Asymmetric Farm-Retail Price Transmission in the Marketing of Vegetables in the Central and Eastern Ethiopia

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Abstract:

This research was based on a weekly secondary price data of 48 weeks of retail and producer prices collected by the researcher's advisor in 2005/06 for cabbage, onion, potato, and tomato in three consuming cities (Adama, Addis Ababa, and Dire Dawa) and five producing districts (Shashamane, Bole, Meki, Haramaya and Kersa. The major aims of the study are to find out if there is long run equilibrium relationship between farm and retail prices for selected fresh vegetables, to identify their order of occurrence, and the nature of responsiveness of RP to fluctuations in FP. The result from the test for cointegration between farm and retail prices supports the existence of cointegration between FP and RP for all items in all market places. In this study, using an asymmetric error correction model, the researcher have tried to show whether price fluctuations at one end of the marketing channel transmits to the other end symmetrically for the selected fresh vegetables in Eastern and Central Ethiopia. The result shows that price transmission follows a mix of both negative and positive asymmetry. Retailers have been found to respond faster to negative shocks than positive in some market places and to positive shocks in others. The Granger causality test of the direction of causality between farm and retail prices for the fresh vegetables was inconclusive. RP has been found to Granger cause FP for some items while it is the FP which precedes RP in others with the exception of two items in Addis Ababa where we fail to reject the null hypothesis of no causality.

Key words: Asymmetric Error Correction Model, Cointegration, Asymmetric Price Transmission and Granger Causality

1. INTRODUCTION

1.1. Background

Agriculture is the backbone of Ethiopia's economy. It accounted for about 46% of the GDP of Ethiopia for the last six years from 2003/04 to 2008/09. More than 90% of the export earnings of the country come from this sector with coffee and oilseeds accounting for over 50% of the share for fiscal years ranging from 2006/07 to 2008/09 (MoFED, 2009). In terms of employment it accounts for about 85% of the economically active population (CSA, 2007).

The Government of Ethiopia has been implementing the second phase of the long term development plan which is known as a Plan for Accelerated and Sustained Development to End Poverty (PASDEP). This document is Ethiopia's guiding strategic framework for the five-year period 2005/06-2009/10. It is a continuation of the first phase of the Poverty Reduction Strategy Program (PRSP) process, which has begun under the Sustainable Development and Poverty Reduction Program (SDPRP), which covered the past three years, 2002/03-2004/05. PASDEP is one of the medium term plans for the realization of the government's vision to bring up the development of the country to middle level income countries and achieve Millennium Development Goals (MDGs) (MoFED, 2009).

For the current five year plan from 2010/11-2014/15, the government has embarked massively on the transformation of the economy by developing a five year Growth and Transformation document. It is a medium term strategic framework for the five-year period. The plan has been prepared considering growth constraining factors and lessons drawn from the implementation of PASDEP, country's long term vision, and external shocks. The major goals of the Growth and Transformation Plan (GTP) are achieving Ethiopia's long term vision, sustain rapid and broad-based growth paths witnessed during the past several years, and eventually end poverty (MoFED, 2010)

Vegetable production is becoming an increasingly important activity in the agricultural sector of the country following increased emphases given by the government to small scale commercial farmers. The major share of the estimated 1.4 million tones of fruits and vegetables is consumed locally and only 4.5% of the total is exported. Ethiopian fruits and vegetables are mainly destined to the Djibouti market. This market accounts for about 90%

of fruits and 69% vegetables of the country's export. The rest is exported to Europe and Middle East (Jema, 2005).

Price theory plays a key role in neo-classical economics. Prices drive resource allocation and output mix decisions by economic actors, and price transmission integrates markets vertically and horizontally. Economists who study market processes are therefore interested in price transmission processes. Specifically, the relation between farm/wholesale and retail prices has been the subject of numerous research studies with the objective of understanding why marketing margins for agricultural products have been changing over time. Of special interest are those processes that are referred to as asymmetric, *i.e*. for which transmission differs according to whether prices are increasing or decreasing.

A common belief is that price transmission between different stages in the marketing chain is not symmetric. Usually, it is claimed that input price increases are transferred more rapidly to consumer prices than corresponding price reductions. A commonly cited source of asymmetric price responses is market power (Scherer and Ross, 1990). Oligopolistic middlemen in the food markets might react collusively more quickly to shocks that squeeze their marketing margins than to shocks that raise them, resulting in asymmetric short-run transmission. Similarly, asymmetric price transmission could result if retail traders believe that competitors will follow an increase in retail prices as prices in the farm/wholesale market rise, but that they will not respond to falling prices in the farm/wholesale market by granting an equivalent reduction.

Another indirect indicator of the competitiveness of price adjustment is whether upward and downward price movements at the locus are translated to the other market with equal speed and completeness (Richards and Patterson, 2003). The speed with which retail prices adjust to price changes originating at the farm is often interpreted as an indicator of either retailers using their control over price to temporarily widen margins, or of the competitiveness of the retail sector. By symmetric price response we mean that retailers (assuming retail price as affected and farm price or wholesale price as causal) pass price changes downstream equally irrespective of whether the change is an increase or a decrease. Asymmetry in price adjustment is often interpreted as poor pricing performance, where retailers are either absorbing price increases to avoid losing market share or failing to expeditiously pass through price reductions in order to temporarily raise their margins.

In Ethiopia and Africa in general, there has been very limited work on the issue at all. In Ethiopia, in particular, there are studies that try to address marketing problems and challenges of vegetables but only very few studies have been done on price transmission (Jema, 2005).

In this study the price linkages among retail and farm gate prices was analyzed to provide empirical evidence about price transmission in the marketing of fresh vegetables in Eastern and Central Ethiopia. Asymmetric price transmission was investigated by testing statistically whether changes (increases and decreases) in the prices at one end of the marketing chain of vegetables affect(or are transmitted to) the other end. Does the reaction of the retail price to a farm price change depend on whether this change is positive or negative, or not?

1.2. Statement of the Problem

Asymmetric price transmission is important because it may point to gaps in economic theory and also because its presence is often considered for policy purposes to be evidence of market failure. The traditional neo-classical approach of free market economy assumes the free functioning of the market and flexibility in prices based on economic conditions. The whole analysis of this school is based on the assumption that market clears and price transmission is symmetric. The actual environment under which price determination takes place is mostly an imperfect market where there is information asymmetry. When price transmission becomes asymmetric, the market might become inefficient. Hence economists who study about market efficiency are concerned about the price transmission process in an economy (Meyer and Cramon-Taubadel, 2004).

If price transmission is asymmetric, the benefits enjoyed by producers, consumers and retailers could be disproportionate. Producers' welfare might be affected negatively if they can't earn reasonable amount of income following the production process and this implies a different distribution of welfare. Hence government and policy makers closely watch the nature of price adjustment in the market.

Agricultural policy leading to high prices at farm level may be expected to lead to high consumer prices of foods, and similarly lower costs for agriculture may be transmitted into lower food prices for consumers. With missing symmetric price transmission, consumers will not benefit from lower production costs in agriculture or food processing – nor will the consumers suffer as a result of higher agricultural costs and prices.

In Ethiopia and other developing countries, agriculture pays an indispensable role since it is the major source of income and livelihood of the majority of the population and a dominant source of export earnings. Production and marketing of vegetables has become increasing important in Ethiopia in recent years following the expansion of small scale irrigation.

It is important to know the way market prices of vegetables are determined and whether fluctuations in farm gate prices are transmitted to retail prices symmetrically to understand the welfare implications of price fluctuation. The inception of this paper goes back to an educational field visit that the researcher had to Fentale Irrigation where he saw a significant difference between producer and retail prices for onion. He observed that retail price of onion is higher than the producer price by over 300% and wondering why this is the case and wanted to know if there is a room for exploitation by middlemen in vegetable marketing.

1.3. Objectives of the Study

The general objective of this study is to investigate whether changes in the farm prices are symmetrically transmitted to consumers' prices or not for selected vegetables in the eastern and central parts of Ethiopia and to investigate the direction of Granger causality between farm and retail prices.

The specific objectives of the study are:

1. To examine the responsiveness of vegetable retail prices to changes in farm or producer prices
2. To investigate if there is a long run equilibrium relationship between farm gate and retail prices at three main cities in Ethiopia
3. To test for the Granger causality between retail and producer prices

1.4. Significance of the Study

This study focuses on the nature of transmission of price fluctuations at farm gate and retail prices for fresh vegetables in Ethiopia. The results of this study would be significant for the following reasons.

It will play an informative role to policy makers regarding the nature and, extent of price transmission involved in fresh vegetables marketing. Through the Granger causality test this study has shown the order of occurrence or precedence of RP and FP for the selected items.

The findings of this research can be an input for decision makers working in areas of FP and RP regulation since it shows the direction of causality. Moreover, the limited number of empirical studies done in Ethiopia over the past in the subject area makes this study among the first few works and this study can initiate other researches and concerned parties to undertake further investigation.

1.5. Scope and Limitations of the Study

This study is delimited to the measurement of the tendency of transmission of price fluctuations at farm gates to retail level prices for fresh produces of onion, potato, cabbage, and tomato in the central and eastern parts of the country. The study area is limited to purposively selected three main cities in Ethiopia, namely Adama, Addis Ababa, and Dire Dawa and main vegetable supplying Farms to these cities. The farm price is collected from five districts of Oromia namely Shashamane, Bole, Meki, Haramaya, and Kersa. Due to lack of long period time series data, this study is limited to the use of time series data collected for one year (48 weeks) on weekly basis.

