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Agricultural markets integration and price transmission in West Africa: Evidence from a meta-analysis

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ABSTRACT

Over the past thirty years, the examination of market integration and price transmission has gained significant importance in West Africa. This rise in significance can be attributed to their role in evaluating the effects of market reform policies implemented by regional governments. Nonetheless, the influence of price transmission and market integration on the current food policies in West Africa and Ghana remains unclear. This research offers a comprehensive overview, drawing on an extensive analysis of 30 studies on price transmission and market integration published between 1997 and 2019. Through the application of Meta-Regression Analysis, our meta-analysis findings demonstrate that the degree of price transmission in West Africa's agricultural markets is relatively limited. The factors contributing to this low level of price transmission and integration in agricultural markets in West Africa include physical infrastructure, market information accessibility, institutional frameworks, levels of competition, market dominance, trade dynamics, conflicts and security concerns, government interventions, as well as export restrictions and bans. Consequently, it is imperative for the regional governments to prioritize the development of physical infrastructure, particularly the enhancement of road networks within the sub-region. Moreover, the expansion of Information and Communication Technology (ICT) tools, like mobile phones, and their effective utilization can significantly enhance access to market information related to agricultural produce across the region.

Keywords: Meta-analysis; price transmission; market integration; food policy; Ghana
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Introduction

Food market integration is a process of market inter-relationships evidenced by tradability and the resultant co-movements of market prices (Penzhorn & Arndt, 2002; Abunyuwah, 2007). It measures the degree to which demand and supply shocks arising in one region are transmitted to another region (Falkler & Goodwin, 2001). There are mainly two forms of market integration, vertical market integration and spatial market integration (Meyer, 2004). While vertical market integration refers to transmission of price signals from one marketing channel to another, spatial market

integration means transmission of price signals between markets in different locations (Minot, 2010). Price transmission, the core of market integration, occurs when a change in one price causes another price to change. Inefficiency in price transmission can have a negative impact on food security of consumers, income stability of farmers, and the entire population.

The attention received by price transmission studies in the field of agricultural economics can be attributed to its theoretical and practical usefulness. Theoretically, prices perform three functions in organizing economic activities in a free market economy. Firstly, price movements transmit information about production and consumption. The price system transmits only the important information and to the people who need to know. Secondly, it provides right incentives to adopt those methods of production that are least costly and thereby use available resources for the most highly valued purposes. Thirdly, prices determine the distribution of income i.e. who gets how much of the product. In general, one cannot use prices to transmit information and provide an incentive to act on that information without affecting the distribution of income (Amikuzunu, 2010). As a result, price transmission plays a crucial role in neo-classical economics by driving resource allocation and output mix decisions of economic actors and integrates markets spatially or vertically. Thus, the absence of price transmission between markets that trade with each other may imply gaps in economic theory (Peltzman, 2000; in Meyer & von Cramon-Taubadel, 2004), and results in less than Pareto efficiency in resource allocation in economic welfare theory.

Practically, price transmission studies are useful to policy makers in many respects. For instance, countries that have liberalized their domestic markets require knowledge on how world price signals are transmitted to their domestic markets. Knowledge on effective price transmission that results in the integration and efficiency of spatially separated markets is also a prerequisite for ensuring a distributional balance between food-deficit and surplus regions in developing countries; and for assessing the role played by profit-seeking arbitrageurs in this regard (Goletti & Babu, 1994; in Abdulai, 2007). Further, research on the degree of interdependence and co-integration between food markets around the world helps in improving decision-making techniques and international investor strategies.

The initial empirical studies in price transmission in West Africa (WA) was attributed to inadequate availability of relevant and complete data, as well as good models to explore price transmission analysis. Nonetheless, the last two decades have witnessed several price transmission and market integration studies in WA. A review of the literature on price transmission and market integration studies in agricultural markets in West Africa revealed that earlier studies examined integration among food markets in a linear framework using simple correlation and regression tests as tools for analysis (Li, 2000). However, in the last 20 years, studies have applied econometric techniques such as co-integration, error correction models, parity bounds model, autoregression, Granger-causality, and Ravallion/Timmer models to test the integration hypothesis (Badiane & Shively, 1998; Abdalai, 2000; Amikuzunu, 2010).

