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A cross-country analysis using
national household survey data

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A cross-country analysis using national household survey data

Lorenzo Moncada and Ana Paula de la O Campos

Food and Agriculture Organization of the United Nations

Leopoldo Tornarolli

Center of Distributive, Labor, and Social Studies (CEDLAS), Argentina

Food and Agriculture Organization of the United Nations

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Abstract

While the Sustainable Development Goals (SDGs) highlight eradicating poverty and achieving food security as two specific objectives (SDGs 1 and 2), interventions aiming to address one or the other goal are often similar in policy orientation and design. Thus, understanding better the relationship between poverty and food insecurity is of great importance to policy makers. The recent diffusion of experience-based food security scales has stimulated research on this relationship at the household level. Nevertheless, most of this literature has not relied on a rigorous measure of poverty, nor has assessed how the poverty-food insecurity relationship can be different among population subgroups such as rural and urban people. This research analyses national household surveys from ten countries in sub-Saharan Africa and Latin America to shed light on the household-level relationship between monetary poverty and food insecurity. Similar to previous studies, results highlight a clear correlation between poverty and food insecurity. However, they also show that, in some instances, the overlap between the set of households classified as poor and those classified as food insecure, can be partial, with not-negligible shares being either classified as poor but not food insecure, or as food insecure but not poor. This mismatch is not surprising, as food security and poverty are two distinct conceptual constructs. Our findings, however, warns against superficial targeting approaches where monetary poverty is used as a proxy of food insecurity and vice versa, highlighting that specific food insecurity and poverty measures are needed to guide respective policies. The analysis also points to certain population groups, such as households involved in agriculture and households suffering from shocks, where classifications based on poverty and food insecurity measures appear to be more discrepant. These results highlight that engaging in agricultural activities contributes to sustaining households' food security when they face welfare shocks, suggesting that agricultural development strategies should not overlook the safety net role of agricultural livelihoods for food security, especially for poorer households. In addition, the results highlight that for reducing food insecurity it is important to extend social protection schemes to large shares of populations, beyond those identified as monetary poor.

Keywords: poverty, welfare, food security, agricultural households, shocks.

JEL codes: C21, C26, D10, D31, I32, Q18.

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1 Introduction

Food insecurity and poverty are widely understood as two mutually reinforcing conditions (FAO *et al.*, 2019). Although the Sustainable Development Goals (SDGs) highlight, as part of their targets, ending both of them separately (SDG 1, Target 1.1, and SDG 2, Target 1.2), in practice, interventions aiming to address one or the other goal are often similar in policy orientation and design, in particular when the focus of food security interventions is on food access. This is often the case for agricultural development, livelihood support, or social assistance programmes such as cash transfers and public works, whose theories of change assume that increasing the income or the productivity of the poor will lead to decreasing food insecurity in the population.

National programmes that have among their objectives reducing food insecurity are sometimes targeted towards households that are considered poor based on national poverty lines or lines that are derived from them.

The most evident case is when programmes select beneficiaries directly based on their monetary poverty status (household level targeting), typically through social registries which include information on households' income and/or other characteristics. Households are selected if their income is below a certain threshold, typically national poverty lines (a mechanism called means testing). Alternatively, households' income (or their probability to be monetarily poor) is predicted based on other characteristics included in the registry, through models estimated on national household surveys (a mechanism called proxy means testing).¹ It is clear that, in these cases, if eligibility is conditional on being classified as poor, programmes will miss the food insecure families that are not identified as poor (Suryanarayana and Silva, 2007).

However, this targeting problem is also relevant for the more common case of programmes that target population groups with certain characteristics that are considered to be associated to poverty (categorical targeting). Criteria such as geographical or socio-demographic characteristics can be defined based on poverty profiles drawn from national household surveys, whereas the programme identifies the typical features of the target population. It follows that if a programme defines its eligibility criteria based on a profile of the poor, and, in turn, if the profiles of the poor and of the food insecure present substantial differences because of a limited overlap at the household level, the programme will likely miss a part of the food insecure population.

Considering that the COVID-19 pandemic dramatically increased the number of people who suffer from poverty and food insecurity in the world, and that other threats such as climate change and the escalation of conflict in some regions continue to challenge the achievement of SDGs 1 and 2, understanding better the relationship between poverty and food insecurity and enhancing both the targeting and the design of anti-poverty and food security interventions is becoming increasingly pressing.

Traditionally, empirical studies analysed the relationship between income or poverty on one side, and calorie consumption or nutritional outcomes on the other side. Although finding a general correlation between the two phenomena, these studies suggested that the set of poor

¹ Examples of programmes that are targeted at household level solely based on poverty status are Brazil's Bolsa Familia and Lebanon's National Poverty Targeting Program, but various other examples of programmes where monetary poverty status is used either as the only eligibility condition or in combination with others (usually of demographic nature) can be found in Kidd and Athias (2019).

and food insecure households might not always match. For example, although early research documented the positive impact of income on food consumption (Abdulai and Aubert, 2004; Strauss and Thomas, 1995; Subramanian and Deaton, 1996), it has also been pointed out that increases in income do not necessarily lead to an increase in the intake of calories and other nutrients (Behrman and Deolalikar, 1987; Deaton and Drèze, 2009). At household level, more recent studies found a strong, yet far-from-perfect correlation between poverty and insufficient intake of calories in both urban and rural areas (Bocoum *et al.*, 2014; Mahadevan and Hoang, 2016). These findings resonate with studies that observed a limited overlap between poverty and malnutrition outcomes at household and individual level (Baulch and Masset, 2003; Brown, Ravallion and van de Walle, 2019).

Many indicators exist to measure poverty and food insecurity and, clearly, the characterization of the relationship between the two deprivations depends on the specific indicators that are taken into consideration. This paper focuses on poverty, measured in monetary terms, and food insecurity, measured through Experience Based Food Security Scales (EBFSS). The focus on these two specific approaches to measuring poverty and food security, respectively, is due to their prominent role for both monitoring global trends of poverty and food insecurity and for guiding national policies and programmes.

EBFSS measure the severity of households' food insecurity based on self-reported experiences regarding their food-related behaviours in the face of limited access to food. Although various EBFSS exist, the Food Insecurity Experience Scale (FIES) emerged as a consolidation of various national and regional EBFSS including the Escala Latinoamericana y Caribeña de Seguridad Alimentaria (ELCSA), with the objective of generating estimates of food insecurity that were comparable across countries and sub-national areas (Ballard, Kepple and Cafiero, 2013). The FIES measures food insecurity along a continuum scale and it is used to estimate two prevalence rates: "moderate or severe food insecurity" and "severe food insecurity". Moderate food insecurity is intended as not having regular access to nutritious, good quality and sufficient food, even if not necessarily suffering from hunger, while severe food insecurity is a condition that involves running out of food and, at worst, going without eating for one or more days (FAO *et al.*, 2020). As such, the latter relates more closely to the concept of hunger than the former. FIES has been adopted to measure SDG indicator 2.1.2, the prevalence of moderate or severe food insecurity.

On the other side, monetary poverty is used for monitoring the SDG targets 1.1 and 1.2, though the international poverty line (currently fixed at USD 1.90 purchasing power parity [PPP] per capita per day) and national poverty lines, respectively. Monetary poverty (defined using national poverty lines) remains the most common measure of poverty that countries use to track their poverty trends and orient their national poverty reduction policies.

The relevance of exploring the relationship between monetary poverty and EBFSS is even greater considering that, from 2014 to 2017, the last year for which the World Bank provides a global estimate of the prevalence of poverty, while food insecurity in the world was increasing, estimated global poverty was decreasing (World Bank, 2020). Given the apparent anomaly of these trends, FAO *et al.* (2019) highlighted the importance of understanding why poverty and food insecurity might diverge over time. However, given that the primary objective of this paper is providing insights for the design and targeting of poverty and food insecurity policies and programmes, instead of tackling the issue of diverging country-level trends, the analysis explores this relationship at the household level within countries.

As mentioned, the recent diffusion of FIES and other EBFSS has stimulated substantial research on the relationship between food insecurity and monetary poverty at the household or individual level. This literature, which is reviewed in detail in Section 2, represents an important contribution to understanding the relationship between EBFSS and poverty. Nevertheless, this research strand presents various limitations. First, most of the evidence comes from studies based on the data that FAO collects and uses to monitor FIES across most countries of the world (e.g. Grimaccia and Naccarato, 2019; Omidvar *et al.*, 2019; Park *et al.*, 2019).² Despite the large coverage of countries, the main limitation of these data (for the purpose of this paper) is that they do not provide the necessary information to compute a rigorous measure of poverty at the household or individual level. With this we mean, a measure of monetary poverty that is based on consumption expenditures or income and computed following the standards used by official national and international monitoring of monetary poverty. In fact, the data collected by FAO to monitor food insecurity trends collect household per capita income, but only through one question related to total income.

Other studies have sought to analyse the relationship between poverty and food insecurity at the household level using more rigorous measures of poverty (e.g. Maitra and Rao, 2015); yet, these have not been representative of the national populations in question (Sandoval, Carpio and Garcia, 2020). This represents a key limitation, given that national household surveys are the data sources generally used to compute both estimates of poverty and food insecurity³ at the national and global level.

In addition, while some studies have analysed the effect of living in a rural vs urban area on food security measured by EBFSS (e.g. Smith, Kassa and Winters, 2017), no study has systematically addressed how the relationship between poverty and food insecurity varies across urban and rural areas.

The purpose of this paper is to shed light on the relationship between food insecurity and poverty at the household level, focusing on EBFSS and monetary poverty measures. More specifically, the research aims to answer the following questions: What proportion of food insecure households are also poor households (and vice versa) across various countries? To what extent is the overlap between the poor and food insecure households different across rural and urban areas? Is there a correlation between monetary poverty and food insecurity at the household level after controlling for various factors? Which other factors mediate this relationship and thus could explain their discrepancy?

In our analysis, we utilize nationally representative household surveys that allow computing both an EBFSS and a measure of either consumption expenditures or income satisfying the standards used for official national and international monitoring of monetary poverty. We identified five surveys from sub-Saharan Africa and five from Latin America that meet these criteria.

First, we assess the extent to which households, based on the survey data, would be simultaneously classified as poor and as food insecure. This part of the analysis shows the

² The data that FAO collects to monitor food insecurity trends have the individual as unit of observation and as such are not strictly comparable with the national household surveys used in this analysis, which have the household as the unit of observation.

³ Even though most of the national estimates of food insecurity that FAO produces to monitor Target 2.1.2 of the SDGs are based on data collected through the Gallup World Poll, when available, FAO prioritizes estimates based on nationally representative household surveys fielded by National Statistical Offices. In fact, FAO actively promotes the integration of the FIES module into national household surveys.

extent to which the food insecurity measure and the monetary poverty overlap based on commonly used definitions of poverty and food insecurity. The second part of the analysis assesses the extent to which households' food insecurity status, established based on the EBFSS measure, remains associated to poverty after controlling for other relevant factors, including socio-demographic characteristics of households, urban-rural location, livelihood strategies, and households' exposure to different types of shocks.

It should be clear that the starting point of this analysis is not that monetary poverty and food insecurity should perfectly overlap. This is an unreasonable expectation, first and above all because, although related, they are two different concepts. Equally clear should be that this paper does not intend to unveil the general relationship between poverty and food insecurity in all their forms, but it focuses only the relationship between accepted definitions of monetary poverty and of experience-based food insecurity to the extent they can be captured by currently available household survey data. This is relevant since both measures are used to monitor the SDGs and are commonly used by governments to design, target, and monitor their policies. Finally, it is important to stress that the aim of the paper is not to establish how poverty or food insecurity should be measured, nor providing an assessment of how monetary poverty and EBFSS are able to measure appropriately their respective concepts.

We find clear evidence that monetary poverty is strongly correlated with food insecurity in all countries included in this research. At the same time, the overlap between households classified as poor and as food insecure can vary considerably between countries and, within countries, between rural and urban areas. We find that the extent to which poor and food insecure population groups coincide critically depends on the thresholds used to define poverty and FI. In particular, we observe a greater overlap when international poverty lines are used instead of national poverty lines, suggesting that the poverty lines defined by countries express heterogeneous levels of material deprivation that can adhere to the concept of food insecurity captured by EBFSS to different extents.

The paper also finds evidence that the relationship between poverty and food insecurity can be weaker or stronger depending on the population groups considered. In the majority of countries included in this analysis, the relationship is weaker for households engaged in agriculture and stronger for families that rely more on wage labour, suggesting that agricultural households are more resilient in terms of food security against shocks that affect their monetary resources.

Overall, the analysis suggests that policies and programmes should avoid, in general, using monetary poverty measures as a proxy for the household food insecurity status to design, target and monitor their interventions. It also suggests that development strategies such as interventions for enhancing smallholders' agricultural productivity which are often deployed to tackle both poverty and food insecurity, should further recognize the safety-net role that agriculture has for the food security of families engaged in it. This is, not only through income generation but also through consumption of own-produced food.

The rest of the paper is organized as follows: Section 2 provides a brief literature review of the evidence on the relationship between food insecurity measured by EBFSS and monetary poverty. Section 3 describes the data used in the paper, explains the adopted definitions of food insecurity and poverty, and identifies a set of factors that might affect their relationship. Section 4 presents the results and Section 5 concludes with a discussion of the main findings and policy implications, including for future research needs.

2 Review of the evidence on the relationship between experience-based food security scales and monetary poverty

This section reviews the most relevant studies analysing the relationship between food insecurity measured by EBFSS and monetary poverty. The studies are divided into those using the data that FAO collects through the Gallup World Poll (GWP) to monitor food insecurity trends and those using national survey data, which may be nationally representative or ad hoc surveys.

2.1 Studies using Gallup World Poll data

Several recent studies leveraged FAO's effort to monitor food insecurity in the world through the GWP. Since 2014, FAO used the GWP to administer the FIES module in more than 150 countries. These data have been made available to researchers, who used them to explore the factors associated to food insecurity in the world.

The main approach of these studies has been that of exploring the characteristics associated with food insecurity globally, in specific regions, or in specific population groups. Some of these studies included a poverty measure (either being in the bottom quintile of the income distribution or having a household per capita income below international poverty lines). Other studies only assessed the relationship between food insecurity and household income. All these studies have individual adults (15 or older) as units of analysis.

Studies based on the GWP found that poverty is strongly correlated with food insecurity except in rich countries (Grimaccia and Naccarato, 2019). Living in poverty increases the chances of being food insecure in various population sub-groups including men, women, people in different age groups, and people with different educational achievements (Grimaccia and Naccarato, 2020). In Latin America, individuals in the bottom income quintile are three times more likely to be food insecure than the average individual (Rezende Machado de Sousa *et al.*, 2019), while poverty is the strongest predictor of food insecurity among all factors considered in research focussing on the Near East and North Africa (Omidvar *et al.*, 2019).

Globally, a ten percent increase in household income is associated with about a 0.4 percentage point lower probability of experiencing severe food insecurity (Smith, Rabbitt and Coleman-Jensen, 2017). However, important heterogeneities exist across different regions and population sub-groups. For example, correlations of income per capita with food insecurity are weakest in East Asia and Pacific and strongest in South America (Pereira, Handa and Holmqvist, 2017), and the relationship is stronger in households with children (Pereira, Handa and Holmqvist, 2021).

In addition to household income or poverty status, the GWP data also revealed strong and significant correlations between individual food insecurity status and economic characteristics of the countries where they live in. In particular it was found that a higher GDP per capita and a lower level of income inequality are associated to individuals being less likely to be food insecure (Holleman and Conti, 2020).

The main advantage of the studies conducted using the GWP data is their large geographical coverage and the standardization of the data across countries. However, their main limitation, for the purposes of our research, lies in the measure of household income included in the data (and the related poverty measures that can be derived from it). Household income is captured through a single question related to annual or monthly total household income, and relies on

imputation when respondents are unable to answer the question with precision. As such, it may present serious measurement errors, especially for rural populations of developing countries whose income often depend on multiple, seasonal, and informal economic activities and whose welfare often depends on the value of self-produced goods.

In addition, the GWP is a global survey, not specifically focused on rural populations and their livelihoods. While the GWP allows to analyse the relationship between food security and place of residence (rural vs urban areas), it does not allow to study the relationship between food security, poverty, and key characteristics of rural populations such as their engagement in agricultural activities.

2.2 Studies using nationally representative or ad-hoc household surveys

In the last ten years, some national statistical offices have been including EBFSS into multi-purpose national household surveys, especially in Latin America. Yet, very few studies have further analysed the information from these surveys to investigate the household-level relationship between EBFSS and monetary poverty measures. At the same time, some studies analysed this relationship based on ad-hoc surveys, in most cases among specific sub-national populations. This was mainly done for testing adaptations of established EBFSS.

Consistently with the analyses based on GWP data, most of these studies find a strong association between monetary poverty and food insecurity. In Mexico, poverty was found to be the strongest predictor of food insecurity among many other factors, even though poverty was more strongly associated with calorie deficiency than EBFSS-based food insecurity (Sandoval, Carpio and Garcia, 2020). Similarly, among urban slum dwellers in Kolkata (India) poverty was found to be the strongest predictor of food insecurity: being poor increased the probability of households to be food insecure by more than 700 percent (Maitra and Rao, 2015). A strong association was also found between the food insecurity status of Mexican households and the poverty level of the municipalities where they live (Vilar-Compte *et al.*, 2020).

However, studies also reveal that there is not a perfect match between poverty and food insecurity at the household level, both in developing and developed countries. For example, Maitra and Rao (2015) found that, in the slums of Kolkata, 47 percent of food insecure households are non-poor, while eight percent of non-poor households are food insecure. Instead, in research from the United States of America, the majority of poor people appeared not food insecure, while a small but not negligible share of the population appeared not poor yet food insecure, especially among the elderly (Bhattacharya, Currie and Haider, 2004). Amankwah and Gurlay (2021), the only multi-country study based on national household surveys that we are aware of, found that the prevalence of food insecurity during the COVID-19 pandemic was inversely related to households' pre-pandemic consumption quintiles in Burkina Faso, Ethiopia, Malawi and Uganda, but not in Nigeria. At the same time, even in these four countries where the relationship between food insecurity and consumption behaved as expected, the prevalence of food insecurity among households in top consumption quintiles was still substantial.

