UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

Food price inflation in Ethiopia

A case study of price transmission and unofficial trade from Djibouti, Kenya and Sudan to Ethiopia

Author
Charlotte Lindberg, 890516-4946

Supervisor
Måns Nerman,
Department of Economics, University of Gothenburg

Abstract

During the recent global food price crises, in 2008 and 2011, Ethiopia had experienced an extreme inflation. The effect on long-term has been shown to determine the domestic prices which is a surprising result for a country like Ethiopia with a little international trade. However, the unofficial-trade has become an increasing matter in the region. By comparing food price data from Ethiopia, Djibouti, Kenya and Sudan over several years this thesis aim to test the price transmission between cities close to the border and by this state that the prices were transmitted by the unofficial trade. The overall result shows that the prices on the Ethiopian domestic markets are closer correlated with the prices in Addis Ababa than to the prices at the markets in Djibouti, Kenya and Sudan.

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1. Introduction

Since 2002, the world has experienced food price inflation with a peak in mid-2008. The Food and Agriculture Organization of the United Nations (FAO) food price index has doubled since 2002 (FAO, 2013) as well as wheat and maize prizes. Rice prices had the highest increase and at the peak had tripled compared to 2002. Several demand and supply factors have been used to explain the rising food prices such as the growing world population (especially in the developing countries), increasing food and feed demand, higher oil prices causing higher transport costs, higher demand of grains and oilseeds as a following of biofuel, low investments in agriculture and low prices leading to a declining food production. These long term factors in combination with some specific events like the Australian drought and the Chinese and Indian change of diet (people now eat more meat) and reduced stocks caused the outburst of the crises. (Hardy, 2010; Abbott and Borot de Battisti, 2011)

Ethiopia is one of the countries that have had the highest food price inflation effects in the world and this has since become a wildly discussed subject. Several studies have been made on why, how and who it affects. Although there is no consensus, it has been suggested that expansionary monetary policy, the rising international prices on food and oil, improved living and production conditions in rural communities and an overall too low agricultural output influence the food price inflation in Ethiopia (Alem & Söderblom, 2011; Rashid ,2010; Devereux, 2000).

In 2010, Durevall, Loening & Birru found that the long-term domestic prices in Ethiopia are determined by international food prices. It also states the limited imports, which denote, merely 5 percent of the agricultural GDP. Therefore, it is hypothesized in the paper that international prices should have only a small effect on the domestic market because of the small import.

Unofficial trade is large and having an increasing importance in the Horn of Africa. This is seen as a normal response to the difficult and time-consuming export regulations as well as to the distorted domestic prices in combination with a lower domestic supply than demand and not enough to secure food supply. It is also argued that several trans-border markets reflect long-standing trading patterns that are seen as more natural than today's formal trading channels (Little, 2010).

The aim of this thesis was to compare food price patterns over time; to test if unofficial trade transmits prices to the domestic market in Ethiopia from neighboring countries. The hypothesis tested was: Is the price trends on Ethiopian markets, in cities close to the border, more similar to the cities on the other side of the border, in the neighboring countries, than to Addis Ababa (the capital of Ethiopia). This was made to test if the reason of the long-run effects of the international prices is caused by unofficial trade.

The overall results of the comparisons could not confirm the stated hypothesis, which means it could not be proven that the prices were transmitted from the international market by unofficial trade. However, in some markets some effects were shown which give indications of that certain trade patterns or certain cities might have bigger influences than others on domestic markets.

This thesis is structured in following manner: Section two is background facts and previous research; the world food price inflation and the effect in Ethiopia as well as in Djibouti, Kenya and Sudan and about unofficial trade. The third section describes the methods used, presents the data and restrictions of this thesis. In section four the result is presented and section five gives the conclusions.

2. Background:

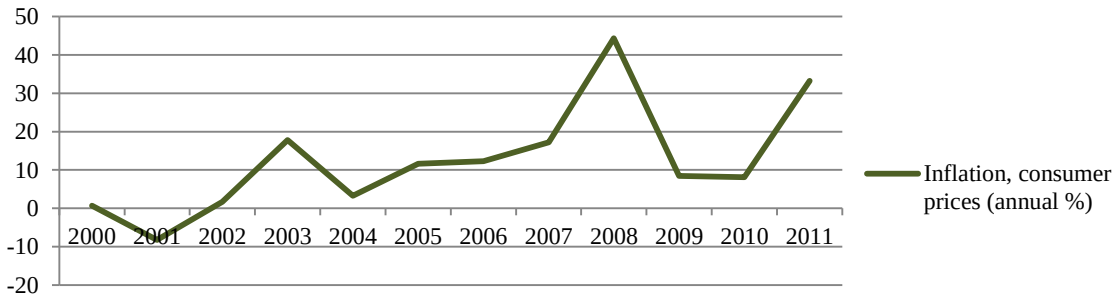
2.1. Ethiopia

Ethiopia is one of the most populated countries in the world with a population of 85 million (World Bank, 2013d). It is also one of the world's least developed countries; ranked 173 out of 186 in 2012 in the UNDP Human Development Index (UNDP, 2013). Since 1995 the amount of people living under the poverty line has decreased from 45.5 % to 29.6 % in 2011. (World Bank 2013c) The economy is based on agriculture which in 2011 was 46.4 % of the total GNP and 85% of the population was employed in that sector. (Central Intelligence Agency, 2013a)

2.1.1. Ethiopian food inflation

During the global food price inflation, Ethiopia was one of the countries in the world that had the highest increasing in inflation rate. The overall inflation increase was from 17.2 % to 44.4 % between 2007 and 2008. At the peak of the inflation in 2008 the Ethiopian food prices had increased on average 92.0 % in one year (Graph 1) (Alem & Söderblom, 2011).

Graph.1. Ethiopian Consumer Price Index



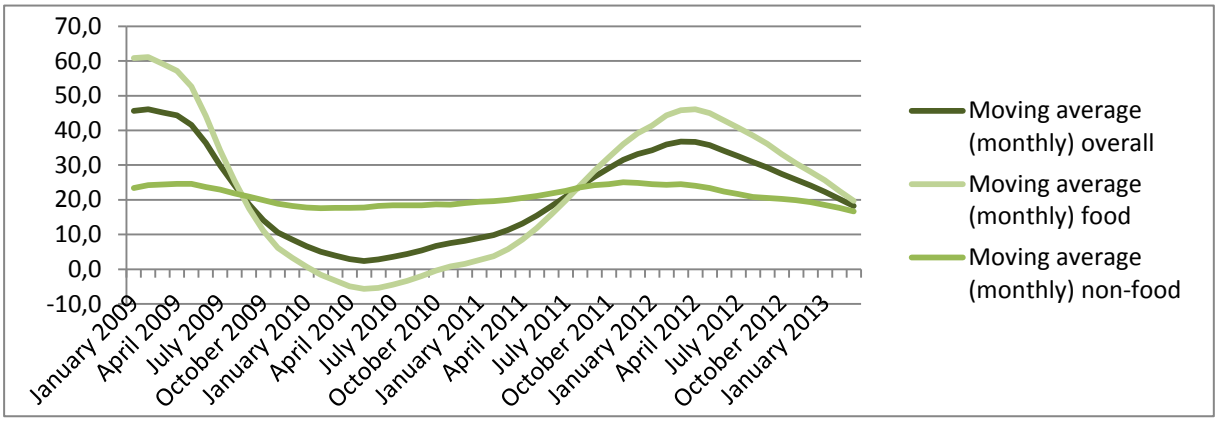
Annual percentage change of Ethiopian CPI, 2000-2011

Source: World Bank – World Development Indicator

In 2011, Ethiopia experienced a new peak in inflation (Graph 2). Some of the driving factors that have been discussed have been expansionary monetary policy that caused excess in the aggregated demand and the rising international prices on food and oil (Alem & Söderblom, 2011). Also, the drought in the Horn of Africa during 2011 has been discussed to have an effect (World Bank, 2011). Devereux (2000) proved that even in good rainfall years the farmers in Ethiopia do not have the capacity of producing enough food to provide for the demand. In 2012, Durevall and Sjö found that in the inflation on short- to-medium run money

growth and shocks in the agriculture supply have effects causing large deviations from the long-run effects that show that the world food price and exchange rate has impacts.

Graph 2. Ethiopian monthly price inflation



Ethiopian inflation 2009-2013, divided in to general inflation, food inflation and non-food inflation

Source: CBA Ethiopia – Consumer Price index

2.2.Djibouti

Formerly being a French territory, Djibouti has been an independent country since 1977. Djibouti is strategically located by the intersection of the Red Sea and the Gulf of Aden, east of Ethiopia and is an important link from Africa to Europe, the Middle East and Asia. The country is 23,200 km^2, although only 1000 km^2 is arable land, which makes Djibouti highly dependent on imports from other countries. The economy is a free-trade zone, heavily reliant on its ports, and the service sector accounts for 80.0% of the total GDP (Central Intelligence Agency, 2013b; World Bank, 2013e; World Bank, 2013f). Furthermore, as seen in Table 1, Djibouti has not experienced the same Consumer Price Index (CPI) inflation as Ethiopia, Kenya and Sudan.