1.6. Hypothesis of the Study

In this study, the researcher has tried to test the following hypotheses:

1. Retailers react faster to farm price increases than decreases
2. Farm gate and retail prices are cointegrated
3. Producer price fluctuations Granger cause retail price fluctuations

1.7. Organization of the Paper

The remaining part of the thesis is organized as follows. Chapter two deals with the theoretical and empirical review of related literature. Chapter three is devoted to the methodology used in this study. The fourth chapter presents the findings of the study while the fifth chapter presents conclusion and recommendations drawn from the results of the study.

2. REVIEW OF LITERATURE

2.1. Price Transmission in Vegetable Marketing

Price transmission refers to the responsiveness of retail and whole sale prices to changes in farm gate prices. It can also be seen as change in output prices following change in input prices. Price transmission is some times divided in to two as vertical and special transmission. Vertical price transmission refers to a measure of fluctuations in output prices following changes in prices of inputs at different levels of marketing chain. Spatial price transmission on the other hand, occurs when comparison is made between prices of a given product at different locations or when change in price of a product in one location leads to a change in its price in other locations (Meyer and Cramon-Taubadel, 2004).

Price transmission could also be a perfect or an imperfect one. Perfect price transmission occurs when the initial change in farm gate or input prices are fully and immediately transmitted to change in output prices. Imperfect price transmission, on the other hand, exists when price changes at one end of the supply chain are not immediately and fully reflected at the other end and asymmetric price transmission is one case of imperfect price transmission (London Economics, 2003).

Asymmetric price transmission is a term used to explain the existence of unequal response to price changes at one end of the channel for price changes introduced at the other end of the channel. Asymmetry arises when retailers respond differently to a price decrease and a price increase.

Asymmetry of price adjustment can exist with respect to either magnitude or speed. A combination of these two is also possible. In the case of magnitude (Figure 1a), long-term elasticities of price transmission differ depending on the direction of the initial price change. This happens because input price P_{f_t} rise is moved more completely to output price p_{r_t} than the corresponding input price reduction. Accordingly, in the case of speed (Figure 1b), short-term elasticities are different. At the time of the input price rise, t_1, the output price responds immediately whereas the reaction to an input price drop takes n periods of time.

The transmission of producer price changes to consumer prices and vice versa depends greatly on the type of product. Products that are perishable and that undergo minimal processing, such as vegetables and fruits, are expected to have a relatively quick price transmission mechanism. Products that undergo a certain level of processing and are not perishable are expected to have a slower price transmission mechanism (Reziti and Panagopoulos, 2008).

It is commonly thought that price transmission between different stages in the market chain is not symmetric. That is, retailers and wholesalers do not respond equivalently to positive and negative price shocks (Reziti and Panagopoulos, 2008; Pelzman, 2000; Meyer and Cramon-Taubadel, 2004).

A number of studies have examined asymmetric price transmission in agricultural markets using different econometric methods. These studies have examined different products, geographic areas and time periods, with the majority of them focusing on the U.S. and U.K. economy and meat and dairy sectors (Reziti and Panagopoulos, 2008).

2.2. Causes of Asymmetric Price Transmission

Even though the literature identifies market structure and the presence of non-competitive behavior as the main cause for asymmetry in farm-retail price transmission (London Economics 2003), factors affecting price transmission can be classified in to three broad categories (Meyer and Cramon-Taubadel,2004). These are:

- Market power
- Adjustment and menu costs
- Miscellaneous

2.2.1. Market power

Regarding market power, conventional economic theory suggests that profit-maximizing firms in competitive markets should adjust their prices quickly and symmetrically to input cost decreases or increases. Agents generally may have unequal market power in a marketing and production channels. Some agents may behave as price makers while some other as price takers, depending on the degree of concentration of each industry (Conforti Peiro, 2004). Particularly, farmers at the beginning of the chain and consumers at the other end often believe that markets are characterized by imperfect competitions in the intermediate stages of the processing and this allows intermediaries to obtain "excess" profits (London Economics, 2003).

Market power will thus lead to positive asymmetry in an oligopolistic retail environment: cost increases will produce an immediate increase in output prices whereas cost decreases will not be instantaneously transmitted to price decreases because firms will maintain prices above the competitive level (Borestein et al., 1997).

2.2.2. Adjustment and menu costs

The second major explanation given for the existence of asymmetric price transmission is related to adjustment costs or menu costs that arise when firms change the quantities and/or prices of inputs and/or outputs. It includes the costs of labeling, advertising, or promoting goodwill which makes remarking of prices expensive. If these costs are asymmetric with respect to increases or decreases in quantities and/or prices, asymmetric price transmission can result or the reaction to a given rise in price might take place with lags.

2.2.3. Miscellaneous

A number of additional explanations for asymmetric price transmission have been proposed that cannot be categorized directly under market power or adjustment costs. The most dominant factors are government intervention, difference in economies of scale and accounting rules and inventory management.

According to Kinnucan and Forker (1987) government intervention can lead to asymmetric transmission. Processors and retailers may believe that a reduction in price may be temporary and may not respond to it since government might intervene through support prices. Processors and retailers will not react to a reduction in farm prices but they will quickly respond to increases in farm prices because they will believe it is more likely to be permanent.

Regarding economies of scale, Bailey & Brorsen (1989) argue that larger firms may benefit from economies of size in information gathering and this asymmetric information between competing firms can cause asymmetric price transmission.

Finally, accountancy rules and inventory valuation may cause sluggish price transmission. Balke et al., (1998) show that the FIFO accounting method can cause asymmetries in the price transmission. A firm which measures inventories by historical costs (FIFO or first-in-first-out) may not change output prices to cost changes immediately until the stock of inventories bought at old prices is depleted. On the contrary, when a firm values inventories through replacement cost criterion (LIFO or last-in-first-out), the firm's output prices will react much quicker to a cost change.

2.3. Granger Causality

Granger Causality is a limited notion of causality where past values of one series A are useful for predicting future values of another series B, after past values of *B* have been controlled for. Granger starts from the premise that the past can not cause the future or the present. If event A occurs after event B, we know that A can not cause B. at the same time if A occurs before B, it does not necessarily imply that A causes B. In effect in Granger causality test, we would like to know whether A precedes B, or B proceeds A, or they are contemporaneous. This is the purpose of Granger causality and it is not causality as it is commonly understood (Maddala, 1991)

2.4. Empirical Studies

There have been different conclusions implied by previous studies on price transmission in the sector of fresh vegetables. Studies done on price transmission of other commodities such as meet and oil in different countries also have found different conclusions.

The study by Hassan and Simioni (2001) tests the existence of and nature of asymmetry between shipping-point and retail prices for French tomato and chicory. The authors used weekly data of prices from the French Ministry of Agriculture, collected at different stages of the marketing channel (shipping, wholesaling, and retailing) and according to product variety and area of production.

Their major findings do not give evidence to the widespread assertion that middlemen with speculative behavior take advantage of price changes occurring at shipping point. In the majority of the cases (twenty-three cases), price transmission appears to be symmetric and they found only in seven relationships out of the total shipping-point and retail price relationships that shipping-point price increases are completely and rapidly passed on to consumers while there is a slower and less complete transmission of shipping-point price declines (Hassan and Simioni, 2001).

In another study Zachariasse and Bunte (2003) examined price transmission for potato products in the Netherlands. According to their findings, price transmission for Potato in the Netherlands follows negative asymmetric transmission were retailers respond to negative price shocks at the farm level (reduction in farm gate prices), but not positive price shocks which actually makes the farmers better off.

Other relevant studies include the study made by Worth in 2000 with an emphasis on examining the price transmission of celery, lettuce, onions, potatoes, carrots, and tomatoes between free-on-board shipping-point prices and retail prices. He used the monthly data from the National Agricultural Statistics Service at the USA for these six vegetables.

His results show no evidence of the existence of price asymmetry for the majority of the vegetables considered (i.e. celery, lettuce, onions, and potatoes). However, there seems to be some evidence that retail prices fluctuations show asymmetry to shipping-point price increases for carrots and tomatoes (Worth, 2000).

Ward (1982) did his study asymmetry in price transmission for various fresh produces in US and found some evidence of asymmetric price transmission. He concluded from his asymmetry tests that price decreases were more likely to be fully passed on to the retail and producer level sectors than were price increases. His result also suggested a long-run relationship between prices so that even if producer and consumer prices drift apart in the short-run, market forces return them to their long-run equilibrium.

Aguiar and Santana (2002) examined the nature of price transmission process for three groups of agricultural products in Brazil and compare their price transmission pattern with the patterns found in previous studies. They assume that price asymmetry has been empirically verified by several studies and wanted to examine if market concentration and product storability are important determinants.

In their study they showed that neither product storability nor market concentration were required for price increases to be more intensely transmitted than price decreases (Aguiar and Santana (2002).

Rezeiti and Panagopoulos did their study on price transmission mechanisms in Greek food sector in 2006 by using cointegration techniques. They considered three categories of goods (i.e. fruits, vegetables and the whole food sector). Their results indicate that a long-run relationship exists between producer and consumer for the aforementioned three markets and regarding the vegetables market the price transmission flows from the producer to the consumer and empirical results reject symmetric price transmission (Rezeiti and Panagopoulos, 2006).

