Chapter 12

STRUCTURAL TRANSFORMATION OF TEFF MARKETS

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Since the beginning of the 2000s, important changes have occurred in Ethiopia's economy.[1] In this chapter, the extent to which these changes have affected teff markets are assessed using primary data collected from wholesale markets and secondary data on teff prices and margins, obtained from Ethiopia's Central Statistical Agency (CSA) and the Ethiopian Grain Trade Enterprise (EGTE). Five possible reasons are considered for teff market transformation and for the changes in teff price margins over the period 2001–2011.[2] This study period has been influenced by changes in five factors that may have affected how teff markets function. First, fast economic and income growth is changing food demand. Second, urbanization is leading to larger rural–urban food and teff marketing flows. Third, investments in road infrastructure and a better organized transport sector have led to significant declines in real transportation costs. Fourth, the widespread availability of mobile phones has improved access to price information for a large number of players in the commercial food circuit and has led, for some, to a different way of sealing commercial deals. Fifth, increased adoption of modern inputs and better access to extension agents are likely to have contributed to an increase in teff supply.

Price data collected since 2001 at wholesale and retail levels show that these changes are associated with significant declines in real margins of teff prices between supplying and receiving markets over time, in real teff milling margins, as well as in retail margins. Teff prices are found to have increased over the period, although these price levels were affected differently in different markets. Price integration and price co-movements between wholesale

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2 One important caveat of this analysis is that the markets that are analyzed, and for which there exists consistent price series data, mostly serve regional centers. It is quite possible that rural markets are more dysfunctional and responsible for famines in rural areas (for papers on famines and market behavior, see, for example, Rivers et al. 1976; Shin 2010; Ravallion 1987; Drèze and Sen 1989).

markets have also improved significantly over the period studied. The teff marketing system thus appears to have markedly transformed in Ethiopia to the benefit of producers and consumers alike.

The structure of the chapter is as follows: First, the data and the methods used are discussed. The next section considers the changes that are likely to have contributed to structural transformation in the country. Then, spatial price variation, price integration, quality price premia, processing margins, and retail margins are explored, before the chapter concludes.

Data and Methodology

Two main datasets are used for the analysis in this chapter, using both primary and secondary data.[3] The EGTE, a grain procurement arm of the government, gathers prices of teff in 66 major wholesale markets in the country. Prices are collected during the early morning, late morning, and afternoon on major market days, and simple averages of these prices over the course of a month are reported as monthly prices. The price information is collected, not by requesting price levels from traders, but by noting the prices through observation of actual transactions. Producer, wholesale, and retail prices are all collected; however, only wholesale and retail prices at 12 selected markets are publicly available.[4] The EGTE data are our preferred source of data given the high quality of the prices that are collected, the consistent methodology used over time, and the geographical spread of the markets surveyed.

A survey was also conducted in 25 major teff wholesale markets in Ethiopia during the beginning of 2012. The objective of this survey was to gather information about changes that had taken place in these markets over the past 10 years. Almost all major cities, as well as the most important production

3 Primary: data were collected by the authors themselves; secondary: data were collected by a third party.

4 "Producer prices" are defined as those prices that are received by producers at the wholesale market; "wholesale prices" are the prices that wholesalers obtain when they sell in large bulks; "retail prices" are prices on the wholesale market or in nearby markets obtained by traders that sell in small quantities to consumers. These price data were electronically gathered and are thus used in the analysis. Because the weights of individual cereals in the national Consumer Price Index (CPI) are relatively low, and due to a lack of any reasonable alternative, this national CPI as constructed by Ethiopia's Central Statistical Agency (CSA) is relied upon to deflate prices. A de-seasonalized index is used. To construct such a de-seasonalized index, a 12-month moving average is calculated and the constructed series is used as the deflator.

areas, were included in this survey.[5] Focus groups, comprising those involved in transporting goods, and key informants for teff in the selected wholesale markets, provided input to the survey. The respondents within the focus groups had significant experience in teff trade in each market (as there were many recall questions). Questions were asked about the extent of changes in transport costs and travel times between different wholesale markets, changes in access to and the spread of mobile phones and the use of mobile phones in teff trade, and changes in the size of the market.[6]

Several aspects of teff price behavior are examined in the section that follows. First, the quality premia and spatial margins are analyzed. The EGTE wholesale price series is used as left-hand variables, and regression models are estimated that include on the right-hand temporal, spatial, and quality variables as explanatory variables. The year-month fixed effects are used to control for all potential temporal variation.[7] These controls allow for a better estimate of the coefficients of interest—that is, of quality and location. In estimating the standard errors, clustering by quarter is allowed, and therefore dependence between months is controlled for. The regression used is as follows:

$$\text{Log (real price of teff)} = f(\text{year*month, market location, quality}) \quad (1)$$

Second, the processing and retail margins are studied. To do this, the wholesale prices are combined with two other datasets. For the analysis of processing margins, teff flour price data collected by the CSA in retail markets are merged with the wholesale teff market prices. The prices are retained only for these markets and for those periods that are common to both datasets. For the analysis of the retail margins, the wholesale prices are merged with the prices collected by EGTE at the retail level. Unfortunately, these retail price data

5 Of the 13 cities with a population more than 100,000, two of these cities were not part of the EGTE price series—that is, Harar and Awassa.

6 While the focus group interviews were carefully fielded and therefore provide a good indication of changes over time, the methods used within the focus group interview are disposed to measurement error and are especially so in the case of recall questions. Consequently, the statistical techniques, which are based on sampling to test differences over time from the recall data, are unreliable.

