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Impact of Soaring Food Price in Ethiopia

Does Location Matter?

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INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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ABSTRACT

Previous studies implicitly assume uniform price-effects across regions or provinces within countries. They also do not address the issue of integration between the world food market and local markets. Instead, they assume a complete transmission of changes in world food prices to local food prices. In this paper, we first establish evidence of regional price heterogeneity across Ethiopia. We also applied the Johansen test for market integration over 95 local maize markets and found that none of the Ethiopian regional markets for maize is integrated to the world market. However, there is significant short-term price effects between the world maize market and some Ethiopian regional markets. Using the Almost Ideal Demand System, we estimate loss in household consumption and calorie intake as induced by food price increases. The results suggest a great deal of heterogeneity across regions as well as between rural and urban areas. Studies that fail to account for the characteristics of household demand across locations are more likely to induce misleading policy recommendations.

Keywords: price, integration, demand, elasticity

1. INTRODUCTION

In Ethiopia, the food inflation rates (end of period) portray a general trend of increasing food prices over the years 2004 to 2008, reaching all-time high levels in 2008. At the national level, the inflation rate steadily increased from a mere 3.4 percent in 2004 to 13.6 percent in 2006 and rose further to 34.9 percent by June 2008. According to the Ethiopian Central Statistical Agency (2008), the rise in the food inflation rate over the period of June 2007 to June 2008 was due to the rise in the prices of "cereals, pulses, meat, oils and fats, milk and eggs, vegetables and fruits, spices (especially whole pepper and chili), potatoes and other tubers and stems, other food items, and food taken away from home."

The consequences of this dramatic development in food price are still debated, as are adequate short-term and long-term responses. For example, von Braun et al. (2008) point out that at the country level, countries that are net food exporters will benefit from improved terms of trade, although some of them are missing out on this opportunity by banning exports to protect consumers. Net food importers, however, will struggle to meet domestic food demand. A recent analysis by Ivanic and Martin (2008) over nine low-income countries suggests that the short-run impacts of higher staple food prices on poverty will differ considerably by commodity and by country, but, that poverty increases are much more frequent, and larger, than poverty reductions. For Wiggins and Levy (2008), in the short-term, incomes of the poor will fall by more than 25 percent and food consumption by almost 20 percent. Medium-term prospects also remain bleak, with incomes and food consumption expected to fall by 11 percent and 8 percent, respectively.

Although the effect of soaring world food prices will largely depend on the demand pattern of households' responsiveness to price change and possible substitution effects, most previous studies failed to account for characteristics of a household demand system. These studies implicitly assume uniform price-effects across regions or provinces within countries. Moreover, most of the studies dealing with the current food crisis do not address the issue of integration between the world food market and local markets. Instead, they assume a complete transmission of the change in world food prices to local food prices. In this paper, we intend to highlight regional price heterogeneity across Ethiopia. We also analyze the level of market price integration between Ethiopian regional maize markets and the world market. Finally, using the Almost Ideal Demand System, we estimate the loss in household consumption and calorie intake as induced by the food price increase by regions.

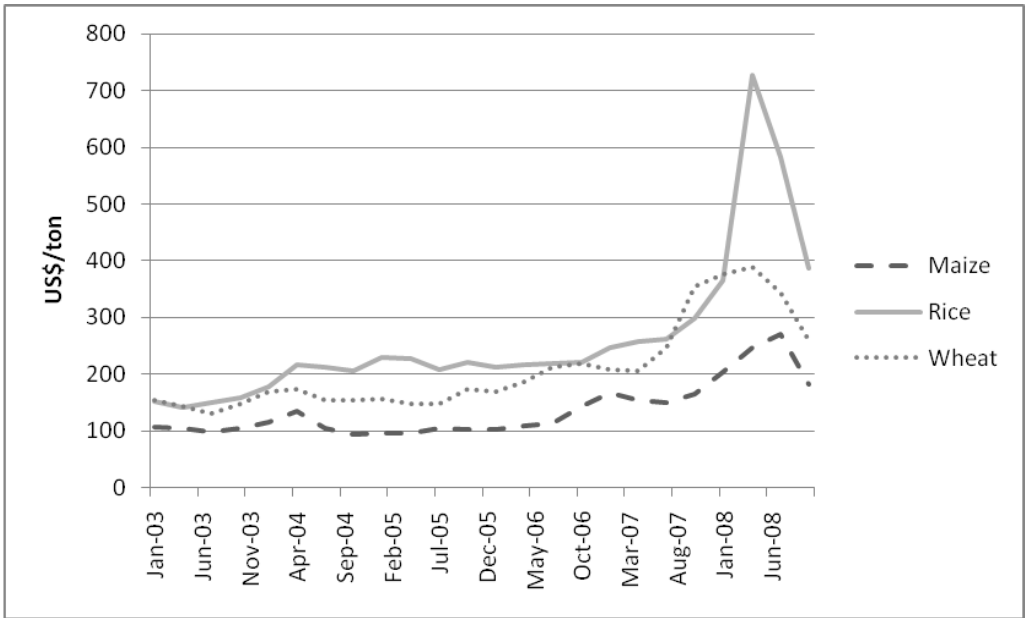
The rest of the paper is organized as follows. In the next section, we discuss regional disaggregation of the trend in food prices in Ethiopia. We also analyze the level of integration of Ethiopian local maize markets to the world market. The methodology to estimate the Ethiopian household demand pattern as well as the loss in consumption and the loss in calorie intake, is presented in the third section. Descriptive analysis of regional household food consumption is presented in the fourth section. Loss in consumption and calorie intake as a result of surging food prices along with characteristics of a household demand pattern are discussed in the fifth section. Concluding remarks and policy implications are presented in the sixth section.

2. SPATIAL ANALYSIS OF TREND OF FOOD PRICE IN ETHIOPIA

According to the International Monetary Fund (2008a), the global economy is in the midst of the broadest and most buoyant commodity price boom since the early 1970s. Oil prices have risen from $30 a barrel in early 2003 to around $140 by the end of June 2008, some 35 percent above the earlier record high in real terms in 1979. Prices of food commodities only started booming in 2006—much later than those of oil, metals, and other minerals—and are generally still far below their 1970s highs. Even though world food prices have risen since the early 2000s, they reached the highest peak in 2008.

The price of wheat has more than tripled in the international market, and maize prices have more than doubled. As Figure 1 shows, the price of rice has jumped to unprecedented levels.

