Market integration and price transmission under institutionalised Ethiopian coffee market: Evidence from nonlinear ARDL model

Abstract

In this paper, market integration and price transmission along the Ethiopian coffee value chain after the introduction of the ECX is investigated. The empirical analysis applies a nonlinear ARDL cointegration methodology as developed by Shin, Yu, and Greenwood-Nimmo (2011). This model allows for more flexible prices and the establishment of asymmetric relationships both in the long- and short-run. The study aims to examine price dynamics for five Ethiopian coffee varieties at three levels, namely producer-ECX, producer-exporter, and ECX-exporter. The overall results for all three levels illustrate the limited capability of the ECX in creating an integrated and transparent market along the Ethiopian coffee value chain. The results also confirm that exporters enjoy an advantage over coffee producers. Furthermore, the evidence of price asymmetry between the producer-exporter prices for quality Ethiopian coffees could be explained by the different markets in which these coffees are traded.

Keywords: Ethiopian coffee, Nonlinear autoregressive distributed lags, Asymmetric price transmission, Ethiopian Commodity Exchange

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1.1 Introduction

Most developing countries have been through several economic reforms over the past three to four decades. These reforms have sought to remove price controls at all levels of the commodity market by liberalising trade, and privatising the government-owned agricultural enterprises. The reforms in the agricultural sector have aimed to empower producers and subsequently, enhance trade efficiency (White and Leavy, 2001). These reforms were often geared towards markets of primary agricultural commodities such as coffee, cocoa, and cotton, due to the crucial role that these commodities play in the economies of the producing countries. For example, in Ethiopia, more than 15 million people have a direct or indirect link to coffee production (ECEA, 2013).

In the early 1990s, the Ethiopian government, under pressure from the World Bank and the international monetary fund (IMF), implemented a Structural Adjustment Programme (SAP). This programme was geared towards market liberalisation, with the objectives of reducing producer price variability, protecting producers from exploitation by private middlemen and possible monopolistic practices, abolishing marketing boards, and allowing private agents to operate as traders and exporters (Worako et al., 2008). Moreover, it was hypothesised that the integration of the producers with the auction and the export market would improve the transmission of international coffee prices to domestic coffee markets, and subsequently to domestic growers. In turn, this was expected to improve coffee supply and quality. However, various studies (Gabre-Madhin and Goggin, 2005; ECX, 2008; Alemu and Worako, 2011) have shown that, like most developing countries, policy interventions in the Ethiopian agriculture sector did not deliver on what was expected of them.

Market integration studies have been particularly useful in forecasting the impact of interventions on price changes within and between markets (Abdulai, 2007). In theory, when price adjustments are not efficiently conveyed to producers, market intermediaries benefit from imperfections and from reduced market transparency (Le Goulven, 2001). More
specifically, the ever-widening gap between coffee retail prices in the high-income countries and producer prices in the coffee-growing countries means that either the producers are not benefiting from consumer price increases or the consumers are not benefiting from producer price reductions. Despite the major disappointment in the policy measures for agricultural sectors in most developing countries, there is previous evidence (Krivonos, 2004; Subervie, 2011; Mofya-Mukuka and Abdulai, 2013) which suggests that in countries where interventions and reforms have been implemented successfully, producers have benefited from better price transmission and received a larger share of export prices. As such, market reforms could improve the bargaining power of producers which would allow them to benefit more from price changes in the trader and/or export market. Peltzman (2000), extensively investigated the asymmetric price transmission in agricultural and food product markets and criticised the standard economic market theory for ignoring the existence of asymmetric price adjustment. This criticism was too highlighted by other researchers such as Katrakilidis and Trachanas (2012), Simioni et al. (2013), and Greenwood-Nimmo and Shin (2013). Furthermore, price asymmetries in agricultural markets are mostly driven by information asymmetry, market power, adjustment cost, collusion, and consumer response to changing commodity prices (Jaffry, 2005).

Poor price signals within the different sections of the markets indicate how agricultural commodity markets are poorly integrated. High transfer costs may also arise as a result of poor market infrastructure (Rapsomanikis et al., 2003). Particularly in developing countries, poor infrastructure and communication services contribute towards larger marketing margins. This is essentially due to the high cost of delivering the locally produced commodity to the export ports, hindering the transmission of price signals, and thus, preventing arbitrage. The ECX was established as a means to overcome these marketing challenges for agricultural commodities and to revolutionise Ethiopian agriculture by creating a dynamic, forward-looking, efficient, and integrated marketing system.
The ECX was established in 2008 by the Ethiopian government as a market place where buyers and sellers could meet to trade, while being assured of quality, delivery, and payment. The ECX aims to facilitate transparency and efficiency through an innovative marketing system, which should protect the interests of all actors, including farmers, farmer groups, processors, traders, exporters, aid agencies, input suppliers, industrial buyers, and consumers. Furthermore, the ECX is particularly unique as its end-to-end integrated marketing system aims to integrate central trading, warehousing, product grade certification, clearance, delivery, and market information dissemination (ECX, 2009; Alemu and Meijerink, 2010). It also operates as a trading platform, using a combination of open outcry (floor) trading and electronic platforms (Paul, 2011).

Although the ECX was established with the aim of creating transparency and competitiveness at all levels of the coffee market, the expected level of competitiveness at the local level has not yet been achieved (Minten et al., 2014). This may be due to the structure of the Ethiopian coffee market, which, like many other agricultural markets, is composed of a large number of small-scale coffee producers and only a few traders. However, an improved level of competition has been observed on the exporter market. According to Minten et al. (2014), the number of exporters has increased to 175 in 2012 from 100 in 2008. In addition, the shares of the largest four (CR4) and eight (CR8) exporters in the coffee market have decreased significantly during the past year. These findings were, however, refuted by the World Bank (2014) which showed that the largest exporters (selling more than 5 million USD per annum) accounted for nearly 80% of coffee exports. The World Bank (2014) argued that the Ethiopian coffee market is difficult for new entrants to penetrate and now has all the features of an oligopsonistic\(^1\) market.

