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Full Length Research Paper

Food Price Inflation and Its Effects on Food Insecurity in Ethiopia: Using a Household Level Panel Dataset

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Abstract

The purpose of this study is to investigate how Ethiopian households' food security situation is impacted by rising food prices. The panel dataset used in this study came from waves one, two, and three of Ethiopia's living standard measuring survey. The fixed-effect logistic regression model has been used for this. The findings showed that, on average, 49.99%, 59.65%, and 64.91% of Ethiopian households experienced food security between 2011/12 and 2014/15. The results of the fixed effect logistic regression model showed that price shock, gender (female), household size in adult equivalent, food price inflation, and distance to market were were favourably correlated with Ethiopia's food insecurity. However, the chance of food insecurity is negatively impacted by a number of factors, including geography (both large and small towns), nonfarm enterprise, house ownership, employment, and educational attainment. This leads to the conclusion that while education, off-farm income, and access to a home positively impacted households' food security in Ethiopia, family size, shocks, inflation of food prices, and a lack of infrastructure increased the likelihood that households would be food insecure. Additionally, this predicts that price volatility and food insecurity will be major issues in the future. Therefore, in order to guarantee a sustainable supply of food, governments should endeavour to stabilise the food market, provide households with the means and chances to raise their per capita income, and develop more simple and faster measures to handle food market management.

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1. Introduction

A serious and expanding global issue is food security. In 2021, 768 million people worldwide—or 9.2% of the global population—are predicted to suffer from malnutrition, according to joint reports from the World Food Program, the Food and Agriculture Organization, and other organizations (FAO, WFP, IFAO, UNICEF, 2021). Furthermore, 282 million Africans suffer from malnutrition, and the continent faces severe food insecurity issues, according to the Africa Food Security and Nutritional 2020 report. About 264 million of them reside in Sub-Saharan Africa, which has been plagued by conflicts, rising food prices, climate change, disruptions in the food supply, and income shortages brought on by the loss of livelihoods and remittances. These issues have now been made worse by the COVID-19 pandemic's numerous effects (FAO, 2021).

Ethiopia faces chronic food insecurity challenges. Between October and December 2020, approximately 8.6 million individuals dealt with severe food insecurity. Out of these, around 7.2 million are considered to be in a crisis situation, while roughly 1.4 million are in an emergency state (IPC, 2021). In the Global Food Security Index of 2019, Ethiopia ranked 91st among 113 countries, with a total score of 39 (GFSI, 2019). As one of the nations most susceptible to famine on the African continent, Ethiopia has a longstanding history of food shortages and famines, significantly driven by climatic shocks (Eshetu & Guye, 2021; Mohammd *et al*., 2021) (Eshetu & Guye, 2021; Mohammd et al., 2021) and soaring food prices (Sikuka, 2021; Mohammd *et al*., 2021). The rise in food prices following 2007 is frequently seen as indicative of a global food insecurity crisis affecting impoverished populations. Acknowledging the impact of food insecurity on everyday life aspects, such as neighborly interactions and feelings of shame, underscores how increases in food prices can diminish community social capital and heighten the vulnerability of those affected to future crises (Hadley et al., 2012).

In Ethiopia, rising food prices are pushing millions further into poverty (Hassen, 2022; Tolina & Abddissa, 2020), diminishing the welfare of poorer communities by reducing their purchasing power (Alemu, 2022). Changes in pricing primarily impact low-income families, net buyers, and households led by women (Kalkuhl et al., 2013), signaling a decline in the purchasing power of vulnerable groups, affecting their access to education, health care, and productive resources, which forces them to reduce both the quantity and quality of their food intake (Compton et al., 2011; Headey et al., 2012). Besides the major effects of food prices on food insecurity, socioeconomic and demographic factors also play a role in Ethiopian households (Agidew & Singh, 2018; Sani & Kemaw, 2019a). Furthermore, factors such as the average years of education among household members, proximity to service centers, ownership of assets, and access to credit services positively influence household food security, while a high dependency ratio and external shocks increase the chances of food insecurity for families (Sisha, 2020b).

In 2021, food price inflation soared by 23.1 percent compared to the previous year, while non-food inflation rose by 14.5 percent (CSA, 2021). Thus, the persistent increase in food inflation, indicative of escalating living costs, will severely affect impoverished households with limited purchasing power that depend on markets for their food supplies. This dramatic increase in food prices, the highest in Sub-Saharan Africa, particularly the surge in cereal prices, has driven many into food poverty since the 2003/04 period, given that food expenditures constitute 57% of total household costs (Geda & Tafere, 2011; Cochrane, 2017).

Research conducted in Ethiopia on the prevalence and correlation of factors contributing to household food insecurity and the impact of rising food prices on food security, along with other determinants of food insecurity, includes studies by (Mohammed et al., 2021; Eshetu & Guye, 2021; Melese et al., 2021; Agidew & Singh, 2018; Ayele et al., 2020; Mota et al., 2019; Derso et al., 2021; Sani & Kemaw, 2019; Nuru & Gereziher, 2020; Yehuala, 2018; Sileshi et al., 2019; Aragie & Genanu, 2017; Mulugeta, 2019;

Admasu, 2019; Birhane et al., 2014); however, these studies also have their shortcomings, as they are based on cross-sectional data from individuals and limited geographical sampling. Due to omitted variable bias and the nature of cross-sectional data, establishing causal relationships between increasing food prices and food insecurity is challenging, complicating the distinction of unique household characteristics, such as attitudes, from other observable traits. Consequently, the correlation observed between food insecurity and independent variables may not accurately reflect reality. Moreover, considering how households are more susceptible to shocks and emergencies, it is more fitting to view food security and vulnerability contexts as dynamic rather than static (Dewan et al., 2006).

