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Market Integration and Price Transmission of Maize in Ethiopia

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ኢትዮጵያ ውስጥ ከቅርብ ጊዚያት ወዲህ የዋጋ ግሽበት ከፍተኛ ችግር ኣየሆነ መጥቷል። ኣንደመፍትሄ መንግስት የተለያዩ የገበያ ዋጋን የማረጋጋት ስራዎችን ቢሰራም ለችግሩ መፍትሄ ሊሆኑ ኣልቻሉም። በኣብዛኛው ሸማቾችና የመንግስት ኣካላት ለዚህ ዋነኛ ተጠያቂ የሚያደርጉት የነጋዴዎች ዋጋን ኣለኣግባብ መጨመርና ዋጋ ሲቀንስ ደግሞ በፍጥነትና ወይም ሙሉ በሙሉ ኣለመቀነስ ነው። የዚህ ጥናት ኣላማ የነጋዴዎችን የገበያ ዋጋ ሲጨምርና ሲቀንስ፣ የሸያጭ ዋጋው ኣተማመን ምን ይመስላል የሚለውን ለማጥናት ነው። ጥናቱ የተከናዎነው በኣስራ ኣምስት የበቆሎ ገበያዎች የተሰበሰበውን የመግዥና መሸጫ ዋጋ በመጠቀም ነው። የጥናቱ ግኝት እንደሚያመለክተዉ የነጋዴዎች ዋጋ ከማህል ኣገር (ኣዲስ ኣበባ) ሲጨምር ኣምብዛም የበቆሎ የሸያጭ ዋጋ ኣይጨምርም። ኣንዳውም በኣንዳንድ የበቆሎ ገበያዎች (ነቀምትና መቀሌ) ነጋዴዎች የመሸጫ ዋጋ ከኣዲስ ኣበባ ሲቀንስ እነዚህ የበቆሎ ገበያዎች ግን በፍጥነት የበቆሎ የመሸጫ ዋጋን ሲቀንሱ ታይተዋል። በኣጠቃላይ ጥናቱ ኣንደሚያሳየው ከሆነ ነጋዴዎችን ለዋጋ ግሽበቱ መሉ ለሙሉ ተጠያቂ ማድረግ ትክክል ኣንዳልሆነ ያሳያል። ነገር ግን መንግስት ዋጋን ለማረጋጋት የሚወስዳቸው ርምጃዎች ወጥና ግልጽ መሆን ኣለባቸው። በተለይ መንግስት የዋጋን ግሽበት የማረጋጋት ስራ በግልጽ በህግ የታገዘና የገበያ ተዋናዮችን ፍላጎት ኣካታች ኣንዲሆን ይህ ጥናት ያስገነዝባል።

Abstract

In this study, we investigated the presence of predatory price adjustment practices in the grain market in Ethiopia by relying on data during the post-agricultural market liberalization period from July 2004 to March 2016. We employed an Asymmetric Error Correction (AECM) model to test the presence of Asymmetric Price Transmission (APT) between integrated wholesale regional maize markets. The results demonstrate that out of 14 regional maize market pairs with the central Addis Ababa maize market, APT is confirmed in only two regional wholesale maize markets of Mek'ele and Nekemete. Hence, the widely held belief by consumers and government that traders' inappropriate price adjustment contributes to the persistence of soaring food prices in Ethiopia is just a misconception. It is argued in this study that the recent surge in maize price in Ethiopia has little to do with APT in maize market.

Keywords: Asymmetry; Cointegration; Food price surge; Maize market; Smallholder

Introduction

Since 2003, grain markets in Ethiopia have been experiencing unprecedented price spikes. Commodity prices have shot-up and the growth rate in food price inflation has been much higher than the world standard. An interesting follow-up question is, therefore, what explains Ethiopia's soaring food price? To answer this, the first step is to isolate the possible market-related causes of soaring food prices. There are two potential candidates for this: (1) price shock diffusion from international markets and (2) domestic supply and demand dynamics.

Policy makers and consumers have consistently blamed private sectors, especially grain traders for unfair price fixing and market allocation in the food market in Ethiopia since 2008. This is because policy makers and consumers have overlooked the important role of traders in providing marketing service to smallholder farmers, and their contribution to grain price stabilization. Resultantly, price fixing and market allocation became an important policy issue, with the pricing practices in the food market called into question by the Ethiopian government in 2011. This resulted in a new policy in food market regulation, and direct government intervention in commercial grain import and distribution at subsidized price for consumers and flourmill factories. In an effort to control unfair pricing, in 2011, the Ethiopian government imposed price caps on 17 basic food items. However, this intervention worsened the problem as it caused a reduction in availability of some food items in the market. Due to that, the government reversed the price cap decision for most crops in June 2011 (Minten *et al*., 2012). In this article, we challenge the widely held perception that traders' inappropriate price adjustment contributes to the persistence of soaring food prices in Ethiopia by taking the case of maize commodity through market integration and price transmission study.

