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Transactions Costs and Spatial Integration of Vegetable and Fruit Market in Ethiopia

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Abstract

This paper analyzes transaction costs and spatial market integration of vegetable and fruit markets between major surplus producing zones and the Addis Ababa retail market taking onions, potatoes, and tomatoes from vegetables and root crops and bananas from fruits. Monthly retail price data from the Central Statistical Agency (CSA) from October 2008 to August 2015 was considered for the research. All retail price series from Addis Ababa and 21 zonal retail markets were transformed into natural logarithms in order to mitigate the fluctuation of individual series and to ease interpretation of the coefficients. The presence of long run relationship between two groups of markets is examined using a test for cointegration based on maximum likelihood approach developed by Johansen and Jesulus (1990). The dynamics of short-run price responses are explored using the vector error correction model (VECM). The result indicated that there is strong support for the presence of long run relationship between the surplus producing zonal vegetables and fruit markets and the Addis Ababa market. Although these markets responded positively for the long-run cointegrating relationship, the speed of price adjustment was found to the modest. A shock in Addis Ababa retail market took, on average, between 3 to 7 months to be fully absorbed in the surplus producing zonal markets. To increase the efficiency of vegetable and fruit markets, there is therefore a need to focus on reducing transaction costs related to transport, improving market information flow, removal of any sort of entry barriers, and introducing enhanced processing and storage technologies to extend shelf life and ensure producers to obtain a reasonable share of retail prices.

Key Words: Transaction costs, vegetable and fruit, retail markets, spatial integration
JEL Classification: M31

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1. Introduction

Markets play a dominant role in the process of any national economic development in general and agricultural sector transformation in particular through facilitating the exchange of goods and services and enhancing welfare for actors engaged in the chain. Markets provide signals about the true cost of resources and guide allocation to their best use. In addition to signals about the value of resources, the market influences the direction of decisions of production to more profitable choices. Integrated markets could help in equalizing the value of a resource across space after accounting for transfer costs between markets (Baulch, 1997).

Markets are said to be integrated when a price increase or decrease (shocks) transmitted to vertically or spatially connected distinct markets. Price transmission is the degree to which market shocks are transmitted up and down in the marketing chain. This phenomenon has long been considered as an important indicator of market performance. In other words, the extent to which a price shock in one market affects a price in another market can broadly indicate whether efficient arbitrage exists in the space that exists between the two points. As indicated by theories of market integration, there are two extremes, namely a full transmission of price shocks indicating the presence of a frictionless and well-functioning market, and at the other end an assumption of total absence of price transmission or market segmentation that may make the very existence of market integration questionable. In most cases, the reality lies somewhere in between. Therefore, the degree of price transmission can provide at least a broad picture of the extent to which markets are functioning in a predictable way and price signals are passing through consistently between different markets (Rapsomanikis, Hallam & Conforti, 2004). This means that market integration helps buffer spatial and temporal surpluses and deficits between different markets and thus benefits consumers and producers, increases the efficiency of spatial and temporal production resource allocation, and mitigates production risks across regions.

In most cases, agricultural markets in developing countries are not well integrated due to lack of well-developed infrastructure mainly because of

high transportation costs, non-existent or weak market institutions that facilitate the flow of goods and information between markets, policy barriers or distortion, and high transaction costs. All these cumulatively result in a reduction in the price information available to economic agents and consequently may lead to decisions that contribute to inefficient outcomes. The majority of rural agricultural markets in Ethiopia usually share this feature, as it is common in many developing countries. Under such circumstances, rural markets may not be able to make quick adjustments to price shocks occurring in neighbouring markets. For this very reason, the analysis of spatial price transmission has attracted a considerable amount of theoretical and empirical work in the context of the "Law of one price". It assumes that if two markets are linked by trade in an efficient market, the movement of price in one market will be equalized with the movement of other markets in the long-run while allowing for deviations in the short-run (Margarido *et al*., 2007). Understanding the extent to which spatial prices are transmitted is a useful guide to take policy measures aimed at improving efficiency of vegetable and fruit markets.

Ethiopia has exhibited sustained economic growth[2] together with a high rate of urbanization and population growth which are expected to bring change in the pattern of food consumption. As some anecdotal evidence indicates, there is a certain degree of transition from the consumption of staple foods to High Value Products (HVVPs) such as meat, fruits, vegetables, and dairy products (Worako, 2008). This increasing demand for HVPs is bound to create market opportunities if smallholder farmers' production systems respond to new market openings. In light of this, the country has also put in place a conducive policy environment for the production of vegetables and fruits including a favourable agricultural development policy and strategies supporting the development of the horticulture sector, which encourages vegetable production, processing, marketing locally for exporting. Creation of a number of supporting institutions and improving infrastructure development such as small to medium scale irrigation schemes, road networks and communication infrastructure coupled with urbanization, increasing public awareness on the importance of vegetables and fruits for

[2]According to Ministry of Finance and Economic Cooperation (2014), the country has registered more than 10 percent real GDP growth over 2004-2014 periods.

health depict the potentials for expanding vegetable and fruit production Ethiopia (WB, 2004).

Vegetable and fruit production and marketing has become lucrative venture in the recent years because the prices of these items have increased considerably together with other food products. This would offer a great opportunity for smallholder producers, if their production system is linked with markets. However, the extent of the benefits accruing to smallholder in turn depends on the efficiency of markets and how they operate. Farmers engaged in the production of fruits and vegetables often earn higher net farm incomes than farmers who focused on the production of cereal crops alone. Studies from developing countries frequently show higher average net farm income per household member among producers of fruits and vegetables. A study conducted in Kenya showed that farmers who produced vegetables and fruits for the export market were found to have farm incomes five times higher per family member compared to smallholder farmers who did not grow horticultural crops (Joosten *et al*, 2015).

Apparently, vegetable production is more profitable than cereals in terms of cropping days since the growing period of vegetables is usually less than that of cereals. Thus, the production of vegetables has a comparative advantage particularly under conditions where cultivable land is scarce while labour is abundant, for which Ethiopia is a good example. In terms of employment and poverty alleviation, production of fruits and vegetables offers ample opportunities because it is usually more labour intensive than the production of staple crops. The research of Huong *et al.* (2013) in the Red River Delta shows that permanent vegetable cultivation requires more labour than the traditional cropping systems with rice followed by seasonal vegetables (Joosten *et al.*, 2015). It also offers greater post-harvest opportunities to add value. Today, packing and processing services such as washing, chopping, and mixing, as well as bagging, branding, and applying bar codes are often out sourced rather than being done at the end-market destination. These processes have created considerable new employment opportunities in developing countries (Fernandez-Stark *et al.*, 2011).

However, the success or failure of the sector's performance depends on the extent of transaction costs facing actors in the marketing chain, mainly

producers. They are price takers and have little bargaining power. This begs the question of what they can do to get a higher price. Producers have limited possibility of selling their produce directly to wholesalers or even retailers because of the intertwined nature of the market structure. Their only contact is often with the collectors/rural traders who either work as agents for wholesalers or own private business. Rural traders/assemblers usually offer prices much lower (Meijerink, 2002) in view of limited competition. In order to overcome these problems, most of trading firms tend to establish long-term relationships with other firms with which they have developed trust. However, relational contracting makes it costly for firms to switch partners (Fafchamps, 1996). Finding another trading partner involves transaction costs and may not lead to obtain a higher price until they have established a good relationship. That is, it is not always easy for new entrants and producers to get immediate buyers. Hence, farmers mostly sell to the collector with whom they have an established contact, leading to at least to a more or less assured better price (IDE, 2006).

Although most of the fruits and vegetables trade is executed through spot markets, the transaction costs in these markets are very high. Transaction costs are high because fruits and vegetables are perishable products, and therefore cannot be stored until sufficient information on qualitative and quantitative demand has been obtained. Moreover, the products are also bulky and costly to move from production sites to marketing centres. This nature of the products, provides an upper hand to traders. As a result, markets are thin and prices are volatile and uncertain. Farmers can supply only in very small quantities and lack the market power to determine the terms of the contract. Traders, on the other hand, are hesitant to commit to prices and quantities in advance due to volatility and uncertainty of market forces.

In addition to the thin market structure, market and institutional problems like high transportation costs due to poor road networks, information asymmetry and market imperfections are detrimental for smallholders' market integration. High transaction costs in the form of information and search, bargaining and negotiation, as well as monitoring and contract enforcement are likely to influence smallholders´ marketing behaviour. This

in turn precludes the price signal transmission and goods movement from low price to high price areas, ultimately segmenting markets. This inefficiency in the marketing chain consequently affects producers from obtaining a reasonable share of the final price.

In Ethiopia, while there has been several market integration studies on cereals and cash crops, there is hardly any research conducted to indicate price transmission and market integration for vegetable and fruit markets. Apparently, it is obscure to what extent the price of major production and consumption area markets are interlinked. Thus, this paper aims at analyzing spatial market integration of four major vegetables and a fruit (i.e., onions, tomatoes, potatoes and banana) between major production zonal and central retail markets.