In some instances, food price inflation and household food insecurity status have been studied in isolation. Recent research has not utilized a substantial amount of micro-level data to assess the national dynamics of food insecurity and its principal determinants over time using panel data, nor have they regarded local food prices as a significant explanatory factor. Additionally, the expected driving factors, such as price shocks and risks, were not accounted for in their analysis of food security impacts. Generally, large panel dataset offers enhanced information, variability, and efficiency compared to pure time series or cross-sectional data (Dimova & Sen, 2010). It can make it possible to minimize the omitted variable bias.

As a result, this research was conducted to address the previously mentioned gaps in understanding by incorporating the various dimensions of food insecurity and its dynamics through national-level panel data, particularly concentrating on the relationship between food price inflation and food insecurity. This study seeks to fulfill the following specific objectives: first, to evaluate the extent of food insecurity and food pricing; and second, to analyze the impact of food prices along with other socioeconomic factors on food insecurity in Ethiopia.

The remainder of the paper is structured in the following manner. The second section addresses the review of related literature. The third section outlines the design, the analytical tools utilized, and the research methodology adopted throughout the study. The fourth section focuses on the findings and examines the empirical results derived from the analyzed data. Lastly, the fifth section provides conclusions and offers recommendations based on the findings.

2. Literature

Various studies have shown a significant relationship between inflation in food prices and the food security status of households. "Food security is achieved when all individuals, at all times, have physical, social, and economic access to adequate, safe, and nutritious food to satisfy their dietary needs and food preferences for an active and healthy life. The four pillars of food security are availability, access, utilization, and stability. The nutritional aspect is a fundamental component of the food security concept" (WFP, 2009). Based on this definition, four distinct variables are crucial for achieving food security: food availability and access (which represent the short-term aspects of food security), sustainable access to food (the long-term aspect), and food utilization. These four dimensions serve as indicators of a household's food security status (Gani et al., 2019).

Approximately 33 million individuals in Ethiopia face chronic malnutrition and food insecurity, with 25% urgently requiring assistance. This issue is particularly severe in the country's dry and semi-arid regions, which constitute roughly 13% of the population and 63% of the nation's land area. The empirical review indicated that most households, especially those in Ethiopia's drylands, experienced food insecurity. Key contributors to food insecurity include drought, geographic challenges, the spread of coronavirus, the lingering impacts of previous poor agricultural seasons, conflict, low household income, the cost of nutritious food, and a lack of understanding regarding the determinants of nutritious food (Asrat & Anteneh, 2020).

Although accurately assessing food security is crucial for effective research and the creation of well-targeted strategies, no single, standardized

methodology exists. Agidew & Singh (2018) pointed out that there are no perfect measures that encompass all facets of food insecurity; rather, household-level food insecurity assessments should be based on a range of specific information, behaviors, and experiences that indicate the varying degrees of severity of households' food insecurity conditions.

In general, two common methods are utilized for measuring household food consumption. The first approach involves expenditure techniques that evaluate gross household production and purchasing power over a specified period. It calculates the increases and decreases of food stocks held over time, with the balance considered as consumed by the households. A drawback of this consumption survey is that it often underreports food expenditures if food is produced at home or gathered locally (FAO, 2008).

The second approach employs the recall method to record the quantity of food consumed by household members within the previous 24 hours. This method, which is related to the expenditure approach, is regarded as more reliable, although it is more expensive and time-consuming to collect the data. Rising food prices have become a significant global issue, particularly affecting low-income urban households in countries like Ethiopia. However, there is limited empirical data regarding urban food security and the strategies urban residents are using to cope with persistently high food prices. The study revealed that 75% of households were food insecure, with 23% experiencing hunger (Birhane et al., 2014).

Research conducted by Alem & Soderbom (2012) in Ethiopia indicates that the impact of rising food prices on food consumption and overall welfare may have been quite severe, especially for specific households in urban Ethiopia. Firstly, the proportion of household spending allocated to food is substantial in urban Ethiopia, indicating that changes in food prices significantly affect welfare. Secondly, minimal food production occurs in urban settings, which means that increasing food prices do not boost urban incomes. Urban households face challenges in producing their own food, setting them apart from rural households. Lastly, there is an absence of formal insurance mechanisms to address such shocks. These factors, among others, suggest that the welfare impacts of elevated food prices can vary greatly among urban households. One reason for this variability is the considerable differences among households in their ability to manage shocks. The significant food price inflation represented the most detrimental economic challenge between 2004 and 2008, prompting many households to modify their food consumption. Furthermore, findings from the aforementioned study reveal that households with low asset levels and those relying on casual work were particularly hard-hit by the surge in food prices.