3 Methodological approach

3.1 Data

Our analysis is based on nationally representative household surveys. To be considered in the paper, survey datasets needed to contain the necessary information to compute both a monetary poverty measure and a food insecurity indicator, the latter based on an EBFSS.

A screening of surveys was performed using the World Bank Microdata Library and the International Household Survey Network (IHSN) repository. The scope of the search was limited to surveys from developing countries, conducted from 2010 to 2020, for which microdata was available online. We screened various surveys from 54 countries based on the requirements mentioned above. If more than a survey with the desired characteristics was available for the same country, we considered the most recent survey.

The final set of surveys selected for this paper comprises ten surveys from ten countries, five in sub-Saharan Africa (Ghana, Malawi, Niger, Nigeria and the United Republic of Tanzania) and five in Latin America (the Plurinational State of Bolivia, Chile, El Salvador, Guatemala and Mexico). All surveys are representative of rural and urban areas within countries. Table 1 provides the details of the final set of surveys.⁴

Table 1. National household surveys used in the analysis

Country	Year	Survey	Experience based food security scale	Welfare measure	No. of households
Sub-Saharan Africa					
Ghana	2016/17	Ghana Living Standard Survey (GLSS)	FIES (12 months, household level)	Consumption expenditures	13 893
Malawi	2016/17	Integrated Household Panel Survey (IHPS)	FIES (12 months, household level)	Consumption expenditures	12 446
Niger	2014/15	<i>Enquête Nationale sur les Conditions de Vie des Ménages et Agriculture</i> (ECVM/A)	FIES (12 months, individual level)	Consumption expenditures	3 616
Nigeria	2018/19	Nigeria Living Standards Survey (NLSS)	FIES (30 days, household)	Consumption expenditures	22 110
United Republic of Tanzania	2017/18	Household Budget Survey (HBS)	FIES (12 months, household level)	Consumption expenditures	9 461
Latin America					
Bolivia (Plurinational State of)	2019	<i>Encuesta de Hogares</i> (EH)	ELCSA (three months, household level)	Income	11 869
Chile	2017	<i>Encuesta de Caracterización Socioeconómica Nacional</i> (CASEN)	FIES (12 months, household level)	Income	70 243

⁴ The samples of the final set of surveys were restricted to include only households for which it was possible to define the monetary poverty and the FI indicators described below. However, this procedure led to dropping negligible shares of the survey observations.

Country	Year	Survey	Experience based food security scale	Welfare measure	No. of households
El Salvador	2019	<i>Encuesta de Hogares de Propósitos Múltiples (EHMP)</i>	ELCSA (three months, household level)	Income	21 331
Guatemala	2014	<i>Encuesta de Condiciones de Vida (ENCOVI)</i>	ELCSA (three months, household level)	Income	11 433
Mexico	2018	<i>Encuesta Nacional de Ingresos y Gastos de los Hogares (ENIGH)</i>	ELCSA (three months, household level)	Income	74 647

Source: Authors' elaboration.

3.2 Definitions of food insecurity and poverty

Food insecurity

In this paper, households' food insecurity status is measured through experience-based food security scales. These scales measure food insecurity at the household level based on respondents' yes/no answers to a set of short questions regarding their ability to access to food. Using the Rasch model, "yes/no" responses are combined to estimate the severity of food insecurity faced by each individual or household. This measure can be conceptualized as the "condition of not being able to freely access the food one needs to conduct a healthy, active and dignified life" (Cafiero, Viviani and Nord, 2018, p.147).

Two EBFSS were used to represent households' food insecurity status: FIES and ELCSA. FIES was the measure included in the surveys of all African countries as well as in Chile. ELCSA instead was the EBFSS adopted by all the surveys of the other Latin American countries. FIES is based on eight questions asking the respondent whether somebody in his/her household experienced certain food insecurity deprivations during a given reference period (usually one, three, or twelve months). ELCSA instead includes eight questions referred to food insecurity of adult household members and further seven questions referred to food insecurity of children. The questions included in FIES and ELCSA are shown in Annexes A and B, respectively. It is important to highlight that the questions of both scales directly ask households about food insecurity deprivations that are due to lack of money and resources, thus making the concept of food insecurity measured by these scales conceptually related to that of poverty.

In this paper, household food insecurity status was derived using a specific online tool developed by FAO⁵ and following its associated technical guide (FAO, 2020). The procedure can be summarized in the following steps, which were undertaken for each survey.

First, a raw score was computed for each household. This was the sum of a household's affirmative answers to the questions of FIES or ELCSA. In the case of ELCSA, only the eight

⁵ The tool is freely available online at <https://fies.shinyapps.io/ExtendedApp>

questions referring to adults were considered to allow calibrating ELCSA against the global standard reference of FIES.⁶

Second, the relevant data needed to estimate the probability of being food insecurity of each observation was uploaded to the online tool. The data included the “yes/no” answer to each FIES question, the survey weights of each observation, a dummy indicating the place of residence (rural or urban) and a categorical variable indicating the region of residence.

Third, the data were validated (i.e. their usability was assessed) by: a) ensuring that the number of observations with complete and non-extreme responses was large enough (above 1 000 observations) to obtain reliable and accurate estimates; b) checking that infit statistics⁷ of each FIES item was below 1.3; c) ensuring that, in the residual correlation matrix, no more than one pair of items had a correlation above 0.4 (in absolute terms); and d) checking that the Rasch reliability parameter was above 0.7. These checks were satisfactory for all surveys and did not result in the need of omitting any of the items from the analysis.

Fourth, to correctly implement the equating procedure that calibrates specific surveys’ food insecurity scales against the FIES global standard scale (to ensure comparability of food insecurity measures across countries), we excluded from the equating procedure the items whose severity was particularly discrepant compared to the global standard scale. To assess this discrepancy, we used a 0.5 difference threshold. In all surveys, no more than two items were excluded from the equating procedure.

Fifth, the probability of being moderately or severely food insecure and the probability of being severely food insecure estimated through the online tool based on the methodology outlined in Cafiero, Viviani and Nord (2018) were assigned to each observation of our datasets based on its raw score.

Finally, in order to obtain dichotomous household-level variables, the probability of being moderately or severely food insecure and the probability of being severely food insecure were dichotomized as one if greater than 0.5, and zero otherwise, following Holleman and Conti (2020).⁸

Poverty

In this paper, poverty is defined in monetary terms and using absolute poverty lines. A household is considered poor if the level of consumption or income of its members is below a certain threshold, the poverty line. Consumption expenditures (either per capita or per adult equivalent, and always spatially and temporally deflated) were used as the welfare⁹ variable

⁶ This calibration process brought about by the FIES methodology ensures the comparability of food insecurity estimates across countries through the definition of a globally comparable and consistent threshold (Cafiero, Viviani and Nord, 2018).

⁷ Infit: inlier-sensitive or information-weighted fit.

⁸ This approach based on thresholds was used to define binary food insecurity status variables at the household level. However, it should be noted that calculating the prevalence of food insecurity in a given population based on the so-defined binary variables might yield slightly different prevalence rates than those obtained using the official FIES/ELCSA methodology, whereas prevalence rates are calculated as the average of households’ probabilities to be moderately and severely food insecure in a given population. Nevertheless, for each country, a check was conducted to assess if the prevalence rates obtained assigning households to a food insecurity status yielded reasonable approximations of the prevalence rates obtained using the official FIES methodology. For all countries, differences in prevalence rates obtained with the two methods were minimal.

⁹ Throughout the paper, for simplicity, we refer to consumption and income with the term “welfare”, borrowing from the tradition in the poverty measurement literature. See for example Ravallion (1996).

for the African countries, while income per capita (also spatially and temporally deflated) was used as the welfare variable for the Latin American countries. The choice of whether to use consumption expenditures or income followed each country's practice for official poverty measurement (and consequently the availability of one or the other indicator in their national household surveys). In fact, poverty is traditionally measured using consumption in Africa and income in Latin America. A consumption-based measure is generally considered a more suitable welfare indicator for less economically developed countries, so the fact that poverty measures in Africa are mostly based on consumption reflects this.

The consumption or income aggregates used to compute poverty measures were taken as provided in the datasets, thus reflecting each country's official methodology for poverty measurement.

The main analysis relies on poverty defined using national and international poverty lines. National poverty lines can be divided into food (or extreme) poverty lines, which normally represent the value of a food basket that is considered the minimum necessary to satisfy calorie intake needs, and (total) poverty lines that, in addition to the food poverty line include the value of a basket of non-food items that are considered essential. The main analysis of the paper focuses on (total) poverty lines, while robustness checks and complementary analyses were carried out using food/extreme poverty lines.¹⁰

For what concerns international poverty lines, the conventional lines of USD 1.90 PPP, USD 3.20 PPP, and USD 5.50 PPP were used assigning to each country the international poverty line that reflected its economic development status at the time of the survey. In other words, low-income countries were assigned the USD 1.90 PPP, lower-middle-income countries were assigned the USD 3.20 PPP, and upper-middle- and high-income countries were assigned the USD 5.50 PPP.

Both national and international poverty lines were considered of interest for the analysis. On one hand, national poverty lines are more adequate to analyse poverty within a country. They better capture the concept of poverty relevant for each country (i.e. what in a country is considered an acceptable standard of living) and thus are more relevant for analyses that concern the targeting and design of national policies. On the other hand, international poverty lines are better suited for comparing poverty among countries, as they hold the value of poverty lines constant across countries using purchasing power parity exchange rates. As such, international poverty lines are more useful to draw generalizations on how monetary poverty and food insecurity measures based on internationally comparable EBFSS (like FIES and ELCSA) relate across countries.

3.3 Factors that can drive the discrepancy between food insecurity and poverty at the household level

In the remainder of this section, we briefly discuss some of the reasons why measures of monetary poverty and of food insecurity (measured by EBFSS) might not go together at the household level, always keeping in mind that a perfect overlap is, in any case, an unreasonable expectation since they are two related, yet distinct phenomena. Then we focus on some key variables that we believe could influence this relationship. Once again, it is important to stress

¹⁰ For Niger, a food poverty line was not available in the survey microdata. Hence, it was derived by multiplying the national poverty line by the share of food expenditures in the total expenditures of a reference group whose consumption was in the interval between one percentile below and one percentile above the national poverty line.

that we are not aiming to discuss the relationship between poverty and food insecurity in general, but the relationship of these two deprivations as measured by these two specific metrics.

Assumptions on why poverty and food insecurity should go together

The measures of food insecurity and poverty used in this paper are conceptually related. On one hand, all FIES/ELCSA questions specify that food insecurity experiences relate to a “*lack of money or other resources*”. Hence, by assumption, food insecure households have reported having faced, at least at some point in time during the period referred to, a situation in which they were lacking resources to afford food, a condition clearly relating, at least in part, to the concept of monetary poverty.

On the other hand, poverty lines are built on the monetary value that is deemed sufficient to meet basic needs, including a minimum energy intake. Hence, one would expect those that have a level of consumption or income above the poverty line (the non-poor) to be food secure, at least in terms of calorie consumption. Similarly, one would expect those below the extreme poverty line to be food insecure since they should not be able to afford a basket of food to achieve an adequate caloric intake.¹¹

Assumptions on why poverty and food insecurity might not go together

Despite these theoretical linkages, there are many reasons why monetary poverty and food insecurity status (assessed through EBFSS) might not jointly apply at the household level. Many of these reasons clearly relate to the specific ways in which the monetary and the EBFSS approaches measure poverty and food insecurity, respectively.

The first reason relates to the different levels of material deprivation that different poverty lines can express. The concept of food insecurity that underpins EBFSS is much broader than simple calorie intake and includes aspects such as uncertainty, food quality, food variety, and regularity of meals. This means that even if households manage to consume an adequate quantity of calories on average, they might still be food insecure due to compromising on other aspects of their diets. For example, it is estimated that the cost of healthy diets (that is, diets that respect a set of dietary recommendations intended to provide nutrient adequacy and long-term health) is between USD 3.27 and USD 4.57 PPP per person a day globally, well above the international extreme poverty line of USD 1.90 a day and even above the international poverty line of USD 3.20 a day (Herforth *et al.*, 2020). In other words, it should not be surprising that the correspondence between food insecurity measured through EBFSS and monetary poverty is less stringent than the correspondence between calorie intake and poverty, simply because the concept of food insecurity captured by EBFSS entails a much larger spectrum of deprivations than simply not accessing enough calories. Given these considerations, the correspondence between monetary poverty and food insecurity will critically depend on the poverty lines of choice, as they express a level of material deprivation that can, to some extent, reflect what is implied by food insecurity.

Second, both measures are calculated over a relatively long period, which can mask their potential transitory nature. Monetary poverty is based on average consumption or income over a period, usually 6 months or one year. FIES and ELCSA are calculated based on the

¹¹ The situation is more ambiguous for those between the food poverty line and the (total) poverty line. Given that their level of consumption should allow to afford a minimum energy intake, they might be expected to be food secure (at least in terms of calorie intake). However, as no household can devote its entire budget to food, it is well plausible that these households are not able to afford the minimum food basket associated with the food poverty line and thus are food insecure.

experiences that households lived in the past twelve, three, or one months.¹² The implication is that a household might have, on average, a level of consumption above the poverty line but, if its income and consumption are volatile, or if any food-related shock occurs, it is plausible that the household face episodes of food insecurity during the reference period of the EBFSS. For example, income variability due to employment seasonality can be a significant factor affecting food access, limiting a household's ability to smooth food consumption over time. Similarly, food security is dependent on food availability, which may not be stable, independently from a household's level of welfare. For example, food availability may be affected by covariate shocks, including weather-related shocks, natural disasters, and conflicts, making food suddenly unavailable or temporary more expensive, and thus negatively affecting access to food even for non-poor households with enough resources to buy food in normal times. Also, a household may have, on average, a level of consumption below the poverty line but, if factors are in place that stabilize food access in the right moment (such as the ability to produce its own food), it might still avoid episodes of food insecurity.

More in general, food insecurity does not depend only on consumption or income (and consequently poverty status), but it is obviously influenced by other factors, including characteristics of the households and the environment where they live. Indeed various studies have shown that household food insecurity is significantly affected by socio-demographic factors such as the age, marital status, education level of the household head, the size of households, and whether households reside in rural or urban areas, even after controlling for household monetary resources (even if the direction association with food insecurity is not always the same across countries). Even more, it is plausible that the same relationship between monetary poverty and food insecurity at the household level is mediated by these characteristics as discussed in the reminder of this section.

Third, it is important to acknowledge that part of the reason why we might observe a discrepancy in poverty and food insecurity status at the household level is related to measurement errors in household surveys. Clearly some households might appear food insecure but not poor or poor but not food insecure simply due to measurement errors in one or the other variable.¹³

In light of these considerations, observing households that are food insecure but not poor and households that are poor but food secure is clearly plausible. These "policy-concerning" groups are important for their implications on the targeting and design of poverty reduction and food security policies. The group of non-poor but food insecure people is particularly concerning because targeting the poor might result in overlooking food insecure population groups. For this reason, it is important to investigate not only the extent to which poverty and food insecurity overlap at household level, but also the factors associated with potential discrepancies.

¹² In this analysis, we ignore potential issues related to the different reference periods of poverty and EBFSS measures across surveys (including that, for countries whose surveys were carried out through multiple visits, poverty and food insecurity modules might have been collected in different moments). We do not believe that this affects the overall results of the analysis, but we acknowledge that it might have some effect on the intensity of the poverty-food insecurity relationship found across countries.

¹³ However, we believe that these measurement errors are likely random, meaning that they do not present systematic patterns for which, for example, food insecure household are more likely than food secure households to be classified as poor even if they are not, or vice versa. If so, estimates of the shares of the population falling into poverty-food insecurity groups, as well as econometric analyses of the relationship of the two phenomena at the household level, should be less precise (i.e. have larger standard errors) but unbiased.

In this paper we focus on the first two problems.¹⁴ The issue related to poverty lines is addressed in a descriptive analysis showing how the shares of the population that fall in different poverty-food insecurity groups change using different poverty lines. Then, the issue of household-level factors that can affect food insecurity *beyond* poverty, and that can mediate the relationship between the two is addressed through econometric analyses that: a) test the relationship of poverty and food insecurity controlling for a set of relevant factors; and b) test if the strength of the relationship is mediated by a subset of these factors. These factors are described more in detail in the reminder of this section.

Variables that can affect the relationship between poverty and food insecurity

To test the relationship of poverty and food insecurity accounting for the fact that other factors might affect food insecurity beyond poverty, we include several control variables in our models that assess the association between poverty and food insecurity. These variables can be divided in socio-demographic, location-related, livelihoods-related, shock-related and preference-related variables.

Socio-demographic variables include the sex, age, education, and marital status of the head, the size of the household, its dependency ratio, and, for some Latin American countries, if the head declares belonging to an indigenous population group. Location-related variables include rural vs urban residence and the subnational region of residence. Livelihoods-related variables include dummy variables indicating if the household engages in crop production and livestock production, if the head's main occupation is a wage job, and if the household receives any remittances (differentiated by domestic and international) or any public assistance. Shock-related variables include dummies indicating whether, in the period covered by the survey, households suffered shocks that limited their capacity to produce, purchase, or consume food through various channels (disruption to agricultural production, livelihoods, high food prices, changes in household composition, and episodes of violence). Finally, the share of food consumption in total consumption (food budget) is used to reflect households' preferences for food security. Annex C includes a table with the definition of these variables.

In a second step, we test whether some of these variables mediate the relationship between consumption/income (and thus poverty) and food insecurity. In particular, we focus on how producing crops, producing livestock, engaging in wage labour, or suffering from different types of shocks can affect the relationship. Finally, to draw a more complete picture, we also test whether these livelihood and shock variables have a different association with food insecurity depending on households' level of welfare. Tables 2 and 3 summarize our hypotheses in this regard.

¹⁴ The issue of measurement errors is not explicitly assessed by this analysis and, as such, could be explored by future extensions of this work.

Table 2. Variables that affect the relationship between welfare and food insecurity

Variable	Expectation	Main explanation
Household engaged in crop/livestock production	Weaken the relationship between welfare and food insecurity	Households engaged in crop or livestock production might have easier access to food even when their level of welfare is low. Thus, their food insecurity is expected to be less dependent on their level of welfare.
Household head's main occupation is a wage job	Makes the relationship between welfare and food insecurity stronger	Households whose head's main occupation is a wage job, are expected to be more reliant on monetary resources to achieve food security. Thus, their food insecurity is expected to be more dependent on their level of welfare.
The household suffered shocks in the previous year	Weakens the relationship between welfare and food insecurity	Shocks can reduce households' food insecurity independently from their welfare. That is, even households whose income or consumption is above the poverty line, on average, can suffer episodes of food insecurity if hit by a shock. Thus, their food insecurity is expected to be less dependent on their level of welfare.