Figure 1. The global food price crisis in 2007–2008

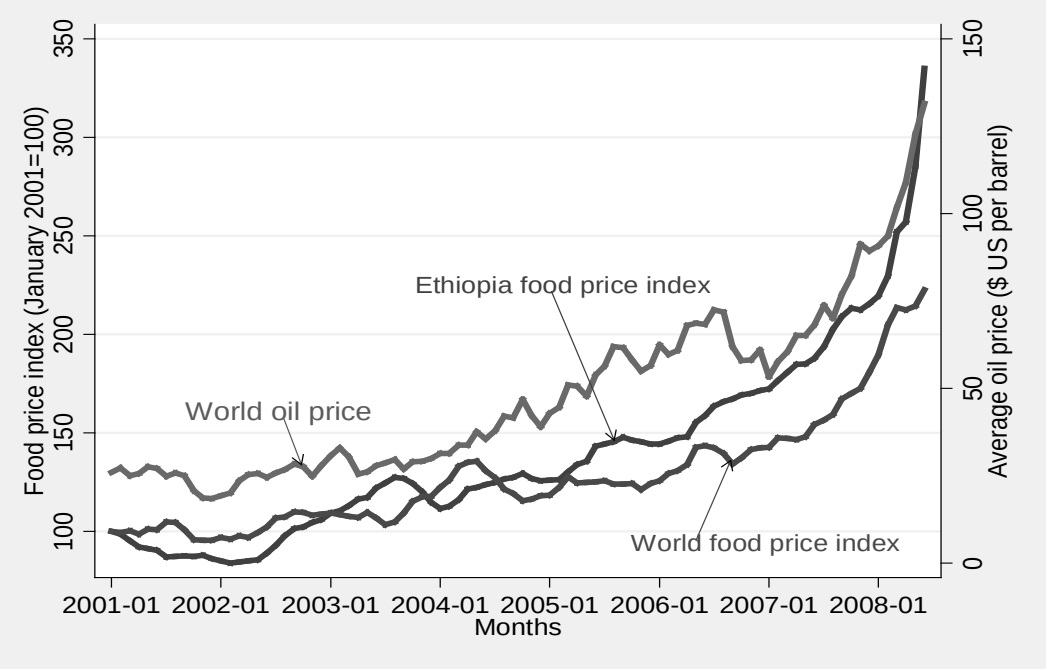


Source: Authors' computation using data from the United Nation's Food and Agriculture Organization, http://www.fao.org/es/esc/prices

The factors behind agricultural price increases are interrelated. Increase in the production of biofuel is considered one of the main factors causing food price instability (Mitchell 2008). Indeed, the demand for cereals for the biofuel industry increases as the price of oil increases; 100 million tons of food grains are converted to biofuel annually (Asian Development Bank 2008). In addition, rapid economic growth in many developing countries and increases in population generated higher demand for food, which did not match the supply in food production. At the same time, the agricultural sector was faced with challenges of land and water constraints, underinvestment in agricultural innovation, and climate change.

Although the Ethiopian food price index seems to share the same increasing trend as the world price index, it is obvious from Figure 2 that since August 2004 the Ethiopian food price index has been consistently higher than the world index. This suggests the existence of significant local causes of the food price surge in Ethiopia, especially the severe drought shock of 2002–2003. The world oil price seems to play a major role in the food price hike in Ethiopia. Even so, when the world oil price dropped below US$70 per barrel between September 2006 and June 2007, the Ethiopian food price index was still rising.

Figure 2. Monthly trend of food price indices and the oil price (January 2001–June 2008)



Source: Authors' computation using data from the Ethiopian Central Statistical Agency (2008) and the International Monetary Fund (2008b).

The dominating trend among the various regions of Ethiopia is that of a steady increase in food prices since 2004 (Table 1). However, there are exceptions. Benishangul-Gumuz is one such case, where the food inflation rate was the highest of all regions at 13.6 percent in 2004 (much higher than the 3.4 percent national rate), then fell to 1.9 percent in 2005, but has risen consistently since then, standing at 46.7 percent at June 2008 (the highest food inflation rate among all regions in 2008). The flow of refugees arriving in Benishangul-Gumuz may explain part of the trend. According to the World Food Program (2008), by end of September 2008 there were 26,492 Sudanese refugees in Gambela and Benishangul-Gumuz, compared with 11,340 Eritrean refugees in Tigray; 5,942 Eritrean refugees in Afar; 29,600 Somalian refugees in Somale (Ethiopia); and 3,104 Kenyan refugees in Oromia.

The food inflation rate was stable in Oromia between 2005 and 2006 at around 14 percent; the Southern Nations, Nationalities, and People's Region's (SNNPR) food inflation rate declined slightly in 2007 compared with 2006 (from 18.1 percent to 16.2 percent); Somale experienced a steady decline in its food inflation rate between 2005 and 2007; and Tigray's food inflation rate dropped from 13 percent in 2005 to 8.8 percent in 2006 but continued to rise thereafter. The striking feature common to all regions is the drastic rise in food inflation rates during the first half of 2008.

Table 1. Food inflation in regions of Ethiopia, end-of-period rates (%)

	2004	2005	2006	2007	2008 Jan. to June
Ethiopia (overall)	3.4	12.8	13.6	21.9	34.9
Addis Ababa	3.7	8.5	19.6	27.0	32.2
Afar	0.5	6.0	15.8	25.6	31.8
Amhara	7.9	11.8	13.3	26.7	35.8
B. Gumuz	13.6	1.9	14.3	24.0	46.7
Dire Dawa	-0.6	11.2	13.2	19.8	31.2
Oromia	-0.1	14.5	14.2	23.6	36.7
SNNPR	2.4	16.1	18.1	16.2	31.3
Somale	-0.6	19.1	14.8	9.0	23.0
Tigray	3.4	13.0	8.8	20.9	39.5

Source: Authors' computation using price indexes obtained from the Ethiopian Central Statistical Agency (2008).

We use the coefficient of variation (CV) as an indicator of the level of price variability over time. Except in 2004, the results suggest that food price variability has been consistently higher in Ethiopia compared with the world market (Table 2). Unlike the world food market's price variability, which has fallen from 7.8 percent in 2007 to 5.4 percent over the first six months of 2008, Ethiopia's has gone up from 8.0 percent to 16.0 percent during the same period. This trend of food price instability during the first six months of 2008 is observed across regions. Within Ethiopia, there seems to be a great deal of heterogeneity in terms of price variability. During the first six months of 2008, the regions of Gambela, Harari, Oromia, SNNPR, and Tigray were the most instable, while Benishangul-Gumuz and Dire Dawa recorded relatively lower levels of instability. In SNNPR, heavy rains and hailstorms caused some damages to crops in several woredas of the Wolayita, Gamo Gofa, Hadiya, and Sidama zones (World Food Program 2008). In Tigray, crops are performing well but are poor in the eastern woredas of Southern and Eastern Tigray. Clearly, policy responses tailored solely on the national price variability are more likely to miss some regions with variability above or below the national average.

