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Price Seasonality in the Catfish Value Chain in Uganda

James O. Bukenya
Alabama A&M University, james.bukenya@aamu.edu

PRICE SEASONALITY IN THE CATFISH VALUE CHAIN IN UGANDA

***James O. Bukenya[1]**
[1]Alabama A&M University, Normal, AL
***Email of author: james.bukenya@aamu.eu**

Abstract

Seasonal patterns in production and demand are common in many agricultural markets. Charting these patterns provides information that complements fundamental and technical analyses. It is in this spirit that this paper seeks to examine price seasonality in the catfish value chain in Uganda. The analysis draws on monthly prices taken from secondary source recorded data and uses moving average index to chart price patterns. The results reveal distinct seasonal patterns in the farm-gate, ex-vessel, retail, and wholesale market channels. Across market channels, the results for farm-gate versus ex-vessel prices reveal that farm-gate prices are more affected by seasonal effects compared to ex-vessel prices. On the contrary, both price series in the retail versus wholesale market channels show a declining trend, with the wholesale price series showing stronger variability compared to the retail price series.

Keywords: Price Volatility, Seasonality, Catfish Value Chain, African Catfish

Introduction

Food price volatility finds one of its most dramatic manifestations in the kind of price hikes seen in poor countries, where the ability to store food is limited and where there may be limited price integration across markets in different regions of a country (Konandreas, 2012; Rezitis and Sassi, 2013; Arezki et al., 2016). Uganda is one of such poor countries where household expenditure is dominated by expenditure on food – with fish serving as one of the primary sources of animal protein in Uganda (Reynolds, 1993). Price fluctuation creates the main risk faced by fish producers and traders in Uganda. Unstable prices are for the most part risky, as the direction and force of the motions are largely unknown on a short-term basis. The economic costs of highly fluctuating prices are not only experienced by fish producers, but are also transferred to the entire value chain. On the demand side, the short-term elasticities are low, because the producer price is a small percentage of the final retail fish price while on the production side, input decisions are made before new output prices are known. It is against this background that the current study seeks to develop an understanding of the degree of variability and seasonality in the African catfish value chain.

A critical factor in driving the choice of target fish species among producers and traders is the price the fish attracts at the market. Equally important is the seasonal behavior of the prices. Basic economic theory suggests that the behavior of agricultural commodity prices over time is governed by shifts in supply and demand. In particular, deviations of actual production from expected supplies can have a pronounced impact on seasonal price patterns. Gilbert et al. (2016) and others have provided some key reasons why knowing the extent of food price seasonality matters: (1) 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., 2015); and (2) food price seasonality relates to the measurement and analysis of poverty, especially in developing countries. Poverty measurement relies heavily on food expenditure information which is typically collected using survey questionnaire only once for each household at a particular point during the year. 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 current study focuses on examining monthly price variations in the farm-gate, ex-vessel, retail, and wholesale market channels using price indexes. The motivation is to allow fish producers and traders to make better-informed decisions and to manage price risk. Seasonal price indexes can be used as an indication of possible price trends for a period of time. Two types of information have been extracted from the price data: 1) the monthly price variations relative to the annual average price or the monthly price indexes, and 2) the price variability within a month during the years included in the analysis. The analysis provides valuable information for fish producers, traders, policy makers and nongovernmental agencies working in the fisheries sector in Uganda.

Literature Review

Previous research on commodity price analysis involves a wide range of techniques across time periods. Some of the notable techniques include autoregressive models, time series regression models with seasonal dummies and monthly and annual price indexes. With the advancement in technology and econometric software, several variations of autoregressive models have been widely used in the literature to understanding agricultural price movements. For instance, Kalkuhl (2014), examined how global commodity prices influence domestic food prices in developing countries using the autoregressive distributed lag model. Empirical analysis revealed that 90% of the global poor live in countries where domestic food prices are influenced by international prices. Agbolaa and Damoense (2003), used an autocorrelation regression procedure for estimating demand functions for pulses, chickpeas, and lentils in India for the period ranging from 1970 to 2000. Empirical results indicate that real GDP, population, urbanization, exchange rate, and relative price are key determinants of import demand for pulses in India. Okoroafor and Chioma (2013) used a time series regression model with seasonal dummies to analyze gateway prices of yam in Abia State, Nigeria. The results revealed that gateway prices are highly influenced by the months especially, the festive and farming seasons.

