**WORKSHEET 2: CALCULATING SPATIAL MARKET INTEGRATION**

**What it is:** Spatial market integration can be calculated by finding the correlation coefficient of prices between two markets. A higher correlation coefficient signals a higher degree of market integration. When markets are integrated, food will flow from surplus areas to deficit areas and prices for similar commodities will move in relation to each other. Poorly integrated markets do not support adequate flows of commodities, and there is a risk of price increases due to constrained supply.

A correlation coefficient will always be between -1 and 1. Prices that move in tandem will have a higher correlation coefficient than prices that do not move together. A negative result shows that prices move in opposition to each other. Markets that are well integrated will have correlation coefficients close to 1. In the following example, Markets A and B are perfectly integrated, with a correlation coefficient of 1. Markets A and C have a correlation coefficient of -1; that is, as prices in Market A are rising, prices in Market C are falling. Markets A and D have a correlation coefficient of 0, meaning there is no relationship between their prices.

|  |  |  |  |
| --- | --- | --- | --- |
| **Mkt A** | **Mkt B** | **Mkt C** | **Mkt D** |
| 1 | 5 | 20 | 57 |
| 2 | 6 | 18 | 7 |
| 3 | 7 | 16 | 2 |
| 4 | 8 | 14 | 3 |
| 5 | 9 | 12 | 23 |
| 6 | 10 | 10 | 7 |
| 7 | 11 | 8 | 78 |
| 8 | 12 | 6 | 56 |
| 9 | 13 | 4 | 8 |
| 10 | 14 | 2 | 3 |

**Correlation coefficient:**

Market A: Market B = **1**

Market A: Market C = **-1**

Market A: Market D = **0**

**Data requirements:** At least three years of monthly price data for the same commodity in the markets you want to assess.

**How to calculate market integration:**

1. **Examine the co-movement of prices.** Once you have decided the markets for which you want to calculate integration and the commodity you will use, create a simple graph of the price series in all the markets you will be examining. While co-movement of prices does not necessarily indicate correlation (other factors may be having an external influence on all the prices, such as inflation, global prices, etc.), having a visualization of the ways prices are moving sets the stage for further analysis. In the graph on the right, we can see that prices in the different markets follow similar patterns.

*Source: WFP Markets Learning Programme*

1. **Detrend and deseasonalize the data.** To take out the common factors that can cause it to appear as if markets are more integrated than they actually are, the prices must be divided by the consumer price index (CPI) and by the seasonal index.

First, find your country’s CPI from the national statistics agency. The CPI should be updated monthly by the statistics bureau. Divide all the monthly prices by the corresponding CPI. You now have a new table of *real* price data in addition to the *nominal* price data.

Next, create the seasonal index:

1. Take the average price for each month across years in all markets.

JANAVG = (P1/2010/CPI + P1/2011/CPI + P1/2012/CPI + P1/2013/CPI + P1/2014/CPI)/5

Where P1/2010 = Average Jan. 2010 price across all markets being analyzed

1. Take the overall average across months and years for all markets

OVERALL AVERAGE = (JANAVG + FEBAVG + MARAVG + APRAVG + MAYAVG + JUNAVG + JULAVG + AUGAVG + SEPAVG + OCTAVG + NOVAVG + DECAVG)/12

1. Divide the monthly average by the overall average

SIJAN = JANAVG / OVERALL AVERAGE

SIFEB = FEBAVG / OVERALL AVERAGE

Use the seasonal index for each month to now divide the *real* price data. You now have another table with data that has been detrended (the inflation component has been removed) and deseasonalized (the seasonal component has been removed).

1. **Calculate the correlation coefficients.** Excel has a function (CORREL) that will automatically calculate the correlation coefficients between your markets. Construct a table with all markets listed in the rows and listed again in the columns. Enter the function for each correlation calculation, similar to the table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Market A** | **Market B** | **Market C** | **Market D** |
| **Market A** | **1** |  |  |  |
| **Market B** | **=correl(mktA,mktB)** | **1** |  |  |
| **Market C** | **=correl(mktA,mktC)** | **=correl(mktB,mktC)** | **1** |  |
| **Market D** | **=correl(mktA,mktD)** | **=correl(mktB,mktD)** | **=correl(mktC,mktD)** | **1** |

For example, if your detrended and deseasonalized price data for Market A are in Column P of your worksheets, rows 4 to 50, and the data for Market B are in Column Q, rows 4 to 50, you would enter the following in the function box of Excel:

**=CORREL(P4:P50, Q4:Q50)**

This will calculate the correlation coefficient and give an indication whether prices in Markets A and B move in a similar way.

***Note:*** *This is not the only way to go about calculating market integration. Different statistical methods, such as the centered moving average (CMA) or using price differences can also be used to detrend prices. Correlation coefficients can also be calculated without detrending and deseasonalizing price data, the results will not be as accurate.*

**How to interpret:** There is no absolute threshold for determining whether markets are well integrated or not. Ideally, if you are going to implement a local or regional purchase or provide cash or vouchers to beneficiaries, you would do so in markets that are well integrated with others so that food commodities will flow into the area and supply will not become constrained in the case of increased demand. Correlation coefficients for your markets should be relatively high in these cases, hopefully above 0.5 or 0.6. The correlation coefficients should not be the only method you use to assess market integration; talking with key informants and with local traders (retailers and wholesalers) to determine their capacity and stocks is also important.

**Additional resources on market integration:**

* **Annex 4 of Lesson 3 – Market Indicators,** from the “Learner’s Notes” for the course on Market Assessment and Analysis developed by Patricia Bonnard at FEWS NET for FAO.Available from <http://www.fews.net/sites/default/files/Market%20Assessment%20and%20Analysis%20Training%20Module.pdf>
* **PDPE Market Analysis Tool: Market Integration**, available from <http://documents.wfp.org/stellent/groups/public/documents/manual_guide_proced/wfp187901.pdf>
* **WFP Market Price Analysis Training – Basic Level, Module 4: Examining Relationships between Markets, Session 4.2 Introduction to Market Integration**, available from <http://learning.vam.wfp.org/pages/wft/pWftContent.asp?c=Price%20Basic-CT>
* The spreadsheet **“Maize Kenya price series detrend and deseasonalize.xls”** (Resource #9 at <http://dyson.cornell.edu/faculty_sites/cbb2/MIFIRA/apps/>) works through an example of how to deflate, deseaonsalize, and then correlate historical maize price series across several markets in Kenya.