Weather conditions leading to differences in the performance of the agricultural sector across regions can also explain some of the price heterogeneity observed across regions. Surveying major wheat-, *teff*-, and maize-growing areas of the country (Etheya, Yetmen, and Bako, respectively), Demeke et al. (2007) found that crop output had increased in all the three sites, but the rate of increase varied across locations: typically 3–5 percent per annum, and higher rates of 22 percent in 2005–2006 for maize in Bako and 13 percent in 2006–2007 for *teff* in Yetmen. However, compared with1999, production has sharply declined in Bako while significantly increasing in Etheya.

Table 2. Price variability (%)

	2001	2002	2003	2004	2005	2006	2007	January–June 2008
Ethiopia	**5.2**	**9.3**	**5.3**	**4.8**	**5.3**	**6.5**	**8.0**	**16.0**
Addis Ababa	2.9	3.7	3.7	3.9	4.6	8.0	7.3	14.9
Afar	3.4	5.8	3.2	1.7	4.9	6.0	8.7	13.4
Amhara	6.9	11.6	6.8	5.6	8.0	5.8	9.9	14.6
B. Gumuz	4.5	10.7	8.6	4.3	4.7	4.5	12.9	12.8
Dire Dawa	3.6	5.3	2.7	3.6	4.5	4.7	7.5	12.1
Gambela	3.9	9.9	3.3	7.3	8.6	6.1	8.6	15.9
Harari	3.4	5.6	1.8	2.7	5.2	6.1	5.9	19.1

Table 2. Continued

	2001	2002	2003	2004	2005	2006	2007	January–June 2008
Oromia	5.5	11.6	5.8	4.8	4.0	7.7	7.6	16.8
SNNPR	3.3	4.5	4.3	4.9	4.3	7.5	6.0	19.2
Somale	1.4	6.1	1.2	5.1	7.9	3.6	4.4	13.9
Tigray	5.3	9.9	5.5	6.6	6.4	3.6	10.6	16.6
World (food)	**3.1**	**5.5**	**4.3**	**5.9**	**1.4**	**4.4**	**7.8**	**5.4**
World (oil)	**13.1**	**11.5**	**7.2**	**12.9**	**10.1**	**8.2**	**16.9**	**15.0**

Source: Authors' computation using data from the Ethiopian Central Statistic Agency and the IMF Commodity Price Data.
Note: Coefficient variation is the ratio between the standard deviation and the mean.

It might also be that inadequate infrastructure and undeveloped food markets in Ethiopia restrict trade between surplus and deficit grain-producing regions, explaining regional heterogeneity in prices (World Bank 2007). A study by the European Commission Delegation to Ethiopia (2007) reports that in maize surplus areas of southwestern Ethiopia, average maize price increased by 38.8 percent, from *Birr* (Ethiopian currency) 116.00 in March 2007 to *Birr* 161.00 in July 2007 due to early depletion of stocks following soaring prices of other grains. At the same time, in deficit areas of eastern and central Ethiopia that procure maize from surplus areas of southern (Meki and Shashemene) and southwestern (Wollega) Ethiopia, a 25.8 percent price increase was reported from March to July 2007.

In this paper, we not only establish the level of integration of regional markets but also analyze how well the Ethiopian regional food markets are individually integrated to the world food market. The World Bank (2007) found that the three most populous regions (Amhara, Oromia, and SNNPR) as well as Addis Ababa had similar rates of food inflation over the period, with cumulative rates of 62–70 percent, suggesting that markets in Amhara and Oromia are closely integrated with the Addis Ababa market. The studies found Tigray and Dire Dawa to be outliers. However, in light of the literature on the subject, and the methodology they have used, the authors of the World Bank (2007) study acknowledge that market integration in Ethiopia has not been conclusively established.

Following Gonzalez-Rivera and Helfand (2001), we argue that *n* markets are spatially integrated if and only if *n-1* cointegrating factors exist. It follows that in the case of the world food market and each of the Ethiopian regions, we should expect one cointegrating factor for each pair. Using the test developed by Johansen (1995), we found that none of the Ethiopian local maize markets was integrated to the world maize market. In other words, these markets do not share a common long-run trend in their respective price with the world maize market. In addition, we could not find evidence of market integration among Ethiopian regional maize markets.

The short term impacts of a 1 percent change in the world maize price on regional maize prices in Ethiopia[1] are reported in Table 3. These impacts are rather limited, less than 5% and non-significant in most of the regions. Only B. Gumuz and Gambela experience high and significant influence from the world maize price on local markets. Both of these regions include markets such as Gambella in Gambela, and Assosa and Bambesi in B. Gamuz which are located near the border with a food importer (Sudan); this might explain their sensitivity to shocks from the world markets.

[1] Each regional equation takes the following form: $p_t = \alpha p_{t-1} + \beta \bar{p}_t + \epsilon_t$, where p_t and $\overline{p_t}$ represent log of regional food price index and that of the world, respectively; ε_t is the error term, $\epsilon \sim N(0, \sigma_\varepsilon^2)$. Robust OLS was used to estimate each equation. Here we report only $\hat{\beta}s$.

Table 3. Average short term impact of world maize price on local prices in Ethiopia

Dependent variable: local maize price	Addis Ababa		SNNPR		Afar		Ahmara		B. Gumuz		Dire dawa	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Price of previous period	**0.928***	0.049	**0.929***	0.033	**0.900***	0.046	**0.926***	0.037	**0.849***	0.062	**0.946***	0.041
World maize price	0.036	0.037	0.071	0.056	0.027	0.048	0.046	0.042	**0.217***	0.078	0.024	0.041
Intercept	0.044***	0.024	*0.027***	0.011	*0.051***	0.021	*0.042***	0.017	0.015	0.015	**0.039***	0.021
	Gambela		Harari		Oromia		Somale		Tigray			
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.		
Price of previous period	**0.745***	0.115	**0.915***	0.043	**0.938***	0.042	**0.740***	0.102	**0.926***	0.045		
World maize price	*0.249**	0.115	0.061	0.071	0.041	0.040	0.133	0.092	0.032	0.037		
Intercept	0.074***	0.038	*0.058***	0.024	*0.031***	0.015	**0.135***	0.048	*0.049***	0.025		