2. Production and Price Trends of Vegetables, Fruits and Root Crops

2.1 Production Trends

Ethiopia produces a variety of vegetable and fruit crops in its different agro-ecological zones through commercial as well as smallholder farmers. Their production in many parts of the country varies in scale from cultivating a few plants in the backyards for home consumption up to a large-scale commercial production for domestic and export markets (Dawit *et al.*, 2004). It is apparent that the importance of horticulture production is well recognized. It plays a significant role both in generating income and improving nutritional status. In addition, it helps in maintaining ecological balance since horticultural crops species are varied and diverse. Further, the sector provides employment opportunities, as its management system is labour intensive.

Ethiopia is a country endowed with a great variety of climate and soil types in which diverse and distinct horticultural crops can grow for home consumption as well as domestic and foreign markets. Regions with the highest potential for horticultural production include the following: (1) Oromia: areas around Addis Ababa (Eastern Shewa, Northern Shewa,

Western Shewa), including some of the major floriculture production areas; (2) Amhara: Lake Tana catchment areas (Bahir Dar Zuria, West Gojam and South Gonder); (3) Tigray: the Raya Valley to the south of Mekele (South Tigray) and Adwa-Axum (Central Tigray) and (4) Southern Nation Nationalities People's Regional State (SNNPR): Hawassa (Sidama), Arbaminch and Chencha highlands (Northern Omo) Adugna (2009). The majority of the horticultural crops come from smallholder farming households. They contribute the lion's share of total national production. As available data shows, 95% of fresh vegetable production and supply is made by them although there is understandably no processing of vegetables at the smallholder level.

The major vegetables produced for domestic consumption are lettuce, head cabbage, Ethiopian cabbage, tomatoes, green peppers, red peppers, and Swiss chard. Compared with fruits and vegetables, the production volume of root crops is the highest (Table 1). The major domestically produced root crops include beetroot, carrot, onions, potatoes, garlic, taro/*godere*, and sweet potatoes. The principal types of fruits for which high volumes of production were recorded are avocados, bananas, guavas, lemons, mangoes, oranges, papayas and pineapples (CSA, 2008). Over 2003 to 2014, on average 3.1 million tons of vegetables, fruits and root crops per annum were produced in the country. The production of bananas, mangoes, papaya and orange was 55.3%, 12.8%, 12.5%, and 8.4%, , respectively.

Table 1 below shows area cultivated (ha), volume of production (ton) and yield (ton) for vegetables, fruits and root crops over the period 2003 to 2014. During this period, total area covered with vegetables increased from 82.3 thousand in 2003 to 192.5 thousand hectares in 2012 and then declined to 132 thousand in 2014. Its area grew by 133% in between 2003 and 2012 with an annual average growth rate of13.3%. Vegetable production grew from 388 to 852.3 thousand tons in the same period with an annual average growth rate of 12%. The growth in supply is mainly accounted for expansion of land under cultivation rather than productivity growth. This can be witnessed from the productivity growth figure which is more or less the same for 2003/2004 and 2015. Root crops and fruits on the other hand

registered consistent productivity growth, on average 11 and 8 tons/ha, over the 2003 to 2014 period, respectively. Average yield for vegetables, however, was around 4tons per hectare over the same period.

Table1: Area and volume of production for vegetables[3] , fruits, and root crops (2003-2014).

	Total area (ha)			Total production (ton)			Yield (ton/ha)		
Year	Fruits	Vegetables	Root crops	Fruits	Vegetables	Root crops	Fruits	Vegetables	Root crops
2003	44,338	82,333	158,731	249,590	387,947	1,605,525	5.6	4.7	10.1
2004	46,464	94,334	156,205	263,402	432,004	1,615,204	5.7	4.6	10.3
2005	45,043	117,650	169,343	428,301	450,200	1,337,468	9.5	3.8	7.9
2006	50,073	95,266	189,424	459,985	345,131	1,409,546	9.2	3.6	7.4
2007	62,731	119,091	184,329	462,148	471,966	1,530,949	7.4	4.0	8.3
2008	47,990	162,125	145742	351,259	598,857	1,213,604	7.3	3.7	8.3
2009	53,086	138,393	212,208	408,912	557,357	1,806,378	7.7	4.0	8.5
2010	54,647	126,675	228,716	486,276	675,606	1,915,561	8.9	5.3	8.4
2011	61,473	160,050	199,900	539,339	755,778	1,671,030	8.8	4.7	8.4
2012	61,973	192,555	203,958	479,336	852,308	1,629,862	7.7	4.4	8.0
2013	71,507	161,488	209,879	499,184	722,894	4,160,872	7.0	4.5	19.8
2014	90,071	139717	216,971	706,649	595,400	5,461,554	7.8	4.3	25.2
AVG	57,450	132,473	189,617	444,532	570,454	2,113,129	8	4	11

Source: CSA data, 2012/13

Three of these commodities showed positive progress in terms of productivity in between 2003 and 2014. This productivity of crops is however relatively very low compared to the potential yield obtained at the research centres, magnifying the existence of a wide divergence between

[3]Vegetables are broadly defined as the edible portions of a plant (excluding fruit and seeds) such as the roots, tubers, stems and leaves.

actual and potential production levels. For instance, the productivity of onions and tomatoes were about 9 and 7 tons per hectare, respectively, compared to the potential yield of 40 and 35 tons per hectare in that order in research centres which implies a wide divergence between potential and actual production.

Low vegetable yield is attributed to shortage of seeds/planting materials, diseases and insect pests, poor post harvest handling and weak linkage with markets and market information. This is further exacerbated by inadequate seed regulatory framework and supply of poor quality seeds, and low capacity for policy implementation as well as unregulated vegetable seed supply. There is also limited capacity for breeding such important vegetable crops like kale, Ethiopian mustard, and pumpkin. Moreover, there is no systemic seed importation system to access seeds regularly. The vegetables seed provision system in the country is at infant stage, primarily depending on the informal, community-based seed production and distribution and on unregulated seed import (Emana *et al*., 2014).

2.1.1 Onion production

Onion is one of the most important vegetables in the Ethiopian consumption basket. It is a vital complementary ingredient for cooking Ethiopian traditional sauce or *wot*, which is consumed together with *enjera*. It accounted for about 10.5 and 4.2 percent of area and quantity of root crops production, respectively (CSA, 2014/15).

Onion is produced and consumed all over the country. However, there are particular areas which contribute the lion's share to the national supply. As average production data for the period 2008 to 2014/15 indicates the following zones made significant contribution to the national production: North Shoa (24.4%), Arsi (13.3%), West Hararge (9.6%), East Shoa (8.4%) and East Hararge (3.5%) (Table 2). The five zones together, on average, accounted for 61.2% of national production. Between 2008 and 2014, the national production of onion grew from 148,855 to 221,846 tons or 21.3% growth per annum. This sustained growth in production may be accounted

for by price incentives to producers, increased urbanization, changing consumption habits and per capita income growth in recent years.

Table 2: Onion production (tons) by major producing zones (2008-2014)

Zone Name	2008	2009	2010	2011	2012	2013	2014	Average (MT/Ha	Share (%)
Arssi	14,572	22,465	42,254	58,043	20,564	30,807	18,227	29,562	13.3
West Harerghe	28,401	14,421	29,000	20,933	22,021	16,893	17,113	21,255	9.6
North Shewa	23,176	18,966	46,612	104,851	48,401	70,012	67469	54,212	24.4
East Shewa	15,064	24,008	11,607	18,158	17,209	26,578	18388	18,716	8.4
East Harerghe	6,268	20,130	2,168	3,559	8,031	8472	5558	7,741	3.5
Top five zones contribution	87,48	99,99	131,64	205,54	131,16	14208	15260	135,78	61.2
National aggregate	148,85	169,31	236,92	328,15	219,18	219,73	230,74	221,84	100

Source: CSA, 2008-2014

2.1.2 Potatoes Production

Potato is a leading vegetable/tuber crop in the country. It plays a major role in terms of nutrition, national food security and poverty alleviation, income generation and provision of employment through its production processing and marketing. Potato is the fastest growing food crop in Sub-Saharan Africa (SSA) and total production in some countries more than doubled during the last 15 years. This is similar to the developments in Asia (China and India) where area and yield greatly increased (FAO, 2013).

Furthermore, potatoes provide considerably more energy and protein than cereals. One of the reasons for this is its high harvest index, i.e., high proportion of all dry matter produced is edible as no straw is made. An added advantage of the crop is that, long before crop maturity, the tubers can be eaten. As the Ethiopian population grows rapidly, potatoes offer opportunities to be one of their main staple foods. In the urban setting, potato is one of the commodities consumed in different meals. It also serves as a

raw material for different food processing industries, being of immense importance in terms of value-addition in food processing industries.

Table 3 depicts trends of potato production at national level and in the top six potato producing zones in the country. These six zones account for 40.7 percent of total national potato production with the following breakdown: Kelem Wollega (16.2%), West Gojam (8.3%), East Gojam (7.4%), Gamo Gofa (6.7%), North Gonder (6.3%) and South Gonder (5.8%). Over the period 2008 to 2014, potato production increased from 384 thousand tons to 912 thousand tons, showing a rate of growth of 34.3 percent per annum.

