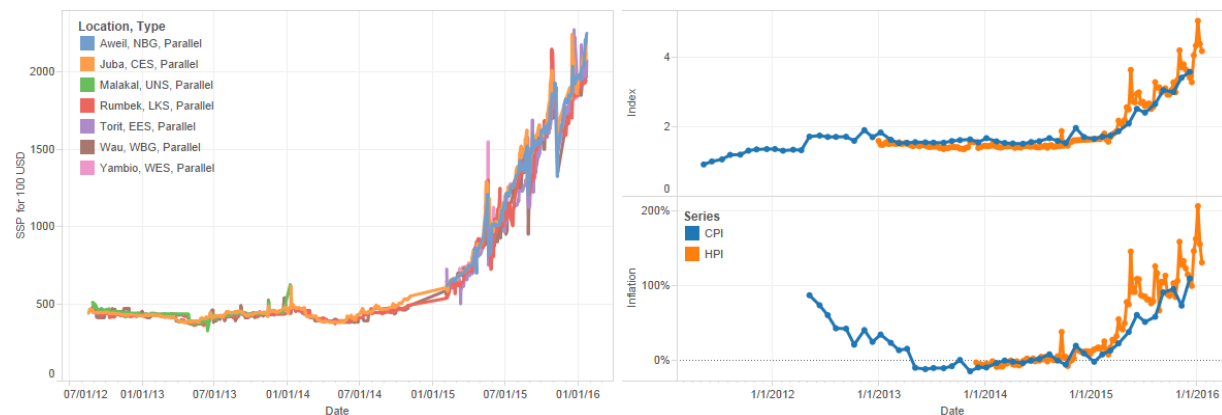


# HFS Market Surveys in South Sudan

## New Online Dashboard for Market Exchange Rates and Market Prices for South Sudan



<http://dataviz.worldbank.org/views/MarketSurveys/Dashboard>

### Summary

The Market Surveys of the High Frequency South Sudan Survey (HFSSS) track daily exchange rate data and weekly market price data in several locations in South Sudan since 2012. The data are now made publicly available in an online dashboard updated in near real-time. The dashboard offers the following visualization and functionality:

- Daily exchange Rate of USD in SSP (buying, selling and midpoint prices)
  - From traders in the parallel market (since 2012)
  - From commercial banks (since 2016)
- Weekly market price data
  - aggregated as price index (HPI; since 2012)
  - comparison with the monthly CPI from the National Bureau of Statistics (since 2011)
  - relative changes (inflation) of the price indices (monthly and annual)
  - shortages of products in markets
- Geographical disaggregation by up to 15 towns in South Sudan
- Download of the underlying data

The initiative is currently funded until the end of 2016. Partners interested in extending the funding are welcome to contact the team. Please direct your questions to Utz Pape ([upape@worldbank.org](mailto:upape@worldbank.org)).<sup>1</sup> We also appreciate short notifications if you use the data in internal or external publications.<sup>2</sup>

<sup>1</sup> Duncan Cook and Andrew Zadel contributed to the analysis and note. The team is grateful for suggestions from Johan Mistiaen and Mamadou Ndione.

<sup>2</sup> Please cite this publication as “World Bank (2016): HFS Market Surveys in South Sudan (2012 to 2016)”.

### Overview

**The High Frequency South Sudan Survey (HFSSS) collects daily exchange rate and weekly market price data as well as household data with high frequency.** The initiative is designed by World Bank, jointly implemented with the South Sudan National Bureau of Statistics (NBS) and funded by a Trust Fund from DfID and the Multi Donor Trust Fund for Sustainable Logistics. The main goal of the initiative is collecting data in South Sudan to inform the Government, Development Partners and other stakeholders. The HFSSS program also serves to strengthen NBS capacity in new and innovative data collection methods, data analysis techniques, and data dissemination strategies. After a pilot phase from 2012 to 2014, the surveys were fully scaled-up in 2015.