7 Most of the agricultural seasons in the highlands of Ethiopia (where the majority of the analyzed markets are located) are similar, with harvests occurring at the same time. Taffesse, Dorosh, and Gemessa (2013), for example, show that 97 percent of all agricultural production in the country occurs during the meher season and that the belg season is of minor importance. Therefore, this does not include additional market-month interactions in the regression as this would also limit the scope of the spatial price analysis.

only exist up to the end of 2009, and thus the analysis is limited to the 2001–2009 period. A similar method is followed as described above and the estimated regression is as follows:

Log (real price of teff) = f(year*month, market location, quality, grain/flour, retail/wholesale) (2)

A major objective of the study is to evaluate the structural transformation of these markets. To understand if a structural break in these time series occurred over the decade 2001–2011, the different variables are set to interact with a time dummy for the second part of the period studied (2006–2011). The significance of these coefficients is then assessed and a comparison is made with the coefficients in the first part of the decade (2001–2005) through an F-test. If a significant difference is detected, a structural break in the market is assumed over the decade. The results of these tests are shown for spatial variation, quality premia, retail margins, and processing margins.

Third, the extent to which teff markets in Ethiopia are integrated is assessed. Following Van Campenhout (2007), the use of threshold autoregressive (TAR) modeling allows estimates to be generated that incorporate thresholds and adjustment parameters to vary over time as follows:

$$\Delta d_t = \begin{cases} \rho_{out} d_{t-1} + \dot{\rho}_{out} t.d_{t-1} + \varepsilon_t & : \; d_{t-1} > \theta_t \\ \varepsilon_t & : \; -\theta_t \le d_{t-1} \le \theta_t \\ \rho_{out} d_{t-1} + \dot{\rho}_{out} t.d_{t-1} + \varepsilon_t & : \; d_{t-1} < -\theta_t \end{cases}, \quad (3)$$

where d_t is the difference between the teff price in Addis Ababa and the regional wholesale market of interest (that is, $d_t = p_{t,A} - p_{t,r}$, where $p_{t,A}$ is the market price in Addis Ababa and $p_{t,r}$ is the market price in regional markets at time t), $\Delta d_t = d_t - d_{t-1}$, ε_t is the estimated residual, t denotes the time trend, θ is an approximation for transaction costs, and ρ_{out} is the adjustment factor for prices outside of the transaction cost band (that is, $-\theta$ to θ).

Possible Reasons for Structural Transformation in Teff Markets

Over the period studied, a number of structural changes have occurred in the overall economy as well as in Ethiopia's food economy—on top of the changes in the international food markets (Headey, Malaiyandi, and Fan 2010)—that have affected teff markets and price formation in the country. Given data constraints, it is impossible to estimate the exact effects of the changes of these

different factors on teff price formation and market transformation, but it seems clear that they have all had some impact.[8] These changes include economic and income growth, urbanization and commercial surplus, transport and communication infrastructure, agricultural technologies, and extension. The following section elaborates on each of these.

Economic and Income Growth

Since 2004, Ethiopia has been one of the world's fastest growing economies, which is a remarkable achievement for a non-oil-exporting African country. While growth of the GDP, which is measured in constant market prices, was negative in the beginning of the decade, it escalated from 2004 on and has stayed in double digits ever since. It remains unclear how the benefits of economic growth were distributed among Ethiopia's population, but the consequence of such growth rates leads to significantly different consumption patterns for the beneficiaries of this growth. This has important implications for food markets.

To understand how food markets have been affected, two effects of GDP growth are distinguished: (1) how the incomes of consumers are affected, and (2) how consumers change their consumption patterns because of increases in income. First, evidence from national household surveys suggests that consumption expenditures are increasing and that poverty levels are decreasing. Real per adult equivalent consumption in 2004/2005 (1,542 birr at 1995/1996 constant prices) was 16 percent higher than the previous five years and 17 percent higher than ten years earlier (Ethiopia, MoFED 2008). Kuma (2010) finds similar results in urban areas, where consumption expenditures grew by almost 15 percent between 1994 and 2004. Analysis of the most recent national household data shows that poverty declined between 2004/2005 and 2010/2011 from 38.7 percent to 29.6 percent, indicating further welfare improvements over the period considered (Ethiopia, MoFED 2012). Although welfare has improved, it is important to note that poverty and livelihood resilience still remains a big challenge, especially in rural areas, and that per capita income growth has started from a very low base. Ethiopia still often suffers from major and variable food shortages—often linked with droughts—and the country continues to be an importer of food.

8 For a discussion of market transformation and its drivers, see, for example, Reardon and Timmer (2007) and Minot and Roy (2007).

Second, as incomes grow, consumption patterns are likely to change as households consume more high-quality foods relative to lower-quality foods (as shown in Chapter 2). An indicator that this is taking place in Ethiopia in the presence of income growth is that income elasticities of demand for meat, fruits, and vegetables are estimated to be considerably higher than for most cereals. Even among cereals, however, some (for example, teff) have high demand elasticities while others (such as sorghum and maize) have low elasticities (Tafere, Taffesse, and Tamru 2010). As such, it is not surprising that urban consumption patterns over the decade have increasingly included more teff, milk and milk products, meat, and fruit (Kuma 2010).

Urbanization and the Increase in Commercial Surplus

Although it started from a low base, Ethiopia has experienced rapid urbanization over the past couple of decades (Schmidt and Kedir Jemal 2009). This trend is important for agricultural markets in particular since urban populations typically do not grow their own food. Instead, they rely on markets for their food needs. As a consequence of these growing urban areas, there is an increasing flow of agricultural commercial surplus within the country.[9] Based on data from the national census in 2007, Schmidt and Kedir Jemal (2009) estimated that 14.2 percent of the Ethiopian population lived in urban areas and that urban centers have grown by up to 3.7 percent per year on average. Using these growth rates, the urban population grew by 44 percent, or by 3.7 million people over the period 2001–2011. To put that number in perspective, consider the following: Assuming that the average urban consumption level of teff was as high as was estimated in the national household survey (HICES) of 2004/2005 (that is, 61.4 kilograms per capita), and that the urban population relied completely on production shipped in from rural areas, commercial flows of teff increased by about 237,000 metric tons between 2001 and 2011. This is equivalent to an additional 30,000 truckloads of teff (of 7.5 metric tons in a widely used Isuzu FSR truck) between rural and urban areas over the decade, or 300 additional trucks per year (assuming 100 return journeys per truck). According to official statistics published by the CSA,