The ECX plays a central role in controlling and directing the Ethiopian coffee market. Furthermore, the local producer markets are organised under regional ECX markets in which coffee producers supply their coffee through cooperatives or traders. The prices offered in the

\(^1\) A Market characterized by a small number of large buyers who control all purchases
ECX markets influence the price setting in the producer market. However, the ECX does not have the mandate to set export prices. Since the ECX follows the international coffee price for price setting, it most likely influences the price-setting strategy of the exporters.

The Ethiopian coffee production and different coffee markets are highly heterogeneous. Part of the heterogeneity emanates from the coffee varieties grown in the different regions of the

Figure 1.1 Critical price information transfers between actors in the coffee supply chain

Note: The arrows refer to price information transfers and not to physical flows of coffee or money
country (see Chapter 2). Moreover, not only are there differences in the quality of the various coffee types, there are also differences in infrastructure. Some local producer markets barely receive any market information. Furthermore, while some markets are connected to all weather roads, other markets barely have access to any type of road. Therefore, unlike the regular commodity exchange, the ECX also has the responsibility of improving the basic market infrastructure at every level of the coffee market where problems result in weak price integration and transmission between the different market actors (Gabre-Madhin and Goggin, 2005). One particular area of interest is the flow of price information throughout the chain (Figure 1.1), and its impact on actual price transmission. Imperfect price integration and transmission results in a price reduction at the farm level that is only slowly, and possibly not fully, transmitted through the supply chain (Subrvie, 2011; Mofya-Bukuaa and Abdulai, 2013; Fousekis, 2015). However, price integration and transmission studies seldom take into account different types and qualities of coffee, while studies on quality (Otero and Milas, 2001; Ghoshray, 2009) argue that quality is important in price relationships. This chapter addresses this gap in the literature as it investigates market integration and price transmission for the five Ethiopian coffee types along the coffee value chain. Moreover, coffee is Ethiopia’s most important agricultural export product, and the sector has been subject to frequent policy reform. For this chapter, we consider three different groups of actors in the chain together with their price relationships for the five coffee varieties. These three groups include the producer–ECX market, the producer-export market, and ECX-export markets.

1.2 Empirical literature

Various studies have examined the market integration and price transmission between the domestic market and the international coffee markets. These studies either compared coffee-producing countries or focused on a country that had undergone a market reform. Fafchamps and Hill (2007), used cross-sectional data to examine the transmission of international coffee prices through the domestic value chain in Uganda. They found that producer price
fluctuations were inconsistent with constant transaction costs, which they assumed to be the result of significant storage and contango marketing costs. They also found that the heightened price was due to the entry of new traders which increased search time for quality coffee. Their empirical tests rejected the storage and marketing costs explanation, but they did find some evidence of trader entry in response to a rise in export price.

Using an Error Correction Model, Xavier (2011) analysed the impact of policy reforms on the market integration between international and domestic coffee prices in Colombia, Ghana, and the Ivory Coast. The findings indicated that the reforms induced stronger relationships between domestic and international prices in Colombia, but not in Ghana nor in the Ivory Coast. The researcher explained that these differences between the countries arose as a result of different domestic institutional arrangements. Li and Saghaian (2013) also used an Error Correction Model to examine the price relationships between producer and world coffee prices for Colombian Milds and Vietnamese Robusta coffee, focusing on the long-run integration and short-run adjustments. They found evidence of long-run relationships between the world price and the grower price for both Colombian Milds and Vietnamese Robusta. Moreover, they found an asymmetric short-run price adjustment towards equilibrium for both types of coffee. In addition, their research results showed a slightly higher degree of market integration for Colombian Milds than for the Vietnamese Robusta coffee.

Furthermore, the impact of coffee sector reforms on the speed of transmission of price shocks in the producer prices was studied by Subervie (2011), using a Threshold Cointegration model. The study investigated the cases of El Salvador, Colombia, and India, and showed that producer and world prices were closely cointegrated after policy reforms, with an increased impact of monthly variations in world prices on producer price variations. The results also pointed to asymmetric price adjustments. The pre-reform period was favourable to producers, since, after the reform, the positive price adjustments were no longer transferred to the producer level, subsequently disadvantaging the producers. Moreover, there were only
transmissions of decreasing prices during a short period of time. Subervie (2011) also highlighted cases in which deviations resulting from reductions in world prices were eliminated relatively quickly in the post-reform period. The Threshold Autoregression Model, as applied by Mofya-Mukuka and Abdulai (2013) to examine the effects of market liberalisation on coffee price transmission from world prices to grower prices in Zambia and Tanzania, showed several structural breaks. The results confirmed that price transmission improved in the case of Zambia where coffee marketing was fully liberalised, although transmission was asymmetric. This implied that price reductions were affecting producers to a greater extent than price increases over an identified threshold. In comparison, the Tanzanian coffee marketing system was not completely liberalised. Negative shocks from the long-run price equilibrium receded faster before the reform, while positive shocks receded faster after the reform.

Amongst the studies on Ethiopian coffee market integration and price transmission, Worako et al. (2008) applied an Error Correction Model to test the impact of liberalisation on price transmission for Ethiopian coffee between 1993 and 2006. The findings indicated that market liberalisation induced a long-run relationship between prices at grower, wholesaler, and exporter levels. The estimation of the models showed that only short-run transmissions from prices on the world market to the domestic markets improved. In addition, the transmission has remained weak in the prices between producer-to-auction and auction-to-world markets. The researchers attributed this to the weak domestic institutional framework coordinating the coffee market. The study concluded by proposing that negative price changes were transmitted much faster than positive ones. Alemu and Worako (2009) applied a three-regime Threshold Vector Error Correction Model to estimate asymmetric transmissions in coffee prices between 1998 and 2006. Their results revealed a unidirectional transmission of shocks from the world price to auction price, and then to producer price. The results also indicated that producer prices were less responsive to changes in world prices (positive or negative) than auction prices. They suggested that the lower responsiveness could be
attributed to the increased use of the domestic market as a major outlet by coffee suppliers at times of lower world prices.

