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ARTICLE

IMPROVING FOOD POLICIES FOR A CLIMATE INSECURE WORLD: EVIDENCE FROM ETHIOPIA

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Climate change and weather shocks have multi-faceted impacts on food systems with important implications for economic policy. Combining a longitudinal household survey with high-resolution climate data, we demonstrate that both climate and weather shocks increase food insecurity; cash assistance and participation in Ethiopia's Productive Safety Net Programme have reduced food insecurity; but food assistance has been ineffective. Importantly, households with savings, and those that stored their harvest to sell at higher prices rather than for home use, suffered less from food insecurity, yet both strategies are harder for the poorest and most food insecure households to adopt. Our paper provides micro-founded evidence needed to design policies that both improve agricultural yields in the context of a changing climate and target households' abilities to cope with shocks that put upwards pressure on food prices.

Keywords: climate change; weather shocks; food security; food policy; safety nets; Ethiopia.

JEL codes: I14; I18; I38; Q18; Q54.

1. Introduction

At a global level, economic growth has tended to be accompanied by a reduction in poverty, which in turn has long been known to have the potential to reduce food insecurity and undernutrition (Haddad *et al.*, 2003; Strauss and Thomas, 1998). Indeed, Smith and Haddad (2002) present compelling evidence that, at least in the late 20th century, income growth has led to a reduction in child undernutrition across low and middle-income countries. Likewise, improvements in food security and nutrition should contribute to economic growth. Yet after decades of steady progress in improving global food security, both the number of people undernourished and the prevalence of undernourishment globally have increased in the past few years, and are projected to increase further (FAO *et al.*, 2020). Climate change is already affecting agricultural production in complex ways and having a measurable negative impact on food security (Romanello *et al.*, 2021), and may well be responsible, at least in part, for this new trend. As such, climate change is likely to make the design of effective food policies to improve food security more complicated but also more important. It is therefore timely to explore the determinants of food insecurity, and the role of food policies in reducing food insecurity, particularly in the context of a changing climate.

Food security is a multi-dimensional concept, comprising access to food, food availability, utilisation and stability. It has been defined as existing when '… all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active

and healthy life' (World Food Summit, 1996). As such, the definition takes into account the physical availability of food; whether individuals can afford the food; the quality and cultural appropriateness of the food; and stability of that access over time (Ville *et al.,* 2019). More recently, food insecurity has been monitored using the Food Insecurity Experience Scale (FIES), which relies on asking people directly about their experiences of food insecurity across eight dimensions, including variety consumed, quantity consumed, running out of food and spending a whole day without eating (Ville *et al.,* 2019).

Macroeconomic policies can affect food security in multiple ways, such as through the impact on food production, global food availability and trade, household income and access to health and education infrastructure (Díaz-Bonilla, 2015). Food insecure households have been found to be particularly vulnerable to food price fluctuations (Díaz-Bonilla, 2015), suggesting that policies that reduce such fluctuations may also improve food security. Further, the stabilisation of prices may in turn contribute to economic growth, as appears to have been the case in Asia in the second half of the 20th century (Timmer, 2000). There is also plenty of evidence that, even controlling for poverty, governments can actively influence food insecurity through targeted policies, particularly in the form of safety nets that provide cash or food transfers, the importance of which for vulnerable populations has been highlighted by the on-going COVID-19 pandemic (Amjath-Babu *et al.,* 2020; Gilligan, 2020; Laborde *et al.,* 2020).

Ethiopia has long suffered from high levels of food insecurity, which have been closely linked to domestic food shortages and famine, which in turn have in part been linked to low-input low-output agriculture and frequent drought conditions (Devereux and Sussex, 2000; Mohamed, 2017). Though the prevalence of undernourishment had been falling in Ethiopia, from 47 per cent in 2000–2002 to 13.8 per cent in 2014–2016, consistent with global trends, in recent years, and similarly consistent with global data, undernourishment has been increasing, reaching 16.2 per cent in 2018–2020, despite relatively high levels of economic growth. In absolute numbers, 7.1 million Ethiopians received emergency food assistance in 2004, falling to just over a million in 2008 (World Bank, 2017). This rapid decline in food insecurity has been partly credited to the Productive Safety Net Programme (PSNP), which was introduced in 2005, with a goal of reducing chronic food insecurity by providing cash transfers, public works and nutritional feeding programmes; and through efforts to increase agricultural productivity. This programme is far more comprehensive than earlier efforts to provide emergency assistance primarily through food aid, and indeed has evolved over time, with increasing emphasis on cash transfers rather than food transfers (Berhane *et al.,* 2014). Studies have found that PSNP has decreased the food gap (defined as the number of times when households could not meet their food needs) in Ethiopia from 3.6 to 2.3 months (Berhane *et al.,* 2011, 2014; Gilligan *et al.,* 2009; Sabates-Wheeler and Devereux, 2010).

Most of the existing literature purporting to determine the socioeconomic impacts of climate change tends to focus only on weather shocks, for example, Antonelli *et al.* (2020), Burke *et al.* (2015), Shayegh *et al.* (2020), and Sisha (2020); or mean temperature change; whether annual (Burke *et al.,* 2015), monthly (Burke *et al.,* 2018), or weekly (Antonelli *et al.,* 2020; Shayegh *et al.,* 2020). In contrast, using high-resolution reanalysis climate data, we also control for climatic shocks in the form of temperature anomalies from a long-term mean; along with four distinct weather shocks, month-to-month change in temperature, three-monthly mean temperature, three-monthly total precipitation, and a perception-based drought variable. Combining this climate and weather data with multiple waves of the Ethiopia Socioeconomic Survey (ESS), we explore whether, and the extent to which, socioeconomic drivers such as education and income, coping mechanisms and safety nets, act as modifiers. The ESS collects information on agricultural activities along with data on education and health, labour force status and labour supply, economic activities and access to services and resources. The richness of the survey allows us to control for various socioeconomic determinants of food insecurity, including gender and education of the household head; income of the households; safety nets in the form of cash and food assistance; coping strategies adopted by households; and price changes of major food items.

In the next section, we focus on government food policies, and specifically the long standing debate on whether, and under what conditions, cash or food transfers are most appropriate and effective. In Section 3, we provide details on the empirical model we employ, and the data set. The results are presented in Section 4 and we conclude in Section 5, focusing on the policy implications of our findings.

2. Government safety nets and food insecurity

Interest in safety nets, a key element of social protection, grew considerably in the early 2000s, but safety nets have been a feature in societies for many millennia. Alderman and Hoddinott (2007) provide a useful summary of their history and breadth. While Bezuneh and Deaton (1997) suggest that 'a fundamental premise of safety net concepts is to undertake investments today that diminish higher social costs in the future', others have conceptualised safety nets as short-term, non-contributory transfers, provided in response to shocks (Alwang and Norton, 2011). There has also been discussion as to whether safety nets should be more integrated into broader efforts to reduce poverty and help households manage risk (Monchuk, 2014). Safety nets have also proven controversial. Part of that controversy is the extent to which safety nets do indeed promote growth and ensure the benefits are shared across society, or rather discourage work and investment and therefore longer term growth and development (Hoddinott, 2008). For example, safety nets may crowd out private precautionary savings (Dercon, 2002).