9 While urbanization has led to increased rural-market flows, higher population growth in rural areas has also led to increased demand for marketed food in rural areas. Using the census data of 1994 and 2007, Schmidt and Kedir Jemal (2009) estimate that the absolute growth of the rural population (13.7 million) was twice as high as the urban population (6.7 million). However, given that most household food consumption in rural areas was of food produced by the rural household, it is unlikely that rural population growth has had as much of an impact on food marketing flows as has increasing urbanization, as city dwellers typically depend completely on purchased food.

there was indeed a large increase in the commercial quantities of teff traded in the country over the period studied. The commercial surplus for teff increased by an estimated 117 percent over this 10-year period.[10]

Focus group participants in the wholesale market survey were asked about level and trends with respect to numbers of traders and brokers in the markets and of cereal trucks arriving in these markets. These numbers confirm that the commercial surplus has rapidly increased over the decade. For example, significantly more trade is reported on average in these markets over time. The reported number of trucks increased over 10 years by almost 70 percent and by almost 80 percent in the lean and peak periods, respectively. These growth rates are faster than the urban population growth rates in the country (Schmidt and Kedir Jemal 2009). This possibly indicates higher consumption levels of teff in the cities over time, more trade between rural areas that might pass through these urban wholesale markets, and shifts from other means of transportation to trucks. The focus groups' assessment of trends in the number of teff traders and brokers that operate on these markets also indicates considerable growth over time. With the number of teff traders perceived to be growing by more than 300 percent over the period studied, and the number of brokers rising by more than 50 percent, competition appears to have become keener and turnover per trader and broker lower.

Roads and Transportation Costs

Several factors have contributed to changes in transportation costs over the period studied. Some of these factors include changes in the road network and investments in road infrastructure improvements, increases in fuel costs, and changes in the types of trucks plying the roads. These are reviewed in turn.

First, since coming to power at the beginning of the 1990s, the Ethiopian government has embarked on a large road investment program, and the current level of infrastructure development in the country is unprecedented. For example, all-weather surfaced roads are in the process of being built or have already been built between the capitals of all regions. Furthermore, the total length of all-weather surfaced roads tripled in fewer than 15 years, from an estimated 32,900 kilometers in 2000 to 99,500 kilometers in 2013. This type of road development has important effects on the connectivity of agricultural markets in the country. Based on interviews with transporters in the wholesale market survey who were questioned about travel times between different

10 Comparing CSA data on production and percentage sold in 2012/2013 with 10 years earlier.

wholesale markets in the country and the Addis Ababa wholesale market, transport times have fallen on average by 20 percent over the period studied, from 10 hours to 8 hours.[11]

Second, fuel prices have risen considerably over time. Until October 2008 the Ethiopian government subsidized fuel prices.[12] But with the abolition of fuel subsidies, combined with the increase in international fuel prices, real fuel prices increased significantly. CSA retail price data indicate that the real price of diesel at the beginning of the 2000s was 60 percent lower than in 2010. Given that fuel is an important determinant of transport costs, this undoubtedly contributed to relatively higher transport costs over time.

Third, the increase in the number of larger capacity trucks plying the roads is putting downward pressure on transportation costs. This follows because the bigger the truck, the lower the per unit transport costs. As increasing quantities of food are being shipped between markets, it is becoming easier to fill larger loads in bigger trucks, and consequently there are greater incentives to enter into food trade with larger trucks. The wholesale market survey data indicate that this is occurring. Over time, the importance of larger trucks (mostly Isuzu FSR; able to carry about 7 to 8 metric tons) has grown compared to smaller ones (regular Isuzu; carrying about 5 to 6 metric tons). The share of FSR trucks in the total number of trucks transporting cereals grew from about 15 percent in 2001 to 33 percent in 2011. The use of trailer trucks, able to transport 20 metric tons, is still limited and its share stayed constant over time. Overall these trailer trucks make up 13 percent of the trucks that transport cereals (they are more important for longer distance journeys).[13]

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11 This trend is consistent with estimates taken from the 1983 and 2007 population censuses. Because of improved infrastructure and of urbanization, the population census data show the percentage of people who were connected with cities increased dramatically over the twenty-three-year period between 1983 and 2007. According to Schmidt and Kedir Jemal (2009), the percentage of the population that lives further than 10 hours away from a city (more than 50,000 people) decreased from 40 percent in 1984 to 12 percent in 2007. Given that a number of large construction projects have continued since the 2007 census, it is safe to assume that this trend has only continued.

12 Ethiopia froze fuel prices between August 2006 and January 2008; it had decreased the price of gasoline in February 2007. In October 2008 it eliminated fuel price subsidies altogether (Kojima 2009).

13 However, given that they are able to transport between twice and four times the load of the smaller trucks, their share of the total quantity of cereal transported is significantly higher than 13 percent. While increasing competition in the transport sector is hard to measure, one rough indicator is the increasing number of trucks imported into the country each year. Comtrade data (data on international trade are collected by the UN and can be downloaded from http://comtrade.un.org/), for instance, show that the number of trucks imported in the country doubled between 2001 and 2011. This increase is greater than observed in the wholesale markets. These imports thus illustrate not only the important increases in commercialization in the country but likely also reflect other important changes, such as in the construction sector.

Collectively, these three factors are likely to have affected transportation costs between wholesale markets in Ethiopia. To assess this, participants in the transporter focus groups were asked to estimate travel costs from 2001 to 2011 for those trips that were commonly taken from the market where they were interviewed. To allow for comparison over time, these prices were deflated by the CPI.[14] The results from recall data from focus group interviews indicate that the mean and median of transport costs fell significantly throughout the decade.[15] The improvements in roads and the shift to bigger and cheaper trucks appear to have outweighed the rise of fuel prices and have resulted in significantly lower real transportation costs between markets in the country.

