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The farm decision role of price information from commodity exchanges: An *ex-ante* evaluation using Quasi-rational price expectations in Ethiopia

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Farmers use different information to predict future returns upon which they base current decisions. In designing information systems, knowledge about the information set used by farmers is relevant to have insight into the necessary information that should be made available for farmers. Using quasi-rational forecasting regression analysis to represent producer price expectation formation, the usefulness of disseminating real time information about the central wholesale prices discovered by the Ethiopian commodity exchange was tested. The results showed that the information about central wholesale prices can help farmers to make unbiased price forecasts. Effective dissemination of real time price information discovered through the Ethiopian commodity exchange was fully supported by the empirical insights from this study.

Key words: Market information, prices, quasi-rational expectation, smallholders, Ethiopia.

INTRODUCTION

The premise of the agricultural market reform process in the developing countries since the 1980s was that efficiently discovered prices will prompt producers to respond more rationally in making production and marketing decisions (Kherallah et al., 2000). The reforms were expected to result in positive supply responses. Evaluation studies during the post-reform period addressed the impacts of the reform process in terms of market integration, price levels, and supply responses (Goletti and Babu, 1994; Alderman and Shively, 1996; Jayne and Jones, 1997; Badiane and Shively, 1998; Chilowa, 1998). Lack of market information is mentioned as one of the major problems constraining market performance and supply response (Chianu et al., 2008). In a liberalised market environment where price fluctuation and risk are important, availability and accessibility of market information is crucial for informed production decision-making and positive supply response.

Ethiopia liberalised its agricultural market since March 1990. The need to attain an overall economic development and food security in the country made it necessary to promote the productivity of smallholder farmers. The strategies to achieve such objectives include the adoption of new agricultural technologies such as commercial fertiliser and improved seeds (Alemu et al., 2008). Such developments, together with favourable climatic factors, was proven successful and led to a substantial increase of grain production in most of the 1990s with bumper harvests reported in Ethiopia during the 1995/1996, 1996/1997, 2000/2001, and 2001/2002 production years (Tadesse, 2002; Howard et al., 2003). As a result, grain prices experienced wide fluctuations between years, though price spreads generally declined in the post-liberalisation period when compared to that of the previous period (Asfaw, 1998).

Price fluctuation is a major obstacle against adoption of improved technologies by farmers (Crawford et al., 2003; Snapp et al., 2003). This had been evident in Ethiopia following the 2001/2002 price fall, especially for maize. Given the risk adverse behaviour of farmers (Rosenzweig and Binswanger, 1993; Grepperud, 1997), price

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fluctuation is expected to influence their decision in adopting improved technologies. This increases the information needs of farmers for making unbiased price forecasts upon which production and input adoption decisions are based. Apart from price fluctuation, the push towards market oriented smallholder agriculture, following the smallholder commercialisation agenda of the country, is likely to ever increase the information need of Ethiopian farmers on prices and other factors. Since actual future prices are unobservable, producers generally base production decisions on expected future prices. As rational economic agents, farmers are expected to optimise their price expectations (and production and technology adoption decisions) by making use of the currently available information on prices at different market levels.

Thus, dissemination of information to farmers on those variables entering their price forecast is useful to improve their forecasts and, consequently, their production and technology adoption decisions. In addition to information about the relevant information type, knowledge on the information needs of farmers helps to inform policy making about information technology and information management in the interest of effectively disseminating real time information to users. Lack of regular and accurate market information is considered as one of the major constraints facing the grain market of Ethiopia, with smallholder farmers having no (or only limited) access to market information and lacking information processing skills (Wolday, 2002; Getnet et al., 2005). Since gathering and processing appropriate market information is costly for individual farmers, a more appropriate way would be the provision of market information services as public goods. Designing and providing market information as public goods requires understanding the information needs of the farmers as a crucial first step of the process. This work was aimed to contribute to the public market information system of Ethiopia by analysing whether disseminating information on the central wholesale market prices discovered by the Ethiopian commodity exchange is useful from the farm decision making point of view. In other words, we like to know whether the price information will enter usefully into the information set of farmers for making forecasts and decisions.

The central wholesale market serves as a centre of effective demand for food crops with a significant role in terms of price discovery and market power affecting prices at other market levels. Such a role of the central market might be necessary to be considered in the production and marketing decisions of farmers. However, information on central market price movements is scarce to farmers because most farmers are geographically and physically isolated from the central market and there is no established institutional mechanism to perform the function of information dissemination on regular basis in a manner accessible for smallholder farmers. The recent initiative in Ethiopia to disseminate real time information to farmers on central wholesale prices discovered efficiently through a commodity exchange system would be useful for farmers to receive unbiased information for making unbiased forecasts.