Econometric models are used to estimate the extent of market integration and the determinant of prices received by producers. The models also assess the value of price linkages along the supply chains of homogenous commodities. However, due to proliferation of econometric models and datasets, the findings of these studies also vary tremendously. The findings highlight several

possible underlying factors that drive price transmission under different contexts and attempt to suggest relevant context-specific policy strategies that may be needed to boost price transmission and market integration and efficiency.

There are diverse findings across studies in West Africa. Some price transmission analyses documented market segmentation while others documented perfect market integration, and under each case, different key determinants of price transmission were identified (Amikuzuno & Ogundari, 2015). The heterogeneity in the findings is not surprising given the divergent range of econometric models and data that were employed in such analyses, as well as the different commodity markets analysed, and the various socioeconomic and geographical contexts under which these studies were conducted (Perdiguero, 2010). Notwithstanding the overall usefulness of the results from price transmission studies in WA and especially Ghana, it is worrying that the high diversity in these findings, the different causal factors they assign to price transmission or the absence of it, and their policy implications in the different West African countries represent a critical weakness. There is a need for a holistic synthesis of the findings of the price transmission studies for WA agricultural markets. Meta-analysis helps to generate unified evidence on the overall extent and determinants of price responsiveness and market performance following policy and/or infrastructural changes in WA.

The present study contributes to existing literature in twofold. Firstly, unlike previous studies that include few numbers of observations from West Africa, the present study focuses exclusively on price transmission estimates from West Africa with broader geographical coverage. This would produce a better understanding of the link between price transmission estimates in West African agricultural markets and attributes of studies reporting these estimates in the region. Secondly, the current study uses meta-regression analysis (MRA) to extend the discussion on price transmission analysis to include identification of drivers of price transmission estimates over the years in West Africa. Thus, arising from the foregoing, the study addresses the following research questions:

i. How did the relationship between reported mean price transmission estimates and year of survey from the selected case studies develop (i.e., rise or decline) over the years?
ii. Are there differences in reported mean price transmission estimates to a set of study specific attributes such as methodology used, model specification, publication outlet, data type, location etc.?
iii. What factors (policy variables) have driven price transmission in agricultural markets as identified from the selected case studies over the years?

Evidence of price transmission in agricultural markets in West Africa

The Ghanaian agricultural markets have been a subject of extensive study on price behaviour especially the maize market. Earlier studies began with researchers such as Alderman (1993), Shively (1996), Badiane & Shively (1998), among other research publications. On the quest for knowledge about how information is transmitted across markets in Ghana and whether government policies in a single market can be achieved in a broader arena, Alderman (1993) employed the Ravallion dynamic model and the standard cointegration technique to find out if price movements for maize are fully transmitted to other regions. However,

imperfections in how market information is processed were noted. The findings of the dynamic model showed functional inefficiency in Ghana using monthly wholesale prices from 1977 to 1990.

In another study of prices and markets in Ghana by Alderman & Shively (1991), the authors used monthly food prices between 1970 and 1990 and adopted a variant of the Ravallion model developed by Timmer (1974). The findings show that, food markets in Ghana appear to function reasonably well with the exception of rice. Markets integrate in the long-run, though prices in the major markets do not transmit instantly to other markets. The findings established that price stabilization in one market would contribute to stability in other markets, especially with maize price movements influencing that of millet and sorghum. However, rice marketing channel in Ghana appears to break between the savannah producers and coastal markets.

Badiane & Shively (1998) also examined the roles of market integration and transport costs in explaining price changes in Ghana using dynamic model of price formation and cointegration techniques. With wholesale maize price data over the period 1980–1993, they showed that the price-adjustment process in local market is determined by the degree of interdependence between that market and the central market in which the price shock originates. Thus, reductions in local prices and local price variance following the introduction of economic reforms in 1983 can be traced to both local and central market forces, as did arbitrage costs between Techiman and the other outlying markets. A common characteristic of the above studies is that, they all use Techiman market in the Bono East Region as the reference market for which prices transmit to other markets (most often Makola in Greater Accra Region, and Bolgatanga in the Upper East Region).

In a similar study as those discussed above, Abdualai (2000) utilizes the threshold cointegration method to examine price linkages between the principal maize markets in Ghana. Results indicate that wholesale maize prices from 1980 to 1997 in the local markets (Accra and Bolgatanga) respond more swiftly to central market price increases than decreases. Also, Accra market reacts faster than Bolgatanga market to changes in Techiman market prices.