Access to Mobile Phones

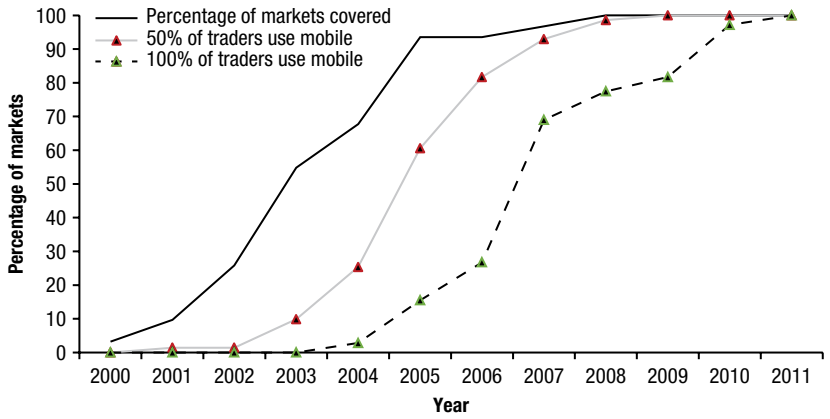
Mobile phones have become widely available in Ethiopia, enabling traders and farmers to exchange information easily. The widespread availability of mobile phones in rural areas of developing countries has led to a number of beneficial effects on farmers and on the trade environment in general (for example, Aker and Fafchamps 2014; Jensen 2007). These effects may also benefit Ethiopian farmers and traders given that at the time of the wholesale survey in early 2012, almost all traders and brokers in the survey used mobile phones in their business. Figure 12.1 shows how cell phone coverage changed over time in the teff wholesale markets in the survey. In 2000 only the Addis Ababa market had cell phone coverage but that quickly changed, and by 2005 there was almost universal coverage of these rural wholesale markets. Figure 12.1 further shows that cell phone usage rates increased to 100 percent for teff traders in the various markets within an average of only four to five years after the introduction of coverage.

To understand the impact of this rapid spread of cell phones on teff trade, the focus groups were questioned further. First, to better understand their access to communication technology over time, focus groups were asked to assess the percentage of teff traders and brokers who had access to fixed phones (land lines) before mobile phones became available. The results reported in Table 12.1 indicate that a large majority of these traders and

14 For those trips where no complete time series could be collected from the group over the whole 10 years, the rest of the series was deleted. Thus there ended up being 204 consistent price series of transport costs between wholesale markets.

15 This is estimated by focus groups to be about 50 percent, although this is admittedly a very rough estimate given that recall error for cost estimates is likely to be large in the presence of high inflation.

FIGURE 12.1 Mobile phone use by teff traders on wholesale markets, cumulative percentage over markets, 2000–2011



Source: Authors' compilation from focus group interviews.

brokers previously had some form of access to fixed phones (for example, at home, on the market, or at another location), and 39 percent of the traders reported having a fixed phone at home before gaining access to mobile phones, indicating that mobile phones did not fill a complete communication void as experienced in other countries.

Second, while telephone communications existed prior to the introduction of mobile phones, mobile phone technology has improved the ease of access to communications as evidenced by the frequency of phone use. According to the focus groups, an average teff broker now makes 31 business calls per day during the peak trading period, while traders make 24. This is roughly three to six times more than the number of calls made using fixed lines before the introduction of mobile phones. It is also worth noting that the number of calls made with mobile phones drops off significantly in the lean period, reflecting the important seasonality in traders' and brokers' teff business activities.

Third, questions regarding the purpose for using mobile and fixed-line phones indicate that 83 percent of teff traders and 57 percent of brokers use mobile phones to transmit prices, compared to 43 percent and 13 percent respectively who did so previously with fixed lines (Table 12.1). Furthermore, 41 percent of the traders and 40 percent of the brokers use the mobile phones to request traders or farmers to come with their teff to the market as they inform them they should be able to find buyers that day. Fewer use phones to agree on prices with sellers and buyers. In Ethiopia standards are often

TABLE 12.1 Use of mobile phones by traders and brokers (%)

	Percentage of traders and brokers			
Use of phone	Mean	Median	Mean	Median
Percentage of traders and brokers who had access to a fixed phone	*now*		*before*	
Traders				
at home			39	40
on the market			21	10
at another location			68	90
Brokers				
at home			11	2
on the market			0	0
at another location			63	90
Estimated number of phone calls per trader per day related to his trade business	*by mobile phone*		*by fixed phone*	
Traders				
in the peak period	24	25	7	5
in the lean period	8	10	3	2
Brokers				
in the peak period	31	30	6	5
in the lean period	13	10	2	2
Use of phone	*"Are mobile phones used to"?*		*"Were fixed phones used to"?*	
Traders				
"inform/transmit prices"	83	90	43	50
"agree on prices (plus quantity/quality) with sellers"	29	15	6	0
"request a showup (quantity requested but without price agreements) with sellers"	40	25	14	0
"agree on deals (prices and quantity) with transporters"	40	35	4	0
"agree on prices (plus quantity/quality) with buyers"	46	50	14	5
"request a showup (quantity requested but without price agreements) with buyers"	41	40	23	10
"follow-up payments with buyers/sellers"	75	100	34	25
Brokers				
"inform/transmit prices"	57	75	15	5
"agree on prices (plus quantity/quality) with sellers"	18	0	0	0
"request a showup (quantity requested but without price agreements) with sellers"	35	0	12	0
"agree on deals (prices and quantity) with transporters"	39	25	5	0

(continued)