In 2012 the population was estimated to be 859 700, with over 40.0 % living in extreme poverty (World Bank, 2013c). Djibouti is found far down in the human develop index, only slightly better placed than Ethiopia, at place 164 out of 186 (UNDP, 2013).

Table 1. Yearly Consumer price Index

	2004	2005	2006	2007	2008	2009	2010	2011
Djibouti	96,99	100,00	103,48	108,62	121,61	123,65	128,53	134,17
Ethiopia	89,60	100,00	112,31	131,67	190,12	206,22	223,00	297,09
Kenya	90,65	100,00	114,45	125,62	158,59	173,23	180,09	205,34
Sudan	92,15	100,00	107,20	115,75	132,31	147,19	166,31	

Source: World Bank, 2013i – World Development Indicator

2.3. Kenya

In 1968 Kenya became independent and is located south west of Ethiopia. The population in 2012 was estimated to 43.18 million and almost 46% lived under the poverty line in 2005. The agricultural sector accounts for 24.2% of GDP, despite the fact that it employs 75.0 % of the labor force (Central Intelligence Agency, 2013c; World Bank, 2013g). Kenya is ranked 139 out of 176 as the most corrupted countries in the world, where a ranking of 1 is considered the least corrupted country (Transparency International, 2012). Furthermore, this is especially due to the police and the legal system, which is considered extremely corrupted (Transparency International, 2013). Nonetheless, Kenya is considered to be the most developed country, of the four in this study, and is ranked 145 out of 186 in the Human Develop Index (UNDP, 2013). As seen in Table 1 Kenya has had a high CPI increase, and the CPI more than doubled between 2005 and 2011.

2.4.Sudan

Sudan is located north of Ethiopia and borders the Red Sea, between Eritrea and Egypt. Since the declaration of independence from the United Kingdom in 1956 Sudan has been embroiled in two long-lasting civil wars during most of this time and since 1989 has been ruled by a military regime. The final peace agreement was signed in 2005 and resulted in 2011 in the independence of South Sudan. Oil has been one of the economy's driving factors, however, the region of South Sudan accounted for about three fourths of the oils production and after the independence of South Sudan, Sudan has struggled to maintain a balanced economy (Central Intelligence Agency, 2013d). Consequently, Sudan is ranked 171 (out of 186) at the Human Development Index (UNDP, 2013) and is considered to be one of the world's most corrupted countries, ranked 173 out of 174 (Transparency International, 2012).

The population was estimated to 37.20 million in 2012, furthermore, in 2009 46.5 % of the population was living below the poverty line (World Bank, 2013h). The agricultural sector accounts for 27.6 % of the total GDP, however, 80.0 % of the labor force is employed in this sector (Central Intelligence Agency, 2013d). Sudan also has experienced a rapid increase in the CPI over the last years, with a total increase of 66.3 % between 2005 and 2010 (Table 1).

2.5.Unofficial trade in the Horn of Africa

The official trade in the Horn of Africa is known to be very small and limited. Trade with Ethiopia consists of manufactured items imported from Kenya and exports of vegetable and

chat (a drug) to Djibouti and Northern Somalia. Unofficial trade, on the other hand, is estimated to be large and having an increasing importance. Furthermore, unofficial trade is considered as a normal reaction to the difficult and time-consuming export regulations, thus, these regulations were implemented to increase and help the regional trade. The domestic supply does not cover the domestic demand, increasing the need for imports. Furthermore, the trans-border markets reflect the long-standing trading patterns. These patterns are considered to make more sense than the new formal trading channels and this is argued as another reason for the increasing unofficial trade. Moreover, evidence shows that for all the livestock, bulk of coffee, vegetables and chat which is smuggled from Ethiopia to neighbor countries, manufactured goods are imported in return, confirming the large unofficial trade. (Teka & Azeze, 2002; Little, 2010)

3. Method

3.1. Price transmission

The aim of this thesis is to investigate whether domestic prices are transmitted from the neighbor countries. To test this, food price data over time was used from different markets in Ethiopia, Djibouti, Kenya and Sudan. This data was compared to see if similar patterns over time could be found and the prices were transmitted between the cities, despite records of low trade. From this, conclusions can be made that unofficial trade has an effect of the domestic prices in Ethiopia.

The hypothesis tested was: is the Ethiopian border cities have more similar price trends with border cities in Kenya, Djibouti and Sudan compared to price trends in Addis Ababa.

3.2.Empirical model

To test similar hypotheses a model to measure the price transmission is mostly commonly used. The most used model for measuring price transmission is "Law of one price" (Mundlack and Larson, 1992) and was also used in this thesis. In this thesis it was used to try the hypothesis if Ethiopian border cities have a more similar price trend with border cities in neighbor countries than with Addis Ababa. The equation used was:

$$Y_{mc} = \alpha + \beta_1 X_{mc} + \ldots + \beta_n X_{mc} + \epsilon$$

Where Y is the dependent variable and is the price index for the border city in Ethiopia, mc is a notation for which market and which commodity type. α is the intercept, the coefficient β is the correlation of price on market X_{mc} with respect on market Y_{mc}. This will be referred as the transmission correlation and it will be the basis of the analysis. β_1=1 means prefect transmission; if the rate of change in Y_{mc} is 1 the rate of change in X_{mc} will also will be equal to 1. $\beta_1 \neq 1$ means no perfect price transmission. Ex. β_1=0.5 means when the rate of change at market X_{mc} rises with 1 unit the price index in market Y_{mc} only rises with 0.5 units. X_{mc} is the price index in the cities which will be compare with the price index in Y_{mc}, either border cities in Djibouti, Kenya, Sudan or Addis Ababa. ϵ is the error term. An multiple OLS regressions with panel data was used where the market code (Y_{mc} and X_{mc}) was the panel variable and the time variable was the month and year.

3.3. Data

The underlying food price data (World Bank, 2013a) is collected from World Food Program (WFP) which is a United Nations (UN) organ. It is the biggest humanitarian food organization in the world. In 2011, WFP provided food to 99.1 million people in 75 countries (WFP, 2013b). This source was the most complete and largest database for food prices. Since it is a UN organ, it is considered to be reliable and believed to have as accurate prices as possible. Furthermore, the database also provides data from all the countries of interest, which can be considered good, since all observations are approved to be in the database by the same conditions.

The data consists of monthly prices from the markets of interest and for three different commodities; wheat, maize and sorghum. In the raw data the units varied, but all prices have been recalculated to price per kilogram to get prices for the same amount of the commodity.

Every month in every year was given an individual time variable (timevar) to make it possible to compare each monthly observation at the dependent market with the observation for that month at the independent market in the OLS regressions. January 2003 was the earliest observation in the raw data and was given the number 1. This gives the base month January 2009 the number 73. These numbers was used in the result for estimations in the graphs.

To reduce the effect of the general inflation a monthly consumer price index (CPI) was used to deflate the prices. The reason for this was to get an as isolated food price inflation as possible and therefore the effect of the general inflation is not desired. A yearly CPI from the World Bank's World develop indicators database were collected (Table 1). An estimated monthly CPI was calculated by dividing the yearly inflation by twelve and let the monthly CPI grow linear over each year. This estimation of monthly growth was chosen because the inflation rates during the last couple of years had risen a lot in these countries. It was considered that an estimated monthly CPI index would get a better deflation of the food prices than to deflate with yearly CPI. To deflate the food prices, the estimated monthly CPI was divided by 100 and then the price per kilogram was divided with this value. This reduced the effect of general inflation and price series with deflated food prices was created.

In the raw data the prices were in domestic prices which are not desired since not the same currency is used in all countries. To reduce the effect of different currencies, a price index was created for each market and different commodities. The index gives the relative change

compared to the base month. This was preferred over recalculate the domestic prices to the same currency with the exchange rate and includes exchange rate inflation. January 2009 was used as base month, which means that all prices were divided by the price on January 2009 for each commodity at each market. So for all commodities at all markets, the index value of January 2009 is 1. The other months has the index value of the price for that month in relation to the price of January 2009.

Furthermore, in the raw data some prices were retail and some wholesale which could generate different price levels. Hence, with the price index, this was not a problem. The price index was relative changes to the base month and the markets either had retail or wholesale over the whole time period. Therefore, no difference was made with regard to the price types and in the regressions they were compared equally.

Table 2 below is an overview over the amount of observation per regression, which commodity and which Ethiopian market that is the dependent market. The numbers in the brackets corresponds to the specific market, commodity and price type. The numbers is derived like this: ABBCD, where A corresponds to the country (1=Sudan, 2=Djibouti, 3=Kenya, 6=Ethiopia), BB is random number for the specific market, C is the commodity (1=Maize, 2=Sorghum, 3= Wheat) and D corresponds to the price type (0=Wholesale, 1=Retail).