Seyoum (2010) sought to explain the price transmission between the international, auction, and producer prices in the Ethiopian coffee market between 1991 and 2009 using a Vector Error Correction model. Similar to Worako et al. (2008), the study found a long-run cointegration between these three markets. The long-run analysis further showed an equivalent change in producer prices, following a change in the auction market. Furthermore, only half of the changes from the international price were passed on to the auction and producer markets in the long run. The model results indicated that the producer and the international markets were poorly integrated and had very weak relationships to one another as compared to the auction and the international market. The researcher linked the weak relationship to the lack of market infrastructure, information asymmetry, and poor transportation systems. More recently, Hernandez et al. (2015) aimed to investigate whether the ECX has had an impact on the international-domestic coffee price relationships. Using Multivariate Generalised Autoregressive Conditional Heteroscedasticity (MGARCH), Dynamic Conditional Correlation (DCC), and Baba-Engle-Kraft-Kroner (BEKK) models, the researchers concluded that the ECX has had only limited success in terms of having a positive impact on price dynamics.

The present study expands on the aforementioned literature through two contributions. Firstly, the study aims to investigate market integration and price transmission along the coffee value chain for the five types of Ethiopian coffee. All previously mentioned studies (Worako et al. 2008; Alemu and Worako, 2009; Seyoum, 2010), except for Hernandez et al. (2015), have examined price transmission against the impact of the 1990’s market reform. However, as far as can be detected, no previous research has comprehensively studied the integration of and price transmission for the different Ethiopian coffees by taking the establishment of the ECX as a point of reference. Secondly, the present study is the first of its kind to implement the Nonlinear Autoregressive Distributed Lag model (NARDL), as recently
developed by Shin et al. (2014), in studying price symmetry in African agriculture and food markets. The model has the advantage of examining both nonlinearity and asymmetry simultaneously in the short- and long-run.

1.3 Data sources and econometric methods

1.3.1 Data and sources

The data used for the study consisted of the average monthly coffee producer price series for the period December 2008 to May 2013. The period between December 2008 and March 2015 was considered for ECX and export coffee prices. The price data for producers were collected from the Central Statistical Agency (CSA) through the monthly Ethiopian Rural Agricultural Price Survey reports (also used in chapter 4). The monthly ECX coffee prices were collected from the Ethiopian Commodity Exchange headquarters in Addis Ababa, while the export coffee prices were gathered from the Ethiopian customs office (also used in chapter 3). Furthermore, the monthly exchange rate was obtained from the National Bank of Ethiopia (NBE). For this study, the price data collected from the producer markets located in the different regions of the country were taken as the producer price. The price data collected from the traders selling their coffee at the ECX were considered as the ECX price. In addition, the export price is the price received by the exporters (traders) after selling their coffee. For all three price types, the researcher collected the data in accordance with the type of coffee, which adds an extra dimension for further analysis. Finally, the study attempted to collect long-run data for cooperative prices for the different types of Ethiopian coffees. The data was solicited from the Oromia cooperative union, however, only data for the period of January 2012 to August 2012 was made available by the cooperative union. Thus, due to the lack of adequate data, the study made comparisons between the cooperative and conventional coffee markets for that period only.

All price data were converted into USD per pound (USD/lb), which serves as a standard unit of price measurement in the international commodity markets. The USD per kg unit of price measurement is used in the figures to follow in order to aid interpretation. The official
monthly average exchange rate was used to convert producer, ECX, and export prices that were documented in the local currency (Birr). Finally, all price series were indexed taking the period December 2008 as a base.

The major coffee types considered for this study were Wollega, Sidama, Yirgacheffe, Jimma, and Harar (Figure 1.1). As also explained in the previous chapters, coffees produced in the different regions in Ethiopia are characterised by vast differences in quality amongst the production areas. The majority of coffee-producing areas are located in the Southern, Southwestern, and Eastern highlands of Ethiopia. Harar coffee, which comes from Eastern Ethiopia, is the premium type out of the five coffees considered in this study and thus, it fetches the highest price in both the domestic and export markets. Yirgacheffe and Sidama coffees, which are produced in the south of Ethiopia, are the second-best quality and brand coffees. Jimma and Wollega, which are relatively low quality coffees, are located close to each other in the south-western part of Ethiopia. However, Wollega coffee is said to be superior to Jimma coffee.

Kufa (2012) distinguishes between the origins and tastes of the different types of coffee in the following way: spicy for Sidama, fruity for Wollega, floral for Yirgacheffe, winey for Jimma, and mocha for Harar. All coffees coming from Harar are unwashed, which is a typical production method for dry environments. Despite these quality differences, all coffees produced in the country are quite homogenous and are perfectly substitutable (Worako et al., 2008).

The price evolution of Ethiopian coffee types between (i) producer and ECX price, (ii) producer and export price, and (iii) ECX and export price are displayed in Figures 1.2, 1.3, and 1.4, respectively. In the producer-ECX price graph, all the producer prices seem to follow the same price movements, except for Harar, which follows its own pattern and fetches a higher price than the other coffee types. In the ECX market, prices for all types of coffee followed a similar price pattern until mid-2011. Early in 2011, the coffee price in the international market increased dramatically for various reasons, including a coffee shortage and increases in
commodity prices. From mid-2011 onwards, the price trend for Harar coffee started to diverge from the trends for the other coffee types and followed a distinct pathway. Producer and ECX price series seem to respond in a similar way to distinct market shocks, except for Harar coffee.

In the producer-export price series (Figure 1.2), the export market prices appear to be especially volatile and the 2011 price hike lasted for a longer time while the effect on the producer price was not as great. Likewise, the ECX-export price (Figure 1.4) portrays a similar pattern.