The rest of this article is structured as follows. Section two describes the market-related causes of soaring grain prices. Section three presents the specification of econometric models used in this study. Section four discusses findings of the study. The last section concludes.

Market-related causes of high food prices

Figure 1 below is schematic diagram demonstrating the possible market-related causes of high domestic grain prices. Suppose there is market integration between international and domestic grain markets. Owing to the assumption of 'small-economy', price signals direction are expected to be unidirectional, running from

world to the domestic grain market. Overall, openness in trade and allowing international arbitrage involvement increase market integration between domestic and world markets. There are different factors that can speed-up or impede the transmission of price shocks from international to domestic grain markets. These include: (1) **Tradability of a commodity**: Transmission from world to domestic grain markets occurs when a commodity is traded on international markets. The price for a non-tradable commodity is influenced by domestic supply and demand dynamics and government policies.

(2) **Commodity trade regimes**: the other factor comprises trade position or trade regimes where domestic commodity price formation depends on these. Depending on a country's production potential and consumption pattern, domestic commodity price formation depends on either of the three trade regimes: autarky, Import Parity Price (IPP), or Export Parity Price (EPP). If a country is a net importer of a commodity, then domestic price formation depends on IPP. In this case, domestic prices should then be a function of world prices, exchange rate, transportation costs, and possible import tax (Meyer *et al*. 2006). In an IPP trade regime, one would expect a high degree of price transmission from world to domestic grain markets. On the other hand, if a country is a net exporter of a commodity, then the trade regime switches to EPP. Under such conditions, the extent of transmission of price shocks from world to domestic markets becomes high. When a country reaches a self-sufficient position, domestic price formation will lie within the price band of IPP and EPP. In the autarky trade regime, aside from government policies, domestic prices are determined by the interaction of domestic supply and demand conditions and are unrelated to international price shocks.

(3) **Trade policy**: government trade policies also influence price shock transmission from international to domestic grain markets. In most cases, the implicit motive of government policy instruments is to either block or reduce the pass-through of price signals from international to domestic markets. For instance, policies like foreign exchange rationing impede the participation of traders on the international grain market. Even if imports become profitable, traders will not freely become involved in international grain trade to exploit profitable import opportunities. As a result, domestic prices for tradable commodity will drift over the upper threshold IPP. This will have direct implications on the domestic prices of tradable commodities and consumer welfare.

In general, high price shock diffusion from international to domestic markets will influence domestic prices of a tradable commodity. Through substitution effects, this will in turn influence prices of non-tradable commodities in domestic markets. The combined effect will raise food price inflation. In fact, this depends on the weight of a commodity in a consumer basket. In a developing country setting, expenditure for food constitutes the largest weight in the consumer basket. Soaring prices in the food market will therefore translate into high food price inflation.

When a country is in a self-sufficient position, domestic demand and supply dynamics determine price formation and instability of a commodity. Some of the factors that might lead to price instability in domestic grain markets include rainfall fluctuation, production stagnation, and population growth. Of particular interest to us is the type of market structure that characterizes the grain industry (performance of grain markets). If the grain market is characterized by high market power, then middlemen will dominate the pricing of a commodity. In this case, traders tend to react quickly to adjust to high price shocks. However, they will become reluctant to pass-through price reductions to end-users. This kind of domination in the grain market structure could create price stickiness (what goes up does not come down), which benefits only middlemen at the expense of producers and end-users. Thus, further disrupting government agricultural policies aimed at increasing agricultural supply and promoting regional production specialization.

