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**Seasonal Food Expenditure Score**

**Methodological note**

**World Food Programme - Policy and Programme Division**

**Analysis & Trends Service - Economic and Market Analysis Unit**

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# Introduction

Low-income countries spend a great proportion of their expenditure - between 56 and 78 percent – on food (Banerjee & Duflo, 2007), and studies show that food demand is highly responsive to food price changes (Regmi, Deepak, Seale, & Bernstein, 2001). However, Regmi *et al.* (2001) argue that price elasticity is not uniform across all food categories as demand for high value food items (e.g. dairy and meat) reacts more to price changes than staple food demand.

In some countries, total household food expenditure may be largely influenced by the seasonality of food price along the year. Price volatility creates uncertainty, but also high seasonal prices, even if expected, threaten the food security of poor households by limiting their purchasing power and thus their access to food.

With this in mind, the Economic and Market Analysis Unit in VAM (OSZA) has developed the Seasonal Food Expenditure Score (SFE), a monthly indicator that captures potential threats to households’ food security due to high seasonal food prices.

The SFE looks at changes in the cost of food basket in a year and detects months in which high seasonal prices have a major impact in the cost of the food basket. The SFE is not meant to detect price anomalies, rather to describe “normal” market conditions. The idea behind is that the diet of poor families is mainly based on staples and price elasticities for staples is low. Thus, an increase in price will put a heavy burden on the household budget and may threat the ability of a household - who spend already a large part of its income on food- to satisfy its food needs.

VAM has developed this indicators in order to support the Budget and Programming Unit (RMBP) in the identification of countries more in need of assistance from WFP. In particular, RMBP’s budget allocation process requires a windows of six month. Accordingly, the SFE is used to compute a forward-looking indicator, the Severity of the Seasonal Food Expenditure Score (SFES), which summarizes every month how much more expensive the food basket will be in the six upcoming months compared to the yearly average cost.[[1]](#footnote-1)

Both the SFE and the SFES, based on the average national cost of the food basket, scores from one to five and allows ranking countries where WFP operates[[2]](#footnote-2). The higher the score, the more the cost of the food basket is expected to exceed the average yearly cost.

# The Food Basket

The food basket is a combination of basic food products which serves as the usual diet of a population and covers adequately the energy requirements of an individual. As the SFE will be derived from the seasonal index of the cost of the food basket, its definition is crucial. This section describes how the composition and the cost of the food basket are determined.

The **composition** of the food basket is country-specific. Ideally, to ensure cross-time comparability, the composition should also be time invariant. However, in order to ensure a significant basket and bypass the limitation of data availability, the items in the food basket are allowed to change across time, but the composition is such to provide a quasi-constant daily caloric intake over time.

The use of caloric intake finds its justification in the vast literature on poverty measure, which constructs the food poverty line by estimating the cost of purchasing 2,100 kcal/day/per capita. It is based on the idea that a minimum consumption of calorie is needed to ensure biological efficiency. Limitations of this methodology are certainly acknowledged. In particular, it neglects nutritional requirements and disregards the fact that food consumption varies according to tastes and household’s income level (Deaton, 1980). Thus, the choice of commodities to be used in estimating the cost of obtaining 2,100 kcal is not a trivial one (World Bank, 2014).

|  |
| --- |
| Table 1 - Armenia’s Food Basket in June 2016 |
|  |

The choice of the products in the food basket used for the calculation of the SFE depends on the caloric contribution of the item itself to the Dietary Energy Consumption (DEC) as reported by WFP (World Food Programme, 2016). The item’s caloric share to the DEC is transformed in quantity consumed assuming an ideal food basket of 2,100 kcal/person/day (Dietary Energy Requirement - DER); however, the food basket used for the SFE is unlikely to provide 2,100 kcal due to lack of data. As an example, Table 1 reports the list of items for the Armenia’s food basket and the caloric contribution of each item. Due to lack of prices for many items and other reason explained in the following paragraph, only wheat and milk could be used for the calculation of the SFE in June 2016. Thus, the food basket provides only 48 percent of DER, which is 1,008 kcal/day/person.

