PDPE Market Analysis Tool: Market Integration

Markets are important determinants of food availability and food access. The extent to which markets make food available and keep prices stable depends on whether markets are integrated with each other. Integrated markets can be defined as markets in which prices for comparable goods do not behave independently. If markets are well integrated, it can be assumed that market forces are working properly, meaning that price changes in one location are consistently related to price changes in other locations and market agents are able to interact between different markets. If markets are integrated, food will flow from surplus to deficit areas - and imports will flow from port and border areas into the hinterland. High prices in deficit areas provide the incentive to traders to bring food from surplus to deficit areas, making food available. As a result of these flows, prices should decline in deficit areas, making food more accessible to households.

What insights can this tool provide?

Prices usually give important indications on whether markets are integrated. Markets are integrated if prices among different locations move in similar patterns, given that the differences between prices is explained by the transfer and transaction costs as food flows between the locations. Otherwise markets are segmented. This could, for example, be a result of prohibitive transaction costs related to poor infrastructure in remote areas or damaged roads or bridges because of a disaster.

When markets are integrated, food flows among regions and prices fluctuate less, enhancing food security. Knowledge about market integration is, therefore, essential for programming. The degree of market integration will inform the analysis of food security, appropriate responses to a crisis, the extent of possible negative effects of food aid and local procurement possibilities. Here are some examples:

- Where markets are poorly integrated - and prices more volatile - vulnerable households will experience more often high prices;
- Regarding response options, cash transfers can be a response option if markets are integrated, food is available and prices are relatively stable;
- Local procurement is also highly dependent on market integration. WFP might be able to procure locally with no detrimental effects on the market if food flows from other regions[1]; and
- In case of an emergency, the degree of market integration affects the estimates for the required amount of food aid because traders might be able to meet part of the food needs of the disaster-affected people.

How to analyse, interpret and use the data?

Analyzing market integration is done by comparing prices in different locations. The chart below provides a framework to analyse prices. This framework can be discussed step by step as follows:

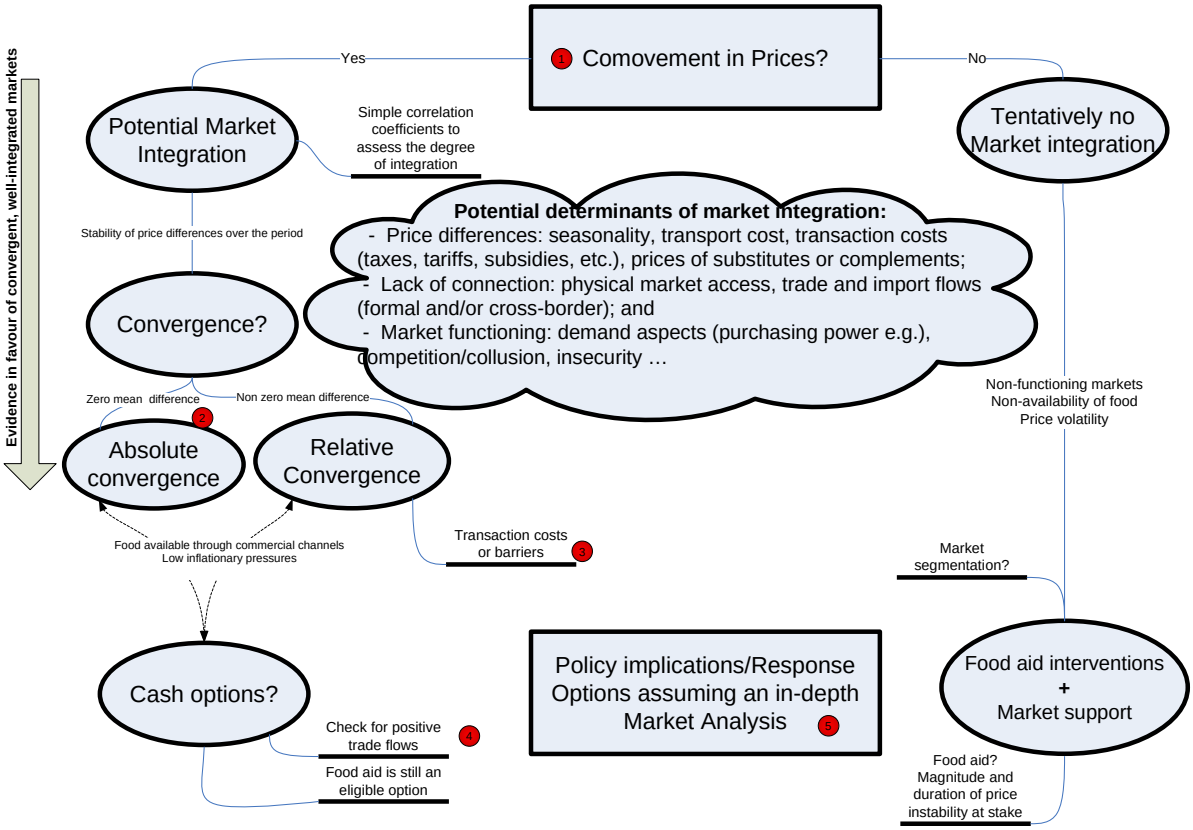
- *Step 1*: Assess whether prices move in tandem or not. One could calculate simple correlation coefficients or plot price series in a graph to check co-movement. If prices co-move, markets may be integrated. However, high correlation coefficients or price co-movement can be a result of other factors,