In the fisheries sector, particularly catfish markets, Buguk et al. (2003) used the exponential generalized autoregressive conditional heteroskedasticity model to analyze price volatility spillovers in the U.S. catfish supply chain based on monthly price data from 1980 through 2000 for catfish feed, its ingredients, and farm-and wholesale-level catfish. Strong price volatility spillover from feeding material to catfish feed and farm-and wholesale-level catfish prices was detected. Bukenya and Ssebisubi (2014) used a threshold autoregressive model to test for the existence of a long-run relationship in the farmed and wild fish markets in Uganda. Their results showed that prices in both market channels are linked in the long-run, implying that farm-raised catfish forms part of the same market as wild-harvested catfish. Similarly, Bukenya and Ssebisubbi (2015) applied threshold autoregressive model to test for price asymmetry between ex-vessel, retail, and wholesale catfish prices in Uganda. The results revealed that ex-vessel and wholesale price adjustments to retail price changes are symmetric while ex-vessel price adjustments to wholesale price changes are asymmetric. The direction of causal relationships was observed from the retail to the wholesale and ex-vessel markets, indicating that retailers are the price leaders in

the catfish supply chain. A variety of index measures, ranging from simple to complex, have also been proposed in the literature. A brief outline and discussion of the principal index types are provided by Tveteras (2005) who notes that the relatively high aggregation level of product groups in the seafood statistics limit the range of index formulas that can be applied. The formula used in the current study was based on simple moving average, which helps smooth out price action by filtering out the "noise" from random price fluctuations. The monthly price index for commodities can be calculated by taking the average of determined price for each month of the year, then calculating the overall average of all the determined prices in the data and lastly dividing each month's average price by the overall average price to obtain the monthly price index. In this study, each month's catfish price index was calculated using the 12-month centered moving average approach. Monthly values of the catfish price series (X_t) are divided by the moving average figure corresponding to each month (MA_t), and expressed in percentage to generate the ratio-to-moving average:

$$M_{\text{ratio}} = \left(\frac{X_t}{MA_t}\right) \text{x} 100 \tag{1}$$

The moving average is calculated as follows:

$$M_m = \frac{1}{2m}[x_{t-p} + 2x_{t-p+1} + \ldots + 2x_{t-1} + 2x_t + 2x_{t+1} + \ldots + 2x_{t+p-1} + x_{t+p}] \tag{2}$$

where $m = 2 \text{ x } p$ and $MA_t = M_{12}(x_t) = \frac{1}{24}[x_{t-6} + 2x_{t-5} + .2x_{t-4} + \ldots + 2x_{t+5} + x_{t+6}]$.

A typical set of monthly indexes consists of 12 indexes that are representative of the data for a 12-month period. Each index is a percent, with the average for the year equal to 100; that is, each monthly index indicates the price level in relation to the annual average of 100 (Lind et al., 2009). For example, if the estimated index in June is 1.3, this means that June's values are typically about 30% larger than the average for all months. Once the seasonal indexes are obtained, each observation is divided by its seasonal index to deseasonalize the data. The reason for deseasonalizing the price series is to remove the seasonal fluctuations so that the trend cycle can be studied. For instance, if a time series of prices that has not been deseasonalized shows a large increase from June to July, it might not be sure whether the change represents a real increase in prices or a seasonal phenomenon. Thus, deseaonalizing the price series removes this uncertainty.

Data Description

The time series data used for the analysis consists of the monthly farm-gate, ex-vessel, retail, and wholesale catfish prices from January 2006 to December 2013. The data are taken from secondary source recorded data by the Aquaculture Management Consultant (AMC, 2013). Data on the three nodes of the value chains are from Buyende, Jinja, Nakasongola, Mukono, Kampala, Wakiso, Buikwe, and Luweero districts in central and eastern Uganda. Landing sites and wholesalers were identified and selected from the respective district fisheries office records and where possible by referral. All prices, expressed in Uganda Shillings (UGX) per kilogram (kg), are deflated using a consumer price index (CPI) deflator to adjust for inflation over the period covered. The CPI data were obtained from the Uganda Bureau of Statistics (UBoS, 2013).

Table 1 presents the descriptive statistics for the real catfish prices across the market channels. The descriptive statistics in Table 1 shows the maximum catfish price (UGX 10,300 per kilogram) is exhibited by the ex-vessel market channel while the minimum (UGX 1,100 per kilogram) is observed in both the farm-gate and retail market channels. The mean price is higher in the ex-vessel market channel, UGX, 5,499. In terms of volatility, as defined by the standard deviation, prices in the ex-vessel catfish market channel seem to be most volatile. The coefficient of variation is higher in the retail market channel (0.52) and lower in the wholesale market channel (0.14). Prices in the farm-gate, retail, and wholesale market channels are skewed to the right, indicating that the series have longer right tails (extreme gains) than left tails (extreme losses), and their distributions have kurtosis values lower than 3, implying that market movements in either direction (gains or losses) occur in the catfish value chain, with frequency less than what would be predicted by the normal distribution. The Jarque-Bera Lagrange multiplier statistics fail to reject the hypothesis of normal distribution for the wholesale catfish real price series.

