part of the process and as such should be included. Valuable resources had been spent looking for items that were not readily available on the UK market.

> A significant change to the 2016 SAF survey what the use of pre-enumeration. It is highly recommending that any country/region undertaking SAFs incorporate the process

The third party that was subcontracted by the UK to conduct the price collection, on the instruction of ONS, undertook the pre-enumeration work using the item list. They were experienced in this field and had successfully undertaken this process many times. A meeting was held between both parties follow the pre-enumeration with the outcome that this process allowed for the change of some of the original items with some changes to the actual item specification. It is recommended that any country/region undertaking a SAF or regional surveys included this use of pre-enumeration as it is highly effective in identifying ahead of the main price collection any items that are either not available or not important or indeed both.

1.4 Method of data collection to cover areas such as paper collection, hand held devises (as used by UK) use of IT to collect data such as scanner data and web scrapped data

Data collection – hand held device

This section will look at data collection using the handheld device. This will cover the following topics;

1.1 The collection device used to record price data from the different shops/outlets. This section will provide details of the device the ONS use to perform their data collection.

1.2 This section will cover the data security of the prices collected. This will include the entry of Personal Identification Numbers (PIN) to ensure data are secure and only visible for one specific collector.

1.3 Data entry will be covered in this section. This will provide information on data entry and the different types of data entry used – for example, drop down menus, free text.

1.1 The collection device and Programme

The ONS uses the Samsung Galaxy Note 3 as their collection device. After consultation with their third-party providers, an application (APK file) was created for collection on android devices.
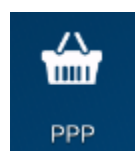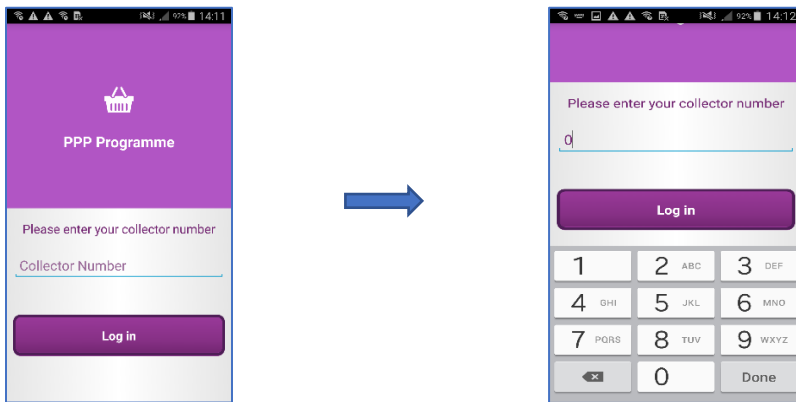

The programme is developed so that it can be used on other similar devices; it is therefore compatible with Android 4.4 and with a UI layout optimised for a 5.7" touchscreen.

1.2 Data security

This section will detail the security and access codes to ensure that the data collected is only visible to those who have collected the prices, i.e. the price collectors.


Here you have the main screen on entry to the tool. This is the first stage of data security. Each price collector will enter their unique collectors ID in the 'Collector Number' field, for example "0123". This will allow the collector access to the files stored on the collection application only for the unique code.
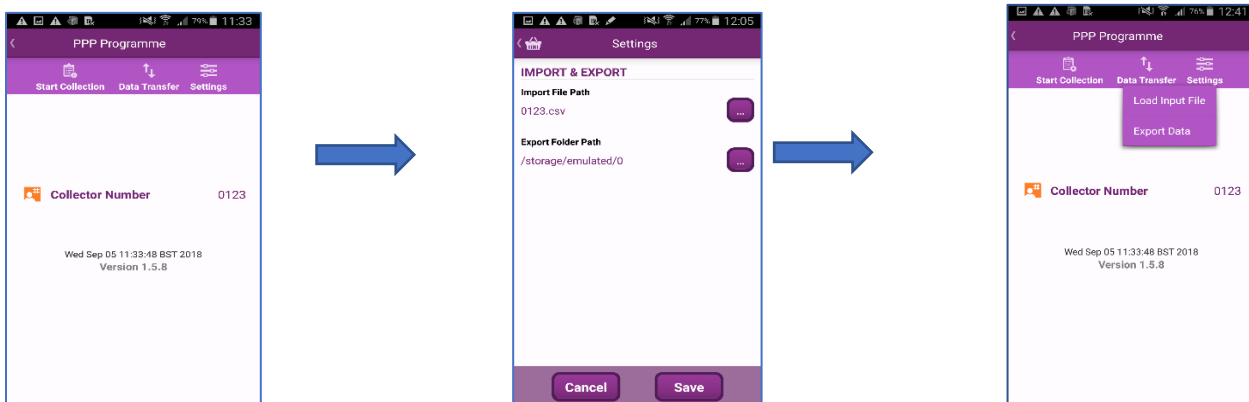

The second stage of security is to import the Item List for collection using a csv file. From the Home Screen, selecting the "Settings" option, you are transferred the Import and Export screen. It is important to ensure that the import file path is coded to match that of the Price Collector. As seen above, the Price Collector code of '0123' is the same on the CSV file to be imported. Once confirmed, this is saved and you return to the home screen to complete the Data Transfer / Import. This is completed by clicking on the Data Transfer tab and selecting 'Load Input File'.

1.3 Data collection, data entry
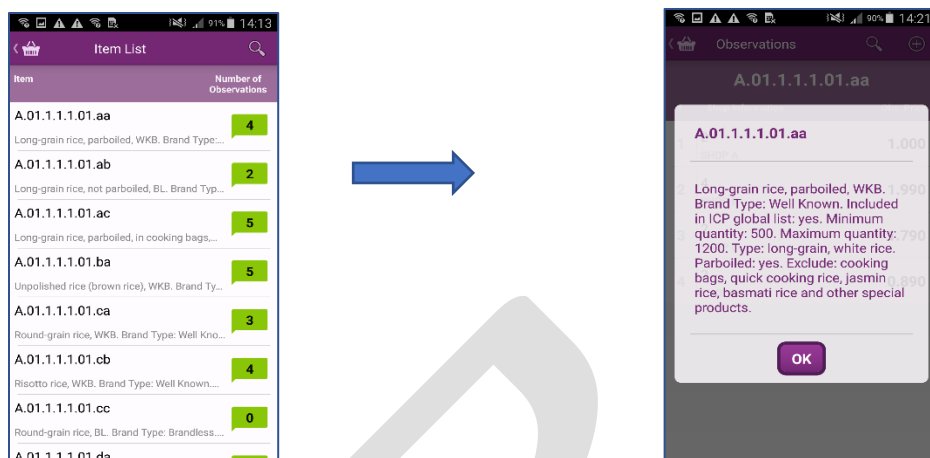
When the Input file is imported, the price collectors can begin their collection. Entering the item list from the home screen using the 'Start Collection' tab. This will bring them to the Item List screen, which lists all item numbers and the start of the item information. To retrieve a more detailed description of the item, the collector can click on an item code which shows the item in more detail.
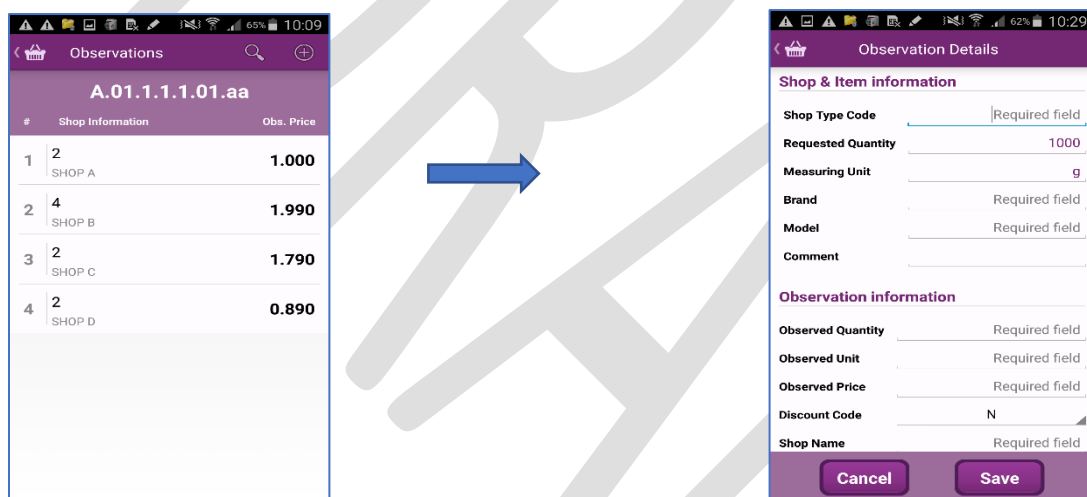
By clicking on the green icon for each item, the price collector is directed to all observations that have already been collected. This screen shows top level information for each observation collected – the outlet type, the outlet name and the price collected.