Table 3: Potatoes production (ton) by major producing zones (2008-2014)

Zone Name	2008	2009	2010	2011	2012	2013	2014	Average	Share (%)
Kelem Wellega	38,702	108,608	93,175	109,411	103731	102,106	*	103,406	16.2
South Gonder	67,227	45,126	49,860	44,297	21989	32,987	27,537	36,966	5.8
West Gojam	44,531	52,095	32,823	24,646	71772	78,134	57,148	52,770	8.3
East Gojam	28,869	54,480	40,929	48,767	54100	57,292	25,964	46,922	7.4
North Gondar	24,829	21,531	24,213	26,905	86520	42,850	39,309	40,221	6.3
Gamo Gofa	27,867	40,532	19,504	23,844	86520	42,849	43,179	42,738	6.7
Top six zones contribution	232,025	322,372	260,505	277,870	320,901	254,112	149,958	259,678	40.7
National aggregate	384,046	572,333	447,334	487,130	863,348	784,993	921,832	637,288	100

Source: CSA, 2008-2014.

2.1.3 Tomato Production

The introduction of cultivated tomato into Ethiopian agriculture dates back to the late 1930s (Samuel *et al.*, 2009). The first record of commercial tomato cultivation was started in the 1980s in the Upper Awash by Merti Agro-industry for both domestic and export markets (Lemma, 2006). According to the CSA statistics, the total area increased to 833 ha by 1993 and to 7,256 ha in 2012 and volume of production grew from 41 to 82 thousand tons in between 2008 and 2011 but dropped later. Currently tomato is one of the national horticulture export crops of the country (Joosten *et al.*, 2015).

Table 4: Tomato production (ton) by major producing zones (2008-2014)

Major production Zones	2008	2009	2010	2011	2012	2013	2014	Average	Share (%)
East Shewa	11,290	3,258	7,306	32,314	*	*	*	13,542	27.4
South West Shewa	6,064	7,919	391	96	*	*	*	3,618	7.3
South Western Tigray	1,249	1,270	926	1,118	*	*	*	1,141	2.3
KembataTembaro	1,196	995	1,609	2,230	*	*	*	1,508	3.1
Hadiya	1,665	6,389	1,336	2,326			1808	2,929	5.9
Arssi	6,329	231	1,724	7,819	*	*	*	4,026	8.2
Top five zones contribution	29,482	20,070	24,351	46,187	*	*	*	30,023	60.8
Total national production	41,815	40,426	55,635	81,978	55,514	39,373	30,700	49,349	100

Source: CSA, 2008-2014

Tomato is a widely grown vegetable crop in Ethiopia. It is consumed in every household in different modes. It is an important co-staple food item mainly in the urban areas. Although its year -to-year quantity of production has remained volatile, the top six tomato producing administrative zones

contributed, on average, 60.8 % of total national supply between 2008 and 2014. These zones include East Shewa, Arsi, Hadiya, Kambata Tambaro, South West Tigray and South West Shoa (CSA, 2012), (Table 4). According to the evidence from Ambecha *et al.* (2011), about 36% of the growers use supplementary irrigation in most of the production zones to sustain commercially viable tomato production.

2.1.4 Banana Production

Banana is among the most widely produced and consumed fruits in Ethiopia. The country is considered to have the potential to expand its production and trade gains from the sector because of diverse agro-climatic advantages, existence of cheap and surplus labour, irrigation opportunities and proximity to the Middle East and the major European markets. However, it should be noted that the production and marketing practices of fruits and vegetables in general and banana in particular by smallholders in the major producing areas are predominantly traditional. It suffers from marketing and production bottlenecks which inevitably result in low yield and low quality products with negative consequences on farmers' income.

Table 5 below depicts five major producing zones and their respective shares in total national production. Gamo Gofa is the top producer accounting on average for 24% of national production over the 2008-2014 years. Sidama zone is the second most important banana producer accounting for 16.2 percent. The other three zones together account for 20 percent. In terms of the total national production, banana has in particular recorded tremendous growth in the last 10 years. Albeit its sale is mainly limited to the domestic markets, banana production increased from 194 thousand tons in 2008 to 478 thousand tons and recorded a 35.2 percent annual average growth. During the same period the area cultivated increased from 29 to 53.9 thousand hectares, registering a 26.5 percent annual growth. However, it is not clear how-strongly these producing zones are integrated with the major markets like the Addis Ababa city.

Most of previous studies showed that marketing constraints of smallholders are diverse and intertwined (Woldie, 2009; Haji, 2008). Among others, (1) lack of integration of smallholders with regional and export markets, (2) weak bargaining power, (3) absence of large number of market participants (buyers) which makes the market more competitive, (4) entry barriers to new entrants both into the regional and central markets, (5) price information asymmetry between the central and the regional traders; and between the regional traders and the producers, (6) a stagnant and buyer determined farm gate price, and (7) high transaction costs are the major marketing impediments. Indeed these problems are not specific to banana marketing. More or less, all other fruits and vegetable markets also share the same problems.

Table 5: Banana production (ton) by major producing zones(2008-2014)

Major production zones	2008	2009	2010	2011	2012	2013	2014	Average	Share (%)
Gamo Gofa	57916	42461	73562	55491	69319	80923	113824	70499	23.7
Sidama	22782	29201	25475	37678	39658	60292	121727	48116	16.2
Jimma	13537	8894	22063	24813	23665	25179	25049	20457	6.9
Wolayta	8516	16476	20949	23951	20278	24164	40176	22073	7.4
Hadiya	7604	11569	20238	23243	15265	16014	27784	17388	5.8
Sub total of 5 zones	110355	108601	162288	165175	168186	206571	328559	178534	60.0
National aggregate	194307	208536	270571	299754	291258	340013	478251	297527	100.0

Source: CSA, 2008-2014.

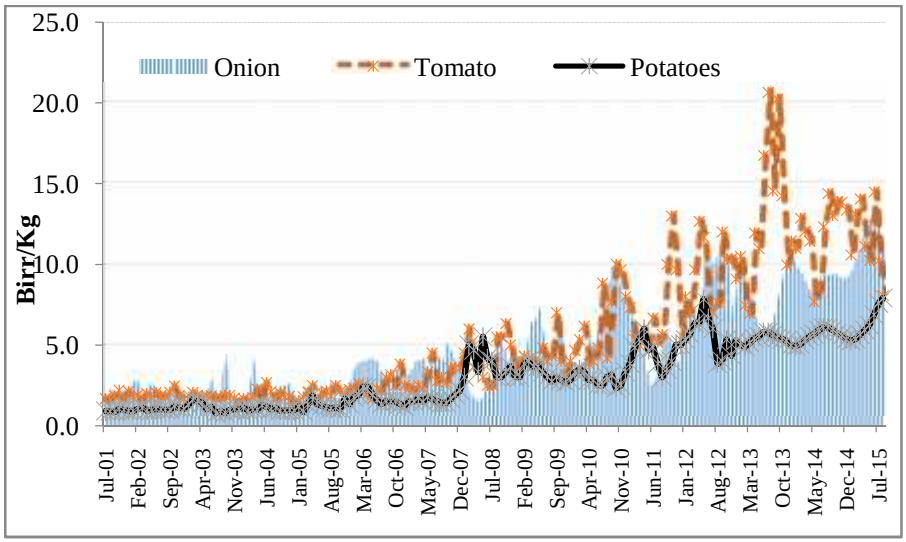
The post-harvest loss of vegetables from the point of production to consumption is on average estimated at 25-35%. The purpose of packing, transport and storage is to mitigate the post-harvest loss gap between producer and consumer, and/or reduce the time interval between harvesting and consumption. The farmers, however, do not have storage facilities at their disposal to speculate for better prices and the products they harvest are usually exposed to the influence of the weather until they are collected by

the end users. The trade practice does not either provide any intermediate storage system to mitigate the adverse effects of weather and fetch fair market prices.

2.2 Price Trends

In recent years Ethiopia has experienced a historically high level of general inflation where food prices of most commodities increased by three fold in the last 10 years. The graph below indicates nominal price trends of onions, tomatoes and potatoes from 2001 to 2015 for Addis Ababa (*Markato*) vegetable and fruit market. Their prices remained highly volatile mainly in the later periods. This may be accounted for the shorter span of shelf life because producers as well as traders have limited room to speculate for better prices keeping the products longer because of their perishable nature.