1 WFP could also procure locally in areas where a lack of market integration prevents available surpluses being moved out to deficit areas.

like a steady increase in all prices, rather than market integration. Checking for outliers - caused by a specific phenomenon in one market e.g. - and stability of price series overtime is also needed.

- *Step 2*: Analyse whether prices converge by calculating the average of price differences between markets in a given period. Convergent markets are integrated markets where prices are at the same level. A zero average suggests absolute convergence, indicating that the markets may be well integrated. A non-zero mean points to relative convergence, indicating that prices move in tandem, but that there are price differences as a result of transaction costs.
- *Step 3*: Compare spatial price differences with transaction costs. If transaction costs are higher than the price differences between two markets, it is likely there is no incentive for traders to move food between these markets at a period of time. Otherwise, the two markets are likely to be integrated.
- *Step 4*: Cross-check with traders if there is any reason why they might not move food. Among other reasons, it is worth analysing risk factors such as seasonal food availability and transport hindrances, changes in policy, security as indicated in the big "cloud of the framework".
- *Step 5*: Implications can be drawn for programming and response options. If the above steps point towards market integration, food is available in markets and prices are stable, cash transfers may be an option. If markets are integrated, the effects of food aid on markets are also likely to be small and temporary.

Graph 1: Market Integration Framework

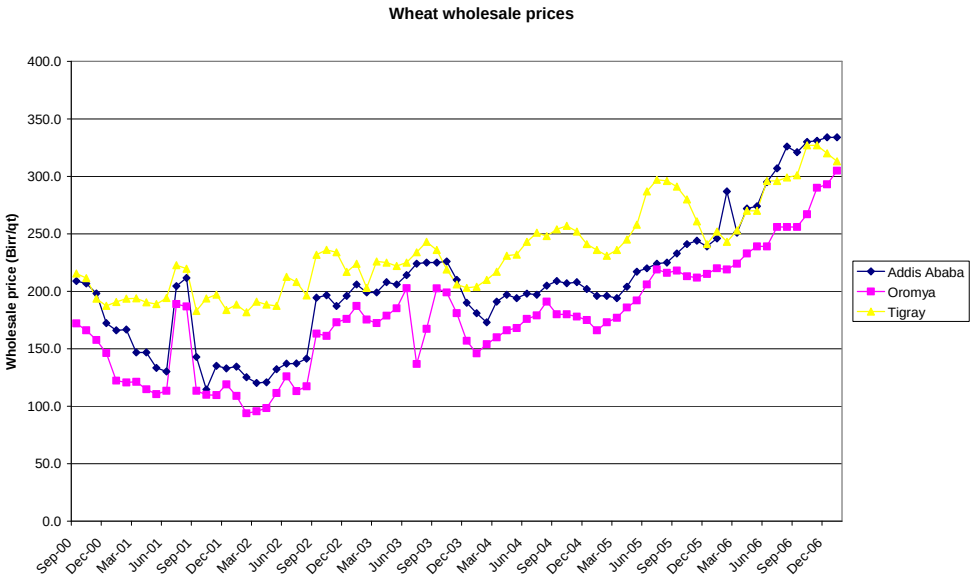


Example: Grain wholesale prices in Ethiopia (2000-2006)

To illustrate the issue of market integration, let us consider the case of Ethiopia's wholesale prices for teff, wheat and maize in 3 main regions/cities: Addis Ababa, Mekelle (Tigray) and Oromya. The price data used are extracted from the Ethiopian Grain Trade Entreprise (EGTE) database and the estimate for transportation costs between Mekelle and Addis Ababa from the Tigray Agricultural Marketing Promotion Agency (TAMPA) bulletin. The steps and calculations are also in an attached Excel spreadsheet: marktint.xls.