In Ethiopia, there are no much work done on the nature of price transmission and the relationship between farm and retail or whole sale prices. The study about price transmission made by FAO in 2004 in seven countries which included Ethiopia is one among the few. It was based on a monthly price data. The study by FAO was based on some of the main staples, particularly maize and sorghum, together with a few other food crops, but excluded the main cash crops of the country, such as coffee (Conforti, 2004)

According to this study, monthly data resulted mostly in $I(1)$ series based on DF and ADF unit root tests. The Engle and Granger (1987) procedure indicated that co-integration is verified in four pairs of prices out of seven. Notably, a long equilibrium emerged between the wheat retail price and the corresponding world reference price, for the retail price of sorghum, and for both the retail and the producer prices of maize. No meaningful relation arose, instead, for sunflower seeds, bovine meat, and the rice retail price, rejecting both co-integration and tests for a long run equilibrium (Conforti, 2004).

Based on these results, the test for asymmetry was only performed for the maize and sorghum retail prices. Both products show a higher speed in the response of prices to positive price shocks, given that the coefficient of the model with the dummy variable is higher compared to the corresponding ones without it. . For maize, the producer price appears to react to changes in the world reference price with a four months delay, whereas two more months are required for the wholesale price. For wheat and sorghum, instead, transmission is faster, taking place within two and three months respectively (Ibid).

Similarly, a Granger non-causality tests were done by FAO and the results are non conclusive for wheat and for the producer price of maize, which appear not to be caused by the corresponding world reference price, whereas the world reference prices of maize and sorghum are Granger-causing the local retail prices for these products .

Alemu and Worarko did a study on price transmission of coffee from producer and auction, auction and FOB and producer and FOB prices using a threshold vector error correction model. The analysis was based on monthly nominal time series national price data which include producer price, auction price and world price ranging from October 1992 to September 2006. The data was obtained from the Central Statistical Agency and Agricultural Market Supporting Department in the Ministry of Agriculture and Rural Development, in Addis Ababa, Ethiopia.

According to the results of their study, there is a unidirectional transmission of shocks from the world price to the auction price and then to the producer price. In addition, it was found that there are asymmetries in price transmissions and adjustments in the auction market; weak interrelationship between producer and world prices causing producer price to be less responsive to changes in the world prices (Alemu and Worarko)

3. METHODOLOGY

3.1. Source of Data

Time series data on the producer prices and the selling prices of traders are essential for the analysis. Unfortunately, in most African countries the availability of time series price data is scarce or non–existent especially for vegetables. The researcher has got time series price data from CSA but found out that particularly the producer price is incomplete and is full of missing values. In this study time series producer and retailer price data for four vegetables, namely, potato, onion, tomato and cabbage which were collected by my advisor thrice a week for 48 weeks in the year 2005/06 with the sponsorship of Swedish International Development Agency (SIDA) were used. These data were collected from five producing districts selected from eastern Hararghie and eastern Shoa zones of Oromia regional state and three main consuming cities in Ethiopia. The districts covered by this study were Shashamane, Dugda Bora and Boset from eastern Shoa, and Haramaya and Kersa from eastern Hararghie. The surveyed consuming cities were Addis Ababa, Adama and Dire Dawa.

Shashamane district from eastern Shoa is well known for the production of potato and supplies a considerable volume of this product to Addis Ababa and Adama markets. Moreover, potato from Shashamane district may also be destined to Dire Dawa in case of seasonal supply deficit from Hararghie areas. Dugda Bora and Boset districts of eastern Shoa are well known for tomato and onion production and are main suppliers of these produce to all consuming cities. Haramaya and Kersa districts of eastern Hararghie are well known for the production of all of these vegetables and the produce from these areas are mainly destined to Djibouti market via Dire Dawa city.

The farm price used for this study is the weekly average of the mid-point of the three–day price range received by the farmer either at the wholesale marketplace or at the farm-gate after sorting and grading were conducted. It is the average of farm prices of the producing districts supplying to a given city. The retail price used in this study is the consumer price in the main cities.

Table 1: Summary of the Sources of Farm Prices for the three Cities

Items	Adama	Addis Ababa	Dire Dawa
Cabbage	Shashamane	Shashamane	Haramaya & Kersa
Onion	Bole & Meqi	Bole & Meqi	Haramaya & Kersa
Potato	Shashamane	Shashamane	Haramaya & Kersa
Tomato	Bole & Meqi	Bole & Meqi	Haramaya & Kersa

3.2. Method of Data Analysis

In this study, data was analyzed using both descriptive statistics and econometric methods. Descriptive analysis refers to the use of ratios, percentages, figures, charts, means and standard deviations. The econometric methods include ADF test for stationarity of farm and retail prices of the selected vegetables, test of cointegration, asymmetry of price transmission, and Granger causality test.

3.3. The Model of Asymmetric Price Transmission

To test the existence of asymmetric price transmission, there are a number of different methods available to the researcher. The choice of method depends on the data availability and the types of questions that need to be answered.

Von Cramon-Taubadel and Fahlbusch (1994) demonstrated that an asymmetric error correction model (ECM) based on the work of Granger and Lee 1989 could be used to test for asymmetric price transmission. Cramon-Taubadel and Loy (1999) extended this application of the asymmetric ECM and concluded that this method was more appropriate than the use of the conventional Houck approach if the price data under investigation were cointegrated.

In this study, the error correction model of Von Cramon-Taubadel (1998) was used to test for the existence of asymmetry in price transmission for fresh vegetables. This approach involves three important steps: the unit root test, the cointegration and asymmetry test.

3.3.1. The Unit Root Test

The unit root test is undertaken to know if weakly market prices are stationary or not based on the Augmented Dickey Fuller test (ADF test). This is done to pre test each variable and to determine its order of integration. Engle and Granger's approach of cointegration applies when the two time series data are integrated of order one. This test is done to avoid spurious regression.

If we express the two prices as an autoregressive process of order one as:

$$Pt^R = \alpha + \rho P^R{}_{t-1} + \varepsilon_t \quad \text{and} \quad Pt^F = \alpha + \delta P^F{}_{t-1} + \varepsilon_t \qquad \text{... (1)}$$

where ε_t is a white noise.

The Agumeted Dickey-Fuller test involves regressing the first difference of these price series on own lagged values and testing for stationarity or non-stationarity.

$$\Delta Pt^R = \alpha + \gamma P^R{}_{t-1} + \sum_{t-1}^{t} \Delta P_{t-1}{}^R + \varepsilon_t \qquad \text{and}$$

$$\Delta Pt^F = \alpha + \theta P^F{}_{t-1} + \sum_{t-1}^{t} \Delta P_{t-1}{}^F + \varepsilon_t$$

Where, $\gamma = \rho - 1$ and $\theta = \delta - 1$ ....(2)

The set of hypotheses is defined as:

H_o: $\gamma = 0$ for Retail price (i.e. RP series have a unit root or are non-stationary) and

H_o: $\theta = 0$ for farm price (i.e. FP series have a unit root or are non-stationary)

3.3.2. The Cointegration Test

The notion of cointegration makes regressions involving stationary variables potentially meaningful. The procedure that is employed to explore the existence of a long run relationship between farm and retail prices in this study was the Engle and Granger approach which was developed in 1987. Test of cointegration is important because it allows us to show the long run relationship between variables even if the series are non stationary individually in levels.

Cointegration test according to Engel and Granger approach involves three steps. These are:

1. Pre-testing the variables for their order of integration using DF and ADF tests
2. Estimating the econometric relationship between the variables in their levels i.e. developing a cointegrating equation using OLS

3. Testing whether the residuals from the cointegrating equations are stationary or not by using DF or ADF tests

The third step in the cointegration test follows from step two. It entails an ADF test for the stationarity of the residual from the cointegrating equation developed in step two. It involves an OLS regression of the first difference of the residual term on its one period lagged values and testing if the coefficient on the lagged term is statistically different from zero or not.

The null hypothesis in the cointegration test is that the residual terms from the cointegrating equation are stationary supporting a long run relationship between FP and RP. The alternative hypothesis states that the residuals from the cointegrating equation are not stationary or has unit root in which case there is no cointegration between FP and RP.

The cointegration test is done by using the Engle Granger approach. Since the estimated residuals are based on the estimated cointegrating parameter, the DF and ADF critical significance values are not quite appropriate. Engle and Granger have calculated these values, which can be found in the references. Therefore, the DF and ADF tests in the present context are known as Engle–Granger (EG) and augmented Engle–Granger (AEG) tests. However, several software packages now present these critical values along with other outputs (Gujarati, 2004, pp 823).

In general, this step involves estimation of a long run equilibrium relationship between retail and farm gate prices .Given that the two prices are both integrated of the same order, the long-run equilibrium relationship assuming P_t^F and P_t^R denote the observed farm and retail prices at time t, respectively, can be estimated as:

$$P_t^R = \beta_0 + \beta_1 P_t^F + U_t \quad \text{...} (3)$$

Where β_1 is the parameter to be estimated and Ut is the disturbance term which may be serially correlated. The cointegration test is done by regressing the residual on its own one-period lagged values and involves running the stationary test. OLS can be used to estimate ρ in the following relationship.

$$\Delta U_t = \rho U_{t-1} + \varepsilon_t \;, \quad \text{...} (4)$$

Where ε_t is a white noise

H_o: $\rho = 0$, unit root and not stationary (FP and RP are not cointegrated)

H_a: $\rho < 0$, stationary, and FP and RP are cointegrated

Since the residual values on Ut are not observed, the test is performed on the estimated residuals U_t^e

$$\Delta U^e{}_t = \rho U^e_{t-1} + +\varepsilon_t \quad \text{……………………………………….. (5)}$$

If the null hypothesis $\rho = 0$ is rejected in favor of the alternative hypothesis $-2 < \rho < 0$, we can conclude that the residual sequence U_t^e is stationary and that the two price series P_t^F and $P^R{}_t$ are cointegrated.

