The Contribution of Agricultural Economics to Price transmission Analysis and Market Policy in Sub-Sahara Africa: What Does the Literature Say?

Joseph Amikuzuno
Department of Agricultural Economics and Extension
University for Development Studies,
Tamale – Ghana
Email: amikj26@yahoo.com

Kolawole Ogundari
Department of Food Economics and Consumprice transmissionion Studies,
University of Kiel, Germany
Email: ogundarikolawole@daad-alumni.de

Paper prepared for presentation at the 86th Annual Conference of the Agricultural Economics Society, University of Warwick, United Kingdom
16 - 18 April 2012

The Contribution of Agricultural Economics to Price transmission Analysis and Market Policy in Sub-Sahara Africa: What Does the Literature Say?

Abstract

Price transmission studies have become increasingly important in Sub Sahara Africa over the last two decades because of their application in assessing the impact of the market reforms policies embarked upon by the region's governments between the mid 1980s and early 1990s. In this study, a meta database obtained from 45 price transmission studies published between 1978 and 2011, is used to provide an overall assessment of the potential impact of selected, study-specific attributes on estimated price transmission coefficients and in identifying asymmetric price transmission. Despite the large dispersion of estimated price transmission coefficients 2.5% - 94.2%, the mean coefficient of 32.2% is an overall assessment that the extent of price transmission in SSA is comparatively low. The predicted impacts of the study-specific attributes on the price transmission coefficients, and on the likelihood of the primary studies to report asymmetric price transmission however differ consistently across the attributes, and provide in general evidence on the critical role such attributes play in determining price transmission results and their implications for policy formulation. Therefore, future research on price transmission should carefully account for the impact of study-specific attributes in their results.

Key words: meta-analysis, Price transmission, asymmetry, Sub-Saharan Africa

1. Introduction

Empirical studies on Price transmission measure the degree to which commodity prices at geographically separated markets or at different levels of the value chain share common long-run price information. Traditional analyses of spatial price relationships began over 60 years ago, with the blueprint popularly called the Enke-Samuelson-Takayama-Judge (ESTJ) equilibrium model for spatial price equilibrium relationships, introduced by Enke (1951), Samuelson (1952) and Takayama and Judge (1964). In the field of agricultural economics, price transmission and market integration analysis has received considerable attention in the past 50 years.

This is because; price transmission studies have both practical and theoretical usefulness. On the theoretical level, price transmission play a key role in neo-classical economics by postulating that prices drive resource allocation and output mix decisions by economic actors, and price transmission integrates markets spatially or vertically. Thus, the absence of price transmission between markets trading with each other may imply gaps in economic theory (Peltzman, 2000 in Meyer and von Cramon-Taubadel, 2004) and result in less than Pareto efficiency in resource allocation in economic welfare theory.

The applied value of price transmission studies is useful to policy makers in many respects. For instance, countries that liberalise their domestic markets require knowledge on how world price signals are transmitted to their domestic markets. Knowledge on effective price transmission which 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 and Babu, 1994 in Abdulai, 2007).

Furthermore, evidence on price transmission is required in understanding the impact of policy changes on the performance of agricultural markets. Particularly, negotiations in the ongoing WTO Doha Round, the economic partnership agreements (EPA), and other bi- or multilateral agreements in developing countries in the face of the recent global economic and food price crises need to be informed by evidence on the ability of domestic agricultural markets in these countries to respond to changes in international prices of agricultural commodities.

Jones (1972) premiered price transmission and market integration analysis in sub-Sahara Africa (SSA). The author used correlation coefficient analysis to estimate the extent of price transmission between geographically separated retail markets in Nigeria. Following Jones (1972), progress in empirical price transmission and market integration studies in SSA slacked, with only nine reported studies in SSA markets out of 61 studies published before 2000 (van Campenhout, 2007). These studies include Ejiga (1977) and Heytens (1986) on Nigerian cowpea, and *gari* and yam markets respectively; Loveridge (1991) on Rwandan beans markets; Teklu et al (1991) on sorghum/cattle markets in

Sudan; Webb et al (1992) on Ethiopian grain markets; Alderman (1993) on Ghanaian maize markets; Golletti and Babu (1994) on Malawian maize markets; Dercon (1995) on Ethiopian teff markets; and Lutz et al (1995) on maize markets in Benin. In addition to the above, some studies conducted before 2000 but not explicitly referenced above include Degaldo (1986), Fafchamps and Gavaian (1996), Bediane and Shively (1998), and Bassolet and Lutz (1999).

The initial dearth of empirical studies in price transmission in SSA was attributed to inadequate availability of relevant and complete data, as well as good models to comprehensively explore price transmission analysis[1]. Over the last decade however, price transmission and market integration studies in SSA have proliferated. For example, Abdulai (2000) for Ghana; Rashid (2004) for Uganda; Kuiper et al (2006) for Benin; Negassa and Meyers, 2007 Ethiopia; van Campenhout 2007 for Tanzania; Meyers 2008 for Ethiopia, Moser et al 2009 for Madagascar among the others presented in Table B of the appendix of this study.

The proliferation is partly attributed to extensive time series data and numerous, sophisticated models made available for price transmission and market integration analysis in many countries. Most importantly however, over 70% of the price transmission analyses in SSA were commissioned to assess the responsiveness of domestic prices to the market reforms embarked upon by a majority of the region's governments in the mid 1980s and early 1990s. Some studies also examine improvements in key price transmission determinants like transportation and market institutions, infrastructure and information, and monetary policy changes on market performance in various countries in SSA. Presently, most SSA's studies on price transmission focus on the effects of the 2007/2008 global food price and economic crises on market performance.

The different price transmission studies conducted in SSA often use different econometric models and datasets to estimate the extent of market integration and the determinants of prices received by producers who are spatially separated from consumers in central markets, or the nature of price dynamics along the supply chains of homogenous or value-added commodities in the same market locations. Their findings highlight several possible underlying factors driving 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.

This notwithstanding, the overall evidence of estimated responsiveness of commodity prices following policy, infrastructural or institutional changes are often unspecific; exhibiting a large dispersion of price transmission coefficients ranging from low and negative price transmission to high and positive price transmission even under the same

[1] All the studies listed above used three of the linear/static models viz. correlation coefficients, Ravallion, Timmer and Cointegration for their analysis.

study. Across studies, some price transmission analyses in SSA document market segmentation while others document perfect market integration and under each case, different key determinants of price transmission are suggested. The heterogeneity in the findings is not surprising given the divergent range of econometric models and quality of data often employed in such analyses, as well as the different commodity markets analysed, and the various socioeconomic and geographical contexts under which these studies are conducted (Perdiguero, 2010).