To insert a new observation, the price collector will press . This takes them to the 'Observation Details' screen where they are required to collect the following information –

Shop Type Code – here the collector inputs a numeric value for the type of shop they are collecting from, e.g. 2 for a Supermarket. Refer to Annex for current list of shop codes (ECP)

Requested Quantity and Measuring Unit – these are pre-set fields and are automatically updated when the collector inputs their Item List file.

Brand – here the collector inputs the name of the product brand.

Model – here the collector inputs the product Model.

Comment – this is an open text field, here the collector can type extra information they feel is important to the collection.

Observed Quantity – here the collector is required to put the size of the item they have collected.

Observed Unit – here the collector inputs the unit that is supplied in the Measuring Unit field.

Observed Price – here the collector inputs the Price for the item at point of sale.

Discount Code – this is a drop-down menu allowing the price collector to choose the code that represents the Price they have collected, e.g. N – Normal Price, Q – Quantity Discount, T – Temporary Discount and R – Regular Retail Price.

Shop Name – the name of the outlet the price is being collected from.

Location – the price collector inputs the Town, City or Region they are collecting pricing in.

Once all required fields are completed the price collector can save their information and this observation will be added to the 'Observations' for that specific item.

Once all prices have been collected and inputted into the hand-held device, the Price Collector can navigate back to the home page using , ready for exporting the data back to the National Statistics Office.
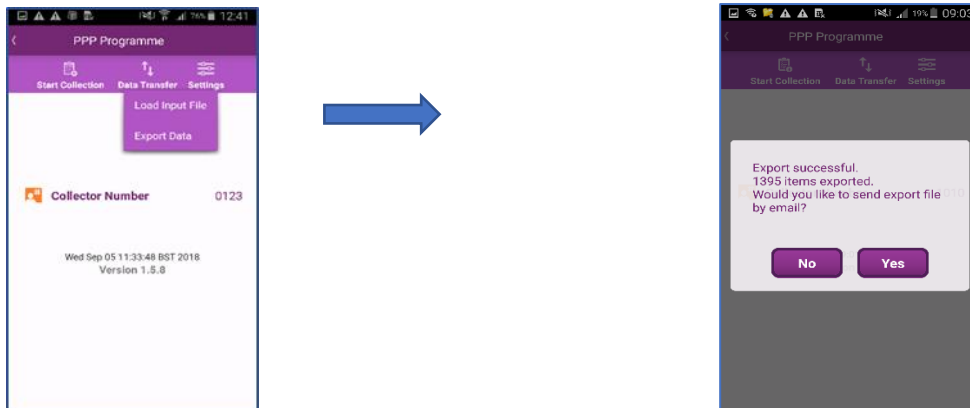
From the home page, the collector can again select the data transfer tab, but now select 'Export Data' to begin the email process. This will give the Collector the option to send an email. When clicking Yes, the data stored within the application will be sent to a predetermined email address coded into the software. This allows the collectors to provide a daily update to the office.

DATA COLLECTION – PAPER FORM

For those who do not have access to hand held or similar devices, there is the option of completing data collection manually, using booklets and manually hand writing each individual observation. (The UK used this method of collection until 2010 when it introduced its first hand device (SOMO). The current device is a Samsung Galaxy Notebook 3.)

Each item will have its own collection sheet, allowing for 10 observations.

A.01.1.4.4.01.ba Yoghurt, multipack, DANONE Activia 4

Brand:	**DANONE**
Reference Quantity:	**g/ml**
Model:	**Activia (named "Bio" in some countries)**
Minimum quantity:	400
Maximum quantity:	1000
Type:	fruit flavoured
Made with:	cow milk, with bifidus
Package type:	multipack
Pieces per pack:	4 - 8
Quantity per piece:	100 - 125 g/ml

SPECIFY: **Pieces per pack |**

Mth.	Shop Type	Shop Id.	Price	Qty.	Ref. Unit	Pieces per pack	Comments
					g/ml		
					g/ml		
					g/ml		

All the details required are input into a row, any further comments about a product are added into the final column.

A price collector will continue to complete inputs until the close of the survey period / month. They will send the collection booklet back to the National Statistics Institute PPP Team to commence validation on the information.

This works differently to the handheld device, where daily validation can be conducted as the data is sent, via email, on a more regular basis.

TO NOTE: Information relating to the IT used for scanner and web scrapped data will be included in final draft as they are still being developed.

1.5 Data collection – price data sources

Three main data sources for price observations were used in the calculation of the UK SAFs and RRCPLs:

- price observations from the existing monthly Consumer Prices Index collection

- 2016 regional price survey, and

- centrally (ONS) collected price observations

It should be noted that the RRCPL dataset is fundamentally the same dataset used for the calculation of the SAFs delivered to Eurostat.

To calculate the SAFs, several approaches to acquire data were used. Refer to Graph 1, Survey by collection method. Where possible, secondary data was obtained from data collected for use in the computation of the UK Consumer Price Index (CPI). One year's worth of CPI data was used, to remove any effect of seasonality. This was checked to ensure that the price of items were comparable across regions.

Primary data collection focused on those items which had no spatial information, had a relatively high weight or made a relatively large impact on the final indices.

The data for the SAF project was sourced from three areas, a central collection conducted by ONS staff; a local collection performed by an external contractor TNS and price data from the UK Consumer Price Index (CPI).

The proportion of items allocated to each collection method is shown in Graph 2. This graph demonstrates the relatively even split between the three collections methods in terms of item coverage.

Graph 2: Proportion of items allocated to each collection method
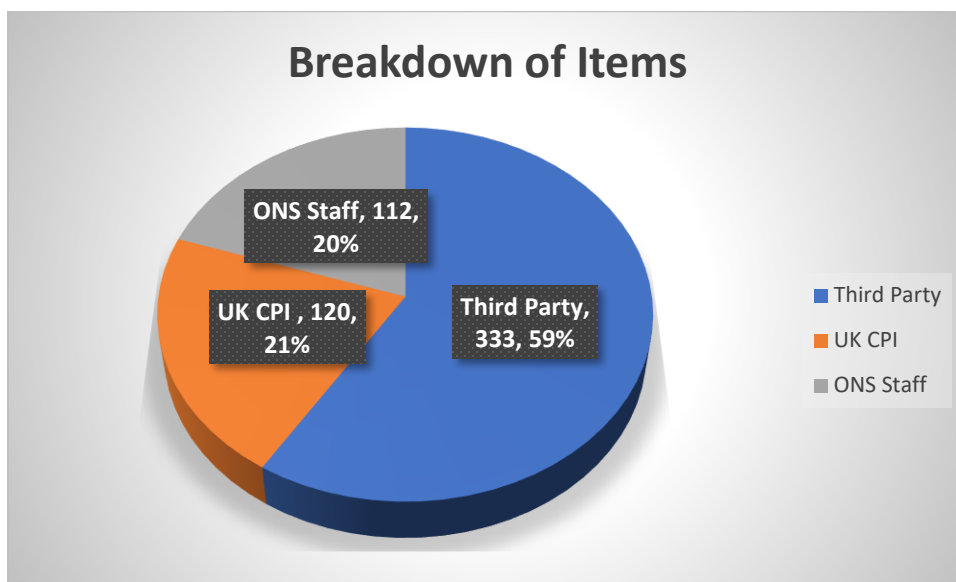
The decision on the mode of collection was made at the individual item level. The first consideration being if it was suitable to use CPI data. If CPI data was deemed unsuitable, but it would be relatively simple to collect prices in the field and regional variation was expected, then local collection in the field for the item was employed. The remaining items were collected centrally from within ONS as they were either viewed as problematic, had no physical outlet or had national pricing. These mainly related to items in the Services survey as in many cases there was no physical outlet to visit out in the field and prices were taken from the internet or by contacting the service provider directly by telephone. This was time consuming (but necessary) and resource intensive as these were some of the most difficult items to price. The result of these decisions ensured that the various surveys typically had a combination of sources as can be shown in Graph 2 below.

Graph 1 demonstrates the extensive use of CPI for the Food, Beverages and Tobacco survey, while CPI data had limited use in all remaining surveys. It is not unexpected as food, beverages and tobacco items have very generic and narrow specifications. The opposite can be said for Furniture and Health where approx 60% of the items were priced centrally, out in the field by TNS with approx 40% priced centrally

by ONS (Prices Division); This was primarily the case for the Health based items and some furniture items where national pricing exists (for example IKEA). The majority of furniture items were collected in the field.