- *Step 1*: A rapid look at the price movements in the graph below for wheat shows how Tigray price evolution is peculiar. When prices in Addis Ababa and Oromiya went up swiftly (e.g. in July 2001 and September 2002), Tigray prices increased much less. On the contrary, in 2004-2005, Tigray experienced two price hikes (first half of 2004 and between March and July 2005) whereas Addis Ababa prices were increasing more moderately. From the correlation coefficients (around 80%) for the different commodities we could assume Addis Ababa and Oromya grain markets are well integrated. Yet, the Addis Ababa and Tigray regions have slightly different price variation patterns (correlation coefficients between 55% (wheat) and 77% (maize)). Regarding price stability over time, there seems, first, to be no significant outlier in any of the market price series that could affect our calculations. Then, the β-coefficients, which give a measure of how quickly changes in one series (location) are transmitted to another series (location), show that Tigray (β_{Tigray}=0.45) is far inerter (much less volatile) than Oromya (β_{Oromya}=0.70) relatively to Addis price variations.

Graph 2: Wheat wholesale prices in Ethiopia



Source: EGTE

- *Step 2*: If we look at Addis Ababa average price differences with Oromya and Tigray , we can develop the table below:

	Average difference Oromya - Addis Ababa (birr/quintal)	*Relative difference to Addis Ababa average price*[2]	Average difference Tigray - Addis Ababa (birr/quintal)	*Relative difference to Addis Ababa average price*
		2001		
Teff	-63	*-29%*	-9	*-4%*
Wheat	-25	*-16%*	43	*28%*
Maize	-21	*-23%*	36	*39%*
		2002		
Teff	-55	*-27%*	-15	*-7%*
Wheat	-24	*-16%*	54	*36%*
Maize	-13	*-14%*	28	*30%*
		2003		
Teff	-48	*-19%*	-15	*-6%*
Wheat	-32	*-15%*	11	*5%*
Maize	-34	*-21%*	7	*4%*
		2004		
Teff	-37	*-14%*	1	*0%*
Wheat	-26	*-13%*	40	*20%*
Maize	-25	*-17%*	24	*-17%*
		2005		
Teff	-39	*-14%*	11	*4%*
Wheat	-20	*-9%*	44	*20%*
Maize	-28	*-16%*	19	*10%*
		2006		
Teff	-41	*-11%*	-3	*-1%*
Wheat	-49	*-16%*	-10	*-3%*
Maize	-30	*-17%*	25	*14%*

The pattern of differences seems constant over time. Exception can be made for wheat prices in Addis Ababa rising above Tigray prices in 2006 and teff price difference between Addis Ababa and Tigray, whose sign alternates but still remains low (relative difference to Addis Ababa price smaller than 10%). We can therefore assume there is no absolute convergence between the different markets apart for Teff between Addis Ababa and Tigray where price difference is close to 0. Oromya prices are on average lower than in Addis Ababa (49 birr per quintal difference in 2006 for wheat) and generally higher for Tigray (25 birr per quintal difference in 2006 for maize).