Figure 1.2 Price evolution of Ethiopian coffee types between producer and ECX price (in USD/kg)
Figure 1.3 Price evolution of Ethiopian coffee types between producer and export price (in USD/kg)

Figure 1.4 Price evolution of Ethiopian coffee types between ECX and export price (in USD/kg)
1.3.2 Econometric analysis: Nonlinear Autoregressive Distributed Lag model (NARDL)

This study applies a Nonlinear Autoregressive Distributed Lag model (NARDL), the asymmetric continuation of the ARDL model, recently developed by Shin et al. (2014). The novelty of this technique is its ability to detect both short- and long-run asymmetries between price series using positive and negative partial sum decomposition. Moreover, the asymmetric ARDL specification allows the analysis of non-stationarity and nonlinearity jointly in the context of an unrestricted error correction model (e.g. see Katrakilidis and Trachanas (2012) and Atil et al. (2014). A detailed explanation of this model is given in chapter 3 (see section 3.4.3).

In addition, the present study tested the statistical relevance of a downward power relationship (the bargaining power goes downwards from exporter to ECX trader, then to producer) along the Ethiopian coffee value chain within three NARDL models, namely, exporter to producer, exporter to ECX, and ECX to producer. As proposed by Shin et al. (2014), the NARDL model specification is written as follows:

Changes in ECX price (pex) to changes in the producer price (pp)

\[ \Delta pp_t = \sigma_0 + h_1 pp_{t-1} + h_2^+ pex_{t-1}^+ + h_3^- pex_{t-1}^- + \sum_{j=1}^{u-1} \alpha_j \Delta pp_{t-j} + \sum_{j=0}^{v-1} \mu_j^+ \Delta pex_{t-j}^+ + \sum_{j=0}^{v-1} \mu_j^- \Delta pex_{t-j}^- + \mu_t \]

Eq. 1

Change in Export price (pE) to changes in the producer price (pp)

\[ \Delta pp_t = \sigma_0 + h_1 pp_{t-1} + h_2^+ pE_{t-1}^+ + h_3^- pE_{t-1}^- + \sum_{j=1}^{u-1} \alpha_j \Delta pp_{t-j} + \sum_{j=0}^{v-1} \mu_j^+ \Delta pE_{t-j}^+ + \sum_{j=0}^{v-1} \mu_j^- \Delta pE_{t-j}^- + \mu_t \]

Eq. 2

Changes in Export price (pE) to changes in the ECX price (pex)

\[ \Delta pex_t = \sigma_0 + h_1 pex_{t-1} + h_2^+ pE_{t-1}^+ + h_3^- pE_{t-1}^- + \sum_{j=1}^{u-1} \alpha_j \Delta pex_{t-j} + \sum_{j=0}^{v-1} \mu_j^+ \Delta pE_{t-j}^+ + \sum_{j=0}^{v-1} \mu_j^- \Delta pE_{t-j}^- + \mu_t \]

Eq. 3

Where, \( pE_t, pex_t, pp_t \) denote the export, ECX, and producer prices; \( pE_{t-1}^+, pE_{t-1}^-, pex_{t-1}^+, pex_{t-1}^- \) represents the partial sums of positive and negative changes in
export and ECX prices; \( u \) and \( v \) are lag orders; \( h_2 = \frac{-h_3}{g^+} \), \( h_3 = \frac{-h_4}{g^-} \) are the long-run impacts of price increases and reductions between the pairs of market prices; and \( h_1 \) represents the price elasticity. The short-run adjustment to positive and negative in one of the pair prices is denoted by \( \mu_j^+ \) and \( \mu_j^- \); \( \sigma_0 \) is the constant.

Following Greenwood-Nimmo et al. (2013), equations 1, 2, and 3 are also re-estimated by imposing short-run symmetry. Such restrictions improve the estimation of the long-run price dynamics. The modified equations are as follows (Greenwood-Nimmo et al., 2013):

\[
\Delta pp_t = \sigma_0 + h_1 pp_{t-1} + h_2^+ pex_{t-1}^+ + h_3^- pex_{t-1}^- + \sum_{j=1}^{u-1} \mu_j \Delta pp_{t-j} + \sum_{j=0}^{v-1} \mu_j \Delta pex_{t-j} + \mu_t \quad \text{Eq. 4}
\]

\[
\Delta pp_t = \sigma_0 + h_1 pp_{t-1} + h_2^+ pE_{t-1}^+ + h_3^- pE_{t-1}^- + \sum_{j=1}^{u-1} \mu_j \Delta pp_{t-j} + \sum_{j=0}^{v-1} \mu_j \Delta pE_{t-j} + \mu_t \quad \text{Eq. 5}
\]

\[
\Delta pex_t = \sigma_0 + h_1 pex_{t-1} + h_2^+ pE_{t-1}^+ + h_3^- pE_{t-1}^- + \sum_{j=1}^{u-1} \mu_j \Delta pex_{t-j} + \sum_{j=0}^{v-1} \mu_j \Delta pE_{t-j} + \mu_t \quad \text{Eq. 6}
\]

This study attempts to test market integration and price transmission for five types of Ethiopian coffee along the market chain through three steps. Firstly, the Shin et al. NARDL approach is used to test cointegration along the market chain. Secondly, the study investigates the existence of price asymmetry for the different types of coffee. Thirdly, following the asymmetric test, the extent of a short- and long-run asymmetric price change is tested.

In addition, the robustness of the NARDL model was tested using two common tools as diagnosis tests. These included the Breusch-Godfrey Lagrange Multiplier test for serial correlation, and the Autoregressive Conditional Heteroscedasticity (ARCH) test for heteroscedasticity, as developed by Engle (1982). These tests are performed on the residuals of the estimated variables. The subsequent results are presented and discussed in the following section.
1.4 Results and discussion

1.4.1 Stationary analysis

Before proceeding with the NARDL bounds tests, we had to ensure that none of the variables under consideration were integrated to an order higher than one. In such an order of integration (I(2) or higher), the computed statistics provided by Pesaran et al. (2001) and Narayan (2005) are not valid (Ang, 2007). In the presence of I(2) variables, the joint computed F-statistics would not be valid.