Notes: All variables are binary. The general term "shocks" is used to represent five different variables expressing if household suffered shocks related to food production, livelihoods, food prices, demographic shocks or violence.

Source: Authors' elaboration.

Table 3. Variables whose association with food insecurity is mediated by welfare

Variable	Expectation	Main explanation
Household engaged in crop/livestock production	Engaging in crop production is associated with lower levels of food insecurity for poorer households, while it is associated with lower reduction or even increases in food insecurity for richer households.	Producing crops can be considered as a safety net for the food security of poorer households. For richer households who can access better livelihood strategies, producing crops is associated only to marginal gains in food security or even to losses in food security. These losses could be due to the higher risks implied by agriculture compared to non-farm businesses or higher-quality salaried jobs.
Household head's main occupation is a wage job	Engaging in wage jobs is associated with lower food insecurity. However, among the poorer segments of the population it might be associated to lower decreases or even to increases in food insecurity.	Wage labour can reduce food insecurity through higher and more reliable streams of income. However, this depends on the quality of wage jobs. We expect better off households to engage in higher-quality wage jobs and thus presenting lower levels of food insecurity. However, we expect poorer households to engage in lower-quality and more casual wage occupations, thus gaining less in terms of food insecurity or even presenting higher food insecurity.
The household suffered shocks in the previous year	Suffering shocks is associated to higher food insecurity along the entire welfare distribution. However, increases in food insecurity are more pronounced for relatively better off households.	We expect shocks to be associated to stronger reductions in food insecurity among better off households since these are the households that have "more to lose" from shocks. In other words, poorer households might already present higher levels of food insecurity, thus presenting lower drops in food security when shocks occur.

Notes: all variables are dummies. The general term "shocks" is used to represent five different variables expressing if household suffered shocks related to food production, to livelihoods, food prices, demographic shocks or violence.

Source: Authors' elaboration.

4 Results

4.1 Overlap of food insecurity and poverty across countries

The first question that we address is the extent to which households in the various countries are simultaneously poor and food insecure. Before directly addressing the question and to provide more context related to each country, Table 4 shows the prevalence of moderate or severe and severe food insecurity and the prevalence of poverty and extreme poverty (with national and international poverty lines).

Table 4. Prevalence of poverty and food insecurity in each country (%)

Country	Extreme poverty (NPL)	Poverty (NPL)	Poverty (IPL USD 1.90 PPP)	Poverty (IPL USD 3.20 PPP)	Poverty (IPL USD 5.50 PPP)	Severe food insecurity (EBFSS)	Moderate or severe food insecurity (EBFSS)
Sub-Saharan Africa							
Ghana 2017	8.2	23.5	7.2	18.5	40.2	6.3	37.2
Malawi 2017	20.1	51.5	72.0	91.0	97.5	51.7	82.4
Niger 2014	20.5	42.4	36.5	71.0	92.2	7.2	42.0
Nigeria 2019	14.0	40.5	39.5	87.0	97.3	7.4	57.1
United Republic of Tanzania 2018	5.6	20.0	26.0	58.4	82.7	20.6	54.8
Latin America							
Bolivia (Plurinational State of) 2019	12.8	36.9	5.7	11.4	26.6	1.9	10.3
Chile 2017	2.3	8.6	0.3	0.7	3.8	3.6	12.9
El Salvador 2019	5.5	26.8	2.9	10.8	30.9	2.5	18.5
Guatemala 2014	23.2	59.2	18.4	36.0	59.7	7.5	41.7
Mexico 2018	16.8	48.8	4.7	12.5	31.7	5.0	24.2

Notes: Numbers in bold indicate the poverty rate yielded by the international poverty line that is more adequate to a country given its level of development in the year of the survey. NPL = national poverty line; IPL = international poverty line; EBFSS = experience-based food security scale.

Source: Authors' elaboration.

From the table, it is immediately clear that the prevalence of monetary poverty, both with national and international lines, overlaps with the prevalence of food insecurity. However, it can also be seen that, in certain cases, the prevalence rates of poverty and food insecurity can present important differences.

Table 4 also shows that, while in some countries the prevalence of poverty yielded by national poverty lines resembles more closely the prevalence of moderate or severe food insecurity (e.g. Ghana, Niger and Chile), in others, the prevalence of moderate or severe food insecurity is more aligned to the prevalence of poverty with international lines (e.g. Malawi, the United Republic of Tanzania, the Plurinational State of Bolivia, El Salvador and Mexico). This means

that, across countries, the extent to which poverty and food security overlap will necessarily depend on which poverty line is used. This is a direct consequence of different poverty lines expressing different levels of material deprivations, as indicated from the substantial, in some cases considerable, differences in the prevalence of poverty yielded by national and international lines.

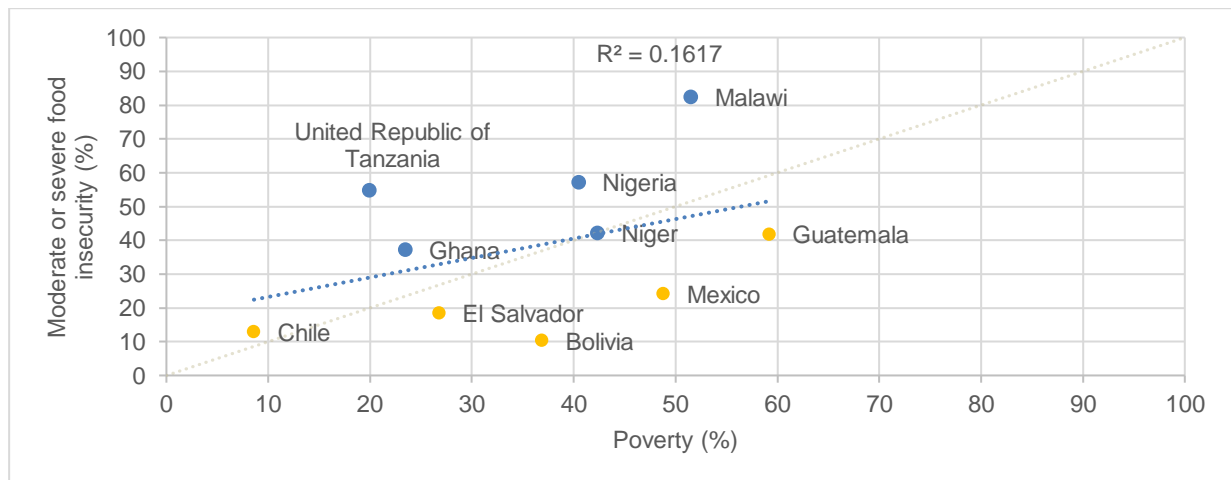
However, it can also be observed that, in general, there is a stronger relationship between the prevalence of poverty and food insecurity using international poverty lines instead of national poverty lines. This is more evident by looking at Figure 1. Figure 1a shows a weak linear relationship between the prevalence of moderate or severe food insecurity and poverty using national poverty lines, summarized by an R^2 value of 0.16. Instead, Figure 1b reveals that the linear relationship using the international poverty line that is more relevant for each country given its development status¹⁵ is strong ($R^2=0.77$), while Figure 1c, where the same international poverty line of USD 3.20 PPP is applied to each country, reveals an even stronger linear relationship ($R^2=0.82$).

Importantly, the fact that the association between the prevalence of food insecurity and the prevalence of poverty across countries is much stronger using international than national lines indicate that international poverty lines are more aligned with a definition of poverty that reflects food insecurity as measured by EBFSS. This finding can be explained by considering that both the measures of poverty based on international poverty lines and measures of food insecurity based on the EBFSS considered in this paper are explicitly conceived to be comparable across countries, while national poverty lines can capture different levels of material deprivations based on different national conceptions of poverty and political priorities.

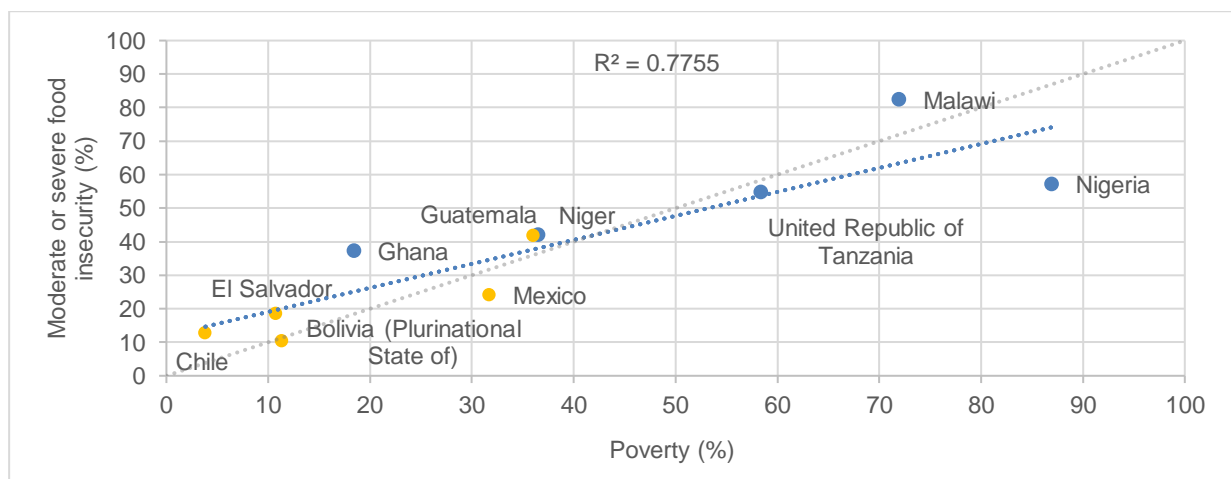
¹⁵ Each country is assigned the international poverty line that best reflects its level of economic development in the year of the survey, according to the World's Bank classification of economies by income. Malawi and Niger are assigned the USD 1.90 PPP line; Mexico and Chile are assigned the USD 5.50 PPP line; all the other countries are assigned the USD 3.20 PPP line.

Figure 1. Linear relationship between prevalence of moderate or severe food insecurity and poverty

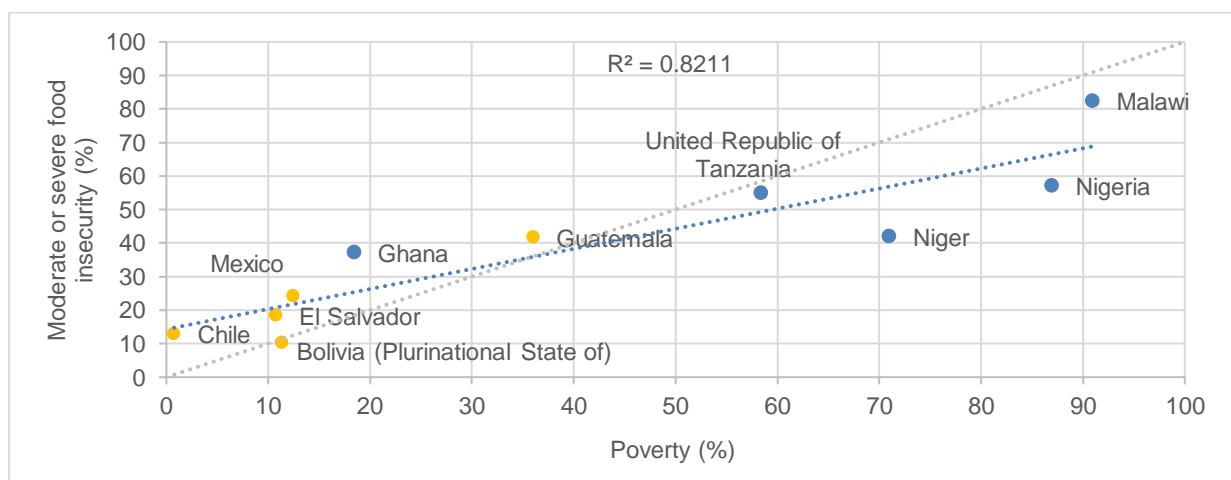
a. National poverty lines



b. International poverty lines



c. International poverty line USD 3.20 a day PPP



Note: In panel b, each country is assigned the international poverty line that best reflects its level of development in the year of the survey.

Source: Authors' elaboration.

Given these observations regarding the prevalence of moderate poverty and moderate or severe food insecurity within countries, to what extent poor and food insecure households overlap? One way to observe the overlap between poverty and food insecurity in a synthetic way is looking at the share of the population in “matched” versus “mismatched” poverty-food insecurity groups. Using national poverty lines (Figure 2a), the share of the population that belongs to “mismatched” groups (i.e. those that are poor but food secure and, more concerning, those that are food insecure but not poor) ranges from about 16 percent in Chile to almost 50 percent in Nigeria. On average, 41 percent of the population in the African countries in the paper falls into groups that are either poor or food insecure, but not both, while this share is just above 30 percent in the Latin American countries of this analysis.

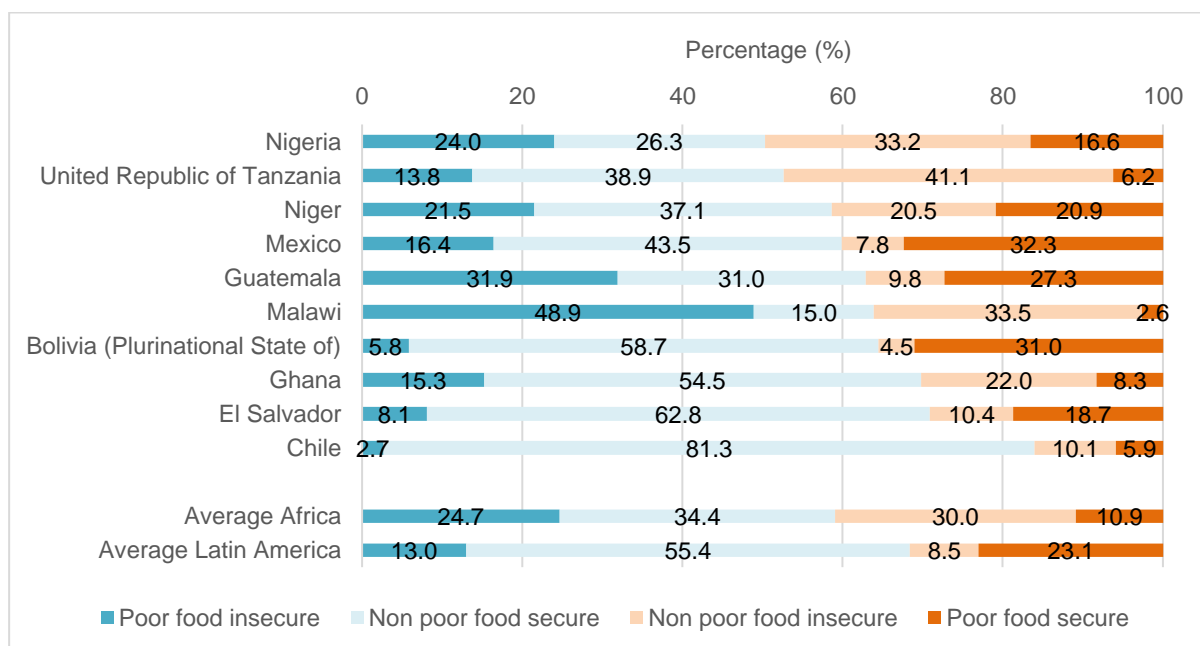
Consistent with what observed previously, using international poverty lines (Figure 2b) leads to a greater overlap, with “mismatched” groups ranging from about 14 percent in Chile to about 41 percent in Nigeria. As in the case of national lines, African countries tend to show a greater mismatch than Latin American countries, with an average share of the population in “mismatched” groups of 34.6 and 25 percent, respectively.

A fact that it is worth noting is that, using national poverty lines (Figure 2a), the composition of the “mismatched” groups appears structurally different across the two continents. While in the African countries the great majority of this population is food insecure despite not being poor (a third of the total population), in the Latin American countries, most of the “mismatch” households are poor although not food insecure (almost a quarter of the total population). This pattern holds also comparing severe food insecurity and extreme poverty (Figure A1), even though the share of the population falling into the “mismatch groups” is much smaller overall (27.6 percent in Africa and 9.3 percent in Latin America).

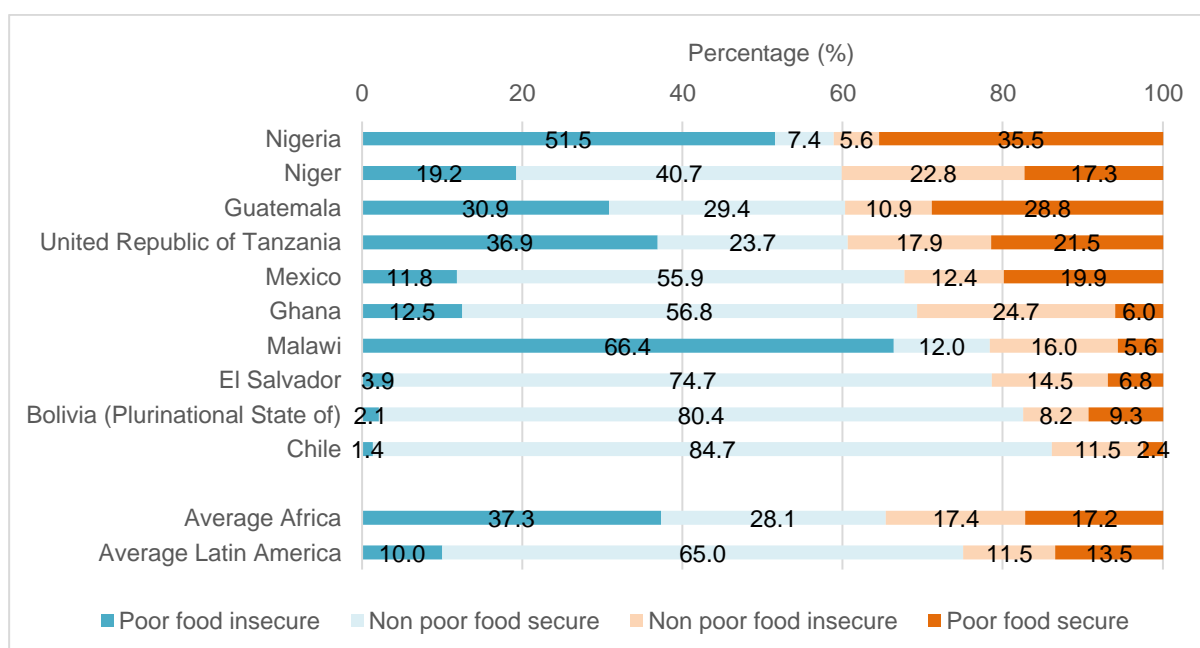
The reason behind this apparent diversity in the composition of the “mismatch” groups is not straightforward. The answer is certainly related to the poverty measure that is adopted. In fact, this pattern almost vanishes when using international poverty lines (Figure 2b).