Asuming-Brempong & Osei-Asare (2007) used the Engle and Granger residual based test to show that imported rice market is segmented from the domestic rice market in Ghana. Egyir *et al*. (2011) also investigated the gains from Information Communication Technology (ICT) based market information services in the Ghanaian food commodity markets using the Ravallion-Timmer model in 11 selected markets. The study revealed that mobile phone had been the single most important ICT tool facilitating the speedy transmission of marketing information. Due to lack of other complementary services, market integration is limited; thus market connectedness values show the presence of short run market integration for groundnut but not for maize and yam. An application of the Johansen cointegration approach in assessing the efficiency of plantain marketing in Ghana by Mensah-Bonsu *et al*. (2011) indicates that arbitrage is working, given the presence of short- and long-run relationships between the central consumption market (Accra market), assembly markets (Kumasi, Sunyani and Koforidua markets) and the production markets (Goaso, Begoro and Obogo markets). However, the speed with which prices get transmitted across the markets is relatively weak, that is 27.7%. The study uses monthly wholesale prices of plantain between 2004 and 2009.

Amikuzuno (2009) points out the conflicting results of the speed of price

transmission in the tomato market in Ghana when the standard threshold autoregressive (TAR) and the extended TAR (estimates the speed of transmission as a time varying parameter) are used in a high and reduced tariff periods following trade liberalization in Ghana. The standard TAR shows deterioration in the speed of price transmission (45% and 49% for high and reduced tariff periods, respectively), while the extended TAR indicates an improvement in the speed of price transmission (65% and 70% for high and reduced periods, respectively) in the tomato markets. In testing for market integration between the north and south of Ghana's groundnut markets, Mockshell & Egyir (2010) found that markets are segmented both in the long and short run. Traders in the groundnut subsector ranked transportation difficulty, lack of standardization in the local market and inadequate credit as the major constraints.

Blay *et al*. (2015) employed the consistent momentum threshold autoregressive (MTAR) model and its extension and GARCH-M model to examine the degree of market integration as well the price volatility of six selected sorghum and millet markets in Ghana. The study found that the various markets were highly integrated; however, the price transmission between reference/central markets (Tamale) and the other regional selected markets (Techiman, Kumasi, Accra, Bolgatanga and Wa) under consideration appears to be asymmetric.

Armah *et al*. (2019) also assessed the impact of the National Food Buffer Stock Company on price transmission in Ghana. Using nonlinear error correction model, the authors confirm asymmetric price transmission in the white maize retail market in Kumasi, Ghana. The findings show that a decrease in white maize wholesale prices are transmitted more quickly, while increases in wholesale prices take longer to get through to consumers. The authors attribute the observed asymmetric price adjustment to the marketing activity of NAFCO in the retail market.

Zakari *et al*. (2014) studied market integration and spatial price transmission in Niger grain markets. Using cointegration and error correction models, the results showed that grain markets in Niger respond to negative and positive shocks in regional and international markets differently. The authors also find that the speed of adjustment of prices to long-run equilibrium varies between 30 percent, 35 percent, 48 percent and 40 percent respectively for millet, sorghum, maize and rice prices. Development of trade policy with the neighboring countries to facilitate regional market integration.

Yovo *et al*. (2022) also assessed asymmetry and transmission of international price shocks of cocoa and coffee in Togo. The results from the threshold autoregressive (TAR) model showed that domestic prices respond less quickly to international price increase than decreases. Furthermore, the asymmetric price transmission for cocoa and coffee is similar. Onubogu *et al*. (2021) employed the vector error correction model to assess price transmission in cowpea and yam markets in Nigeria. Their study reports a presence of long-run relationships across the markets while the speed of adjustment to equilibrium after price shocks in the yam and cowpea markets varied across markets.

Materials and Methods

Meta-analysis overview

Meta-analysis (MA) allows researchers to combine results of several homogenous studies into a unified analysis that provides an overall estimate of interest for further discussion (Sterne, 2009). It provides the same methodological

rigor as a qualitative review. A general model of carrying out MA is the use of regression techniques. Meta-regression analysis (MRA) is defined as a quantitative method used to evaluate the effect of methodological and other study-specific characteristics on published empirical estimates of some indicators (Alston *et al*., 2000). In this study, price transmission estimates from the primary study is treated as dependent variable, while study attributes such as year of data collection (or year of survey), model specification, methodology, data type etc. are taken as explanatory variables.