Table 2. Amount of observations per regression

Djibouti, Wheat

Ethiopian dependent market	Mekele (60130)	Dire Dawa (61131)	Jijiga (61231)
Obesrvations	52	53	50
No. independent markets	6	6	6
Total observations	364	371	350

Independent markets: *Djibouti: Ali Sabieh (20231), Dikhil (20331), Arta (20431), Tadjourah (20531), Obock (20631) Ethiopia: Addis Ababa (60430)*

Kenya, Maize

Ethiopian dependent market	Yabelo (66211)	Gamo Gofa (63711)	Gode (63811)
Obesrvations	75	56	76
No. independent markets	3	3	3
Total observations	300	224	304

Independent markets: *Kenya: Mandera (30811), Lodwar (30911) Ethiopia: Addis Ababa (60410)*

Sudan, Wheat

Ethiopian dependent market	Gonder (63930)	Mota (65031)
Obesrvations	47	36
No. independent markets	4	4
Total observations	235	180

Independent markets: *Sudan: Kassala (10231), Kosti (10431), Al-Damazin (10731) Ethiopia: Addis Ababa (60430)*

Sudan, Sorghum

Ethiopian dependent market	Mekele (60120)	Gonder (63920)	Metu (64821)
Obesrvations	69	69	56
No. independent markets	4	4	4
Total observations	345	345	280

Independent markets: *Sudan: Kassala (10221), Kosti (10421), Al-Damazin (10721) Ethiopia: Addis Ababa (60420)*

3.4. Focus and restriction

This thesis's focus was a comparison between Ethiopian cities and cities in Djibouti, Kenya and Sudan. This was because the access to quality data in these countries was possible. For Somalia and Eritrea, on the other hand, the lack of data has made it impossible to include those countries in this study. Since South Sudan became independent in July 2011 (World bank, 2012) it was not possible to find any good data for price inflation so that was why South Sudan not was included in this study. The raw data consisted of 13 261 monthly price observations from Ethiopia, Djibouti, Kenya, Sudan, South Sudan and Somalia. Most of them were from Ethiopia and in total 8 304 of them. By looking at the distance on the map between the cities that had available price observations for the same commodities the cities that was going to be used in the comparisons were chosen.

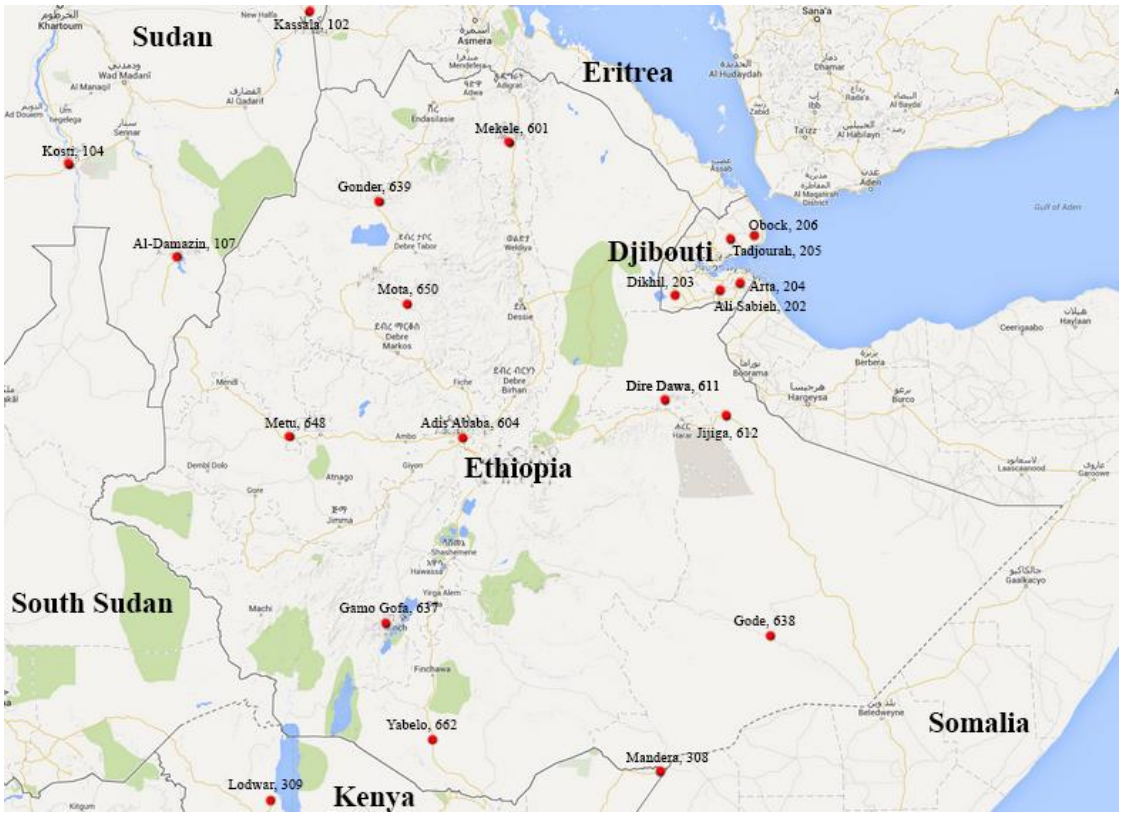
South Arabia and India are two of Ethiopia's biggest trade partners (European Trade Commission, 2011). Moreover, Ethiopia is a landlocked country and because of conflicts with Eritrea and Somalia (RULAC, 2013) it is reasonable to believe that Ethiopia is using the port in Djibouti as their main port. Therefore, prices in Ethiopia are compared with all cities in Djibouti with accessible data. The assumption is that if goods are transported from Ethiopia to the harbor in Djibouti, unofficial trade is possible anywhere along the way. Hence, all the cities in Djibouti are considered border cities[1]. Furthermore, Djibouti is a small country, in

[1] Cities close to the border that is used for comparison will be referred to as "border cities".

relation to Kenya and Sudan, and all the Djiboutian cities are within reasonable driving distance in comparison to the other countries.

For Kenya and Sudan the cities closest to the border by looking at the map where quality data were available were chosen.

Graph 3. Map with location of cities in comparison



Note: the locations are not exact, but an estimation.

Source: maps.google.com

3.5. Methodology and source criticism

The lack of complete and quality food price data complicated the work. Though, there was a lot of high quality data in Ethiopia; the situation is not the same in the neighboring countries. With the available data, eleven regressions were possible. Most of those regressions contained monthly observations for several years until 2012, including both the price inflation shocks, in 2008 and 2011. The exception was the two regressions for wheat prices in Ethiopia and Sudan, which only included data over the price inflation shock in 2008 and not in 2011.

For deflating the prices, a monthly non-food price inflation index would have been preferred. This would have taken away all the inflation that not was the food price inflation. The real monthly inflation instead of estimated inflation would also have better isolation the food price

inflation. Moreover, it is proven that food and non-food inflation behave very differently (Durevall, Loening & Birru, 2010), which also can be seen for Ethiopia in figure 2. The figure shows the differences in inflation in Ethiopia and chances are that similar differences can be found in the other countries as well. However, it was not possible to find equal indexes for the other countries in the comparison and since equal price deflation method for all countries was preferred this index for Ethiopia was not used. With the used method, the CPI, it is possible that some effects of the food inflation are reduced which might not have given the optimal outcome; food price inflation might be lower than the reality.

For the distance between the cities, Google maps preferred travel way was used as an estimation of the distance. This was used to test if there was any change in the price transmission depending on the distance of the cities. However, it was not an estimation of how the actual trading patterns are but since the infrastructure in the countries at the Horn of Africa is very poor (Little, 2005), this was believed to still be a good enough estimation for these comparisons.

4. Result

The results were first compared in graphs to visibly see how the price indexes changed over time. This was to get an indication if there were some common patterns for all the comparisons. Then to test more precisely how the patterns for the price index correlates an OLS regression was made. The regressions were made with an Ethiopian border city as the dependent variable and the border cities in the neighbor country, as well as Addis Ababa, were used as independent variables. As explained in section 3, the coefficients for the independent variables are the measurement for the price transmission. In table 3 the time variables mentioned in the result is interpreted as the month and year they represent as well as time variable 1.

Table 3. Time variable values of months and year

Timevar	Month	Year	
1	January	2003	
60	December	2007	
73	January	2009	*base month*
90	June	2010	
100	April	2011	

4.1. Djibouti and Ethiopia

4.1.1. Wheat

Most of the wheat prices in border cities in Djibouti had low correlated to cities in Ethiopia (Table 3). However, a few coefficients were statistically significant and gave results to interpret.