**The Market Price Survey (MPS) and Exchange Rate Survey (ERS) have been conducted in 6 major towns since 2012 and were recently expanded to 15 locations.**<sup>3</sup> The data are collected using handheld tablet computers and uploaded directly to a cloud-based server. The data are automatically processed on the server and made available in an online Tableau dashboard where the data can be visualized and downloaded. A guide to use the Tableau dashboard is included in the Annex. The publicly available dashboard can be found here:

<http://dataviz.worldbank.org/views/MarketSurveys/Dashboard>

**The household survey component of the HFSSS collects data on livelihoods and a range of other indicators once or twice a year.** The pilot data of the household survey component was analyzed in a World Bank brief “Monitoring Welfare and Perceptions in South Sudan 2012 – 2014: Findings from the High Frequency South Sudan Survey”. The pilot survey was scaled up to become representative at the state level and for rural and urban populations. The first wave (February to September 2015) covers six states and focuses on household consumption. The second wave (planned for April to September 2016) will expand to a seventh state. This note only covers the MPS and ERS.

### The Exchange Rate Survey

**The ERS collects daily prices for USD in South Sudan.** The ERS tracks the buying and selling prices for 100 USD from traders in the parallel market. Prices from multiple traders are recorded in every location every day, and the average prices are used. Since the exchange rate was floated in December 2015, the ERS also collects the buying and selling prices from commercial banks.<sup>4</sup> The collected data is rudimentarily cleaned.<sup>5</sup> The dashboard visualizes the buying and selling prices as well as the midpoints calculated as the average of the buying and selling prices.

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<sup>3</sup> The data collection could not yet be resumed in Malakal due to security constraints.

<sup>4</sup> Enumerators only ask for the prices but do not engage in a transaction.

<sup>5</sup> If the buying price is above the selling price, both prices are swapped. Buying and selling prices below the official exchange rate are discarded (before 15<sup>th</sup> December 2015). Outliers are defined as deviating more than 25 percent from the average price in the previous five and following five calendar days with missing prices linearly interpolated.

### The Market Price Survey

**The MPS records weekly price data for 20 consumer items in South Sudan.**<sup>6</sup> Retail prices are recorded for all 20 products and wholesale prices are recorded for 8 products at specified markets. A wide range of physical items are covered, such as sorghum, lentils, dried fish, charcoal, and petrol. Market traders are asked the prices they are offering for a typical quantity of their goods. The prices are recorded with the tablet and the precise weight of the products is determined with a digital scale allowing for the calculation of comparable unit prices.<sup>7</sup>

**Data collection for the MPS resembles the Consumer Price Index (CPI) for South Sudan, but differs in several ways.** CPI data collection is carried out in Juba and Wau by a permanent team of enumerators within NBS. The CPI basket of goods contains 118 items including school fees, toiletries, medical care and other goods and services not featured in the MPS. The data are collected only on a monthly basis, whereas MPS data are collected weekly. The CPI data collection purchases products rather than just asking for prices as done by the MPS. This is likely to affect the reported prices in the MPS because the first price asked is often considerably larger than a bargained price at the time of purchase.

**Price data from the MPS are aggregated to create a High-Frequency Price Index (HPI) similar to the CPI.** Each item in the CPI has a weight reflecting its share of total consumer expenditure in the basket of goods covered by the index. The HPI adopts the weights from the CPI and adjusts them to account for items that are not included in the MPS. A detailed description of the methodology to construct weights as well as the exact cleaning procedure for outliers can be found in Annex.

**The dashboard compares the HPI with the CPI and offers a shortage index.** The HPI and CPI can be compared as they are constructed using compatible weights. For both indices, annual and monthly inflation is calculated. For the HPI, a smoothed inflation using a 4-week moving average to reduce volatility is also available. In addition, a shortage index is calculated representing the relative weight of products unavailable in the market in the given week.<sup>8</sup>

**By construction, the HPI is more volatile than the CPI.** The HPI only includes 20 items representing 55 percent of the CPI weights. Thus, the HPI ignores price movements in the other products. This is problematic for products included in the HPI without their (seasonal) substitutes. Consumers often substitute products that are out-of-season with products in-season, e.g. in the case of fruits and vegetables. The CPI includes a larger number of substitutes and, thus, reflects better substitution effects. In contrast, the HPI tends to over-emphasize price volatility.