After the work of Glass (1976), meta-analysis has become the standard method of searching for general patterns in a body of existing specific research results. MA is popular in medical, educational, pharmaceutical, and marketing researches as noted by Thiam *et al*. (2001). A review of the literature shows that MA has also been extended to a wide range of results in economic research. These include effect of immigration on wages (Longhi *et al*., 2005), income and calorie intake (Ogundari & Abdulai, 2013), income inequality and economic growth (de Dominicis *et al*., 2008), effect of aid on economic growth (Mekasha & Tarp, 2013), energy consumption and economic growth (Chen *et al*., 2012), and effect of currency unions on trade (Havranek, 2010). Others are price and income elasticity of demand for meat (Gallet 2010), price and income elasticity of demand for alcohol (Gallet, 2007), income elasticity of demand for cigarette (Gallet & List, 2003), exchange rate volatility and trade (Josheski & Lazarov, 2012), debt and economic growth (Moore & Thomas, 2010), and willingness to pay for reduction in pesticide risk exposure (Florax *et al*., 2005).

The meta-regression model

Below is the specification of the meta-regression model used in the present study;

$$study\_effect_i^{'} = \alpha_0 + \sum_{j=1}^{j} \alpha_k X_k^{'} + \sum_{j=1}^{j} \beta_j Z_j^{'} + \upsilon_i ; \upsilon_i \square N(0, \delta_{\upsilon i})$$

where, $study\_effect_i^{'}$ is a vector denoting a study effect of interest from the i-th primary study conducted in the i-th country in West Africa, namely price transmission coefficient; $X_k^{'}$ and $Z_j^{'}$ are vectors of study specific characteristics hypothesized to explain the estimated study effect from each primary study; $X_k^{'}$ represents continuous variables such number of observations/sample size (ranging from 34 to 401), data year (from 1980-2019) and year of publication (from 1997-2019); and $Z_j^{'}$ represents indicator variables on whether or not the primary studies included under this review are working or conference papers, included food crop products, analysed vertical price transmission, used differenced prices, and used monthly data. In addition, whether or not the primary studies employed ARDL, VARR-VECM, Co integration, conducted unit root and causality tests, and target regions or countries (i.e. Nigeria, Ghana, West Africa) of the primary studies. The α_0, α_k and β_j are parameters to be estimated while υ_i is the error term of the meta-regression. The MRA of the price transmission coefficients is performed using Weighted Least Square (WLS) with the square root of the sample size as the weight. The use of WLS for the former is consistent with the insight that WLS deals with heteroscedasticity in the effect size as earlier revealed by Stanley (2008) and later supported by Nelson & Kennedy (2009).

Meta dataset

The studies used in this paper were sourced from published journals including Agricultural Economics, International Journal of Business and Economics, Journal of Development and Agricultural Economics, Journal of Agricultural Economics, International Journal of Development Issues, Environmental and Resource Economics, Journal of Political Economy, Energy Policy, Journal of Development Economics among others, and other online databases. The meta-dataset for the analysis was obtained from 30 published, conference and working papers analyzing included price transmission and market integration in West Africa. The words or phrase search for include price transmission, market integration, agricultural market integration and agricultural trade. The reviewed studies covered seven WA countries and five agricultural commodities of WA. The 30 studies reviewed yielded 115 observations from which a number of study specific characteristics or variables were extracted. A summary of the study variables compared with the average number of observations for each variable and the corresponding mean, minimum and maximum values of estimated price transmission coefficients are presented in Table 1. It included the mean and standard deviation values of the dependent and moderator variables in the MRA.

Results and Discussion

The review of the study variables and the descriptive statistics of the corresponding price transmission coefficients raise several issues as shown in Table 1. About 83.8% of the primary studies in this analysis were published in journal articles, and about 4% were working papers, with the rest (11.8%) being conference proceeding. Price transmission studies which focus on crop products account for more than 96% of the observations, which included cereals, fruits, legumes, and vegetables with a mean estimated price transmission coefficient of 0.1785, 0.4439, 0.6405, and -0.1139, respectively. Animal products-based studies accounted for just 4% of the observations with a mean price transmission coefficient of 0.882. The fact that most of the studies focus on crop commodity markets, agree with the reality that staple food and cash crops are more important in West African agriculture and marketing systems than livestock.