In this comparison the price index for the Ethiopian cities Mekele respectively Jijiga looks like they was following a closer pattern to the borders cities in Djibouti then to Addis Ababa, between month 73 (January 2009) and month 100 (April 2011), which is visibly shown in graph 4 and 6. Suggesting that the prices been transmitted from Djibouti. Furthermore, this was also robust tested by the OLS regression (table 4) and a significant high correlation between Jijiga and the Djiboutian city Ali Sabieh was proven. The price transmission coefficient given was 1.112 which means when the price index in Jijiga increased with 1 unit

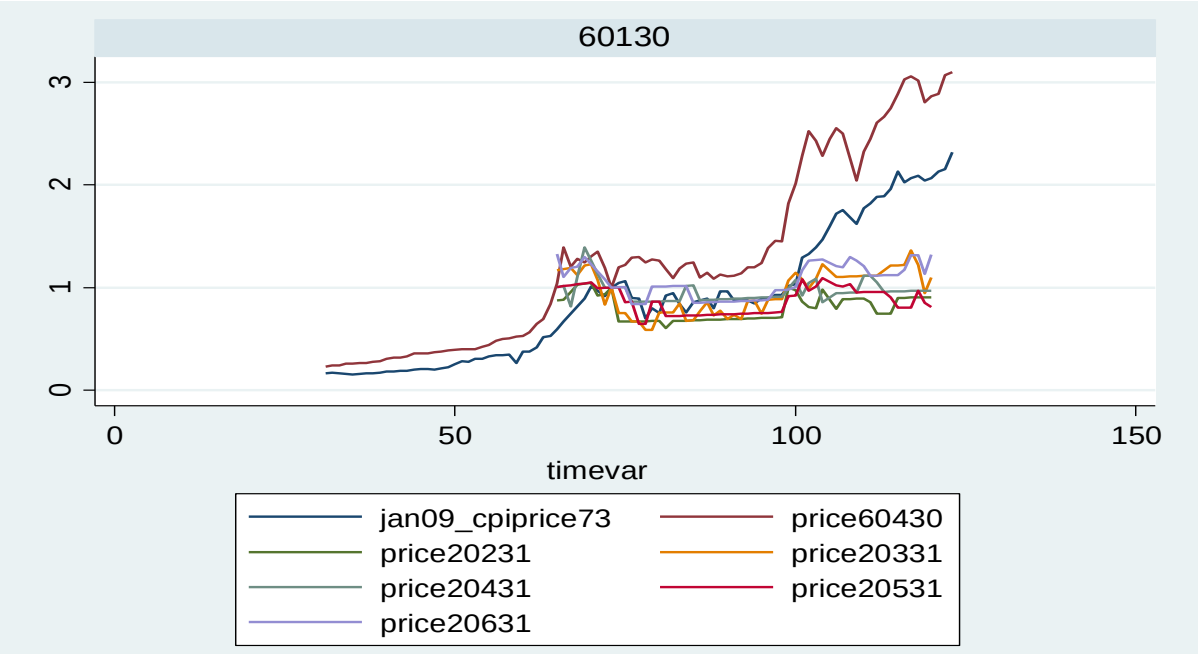
the price in Ali Sabieh on average was increased by 1.112 units. This result suggests that the price on the Djiboutian markets might have an effect on the domestic prices in Ethiopia.

In 2011, when the second price inflation shock occurred, the Ethiopian prices (Ethiopian border cities and Addis Ababa) increased more rapidly than the prices in Djiboutian cities, which indicates on a low level of price transmission from Djibouti over the last two years. This is shown very clearly in the graphs 4-6, around month 100 (April 2011) the price indexes in Ethiopia is separated from the Djiboutian indexes and rises in a higher speed. Furthermore, the graphs show that the Djiboutian price indexes stay more or less around the same price level but the Ethiopian price index increases to price levels between 2 and 4 times the base month (January 2009) after 2011.

The overall result shows that the prices were higher correlated with Addis Ababa then the border cities in Djibouti. Nevertheless, as mentioned above, the correlation between Jijiga and Ali Sabieh show that it is possible that the domestic prices are affected by the Djiboutian market prices.

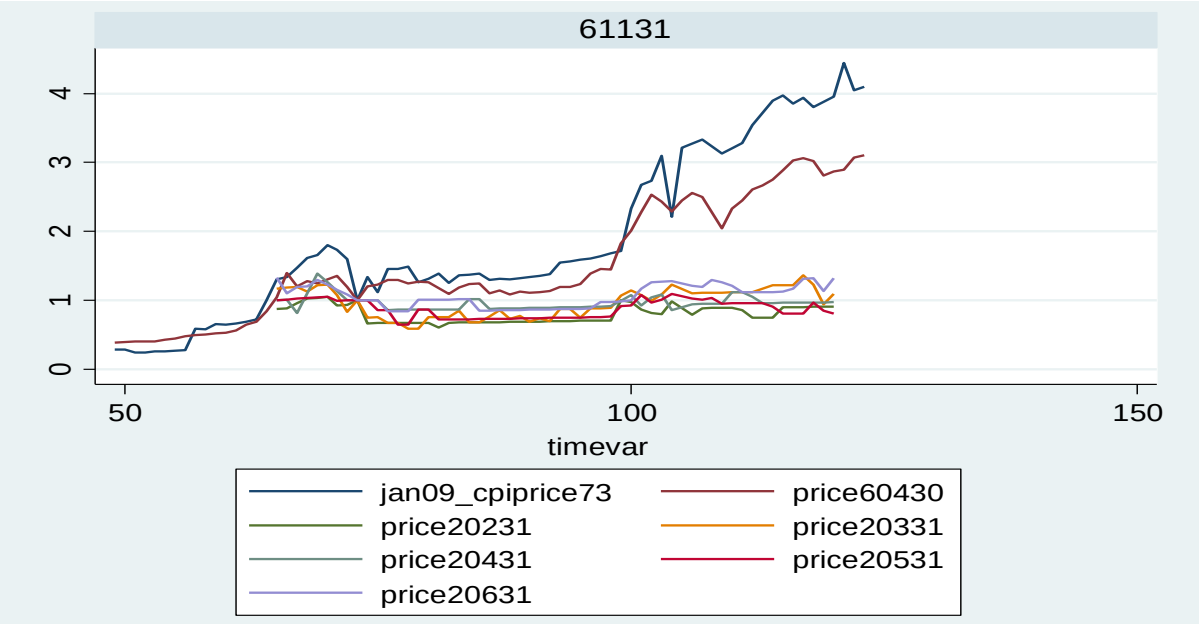
The difference in the distance does not seem to have any bigger effect on the correlations; however, it seems like Melkele has the overall lowest correlation with all the other cities, which also is the city located at the longest distance.

Graph 4. Price index Wheat, Djibouti and Ethiopia – Mekele (60130)



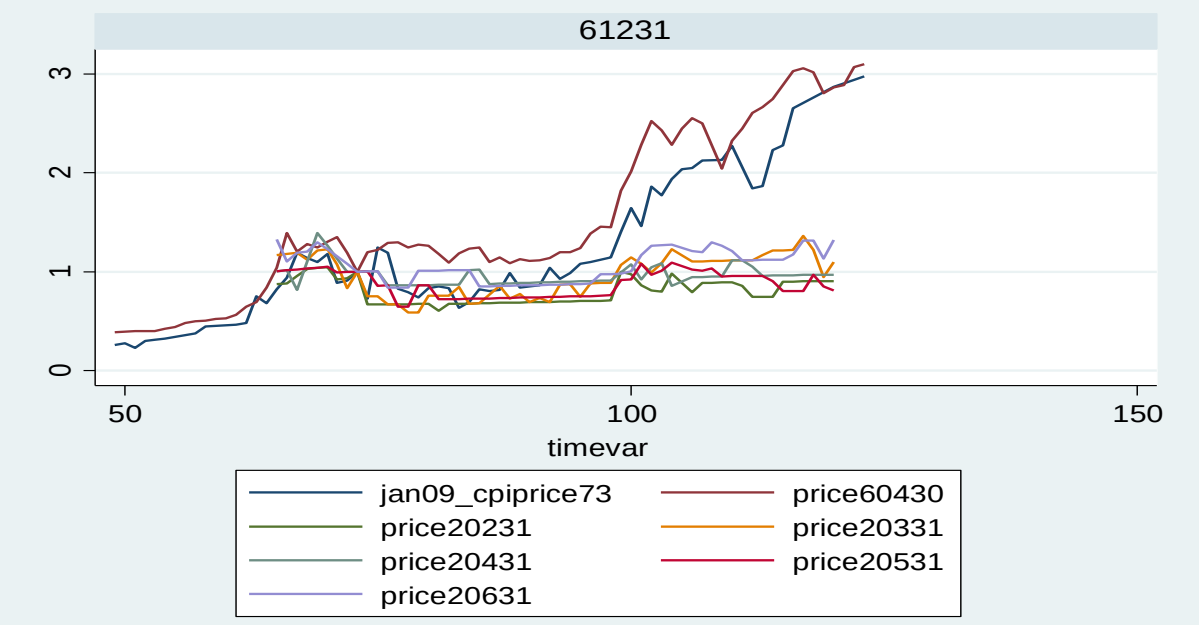
Ehtiopia: Melekle (jan09_cpiprice73 Addis Ababa (60430)), Djibouti: Ali Sabieh (20231), Dikhil (20331), Arta (20431), Tadjourah (20531), Obock (20631) Addis Ababa (60430)