As mentioned at the beginning of this section, the composition of the food basket may change over the years, but the sum of the caloric contribution of the food items in the basket is kept constant. This result is obtained by (i) fixing the caloric content of the country food basket equal to the maximum common caloric intake in the country across years and (ii) including the most consumed food items. In the example of Armenia, the food basket could have provided 80 percent of DER from April 2012 up today, but only 48 percent in the previous years; thus, the food basket for Armenia was built in such a way to provide only 48 percent of DER across the entire time span. The proportional caloric contribution to DEC is used as a proxy of the relative importance of the item in the food basket (World Food Programme, 2016); thus, the higher the percentage caloric contribution of a product, the most likely it will be included in the food basket. In Armenia, price for milk was not available before April 2012; thus, potatoes and rice were included in the food basket together with wheat in order to provide 48 percent of DER. Once that price for milk was available, it took the place of rice and potatoes in the food basket because its share to DEC was higher.

Furthermore, in order to get a food basket more significant possible, when the use of the last five years of observations only allows for a higher caloric content of the food basket, older observations are dropped and the SFE is built using only the last five years of observations. In the Armenia example, it will be possible to use a food basket covering 80 percent of DER for the SFE calculation in April 2017.

Finally, when different price series for the same food group are available (e.g. price for different varieties of rice), only one item per group is included in the basket. Priority for inclusion is assigned according to the following criteria:

* + - * 1. the longest and most complete series, and within this group the cheapest[[3]](#footnote-3) item;
        2. the longest series, and within this group the cheapest item;
        3. the series meeting the minimum data requirements[[4]](#footnote-4), and within this group the cheapest item.

Two examples below (Figure 1 and Figure 2) can further help to understand the rules used to build the food basket.

Figure 1 - Food basket in Côte d'Ivoire

|  |  |
| --- | --- |
|  | *The items icluded in the food basket partially differ before and after August 2013, but the caloric contribution to the DEC is quasi-constant (52% till August 2013, 50% from September 2013).*  *Till August 2013, palm oil, maize, beef and peanut were not included in the basket as rice, yam and cassava were enough to provide 50% of DEC, and yam was prefered as its caloric contribution was higher.*  *Due to the unavailability of prices for yam after August 2013, palm oil, maize, beef and peanut were included in the basket.* |
|  |

Figure 2 - Food basket in Djibouti

|  |  |
| --- | --- |
|  | *The items icluded in the food basket differ before and after March 2015, but the caloric contribution to the DEC is constant (51%) and the food groups rappresented in the basket are the same (wheat and rice).*  *For the food group ‘wheat’, ‘wheat flour – wholesale’ was selected because the longest series within the food group. When the series interupted, in March 2015, the product was substituted by another item from the same food group. ‘Bread’ was preffered to ‘pasta’ because a cheaper item. Similar for the rice: ‘rice (belem)’ was the cheapest series.* |
|  |

The composition of each country’s food basket, along with its average, minimum and maximum caloric contribution to DER, and the caloric contribution of each item in the basket are reported as Annex I in a separated excel file.

The procedure for calculation of the **cost of the food basket** assumes that: (i) the caloric content of the food basket is time-invariant, (ii) the per capita daily caloric requirement is equal to 2,100 Kcal for each country, and (iii) the energy density of each food item is time- and space-invariant. Based on these assumptions, the cost of the basket is computed in four simple steps:

1. compute the per capita daily caloric intake deriving from the consumption of each item in the food basket:
2. derive the per capita daily quantity consumed of each item in the food basket:
3. compute the daily cost of the quantity consumed:
4. obtain the total monthly cost of the food basket across time:

,

*where* is the per capita daily DER, is the percentage caloric contribution of each item *i* to the daily intake in country *c*[[5]](#footnote-5)*,* is the energy content of each food item[[6]](#footnote-6), and is the price of each food item at time *t*[[7]](#footnote-7)*.*

The cost of the food basket is computed only at the national level. If national and market-specific prices are both available, the national prices are preferred unless they do not meet data requirements. If so, national averages are computed as a simple averages of market-specific prices.