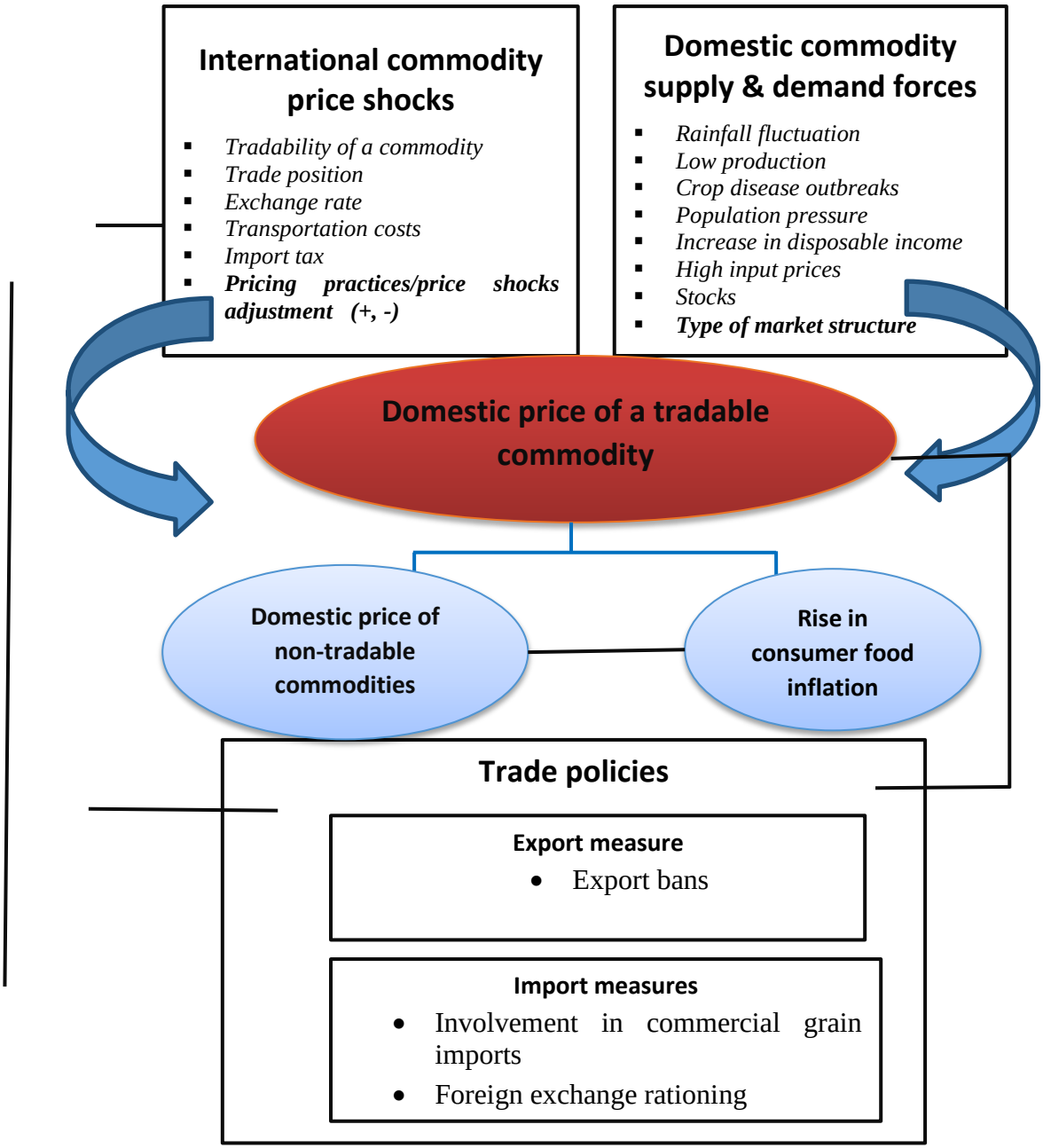

Figure 1. Conceptual framework for understanding soaring domestic grain prices instability
Source: Author own elaboration

Asymmetric Error Correction Model (AECM)

Here, we are primarily concerned in testing the price adjustment response of regional maize markets to positive and negative price deviations from previous year disequilibria. To analyse this, we have relaxed the standard two-step Engle and Granger (1987) cointegration model by decomposing the error correction term into positive and negative components. Earlier studies on asymmetric price transmissions (APT) applied the Wolffram–Houck (W-H) (Wolffram, 1971; Houck, 1977) method to investigate the short-run and long-run asymmetric price transmissions. The W–H method for the response of market price p_t^i to changes in p_t^j market price is specified as follows:

$$\sum_{t=1}^{\iota} \Delta P_t^i = \beta_0 + \beta^+ \sum_{t=1}^{\iota} \Delta P_{j,t}^+ + \beta^- \sum_{t=1}^{\iota} \Delta P_{j,t}^- + \varepsilon_t \quad (1)$$

where

$\Delta P^+ = \Delta P$ for all $\Delta P > 0$, and 0 otherwise

$\Delta P^- = \Delta P$ for all $\Delta P < 0$, and 0 otherwise;

$\Delta P_{i,t}$ = the first difference of the price on market i at time t, β_0, $\beta^+$and β^- are coefficients and ι is the current time period.