Figure 2. Share of the population in different poverty-food insecurity groupings

a. National poverty lines



b. International poverty lines



Notes: Regional averages are calculated as simple averages of country-level shares. In panel b, each country is assigned the international poverty line that best reflects its level of development in the year of the survey.

Source: Authors' elaboration.

A targeting scenario using national poverty lines

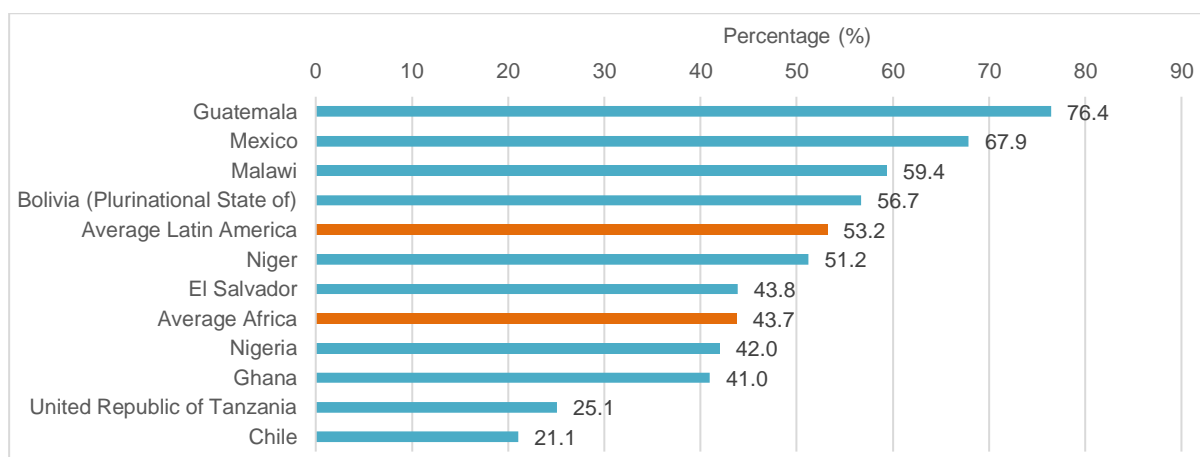
As mentioned in the introduction, assessing the extent to which poor and food insecure households coincide is relevant for the targeting of public policies. Social assistance or agricultural development programmes that have among their objectives reducing food insecurity are sometimes targeted towards households that are considered poor based on

national poverty lines or lines that are derived from them. It follows that, if eligibility is conditional on being classified as poor, programmes will miss the food insecure families that are not identified as poor.

Figure 3 reveals a generally not negligible mismatch between food insecurity and poverty, ranging from Chile, where only 21 percent of food insecure households are poor, to Guatemala, where 75 percent of food insecure households are also poor. This discrepancy indicates that, if public policies of the countries included in this analysis tried to reach the food insecure by targeting households based on their monetary poverty status (for example, as provided by several social registries), large shares of the food insecure population could be left out of public interventions. If a public policy of Chile hypothetically extended a programme to all and only the households that are considered poor based on the national poverty line, it would reach only 21 percent of the country's food insecure households.

On average, the overlap is greater in Latin American countries of our sample (53 percent) than in the African countries available (44 percent). This is partly because, using national poverty lines, there are many more poor households than food insecure households in those Latin American countries studied, whereas in Africa this is the opposite.

Figure 3. Share of moderate or severe food insecure households who are poor (national poverty lines)



Note: Regional averages are calculated as simple averages of country-level shares.

Source: Authors' elaboration.

When looking at the proportion of the severely food insecure households that are also extremely poor, the mismatch is much larger for the countries considered (Figure A2). In fact, if public policies of both the African and Latin American countries included in this paper were to target a hypothetical social assistance programme at the extremely poor households only, this programme would reach only about 25 percent of the severely food insecure households, on average.

Although these figures refer to a simplistic scenario where programmes are targeted to households only based on their monetary poverty status, they are also illustrative of what could happen in the case of programmes targeted using socio-demographic or geographic characteristics that are considered to be associated to poverty (categorical targeting). In fact, if a programme defines its eligibility criteria based on a profile of the monetarily poor, and, in turn, the profiles of the monetarily poor and of the food insecure present substantial differences

because of a limited overlap at the household level, the programme will likely miss a part of the food insecure population.

What determines if the overlap at the household level is high or low in a given country? Not surprisingly, the proportion of the food insecure households who are also poor is strongly correlated to the prevalence of poverty in the country (Figure A3). That is, the higher the level of poverty in the country, the higher the proportion of food insecure households that are also poor. This finding corroborates the already-made observation that the overlap between food insecurity and poverty at the household level will necessarily depend on the poverty line that is adopted.

4.2 Food insecurity and poverty in rural and urban areas

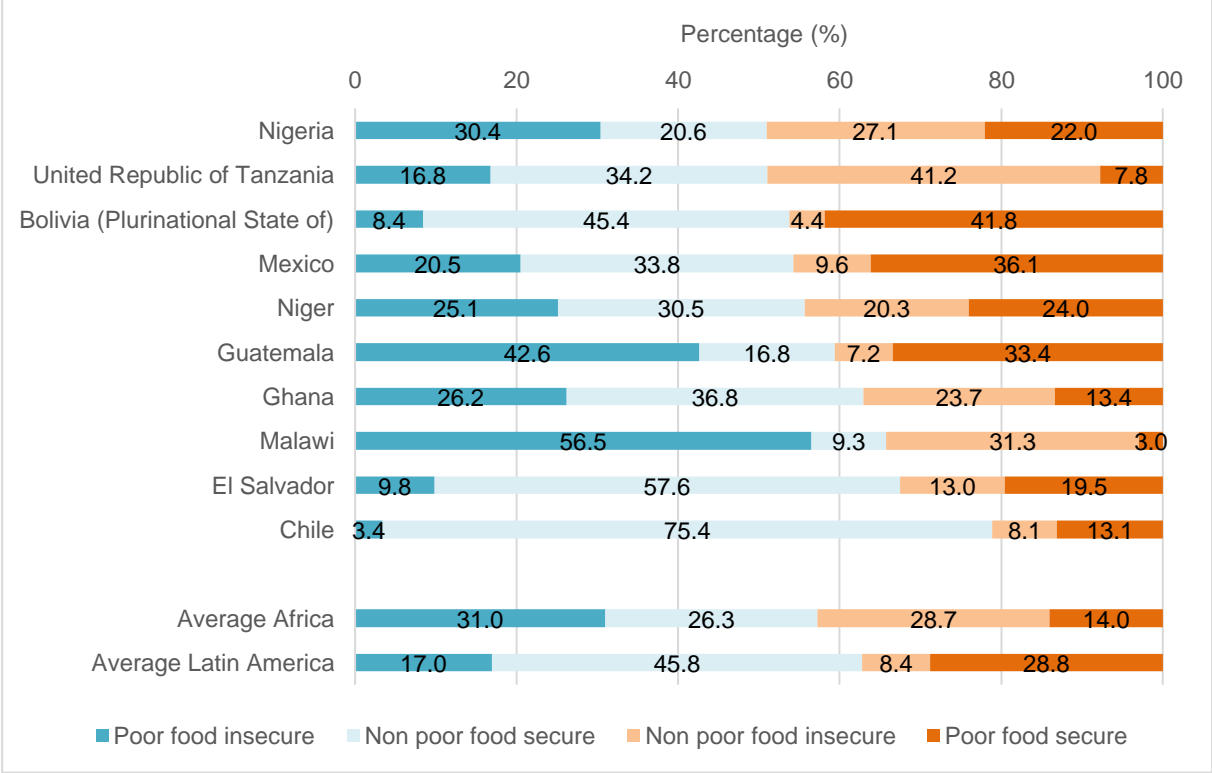
So far, the extent of the overlap between household poverty and food insecurity within countries was analysed. Now whether the two measures overlap differently in rural and urban areas is explored. For brevity the focus will be only on national poverty lines, noting that the observed rural-urban patterns hold also using international poverty lines.

The overall overlap between poverty and food insecurity, measured as the share of the population that falls into “matched” poverty-food insecurity groups, appears larger in urban areas (

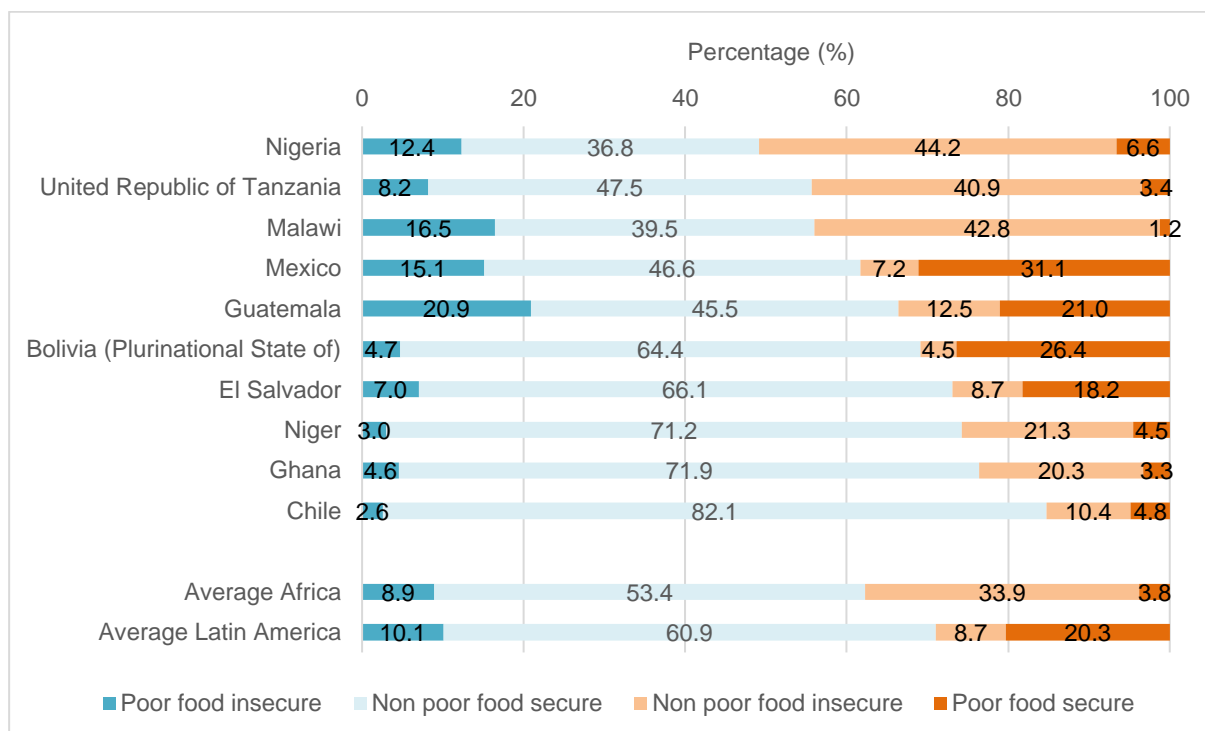
Figure 4). This is mainly because, in urban areas of most countries, there are much larger shares of households that are non-poor and food secure. In terms of “mismatched” groups, instead, it is important to note that rural areas are characterized by a substantially larger share of households that are poor yet food secure, both in African and Latin American countries.

Figure 4. Share of the population in different poverty-food insecurity groups – rural vs urban areas (national poverty lines)

a. Rural



b. Urban



Source: Authors' elaboration.

To observe the relationship between poverty and food insecurity more in detail, and to explore how it varies across rural and urban areas, Figure 5 shows the prevalence of moderate or severe food insecurity across welfare ventiles in rural and urban areas.

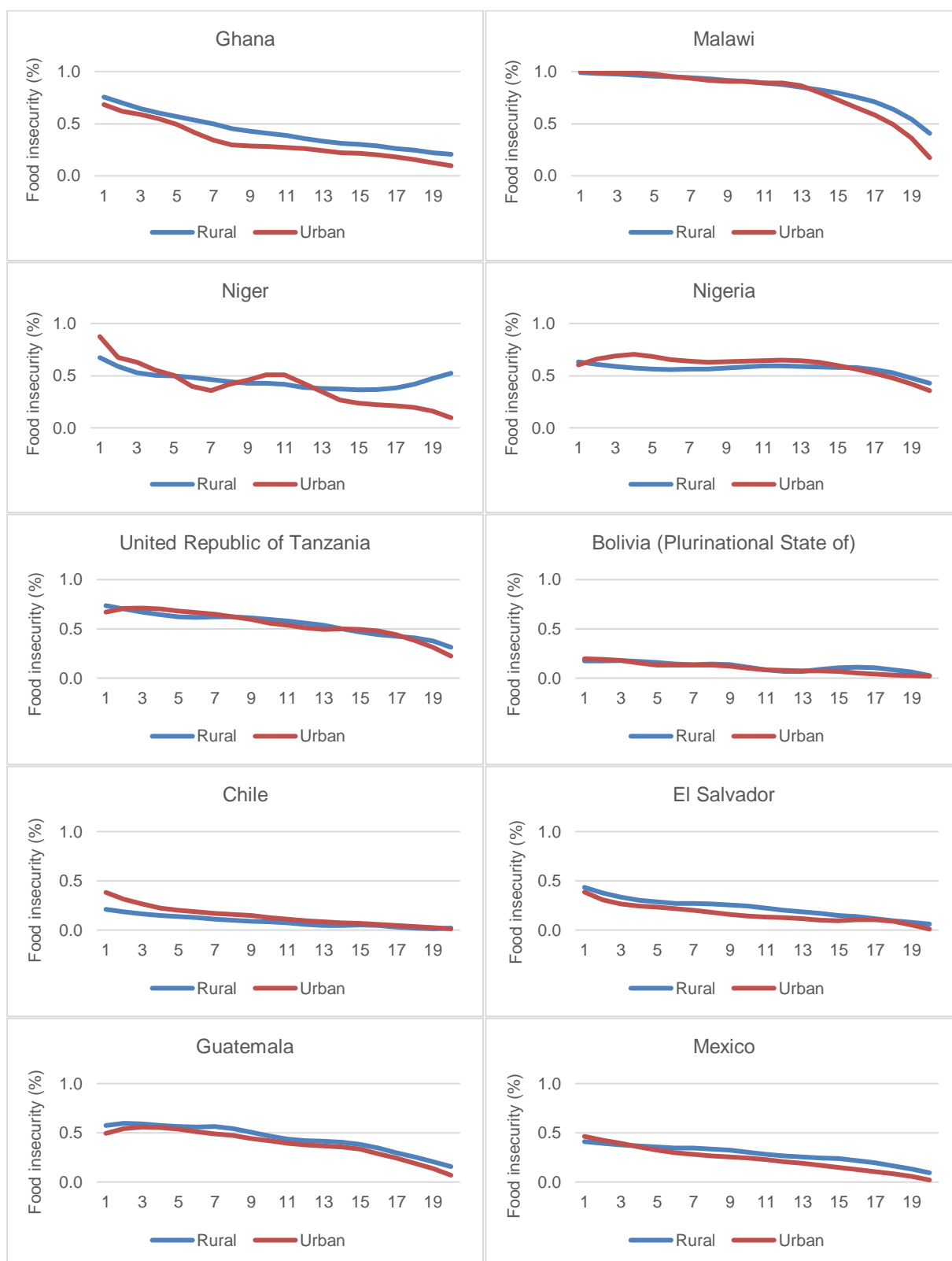
As expected, in most countries, the proportion of households who are food insecure constantly decreases with welfare (measured by either income or consumption) in both rural and urban areas. However, in Niger and rural areas of the Plurinational State of Bolivia, food insecurity increases over some segments of the welfare distribution.¹⁶

In four out of ten countries (Ghana, El Salvador, Guatemala, and Mexico), rural people suffer from higher levels of food insecurity across almost the entire welfare distribution. This suggests that there are other factors beyond monetary resources that make people in rural areas more food insecure in these countries.

Chile represents the opposite case, where urban people are more food insecure than rural people across almost the entire distribution. This is in line with Smith, Rabbitt and Coleman-Jensen (2017), that found that, in richer countries, food insecurity tends to be higher in urban areas. Food insecurity tends to be higher also in urban areas of Nigeria, even though this pattern is reversed in the top 25 percent of the distribution. In the Plurinational State of Bolivia, Niger and the United Republic of Tanzania, there are no clear differences in the level of food insecurity among rural and urban areas.

¹⁶ The cases of Niger and the Plurinational State of Bolivia are difficult to interpret. Possible explanations might relate to the particular household compositions or types of livelihoods characterizing wealthier rural households in these two countries. However, data issues cannot be excluded.

Figure 5. Prevalence of moderate or severe food insecurity across welfare ventiles in rural and urban areas



Notes: Welfare is represented by per capita consumption in African countries and by per capita income in Latin American countries. The prevalence of food insecurity across ventiles shown in the figure is obtained through locally weighted scatterplot smoothing (using a smoothing parameter or “bandwidth” of 0.4). This smoothing procedure is applied to make the relationship between the two variables easier to interpret and less sensitive to noise in the data, especially for surveys with a limited number of observations in the rural or urban sectors.

Source: Authors' elaboration.