Table 1. Descriptive Statistics

	Farm-gate	**Ex-vessel**	**Retail**	**Wholesale**
Mean	4189	5499	3377	2344
Median	3840	6250	3450	2322
Maximum	7871	10300	7025	3205
Minimum	1100	2000	1100	1620
Std. Dev.	1926	2381	1755	335
Coefficient of variation	0.46	0.43	0.52	0.14
Skewness	0.26	-0.06	0.46	0.21
Kurtosis	1.93	1.67	1.99	2.77
Jarque-Bera	5.73	7.18	7.45	0.93
Probability	0.06	0.03	0.02	0.63
Observations	96	96	96	96

Results and Discussion

Seasonal Trends in Farm-Gate Prices

Figure 1 plots the estimated monthly price pattern for catfish farm-gate prices, with the estimated monthly variability factors listed at the bottom of the Figure. A review of the Figure reveals that there are relatively distinct seasonal patterns. For most years, prices peak sometime between the months of June and August. Prices then decrease around September, before the lowest prices are reached in November. Figure 1 shows that prices in the ‘‘high price’’ period are on average 13% higher than in the ‘‘low price’’ period. In August, for instance, the estimated monthly price index of 106.5 suggests that the average August price is 106.5% of the annual average price. The variability factor of 8.9 reveals that, statistically, the August price can vary 8.9% points higher or lower than the monthly index. Thus, the August price in a particular year may be as high as 115.4% (106.5 + 8.9) or as low as 97.6% (106.5–8.9) of the annual average. Based on the graph, boosted Christmas prices are not a general rule. However, since increased demand before Christmas is an

indisputable fact, it seems that farmers have adjusted to the increased demand, with a corresponding increase in supply.

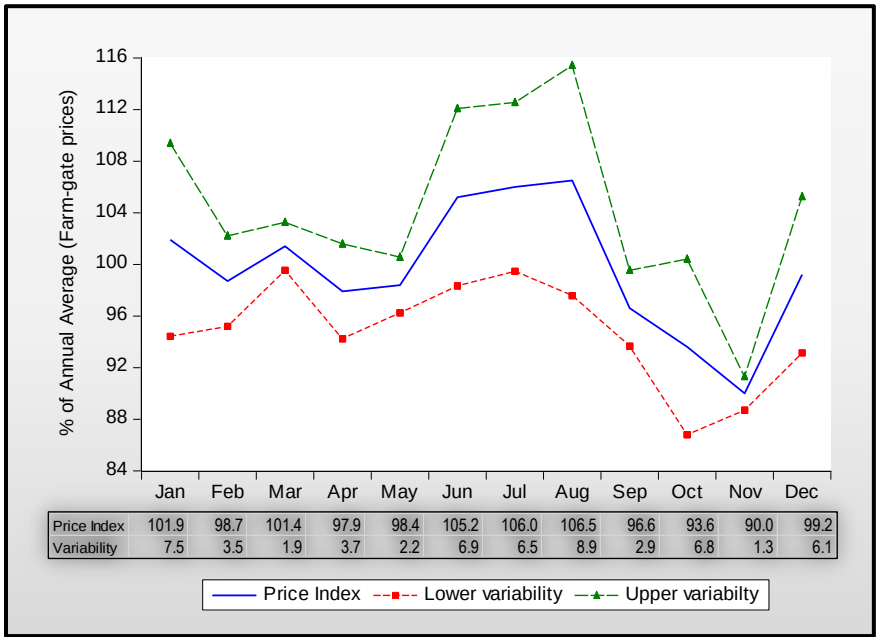

Figure 1. Moving Average Variation in Farm-Gate Catfish Real Prices

The estimated farm-gate seasonal price index can also be used to forecast prices for the months ahead based on the past relationship. For instance, the historical deseasonalized-farm-gate catfish real price averaged UGX2,521/kg (or $1.01/kg) in December 2013 (Table 2). Accordingly, forecasting the January 2014 average price per kilogram requires dividing December's average price (UGX2,521) by the price index for December (99.2%); then, multiplying by the price index for January (101.9%) = UGX2,590/kg (or $1.04/kg). Adjusting for the variability suggests that the January 2014 average farm-gate price would fall between UGX2,583/kg (or $1.03/kg) and UGX2,598/kg (or $1.04/kg).

Table 2. Actual, Deseasonalized, and Seasonal Index (Farm-gate Prices)