Standard intertemporal consumption models indicate that a temporary price shock has a minimal impact on utility, especially if households aim for a consistent consumption trajectory and can manage consumption over time through borrowing or utilizing previously accumulated financial assets. However, some households in urban Ethiopia may lack the capacity to smooth their consumption over time, making certain groups more susceptible to shocks. Specifically, it appears that low-income households might struggle to self-insure due to their limited financial resources. Additionally, variations in consumption habits could also influence the welfare effects across different households. For instance, our data shows that lower-income households allocate a greater portion of their food spending to cereals compared to wealthier households. As will be demonstrated later, cereals are among the food items that experienced particularly high inflation, suggesting that economically disadvantaged households may have been hit particularly hard during periods of elevated food prices. Moreover, the impact of food price shocks seems likely to differ based on employment status. For example, casual urban workers may be significantly affected by food price increases, especially if they adversely influence local demand. However, previous studies did not investigate prices as explanatory factors, but rather focused solely on changes in consumption.

The effects of rapid food price inflation in Ethiopia's cities and larger rural towns have been evaluated, particularly concerning whether casual

wages in these mainly urban areas adjusted in response to increasing food costs. There was a noticeable decline in the food purchasing power of casual wages between 2007 and 2008, coinciding with the initial spike in food prices, and again in 2011. During the 2007–2008 surge, purchasing power related to food fell by approximately 20 percent. In contrast, the overall purchasing power, which accounts for trends in non-food prices, only decreased by about 10 percent (Hadley et al., 2012). An increase in cereal prices has led to significant welfare declines for households in urban regions. Conversely, households in rural areas that have ample land generally benefited from rising food prices, while land-poor and typical farming households faced negative growth (Abebe and Andinet, 2013). In the future, it is anticipated that prices will not only continue to rise but also become more unpredictable. A study conducted by Oxfam projects global price increases for key staples to be between 120% and 180% by 2030 (Oxfam, 2012b). Additionally, the global agricultural market is expected to face heightened vulnerability to climate fluctuations, leading to greater instability. According to Oxfam (2012a), "extreme weather events in a single year could result in price spikes similar to the cumulative effects of two decades of projected long-run price increases." For instance, a drought in North America in 2030 akin to the one in 1988 could increase corn export prices by roughly 140% and elevate world wheat prices by about 33%.

3. Methods and Materials

3.1 Data Description

For this research, secondary data spanning from the 2011-2012 period to 2015-2016 was utilized, drawn from panel surveys conducted by the Central Statistics Agency (CSA) of Ethiopia, particularly the Ethiopian Socio-Economic Survey (ESS) carried out in partnership with the World Bank, alongside data from the Living Standards Measurement Study (LSMS) team as part of the Integrated Surveys on Agriculture Program (ISAP) and a global dataset covering 1970-2021. The initial wave took place in 2011-12, the subsequent wave was held in 2012-13, and data for the third wave was gathered in 2015-16.

The survey employed a two-stage probability sampling process; the first stage involved selecting the enumeration areas (EAs). Thus, the selected sample EAs were determined based on probability proportional to the size of the total EAs in each region, which included the most populated areas: Tigray, Amhara, Oromia, the South Nations and Nationalities Peoples Region, and Addis Ababa. Ultimately, sample weights with post-stratification adjustments were computed for households to guarantee representation across all regions.

3.2 Econometric model specification

In order to analyze panel data, the researcher created an unbalanced panel data set derived from the World Bank database. In this study, households classified as food insecure, having a status of food insecurity that occurs more than once, are assigned a value of "1," indicating food insecurity. Conversely, households that are food secure, which rely on a single secure status, are given a value of "0," signifying food security. As the dependent variable is binary and not quantitative, and given the large sample size with observations over three periods, logistic regression is a suitable method for estimation.

The standard link function selected for binary responses in logistic regression is demonstrated in Equation 1.

$$Logit\{Pr(y_{it}=1|x_{it})\} = ln\frac{Pr(y_{it}=1|x_{it})}{1-Pr(y_{it}=1|x_{it})} = \beta_1 + \beta_2 x_{it} \quad \text{Equation 1}$$

The fraction in parentheses within equation (1) indicates the likelihood that $\boldsymbol{y_{it}=1}$, given $\boldsymbol{x_{it}}$, which reflects the anticipated count of "1" responses for every "0" response. In other words, it represents the expected number of successes in relation to failures concerning food security status, similar to how probabilities are expressed in gambling. The logit model can also be reformulated by exponentiating the coefficients, allowing for interpretation as odds ratios; these odds ratios indicate the expected change in the probability of experiencing food insecurity relative to the explanatory variable.

$$Odds\ (y_{it} = 1|x_{it}) = exp\ (\beta_1 + \beta_2 x_{it}) \quad \text{Equation 2}$$

$$Odds\ ratio = \frac{Pr(y_{it} = 1|x_{it} + 1)}{pr(y_{it} = 0|x_{it} + 1)} / \frac{Pr(y_{it} = 1|x_{it})}{Pr(y_{it} = 0|x_{it}} = exp(\beta) \quad \text{Equation 3}$$

The relationship between the odds and probability is illustrated in Equation 6. The probability that response is 1 in the logit model is expressed in Equation 4.