3.3.3. Developing an alternative specification for the price transmission process

The ‘‘Houck’’ approach of testing asymmetry in price transmission, which was developed by Houck (1977) , tests asymmetric price transmission based on the segmentation of price variables into increasing and decreasing phases. Houck’ model can be written as:

$$\Delta P^R{}_t = \alpha_0 + \alpha_1 \Delta P_t^{F+} + \alpha_2 \Delta P_t^{F-} + +\varepsilon_t \quad \text{……………………………..(6)}$$

Where P_t^R and P_t^F are retail and farm prices of the marketing chain, respectively, t_1,2,..T and Δ is the first difference operator. This approach implicitly assumes that changes in farm prices are drivers of changes in retail prices. In addition, it has not considered the inherent non stationarity of prices or long-run stationary equilibria (cointegration) relationships among prices (Capps and Sherwell 2007)

Regressions involving non-stationary variables often produce results that are spuriously significant, suggesting the existence of relationships that do not, in fact, exist. Since then, econometricians have developed tests for non-stationarity and methods for avoiding spurious regression that are generally known under the heading ‘cointegration analysis

If P^Rt and P^Ft are cointegrated, then, by the Engle-Granger Representation Theorem it is possible to develop an alternative specification for the price transmission process. Engle-Granger Representation Theorem says that if there is evidence of cointegration between two or more variables, a valid error correction term should exist between them. The Granger representation theorem, states that if two variables *Y* and *X* are cointegrated, then the relationship between the two can be expressed as ECM.

The cointegrating regression considers only the long-run property of the model, and does not deal with the short-run dynamics explicitly. Clearly, a good time series modelling should describe both short-run dynamics and the long-run equilibrium simultaneously. An ECM captures the short term dynamics in a model.

In general the Error Correction Model can be presented as:

$$\Delta P^R t = \alpha_o + \alpha_1 \Delta P^F t + \alpha_2 U_{t-1} + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(7)$$

Where:

- U_{t-1} is the Error Correction Term (ECT) or the lagged residuals from the cointegration equation

$$U_{t-1} = (P^R{}_{t-1} - \beta_0 - \beta_1 P^F{}_{t-1}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(8)$$

ECT measures short run deviations from the long run equilibrium. It also 'corrects' any deviations from the long run equilibrium that may be left over from previous periods. The error correction mechanism (ECM) developed by Engle and Granger is a means of reconciling the short-run behavior of an economic variable with its long-run behavior.

The procedure of testing for asymmetry requires the creation of dummy variable from the ECT where ECT+ measures the movement towards equilibrium by the RP when there is a negative shock to FP or a decrease in farm price and ECT- measures the movement towards equilibrium by the RP when there is a positive shock to FP or an increase in farm price.

Splitting the ECT into positive and negative components (i.e. positive and negative deviations from the long-term equilibrium as ECT^+ and ECT^- makes it possible to test for asymmetric price transmission according to Meyer and Von Cramon –Taubadel, 2004. Cramon-Taubadel and Loy (1999) extended the application of the asymmetric ECM and concluded that this method was more appropriate than the use of the conventional Houck approach if the price data under investigation were cointegrated.

When the ECT is positive, P^R_{t-1} is too high above its equilibrium value, so in order to restore equilibrium, $\triangle P^R_t$ must be negative. This intuitively means that the error correction coefficient must be negative such that the ECM is dynamically stable. In other words, if P^R_{t-1} is above its equilibrium, then it will start falling in the next period and the equilibrium error will be corrected in the model.

Alternatively, a negative ECT or a positive shock can be taken as a case where RP is very low relative to FP or when there is an increase in FP, ceteris paribus. On the other hand a negative shock or a positive ECT may indicate a case of very high RP relative to FP

The ECM, including lagged changes in the farm prices takes the following form:

$$\Delta P^R t = \alpha_o + \sum_{j=1}^{k} \alpha_j \Delta P^F{}_{t-j+1} + \Phi^+ ECT^+{}_{t-1} + \Phi^- ECT^-{}_{t-1} + \gamma_t \ldots\ldots\ldots\ldots\ldots(9)$$

The null hypothesis in the test for asymmetry is that the response by RP is the same whether the shock or the deviation is positive or negative in FP i.e. the coefficient of ECT+ and ECT- are not statistically different from each other.

In addition to forming a dummy variable on the ECT, the input price can be divided in to positive and negative components to allow for more complex dynamic effects.

Symmetric price transmission is rejected if $\Phi^+ and \Phi^-$ are significantly different from one another, which can be evaluated using an F-test. A Joint F-test is used to determine the symmetry or asymmetry of the price transmission process at a 0.05 significant level. In general, the test for the null and alternative hypothesis can be written as:

Ho: $\Phi^+ = \Phi^-$ (i.e. price transmission is symmetric)

Ha: $\Phi^+ \neq \Phi^-$ (i.e. price transmission is asymmetric)

3.4. The Granger Causality Test

In a regression of *Y* on other variables (including its own past values) if we include past or lagged values of *X* and it significantly improves the prediction of *Y*, then we can say that *X* (Granger) causes *Y*. Since the future cannot predict the past or cannot cause a change in the past, if variable *X* (Granger) causes variable *Y*, then changes in *X* should *precede* changes in *Y* (Gujarati 2004, pp 697)

To run the Granger causality test between farm price and retail price, a VAR model of RP and FP was developed and Wald statistic was used to see if there is causality between them. Alternatively, a joint F test has been also done to check for the presence of Granger causality. A simple Granger causality test involving the two variables, farm and retail price is written as:

$$Pt^{R} = \alpha_0 + \sum_{j=1}^{n}\theta_j P^{R}{}_{t-j} + \sum_{j=1}^{n}\partial_j P^{F}{}_{t-j} + u_t \quad \text{………………………}10\text{, and}$$

$$Pt^{F} = \alpha_0 + \sum_{j=1}^{n}\eta_j P^{R}{}_{t-j} + \sum_{j=1}^{n}\phi_j P^{F}{}_{t-j} + v_t \quad \text{……………………..…}11$$

The number of lags included in the regression is determined by using Akaike Information Criteria (AIC). It entails regressing the dependent variable on different number of lagged values and selection of lag lengths the produces the smallest AIC.

The null hypotheses to be tested are:

H_0: ∂_j = 0 for j=1, 2, 3,………………= n , for equation(10) which means that FP do not Granger cause RP

H_0: η_j = 0 for j=1, 2, 3…………………= n, for equation (11) which means that RP do not Granger cause FP

If a null hypothesis is rejected, it is possible to infer that farm price Granger causes retail price or vice versa. This shows the case of unidirectional causality between FP and RP. If none of the hypothesis is rejected, it means that farm price do not Granger cause retail price and retail price also do not Granger cause farm (farm) price. It indicates that the two variables are independent of each other. Finally, if we reject both null hypotheses, it indicates that FP Granger cause RP and RP also Granger cause FP. This is the case of Feedback or bilateral Granger causality between FP and RP (Gujarati, 2004).

4. RESULTS AND DISCUSSION

4.1. Descriptive Analysis

This section presents descriptive analysis of farm and retail price of all four vegetables. In markets where there are two farm prices, average values are used. Particularly, farm price of onion and tomato in Addis Ababa and Adama is the average of farm prices from Bole and Meki. Similarly, farm prices of all the four vegetables for Dire Dawa market are the average of farm prices from Kersa and Haramaya.

As shown in Table 2 the mean value of farm price of cabbage varies from a minimum value of Birr 19.75 in Shashamane to a maximum of Birr 65.43 in Haramaya. The average retail price of cabbage on the other hand reaches maximum in Dire Dawa with Birr 142 and minimum in Addis Ababa with Birr 121.

For onion, the average value of farm price varies from a minimum value of Birr 137.69 in Bole to a maximum of Birr 174 in Haramaya. The average retail price of onion reaches maximum in Dire Dawa market with Birr 290 and minimum in Addis Ababa with Birr 236.

Similarly, the average farm price of potato ranges from a minimum value of Birr 67.10 in Shashamane to a maximum of Birr 140 in Haramaya while the average retail price achieves its minimum value of Birr 170.28 in Adama and reaches a maximum value of Birr 207 in Dire Dawa

A summary of mean values of FP and RP for tomato are also included in Table 2. Producer price of tomato is minimum on average in Bole and maximum in Bole. The average retail price is minimum in Adama market and maximum in Dire Dawa market.

In general, retail price of all the four vegetables have been found to be high in Dire Dawa which could be probably due to the location disadvantage. Some of the produces may come to Dire Dawa from as far places as Adama which entails additional transportation costs and this might push the retail price upwards. On the contrary, both FP and RP are relatively low in Adama, Bole, Meki, and Shashamane probably due to location advantage since they are surrounded by several vegetable producers in all directions.