Year		January	February	March	April	May	June	July	August	September	October	November	December
2006	a	2392	2360	2213	2182	2156	2303	2353	2344	2314	2260	2168	2023
	b	2492	2439	2215	2166	2232	2161	2159	2095	2276	2481	2321	2123
2007	a	2047	2070	2256	2466	2141	2317	2550	2351	2087	1818	1812	1799
	b	2097	2136	2241	2474	2199	2191	2379	2112	2045	1982	1938	1878
2008	a	1811	1858	1903	2024	1958	2327	2662	2566	1763	1782	1620	2310
	b	1821	1912	1875	2053	2001	2234	2533	2324	1726	1931	1728	2378
2009	a	2326	2226	2426	1936	2109	2826	2133	2549	2508	1872	2385	2277
	b	2283	2272	2383	1993	2140	2758	2074	2341	2465	1999	2543	2300
2010	a	2885	2379	2538	2294	2596	2313	2239	2537	2525	2388	1730	2418
	b	2784	2402	2476	2386	2625	2297	2212	2383	2500	2504	1834	2410
2011	a	2228	2186	2100	2078	2056	2109	2274	2219	1843	2252	2259	2437
	b	2115	2184	2049	2174	2065	2127	2269	2138	1840	2306	2388	2397
2012	a	2627	2569	2540	2408	2611	2659	2805	2768	2740	2940	2724	2906
	b	2491	2552	2480	2500	2623	2711	2787	2726	2765	2967	2868	2835
2013	a	3065	3059	3205	3048	2873	2739	2728	2538	2383	2363	2312	2600
	b	2914	3027	3148	3141	2894	2800	2688	2523	2426	2373	2434	2521
Mean	a	2423	2338	2398	2305	2313	2449	2468	2484	2270	2209	2126	2346
Mean	b	2375	2366	2358	2361	2347	2410	2387	2330	2255	2318	2257	2355
	SI	**101.9**	**98.7**	**101.4**	**97.9**	**98.4**	**105.2**	**106**	**106.5**	**96.6**	**93.6**	**90**	**99.2**

SI: Seasonal Index; a: Catfish Real Price (UGX/kg); b: De-seasoned Catfish Real Price (UGX/kg)

Seasonal Trends in Ex-vessel Prices

Figure 2 plots the estimated monthly price pattern for catfish ex-vessel prices, with the estimated monthly variability factors listed at the bottom of the Figure. The highest price index of 105.6 is observed during February while the lowest price index of 95.0 is in September. In February, for instance, the estimated monthly price index of 105.6 suggests that the average February price is 105.6% of the annual average price. The variability factor of 2.8 reveals that, statistically, the February price can vary 2.8% points higher or lower than the monthly index. Thus, the February price in a particular year may be as high as 108.4% (105.6 + 2.8) or as low as 102.8% (105.6–2.8) of the annual average.

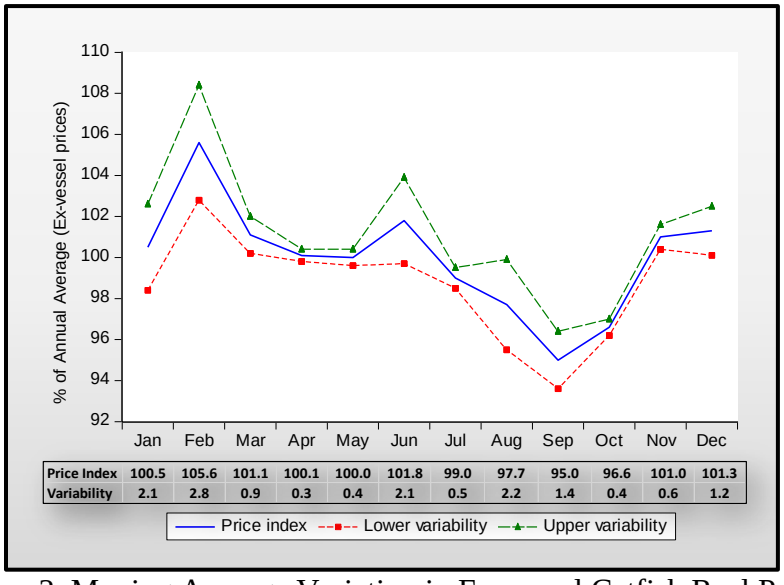

Figure 2. Moving Average Variation in Ex-vessel Catfish Real Prices

The estimated ex-vessel seasonal price index can also be used to forecast prices for the months ahead based on the past relationship; and given that the series exhibited a normal distribution. For instance, the historical deseasonalized ex-vessel real catfish price averaged UGX9, 156/kg (or $3.66/kg) in December 2013 (Table 3). Thus, to forecast the monthly price for January 2014 requires dividing December's average price by the price index for December (101.3); then, multiplying by the price index for January (100.5) = UGX9,084/kg (or $3.63/kg). Adjusting for the variability suggests that the January 2014 average ex-vessel price would fall between UGX9,082/kg (or $3.63/kg) and UGX9,086/kg (or $3.64/kg).