As Ethiopia has already launched a commodity exchange system, the wholesale price discovery mechanism for grains in the central market will be overtaken by the commodity exchange as it matures. The exchange envisages dissemination of real time price information to different actors (farmers, traders, and consumers). In effect, the commodity exchange will play an institutional role of disseminating real time market information on central wholesale prices. Whether the price information is useful for unbiased decision making by farmers, by entering into their information set for price forecast is a relevant concern both for the government and for the commodity exchange system in designing public market information system. This work tried to address such concern by making an *ex-ante* evaluation on the usefulness of the price information about the central wholesale market to farmers. The work discussed the factors influencing farmers' price expectation formation. This was followed by a theoretical overview on the quasi-rational forecasting models as representations of farmers' price expectation formation.

Price expectation formation

The lag between agricultural production decisions and the actual realisation of output induces uncertainty about the future returns. This makes price forecasting indispensable for farmers. Since future prices are unobservable, farmers make production decisions based on expected future prices. In doing so, farmers become involved in gathering and processing of price information unless transaction costs are prohibitive. Mostly, farmers gather information from unofficial sources such as neighbours, friends or traders. Such decision making under uncertainty and under an environment with imperfect information involves formation of judgements in order to evaluate alternative courses of action. Producers' price expectations play a significant role in the analysis of agricultural supply response since price expectations influence production and marketing decisions of producers (Sulewski et al., 1994; Moschini and Hennessy, 2001). Consequently, understanding what information set farmers use and how they formulate price expectations remain integral parts of economic research and agricultural supply response models (Fisher and Tanner, 1978). Much attention is given to the hypothesised formulations of producers' price expectations in the course of methodological developments. In a world of uncertainty, the expectations hypothesis is a key assumption in modelling real market price movements (Hommes et al., 2002).

There are different hypotheses about the formulation of

price expectations by farmers and about the information set they use in formulating such expectations. The three well-known hypotheses are the naïve expectation hypothesis, the adaptive expectation hypothesis, and the rational expectation hypothesis. The naïve expectation hypothesis assumes that prices remain the same through time and it models tomorrow's expected price simply as today's price. As such, it is assumed that agents do not use any information other than the last period's price to make expectations about the future prices. The adaptive expectations hypothesis assumes that agents make adjustments in making price expectations in order to correct for the last period's expectation error. Accordingly, the currently held price expectation is a weighted average of the expectations held last period and the actual price observed currently. On the other hand, rational expectations hypothesis assumes that agents use all available information in making optimal expectations about future prices (Muth, 1961). As a result, the models that represent the rational expectations of agents involve behavioural equations on both the endogenous and exogenous variables, with the conditional expectations of variables based on all the available information set giving the expected future price.

The rational expectations hypothesis implies that full knowledge of the true data generating process exists and anticipated future values of relevant variables are equal to their expectations conditional on all past data and the model itself which describes the behaviour based on those expectations (Nerlove and Fornari, 1998; Evans and Ramey, 2003). Owing to such theoretical appeals, the rational expectations hypothesis became dominant in modelling expectations of agricultural prices for the last 20 years (Holt and McKenzie, 2003). However, when information is costly to obtain and process, conditional expectations of the future values of variables based on all the currently available information set may not be the best approximation of the agents' expectations (Orazem and Miranowski, 1986). In consideration of such practical limitations against an assumption of fully rational expectations, there is a shift of focus in recent research of agricultural price expectations towards quasi-rational expectations which has a more realistic assumption about agents' information set used in making expectations (Holt and McKenzie, 2003). Typical quasi-rational expectation models assume that agents' expectations can be represented by predictions from simple price forecasting regression. Nerlove and Fornari (1998) provided a good discussion on quasi-rational expectations and apply it to US beef cattle supply whereas Holt and McKenzie (2003) applied the method to US broiler prices. Also, Chavas (1999), through the investigation of the nature of expectation formation in the US broiler market, concluded that, significant part of pricing is consistent with quasi-rational expectation.

Similarly, assuming that the quasi-rational expectation hypothesis has empirical relevance in the price expectations of smallholder farmers, in this study a quasi-rational forecasting model for the producer prices of white teff and white wheat in Ethiopia was developed. Provided that there exist domestic grain market integration in Ethiopia (Dercon, 1995; Gabre-Madhin, 2003), there can be short and long-run price transmission from the central wholesale price to the local (producer) prices. Based on this evidence, it is assumed that farmers, as rational economic agents, use such central wholesale market price information in their price expectation formation. Given that smallholder farmers in Ethiopia incur the single most important farm input cash outlay on commercial fertilizer, the role of such cost in influencing the future prices of products and producers' price expectations is considered. Moreover, rainfall quantity and its distribution are considered since rainfall patterns affect the prices of food crops with a complex dynamics (Asfaw and Jayne, 1997). There are empirical evidences showing that smallholder farmers make use of climatic factors in making forecasts (Hansen, 2004; Luseno et al., 2003).