Thus, despite the overall usefulness of the results from price transmission studies in SSA, 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 SSA countries represent a critical weakness. Particularly, formulating holistic market reforms and future trade WTO and EPA agreements for SSA as a single economic block and promoting intra SSA trade based on the different estimates from the above studies remains challenging. This is because of the large uncertainties in the actual extent of price transmission, the underlying factors driving price transmission and the policy measures really required to improve market performance in SSA.

If the extent and determinants of price transmission and market integration in SSA cannot be comprehensively identified from the mixed results of the many empirical studies, then policy makers may easily be wrong about how SSA markets will respond to new trade policies like ensuing from the EPAs and WTO. Thus, there is a need for a holistic synthesis of the findings of price transmission studies in SSA's agricultural markets. This is the only way to generate unified evidence on the overall extent and determinants of price responsiveness and market performance following policy and/or infrastructural changes in SSA; and presenting SSA as an economic block with useful knowledge for engaging in future market policy reforms.

To this end, our study is a combination of qualitative and quantitative survey of 45 studies on price transmission for 19 of the most important SSA agricultural products of the continent and conducted in 20 different countries of SSA. Our approach lays particular emphasis on the data and methods used, while the results present possible causes attributed for the presence or absence of price transmission in the various studies. By combining the different evidence on price transmission in the different countries, we obtain a unified picture of the extent of, underlying factors causing and the broad policy measures needed to improve price transmission between agricultural markets within SSA as a whole and between SSA's agricultural markets and similar markets of SSA's major trading partners.

In addition, by covering the whole of the SSA region and including several critical study attributes and variables, our analysis is unique as it goes beyond the usual simple static review of the literature, to undertake an extensive meta-analysis, and providing a unified, quantitative assessment of the extent of, underlying factors causing and the policy strategies for improving price transmission in SSA agricultural markets.

The next section undertakes a brief review of the empirical models employed in price transmission analysis, while section 3 provides detailed descriprice transmissionion of an over view on meta-analysis as a conceprice transmission, meta-dataset used for the analysis and empirical model used for the meta-regression. Sections 4 and 5 present the findings and conclusions from the analysis.

2. Models for Estimating price transmission and Market Integration

As noted in section one, the analysis of price transmission spatially or vertically has attracted much attention over the last five decades and likewise several analytical models for estimation. This section undertakes a review of the main econometric models used for price transmission analysis over the years. The following brief review is standard but informative, and chronologically begins from the simple linear correlation and regression models, through cointegration- and error correction-based to recent regime-switching models. Details on the various models may be found in the price transmission literature.

2.1. *Static Correlation and Regression Models*

Premier Price transmission and market integration analysis used standard static models viz. bivariate correlation and regression models, to test for the law of one price (LOP). Bivariate correlation models (BCM) measure the extent of market integration by examining the co-movement of price series at fixed transfer costs. For instance, if P_t^i and P_t^j are two contemporaneous price series in markets i and j connected by trade for a homogenous commodity, the correlation coefficient, r, is obtained by:

$$r = \frac{\sum_{k=1}^{n}\left[(P_t^i - \bar{P}^i)(P_t^j - \bar{P}^j)\right]}{\sqrt{\sum_{k=1}^{n}(P_t^i - \bar{P}^i)^2 \sum_{k=1}^{n}(P_t^j - \bar{P}^j)^2}} \tag{1}$$

Where $\overline{P^i}$ and $\overline{P^j}$ are the mean values of P_t^i and P_t^j respectively.

The bivariate regression models (BRM) of price transmission and market integration are commonly specified as:

$$P_t^i = \beta_0 + \beta_1 P_t^j + \beta_2 T_t + \beta_3 R_t + \varepsilon_t \tag{2}$$

Where P_t^i and P_t^j may be in their first-difference or logarithms form, T_t is transaction cost, R_t denotes other factors influencing prices. The β_is are the coefficients to be estimated. Even though the static models are easy to estimate using only price data, but their assumption of stationary price behaviour and fixed transactions costs make them underestimate the extent of market integration (Barrett, 1996; Baulch 1997).

2.2. Dynamic Models

Dynamic market integration models recognize and specify lead/lag relationships in price transmission to account for the dynamic nature of prices and transaction costs. Unlike the static approaches that merely investigate whether markets are integrated or segmented, the dynamic methods check in addition the extent of integration by estimating speeds of price adjustment. A review of three of the dynamic models used in market integration analysis is given below.

Granger Causality Tests

Granger (1969) causality test provides evidence of whether price transmission is occurring between two markets, and in which direction. P_t^i is said to granger-causes P_t^j if both current and lagged values of P_t^i improves the accuracy of forecasting P_t^j (Judge et la, 1988). Typical Granger causality models are specified as in (3).

$$\begin{aligned} P_t^i &= \sum_{K=1}^{n} a_k P_{t-1}^j + \sum_{K=1}^{n} b_k P_{t-1}^i + \varepsilon_{1t} \\ P_t^i &= \sum_{K=1}^{m} c_k P_{t-1}^j + \sum_{K=1}^{m} d_k P_{t-1}^i + \varepsilon_{2t} \end{aligned} \tag{3}$$

Ravallion and Timmer Models of Market Integration

Ravallion's (1986) model specifies a radial framework of numerous rural markets linked to a central market, and his test for market integration determines whether the price of a commodity in a given producer market is influenced by its price in a central market. The variant of the Ravallion's model commonly used in price transmission analysis is:

$$P_{it} = \sum_{j=1}^{n} a_{ij} P_{it-j} + \sum_{j=0}^{n} b_{ij} P_{1t-j} + c_i X_{it} + \varepsilon_{it} \quad \forall i = 2,\ 3,\ \ldots,\ N \tag{4}$$

Where a_{ij}, b_{ij}, and c_i are the parameter estimates, and j (j = 1, 2 ... n) is the lag lengths.

Timmer (1987) assumed that the central market price is predetermined relative to the local market prices and made two modifications to the Ravallion model by using the logarithm of the prices and a single lag rather than the six lags used by Ravallion. Timmer specification is:

$$P_t^i = c_0 (P_t^1 - P_{t-1}^1) + (c_0 + c_{1i}) P_{t-1}^1 + c_{11} P_{t-1}^i + \gamma X_{it} + \varepsilon_{it} \tag{5}$$

where assuming that γ = 0, then $c_0 + c_{1i}$ and c_{11} are the contributions of the central and local market price history respectively to current prices.