Notes: All variables are in logarithmic form.
*,**,*** means significant at 1, 5, and 10%.
S.E.: standard error

3. FOOD DEMAND PATTERN

Almost Ideal Demand System

To describe Ethiopian households' demand patterns, we use elasticities (Table 4) derived from the Almost Ideal Demand System (AIDS) model based on the expenditure function (Deaton and Muellbauer, 1980a). For each commodity *i*, the expenditure share is given as follows:

$$w_i = \alpha_i + \sum_{k=1}^{n} \gamma_{ik} lnp_k + \beta_i ln\left(M/P\right) \tag{1}$$

where p_k is the market price of commodity *k*, *M* represents consumers' total expenditures or income, and *P* is a price index defined as:

$$lnP = \alpha_0 + \sum_{i=1}^{n} \alpha_i lnp_i + \frac{1}{2}\sum_{i=1}^{n}\sum_{k=1}^{n} \gamma_{ik} lnp_i lnp_k \tag{2}$$

Table 4. Demand elasticities derived from the Almost Ideal Demand System

Type	Formula
Expenditure elasticity	$e_i = 1 + \beta_i / w_i$
Uncompensated price elasticity	$e_{ik} = -\theta_{ik} + \{\gamma_{ik} - \beta_i (w_k - \beta_k ln(M/P))\} / w_i$
Compensated price elasticity	$e^{-}_{ik} = -\theta_{ik} + \frac{\gamma_{ik}}{w_k} + w_k$
Income elasticity	$\vartheta_i = e_i \Omega$

Note: θ_{ik} is the Kronecker delta, which is unity if $i = j$ and zero otherwise; ϑ_i is the income elasticity for good *i*, Ω is the elasticity of expenditures on the commodity group as a whole with respect to income.

The linear AIDS model is estimated using the iterative Seemingly Unrelated Estimation method. Because of exact multicollinearity, one equation is dropped and its estimates recovered using theoretical restrictions. To avoid inherent nonlinearities induced by equation (2), Deaton and Muellbauer (1980b) instead recommend the use of Stone's index, $\log P = \sum_k w_k \log p_k$. However, Moschini (1995) points out that by doing so, AIDS loses its original properties because Stone's index is not invariant with respect to the choice of units of measurement for prices and quantities. In this paper, we estimate the linear approximate AIDS model using a version of the Tornquist index, where prices are normalized by their means.

Welfare Measures

To estimate welfare change as a result of price increase, we took important welfare measures, the compensating variation that estimates overall food consumption change as a result of price change, and nutrient elasticity with respect to price. The overall change in food consumption induced by change in price is an indication of welfare change and is approximated as follows:

$$CV \approx \sum_{I=1}^{n} w_i \Delta lnp_i + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} w_i \bar{e_{ij}} \Delta lnp_i \Delta lnp_j \quad (3)$$

where w_i is the expenditure share of commodity *i*, Δlnp_i approximates price change for commodity *i*, and $\bar{e_{ij}}$ represents the Hicksian's compensated cross-price elasticity.

Nutrient elasticity is given by the change in nutrients such as minerals, vitamins, and lipids as commodity prices change by 1 percent. To derive the nutrient elasticity with respect to price, Huang and Lin (2000) propose the methodology described as follows:

Let a_{ki} be the quantity of the k^{th} nutrient in a total of *k* nutrients obtained from a unit of the i^{th} food. The total quantity of that nutrient, say φ_k , obtained from various foods may be expressed as a "consumption technology" of consumer behavior :

$$\varphi_k = \sum_{i=1}^{n} a_{ki} q_i \quad (4)$$

The demand for the i^{th} food item can be expressed as:

$$q_i = f(p_1, \ldots, p_n, m) \quad (5)$$

It follows that the demand system can be expressed as the first-order differential approximation of the conceptual demand relationships (Huang and Lin 2000) as:

$$dq_i/q_i = \sum_{j=1}^{m} e_{ij}\left(dp_j/p_j\right) + \eta_i\left(dm/m\right) \quad (6)$$

where e_{ij} is the uncompensated demand elasticity of the i^{th} commodity (see Table 4), with respect to a price change of the i^{th} commodity, and η_i is expenditure (or income) elasticity showing the effect of the i^{th} quantity in response to a change in per-capita expenditure. By differentiating equation (4) with respect to price and expenditure and then incorporating equation (6), Huang (1996) showed that relative changes in nutrient consumption can be expressed as a function of relative changes in prices and expenditure as follows:

$$\begin{aligned} d\varphi_k/\varphi_k &= \sum_j \left(\sum_i e_{ij} a_{ki} q_i/\varphi_k\right)\left(dp_j/p_j\right) + \left(\sum_i \eta_i a_{ki} q_i/\varphi_k\right)\left(dm/m\right) \\ &= \sum_j \pi_{kj}\left(dp_j/p_j\right) + \rho_k\left(dm/m\right) \end{aligned} \quad (7)$$

where $\pi_{kj} = \sum_i e_{ij} a_{ki} q_i/\varphi_k$ and $\rho_k = \sum_i \eta_i a_{ki} q_i/\varphi_k$; π_{kj} represents the weighted average of all own- and cross-price elasticities (e_{ij}'s) in response to a change in the j^{th} price, with each weight expressed as the share of each food item's contribution to the k^{th} nutrient. Similarly, the measurement of ρ_k represents the weighted average of all income elasticities (η_i's) , with each weight again expressed as the share of each food's contribution to the k^{th} nutrient.

4. HOUSEHOLD FOOD CONSUMPTION—REGIONAL DESCRIPTIVE ANALYSIS

The Ethiopia Household Income, Consumption, and Expenditure Survey (EHICES) of 1999–2000 is used for this purpose. The survey was administered by the Central Statistical Authority of Ethiopia from June 1999 through February 2000. It took place in two rounds covering the two major seasons: the slack season and the peak (harvest) season. Data is collected on all foods acquired by households over a one- to two-week period, including their food purchases, foods consumed from their own farms or gardens, and foods received in-kind.

On average, except in SNNPR, where cereals [2] expenditures account for only 32.4 percent of total food expenditures, cereals expenditures dominate household food budgets (Table 5). Cereals expenditures represent at least 50 percent of household food budgets in Dire Dawa (54.6 percent), Tigray (53.6 percent), Addis Ababa (50.5 percent), Harari (50.5 percent), Amhara (50.4 percent), and Oromia (50.2 percent). As for other food items, expenditures vary across regions; for example, pulses and legumes account for 14.0 percent of total food expenditures in Amhara, compared with 4.4 percent in Dire Dawa and 1.7 percent in Somale.