$$Pr = y_{it} = 1|x_{it} = Logit\ - 1 = (\beta 1 + \beta 2 x_{it})\ \frac{exp(\beta_1 + \beta_2 x_{it})}{1 + exp(\beta_1 + \beta_2 x_{it})} \quad \text{Equation 4}$$

Construction of the food poverty threshold as an indicator of food security: In order to assess food security and food insecurity, the research utilized the weighted average of yearly food spending per adult equivalent for its straightforward calculation and the availability of data in the survey dataset (Law et al., 2018). The value of food (F*j) consumed by each household per adult equivalent, which incorporates both the total amount spent on food purchases (P*j) and the value of food received as gifts or produced by the household (G*j), was calculated as follows (Bazezew, 2012).

$$F * j = P * j + G * j \quad \text{Equation 5}$$

The adult per equivalent (Hj) for every household was calculated by adjusting household size according to sex, age, and activity levels into an adult equivalent scale. The total value of food consumed per adult equivalent (F*j) was then determined by dividing the total food expenditure by the household's adult equivalents (Eneyew & Bekele, 2012).

$$Odds = \frac{Pr}{1-Pr} \quad \text{or} \quad Pr = \frac{Odds}{1+Odds} \quad \text{Equation 6}$$

$$F * j = \frac{F_j}{H_j} \quad \text{Equation 7}$$

Where, $F * j$ =total value of the food consumed per adult equivalent; Fj=total value of food consumed by kth household and Hj =adult equivalent for kth household

The per adult equivalent household expenditure was calculated by adding the total food spending on purchased items to the values of food received and produced by the household (Rose et al., 2013; John et al., 2020).

Food expenditure deficiency of the household can be illustrated in Equation 8.

$$Gi = [\frac{Z - Y}{Z}] \quad \text{Equation 8}$$

$$Headcount\ ratio = q/n$$

Where, Z= food security line (2/3 annual mean per adult equivalent food expenditure)

Q= the numbers of i^{th} households below the food security threshold line, N=total numbers of households in the sample size, Y= the per capita equivalent food expenditure of the households in survey data

Furthermore, households whose annual mean consumption expenditure per adult equivalent falls below ETB 3282.67 (which corresponds to the estimated food security threshold line from the study) are deemed food insecure, while those with a 2/3 annual mean food consumption expenditure exceeding ETB 3282.67 per adult equivalent are classified as food secure. A fixed effect logistic regression was also utilized to examine how food price inflation impacts the food security status of households. The dependent variable in this analysis is the insecurity status as defined earlier. The binary logistic regression model is applied to longitudinal data (Sisha, 2020a), as outlined in Equation 9.

$$Y_{it} = \alpha_i + \beta x_{it} + \mu z_i + u_{it} \quad \text{Equation 9}$$

4. Result and Discussion

4.1 The regional Distribution of Household Food security status in Ethiopia

Table 1 presents the percentage of households experiencing food insecurity across Ethiopia's nine

regional states and two administrative cities. The results indicated that food insecurity is widespread throughout most of Ethiopia, with rates of 63% in Benshagul Gumize (6), 55.18% in Amhara (3), 50.52% in SNNP (7), 47.06% in Gambella (8), and 31.63% in Tigray (1). In contrast, the regions with the highest levels of food security over time were Harari at 84.3% (9), Addis Ababa at 81.05%, Afar (2) at 73.5%, and Somali (5) at 72.3%.

Table 1: Distribution of household food insecurity status by region in Ethiopia

HH_ food insecurity status		Region											
region		1	2	3	4	5	6	7	8	9	A. A	Dire	Total
fd- secure	HH No	1033	294	1237	1720	549	136	1535	180	364	387	308	7743
	%	68.3	73.5	44.82	65.2	72.3	37	49.48	52.94	84.3	81.5	81.05	58.81
Fod in secure	HH no	478	106	1523	919	210	232	1567	160	68	88	72	5423
	%	31.	26.5	55.18	34.8	27.7	63	50.52	47.06	15.7	18.5	18.95	41.19
Total		1511	400	2760	2639	759	368	3102	340	432	475	380	13166
Pearson chi2(10) = 899.6552 Pr = 0.000													

Source: own calculation from the LSM-ISA (2022)

4.2 Analysis of food insecurity status of household based on resident's location

Table 2: Food insecurity status of household based on resident's location

HH food in security status		location of HH (EA rural-urban indicator)			
Location		Rural	Small Town	large town	Total
Food secure	Sample HH	5304	536	1903	7743
	percentages	53.40	65.61	78.73	58.81
Food insecure	Sample HH	4628	281	514	5423
	percentages	46.60	34.39	21.27	41.19
Total		9932	817	2417	13166

Source: own calculation from the LSM-ISA (2022)

The food insecurity status of households in Ethiopia is closely linked to their location. As indicated in Table 2, living in rural areas and small towns raises the chances of experiencing food insecurity, whereas residing in medium and large towns lowers those chances. A significant portion of households (79.6%; 6.16; 18.25) are situated in rural areas, small towns, and large towns throughout the nation. In rural regions, 46.6% of households are food insecure, compared to 34.39% in small towns, and only 21% in medium to large towns. This highlights that households in rural and small town settings are significantly more susceptible to food insecurity.