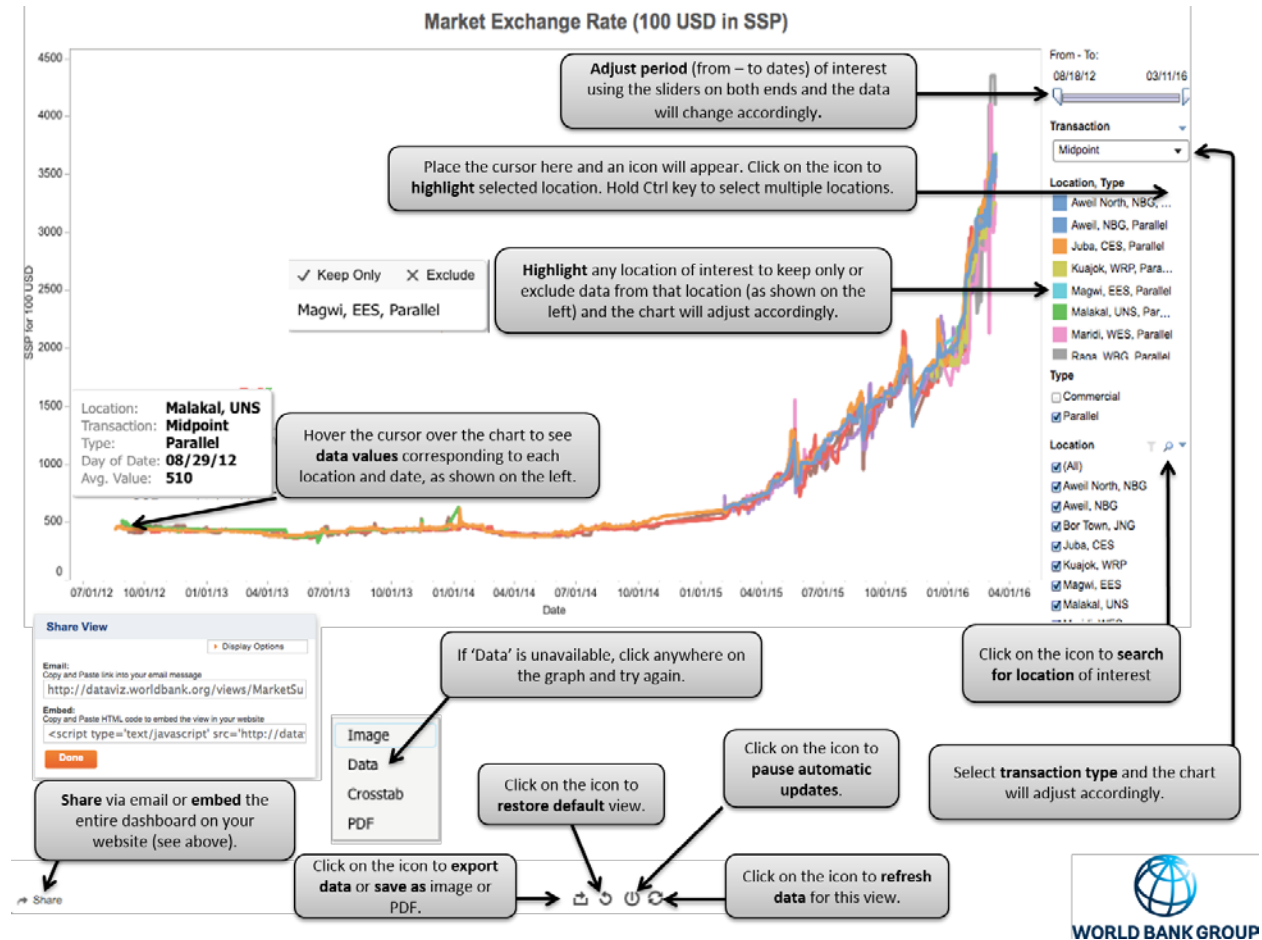
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<sup>6</sup> A list of the products is available in Annex. The MPS has been expanded to include 37 products, as of November 2015. Retail prices are collected for all 37 products, and wholesale prices for 13 of those. Also from November 2015, the MPS covers 15 locations.

<sup>7</sup> The goods are not purchased, and thus money does not change hands as part of the MPS.

<sup>8</sup> Note that the HPI adjusts weights to compensate for the weight of missing products in the respective weeks.