Table 5. Expenditure shares by food items (%)

	Cereals	Pulses and legumes	Meat	Sugar and honey	Vegetables	Other	Total
Tigray	53.6	8.7	6.3	2.5	6.5	22.5	100.0
Afar	42.6	6.9	3.4	2.9	4.3	39.9	100.0
Amhara	50.4	14.0	6.7	1.3	4.2	23.4	100.0
Oromia	50.2	7.5	5.0	2.2	6.4	28.8	100.0
Somale	47.7	1.7	3.9	11.7	5.3	29.7	100.0
B. Gumuz	43.8	9.3	7.7	2.1	8.3	28.7	100.0
SNNPR	32.4	7.6	4.0	1.0	7.2	47.8	100.0
Gambela	43.5	5.7	7.5	2.4	11.3	29.6	100.0
Harari	50.5	5.3	4.6	3.3	5.7	30.7	100.0
Addis Ababa	50.5	7.9	7.5	3.5	5.4	25.3	100.0
Dire Dawa	54.6	4.4	3.9	4.2	5.6	27.3	100.0

Source: Authors' calculations using data from EHICES 1999–2000.

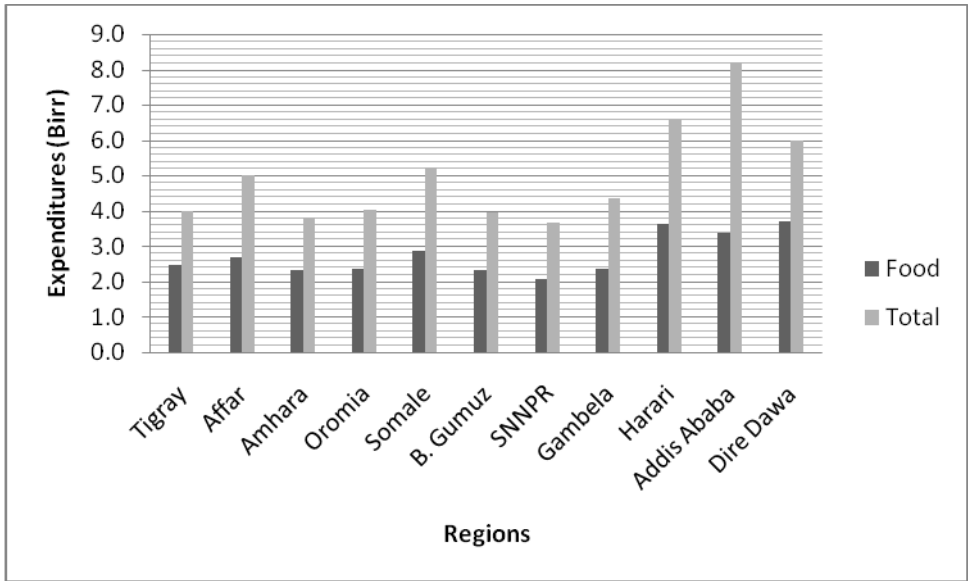
The consumption pattern in Table 5 may be explained in part by the spatial distribution of production across regions. For example, different cereals are found in different areas, reflecting both climatic and cultural contexts (Central Statistical Agency et al. 2006). *Teff* is predominant in the central and northern highlands. Barley tends to dominate in cooler areas. Wheat production is concentrated in the Arsi-Bale highlands of eastern Oromia. However, maize and sorghum are produced over a wider range of climates and elevations than other cereals. Cereals account for almost 80 percent of all temporary crops grown in Ethiopia. Of these, *teff* constitutes a little more than a fourth of the total cultivated area (26 percent), followed by maize (24 percent), sorghum (17 percent), wheat (15 percent), and barley (13 percent). The distribution of these cereals is strongly influenced by elevation and therefore varies across locations.

Figure 3 presents both household daily food expenditures and total expenditures by adult equivalent in Ethiopian currency, *Birr*. As expected, Addis Ababa tops all other regions in terms of adult equivalent daily total spending (8.2 *Birr*) but third in terms of food spending, behind Dire Dawa (3.7 *Birr*) and Harari (3.4 *Birr*). However, in terms of food expenditures as a share of total daily expenditures, Addis

[2] Cereals include *teff*, maize, wheat, sorghum, and barely.

Ababa has the lowest (41.2 percent), compared with 62.1 percent for Dire Dawa, 61.9 percent for Tigray, and 60.9 percent for Amhara. This is an indication that households living in Addis Ababa might be better off than those living in other parts of Ethiopia.

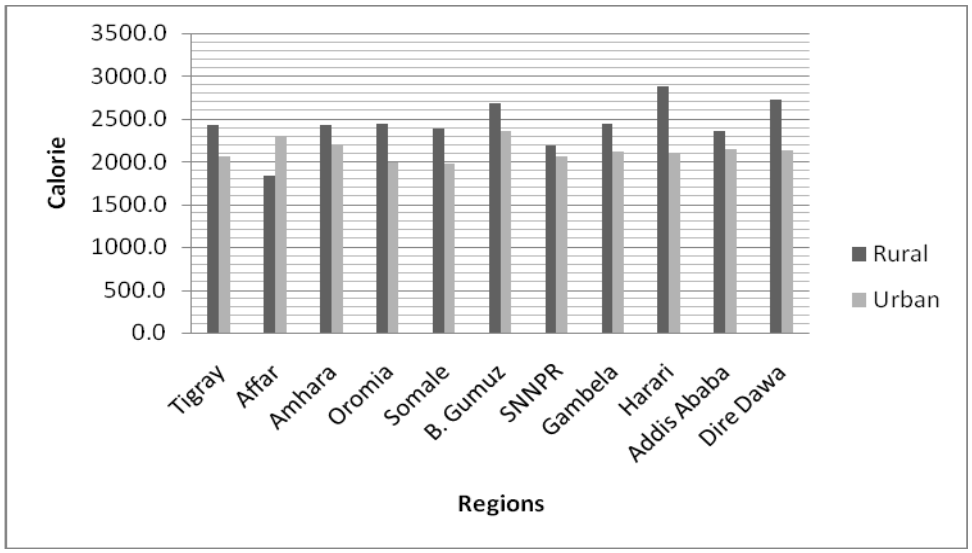
Figure 3. Adult equivalent daily expenditures (*Birr*)



Source: Authors' calculations using data from EHICES 1999–2000.