1.5.1 Consumer Price Index data

The use of CPI price data formed an important component of the 2016 SAF project. CPI data collection involves collecting the same product month after month. If the product matches the CPI item description, the actual quality of the product being priced can deviate from location to location. Spatial collection, on the other hand, involves collecting prices for a product ensuring comparable quality across regions. It is for this reason that PPP item specifications are much tighter than CPI item descriptions. For the SAF project, CPI data was only used where comparable quality across regions could be ensured for a particular CPI item. CPI/PPP synergy was a must if the CPI was to be used.

Price data is collected for around 700 items for use in the UK CPI. The initial stage to determine whether the use of CPI data was appropriate was to map CPI items to PPP items. On a case by case basis, the CPI item description was compared to the PPP item specification. Decisions were made by the UK project team about whether the CPI item description was comparable to the PPP item specifications. 120 CPI items were identified as having a sufficiently comparable item description to be considered for use in the SAF project.

In many cases, the decision to use CPI data was relatively straightforward, particularly for food items. For those CPI items where their suitability was not obvious, the Coefficient of Variation (CV) of the arithmetic mean of CPI prices for each item was used to aid in the decision of whether the use of CPI data was appropriate or not. Prior to analysing the CVs, it was important to understand what these values meant for the purpose of the SAF project. The smaller the CV, the lower the variability, or dispersion of CPI prices. It was not possible to determine whether this dispersion was due to differences in price levels across regions, or differences in the quality of the item being priced. For example, a high CV indicates a large variability in prices for a particular item, which may be due to differences in price levels, differences in quality, or both. It was for this reason that the value of the CV was not the only criteria used in determining the suitability of the CPI, but it was a useful tool.

Care was taken to only use CPI data where appropriate for the SAF project. On a case by case basis, consideration was given to both the tightness of the CPI item description and the value of the item's CV. The use of CPI data (approximately 277,500 prices were used) was suitable for 120 PPP items. Utilising the CPI data meant a significant reduction in the number of items that needed to be collected locally, while ensuring the data was fit for purpose in the calculation of SAFs. This in turn allowed the resources to be effectively employed elsewhere.

To ensure the integrity of the produced statistics, the use of CPI data was limited outside of the Food, Beverages and Tobacco survey. For the other five consumer surveys, in the main, it was felt that the CPI descriptions could not ensure comparisons between items of equal quality. This was especially the case with furniture, where the item specifications needed to be followed very precisely to allow for true comparison.

1.5.2 Local collection

The external or local collection was conducted by a company called TNS Ltd. This company is currently contracted to collect price data for the UK Consumer Price index. TNS was also engaged in the price collection for both the 2004 and 2010 surveys, collecting the majority of items, 333 (of which 332 were used in the calculations) in total or 59% of the total 564 items. A member of the PPP team collected

additional prices in Swansea (Wales) to improve coverage and in Torfaen where staff could be easily deployed from the Newport office (based in Wales) to support the TNS effort.

The external data collection was conducted between the period 26th September to 4th November 2016.

- The external collection was less challenging for 2016 due to 'Lessons Learnt' during the 2010 survey; which has been improved upon including an improvement to the item list (updated to include pictures and important guidance notes by basic heading). The overall process was much better organised and communication was quicker making the overall process more efficient. The main difference and improvement was field staff working in geographical areas as opposed to specified outlets made the collection much quicker.

Food, Beverages and Tobacco was the most successful category. This is not unexpected as the items are typically easily sourced and also have some similarity to the items collected for CPI which assisted the collectors. The Services, Personal Appearance, Furniture and particularly Transport, Hotels and Restaurants surveys all proved more challenging in reaching targets. These are the areas that the majority of the price collectors had difficulties.

1.5.3 Pre- survey

From the 2010 SAFs local collection, communication was identified as a key factor in ensuring the success of the 2016 project. The SAF project team initially engaged TNS at their price collector conference at their headquarters in London giving a high-level overview of the project, highlighting key themes, requirements and lessons learned from 2010. Key of which was the explanation of the differences between CPI and PPP price collection and the application of the Basic Model Rule. This conference was also key in receiving feedback from those collectors who were part of the 2010 exercise and gave guidance on the initial stages of preparation for the project.

Significant time was spent composing and finalising the price collection item list and guidance document for local collection by TNS. This went through several stages in consultation with TNS and the project support team to ensure that the documents were fit for purpose. Confirming all price collectors understood the importance of collecting prices for comparable items against the item descriptions to achieve credible data for use in the calculations.

A pre-survey meeting was held with TNS at their Headquarters in London with supervisor price collectors dialling in via teleconference having received with copies of the draft list in advance. Each item was reviewed in turn and any uncertainty on item descriptions or requirements for the item was queried and refined for ease of price collection in the field. The supervisor price collectors then conducted pre-enumeration in the field and were able to flag unavailable items before price collection commenced to ensure a high level of availability across the regions in the UK in advance of price collection.

This was a very effective way of preparing the survey materials for the local price collection and was invaluable in ensuring price collectors from TNS understood what was required in terms of quality in the data they provided.

A similar process was applied to the items collected centrally by ONS. Basic headings were checked for items that were most representative for the UK. For those headings where the UK PPP team have historically been challenged in gathering the target number of price quotes per item i.e. Services for the maintenance

and repair of the dwelling, enabled the team to take the opportunity to create a UK item description to ensure success in price collection across all regions.

1.5.4 Regional price survey

Graph 3 details the average number of price observations that were collected in the local and central locations by PPP survey. Items where the number of observations was one (due to invariability through national pricing) or zero (due to unavailability of items) have not been included.

Graph 3: Average number of observations per item by survey
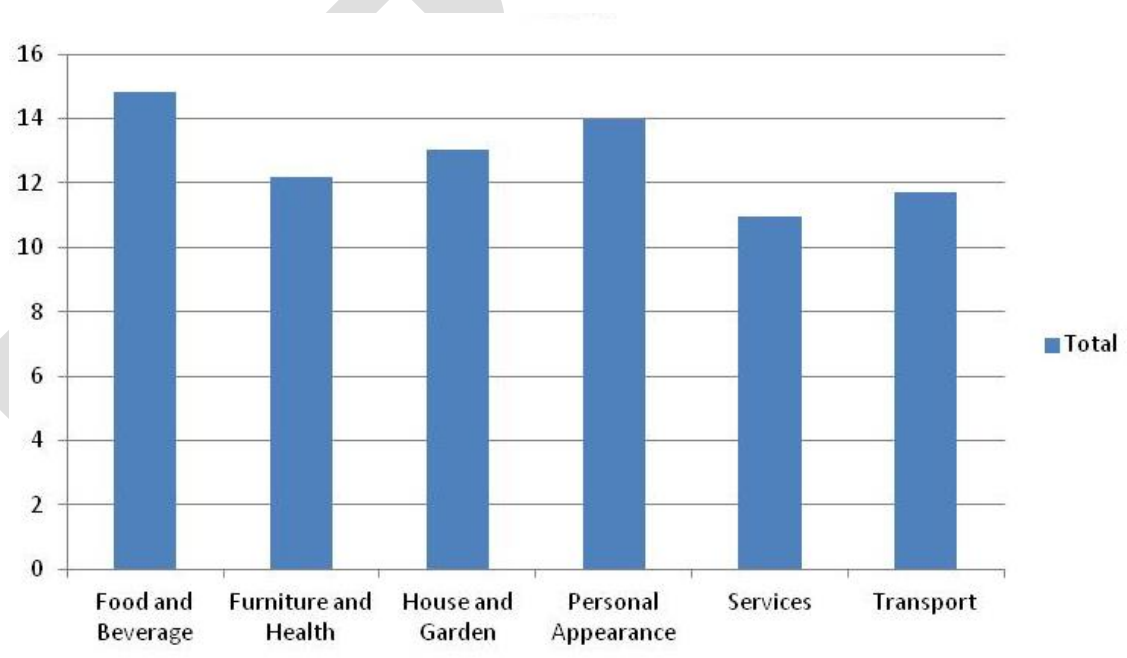
1.5.5. Central collection based in office, ONS

The final 112 items were collected by ONS staff in an internal, central collection. This collection was reserved for items where it was possible to collect reliable quotes by phone or internet such as in transport or service areas, where it was felt that inexperienced PPP collectors may find it difficult to match detailed specifications in stores such as televisions, laptops and for items that had national pricing.

The central collection was conducted by ONS staff experienced in PPP collection and also utilised other staff across the Prices division.