Graph 5. Price index, Wheat Djibouti and Ethiopia - Dire Dawa (61131)



Ethiopia: Dire Dawa (jan09_cpiprice73), Addis Ababa (60430) Djibouti: Ali Sabieh (20231), Dikhil (20331), Arta (20431), Tadjourah (20531), Obock (20631)

Graph 6. Price index Wheat, Djibouti and Ethiopia - Jijiga (61231)



Ethiopia: Jijiga (jan09_cpiprice73), Addis Ababa (60430), Djibouti: Ali Sabieh (20231), Dikhil (20331), Arta (20431), Tadjourah (20531), Obock (20631)

Table 4. Test of price transmission from Djiboutian cities to Ethiopian cities. OLS regression of wheat price index

	Price index 60130 (Mekele)	Price index 61131 (Dire Dawa)	Price index 61231 (Jijiga)
Price Index 20231 (Ali Sabieh)	-0.016	-0.227	1.112
	(0.348)	*(0.478)*	*(0.413)**
Price index 20331 (Dikhil)	-0.009	0.270	-0.071
	(0.251)	*(0.341)*	*(0.306)*
Price index 20431 (Arta)	0.143	0.619	-0.327
	(0.302)	*(0.365)***	*(0.319)*
Price index 20531 (Tadjourah)	-0.223	-0.805	-0.766
	(0.293)	*(0.405)***	*(0.360)**
Price index 20631 (Obock)	-0.001	0.323	0.422
	(0.290)	*(0.396)*	*(0.343)*
Price index 60430 (Addis Ababa)	0.662	1.343	0.801
	*(0.054)**	*(0.068)**	*(0.063)**
Const.	0.140	-0.507	-0.289
	*(0.228)***	*(0.300)***	*(0.257)*
Number of obs.	52	53	50
R-squared	0.8978	0.9558	0.9090
Adj R-squared	0.8842	0.9500	0.8964

**=sig. 5% level, **=sig. 10% level*

Tabel 5. Driving distance in kilometers

	Mekele	Dire Dawa	Jijiga
Ali Sabieh	788	229	396
Dikhil	759	278	445
Arta	770	298	465
Tadjourah	787	394	562
Obock	969	577	744
Addis Ababa	772	449	631

Distances are estimated by Google maps suggested driving directions.

4.2. Kenya and Ethiopia

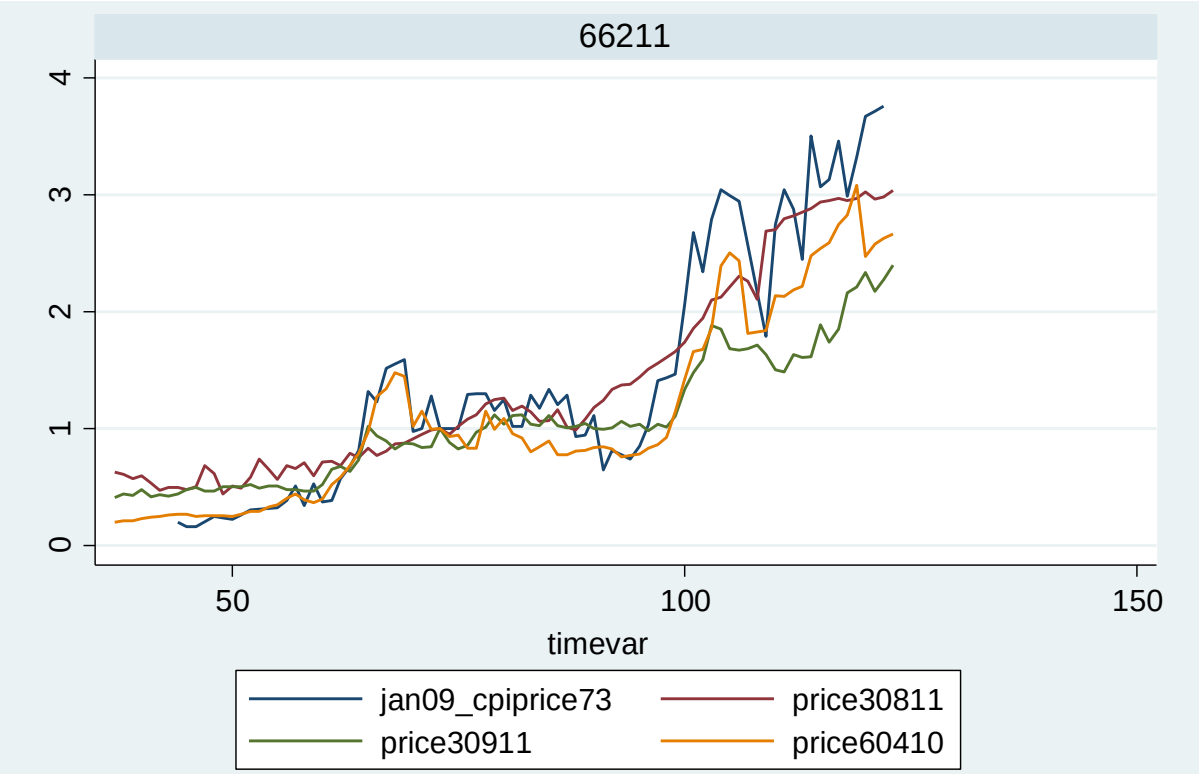
4.2.1. Maize

The graphs 7-9 in this comparison between Kenya and Ethiopia of Maize prices shows that the two cities in Kenyan cities have similar patterns respectively the Ethiopian cities follow the same rate of change until around month 90 (June 2010). After this time the graphs shows different results. Graph 7 shows that the Kenyan city Mandera had a price level between the Ethiopian cities Yabelo and Addis Ababa. Graph 9, for the comparison with the Ethiopian city Gamo Gofa, show that after month 90 the Kenyan cities continues on very different price levels, Lodwar had a lower increase in the prices compared to Mandera. Moreover, the Ethiopian cities (Gamo Gofa and Addis Ababa) had an increase between these two cities. In graph 9 there is a completely different pattern, after month 90 compared to graph 7 and 9. The Ethiopian city Gode increases in a much higher speed than the other cities and Addis Ababa and the Kenyan cities seems to have a close correlation.

Moreover, by looking at table 6 the results show some significant correlation between the border cities and the highest correlation is between Gode and Mandera. The price transmission coefficient is 0.944, which means that when the price index in Gode increases with 1 unit the price index in Mandera on average increases with 0.944 units, which can be considered as a high correlation. Looking at the driving distances, Madera is quite far from Gode compared to the other Ethiopian cities Yabelo and Gamo Gofa, that have much lower price transmission. However, by looking at the map, Mandera is just at the border to Ethiopia and Somalia, quite close to Gode, suggesting that the distance between the cities actually might have an effect on the price transmission. It is possible that other trade routes are used or other effects, not included in this study, have an increasing effect at the price transmission. Furthermore, Gode has the longest distance to both Lodwar and Addis Ababa and the correlation for these cities are lower than for Yabelo and Gamo Gofa, indicating that the distance has an effect.

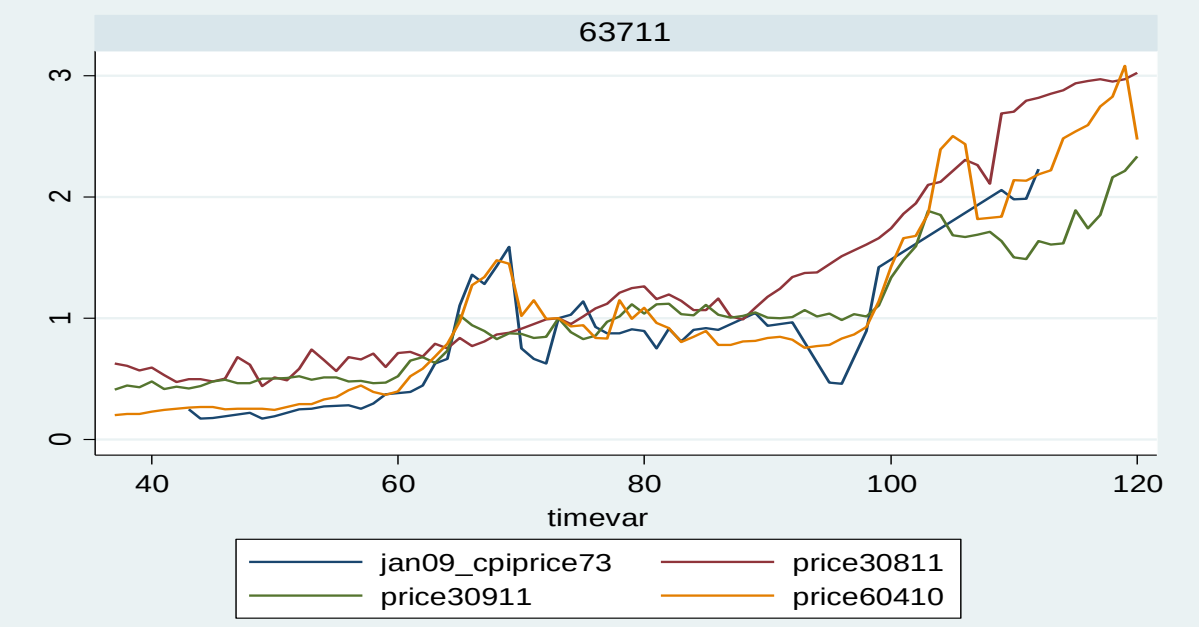
The overall results, however, shows that the Ethiopian border cities have a higher correlation with Addis Ababa then the border cities in Kenya but also correlation between some of the border cities indicate that the Kenyan food prices also have an effect on the Ethiopian prices.