- *Step 3*: Focusing on Tigray, TAMPA points at an average 40 birr per quintal transportation costs in 2006 for grain from Addis Ababa to Mekelle (we assume transportation cost to be constant over the period of analysis). This is approximately the price difference for wheat for example (except in 2003 and 2006), reflecting existence of incentives for traders to move wheat from Addis Ababa to Mekelle. This same transportation cost difference is not big enough for maize trade.
- *Step 4*: Knowledge in the WFP Country Office concerning food flows among the regions confirms that the flows are indeed better from Oromya to Addis Ababa than from Addis Ababa to Tigray.
- *Step 5*: The Productive Safety Net Programme (PSNP) advisory board, on which WFP sits, recently advised to reduce food-based safety net programmes in Oromya region in favour of cash-based interventions. This could indeed be

2 Relative differences to Addis Ababa average price are the average difference divided by the average price in Addis.

justified based on the degree of market integration. On the other hand, Tigray's situation needs to be closely monitored as most of the cash-based woredas (districts) in the PSNP asked for switching to food.

Limitations

i) High volatility or persistent price differences need further analysis. A temporary segmentation among markets might denote other issues and not reflect behavioural changes that could involve programming adjustments. The volatility of prices across locations, as well as in one given location, might nevertheless give the wrong signals to households (frequent important variations will blur households' purchase intentions) and therefore increase their vulnerability.

ii) Demand-side variables are often needed to understand the reasons of market (dis)integration, as well as derive what the main implications for households' food security are. A low purchasing power potential in an area may explain the lack of incentives for traders to move food there. Conversely, in a segmented market, prices will remain high due to the low food inflows, thus detetiorating household food access. Unfortunately, data on purchasing power is not easy to come by and often considered unreliable. One could nevertheless analyse the terms of trade between food prices and livestock, cash crop prices or wages (or other income-generating activities) to capture such situations (see MARKIT tool on terms of trade).

iii) Often various retail markets are highly integrated with a well-identified marketplace, such as, for example, a particular wholesale market (radiality). In such cases, an analysis of price seasonality and transport cost changes through the seasons are necessary. Unfortunately, the availability of those data is often a problem. Proxies or specific tools can be used (see MARKIT tool on price seasonality). For instance, if transport cost cannot be monitored, distance, fuel prices and road conditions can be used to have a proxy indicator because they have a direct impact on transport cost.

How to calculate the indicators

Following the steps given in the section above, here are some elements to analyse the price data to capture market integration. The different steps are followed in the attached Excel datasheet on Ethiopia data.

- *Step 1:* A simple graph of the different prices over time can often reveal whether prices move in tandem or not. Normally wholesale prices are preferred to retail prices because we assume that traders move large quantities between markets while retailers sell locally[3]. It is important to use either only wholesale prices between two markets or only retail prices between two markets, not a combination. Using the same type of price will make it easier to compare with transaction costs, as long as we are dealing with price differences. Prices in one region might lag behind changes in prices in other regions because of the time it takes to react to price differences and move food. But if a common pattern exists, even with some delay, it is usually clear.
  The correlation coefficient ρ could also be used to give an idea of the intensity of the co-movement. It is usually computed as follows[4]:

3 There should not be a huge difference between retail price differences and wholesale price differences because the margins and additional costs will likely be similar between wholesalers and retailers.

4 See CORREL() function in Excel

$$\rho_{MarketA,MarketB} = \frac{\sum_{i=1}^{T}(MarketA_i - \overline{MarketA}) \bullet (MarketB_i - \overline{MarketB})}{\sqrt{\sum_{i=1}^{T}(MarketA_i - \overline{MarketA})^2} \bullet \sqrt{\sum_{i=1}^{T}(MarketB_i - \overline{MarketB})^2}}$$

where $MarketX_i$ represents the price of the commodity at time i in market X and $\overline{MarketX} = \frac{1}{T}\sum_{i=1}^{T} MarketX_i$ the average of the prices over the period T in market X. ρ varies between -1 and 1. The closer to 1, the more correlated the prices are and allegedly the better the integration between the markets. The coefficient of correlation is close to 0 when there is no (linear) link between the two sets of prices and therefore presumably no flows between the markets that could regulate the prices through incentives. As far as checking for stability of prices is concerned, a rapid look at the graph helps identify outlying values (abnormal prices in one market e.g.). Indeed, too many of them could threaten the validity of the tools used in the next steps. An erratic data series might therefore need some stand-alone analysis of the market situation.