Both central wholesale price, price of commercial fertilizer, and rainfall amount are theoretically and empirically relevant in the information set of farmers for making price forecasts. Accordingly, it could be possible to make inference about producers' price expectations using dynamically specified information on the current and lagged levels of these variables. The estimated models can be checked for mis-specification using the properties of the disturbance terms and the adequacy of the forecasting models can be checked using the properties of the forecast errors. If the forecasting models make the producer price forecasts consistent with the actually observed producer prices, the models could be maintained as tentatively adequate.

MATERIALS AND METHODS

A quasi rational forecasting model of producer prices

According to the assumption in quasi-rational expectations, agents' price expectations can be represented with forecasts from dynamic regressions that model the changes in prices as a function of the changes in explanatory variables. Holt and McKenzie (2003) mentioned that a quasi-rational forecasting regression for commodity cash price, P_t, based on X_{t-1} explanatory variables used by agents to predict price change in period t may be written as:

$$\Delta P_t = b\Delta X_{t-1} + \rho\, z_{P,t-1} + u_t \tag{1}$$

Where, b and X are vectors of coefficients and regressor variables, respectively, $z_{P,t-1}$ is the cointegrating vector or long-run relationship between the dependent variable P_t and its explanatory variables (X_t) with ρ as the cointegrating term, Δ

Table 1. ADF unit root test results for producer prices of white teff and white wheat.

Test statistic	Calculated value		Critical value*		
	White teff	White wheat	1%	5%	10%
Φ_3	4.95	2.45	9.84	6.78	5.67
$\hat{\tau}_\beta$	-3.12	-1.11	-4.14	-3.49	-3.16
Φ_1	2.45	4.91	6.96	4.81	3.92
$\hat{\tau}_\mu$	-1.56	-2.21	-3.57	-2.92	-2.59

* Critical values were taken from Dickey and Fuller (1981), for a sample size of 50.

is the difference operator, and u_t is an error term. After estimating (1) with ordinary least squares, the fitted values can be used to represent agents' price expectations, P_t^e :

$$P_t^e = P_{t-1} + b\Delta X_{t-1} + \rho\, z_{P,t-1} + v_t \qquad (2)$$

Where, v_t stands for the forecast error defined as the difference between the actual and the forecasted prices ($P_t - P_t^e$) and for unaccounted information in making P_t^e . In order to render the forecast error term v_t a white noise property, the quasi-rational forecasting regression under (1) should be augmented with the relevant information set, that is, the relevant explanatory variables and their appropriate lags. As shown in Nerlove and Fornari (1998) and Holt and McKenzie (2003), the forecast error term v_t can be used to test the adequacy of the underlying forecast model in the sense that the forecast error term v_t is uncorrelated with any information set available during the time of forecast (that is, no systematic forecast error). If there is any relevant information available during the time of forecast, which is known to enter the producers' price expectations behaviour but omitted in the forecasting regression, the forecast error becomes correlated with the omitted information indicating that the forecast regression is misspecified and inadequate for inference. On the other hand, absence of serial correlation in the forecast error term v_t and, in its presence, absence of any prior justification for the cause of the serial correlation, such as omitted information and omitted lags of the already included explanatory variables, indicates that the forecasting model is tentatively adequate for inference on producers' price expectations. Actually, since producers' price expectation P_t^e (2) is partially derived from the fitted values of (1), statistical inference on the forecast error term v_t becomes inapplicable as a testing mechanism of model adequacy. Therefore, a quasi-rational forecasting regression of the form specified under (1) can be estimated directly and its error term, u_t , can be used for inference on the adequacy of the forecasting regression, based on which the public information need of farmers to make optimal forecast on producers' prices can also be assessed. The quasi-rational forecasting regression (1) used in predicting producer price movements is specified in an error-correction mechanism (ECM)

which plausibly explains the short-term properties of price movements while, at the same time, giving information on the long-term equilibrium relationships. ECM is considered as an appropriate modelling strategy to account for short-term price movements.