Graph 7. Price index Maize, Kenya and Ethiopia - Yabelo (66211)



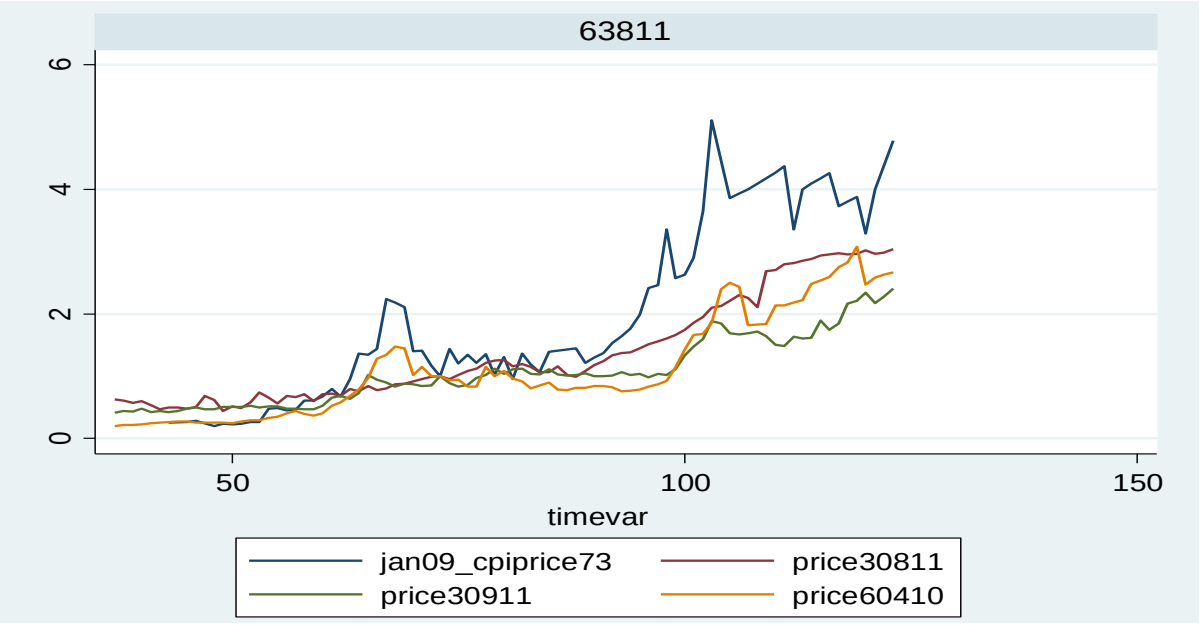
Ehtiopia: Yabelo (jan09_cpiprice73), Addis Ababa (60410,) Kenya: Mandera (30811), Lodwar (30911)

Graph 8. Price index Maize, Kenya and Ethiopia - Gamo Gofa (63711)



Ehtiopia: Gamo Gofa (jan09_cpiprice73), Addis Ababa (60410,) Kenya: Mandera (30811), Lodwar (30911)

Graph 9. Price index Maize, Kenya and Ethiopia - Gode (63811)



Ehtiopia: Gode (jan09_cpiprice73), Addis Ababa (60410,) Kenya: Mandera (30811), Lodwar (30911)

Table 6. Test of price transmission from Kenyan cities to Ethiopian cities. OLS regression of maize price index

	Price index 66211 (Yabelo)	Price index 63711 (Gamo Gofa)	Price index 63811 (Gode)
Price Index 30811 (Mandera)	0.117 *(0.105)*	-0.071 *(0.084)*	0.944 *(0.226)**
Price index 30811 (Lodwar)	0.523 *(0.186)**	0.354 *(0.180)***	0.160 *(0.383)*
Price index 60410 (Addis Ababa)	0.871 *(0.111)**	0.891 *(0.094)**	0.612 *(0.233)**
Const.	-0.315 *(0.078)**	-0.179 *(0.070)**	-0.292 *(0.158)***
Number of obs.	75	56	76
R-squared	0.9535	0.9215	0.8841
Adj R-squared	0.9516	0.9169	0.8793

=sig. 5% level, *=sig. 10% level*

Table 7. Driving distance in kilometers

	Yabelo	Gamo Gofa	Gode
Mandera	631	970	1225
Lodwar	1473	2020	2361
Addis Ababa	564	434	999

Distances are estimated by Google maps suggested driving directions.

4.3. Sudan and Ethiopia

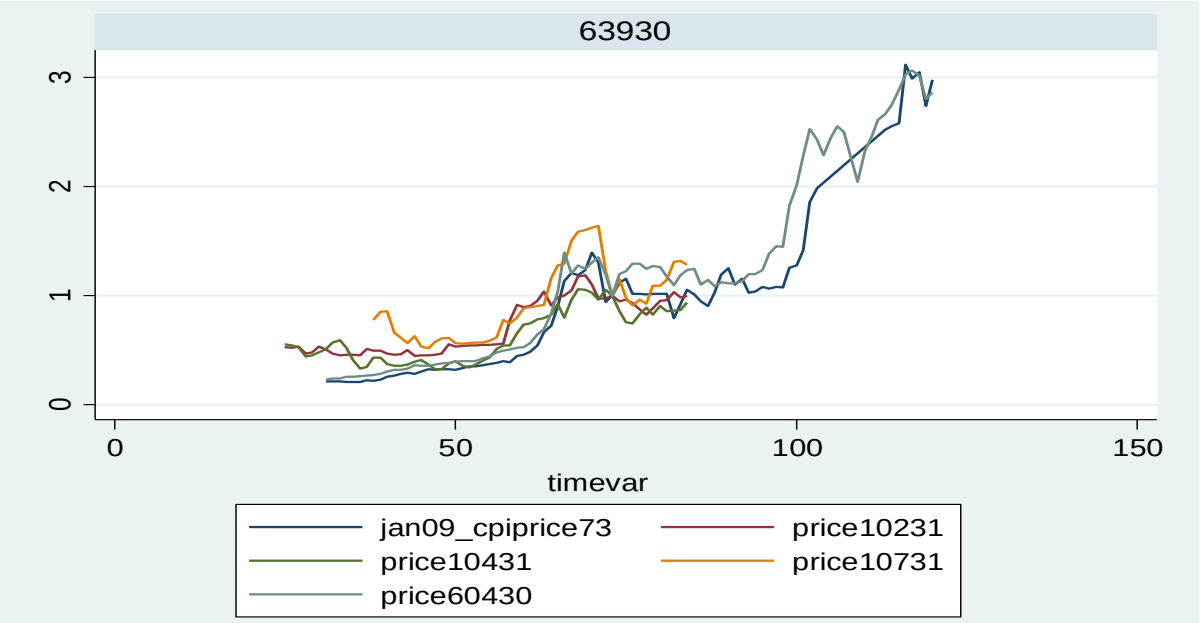
4.3.1. Wheat

The wheat prices in Sudanese border cities and the Ethiopian border cities, Gonder and Mota , seem to be quite highly correlated by looking at the graphs 10 and 11. What can be noticed is that is that the Ethiopian border cities as well at Addis Ababa is starting at a lower index level and seems to have a more rapid increase, around month 60 (December 2007). This is in the beginning of the world inflation shock, which peaked in mid-2008. Furthermore, the graphs 10 and 11 show the pattern of that both Ethiopia and Sudan were affected by the global food price shock, in 2008, but that Ethiopia had a bit more rapid increase since the start on a lower level. Unfortunately, because of the lack of data, there are no possibilities to test the correlation of the prices over the second price inflation chock.

Moreover, when looking at table 9 there is barely any correlation between the Ethiopian border city and the Sudanese border cities. The table shows coefficients close to zero meaning that there is no indication of price transmission. Nonetheless, only two of the coefficients show significant results, and one of them is Addis Ababa, indicating that there is no correlation between the cities.