The collection began on the 26th September and ceased on the 4th November 2016. Before the collection began, certain items were deemed to have national pricing policies, these included 20 items for cars and motorcycles. This brought the number of items to be centrally collected to 112. Further research was undertaken, firstly on items where national pricing policies were in effect and secondly for those items where prices could not be collected; this ensured a targeted central collection.

Where items had a national price a single price observation was collected and replicated across all regions where the outlet had been sampled. Intelligence on national pricing was collected direct from retailers and through the analysis of prices as they were received from the local collection. In these cases, once national pricing was identified, collection ceased. It was also identified that for the heading A.04.5.5 - "Heat Energy" it would not be possible to provide UK prices as the PPP descriptions of the product provided did not match anything provided in the UK.

It became apparent quite early in the survey process that for many items it would not be possible to collect five price quotes from each location selected. An example of this being items relating to flights. Some regions in the UK do not have a large number of airports, for example, Wales has only one national airport, Cardiff and the number of flights matching the PPP specifications was limited. As many of these items was collected as possible, but it was impossible to completely fill the initial requirement for collecting 15 price quotes per region.

SECTION TWO – VALIDATION AND DATA CLEANING

As with section one, this section will aim to discuss the methods used in the actual validation and cleaning of the dataset and to provide practical guidance for regions/countries undertaking validation and data cleaning once they have received the actual price data. Working examples will be provided. Areas covered will include;

2.1 Methods used in validating dataset at item level, basic heading level and aggregate level. Use of specific criteria in the validation.

2.2 Validation conducted – covering both validation collected during the price collection period and following the end of the collection

2.3 Future development for validation purposes.

2.4 Checking of data (this covers ONS' internal auditor's actual revisiting the outlets to check the accuracy of the prices and specification of the item). A sub sample of items and locations are sampled. This is key for quality assurance purposes and to have trust in the actual data. Working example will be provided.

2.5 Discuss how the procedures used in the UK (fundamentally ECP processes) compare with those used in the ICP (Quaranta Tables and Dikhanov tables both of which are used to provide similar measures of price variation for both products and countries).

2.1 Methods used in validating dataset at item level, basic heading level and aggregate level. Use of specific criteria in the validation.

The UK have developed a Management Information System (MIS) in Microsoft Excel, developed specifically for the survey management and validation stages. The MIS is used to store data at specific stages of collection and validation allowing an audit throughout. Data stored will include, regional

average prices, minimum and maximum prices, number of observations, items with no observations, items with low observations and those items with increased variation in data.

The MIS is also used to compare data survey on survey, looking at movements in data. The UK team will research changes and detail these in the spreadsheet. This increases the audit trail and allows the team to comment on changes.

Below is a screen shot of the MIS used by the UK in SAFs and the regular PPP surveys. This illustates at the top level previous prices compared to new prices (average, minimum and maximum), price variation for each survey, representativity of the items and also the percentage change in price from previous to new average price.

Item Code	Item Name	Previous Average Price £s	Previous Min Price	Previous Max Price	?	Previous Representativity	New Average Price £s	New Min Price	New Max Price	New Checking	New Representativity	Average price % change
A.01.1.1.1.01.aa	Long-grain rice, parboiled, WKB	2.88	1.28	4.78	?	*	2.63	1.00	4.98	???	Yes	-8.68%
A.01.1.1.1.01.ab	Long-grain rice, not parboiled, BL	0.43	0.40	0.50		-	0.45	0.45	0.45			4.65%
A.01.1.1.1.01.ac	Long-grain rice, parboiled, in cooking bags, WKB	3.83	1.98	5.98	?	*	4.34	1.49	5.80	?		13.32%

Following on from the top level data validation, the data are scrutinised further at observation level. The following information is collated and each price is compared to all others for that specific item. Below is a snapshot of the table used to compare. It illustrates the variance coefficient of a selected item, the ratio of that items minimum and maximum price, the location/region of the price collected and the ratio of the price collected against the average price of the. As there is a price flag of three question marks (???), this data will be checked and those observations with a high or low-price ratio will be investigated.

The high variation is always the starting point for the validation as high variation can indicate errors in data as well as genuine price divergence.

VAR_COEFF	MIN_MAX_RATI	Region	price_fl	price_ratio
0.536673233	18.45238095	London	???	1.297954033
0.536673233	18.45238095	South East	???	0.759684861
0.536673233	18.45238095	East Midlands	???	1.336129152

2.2 Validation conducted

This section will cover the validation undertaken both during the price collection period and following the end of price collection period, covering both the validation conducted by the third party subcontracted to collect out in the field and the validation conducted in house by the UK PPP team. Limited validation was conducted on the CPI data as it had already been used in the construction of the UK national CPI and as such had been validated.

2.2.1 Third Party Contractor validation

Throughout collection, the third party subcontracted to collect the data complete their own validation be-fore delivery of data to the ONS. This is conducted throughout the collection period and prior to delivery of the final dataset. Based on the top-level data, items are sorted by Item Code, Locations, Shop Names and Collected Date Time and duplicate records were removed.

For each item, the following actions are taken:

- A review that shop and brand levels are correct.
- A review of model number and comments matched the specification or highlighted where some of the specification are not met.
- A check that observed quantity and unit are generating the correct reference price.
- A review that the highest and lowest prices are not indicating an incorrect item.
- A comparison of prices by shop.

For all data:

- Check on £0 prices
- Check no £0 reference prices
- Check on Price ratio
- Review shop types for consistency
- Review shop names for consistency

All checks are carried out piecemeal as data are received at the office and on the data set before final data delivery. Attention was made on the more difficult commodity groups, such as clothing, furniture and electrical items where historically these have a lot of 'noise' or high variation. Interpretation of brands was also an issue, i.e. definition of Well Known Brand low, medium and high.

Incorrect items are deleted from the data file and submitted to the ONS separately so that they could be included in the final dataset if they were deemed to be sufficiently close to the item definition as to be acceptable.

2.2.2 'In House' validation (ONS)

The UK Project team received data files from the third-party contractor every few days. The validation consisted of the following;

Identification of national pricing. This is where the price for an item is the same in each of the outlets owned by the same company. The number of key retailers and service providers in terms of contributions to the industry adopting national pricing is increasing, particularly with the advent of internet shopping. There are also a number of items, that regardless of which outlet they are purchased from, are identified as having national pricing such as Apple products.

Unavailability of items. Validation during the early stage of the data collection allows the UK Project team to provide the third-party with alternative items which can be collected thereby ensuring that repre-sentative items are included in the final dataset.

Multiple and Independent retailers. Checks are made to ensure that each item has the correct ratio of multiple and independent retailers.

Problematic items. The validation conducted during the price collection period proves invaluable in quickly identifying items which price collectors are finding difficult to price. The project team are able to provide the third-party with advice on the way forward.

Branding. During validation, checks are made to ensure that the items collected adhered to the correct branding.

Once the final data file is received from the third-party, further comprehensive validation is conducted. This involves the following;

Meeting certain validation criteria;

- identification of £'000s errors
- cross checking of brands
- validation of reference quantities and the resultant prices
- ensuring that the price observation adhere to the item specification

2.3 Future development of validation process

The UK PPP team are currently developing the use of the computer programming tool, Python, to conduct the validation of their collected data. The use of Python enables the team to carry out detailed and quick analysis of the large dataset.

The use of Python allows the UK team to analyse each item and collate all information on the locations/regions that have been priced and those locations that haven't during the collection period. The team can then allocate resource to those areas where further collection is required, saving time and resource in areas already covered.

Further analysis of the data can be conducted once all data has been collected. The team will use Python to analyse price movement from location to location which highlights those areas where prices are highest, price changes survey on survey and the team will conduct analysis on the effects of discounts. The analysis on discounts will allow the team to look at whether the inclusion of discounts within the data increase or decrease the average prices.

2.4 Back checking of data

Back checking or validation of the actual price collected out in the shops is part of the process of validation and is undertaken by the sub contractors field supervisors in collaboration with ONS auditors. Back checking is a common term applied to checking the data inputs from a sample of observations, in this case as collected by the sub contractor. Back checks are carried out before final data are submitted.

For the SAF project, ONS instructed its auditors to pay special attention to the actual specification firstly and then secondly, where possible to confirm the price. Three out of the 21 locations were randomly sampled to be audited. The number of observations to be audited equated to approximately 2% of total prices collected. This level of audit is in line with current data collection practise for the UK CPI. In the case of the 2016 SAF project the majority of observations passed with specification and price check, well within the limits set.