Data and model estimation

Quasi-rational forecasting models of producer price of white teff and white wheat was developed using central wholesale market prices, commercial fertiliser prices, rainfall quantity, and lags of both the dependent and the explanatory variables to explain the movements of producer prices. The data used in the study refer to observations recorded between 1996 M1 to 2000 M12. The data refer to *Ambo* district, a surplus producing area located in the West Shoa Administrative Zone of Oromiya Regional State, Ethiopia.

The study area is a fairly representative for the central highlands of Ethiopia where grain production is the dominant agricultural activity. As elsewhere in the country, smallholder farmers are the major producers and suppliers of grains in the area and they produce cereals both for household consumption and income generation purposes. Though there is the broadcasting of price quotes on selected regional markets in the country through the Ethiopian radio, not all farmers have access to the information service. Public market information provision, including price information, is not yet included in the local agricultural extension package rendered to farmers nor can farmers afford to procure and process market information from official sources on their own, probably due to high transaction costs of information searching and processing. Data on the producer prices of white teff (PT) and white wheat (PW) and on the central wholesale prices of white teff (WT) and white wheat (WW) are monthly averages adjusted for inflation (deflation) [using the Consumer Price Index (1995/1996 = 100)] and for seasonality (using the Grand Seasonal Index of each month) in order to control for seasonal effects.

Producer price of white teff (PT) and white wheat (PW)are tested for unit roots using the Augmented Dickey-Fuller (1981) (ADF) test and each series is found consistent with a non-stationary stochastic process, that is I(1), without a constant and without a time trend (Table 1). Such non-stationarity of producer prices is expected to make the decision-making environment of farmers uncertain and risky, which, in turn, makes their information need very high in order to make optimal price expectations. Each producer price series is also tested for a possible single structural break due to the Ethio-Eritrea border conflict during the sample period (T_b = May 1998) and using the Innovative Outlier Augmented Dickey-Fuller (IOADF) test of Perron (1989).

The test results for each series failed to reject the null hypothesis

Table 2. First stage unrestricted ECM estimation.

Dependent variable	Regressor	Coefficient	F-statistic of zero restrictions on the coefficient of lagged variables in levels
ΔPT	RF	0.762 (0.006)	4.44***
	$\Delta PT(-1)$	0.065 (0.397)	
	$\Delta WT(-1)$	-0.178 (-1.166)	
	$\Delta PF(-1)$	-0.410 (-1.981)*	
	$PT(-1)$	-0.333 (-2.520)**	
	$WT(-1)$	0.049 (0.541)*	
	$PF(-1)$	0.270 (3.463)***	
ΔPW	RF	-0.032 (-1.099)	4.01**
	$\Delta PW(-1)$	-0.212 (-1.212)	
	$\Delta WW(-1)$	0.789 (1.828)*	
	$\Delta PF(-1)$	0.020 (0.042)	
	$PW(-1)$	-0.452 (-2.988)***	
	$WW(-1)$	0.497 (2.422)**	
	$PF(-1)$	-0.034 (-0.170)	

Values in parenthesis are *t*-ratios; ***, ** signal significance at 1% and 5%, respectively.

of unit root against the alternative of trend stationary series with a single structural break. The $\widetilde{\tau}_A$ statistics for producer price of white teff and white wheat were -3.26 and -0.91, respectively, while the critical values were -3.76 at 5% and -3.46 at 10% significance level for $\lambda = 0.50$. To be consistent with the time series properties of the price data (non-stationarity), it is important to ensure cointegration among the variables that enter the quasi-rational forecasting regression, hence ensuring an error correction mechanism. The ARDL modelling approach for the cointegration analysis developed by Pesaran and Shin (1998) and the bounds testing procedure by Pesaran et al. (2001) to test cointegration were used. As the first stage of the analysis, the following unrestricted ECM was estimated using ordinary least squares technique:

$$\Delta P_t = a_0 + a_1 T + \phi_1 P_{t-1} + \phi_2 X_{1,t-1} + ... + \phi_k X_{k,t-1} +$$

$$\sum_{i=1}^{n-1} \beta_i \Delta P_{t-i} + \sum_{i=1}^{m_1-1} \varphi_{1i} \Delta X_{1,t-i} + ... + \sum_{i=1}^{m_k-1} \varphi_{ki} \Delta X_{k,t-i} + u_t \qquad (3)$$

Where, a_0 is a constant, T is a time trend, P is the producers' price, $X_1, ..., X_k$ are explanatory variables, n and m are maximum lag orders, and $a_1, \phi_1, ..., \phi_k, \beta_i, \phi_{1i}, ..., \phi_{ki}$ are coefficients. The lag orders of the first differences in the respective models were chosen to be one based on the evidences from the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC). Since the underlying ARDL model of such an ECM model is a reduced form model in which the lags of the dependent variables are treated as pre-determined exogenous variables,

ordinary least squares (OLS) estimation provides unbiased and consistent estimates provided that there is cointegration (see, for example, Alexander and Wyeth, 1994).