Figure 1: Addis Ababa retail price trends of onions, tomatoes and potatoes (Birr/kg)



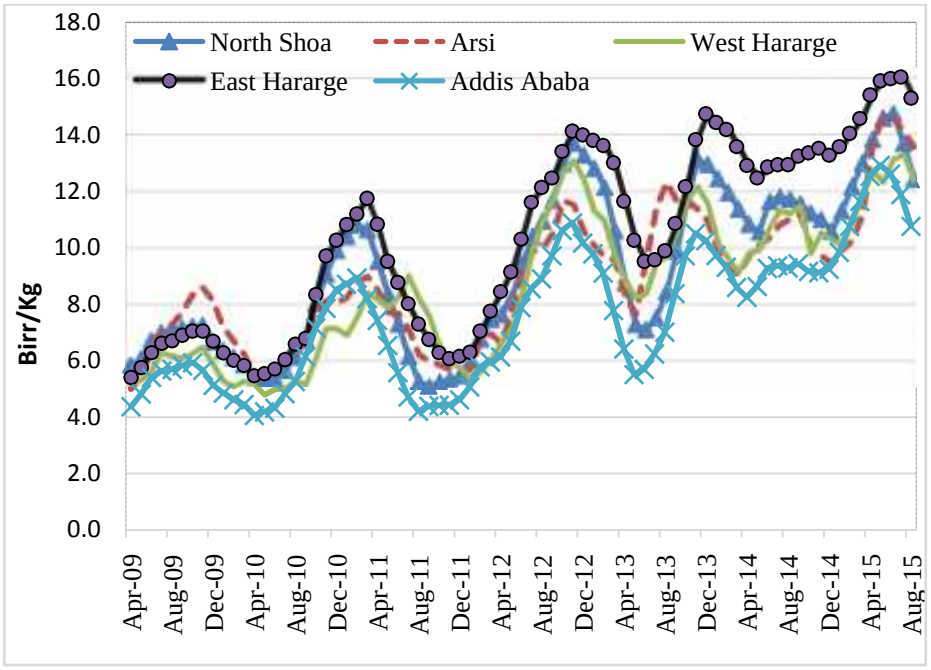
Source: CSA, 2001-2012

Due to the dominance of rain-fed production system, supply of vegetables and fruits is subjected to high fluctuation with variability of weather condition and consequently prices. Its supply declines during the main rainy season between June and mid-September. As a result, prices are usually high during these

months. Conversely, between October and January there is a moderate supply of fresh vegetables but starts to rise in February and reaches its peak level in April and May when prices are relatively lower (Figure 1 above).

Figure 2 below shows onion retail price trends (on the basis of a six month Moving Average price[2]) for the six major producing zones as reported in the CSA production statistics. We observe three major facts from the graph: (1) despite the geographic divergence in the production zones, all prices converged to each other; (2) prices were highly volatile. In 2013 it hiked to a historically highest level (Birr 18/kg) and dropped in the subsequent year. In April 2014 it approached the lowest level ever and started to peak again and dropped; (3) Onion price in Western Tigray was the highest compared to all other zones, which may be accounted for by either a high demand compared to supply and/or cross-border trade.

Figure 2: Onion retail price trends (six month moving average price)

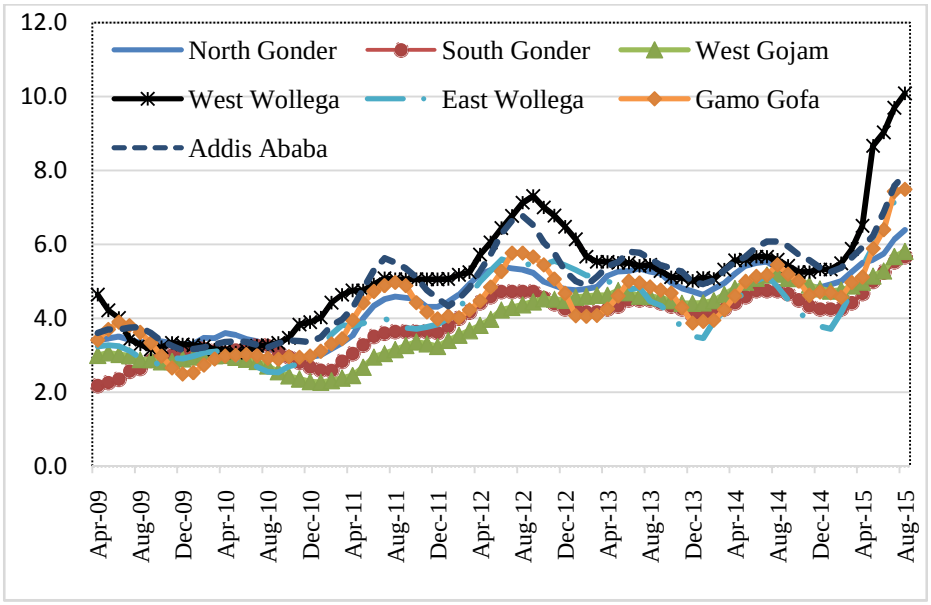


Source: CSA Retail Price, 2015

We applied a six month Simple Moving Price (SMP) to filter out the "noise" from random price fluctuations. A moving average (MA) is a trend-following or lagging indicator because it is based on past prices.

Figure 3 shows potato price trends (six month SMA price) for the six major producing zones and for Addis Ababa. Prices of all zones converged to each other. Only West Wollega price slightly drifted away from other zones. There was no visible price divergence between producing and consuming zones. The correlation coefficient between Addis Ababa and the major producing zones was 0.87, implying a high correlation. Standard Deviation (SD) of price is high only for West Wollega and Addis Ababa prices. All the rest more or less have the same price movement.

Figure 3: Potatoes retail price trends (six months moving average price)

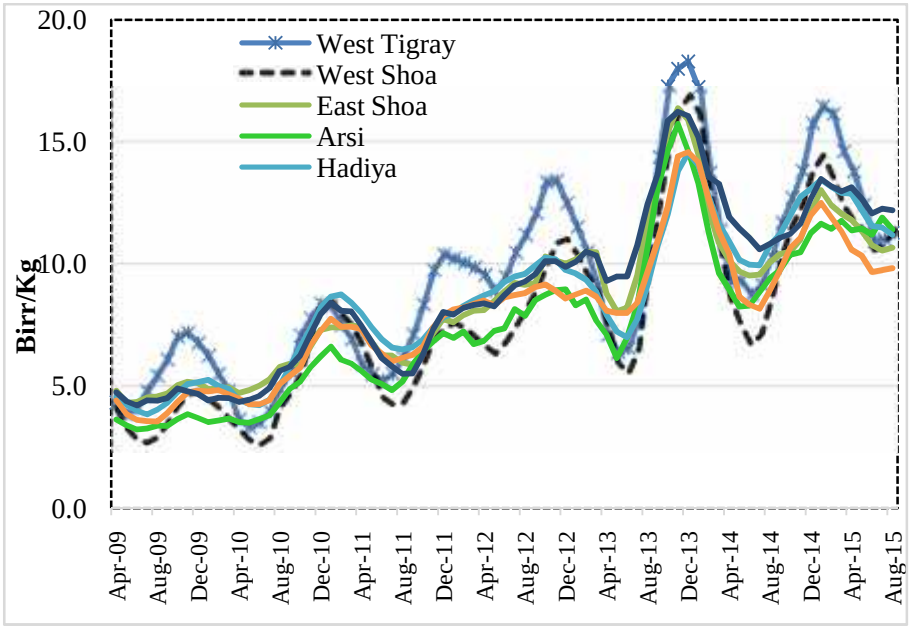


Source: CSA Retail Price, 2015

Figure 4 below posts trends of retail prices for tomato in five major retail markets. As discussed earlier, all selected zonal retail prices exhibited an upward co-movement. All zonal retail prices were highly correlated with the Addis Ababa price (correlation coefficient 0.87). Price of tomatoes for

Western Tigray was constantly higher by 11 percent compared to average prices for all others. Tomatoes from Hadiya relatively fetched the lowest price compared to others, which may be attributed to its quality level and market imperfection. Standard Deviation for Western Tigray and West Shoa were relatively higher compared to the others.

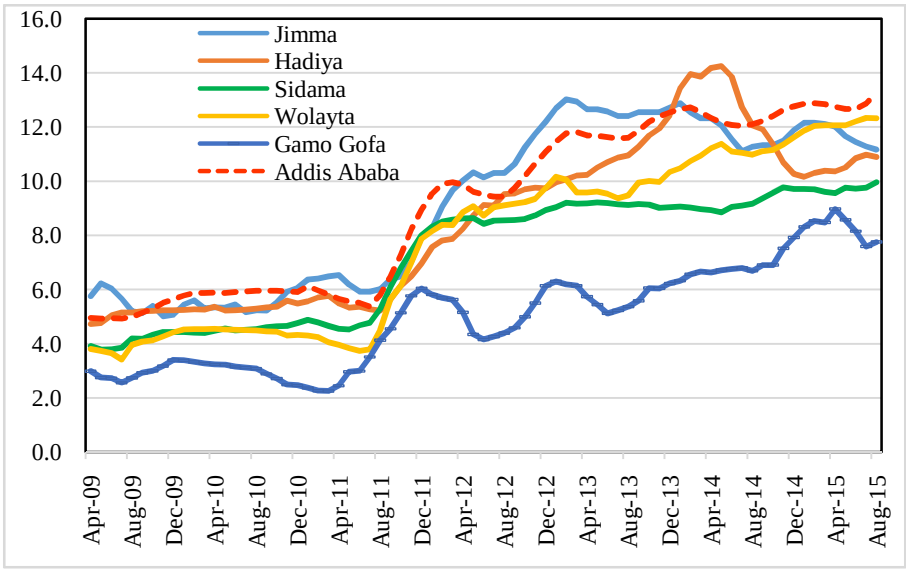
Figure 4: Tomato retail price trends (six months moving average price)



Source: Retail price, 2015

Figure 5 below shows banana retail price trends for Jimma, Sidama, Gamo Gofa, Hadiya, Wolayta and Addis Ababa markets based on retail price data from CSA. The retail prices between 2009 and 2012 for zones other than Gamo Gofa exhibited co-movement. However, over the two years, 2013 to 2015, retail prices of all zones drifted from each other. Retail price of Gamo Gofa remained far below. Its overall price for the whole period was about 50 percent of Addis Ababa retail price. Sidama price was also lower by more than 20 percent from the Addis Ababa price. What accounts for such huge retail price difference between major markets is of paramount importance and section 2.5 addresses this issue.