2.3 Co-integration Models

The cointegration of a pair of markets means that the dynamics of the price relationships in the markets converge in the long run towards the LOP. If two price series, P_t^i and P_t^j, in two spatially separated markets contain stochastic trends and are integrated of the same order, say I (d), the markets are said to be cointegrated if there is a linear relationship - P_t^i + βP_t^j □ I (0), between the price series. The two commonly employed approaches to cointegration analysis are Engel and Granger (1987) used for bivariate analyses and the Johansen (1990) variance autoregressive (VAR) approach used in multivariate analyses. The first step in employing any of the two approaches is testing unit roots in the price series individually under a null hypothesis of unit roots using the Dickey-Fuller (DF), augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and/or a host of other procedures.

2.4. Switching Regime Regression Models (SRM)

Usually, prices are related nonlinearly, contrary to the assumption in much of the premier price transmission literature that linear price relationships exist. The realisation that price relationships may be nonlinear due to transactions costs motivated the introduction of a class of models collectively called switching regime models (SRM). Four classes of SRM are widely used in the literature for price transmission analysis – the error correction models (ECM), threshold autoregressive (TAR) models; parity bound models (PBM) and Markov-switching models (MSM).

The Error Correction Models (ECM)

The ECM is an extension of the cointegration model. If P_t^i and P_t^j are cointegrated, then the equilibrium relationship between them can be specified as: $P_t^c - \beta_1 P_t^s - \beta_0 = \varepsilon_t$. And if ε_t, the error term, is assumed to follow an autoregressive (AR) process, then $\varepsilon_t = \alpha\varepsilon_{t-1} + e_t$. This means the equilibrium relationship between P_t^i and P_t^j can be expressed as:

$$P_t^c - \beta_1 P_t^s - \beta_0 = \alpha\varepsilon_{t-1} + e_t \qquad (6)$$

The above equation implies that the long run relationship (cointegration) between P_t^i and P_t^j is a function of the autoregressive process ε_{t-1}, where ε_{t-1} is the deviation from long run equilibrium, and called the error correction term (ECT), while α measures the response of P_t^i and P_t^j to deviation from equilibrium. The stand ECM has been extended to asymmetric error correction (EC), vector EC and switching vector EC models.

Threshold Autoregressive (TAR) Models

The TAR models explicitly recognize the influences of transactions costs faced by traders on spatial market integration and account for them without necessarily using actual transactions costs data. The idea is that, inter-market price differentials must exceed thresholds bands arising from transactions costs, before provoking existing market equilibrium and causing price adjustment to ensure market integration. Typically, a vector autoregressive (VAR) specification of the threshold model is stated as:

$$\Delta P_t = \begin{cases} \sum_{i=1}^{l} \alpha^{(1)} \Delta P_{t-i} + \theta^{(1)} \varepsilon_{t-1} \text{ if } |\varepsilon_{t-1}| \le c \\ \sum_{i=1}^{l} \alpha^{(2)} \Delta P_{t-i} + \theta^{(2)} \varepsilon_{t-1} \text{ if } |\varepsilon_{t-1}| > c \end{cases} \tag{7}$$

Where P_t the vector of is prices being analysed, c denotes the value of the threshold giving rise to the alternative regimes and ε_{t-1} is the variable used to capture threshold behaviour.

Parity Bound Models (PBM)

The PBM explicitly consider transaction costs and trade flow data, in addition to price series, in analysing market integration; and unlike the conventional dynamic approaches, which strictly accept price transmission or reject a null hypothesis at a given significance level, PBM have the advantage of allowing for a continuum of inter-market price relationships within the range of perfect market integration and complete market segmentation.

Baulch (1997) introduced the PBM to price transmission and market integration analysis, while Barrette and Li (2002) made significant extension to it. The original PBM model is a maximum likelihood function specified as:

$$L = \prod_{t=1}^{r} \left[\lambda_1 f_t^1 + \lambda_2 f_t^2 + (1 - \lambda_1 - \lambda_2) f_t^3 \right] \tag{8}$$

Where λ_2 and λ_1 are the estimable probabilities of the market being in regimes 1 and 2 respectively, $1-\lambda_1-\lambda_2$ is the probability of the market being in regime 3.

Markov Switching Models (MSM)

The standard Markov-switching model is formulated based on the price transmission that if y_t is a time series variable with a finite set of M regimes such that each y_t is associated with an unobservable regime dummy variable s_t; i.e. $s_t \in (1,\ldots,M)$ and s_t = 0 or 1, then a Markov-switching specification of the autoregressive process for y_t in a two-regime case is:

$$\begin{aligned} y_t &= \phi_1 y_{t-1} + \varepsilon_{1t} \qquad \text{If system is in regime 1} \\ y_t &= \phi_2 y_{t-1} + \varepsilon_{2t} \qquad \text{If system is in regime 2} \end{aligned} \tag{9}$$

where ϕ_1 is the autoregressive parameter of the series when the current regime is 1, and ϕ_2 is the parameter when the current regime is 2.

The principal conclusions to make following the review of the techniques employed in the literature for assessing spatial and vertical price transmission, and hence market integration are that the various models, though building upon the limitations of preceding models, have their own limitations. The critical limitations are partly the source of diverse results from different studies and justify our attempt at synthesising findings from PRICE TRANSMISSION studies in SSA and producing unified results.

3. An over view of Meta-Analysis, empirical model and the meta-dataset

3.1. Meta-analysis: *An over view*

Following the pioneer work of Glass (1976), meta-analysis has become the standard method of searching for general patterns in a body of existing specific research results. Generally meta-analysis allows researchers to combine results of several studies into a unified analysis that provides an overall estimate of the effects of interest and to quantify the uncertainty of that estimate (Sterne, 2009). Policy analysts often use this tool to synthesize body of existing literature especially when there is a large literature reporting such evaluations worldwide (Hedges and Olkin, 1985).

Meta-analysis is quite popular in medical and marketing research, and is currently gaining increasing significance in the applied economics literature. Among the few identified so far in applied economics literature include meta-analysis of income or price elasticities of demand (see Gallet and List 2003; Gallet 2007; Gallet 2010 a and b etc). Others include meta-analysis of technical efficiency studies (see Bravo-Ureta *et al.*, 2007; Ogundari and Brümmer, 2011); effect of aid on economic growth studies (Mekasha and Tarp, 2011); effect of income on calorie intake studies (see Ogundari and Abdulai, 2012); economic freedom and economic growth studies (see Doucouliagos, 2005); and willingness to pay for farm animal welfare studies (see Lagerkvist and Hess, 2011) etc.

A general model of carrying out meta-analysis 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). Thus, the present study relies on the MRA to assess the effect of the choice of econometric model, study location, type of data and other study-specific characteristics on published empirical estimates of price transmission in SSA.

