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Food price seasonality in Africa: Measurement and extent

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ABSTRACT

Everyone knows about seasonality. But what exactly do we know? This study systematically measures seasonal price gaps at 193 markets for 13 food commodities in seven African countries. It shows that the commonly used dummy variable or moving average deviation methods to estimate the seasonal gap can yield substantial upward bias. This can be partially circumvented using trigonometric and saw-tooth models, which are more parsimonious. Among staple crops, seasonality is highest for maize (33 percent on average) and lowest for rice (16½ percent). This is two and a half to three times larger than in the international reference markets. Seasonality varies substantially across market places but maize is the only crop in which there are important systematic country effects. Malawi, where maize is the main staple, emerges as exhibiting the most acute seasonal differences. Reaching the Sustainable Development Goal of Zero Hunger requires renewed policy attention to seasonality in food prices and consumption.

1. Introduction

It is well-known that agricultural prices vary across seasons, typically peaking just before the harvest, and dropping substantially immediately thereafter. Despite this, there exists little systematic research on the extent of this seasonal variation across food commodities, countries, or markets within countries. The only comprehensive analysis that systematically applies the same methodology across commodities and countries is Sahn and Delgado (1989). This is by now somewhat dated. The consequence is that, although "we all know about seasonality", it is very unclear precisely what it is we know.[3]

Knowing the extent of food price seasonality matters for a number of reasons. First, when food prices display high seasonality, so may also be dietary intake and nutritional outcomes, with episodes of nutritional deficiencies during the first 1000 days of life particularly detrimental for cognitive development and future earnings (Dercon and Portner, 2014). The 2015 adoption of Sustainable Development Goal II of Zero Hunger[4] adds pertinence.[5] When production is cyclical, some seasonality in prices is normal; intertemporal arbitrage is needed and storage costs ensue, which drive a wedge between prices before and after the harvest.[6] This gap can be

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[2] Gauss programs for the empirical analysis conducted in this paper are available at: https://sites.google.com/site/christopherlesliegilbert/data.

[3] A number of country-specific studies exist but these stop short of quantifying the extent of seasonal price variation. Examples include Allen (1954), who analyzed seasonality in UK food prices over the immediate post-war decade, and Statistics New Zealand (2010), which reviewed seasonality in New Zealand fruit and vegetable prices. Recent country case studies from Sub-Saharan Africa, where food price seasonality is expected to be highest, include Manda (2010) (maize, Malawi), Aker (2012) (millet, Niger), Gitonga et al. (2013) (maize, Kenya), and Hirvonen et al. (2015) (food price index, Ethiopia).

[4] http://www.un.org/en/zerohunger/challenge.shtml.

[5] The need for reviving attention to the reality of seasonality in African livelihoods among development scholars and practitioners is also highlighted by Devereux et al. (2011).

[6] Price seasonality may also follow from seasonal patterns in demand such as those related to festivities, e.g. high sugar demand in preparation of the Eid festival, or celebration of the New Year and Orthodox religious festivities (Meskel) in September in Ethiopia (Hirvonen et al., 2015).

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compounded by poorly integrated markets and trade restrictions, market power along the marketing chain, and sell-low, buy-back-high behavior among liquidity and credit constrained households (Stephens and Barrett, 2011). They can push up the seasonal price gap well beyond the levels expected in settings with well-functioning markets.

Excess seasonality in prices may further translate into seasonal variation in dietary intake and nutrition, for example, when households are credit constrained or ill-equipped with other coping strategies, as has been documented in Ethiopia (Dercon and Krishnan, 2000), Bangladesh (Khandker, 2012), and Tanzania (Kaminski et al., 2016).[7] Moderation of seasonal price variation (for example through facilitation of storage or access to credit) could then be a way to increase overall food and nutrition security.

A second reason for refocusing attention to food price seasonality relates to the sharply increased volatility of world food prices in the immediate aftermath of the 2007–08 world food crisis (Gilbert and Morgan, 2010, 2011) although volatility levels appear to have dropped back since that time (Minot, 2014). This volatility was transmitted to a greater or lesser extent to food prices in developing countries and attracted considerable government attention (Galtier and Vindel, 2012; World Bank, 2012; Ceballos et al., 2015). Food price volatility arises from both international and domestic shocks to production (harvest shocks) or consumption (changes in purchasing power). However, seasonality (i.e. known fluctuations) also contributes to price volatility (especially domestically) and would require different policy instruments to address it. Little is known on the extent of this possibility.