Table 3. Actual, Deseasonalized and Seasonal Index (Ex-vessel Prices)

Period	Ex-vessel	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2006	a	2000	2200	2000	2100	2200	2300	2300	2300	2400	2300	2300	2300
	b	2022	2044	1967	2097	2193	2290	2332	2395	2502	2388	2267	2252
2007	a	2000	2200	2500	2500	2500	2500	2400	2400	2600	2700	3000	3400
	b	2007	2053	2457	2499	2499	2488	2429	2483	2717	2801	2960	3337
2008	a	3000	3500	3100	3500	3500	3600	4500	3700	3700	3800	3400	4000
	b	2998	3285	3056	3496	3496	3564	4555	3804	3875	3935	3361	3935
2009	a	5000	5000	5000	4500	5000	5000	5000	5000	5000	5000	6500	6700
	b	4981	4739	4955	4488	4992	4902	5055	5116	5253	5172	6442	6617
2010	a	7000	6800	7000	5500	6000	6500	7000	7000	6800	6800	7200	7000
	b	6974	6444	6934	5484	5989	6372	7079	7164	7144	7034	7135	6912
2011	a	7400	7500	7500	7700	7600	7800	7450	7300	6500	6600	6800	7200
	b	7328	7158	7433	7682	7601	7615	7517	7426	6880	6827	6738	7135
2012	a	7300	7350	7000	7000	7240	7350	7000	7800	7450	8000	8100	7900
	b	7180	7046	6940	7002	7252	7150	7050	7893	7914	8268	8031	7852
2013	a	8050	7950	8200	9000	10300	10000	9150	8800	8607	8745	9052	9183
	b	7878	7673	8158	9000	10332	9681	9204	8858	9139	9033	9008	9156
Mean	a	*5219*	*5313*	*5288*	*5225*	*5543*	*5631*	*5600*	*5538*	*5382*	*5493*	*5794*	*5960*
Mean	b	5171	5055	5237	5218	5544	5508	5653	5642	5678	5682	5743	5899
SI		**100.5**	**105.6**	**101.1**	**100.1**	**100**	**101.8**	**99**	**97.7**	**95**	**96.6**	**101**	**101.3**

SI: Seasonal Index; a: Catfish Real Price (UGX/kg); b: De-seasoned Catfish Real Price (UGX/kg)

Farm-gate versus Ex-vessel Seasonal Price Trends

The comparison of price patterns in the two market channels is motivated by a previous study (Bukenya and Ssebisubi, 2014) that indicated that at the downstream market channels (ex-vessel and farm-gate) prices are linked in the long-run, implying that farm-raised catfish forms part of the same market as wild-harvested catfish in Uganda. Figure 3 plots the estimated monthly price patterns for farm-gate and ex-vessel monthly indexes. As depicted in the Figure, the highest price index (106.5 in August) is observed in the aquaculture sector (farm gate) in comparison to the wild fisheries sector (ex-vessel). The highest point (105.6) in the capture fisheries sector is observed during February. Similarly, the lowest price index (90.0) is observed in the aquaculture sector during November while the lowest price index of 95.0 for the capture fisheries sector is observed during September. Although both price indexes show a declining trend in the years between 2006 and 2013, the analysis suggests that farm-gate prices are more affected by seasonal effects than

ex-vessel catfish prices (Figure 4). Overall, catfish prices in both market channels display a non-stationary structure.

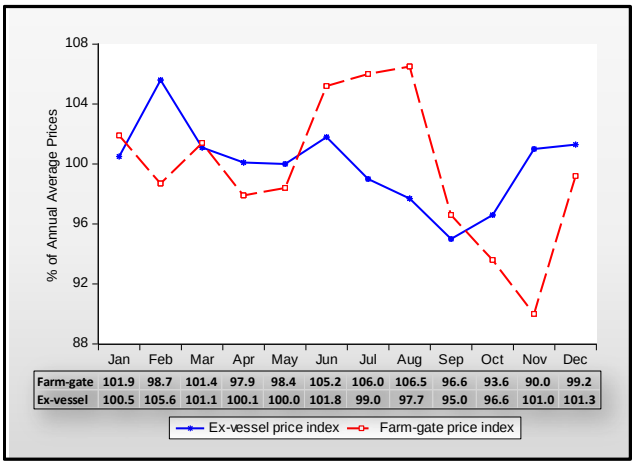

Figure 3. Moving Average Variation in Farm-gate and Ex-vessel Catfish Real Prices

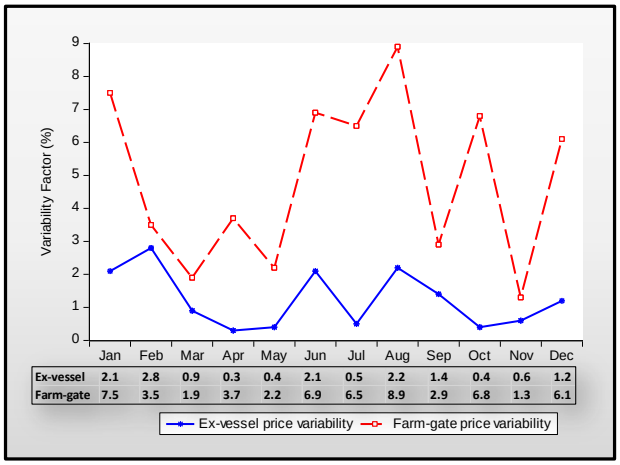

Figure 4. Variability in Farm-gate and Ex-vessel Catfish Real Prices

Seasonal Trends in Retail Prices

Figure 5 plots the estimated monthly price pattern for catfish retail prices, with the estimated monthly variability factors listed at the bottom of the Figure. The highest price index of 103.5 is observed in March, while the lowest price index of 96.2 is in August. In March, for instance, the estimated monthly price index of 103.5 suggests that the average March price is 103.5% of the annual average price. The variability factor of 4.4 reveals that, statistically, the March price can vary 4.4% points higher or lower than the monthly index. Thus, the March price in a particular year may be as high as 107.9% (103.5 + 4.4) or as low as 99.1% (103.5–4.4) of the annual average.