4.3 Patterns and dynamics of food insecurity in Ethiopia

Table 3: Transition of food insecurity status over time

Household fs status		years of HH_wave			
		2011	2013	2015	Total
Food secure	Total HH	1847	2855	3041	7743
	percentages	49.99	59.65	64.91	58.81
Food insecure	Total HH	1848	1931	1644	5423
	percentages	50.01	40.35	35.09	41.19
Total		3695	4786	4685	13166
Pearson Chi2 = 192.11 Prob = 0.0000					

Source: own calculation from the LSM-ISA (2022)

4.4 Trends of food price inflation in Ethiopia over time

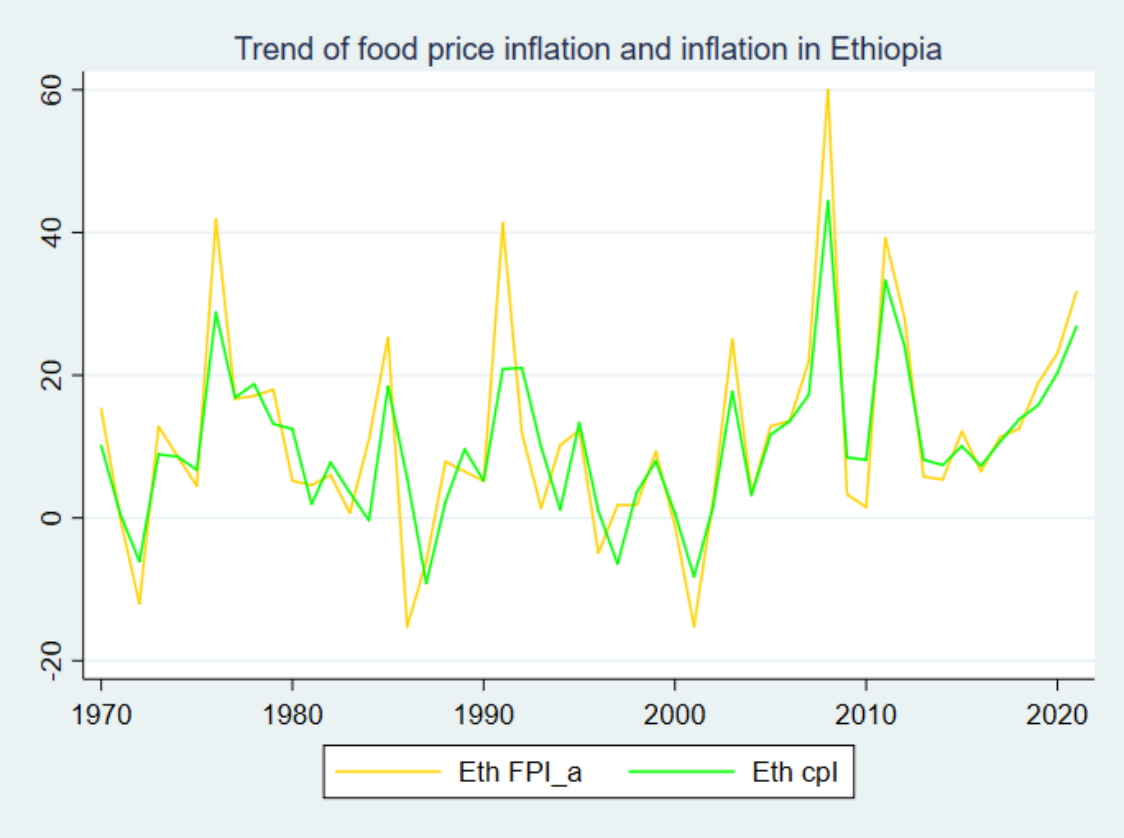

Figure 1: Comparison between food price inflation and general inflation in Ethiopia.

Source own calculation from a global database of inflation (2022)

Figure 1 illustrates the trends in food price increases and the inflation rate in Ethiopia from 1970 to 2020. All series displayed similar patterns of cyclical fluctuations, although food price inflation exhibited sharper spikes in both upward and downward directions compared to general inflation during the period of 1970-2016. Furthermore, there was a noticeable

upward trend in both food price inflation and general inflation, with food price inflation showing a steeper increase than general inflation from 2017 to 2021. Overall, the polynomial trend lines fitted to the changes in food price inflation and general inflation over time are represented in (Figure 1) as Y_t = 5.994 + 0.1959t and Y_t = 5.4535 + 0.1806t, which allows for projections of future changes in food price inflation and general inflation in Ethiopia.

4.5 Determinants of food insecurity in Ethiopia

For the purpose of model specification, both pretest and post-estimation assessments were performed. The assessment for multicollinearity was carried out using the variance inflation factor (VIF), which yielded a mean value of 3.68, falling below the threshold of 10 and thereby being acceptable based on standard guidelines. The data exhibited no issues related to multicollinearity.