**Annex 1: Quick Guide for Tableau Dashboard**



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### Annex 2: MPS and ERS Locations and Products

Table 1: MPS and ERS Locations

State	Location	Data series start	Comment
Upper Nile	Malakal	30-Dec-2012	location on standby since January 2014 (insecurity)
Jonglei	Bor Town	13-Dec-2015	
Warrap	Kuajok	6-Dec-2015	
Warrap	Tonj South	3-Jan-2016	
Northern Bahr el Ghazal	Aweil	1-Feb-2015	
Northern Bahr el Ghazal	Aweil North	14-Feb-2016	
Western Bahr el Ghazal	Wau	30-Dec-2012	
Western Bahr el Ghazal	Raja	7-Feb-2016	
Lakes	Rumbek	30-Dec-2012	
Lakes	Rumbek East	10-Jan-2016	
Western Equatoria	Yambio	1-Feb-2015	
Western Equatoria	Maridi	27-Dec-2015	
Central Equatoria	Juba	30-Dec-2012	
Central Equatoria	Yei	13-Dec-2015	
Eastern Equatoria	Torit	1-Feb-2015	
Eastern Equatoria	Magwi	13-Dec-2015	

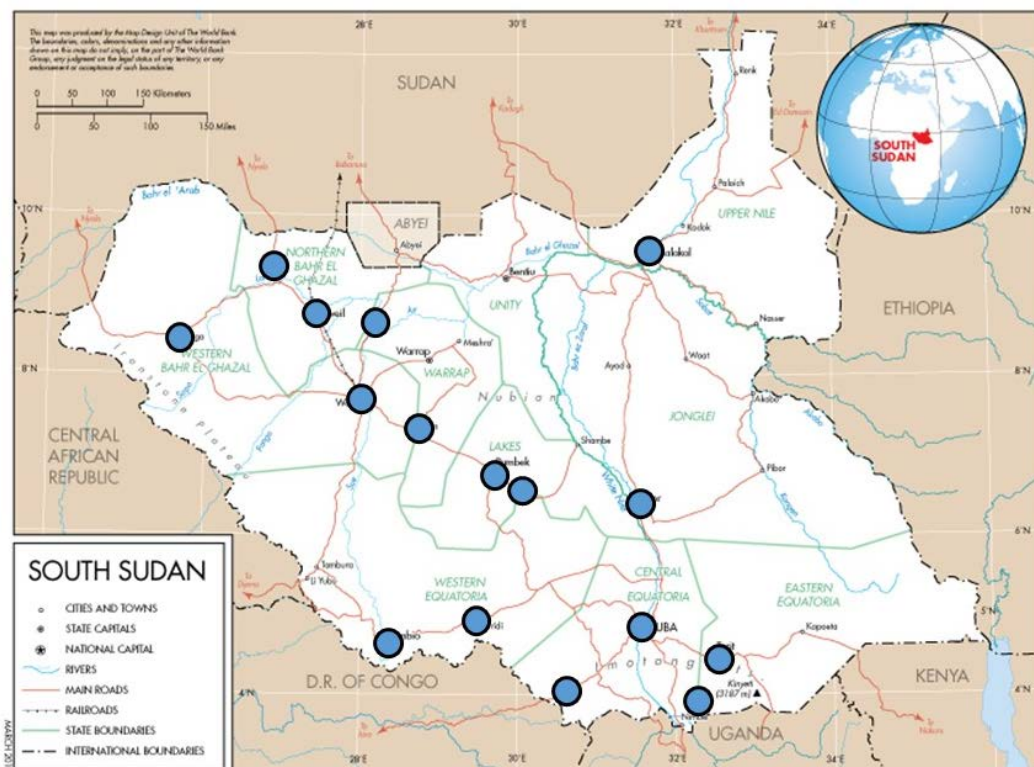


Figure 1: MPS and ERS Locations

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Table 2: Complete Listing of Products in MPS