TABLE 12.1 Continued

Use of phone	Percentage of traders and brokers			
	Mean	Median	Mean	Median
Use of phone	*"Are mobile phones used to"?*		*"Were fixed phones used to"?*	
Brokers				
"agree on prices (plus quantity/quality) with buyers"	15	0	2	0
"request a showup (quantity requested but without price agreements) with buyers"	40	10	14	0
"follow-up payments with buyers/sellers"	47	30	17	0
Number of observations	**25**		**25**	

Source: Authors' compilation from focus group interviews.

lacking, and as a result, it is likely that buyers may wish to inspect the produce personally before sealing a deal. A large majority of traders use phones to follow up on payments of traders and buyers. This number is much lower for brokers, possibly because their transactions are less likely to involve extending credit. Compared to the situation before mobile phones were introduced, it is clear that more information is obtained and more deals are struck by phone. Indeed, more than twice as many teff traders and brokers use their mobile phones today for conveying price information and for making deals with sellers, buyers, and transporters than did so with fixed-line phones when these were the only available method in telecommunications.

Finally, focus group participants were asked subjective questions about how the situation in teff trade has changed since mobile phones were introduced. While it is highly unlikely that mobile phones were the sole cause of the changes reported by the focus groups, the spread of mobile phones likely did contribute in some way. Most of the teff traders and brokers report interacting with more sellers, buyers, and transport brokers before making deals. Since physical location of the market matters less with mobile phone technology, traders and brokers appear to be bypassing wholesale markets in rural areas and in Addis Ababa. While the wholesale markets are not completely bypassed, the focus groups report that in rural areas this is occurring to a greater or less extent in 100 percent of the markets for traders and 82 percent for brokers. Furthermore, 60 percent of the trader and 64 percent of the broker focus groups report bypassing the Addis Ababa wholesale market. The traditional role that Addis Ababa has played as a clearinghouse in the teff trade in Ethiopia primarily because of its central geographical location and

the lack of alternative roads (Gabre-Madhin 2001a) may therefore slowly be changing because of easier access to information and because of the improved road network.

Agricultural Technology and Agricultural Extension

A number of changes have taken place over the period studied that have led to increases in agricultural production. While part of the increased production appears to be driven by the expansion of cultivated land (Taffesse, Dorosh, and Gemessa 2013), and while the adoption of improved agricultural technologies in the country is rather low, there are some indicators that bode well for increased productivity. Foremost among these are the increasing availability and adoption of improved modern technologies and the widespread placement of extension agents. Undeniably, those in better-connected areas have greater access to these technologies and services (Minten et al. 2013).

First, although adoption rates for improved cereal seeds are low (as shown in official statistics), these rates are underestimated, and adoption has seemingly improved over the period studied (Spielman, Kelemwork, and Alemu 2011). Improved seeds have primarily been used with the cereals maize and wheat (Spielman, Kelemwork, and Alemu 2011), although the adoption of an improved teff (Quncho) seed variety accelerated in the latter part of the decade (Minten et al. 2013). Second, fertilizer consumption in Ethiopia grew from 140,000 metric tons in the early 1990s to about 650,000 metric tons in 2012, and the fertilized area dedicated to cereal production more than doubled over the decade (Rashid et al. 2013).

Third, the Ethiopian government has invested heavily in the expansion of the agricultural extension system. At the end of 2010, the government had placed 45,000 extension agents in villages. This compares to 2,500 and 15,000 extension agents in 1995 and 2002, respectively (Davis et al. 2010). With a target of three extension agents per kebele, Ethiopia has one of the largest extension agent–farmer ratios found in the world today (Davis et al. 2010).[16]

The details, shown in Table 12.2, provide a summary of the possible covariates of structural transformation in Ethiopia's cereal markets and how they changed over the period studied. In all cases, important changes are noticeable.

16 While there are questions on the efficacy of this system (Davis et al. 2010), evaluations have shown that access to extension did positively affect agricultural yields (Dercon et al. 2009) and adoption of improved technologies (Krishnan and Patnam 2012).

TABLE 12.2 Changes in structural factors over 2001–2011

Driver	Number of observations	Average 2001–2005	Average 2006–2011
1. Economic growth			
GDP per capita (constant 2005 US$, PPP)	10	6.7	10.6
2. Urbanization/commercial surplus*			
Cereal trucks per week arriving			
in peak period	31	37	50
in lean period	31	15	21
3. Roads and transportation costs**			
Time taken to travel between markets (hours)	205	9.6	8.4
Real transportation costs between cereal wholesale markets (constant 2010 costs; birr/quintals per trip)	205	128	79
4. Mobile phones***			
Share of markets (%) where at the end of the period			
100% of teff traders are using mobile phones	25	12	100
50% of teff traders are using mobile phones	25	60	100
100% of teff brokers are using mobile phones	17	6	100
50% of teff brokers are using mobile phones	17	29	100
5. Agricultural technology			
Share of cereal land with improved seeds (%)	10	5	5
Share of fertilized cereal land (%)	10	47	51

Source: Authors' compilation from World Bank macroeconomic data (1); focus group discussions (2, 3, 4); CSA Agricultural Sample Surveys (5).

Note: * = 31 observations reflecting the 31 markets visited; ** = the 205 observations reflect the major effective product flows of the 31 surveyed wholesale markets with the other major wholesale markets (time and costs were only asked for those markets where there was an effective flow); *** = 25 teff wholesale market focus groups.

In short, the changes in the overall and agricultural economy are likely to manifest themselves in a number of predicted outcomes in teff markets. For example, increasing urbanization, increasing supply, and income growth is likely to lead to more quantities traded and greater economies of scale and thus lower margins. In addition, access to better price information should lead to a more efficient marketing system and consequently decrease overall margins. Finally, changes in food consumption patterns (see Chapter 2) due to income growth may be reflected in higher-quality premia, if such changes in the supply of high-quality products do not keep pace with the growing demand for these products. The next section addresses these questions,

analyzing in particular spatial price variation, spatial market integration, quality premia, and margins (processing and retail) in teff markets.