To determine whether to use fixed or random effects, a Hausman test was performed, where the null hypothesis suggested that the random effects model is preferred as opposed to the fixed effects model. The results of the Hausman test for all variables revealed a significant p-value (P-value < 0.05), indicating the usage of a fixed effects model. Consequently, our findings indicate that the fixed effects model is more effective and should be utilized in this case, as the p-value of 0.000 is lower than 0.05. A fixed effects binary logistic regression analysis was conducted to identify the factors that determine the food security status of households, with the dependent variable categorized as either food secure or insecure. Hosmer, Lemeshow, and Sturdivant (2013) recommend reordering the data based on predicted probabilities and subsequently creating groups of nearly equal size. Furthermore, the analysis indicated that the model is not rejected since the Prob > chi2 = 0.1530; goodness-of-fit tests all exceeded the significance level of 0.05, suggesting that the model adequately fits the data.

Table 4: Determinants of Food insecurity status in Ethiopia

HH_Fins_status		Coef.	St.Err.	Z	p>|z|	(dy/dx)	Odds Ratio
Location of HH	Small Town	-0.182*	0.110	-1.65	0.098	-0.026	0.834
	Large Town	-0.617***	0.106	-5.82	0.00	-0.089	0.539
Fcpi		.006183***	.001084	5.70	0.00	0.001	1.006
Household Education level	Basic Edu	-0.2823**	0.1097	-2.57	0.011	-0.040	0.754
	Primary	-0.4035***	0.11967	-3.37	0.001	-0.058	0.668
	Secondary	-0.262	0. 273	-0.96	0.321	-0.038	0.769
	Certificate	-0.619	0.935	-0.66	0.479	-0.089	0.539
	Diploma	0.711	0.693	1.03	0.413	0.102	2.035
	Uinv Degree	-0. 052	0.538	-0.10	0.954	-0.008	1.053
HH_Sex (Female)		0.295***	0.062	4.80	0.00	0.042	1.344
hh_Age		.0023237	.0017821	1.30	0.191	0.000	1.002
HH_Credit (Yes Acc to cred)		0.1163*	0.0598	1.94	0.051	0.017	1.123
HH_shock (Yes)		.1600419**	.062594	2.56	.011	0.023	1.174
HH_Assistance (Yes)		.179	.123	1.45	0.143	0.026	1.197
HH house	Privately Owned	-0.19**	0.095	-2.00	0.046	-0.027	0.827
	Free of rented	0.113	0.128	0.88	0.367	0.016	1.119

non_farm_enterprses (Yes)		-0.3463***	0.0899	-3.85	0.00	-0.050	0.707
HH_em-ployemet	Gov't org	-0.549***	0.174	-3.15	0.067	-0.079	0.578
	Non govt Orga	-0..276	0.352	-0.78	0.005	-0.04	0.758
hh_marital (Never Married)		0.2030	0.1368	1.48	0.132	0.029	1.225
Fz in Adulteq		0.2817***	0.0161	17.50	0.00	0.040	1.325
dist_road		-0.00056	0.0014	-0.40	0.691	-0.000	0.999
dist_market		.0027513***	.0006777	4.06	0.00	0.0004	1.003

Mean dependent var	0.486	SD dependent var	0.500
Pseudo r-squared	0.123	Number of obs	8177
Chi-square	731.906	Prob > chi2	0.000
Akaike crit. (AIC)	5258.862	Bayesian crit. (BIC)	5434.089

*** p<.01, ** p<.05, * p<.1

Source: own analysis from LSMS-ISA

Table 4 revealed that the significance of food price inflation at a 1% level indicates that it has a positive impact on a household's food insecurity status. When the mean food price inflation rises by 1%, the likelihood of a household experiencing food insecurity increases by 0.1%. Several factors contribute to this finding. First, rising food prices are pushing millions deeper into poverty. Additionally, changes in prices primarily affect low-income families, net buyers, and households led by women, leading to a decline in the purchasing power and access to education, healthcare, and productive resources for vulnerable groups, which compels them to reduce both the quantity and quality of their diets. This result aligns with earlier studies (Birhane et al., 2014).

Housing ownership: The relationship between housing ownership and food insecurity was found to be negative and statistically significant at the 5% level. The marginal effect indicates that households with housing in urban and rural areas have a 2.7% lower probability of experiencing food insecurity compared to those without housing in these regions over time. Ownership of housing likely plays a crucial role in enhancing food security. Households that own their homes may be better positioned to ensure food security, as their overall expenses (e.g. rent) aside from food consumption are reduced. In other words, on average, families with their own homes in urban areas face lower risks of food insecurity since they can generate income through renting out their properties. This discovery is consistent with previous research (Awoke et al., 2022; Eshetu & Guye, 2021).

Food shocks experienced by households: The average marginal effect of this variable shows that food price shocks significantly and positively impacted food insecurity at a 5% level. Households experiencing economic shocks (price increases) had a 2.3% greater chance of being food insecure compared to those who did not face any such shocks during the survey periods. This suggests that various types of shocks adversely affect the sustainability of food security. Thus, households that encounter any shocks negatively and significantly influence their food security dynamics. This finding is consistent with earlier work (Nuru & Gereziher, 2020; Sisha, 2020; Mohammed et al., 2021).