Product name	COICOP code	Retail prices collected in MPS	Wholesale prices collected in MPS	New item added to MPS in Nov 2015	Item included in CPI
Maize Flour	0111-01	X	X		X
Maize Grain	0111-02	X	X		X
Rice	0111-04	X	X		X
Sorghum Flour	0111-05	X	X		X
Sorghum Grain	0111-06	X	X		X
Bread	0111-08	X			X
Millet Grain	0111-81	X	X	X	
Millet Flour	0111-82	X	X	X	
Goat Meat	0112-01	X			X
Beef Meat	0112-02	X			X
Dried Fish	0113-02	X			X
Cooking Oil	0115-01	X	X		X
Mango	0116-01	X		X	X
Banana	0116-02	X		X	X
Oranges	0116-03	X		X	X
Sesame	0116-81	X	X	X	
Plantain	0116-82	X		X	
Pineapple	0116-83	X		X	
Janjaro Beans	0117-01	X		X	X
Green Okra	0117-02	X			X
Groundnut Grain	0117-03	X	X		X
Lentils	0117-04	X	X		X
Onions	0117-05	X			X
Fresh Tomatoes	0117-06	X			X
Milokhia	0117-09	X			X
Cassava Tubers	0117-11	X	X	X	X
Cassava Flour	0117-12	X	X	X	X
Cow Peas	0117-81	X		X	
Pigeon Peas	0117-82	X		X	
Eggplant	0117-83	X		X	
Cucumber	0117-84	X		X	
Pumpkins	0117-85	X		X	
Cabbage	0117-86	X		X	
Sugar	0118-01	X			X
Food Salt	0119-03	X			X
Charcoal	0454-01	X			X
Petrol	0722-02	X			X

**Annex 3: Outlier detection**

Before creating the price index, the MPS data are cleaned by dropping outliers and imputing missing values. Outliers are detected by examining whether a given price observation is very different from other recorded prices for the same product. Manual cleaning is also carried out by NBS staff who verify the incoming data and communicate with enumerators in the field. In cases where multiple submissions are received for the same week, only the last (most recent) submission is retained.

The outlier detection algorithm is based on a moving average process. This allows outlier detection to remain accurate despite major shifts in price levels that have occurred since the beginning of data collection. Each product is considered individually, with retail and wholesale prices for each product being defined as separate price series. The calculations are based on calculated price per kilo (or per liter), which is referred to as the “unit price.” Firstly, prices missing from the dataset are imputed with linear interpolation to allow for a balanced calculation of averages. The moving average is the average of the unit price for that product in the two previous weeks and two subsequent weeks (i.e. the average of 4 observations). These values are not all available in the first two weeks or last two weeks of a data series, in which case only the available values are averaged. A given unit price is considered an outlier if it is higher or lower than this moving average by more than 50%.

Observations flagged as outliers are dropped from the dataset. These missing values are then imputed. Imputation means that the missing price is replaced with a linear interpolation of the unit price for that item, effectively drawing a straight line between weeks where data are available to create a value where data are not available.

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Table 3: Percentage of Observations Flagged as Outliers

Product name	COICOP code	Number of observations, retail	Percent outliers, retail	Number of observations, wholesale	Percent outliers, wholesale
Maize Flour	0111-01	878	2.7	874	1
Maize Grain	0111-02	817	2.3	686	0
Rice	0111-04	945	2.2	946	0.2
Sorghum Flour	0111-05	592	1.9	13	0
Sorghum Grain	0111-06	912	3.1	844	1.3
Bread	0111-08	924	5.5	n/a	n/a
Millet Grain	0111-81	172	3.5	93	5.4
Millet Flour	0111-82	126	12.7	8	0
Goat Meat	0112-01	868	0	n/a	n/a
Beef	0112-02	927	0.3	n/a	n/a
Dried Fish	0113-02	938	6.6	n/a	n/a
Cooking Oil	0115-01	945	1	948	0.9
Mango	0116-01	225	17.8	n/a	n/a
Banana	0116-02	232	13.8	n/a	n/a
Oranges	0116-03	222	12.2	n/a	n/a
Sesame	0116-81	246	8.1	101	4
Plantain	0116-82	87	4.6	n/a	n/a
Pineapple	0116-83	156	19.2	n/a	n/a
Janjaro Beans	0117-01	259	6.9	n/a	n/a
Green Okra	0117-02	889	13	n/a	n/a
Groundnut Grain	0117-03	731	5.3	672	1.5
Lentils	0117-04	902	3.1	877	0.8
Onions	0117-05	942	8.4	n/a	n/a
Fresh Tomatoes	0117-06	922	10.4	n/a	n/a
Milokhia	0117-09	926	15.9	n/a	n/a
Cassava Tubers	0117-11	190	12.6	20	0
Cassava Flour	0117-12	177	7.9	126	4.8
Cow Peas	0117-81	139	5	n/a	n/a
Pigeon Peas	0117-82	87	5.7	n/a	n/a
Eggplant	0117-83	191	19.9	n/a	n/a
Cucumber	0117-84	117	12.8	n/a	n/a
Pumpkins	0117-85	98	18.4	n/a	n/a
Cabbage	0117-86	167	22.8	n/a	n/a
Sugar	0118-01	945	2.5	n/a	n/a
Food Salt	0119-03	946	1.1	n/a	n/a
Charcoal	0454-01	925	6.1	n/a	n/a
Petrol	0722-02	942	2.2	n/a	n/a