Detection of asymmetry is through testing whether $\beta^+ = \beta^-$. Short-run and long-run asymmetry can be tested by introducing lag terms in $\sum \Delta P_{j,t}^+$ and $\sum \Delta P_{j,t}^-$ into Equation (1) above. According to von Cramon-Taubadel (1998), the W–H specification suffers from first-order serial correlation, which is often indicative of spurious regression. The presence of spurious regression is corrected if the analysed variables are cointegrated. In his analysis on vertical APT in the German pork market, von Cramon-Taubadel (1998) has shown that the above W–H specification is inconsistent with cointegration.[1] In response, the author has proposed the use of Asymmetric Error Correction Model (AECM) for cointegrated variables. This approach combines cointegration and asymmetry based on the assumption that p_t^i and p_t^j are linked by a unique long-run relation, while the contemporaneous and short-run dynamics that correct departures from equilibrium relation are asymmetric (von Cramon-Taubadel and Fahlbusch, 1997).

In this study, the von Cramon-Taubadel (1998) approach is adopted to test for asymmetry in price adjustment. The AECM is outlined in Equation (2) below and

[1] See Von Cramon-Taubadel and Loy (1996) and von Cramon-Taubadel (1998) for detailed explanation on how re-parameterisation of the W-H specification in Equation (4.4) is incompatible with cointegration.

it is obtained by decomposing the lagged error correction term obtained from the two-stage Engle and Granger (1987) cointegration approach into its positive (ECT_{t-1}^{+}) and negative parts (ECT_{t-1}^{-}). Splitting the error correction term[2] into positive and negative parts would enable us to observe whether the speed of price adjustment of regional wholesale maize markets to upward and downward price deviations from the equilibrium position are different. In other words, whether price transmission is asymmetric.

$$\Delta P_t^i = \beta_0 + \beta_1 \sum_{k=1} \Delta P_{t-k}^i + \beta_2 \Delta P_t^j + \beta_3 \sum_{h=1} \Delta P_{t-h}^j + \beta_4^+ ECT_{t-1}^+ + \beta_4^- ECT_{t-1}^- + \varepsilon_t \quad (2)$$

where $ECT = ECT_{t-1}^{+} + ECT_{t-1}^{-}$. An F-test can be used to test the null hypothesis of symmetric price adjustment ($\beta_4^+ = \beta_4^-$).

Results and Discussion

Maize price leadership

The extended VAR procedure of the Toda and Yamamoto (1995) causality test analyses the lead-lag price relationships among regional wholesale maize markets. The central market hypothesis test was conducted in two stages. Firstly, the wholesale maize market price relationship between Addis Ababa and major surplus maize markets is examined. Secondly, the deficit maize markets and the leadership role of the Addis Ababa maize market price are investigated. The classification of markets as deficit and surplus maize markets is based on the USAID maize production and market flow map.

Before commencing the estimation of the T-Y causality test, one must identify the maximum order of integration of the underlying variables as well as the optimal lag length of the VAR system. To address this, Dickey and Fuller (1979) proposed

[2] It is also possible to segment the contemporaneous term of the right-hand side of the equation of the central maize market ΔP_t^j into positive and negative parts to test for asymmetric contemporaneous adjustment. This type of asymmetry is considered in Chapter 6. For a detailed explanation on the different means of introducing asymmetry into the Error Correction Regression, see von Cramon-Taubadel and Loy (1996).

a test to detect the non-stationarity of series using the ADF test. Table 1 below depicts the results of unit root tests based on ADF, ERS, and KPSS statistics in levels and first difference of the variables. The results suggest that all variables are nonstationary in levels while they turn stationary in first difference. Therefore, the maximum order of integration should be equal to one.