Calorie intake per adult equivalent in urban areas varies from a low of 1,834.3 in Afar to a high of 2,885.8 in Harari (Figure 4). In rural areas, it varies from a low of 1,980.3 in Somale to a high of 2,359.9 in B. Gumuz. Overall, calorie intake tends to be higher in rural areas than in urban areas, except in Afar. Urban areas of Tigray, Oromia, and Somale fall short of the minimum standard of daily energy intake for the average Ethiopian set by the World Food Program, which is 2100 calories per day.

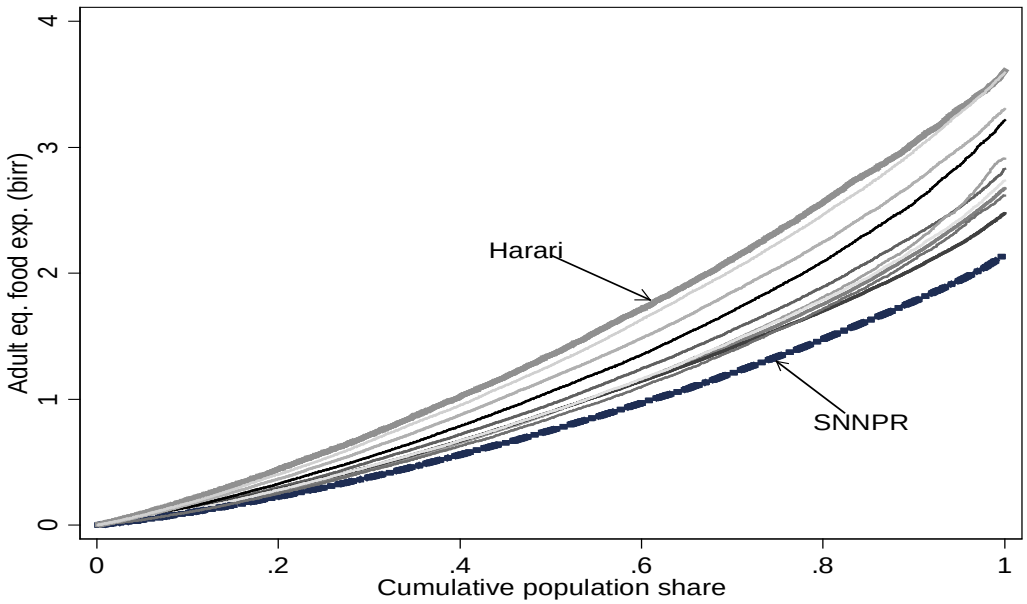
Figure 4. Adult equivalent calorie intake



Source: Authors' calculations using data from EHICES 1999–2000.

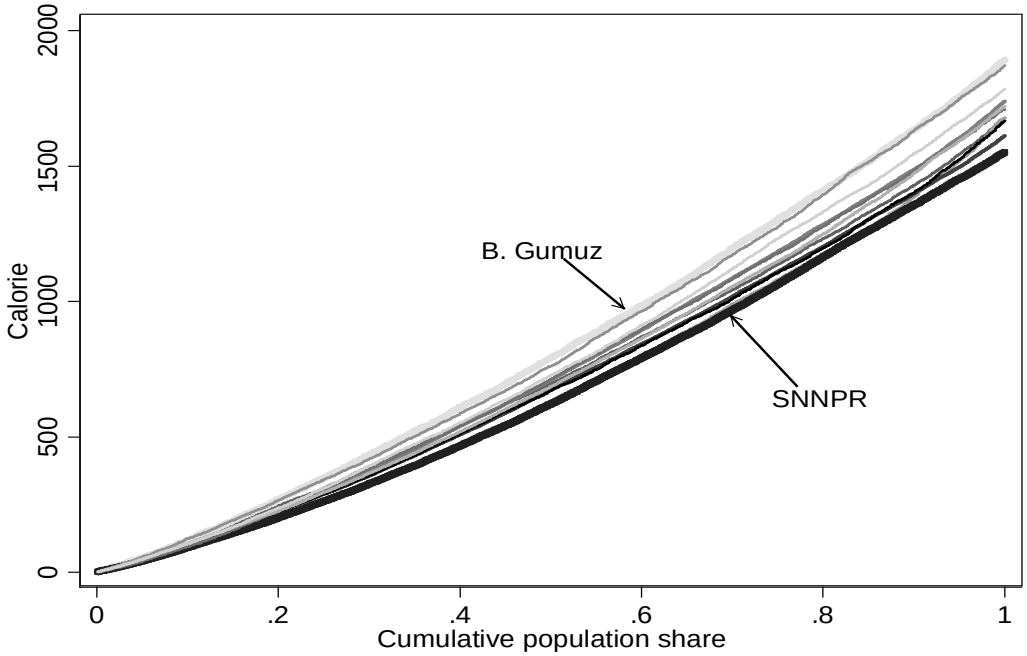
Figures 5 and 6 present the Lorenz curves for adult equivalent food expenditures and adult equivalent calorie intake. They suggest significant regional heterogeneity in consumption inequality, more so for food expenditures than calorie intake. Moreover, in both cases inequality is systematically higher in SNNPR compared with other regions.

Figure 5. Lorenz curve for adult equivalent food expenditures



Source: Authors' calculations using data from EHICES 1999–2000.

Figure 6. Lorenz curve for adult equivalent calorie intake



Source: Authors' calculations using data from EHICES 1999–2000.

5. ESTIMATION RESULTS

Overall, the results reported in Table 6 suggest that an increase in income induces an increase in the demand for all food items across regions. Hence, across regions, all goods can be classified as *normal goods* meaning that their demands increase with income.

Nationally, we found income elasticity of 0.59 for cereals, 0.44 for pulses and legumes, 0.795 for meat, 0.485 for sugar and honey, and 0.225 for vegetables.

In rural Dire Dawa meat is found to be a luxury good, while vegetables are an inferior good in rural areas of Amhara, Dire Dawa, and Tigray. We found that as a result of change in income, the demand for cereals changes uniformly across regions. Nationally, except for meat, demand elasticity with respect to income tends to be much higher in urban areas than in rural areas. In addition, much of the regional heterogeneity is observed in rural areas; indeed, only for pulses and legumes is the variance of income elasticity lower in rural areas than in urban areas.

As reported in Table 7, own-price elasticity exhibits much more variability across regions than does income elasticity. However, across regions, no significant difference is observed in own-price elasticities for cereals except in rural SNNPR, where price elasticity (-0.27) is way below the national average of -0.82. The difference in price elasticity between rural (-0.27) and urban (-0.84) SNNPR highlights inequality found in food expenditures and calorie intake within the region. Across regions, cereals are price inelastic. On average, household consumption is expected to fall by 0.82 percent and 0.86 percent for a 1 percent increase in the price in rural and urban areas, respectively. Unlike cereals, demands for all other food items exhibit a great deal of geographical heterogeneity in terms of their response to price change. For example, pulses and legumes appear as Giffen goods, whose demand increases with increases in price, in Somale, rural Dire Dawa, and Gambela.