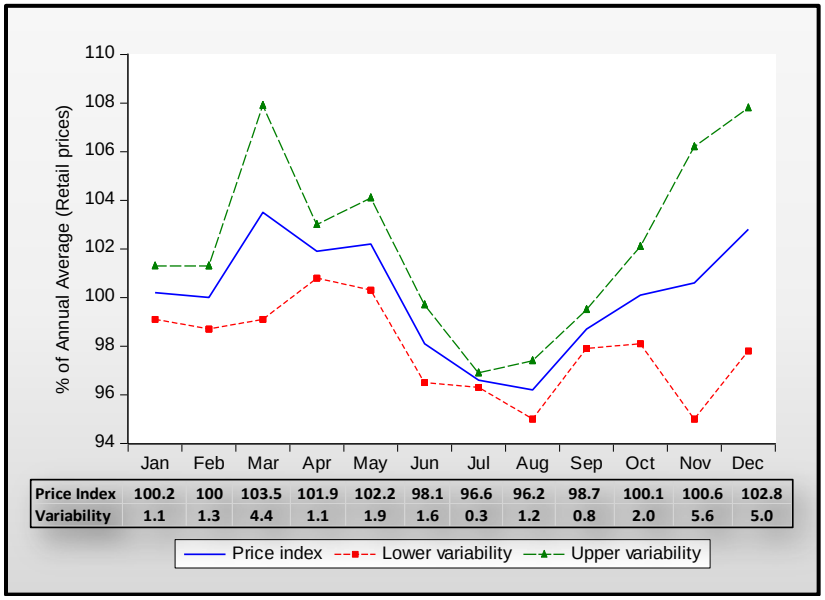

Figure 5. Moving Average Variation in Retail Catfish Real Prices

The estimated retail seasonal price index can also be used to forecast prices for the months ahead based on the past relationship; and given that the series exhibited a normal distribution. For instance, the historical deseasonalized retail real catfish price averaged UGX6,666/kg (or $2.67/kg) in December 2013 (Table 4). Thus, to forecast the monthly price for January 2014 requires dividing December's average price by the price index for December (102.8); then, multiplying by the price index for January (100.2) = UGX6,497/kg (or $2.60/kg). Adjusting for the variability suggests that the January 2014 average retail price would fall between UGX6,496/kg (or $2.60/kg) and UGX6,498/kg (or $2.61/kg). The small average variability factor of less than 2% shows the index's reliability in projecting future price trends.

Table 4. Actual, Deseasonalized and Seasonal Index (Retail Prices)

Period	Retail	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2006	a	1100	1200	1300	1400	1500	1300	1300	1300	1400	1400	1400	1400
	b	1108	1194	1227	1367	1449	1310	1348	1359	1409	1379	1444	1412
2007	a	1400	1400	1500	1400	1500	1500	1400	1300	1500	1600	1500	1400
	b	1406	1392	1420	1365	1452	1514	1451	1360	1513	1581	1539	1403
2008	a	1800	1900	2100	2000	2100	2100	2100	2200	2200	2300	2400	2100
	b	1800	1890	1994	1953	2043	2128	2173	2300	2228	2281	2441	2077
2009	a	1800	2200	2400	2500	2500	2500	2500	2500	2800	3000	3100	3500
	b	1793	2191	2297	2447	2447	2549	2585	2603	2845	2991	3103	3416
2010	a	3500	3500	3500	3500	3500	3400	3500	4000	3500	3500	3800	3900
	b	3479	3500	3387	3434	3444	3479	3618	4155	3560	3506	3749	3752
2011	a	3900	3900	4100	4150	4150	4000	4300	4300	4350	4450	5000	5000
	b	3875	3914	4022	4081	4095	4106	4446	4448	4421	4482	4862	4770
2012	a	4500	4600	4800	4950	5100	5000	4900	5150	5500	5600	6000	6100
	b	4472	4638	4756	4885	5035	5134	5066	5315	5585	5654	5793	5790
2013	a	6000	5900	6000	6200	6500	6500	6400	6500	6597	6686	6970	7025
	b	5967	5964	5968	6139	6420	6679	6618	6689	6699	6754	6703	6666
Mean	a	3000	3075	3213	3263	3356	3288	3300	3406	3481	3567	3771	3803
Mean	b	2988	3085	3134	3209	3298	3362	3413	3529	3532	3578	3704	3661
SI		**100.2**	**100**	**103.5**	**101.9**	**102.2**	**98.1**	**96.6**	**96.2**	**98.7**	**100.1**	**100.6**	**102.8**