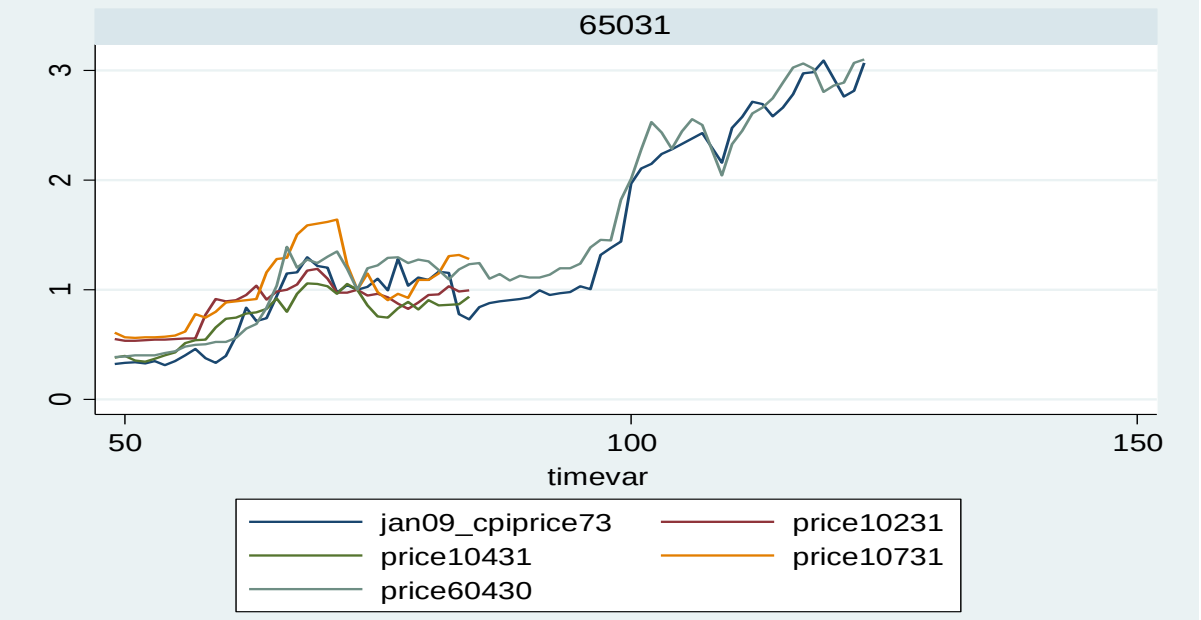
Furthermore, for this regression we can also see that the distance between the cities does not seem to have any effect. However, the suggested route from Google maps to Al-Damazin was through South Sudan but by looking at the map Al-Damazin is much closer as the crow flies and it is possible that other routs may be preferred. Al-Damazin is the only Sudanese border city that shows any significant results, however, with a low coefficient of 0.195 indications that the wheat prices in Sudan has a low effect on the prices in Ethiopia. Nevertheless, in this correlation consists of only price observations for three years, which was considered enough to include the comparison in this study but can have had an effect on the low result.

Graph 10. Price index Wheat, Sudan and Ethiopia - Gonder (63930)



Ehtiopia: Gonder (jan09_cpiprice73), Addis Ababa (60430), Sudan: Kassala (10231), Kosti (10431), Al-Damazin (10731)

Graph 11. Price index Wheat, Sudan and Ethiopia - Mota (65031)



Ethiopia: Mota (jan09_cpiprice73), Addis Ababa (60430), Sudan: Kassala (10231), Kosti (10431), Al-Damazin (10731)

Table 8. Test of price transmission from Sudanese cities to Ethiopian cities.

OLS regression of wheat price index

	Price index 63930 (Gonder)	Price index 65031 (Mota)
Price Index 10231 (Kassala)	0.056	0.254
	(0.148)	*(0.296)*
Price index 10431 (Kosti)	-0.020	0.240
	(0.178)	*(0.320)*
Price index 10731 (Al-Damazin)	0.195	-0.103
	*(0.074)**	*(0.151)*
Price index 60430 (Addis Ababa)	0.735	0.716
	*(0.061)**	*(0,111)**
Const.	-0.110	-0.147
	*(0.041)**	*(0.100)*
Number of obs.	47	36
R-squared	0.9672	0.8921
Adj R-squared	0.9640	0.8782

**=sig. 5% level, **=sig. 10% level*

Table 9. Driving distance in kilometers

	Gonder	Mota
Kassala	435	838
Kosti	811	1076
Al-Damazin	1404	1609
Addis Ababa	726	369

Distances are estimated by Google maps suggested driving directions.

4.3.2. Sorghum

This price comparison with sorghum between the Ethiopian cities (Mekele, Gonder and Matu) and Sudanese cities (Kassala, Kosti, Al-Damazin) consists of data between 2005 until 2012 total gives 69 observations for the regressions made with Mekele and Gonder and 56 observations in the regression with Matu.

In the graphs 12-14 all the markets seems to follow similar patterns during "normal times", namely, not during periods of inflation crises in 2008 and 2011. Furthermore, what is

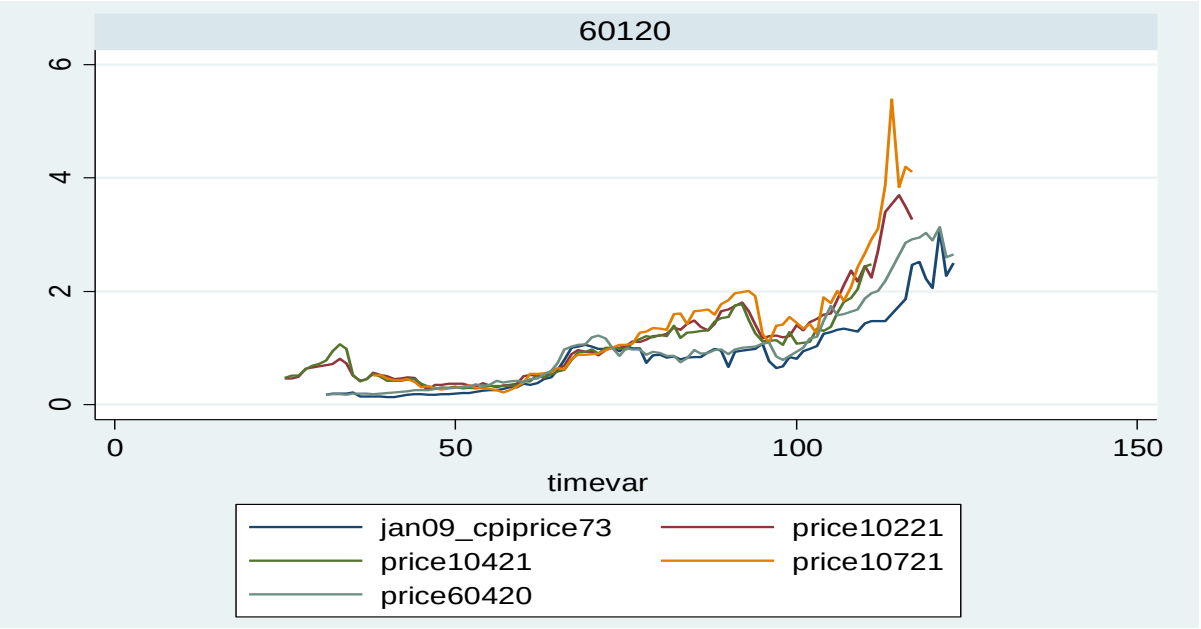
noticeable is that the Sudanese cities seem to have been more affected and have had higher food price inflation during the crises periods than the Ethiopian cities.

The Ethiopian city Metu is the market that, by looking at the graphs, seems to have the most similar inflation pattern as the Sudanese cities as well as with Addis Ababa. Furthermore, this regression does not stretch for as long as the regressions with Mekele and Gonder and in those regressions the Sudanese cities inflation has a rapid increase after the time were the comparison with Metu ends.

By looking at table 10 Metu is the one regression showing the most significant results. The price transmission coefficient for the Sudanese cities is the highest with Kassala, 0.883, which means that when the price index for wheat in Metu increases with 1 unit the price index for wheat in Kassala on average increases with 0.883, which can be considered as a high correlation. Moreover, Metu is the Ehtiopian city that is located furthest away from Kassala, by the estimated driving distance. Suggesting that the distance between the cities has no impact on the price transmission. This regression also shows a perfect price transmission between Metu and Adis Ababa, the transmission coefficient has the value of 1.