Price Behavior

Spatial Price Variation

Ethiopia is characterized by a very diverse agroecology that results in different agricultural production and consumption patterns across the country and in spatial specialization (Chamberlin and Schmidt 2011; Ethiopia, CSA, EDRI, and IFPRI 2006). To better understand the spatial flows of teff in Ethiopia, the focus groups in the wholesale markets were asked questions about trucks arriving in and departing from their markets and about the types of loads carried. Using this information, it is possible to identify areas in Ethiopia that supply and receive teff. The supply base for teff is more diverse than for other cereals, but most of the demand comes from Addis Ababa, Dire Dawa, and Mekelle—three of the most important cities in the country.

To test the degree to which these flows are reflected in wholesale market price differences, the prices of produce from different markets to the Addis Ababa market (the default market) are compared using the model described in equation (1) at the beginning of this chapter. Since the dependent variable (real price of teff in market *j*) is expressed in logs, the reported coefficients for the market dummies in Table 12.3 show the relative difference in real prices compared to the Addis Ababa market (the left-out category). In a second specification the analysis period is effectively split into two parts (2001–2005 and 2006–2011). This is done by including a dummy for the latter period separately and interacting it with all of the other coefficients in the model. The Addis Ababa market in the first and second period are therefore the default markets. The structural change is tested by comparing price differences in the first period to those in the second period (significant changes are highlighted in gray in Table 12.3). In particular, it is the price changes that are of interest from the major supplying areas—with the price of the Ambo market taken as an indicator for these—to the other markets. Significant changes at the 5 percent level over the period are shaded in Table 12.3.

Three salient points arise from the results in Table 12.3. First, although Addis Ababa is Ethiopia's biggest city, teff prices are not always at their highest there. For example, prices tend to be higher in teff deficit areas such as the eastern city of Dire Dawa, where the prices of teff are 12 percent higher than

TABLE 12.3 Regional wholesale price differences compared to Addis Ababa (results of coefficients of regression)

			Teff	
†	Market	Dummy time interaction	Coefficient	t-value
1	Ambo	none	**–0.05**	–5.61
	Assela	none	**0.02**	3.17
	Bale Robe	none	**0.08**	4.77
	Dessie	none	**0.04**	3.13
	Dire Dawa	none	**0.12**	7.49
	Gondar	none	0.00	0.29
	Jimma	none	**–0.04**	–3.35
	Mekelle	none	**0.08**	7.58
	Nazreth	none	0.00	0.28
	Nekemt	none	**–0.14**	–16.96
	Shashemene	none	–0.01	–0.48
2	Ambo	2001–2005	**–0.06**	–5.27
	Assela	2001–2005	**0.03**	2.51
	Bale Robe	2001–2005	0.03	1.18
	Dessie	2001–2005	**0.09**	3.97
	Dire Dawa	2001–2005	**0.18**	7.13
	Gondar	2001–2005	**0.08**	7.91
	Jimma	2001–2005	**–0.04**	–3.74

in Addis Ababa (see the first section of Table 12.3). In the northern cities of Mekelle and Dessie, teff is also significantly more expensive than in Addis Ababa.[17] Teff prices in major supply areas—such as Ambo—tend to be lower than in Addis Ababa.

Second, there are substantial changes in the relative ratios between the first and second halves of the decade (see the second section of Table 12.3), possibly reflecting the effective changes in transport costs between wholesale markets. Differences in teff prices relative to the major supply area declined significantly within 5 of the 11 markets. For two major demand "sinks," Mekelle and Dire Dawa (after Addis Ababa, these are the country's two biggest cities), price

17 Mekelle is the capital of Tigray region. Tigray is among the poorest and most vulnerable regions in the country, together with the pastoralist regions (Ethiopia, MoFED 2012). Dessie is the capital of the South Wollo zone. The population in this zone has been hit hard by several famines in the past (Graham, Rashid, and Malek 2012).

†	Market	Dummy time interaction	Teff	
			Coefficient	t-value
	Mekelle	2001–2005	**0.13**	13.38
	Nazreth	2001–2005	**0.02**	2.05
	Nekemt	2001–2005	**–0.17**	–13.01
	Shashemene	2001–2005	–0.03	–1.60
	Ambo	2006–2011	**–0.04**	–3.16
	Assela	2006–2011	**0.02**	2.01
	Bale Robe	2006–2011	**0.12**	6.03
	Dessie	2006–2011	0.00	0.34
	Dire Dawa	2006–2011	**0.07**	6.30
	Gondar	2006–2011	**–0.05**	–4.08
	Jimma	2006–2011	–0.04	–1.92
	Mekelle	2006–2011	**0.04**	3.52
	Nazreth	2006–2011	–0.01	–1.47
	Nekemt	2006–2011	**–0.12**	–13.54
	Shashemene	2006–2011	0.01	0.92

Source: Authors' calculations.

Note: † = model specification; Addis Ababa is the default market in all specifications; shaded values represent statistically significant differences at the 5 percent level between the 2001–2005 and 2005–2011 periods from that market to major supplying areas, which coefficients are underlined (teff; Ambo); shaded values indicate statistically significant differences at the 5 percent level between the 2001–2005 and 2005–2011 periods for the price differences between the supplying regions and the Addis Ababa (default) market; coefficients in **bold** are significant at the 5 percent level; robust white standard errors to within cluster (by quarter) correlation.

differences relative to Addis Ababa fell. Similar changes occurred between supply areas and Addis Ababa with respect to these price differences (see the Ambo market with a negative coefficient in Table 12.3) but to a lesser extent. Despite a lack of infrastructure improvements in some of the supplying areas, decreases in price differences are occurring, such as in Nekemt, where this difference has fallen significantly.