Table 2: Descriptive Statistics of Farm and Retail Prices

Producing district	Vegetable type	Farm prices (Birr/100kg)				Consuming city	Retail prices (Birr/100kg)			
		Mean	Std	Min	Max		Mean	Std	Min	Max
Shashamane	Potato	67.10	28.94	29.33	126.67	Addis Ababa	178.65	32.59	136	240
						Adama	170.28	39.84	100	266
	Cabbage	19.75	6.84	7.67	37.33	Addis Ababa	121.54	14.02	96	160
						Adama	129.48	27.02	67.67	160
Meki	Onion	146.12	42.60	53.33	231	Addis Ababa	236.15	35.13	175	320
						Adama	247.91	4.53	175	350
	Tomato	49.82	23.21	20	128.33	Addis Ababa	120.99	14.26	90	153.33
						Adama	118.89	34.85	51.67	230
Bole	Onion	137.69	41.24	55	225	Addis Ababa	236.15	35.13	175	320
						Adama	247.91	4.53	175	350
						Dire Dawa	290.66	46.48	216	392
	Tomato	46.85	17.57	22.5	90	Addis Ababa	120.99	14.26	90	153.33
						Adama	118.89	34.85	51.67	230
Haramaya	Potato	140.79	46.26	77	290	Dire Dawa	207.28	40.95	140	317
	Onion	174.15	50.88	86.25	285	Dire Dawa	290.66	46.48	216	392
	Tomato	76.60	23.63	42.5	133.5	Dire Dawa	142.20	35.04	100	227
	Cabbage	65.43	24.17	32.5	151.25	Dire Dawa	142.12	35.11	75.67	200
Kersa	Potato	136.55	32.90	83	200	Dire Dawa	207.28	40.95	140	317
	Onion	150.77	31.17	97	210	Dire Dawa	290.66	46.48	216	392
	Tomato	68.27	22.89	36	123	Dire Dawa	142.20	35.04	100	227
	Cabbage	42.21	12.47	25	80	Dire Dawa	142.12	35.11	75.67	200

4.2. Stationarity Tests

The first step in the analysis of cointegration and ECM is to test whether the concerned data series are stationary or not. ADF test was applied to the four vegetables from the three market places. This test was done to find out if the farm and retail prices are I (0) or I (1). The behavior of the data has been studied using time series graphs and was found to be a non stationary series without trend but with a drift.

Table 3: Augmented Dickey-Fuller test for a unit root (with a drift and no trend) for farm and retail price of Cabbage and the first difference in FP and RP

Vegetable	Adama	Addis Ababa	Dire Dawa
Intercept	**3.418**	**3.418**	**4.722**
	(1.770)	**(1.770)**	**(4.30)**
FP_{t-1}	**-0.177**	**-0.177**	**-0.069**
	(0. 085)	**(0. 085)**	**(0.078)**
P-value	**0.247**	**0.247**	**0.793**
L	**0**	**0**	**0**
Intercept	**20.276**	**37.941**	**50.709**
	(12.989)	**(12.278)**	**(16.301)**
RP_{t-1}	**0.152**	**- 0.307***	**- 0.351***
	(0.096)	**(0.101)**	**(0.111)**
P-value	**0.491**	**0.0304**	**0.023**
L	**4**	**0**	**0**
1^{st} Diff of $FP_{(t-1)}$	**-1.15**	**-1.15**	**-1.24**
	(0.149)	**(0.149)**	**(0.156)**
L	**0**	**0**	**0**
P-value	**0.000**	**0.000**	**0.000**
1^{st} Diff of $RP_{(t-1)}$	**-1.41**	**-1.243**	**-1.243**
	(0.337)	**(0.148)**	**(0.150)**
P-value	**0.001**	**0.000**	**0.000**
L	**4**	**0**	**0**

Critical values used in ADF test: 10%=-3.2056, 5%= -2.93, 1%= -3.58
L is lag length determined using AIC
* shows significane at 1%

Table 3 through Table 6 summarizes the stationarity test of FP and RP of all the four vegetables in the study are. Stationary test has also been carried out on the first differences of FP and RP to find the order of integration. At a 0.05 significance level, we fail to reject the null hypotheses of the existence of a unit root for the farm price of cabbage in the study areas.

For the retail price we needed a significance level (0.01) in Addis Ababa and Dire Dawa markets while it is non stationary in Adama at the usual significance level of 0.05. This implies that the two price series of cabbage are non stationary in levels in Adama, Addis Ababa, and Dire Dawa markets. Lag lengths in the dependent variables have been determined with the help of AIC.

To know the order of integration of cabbage stationarity test has been carried out on the first differences of FP and RP and the result shows that the hypothesis of non stationarity (unit root) is rejected even at 1% for all the cities. Hence farm and retail prices of cabbage are integrated of order one series i.e. I(1) in all cities.

Table 4: Augmented Dickey-Fuller test for a unit root (with a drift and no trend) for farm and retail price onion and the first differences in FP and RP

Vegetable	Adama	Addis Ababa	Dire Dawa
Intercept	**13.08**	**13.080**	**18.033**
	(8.339)	**(8.339)**	**(11.829)**
FP_{t-1}	**-0.094**	**-0.094**	**-0.11**
	(0. 056)	**(0. 056)**	**(0.071)**
P-value	**0.436**	**0.436**	**0.495**
L	**2**	**2**	**0**
Intercept	**22.246**	**57.55**	**51.688**
	(16.07)	**(23.764)**	**(33.535)**
RP_{t-1}	**- 0.090**	**-0.247**	**-0.174**
	(0.064)	**(0.099)**	**(0.113)**
L	**0**	**5**	**2**
P-value	**0.573**	**0.119**	**0.512**
1^{st} Diff of $FP_{(t-1)}$	**-0.647**	**-0.647**	**-1.173**
	(0 .196)	**(0 .196)**	**(0.149)**
L	**1**	**1**	**0**
P-value	**0.015**	**0.015**	**0.000**
1^{st} Diff of $RP_{(t-1)}$	**-0.944**	**-1.199**	**-1.718**
	(0.147)	**(0.269)**	**(0.216)**
P-value	**0.000**	**0.000**	**0.000**
L	**0**	**2**	**1**

Critical values used in ADF test: 10%=-3.2056, 5%= -2.93, 1%= -3.58
L is lag length determined using AIC

Similarly, Table 4 summarizes the results of the stationarity test of onion in the three cities. Using a significance level 0.05 for all cities, we fail to reject the null hypotheses of the existence of a unit root for both the farm and retail prices. This implies that the two price series are non stationary in levels.

To determine the order of integration of farm and retail prices of onion, stationarity test has been carried out on the first differences of FP and RP and the result shows that the hypothesis of non stationarity (unit root) is rejected in all market places. Hence farm and retail prices of onion are difference stationary and are integrated of order one series i.e. I (1) in all the cities.

Table 5: Augmented Dickey-Fuller test for a unit root (with a drift and no trend) for farm and retail price of potato and the first difference in FP and RP

Vegetable	Adama	Addis Ababa	Dire Dawa
Intercept	**4.825**	**4.825**	**15.207**
	(3.689)	**(3.689)**	**(9.736)**
FP_{t-1}	**-0.0726**	**-0.0726**	**-0.109**
	(0.05)	**(0.05)**	**(0.067)**
L	**2**	**2**	**0**
P-value	**0.55**	**0.55**	**0.475**
Intercept	**12.724**	**10.918**	**62.743**
	(13.231)	**(8.842)**	**(22.733)**
RP_{t-1}	**- 0.078**	**-0.0598**	**-0.302**
	(0.075)	**(0.049)**	**(0.107)**
L	**1**	**0**	**0**
P-value	**0.739**	**0.66**	**0.056**
$\triangle FP_{(t-1)}$	**-0.68**	**-0.68**	**-1.044**
	(0.206)	**(0.206)**	**(0.148)**
L	**1**	**1**	**0**
P-value	**0.015**	**0.015**	**0.000**
$\triangle RP_{(t-1)}$	**-1.31**	**-0.708**	**-1.315**
	(0.148)	**(0.210)**	**(0.142)**
L	**0**	**1**	**0**
P-value	**0.000**	**0.0118**	**0.000**

Critical values used in ADF test: 10%=-3.2056, 5%= -2.93, 1%= -3.58
L is lag length determined using AIC

Table 6: Augmented Dickey-Fuller test for a unit root (with a drift and no trend) for farm and retail price of tomato and the first difference in FP and RP

Vegetable	Adama	Addis Ababa	Dire Dawa
Intercept	**8.843**	**8.843**	**9.991**
	(4.221)	**(4.221)**	**(5.663)**
FP_{t-1}	**-0.172**	**-0.172**	**-0.123**
	(0. 081)	**(0. 081)**	**(0.076**
L	**0**	**0**	**0**
P-value	**0.24**	**0.24**	**0.471**
Intercept	**19.563**	**32.236**	**22.022**
	(8.506)	**(14.846)**	**(11.404)**
RP_{t-1}	**-0.147**	**-0.262**	**-0.147**
	(0.069)	**(0 .123)**	**(0.078)**
L	**0**	**2**	**0**
p-value	**0.236**	**0.234**	**0.339**
$\triangle FP_{(t-1)}$	**-1.052**	**-1.052**	**-1.312**
	(0.150)	**(0.150)**	**(0.205)**
L	**0**	**0**	**1**
P-value	**0.000**	**0.000**	**0.000**
$\triangle RP_{(t-1)}$	**-1.024**	**-1.280**	**-1.018**
	(0.151)	**(0.182)**	**(0.151)**
L	**0**	**1**	**0**
P-value	**0.000**	**0.000**	**0.000**

Critical values used in ADF test: 10%=-3.2056, 5%= -2.93, 1%= -3.58
L is lag length determined using AIC

A similar analysis was carried out to see if potato and tomato price series show the same behavior. As shown in Table 5 using a significance level 0.05, we fail to reject the null hypotheses of the existence of a unit root for both farm and retail prices of potato and hence potato price series has a unit root while the first difference in FP and RP of potato is stationary.