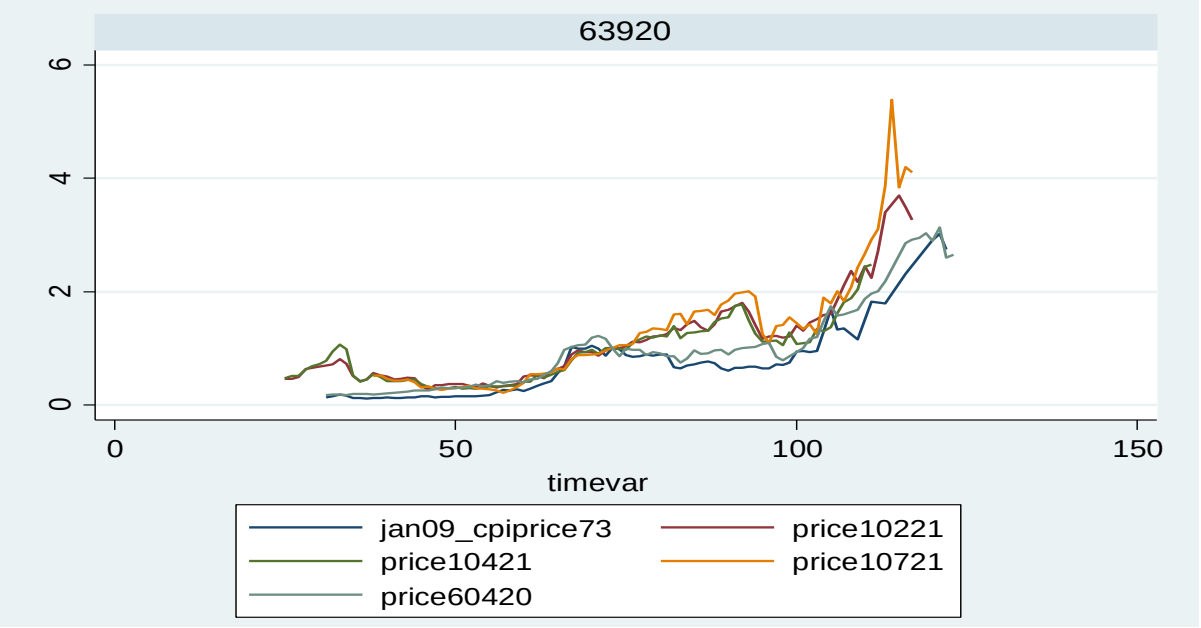
The coefficients in the regressions for Mekele and Gonder indicated that there is only a very low or no price transmission from the Sudanese cities, with coefficients with negative values and with the highest value on 0.161 for Gonder (Ehtiopia) and Kosti (Sudan). The price correlations between the Ethiopian border cities and Addis Ababa is for all three cities high especially for Metu and Gonder with coefficient of 1 respectively 1.010. Furthermore, as mentioned, the Sudanese city Kassala also have a high price transmission coefficient of 0.883, suggesting that the prices in Sudan might have an effect on the Ethiopian domestic markets.

Graph 12. Price index Sorghum, Sudan and Ethiopia - Mekele (60120)



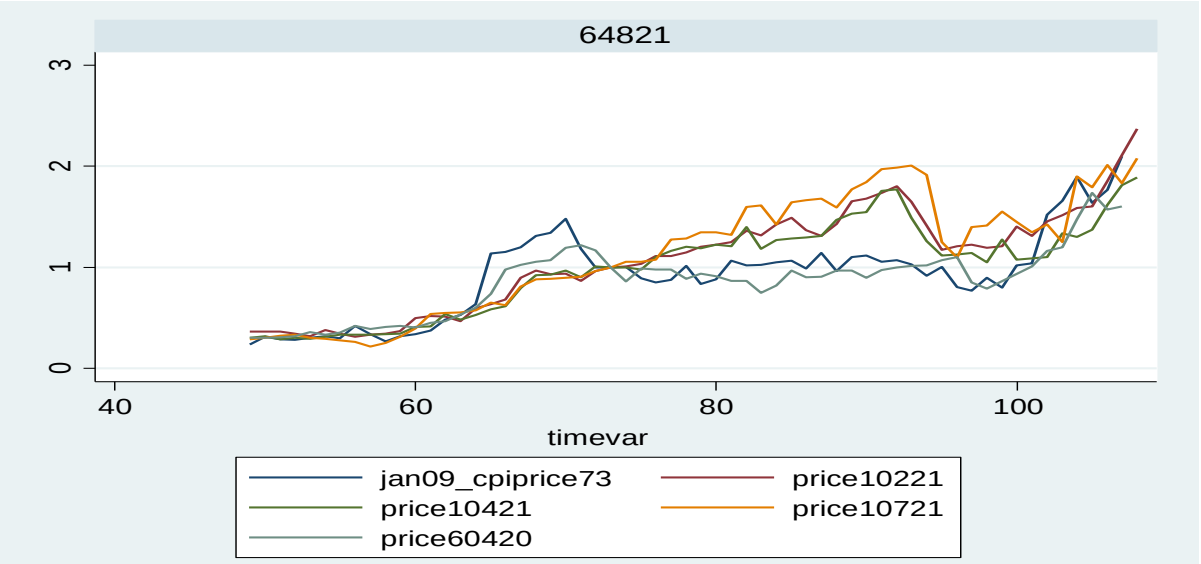
Ethiopia: Mekele (jan09_cpiprice73), Addis Ababa (60420) Sudan: Kassala (10221), Kosti (10421), Al-Damazin (10721)

Graph 13. Price index Sorghum, Sudan and Ethiopia - Gonder (63920)



Ethiopia: Gonder (jan09_cpiprice73), Addis Ababa (60420), Sudan: Kassala (10221), Kosti (10421), Al-Damazin (10721)

Graph 14. Price index Sorghum, Sudan and Ethiopia – Metu (64821)



Ethiopia: Metu (jan09_cpiprice73), Addis Ababa (60420), Sudan: Kassala (10221), Kosti (10421), Al-Damazin (10721)

Table 10. Test of price transmission from Sudanese cities to Ethiopian cities. OLS regression of wheat price index

	Price index 60120 (Mekele)	Price index 63920 (Gonder)	Price index 64821 (Metu)
Price Index 10231 (Kassala)	0.013 *(0.150)*	-0.261 *(0.161)***	0.883 *(0.286)**
Price index 10431 (Kosti)	0.104 *(0.148)*	0.161 *(0.160)*	-0.473 *(0.258)***
Price index 10731 (Al-Damazin)	-0.027 *(0.100)*	0.020 *(0.106)*	-0.266 *(0.159)***
Price index 60430 (Addis Ababa)	0.771 *(0.060)**	1.010 *(0.063)**	1.000 *(0.105)**
Const.	-0.008 *(0.027)*	-0.087 *(0.030)**	-0.100 *(0.055)***
Number of obs.	69	69	56
R-squared	0.9415	0.9357	0.8933
Adj R-squared	0.9379	0.9316	0.8849

**=sig. 5% level, **=sig. 10% level*

Table 11. Driving distance in kilometers

	Mekele	Gonder	Metu
Kassala	652	1341	1341
Kosti	1351	1579	1579
Al-Damazin	1782	1298	1298
Addis Ababa	772	545	545

Distances are estimated by Google maps suggested driving directions.

5. Conclusions

The food price inflation is a wildly discussed topic and several studies have been done to understand its reasons. At the same time, illegal trade is an increasing matter in the region. It has been shown that the Ethiopian domestic prices in the long-run are affected by international food prices and the aim of this thesis was to investigate if this is because of unofficial trade. This was tested by looking if the correlation of price patterns over time were more similar between Ethiopian border cities and border cities in Djibouti, Kenya and Sudan than with Addis Ababa.

Taken together, the prices in border cities in the neighbor countries were mostly low correlated to the Ethiopians. The hypothesis, more similar price trends between border cities on either side of the borders compared to Addis Ababa could not be confirmed. In general the correlations were higher for Ethiopian border cities and Addis Ababa than for Ethiopian border cities and border cities in neighborhood countries.

Nonetheless, this means that illegal trade does not have any affect, but it cannot be confirmed between the cities in the comparisons. But these cities were selected by the distance to the border by looking at the map and available data. This could be considers as a limit, instead of looking at actual official and unofficial trade channels between cities and compare these cities.

Furthermore, in some of the markets effects were shown which gives indications of that certain trade channels or certain cities might have bigger influences than others on the Ethiopian domestic prices and that the prices markets in the neighborhood countries might have an effect.

Differences between the regions in the countries has not been taken in to account, such as; regions with low water supply and infrastructure barriers, which might have been able to given a wider explanation why certain cities had have a higher or lower food inflation over the past couple of years.

It is interesting to look at Djibouti, which seems to have had an overall lower food price inflation (as well as CPI increase) than the other countries and not been as affected by the global crises as the other countries. Since Djibouti is a country with a big import and highly dependent at the trade (Central Intelligence Agency,2013b), it is a surprising result that Djiboutian prices only seem to have had a low effect of the international food price crises.

Furthermore, the Sudanese cities had a bigger effect than the Ethiopian cities from the second food price inflation crisis in 2011. One reason might be that in 2011 South Sudan became independent and a big part of Sudan's oil resources are found in South Sudan and for Sudan this might meant higher transport costs, which could lead to higher food prices. However, this topic is not covered within this study but could be disused in further studies.

Moreover, especially as Kenya and Sudan is ranked as two of the countries with the highest corruption in the world the effect of this would be interesting for further studies. If this has effects and if certain trade channels can be found where the trade is not monitored and regulated. This could also be a reason to why the effect from Kenya and Sudan was found higher than with the Djiboutian border cities and the Ethiopian border cities.

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