2.5 Discuss how the procedures used in the UK (fundamentally ECP processes) compare with those used in the ICP (Quaranta Tables and Dikhanov tables both of which are used to provide similar measures of price variation for both products and countries).

SECTION THREE – SYNERGIES BETWEEN CPI AND PPPS

This section will briefly address the issues around the historic lack of synergy between CPI and PPPs and discuss ways in which synergies could be improved as this subject matter is being addressed in detail in a separate agenda item in the third meeting of the Country Operational Guidelines and Procedures Task force. It will also look at the current synergies from a UK perspective between CPI and PPPs. Areas covered include;

3.1 Historical issues of UK using CPI for PPP purposes and the challenges the UK faced.

For the UK, there has been continued historical difficulties in using CPI data for PPP purposes. This is primarily caused by the detailed specifications required in the PPP collection in comparison to broader CPI items specifications. For example, in the UK CPI a "t-shirt" item, allows a collector to price for any t-shirt regardless of brand or material composition if it is the same or comparable to the previous months CPI item. For PPP purposes, the t-shirt will have a more detailed specification, including details such as brand level or the material composition. Due to these differences in the specifications, the PPP team are unable to use the average prices taken from the CPI collection, as it is unknown if observations would meet the PPP specification requirements.

The example below shows the difference between the PPP and the CPI specification and the level of detail required for the PPP collection.

PPP Specification

Men's polo T-shirt, short sleeves, WKB-H

Material – approx. 100% cotton

Collar-style – shirt; placket with 2-3 buttons

Sleeves – short

Colour – one.

CPI Specification –

Men's Casual, sleeve Top with Collar, e.g. Polo.

As can be seen from the graph below, Food is the aggregate where most use is made of CPI data for PPP purposes, particularly for the SAF project. This is due to the specification being very comparable if not identical.

The UK has previously been involved in a Eurostat project called Detailed Average Prices (DAP) to consider using average prices across several different calculations for the food aggregate. 2015 data collection was the eighth and final exercise. The DAP project has been discontinued given some limitations of the comparability of the results, the existence of other data alternatives for DG JUST (Director General for Justice and Consumers) and the slow decrease of the number of countries taking part in the project.

3.2 Current practice on the use of CPI price data in the PPP exercise. This will cover the methods/approach used to decide on which items have synergy and why and those items where there was lack of synergy.

As mentioned in 3.1, currently the UK PPP team do not use CPI price data in the regular PPP surveys. Due to the detailed nature of the PPP item list, it has been found difficult to find synergies between the data. That said, at basic heading level, movements in the CPI is used for quality assurances purposes during the validation rounds of the PPP regular surveys; movement in CPI is mapped against the movement ion PPPs between the three year intervals and any significant divergence is investigated.

However, when conducting the Spatial adjustment project, the UK used CPI data, mainly for food where there was very tight correlation between the specifications. One year's worth of CPI data was used, to remove any effect of seasonality. This was checked to ensure that the price of items was comparable across regions.

Graph 1 - Survey by collection method
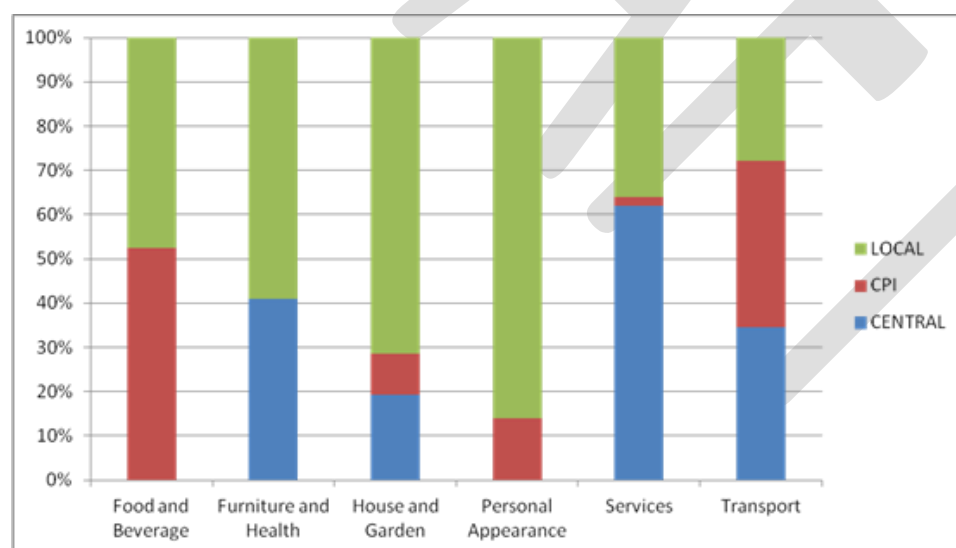
As seen in the graph above, the CPI was used for most of Food and Beverages, and a large proportion of the Transport basic heading in the UK Spatial Adjustment Project 2016. Care was taken to only use

CPI data where appropriate for the SAF project. On a case by case basis, consideration was given to both the tightness of the CPI item description and the value of the item's CV.

3.3 Future developments. There are several initiatives being undertaken in ONS which could potentially improve synergies between CPI and PPPs. These initiatives will be discussed in detail in this section.

The UK are currently in the development stages of acquiring and analysing test data for web-scraped and scanner data. It is hoped, that once data are received directly from websites or companies, then there will be increased synergies between CPI and PPP data.

The use of web-scraped data has progressed further; this provides a snapshot of prices on the company's websites. It is hoped that the data will be used in both CPI and PPP data calculations, as the detail can be specifically collected from the websites. For example, a specific brand of jeans can be collected from a website – this can be used in the monthly CPI under a jean item, but also it can be used in the PPP calculations under the specific item.

The PPP item list asks for the specific items – Men's blue jeans, LEVIS 501. Using web-scraped data, all observations for this item can be used to create an average price for the survey collection month for PPPs. But also, as the web-scraped data will be collected throughout all months, the CPI can use the data for this specific item to help calculate inflation month on month.

The UK CPI and PPPs are in the development stage of including scanner data within their calculations. The inclusion of scanner data will increase the synergies between the CPI and PPP data. The average prices collated from CPI collection of scanner data will be used with PPP's as the data can be provided for specific items. The individual average prices will be for specific items that can be matched to the PPP specifications and either included or excluded.

SECTION FOUR – INTERGRATION OF CPI AND PPPS

This section is closely aligned to section Three – Synergies between PPPs and CPIs but for this paper it is intended to keep them separate but there will be some overlapping. This section will cover;

4.1 UK experience of integration of CPI and PPPs

4.2 Future work in integrating CPI and PPPs

SECTION FIVE – CALCULATION OF SPATIAL ADJUSTMENT FACTORS AND RELATIVE REGIONAL COMPARATIVE PRICE LEVELS

This section will cover in detail how the calculation of Spatial Adjustment Factors (SAFs) and Relative Regional Comparable Price Levels (RRCPLS) and include working examples to act as a practical.

5.1 Methodology used in constructing SAFs and regional price levels. A step by step guide on the calculation of SAFs and regional price data will be provided as a working example.

5.2 Interpreting the final outputs and quality checks involved at sub aggregate and aggregate levels.

5.1 Methodology used in constructing SAFs and regional price levels, including the calculation of average prices. A step by step guide on the calculation of SAFs and regional price data will be provided as a working example.

Calculation of both the UK SAFS and UK RRCPLs starts with the calculation of the average prices. The calculation of the average prices is the first step in the actual calculation of both SAF and RRCPLs and the same method is adopted for both' albeit the SAFs were primarily concerned with arriving at a correction coefficient for the UK and the UK excluding England whereby the RRCPLS were concerned with calculating average price levels relative to other regions/countries. For this paper, the calculation and the methods used in arriving at SAFs and RRCPLs have been dealt with separately as the reader might only be interested in one and therefore it makes for easier reading to keep them separate.

5.1.1 Spatial Adjustment Factors

As previously explained, there are two main stages to the calculations of the SAFs; namely the calculation of the average prices themselves and secondly construction of the actual SAFs and the method used. Both are described in detail below.

5.1.1.1. Calculating average prices

i. Consumer Prices Index data

One of the advantages of using UK CPI data is that we are able to calculate an annual average price. When using CPI data over a period of 12 months, an annual average price for each region was calculated. This was done by first calculating a monthly average price for each region using an unweighted, arithmetic mean. The annual average price was then calculated by using an unweighted, arithmetic mean of the monthly average prices. The reason for calculating a monthly average price first was due to the fact that the number of prices collected each month differed slightly. Averaging the monthly average prices meant allocating an equal weight for each month. This approach also had the advantage of implicitly weighting by location within a region, as the larger locations generally had more price observations.

ii. Direct collection (in the field and at the desk)

For data collected centrally (collected by ONS) and data collected in the field (collected by subcontractor), the average price for each location was calculated by taking the unweighted, arithmetic mean of all prices collected in each region.