Finally, Table 6 presents a summary of the results of the stationarity test of tomato in the three cities. We fail to reject the null hypothesis of the existence of a unit root for both the farm and retail prices in all market places at a 0.05 significance level. Hence the two price series are non stationary in levels.

Alternatively, OLS regressions of RP on FP for all vegetables in all the three cities have been carried out to see if the regression of RP on FP in levels is meaningful. The regression of RP on FP for the four vegetables in the entire market places have shown a Durbin Watson (d) test statistic which was very small and sometimes even less than the R-squared showing a possibility of a spurious regression between RP and FP (Annex: 2).

A linear regression of RP on farm price for all items in Adama seems to the support the case of spurious or non sense regression. The D-W d-statistic was found to be very low or less than unity except for onion. These results show that the relationship generated by an OLS regression between RP and FP is meaningless unless FP and RP are found to be cointegrated.

An OLS regression of RP on FP of the four items results in a similar conclusion in Addis Ababa and Dire Dawa markets. For all the four vegetables a D W d-statistic was very small and cointegration test should be done to say something about the usefulness of these coefficients.

Given such a low level of d-w test statistic for variables most of which have been known to be price series of integrated of order one, the next step is to go for the cointegration test. If the price series are found to be cointegrated, these relationships which seem to be spurious regression are interpreted as a long run relationship between the price series.

An OLS regression of the first difference of RP on first difference of FP has been done for all the four vegetables and the result shows that the regression is not spurious since the first differences of FP and RP have been found to be stationary for all items.

As shown in Annex 3, the D W d-statistic of the regression of the first difference of RP on first difference of FP for all vegetables is close to two in Adama. This shows that the regression is not spurious.

The D W d-statistic of the regression of the first difference of RP on FP for all vegetables in Addis Ababa and Dire Dawa is also close to two. These results support the absence of spurious regression since the first differences are all stationary.

In general, though farm and retail prices are non stationary in levels, their first differences have been found to be stationary. Stationarity test has been carried out on the first differences of the four vegetables in order to know the degree of integration of the price series. The results show that, the hypothesis of non stationarity (unit root) is rejected at 0.05 significance level for the first differences of RP and FP in all the three cities. Hence Farm and retail prices of all the four items (Cabbage, Onion, Potato, and Tomato) are integrated of order one series i.e. I (1) in the study area.

4.3 Tests of Cointegration

In this study, the first two steps required to analyze cointegration have been already accomplished under tests of stationarity. It has been found out that farm and retail prices of all items are integrated of order one series or are difference stationary series. The next step is to test for the stationarity of the residuals from the cointegrating equations. A regression of RP on FP is probably a spurious regression unless the residual is found to be stationary. When variables are cointegrated, the regression of one on the other tells us some thing about their long run relationship than a short run relationship

Tables 7, 8, 9 and10 below show the results of the cointegration test between RP and FP for all items in the three markets. As indicated in Table 7, ADF test of the residuals for cabbage from the cointegrating equation shows that the residuals are stationary or I (0) for all consuming cities at a 0.05 significance level. The null hypothesis of no cointegration is rejected in all cases with a small p-value and long run relationship was established. A DW d-test statistic close to two (not shown in the tables) implies that these regressions are not spurious. Hence FP and RP are cointegrated and the coefficients of the cointegrating equations show long run relationships between FP and RP. The R-squared values were found to be relatively small (not shown here) for all items and this might be because of the fact that we are working with differences in the residual terms not in levels. Lag lengths are determined with the help of AIC in all cases.

Table 8 presents cointegration test result for onion from the three consuming cities while Table 9 shows cointegration test results for the potato. The null hypothesis of no cointegration is rejected in all cases (the p-value is nearly zero) for both items. The cointegrating equation shows that the residuals are stationary or I (0) for all vegetables at a 0.05 significance level. Hence FP and RP are cointegrated and the coefficients of the cointegrating equation can be interpreted as values showing a long run relationship between FP and RP. Values in parenthesis are the standard errors of the corresponding variable estimates.

Table 7: Results of the Cointegration test between Weekly Retail Prices and Farm Prices (without a drift) for Cabbage

Variables	Adama	Addis	Dire Dawa
Lagged value of the residual (Uhatlg)	**-0.407 (0.148)**	**-0.321 (0. 102)**	**-0.499 (0.128)**
L	**4**	**0**	**0**
P-value	**0.009**	**0.003**	**0.000**
Result	**Cointegration**	**Cointegration**	**Cointegration**

L shows no of lags of the dependent variable (△residual) included based on AIC

Table 8: Results of the Cointegration test between Weekly Retail Prices and Farm Prices (without a drift) for Onion

Variables	Adama	Addis	Dire Dawa
Lagged value of the residual (Uhatlg)	**-0.561 (0. 129)**	**- 0.604 (0.250)**	**-0.7461 (0.235)**
L	**0**	**3**	**2**
p-value	**0.000**	**0.02**	**0.003**
Result	**Cointegration**	**Cointegration**	**Cointegration**

L shows number of lags of the dependent variable (△residual) included based on AIC

Table 9: Results of the Cointegration test between Weekly Retail Prices and Farm Prices (without a drift) for Potato

Variables	Adama	Addis	Dire Dawa
Lagged value of the residual (Uhatlg)	**-0.394 (0. 115)**	**-0.466 (0.120)**	**-0.697 (0. 168)**
L	**0**	**0**	**1**
P-value	**0.001**	**0.000**	**0.000**
Result	**Cointegration**	**Cointegration**	**Cointegration**

L shows number of lags of the dependent variable (△residual) included based on AIC

Table 10: Results of the Cointegration test between Weekly Retail Prices and Farm Prices (without a drift) for Tomato

Variables	Adama	Addis	Dire Dawa
Lagged value of the residual (Uhatlg)	**-0.431** **(0.116)**	**-0.584** **(0. 186)**	**-0.582** **(0. 135)**
L	**0**	**3**	**0**
P-value	**0.001**	**0.003**	**0.000**
Result	**Cointegration**	**Cointegration**	**Cointegration**

L shows number of lags of the dependent variable (△residual) included based on AIC

The final step in cointegration analysis is to develop an Error Correction Model (ECM) based on the Granger Representation Theorem.

In this study, an error correction model of the form given in equation (7) has been estimated. The error correction terms are found to be significant for all vegetables in Adama and ranges from a minimum of about 25% for cabbage to 58% of onion (Annex: 4). This result shows that RP of onion moves back towards equilibrium by 58% following a deviation from long run equilibrium one week later while RP of cabbage moves back only by 25%. Similarly, RP of potato and tomato moves back towards equilibrium by 38% and 31%, respectively one week later after the shock to the model or a change in producer price.

The error correction terms are also significant for all vegetables in Addis Ababa and show a relatively better move back towards long run equilibrium due to short term fluctuations in FP. The maximum value for the short term adjustment in Addis Ababa is 67% movement back towards equilibrium by the RP for onion following a shock to the model one week later while RP of cabbage shows the smallest percentage movement back towards equilibrium which is about 30%.

The short term dynamics of the RP of the selected vegetables from Dire Dawa are also shown in Annex 4. In Dire Dawa market, potato shows the maximum percentage movement back towards the equilibrium one week later which is 67% while tomato shows the minimum percentage of about 43%.

In general, RP of onion shows strong movement back towards equilibrium in all the three cities while cabbage has the minimum percentage movement.

4.4. Tests of Asymmetry of Price Transmission

Empirically, asymmetry was tested by incorporating lagged values of farm prices of the vegetables. The lag structure was determined using AIC. AIC have been calculated for a maximum of 10 lags which accounts for over 20% of the observation period. In addition to lagged values of FP, the researcher has also incorporated lagged values of RP and found out that the conclusion is generally the same (not presented here) though coefficients and lag lengths might slightly differ for some items. Results with inclusion of lagged values of the retail prices are not shown here for simplicity.

Table 11 shows a summary of the results of asymmetry test, lag lengths and coefficients along with their p-value, AIC, R^2, Durban-Watson (d) statistic and the F statistic of cabbage in all the three cities. For cabbage, retail price responds asymmetrically to shock in farm price in all the market places. According to the findings of this study, the retail price of cabbage responds asymmetrically to positive shock in farm price in Adama that seems to squeeze the profit of retailers than to negative shock. The coefficient of the negative shock was found to be insignificant showing negligible response by retailers to negative shock (decrease) in farm price. That is, at a 0.05 significance level, we reject the null hypothesis of symmetric price transmission for cabbage since the coefficient of the negative shock (decrease in farm price) is insignificant.

A similar result has been observed for cabbage in Dire Dawa market. Retail price of cabbage is more sensitive to positive shocks in farm prices than negative shocks. Retailers respond more rapidly to an increase in farm prices relative to retail prices than they do for decreases in farm prices of cabbage in Dire Dawa.

These results of asymmetry test for cabbage in Adama and Dire Dawa show that increase in producer prices which results in reduction of the marketing margin appeared to be passed on to retail prices faster than producer price reductions.

In Addis Ababa, retailers are also found to respond asymmetrically to shocks in farm prices of cabbage relative to retail prices though in this market the result seems to benefit producers. In this market, retailers respond to negative price shocks at the farm level (reduction in farm gate prices) which is captured by the coefficient of the positive error term. Farm price decreases are more likely to be fully passed on to retail prices than price increases. This could be the case since retailers may not take the risk of a decrease in demand when there is an increase in retail price following an increase in farm price since the item under investigation loses its freshness in a day or two or can not be stored for long.