Third, the variation in price differences among the wholesale markets with respect to the Addis Ababa markets declined over time. The difference between the highest and the lowest price differences in the first half of the decade compared with the second half declined by 11 percentage points.

Spatial Price Integration

The degree to which cereal prices move together across markets throughout Ethiopia (that is, how well they are integrated) provides a measure of how well

TABLE 12.4 Degree of market integration of Addis Ababa with other teff wholesale markets, 2001–2011

Integration variables	Year	White teff	Mixed teff	Red teff
Total market pairs		6	6	6
% integrated markets	2001	50	50	50
	2011	83	100	100
Number of pairs where coefficient time trend is significant at 5% level		2	3	3
Half-life of adjustment to price changes (in weeks)	2001	4	12	9
	2011	3	6	7
Transaction cost (% average price)	2001	9	8	15
	2011	8	7	8

Source: Authors' calculations.

these markets function. Thus the integration of wholesale markets is analyzed by studying various market pairs for teff using the TAR model described in equation (3). In particular, Addis Ababa is paired with the five most important regional teff wholesale markets for each of the three teff qualities, thus reflecting major teff flows in the country.[18] Three important results stem from this market integration analysis (Table 12.4). First, there has been an improvement in market integration over the decade studied. In the aggregate, significantly more markets were integrated in 2011 than in 2001.[19] Furthermore, all of the most important markets for mixed teff and red teff were well integrated at the end of 2011, while only half were in 2001. Of the regional white teff markets, 83 percent were integrated with respect to the Addis Ababa market in 2011, compared with 50 percent in 2001.

Second, the speed of price adjustments has also improved considerably. This is illustrated in the average half-life of adjustment to price changes that declined significantly in 2011 compared with 2001. In other words, it now takes less time for teff prices between wholesale markets to adjust halfway

18 In the TAR model, unit root behavior in the transaction cost band is imposed by setting $\rho_{in} = 0$. This reduces the estimated model inside the band (if $-\theta_t \leq d_{t-1} \leq \theta_t$) from $\Delta d_t = \rho_{in} d_{t-1} + \varepsilon_t$ to $\Delta d_t = \varepsilon_t$. Consistent with the TAR model's requirement, all the markets considered for all categories of cereals are tested for a unit root and only those that are nonstationary in level terms and stationary in the price differences for any market pair were considered for the analysis.

19 A market pair is considered integrated when the price adjustment in one market in response to a shock in the other is statistically significant in the TAR model. It is considered well integrated when the estimated adjustment parameter is not statistically different from −1 (that is, prices in the two markets move in step with each other).

from deviations in long-run equilibrium prices than it did in 2001. Third, the transaction costs between markets estimated in the TAR model (that is, the thresholds) fell. Certainly the declines have sometimes been substantial, averaging nearly 50 percent for red teff between 2001 and 2011.[20] These declines have been slightly lower for other types of teff.

Quality Premia

When consumers become wealthier, they demand more high-quality food products. This often implies an increase in *willingness-to-pay* for quality for such products (for example, Vandeplas and Minten 2011). To gauge whether this is occurring in Ethiopia, the EGTE wholesale market price data are used to examine the levels of and trends in quality premia at the national level and in Addis Ababa. The color of the teff grain provides a measure of quality, and this is the only quality information available in the data. Although color is often only one characteristic of teff quality, Bekele and Ayele (2006) and Minten et al. (2013) find that it is an especially important associate of quality premia paid in the Ethiopian marketplace.

The results of the regression analysis on price premia (from equation [1]) and their evolution over time in Table 12.5 illustrate two points. First, quality premia do exist in the Ethiopian markets in that white cereals all command a premium over mixed-quality teff or red teff. These premia are as high as 27 percent for white teff over red teff in the national market. The price premia paid in Addis Ababa are generally higher than in other markets. Second, the quality premia change surprisingly little over time. In none of the cases are the changes between the first and second halves of the decade 2001–2010 significant. Moreover, the quality premia paid by consumers are stable or declining.

Processing Margins

Part of the supply chain that affects the transmission of prices from producers to consumers is the processing sector. To analyze how processing and milling margins have changed as part of the structural transformation of teff markets in Ethiopia, the prices of milled products such as flour are compared to the wholesale grain prices as described in the data and methodology section.

20 Unfortunately, no data are available on observed transaction costs between these markets. In the focus group interviews, respondents were asked about average transportation costs over the past year. From this, transportation costs (an important part of the transaction costs) as a share of average annual prices in Addis Ababa at the time of the survey are found to be as high as 7 percent for white teff, 8 percent for mixed teff, and 9 percent for red teff. These numbers are close to the transaction costs estimates from the price integration model (based on weekly data) and suggest that the results of the model are mostly consistent with these data.

TABLE 12.5 Quality premia of teff

	Compared to	Overall		Period 2001–2005		Period 2006–2010		F-test structural change	
		Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	F-value	Prob>F
All markets									
Mixed teff	White teff	**–0.12**	–18.57	**–0.12**	–11.20	**–0.12**	–15.20	0.00	0.99
Red teff	White teff	**–0.27**	–24.52	**–0.28**	–14.27	**–0.26**	–22.42	1.14	0.29
Addis Ababa									
Mixed teff	White teff	**–0.11**	–9.43	**–0.12**	–6.58	**–0.11**	–6.80	0.36	0.55
Red teff	White teff	**–0.32**	–17.54	**–0.33**	–10.13	**–0.32**	–15.15	0.16	0.69

Source: Authors' calculations.

Note: Coefficients in **bold** are significant at the 5 percent level; robust white standard errors to within cluster (by quarter) correlation.

To test the extent to which prices of processed products changed over time relative to raw materials, changes in processing margins are examined. The model described in equation (2) is applied using retail price data for the Addis Ababa market as well as for all wholesale markets. Through this analysis flour margins are found to be declining over time (Table 12.6). This result may reflect an improvement in the milling sector.