Key debates in the literature over how to implement social safety nets include whether cash, food or vouchers are most appropriate; whether conditionally should be attached; and how to target (Gentilini and Omamo, 2009; Sabates-Wheeler and Devereux, 2010). Food-based safety nets are, as their name suggests, tied to the provision of food, directly or through vouchers (Rogers and Coates, 2002). There is some evidence that historically, food aid was paid little attention by international organisations such as the World Bank and IMF (Bezuneh and Deaton, 1997), even though empirical evidence suggests that food-based safety nets can under some circumstances be an important tool for reducing poverty and food insecurity (Brown and Gentilini, 2007).

In theory, cash transfers, being fungible, allow individuals to maximise their utility (Lhachimi and Seuring, 2019), and so might be considered a better option than providing people with food, whether directly or as food vouchers (Rogers and Coates, 2002). Indeed, there is growing evidence in sub-Saharan Africa that unconditional cash transfers are effective at increasing households' consumption of food, livestock holdings and purchases of durables; and are effective responses to short term food crises (Ralston *et al.*, 2017). However, evidence from the literature also suggests that whether cash or food transfers are more effective at reducing food insecurity is likely to be dependent on the specific situation, and the details of how a policy is designed and implemented (Babatunde and Olagunju, 2020). For example, cash transfers may be less effective where food markets are not functioning effectively (Dietrich and Schmerzeck, 2019). In the context of Kenya's Hunger Safety Net Programme (HSNP), Dietrich and Schmerzeck (2019) find this to be the case for more isolated communities. Cash transfers may also increase poor households' exposure to food price fluctuations (Addisu, 2020). Food transfers tend to be more costly to implement, limit choice, and may distort food markets (Babu, 2002). However, food transfers tend to be controlled by women, and may therefore benefit childhood food security directly, whereas men are more likely to control cash transfers, suggesting that there is a strong gender element linked to safety nets and food security (Sabates-Wheeler and Devereux, 2010). Food transfers may also be more appropriate where food markets are thin and cash transfers could push up food prices (Sabates-Wheeler and Devereux, 2010).

In the context of India, Pingali *et al.* (2019) suggest that food-based safety net programs may have failed because they focus on calorie-based supplementation, rather than broader measures of nutrition. In contrast, they find that public works programs provide multiple benefits that include households increasing their expenditure on food and improving their broader nutritional intake. More generally, there are broad concerns over the extent to which 'tied' aid is likely to be inefficient, particularly in terms of logistics and cost, distorting markets and limiting consumer choice (Babu, 2002). Unlike in-kind transfers, cash transfers allow individuals to buy goods that maximise the increase in their utility, but such choices might include goods that are harmful to health (Lhachimi and Seuring, 2019).

There have been a number of randomised interventions to test the impact of cash versus in-kind transfers. Examples include Hoddinott *et al.* (2014), who undertook a randomised intervention in Niger to test the impact of cash and food transfers on food security. They found that those households that received a food basket experienced lower levels of food insecurity whilst those that received cash spent more on agricultural inputs. However, as has been observed in the literature, the cost of implementing the food transfers was

higher. Schwab (2020) similarly undertook a randomised comparison. He found that households in Yemen that received a cash transfer had a greater diversity and higher quality of diet, compared with those that received in-kind food comprising wheat flour and oil. Similar to Hoddinott *et al.* (2014), implementing food transfers was more costly. Bhalla *et al.* (2018) study the impact of Zimbabwe's Harmonised Social Cash Transfer (HSCT) on food security in the country and find that Food Security and Diet Diversity scores improve for households eligible for cash transfer. However, the authors find no improvements for food consumption. Miller *et al.* (2011) also conclude that cash transfers from the Malawi Social Cash Transfer Scheme (SCTS) allowed households to increase food expenditures and improve dietary diversity.

Sabates-Wheeler and Devereux (2010), though now somewhat dated, suggested that the debate over whether cash or food is the better safety net remains unresolved. They further observed that in reality, governments are likely to employ a combination of approaches to dealing with social protection, with many governments offering cash transfers even for emergency purposes, and food aid remaining important especially when there are commodity market failures. The World Food Programme has tended to allocate around half of its operational funds to in-kind food (around 50 per cent in 2019 compared with 57 per cent in 2018), and around a third to cash transfers (with and without restrictions).[1]

3. Methods and data

3.1. Empirical framework

We use a fixed-effects linear probability model (LPM) using longitudinal micro survey data (with the same households tracked across the waves) from the ESS combined with high-resolution climatic data to investigate the determinants of food insecurity in Ethiopia (equation (1)). The LPM is a type of OLS regression model for binary outcomes:

$$y_{it} = \delta X_{it} + \phi Z_{it} + \theta C_{it} + \pi H_{it} + \alpha_i + \phi_m + \gamma_t + \epsilon_{it}, \quad (1)$$

where y_{it} is a binary outcome for household i in wave t in response to a specific food insecurity related question (see Section 3.2). The dependent variable is equal to 1 if the household responded that they had suffered from food insecurity for one or more days during the last seven days. Following existing literature (Antonelli *et al.,* 2020; Shayegh *et al.,* 2020), δX_{it} is a vector of socioeconomic and demographic characteristics of each households such as gender, age and education of the household head, household size, total household income (from agricultural and non-farm activities), and whether a household was able to rely on savings in response to a shock. We expect that the probability of food insecurity would be higher for larger households, while higher income households are likely to have a lower chance of food insecurity. In terms of human capital dividends, households with relatively more education may have a lower probability of suffering from food insecurity. ϕZ_{it} is a vector of safety nets, controlling for whether a household received cash and/or food benefits and/or participated in the PSNP. Our main specification also includes interaction terms between these safety nets and mean temperature of the 3 months prior to the interview date to study any potential modifying effect of social protection policies on weather shocks on food insecurity. θC_{it} is a vector of both climate and weather shocks, including annual temperature anomaly, measured by the difference between a given year's mean temperature and the long-term mean of the 1981–2010 period[2]; monthly temperature variability, which measures the month-to-month change in temperature; mean temperature of the 3 months prior to the interview date; total precipitation 3 months prior to the interview date; and whether a household reported to have experienced a drought in the previous 12 months. The temperature and the precipitation variables are extracted from the ERA5 dataset while the drought variable is extracted from the ESS dataset.[3]

[1] WFP Management Plan (2019–2021); available at https://docs.wfp.org/api/documents/WFP-0000099365/download.
[2] Temperature anomaly is computed for: 2011 for wave 1, 2013 for wave 2 and 2015 for wave 3.
[3] The respondents were asked if they had faced a drought in the previous 12 months, and as such is a perception-based variable.

