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### SDG INDICATOR 2.c.1 “INDICATOR OF FOOD PRICE ANOMALIES”

## I. Introduction

Indicator 2.c.1., or the Indicator of Food Price Anomalies (IFPA), measures countries achievements towards target 2.c: Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility.

The IFPA is an indirect measure of Target 2.c, as it is a measure of food price volatility, detecting abnormal growth of prices in food markets. To interpret the IFPA, country analysts need to understand the methodology involved in calculating the indicator as well as the basic principles of food market analysis.

The indicator of food price anomalies (IFPA) identifies markets prices that are abnormally high. The IFPA relies on a weighted compound growth rate that accounts for both within year and across year price growth. The indicator directly evaluates growth in prices over a particular month over many years, taking into account seasonality in agricultural markets and inflation, allowing to answer the question of whether or not a change in price is abnormal for any particular period.

## II. Methodology

### a. Rationale for the SDG Indicator 2.c.1

The connection between food and national security was brought into sharp focus during the food price crisis of 2007/2008. In a globalised world, keeping an eye on food commodity prices and a careful watch for price hikes has never been more important. In many countries, market prices are sometimes the only source of information available to assess the severity of a local shock to either access or availability of food. They are ideal to use as the basis of an early warning indicator.

Feeding into FAO's Global Information and Early Warning System (GIEWS) and its activities of Food Price Monitoring and Analysis (FPMA) at country level, the indicator of food price anomalies offers

governments regular price information on a basket of goods. Results are disseminated and analysed through the FPMA website and bulletin on a monthly basis with the aim of providing early warning to countries where there is a potential impact on economic access to key food products as a result of abnormally high food prices. It helps countries ensure appropriate measures can be taken to soften the blow when consumer markets fluctuate.

### b. Computation method

The indicator of price anomalies (IFPA) relies on two compound growth rates (CGR's), a quarterly compound growth rate (CQGR) and an annual compound growth rate (CAGR). A CGR is a geometric mean that assumes that a random variable grows at a steady rate, compounded over a specific period of time. Because it assumes a steady rate of growth the CGR smoothes the effect of volatility of price changes. The CGR is the growth in any random variable from time period  $t_A$  to  $t_B$ , raised to the power of one over the length of the period of time being considered

$$CXGR_t = \left( \frac{P_{t_B}}{P_{t_A}} \right)^{\frac{1}{t_B - t_A}} - 1 \quad (1)$$

Where:

$CXGR_t$  is the quarterly or annual compound growth rate in month  $t$   
 $P_{t_A}$  is the price at the beginning of the period  
 $P_{t_B}$  is the price at the end of the period,  
 $t_B - t_A$  is the time in months between periods  $A$  and  $B$ .

The quarterly ( $QIFPA_{yt}$ ) and annual ( $AIFPA_{yt}$ ) indicators of food price anomalies are then defined as:

$$\left( \frac{CXGR_{yt} - \overline{W\_CXGR_t}}{\hat{\sigma}_{W\_CXGR_t}} \right) = XIFPA_{yt} \quad (2)$$

Where:

- $CXGR_{yt}$  is either the quarterly or annual compound growth rate in month  $t$  for year  $y$
- $\overline{W\_CXGR_t}$  is the weighted average of either the quarterly or annual compound growth rate for month  $t$  across years  $y$
- $\hat{\sigma}_{W\_CXGR_t}$  is the weighted standard deviation of either the quarterly or annual compound growth rate for month  $t$  over years  $y$ ,
- $XIFPA_{yt}$  is either the quarterly or annual indicator of a price anomaly.

Mathematically the IFPA for a particular year  $y$  in month  $t$  is calculated as the weighted sum of the quarterly indicator of food price anomalies ( $QIFPA_{yt}$ ), and the annual indicator of food price anomalies ( $AIFPA_{yt}$ ) as stated in equation 1.

$$IFPA_{yt} = \gamma QIFPA_{yt} + (1 - \gamma) AIFPA_{yt} \quad (3)$$

Where:

- $IFPA_{yt}$  is the indicator of food price anomalies in year  $y$  and month  $t$
- $QIFPA_{yt}$  is the quarterly indicator of food price anomalies in year  $y$  and month  $t$
- $AIFPA_{yt}$  is the annual indicator of food price anomalies in year  $y$  and month  $t$
- $\gamma$  is a weight with a value of 0.4

The weight  $\gamma$  establishes the relative importance of quarterly ( $QIFPA_t$ ) anomalies to the year-on-year price variations ( $AIFPA_{yt}$ ). The weight  $\gamma(1 - \gamma)$ --SDG indicator 2.c.1 is then calculated as the arithmetic mean over  $t$  months of the  $IFPA_{yt}$   $IFPA_y = \frac{1}{t} \sum_{i=1}^t IFPA_{yt}$

(4)

Where:

- $IFPA_y$  is the annual indicator of food price anomalies in year  $y$
- $IFPA_{yt}$  is the indicator of food price anomalies in year  $y$  and month  $t$
- $t$  is the number of months in a year