3.2 The Empirical model

As earlier mentioned, the present study is designed to employ MRA to quantitatively examine the nexus between the study-specific characteristics on price transmission in SSA and price transmission estimates of interest. The price transmission estimates of interest includes; coefficient of price transmission and whether the study identified asymmetric price transmission or otherwise. Guided by this, equation 10 presents the empirical model for the MRA in the study.

$$study\_effect_i' = \psi_0 + \sum_{k=1}^{K} \alpha_k X_k' + \sum_{j=1}^{J} \beta_j D_j' + \varepsilon_i \qquad (10)$$

Where, $study\_effect_i'$ is a vector denoting a study effect of interest from the primary studies, namely: 1) reported price transmission coefficient and 2) evidence of asymmetric price transmission in the primary studies. The later, is a dummy variable that takes value of 1 if the study identified asymmetric price transmission and 0 otherwise. X_k' and D_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 1978 - 2010) and year of publication (from 1994 -2011), and D_j' represents indicator variables on whether or not the primary studies included under this review are working or conference papers; cover food crop products; analyse vertical price transmission; use differenced prices, monthly data; and finally whether or not the primary studies employ ARDL, VARR-VECM, Co integration, and PBM models, conducted unit root and causality tests and target sub-regions (i.e. west, east or southern Africa) of the primary studies. The ψ_0, α_k and β_j are parameters to be estimated while ε_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 analysis based on asymmetric price transmission in the primary studies is undertaken by means of the probit model. The use of WLS for the former is consistent with the insight that WLS deals with heteroskedasticity in the effect size as earlier revealed by Stanley (2008) and later supported by Nelson and Kennedy (2009).[2]

3.2. The Meta-Dataset

The studies used in this paper were sourced from Google Scholar, ISI Web of Science, ASC index, previous bibliography, and other online databases. In this way, the meta-

[2] The effect size here is referred to reported price transmission coefficient from the primary studies.

dataset for the analysis is obtained from 45 published, conference and working papers analysing price transmission and market integration in SSA (see Appendix B). The reviewed studies cover 20 SSA countries and 19 of the most important agricultural commodities of SSA. The 45 studies reviewed yielded 421 observations from which a number of study specific characteristics or variables are extracted.[3]

A summary of the study variables vis-à-vis 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, while in Appendix A, we present the mean and standard deviation values of the dependent and moderator variables included in the MRA.

Table 1: Summary statistics of the PT coefficient by study specific characteristics

Variables	Number of Observation	PT coefficient		
		Mean	Min.	Max.
Papers published in Journal	213	0.3098	0.0020	0.9980
Papers in Conference proceeding	078	0.4451	0.0390	0.9300
Working papers	120	0.3188	0.0300	0.9300
Studies with asymmetric PT	053	0.2589	0.0700	0.8070
Studies with symmetric PT	374	0.3465	0.0020	0.9980
Studies with Vertical PT analysis	019	0.3176	0.1170	0.8070
Studies with Spatial PT analysis	407	0.3381	0.0020	0.9980
Studies with monthly data	316	0.3737	0.0110	0.9980
Studies with weekly data	105	0.2289	0.0020	0.9660
Studies that uses level data	032	0.5092	0.1100	0.9980
Studies that uses differences data	389	0.3235	0.0020	0.9980
Studies with focus on food products	405	0.3378	0.0020	0.9980
Studies with focus with non-crops	018	0.3279	0.0200	0.8700
Studies with ARDL method	081	0.3094	0.0110	0.9660
Studies with ECM method	198	0.3038	0.0300	0.9980
Studies with VAR-VECM method	079	0.1981	0.0020	0.8300
Studies with co integration method	073	0.2692	0.0200	0.8700
Studies with PBM method	091	0.3152	0.0200	0.9980
Studies with OTHER method*	051	0.3134	0.0200	0.9120
Studies with unit root tested	285	0.2715	0.0020	0.9600
Studies with causality tested	128	0.3489	0.0200	0.9600

**Note: Other method includes studies with TAR model, Correlation coefficient, and switching regression.*

The review of the study variables and the descriptive statistics of the corresponding price transmission coefficients raise several issues as may be seen in Table 1. About 50% of the primary studies in this analysis is published journal articles, about 28% are working papers, while the rest (22%) are conference proceeding.

[3] This observation was made possible because all the primary studies reported more than one estimate with an average of about 9 estimates per study.

Price transmission studies which focus on crop products account for more than 95% of the observations and have a mean estimated price transmission coefficient of 0.337(33.7%)[4] as against animal products-based studies accounting for just 4% of the observations and having a mean price transmission coefficient of 0.327 (32.7%). The fact that most of the studies focus on crop commodity markets agrees with the reality that staple food and cash crops are more important in SSA's agriculture and marketing systems than livestock. Perhaps because of this, data on crop products is more available for price transmission analysis than data is on livestock in SSA.

The error correction model is the most popular method for analysing price transmission in SSA. About 47% of the observations are based on primary studies that used the error correction model (ECM). This model has a higher power in estimating the effects of policy shocks on price transmission and able to handle the non-linearities in prices and transaction costs revealed in the insights of Baulch (1997) and McNew (1996). In this way, applying the ECM is relevant for SSA, where most price transmission studies were undertaken to estimate the impact of market reforms on the performance of domestic markets. The parity bound model (PMB) is the second most popular price transmission model in the SSA's price transmission literature, representing about 22% of the cases. In line with the analytical theory in price transmission analysis, about 68% of the studies tested for unit roots while 30% extended the analysis to examining causality.

Across the variables considered, the minimum estimated price transmission coefficients ranging from 0.002 (0.2%) to 0.117 (11.7%) illustrate that there exist cases of very low levels of price transmission or near market segmentation. About 76% of the estimated price transmission coefficients are less than 0.50 (59%). These represent cases whereby due to constraints to arbitrage such as price-distorting policies, delays in flow of market information, underdeveloped market infrastructure or autarky due to unprofitable arbitrage, remote agricultural commodity markets in producing areas are isolated from central markets.

Nevertheless, it can be shown that some markets (about 24% with coefficients over 0.50) are considerably responsive to price shocks given the estimated maximum price transmission coefficients ranging across the study-characteristics from 0.807 (80.7%/high price transmission) to 0.998 (99.8%/perfect price transmission). These represent markets which are possibly connected by efficient trader, market information and transportation networks. Averagely across the variables, price adjustment in response to price shocks in SSA markets range from 0.198 (19.8%) to 0.509 (50.9%) per month or week towards ensuring equilibrium.

In Figure 1, we present the distribution of the price transmission coefficient from the primary studies. The distributions show a larger dispersion of price response to market anomalies. This is in line with the different extents of price transmission and market

[4] Representing the estimated as percentages is only valid where the analysis is done in the log values of the variables

integration observed in the analysis and that is expected in SSA due to differences in the key determinants of price transmission across the different countries of SSA.