5.1.1.2 Methodology used in constructing spatial adjustment factors

5.1.1.2.1 Using the EKS method

The methodology ONS used to construct the spatial adjustment factors is consistent with the approach used by Eurostat in calculating their PPPs at the basic heading level. The EKS (Èltetö-Köves-Szulc) method was used to impose transitivity on an existing set of intransitive binary indices.

Transitivity is a desirable property as the same result is obtained when comparing PPPs directly between two regions and when comparing PPPs indirectly through the introduction of a third region. In addition to being transitive, the resulting multilateral EKS PPPs differ as little as possible from the original binary PPPs.

The use of EKS can lead to bias when one region has a larger number of representative items than the other region. EKS-S is a modified version of EKS that takes into account the representativity of items in different regions. ONS has assumed equal representativity across the UK; therefore, it was not necessary to use the EKS-S method. This assumption was deemed plausible as the items were being compared within a country rather than across countries where more variation would be expected. Therefore, it was considered that the use of EKS should not lead to bias due to representativity differences between regions.

Due to the unavailability of weighting information for PPP items below the basic heading level, a Fisher-PPP index could not be calculated. Instead, a Jevons-PPP index, or an equally weighted geometric mean of the price relatives, was calculated. Although a Jevons index is usually transitive, the use of EKS was still needed to enforce transitivity because some regions contained missing prices. A weight was then applied at Basic Heading level which was sourced from the Living Cost and Food Survey, the UK's equivalent of the Household Expenditure (Budget) survey.

5.1.1.2.2   Construction of the spatial adjustment factors

The following steps were used by ONS to construct the spatial adjustment factors;

i.   A bilateral comparison of the PPP item's average price was calculated for each combination of regions. With seven regions, this meant 49 different price relatives for each item.

ii.   The price relatives were then mapped to their respective basic heading for each region.

iii.   The unweighted, geometric mean of the PPP item price relatives were calculated for each basic heading.

iv.   EKS applied to enforce transitivity on the binary PPPs.

v.   The weighted geometric mean of each row in the EKS matrix was taken, giving an adjustment factor where UK=1 for each region.

vi.   The inverse of the adjustment factor London (UK=1) was taken to produce the spatial adjustment factor delivered to Eurostat.

5.1.2 Relative regional consumer price levels of goods and services

As already commented the construction of UK regional price levels were only calculated as a result of the work undertaken by the UK on updating of the UK SAFs for Eurostat as part of a requirement under the PPP regulation. However, they were a welcomed by product and it did not require a significant amount to work to produce; the same dataset was used for both the SAFs and RRCPLS outputs.

5.1.2.1. Calculating average prices

5.1.2.1 Consumer Prices Index data

The use of CPI price data formed an important component of the RRCPLs calculations. CPI data was obtained for approximately a quarter (124) of the items in the basket used in the calculation of the RRCPLs. The majority of the items where CPI data was used were for the *Food and Non Alcoholic Beverages* and *Alcohol and Tobacco* divisions; for these two divisions just over 50% of the data used were CPI items. These divisions contain items that are well defined in the CPI item description and which ensure a like for like comparison across different regions. A major consideration in choosing items from the CPI basket was their closeness in specification to items in the PPP basket of goods and services. Those CPI items that align very closely to the PPP specification were selected and their existing price observations were included in the dataset.

The prices extracted from the CPI database refer to the twelve month period July 2015 to June 2016 and accounted for approximately 277,500 observations. An average price for the item in each region was calculated for each month. An annual average price was then calculated by taking an unweighted average of the monthly average prices.

5.1.2.2 Methodology used in constructing relative regional consumer price levels

It is important to note that the methodology adopted by the UK in the calculations of RRCPLs is consistent with that used by Eurostat in the calculation of PPPs for the Eurostat-OECD Programme. As commented previously, it is important to note that while RRCPLs compare regions and countries within the UK to each other, the ECP produces PPPs which compare participating countries to each other within the Programme.

> The approach used to construction relative regional consumer price levels is consistent with that adopted by Eurostat in the calculation of the PPPs.

The basic approach to calculating relative regional consumer price levels is to measure the cost of purchasing a common basket of goods and services in each region and express that cost relative to buying the same basket nationally (where the UK=100). That is, how much more (or less), relatively speaking, does it cost to buy the basket in one particular region, compared with a UK average cost for the same basket. Similar to the CPI, it is not feasible to collect prices for every type of good and service that consumers spend their money on. Nor is it possible to collect prices from every single outlet or service provider that consumers make purchases from. Therefore, it is necessary to sample for items, locations, outlets, and service

providers. The main difference compared with the CPI, and important to note, is that regional price level comparisons are designed to compare prices of a common basket of goods and services at one particular point in time, i.e. a spatial comparison, in different regions in the UK, whereas the CPI measures the difference in prices of the same basket of goods and services throughout the UK over a period of time, i.e. temporal comparison. This is a significant difference that is important to understand. It is important to note that the RRCPLs cannot be compared over time as they are a spatial comparison and not a temporal one.

To be able to compare prices at a particular point in time, it is important to ensure that an identical basket of goods and services is priced for all of the regions. This is critical in developing comparable outputs and ensures that observed price differences in the regions are due to price alone and not influenced by variability in the quality of items priced across regions. For example, a comparison of an observed price of a branded item in one region with the observed price of an unbranded item in another region will reflect in part that the items are not comparable and that unbranded items are typically cheaper.

Having collected observed prices for the goods and services included in the basket an average price is calculated in each region for each item. Two stages were employed to calculate and aggregate the RRCPLs. The first stage was below the elementary aggregate level, referred to here as the basic heading. Basic headings are the building blocks for the RRCPLs and are the lowest level for which expenditure weights can be obtained. A basic heading comprises a group of similar, well-defined goods or services. In total, 168 basic headings have been defined for this process. A few examples of basic headings are; *Ladies Coats and Jackets, Jewellery, Wine, Wardrobes* and *Chocolate*. Above the basic heading level, RRCPLs were calculated and aggregated using the Classification of Individual Consumption according to Purpose (COICOP) used in the CPI. Regional expenditure was obtained from ONS's Living Costs and Food survey and adapted to create regional weights for the 168 basic headings.

As there is no data available on the expenditure on the individual items below a basic heading, a basic heading RRCPL has to be calculated from price data only. Below the basic heading, price relatives for each pair of regions were first calculated; with five regions (London, England (excl London), Wales, Scotland and Northern Ireland), this resulted in 25 unique price relatives. To combine the price relatives of the items at the basic heading level, an equally weighted geometric mean of these relatives was calculated for each pair of regions.

Once the RRCPLs had been calculated at the basic heading level, regional weights were used to aggregate the basic headings to successive COICOP levels. For each pair of regions, the basic heading RRCPLs are weighted, summed and averaged using first the expenditures on the basic headings of the first region as weights, and then the expenditures on the basic headings of the second region as weights. This gave two weighted RRCPLs: a Laspeyres-like RRCPL and a Paasche-like RRCPL. The geometric mean of these two RRCPLs was then calculated, which produced a single Fisher-like RRCPL between the two regions.

Once each level of aggregation is provided with a matrix of Fisher-like RRCPLs, it was necessary to apply a method to impose transitivity on the Fisher-like RRCPLs. Transitivity is a desirable property for spatial price indices as the same result is obtained when comparing RRCPLs directly between two regions and when comparing the RRCPLs indirectly through the introduction of a third region.

The method used by Eurostat, and adopted by ONS, to impose transitivity is the EKS (Èltetö-Köves-Szulc) method. The RRCPL that results from application of the EKS method (the EKS RRCPL) is defined as the geometric mean of the direct RRCPL and all the indirect RRCPLs between a pair of regions, with the direct RRCPL having twice the weight of each indirect RRCPL. To produce the data in Table 1, England (excl. London) and Wales would need to be compared directly and through London, Scotland and Northern Ireland.

In addition to being transitive, the resulting EKS RRCPLs differ as little as possible from the original Fisher-like RRCPLs. After applying EKS, we are left with a 5x5 matrix of the bilateral EKS RRCPLs. Standardisation of the EKS RRCPLs is required in order to obtain a set of RRCPLs that has the UK as its base. This is done by dividing each RRCPL by the geometric mean of the RRCPL in its column of the matrix. This results in five EKS RRCPLs, one for each region (all the entries in each row have the same value after standardisation), with the UK as the base, where UK=100.