Figure 5: Banana retail price trends (six months moving average price)



Source: CSA, 2014

2.3 Spot Marketing of Vegetables and Fruits

The spot market is the default marketing option for vegetable and fruit farmers. The spot market for vegetable and fruits function in the absence of well-established institutional environment without formal rules and regulations. Contracts between farmers and rural traders are informal, based on verbal agreements. In the case of a conflict, the transaction costs of resorting to formal institutions (such as the police, courts) are usually higher than the costs involved in the informal mediation.

In such a situation, traders know that farmers have little room to influence their price setting. Besides, the traders have established personal relations for decades so that no trader wants to violate the decision of another. These conditions together with lack of financial system to support producers to invest more on their production, farmers are precluded from motivation and investment on innovative technologies. Therefore, the future of the sector hinges on strengthening producers' organizations (POs) and building their capacities to collectively bargain and secure a proper share of market prices.

Lack of a strong institutional arrangement to guide the behaviours of market participants in the market is an added challenge. Holloway *et al.* (2000) and Staal *et al.* (1997) found a positive effect of organizations of collective action, such as cooperatives, in reducing transaction costs. These benefits accrue to both producers and buyers as cooperatives reduce the costs of information for both sides and take advantage of economies of scale in collection and transport.

An efficient and integrated marketing system may greatly contribute to increase in the marketable surplus by scaling down the losses arising from inefficient processing, storage, and transportation. It guarantees better prices to farmers for their products and induces them to invest their net surpluses for the purchase of modern inputs to increase productivity (Khols & Uhl, 1998). For perishable commodities, the imperfection is more apparent as intermediaries have the opportunity to exploit the inelastic nature of short-run supply to mark-up prices in excess of marginal cost (Sexton, Zhang & Chalfant, 2005).

2.4 Transaction and Marketing Costs

Fruits and vegetables from the production zones are supplied to one or more of the domestic and export markets. Domestic markets include central markets, local nearby markets, and village markets. Djibouti is the only export destination for a limited volume of some of the fruit types like Banana and Mango. Markets where smallholders sell their products include farm gates, village markets and some local markets. As a study by IDE (2006) depicts, about 76 and 13percent of vegetable and fruit farmers in Arbaminch and Chencha areas sell at farm gates and village/nearby local markets, respectively. There is no individual or farmers organization to directly supply to central or regional markets. Bulkiness fruits and vegetables to transport, high transport cost and barrier to enter main markets as supplier are major causes for sales of the lion's share at farm gates. The buyers of the produces from the smallholders at these markets include cooperatives regional traders, local market traders, village market traders/assemblers and sometimes direct consumers. Unions usually have

only one customer, the Ethiopian Fruits Marketing Enterprise (Et-Fruit). Unions do not either have their own trucks to collect from every site, pay less per seedling compared to private buyers.

Smallholders right from the farm gate through private regional traders, mainly supply bananas to the different central markets. The largest share of the produce of smallholders in the area is supplied through this channel. The regional traders collect from smallholder growers at farm gates either directly or through their agents/assemblers. They, then bulk and transport to the different marketing centres (mostly to the Addis Ababa fruits and vegetables central market located at *Piassa*) and sell to wholesalers in central markets. The central market wholesale traders then prepare the crop (keeping the stock under warm condition for about three days) for later sale to central market retailers, private business organizations, and rarely for export to Djibouti.

As a large number of market assessments reveal, the structure of marketing fruits and vegetables through Addis Ababa vegetables and fruits central market (AVFM) revealed that the structure is found to be non-competitive, both at the central markets and the farm gates for a number of reasons (International Development Enterprise, IDE, 2006).

First, the number of central market wholesale traders is limited mainly because of limited/fixed central market places in each of the major cities. Second, the existing wholesale traders use different mechanisms/agreements or collude to avoid competition on issues such as volume to be purchased daily and purchase prices. For example, a wholesale trader from the central market is not allowed to buy from regional traders other than his/her client thus regional traders have limited or no option to have competitive prices. The other mechanism is jointly establishing quality classes and determining prices for each of the quality classes. The third reason for non-competitiveness is absence of free entry into the central market wholesale trading and regional trading. The limited central market places are monopolized, with no room for new entrants. Moreover, the existing central market wholesale traders and regional traders jointly put different entry

barriers. The central traders and regional traders have some sort of established agreement between them that enables them to avoid a new entry to both the central market and to regional trading. On the basis of such an agreement, the regional traders do not want to sell for any new/strange entrants to the central wholesale trading market and also the central traders do not buy from any new/strange regional trader.

Not only the central market but also farm gate market is non-competitive. There is only a limited number of regional traders as a result of the reasons discussed above. Every regional trader has its own client smallholder supplier such that no regional trader is allowed to buy from a client other than his own. Moreover, the regional traders jointly determine farm gate prices.

Another characteristic of marketing through this channel is the prevalence of several marketing costs. Marketing costs to regional traders, for example include: brokers' fees, labour costs-loading and packing on trucks, transport costs, accommodation costs, parking fees, weight loss because of excessive garbage removal in the central markets and because of loss of moisture content during transportation, etc. Assessments made regarding wholesale prices in the Addis Ababa central market revealed that the prevalence of three sets of prices depending on the quality of the banana supplied (first grade, second grade and third grade).

The quality class is simply set by wholesalers based on the size of the fruit and whether it is separated from the head or not are the criteria used for grading the produce. Accordingly, those that are not separated from the head and with bigger sizes are classified as grade one, while those with smaller sizes are classified as grade two and those that are separated from the head are classified as grade three. The majority (about more than 80 percent) of the banana fruit marketed in the Addis Ababa central markets is of first grade, about 18 percent is of second grade and about 2 percent is of third grade, based on personal observation. The price difference between producer and wholesaler is excessively high. Anecdotal evidence from IDE (2006) revealed the prevalence of excessive weight cheatings by the regional traders

in buying from smallholder growers. Though there is a need to compensate the potential weight losses due to excessive garbage removal and moisture loss while transporting to the Addis Ababa central market, in reality unaccounted for weight is so high that it can be considered as a special type of cheating.

3. Empirical Model

3.1 Data Sources

The study is based on secondary data on price, production and consumption obtained mainly from the Central Statistical Agency (CSA) for the period 2008 – 2014. All the zones producing onions, tomatoes, potatoes and bananas were ranked from top to down on the basis of their average contribution to total production for the same period. Having done this, the top four to six production zones were selected for each commodity on the basis of their contribution to national production. Monthly average retail prices for selected zones was compiled for the period stated above and analyzed together with the Addis Ababa retail prices. The Addis Ababa retail market was selected as central or reference market, which depends on supply of commodities from surplus producing areas. In other words, the aim of the study is to assess the extent of co-integration between producing (surplus) and consuming (deficit) markets. This secondary data was reinforced with information obtained from some key informants, exhaustive literature survey and casual visit to the fruit and vegetable market in Addis Ababa, *Piassa* (i.e., *atekilittera*). The scope of the work is also limited to a few selected commodities, namely, tomatoes from vegetables, potatoes and onions from root crops and bananas from fruits as representatives for each group. Indeed, these crops as a group and individually account for substantial shares of area and production of their respective groups.

3.2 Method of Analysis

Earlier studies on cointegration (e.g. Richardson, 1978) mainly relied on simple correlation between prices on pairs of markets. Later, Stigler and Sherwin (1985) considered the correlation of price differences. Gupta and

Mueller (1982) also employed Granger causality tests to measure the price relationship between markets, while Delgado (1986) used a variance decomposition approach to evaluate integration between markets. The seminal work by Ravallian (1986) is considered the most prominent innovation and progress in time series modelling (Barret, 1996). Co-integration together with an Error-Correction Model (ECM) of Engle and Granger (1987) has received important recognition for the specification and estimations of dynamic economic models. The error correction representation enables us to differentiate between long-run and short-run relationships of time series variables. Once the series is found to have a long-run relationship, the next step of Engle and Granger is making use of the estimated error correction term to investigate further the short-run dynamics or market integration. In other words, it explores how price changes in one market will be "immediately" passed onto another market. ECM also provides a framework for testing for asymmetric and nonlinear adjustment to a long-term equilibrium. Granger and Lee (1989) proposed an asymmetric error correction model (AECM) where the speed of the adjustment of the endogenous variable depends on whether the deviation from the long run equilibrium is positive or negative.