Table 1. Unit root tests[3]

	ADF	ERS	KPSS
Level (constant, no trend)	**Test statistics**		
Addis Ababa	-1.63	-0.55	0.95***
Ambo	-1.82	-0.76	0.93***
Bahir Dar	-1.53	-0.62	0.91***
Debre-Birhan	-1.53	-0.40	0.96***
Debre-Markos	-1.62	-0.68	0.90***
Dese	-1.66	-0.56	0.92***
Gondar	-1.69	-0.75	0.91***
Hosaena	-1.42	-0.34	1.00***
Mek'ele	-1.64	-0.61	0.92***
Nazareth	-1.47	-0.43	0.98***
Nekemte	-1.93	-0.87	0.88***
Shashemene	-1.42	-0.37	0.99***
Woliso	-1.69	-0.63	0.93***
Ziway	-1.39	-0.35	0.99***
Jimma	-1.75	-0.81	0.86***
First difference (constant, no trend)			
Addis Ababa	-2.88*	-2.83***	0.072
Ambo	-3.12**	-3.14***	0.069
Bahir Dar	-3.08**	-3.09***	0.082
Debre-Birhan	-2.95**	-2.30**	0.046
Debre-Markos	-2.81**	-2.79***	0.073
Dese	-2.93**	-2.91***	0.074
Gondar	-3.01**	-3.03***	0.076
Hosaena	-3.14**	-2.66***	0.061
Mek'ele	-3.33**	-3.32***	0.074
Nazareth	-3.25**	-3.07***	0.084
Nekemete	-3.36**	-3.17***	0.055
Shashemene	-3.45**	-3.35***	0.058
Woliso	-3.35**	-3.24***	0.066
Ziway	-2.93**	-2.82***	0.071
Jimma	-3.08**	-3.09***	0.058

Notes: ***, **, * reject the null hypothesis at 1 %, 5 %, and 10 % significance levels, respectively

[3] The study used the Ethiopian Grain Trade Enterprise (EGTE) monthly wholesale maize price data. The dataset incorporates fifteen maize market locations in Ethiopia: central market (Addis Ababa Ehel-Berenda market) and regional maize markets (Ambo, Bahir-Dar, Debre-Birhan, Dese, Debre-Markos, Gondar, Hosaena, Jimma, Mek'ele, Nazareth, Nekemete, Shashemene, Woliso, and Ziway). The price series is from July 2004 to March 2016 (141 months).

Based on the information criterion (Akaike Information Criterion (AIC), and Hannan-Quinn Information Criterion (HQ)), the optimal lag length of the VAR in the surplus and deficit maize markets equations is selected as eight and three, respectively. Thus, supporting the rational and validity of the T-Y approach of Granger causality, as the true lag length of the model is greater than the order of integration. In the next stage, we augment the VAR by the maximum order of integration of the series and estimate VAR (9) and (4) for the surplus and deficit maize markets equations. However, estimating VAR (9) using 141 monthly observations caused an over-parameterization problem as the VAR with 9 lags and 13 markets contain approximately 1534 parameter estimates. To address this problem, we used an alternative approach to estimate the price relationship analysis between the Addis Ababa and surplus regional maize markets. To do this, we treat the Addis Ababa maize market as the central market, and then define two concentric rings around Addis Ababa. That is, the first ring contains surplus maize markets within 200 km of Addis Ababa and considered as the near markets. On the other hand, the outer ring markets defined as the distant markets and includes all other surplus regional maize markets. The analysis further simplified by examining the average prices with each ring. A newly estimated three-variable-VAR model addressed the over-parametrization problem.

Tables 2 and 3 below present the results of T-Y modified Wald test of causality among deficit and surplus regional maize markets in Ethiopia. The findings from T-Y causality test indicate that the Addis Ababa maize market price movement influences surplus maize markets located around Addis Ababa. Likewise, the Addis Ababa maize market price dictates the maize price formation of all the deficit regional maize markets considered in this study. Therefore, the null hypothesis of no causality from the Addis Ababa maize price to the above-mentioned surplus and deficit maize markets has been rejected. The direction of causation is bi-directional from the Addis Ababa maize market to the deficit Dese maize market and surplus regional maize markets situated near to Addis Ababa. However, distance surplus maize markets are only influenced by inner markets.

Table 2. T-Y causality test between Addis Ababa and deficit maize markets

Maize markets	Addis	Dese	Mek'ele
Addis Ababa		8.66 (0.034)**	10.64 (0.014)**
Dese	31.23 (0.00)***		20.59 (0.00)***
Mek'ele	5.39 (0.145)	12.50 (0.00)**	

Notes: Null hypothesis of non-causality: χ^2 (2) statistics
Probability values in parentheses; ****, ** reject the null hypothesis at 1 % and 5 % significance levels

Table 3. T-Y causality test between Addis Ababa and surplus maize markets

Maize markets	Addis	Inner ring	Outer ring
Addis Ababa		6.55 (0.038)**	4.33 (0.11)
Inner ring markets	27.84 (0.00)***		37.43 (0.00)***
Outer ring markets	2.92 (0.23)	11.35 (0.00)***	