πH_{it} includes two dummy variables. The first indicates if the area harvested was lower than the area planted. It is likely that a lower than expected harvested area would increase the chances of a household suffering from food insecurity. The second dummy variable indicates whether the main purpose of households storing their own produce was to sell at a higher price or to keep for home use. Home uses (the reference category) identified in the survey include own consumption and saving seeds to plant next season, though the latter is mentioned infrequently. A household's decision to store crops for home use or to sell later at a higher price may influence whether that household has greater access to basic food items or greater access to cash that can also be used to diversify diets. We also include household, wave and month of interview fixed-effects, to control for unobserved time-invariant household heterogeneity (constant unobserved factors that may influence measured food security among households), time variant unobserved heterogeneity across survey waves, and seasonality, respectively. Our analysis uses the sampling weights reported in the surveys. We use clustered standard errors at the regional level to account for correlation and heteroskedasticity among households within a given region.

3.2. Data

For our analysis, we combine two datasets. For the socioeconomic data, we use three waves of ESS. This is conducted with a two-stage probability sample and implemented in collaboration with the World Bank Living Standards Measurement Study (LSMS). The survey aims to collect information on agricultural data, socioeconomic characteristics at the household-level, welfare indicators, occupational and income characteristics and food security. ESS is a nationally representative longitudinal survey of over 5000 households followed over time living in rural and urban areas (figure 1). The first wave of the ESS was conducted between August 2011 and January 2012, the second between September 2013 and April 2014 and the third between September 2015 and April 2016. We extract the following four questions from the food security module of the ESS:

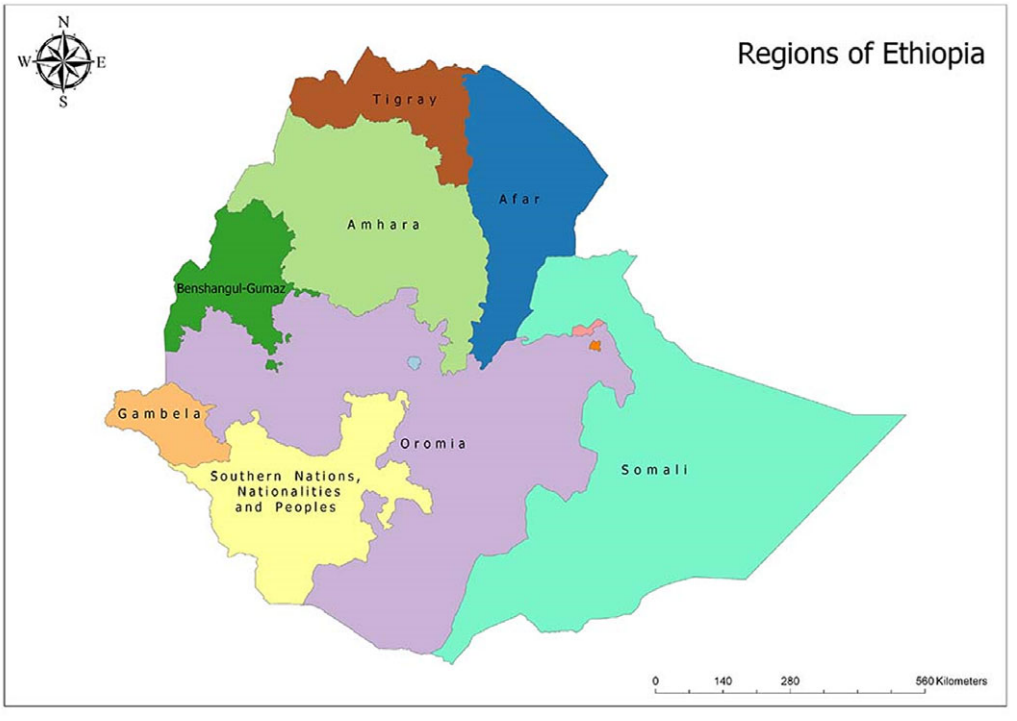


Figure 1. (Colour online) Map of Ethiopia. *Source*: USAID

1. In the past 7 days, how many days have you or someone in your household had to rely on less preferred foods?
2. In the past 7 days, how many days have you or someone in your household had to limit the variety of foods eaten?
3. In the past 7 days, how many days have you or someone in your household had to limit portion size at mealtimes?
4. In the past 7 days, how many days have you or someone in your household had to go a whole day and night without eating anything?

With regard to the climate data, we use reanalysed climate data from ERA5-Land, the fifth generation European Centre for Medium-Range Weather Forecasts (ECMWF) atmospheric reanalysis of the global climate. Reanalysed climate data combines global climate model (numerical representation of the recent climate) with observational and satellite observations. Reanalysed data has the advantage of producing long time series and spanning the entire planet (Hersbach *et al.*, 2020). Data from ERA5-Land is available at a spatial resolution of 0.1° × 0.1° and hourly temporal resolution (C3S, 2017). We extracted the climatic data for each household using the geographical coordinates of the households from the survey data before computing the monthly and three-monthly temperature and precipitation values. Finally, they are matched by the date of each respondent's interview.

4. Results

4.1. Descriptive statistics

Table 1 below provides the descriptive statistics of the major variables used in the paper. The data show that 48 per cent of the respondents in the survey are female and average age of these respondents is

Table 1. Descriptive statistics

Variable	Estimate
Rely on less preferred food	24.8
Limit the variety of foods eaten	21.6
Limit portion size at meal times	17.1
Go a whole day and night without eating	2.4
Gender (female %)	48.1
Age	22.4
Household size	4.7
Share of households relied on savings	31.7
Annual temperature anomaly (°C)	0.54
Annual temperature (°C)	22.4
Annual precipitation (mm)	1070.9
Share of households experiencing drought	22.4
Free food	9.1
PSNP/cash-for-work	4.0
Store to sell at a higher price	15.9

slightly over 22 years. The data suggest that around 9 per cent of households accessed food safety nets, and just over 4 per cent accessed cash, either through the PSNP programme, or through cash-for-work programmes. However, this data is skewed left as the coverage of the PSNP programme in the urban areas is relatively low.

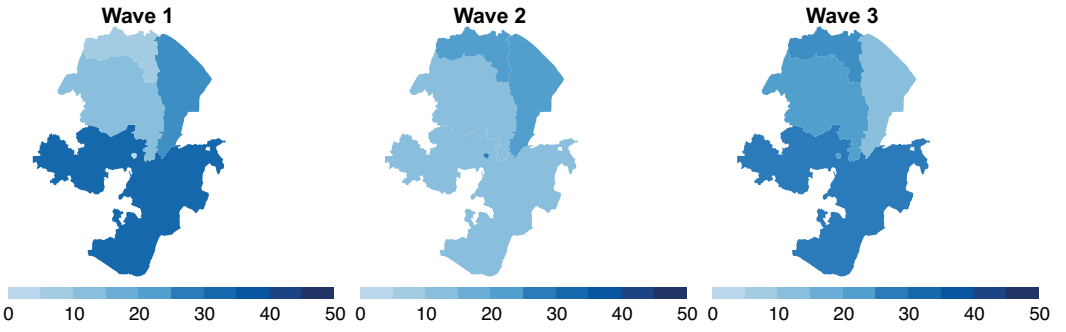
The maps in figure 2a–d reveal a country where food security is compromised across multiple dimensions, and across space and time, with households in Gambelia, Somalie, and the Southern Nations, Nationalities and People's Region (SNNP) experiencing the highest levels of food insecurity in Ethiopia. With regards to the most extreme measure of food insecurity, going without eating for the whole day, the data suggest that there has been a clear improvement over time across the three waves. However, for what might be termed the more nuanced concepts of food insecurity, such as relying on less preferred foods, there has not been a similar consistent improvement, as we might have anticipated given that the country was experiencing considerable economic growth over this time. By exploring four different concepts of food security, we can see that households, particularly in the south of the country, appear to be making adjustments in their eating habits, not just reducing how much they consume, but switching to less preferred and possibly lower quality foods, and possibly compromising their nutritional status by limiting the variety of foods that they consume.