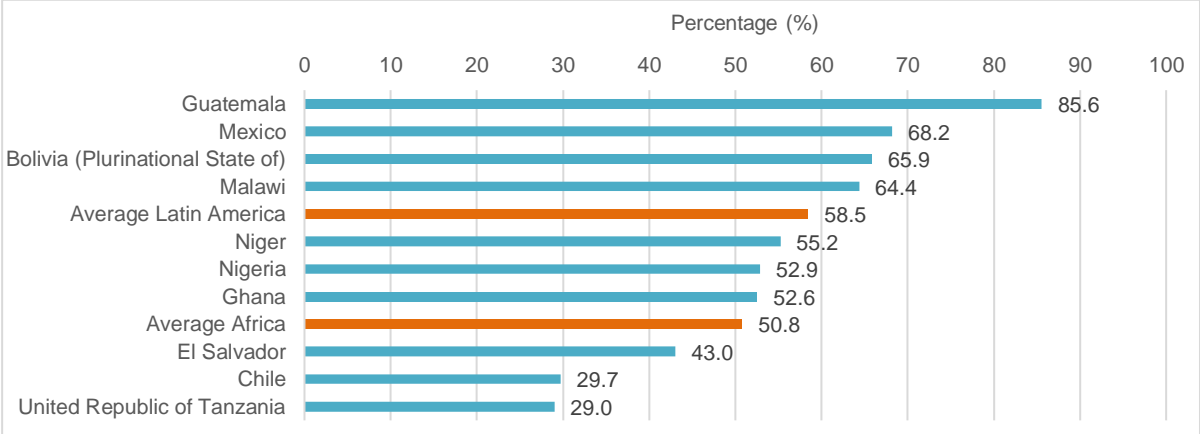
A targeting scenario using national lines for rural and urban areas

Figure 6 shows the percentage of the food insecure households who are also poor in rural and urban areas. As previously discussed, this represents an approximation of what would happen if public policies in the countries included in the analysis aimed at reaching the food insecure by targeting all and only the monetarily poor households. It immediately stands out that the share of food insecure households that would be reached by such a targeting strategy is much more limited in urban areas, especially in African countries. On average, in African countries, public policies would reach only one out of five food insecure households in urban areas, while in rural areas they would reach about half of the food insecure households.

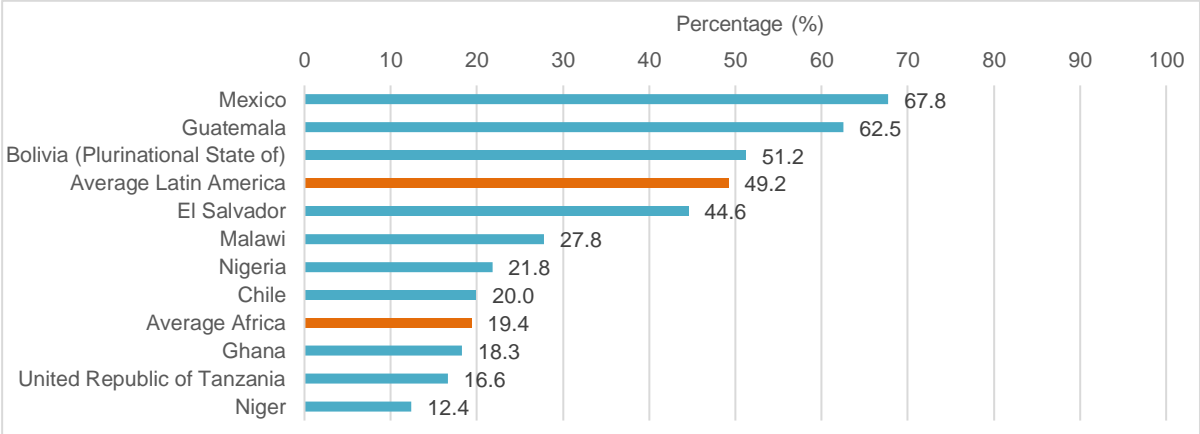
The explanations behind the observed pattern may be multiple but the main reason may lie in the different levels of food insecurity and poverty that characterize rural and urban areas in the various countries (Figure 7). Both food insecurity and poverty are greater in rural areas in most countries. However, the rural-urban gap in relation to poverty is much wider than the urban-rural gap in relation to food insecurity, especially in the African countries of the analysis. A similar phenomenon was observed by Maitra and Rao (2015) in Kolkata, India.

Figure 6. Share of food insecure households that are also poor – rural vs urban areas (national poverty lines)

a. Rural

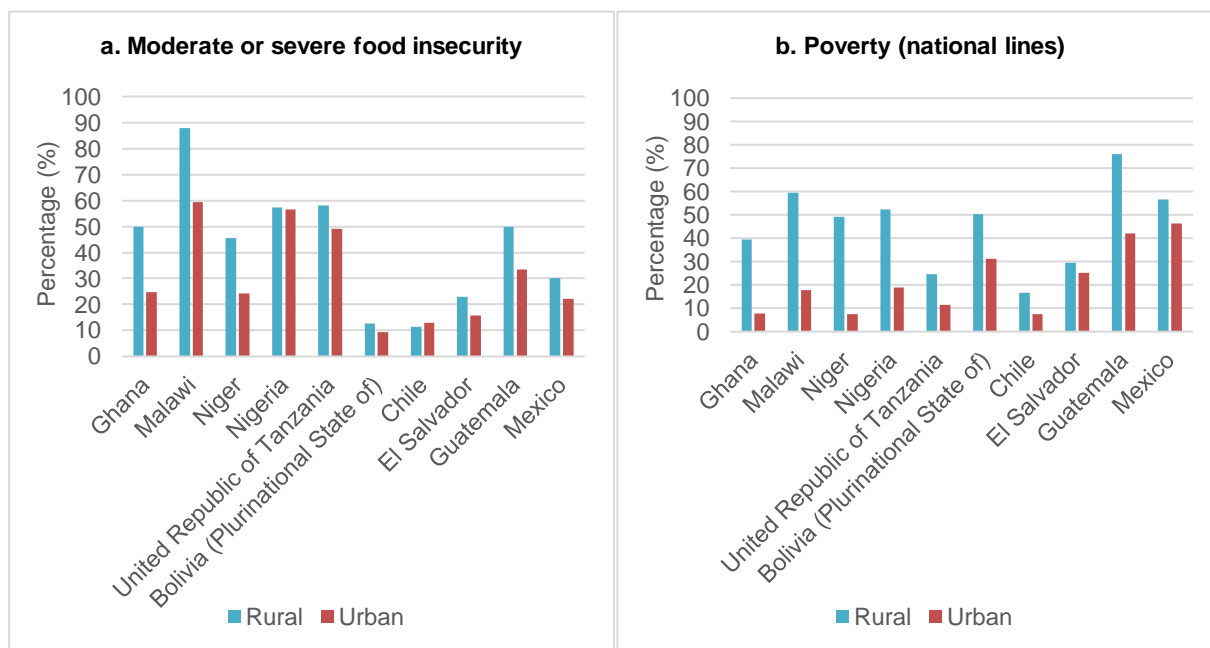


b. Urban



Note: Regional averages are calculated as simple averages of country-level shares.
 Source: Authors' elaboration.

Figure 7. Prevalence of food insecurity and poverty in rural and urban areas



Source: Authors' elaboration.

4.3 The correlation between monetary poverty and food insecurity controlling for other factors

The descriptive analysis presented so far reveals a clear relationship between poverty and food insecurity at the household level. However, it also highlights that the strength of the relationship can be different in different countries and, within countries, across rural and urban areas. In addition, it shows that the strength of the relationship critically depends on the poverty line that is used.

In this section, we investigate the correlation between monetary poverty and food insecurity after controlling for various household-level factors that might drive food insecurity through and beyond poverty¹⁷. This allows to characterize with more precision the relationship between these two phenomena at the household level.

In a first exercise, we estimate a fractional outcome regression model of households' probability of being moderately or severely food insecure.¹⁸ This probability is regressed on the welfare level of the household, measured by the logarithm of household per capita consumption or income, and a set of control variables that could be computed for all countries. These control variables encompass most of the socio-demographic, livelihood, and place-of-residence variables discussed in Section 3.

¹⁷ Even though we refer to these factors as potential drivers of food insecurity, it should be clear that the cross-sectional nature of our data does not allow any claims of causality.

¹⁸ The fractional outcome regression (Papke and Wooldridge, 1996) is specifically conceived to model continuous dependent variables that range between 0 and 1, including the corner values. Since our variable of interest is the probability of being food insecure, including values of 0 and 1, we consider the fractional outcome regression to be an appropriate model for the analysis. We estimate fractional outcome regression models using the logistic function as cumulative distribution function. For more details on the fractional outcome regression see Papke and Wooldridge (1996).

In our preferred model we use the probability of being moderately or severely food insecure (instead of the food insecurity status) and per capita income or consumption (instead of poverty status) to exploit the whole distribution of poverty and food insecurity conditions and to make the characterization of the correlation between these two phenomena less dependent on the specific definitions of food insecurity (moderate or severe or just severe) and poverty (total or extreme poverty, national vs international poverty lines) and, as such, easier to generalize. As explained later in this section, we conduct various robustness checks using different alternative models.

Table 5 shows the results of the estimation. In what follows, the focus is on the interpretation of the sign and the statistical significance of the coefficients, rather than their magnitude.

Table 5. Determinants of the probability of moderate or severe food insecurity (fractional outcome model)

	Ghana	Malawi	Niger	Nigeria	United Republic of Tanzania	Bolivia (Plurinational State of)	Chile	El Salvador	Guatemala	Mexico
Welfare variable										
Log per capita consumption or income	-0.629***	-1.980***	-0.892***	-0.807***	-0.791***	-0.513***	-1.026***	-0.867***	-0.412***	-0.673***
Socio-demographic										
Women-headed HH (d)	0.160**	0.127	0.152	0.215***	0.131*	0.098	0.228***	0.132*	0.035	0.086**
Separated HH head (d)	0.367***	0.159	0.391	0.170*	0.412***	0.251*	0.271***	0.051	0.208*	0.233***
HH size	-0.058***	-0.175***	-0.058***	-0.022***	-0.040***	-0.045*	-0.133***	-0.013	0.009	0.014*
Dependency ratio	0.335***	-0.085	0.078	-0.216**	0.178	0.193	-0.421***	-0.220**	-0.111	-0.240***
Age of HH head	-0.006***	-0.007**	0.004	-0.010***	-0.004*	-0.008***	-0.015***	-0.004*	-0.012***	-0.010***
Education of HH head	-0.065***	-0.081***	-0.052**	-0.033***	-0.087***	-0.065***	-0.070***	-0.024***	-0.094***	-0.065***
Livelihoods										
Crops (d)	0.188**	0.257**	0.307*	0.028	-0.038	-0.383**	0.165***	0.032	-0.219***	-0.091**
Livestock (d)	0.162**	-0.089	-0.07	-0.043	-0.11	-0.458**	-0.13	-0.135	0.015	-0.124***
Internat. remittances (d)	-0.382	-0.087	-0.146	-0.550***	0.072	0.061	0.65	-0.245***	-0.435***	-0.096*
Internal remittances (d)	0.193***	0.294***	0.461***	0.186***	0.409***	0.139	0.197***	0.180**	0.223***	0.178***
Assistance (d)	0.179	0.190**	0.561***	0.258***	0.535***	0.055	0.217***	0.131	0.373***	0.018
Location										
Rural (d)	0.147**	0.167	0.318*	-0.142***	0.001	0.281*	-0.338***	-0.03	0.066	-0.093***
Sub-national areas (d)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13 893	12 446	3 616	22 106	9 454	11 718	69 967	21 331	11 391	74 583
Pseudo R2	0.177	0.267	0.122	0.084	0.12	0.072	0.108	0.075	0.112	0.089

Notes: Raw coefficient are displayed. Sub-national regions are included as a series of dummy variables to control for unobserved place-specific factors that might affect households' food insecurity. (d) indicates a dummy variable. Constant term is omitted. HH = household.

Source: Authors' elaboration.

Welfare

The results show a highly statistically significant negative association of household per capita consumption or income with food insecurity in all countries. In other words, the probability of a household being food insecure decreases when its per capita consumption or income increases (and vice versa). This result confirms the patterns suggested by the descriptive analysis and highlights that income and consumption (and thus monetary poverty) are directly correlated with food insecurity, even after controlling for many other factors that affect households' access to food.

Similar results are obtained when the estimation is performed separately for rural and urban areas.¹⁹ An interesting regularity is that the coefficient associated to household welfare is higher, in absolute terms, in urban than in rural areas for all examined countries. This implies that the association between monetary welfare and food insecurity is higher for urban than for rural households.

As a robustness check, we estimate alternative models, including: a) a simple linear regression using the same food insecurity and welfare variables of the main model; b) an ordered logit model where food insecurity is represented by the FIES or ELCSA's raw score; c) logit models with food insecurity and poverty status defined as binary variables (with poverty status alternatively defined with international and national poverty lines). All these specifications confirm that, even after controlling for other variables, there is a highly significant negative association between welfare and food insecurity, or a highly significant positive association between poverty status and food insecurity. More details on these robustness checks are provided in Table A2 in the Annex.

As an additional robustness check, for a subset of countries with available information (three from Latin America and three from Africa), we estimate an extended specification of our fractional outcome regression model, including additional control variables among those discussed in Section 3. In the case of the three Latin American countries (the Plurinational State of Bolivia, Guatemala, and Mexico), the model includes three additional variables: a dummy variable capturing if the household head is indigenous, a dummy variable informing if the household head works as a salaried worker, and a continuous variable measuring the share of the household budget devoted to food expenditures. The model for the three African countries (Malawi, Niger, and Nigeria) includes the last two variables plus a set of five dummy variables indicating whether households suffered from various types of shocks in the previous 12 months.

Despite adding further control variables, it is still possible to observe a highly significant negative association between welfare and food insecurity in all countries (Table A3 in the Annex).

Control variables

Although the focus of this exercise is estimating the association between food insecurity and welfare controlling for other factors, the next paragraphs briefly summarize the main results for the control variables. This can provide an indication of which factors, beyond poverty, affect food insecurity.

In all countries, women-headed households tend to be more food insecure than male-headed households, although coefficients are statistically significant only in six countries. This is

¹⁹ Regression tables not shown but available upon request.

consistent with findings from previous studies in Latin America and India (Maitra and Rao, 2015; Sandoval, Carpio and Garcia, 2020; Vilar-Compte *et al.*, 2015). Similarly, households headed by separated individuals tend to be more food insecure.

Instead, households headed by older and more educated people show lower levels of food insecurity on average. That regarding education is a finding observed in many previous studies (Maitra and Rao, 2015; Mundo-Rosas *et al.*, 2019; Sandoval, Carpio and Garcia, 2020; Vilar-Compte *et al.*, 2020; Yousaf *et al.*, 2018).

The probability of being food insecure decreases with the number of household members in all African countries. An explanation could be that where livelihoods are relatively more agricultural and require more workforce, smaller households might be more penalized in terms of food security. In Latin American countries, this relationship is less clear: a greater household size is associated with less food insecurity in Chile and the Plurinational State of Bolivia, while it is associated to higher food insecurity in Mexico. These mixed results are consistent with the literature, suggesting that the association of household size with food security depends on the context. For example, it is positive among urban households in Kolkata and rural households in Rwanda (Danso-Abbeam *et al.*, 2021; Maitra and Rao, 2015) but negative among Mexican households and rural households in Pakistan (Vilar-Compte *et al.*, 2020; Yousaf *et al.*, 2018).

The coefficient of the variable capturing the proportion of inactive members within households is statistically significant in five countries. In Ghana, the coefficient is positive as expected, implying that the probability of being food insecure is higher for households with a higher proportion of inactive members. However, the coefficient is unexpectedly negative in Chile, El Salvador, Mexico, and Nigeria. Conducting further checks in these countries we observe that the simple linear correlation between food insecurity and dependency ration is positive as expected. However, when welfare is controlled for, the association becomes negative. This might suggest that once the welfare status of the household is controlled for, households with higher proportions of children and elderly might be more food secure as they are more likely to receive various types of assistance.

Engagement in crop production is associated to more food insecurity in four countries and with less food insecurity in three countries, reflecting the diversity of agriculture as well as the different profiles of farmers across countries. Engagement in livestock presents a mixed picture too, with households engaged in this activity being more food insecure in Ghana and less food insecure in the Plurinational State of Bolivia and Mexico, similarly to what was found in the Rwandan context by Danso-Abbeam *et al.*, (2021).

Receiving remittances from abroad is associated to lower food insecurity in the majority of countries, although the association is statistically significant only in Nigeria, El Salvador, Guatemala and Mexico. Instead, households who receive domestic remittances (transfers from people within their country) and public assistance tend to be more food insecure across all countries, indicating the higher vulnerability of these population groups and confirming previous observations in African and Latin American countries (Rogan, 2018; Vilar-Compte *et al.*, 2015).

Living in a rural area is associated to higher or lower food insecurity depending on the countries. All else being equal, rural household appear more food insecure in Ghana, Niger, and the Plurinational State of Bolivia and appear less food insecure in Nigeria, Chile and Mexico. Also in this case, this could be explained by the heterogeneity of rural areas and rural populations across countries.

4.4 Potential factors that drive the discrepancies between poverty and food insecurity

The association between welfare and food insecurity in different population subgroups

After having demonstrated that welfare and food insecurity (and thus poverty and food insecurity) are strongly related, even after controlling for other variables that affect food insecurity, we test whether producing crops, producing livestock, engaging in wage labour, or suffering from different types of shocks can affect the strength of this relationship. This analysis can shed light on when poverty and food insecurity are more likely to go together.

We estimate the fractional outcome regression model described before including, one at the time, interaction terms between the welfare variable and dummy variables of interest. In the case of wage dummy variable, the model is estimated for all countries except The United Republic of Tanzania, where the wage variable is not available. Results regarding shocks refer only to Malawi, Niger and Nigeria.