Following the Engle and Granger approach, an ECM model was chosen for this study. The model captures the speed of adjustment of local prices in response to changes in terminal or world market prices[4]. The statistical advantage of co-integration analysis is that it allows to estimate existence of stationary linear combinations of non-stationary variables (i.e., time dependent mean and variance) using differencing techniques. Cointegrated prices do no drift apart in the long-run and tend to move towards a shared

[4]In theory, spatial price determination models suggest that if two markets are linked by trade in a free market regime, excess demand or supply shocks in one market will have an equal impact on price in both markets. The implementation of import tariffs, in general, will allow international price changes to be fully transmitted to domestic markets in relative terms. Thus, a proportional increase in the international price will result in an equal proportional increase in the domestic price, at all points in time provided that tariff levels remain unchanged.

equilibrium path; thus cointegration analysis mainly tests for long-run market integration[5].

In addition to ECM, descriptive trend analysis, Granger causality tests and Johansen cointegration tests have been employed to analyze the co-movement, and causal effects of change in one market on another. Granger causality tests assess the presence of at least unidirectional or bi-directional causality since each market uses information from the other when forming its own price expectations. It also depicts about leader-follower relationships in terms of price adjustments (Gupta and Mueller, 1982).

In this specific case, we selected Addis Ababa, the central market of Ethiopia as a reference market for national price setting. Thus we assumed all price decisions in all other vegetable and fruit crops producing zones influenced by what happens in the Addis Ababa retail market. Hence, the Addis Ababa market considered as an independent market and is represented by "X" and all other zonal markets are considered as dependent markets represented by "Y". In other words, Addis Ababa retail price of tomatoes, oranges, potatoes and bananas (i.e., APT, APO, APP and APB)[6]are represented by 'X' or as independent variables. The specification of a long-run relation can thus be stated as follows:

$$Y_t = \alpha + \beta_1 X_t + \mu_t \qquad \textbf{(1)}$$

However, since the long run relation between zonal and Addis Ababa retail prices might depend not only on the current but also on lagged prices, Equation 2 and 3 allow for this price lags.

$$Y_t = \alpha + {}_1X_t + {}_2X_{t-1} + \mu_t \qquad \textbf{(2)}$$

[5] However, cointegration technique does not solve the limitations of the methods derived from the exclusion of transfer costs which begs for use of a new approach. Nevertheless, where no reliable and periodic data on the transaction costs and trade flows existing methods which are based on prevailing market prices are appropriate.

[6] The abbreviations represent: APT - Addis Ababa retail price of tomatoes; APO - Addis Ababa retail price of orange; APP - Addis Ababa retail price of potato and APB - Addis Ababa retail price of banana

The low Akaike Info Criterion (AIC) used to select the appropriate empirical model among different distributed[7] lags to determine the optimal lag length.

According to Engle and Granger's two-step approach to cointegration analysis, two non-stationary I(1) variables are said to be cointegrated if both series integrated of the same order and their linear combination yield a disturbance term that is stationary *I*(0). In the first stage, the methodology applies an OLS estimation of the long-run equilibrium relationship of two or more non-stationary variables as

$$Y_t = \sim + \ _1X_t + \ _3X_{t-1} + Y_{t-1} \ldots + \ _nX_{nt} + U_t \quad \textbf{(3)}$$

where Y_{it} *and* x_t are the individual *I*(1) price components, $_i$'s are the parameters vectors to be estimated, and U_t is the error term. In order to conclude that the price series are co-integrated, the residuals from OLS have to obey stationary process. That is, if the residual errors are stationary then the linear combination of the two price series is stationary (i.e., two markets are cointegrated).

The second-step focuses on the OLS estimation of $\circ$ in the regression equation of the error terms from Equation 4 that is considered to be temporary deviation from the long-run equilibrium and specified as follows:

$$\Delta U_t = \circ U_{t-1} + e_t \quad \textbf{(4)}$$

Where e_t is a white noise disturbance term. The magnitude of coefficients in (5) informs about the speed of adjustment[8] with which the process gets back to its equilibrium after an exogenous shock.

[7]If a model contains both the current and past (lagged) values of the explanatory it is said to be distributed lag model

[8] The speed of adjustment is the coefficient of one period lagged residuals in an error correction model.

According to the Granger representation theorem, coefficients are different from zero ($'S \neq 0$) implies the existence of an error-correction representation of variables or short term dynamics among prices of differentiated markets specified as stated below [9]:

$$\Delta Y_{it} = {}_1\Delta X_{it-1} + {}_2\Delta X_{it-n} + {}_{20}\Delta X_{jt-1} + \cdots\cdots + {}^{a}{}_{2n}\Delta X_{jn-1} + (X_{it-1} - {}_0 - \hat{X}_{jt-1}) + £_t \quad (5)$$

Where ${}_i{}'S$ are estimated short-run counterparts for long-run solution, n represents the lag length of the time, λ represents speed of adjustment and et is stationary random process that captures other information not contained in the lagged values of ΔYt and ΔXt.

Johannsen's cointegration test has been employed to determine whether or not all national prices are jointly co-integrated with the national market. The global prices are expressed in local currency to remove the effect of exchange rate depreciation of the domestic currency vis-a-vis the US dollar. Moreover, the domestic prices have been deflated with constant prices in order to account for inflationary pressure.

4. Results and Interpretations

4.1 Results of Unit Root Tests

For our analysis, the 20 zonal retail market centres of surplus producing areas were selected as representative of the zones and the Addis Ababa retail market is considered as the central market. The presence of spatial integration analysis for onion markets was done taking into consideration Addis Ababa, Asela, Asebe Teferi, Debre Berhan, Shashemene and Harar towns/zonal onion retail markets. In the case of potato, Addis Ababa, Debere Tabor, Bahir Dar, Debere Markos, Gonder, Arbaminch and Asela markets are chosen to be the representative markets. For tomatoes, Addis Ababa, Shashemene, Welisoe, Maychew, Alaba, Hosaena, and Ambo markets were

9 Although a fully specified ECM constitutes also the dynamic terms that contribute to the current changes in the dependent variable, the specification here constitutes only the lagged dis-equilibrium.

selected. Finally, for banana, Addis Ababa, Arbaminch, Awassa, Jimma, Soddo and Hosaena zonal markets were considered for analysis. These markets are selected on the basis of their contribution to national production (see Table 2-5).

In this paper, we used a monthly price data series from September 2008 to August 2015. Moreover, in the analysis we transformed all data into natural logarithmic form to reduce the influence of extreme values and ease of interpretation. Before going to the detailed analysis, the presence of unit root was tested using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests for each series and a number of lags were chosen using Akaike Information Criteria (AIC). The presence of cointegration was checked using Johansen's trace statistic and maximum eigenvalue statistics, hypothesizing that there is no cointegrating vector among the series under the null hypothesis. Finally, by normalizing all markets with respect to Addis Ababa we calculated the cointegration relationship and the short-run dynamics using the vector error correction model (VECM).

In the first instances, we tested for the presence of unit root at level and first differences for the series in the selected vegetable retail markets. The retail price series for all commodities for the representative markets failed to reject the presence of unit root at level for ADF and PP tests, which imply that the series are non-stationary at level, i.e., the variables follow a random walk (Table 6). However, first differencing proves the series to be stationary, depicting that the price series are integrated with degree of order one, I(1).

Having observed that all the price series are integrated of the same order I(1), the presence of spatial integration between the market pairs was undertaken taking Addis Ababa as the central market[10]. This was also tested using Johansen's cointegration test.

[10] As ADF test result indicates, onion price for Addis Ababa and Shashemene is significant in level at 10% significance level. However, this result is not confirmed by PP test that not considered as robust.

Table 6: Results of ADF and PP Unit Root Tests on Monthly Retail Price Data

Commodity	Markets	ADF Test		PP Test	
		Level	1st Difference	Level	1st Difference
Onion	Addis Ababa	-2.69	-10.36**	-2.92	-21.02**
	Asebe Teferi	-1.75	-7.86**	-3.35	-38.05**
	Asela	-1.31	-7.59**	-2.30	-29.27**
	Debre Berhan	-1.25	-9.42**	-2.26	-14.43**
	Harar	-0.90	-9.06**	-1.31	-22.98**
	Shashemene	-2.36	-7.71**	-1.91	-22.08**
Potato	Addis Ababa	-1.56	-12.90**	-1.44	-13.05**
	Arbaminche	-1.48	-9.74**	-2.84	-21.41**
	Asela	-1.96	-11.48**	-2.28	-23.32**
	Bahir Dar	-0.47	-11.34**	-0.55	-16.34**
	Debre Markos	-1.62	-18.02**	-1.97	-25.80**
	Debre Tabor	-1.12	-10.68**	-1.30	-19.11**
	Gonder	-1.66	-18.10**	-2.00	-24.01**
Tomato	Addis Ababa	-0.45	-9.32**	-2.23	-35.98**
	Ambo	-1.42	-7.14**	-3.53	-17.34**
	Asela	-2.32	-7.57**	-4.45	-27.44**
	Mychew	-1.51	-9.12**	-3.46	-27.74**
	Shashemene	-0.39	-8.12**	-1.84	-44.97**
Banana	Jimma	-1.33	-13.66**	-1.74	-15.48**
	Hadiya	-1.15	-9.59**	-1.22	-12.01**
	Sidama	-1.19	-12.70**	-0.90	-13.04**
	Wolayta	-0.20	-9.03**	-0.60	-14.12**
	Gamo Gofa	-2.17	-12.40**	-2.77	-14.16**
	Addis Ababa	0.04	-7.45**	-0.21	-7.50**

The asterisks ** denote the rejection of the null hypothesis of presence of unit root in the series at the 1% significance level. The critical values at the 1% significance level are -3.48 for both ADF and PP tests.