Table 12 shows a test of the nature of retail price transmission of onion in Adama, Addis Ababa, and Dire Dawa markets. In all the three consuming cities, we reject the null hypothesis of symmetric price transmission for onion. The joint F test shows that price transmission is asymmetric in all the cities.

In all cases for onion, farm price decreases (negative shocks) were found to be more likely to be fully passed on to retail prices than price increases which does not support the widespread assertion of exploitation by middle men in vegetable marketing. Retailers are found to respond to changes in farm prices when there is reduction in producer prices. This is the case where retailers adjust their price faster to reductions in producer price than increases and this behavior of retailers seems to benefit both consumers and producers. Consumers are not punished by higher retail prices of onion every time farm price increases but are given frequent reductions in RP when farm price of onion goes down. Given the fact that FP of onion precedes RP in the consuming cities, except in Dire Dawa where there is bilateral causality, (see the Granger causality test results below), the responsiveness of the retailers to alternative shocks in FP benefit both consumers and producers.

The asymmetry test for potato in all the three cities (Table 13) shows that retail price responds asymmetrically to positive and negative shocks to farm prices. After including appropriate lag lengths of FP, fluctuations in RP have bee found to be asymmetric. In Addis Ababa and Adama markets, retailers respond faster to an increase in farm prices than reductions in farm prices while the opposite is true in Dire Dawa market. The results in Adama and Addis Ababa supports the general case of exploitation by middle men in vegetable marketing since retail price does follow producer price increase than decrease. A relatively small D W d- statistic could be due to the fact that the variables are analyzed in differences not in level forms.

Finally, as shown in Table 14 retailers are more sensitive to farm price reductions for tomato in Addis Ababa and Dire Dawa than producer price increases and more to producer price increases in Adama market. The nature of asymmetry in Dire Dawa and Addis Ababa markets could be explained by the perishability or a small shelf life of tomato. This idea of perishability of vegetables has been forwarded by Ward (1982) as the major source of negative asymmetry. Generally price transmission is asymmetric for tomato in all markets places as it is for the remaining three items.

Table 11: Results of Asymmetric Price Transmission Test for Cabbage

	Adama	Addis Ababa	Dire Dawa
Intercept	- 6.018[a] (3.877) [b]	2.226 (2.481)	- 4.208 (7.259)
ΔFP_{t-1}	- 0.0234 (0.463)	- 0.0941 (0.3624)	- 0.1106 (0.505)
ΔFP_{t-2}	0.0297 (0 .468)	_____	____
ΔFP_{t-3}	- 0.331 (0.453)	_____	_____
ΔFP_{t-4}	_____	_____	____
ECT^{+}_{t-1}	0.1067 (0.235)	- 0.4403* (0.1811)	- 0.2378 (0.249)
ECT^{-}_{t-1}	-1.010 * (0.235)	-0.1649 (0.261)	-0.70197* (0.286)
R^2	0.4102	0.202	0.235
DW	1.767	2.198	2.013
F statistic	18.42	5.91	6.03
AIC	7.968	7.477	9.499

[a] Parameter value
[b] standard error
* shows significance at 0.05 level

Table 12: Results of the Asymmetric Price Transmission Test for Onion

	Adama	Addis Ababa	Dire Dawa
Intercept	0.9515[a] (3.755) [b]	0.8121 (5.1336)	5.398 (7.327)
ΔFP_{t-1}	0.3040 (0.1837)	0.33712 (0.1824)	-0.314 (0.265)
ΔFP_{t-2}	_____	0.2724 (0.1894)	_____
ΔFP_{t-3}	____	-0.0577 (0.1896)	_____
$ECT^{+}{}_{t-1}$	-0.5173 * (0 .236)	-0.6697* (0.3687)	-0.7874* (0.286)
$ECT^{-}{}_{t-1}$	-0.3457 (0.2537)	- 0.5151 (0.4141)	-0.404 (0.2667)
R^2	0.3689	0.2920	0.2984
DW	2.007	2.077	1.7762
F statistic	4.81	3.30	7.60
AIC	8.4379	8.673	9.675

[a] Parameter value
[b] standard error
* shows significance at 0.05 level

Table 13: Results for the Test of Asymmetric Price Transmission for Potato

	Adama	Addis Ababa	Dire Dawa
Intercept	-7.2217[a] (4.6817) [b]	-1.3267 (2.1996)	2.468 (7.452)
ΔFP_{t-1}	-0.1657 (0.2799)	0.05346 (0.1695)	- 0.08437 (0.2461)
ΔFP_{t-2}	____	0.1843 (0.1518)	_____
ΔFP_{t-3}	____	0.3570 (0.1445)	_____
ΔFP_{t-4}	____	- 0.3692 (0.1412)	_____
$ECT^{+}{}_{t-1}$	- 0.0321 (0.2285)	- 0.2140 (0.1958)	- 0.7360* (0.359)
$ECT^{-}{}_{t-1}$	- 0.77195* (0.248)	- 0.5006* (0.2247)	-0.4425 (0.331)
R^2	0.2429	0.5249	0.220
DW	1.87	1.7624	2.062
F statistic	9.69	4.96	4.20
AIC	8.698	7.237	8.546

[a] Parameter value
[b] standard error
* shows significance at 0.05 level

Table 14: Results for the Test of Asymmetric Price Transmission for Tomato

	Adama	Addis Ababa	Dire Dawa
Intercept	-5.7097[a]	1.1087	2.6258
	(4.166) [b]	(2.616)	(4.3637)
ΔFP_{t-1}	- 0.4070	0.0306	0.3550
	(0.2194)	(0.1377)	(0.2622)
ECT^{+}_{t-1}	0.3233	- 0.6315*	- 0.480*
	(0.2343)	(0.2781)	(0.1924)
ECT^{-}_{t-1}	-0.7991*	- 0.3438	- 0.2546
	(0.3121)	(0.249)	(0.3339)
R^2	0.1669	0.2484	0.3106
DW	1.7398	1.4858	1.774
F statistic	6.55	5.15	6.22
AIC	8.4846	7.5747	8.546

[a] Parameter value
[b] standard error
* shows significance at 0.05 level

4.5. The Granger Causality Test

Table 15 shows a summary of the Granger causality test in Adama. Granger causality was accepted for all items although the direction of causation varies. For cabbage and tomato, Granger causality was found to run from retail price towards farm price. This implies that retail prices precede farm prices for cabbage and tomato in Adama. For potato there is bilateral or bidirectional causality between FP and RP. We reject the null hypothesis of no causality for potato in both directions (i.e. from FP to RP and vice versa). This result shows that the direction of causation sometimes runs from RP to FP and from FP to RP at other times. For onion farm price has been found to Granger cause retail price. Therefore, in Adama market, RP seems to predominantly precede FP for the majority of the items under investigation.

As shown in Table 16, in Addis Ababa, the result of causality test was inconclusive. FP was found to Granger cause RP for both onion and potato while there was no Granger causality between FP and RP for cabbage and tomato. For cabbage and tomato we fail to reject the null hypothesis of no Granger causality between farm and retail prices. Therefore, FP and RP do not Granger cause each other. Absence of causality could be due to the long distance that prevails between farm market and retail price locations (between Shashamane and Addis Ababa for example), a bulk of productions of cabbage and tomato sold in Addis Ababa market from other sources or to measurement error.

Table 15: Results for Granger Causality Test from Adama [a]

H_0	Wald Stat	Lag(L)	Eigen value stability condition	Lagrange multiplier test	Result
FP of Cabbage does not cause RP	1.59	1	VAR is stable	No autocorrelation	No Causation
RP of Cabbage does not cause FP	3.01**	1	VAR is stable	No autocorrelation	Causation
FP of Onion does not cause RP	21.19*	1	VAR is stable	No autocorrelation	Causation
RP of Onion does not cause FP	0.012	1	VAR is stable	No autocorrelation	No Causation
FP of Potato does not cause RP	6.38**	3	VAR is stable	No autocorrelation	Causation
RP of Potato does not cause FP	11.90*	3	VAR is stable	No autocorrelation	Causation
FP of Tomato does not cause RP	0.082	1	VAR is stable	No autocorrelation	No Causation
RP of Tomato does not cause FP	7.36*	1	VAR is stable	No autocorrelation	Causation

[a] The null hypothesis is that one series does not Granger cause another

[b] lag length (L) of both FP and RP are determined using AIC

* indicates statistical significance at 0.05 level

** indicates statistical significance at 0.1 level

Table 16: Results for Granger Causality Test from Addis Ababa [a]

H_0	Wald Stat	Lag(L)	Eigen value stability condition	Lagrange multiplier test	Result
FP of Cabbage does not cause RP	1.71	1	VAR is stable	No autocorrelation	No Causation
RP of Cabbage does not cause FP	0.135	1	VAR is stable	No autocorrelation	No Causation
FP of Onion does not cause RP	7.067 *	1	VAR is stable	No autocorrelation	Causation
RP of Onion does not cause FP	0.378	1	VAR is stable	No autocorrelation	No Causation
FP of Potato does not cause RP	49.46*	5	VAR is stable	No autocorrelation	Causation
RP of Potato does not cause FP	4.89	5	VAR is stable	No autocorrelation	No Causation
FP of Tomato does not cause RP	3.16	3	VAR is stable	No autocorrelation	No Causation
RP of Tomato does not cause FP	0.572	3	VAR is stable	No autocorrelation	No Causation

[a] The null hypothesis is that one series does not Granger cause another.