Since distribution of the estimated price transmission coefficient extracted from the primary studies is skewed to the right (between 0 and 1), then the impact of market anomalies and price shocks on price transmission in SSA agricultural markets is clearly more positive, with overall minimum, mean and maximum price transmission coefficient being 0.025, 0.322 and 0.942, respectively.

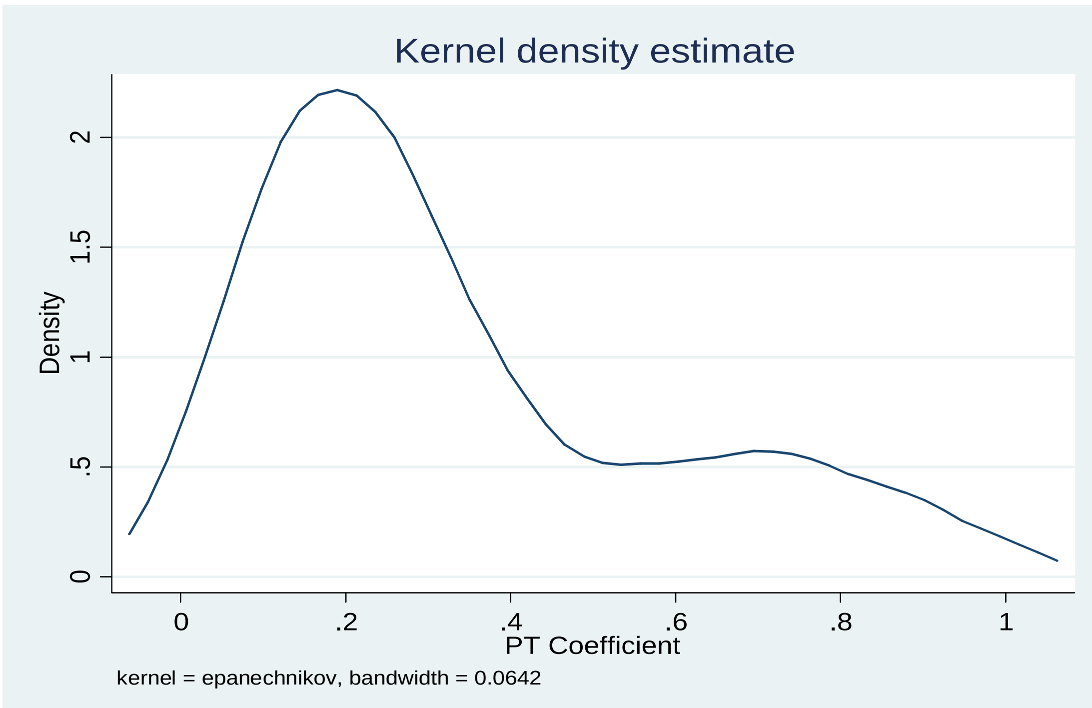

Figure 1: Distribution of the retrieved price transmission (PRICE TRANSMISSION) coefficients

The economic interpretation of the distribution of the price transmission coefficients is that some agricultural markets in SSA may be segmented, implying a negligible level of price transmission occurs 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 0.332), 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 1.5) as may be case where traders use market power and near-oligopolistic pricing strategies to ensure asymmetries in price transmission between remote producer and urban consumer agricultural markets (Amikuzuno, 2010).

The overall average of the elasticity of price transmission (0.322) in SSA agricultural markets is low compared with the transmission coefficient (0.740) for the USA agricultural markets even as far back as from 1961-1983 (USDA, 2009), that of the EU12 (0.660) or the EU27 (0.500) reported by EU (2009), or the average price transmission elasticity of 0.62 and 0.34 for selected commodities in India and China respectively (Imai et al, 2008).

4. Results and Discussion

4.1. Study-specific characteristics and price transmission Coefficient: *The nexus*

In this section, we attempt using the full sample of observations, to assess the relative impact of study specific variables on the price transmission coefficients estimated under the primary studies. Table 2 presents the results of the relationship between reported price transmission coefficients and selected study-specific variables.

Table 2: Weighted Regression of the MRA for the coefficient of price transmission

Variables	Parameters	Coefficient	Std.Err[$]	P-value
SAMPLE SIZE	α_1	-0.0006***	0.0002	0.003
DATAYEAR	α_2	0.0028	0.0039	0.468
PUBLICYEAR	α_3	-0.0160**	0.0066	0.015
D_WORKINGP	β_1	0.0628*	0.0365	0.086
D_CONFERENCEP	β_2	0.1535***	0.0396	0.000
D_MONTHLY	β_3	0.0657*	0.0369	0.076
D_FOODP	β_4	0.2161**	0.0995	0.030
D_DIFFERENCES	β_5	0.1072	0.0745	0.151
D_ARDL	β_6	-0.0095	0.0407	0.815
D_ECM	β_7	-0.0366	0.0442	0.408
D_VAR-VECM	β_8	0.0157	0.0387	0.686
D_COINTEGRATON	β_9	-0.0162	0.0460	0.725
D_PBM	β_{10}	0.1895***	0.0600	0.002
D_UNITROOT	β_{11}	-0.1349***	0.0409	0.001
D_CAUSALITY	β_{12}	0.0765**	0.0355	0.032
D_WESTAFRICA	β_{13}	0.0177	0.0357	0.620
D_EASTAFRICA	β_{14}	-0.0238	0.0333	0.475
Constant	ω_0	26.4932	7.8176	0.001
R-squared			0.3387	
F-statistics (17,403)			22.32	
Prob.>F			0.0000	

*Dependent variable is the estimated coefficient of price transmission from the primary studies; [$]The estimate is a robust standard error; *, **, and *** represent levels of significance at 10%, 5%, 1%, respectively.*

Thus the Table shows that the major impacts of the study characteristics on the extent of price transmission as measured by the estimated price transmission coefficients differ across the moderator variables. The coefficients for sample size and year of publication are negative but significant. This means, sample size (number of observations) and year of publication have a decreasing impact on reported price transmission coefficients in the selected studies. This means, as sample size or year of publication of the study increase, the magnitude of the estimated price transmission coefficients significantly decreases, although by smaller proportions.

This observation is in contrasts with the findings of Ogundari and Bruemmer (2011) and Perdiguero (2010) that despite the time lags between years of data collection and publications by empirical studies, more recent studies may estimate higher effect size than previously published studies. This is even more so interesting in SSA markets which are expected to improve in terms of price transmission and market integration along with recent improvement in the quality of infrastructure and market information flow via mobile phones. It might also be that the more improved model and quality of data used by recent studies improves the econometric estimation of the price transmission. The reducing-effect of the number of observations (sample size) on the price transmission coefficient imply as more and more observations are covered by price transmission analysis, then it is less likely to increase the magnitude of the price transmission coefficients.