TABLE 1

Summary statistics of the price transmission coefficients by study specific characteristics

Variables	Proportions	PT coefficients		
		Mean	Min.	Max.
Papers				
Conferences	0.1186	0.4927	-0.154	1.107
Journals	0.8383	0.1990	-1.45	1.710
Thesis	0.042	-0.084	-0.129	-0.041
Methods used				
AVCM	0.2288	-0.059	-0.355	0.604
VAR	0.144	0.7420	0.0400	1.183
VECM	0.6186	0.2130	-1.455	1.710
Commodities				
Cereals	0.6355	0.1785	-1.115	1.200
Fruits	0.1355	0.4439	-0.611	1.71
Legumes	0.0508	0.6405	0.0411	0.925
Non- food crops	0.0423	0.8820	0.8299	0.945
Vegetables	0.1355	-0.114	-1.455	0.310
Data frequency				
Monthly	0.8389	0.296	-1.115	1.710
Biweekly	0.0932	-0.247	-1.455	0.283
Weekly	0.0677	-0.002	-0.210	0.905
Location				
Benin	0.0932	0.840	0.600	1.200
Burkina Faso	0.0593	-0.131	-0.210	-0.002
Ghana	0.4322	0.339	-1.455	1.703
Niger	0.1101	-0.865	-0.355	0.2023
Nigeria	0.127	0.387	0.006	0.945
Senegal	0.025	0.473	0.041	0.828
Togo	0.0677	-0.249	-0.512	0.384

Source: Authors Computation, **2023**

The error correction model is the most popular method for analysing price transmission in SSA. About 84% of the studies used the error correction model (ECM) or its extended versions. This model has a higher power in estimating the effects of policy shocks on price transmission and is able to handle non-linearities in prices and transaction costs as revealed in the insights of Baulch (1997), and McNew (1996). In this way, applying the ECM is relevant for WA, where most price transmission studies were undertaken to estimate the impact of market reforms on the performance of domestic markets. In line with the analytical theory in price transmission analysis, about 80% of the studies tested for unit roots while 30% extended the analysis to examine causality.

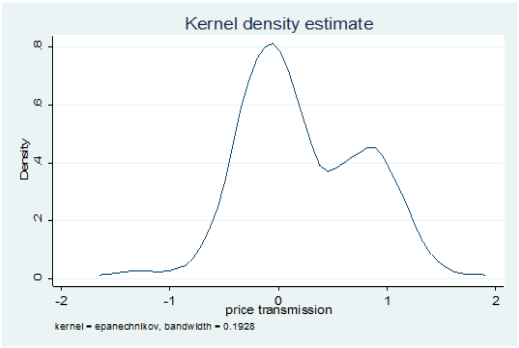

Fig. 1: Distribution of the price transmission coefficient;

The distribution (Figure 1) shows a larger dispersion of price response to market anomalies. This is in line with the different extents of price transmission and market integration observed in the analysis which is expected for West Africa due to differences in the key determinants of price transmission across the different countries. The distribution of the estimated price transmission coefficient extracted from the primary studies was skewed to the right (between -1.5 and 2). The impact of market anomalies and price shocks on price transmission in WA agricultural markets is clearly mixed meaning its either positive or negative with overall minimum, mean and maximum price transmission coefficient being -1.455, 0.223 and 1.71, respectively.

The economic interpretation of the distribution of the price transmission coefficients is that some agricultural markets in West Africa may be segmented, implying a negligible level of price transmission occurring between spatially separated markets or different levels of the supply chain due to autarky (with price transmission coefficients around 0). The majority of the markets averagely react to price shocks (with price transmission coefficients around 0.223), while few markets tend to exhibit near-perfect price transmission, implying that changes in prices at a given market or level of the supply chain are fully and instantaneously transmitted to the other markets or levels of the chain (with price transmission coefficients around 1). Some markets even overreact to price shocks (with price transmission coefficients around 1.7) as may be the case where traders exercise market power and near-oligopolistic pricing strategies to ensure asymmetries in price transmission between remote producer and urban consumer agricultural markets (Amikuzuno, 2010; Armah *et al*., 2019).

The overall average elasticity of price transmission (0.223) in WA agricultural markets is low compared to other parts of the world (Table 1). For instance, the transmission coefficient for the USA agricultural markets even as far back as from 1961–1983 (USDA, 2009) was 0.740, while that of the EU27 was 0.500 (EU, 2009). An average price transmission elasticity of 0.62 and 0.34 was recorded for selected commodities in India and China, respectively (Imai *et al*., 2008). However, Ghana, Nigeria and Benin have average price transmission coefficients of 0.339, 0.389 and 0.473, respectively, which were relatively higher than the WA average price transmission coefficient. This shows that even though the individual countries may be integrated, the agricultural markets in the sub-region was segmented. This has implication for trade flows between countries in West Africa with respect to the commodities and consequently, food security in the sub-region.