RESULTS AND DISCUSSION

Estimated quasi-rational forecasting regression of each producer price change equivalent to (1) was obtained from the underlying ARDL models selected on the basis of statistical criteria. The corresponding ECM models (Table 3) gave the quasi-rational forecasting regression of each producer price change equivalent to (1). The results of the forecasting regressions showed that each regressor variable, including the lagged error-correction term, had the right sign which was consistent with standard economic theory, although some of the coefficients were statistically insignificant. To assess the adequacy of the estimated quasi-rational and the fitted producers' price forecasting models, the following properties on the forecast errors and residuals were considered: Root mean sum squares of the dynamic forecast errors, serial correlation of the ARDL residuals, and correlation of the producers' forecast errors v_t in the fitted producers' price forecast model (2) with omitted information. The values of R^2 in Table 3 are informative that is there was good fit of the estimated models.

Table 3. Quasi-rational forecasting regression of producer prices of white teff and white wheat.

ΔPT_t		ΔPW_t	
Variable	**Coefficient**	**Variable**	**Coefficient**
ΔWT_t	0.56 (5.25)***	ΔWW_t	0.45 (2.31)**
ΔPF_t	0.20 (3.87)***	ΔPF_t	0.09 (0.48)
ΔRF_t	-0.004 (-0.38)	ΔRF_t	-0.03 (-1.13)
$z_{PT,t-1}$	-0.34 (-3.78)***	$z_{PW,t-1}$	-0.54 (-4.83)***
R^2	0.54	R^2	0.31
DW-statistic	2.06	DW-statistic	2.15

Values in parenthesis are t-ratios; $z_{PT,t-1} = (PT - 0.36WT - 0.61PF + 0.01RF)_{t-1}$; $z_{PW,t-1} = (PW - 0.83WW - 0.17PF + 0.06RF)_{t-1}$; ***, ** signal significance at 1% and 5%, respectively.

Table 4. Root mean sum squares of forecast errors for the changes in producer prices of white teff and white wheat.

Parameter	White teff		White wheat	
	Estimation period (1996M1-2000M5)	**Forecast period (2000M6-2000M10)**	**Estimation period (1996M1-2000M5)**	**Forecast period (2000M6-2000M10)**
Root mean sum square	0.039	0.021	0.056	0.046

Root mean sum squares of dynamic forecast errors

Out-of-sample dynamic forecasts for the changes in the PT and PW were calculated based on the estimated quasi-rational forecasting regressions and compared with the in-sample forecast errors in order to judge the performance of the estimated quasi-rational forecasting model. The root mean sum squares ($RMSS$) of forecast errors were calculated as follows:

$$RMSS = \sqrt{\sum_{j=1}^{n} (e_{t+j}^*)^2 / n}$$

(4)

Where, e_{t+j}^* is the forecast error defined as the difference between the actual value P_{t+j} and the forecast value $P*_{t+j}$, $j = 1, 2, ..., n$, with n being the forecast horizon. While low $RMSS$ generally indicates good fit of the quasi-rational forecasting regressions, a comparison between the in-sample and the out-of-sample $RMSS$ values was made in order to see whether the two values were fairly similar. The $RMSS$ values of the estimation (in-sample) and the forecast (out-of-sample) period for the changes in the prices of the producer prices were fairly similar in the case of each food crop (Table 4). This indicated that the estimation technique and the developed quasi-rational forecasting models were robust to forecast current producer price changes of each food crop.

Serial correlation of the ARDL residuals

Since the quasi-rational forecasting regression (ECM) is a reformulation of the ARDL model, inference can be made on the properties of the residuals of the underlying ARDL model, possibly with similar conclusions arising about the adequacy of the forecasting regression. Serial correlation of the residuals of the fitted ARDL values may indicate some sort of misspecification of the forecasting regression. With this idea in mind, the residuals of the fitted ARDL values for serial correlation were tested (Table 5). According to the test results, there was no significant autocorrelation coefficient at any lag order, indicating lack of evidence both for omitted information and for model misspecification.

Correlation of producers' price forecast errors with omitted price information

The fitted producer price forecast models for white teff and white wheat (based on the assumption of the applicability of quasi-rational forecasting regressions), can be represented as follows:

Table 5. Box-Pierce serial correlation test results for ARDL residuals and for producers' price forecast errors.