Across regions, the results suggest that the demand for meat goes up as price increases, more so in rural areas (1.96) than in urban areas (0.67). A similar pattern is also observed for sugar and honey in rural areas. As reported by Levitt (2008), in the case of rice in rural China, such Giffen behavior is likely to be found among households that are extremely poor and consume a simple diet of primarily a basic good.

Table 6. Income elasticity

	Cereals		Pulses and legumes		Meat		Sugar and honey		Vegetables	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Addis Ababa	0.59	0.59	0.53	0.50	0.79	0.73	0.48	0.55	0.21	0.37
Afar	0.59	0.59	0.47	0.50	0.74	0.76	0.49	0.56	0.11	0.42
Amhara	0.59	0.59	0.53	0.53	0.82	0.70	0.32	0.51	-0.12	0.35
B. Gumuz	0.59	0.59	0.51	0.53	0.76	0.70	0.41	0.52	0.28	0.46
Dire Dawa	0.59	0.59	0.32	0.43	1.06	0.76	0.44	0.56	-1.25	0.46
Gambela	0.59	0.59	0.36	0.44	0.83	0.69	0.42	0.54	0.46	0.45
Harari	0.59	0.59	0.46	0.45	0.94	0.74	0.48	0.56	0.22	0.45
Oromia	0.59	0.59	0.48	0.48	0.82	0.76	0.35	0.53	0.26	0.41
SNNPR	0.60	0.59	0.38	0.50	0.81	0.77	0.34	0.49	0.34	0.45
Somale	0.59	0.59	0.22	0.06	0.99	0.75	0.57	0.58	0.18	0.34
Tigray	0.59	0.59	0.48	0.51	0.82	0.77	0.45	0.55	-0.23	0.32
Average	**0.59**	**0.59**	**0.43**	**0.45**	**0.85**	**0.74**	**0.43**	**0.54**	**0.04**	**0.41**
Variance	**0.00**	**0.00**	**0.10**	**0.13**	**0.10**	**0.03**	**0.07**	**0.03**	**0.47**	**0.05**

Source: Authors' calculations using data from EHICES 1999–2000.

Table 7. Marshallian own-price elasticity

	Cereals		Pulses and legumes		Meat		Sugar and honey		Vegetables	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Addis Ababa	-0.90	-0.88	-0.65	-0.48	1.23	0.57	0.52	-0.49	-0.08	-0.47
Afar	-0.87	-0.85	-0.33	-0.52	0.70	0.86	0.39	-0.62	0.18	-0.57
Amhara	-0.88	-0.85	-0.68	-0.64	1.55	0.28	2.63	0.14	0.71	-0.41
B. Gumuz	-0.87	-0.82	-0.57	-0.64	0.97	0.19	1.45	-0.06	-0.25	-0.67
Dire Dawa	-0.90	-0.88	0.50	-0.10	4.27	0.95	1.03	-0.64	3.45	-0.68
Gambela	-0.86	-0.85	0.28	-0.16	1.76	0.14	1.29	-0.37	-0.67	-0.65
Harari	-0.90	-0.87	-0.29	-0.23	2.95	0.64	0.45	-0.63	-0.09	-0.64
Oromia	-0.78	-0.87	-0.38	-0.40	1.58	0.93	2.20	-0.20	-0.20	-0.56
SNNPR	-0.27	-0.84	0.16	-0.50	1.45	1.04	2.29	0.30	-0.39	-0.65
Somale	-0.88	-0.86	1.01	1.92	3.56	0.80	-0.77	-0.84	0.01	-0.38
Tigray	-0.90	-0.88	-0.36	-0.56	1.59	1.00	0.84	-0.45	0.97	-0.33
National average	**-0.82**	**-0.86**	**-0.12**	**-0.21**	**1.96**	**0.67**	**1.12**	**-0.35**	**0.33**	**-0.55**

Source: Authors' calculations using data from EHICES 1999–2000.

Consumption Loss

In the short run, in response to food price increases, there seems to be a consensus for the implementation or expansion of social safety nets programs that target the most vulnerable social groups (von Braun et al. 2008). The nature and magnitude of such programs, as well as their effectiveness, will largely depend on the households' demand patterns, which in turn depend also on geographical attributes of the households. In Table 8 we present the monetary value of compensating variations that can be used to design and estimate the cost of such programs. In the present case, compensating variation represents the expected loss in overall food consumption induced by an increase in food price. It also represents the amount by which households should be compensated in order to maintain their well-being at the same level as before the price change.

Results reported in Table 8 suggest that consumption loss varies widely across regions and food items. Due to the dominance of cereals in household food budgets, compensation or loss as a result of price increase is much higher for cereals than for other food items. Across regions, the amount of consumption loss is unevenly distributed. For example, with cereals, households in Addis Ababa, Dire Dawa, and Harari experience consumption loss far more than those in SNNPR and Afar. Even within each region, there is still a notable difference between urban and rural areas. On average, consumption loss is higher in rural areas than in urban areas for cereals, pulses, and legumes.

Table 8. Yearly loss in household consumption as a result of 50 percent increase in own price (Birr)

	Cereals		Pulses and legumes		Meat		Sugar and honey		Vegetables	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Addis Ababa	1097.8	865.1	172.5	119.1	224.3	283.8	38.7	69.1	77.2	116.0
Afar	513.6	554.9	82.8	104.7	159.3	199.2	21.3	67.7	50.2	98.5
Amhara	757.3	553.3	179.9	127.4	188.2	292.3	24.8	42.5	61.3	88.5
B. Gumuz	543.4	425.6	95.1	115.8	163.0	234.8	27.1	48.0	70.3	105.9
Dire Dawa	1258.4	838.8	66.5	86.5	179.9	214.0	44.4	87.1	59.2	158.7
Gambela	448.6	554.5	92.4	89.2	131.4	229.3	25.7	56.3	116.9	121.3
Harari	1219.7	633.7	106.7	73.9	163.2	188.6	57.8	62.8	94.8	112.1
Oromia	719.9	554.1	113.7	86.0	159.8	169.1	26.0	48.6	72.2	92.2
SNNPR	279.4	521.3	71.0	98.8	147.6	189.9	20.6	40.8	67.7	110.2
Somale	775.6	726.5	47.8	66.1	115.3	208.6	86.5	170.4	76.8	132.0
Tigray	791.9	552.9	94.5	85.0	142.9	150.0	24.3	42.3	67.7	71.1
Average	**764.2**	**616.4**	**102.1**	**95.7**	**161.3**	**214.5**	**36.1**	**66.9**	**74.0**	**109.7**

Source: Authors' calculations using data from EHICES 1999–2000.