Notes: Inner ring markets include Ambo, Debre-Birhan, Nazareth, Woliso, and Ziway surplus maize markets, while the rest surplus regional maize markets are grouped under outer ring markets; null hypothesis of non-causality: χ^2 (2) statistics; probability values in parentheses; ****, ** reject the null hypothesis at 1 % and 5 % significance levels

Long-run relationships

A set of variables is defined as cointegrated if a linear combination of them is stationary (Brooks, 2008). Cointegrated variables may also be seen as constituting a long-term relationship or equilibrium relationship. This is because market forces, such as the arbitrage process among integrated markets, are expected to bring a price difference to an equilibrium position. Therefore, in cointegrated variables, a short-run deviation from a long-run equilibrium position is possible, but in the long term, arbitrage processes would restore the price difference to an equilibrium position.

Since the price series is non-stationary and integrated of the same order, cointegration analysis is therefore appropriate to investigate the long-run relation among maize market prices. Given the large number of maize markets, cointegration tests are conducted in a pairwise fashion. Following the result of the T-Y causality test, the Addis Ababa maize market is treated as an exogenous maize market.[4] Thus, in the subsequent cointegration and APT analysis, the

[4] In the context of market integration analysis, a market price is exogenous if it does not respond to changes in other commodity market prices. This market is also called a dominant market. In this case, the price relationship between a

regional wholesale maize markets are paired with the Addis Ababa maize market. The use of the Addis Ababa maize price as that of a central market is appropriate to this study because with 15 maize markets, there are 105 [(n^2-n)/2] possible market pairs.

Cointegration among maize market pairs are tested using Johansen's method (Johansen 1991). The results for the cointegrated maize market pairs are presented in Table 4 below. Trace and Maximal Eigenvalue test statistics provide no conflicting results. In both cases, the null of zero cointegrating vectors (r = 0) is rejected. However, the hypothesis of more than one cointegrating vector is rejected in both test statistics. The last column in Table 4 presents the lag length selected for long-run analysis of market pairs. Optimum lags were chosen using the information criterion (AIC, SBC, and Likelihood Ratio (LR)).

Table 4. Johansen tests between cointegrated wholesale maize market pairs

Markets	Trace Ho	Trace statistic	Max Ho	Max-Eigen statistic	Lags
Addis – Ambo	$r = 0$	29.08***	r=0	29.00***	2
	$r \leq 1$	0.075	r=1	0.075	
Addis – BD*	$r = 0$	23.81***	r=0	20.09**	2
	$r \leq 1$	3.72	r=1	3.72	
Addis – DB*	$r = 0$	19.74***	r=0	19.64***	3
	$r \leq 1$	0.10	r=1	0.10	
Addis – Dese	$r = 0$	25.29***	r=0	25.20***	2
	$r \leq 1$	0.09	r=1	0.09	
Addis – Gondar	$r = 0$	20.38***	r=0	20.37***	2
	$r \leq 1$	0.008	r=1	0.009	
Addis – Jimma	$r = 0$	18.53***	r=0	18.47***	9
	$r \leq 1$	0.06	r=1	0.06	
Addis-Mek'ele	$r = 0$	13.71**	r=0	13.71**	3
	$r \leq 1$	0.003	r=1	0.003	
Addis-Nekemete	$r = 0$	22.44**	r=0	18.87**	8
	$r \leq 1$	3.57	r=1	3.57	
Addis – Woliso	$r = 0$	35.06***	r=0	34.91***	2
	$r \leq 1$	0.15	r=1	0.15	
Addis – Ziway	$r = 0$	27.01***	r=0	26.87***	2
	$r \leq 1$	0.15	r=1	0.15	

Notes: *BD and DB stand for Bahir Dar and Debre-Birhan markets, respectively[5]
***, ** significance levels at 1 and 5 %, respectively

central and regional market will form a dominant–satellite price relationship. In the dominant market, price is determined outside of the system (group of markets) that is analysed. However, supply and demand shocks in this market feed through to other markets because of market linkage (Asche *et al*., 2012).

5 Cointegration test specifications for maize market pairs are mixed. Some market pairs are estimated with no deterministic trend (no intercept and no trend), while other pairs are estimated with no deterministic trend (intercept and no trend).