Furthermore, we found that publication outlet, data frequency and type of agricultural product all have positive and statistically significant effects on the estimated price transmission coefficients. Interestingly, this means conference and working papers seem to estimate higher price transmission coefficients than journal papers do, with estimated coefficients in conference and working papers being respectively about 0.06 and 0.15 units higher than similar estimates in journal papers. This is expected due to the rigorous peer review of journal papers. The positive and significant effect of the monthly data variable means studies using data of monthly frequencies improves the amplitude of price transmission coefficients by about 0.07 units over estimates obtained from weekly data.

Based on the type of product analysed, studies based food crop products appear to have significant and greater positive effects on estimated price transmission coefficients than studies based on livestock products, which constituted only 18 of the 421 observations included in the analysis. Despite the number of observations, the fact that crop production is more important than livestock in SSA, it is more logical that network of traders and information flow on crop prices should ensure that price transmission spatially or vertically between crop markets exceeds that between markets for livestock. It is also important to note that livestock products are also more perishable and difficult for arbitrageurs to move across spatial markets in SSA where refrigerated transport systems are lacking.

All dummies representing econometric models used by the primary researchers in the MRA except the parity bound model (PBM) do not significantly affect the estimated values of price transmission coefficients in SSA. Whereas it is interesting to note that generally there is no model-bias in estimated price transmission coefficients in the primary studies, the insight is that studies that applied the PBM (about 16% of the studies included here) are more likely to have higher (about 0.19 units higher) estimated coefficients than those that do not use this method.

Lastly, studies that tested for units roots are more likely to obtain lower estimates of price transmission coefficients (about 0.13 units lower) than studies which did not test for unit roots. As we saw in previous section, most price data are non-linear and studies that tested for unit roots removed these non-linearities by differencing or using non-linear models, and are thus more likely to avoid the overestimation of price transmission coefficients. In contrast, studies that tested for the existence of causality tended to have significantly higher price transmission coefficients, though the effect of this variable on the value of the transmission coefficient is only 0.08 units.

All other variables included in the MRA regression to assess the impact of the study-specific characteristics on the price transmission coefficients are not significant. Interestingly, even geographical variables i.e. West Africa and East Africa have no significant effects on the estimated price transmission coefficients. This means that even though the performance of agricultural markets in the three different sub-regions – west, east and southern Africa might differ, the location of studies is not an essential element for explaining observed differences in the estimated results. Therefore, our findings in this section agree to a large extent with findings from similar studies by Ogundari *et al* (2012), Ogundari and Bruemmer (2011), and Perdiguro (2010).

4.2. Determinants of existence of asymmetry price transmission[5]

In this section, we present the results of the analysis based on the use of asymmetric price transmission by the primary studies. The aim is to identify the determinants of asymmetric price transmission. Thus, Table 3 presents the result of how study specific characteristics explain the existence of asymmetry in the selected primary studies on price transmission in SSA.

Our findings show that sample size (i.e. number of observations) and year of data (i.e. the sample period) significantly increase the likelihood that the selected studies found asymmetry in their analyses. Evidence in the literature shows sensitivity of the estimated asymmetric price transmission (APT) coefficients to sample size (Bermejo et al, 2011 in Nakajima, 2011). It is expected generally that the larger the sample size for a given analysis, the better it is for especially the non-linear, switching regression models

[5] This refers to reciprocal relationship between increases and decreases in prices between spatially separated markets or between intermediate levels in the supply chain for a homogenous product.

of price transmission to accurately estimate the nature and extent of price transmission between markets or product levels. Similarly, we expect that studies based on data collected more recently (after market reforms) should have a higher likelihood of identifying asymmetric price transmission (APT) because of the improved data quality and analytical models applied.

Table 3: Probit Regression for evidence of asymmetry price transmission

Variables	Parameters	Coefficient	Std.Err	P-value
SAMPLE SIZE	α_1	0.0272***	0.0041	0.000
DATAYEAR	α_2	0.3995***	0.0802	0.000
PUBLICYEAR	α_3	-0.5321***	0.0983	0.000
D_WORKINGP	β_4	-0.3059	0.4107	0.456
D_CONFERENCEP	β_1	1.0943***	0.3883	0.005
D_NON-FOODP	β_2	-0.9256	2.7518	0.737
D_VERTICAL	β_3	8.4086***	1.3777	0.000
D_MONTHLY	β_4	5.1915***	1.0259	0.000
D_ARDL	β_5	0.7599**	0.3426	0.027
D_UNITROOT	β_6	-0.5239	0.3998	0.190
D_CAUSALITY	β_7	-0.3505	0.3154	0.267
D_WESTAFRICA	β_8	2.2531***	0.5632	0.000
D_EASTAFRICA	β_9	1.9252***	0.5256	0.000
Constant	ω_0	257.1488***	81.4414	0.002
Pseudo R-Squared			0.5486	
LR chi2(13)			174.83	
Prob.>chi2			0.000	

Dependent variable equal to 1 if the study has found the existence of asymmetry price transmission and 0 otherwise; ;
, **,and * represent levels of significance at 10%, 5%, 1%, respectively.*

In contrast, publication year has a highly significant but negative effect on the identification of asymmetric price relationships by the primary studies. A negative relationship between year of publication and asymmetry means that more recently published studies have a higher probability of identifying symmetric price relationships between spatial markets or product levels in the value chain. Since data year and publication year are somewhat related, the contrast in the findings is only possible where the lag between data collection and publication of results is large. In addition, improvements in market infrastructure and information flow via mobile phones, producers and arbitrageurs in SSA agricultural sector are expected to guarantee symmetry in the transmission of price shocks between the region's agricultural markets.

Besides, we found that studies published as conference papers, studies based on vertical price transmission, studies that use monthly data and the ARDL model as well as conducted in the West and East Africa sub-regions have higher and significant positive chances of identifying asymmetric price transmission. The high, positive and significant coefficient of conference papers probably implies that published articles in journals have more lax standards when it comes to model specification or statistical method which might have influence on the estimated price transmission coefficient in the primary studies.

Regarding the type of data frequency, studies using monthly data are not expected to report more cases of APT than studies based on weekly data. This is because any empirical attempt to quantify dynamic relationships such as APT requires data with a frequency that exceeds the frequency of the adjustment process (for example, the arbitrage transactions that integrate markets). That is if, as might be expected in many cases, price transmission takes place within days or weeks, monthly and even lower frequency price data will not be able to capture APT(Loy and von Cramon-Taubadel (1996) in Meyer and von Cramon-Taubadel (2004)).