Table 1.1 shows the Augmented Dickey-Fuller (ADF) test results for price series after the establishment of the ECX. The unit root test was performed at level and at first difference with the intercept, and with the intercept and trend term. The optimum lag was selected by using the Akaike information criterion (AIC). Based on the critical values reported, only the Harar producer price appeared to be stationary at the level, while all other price series became stationary after the first difference. Table 1.1 also shows that none of the series have an integration order of I(2) or higher, which satisfies the precondition to undertake a cointegration analysis using ARDL.

<table>
<thead>
<tr>
<th>Coffee type</th>
<th>At level/First difference</th>
<th>Producer price</th>
<th>Order of integration</th>
<th>ECX price</th>
<th>Order of integration</th>
<th>Export price</th>
<th>Order of integration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>τc</td>
<td>τc,t</td>
<td>τc</td>
<td>τc,t</td>
<td>τc</td>
<td>τc,t</td>
<td>τc</td>
</tr>
<tr>
<td>Harar</td>
<td>At level</td>
<td>-4.83***</td>
<td>-4.84***</td>
<td>I(0)</td>
<td>-1.48</td>
<td>-1.09</td>
<td>I(1)</td>
</tr>
<tr>
<td></td>
<td>First difference</td>
<td>-</td>
<td>-</td>
<td>-7.16***</td>
<td>-7.33***</td>
<td>-12.75***</td>
<td>-12.88***</td>
</tr>
<tr>
<td>Yirgacheffe</td>
<td>At level</td>
<td>-7.86***</td>
<td>-7.79***</td>
<td>I(1)</td>
<td>-1.48</td>
<td>-1.62</td>
<td>I(1)</td>
</tr>
<tr>
<td></td>
<td>First difference</td>
<td>-2.0</td>
<td>-3.4*</td>
<td>-7.57***</td>
<td>-7.52***</td>
<td>-14.13***</td>
<td>-13.97***</td>
</tr>
<tr>
<td>Sidama</td>
<td>At level</td>
<td>-2.1</td>
<td>-3.4*</td>
<td>I(1)</td>
<td>-1.66</td>
<td>-1.44</td>
<td>I(1)</td>
</tr>
<tr>
<td></td>
<td>First difference</td>
<td>-7.28***</td>
<td>-7.21***</td>
<td>-7.20***</td>
<td>-7.19***</td>
<td>-8.18***</td>
<td>-8.11***</td>
</tr>
<tr>
<td>Wollega</td>
<td>At level</td>
<td>-2.53</td>
<td>-3.4*</td>
<td>I(1)</td>
<td>-2.13</td>
<td>-1.83</td>
<td>I(1)</td>
</tr>
</tbody>
</table>
First difference  -7.8***  -7.73***  -5.68***  -5.86***  -2.84***  -15.32***

Jimma

At level  -2.30  -3.3* I(1)  -2.08  -1.82 I(1)  -1.64  -1.69 I(1)
First difference  -6.3***  -6.24***  -5.57***  -5.69***  -11.99***  -11.9***

Note: *** and * indicates statistical significance at the 1% and 10% level, respectively.

1.4.2 Coffee market channels

As previously mentioned, coffee is marketed through two alternative channels. Most the coffee trade takes place through a conventional coffee channel, which consist of collectors, traders, and exporters. Only a small share of the coffee is traded through the cooperative channel, which encompasses primary cooperatives and unions that collect coffee from their member farmers.

Figures 1.5 and 1.6 compare the price evolutions in the cooperative and conventional coffee markets between January 2012 and August 2012. The evolution of the coffee prices for the producer, cooperative, ECX, and export chains were computed for each type of coffee. Results suggest that the cooperative channel earns a higher export price. The availability of alternative niche markets (for example, fair trade and organic markets) allows cooperatives to take advantage of a price premium. A comparison of the ECX price and cooperative prices shows mixed results for the different types of coffee with neither the ECX nor the cooperative price fetching consistently higher prices.

Furthermore, price gaps between producer-ECX and producer-cooperative are similar for all of the coffee types. Regardless of the coffee type, the coffee price at the ECX level is double that of the producer price. Turning to the price patterns between producer and export prices, the export price received by the union in the cooperative channel is much higher than the producer price. This particular price gap is observed for all the coffee types and is larger for premium coffee types such as Harar and Yirgacheffe. Moreover, the same pattern is observed in the conventional coffee market, but the gap is not as large as with the cooperative channel. This pattern was also observed by Minten et al. (2014), who investigated the impact of
the management change with the establishment of the ECX on the promotion of quality premiums. They found that after the introduction of the ECX, the price premiums for the cooperatives, as compared to traders, increased by 9%.

Harar coffee is the premium coffee out of the five coffees considered in this study and it fetches the highest price in both the domestic and export markets. The second-best quality coffee is Yirgacheffe coffee, which sometimes exceeds the quality expectations of the Harar coffee in the international market. Interestingly, in the cooperative market channel, Yirgacheffe coffee fetches a higher price than Harar coffee. Minten et al. (2014) relates the higher coffee price to options for coffee certification which are more relevant for Yirgacheffe coffee. As previously discussed in chapter 2, much of the Harar coffee is exported to the Saudi market.

To understand the vast price gap between export-ECX and export-producer prices, one needs to understand the costs incurred by the producers, traders, and exporters in the Ethiopian coffee value chain. In a USAID (2010) study in 2008, the estimated average cost at the farm gate was 1.06 USD per kg, whereas the average farm gate price per kg of green coffee was 2.16 USD. The cost of collecting and processing by traders was estimated at 0.33 USD per kg, and they charged a margin of 0.386 USD per kg. The export cost for the traders (exporters) was calculated at 0.58 USD per kg, with an exporters’ margin of 0.49 USD. In addition to the long and costly value chain, the productivity of the Ethiopian coffee industry is rather low, with rather high production costs (Van Der Vossen, 2005). The average Ethiopian coffee yield is 300kg/ ha, which is equal to a third of Colombia’s yield (900kg/ ha), half of El Salvador’s yield, and a quarter of Costa Rica’s and Brazil’s yields of 1.2MT/ ha and 2MT/ ha, respectively (Van Der Vossen, 2005; MARO et al., 2014). Worako et al. (2014) included cost items in their study that had been ignored by previous studies, such as impurity and weight losses during cleaning. The study calculated the average value chain cost of the farm gate-ECX and ECX-export and found that 0.42 USD per kg was incurred by the trader (farm gate-ECX), while 0.46 USD per kg was incurred by the exporter.
1.4.3 NARDL bounds tests for cointegration

Model (1) represents the price transmission from the ECX to the producer, while model (2) portrays the price transmission between exporter and producer. Furthermore, model (3)
portrays the price transmission between exporter and the ECX. A general-to-specific approach was used to determine the lag order (Shin et al., 2014). For each of the three models (table 1.2), a maximum lag order of 4 was set as a starting point for iteration and dropping insignificant regressors.