4.2 Results of Spatial Integration

The result of cointegration test between market pairs is given in Table 7 below. Each of the zonal retail markets are tested for their relationship with

Addis Ababa. As exhibited in Table 7, Johansen's trace and maximum eigenvalue test statistics disclose the existence of one cointegration relationship between the market pairs at 5% significance level except in the case of Addis Ababa - Debre Markos potato market; Addis Ababa-Hosaena, Addis Ababa-Jimma, and Addis Ababa-Hawassa banana retail markets lack integration. The trace and maximal eigenvalue statistics indicate that the absence of co-integration between Addis Ababa and these markets. In general, results are mixed; existence of long run co-movement of prices is seen between the surplus producing retail markets for some of commodities with Addis Ababa retail market (i.e., for potato, tomatoes, and onion). However, in the case of banana, the strength of long run co-movement of retail prices was found to be weak except for Addis Ababa-Soddo and Addis Ababa-Arbaminch.

Prices were expressed in terms of logarithms, and hence the co-integrating vectors tell the long run elasticity of the Addis Ababa prices with respect to surplus producing market prices. For onion the long run elasticity of price transmission ranged between 0.75 in the case of Harar to 0.88 for Asebe Teferi. For potato, the long run price elasticity ranged from 0.82 in the case of Asela to 1.15 in Bahir Dar market. For tomato market, higher long run price elasticity is revealed relative to onion. For the banana market, the long run price elasticity ranged from 1.2 in Hawassa to 0.9 in Hosaena. Hence, these high long-run elasticity results imply that a higher proportional price change in the Addis Ababa market will be transmitted to surplus producing vegetable and fruit markets in the long-run.

The error correction coefficient which reflects speed of adjustment for short run dynamics is indicated in the column 6 of Table 7. In the case of onion markets, the speed of adjustment is faster in Shashemene relative to other surplus producing retail markets. 36 percent of the disequilibrium that exists in the long run relationship between two markets is corrected every period; in other words it takes about 3 months to fully correct the deviation existing in the long run relationship of the pair wise onion price. However, the lowest speed of adjustment was noted in the Addis Ababa-Asebe Teferi market taking about six months to fully correct the deviation existing in the long run

relationship. This may be accounted for the relatively longer distance and transportation costs. For the rest of the markets, the disequilibria were adjusted in 3 to 4 months' period.

In the case of the potato market, the error correction terms ranged between -0.14 to -0.29. This indicates that about 14 to 29 percent of the deviation that exists in the long run relationship with the central market is corrected in one month's time. Surprisingly, the slowest speed of adjustment was witnessed in the case of Debre Tabor (i.e, 7 months) and the fastest speed of adjustment in the case of Gonder, taking 3.5[11] months for adjusting deviation with the central market. For the rest of the representative potato surplus producing retail markets, the deviation from the long run relationship to the central market is corrected in a span of 4 to 5 months.

In the case of the tomato markets, the error correction coefficients were found to be statistically insignificant for Ambo, Asela and Mychew with the exception of Addis Ababa–Shashemene pair wise market[12]. Tomato is highly perishable and movement from production to consumption centre costly in terms of transportation and storage facilities. This may be accounted for weak short term dynamics observed from the result.

[11] Speed of adjustment is number of months required to adjust deviation from the equilibrium which calculated by multiplying speed of adjustment coefficient by twelve months.

[12] However, it has wrong sign

Table 7: Johansen's Co-integration Test Statistics, long run and speed of adjustments between markets

Commodity	Market Pairs	Trace Statistic	Max-Eigen Statistic	Long run Elasticity (t –stat in [])	Speed of Adjustment coefficients (t stat in[])
Onion	Addis Ababa – Asebe Teferi	28.65**	24.67**	0.88 [9.42]	-0.17[-2.01]
	Addis Ababa-Asela	24.64**	20.78**	0.79 [8.65]	-0.28[-3.31]
	Addis Ababa – Debre Berhan	20.75**	17.23*	0.86 [11.89]	-0.23[-2.49]
	Addis Ababa - Harar	16.96**	15.39**	0.75 [8.87]	0.31[-2.67]
	Addis Ababa - Shashemene	34.13**	30.13**	0.84 [15.10]	-0.36 [-2.96]
	Addis Ababa - Arbaminche	38.08**	36.34**	0.98 [-19.33]	-0.21[-2.89]
Potato	Addis Ababa-Asela	40.38**	37.74**	0.82 [-26.36]	-0.23 [-2.36]
	Addis Ababa –Bahir Dar	29.06**	28.44**	1.15 [-16.17]	-0.20 [-2.54]
	Addis Ababa - Debre Markos	15.48	13.99	*	*
	Addis Ababa –Debre Tabor	15.83**	14.73**	0.84 [8.81]	-0.14[-2.51]
	Addis Ababa -Gonder	27.01**	25.28**	1.06 [-16.13]	-0.29[-3.99]
	Addis Ababa -Ambo	46.89**	44.94**	0.94 [13.53]	-0.03[-0.63]
Tomato	Addis Ababa-Asela	22.41**	20.80**	1.45 [-9.90]	-0.01 [-0.25]
	Addis Ababa -Mychew	31.23**	29.49**	1.50 [-10.96]	-0.01[-0.21]
	Addis Ababa - Shashemene	28.13**	27.16**	1.12 [-26.48]	-0.56 [-2.98]
Banana	Addis Ababa - Arbaminch	11.49**	11.49**	0.92 [23.21]	0.59 [2.20]
	Addis Ababa - Hosaena	6.59	6.49	0.90 [19.66]	0.23 [0.94]
	Addis Ababa - Jimma	6.59	6.49	0.93[29.46]	0.41 [1.71]
	Addis Ababa - Hawassa	7.54	6.38	1.21 [27.45]	0.27 [1.61]
	Addis Ababa - Soddo	18.59**	18.49**	0.92 [23.21]	-0.67 [-2.66]

The asterisks ** denote the rejection of the null hypothesis of no cointegration at 5% significance levels. The 5 % significance level is 15.49 and 14.26 for trace statistic and maximum eigenvalue statistic, respectively. Numbers in the square bracket are t-statistics of estimated parameters .The 5% critical value is 1.96, and 1% critical value is 2.576 for t test in each case.

Finally, the long run cointegrating relationship between the Addis Ababa and major banana producing zonal retail market centres was found either weak or non-existent as the trace and maximal eigenvalue statistics shows. No cointegration relationship was observed between Addis Ababa-Hosaena, Addis Ababa-Jimma, and Addis Ababa-Hawassa for the banana market. Addis Ababa and Soddo market only exhibited faster speed of price adjustment (about 67% of deviation in a month).Addis Ababa – Arbaminch market has wrong signs that are difficult to explain. This lack of integration between pairs of retail markets may be accounted for both high transaction costs of banana marketing plus low price difference in some cases between reference and local markets. Since demand for banana is very high in the local markets of the producing centres like in Jimma and Hawassa towns, traders may have limited interest to transport the product to the reference market, due to low price margins.

4.3 Results of Granger Causality Test

Table 8 discusses results of bivariate Granger causality test or direct Granger test to know direction of causality as well as its presence between Addis Ababa and 20 zonal retail markets. The Granger causality test is carried out by regressing each variable on its own lags and lagged values all other explanatory variables, and then testing the joint statistical significance of the coefficients of all lagged values of all explanatory variables. Accordingly, we carried out Granger causality test for the stated vegetables and fruits market pairs using retail price transformed into natural logarithmic form.

As results indicate, out of 20 market pairs, for the 17 cases, the null hypothesis which state “Addis Ababa market does not Granger Cause other retail market” was rejected implying that Addis Ababa retail market is the most important market for most regional vegetable and fruit markets; serves as a reference market from price signal flow, that is, uni-directional causality runs from Addis Ababa to almost all zonal markets (see Table 8).