4.2. Empirical findings

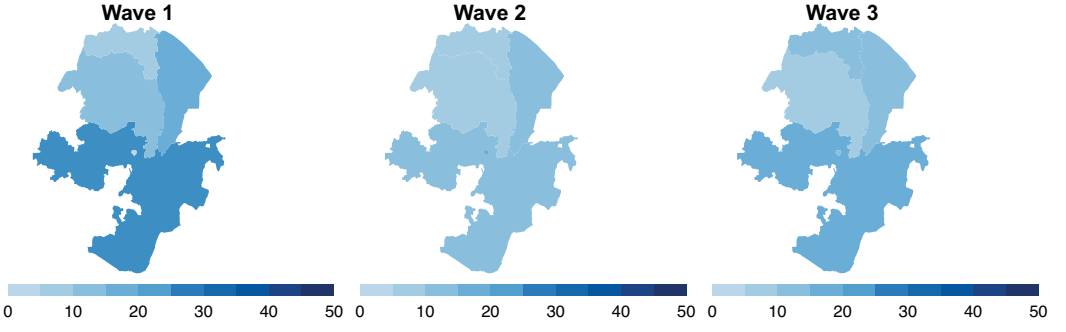
Our findings (table 2) suggest that both the level and volatility of temperatures increase multi-dimensional food insecurity in Ethiopia (as manifested by relying on less preferred food items consumed, reduced consumption, limiting portion size and not eating for the whole day). The highest impact of these two variables is on reduced consumption through limited variety of foods consumed. While these two temperature variables provide the impact of weather shocks on food insecurity, increasing temperature anomaly (climate shock) also results in an increase in the chance of food insecurity among households (highest impact on households having to rely on less preferred food items). Increase in total precipitation (average of previous 3 months) on the other hand, reduces the probability of food insecurity. Households that reported facing drought as one of the shocks also had a higher probability of food insecurity (again the highest impact is on reduced consumption through limited variety of foods consumed).

Food security is strongly influenced by a household's ability to afford food and as expected, higher income households seem to be more food secure. Our results also show that increasing prices of food items resulted in an increase in the incidences of food insecurity among households. In terms of sociodemographic determinants of food insecurity in Ethiopia, the econometric results reveal that female-led households have a higher chance of suffering from food insecurity compared to male-led households. We also find that households with relatively higher educated heads tend to suffer less from food insecurity, although the coefficients for education are rather small. Further, larger households have a higher probability of food insecurity (highest impact on limited portion size and going without eating for the whole day).

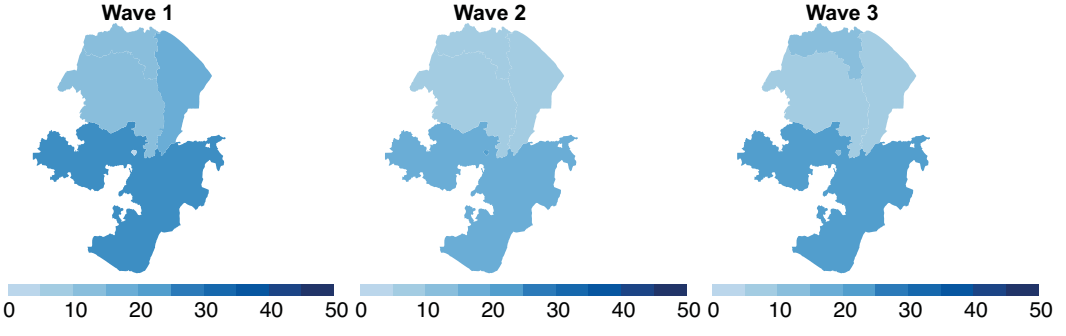
Focusing on the policy aspects of our research, we study the efficacy of government cash assistance versus food assistance. Our results suggest that assistance in the form of PSNP and/or cash transfers have been more effective than the provision of free food in reducing the probability of food insecurity in Ethiopia. Indeed, the results suggest that food assistance has failed to reduce food insecurity over the three waves of ESS in Ethiopia. The interaction of the safety nets and average temperature of the previous 3 months suggests that though increases in three-monthly temperature increase the probability of food insecurity for the average household, a safety net in the form of PSNP participation or cash transfer results in a slight decline in these impacts. As such, PSNP participation or cash transfer do act as modifiers to adverse impacts of weather shocks on food security in Ethiopia.



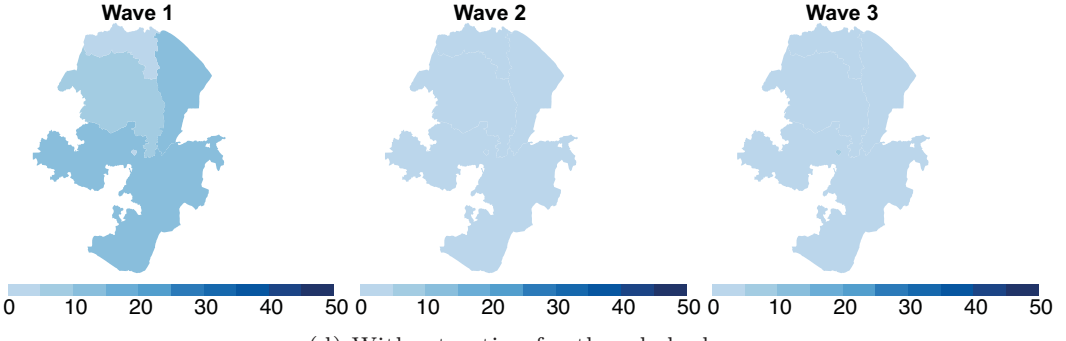
(a) Rely on less preferred foods



(b) Limit the variety of foods eaten



(c) Limit portion size at meal-times



(d) Without eating for the whole day

Figure 2. (Colour online) Food security situation in Ethiopia (2011–2012; 2013–2014; and 2015–2016)

Table 2. Determinants of food insecurity in Ethiopia—modifying impacts of safety nets