#### **Annex 4: Construction of weights for the HPI**

The price data collected in the Market Price Survey (MPS) are aggregated to create a price index resembling the Consumer Price Index (CPI) for South Sudan. This is called the High Frequency Price Index (HPI). Each item in the CPI has a weight reflecting its share of total consumer expenditure in the basket of goods covered by the index. The HPI adopts the weights from the CPI and then adjusts them to account for items in the CPI that are not included in the MPS.

When tracking movements in prices over time it is common to create a composite index representative of the items consumed by a typical household. Each item is assigned a weight reflecting its share of total consumer expenditure in the basket of goods that make up the index. Items on which households typically spend more (such as grains and meat in South Sudan) have a higher weight and thus have a greater influence on the index. Items on which households typically spend less (such as baking powder or apples in South Sudan) have a lower weight and a smaller influence on the index. The most comprehensive index of this sort would include all of the products consumed by any household. In order to make this work more feasible, data are collected for only the most commonly consumed items. The resulting composite index is called a Consumer Price Index (CPI).

South Sudan's CPI contains over 100 items and is compiled on a monthly basis. In order to collect data more frequently than the CPI, the MPS focuses on a subset of items and records their prices on a weekly basis in several locations throughout South Sudan. This subset of items was chosen based on two criteria. First, items were selected if they are consumed often in South Sudan. Such items have large weights in the CPI. Second, the set of items in the MPS was balanced so as to represent a range of different categories of household consumption, such as cereals and vegetables.

The HPI was built to reflect average consumption in South Sudan in a manner similar to the CPI. Therefore, the HPI adopts the weights of the CPI while taking into consideration the fact that only a subset of items from the CPI have been included. Thus, the weight of an item that is only included in the CPI is shared among similar products included in the HPI. For instance, chicken is featured in the CPI, but does not appear in the HPI. The weight of chicken is therefore shared among the other meat products that appear both in CPI and the HPI. In other words, the price of other meat products is used as a proxy for the price of chicken. The assumption is that the price trend of similar products is homogenous.

The categorization of items is based on a standard international system of codes known as Classification of Individual Consumption according to Purpose (COICOP). These codes classify consumption expenditure within a hierarchy of categories. A "division" is the most general category (e.g. 01 Food and Non-alcoholic Beverages, 02 Alcoholic Beverages, Tobacco and Narcotics), a "group" is more specific, (e.g. 01.1 Food, 01.2 Non-alcoholic Beverages), and a "class" is more specific still (01.1.1 Bread and cereals, 01.1.2 Meat). After division, group, and class have been defined, an individual item will be given its own two-digit number (e.g. 01.1.1-07 Maize).

The HPI weights are calculated by an algorithm based on the COICOP categorization allowing items in the MPS to "bear the weight" of the CPI items that are missing in the MPS. This method preserves the importance of each category relative to the other categories at a given level by proportionally inflating the weight of the items that are present. This adjustment is done at the lowest level, and the same operation is then repeated at the next higher level in the classification hierarchy. This process is repeated until all classes, groups and divisions have been taken into account.

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In more detail, weights for the HPI are derived by the following process: First, items that are included in both the CPI and the HPI receive the corresponding weights from the CPI. Second, the CPI weight for each class is calculated including items that are not covered in the HPI. Third, HPI item weights are inflated by the CPI weight for each corresponding class so that all classes in the HPI have the same weight as the corresponding classes in the CPI. The adjusted weight at the class level of an item in the MPS is the product's CPI weight over the sum of the CPI weights of all MPS items in that class, multiplied by the total CPI weight of that Class. The last two steps are repeated for groups and, subsequently, divisions to ensure that the HPI also reflects the weight of higher categories even if no item from the corresponding class or group is included in the HPI.