The results displayed in Table 1.2 confirm that the producer and ECX markets have established a significant level of cointegration. The continuous adjustment of the producer price with the ECX price was expected from the establishment of the ECX, since it aimed to create transparency in the Ethiopian commodity market. The establishment of a long-run cointegration between the prices on the producer and export markets for all coffee types also suggests that market information is accessible at producer level. Similarly, the results of the model testing the integration between Export and ECX prices, suggest that prices are integrated in the long run. Thus, the ECX does not have to follow the international coffee price when setting a price. Rather, it sets a range of prices for a trader to make a bidding. The price setting takes the previous day’s price as a reference point to protect traders from incurring a loss while exporting the coffee.

<table>
<thead>
<tr>
<th>Price pairs</th>
<th>ECX-Producer</th>
<th>Export-Producer</th>
<th>Export-ECX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NARDL model (1) with LR and SR asymmetry</td>
<td>NARDL model (2) with LR and SR asymmetry</td>
<td>NARDL model (3) with LR and SR asymmetry</td>
</tr>
<tr>
<td></td>
<td>$F_{PSS}$</td>
<td>$F_{PSS}$</td>
<td>$F_{PSS}$</td>
</tr>
<tr>
<td>Harar</td>
<td>16.07***</td>
<td>11.46***</td>
<td>12.19***</td>
</tr>
<tr>
<td>Jimma</td>
<td>9.73***</td>
<td>15.72***</td>
<td>74.98***</td>
</tr>
<tr>
<td>Sidama</td>
<td>9.50**</td>
<td>23.58***</td>
<td>13.54***</td>
</tr>
<tr>
<td>Wollega</td>
<td>38.06***</td>
<td>19.7***</td>
<td>17.21***</td>
</tr>
<tr>
<td>Yirgacheffe</td>
<td>34.8***</td>
<td>33.9***</td>
<td>26.9***</td>
</tr>
</tbody>
</table>

Notes: *** and ** indicate statistical significance at the 1% and 5% level, respectively. By taking a maximum lag of 4, a general-to-specific approach is used to reach the optimal lag length.
1.4.4 Asymmetric price transmission

Table 1.3 displays the results of the symmetry tests for producer-ECX, producer-export, and ECX-export prices as presented in equations 1, 2, and 3. The long-run test results fail to reject the null hypothesis of symmetry between producer and ECX price changes for all types of coffee. This implies that the prices of the different coffee types were transmitted symmetrically between producers to the ECX in the long-run. The Wald test for the short-run symmetric test was only significant for the prices of Harar coffee. Harar coffee showed both positive (SP+ = 1.21) and negative (SP- = 0.94) price transmission between producer and ECX prices (Table 1.4). In addition, the price transmission was larger for positive price changes than for negative changes. Such positive cumulative effects are fortunate for Harar coffee producers, even though they only last for a short time. The short-run price transmission for both Jimma (Sr = 1.58) and Sidama (Sr = 7.11) was detected only from the negative component. The coefficients indicate that a negative change in export price of 1%, resulted in a decrease of 1.58% and 7.11% in producer price of Jimma and Sidama coffee, respectively. The change in the price of Sidama coffee might appear relatively large, however, the effect in absolute value is rather small due to the low price that producers receive. As such, price changes are more sensitive when the changes occur at higher levels of the market.

Furthermore, the results of the Wald test rejected the null hypothesis of long-run price symmetry between producer-exporters for the price of Harar, Sidama, and Yirgacheffe coffees. The results also show an interesting interaction between the positive and negative price changes for the three types of coffee (Table 1.4). The Harar coffee price showed a significant transmission of negative price changes (Lp- = 0.43) between export and producer prices in the long-run, which suggests that only price decreases are transmitted in the long-run. Price transmission between export and producer prices for Yirgacheffe coffee were significant for both positive and negative price changes (Lp+ = 0.90, Lp- = 1.37). The magnitude of the negative price change is larger than that of positive price changes, which is unfavourable for Yirgacheffe coffee producers. The only type of coffee for which a positive price change transmission was found between export and producer prices in the long-run was Sidama
coffee (Lp+ = 5.98). The common characteristic of the coffees (Harar, Sidama, and Yirgachefe) that show a long-run price asymmetry between export and producer prices is that they are coffees that are better known for their quality and that are branded. The Wald test for the short-run symmetric test also revealed a significant transmission for the prices of Jimma and Sidama coffee.