Non-farm enterprise: Households engaged in non-farm enterprises were found to have a negative association with food insecurity status, showing significance at the 1% level. The marginal effect indicates that when compared to households without non-farm enterprises, those that own them have a 5% lower probability of facing food insecurity over time. Therefore, off-farm activities in rural settings could serve as a potential avenue to foster economic growth and enhance rural well-being. The direct impact relies on the size of the enterprises and their

responsiveness to agricultural development and connections with export markets, while the indirect impact is primarily determined by the financing, processing, and marketing structures that support both agricultural and non-agricultural growth. Non-farm enterprises serve as a significant source of employment and income across the developing world (Younais, 2022; Farooq & Younais, 2022). Therefore, they can play a vital role in reducing rural poverty and promoting equality and equity. There is a positive correlation between non-farm activities and household food security, as they provide job opportunities, increased income, and can even enhance agricultural productivity. This result aligns with previous studies (Awoke et al., 2022; Agidew and Singh, 2018).

Access to credit: - The availability of credit for households, linked to their food insecurity status, shows a positive relationship at a 10% significance level. Households that are granted access to credit experience a 1.7% increase in the likelihood of being food insecure when compared to those without credit access over time. This indicates that households without credit access fare better in terms of food security than those who have received credit. The research further noted that access to credit negatively impacts food security for cultural reasons, as resource-poor households tend to take out loans specifically for purchasing cereals. It is recommended that training be provided to households that take credit on effective ways to utilize it to enhance their food security over time. These findings align with research conducted by (Aweke et al., 2020; Sisay Yehuala, 2018).

HH employment: Government employment within the household was found to have a negative and statistically significant impact on food insecurity at a 1% level. Gaining access to job opportunities allows households to diversify their income and increase their earnings. Variations in employment access can influence food insecurity levels in urban households. When a household member becomes employed by the government, the likelihood of that household facing food insecurity decreases by 7.9% compared to those who are unemployed (Table 3.2). This outcome supports the findings of (Welderufael, 2014).

Location: - The location of households in small and large towns shows an improved food security status compared to those in rural areas, with significance levels of 10% and 1%, respectively. Households situated in small towns have a 2.6% lower probability of being food insecure compared to households residing in rural locations throughout the survey periods. Similarly, households in large towns demonstrate an 8.9% lower probability of food insecurity compared to those in rural areas over the same timeframes (Table 4). The fixed effect logistic regression results indicated that rural households experienced higher levels of food insecurity compared to urban households. One potential explanation for this is that lack of education in rural areas does not enhance agricultural productivity, contributing to food insecurity (Agidew and Singh, 2018). Increased migration from rural to urban areas also results in a loss of workforce in the rural population, which negatively impacts food production. Many socioeconomic studies differentiate between rural and urban contexts. This distinction is also applicable in research on food insecurity. For rural communities, attention should focus on socioeconomic and agro-ecological conditions and the performance of smallholder farmers, while urban economies should additionally consider issues like price fluctuations and market stability (Sisha, 2020a). Nonetheless, significant differences exist between urban and rural regions in economic opportunities, population density, and access to financial markets and services, all of which can influence various aspects of life, including food security. The current findings are consistent with studies conducted by (Adem, 2021; Sisha, 2020).

Distance to market (dist_market): - The distance to the market significantly and positively influences food insecurity status at a 1% probability level across all rural, small, and large-town areas of Ethiopian households. This positive correlation suggests that households facing greater distances to the market are more likely to experience food insecurity. Specifically, for every additional kilometer that market centers are from a household, the likelihood of food insecurity increases

by 0.04% over time (Table 4.2). There are two potential ways in which market access can impact household food security. If a household produces surplus goods and aims to sell them, those with better access (i.e., closer to the market) can reduce their transportation-related transaction costs. Conversely, if a household seeks to purchase crops for consumption stability, those nearer to the market will benefit from reduced costs. Another potential explanation is that households located closer to market centers might have increased opportunities to engage in non-farm activities, thus improving their access to food. These findings align with the research conducted by (Mohammd et al., 2021; Shetu & Guye, 2021; Aragie & Genanu, 2017; Melese et al., 2021).

Education level of household head: This factor negatively and significantly influences food insecurity at a 1% probability level. The positive correlation indicates that households led by literate individuals experience greater food security than those led by illiterate heads. A likely explanation is that the education level of the household head significantly enhances working efficiency, competency, income diversification, technology adoption, and the visionary capacity to foster a supportive environment for educating dependents, thereby improving long-term living conditions. Consequently, literate heads reduce the likelihood of their households facing food insecurity. The marginal effect shows that when the average rate of basic education among households is low, the probability of experiencing food insecurity is 4% lower compared to households lacking education. Similarly, the marginal effect indicates that when the average primary education rate is less than that of non-educated households, the likelihood of food insecurity decreases by 5.8%. The correlation between educational qualifications and food insecurity is a widespread phenomenon. This outcome is consistent with findings from (Eshetu & Guye, 2021; Mohammd et al., 2021; Awoke et al., 2022a).

Family member in adult equivalent: This continuous variable assesses the adult equivalent count residing in and relying on a single household. An increase in household size implies a greater number of individuals relying on the limited resources of that household. The results demonstrate that the overall number of family members is positively associated with the household's food insecurity status and is statistically significant at the 1% probability level. The positive correlation indicates that as family size increases, so does the probability of experiencing food insecurity. The marginal effect illustrated in (Table 4.2) shows that when the average family size rises by 1% in adult equivalent terms, the probability of a household facing food insecurity escalates by 4%, assuming other independent variables remain unchanged.