An example is given for the sake of clarity. The CPI basket includes 5 items in the Meat Class (COICOP 01.1.2). Between them they have a weight of 7.49 in the CPI, reflecting that 7.49% of the average household's expenditure is on meat. However, only beef and goat (the two with the highest weights) are included in the HPI basket. The total weight of these two products before adjustment is 5.94. The HPI weight is adjusted by multiplying the original weights for both items by an inflation factor proportional to the weight of missing items (7.49/5.94). The total weight of the Meat Class in the CPI and the Meat Class in the HPI is thus equalized.<sup>9</sup> This process is then repeated up through the classification hierarchy, first for the Food Group (COICOP 01.1) and then for the Food and Non-alcoholic Beverages Division (COICOP 1).

Table 4: HPI Weight Adjustment for Meat Class Products

Product	Included in the HPI	CPI weight	Adjusted HPI weight (first iteration)
Goat and sheep meat	yes	3.85	4.85
Fresh beef	yes	2.09	2.64
Chicken	no	0.61	
Accessories (beef/veal)	no	0.56	
Liver (beef/veal)	no	0.38	
		7.49	7.49

<sup>9</sup> The total weight of non-included items is 1.6. Of the included items within this class, beef has a share of  $2.1/(2.1+3.9)$ , or roughly 0.4. Therefore the adjusted weight for beef is its original weight plus its share of the weight of non-included items that it needs to represent:  $2.1+0.4*1.6=2.6$ .

Equivalently, the included products in this class have a weight of only  $(2.1+3.9)/7.5=0.8$ . For them to represent their entire class their weight must therefore be inflated by  $1/0.8=1.25$ . Indeed, in the case of beef  $2.1*1.25=2.6$ .

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Figure 2: HPI Weight Adjustment for Meat Class Products