	(1)	(2)	(3)	(4)
	Limited variety of food	**Reduced consumption**	**Ran out of food**	**Whole day without eating**
HH head gender (female)	0.150**	0.160**	0.157**	0.146**
	(0.034)	(0.021)	(0.042)	(0.048)
Household size	0.108***	0.109***	0.201***	0.208***
	(0.007)	(0.002)	(0.002)	(0.008)
HH head age	−0.030***	0.054***	−0.033***	−0.038***
	(0.000)	(0.001)	(0.006)	(0.001)
HH head age-squared	0.0004***	0.0004***	0.0002***	0.0002***
	(0.000)	(0.000)	(0.000)	(0.001)
HH head years of schooling	−0.005**	−0.005**	−0.003**	−0.005**
	(0.029)	(0.027)	(0.019)	(0.026)
Log of total income	−0.026***	−0.022***	−0.028***	−0.024***
	(0.004)	(0.000)	(0.000)	(0.008)
Relied on savings	−0.208***	−0.155***	−0.031***	−0.118***
	(0.000)	(0.004)	(0.007)	(0.009)
Temperature anomaly	0.011**	0.009**	0.016**	0.015**
	(0.031)	(0.035)	(0.020)	(0.041)
Monthly temperature variability	0.014**	0.021***	0.028***	0.014***
	(0.028)	(0.004)	(0.003)	(0.000)
Average temperature (previous 3-months)	0.016***	0.010***	0.014***	0.019***
	(0.001)	(0.000)	(0.009)	(0.000)
Total precipitation (previous 3-months)	−0.030***	0.055***	−0.023***	−0.029***
	(0.009)	(0.000)	(0.003)	(0.006)
Drought	0.131**	0.244**	0.109**	0.081**
	(0.031)	(0.024)	(0.033)	(0.041)
Increase in price of major food items	0.207*	0.130***	0.171***	0.058**
	(0.089)	(0.001)	(0.009)	(0.027)
PSNP/Cash assistance	−0.008***	−0.018**	−0.025***	−0.031***
	(0.001)	(0.021)	(0.000)	(0.007)
Food assistance	0.104	0.185	0.212	0.007
	(0.105)	(0.158)	(0.102)	(0.111)

(Continued)

Table 2. *Continued*

	(1)	(2)	(3)	(4)
	Limited variety of food	**Reduced consumption**	**Ran out of food**	**Whole day without eating**
PSNP/Cash assistance#Average temperature (previous 3-months)	−0.004**	−0.006**	−0.011**	−0.013***
	(0.021)	(0.031)	(0.044)	(0.009)
Food assistance#Average temperature (previous 3-months)	−0.003	−0.008	−0.104*	−0.119**
	(0.115)	(0.204)	(0.010)	(0.048)
Harvest less than planted	0.202**	0.159***	0.231***	0.177***
	(0.031)	(0.004)	(0.009)	(0.000)
Storage to sell at a higher price (reference category: household consumption and/or to use as seeds)	−0.004***	−0.027***	−0.022**	−0.089***
	(0.000)	(0.005)	(0.037)	(0.002)

Note: p-values are in parentheses.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.10$.

Further, in terms of coping strategies adopted by households, we find that households that were able to rely on their savings were less likely to suffer from food insecurity, even controlling for total household income. Interestingly, agricultural households that stored their harvested crops in anticipation of being able to sell at higher prices in the future (rather than for own-household consumption smoothing and/or to use as seeds for planting), had a lower probability of suffering from food insecurity. These findings suggest that access to cash has a positive influence on households' ability to improve food security. Our results are consistent across the four indicators of food insecurity both in terms of magnitude of the coefficients and statistical significance.

4.3. Robustness tests

As a robustness test, we use regional fixed-effects instead of household fixed-effects. This specification allows us to control for the potential differentiated impact of the rural–urban divide in Ethiopia on food insecurity. While the results are similar to our base specification, the coefficients are generally larger. We add a dummy variable indicating whether the household is from a rural or urban area of Ethiopia and an interaction term between this variable and the average temperature of the previous 3 months. These results suggest that a household in an urban area is less likely to suffer from food insecurity (across all the four food security indicators) relative to a rural household. The coefficients of the interaction term suggest that the effect of 3-months average temperature on food security is lower for an urban household compared to a rural one (table 3).

We also re-run our base specification (equation (1)) without the temperature and safety net interaction terms. These results (table 4) are consistent with those provided in table 2 above both in terms of signs of the coefficients and significance.

Table 3. Determinants of food insecurity in Ethiopia

	(1)	(2)	(3)	(4)
	Less preferred foods	**Reduced consumption**	**Limited portion size**	**Whole day without eating**
Urban (reference category: Rural)	−0.029**	−0.031**	−0.030**	−0.043*
	(0.044)	(0.047)	(0.027)	(0.062)
HH head gender (female)	0.172**	0.169**	0.164**	0.161**
	(0.039)	(0.036)	(0.048)	(0.040)
Household size	0.168*	0.128	0.228*	0.263*
	(0.052)	(0.145)	(0.061)	(0.071)
HH head age	−0.036**	0.059**	−0.048*	−0.043***
	(0.025)	(0.019)	(0.055)	(0.000)
HH head age-squared	0.0005***	0.0004***	0.0006***	0.0004***
	(0.001)	(0.008)	(0.002)	(0.009)
HH head years of schooling	−0.009**	−0.008**	−0.007**	−0.008**
	(0.049)	(0.027)	(0.014)	(0.036)
Log of total income	−0.032**	−0.034***	−0.042**	−0.044**
	(0.012)	(0.09)	(0.038)	(0.027)
Relied on savings	−0.351**	−0.166**	−0.051*	−0.167**
	(0.022)	(0.032)	(0.055)	(0.029)
Temperature anomaly	0.016**	0.012**	0.017**	0.019**
	(0.031)	(0.036)	(0.020)	(0.024)
Monthly temperature variability	0.028**	0.039**	0.033**	0.030**
	(0.011)	(0.014)	(0.018)	(0.026)
Average temperature (previous 3-months)	0.038**	0.027**	0.019***	0.024**
	(0.022)	(0.014)	(0.009)	(0.013)
Urban#Average temperature (previous 3-months)	−0.004**	−0.008**	−0.009**	−0.010***
	(0.017)	(0.028)	(0.039)	(0.007)
Total precipitation (previous 3-months)	−0.059**	−0.011*	−0.047**	−0.058**
	(0.030)	(0.063)	(0.035)	(0.023)
Drought	0.158***	0.258**	0.169***	0.109*
	(0.004)	(0.034)	(0.004)	(0.051)
Increase in price of major food items	0.258***	0.121**	0.168*	0.158**
	(0.001)	(0.015)	(0.057)	(0.019)

(Continued)

Table 3. *Continued*

	(1)	(2)	(3)	(4)
	Less preferred foods	**Reduced consumption**	**Limited portion size**	**Whole day without eating**
PSNP/Cash assistance	−0.004***	−0.024**	−0.029**	−0.037**
	(0.007)	(0.032)	(0.018)	(0.034)
Food assistance	0.111	0.045	0.143	0.107
	(0.388)	(0.203)	(0.364)	(0.433)
Harvest less than planted	0.109*	0.122**	0.301**	0.211**
	(0.041)	(0.016)	(0.042)	(0.020)
Storage to sell at a higher price (reference category: household consumption and/or to use as seeds)	−0.017**	−0.023*	−0.010***	−0.074**
	(0.011)	(0.053)	(0.008)	(0.037)

Note: p-values are in parentheses.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.10$.