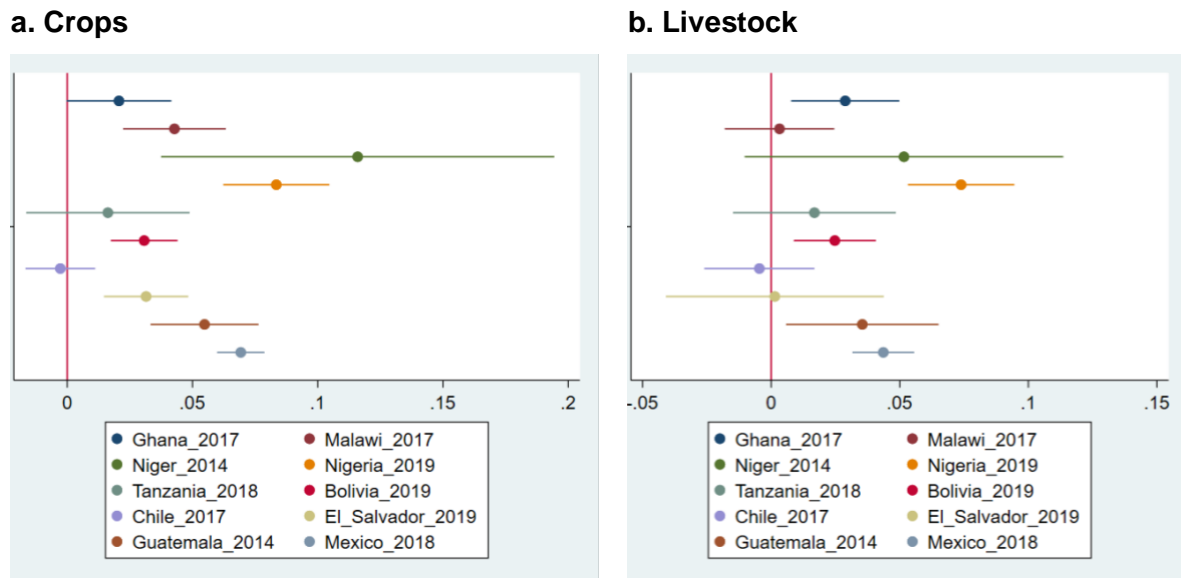
After estimating the models,²⁰ we calculate the difference between the marginal association of welfare and food insecurity at different values of the dummy variable of interest, as well as the 95 percent confidence intervals of these differences. For example, in the case of the dummy variable indicating whether the household engages in cultivating any crop, we first include an interaction term between the variable “crops” and the welfare variable in the base model. Then we compute the difference between the marginal effect of welfare on food insecurity when households engage in crops and when they do not. Robustness checks were conducted using simple linear regression instead of the fractional outcome model. These checks, whose output is available upon request, revealed largely similar results.

Figure 8 shows that households who engage in cultivating crops are characterized by a weaker association between monetary measures of welfare and food insecurity. That is, the previous analysis showed that there is a negative association between the two in all the countries; hence, a positive difference in marginal effects indicates a less negative, and thus weaker, association between welfare and food insecurity. In other words, as consumption or income decreases, the probability of being food insecure increases relatively less for households engaged in crop production than for households that are not. The difference is statistically significant (i.e. the confidence intervals shown in Figure 8 do not include zero) for eight out ten countries. Similarly, those who engage in livestock tend to show a weaker relationship between welfare and food insecurity, although the difference is statistically significant only in the Plurinational State of Bolivia, Ghana, Guatemala, Mexico and Nigeria.

These findings tend to confirm the hypothesis that engagement in crop and livestock production can play a safety-net role, particularly in agricultural settings, helping households to fulfill their food security needs even when they face lower levels of welfare. These findings are also consistent with previous studies in South Africa (Rogan, 2018) and Pakistan (Yousaf *et al.*, 2018).

²⁰ Regression outputs are not shown for reasons of space but are available upon request.

Figure 8. Difference in marginal effects of welfare on food insecurity by crop and livestock production

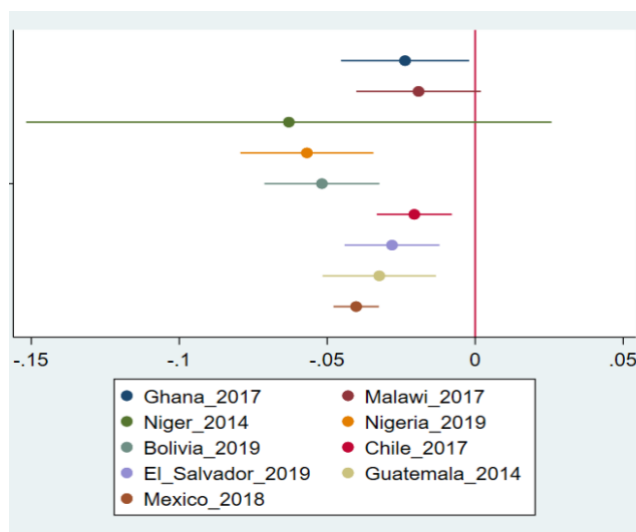


Note: Confidence intervals are calculated at the 95 percent confidence level.

Source: Authors' elaboration.

In accordance with our expectations, households whose head's main occupation is wage labour tend to present a stronger association between welfare and food insecurity (Figure 9). That is, the negative difference in marginal effects between households whose head's main occupation is wage labour and the rest of the households indicates that the first group presents an even more negative, and thus stronger, association between welfare and food insecurity. This difference is statistically significant in seven out of nine countries included in the analysis (with Malawi being at the edge of statistical significance). These results indicate that, all else being equal, households relying on wage labour as their main livelihood strategy might have a greater vulnerability (in terms of food insecurity) to welfare shocks.

Figure 9. Difference in marginal effects of welfare on food insecurity by head's engagement in wage labour

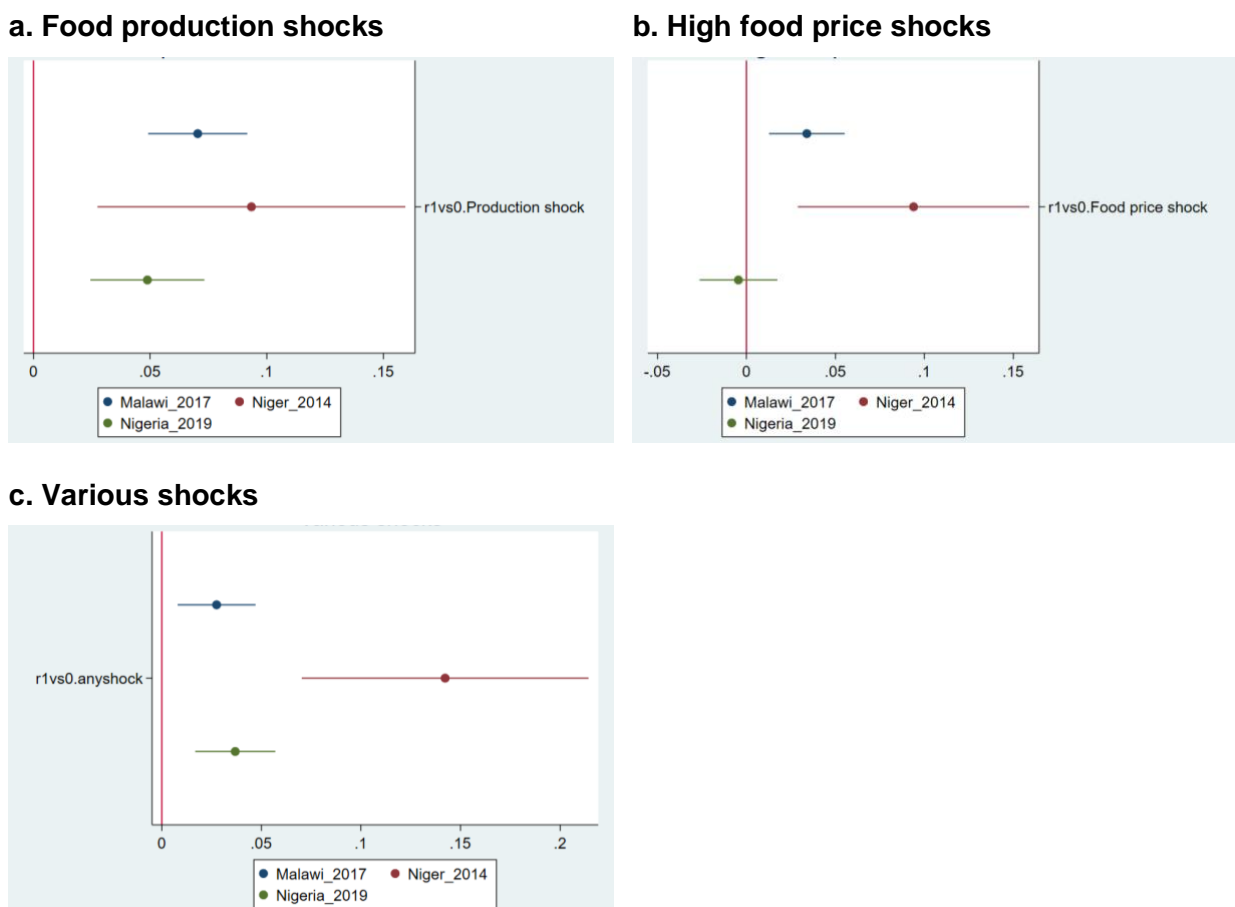


Note: Confidence intervals are calculated at the 95 percent confidence level.

Source: Authors' elaboration.

Finally, our results indicate that, as hypothesized, different types of shocks weaken the relationship between welfare and food insecurity. In other words, the probability of being food insecure of households who suffer from shocks is less dependent on their welfare. This is illustrated in Figure 10. Except for the case of high food prices in Nigeria, households who suffer shocks that limit their capacity to produce, purchase or consume food under different channels, present a weaker relationship between welfare (and thus poverty) and food insecurity. These results resonate with a recent analysis in five countries in sub-Saharan Africa showing that the COVID-19 pandemic led to a reduction of food consumption across the whole consumption distribution (Amankwah and Gourlay, 2021). A similar trend was observed for the 2008 financial crisis in Mexico (Vilar-Compte *et al.*, 2015).

Figure 10. Difference in marginal effects of welfare on food insecurity by different types of shocks



Notes: Confidence intervals are calculated at the 95 percent confidence level. * include livelihood, demographic and violence related shocks.

Source: Authors' elaboration.

The association between household characteristics and food insecurity depending on welfare

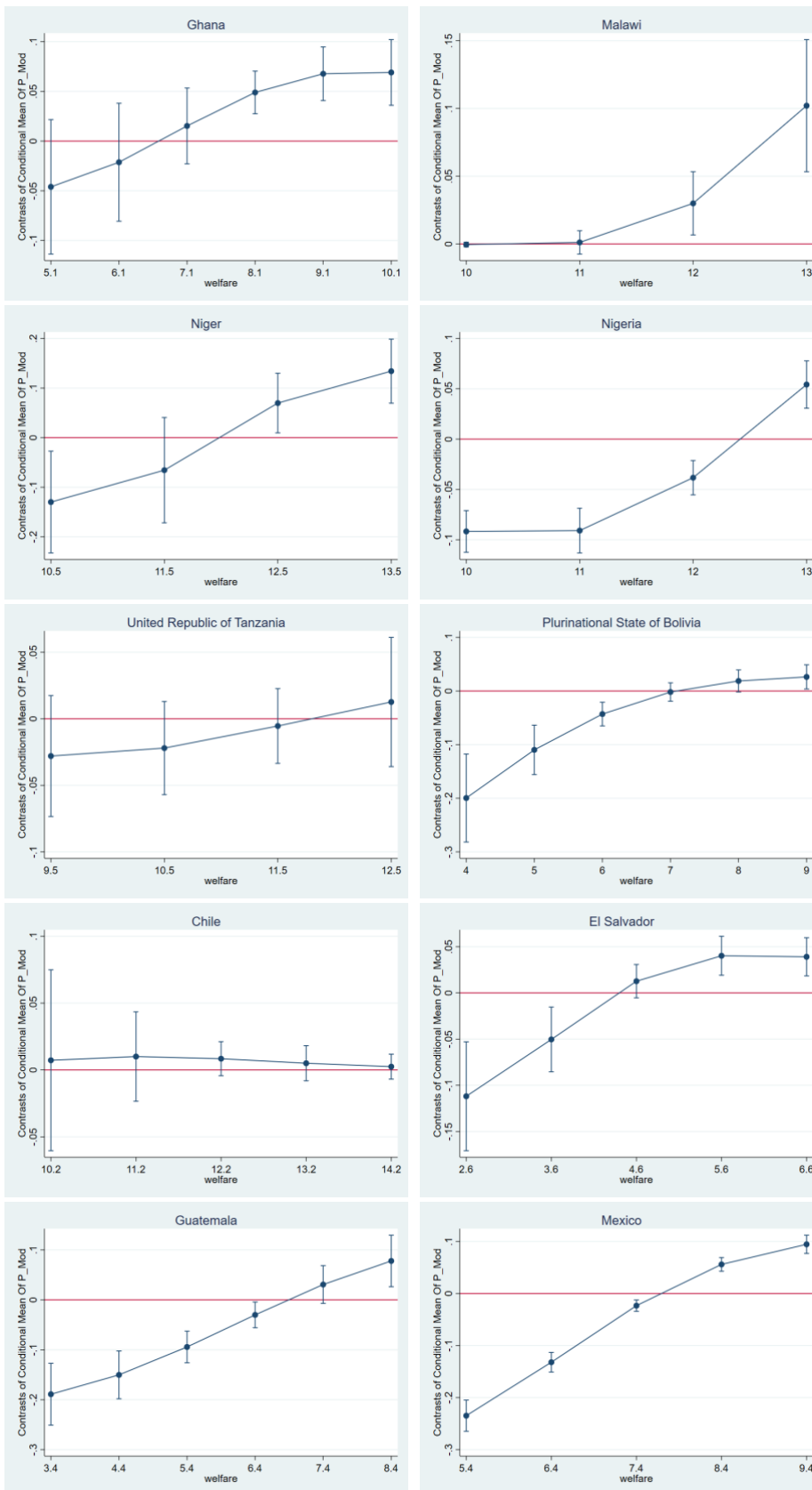
Although the main objective of the analysis was showing how livelihood and shock-related variables could mediate the relationship between welfare and food insecurity, it is also interesting to observe how welfare can mediate the association between these population characteristics and food insecurity. Using the same models with interactions described before, we calculate the marginal effect of the dummy variable of interest at different levels of the welfare distribution.

In six out of ten countries, engaging in crop production is associated with a lower probability of being food insecure at lower levels of welfare, while it is associated with higher probabilities of being food insecure at higher levels of welfare (Figure A1). In two additional countries (Ghana and Malawi), engaging in crops is associated with higher food insecurity among richer households, while it does not present any “effect” among poorer households. These findings tend to confirm our hypotheses that agriculture can represent a food security advantage (or at least that is not a disadvantage) for the poorer populations who might not be able to access alternative profitable and stable occupations. Similarly, the results could be explained by the different types of production undertaken by poorer households (more oriented toward self-consumption) compared to better-off households (more oriented to the market). Livestock production presents very similar patterns, although for a more limited number of countries (see Figure A4).

In all Latin American countries and Nigeria, households whose head’s main occupation is wage labour tend to present higher food insecurity across almost the entire welfare distribution (Figure 12). Interestingly, the food insecurity “penalization” associated to wage labour is higher for poorer households and tend to disappear (or even reverse) among the richest households. Malawi and Ghana present a similar pattern: while wage labour is not associated to any gain or loss in food insecurity among poorer households, it is associated with lower food insecurity as welfare increases. Overall, these results are consistent with our hypotheses. On one hand, poorer households tend to engage in lower-quality wage jobs, which do not help reduce their food insecurity or, as it seems the case for most countries in our analysis, even increase it. On the other hand, better off households can access higher-quality wage jobs (such as fixed employment), which help reduce, or at least not increase, their food insecurity.

As expected, the positive association between suffering shocks and food insecurity tend to grow with welfare in almost all countries, corroborating the idea that better off households have “more to lose” from shocks (Figure 13). However, we expected shocks to be associated to higher (or at least not lower) food insecurity across the entire distribution. However, in Niger and Nigeria (for food price shocks only), suffering shocks is associated with lower food insecurity among the poorest households. A potential explanation could be that poorer households suffering from shocks receive more assistance. However, we cannot exclude that this observation is related to characteristics of these households that we are not able to control for in our models.

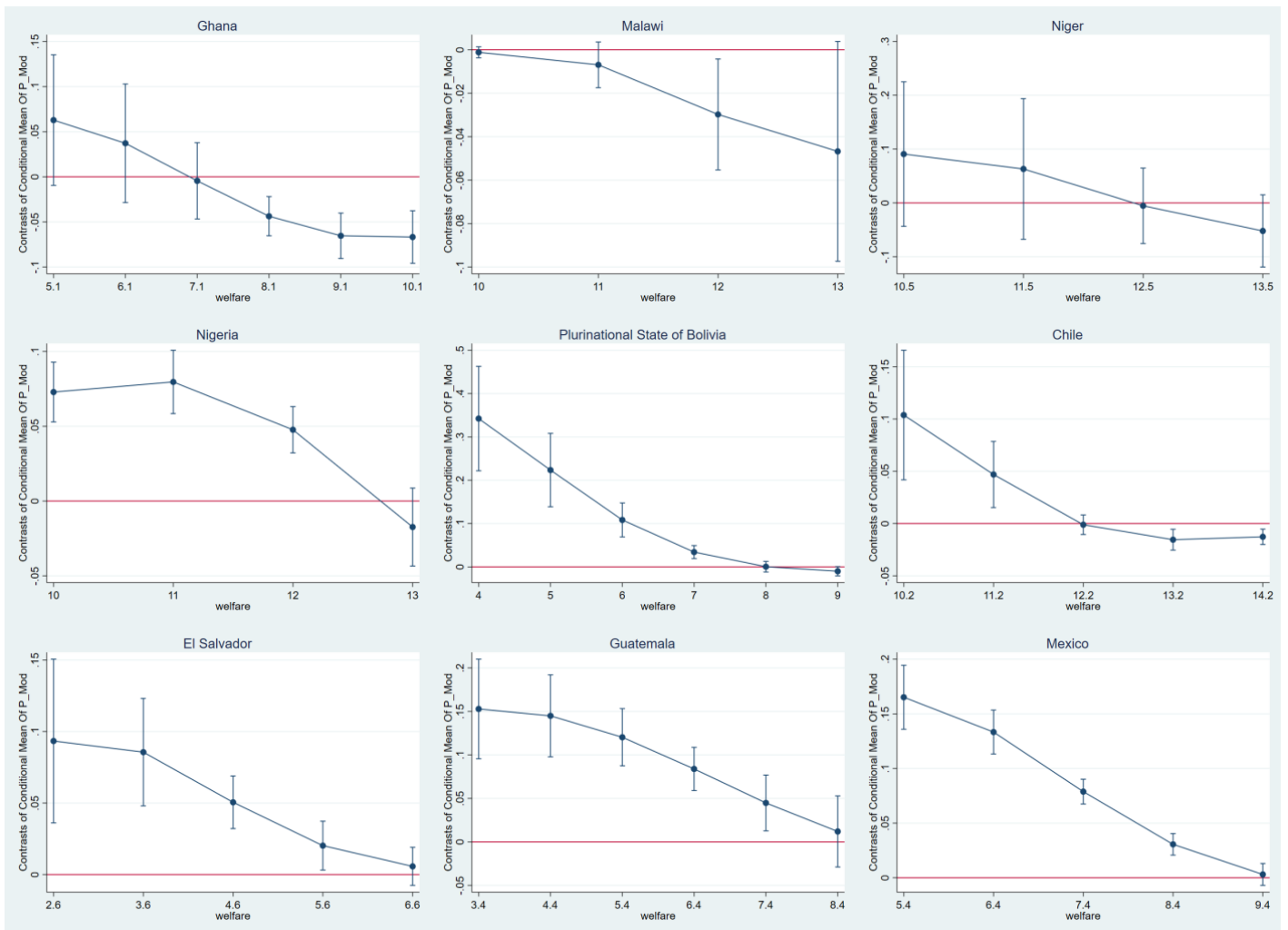
Figure 11. Marginal effect of engaging in crop production on food insecurity by level of welfare



Notes: Confidence intervals are calculated at the 95 percent confidence level. P_Mod: probability of moderate or severe food insecurity.