Worked example of calculation

Linked as an excel file is a worked example for food and shows the method used for calculation of basic PPPs and applying EKS to enforce transitivity. This was run in a programme called SAS. This is currently in excel format.

SECTION SIX – FUTURE DEVELOPMENTS

This section will look at future developments that will be undertaken as part of a wider initiative within ONS to produce 'better statistics for government to make better decisions'. This will cover the following topics;

TO NOTE: THIS SECTION WILL BE UPDATED FOR FINAL PAPER AS ACT HAS JUST HAD ROYAL ASSENT TO BECOME LAW AND THEN DETAILS WILL BECOME AVAILABLE BUT BASICALLY, THIS ALONG WITH OFFICIAL UK STATISTICS OF TRADE ACT 1947 WILL LEGALLY MANDATE COMPANIES TO PROVIDE UK, ONS WITH SCANNER AND OTHER ALTERNATIVE DATA SOURCES.

6.1 Transformation of ONS to capture the new innovative ways ONS are adapting to be more efficient and capable. This section will detail the initiatives and the support ONS has invested in technology and capability, specifically looking at the ways that this will help support the possible synergies and integration between CPI and PPPs.

6.2 Current work underway between by the CPI looking at web scrapping and scanner data including building relationships with key retailers and service providers. Discuss how these potentially new data sources and methods of obtaining data could strengthen price data used in SAFs and PPPs in general.

6.3 Digital Economy Act- ONS has a new bill going through the UK parliament. This section will explain the implications for PPPs and CPIs and the benefits of the act, if any, which could potentially help

IMPORTANCE AND USES OF SAFS AND REGIONAL PRICE LEVELS

This section will look at the key uses of Spatial Adjustment Factors (SAFs) and regional price levels with the additional aim of extending the interests, knowledge and awareness of these beyond those countries/regions that already compile SAFs and/or regional price levels.

1.1 Uses of spatial adjustment factors

1.1.1 Allows for true comparability across countries/regions

Producing comprehensive SAFs is always going to be a challenge for any country or region but it is important that they are calculated if there are known differences in prices across the country. Spatial Adjustment Factors, or SAFs as they are most commonly referred to, are an important element of the calculation of national annual average prices. For many regions or countries, price collection for consumer goods and services are restricted to the 'capital city'. For example, in the case of the UK, prices are collected only in the UK capital city of London. However, to arrive at national average prices that are representative of the country and which can them be compared across all countries, SAFs should be produced.

Regular surveys are administered on a three-year rolling basis (this is the case for the European Comparison Programme) (ECP) and it is being considered for adoption for the International Comparison Programme (ICP). That said, for both the ECP and ICP, national annual average prices are required. It is for this reason why SAFs are used and are key to the calculation of a national average price; the fundamental aim is to take average prices to national average prices. In the case of the UK, to take average London prices for specific goods and services to a UK national average price.

1.1.2 Reduces burden on National Statistical Institutes

Another important factor is that producing SAFS say, every six years reduces the burden on National Statistical Institutes (NSIs) both in terms of finances and resources. As previously mentioned, annual national average prices are required and for most countries it would be an impossible task to conduct a nationwide price collection every year for consumer goods and services. In the most cases, the prices submitted by the NSIs to Eurostat and OECD are not national as they generally refer only to the capital city of the country in question. However, there are several member states in the ECP that do not have any regional price variation and therefore do not supply SAFs to Eurostat. They do however, provide TAFs (Temporal Adjustment Factors).

1.1.3 Regulated by Eurostat/OECD

For countries participating in the European Comparison Programme (members of the European Union, EFTA countries and candidate countries) they are regulated [1]by the Purchasing Power Parities Regulation, in the absence of average national prices, to undertake a Spatial Adjustments Factor exercise to supply SAFs that take city prices to national prices. (For information – there is a second stage of this process - temporal factors will take monthly prices to annual prices.) The regulation stipulates that spatial adjustment fact (which are to be supplied at basic heading level) should be no more than six years old at the reference period of the survey.

1.2 Uses of regional indices – price levels or price changes?

Regional price levels have been produced several times by the UK. Refer to section 1.2.2 '*Demand for regional price data'* and involve comparing price levels across regions – a spatial index. This was also the focus of other regional prices published and shows the relative costs of a fixed basket of goods and services in different regions. Many prices varied very little by region and some prices that are set nationally may not vary at all. Indeed, some items have national pricing such as postage and communications and some brands have national pricing such as APPLE products. With strong competition on the UK market, particularly among the top four supermarkets there is very little divergence or variation. Indeed, many of SAFs for the aggregate of Food, Beverages and Tobacco are close to 1, due to this competition and national pricing. A few commodities may behave very differently in different regions and the most key one is housing. This would not be needed for CPI but is kea major component of CPIH and therefore would be a major component of regional differences in the UK.

The existing publication of Relative Regional Consumer Price Levels (RRCPLs) as already commented previously is derived from the information used in the six yearly calculations of the Spatial Adjustment Factors (SAFs). This information used in the calculations also provides estimates of regional; price levels for a fixed national basket of goods and services, excluding n housing. Regional weights for the aggregation of each basic heading are derived from the UK household budget survey, namely the Living Cists and Food survey, reflecting at least part of the differences in expenditure patterns by region.

An alternative approach is tom produce a temporal price index in each region, in effect regional price inflation. However, such indices will not produce information that is suitable for comparing price levels between regions. To have both regional inflation and regional levels, it will necessary to produce two types of index.

For the UK one of the major by-products or benefits of conducting the Spatial Adjustment Factor project was the opportunity to produce Relative Regional Consumer Price Levels (RRCPLs). An article was published by the UK providing analysis of price levels for consumer goods and services for many regions in the UK (including the composite countries of Wales, Northern Ireland and Scotland) as well as London and other key regions within England. The analysis primarily focused on price level indices which provided a comparison of regions price levels in the UK relative to the UK average.

As commented, the results were based on a sample of a large sample of observations using the underlying price data from the three main sources that was used in the SAF calculators; namely CPI data,

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[1] Regulation (EC) No 1445/2007 of the European Parliament and of the Council establishing common rules for the provision of basic information on Purchasing Power Parities and for their calculation and dissemination.

a nationwide regional survey of prices conducted by a third part and finally data collected internally by the UK statistical office, ONS. It therefore took minimal work, (relative to the importance of the outputs) to undertake an analysis of regional price levels as the dataset had been validated and SAFs already calculated. Comparability across regions was ensured by having tightly defined specifications s for each of the items in the basket

1.2.1   Allows for comparison of piece levels across regions

The main use of Relative Regional Consumer Price Levels (RRCPLs) and the reason the UK made the decision to publish such data was to allow for a comparison of price levels across regions of the UK. Supplementary data was published to a more detailed regional level within England but only at the aggregate level as it was no felt that the dataset was robust enough for more detailed disaggregated data. Data was published at total and division level (based on COICOP classification) for five regions (London (England (excluding London), Scotland Wales and Northern Ireland

1.2.2.   Demand for regional price data

There has always been a demand and interest for regional price levels from the devolved assemblies of Wales, Scotland and Northern Ireland and England as well as other government departments, policy makers, academics, researchers, etc. The latest data published by the UK was in March 2018, Relative regional consumer price levels of goods and services, UK:2016 (refer to link below).

In the 2003 budget, the then UK Chancellor of the UK government announced plans to produce regional price levels for the UK. We published our plans for addressing this need the same year in Developing estimates of relative regional consumer price levels. More recently regional price data was published in 2011 and now in 2018. Both final two datasets were produced because of the requirement by Eurostat for the UK to deliver SAFs.

The UK has also responded to user demands for regional price data in recent years;

i.   2001 - produced indicative figures for 2000 on the variation in prices between regions

ii.   2004 - published estimates of 2003 regional price levels, partial update on 2000

iii.   2005 - published regional price levels for 2004, similar to 2003 estimates

iv.   2011 - published regional price levels for 2010, regions price levels compared with UK

v.   2018 – published regional price levels for 2016, regions price levels compared with UK

In November 2017, ONS commissioned work by Southampton university to conduct a feasibility study into producing a regional CPIH (Consumer Price index, including owner occupied housing costs. Refer to section 6 Future developments.

1.3 Development of UK CPIH - calculating at regional level

The UK CPIH (Consumer Prices Index, including owner occupiers housing costs) is used to measure consumer price inflation in the UK. It was introduced in 2013 as a more complete measure of inflation as it included owner occupiers housing costs(OOH), which make up a major proportion of household budgets in the OOH calculations and some other elements were made.