Loss in Calorie Intake

Unlike previous studies, in this paper we estimate the price elasticity of calorie intake, taking into account both own-price and cross-price effects (Table 9). Overall, for a 50 percent increase in the price of cereals, the amount of daily calorie intake is expected to decrease. The price effect varies across regions and from rural to urban areas.

Table 9. Decrease in calorie intake induced by increase in price (%)

	Rural	Urban
Addis Ababa	-15.7	-12.3
Afar	-24.8	-12.5
Amhara	-18.8	-12.1
B. Gumuz	-14.8	-8.4
Dire Dawa	-22.1	-12.9
Gambela	-15.6	-11.4
Harari	-14.9	-10.9
Oromia	-13.5	-11.8
SNNPR	-6.9	-9.8
Somale	-15.0	-11.8
Tigray	-24.1	-16.1

Source: Authors' calculations using data from EHICES 1999–2000.

Overall, except in SNNPR, rural households are more affected than their urban counterparts in calorie intake due to a cereals price increase. Households living in rural SNNPR are the least affected (-6.9 percent), and those in Afar are the most affected (-24.8 percent).

6. CONCLUDING REMARKS

All regions in Ethiopia have experienced a drastic rise in food inflation since 2004. Performing the Johansen's test for cointegration, we found that none of the Ethiopian regional maize markets had a long-term connection to the world market, nor could we establish evidence of market integration among regional markets. However, there is significant short-term price effect between the world maize market and some Ethiopian regional markets.

Lorenz curves for adult equivalent food expenditures and adult equivalent calorie intake suggest significant regional heterogeneity in consumption inequality, more so for food expenditures than for calorie intake. In both cases inequality is systematically higher in the SNNPR compared with other regions.

We estimate consumption loss as well as loss in calorie intake as a result of price increase. Overall, the results suggest a great deal of heterogeneity across regions as well as between rural and urban areas. Due to the dominance of cereals in household food budgets, compensation or loss as a result of price increase is much higher for cereals than for other food items. Across regions, the amount of consumption loss is not evenly distributed. In terms of loss in calorie intake, except in SNNPR, rural households are more affected than their urban counterparts.

The main point of this paper is to highlight the importance of understanding household demand behavior across locations as it impacts the design, implementation, and effectiveness of short-term responses to increasing food prices. Studies that fail to account for the characteristics of household demand across locations are more likely to yield misleading policy recommendations. It follows that effective policy responses should account for geographic heterogeneity in household consumption behavior. Our results suggest that targeting national averages might not be efficient.

REFERENCES

Asian Development Bank. 2008. Soaring Food Prices: Response to the Crisis. Available at: www.adb.org/Documents/Papers/soaring-food-prices/soaring-food-prices.pdf.

Central Statistical Agency (CSA) of the Federal Democratic Republic of Ethiopia (FDRE), the Ethiopian Development Research Institute (EDRI), and the International Food Policy Research Institute (IFPRI). 2006. Atlas of Ethiopian Rural Economy. Washington, DC: IFPRI.

Central Statistical Agency. 2008. Country and regional level consumer price indices: for the month of June 2008. Information No. 9. Addis Ababa.

Deaton, A.S., and J. Muellbauer. 1980a. "An Almost Ideal Demand System," *American Economic Review* 70: 312-326.

Deaton, A., and J. Muellbauer. 1980b. *Economics and Consumer Behavior*. Cambridge UK: Cambridge University Press.

Demeke, M., A. Alemu, B. Bushie, S. Yifredew, T. Ferede. 2007. Exploring demand and supply factors behind recent developments in grain prices: Key issues and hypotheses. Unpublished report for DFID- Ethiopia.

European Commission Delegation to Ethiopia. 2007. Grain market price assessment report. RDFS Section.

Gonzalez-Rivera, G., and S. Helfand. 2001. The extent, pattern, and degree of market integration: A multivariate approach for the Brazilian rice market. *American Journal of Agricultural Economics* 83: 576–92.

Huang, K.S., and B.-H. Lin. 2000. Estimation of food demand and nutrient elasticities from household survey data. Food and Rural Economics Division, Economic Research Service, U.S. Department of Agriculture. Technical Bulletin No. 1887.

Huang, K.S. 1996. Nutrient elasticities in a complete demand system. *American Journal of Agricultural Economics*. 78: 21–29.

International Monetary Fund. 2008a. Food and fuel prices—Recent developments, macroeconomic impact, and policy responses. Washington, D.C.

International Monetary Fund. 2008b. Primary Commodity Prices. Washington, DC. Available at: www.imf.org/external/np/res/commod/index.asp.

Ivanic, M., and W. Martin. 2008. Implications of higher global food prices for poverty in low-income countries. World Bank, Policy Research Working Paper 4594.

Johansen, S. 1995. *Likelihood-based inference in cointegrated vector autoregressive models.* Oxford: Oxford University Press.

Levitt, S.D. 2008. "The Indiana Jones of economics," *The New York Times.* Available at: http://freakonomics.blogs.nytimes.com/2008/05/07/the-indiana-jones-of-economics-part-iii/

Mitchell, D. 2008. A note on rising food prices. Policy Research Working Paper No. 4682. The World Bank, Washington D.C.

Moschini, G. 1995. Units of measurement and the Stone index in demand system estimation. *American Journal of Agricultural Economics* 77: 63–68.

von Braun, J., A. Ahmed, K. Asenso-Okyere, S. Fan, A. Gulati, J. Hoddinott, R. Pandya-Lorch, M. W. Rosegrant, M. Ruel, M. Torero, T. van Rheenen and K. von Grebmer. 2008. High Food Prices: The What, Who,and How of Proposed Policy Actions. *Policy Brief.* Washington, DC: International Food Policy Research Institute.

Wiggins, S., and S. Levy. 2008. Rising food prices: A global crisis. Briefing Paper 37. Overseas Development Institute.

World Bank. 2007. Ethiopia: Explaining food price inflation. Policy Note. World Bank: Addis Ababa.

World Food Program. 2008. Ethiopia Country Office Food Security Update. Ethiopia, Addis Ababa.

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