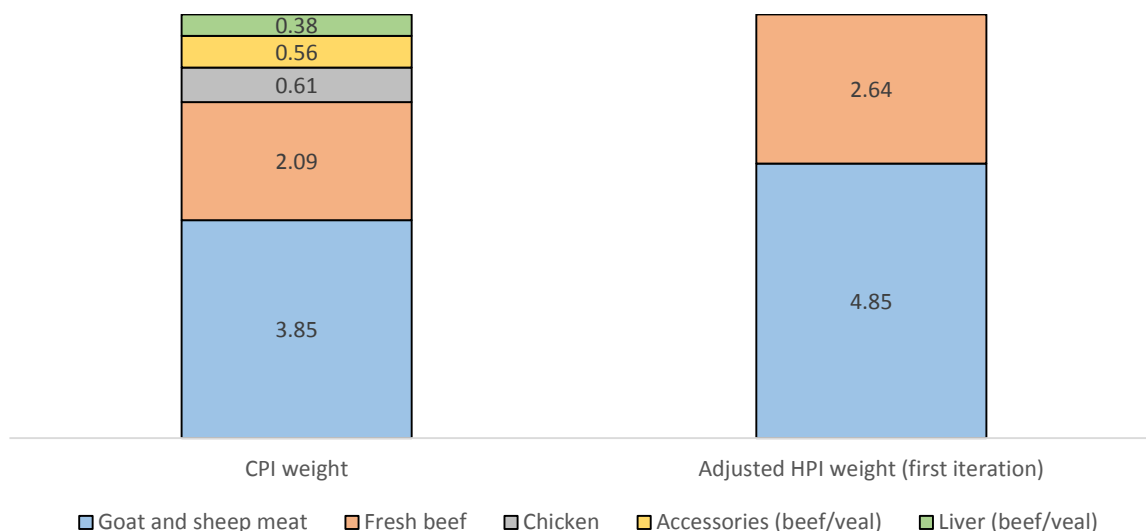


Table 5: CPI and HPI Weights for all HPI Products

Product Name	COICOP code	CPI weight	Adjusted HPI weight
Maize Flour	01.1.1-01	3.29	5.14
Maize Grain	01.1.1-02	1.59	2.48
Rice	01.1.1-04	0.95	1.48
Sorghum Flour	01.1.1-05	9.18	14.33
Sorghum Grain	01.1.1-06	12.38	19.33
Bread	01.1.1-08	2.43	3.79
Goat Meat	01.1.2-01	3.85	7.17
Beef	01.1.2-02	2.09	3.89
Dried Fish	01.1.3-02	3.69	8.48
Cooking Oil	01.1.5-01	3.07	4.54
Green Okra	01.1.7-02	1.36	2.82
Groundnut Grain	01.1.7-03	2.85	5.90
Lentils	01.1.7-04	0.96	1.99
Onions	01.1.7-05	0.91	1.88
Fresh Tomatoes	01.1.7-06	0.32	0.66
Milokhia	01.1.7-09	0.4	0.83
Sugar	01.1.8-01	3.55	6.24
Food Salt	01.1.9-03	0.95	2.17
Charcoal	04.5.4-01	1.33	3.38
Petrol	07.2.2-02	0.23	3.48
		55.38	100.00

**Annex 5: Construction of town-specific HPI**

The HPI is an index reflecting the price of a bundle of items. It can be used to compare price levels across time and across space. Along the lines of the calculation of the CPI, the national HPI  $I(t)$  at time  $t$  is calculated as a weighted average of town-specific HPIs

$$I(t) = \sum_x W_x I_x(t)$$

where  $W_x$  denotes the weight for town  $x$ . Note that the national HPI only uses the towns included in the CPI (currently being Juba and Wau with a weight derived of the CPI of 0.82 respectively 0.18).

The town-specific price indices first must be anchored before the indexes are evolved by the weighted growth rates of the prices in the bundle. The HPI for Juba is anchored in the week of 8<sup>th</sup> February 2015 and set equal to the CPI of Juba

$$I_x(t) = C_x(t) \text{ for } t = T(x) \text{ and } x = x^*$$

with  $I_x(t)$  and  $C_x(t)$  denoting the HPI respectively CPI at time  $t$  for location  $x$ ,  $T(x)$  denotes the anchor date for town  $x$  and  $x^*$  denotes Juba. Thus,  $T(x^*)$  is 8<sup>th</sup> February 2015. For any other date  $t \neq T(x)$ , the HPIs evolve by

$$I_x(t) = G_x(t)I_x(t - 1) \text{ for } t \neq T(x)$$

with  $G_x(t)$  denoting the weighted average growth rate of the prices in the bundle:

$$G_x(t) = \sum_i w_i g_{x,i}(t) \text{ and } g_{x,i}(t) = \frac{p_{x,i}(t)}{p_{x,i}(t - 1)}$$

where  $p_{x,i}(t)$  is the price of product  $i$  in market  $x$  at time  $t$ .

For other towns than Juba, the HPI cannot be anchored to the CPI of that town as the CPI only covers a small subset of towns included in the HPI. Therefore, the HPI for all towns except Juba are anchored to the HPI of Juba.<sup>10</sup> However, the anchoring takes into account the price difference between Juba and the town at the anchoring date. This improves comparability of the town-specific HPIs independent of the start date of data collection in the towns. The anchoring date is the week of data collection in that town closest to 8<sup>th</sup> February 2015 (Table 6). The anchoring for towns except Juba can be written as

$$I_x(t) = G'_x(t) I_{x^*}(t) \text{ for } t = T(x) \text{ and } x \neq x^*.$$

$G'_x(t)$  is the weighted average of price differences between town  $x$  and Juba:

$$G'_x(t) = \sum_i w_i g'_{x,i}(t) \text{ with } g'_{x,i}(t) = \frac{p_{x,i}(t)}{p_{x^*,i}(t)} \text{ for } t = T(x) \text{ and } x \neq x^*.$$

<sup>10</sup> Note that the HPI for Wau could also be anchored to the CPI of Wau. For consistency in the treatment of all towns (except Juba), it was decided to anchor Wau in the same way as other towns.

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*Table 6: Anchoring dates for CPI.*

<b>Town</b>	<b>Date</b>
Aweil	8-Feb-15
Aweil North	14-Feb-16
Bor Town	20-Dec-15
Juba	8-Feb-15
Kuajok	6-Dec-15
Magwi	13-Dec-15
Malakal	5-Jan-14
Maridi	27-Dec-15
Raga	7-Feb-16
Rumbek	8-Feb-15
Rumbek East	10-Jan-16
Tonj South	3-Jan-16
Torit	8-Feb-15
Wau	8-Feb-15
Yambio	8-Feb-15
Yei	13-Dec-15