Stability of a given market relative to a main market (Market '0') can also be measured through the ß-coefficient:

$$\beta_{MarketX} = \frac{Cov(MarketX, Market0)}{Var(CPI)} = \frac{\frac{1}{T}\sum_{i=1}^{T}(MarketX_i - \overline{MarketX}) \bullet (Market0_i - \overline{Market0})}{\frac{1}{T}\sum_{i=1}^{T}(Market0_i - \overline{Market0})^2}$$

Market '0' is referring to prices on a main market that can also be the Consumer Price Index in the country, or its food subgroup. If the ß-coefficient is 0.8, the prices have varied approximately 0.8% in the market of interest when the main market prices have varied 1%. The prices on this market are therefore less volatile than on the main market. A ß-coefficient of 0.5 (or 2) means the price in Market X are moving twice as slow (twice as fast) and thus indicating an inerter (more volatile) market;

- *Step 2:* The next step is the analysis of the difference between market A and market B prices, if any. One can derive the average difference as follows:

$$Diff_{A-B} = \frac{1}{T}\sum_{i=1}^{T}(MarketA_i - MarketB_i)$$

whose sign indicates which market has, on average, higher prices and whose magnitude indicates how important the gap is. A difference close to zero indicates an absolute convergence, i.e. potentially a very good integration between the two markets. A non null difference - relative convergence - needs more investigation. A chart of the price differences over time (rather than the prices themselves) could be helpful. Along this line, one can compute the relative difference to one market to understand what the estimated level of difference represents. Relatively to market A price level, the difference will then be:

$$relativeDiff_A = \frac{\frac{1}{T}\sum_{i=1}^{T}(MarketA_i - MarketB_i)}{\overline{MarketA}};$$

- *Step 3:* From secondary sources (or from WFP logistics and procurement units), estimates of transportation costs can be useful to explain price differences in the case of relative convergence. These costs may explain market segmentation if they are larger than the price differences calculated above because they

make it unprofitable for traders to move commodities from one market to another. A simple comparison over time between the transportation costs and the price differences in a chart gives a good idea of the possible incentives for traders;

- *Step 4:* A rapid checking of actual flows between the areas, through traders' interviews/focus groups, is necessary to derive any conclusions on market integration. Analysis through prices does not provide all the answers on market integration. The actual existence of positive trade flows is the only sufficient condition for market integration. Therefore, to the extent possible, traders interviews enquiring about their willingness to move food and risks associated, are extremely useful complement to price integration analysis; and
- *Step 5:* Market integration provides important elements for the response analysis, including whether cash transfers are an option, and the design of programmes (see MARKIT cash decision tool).

Data needs, data sources

Data needs	Type and transformation	Data sources
Time-series for prices (per unit) of main food staple(s) in major urban/wholesale markets, including border markets and rural markets, if available. Data needs depend on the depth of analysis required on market integration	Weekly or monthly data, plotted against time in graph, correlation coefficients of price trends, spatial price differences, price differences per major seasons	WFP monitoring (FSMS); NGOs (for some rural areas); government (for major urban areas and wholesale markets, import prices); Ministry of Agriculture
Transportation costs per unit between major markets, including wholesale, border and rural markets, by major seasons, if available	Average cost per unit, cost changes by season	WFP procurement/logistics, ad hoc traders' interviews
Flows of food among these markets	Basic set of questions on the willingness and risks for moving food	Ad hoc trader interviews, observations

[WFP/PDPE, 7viii2007]