Study-specific characteristics and price transmission in West Africa

Table 2 presents the results of the relationship between reported price transmission coefficients and selected study-specific variables. It shows the effects of the study characteristics on the extent of price transmission as measured by the estimated price transmission coefficients.

The coefficients for year of publication were

negative and significant. This means that year of publication has a decreasing effect on the reported price transmission coefficients in the selected studies. Therefore, as year of publication of the study increases, the magnitude of the estimated price transmission coefficients significantly decreases. This observation confirms the findings of Amikuzunu (2012), who found an inverse relationship between publication year and price transmission coefficients.

TABLE 2

Weighted regression of the MRA for the coefficients for price transmission

However, the above observation contradicts with the findings of Ogundari & Bruemmer (2011), and

Variables	**Parameters**	**Coefficient**	**Std. Err**	**P-Value**
Data point(Sample size)	α_1	0.0044	0.004097	0.283
Data year	α_2	0.4317**	0.2025	0.033
Publication 2000-2010	α_3	-6.781**	3.379	0.051
Publication 2011 to date	α_4	-7.862**	3.5812	0.028
Journals	β_1	-0.2836	0.2536	0.269
Thesis	β_2	-0.4630	0.4725	0.327
VAR-VECM	β_3	0.2841	0.342	0.404
VECM	β_4	-2.298**	0.929	0.013
Fruits	β_5	1.812**	0.577	0.002
Legumes	β_6	-0.3636	0.3363	0.280
Non- food crops	β_7	1.046**	0.3658	0.025
Vegetables	β_8	0.8794**	0.3232	0.007
Monthly	β_9	1.750**	0.8756	0.046
Weekly	β_{10}	-2.345**	1.063	0.027
Ghana	β_{11}	-0.588	0.347	0.090
Niger	β_{12}	-1.0132**	0.403	0.012
Nigeria	β_{13}	0.133	0.556	0.811
Constant	α_0	-859.05	403	0.003
Model $Chi^2(17)$			1979.78	
Prob>F			0.0000	

Source: Authors Computation, 2023

Perdiguero (2010), who observe that despite the time lag between data collection and publication year, recent studies estimate higher effect size than previously published studies. This is expected to further improve price transmission and market integration consistent with recent improvements in the quality of infrastructure and market information flow, through the application of ICT tools in agriculture such as mobile phones. The use of both improved model and better-quality data by recent studies has also improved the econometric estimation of price transmission.

With regard to the product analysed, studies based on fruits and vegetable products appeared to have significant and greater positive effects on estimated price transmission coefficients than studies based on cereals. It is also important to note that fruits and vegetable are also more perishable than cereals and legumes and require arbitrageurs to move across spatial markets within their respective countries quickly to avoid the product spoilage since refrigerated transport systems are lacking in WA. The results also revealed that 63.5% of the studies in West Africa were cereals-based, thus the large number of crop-based studies seems to suggest that crop production is more important than livestock in West Africa (Table 2).

It is logical that network of traders and information flow on crop prices will ensure that prices are transmitted spatially or vertically between crop markets. The proliferation of these crop-based studies may be due to availability of data regarding these crops and also the implication of such studies on consumer and producer welfare in Ghana, particularly and the sub-region as a whole. Also, the price transmission coefficient of non-food crops is positive and significant. This means that studies on livestock and fish will have faster price transmission than cereals. This is mainly due to the perishability of these products, which requires faster interaction between market participants to move the commodities from the producing centers to the consuming markets and hence faster flow of price information.

The positive and significant effect of the monthly data variable means studies using data monthly frequencies improves the amplitude of price transmission coefficients by about 1.750 units over estimates obtained from biweekly and weekly data. All econometric models used by the primary researchers in the MRA, except the VECM, do not significantly affect the estimated values of price transmission coefficients in WA. This may due to high number of studies that used VECM and its extended version. Additionally, studies that used VECM model are likely to estimate lower price transmission coefficient than studies that used VAR. Studies that applied the VAR are more likely to have higher (about 0.28 units higher) estimated coefficients than those that do not use this method.