Results from the Johansen cointegration tests show that no cointegration was found between Addis Ababa and the regional maize markets of Debre-Markos, Hosaena, Shashemene, and Nazareth market pairs. Given the proximity of Nazareth and Addis Ababa, the absence of cointegration between these two wholesale maize markets was not expected. The two markets are located within a radius of 86.5 km and are connected with good, all-weather roads. Therefore, transaction costs and costs for acquiring market information are expected to be low. This result may provide evidence that transportation costs and infrastructure facilities might not have that much influence on cointegration between these two adjacent markets. This remark is consistent with the finding of Getnet *et al*. (2005) of a low degree of market integration between the neighbouring Addis Ababa and Ambo markets (119 km). The presence of market segmentation between adjacent maize markets might be attributable to imperfect competition in the maize market structure, which further motivates us to investigate the phenomenon of APT in maize market structure in Ethiopia.

Asymmetric Price Transmission

In this section, we discuss the findings from AECM obtained by segmenting the speed of adjustment for previous year disequilibria into positive and negative components. Estimates of AECM for regional maize markets as dependent variables are presented in Table 5 below. The results from Table 5 show that the contemporaneous changes in coefficients are significant at 1 percent and less than one in all regional maize market equations. This implies that the regional wholesale maize markets do not respond fully within one month to the Addis Ababa wholesale price changes, and that monthly data is frequent enough for investigating the dynamics of maize price transmission. The results further demonstrate that out of 14 maize market pairs with the central Addis Ababa market, APT is confirmed in only two wholesale maize markets, those of Mek'ele and Nekemete. Contrary to our expectations, negative asymmetric price adjustment exhibits in both the Mek'ele and Nekemete wholesale maize markets. Since ECT_{t-1}^{+} indicates that regional wholesale maize prices are higher than the central Addis Ababa price, i.e. the margin is higher, compared with the long-run equilibrium value. In these markets, therefore, wholesalers respond more rapidly when the margin is stretched than when it is squeezed. In the Mek'ele market, wholesalers do not correct the negative price difference from previous year disequilibria. Our AECM results are in line with the findings of Wondemu (2015) who found that there was no APT in the Dire-Dawa and Mek'ele maize market

price adjustments to the central Addis Ababa wholesale maize market price shocks.

Several factors may contribute to the absence of asymmetric price adjustment in wholesale maize market in Ethiopia. The active presence of the Ethiopian Grain Trade Enterprise (EGTE) in the maize market may contribute to symmetric price transmission in the maize market in Ethiopia. The EGTE is the only parastatal organization involving in the procurement of maize from farmers, for three purposes: the national food reserve, school feeding, and the Productive Safety Net Programme (PSNP). In addition to these activities, the enterprise is also involved in maize price stabilization. In response to a maize price plunge, EGTE procured 18 000 tons from farmers, and exported about 11 000 tons of maize in 2002.

Besides the EGTE, other non-governmental organizations such as the World Food Programme (WFP) are also involved in the maize market in Ethiopia. The recent launch of the Purchase for Progress Program (P4P) and purchase from Africans to African (PAA) programmes of the WFP ought to play an important role in maize price determination by linking producers to output markets. Both programmes have targeted local procurement of white maize commodity from farmers for humanitarian assistance to other neighbouring countries. From 2010 to 2013, the P4P of the WFP purchased 26 212 tons of maize and beans, generating nearly USD8 million for Ethiopian smallholders. Close to 600 000 maize farmers, excluding large-scale maize traders, have benefited from the programme (Nogales and Fonseca, 2014). In general, these initiatives may contribute to stiff competition in wholesale maize markets. Hence, the active participation of these organisations in the maize market is expected to improve the competitive structure of the maize market in Ethiopia.

In summary, from the analysis of APT, we would conclude that asymmetric price adjustment has not contributed to the recent maize price surge in Ethiopia.

Table 5. Estimates of Asymmetric error correction for regional maize markets, July 2004 to March 2016