Therefore, the long-run test results fail to reject the null hypothesis of symmetry between Exporter and ECX price changes for all five types of coffee. However, a negative price transmission between export and ECX prices for Harar coffee was found in the short-run (Sr− =0.22. Moreover, a decrease of 1% in the export price for Harar coffee lowers the price on the ECX by 0.22%. Although the effect is small, it is to the disadvantage of the traders in the ECX market as only negative price changes are transmitted. Furthermore, evidence of short-run asymmetric price transmission for the prices of Jimma and Sidama coffees was not found.
## Table 1.3 Long-run and short-run asymmetry test

<table>
<thead>
<tr>
<th>Price pair</th>
<th>Producer-ECX</th>
<th>Producer-Export</th>
<th>ECX-Export</th>
<th>ECX-Export</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NARDL model (eq. 1) with LR and SR asymmetry</td>
<td>NARDL model (eq. 4) with restricted SR</td>
<td>NARDL model (eq. 2) with LR and SR asymmetry</td>
<td>NARDL model (eq. 5) with restricted SR</td>
</tr>
<tr>
<td>Harar</td>
<td>W&lt;sub&gt;LR&lt;/sub&gt; -0.34 (0.45)</td>
<td>0.16 (0.77)</td>
<td>0.69 (0.04)**</td>
<td>0.69 (0.04)**</td>
</tr>
<tr>
<td></td>
<td>W&lt;sub&gt;SR&lt;/sub&gt; 2.15 (0.01)***</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Jimma</td>
<td>W&lt;sub&gt;LR&lt;/sub&gt; 1.76 (0.49)</td>
<td>1.76 (0.49)</td>
<td>0.84 (0.50)</td>
<td>-0.32 (0.77)</td>
</tr>
<tr>
<td></td>
<td>W&lt;sub&gt;SR&lt;/sub&gt; -</td>
<td>1.58 (0.00)***</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sidama</td>
<td>W&lt;sub&gt;LR&lt;/sub&gt; 0.41 (0.81)</td>
<td>0.41 (0.81)</td>
<td>6.60 (0.00)***</td>
<td>6.60 (0.00)***</td>
</tr>
<tr>
<td></td>
<td>W&lt;sub&gt;SR&lt;/sub&gt; -</td>
<td>-</td>
<td>5.43 (0.00)***</td>
<td>-</td>
</tr>
<tr>
<td>Wollega</td>
<td>W&lt;sub&gt;LR&lt;/sub&gt; 1.43 (0.36)</td>
<td>1.43 (0.36)</td>
<td>0.66 (0.58)</td>
<td>0.66 (0.58)</td>
</tr>
<tr>
<td></td>
<td>W&lt;sub&gt;SR&lt;/sub&gt; -</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Yirgachelle</td>
<td>W&lt;sub&gt;LR&lt;/sub&gt; -0.052 (0.96)</td>
<td>-0.05 (0.96)</td>
<td>2.28 (0.02)**</td>
<td>2.28 (0.02)**</td>
</tr>
<tr>
<td></td>
<td>W&lt;sub&gt;SR&lt;/sub&gt; -</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes: W<sub>LR</sub> denotes the Wald test for long-run symmetry defined by $\frac{-h_2^+}{h_1} = \frac{-h_3^-}{h_1}$; W<sub>SR</sub> denotes the Wald test for short-run symmetry defined by $\sum_{j=0}^v \mu_j^+ = \sum_{j=0}^v \mu_j^-$; p-values are written in brackets; *** and ** indicate statistical significance at the 1% and 5% level, respectively.
Table 1.4 The long-run and short-run positive and negative price coefficients

<table>
<thead>
<tr>
<th>Price pair</th>
<th>Type of relationship</th>
<th>Producer-ECX</th>
<th>Producer-Export</th>
<th>ECX-Export</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harar</td>
<td>Lₚ⁺</td>
<td>-</td>
<td>-</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td>Lₚ⁻</td>
<td>-</td>
<td>-</td>
<td>-0.43**</td>
</tr>
<tr>
<td></td>
<td>Sₚ⁺</td>
<td>1.21**</td>
<td>0.02</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Sₚ⁻</td>
<td>0.94**</td>
<td>0.04</td>
<td>0.22**</td>
</tr>
<tr>
<td>Jimma</td>
<td>Lₚ⁺</td>
<td>1.86</td>
<td>0.23</td>
<td>1.42</td>
</tr>
<tr>
<td></td>
<td>Lₚ⁻</td>
<td>0.092</td>
<td>0.94</td>
<td>0.58</td>
</tr>
<tr>
<td></td>
<td>Sₚ⁺</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Sₚ⁻</td>
<td>1.58***</td>
<td>0.00</td>
<td>-</td>
</tr>
<tr>
<td>Sidama</td>
<td>Lₚ⁺</td>
<td>0.90</td>
<td>0.35</td>
<td>5.98***</td>
</tr>
<tr>
<td></td>
<td>Lₚ⁻</td>
<td>0.48</td>
<td>0.63</td>
<td>-0.62</td>
</tr>
<tr>
<td></td>
<td>Sₚ⁺</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Sₚ⁻</td>
<td>-</td>
<td>-</td>
<td>7.11***</td>
</tr>
<tr>
<td>Wollega</td>
<td>Lₚ⁺</td>
<td>0.64</td>
<td>0.53</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td>Lₚ⁻</td>
<td>-0.79</td>
<td>0.35</td>
<td>-0.062</td>
</tr>
<tr>
<td></td>
<td>Sₚ⁺</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Sₚ⁻</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Yirgacheffe</td>
<td>Lₚ⁺</td>
<td>0.39</td>
<td>0.58</td>
<td>0.90*</td>
</tr>
<tr>
<td></td>
<td>Lₚ⁻</td>
<td>0.44</td>
<td>0.58</td>
<td>-1.37**</td>
</tr>
<tr>
<td></td>
<td>Sₚ⁺</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Sₚ⁻</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: Lₚ⁺, Lₚ⁻, Sₚ⁺, and Sₚ⁻ indicate the positive and negative long-run and short-run coefficients, respectively.


### 1.5 Robustness tests

Table 1.5 presents the results of serial correlation and autoregressive conditional heteroscedasticity tests as robustness checks. In all cases, the LM statistics were insignificant and therefore, no evidence of autocorrelation problems was found. The ARCH test was performed at the 5% confidence level and the results revealed that all price series are free from heteroscedasticity. Appendix II shows the results of the stability tests performed using the cumulative sum (CUSUM) test. Thus, the diagnostic results show that the above estimation results are free from model specification errors and are stable.