Table 4. Determinants of food insecurity in Ethiopia

	(1)	(2)	(3)	(4)
	Less preferred foods	**Reduced consumption**	**Limited portion size**	**Whole day without eating**
HH head gender (female)	0.151**	0.163**	0.155**	0.147**
	(0.032)	(0.025)	(0.041)	(0.045)
Household size	0.102***	0.111***	0.207***	0.204***
	(0.008)	(0.003)	(0.001)	(0.009)
HH head age	−0.031***	0.052***	−0.033***	−0.033***
	(0.000)	(0.000)	(0.001)	(0.000)
HH head age-squared	0.0004***	0.0005***	0.0003***	0.0002***
	(0.000)	(0.000)	(0.001)	(0.001)
HH head years of schooling	−0.005**	−0.004**	−0.003**	−0.004**
	(0.031)	(0.025)	(0.011)	(0.023)
Log of total income	−0.025***	−0.028***	−0.021***	−0.031***
	(0.000)	(0.000)	(0.001)	(0.003)
Relied on savings	−0.205***	−0.148***	−0.036***	−0.111***
	(0.001)	(0.009)	(0.000)	(0.010)

(Continued)

Table 4. *Continued*

	(1)	(2)	(3)	(4)
	Less preferred foods	**Reduced consumption**	**Limited portion size**	**Whole day without eating**
Temperature anomaly	0.013**	0.009**	0.011**	0.010**
	(0.037)	(0.042)	(0.025)	(0.048)
Monthly temperature variability	0.017***	0.026***	0.021***	0.011***
	(0.009)	(0.000)	(0.007)	(0.001)
Average temperature (previous 3-months)	0.011***	0.015***	0.008***	0.012***
	(0.004)	(0.001)	(0.008)	(0.002)
Total precipitation (previous 3-months)	−0.031***	0.052***	−0.033***	−0.033***
	(0.000)	(0.000)	(0.001)	(0.000)
Drought	0.133**	0.201**	0.105**	0.096**
	(0.039)	(0.022)	(0.042)	(0.048)
Increase in price of major food items	0.202***	0.142***	0.156***	0.112***
	(0.006)	(0.000)	(0.002)	(0.010)
PSNP/Cash assistance	−0.009***	−0.012***	−0.017***	−0.024***
	(0.000)	(0.002)	(0.009)	(0.003)
Food assistance	0.147	0.104	0.336	0.208
	(0.211)	(0.303)	(0.178)	(0.344)
Harvest less than planted	0.214***	0.142***	0.244***	0.301***
	(0.002)	(0.000)	(0.007)	(0.002)
Storage to sell at a higher price (reference category: household consumption and/or to use as seeds)	−0.008***	−0.010***	−0.014**	−0.061***
	(0.006)	(0.000)	(0.044)	(0.000)

Note: p-values are in parentheses.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.10$.

5. Discussion and policy implications

There is a considerable focus in the climate economics literature on the socioeconomic impacts of weather shocks. Our paper, building on this literature, combining household survey data with high-resolution climate and weather data, and controlling for a rich set of predictors, makes a novel contribution by investigating the impact of both climate and weather shocks on food insecurity. Our results show that both these shocks adversely affect the probability of household-level food insecurity. Our econometric results are consistent across the four indicators of food insecurity (relying on less preferred food items, reducing consumption of food items, limiting portion sizes and going a whole day without eating). While our results are intuitive with respect to socioeconomic determinants, we quantify the effects and identify important heterogeneities, and as such provide evidence supporting the need for multi-approached macroeconomic policies tailored to local contexts. Our approach also allows us to identify and highlight spatial heterogeneities, including an important finding that urban households have a lower probability of suffering from food insecurity compared to rural ones; and that the impact of

temperature related weather shock is also lower on urban households. Climate and weather shocks have adverse effects on food security even after controlling for socioeconomic factors including income and rising food prices. Possible transmission channels could be declining nutritional content of food or additional physiological stress on human bodies, caused by heat and heat stress.

Our micro-based findings have a number of important implications for food security policy at the macro level, particularly in the context of a changing climate. First, our analysis suggests that, in Ethiopia during the time period covered by the data, cash transfers have been more effective than food assistance in reducing food insecurity. That cash has been found to be more effective than food is consistent with the general consensus in the literature. However, the literature also makes clear that local contexts matter; and how climate shocks are manifested, whether as food shortages, rising prices, or falling incomes, is likely to influence the most appropriate design of the policy instrument. Dejene and Cochrane (2021) collected data for 387 land scarce or landless households enrolled in the PSNP programme from Ethiopia's Southern region in 2017 and 2018. Almost all the households experienced some dimension of food insecurity, indeed 92 per cent reported worrying that their household would not have enough food, yet 88 per cent of the households are reported to have used their cash transfers to pay off debts. These findings make clear both the fungibility of cash transfers, and that food insecure households may not, in the short-run, prioritise increased expenditure on food when they have other more pressing issues to deal with. However, to the extent that safety nets can play a role in longer term poverty reduction, risk management and economic growth more broadly, households might be increasing their chances at reducing food insecurity in the longer term, consistent with Bezuneh and Deaton (1997) who highlight the role of safety nets as investments in the future. Though our findings are consistent with the literature that suggests that food assistance is generally less effective than cash, it is not clear as to why food assistance appears to be ineffective with regards to reducing food insecurity in our paper. Reasons for this lack of effectiveness could be related to the logistical challenges of food distribution; or the crowding out of food production (Arega and Shively, 2019). However, further research is needed to determine the mechanisms through which these different forms of assistance are more or less effective.

Second, though there is evidence in the literature that safety nets can both contribute to food security and to longer term economic growth and development (Hoddinott, 2008), some studies have suggested that safety nets could crowd out private precautionary savings (Dercon, 2002). Our findings suggest that households that had savings to rely on had a lower chance of suffering from food insecurity. Thus, with respect to coping mechanisms, programmes that encourage and enable households to save will likely improve food security. We recognise of course that it is particularly hard for the poorest households to save. However, there is evidence that poor households may 'undersave' due to imperfect markets (Karlan *et al.,* 2014), suggesting an important role for government policy in reducing and removing market failures. More broadly, safety nets are likely to have longer term impacts on economic growth through improvements in health of the population. These impacts may not be picked up in the short and medium-term, but this growth in turn could also benefit food security in the longer term (Alderman and Yemtsov, 2014), consistent with the human capital—growth literature (Barro, 2001). While increase in income in Ethiopia is expected to improve the food security situation, adverse impacts of climate and weather shocks are likely to offset some of these gains.

Third, the role of storage has long been recognised as important for consumption smoothing in agriculture-dependent households, and consistent with this, here we identify household-level storage as an important element of reducing food insecurity, particularly where households intend to sell, rather than consume the stored food and/or to use as seeds for planting, once prices increase. As climate change increasingly disrupts both international food systems and domestic production, the role of strategic grain reserves at the country level is increasingly being discussed (Bank, 2021). Implicit in our research findings is that a better understanding of how state, private and individual household storage are likely to interact and affect food security, is needed. Tesfaye and Tirivayi (2018) find evidence that improved storage technologies, such as the use of metal silos, and airtight drums, can improve food and nutrition security in Ethiopia.