Lag order	White teff			White wheat		
	Autocorrelation coefficient	Box-Pierce statistic	msl (%)	Auto correlation coefficient	Box-pierce statistic	msl (%)
1	-0.06 (-0.05)	0.18 (0.15)	67 (70)	-0.13 (-0.13)	0.92 (1.00)	34 (32)
2	-0.14 (-0.14)	1.30 (1.24)	52 (54)	0.02 (0.02)	0.93 (1.02)	63 (60)
3	-0.08 (-0.08)	1.68 (1.61)	64 (66)	0.02 (0.04)	0.96 (1.10)	81 (78)
4	0.09 (0.10)	2.22 (2.16)	70 (71)	-0.05 (-0.03)	1.10 (1.14)	89 (89)
5	0.17 (0.16)	3.92 (3.71)	56 (59)	0.07 (0.07)	1.36 (1.42)	93 (92)
6	-0.09 (-0.09)	4.36 (4.22)	63 (65)	0.08 (0.08)	1.70 (1.79)	95 (94)
7	-0.10 (-0.10)	4.89 (4.81)	67 (68)	-0.06 (-0.07)	1.89 (2.07)	97 (96)
8	-0.07 (-0.06)	5.16 (5.05)	74 (75)	-0.01 (-0.02)	1.90 (2.10)	98 (98)
9	0.04 (0.04)	5.25 (5.16)	81 (82)	-0.02 (-0.02)	1.91 (2.11)	99 (99)
10	0.04 (0.04)	5.34 (5.25)	87 (87)	-0.05 (-0.05)	2.07 (2.28)	100 (99)
11	-0.04 (-0.04)	5.42 (5.33)	91 (91)	0.07 (0.07)	2.38 (2.57)	100(100)
12	-0.26 (-0.26)	9.53 (9.36)	66 (67)	-0.03 (-0.04)	2.44 (2.67)	100(100)

Msl; Marginal significance level of the test statistic; values in parenthesis indicate test results for producers' price forecast errors.

$$PT_t^e = PT_{t-1} + 0.55\Delta WT_{t-1} + 0.20\Delta PF_{t-1} - 0.004\Delta RF_{t-1} - 0.34(Z_{PT,t-1}) + v_{t1}$$
$$\quad\quad (5.25)^{***} \quad (3.87)^{***} \quad (-.38) \quad\quad (-3.78)^{***}$$
$$(5)$$

$$PW_t^e = PW_{t-1} + 0.45\Delta WW_{t-1} + 0.09\Delta PF_{t-1} - 0.03\Delta RF_{t-1} - 0.54(Z_{PW,t-1}) + v_{t2}$$
$$\quad\quad (2.31)^{**} \quad\quad (0.48) \quad\quad (-1.13) \quad\quad (-4.83)^{***}$$
$$(6)$$

Figures in parenthesis indicate the t-ratio; ***p<0.01, **p<0.05. If the assumption of a quasi-rational expectation holds true [that is producers' expectations are consistent with predictions from a dynamic regression equation as given under (5) and (6)], fitted producer price forecasts from such models would be similar to the actual producers' price expectations. Comparison of the fitted producer price forecasts from each of the above models with the actual producer prices (PT_t and PW_t) enabled the assessment of the properties of the forecast errors (v_{t1} and v_{t2}) and inference on the adequacy of the fitted producer price forecast models. Nevertheless, for models fitted from the ARDL (ECM) models, the producers' price forecast errors (v_{t1} and v_{t2}) did not have statistical properties different from that of the ARDL residuals.

This is apparent from the entries of Table 5 in parenthesis, which were nearly similar to the adjacent entries for the ARDL residuals and provided supporting evidence to the conclusions from the results of the root mean sum squares and ARDL residuals. Omitted relevant own and cross price information in each producers' price expectation model was expected to produce a strong correlation coefficient with the corresponding producer price forecast error, making the estimated producers' price expectation model inadequate. While there might be different sets of omitted information, the most likely candidates are commodity prices (including prices of closer substitutes) at different market levels. The properties of correlation coefficients between price forecast error (v_{t1} and v_{t2}) and the suspected price information omitted from the estimated models were analyzed. None of the correlation coefficients (Table 6) was strong enough except the case of forecast error of white wheat producer price in relation to the central market retail price of white teff (-0.64). The results ensured that no relevant central and local market product price information was omitted in the quasi-rational forecasting regressions. Caution should be exercised not to be misled by this evidence since a low correlation coefficient might not necessarily mean that the price information mentioned in Table 6 was irrelevant for producers to make price expectations. Rather, it might be a result of strong multicollinearity between the central wholesale prices already entered in the quasi-rational forecasting regression and the rest of the central and local market price information. To the extent that the omitted information is reflected in the central wholesale prices entering the quasi-rational forecasting model and that the root mean sum squares, the ARDL residuals, and the producers' price forecast errors did not show overriding evidences of model misspecification, the quasi-rational forecasting regressions and the producers' price expectation models developed in this study can be maintained as tentatively adequate for inference on the usefulness of disseminating real time information to farmers on central wholesale prices, discovered through the Ethiopian commodity exchanges system.