Furthermore, changes in the milling sector are confirmed by secondary data from the Addis Ababa Trade and Industry Office Database. For example, the number of mills in the capital city increased substantially over the decade studied. While there was on average less than one mill per ward (kebele) in the middle of the decade, by 2011 there were five. Although part of this increase is probably due to a more formal approach within the milling sector, and consequently those informal mills are now being recorded in the data, this is however unlikely to explain the entire increase. A consequence of this growing number of mills may be an increase in competition and a relative reduction in milling costs. Retail data collected by CSA endorse this since the real price charged for milling cereals at the end of 2010 was 50 percent lower than it was a decade earlier.

Retail Margins

The final link in the supply chain affecting the transmission of prices from producers to consumers is at the retail level. To estimate the changes that have taken place at this level, retail margins are analyzed by using data collected by EGTE on retail pricing and merging these data with their wholesale price series. These retail price data are collected from traders who operate in or close

TABLE 12.6 Premium of flour over teff grain (measured as prices of teff flour retail to teff grain wholesale)

	Overall		Period 2001–2005		Period 2006–2010		F-test structural change	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	F-value	Prob>F
All markets								
Teff	**0.22**	13.62	**0.29**	19.76	**0.15**	7.90	**44.43**	0.00
Addis Ababa								
Teff	**0.31**	13.15	**0.37**	12.61	**0.24**	7.46	**10.89**	0.00

Source: Authors' calculations.

Note: Coefficients in **bold** are significant at the 5 percent level; robust white standard errors to within cluster (by quarter) correlation.

to the wholesale market and who sell directly to consumers. In many cases, however, these retail traders are also involved in wholesale activities.

There are two caveats with respect to the EGTE retail price data that deserve highlighting before examining the results. First, these retail data are only available through the end of 2009. Therefore, the retail margin analysis is limited to comparisons between the periods 2001–2005 and 2006–2009. Second, the retail data collected are not representative of the entire retail sector within the cities. This is because the data are only collected for those particular retail agents near to or in the wholesale markets. As such, they do not include retailers far away from wholesale markets, nor do they include the amalgam of retailers who supply cereals through their shops or supermarkets or especially through small mills. Nonetheless, despite these shortcomings, the data provide indications about the sizes of retail margins and how they evolve over time.

Three relevant findings emerge from the teff retail margin regressions in Table 12.7 for Addis Ababa and for all the markets for which the data were available. First, retail margins in Addis Ababa are significantly higher than in the rest of the country. This is not surprising, however, given the higher retail costs associated with a large city the size of Addis Ababa (for example, real estate costs and higher labor costs).[21] Second, retail margins have generally fallen over time. In the cases tested, the decline is significant. Furthermore, teff margins declined significantly in Addis Ababa. Indeed, the average retail margin fell by half in the capital city.

21 For example, Ethiopia, MoFED (2012) shows that nonfarm prices in Addis Ababa (mostly rent) are significantly higher than in the rest of the country.

TABLE 12.7 Retail margins for teff, 2001–2005 and 2006–2009

	Overall		Period 2001–2005		Period 2006–2009		F-test structural change	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	F-value	Prob>F
All markets	**0.016**	14.71	**0.018**	12.69	**0.014**	9.41	**4.12**	0.05
Addis Ababa	**0.043**	10.62	**0.056**	10.64	**0.028**	13.11	**24.52**	0.00

Source: Authors' calculations.

Note: Coefficients in **bold** are significant at the 5 percent level; robust white standard errors to within cluster (by quarter) correlation.

Conclusion

The structural transformational changes taking place in teff markets is associated with many possible reasons. In this chapter these changes as well as the changes themselves in terms of teff price behavior have been examined. A wholesale market survey was fielded at the beginning of 2012 and monthly price data were collected in major wholesale markets by the EGTE throughout the country. A number of findings come out of this analysis. First, quality premia among teff are found to exist, but these premia changed little over time. Second, the spatial variation in teff prices among wholesale markets and the margins between supplying and receiving markets have decreased significantly over time. Third, markets are becoming more spatially integrated as prices move together and co-vary among more markets since price adjustments take less time to establish. Fourth, retail and milling margins declined by half. Such price changes have been noted for most other major cereals in Ethiopia (Minten, Stifel, and Tamru 2012).

While better road conditions, declining transportation costs, and smaller marketing margins generally result in a more efficient agricultural economy, change inevitably results in both winners and losers. The winners are the suppliers in major production zones as they receive higher prices on average, while urban consumers in the big cities also benefit from the lower prices that result from lower margins. The losers are likely to be the net consumers residing near to or in the supplying areas as they might now be faced with higher prices. Furthermore, producers who reside close to the consuming areas may be worse off as they now face relatively lower prices. Nonetheless, the net gain for the economy as a whole from such market improvements is likely to be substantial (for example, Gardner 1975). Moreover, despite the high increase in the nominal commodity prices that could have benefited the net-sellers, the real prices for teff have not changed much (see Chapter 8). The same case exists for most

other staples (Minten, Stifel, and Tamru 2012). Increases in prices may hurt the net-buyers, many in rural areas and almost all consumers in urban areas, but especially the poor or families around the poverty line.

While these findings are overall encouraging for Ethiopia, there is still significant room for market improvement. First, despite the large sums of money invested in road improvements, Ethiopia started from a low base and still has one of the lowest road densities in the world (von Braun and Olofinbiyi 2007). Second, even when roads are constructed, transport costs are still relatively high compared with some other countries, and further measures are needed to reduce transportation costs (Teravaninthon and Raballand 2009). Third, while access to information is now widely available for traders and brokers, the use of mobile phones by farmers is still one of the lowest in Africa (Nakasone, Torero, and Minten 2014). Fourth, although modern input adoption has improved considerably, adoption levels, especially of improved seeds, are still low often because of the lack of supply.

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