There is great user demand for regional data, both regional price levels and Consumer Price Index at regional level

There is a demand within the UK for regional data, whether this be price levels or inflation.

Users of price statistics have for a long time suggested that regional indices of consumer prices would be valuable statistics in helping to understand how inflation varies across the UK, and whether there are important differences in regional inflation (RPI Advisory Committee 1971, Fenwick and O'Donoghue 2003, UK Statistics Authority 2013). The assumption has been that the number of price quotes is too small at a regional level to support the calculation of indices, and it has not been a sufficiently high priority to invest in additional price collection for this purpose. Some limited information on variation in regional prices has been made available through Office for National Statistics (ONS) publications on Relative Regional Consumer Price Levels (RRCPLs. These publications have used information from additional price collections made every six years for the purposes of adjusting Purchasing Power Parity (PPP) statistics.

PPP prices are collected in the capital city of the country, and a periodic exercise is undertaken to adjust to the whole country. RRCPLs show the differences in price levels between regions, but are not designed to show price change (inflation), and because of the methodology and differences in the weights, they cannot be used even for a once-every-six-years approximation to regional inflation. Therefore, the ONS has commissioned some work to investigate the potential for the existing consumer price collections to support the calculation of regional price indices for CPIH at regional level for the nine regions of England and the devolved assemblies of the UK, Wales, Scotland and Northern Ireland. This is the same regional breakdown as for the Relative Regional Consumer Price Levels (RRCPLs).

A regional CPIH measure would provide valuable insight for policy makers into the nature of how variable inflation rates are within the UK and the potential causes of inter regional inflation differences

There is however major hurdles or restriction; that is whether the currently available data sources for the CPIH lead to sufficiently reliable measures at the regional level. The feasibility study concluded that regional CPIH are not suitably reliable statistics when using the same methods currently used for the national CPIH. The main challenges were inadequate sample size at regional level, a modification of region based weights within strata and lack of expenditure weights at item level. However, the regional CPIH does capture the general trends similar to that of the CPIH which show that there is potential for it to be developed to be more useful. It is proposed that a study into alternative statistical methods is suggested to overcome the limitations of the smaller regional sample sizes. Such statistical methods which may provide improved regional CPIH reliability, would be small are estimation methods, smoothing

methods and finite population corrections. Also aggregating the available data in larger categories may provide more robust, but less sensitive indices.

Next steps for development of regional price inflation and regional price levels

There continues to be a demand for regional price data. A limitation of the approach for example used to construct SAFs is that due to the need to have a large field based collection to address the areas where CPI data is insufficient, it can only reasonably be completed every six years. This is when, as previously noted, ONS is required to meet its obligations to Eurostat in updating SAFs.

At the time of writing this article, there are no immediate plans to assess the feasibility and usefulness of developing and publishing annual results for the areas where CPI data can be used for spatial comparison or to produce regional price data more regularly. That said, however, has already mentioned ONS has recently commissioned work by Southampton University to conduct a feasibility study into producing rCPIH (Consumer Price Index, including owner occupied housing costs.

It is important to note that these are different from the RRCPLS which show the relative difference in price levels between regions. In comparison, the regional CPIH consistent (referred to as rCPIH) inflation rates are designed to show price change over time (inflation). The aim of the feasibility study was to investigate the potential for the existing consumer price collections to support the calculation of regional price indices. More specifically, it assesses the feasibility of calculating the CPIH at a regional level for the nine regions of England, and Wales, Scotland and Northern Ireland from existing data. A reasonable rCPIH measure would provide valuable insight into the nature of how variable inflation rates are within the UK and the potential causes of inter-regional inflation differences. However, the major restriction is whether the currently available data sources lead to sufficiently reliable measures at the regional level.

In brief, the study found that it is possible to construct rCPIH series from the available data sources. The basic patterns in the series are similar to those in the national CPIH. The individual rCPIH differ in ways that could be expected, for example, with London prices increasing at a greater rate than other regions, driven primarily by housing. Although these provisional rCPIH are somewhat useful, the reliability of specific components of the data and procedures are relatively low. Small sample sizes create a great deal of irregularities and uncertainties in the indices as measured by approximate variances, which is the main issue. Therefore, although it is feasible to construct regional CPIHs, considerable further development is required to ensure that the rCPIH can reliably represent the inflation within each of the regions. ONS will continue to work with Southampton University to progress some of the recommended next steps at outlined in the feasibility study, including investigating the assumptions of the provisional rCPIH such as using national item indices when regional data are not available. Further updates will be published as the work progresses.

ANNEX ONE

GLOSSARY

BASIC HEADING – the lowest level of aggregation in GDP breakdown for which PPPs are calculated

BASIC PRICE – The amount received by the supplier from the consumer for a good or service. This price is before tax or discounts.

BASIC MODEL - The product in its simplest form, not including any added extras or benefits.

COMPARABILITY – the property to ensure that prices collected within different regions, states or countries are produced or supplied to the specification.

DISCOUNTS – a reduction in the normal or regular price or increased quantity for the same price of a product or service offered by the retailer of service provider. Primarily, they are temporary discounts or quantity discounts. The reduced price must be available for a period of less than four weeks to be classed as a discount. If the reduced price is available to the consumer for more than four weeks it is then a regular price. There are primarily two types of discounts; temporary (offered in the form of a price reduction) and quantity discounts (offered in the form of an additional quantity of the same products for free or at a lower price.

EKS METHOD – the method used by Eurostat and the OECD to calculate PPPPs for basic headings and to aggregate basic heading PPPs to obtain PPPs for each level of aggregation up to and including GDP. The EKS is a procedure whereby any set of intransitive binary index numbers are made transitive while respecting characteristicity. The procedure is independent of the method used to calculate the intransitive binary indices.

ITEMS – A detailed specified good or service for which prices are to be collected

ITEM LIST – This is a common list of well-defined or specified goods and services from which countries participating in a comparison (such as the ICP) make a selection of products or items to price for the purpose of calculating PPPs. Also referred to as a basket or product list.

ITEM SPECIFICATION – the unique properties specific to an item to ensure the same item is priced in all locations.

NATIONAL AVERAGE PRICE - a price that has been averaged over all locations of a country (using SAFs) to take account of regional price variations and the complete reference year (a calendar year as opposed to a specific month) to allow for seasonal variations (using TAFs) and changes in prices

OUTLET – a place where goods or services are purchased such as a shop, market, internet site, mail order, service establishment or indeed any place where products or services can be purchased by the purchaser.

PRICES – the purchaser prices paid by the final consumer

PURCHASING POWER PARITIES (PPPs) – spatial deflators and currency convertors that eliminate the effects of the differences in price levels between members of the Programme, thus allowing volume comparisons of GDP components and comparisons of price levels

PRICE LEVEL INDEX (PLIs)– commonly referred to as PLIs, these are the ratio of PPPs to exchange rates. The PLI expresses the price level of a given region or country relative to another by dividing the Purchasing Power Parities by the current nominal exchange rate. If the PLI is greater than 100 for a region or country then that country is relatively expensive compared to other countries with which it is being compared. If it is less than 100, then the country is relatively cheap compared to others with which it is being compared.

REPRESENTATIVE ITEMS - those items in the basket of goods and services which are deemed to be, in terms of relative consumers expenditure, among the more important items within a specific basic heading

NON-REPRESENTATIVE ITEMS – the opposite of the above. Those items in a basic heading where consumer spend is very low compared to other items within the same basic heading

SPATIAL ADJUSTMENT FACTORS – also referred to as SAFs they are factors used to adjust average prices from usually one (or in some countries more than one) location within the economic territory of a member state to national average prices

TEMPORAL ADJUSTMENT FACTORS – also referred to as TAFs they are factors used to adjust average prices at the time of a survey (usually a specific month) to annual average prices

TRANSITIVITY – the property whereby the direct PPP between any two member states (countries) gives the same result…

TRANSACTION PRICE – the price paid by the consumer at the point of sale/purchase.

ANNEX TWO - SHOP TYPES

OUTLET TYPE	DESCRIPTION/EXAMPLES
Large shop	Supermarkets, hypermarkets and department stores
Medium or small shop	Mini-markets, kiosks, neighbourhood shops, grocery stores, convenience stores

Market	Open markets, covered markets, wet markets
Street outlet	Mobile shops, street vendors
Bulk and discount store	Wholesale stores, discount stores
Specialised store	Supply stores, hardware stores, furniture stores
Private service provider	Taxi cabs, hotels, restaurants, private schools, private hospitals
Public or semi-public service provider	Water suppliers, electric power companies, public schools, public hospitals
Other kind of trade	Internet shopping sites, mail order (catalogue) orders