An example of the calculation of the food basket is shown in Table 2.

Table 2 - Cost of the food basket in Côte d'Ivoire in August 2013



*Source: authors’ calculation on VAM/WFP, NutVal.Net, and GIEWS/FAO data.*

Once time series for the cost of country-specific food baskets are computed, the seasonal index of the food bundle is constructed for each country.

# The Seasonal Index

The seasonal index describes the predictable average seasonal patterns of the cost of food basket over a year.

A seasonal index is obtained by separating trend and seasonal components of the time series. In particular, for the calculation of the SFE, the seasonal index is obtained from the modified centered moving average of logged data (Log CMA). The procedure is advocated and described by Ittig (2004). In particular, the Log CMA procedure involves five steps:

1. compute the centered moving averages of order 12 for the logarithms of the cost of the food basket () for each country *c*, month *m*, and year *y*:
2. compute the deviation of the logarithm cost of food basket from the centered moving average:
3. calculate the average deviation for each month of the whole time period available in order to obtain 12 values, one for each month (often referred to as the Grand Seasonal Index):

, *where* *Y* is the count of *y*

1. apply the exponential function with base *e*:*[[8]](#footnote-8)*
2. normalize the seasonal index :

An example of the calculation of the seasonal index is shown in Table 3.

Table 3 - Calculation of the seasonal index for Afghanistan

|  |  |  |
| --- | --- | --- |
|  |  |  |
| *Note: avg1 and avg2 indicate the simple averages of the logarithm cost of the food basket for the entire 2007 and the period between February 2007 and January 2008 respectively. The centered moving average for July 2007 (highlighted in blue) is given by the average of avg1 and avg2 - first step of the Log CMA procedure. Column (b) contains the differences between the logarithm cost of the food basket and Log CMA - second step. In column (c), the logarithm of the seasonal index for each month is obtained as simple average of all values for that month in column (b) – third step. The seasonal index in column (d) is obtained by exponentiation of the values in column (c) – fourth step. Finally, the normalized seasonal index for each month is given by the corresponding value in column (d) divided by the mean of column (d) – fifth step.*  *In this example, the food basket covers 80 percent of the DER.* | | |

The normalized seasonal index calculated in Table 3 is displayed in Figure 3. The values quantify to what extent, on average, the monthly cost of the food basket deviates from the 12-month average. The graph exhibits a typical seasonal pattern. It shows that May is the most expensive month with the food basket being 2% more expensive than the yearly average, and that the cost of the daily 1,680 kcal/per capita increases starting in October.

Figure 3 - Normalized seasonal index in Afghanistan

Yearly average

The Log CMA procedure described above identifies a *c x 12* matrix containing a value for each month-country combination (Table 4).

Table 4 - The normalized seasonal index by country and month ()

*Note: extracted on August 11, 2016*

# The Seasonal Food Expenditure Score

The Seasonal Food Expenditure Score (SFE) is a monthly indicator that scores months based on the cost of the country food basket with the aim to detect potential threats to households’ food security due to high seasonal food prices.

The SFE is obtained from the seasonal index of the cost of a country-specific food basket. Thus, once Table 4 has been filled, the SFEcan be computed**.** The new *c x 12* matrix containing the SFE (Table 5) is derived by assigning to each month-country combination a score between 1 and 5. The score is based on the value of the and the following rule:

|  |  |  |
| --- | --- | --- |
| **SFE** |  |  |
| **1** | ≤ 1 |  |
| **2** | 1 < ≤ 1+w | , where |
| **3** | 1+w < ≤ 1+2w |  |
| **4** | 1+2w < ≤ 1+3w |  |
| **5** | 1+3w < ≤ 1+4w |  |

The first class (SFE equals one) contains all country-months where the cost of the food basket is equal to or less than the country yearly average cost (i.e. SI<=1). The other four classes (2 to 5) have same width *w* and containall months where the cost of the food basket is higher than the mean. The higher the score, the more the cost of the food basket in that month is expected to exceed the average yearly cost. In particular, the upper threshold of the higher class (4*\*w*) equals the highest deviation from the mean among all months and countries (i.e. the highest values in Table 4). As the values of the classes’ boundaries are endogenously defined, they can change when new estimation for the SFE are produced. Consequently, the scores cannot be compared across time, but only across space (i.e. the ranking of the countries is comparable when new estimates are available).