The use of the ARDL model to estimate price transmission is also more likely to identify APT. In fact the ARDL model and ECM have been the most popular frameworks to investigate price asymmetries (Frey and Manera, 2005). The ARDL model has the advantage of handling both stationary price series as well as non-stationary series that is differenced, and is widely used in the early price transmission studies in SSA. The revelation again shows that like data frequency, the type of model employed can have significant impact on the identification of APT in price transmission analysis, and modelling price transmission analysis with the ARDL specification affects the pattern of price transmission identified.

Finally, with regards to the location variables, the results show that price transmission studies conducted in west or east Africa have a higher probability of identifying APT than studies located in southern Africa. In the literature, spatial APT in agricultural is caused by poor infrastructure, transport and communication services between remote producer markets and urban central markets, while vertical APT arises from market power by a specific category of traders along the supply chain. On this basis, the results mean that market infrastructure; transport and communication services in west and east Africa may be less developed than that of southern Africa.

5. Conclusions

The analysis of price transmission in Sub Sahara Africa has received considerable attention over the last 15 years in the Agricultural Economics literature. Most of the analyses have been conducted to assess the effect of market policy reforms implemented by most SSA countries between the mid 1980s and early 1990s on the performance of their domestic markets. This is because of the insight that the success of the market reforms depends on the extent of price transmission between spatially separated markets or along product value chains.

Whereas results from the various price transmission analyses on their individual levels often produce useful results for policy making in the target countries of the studies, overall, the results show a mixed picture of the extent, nature and determinants of price transmission in

SSA. The literature attribute the differences in the results obtained by the different price transmission results to a set of study-specific elements viz. data-related factors like sample size, data frequency and period of collection; publication-related factors like year and outlet of publication, product covered by the analysis, as well as model- and study location-related variables.

Our meta-analysis highlights the critical role these elements play in determining the size and statistical significance of the price transmission coefficients reported by studies in SSA between 1978 and 2011, and how these attributes affect the identification of APT by the studies. We discovered that the sample sizes of reviewed studies have a reducing-effect on price transmission coefficient, meaning as more and more observations are covered by a given study, then the size of the price transmission coefficients estimated is likely to decrease.

Furthermore, publication outlet, data frequency and type of agricultural product all have positive and statistically significant effects on the estimated price transmission coefficients. Specifically, conference and working papers seem to estimate higher price transmission coefficients than journal papers do, with estimated coefficients in conference and working papers being respectively about 0.06 and 0.15 units higher than similar estimates in journal papers, whereas using data of monthly frequencies improves the amplitude of the estimated price transmission coefficients by about 0.07 units over estimates obtained from weekly data.

We also observe that studies based food crop products appear to have significant and greater positive effects on estimated price transmission coefficients than studies based on livestock products, which constituted only 18 of the 421 observations included in this meta-analysis. We attribute this to the greater importance placed on crop production and marketing systems in SSA than on livestock. Even though model selection does not generally appear to affect estimated results, the insight is that studies that applied the PBM (about 16% of the studies included in this analysis) are more likely to have higher (about 0.19 units higher) estimated coefficients than those that do not use this method.

Based on the findings on APT reported by the primary studies, our findings showed that the sample size and year of data significantly increase the likelihood that the primary studies found asymmetry in their analyses. In contrast, publication year has a highly significant but negative effect on the identification of asymmetric price relationships by the primary studies, implying that more recently published studies have a higher probability of identifying symmetric price relationships between spatial markets or product levels in the value chain.

Besides, studies published as conference papers, or based on vertical price transmission as well as studies that used monthly data and the ARDL model or were conducted in the West and East Africa sub-regions has higher and significant positive chances of identifying asymmetric price transmission. The high, positive and significant effects of these study-specific attributes on the likelihood of the various studies to identify APT implies these attributes are important in determining the nature, extent and determinants of price transmission in SSA, and should be considered in future research and in the use of price transmission results in policy making.

References

Alderman, H., 1992. "Inter-commodity Price Transmittal: Analysis of Food markets in Ghana". *Policy Research Working Paper No. 884 of the World Bank.* Pp 35.

Alston, J.M., M. C. Marra, P.G. Pardey and T. J. Wyatt (2000). Research Returns Redux: A Meta-Analysis of the Returns to Agricultural R & D. *The Australian Journal of Agricultural and Resource Economics*. 44 (2): 185-215.

Amikuzuno, J. (2010). Spatial Price Transmission and Market Integration in Agricultural Markets after Liberalization in Ghana: Evidence from Fresh Tomato Markets. Saarbruecken: *South-West German Press.*

Barrett, C.B. & Li, J.R. (2002). Distinguishing between equilibrium and integration in spatial price analysis. *American Journal of Agricultural Economics*, 84:292-307.

Barrett, C.B. (1996). "Market Analysis Methods: Are Our Enriched Toolkits Well Suited to Enlivened Markets?" *American Journal of Agricultural Economics*, 78: 825-829.

Blauch, B. (1997). Testing for food market integration revisited. *Journal of Development Studies*, 33:477-487.

Bravo-Ureta, B. E., D. Solis, V.H. Moreira Lopez, J. F. Maripani, A. Thiam and T. Rivas (2007). Technical Efficiency in Farming: A Meta-Regression analysis. *Journal of Productivity Analysis*, Vol. 27: 57-72.

Degaldo C. L. (1986). A Variance Components Approach to Food Grain Market Integration in Northern Nigeria, *American Journal of Agricultural Economics*, 68(4).PP 969 – 979.

Dercon, S. (1995). On market integration and liberalization: method and application to Ethiopia. *Journal of Development Studies*, 32:112-143.

Doucouliagos, C (2005). Publication bias in the economic freedom and economic growth literature, *Journal of Economic Survey*, 19 (3):367-387.

Engle, R.F. & Granger, C.W.J. (1987). Cointegration and error correction: representation, estimation and testing. *Econometrica*, 55:251-276.

Enke, S. (1951). Equilibrium among spatially separated markets: solution by electrical analogue. *Econometrica*, 19:40-47.

EU (2009). Analysis of price transmission along the food supply chain in the EU Brussels, 28.10.2009

Fafchamps, M. and Gavian, S., ''The Spatial Integration of Livestock Markets in Niger,'' *Journal of African Economies*, 5(3): 366-405, October 1996.

Glass, G. V (1976). Primary, secondary and meta-analysis of research, *Educational research* Vol.5: 3-8.

Hedges, L. V. and I. Olkin (1985). Statistical methods for meta-analysis. *Academic Press Inc.*, New York.

Gallet, C (2010a). Meat Meets Meta: A quantitative Review of the Price Elasticity of meat. *American Journal of Agricultural Economics*, 92(1): 258-272.