Other variables included in the MRA regression to assess the impact of the study specific characteristics on the price transmission coefficients are not significant. The findings in this section agree to a large extent with findings from similar studies by Ogundari *et al*. (2012), Ogundari & Bruemmer (2011), and Perdiguro (2010). The result also revealed that studies conducted in Ghana have lower price transmission than those obtained from other countries and this is mainly due to variety of estimation methods used in the various primary studies for Ghana.

Conclusion and Recommendations

This study on price transmission and market integration contributes to the existing knowledge of the effectiveness of agricultural markets in West Africa, particularly in Ghana.

Research on price transmission and market integration in this region, notably in Ghana, has garnered significant attention over the past two decades. Most of these analyses aimed to evaluate the impact of market policy reforms, such as structural adjustment reforms and market liberalization policies, which were implemented by several West African countries between the mid-1980s and early 1990s, on the performance of their domestic markets. This focus stems from the recognition that the success of these market reforms is contingent upon the degree of price transmission between geographically separated markets or within product value chains.

Although individual-level findings from the various price transmission analyses have provided valuable insights for policymaking in the targeted countries, the results depict a mixed panorama regarding the extent, nature, and determinants of price transmission in West Africa. The literature attributes the disparities in the outcomes obtained by different price transmission analyses to a range of study-specific factors, including aspects related to data, publication, products under examination, as well as model and study location-related variables.

This comprehensive analysis underscores the pivotal role played by these factors in shaping the magnitude and statistical significance of the reported price transmission coefficients in West Africa between 1997 and 2019. It revealed that the year of publication of the reviewed studies had a diminishing effect on the price transmission coefficient. Additionally, it was observed that employing monthly data frequencies led to an increase of approximately 1.750 units in the estimated price transmission coefficients compared to estimates derived from weekly data.

Furthermore, it was observed that studies focusing on food crop products, such as fruits, cereals, and non-food crops, exhibited significant and notably higher positive impacts on the estimated price transmission coefficients compared to other agricultural products. This phenomenon is attributed to the pronounced emphasis placed on crop production and marketing systems in West Africa. While the choice of model did not generally seem to impact the estimated results, it was noted that studies utilizing the Vector Autoregressive (VAR) method (accounting for approximately 15.2% of the studies included in this analysis) were more likely to yield higher estimated coefficients than those that did not employ this method. The review also identified several factors driving price transmission in various countries in West Africa, including elements such as physical infrastructure, market information, institutions, competition, market power, trade, government intervention, and export restrictions/bans.

Policy recommendations

The level of price transmission in West Africa shows that the sub-region either does not trade, or trades at low levels with each other regarding the commodities studied. Price transmission in West African agricultural markets is generally low as a result. It is thus recommend that the respective countries take steps to address challenges such as high transport costs due to bad road infrastructure, and numerous non-official barriers such as road blocks and bribes, in order to accelerate trade flow between these countries.

The results also show that the most studied commodity in Ghana is maize and almost all such studies used the same marketing route (Accra, Tamale, Bolgatanga). Though price transmission along this route has improved over the years, it may give a false overview of market integration of the entire country. Future studies by researchers should

be extended to other commodities such as pineapple, pawpaw, fish, livestock and legumes and cover other marketing centers within the country. This would reveal the real state of market integration in agricultural markets in Ghana.

Also, most of the primary studies used VECM which is likely to underestimate price transmission coefficients. The main reason for the extensive used of VECM instead of other models such as threshold autoregressive (TAR) models, parity bound models (PBM) and Markov-switching models (MSM) is because of non-availability of required data such as transaction cost, trade flow data in addition to price series. It is thus recommended that institutions responsible for the collection of market information are resourced to accurately collect transaction cost, trade flow data and price data, to allow researchers to use more recent econometric models that improve the estimation of price transmission in Ghana as well as WA.

The study also discovered that physical infrastructure, market information, institutions, competition, market power, trade, government intervention and export restrictions/bans are main drivers of price transmission and integration in agricultural markets within West Africa. It is thus recommended that regional governments prioritize development of physical infrastructure such as road networks in the sub-region. Expansion of ICT tools and its application will also facilitate access to market information on agricultural produce in the region.

Lastly, studies-based on food crop products such as fruits, cereals, and non-food crops have significant and greater positive effects on estimated price transmission coefficients than other agricultural products. This is attributed to the greater importance placed on crop production and marketing systems in West Africa. Hence, it is recommended that food policy formulators focus on development of other non-crop sectors such livestock production.

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