On the other hand, when we consider existence of bi-directional causality between Addis Ababa and 20 retail markets, it was exhibited in the two

banana retail markets (i.e., between Addis Ababa and Arbaminch and Addis Ababa and Soddo). For potatoes markets, we found bi-directional causality between Addis Ababa and all other retail markets. Similarly, for tomato markets also we found similar causality between Asela and Addis Ababa markets. In these cases any retail price change in pairs of markets affect each other. These findings are consistency with long-run cointegration results.

Finally, the long run cointegrating relationship between the Addis Ababa and major banana producing zonal retail market centres was found either weak or non-existent as the trace and maximal eigenvalue statistics shows. No cointegration relationship was observed between Addis Ababa-Hosaena, Addis Ababa-Jimma, and Addis Ababa-Hawassa for the banana market. Addis Ababa and Soddo market only exhibited faster speed of price adjustment (about 67% of deviation in a month).Addis Ababa – Arbaminch market has wrong signs that are difficult to explain. This lack of integration between pairs of retail markets may be accounted for both high transaction costs of banana marketing plus low price difference in some cases between reference and local markets. Since demand for banana is very high in the local markets of the producing centres like in Jimma and Hawassa towns, traders may have limited interest to transport the product to the reference market, due to low price margins.

Table 8: Grange Causality Test

V&F	Null Hypothesis:	F-Statistic	Prob.
	Arbaminch banana market does not Granger Cause Addis Ababa	5.6067***	0.0054
	Addis Ababa market does not Granger Cause Arbaminch	3.2013**	0.0463
1. Banana	Hosaena market does not Granger Cause Addis Ababa	0.5996	0.5516
	Addis Ababa market does not Granger Cause Hosaena	10.6553***	0.0000
	Jimma market does not Granger Cause Addis Ababa	0.3537	0.7032
	Addis Ababa market does not Granger Cause BANJM	8.5659***	0.0004
	Hawassa market does not Granger Cause Addis Ababa market	5.2921***	0.0071
	Addis Ababa market does not Granger Cause Hawassa	1.8033	0.1717
	Soddo market does not Granger Cause Addis Ababa market	3.10435**	0.0506
	Addis Ababa market does not Granger Cause Soddo market	14.5374***	0.0000
	Asela market does not Granger Cause Addis Ababa market	0.29168	0.7478
2. Onion	Addis Ababa market does not Granger Cause Asela	10.578***	0.0000
	East Hararge market does not Granger Cause Addis Ababa market	0.8753	0.4209
	Addis Ababa market does not Granger Cause East Hararge	21.9554***	0.0000
	North Shoa market does not Granger Cause Addis Ababa market	1.8005	0.1722
	Addis Ababa market does not Granger Cause North Shoa	26.3455***	0.0000
	West Hararge does not Granger Cause Addis Ababa market	1.6067	0.2073
	Addis Ababa market does not Granger Cause West Hararge	8.8850***	0.0003
	Nekemt market does not Granger Cause Addis Ababa market	6.0927***	0.0035
	Addis Ababa market does not Granger Cause	2.9799*	0.0568

	Nekemt		
3. Potatoes	Arbaminch market does not Granger Cause Addis Ababa market	6.6056***	0.0023
	Addis Ababa market does not Granger Cause Arbaminch	14.48***	0.0000
	Gonder market does not Granger Cause Addis Ababa market	6.68303***	0.0021
	Addis Ababa market does not Granger Cause Gonder market	11.9842***	0.0000
	Debre Tabore market does not Granger Cause Addis Ababa	7.902***	0.0008
	Addis Ababa market does not Granger Cause Debre Tabore	1.5687	0.2150
	Bahir Dar market does not Granger Cause Addis Ababa market	2.9762*	0.0570
	Addis Ababa market does not Granger Cause Bahir Dar	4.0941**	0.0205
	Asela does not Granger Cause Addis Ababa market	7.2511***	0.0013
	Addis Ababa market does not Granger Cause Asela	7.6164***	0.0010
	Shashemene does not Granger Cause Addis Ababa market	0.1526	0.8587
	Addis Ababa market does not Granger Cause Shashemene	7.7276***	0.0009
4. Tomatoes	Hosaena market does not Granger Cause Addis Ababa market	1.50444	0.2287
	Addis Ababa market does not Granger Cause Hosaena	12.3605***	0.0000
	Durame market does not Granger Cause Addis Ababa market	0.29906	0.7424
	Addis Ababa market does not Granger Cause Durame	6.8466***	0.0018
	Ziway market does not Granger Cause Addis Ababa market	0.46843	0.6278
	Addis Ababa market does not Granger Cause Ziway market	4.1445**	0.0196
	Maychew does not Granger Cause Addis Ababa market	1.04876	0.3554
	Addis Ababa market does not Granger Cause Maychew	1.91119	0.1549

Source: Authors analysis based on retail price data from CSA

From the above results, we can deduce that the Addis Ababa retail market is a very important or leader market while all others are follower markets in terms of price adjustments for most of vegetables and fruits. The salient implication of this finding is that any market imperfection occurring in the Addis Ababa retail market, can affect negatively all other markets which have established connection that correction of all imperfection of Addis Ababa retail market has great implications for future vegetable and fruit market development in Ethiopia.

5. Conclusion and Policy Implications

This paper investigated spatial market integration between Addis Ababa and top 20 vegetables and fruits producing zonal retail markets using average monthly retail price data from 2008 to 2015. Onions, tomatoes, potatoes and bananas were selected as representative for vegetables and fruits. We employed both descriptive and empirical tools to analyze.

As some of the most important results from descriptive analysis indicate that:

- Smallholders engaged in the production and marketing of vegetables and fruits are found to be constrained by both supply and demand side barriers. Supply of fruits and vegetables is highly constrained by lack of water to engage in sustainable production. Though there is abundant surface water there is limited capacity to use it effectively. Only a limited number of farmers make maximum gains from the sector. Irrigation is commonly practiced both to supplement rainwater shortages and for production under irrigation during dry seasons. However, most smallholder fruits and vegetables growers do not have access to different water resources and control over water to produce under irrigation. Lack of access to quality seedlings, infestation of pests and disease, limited use of improved production practices, soil infertility, lack of appropriate credit facilities are found to be the major constraints limiting the performance of the sector.
- On the demand side, smallholders also lack markets to sell what is produced given limited access to potential marketing centres because of

high transportation costs for moving the products. This in turn spoils their motivation to embark on additional investment in the sub-sector. On the other hand, as retail price analysis indicates farmers are still unable to receive fair prices for their products. For instance, the retail price for bananas in Gamo Gofa has remained far below Addis Ababa price. Producers obtained about 50 percent less than the Addis Ababa retail price on average, during 2008-2015. Producers prices in Sidama were also 20 percent lower from Addis Ababa retail price over the same period.

- Market power is controlled by a few wholesale and retail market traders who manipulate prices using their strong network from farm gate to retail markets. Lack of strong and functional institutional arrangement for the sub-sector further exasperate the situation.

As salient results from empirical analysis indicate that:

- All price series data considered in the analysis was tested for stationarity. The results of Augmented Dickey Fuller test (ADF test) indicated that price series considered in the analysis were found to be integrated of order one, I(1) with a few exceptions. The study also utilized the Johanen's cointegration test which is based on Maximum Likelihood (ML) approach. Using this method, we found that the Addis Ababa the vegetable market is integrated with the surplus producing markets of potatoes, tomatoes and onions but no clear cointegration was observed for banana markets except for Soddo.
- Albeit the pace of adjustment was uniformly moderate for onions and potatoes a shock in the price of the central market, on average, takes between 3 to 7 months to be fully adjusted in major producing markets. In the case of tomatoes, the Addis Ababa - Shashemene market showed a faster speed of adjustment, taking about 2 months for Addis Ababa market to fully absorb the shock that happened in Shashemene. For the rest of the markets the speed of adjustment took long periods. This might be attributed to the degree of perishability of tomatoes relative to onions and potatoes. For the pair wise vegetable markets with Addis Ababa, the delays in the speed of adjustment suggests that the market was

experiencing various structural as well as price rigidities. The main causes for this phenomenon might be attributed to the oligopolistic behaviour of traders at the central or Addis Ababa market, asymmetric information and lack of facilities including transport, storage and processing which could have reduced risk and price volatility related to vegetable and fruit markets.

- As results of Ganger causality test shows, out of 20 pairs of retail markets, for 17pairs unidirectional causality run from Addis Ababa to other zonal retail markets was exhibited– implying the power of Addis Ababa market as the most important leading market for price adjustment. Thus, any imperfection in Addis Ababa wholesales market has a direct effect on regional prices.

Spatial market integration has an important implication for growth in the agricultural sector. Although there has been substantial progress in the recent years in terms of achieving infrastructure development by the Government, various institutional arrangements which could potentially lower transaction costs and raise bargaining the powers of producers are missing mainly at producer level. To mention some: lack of market information, high marketing and transaction costs due to collusion of central and regional traders, and high perishability and seasonality of the production system weakened market power of producers. Hence, it is important to strengthen either the existing or establish new Producer Organization (PO) to facilitate flow of goods, information, and enforce existing rules and regulations of vegetable and fruit markets to benefit producers through securing a proper share of the final prices.

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