

## Methods used to estimate the poverty impact of increases in international food prices

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### Background

The prices of agricultural commodities have increased on international markets since the outbreak of the Covid-19 pandemic in early 2020 and spiked after the invasion of Ukraine by Russia in February 2022. The price increases were particularly notable in the case of wheat, maize, and sorghum, which are staple foods in many developing countries. This prompted a wave of research to better understand the effect of these price changes on income and poverty in low-income countries.

IFPRI carried out a set of country studies to explore the poverty impact of higher staple grain prices on six countries in sub-Saharan Africa: Mali, Burkina Faso, Niger, Nigeria, Kenya, and Ethiopia (see Martin and Minot, 2023a, 2023b, and 2023c and Minot and Martin, 2023a, 2023b, and 2023c). This brief describes the methods and data used in those studies.

### Conceptual Framework

The analysis of how increases in international food prices affects household income and poverty in low-income countries can be divided into two questions. First, how do changes in international prices (meaning the price in major exporting countries) affect the wholesale and retail prices of the same commodities in domestic markets in sub-Saharan Africa? Second, how do changes in domestic prices of staple grains influence household income and poverty?

Regarding the first question, it is risky to assume that changes in international commodity prices are fully transmitted to domestic markets. The proportional change in domestic prices is often less than the proportional change in international prices of the same commodities for several reasons (Minot, 2011). The margins between international and domestic prices reflect transportation costs, port handling fees, insurance, and domestic transport, as well as profit margins for exporters and domestic wholesalers. If any of these margins are fixed in monetary terms (e.g. US\$ per ton), then the proportional increase of (higher) domestic prices will be less than the proportional increase in (lower) international prices. In addition, if the price increases induce the country to stop importing, the

international price may increase without any corresponding increase in domestic prices. Finally, policy response may limit the transmission of the price shock to domestic markets. For example, the country may reduce import tariffs to insulate domestic consumers from the international price increases (Martin and Minot, 2023).

In this analysis, we assume that any increase in the real (inflation-adjusted) price of staple grains is associated with the rise of commodity prices on the world markets. This is based on the idea that, in the absence of a change in international prices, the domestic prices of staple grains would rise with the rate of general inflation in the country. We recognize that weather shocks may affect domestic supply and market prices, particularly for non-traded commodities such as cassava and millet. But for internationally-traded commodities, it is likely that changes in international prices are the main driver of domestic price changes.

The second question is how domestic prices affect the real income of households and poverty. Here, the analysis makes use of household survey data that describes the importance of each staple commodity in the household budget and as a source of income. A higher price raises the income of households that are producers of the commodity in proportion to the share of income derived from the commodity. Likewise, a higher price reduces the real income (purchasing power) of households that consume the commodity in proportion to the share of their budget allocated to it. These concepts are described in quantitative terms in the Methods section below.

## Data

The analysis makes use of data on price changes of three commodities, maize, wheat, and sorghum, in six countries, Mali, Burkina Faso, Niger, Nigeria, Ethiopia, and Kenya. In most cases, the price changes are based on data from the FAO Global Information and Early Warning System (FAO, 2023). In cases where the FAO data does not cover the commodities we need, we make use of price data compiled by the World Food Programme (WFP, 2023) or FEWSNET. Table 1 provides more detail on the prices used and the source of each.

**Table 1. Price data and their sources**

Country	Commodity	Details	Source
<b>Kenya</b>	Wheat	Nairobi retail price of bread	FEWSNET
	Maize	Retail price of maize meal	FEWSNET
	Sorghum	Red sorghum price in Kisumu	FEWSNET
<b>Ethiopia</b>	Wheat	Addis Ababa wholesale price of wheat	FAO GIEWS
	Maize	Addis Ababa wholesale price of maize	FAO GIEWS
	Sorghum	Addis Ababa wholesale price of sorghum	FAO GIEWS
<b>Nigeria</b>	Wheat	Damaturu retail price of bread	WFP
	Maize	Lagos wholesale price of white maize	FAO GIEWS
	Sorghum	Lagos wholesale price of white sorghum	FAO GIEWS