SI: Seasonal Index; a: Catfish Real Price (UGX/kg); b: De-seasoned Catfish Real Price (UGX/kg)

Seasonal Trends in Wholesale Prices

Figure 6 plots the estimated monthly price pattern for wholesale catfish prices, with the estimated monthly variability factors listed at the bottom of the Figure. The highest price index of 101.9 is observed during July and November while the lowest price index of 97.2 is recorded in February. In July, for instance, the estimated monthly price index of 101.9 suggests that the average July price is 101.9% of the annual average price. The variability factor of 3.6 reveals that, statistically, the average price in July can vary 3.6% points higher or lower than the monthly index. Thus, the July price in a particular year may be as high as 105.5% (101.9 + 3.6) or as low as 98.3% (101.9–3.6) of the annual average.

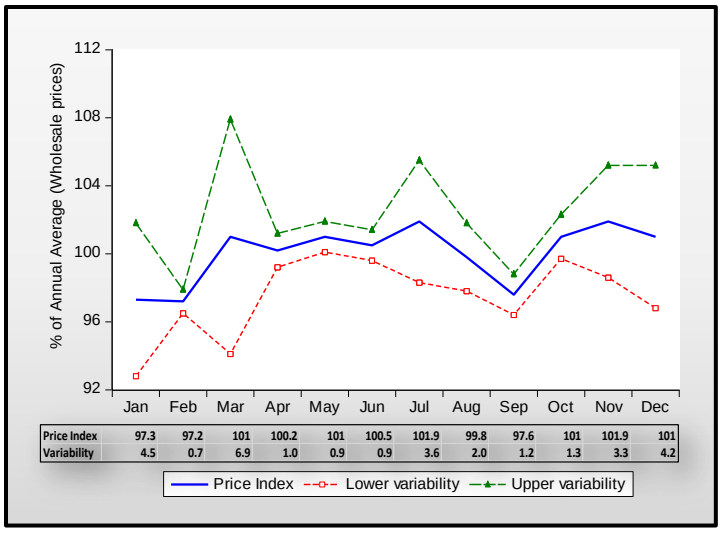

Figure 6. Moving Average Variation in Wholesale Catfish Real Prices

The estimated wholesale seasonal price index can also be used to forecast prices for the months ahead based on the past relationship; and given that the series exhibited a normal distribution. For instance, the historical deseasonalized wholesale real catfish price averaged UGX7,556/kg (or $3.02/kg) in December 2013 (Table 5). Thus, to forecast the monthly price for January 2014 requires dividing December's average price by the price index for December (101.0); then, multiplying by the price index for January (97.0) = UGX7,738/kg (or $3.10/kg). Adjusting for the variability suggests that the January 2014 average ex-vessel price would fall between UGX7,731/kg (or $3.09/kg) and UGX7,746/kg (or $3.10/kg).

Table 5. Actual, Deseasonalized and Seasonal Index (Wholesale prices)

Period	Wholesale	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2006	a	1100	1200	1500	1500	1500	1500	1700	1700	1700	1700	1500	1800
	b	1165	1244	1412	1488	1497	1496	1626	1680	1732	1700	1506	1834
2007	a	1800	2100	2100	2000	2100	2200	2400	2300	2200	2220	2400	2200
	b	1896	2170	1998	1991	2086	2188	2307	2278	2239	2214	2400	2231
2008	a	2500	2800	3200	3100	2900	3000	3000	3100	3100	3500	3200	3200
	b	2612	2880	3102	3106	2868	2972	2910	3083	3158	3469	3178	3218
2009	a	3500	2500	3000	3000	3500	3880	3600	3500	3600	3660	3700	3600
	b	3621	2563	2968	3010	3458	3836	3534	3498	3678	3602	3645	3577
2010	a	3800	3900	3900	4200	4500	4700	4600	4800	4800	5100	6100	5500
	b	3882	3996	3934	4220	4434	4655	4555	4829	4917	5009	5957	5413
2011	a	5100	5000	4900	5000	5000	5000	5150	5150	5000	5500	5600	5650
	b	5150	5132	5000	5001	4931	4973	5136	5203	5137	5419	5430	5505
2012	a	5600	5000	5700	6000	6000	6000	6200	6120	6150	6400	6900	7000
	b	5608	5144	5841	5978	5930	5997	6190	6198	6341	6337	6656	6781
2013	a	7100	6900	7200	7500	7500	7400	7450	7350	7352	7614	7871	7827
	b	7092	7107	7367	7437	7447	7418	7440	7447	7606	7543	7578	7556
Mean	*a*	*3813*	*3675*	*3938*	*4038*	*4125*	*4210*	*4263*	*4253*	*4238*	*4462*	*4659*	*4597*
Mean	*b*	*3878*	*3779*	*3953*	*4029*	*4081*	*4192*	*4212*	*4277*	*4351*	*4412*	*4544*	*4514*
SI		**97**	**97**	**101**	**100**	**101**	**101**	**102**	**100**	**98**	**101**	**102**	**101**