Conclusion

Price volatility and risk induce uncertainty to producers and making of price expectations are important aspects

Table 6. Correlation coefficients between producers' forecast errors and omitted price information.

Forecast error	Price information				
	Central market price		Local market price		
	Retail	Wholesale	Retail	Wholesale	Producer
v_{t1}	0.02[T]	n.a.	-0.08[T]	-0.05[T]	n.a.
	0.12[W]	0.13[W]	0.14[W]	0.12[W]	0.09[W]
v_{t2}	0.24[W]	n.a.	0.19[W]	0.17[W]	n.a.
	-0.63[T]	-0.12[T]	0.03[T]	0.05[T]	0.02[T]

T, White teff; W, white wheat; n.a., not applicable.

of production, technology adoption and marketing decisions. Producers use different information to predict future prices. When obtaining and processing information is costly for individual farmers, which generally is the case in developing countries, it might be necessary to provide market information as public goods through institutionalised market information systems. In this process, identification of the relevant information set that the farmers need is an important first step. As Ethiopia already launched a commodity exchange system, the price discovery mechanism for agricultural products is expected to be improved tremendously. The exchange envisages dissemination of real time price information for the consumption of different groups such as the producers, traders, and consumers. Whether the price information is useful for farming decisions by entering into the information set of farmers for price forecast purpose is a relevant concern in designing market information system. Using quasi-rational expectation formation, this study investigated the usefulness of disseminating real time information about central wholesale prices to smallholder farmers in Ethiopia. Each model was assessed for its adequacy based on the properties of the forecast errors. The results provide evidence on the potential benefit of real time price information dissemination to farmers to assist farm level forecasting and production, technology adoption and marketing decisions. The finding supports the intended role of the Ethiopian commodity exchange as an organised central wholesale price discovery and information dissemination centre. Based on such evidences, scaling up the real time price information dissemination activity of the Ethiopian commodity exchange, together with enhanced support for information technology and management, is commendable.

REFERENCES

Alemu D, Mwangi W, Nigussie M, Spielman DJ (2008). The maize seed system in Ethiopia: Challenges and opportunities in drought prone areas. Afri. J. Agric. Res., 3(4): 305-314.

Alexander C, Wyeth J (1994). Cointegration and market integration: an application to the Indonesia rice market. J. Dev. Stud., 30(2): 303-328.

Alderman H, Shively G (1996). Economic reform and food prices: evidence from markets in Ghana. World Dev., 24(3): 521-534.

Asfaw N (1998). Vertical and Spatial Integration of Grain Markets in Ethiopia: Implication for Grain Market and Food Security Policies. Grain Marketing Research Project, Working Paper, p. 9, MEDAC, Addis Ababa.

Asfaw N, Jayne TS (1997). The Response of Ethiopian Grain Market to Liberalisation. Grain Marketing Research Project, Working Paper No. 6, Ministry of Economic Development and Cooperation, Addis Ababa.

Badiane O, Shively GE (1998). Spatial integration, transport costs, and the response of local prices to policy changes in Ghana. J. Dev. Econ., 56(2): 411-431.

Chavas JP (1999). On dynamic arbitrage pricing and information: The case of the US broiler sector. European Review of Agricultural Economics 26(4): 493-510.

Chianu JN, Mairura F, Ekise I, Chianu JN (2008). Farm input marketing in western Kenya: Challenges and opportunities. Afr. J. Agric. Res., 3(3): 167-173.

Chilowa W (1998). The impact of agricultural liberalisation on food security in Malawi. Food Policy, 23(6): 553-569.

Crawford E, Kelly V, Jayne TS, Howard J (2003). Input use and market development in Sub-Saharan Africa: an overview. Food Policy, 28(4): 277-292.

Dercon S (1995). On Market Integration and Liberalisation: Method and Application to Ethiopia. J. Develop. Studies 32(1): 112-138.

Evans GW, Ramey G (2003). Adaptive Expectations, Underparameterization and the Lucas Critique. University of Oregon Economics Department Working Paper. University of Oregon, Eugene.