Gallet. C.A (2010b). The income elasticity of meat: a meta-analysis. *The Australian Journal of agricultural and Resources Economics*, 54:477-490.

Gallet, C. A. (2007). The Demand for Alcohol: A Meta-Analysis of Elasticities. *Australian Journal of Agricultural and Resource Economics* 51(2): 121–35.

Gallet, C. A., and J. A. List. (2003). Cigarette Demand: A Meta-Analysis of Elasticities. *Health Economics* 12(10): 821–35.

Goletti, F. & Babu, S. 1994. Market liberalization and market integration of maize markets in Malawi. *Agricultural Economics*, 11:311-324.

Imai, K., Gaiha, R. and Thapa, G.(2008). Transmission of World Commodity Prices to Domestic Commodity Prices in India and China. BWPI Working Paper 45

Jones, W.O. (1972) *Marketing Staple Food Crops in Tropical Africa*. London: *Cornell University Press.*

Lagerkvist, C.J and S. Hess (2011). A meta-analysis of consumer willingness to pay for farm animal welfare. *European Review of Agricultural Economics*, Vol. 38(1): 55-78.

Liefert .W and S. Persaud (2009): The Transmission of Exchange Rate Changes to Agricultural Prices. *Economic Research Report-76;* Economic Research Service/USDA .

Lutz C., Van Tilburg, A. and B. van der Kamp (1994). "The Process of Short- and Long-term Price Integration in the Benin Maize Markets." *European Review of Agricultural Economics*, 22: 191-212.

McNew, K. 1996. "Spatial Market Integration: Definition, Theory, and Evidence" *Agricultural and Resource Economics Review*, Vol. 25, Number 1, Pp. 1-11.

Mekasha. T.J and F. Tarp (2011). Aid and Growth: What meta-analysis reveals. *Working paper No. 2011/22 United Nations University-World Institute for Development Economic Research.*

Meyer, J. and S. von Cramon-Taubadel, 2004. "Asymmetric price transmission: A survey", *Journal of Agricultural Economics*, Vol. 55: 581-611.

Mwanaumo, A., Masters W. A. and Preckel P. V. (1997). A Spatial Analysis of Maize Marketring Policy Reforms in Zambia. *American Journal of Agricultural Economics*, 79: 514 – 523

Nelson, J. P and P. E. Kennedy (2009). The use of meta-analysis in environmental and natural resource economics: an assessment, *Environmental and Resource economics*, Vol 42: 345-377.

Nakajima ,T (2011). Asymmetric Price Transmission in the U.S. Soybean Exports. *International Journal of Agricultural Research*, *6: 368-376.*

Ogundari, K and A. Abdulai (2012). A meta-analysis of the response of Calorie Demand to Income changes. Paper prepare for presentation at the International Association of Agricultural Economist (IAAE) conference in Brazil August 2012.

Ogundari, K., T. T. Amos and V.O. Okoruwa (2012). A Review of Nigerian agricultural production efficiency literature, 1999-2011: What does one learn from frontier studies? *African Development Review*, Vol. 24(1): 93-106.

Ogundari, K and B. Brümmer (2011). Technical efficiency of Nigerian Agriculture: A meta-regression analysis. *Outlook on agriculture*, Vol. 40 (2):171-180.

Pelzman, Sam [2000] "Prices Rise Faster than they Fall," *Journal of Political Economy*, vol. 108, pages 466-502.

Rashid S., 2004. "Spatial Integration of Maize Markets in Post-Liberalised Uganda". Markets, Trade and Institutions Division (MTID) of IFPRI Discussion Paper No. 71.

Perdiguero, J. (2010). Symmetric or Asymmetric Gasoline Prices? A meta-analysis Approach. IREA Working Paper No: 2010/13.

Samuelson, P.A. 1952. Spatial price equilibrium and linear programming. *American Economic Review*, 42:560-580.

Sterne,J.A.C (2009) .*Meta-Analysis in Stata: An Updated Collection from the Stata Journal*, Stata Press publication USA.

Stanley, T.D (2008). Meta-regression methods for detecting and estimating empirical effects in the presence of publication selection. *Oxford Bulleting of Economics and Statistics* Vol. 70: 103-127.

Takayama, T. & Judge, G.G. 1971. *Spatial and temporal price allocation models*. Amsterdam: North Holland.

Van Campenhout, B. (2007) .Modelling trends in food market integration: Method and an application to Tanzanian maize markets, 112-127. In *Food Policy* 32 (1).

Von Cramon-Taubadel S, Loy JP (1996). Price Asymmetry in the International Wheat Market: Comment. *Canadian Journal Agricultural Economics* 44: 311- 317.

Appendix A

Descriptive statistics of variables used in Meta-Regression Analysis (MRA)

Variables	Description	Mean	Std. Dev
Dependent Variables			
D_Asymmetry	Equal to 1 if the article found asymmetry PT	0.1259	0.3321
PT_Coefficient	PT coefficient from the primary study	0.3399	0.2584
Moderators			
SAMPLE SIZE	Sample size from the primary study	134.79	56.05
DATAYEAR	Average year of the data used by the studies	1997.6	6.57
PUBLICYEAR	Year of publication of the primary studies	2004.9	5.25
D_WORKINGP	Equal to 1 if the article is working paper	0.3088	0.4625
D_CONFERENCEP	Equal to 1 if the article is conference paper	0.1853	0.3889
D_MONTHLY	Equal to 1 if the article uses monthly data	0.7506	0.4331
D_FOODP	Equal to 1 if the article is on food products	0.9619	0.1914
D_NON-FOODP	Equal to 1 if the article is on non-food	0.0428	0.2025
D_DIFFERENCES	Equal to 1 if the article uses differences data	0.9239	0.2653
D_VERTCIAL	Equal to 1 if the article focus on vertical PT	0.0451	0.2078
D_ARDL	Equal to 1 if the article uses ARDL method	0.1924	0.3947
D_ECM	Equal to 1 if the article uses ECM method	0.4703	0.4997
D_VAR-VECM	Equal to 1 if the article uses VAR-VECM	0.1876	0.3909
D_COINTEGRATON	Equal to 1 if the article uses co integration	0.1734	0.3790
D_PBM	Equal to 1 if the article uses PBM	0.2162	0.4121
D_UNITROOT	Equal to 1 if the article tested for unit root	0.6769	0.4682
D_CAUSALITY	Equal to 1 if the article tested for causality	0.3040	0.4605
D_WESTAFRICA	Equal to 1 if the article is from West Africa	0.3705	0.4835
D_EASTAFRICA	Equal to 1 if the article is from East Africa	0.2542	0.4359

Note: PT stands for price transmission