SI: Seasonal Index; a: Catfish Real Price (UGX/kg); b: De-seasoned Catfish Real Price (UGX/kg)

Retail versus Wholesale Seasonal Price Trends

Since the majority of catfish traders in the study area function as both retailers and wholesalers, a comparison of price patterns in the upstream market channels is conducted to examine whether there is a clear, distinct pattern over the studied period. Thus, Figure 7 compares the estimated indexes for retail and wholesale monthly catfish prices. As depicted in the Figure, both the highest and lowest price indexes (105.6 in February and 95 in September), respectively, are observed in the retail market. Both price indexes show a declining trend in the years between 2006 and 2013, with the wholesale market showing stronger variability compared to the retail market channel (Figure 8). Overall, prices in both market channels display a non-stationary structure.

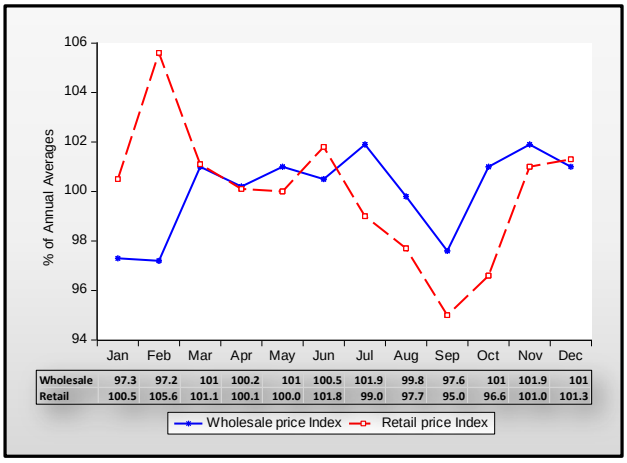

Figure 7. Moving average variation in retail and wholesale catfish real prices

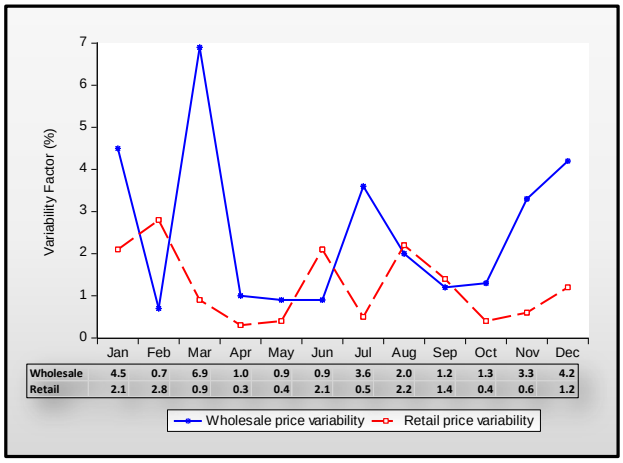

Figure 8. Variability in retail and wholesale catfish real prices

Conclusion

The findings reveal relatively distinct seasonal patterns in the farm-gate price series. For most years, prices in the farm-gate market channel peaks between June and August. Prices then decrease around September, before the lowest prices are reached in November. The prices in the ‘‘high price’’ period are on average 13% higher than in the ‘‘low price’’ period. In the ex-vessel value chain, the highest and lowest index price indexes were observed during February and September, respectively. Similarly, the highest and lowest price indexes in the retail market channel were observed in February and September, respectively. The highest price index months for the wholesale market were July and November; the lowest price index for the wholesale market was registered in February. The results of the comparison for farm-gate versus ex-vessel prices revealed that farm-gate prices are more affected by seasonal effects than ex-vessel catfish prices. Contrarily, the comparison between retail and wholesale market channels revealed that both price indexes show a declining trend, with the wholesale market showing stronger variability compared to the retail market channel. Based on the findings, it can be concluded that, seasonality of catfish supply is one of the major causes of variation in prices, and therefore, the government should consider measures of market stabilization policies that would ensure timely sharing of market information between actors to reduce monthly price fluctuations.

The study had two main limitations. First, the study examined an industry that is prevalent with market imperfections at the production, harvesting, and marketing levels. Second, the small sample

size of the data set warrants some caution when drawing broader conclusions from the results. Despite these limitations, it is clear from the results that, fundamentally, seasonal variations do matter, even in these highly imperfect markets. An attempt to stabilize catfish prices without paying close attention to seasonal variations in price formation might not yield the desired outcome.

Acknowledgment

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