Fisher BS, Tanner C (1978). The Formulation of Price Expectations: An Empirical Test of Theoretical Models. Am. J. Agric. Econ., 60(2): 245-248.

Gabre-Madhin EZ (2003). Why is Ethiopia facing Another Famine? On Markets and Market Failure. IFPRI, Washington.

Getnet K, Verbeke W, Viaene J (2005). Feasibility of on-farm commercial grain storage in the smallholder agriculture of Ethiopia. Outlook Agric, 34(1): 41-47.

Goletti F, Babu S (1994). Market liberalisation and integration of maize markets in Malawi. Agric. Econ., 11(2-3): 311-324.

Grepperud S (1997). Soil degradation choice under production and price uncertainty. Discussion papers No. 186, Statistics Norway, Oslo, Norway.

Hansen J (2004). Can smallholder farmers benefit from seasonal climate forecasts? 4th International Crop Science Congress, International Research Institute for Climate Prediction, New York, USA.

Holt MT, McKenzie AM (2003). Quasi-rational and ex ante price expectations in commodity supply models: An empirical analysis of the US broiler market. J. Appl. Econ., 18(4): 407-426.

Hommes CH, Sonnemans J, Tuinstra J, van de Velden H (2002). Learning in Cobweb Experiments. Department of Economics, University of Amsterdam, Amsterdam.

Howard J, Crawford E, Kelly V, Demeke M, Jeje JJ (2003). Promoting high-input maize technologies in Africa: The Sasakawa-Global 2000

experience in Ethiopia and Mozambique. Food Policy, 28(4): 335-348.

Jayne TS, Jones S (1997). Food marketing and pricing policy in Eastern and Southern Africa: A survey. World Dev., 25(9): 1505-1527.

Kherallah M, Delgado C, Gabre-Madhin E, Minton N, Johnson M (2000). Agricultural market reforms in Sub-Saharan Africa: A survey of research findings. IFPRI, Washington.

Luseno WK, McPeak JG, Barrett CB, Little PD, Gebru G (2003). Assessing the value of climate forecast information for pastoralists: Evidence from Southern Ethiopia and Northern Kenya. World Dev., 31(9): 1477-1491.

Moschini G, Hennessy DA (2001). Uncertainty, risk aversion, and risk management for agricultural producers. In: (Gardner, B.L., Raussser, G., Eds.). Elsevier Science, Amsterdam. Handbook Agric. Econ., 1: 87-153.

Muth JF (1961). Rational expectations and the theory of price movements. Econometrica, 29(6): 315-335.

Nerlove M, Fornari I (1998). Quasi-rational expectations, an alternative to fully rational expectations: An application to US beef cattle supply. J. Econ., 83(1-2): 129-161.

Orazem P, Miranowski J (1986). An indirect test for the specification of expectation regimes. Rev. Econ. Stat., 68(4): 603-609.

Perron PP (1989). The Great Crash, the Oil Price Shock and the Unit Root Hypothesis. Econometrica, 57(6): 1361-1401.

Pesaran MH, Shin Y (1998). An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis. In: Strom, S., Diamond, P., (Eds.), Centennial Volume of Regnar Frisch. Cambridge University Press, Cambridge.

Pesaran MH, Shin Y, Smith RJ (2001). Bounds testing approaches to the analysis of level relationships. J. Appl. Econ., 16(3): 289-326.

Rosenzweig MR, Binswanger HP (1993). Weather, weather risk and the composition and profitability of agricultural investments. Econ. J., 103(416): 56-78.

Snapp SS, Blackie MJ, Donovan C (2003). Realigning research and extension to focus on farmers' constraints and opportunities. Food Policy, 28(4): 349-363.

Sulewski T, Spriggs J, Schoney RA (1994). Agricultural Producer Price Expectations. Canadian J. Agric. Econ., 42(3): 301-310.

Tadesse K (2002). Trends in Agricultural Production, Technology Dissemination, and Price Movements of Outputs and Inputs. In: (Bonger, T., Gabre-Madhin, E., Babu, S., Eds.), Agricultural Technology Diffusion and Price Policy. Proceedings of a Policy Forum, Report No. 1: 37-54. 2020 Network for East Africa, Addis Ababa.

Wolday A (2002). The Structure and Functioning of the post-PADETS Grain Marketing System in Ethiopia. In: (Bonger, T., Gabre-Madhin, E., Babu, S., Eds.), Agricultural Technology Diffusion and Price Policy. Proceedings of a Policy Forum, Report No. 1: 55-82. 2020 Network for East Africa, Addis Ababa.