<table>
<thead>
<tr>
<th>Location</th>
<th>LM</th>
<th>Producer-export</th>
<th>ECX-export</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harar</td>
<td>4.89 (0.08)</td>
<td>4.22 (0.12)</td>
<td>1.28 (0.52)</td>
</tr>
<tr>
<td>Jimma</td>
<td>21.30 (0.67)</td>
<td>4.50 (0.80)</td>
<td>30.18 (0.26)</td>
</tr>
<tr>
<td>LM</td>
<td>1.62 (0.44)</td>
<td>1.09 (0.57)</td>
<td>0.61 (0.73)</td>
</tr>
<tr>
<td>Arch</td>
<td>2.78 (0.94)</td>
<td>16.15 (0.24)</td>
<td>1.80 (0.98)</td>
</tr>
<tr>
<td>LM</td>
<td>0.004 (0.99)</td>
<td>1.26 (0.53)</td>
<td>0.97 (0.61)</td>
</tr>
<tr>
<td>Arch</td>
<td>6.00 (0.64)</td>
<td>0.94 (0.33)</td>
<td>9.07 (0.33)</td>
</tr>
<tr>
<td>Sidama</td>
<td>1.47 (0.47)</td>
<td>1.18 (0.55)</td>
<td>0.17 (0.91)</td>
</tr>
<tr>
<td>Arch</td>
<td>0.001 (0.97)</td>
<td>3.32 (0.91)</td>
<td>9.77 (0.28)</td>
</tr>
<tr>
<td>Wollega</td>
<td>0.66 (0.71)</td>
<td>1.83 (0.39)</td>
<td>0.89 (0.63)</td>
</tr>
<tr>
<td>Arch</td>
<td>4.57 (0.80)</td>
<td>0.43 (0.50)</td>
<td>11.11 (0.19)</td>
</tr>
</tbody>
</table>

### 1.6 Conclusions

The link between market policy reforms and price transmission has been at the centre of debate within the commodity marketing literature due to its economic and welfare implications. Ethiopia, like other developing countries, relies heavily on a limited number of primary commodities, which makes policy interventions in these markets very sensitive to welfare effects. More specifically, the Ethiopian coffee sector, which accounts for the lion’s share of the country’s exports, is a source of livelihood for more than 15% of the population.
As the coffee sector is based on a long value chain, any policy implemented within the sector will have major repercussions.

Thus, the objective of this study has been to empirically investigate the market integration and price transmission symmetry for the five major types of Ethiopian coffee along the coffee value chain after the implementation of the ECX. The ECX aimed to establish an institutionalised Ethiopian coffee market. The introduction of the ECX was intended to overcome the major constraints observed in the coffee market, such as lack of adequate market information, lack of integration, lack of transparency, high marketing and transaction costs, lack of trust between buyers and sellers, collusion, and dominance of exporters. This study applied nonlinear autoregressive distributed lag models to capture the asymmetric responses in the prices at producer level from price changes at the ECX and export level, as well as the prices at the ECX level from price changes at the export level. Using monthly price data for the period 2008-2013, responses to both negative and positive price changes, as well as in the short- and long-run, were considered.

The results suggest that the prices of different coffee types are integrated between producers and the export and ECX level, and between the ECX and the export level. Furthermore, the results showed a symmetric price transmission between producer and ECX, except for Harar coffee, for which no evidence of short-run price asymmetry was found. The models of price transmission between producer and exporter prices further suggest the presence of both asymmetric and symmetric price transmission in the long- and short-run for Harar, Sidama, and Yirgacheffe coffee. The current results also indicate that the magnitude with which negative price changes between exporter and producer were transmitted is greater than that of positive price changes. Notably, the presence of price asymmetry for quality and branded Ethiopian coffees (Harar, Sidama, and Yirgacheffe) between the producer-exporter prices could point towards the importance of quality in price setting. Another important finding is the lack of asymmetric price relationships between the ECX and export markets for all types of Ethiopian coffee, except Harar coffee, for which a negative price transmission was found.
In general, there are various reasons for why exporters are more powerful in the Ethiopian coffee value chain. A first factor could be the increased market power of the existing coffee exporters. While the ECX increased competition at the level of the export, a World Bank (2014) study revealed that the largest exporters (selling more than 5 million USD per annum) carry out nearly 80% of coffee exports. The study further criticised that new exporters entering the market seem to face difficulties in terms of establishing trade, understanding the coffee markets, and accessing credit. These entry barriers allow existing exporters to collude and to create an oligopsonistic market. Secondly, the asymmetric price transmission coming from the exporter to the producer market could indicate a higher adjustment cost incurred by the exporters. When exporters have limited time to meet the import requests, they make adjustments at the expense of the producers.

Overall, the results suggest that exporters enjoy an absolute advantage over the coffee producers who experience a reduction in the price they receive when market prices go down, yet they do not receive a higher price when the market prices go up. The current results also highlight the limited capability of the ECX in achieving the goals it had set for creating an integrated and transparent market along the Ethiopian coffee value chain. However, considering the length of time that the ECX has been operating in the Ethiopian coffee market, and the disorganised and uncoordinated Ethiopian coffee market prior to the establishment of the ECX, it may be too early to conclude that the institutionalisation process is a failure. Policy measures aimed at empowering the coffee producers, and at the same time creating a competitive market both at ECX and export level, could further contribute towards an integrated and transparent coffee market in Ethiopia.

Improving the effectiveness of a commodity exchange remains a challenge in a dysfunctional producers’ and traders’ market. Improvements may be needed for better knowledge on quality and grading at the producer level. Since the number of traders and cooperatives operating at the producer level are few in number, establishing grading and inspection centres at the farm gate level would encourage producers to know the quality of the coffee that they supply and to use this information when bargaining with the traders.
Establishing such grading labs have been shown to have successful results in cooperatives supported by USAID in southern Ethiopia.

Furthermore, lowering the entry barriers to members at ECX could also improve transparency in the market. The high price to be paid for a membership seat in ECX is serving as a filtering mechanism for creating financially strong exporters which paves the way for collusion. Again, increasing the number of the exporters by itself does not guarantee the competitiveness of the export market. Therefore, ECX needs to set up an effective pricing scheme as a means for considering the capacity of the different exporters.

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