The third reason relates to the measurement and analysis of poverty (the focus of the first Sustainable Development Goals). Poverty measurement relies heavily on food expenditure information which is typically collected only once for each household during at a particular point during the year (with a 7–30 day recall period). The annual expenditures measures derived from these surveys will be incorrect when food price seasonality is substantial and not corrected for, as is mostly the case in current practice (Muller, 2002; Van Campenhout et al., 2015).

The seasonal gap—the difference between the high price immediately prior to the harvest and the low price following the harvest, averaged across years—is the standard measure used to measure the extent of seasonality. It is common to estimate this gap from a (monthly) dummy variables regression on trend-adjusted prices or simply from the (monthly) mean price deviation around a moving average trend (Goetz and Weber, 1986, Chapter IV).

Using Monte Carlo simulations, this paper shows that, when samples are short (5–15 years), these approaches can seriously overestimate the extent of seasonality, especially when there is either little seasonality or where the seasonal pattern is poorly defined. Although the coefficients of individual monthly dummy variables, or the monthly price averages, are individually unbiased, the seasonal gap, which is obtained as the difference between the maximum and the minimum dummy coefficient, each identified from the data, is upwardly biased. This problem has hitherto not been noted despite the relatively short samples typically used in the development literature on seasonality.

It is shown that the problem can be mitigated by using trigonometric or sawtooth models. These more parsimonious models impose some structure on the nature of seasonality, thereby substantially reducing the number of parameters to be estimated and providing more observations per estimated parameter. This substantially reduces the upward bias in the estimated gap. When there is more than one season, which is less common, the dummy variable approach may still perform better, because it is more flexible.

To select the preferred specification and minimize the upward bias when estimating the seasonal gap, a three step procedure is advanced. Systematically applying this three step approach, the extent of price seasonality is measured by market place (typically major provincial centers) for 13 food commodities in seven Sub-Saharan African countries, or a total of 1053 market place-commodity pairs. In each case, there are between six and 13 years of monthly data depending on the country, market place and commodity.

The findings indicate that seasonality in African food markets remains sizeable. The seasonal gap is highest among vegetables (60.8 percent for tomatoes) and fruits, and lowest among commodities which are produced throughout the year (eggs) and/or whose harvest is not season bound (cassava). Among staple grains, seasonality is highest for maize (33.1 percent on average) and lowest for rice (16.6 percent). These gaps are two and a half to three times higher than on the international reference markets, pointing to substantial excess seasonality. While excess seasonality is observed in virtually all the maize and rice markets studied, there is wide heterogeneity within and across countries. Seasonality is especially high in Malawi, where maize is also the main staple, causing a double seasonality burden for most households.

In what follows, Section 2 sets the stage by reviewing general considerations on the data, seasonality metrics and the overall estimation approach. Section 3 looks at the commonly used methods for estimating the seasonal gap and shows that these can result in upwardly biased estimates when data samples are short. The performance of alternative and more parsimonious seasonality models is examined in Section 4. Section 5 introduces the price data from the thirteen commodities and seven African countries examined here and discusses the findings. Section 6 concludes.

2. Material, metrics and method – general considerations

Many developing country governments publish monthly prices for staple food commodities for major locations in their territories. These prices are obtained by sending observers to markets in these locations, who record the prices at which the different commodities are transacted. It is unclear how much intra-month averaging is undertaken, but at least for some countries (e.g. Uganda), the monthly prices derive from weekly observations. Much of this price information results from the FEWSNET initiative, supported by USAID, and the FAO's GIEWSNET initiative.

Three features of these price data stand out. First, the price data collection initiatives are relatively recent so that the time series available are usually short. Second, in many of the price series, the frequent occurrence of missing observations compounds the short duration of the series. Gaps may arise for example because the observers did not see transactions in the foods in question when they visited the markets. In some other instances, prices are missing for all locations in a particular month suggesting an administrative explanation. Finally, in most countries, only a small number of (mainly urban) locations (five to fifteen) are covered, though some governments (Malawi in our sample) attempt to be more comprehensive. These features of the data are important to keep in mind when measuring seasonality in developing countries. They also caution against overgeneralization based on a small number of market locations within countries, as seasonality will prove to differ substantially from place to place.

In agriculture, seasonality measures attempt to capture the part of the intra-annual variability of the monthly observations that is specifically related to the crop cycle. The simplest case is that of a subsistence crop with a single annual harvest and for which

[7] Few studies explicitly study the link between food price seasonality and seasonality in diets and nutrition. Related studies include Chambers et al. (1981) and Dostie et al. (2002), and Stephens and Barrett (2011).