Fourth, consistent with findings of Alemu and Mengistu (2019), climate change is likely to worsen food security in East African countries through higher temperatures and lower precipitation. Effective food policies will likely need to address both longer term trends and short term shocks. As such, food policies might be directed both to improving agricultural yields in the context of a changing climate where temperatures are increasing, and drought is more likely; and at improving households' abilities to cope with immediate term weather shocks that tend to drive prices up and make food less affordable.

Finally, though we focus in this paper on the quantity of food households are able to access, a broader understanding of food security is likely to be needed, driven by appropriate data collected that addresses the quality and nutritional content of food, along with quantity.

References

Addisu, T. (2020), 'Price volatility and food insecurity the case of Ethiopia', Ph.D. Thesis, Wageningen University and Research Center.

Alderman, H. and Hoddinott, J. (2007), 'Growth-promoting social safety nets', in *Twenty Twenty (2020) Focus Brief on the World's Poor and Hungry People*, Washington, DC: International Food Policy Research Institute (IFPRI), Chap. 16, pp. 102–5.

Alderman, H. and Yemtsov, R. (2014), 'How can safety nets contribute to economic growth?', *The World Bank Economic Review*, **28**, pp. 1–20.

Alemu, T. and Mengistu, A. (2019), 'Impacts of climate change on food security in Ethiopia: Adaptation and mitigation options: A review', in Castro, P., Azul, A.M., Leal Filho, W. and Azeiteiro, U.M. (eds), *Climate Change-Resilient Agriculture and Agroforestry: Ecosystem Services and Sustainability*, Cham: Springer International Publishing, Chap. 2, pp. 397–412.

Alwang, J. and Norton, G.W. (2011), 'What types of safety nets would be most efficient and effective for protecting small farmers and the poor against volatile food prices?', *Food Security*, **3**, pp. 139–48. doi:10.1007/s12571-010-0089-9.

Amjath-Babu, T.S., Krupnik, T.J., Thilsted, S.H. and McDonald, A. (2020), 'Key indicators for monitoring food system disruptions caused by the covid-19 pandemic: Insights from bangladesh towards effective response', *Food Security*, **12**, pp. 761–8. doi:10.1007/s12571-020-01083-2.

Antonelli, C., Coromaldi, M., Dasgupta, S., Emmerling, J. and Shayegh, S. (2020), 'Climate impacts on nutrition and labor supply disentangled: An analysis for rural areas of Uganda', *Environment and Development Economics*, **26**, pp. 1–26.

Arega, M.A. and Shively, G. (2019), 'Food aid, cash transfers and producer prices in Ethiopia', *African Journal of Agricultural and Resource Economics*, **14**, p. 301039.

Babatunde, R.O. and Olagunju, F.I. (2020), 'Cash or food transfer? Assessing the effectiveness of social safety nets for households during COVID-19 pandemic in Nigeria', available online at https://www.uneca.org/sites/default/files/AEC/2020/presentations/cash_or_food_transfer-_assessing_the_effectiveness_of_social_safety_nets_for_households_during_covid-19_pandemic_in_nigeria_.pdf.

Babu, S. (2002), 'Social safety nets for poverty reduction in South Asia–global experiences', *Sri Lankan Journal of Agricultural Economics*, **5**, pp. 1–9.

Bank, W. (2021), 'The role of strategic grain reserves in enhancing food security in Zambia and Zimbabwe', Economic and Sector Work (ESW) Studies, World Bank Group, Washington, DC.

Barro, R.J. (2001), 'Human capital and growth', *The American Economic Review*, **91**, pp. 12–7, http://www.jstor.org/stable/2677725.

Berhane, G., Gilligan, D.O., Hoddinott, J., Kumar, N. and Taffesse, A.S. (2014), 'Can social protection work in Africa? The impact of Ethiopia's productive safety net programme', *Economic Development and Cultural Change*, **63**, pp. 1–26. doi:https://doi.org/10.1086/677753.

Berhane, G., Hodinott, J., Kumar, N., Taffesse, A., Diresse, M., Yohannes, Y., Sabates-Wheeler, R., Handino, M., Lind, J., Tefera, M. and Feyera, S. (2011), 'Evaluation of Ethiopia's Food Security Program: Documenting progress in the implementation of the productive safety net program and the household asset building program'. IFPRI Discussion Paper Series. IFPRI.

Bezuneh, M. and Deaton, B. (1997), 'Food aid impacts on safety nets: Theory and evidence—A conceptual perspective on safety nets', *American Journal of Agricultural Economics*, **79**, pp. 672–7. doi:10.2307/1244170.

Bhalla, G., Handa, S., Angeles, G. and Seidenfeld, D. (2018), 'The effect of cash transfers and household vulnerability on food security in Zimbabwe', *Food Policy*, **74**, pp. 82–99. doi:10.1016/j.foodpol.2017.11.007.

Brown, L. and **Gentilini, U.** (2007), 'On the edge: The role of food-based safety nets in helping vulnerable households manage food insecurity', in *Food Insecurity, Vulnerability and Human Rights Failure*, London: Palgrave Macmillan, Chap. 4, pp. 82–105.

Burke, M., González, F., Baylis, P., Heft-Neal, S., Baysan, C., Basu, S. and Hsiang, S. (2018), 'Higher temperatures increase suicide rates in the United States and Mexico', *Nature Climate Change*, **8**, pp. 723–9.

Burke, M., Hsiang, S.M. and Miguel, E. (2015), 'Global non-linear effect of temperature on economic production', *Nature*, **527**, pp. 235–9. doi:10.1038/nature15725.

C3S (2017), 'ERA5: Fifth generation of ECMWF atmospheric reanalyses of the global climate', https://cds.climate.copernicus.eu/cdsapp#!/home.

Dejene, M. and Cochrane, L. (2021), 'Safety nets as a means of tackling chronic food insecurity in rural Southern Ethiopia: What is constraining programme contributions?', *Canadian Journal of Development Studies/Revue canadienne d'études du développement*, pp. 1–19. doi:10.1080/02255189.2021.1914559.

Dercon, S. (2002), 'Income risk, coping strategies, and safety nets', *The World Bank Research Observer*, **17**, pp. 141–66, http://www.jstor.org/stable/3986329.

Devereux, S. and Sussex, I. (2000), 'Food insecurity in Ethiopia', Discussion Paper, Institute for Development Studies.

Díaz-Bonilla, E. (2015), *Macroeconomics, Agriculture, and Food Security: A Guide to Policy Analysis in Developing Countries*, Washington, DC: International Food Policy Research Institute (IFPRI).

Dietrich, S. and Schmerzeck, G. (2019), 'Cash transfers and nutrition: The role of market isolation after weather shocks', *Food Policy*, **87**, p. 101739. doi:10.1016/j.foodpol.2019.101739.