A household that accommodates multiple families may encounter challenges in providing enough food for everyone. Consequently, a larger number of family members within a household impacts their financial stability, increasing the likelihood of food insecurity compared to households with fewer members. Furthermore, most respondents reported limited access to agricultural technologies necessary for producing adequate food to support larger families. An increased family size without the use of enhanced technology contributes to food insecurity. This finding aligns with the research conducted by (Awoke et al., 2022; Agidew and Singh, 2018; Melese et al., 2021; Mota et al., 2019; Eshetu & Guye, 2021; Derso et al., 2021).

The gender of the household head plays a role in the differences observed in food insecurity levels; transitioning from male-headed to female-headed households shows that being female significantly raises the likelihood of experiencing food insecurity by 1%. According to estimates derived from fixed-effects logistic regression analysis of three periods of panel data, when other variables are controlled, the average probability of food insecurity among female-headed households is 4.2% higher than that for male-headed households over time. A potential explanation for this is that male-headed households typically have improved access to social and physical resources, allowing them to produce, buy, and consume a wider variety of nutritious food items (Sani & Kemaw, 2019b). Additionally, male-headed households often have the

advantage of mobilizing labor more effectively and tend to possess greater farming expertise than female-headed ones, who, as the primary income earners, encounter numerous challenges, including limited time, a lack of suitable technologies for their physical capabilities, and restrictions on their ability to travel outside the community for various activities (Awoke et al., 2022a).

Numerous studies exploring food insecurity at the household level have shown that female-headed households are less likely to achieve food security than their male counterparts (Agidew & Singh, 2018). As a result, female-headed households are more susceptible to food insecurity relative to male-headed households. This conclusion is consistent with previous research findings (Mohammed et al., 2021; Melese et al., 2021; Gebremichael et al., 2021; Awoke et al., 2022).

5 Conclusion & Recommendations

Food insecurity continues to be a primary focus of development efforts in Ethiopia. This research is designed to explore how food prices and various socioeconomic factors influence food insecurity in Ethiopia. The study utilized a comprehensive panel survey conducted by the World Bank and Ethiopia's Central Statistics Agency as part of the Living Standard Measurement Study: Integrated Surveys on Agriculture (LSMS-ISA).

The results indicated a change in food security levels over time, achieving statistical significance at the 1% level. In the initial wave, only 49.99% of households within the sample were deemed food secure, which increased to 59.65% and 64.91% in the second and third waves, respectively. Consequently, at the 5% level of significance, the transition level of food security varied and saw an increase of 9.66% and 5.26% in the second and third waves compared to the first wave. Regarding geographic distribution, 53.40% of rural households were food secure, while 65.61% of households in small towns and 78.73% in medium and large cities achieved food security. This indicates a substantial number of food-insecure households in rural and small-town areas, highlighting the ongoing issues of food insecurity and vulnerability in these regions.

The fixed effect logistic regression analysis illustrated that factors such as household food price inflation, female-headed households, family size adjusted for adults, lack of access to credit, the number of food shocks experienced, and the distance to the nearest market were all associated with increased food insecurity. In contrast, educational attainment, ownership of property, residing in small and large towns, employment levels, and non-farm enterprises contributed positively to food security. This suggests that the level and susceptibility to food insecurity in Ethiopia have worsened due to family size, insufficient infrastructure, and the occurrence of food shocks, yet can be mitigated through improved access to housing, education, employment, and residences in more advantageous areas.

The fitted trend lines demonstrated that both food price inflation and general inflation have escalated in Ethiopia, with food price inflation rising at a faster rate and constituting a larger portion of the overall inflation. In rural households without land ownership and urban areas reliant on market-sourced food supplies, increases in food and non-food prices can threaten family food security. As such, rising prices have differing impacts on poverty and hunger. Low-income families may face the burden of high food prices by depleting their assets, reducing the quantity or variety of food consumed, or cutting back on other essential expenses like health care and education. Price shocks significantly affect households' overall well-being. The research confirmed that food price inflation negatively influenced household consumption and food security in several ways. Therefore, we advise the government to stabilize food price inflation through appropriate short-term and long-term strategies. In the immediate term, the government could manage living costs by enforcing price controls and regulations to ensure market efficiency. Over the long term, efforts should focus on boosting agricultural production to achieve food self-sufficiency. Food price inflation results from the direct importation of essential food items such as cooking oil and agricultural inputs like

soil fertilizer. Additionally, the government should aim to enhance the income levels of the impoverished population. This recommendation is based on the understanding that low-income families struggle to afford food at current market prices, as their purchasing power diminishes over time while income remains stagnant.

Food costs are expected to remain steady as productivity enhances and resources are allocated more fairly. The issues of food insecurity and fluctuating prices pose significant challenges looking ahead. Consequently, governments need to implement clearer strategies to effectively manage agricultural risks in pursuit of sustainable development objectives. Rising food prices threaten consumers' ability to afford necessities. It is essential for governments to establish more transparent and prompt initiatives to improve food market regulation, ensuring a sustainable food supply.

Disclosure statement

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