Source: Authors' elaboration.

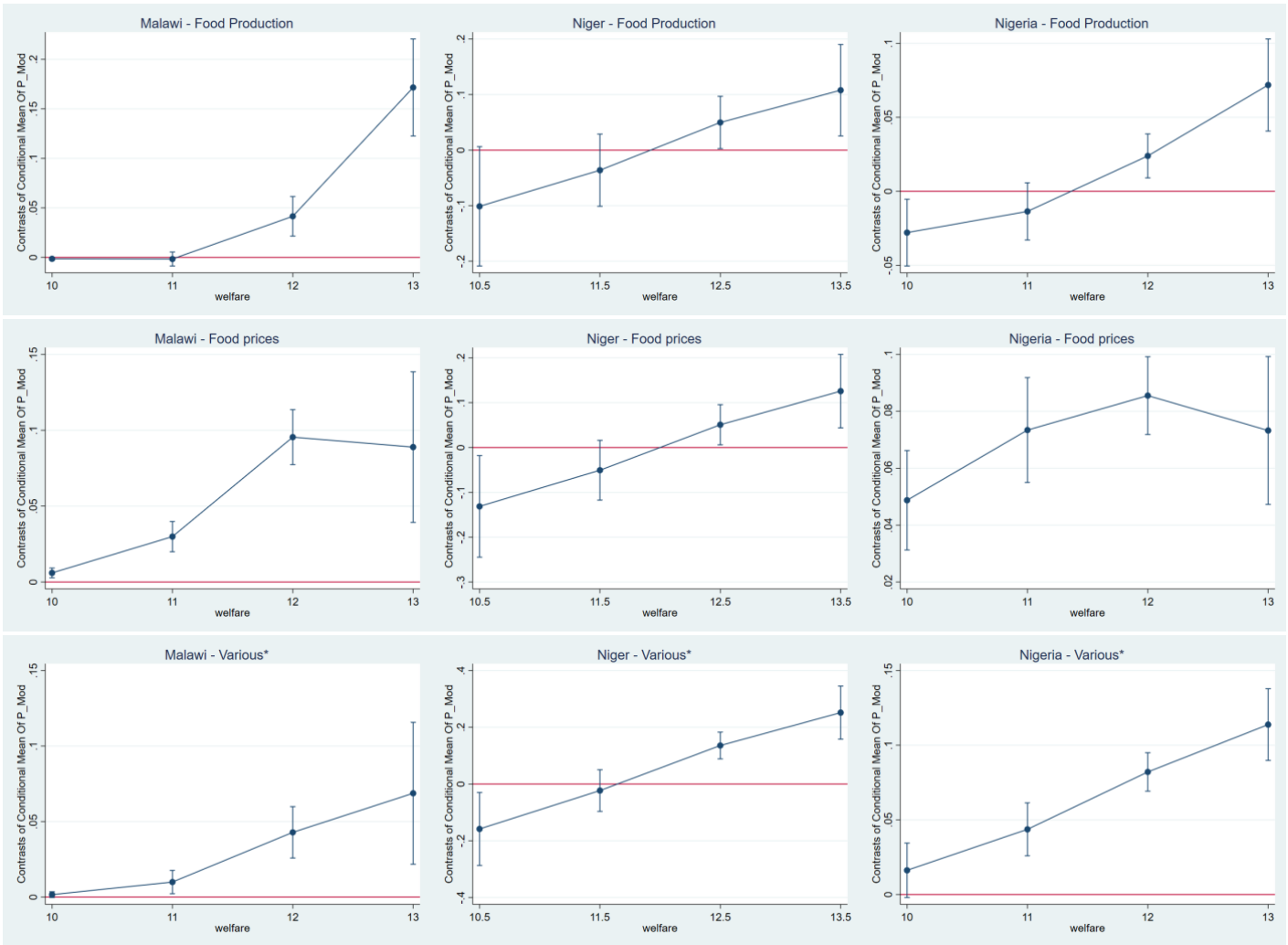
Figure 12. Marginal effect of engaging in wage labour on food insecurity by level of welfare



Notes: Confidence intervals are calculated at the 95 percent confidence level. P_Mod: probability of moderate or severe food insecurity.

Source: Authors' elaboration.

Figure 13. Marginal effect of shocks on food insecurity by level of welfare



Notes: Confidence intervals are calculated at the 95 percent confidence level. P_Mod: probability of moderate or severe food insecurity. * include livelihood, demographic and violence related shocks.

Source: Authors' elaboration.

5 Discussion and conclusions

5.1 Policy implications

While in the last two decades the world has made significant progress in reducing poverty, the same is not seen in food security. Even more, in the recent years preceding the COVID-19 pandemic, while global poverty continued its decline, the prevalence of food insecurity in the world was on the rise.

The COVID-19 pandemic dramatically increased the number of people who suffer from poverty and food insecurity in the world. At the same time, other threats to food security and poverty such as climate variability and extremes and the escalation of conflict in some regions, continue to challenge the achievement of SDGs 1 and 2. This means that enhancing both the targeting and the design of anti-poverty and food security interventions is becoming increasingly pressing.

Although it is recognized that poverty and food insecurity are related phenomena, increasing the effectiveness of policies aimed at eradicating poverty and achieving food security requires a better understanding of their relationship. In fact, while the Targets 1.1 and 2.1 of the SDGs highlight these two objectives separately, in practice, interventions aiming to address one or the other target are often similar in policy orientation and design, especially when the focus of food security interventions is on food access. This is often the case for agricultural development, livelihood support, or social assistance programmes such as cash transfers and public works, whose theories of change assume that increasing the income or the productivity of the poor will lead to decreasing food insecurity in the population.

In this analysis, we first explored the extent to which food insecure and poor populations coincide across various countries. We did so by focusing on monetary poverty, which is used to monitor progress towards SDG 1 through indicators 1.1.1 and 1.2.1 and EBFSS, to which FIES, the measure used to monitor progress towards SDG 2 through indicator 2.1.2, belongs.

We find a substantial overlap of poor and food insecure households, indicating a clear correlation between these two deprivations at the household level. Despite the overall solid correlation, we find also that the extent to which poverty and food insecurity overlap can vary considerably across countries, and this greatly depends on the definition of monetary poverty that is adopted. This is not surprising, considering that different poverty lines express different levels of material deprivation that can reflect food insecurity (as measured by EBFSS) to different extents. Overall, we find a substantially greater overlap between food insecurity and poverty if international poverty lines are used instead of national lines.

However, independently from the adopted poverty line, this analysis highlights that the overlap between poverty and food insecurity is not perfect, and in some cases can be limited, confirming the results of previous studies that focused on calorie and nutrition-based indicators of food insecurity. Although not surprising, since poverty and food insecurity are related yet different phenomena, this finding highlights the importance of using specific measures for each type of deprivation. Although the aim of this paper was not to establish how poverty and food insecurity should be measured (and our results should not be interpreted as a weakness of monetary poverty or EBFSS to measure their respective concepts), our results warn against hasty assumptions regarding the overlap between poverty and food insecurity.

Even more, our results warn against superficial targeting approaches in real-world settings. Using national poverty lines, the thresholds normally used as a reference to target national

social assistance policies to the monetarily poor, substantial shares of countries' populations fall into "policy-concerning" poverty-food insecurity groups. These groups include those who are considered poor but not food insecure and, more importantly, those who are considered food insecure but not poor. This suggests that, when possible, governments should avoid using monetary poverty as proxy of food insecurity to directly identify programme beneficiaries but also to define the size and the characteristics (sociodemographic or geographic) of the population groups to be targeted in food security interventions. For example, a government willing to identify the population groups or the geographic areas to be prioritized for a programme whose objective is reducing food insecurity, should do it using a specific measure of food insecurity like FIES or other EBFSS, instead of taking shortcuts and do so relying on a monetary poverty indicator.

Our analysis also highlights that the extent to which monetary poverty and food insecurity (measured by EBFSS) overlap can vary substantially between rural and urban areas within countries. Overall, we find that the overlap between poverty and food insecurity is greater in urban areas, mainly due to substantial shares of the population that are neither poor nor food insecure. Nevertheless, even when the overlap is relatively greater, like in urban areas, governments must be mindful of the composition of the "policy-concerning" groups. For example, we find that, in the five African countries included in this analysis, 80 percent of the food insecure households in urban areas would not be considered poor by national definitions. This finding, which echoes the results of Brown, Ravallion and van de Walle (2019) in relation to poverty and undernutrition in sub-Saharan Africa, is mainly due to the fact that, in African cities, the problem of food insecurity is much more common than that of monetary poverty (using national definitions). For that reason, in urban areas, a large share of the population is considered food insecure despite not being poor. Conversely, rural areas are characterized by a substantially larger share of households that are poor yet food secure, both in African and Latin American countries.

This analysis makes clear that the overlap between poverty and food insecurity can be heterogeneous between and within countries and that this variation is greatly dependent on the thresholds adopted to define who is poor. However, beyond issues related to the definition of poverty and food insecurity, the analysis sought to understand with more precision the relationship between these two phenomena at the household level. In particular, the analysis tried to shed light on the circumstances in which the two phenomena are more or less likely to go together.

First, we find that income and consumption, and thus monetary poverty, are strongly correlated with food insecurity (as measured by EBFSS), even after controlling for relevant factors that affect households' access to food. This points to an intrinsic direct relationship between these two phenomena, whereas better-off households are less likely to be food insecure.

Second, we find evidence that crop farming and, to a more limited extent, livestock production can act as a safety net mechanism for food security, particularly for poorer households. In many of the countries included in this analysis, the households who are engaged in these activities, particularly crop farming, present a weaker relationship between welfare and food insecurity. This means that a decrease in their level of monetary welfare translates into a relatively lower increase in their chances to be food insecure, compared to household not engaged in these activities. Similarly, our analysis shows that engagement in these agricultural activities is often associated with lower levels of food insecurity among poorer households, while it is associated to higher levels of food insecurity among better-off households.

In an almost specular way, we show that households whose livelihoods are more reliant on wage labour present a stronger association between monetary welfare and food insecurity, meaning that their food security is more dependent upon their monetary resources. Similarly, poorer households seem to be more penalised (or at least less benefitted) in terms of food security when they engage in wage labour. This points at the different types and qualities of wage jobs that can be accessed by poorer households compared to better-off ones.

The findings on farming and wage labour engagement corroborate and provide a potential explanation for the pattern found in relation to urban and rural areas. That is, since relying on wage labour make households' food security more dependent on their monetary resources and given that urban areas are characterized by relatively more wage labour livelihoods compared to rural areas, this can explain why monetary poverty and food insecurity tend to coincide more in urban areas.

Additionally, we find evidence that households who suffer from shocks that limit their ability to produce, purchase, or produce food present a weaker relationship between welfare indicators (income or consumption based) and food insecurity, and that shocks are associated with relatively larger increases in food insecurity among richer households. This offers a potential explanation of why, among other factors, non-poor households might face food insecurity.

Which are the implications of these findings for the design of poverty and food insecurity policies? A key set of interventions often deployed to tackle both food insecurity and poverty includes those for enhancing agricultural productivity through technology and innovation and those for increasing access to high-value markets through specialization and value chain arrangements. While it is reasonable to expect and there is evidence that these types of interventions can reduce food insecurity through greater incomes, those in charge of designing these agricultural development programmes should not overlook the role that agriculture has as a safety net for the food security of families that rely on it, not only through income generation, but also through consumption of own produced food. As shown in this analysis, those engaged in agriculture tend to show greater food security resilience against poverty and, plausibly, against welfare shocks such as that brought about by the COVID-19 pandemic. Also, the research shows that agriculture is associated to lower food insecurity among the poorest households.

In a similar vein, agricultural and rural development interventions aiming at promoting livelihood diversification in off-farm and non-agricultural activities should consider that higher reliance on wage labour can be associated with higher levels of food insecurity and lower resilience against welfare shocks, especially for the poor. To avert these potential consequences, it is important that these interventions focus on providing higher-quality wage jobs, not only in terms of productivity but also in terms of stability.

Finally, the research provides indications that pushing people out of poverty is likely not enough to prevent food insecurity, as other factors such as shocks related to food production, non-agricultural livelihoods, food prices, household composition, and violence appear to increase households' likelihood to be food insecure, even after controlling for household welfare. This points to the importance of social protection schemes directed at the entire population (i.e. not only at those who are already poor) to tackle welfare shocks, even if temporary, to avoid that household face episodes of food insecurity.

5.2 Limitations and research gaps

This analysis is not exempt from limitations. First, the cross-sectional nature of our data does not allow to make conclusions about causal effects. For example, we can conclude that, in most countries, those who receive international remittances are, on average, less likely to be food insecure. However, we cannot conclude that they are less food insecure *because* they receive international remittances. Addressing this issue would require the use of panel data. However, when we screened national household surveys for conducting this analysis, we could not find a panel dataset with a measure of monetary poverty and an EBFSS that were consistent at least across two waves. Nevertheless, as the use of FIES and other EBFSS continues to expand and national statistical offices continue integrating EBFSS modules into national household surveys, it is likely that such a dataset will soon become available.

A second limitation of this analysis is the impossibility of isolating the role of intra-household inequality. Although our data do not permit to observe the different poverty and food insecurity status of individuals within households, it is possible to hypothesize that intra-household inequality contributes to the observed discrepancies and, in particular, to observing households that are food insecure but not poor. In fact, while EBFSS can capture this inequality more easily (because they ask if *anyone* in the household suffered from food deprivations in a given period), monetary poverty can more easily hide deprivations within the households (because of the assumption that welfare is equally distributed among members). The issue of intra-household inequality relates to the more general problem of measurement errors in household surveys that, as already acknowledged, is not directly addressed in this analysis and, as such, could represent ground for future research.

In addition, it is acknowledged that the need to harmonize data from different national household surveys limited the possibility of including further variables that could mediate the relationship between poverty and food insecurity. These include, for example, food-related behavioural characteristics of households or more detailed characterizations of their livelihoods.

Finally, it is important to stress again that this analysis focused specifically on EBFSS and monetary poverty. As such, we did not pretend to unveil the general relationship between poverty and food insecurity, but were interested in the relationship between these two well-established measures. This means that we cannot rule out that our findings on the relationship between food insecurity and poverty depend on the indicators that we used to measure the two phenomena. For example, using conceptually more comprehensive measures of poverty such as multidimensional poverty indices might lead to observing a stronger correlation with food insecurity. Hence, replicating this analysis using different measures of poverty or food insecurity represents an opportunity for future research.

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Annexes

Annex A. FIES module

The FIES module is composed by eight questions. The questions can refer to the respondent or his/her household. The questions usually refer the last 12 months, even though sometimes other references periods are used (last three months or last 30 days). Here is shown an example of FIES module referring the last 12 months and the respondent's household. Importantly, the questions can be phrased slightly differently in different questionnaires to account for linguistic and cultural differences across countries.

During the last 12 months, was there a time when, because of lack of money or other resources:

1. You or others in your household were worried you would not have enough food to eat?
2. You or others in your household were unable to eat healthy and nutritious food?
3. You or others in your household ate only a few kinds of foods?
4. You or others in your household had to skip a meal?
5. You or others in your household ate less than you thought you should?
6. Your household ran out of food?
7. You or others in your household were hungry but did not eat?
8. You or others in your household went without eating for a whole day?

Annex B. ELCSA module

ELCSA consists of 15 questions, divided into two sections: a first section with eight questions referring to various situations experienced by the household as a whole and the adult members of the household; and a second section with questions referring to conditions that affect children under 18 years of age. The reference period is typically the last three months even though a shorter period of one month is used sometimes. Like FIES, the questions of ELCSA can be phrased slightly differently to account for linguistic and cultural differences across countries. Here is shown an example of ELCSA module (free translation from Spanish):

Household and adults in the household

In the last three months, due to lack of money or other resources:

1. Have you ever worried about food running out in your home?
2. Has your household ever run out of food?
3. Have you ever stopped eating a healthy diet in your home?
4. Have you or any adult in your household ever eat a diet based on a small variety of foods?
5. Have you or any adult in your household ever stopped eating breakfast, lunch or dinner?
6. Have you or any adult in your household ever eat less than they should?
7. Have you or any adult in your household ever felt hungry but did not eat?
8. Have you or any adult in your household ever ate only once a day or did you stop eating for an entire day?

Children in the household

In the last three months, due to lack of money or other resources:

9. Has anyone under the age of 18 in your household ever stopped eating a healthy diet?
10. Has anyone under the age of 18 in your household ever had a diet based on a small variety of foods?
11. Has anyone under the age of 18 in your household ever stopped eating breakfast, lunch or dinner?
12. Has anyone under the age of 18 in your household ever eat less than they should?
13. Have you ever had to decrease the quantity of food served at meals to someone under 18 in your household?
14. Has anyone under the age of 18 in your household ever felt hungry but did not eat?
15. Has anyone under the age of 18 in your household ever eaten once a day or stopped eating for an entire day?