FAO, IFAD, UNICEF, WFP and WHO. (2020), *The State of Food Security and Nutrition in the World 2020. Transforming food systems for affordable healthy diets*, Rome: FAO.

Gentilini, U. and Omamo, S. (2009), *Unveiling Social Safety Nets*, Rome: World Food Programme.

Gilligan, D. (2020), 'Social safety nets are crucial to the covid-19 response: Some lessons to boost their effectiveness', in Swinnen, J. and McDermott, J. (eds), *COVID-19 and Global Food Security*, Washington, DC: International Food Policy Research Institute (IFPRI), Chap. 23, pp. 102–5.

Gilligan, D.O., Hoddinott, J. and Taffesse, A.S. (2009), 'The impact of Ethiopia's productive safety net programme and its linkages', *The Journal of Development Studies*, **45**, pp. 1684–706. doi:10.1080/00220380902935907.

Haddad, L., Alderman, H., Appleton, S., Song, L. and Yohannes, Y. (2003), 'Reducing child malnutrition: How far does income growth take us?', *The World Bank Economic Review*, **17**, pp. 107–31.

Hersbach, H., Bell, B., Berrisford, P., Hirahara, S., Horányi, A., Muñoz-Sabater, J., Nicolas, J., Peubey, C., Radu, R., Schepers, D., Simmons, A., Soci, C., Abdalla, S., Abellan, X., Balsamo, G., Bechtold, P., Biavati, G., Bidlot, J., Bonavita, M., De Chiara, G., Dahlgren, P., Dee, D., Diamantakis, M., Dragani, R., Flemming, J., Forbes, R., Fuentes, M., Geer, A., Haimberger, L., Healy, S., Hogan, R.J., Hólm, E., Janisková, M., Keeley, S., Laloyaux, P., Lopez, P., Lupu, C., Radnoti, G., de Rosnay, P., Rozum, I., Vamborg, F., Villaume, S. and Thépaut, J.N. (2020), 'The ERA5 global reanalysis', *Quarterly Journal of the Royal Meteorological Society*, **146**, pp. 1999–2049. doi:10.1002/qj.3803.

Hoddinott, J. (2008), 'Social safety nets and productivity enhancing investments in agriculture', *SSRN Electronic Journal*; doi: 10.2139/ssrn.1661284.

Hoddinott, J.F., Sandström, S. and Upton, J. (2014), 'The impact of cash and food transfers: Evidence from a randomized intervention in Niger', IFPRI Discussion Papers 1341, International Food Policy Research Institute (IFPRI), https://ideas.repec.org/p/fpr/ifprid/1341.html.

Karlan, D., Ratan, A.L. and Zinman, J. (2014), 'Savings by and for the poor: A research review and agenda', *Review of Income and Wealth*, **60**, pp. 36–78. doi:10.1111/roiw.12101.

Laborde, D., Martin, W. and **Vos, R.** (2020), 'Poverty and food insecurity could grow dramatically as covid-19 spreads', in Swinnen, J. and McDermott, J. (eds), *COVID-19 and Global Food Security*, Washington, DC: International Food Policy Research Institute (IFPRI), Chap. 2, pp. 16–9.

Lhachimi, S.K. and Seuring, T. (2019), 'Thou shalt be given… but how? A replication study and extended cost-effectiveness analysis of a randomized experiment on food assistance in Northern Ecuador', *Journal of Development Effectiveness*, **11**, pp. 373–90. doi:10.1080/19439342.2019.1666901.

Miller, C.M., Tsoka, M. and Reichert, K. (2011), 'The impact of the social cash transfer scheme on food security in Malawi', *Food Policy*, **36**, 230–8. doi:10.1016/j.foodpol.2010.11.020.

Mohamed, A. (2017), 'Food security and economic growth', *International Journal of Health Economics and Policy*, **2**, pp. 86–96. doi:10.11648/j.hep.20170203.11.

Monchuk, V. (2014), 'Reducing poverty and investing in people: The new role of safety nets in Africa – experiences from 22 countries'. doi:10.1007/s12571-010-0089-9.

Pingali, P., Aiyar, A., Abraham, M. and **Rahman, A.** (2019), 'Reimagining safety net programs', in *Transforming Food Systems for a Rising India*, Cham: Springer International Publishing, pp. 135–64.

Ralston, L., Andrews, C. and Hsiao, A. (2017), 'The impacts of safety nets in Africa: What are we learning?', Policy Research Working Paper, No. 8255, World Bank, Washington, DC. Available online at https://openknowledge.worldbank.org/handle/10986/28916.

Rogers, B. and Coates, J. (2002), 'Food-based safety nets and related programs', Social Protection Discussion Paper Series No. 0225, World Bank Group, Washington, DC.

Romanello, M., McGushin, A., Di Napoli, C., *et al.* (2021), 'The 2021 report of the Lancet countdown on health and climate change: code red for a healthy future', *The Lancet*, **398**, 10311, pp. 1619–1662.

Sabates-Wheeler, R. and Devereux, S. (2010), 'Cash transfers and high food prices: Explaining outcomes on Ethiopia's productive safety net programme', *Food Policy*, **35**, pp. 274–85. doi:10.1016/j.foodpol.2010.01.001.

Schwab, B. (2020), 'In the form of bread? A randomized comparison of cash and food transfers in Yemen', *American Journal of Agricultural Economics*, **102**, pp. 91–113. doi:10.1093/ajae/aaz048.

Shayegh, S., Manoussi, V. and Dasgupta, S. (2020), 'Climate change and development in South Africa: The impact of rising temperatures on economic productivity and labour availability', *Climate and Development*, **13**, pp. 725–35.

Sisha, T.A. (2020), 'Household level food insecurity assessment: Evidence from panel data, Ethiopia', *Scientific African*, **7**, p. e00262. doi:10.1016/j.sciaf.2019.e00262.

Smith, L.C. and Haddad, L. (2002), 'How potent is economic growth in reducing undernutrition? What are the pathways of impact? New cross-country evidence', *Economic Development and Cultural Change*, **51**, pp. 55–76.

Strauss, J. and Thomas, D. (1998), 'Health, nutrition, and economic development', *Journal of Economic Literature*, **36**, pp. 766–817.

Tesfaye, W. and Tirivayi, N. (2018), 'The impacts of postharvest storage innovations on food security and welfare in Ethiopia', *Food Policy*, **75**, pp. 52–67. doi:10.1016/j.foodpol.2018.01.

Timmer, C.P. (2000), 'The macro dimensions of food security: economic growth, equitable distribution, and food price stability', *Food Policy*, **25**, pp. 283–95. doi:10.1016/S0306-9192(00)00007-5.

Ville, A.S., Po, J.Y.T., Sen, A., Bui, A. and Melgar-Quiñonez, H. (2019), 'Food security and the food insecurity experience scale (FIES): Ensuring progress by 2030', *Food Security*, **11**, pp. 483–91. doi:10.1007/s12571-019-00936-.

World Bank (2017), 'Project appraisal document for a productive safety net project', Report No. 29767-ET, World Bank.

World Food Summit (1996), Rome Declaration on World Food Security.

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