Coefficients	Regional maize markets (dependent variable)													
	Nazareth	Dese	Jimma	Ambo	Mek'ele	DM	Ziway	Shashemene	Woliso	Hosaena	Nekemete	DB	BD	Gondar
Constant	-3.421	1.278	6.229	0.284	11.06**	-2.907	0.748	-3.204	1.033	0.959	**6.794***	1.153	2.167	2.612
D(Addis)	**0.782*****	**0.764*****	**0.936*****	**0.659*****	**0.626*****	**0.641*****	**0.630*****	**0.668*****	**0.785*****	**0.569*****	**0.469*****	**0.752*****	**0.375*****	**0.381*****
ECT_{t-1}^{+}	**0.069**	**-0.39*****	**-0.75*****	**-0.66*****	**-0.542*****	**-0.161****	**-0.53*****	**-0.231****	**-0.63*****	**-0.717*****	**-0.709*****	**-0.42*****	**-0.30*****	**-0.219*****
ECT_{t-1}^{-}	**-0.249***	**-0.381****	**-0.423***	**-0.71*****	**0.029**	**-0.359*****	**-0.53*****	**-0.407*****	**-0.56*****	**-0.775*****	**-0.330****	**-0.43*****	**-0.275****	**-0.263****
P_{t-1}^{d}	**-0.390*****	-0.160	-0.028	0.120	**-0.216****	-0.103	**0.353*****	**0.253*****	**0.207****	-0.051				
P_{t-2}^{d}	**-0.320****	0.075	-0.077	-0.003	**-0.249*****	0.142	-0.116	**-0.218****						
P_{t-3}^{d}	**-0.499*****	-0.072	-0.148	**0.206****										
P_{t-4}^{d}	**-0.442*****	-0.175	0.060	-0.055										
P_{t-5}^{d}	-0.080	-0.140	0.004											
P_{t-6}^{d}	**-0.375*****	0.164	0.113											
P_{t-1}^{Addis}	**0.506*****	0.103	-0.078	-0.108	0.049	0.024	-0.091	-0.044	-0.181	0.142				
P_{t-2}^{Addis}	**0.386*****	0.013	-0.033	-0.090	0.232**	0.021	-0.022	0.088						
P_{t-3}^{Addis}	**0.313****	0.045	-0.022	-0.080										
P_{t-4}^{Addis}	**0.348*****	0.129	-0.041	-0.018										
P_{t-5}^{Addis}	0.128	-0.098	-0.285											
P_{t-6}^{Addis}	0.087	0.034	0.209											
Adj. R^2	0.569	0.425	0.463	0.468	0.415	0.505	0.389	0.454	0.456	0.490	0.502	0.426	0.297	0.363
LM test	0.279	0.246	0.249	0.516	0.290	0.113	0.881	0.379	0.254	0.221	0.718	0.556	0.803	0.599
Wald test of H_0: $ECT_{t-1}^{+} = ECT_{t-1}^{-}$	2.700	0.003	0.139	0.069	**7.173*****	1.754	0.0003	1.203	0.117	0.083	**2.886***	0.0003	0.843	0.129

Notes: P_{t-k}^{d} represents lag length of the dependent regional maize markets; Lag length is selected using AIC and SBC criteria; The Breusch-Godfrey (1978) (LM) test for higher-order serial correlation rejected the presence of autocorrelation in all equations. The values reported in the LM test are the probability values where the test failed to reject the null hypothesis of no serial correlation in the individual maize equations;

***, **, * denote rejection of the null hypothesis at 1 %, 5 %, and 10 % significance level, respectively.

Conclusion and Policy Implications

By overlooking the important role of grain traders in providing marketing service to smallholder farmers and grain price stabilization, since 2008, policy makers have consistently blamed traders for persistence of soaring food prices in Ethiopia. This perception of policy decision makers have also shared by consumers. This resulted in a new policy in food market regulation and direct government intervention in commercial grain import for selected crops. This study empirically tested whether there exists price manipulations in the adjustment process of grain traders by taking the case of wholesale maize markets in Ethiopia.

Despite the widely held belief by consumers and government that traders' inappropriate price adjustment contributes to the persistence of soaring food prices in Ethiopia, we found no evidence to support this argument. Instead, wholesale maize traders' tend to adjust homogenously to increase and decrease in maize price deviations from the central Addis Ababa maize market. Surprisingly, regional wholesale maize markets of Mek'ele and Nekemete adjust prices more quickly for decrease in prices stemming from the central Addis Ababa wholesale maize market than increase in prices.

The active presence of the Ethiopian Grain Trade Enterprise and involvement of non-governmental organization such as the WFP in domestic maize market may contribute to the absence of asymmetric price adjustment in wholesale maize market in Ethiopia. The government state trading enterprise, the EGTE, intervention in the domestic maize market as a facilitator for maize market through occasional buying and selling in times of soaring food prices and bumper harvests is expected to improve the maize market structure. Furthermore, the involvement of other agencies such as the WFP in maize procurement from farmers has enabled farmers to organize themselves in group marketing. Group marketing can eliminate the possible exploitation of uninformed smallholder farmers by marketing intermediaries (Pokhrel and Thapa, 2007). We believe that these interventions have brought a healthy competition in wholesale maize market in Ethiopia.

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