The full *c x 12* matrix containing the SFE and the values of the classes’ boundaries are reported as an Annex II in a separate excel file.

Table 5 - The Seasonal Food Expenditure Score (SFE)

 *Note: extracted on August 11, 2016*

# The Severity of the Seasonal Food Expenditure Score

The Severity of the Seasonal Food Expenditure Score (SFES) is a forward-looking indicator, which scores months based on how much more expensive the food basket is expected to be in the six upcoming months compared to the yearly average cost.

The method for the calculation of the SFES borrows from the literature on poverty measure. In particular, it recalls the squared poverty gap index, also known as the poverty severity index.

The poverty severity index is the weighted average, over all people, of the gaps between poor people’s living standards and the poverty line (as a percentage of the poverty line); the weights are the poverty gaps themselves. The measure belongs to the family of measures proposed by Foster, Greer, and Thorbecke (1984):

*with* *α* ≥ 0 , *z* the poverty line, () the poverty gap, and ()=0 if .

Similarly to the poverty severity index, the weighted average, over the six upcoming months, of the positive deviation of the cost of the food basket from the yearly average cost can be computed. The starting point for the calculation is the SFE, and the benchmark (e.g. the poverty line in the case of the poverty severity index) is one. Indeed, a score of one for SFE reflects a ‘harmless situation’: months were the cost of food basket is equal to or less than the average yearly cost. The Squared Gap of the SFE (SG\_SFE) is given by:

By setting *α*=2, the measure implicitly puts more weight on months with higher SFE.

The new *c x 12* matrix containing the SFES (Table 6) is derived with a similar procedure used for the SFE. A score between 1 and 5 is assigned to each month-country combination based on the value of the and the following rule:

|  |  |  |
| --- | --- | --- |
| **SFES** |  |  |
| **1** | = 0 |  |
| **2** | 0 < ≤ δ | , where |
| **3** | δ < ≤2δ |  |
| **4** | 2δ < ≤3δ |  |
| **5** | 3δ < ≤4δ |  |

The SFES is equal to one only if the cost of the food basket is equal or less than the yearly average cost in all of the six upcoming months. Instead, the upper threshold of the highest class (4\* δ) detects the average squared deviation of the six consecutive months with the highest cost of the food basket among all countries. Thus, the higher the score, the more on average the cost of the food basket in the six upcoming months is expected to exceed the average yearly cost.

Similarly to the SFE, the classes’ boundaries are endogenously defined. Consequently, the scores cannot be compared across time, but only across space.

Table 6 - The Severity of the Seasonal Food Expenditure Score



*Note: extracted on August 11, 2016*

The complete *c x 12* matrix containing the SFEs and the values of the classes’ boundaries are reported as Annex III in a separate excel file.

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1. RMB will use the SFES in conjunction with other indicators (i.e. IFPRI Global Hunger Index and a qualitative “Regional Attention” indicator) to prioritize countries and allocate multilateral funds. [↑](#footnote-ref-1)
2. The number and list of countries is contingent upon data availability. As more data becomes available, more countries can be added to the analysis. [↑](#footnote-ref-2)
3. i.e. the lowest average price in the last 3 years [↑](#footnote-ref-3)
4. Series should at least cover 3 years, have less than 30% data gap and have at least one observation for all months. [↑](#footnote-ref-4)
5. Source: The Market Monitor, quarterly publication (World Food Programme, 2016) [↑](#footnote-ref-5)
6. Source: NutVal 4 (http://www.nutval.net/2007/05/downloads-page.html) [↑](#footnote-ref-6)
7. Source: VAM Food Price Database, partly integrated by the FAO/GIEWS Food Price Database. [↑](#footnote-ref-7)
8. e is the base of the natural logarithm, approximately equal to 2.71828 [↑](#footnote-ref-8)