Annex C. Control variables used in the analysis

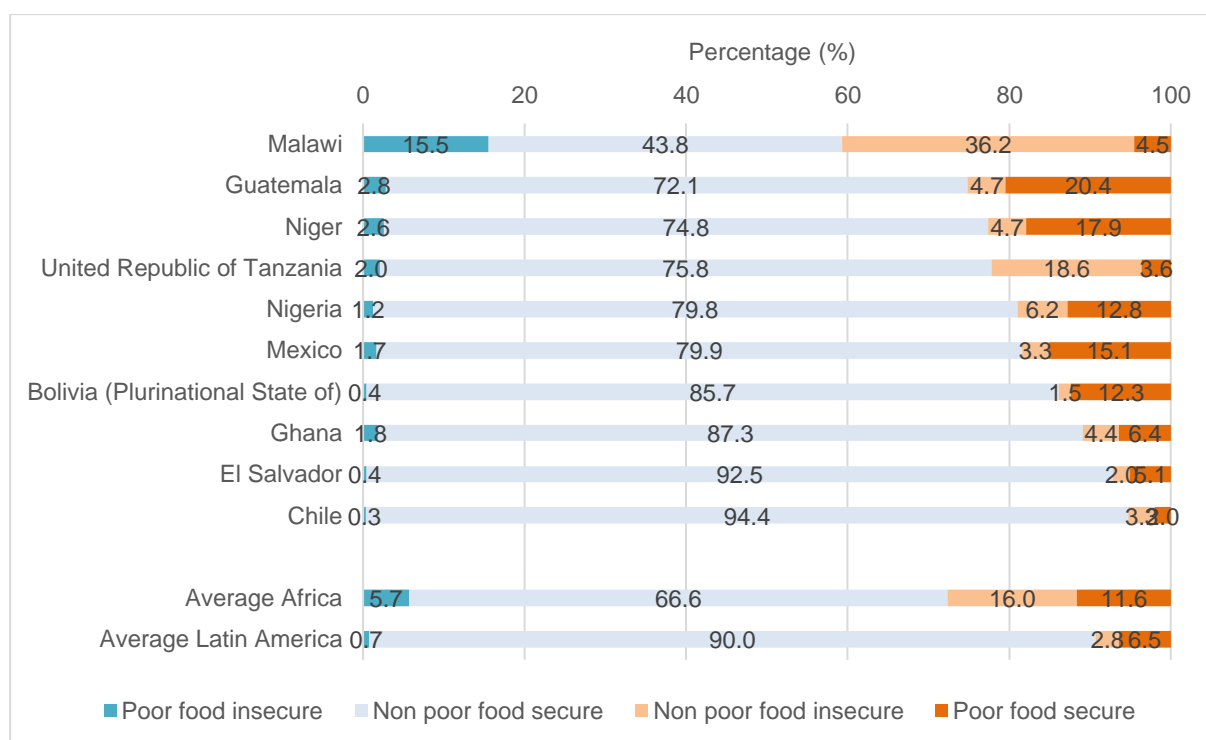
Table A1. Definition of control variables used in the analysis

Variable	Type	Description
Socio-demographic characteristics		
Household size	Continuous	number of members in the household
Age of head	Continuous	age of household head in years
Women-headed	Binary	1 = women-headed household; 0 = men-headed household
Education of head	Continuous	education of household head in years
Separated head	Binary	1 = head is separated or divorced; 0 = head is not separated
Dependency ratio	Continuous	number of household members not in working age (15–64) divided by household size
Indigenous	Binary	1 = the head of the household is considered indigenous; 0 = otherwise
Geography		
Region	Binary	1 = household is resident in a given region; 0 = otherwise
Rural	Binary	1 = household is resident in a rural area (based on national definition); 0 = otherwise
Livelihood characteristics		
Wage head	Binary	1 = the head of the household is a salaried/wage worker (based on the last seven days); 0 = otherwise
Crops	Binary	1 = the household engages in cultivating crops; 0 = otherwise
Livestock	Binary	1 = the household engages in livestock production; 0 = otherwise
International remittances	Binary	1 = the household receives remittances from abroad; 0 = otherwise
Internal remittances	Binary	1 = the household receives remittances from within country; 0 = otherwise
Assistance	Binary	1 = the household receives any type of social assistance; 0 = otherwise
Shocks		
Production shock	Binary	1 = household was affected by a shock that limited its capacity to produce food (e.g. weather-related events, pests, animal disease) in the last year; 0 = otherwise
Livelihood shock	Binary	1 = household was affected by a shock that limited its capacity to purchase food through livelihood disruption (e.g. loss of job, failure or bad performance of non-agricultural business) in the last year; 0 = otherwise
Food price shock	Binary	1 = household was affected by a shock that limited its capacity to purchase food because of high food prices in the last year; 0 = otherwise
Demographic shock	Binary	1 = household was affected by a shock that limited its capacity to produce, purchase, or consume food through changes in its demographic characteristics (e.g. death of a member, birth of a member, separation) in the last year; 0 = otherwise
Violence shock	Binary	1 = household was affected by a shock that limited its capacity to produce/purchase/consume food through theft or violence in the last year; 0 = otherwise
Household preferences regarding food security		
Food budget	Continuous	Household per capita expenditure divided by household total expenditures

Source: Authors' elaboration.

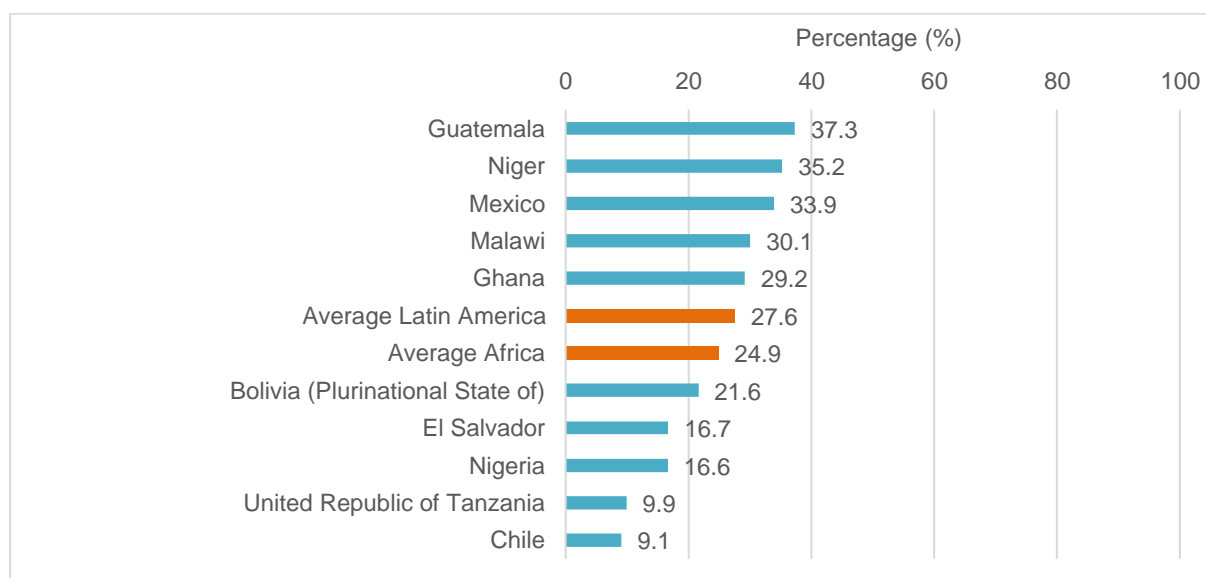
Annex D. Additional results

Figure A1. Share of the population in different extreme poverty – severe food insecurity groups



Source: Authors' elaboration.

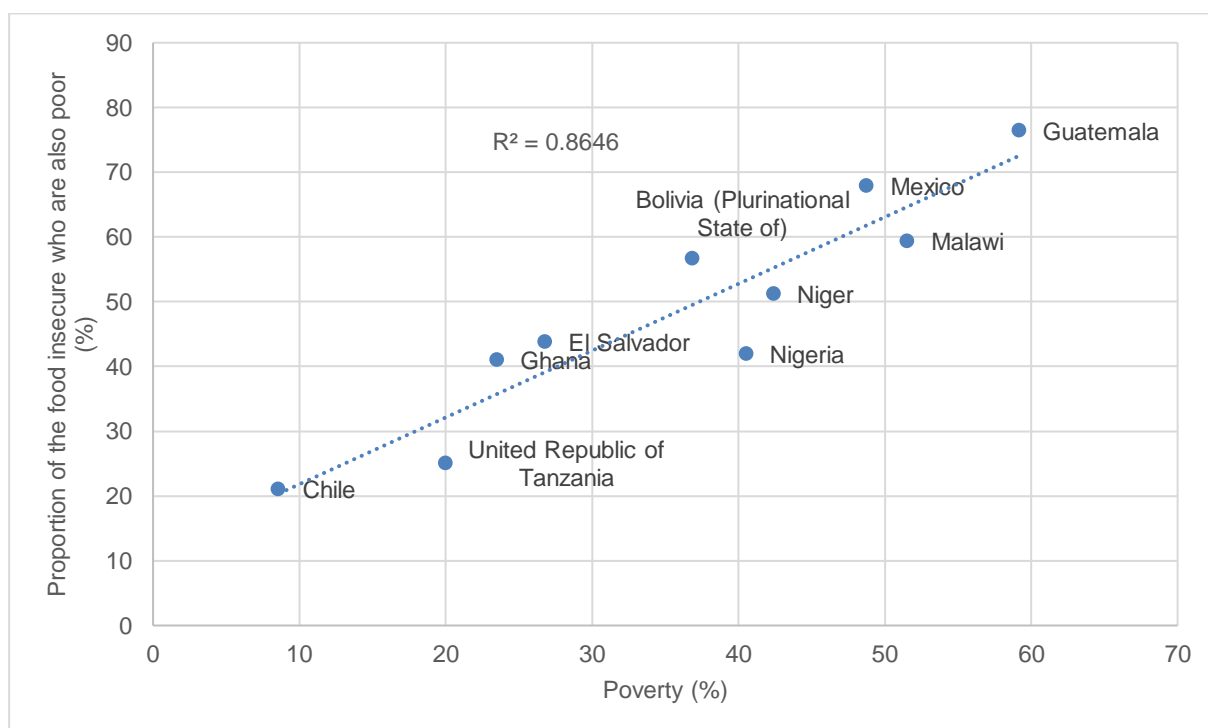
Figure A2. Proportion of the severely food insecure who are also extremely poor (national poverty lines)



Notes: Regional averages are calculated as simple averages of country-level shares.

Source: Authors' elaboration.

Figure A3. Proportion of the food insecure who are also poor vs prevalence of poverty (national poverty lines)



Source: Authors' elaboration.

Table A2. Models estimated to assess the association between welfare/poverty and food insecurity, controlling for other factors

Model	Independent variable	Dependent variable	Association observed
Fractional outcome regression logit (preferred model)	Probability of being moderate or severely food insecure	Log per capita income or consumption	Negative and statistically significant for all countries
Simple linear regression	Probability of being moderate or severely food insecure	Log per capita income or consumption	Negative and statistically significant for all countries
Ordered logit	Food insecurity Raw score	Log per capita income or consumption	Negative and statistically significant for all countries
Logit	Food insecurity status (moderate or severe)	Poverty status (defined using international poverty lines)	Positive and statistically significant for all countries
Logit	Food insecurity status (moderate or severe)	Poverty status (defined using national poverty lines)	Positive and statistically significant for all countries

Source: Authors' elaboration.

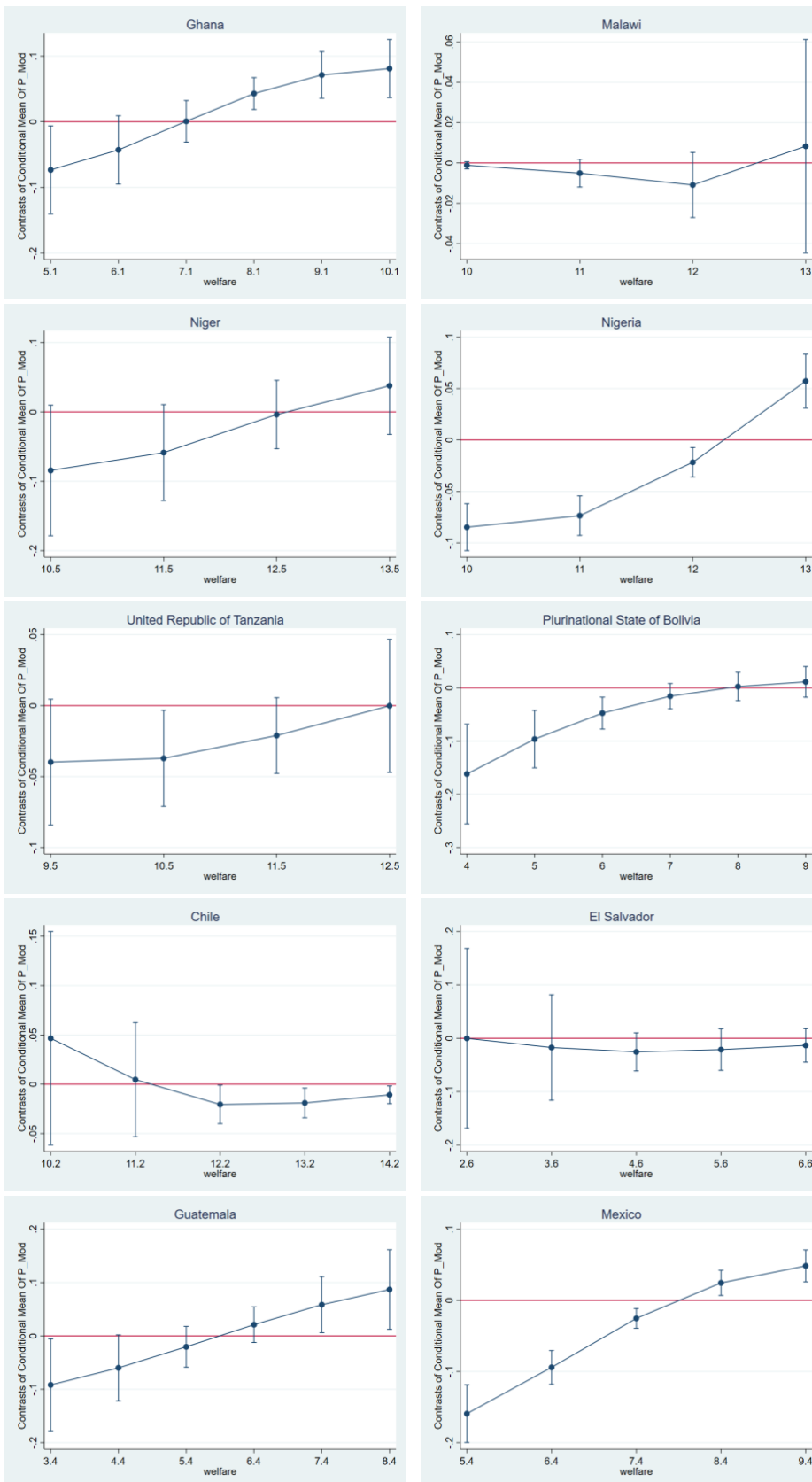
Table A3. Determinants of the probability of moderate or severe food insecurity (fractional outcome model): extended model

	Malawi	Niger	Nigeria	Bolivia (Plurinational State of)	Guatemala	Mexico
Welfare variable						
Log per capita consumption or income	-2.028***	-0.834***	-0.896***	-0.317***	-0.391***	-0.678***
Socio-demographic						
Women-headed HH (d)	0.103	0.119	0.221***	0.116	0.150*	0.150***
Separated HH head (d)	0.142	0.412	0.177*	0.280*	0.193*	0.211***
HH size	-0.179***	-0.050**	-0.032***	-0.033	0.001	0.014*
Dependency ratio	-0.13	-0.067	-0.265***	0.156	-0.159	-0.214***
Age of HH head	-0.005*	0.004	-0.009***	-0.008***	-0.007***	-0.005***
Education of HH head	-0.074***	-0.038*	-0.030***	-0.057***	-0.080***	-0.062***
Indigenous (d)				0.526***	0.095	0.369***
Livelihoods						
Crops (d)	0.141	0.205	-0.04	-0.270*	-0.195**	-0.103***
Livestock (d)	-0.189**	-0.133	-0.138***	-0.504**	0.027	-0.101**
Wage (d)	-0.207*	-0.16	0.083	0.442***	0.273***	0.305***
International remittances (d)	-0.092	-0.113	-0.527***	0.088	0.226***	-0.045
Internal remittances (d)	0.258***	0.437***	0.099**	0.17	-0.348***	0.207***
Assistance (d)	0.121	0.558***	0.159***	0.051	0.354***	0.01
Location						
Rural	0.068	0.04	-0.148***	0.176	0.012	-0.105***
Sub-national areas (d)	Yes	Yes	Yes	Yes	Yes	Yes
Preferences						
Food budget	-0.547*	2.113***	0.268*	1.363***	1.390***	-0.026
Shocks						
Production shock	0.471***	0.13	0.130***			
Livelihood shock	0.297***	0.256	0.350***			
Food price shock	0.695***	0.112	0.406***			
Demographic shock	0.287***	0.623***	0.350***			
Violence shock	0.346***	0.366	0.454***			
Observations						
	12 446	3 616	22 106	11 666	11 391	74 518
Pseudo R2						
	0.294	0.136	0.103	0.083	0.119	0.096

Notes: Raw coefficient are displayed. Sub-national regions are included as a series of dummy variables to control for unobserved place-specific factors that might affect households' food insecurity status. (d) indicates a dummy variable. Constant term is omitted. HH = household.

Source: Authors' elaboration.

Figure A4. Marginal effect of engaging in livestock production on food insecurity by level of welfare



Notes: Confidence intervals are calculated at the 95 percent confidence level. P_Mod: probability of moderate or severe food insecurity.

Source: Authors' elaboration.

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CONTACTS

Agrifood Economics Division – Economic and Social Development

ESA-Director@fao.org

www.fao.org/agrifood-economics

Food and Agriculture Organization of the United Nations
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