[b] lag length (L) of both FP and RP are determined using AIC

* indicates statistical significance at 0.05 level

Table 17: Results for Granger Causality Test from Dire Dawa [a]

H_0	Wald Stat	Lag(L)	Eigen value stability condition	Lagrange multiplier test	Result
FP of Cabbage does not cause RP	1.80	1	VAR is stable	No autocorrelation	No causation
RP of Cabbage does not cause FP	3.53**	1	VAR is stable	No autocorrelation	Causation
FP of Onion does not cause RP	8.48 *	1	VAR is stable	No autocorrelation	Causation
RP of Onion does not cause FP	16.59*	1	VAR is stable	No autocorrelation	Causation
FP of Potato does not cause RP	4.92*	1	VAR is stable	No autocorrelation	Causation
RP of Potato does not cause FP	0.839	1	VAR is stable	No autocorrelation	No Causation
FP of Tomato does not cause RP	13.89*	1	VAR is stable	No autocorrelation	Causation
RP of Tomato does not cause FP	1.17	1	VAR is stable	No autocorrelation	No Causation

[a] The null hypothesis is that one series does not Granger cause another

[b] lag length (L) of both FP and RP are determined using AIC

*   indicates statistical significance at 0.05 level
** indicates statistical significance at 0.1 level

As shown in Table 17, in Dire Dawa, retail price was found to Granger cause farm price for cabbage while there is bilateral causality between FP and RP for onion. The direction of causality runs from FP towards RP for tomato and potato in Dire Dawa

In summary, the Granger causality test of Cabbage exhibits different results in the three cities. The result shows that there is Granger causality running from RP towards FP in Adama and Dire Dawa markets while there was no causality in Addis Ababa. The Granger causality test for onion shows that FP Granger causes RP in Adama and Addis Ababa while there is bilateral causality is Dire Dawa. There is bilateral causality in Adama, no causality in Addis Ababa and causality running from FP towards RP in Dire Dawa for potato. Finally, for tomato, the Granger causality Wald test shows that there is no causation in Addis Ababa, causation running from FP towards RP in Dire Dawa and from RP towards FP in Adama.

In general, farm prices have been found to Granger cause retail prices in some instances and retail prices have been also shown to Granger cause farm prices in others. There have been also two cases of bilateral causality where Granger causation runs in both directions from FP to RP and vice versa. These are for potato and onion in Adama and in Dire Dawa, respectively. In Addis Ababa market, we fail to reject the null hypothesis of no causality for cabbage and tomato. This might be due to the fact that this market has a number of other alternative suppliers from other places and the current sources are relatively far from Addis Ababa market (Shashamane for potato and Meki and Bole for tomato) or a measurement error.

In addition to running the all tests mentioned above from secondary data, the researcher has also made personal observations of the marketing mechanisms in two of the three consuming cities (Adama and Addis Ababa) and in two production areas (Bole and Meki) to supplement the results.

Producers predominantly sell their produce on the field through the help of brokers. It was found that there is limited opportunity for farmers to directly sell their produce to final consumers due to the prevalence of market imperfections in this market. Even in the “Atikilt Tera” market which is located in Piazza and is the largest open market for vegetables in

Ethiopia, producers are systematically discouraged from selling directly to consumers through the informal network established by the few dominant wholesalers. According to some vegetable growers in the study area, it is also difficult for them to compete with such big wholesalers in the marketing of their produce and to even sell their output to wholesalers directly without the involvement of the brokers as intermediaries.

In terms or order of occurrence, at the farm gate it seems that the RP precedes the FP in several instances since retails negotiate on producer price by telling producers the latest retail prices that prevail in the corresponding consuming cities. Sometimes they are quoted as saying, "the retail price has now gone down in cities, and we can not purchase your produce at the amount you are asking." This could be taken as a case where RP Granger causes or lead FP. Amazingly, the behavior of the retailers change when they are back in cities. For an increase in retail prices they commonly link it to a prior increase in produce prices at the farm gate markets saying ''the farm prices of the items have increased and that is why retail prices have gone up" which might be taken as a case where FP Granger causes or precede RP. The producers also try to know the latest RP for their item before concluding the deal on price negotiations which again indicate the precedence of RP in vegetable marketing but the fact that most of the vegetables they grow are perishable limits the negotiation power of the growers. From the causality test results, in more than half of the cases, including bilateral causality cases, producer prices have been found to precede retail prices.

The implication of all these complications in vegetable marketing is that there are possibilities for exploitation of the farmer due to market imperfections leading to unequal market power and asymmetric information.

5. SUMMURY, CONCLUSIONS, AND RECOMMENDATIONS

5.1. SUMMURY AND CONCLUSIONS

The main theme of this thesis was to test the nature of price transmission mechanism in vegetable marketing and to explore the direction of Granger causality between farm and retail prices of selected items in central and eastern Ethiopia. In addition, it also tries to show if farm and retail prices are cointegrated or if there is a long run relationship between farm and retail price for the selected vegetables. More specifically, this study explores the responsiveness of retail prices to fluctuations in farm prices for cabbage, onion, potato, and tomato using a weekly data of 48 weeks. The analysis was done using Engel-Granger approach for cointegration, an ECM for the asymmetry test and Granger causality Wald test for the Granger causality test.

Empirical results show that farm and retail prices are cointegrated. Farm and retail prices of all items in all the three cities are found to have a long run relationship. Individually farm and retail prices are non stationary in levels but their first difference have been shown to be stationary and regressing RP on FP is meaningful and shows long run relationship between them. An ECM was also developed to analyze the rate at which RP moves back to wards equilibrium following a shock to FP one period later.

The cointegration analysis shows that even though the magnitude at which RP moves back towards equilibrium varies from place to place and from item to item, the coefficient of the ECT is found to be statistically different from zero.

The empirical result in this study shows that price adjustment in RP is asymmetric for all items in all market places. It is difficult to draw definite generalizations regarding the type of asymmetry in price transmission i.e. whether price transmission predominantly follows negative or positive asymmetry. There is no uniformity in the asymmetry across the market places for all items except for onion.

For onion, a decrease in producer price is found to be passed on to retail prices faster than increases in producer prices in all market places. For onion price transmission is asymmetric in favor of price reductions in farm prices or there is negative asymmetry for onion which could be at the advantage of producers and consumers. For the other three items, RP responds differently to reductions and rises in producer prices in different market places. For example, asymmetry is in favor of price rise for cabbage in Adama and Dire Dawa while it supports farm price decline in Addis Ababa. For potato, the error correction term is statistically significant for a rise in producer price in Adama and Addis Ababa markets but statistically insignificant in Dire Dawa market. There is negative asymmetric price transmission for tomato in Addis Ababa and Dire Dawa but a positive asymmetry in Adama.

The Granger causality test results indicate the existence of a Granger–causality relationship running from FP to RP in some cases and from RP towards FP for others or both in some few cases. The study also showed that there is no Granger causality between FP and RP in Addis Ababa market for two items.

Retail price of cabbage are found to Granger cause producer price in Adama and Dire Dawa markets while the Addis Ababa market shows no Granger causality. For onion, except in Dire Dawa, where there is bilateral causality between FP and RP, farm prices are found to Granger cause retail prices. With the exception of Adama, where there is bilateral causality between FP and RP for potato, producer price seems to precede retail price in Addis Ababa and Dire Dawa markets.

The Granger causality test of tomato exhibits different results in the three cities. The result shows that there is no causality between FP and RP in Addis Ababa, causality running from RP towards FP in Adama and causality running from FP towards RP in Dire Dawa.

5.2. RECOMMENDATIONS

In this study, tests of stationarity, cointegration, asymmetry in price transmission and Granger causality between FP and RP has been done.

Price transmission between farm and retail prices has shown asymmetry in all cases and may benefit producers and consumers in case of negative asymmetry. Interventions to control price fluctuations and determinations which are not based on information on the nature of price transmission might lead to a bad outcome.

Even though, price transmission has shown asymmetry in all cases, the result of this study shows that it is not clear as to the dominant type of asymmetry in vegetable marketing in Central and Eastern Ethiopia (a choice between negative or positive asymmetry). Further study on the subject matter with broad geographical and item coverage and a different methodology could be essential to shape the knowledge on the nature of price transmission in vegetable marketing in Ethiopia in general.

The Granger causality test result in this study was inconclusive as to the directions of the causality between FP and RP. The study shows that FP precedes RP in more than half of the cases (incorporating the bilateral causality cases) and RP precedes FP in Adama and Dire Dawa markets for some items.

Based on causality test results, it is possible to forward two things. Firstly, further study is recommended to generalize the results for other similar markets and items and to find out explanations for no Granger causality for cabbage and tomato in Addis Ababa market. Secondly, it is good to have a meaningful surveillance and follow up of the market behavior and the price determination process in market places where FP precedes RP. The appearance of FP before RP could open a room for exploitation by intermediaries or retailers owing to the bulkiness of vegetable production and the problem of storing most of them for a long period of time.

Expansion of market opportunities for vegetable growers and reduction of market power of few wholesalers is also very crucial for faire distribution of the return from vegetable production and marketing. Expansion and support for producer cooperatives could increase the market power of the growers and could limit that of the intermediaries.

Modernizing the marketing system of vegetables could help in this regard. The inauguration of the Ethiopian Commodity Exchange (ECX) by the government is a good beginning and should be further supported to incorporate pricing of vegetables in its marketing networks.

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