### c. Interpretation

The thresholds for the  $IFPA_y$  are expressed as the normalized difference of the compound growth rate of prices from their historical mean for the predefined period of time. And three ranges are established: 1) a less than half a standard deviation difference from the mean is considered normal; 2) a difference that is half but less than one standard deviation is considered moderately high; 3) a difference from the historical mean that is at least one standard deviation greater than the mean is considered abnormally high.

$$\begin{aligned} 0.5 \leq IFPA_y < 1 & \quad \text{Moderately High} \\ IFPA_y \geq 1 & \quad \text{Abnormally High} \\ -0.5 \leq IFPA_y < 0.5 & \quad \text{Normal} \end{aligned}$$

We use one standard deviation as the relevant threshold since we want to minimize the probability of missing a significant market event. Events that deviate by more than one standard deviation from their historical distribution have a low probability of occurring and thus are easier to identify as abnormally high prices.

### d. Treatment of missing values

For the purposes of the indicator missing values are only imputed for commodity prices compiled in the [FPMA](#) tool when 3 or less months of data are missing. If more than 3 consecutive months of data are missing the series may be dropped from monitoring. The formula used for this imputation is as follows

$$Price_{t+1} = Price_{t-1} \times (Price_{t-1}/Price_{t-12})^{(1/12)}$$

Where:

- $Price_{t+1}$  is the one period ahead imputed price
- $Price_{t-1}$  is the price from the previous period

- $Price_{t-12}$  is the price for the same period a year earlier
- For the food price index in [FAOSTAT](#) used for the global analysis, the data is imputed

#### **e. Regional aggregates**

Results are organized on a regional basis but are not aggregated as such. This is because the commodities and food baskets monitored across countries are not sufficiently homogenous to aggregate into one price index. Instead during the reporting if a majority of countries within a region presents abnormally high prices, either for a particular commodity or the food price index, this region is quantified as a region suffering from abnormally high levels of price volatility. Similarly at the global level the number of regions presenting high levels of price volatility are quantified.

#### **f. Sources of discrepancies**

FAO does not alter government data on prices either published publically on national websites or as reported to the IMF of FAO. There should be minimal or no difference between data reported by FAO and national figures.

#### **g. Quality assurance**

As stated FAO does not alter the national level data. Therefore it relies on the methods and quality standards imposed by the countries in their price collection activities either for reporting on national level commodity prices or the calculations of the food price index, which is used as part of the estimation of national inflation accounts

#### **h. Limitations**

The indicator of food price anomalies is just a rough guide of market dynamics. As such, one cannot rely on it as the sole element to consider when giving a food security alert or characterizing prices as abnormally high. Instead its' results must be weighed with other available information on market fundamentals and possible short term policy shocks that can explain these price movements. This is especially important when evaluating whether or not the observed shocks in prices will persist or are transitory. Moreover, the indicator does not attempt to directly assign causality to the implementation of any given policy or market strategy, nor can it do so.

### **III. Data Sources**

#### **a. Description**

The IFPA is monitored at a national and global level. FAO relies on official domestic price data that it compiles in its' Food Price Monitoring and Analysis ([FPMA](#)) tool to calculate and monitor the indicator at the national level. Five cereal products are monitored: maize & maize products, wheat & wheat flour, rice, sorghum and millet. While diets across the world have become more diversified with increasing incomes, cereals still account for 45 percent of a person's daily caloric intake, making this commodity group the most important in terms of its contribution to caloric intake, particularly for low income populations (FAOSTAT, 2017). For the global level, FAO will monitor and apply the IFPA to countries' officially reported food price indices as reported in [FAOSTAT](#), which facilitates cross country comparisons as it uses a national level food basket covering all the most important commodities consumed. While the basket differs from country to country, this approach is more reflective of national and global trends as countries have predefined the commodities that have

the most impact on local consumers. This approach also facilitates the implementation of the indicator as countries will not be asked to create a new index or modify existing methodologies.

#### **b. Collection process**

No data collection process at the country level is anticipated beyond the regular activities of FAO. For commodity prices FAO will continue to compile price data from official sources such as market information systems or national statistical agencies. This data will be continue to be available to the public through FAOs FPMA Tool. For the food price index FAO will rely on the data compiled and reported in FAOSTAT.

Data to calculate the IFPA are available on a regular basis for the Food Price Index for about 138 countries and 79 countries for up to 2016 for former and up to October 2017 for the latter. For consistency and taking into account data availability, reporting will begin for the year 2016

#### **IV. Conclusion**

FAO calculates the indicator of food price anomalies using country level data, but no country calculates the indicator on its own. However, from 2018 FAO will facilitate the ability for any country to calculate the indicator

FAO is now developing a module in the FPMA Tool, which would allow countries to calculate the indicator automatically. Furthermore in 2018 FAO will launch it's e-learning course on the indicator in four languages (English, Spanish, French, and Russian)

Further implementation of the FPMA Tool at the country level will enable reporting on the indicator. Currently the FPMA Tool is being deployed in 13 countries and in the Central America region FAO and other partners are helping integrate regional commodity prices for 6 countries.