<b>Niger</b>	Wheat	Yaounde retail price of wheat flour	FAO GIEWS
	Maize	Niamey retail price of maize	FAO GIEWS
	Sorghum	Niamey retail price of sorghum	FAO GIEWS
<b>Burkina Faso</b>	Wheat	Mopti (Mali) retail price of wheat flour	WFP
	Maize	Ouagadougou retail price of white maize	FAO GIEWS
	Sorghum	Ouagadougou wholesale price of sorghum	FAO GIEWS
<b>Mali</b>	Wheat	Mopti retail price of wheat flour	WFP
	Maize	Bamako retail price of maize	WFP
	Sorghum	Bamako wholesale price of sorghum	FAO GIEWS

The main analysis uses the percentage change in real domestic prices from February 2020 to three periods: January 2022, May 2022, and July 2022. The base period (February 2020) represents the pre-pandemic period, January 2023 is the month before the invasion of Ukraine, May 2022 is the month during which international grain prices peaked, and July 2022 is the post-peak period. The international prices of grains have not changed substantially since July 2022, so the analysis does not estimate changes in poverty over this period.

The distributional impact of price changes makes use of household survey data for each of the six countries. The survey data has been collected in the Povana database, which gathers household-level data on the composition of income and expenditure (including home production) of various goods and services (Amun and Laborde, 2021). The number of product categories varies by country, but across the six countries analyzed, it varies between 71 and 92. This database provides household-level values for consumption expenditure ( $y_h$ ), household size ( $S_h$ ), the value of production of each commodity ( $Q_{ih}$ ), and the value of consumption of each commodity ( $C_{ih}$ ). When aggregating across households to calculate the headcount poverty, the analysis also makes use of the sampling weights in the Povana database.

## Methods

Deaton (1989) showed that the first-order impact of a change in the price of a commodity on household income can be calculated as follows:

$$\frac{\Delta y_h}{y_h} = \frac{\Delta p}{p} \left( \frac{Q_h - C_h}{y_h} \right)$$

where  $y_h$  = real household expenditure

$p$  = the price of the commodity

$Q_h$  = the value of household production of the commodity

$C_h$  = the value of household consumption of the commodity

It is a first-order approximation in the sense that it does not take into account household response to the price change, which is welfare-increasing but small. As such, this can be considered the short-term impact of the price change. The expression in parentheses is sometimes called the net benefit ratio and can be interpreted as the short-run elasticity of welfare with respect to the commodity price.

The sign of the net benefit ratio indicates the net sales position of the household. If it is positive, the household is a net seller and will benefit from a price increase; if it is negative, the household is a net buyer and will lose from a price increase.

This is extended to the multi-commodity case as follows, where the commodity index is  $i$ .

$$\frac{\Delta y_h}{y_h} = \sum_i \frac{\Delta p_i}{p_i} \left( \frac{Q_{hi} - C_{hi}}{y_h} \right)$$

The headcount poverty rate after the price change can be estimated by calculating the share of the population living in households whose per capita income is below the poverty line.

$$P_0 = \frac{\sum S_h I(g(y_h, S_h) < P)}{\sum S_h}$$

where  $P_0$  = the headcount poverty rate

$S_h$  = the size of household  $h$

$I(\cdot)$  is the indicator function, equal to 1 if the argument is true and 0 if false

$g(y_h, S_h)$  = a welfare measure based on household income and household size

$P$  = the poverty line

The numerator is the number of people in households living below the poverty line, while the denominator is sum of household sizes, that is, the total population.

In this analysis, welfare measure is the adjusted per capita value of consumption expenditure, where the adjustment refers to raising the household size to the power of 0.6 to reflect economies of scale in household size. Thus,

$$g(y_h) = y_h / (S_h)^{0.6}$$

To derive the poverty line ( $P$ ), we select the adjusted per capita consumption expenditure that replicates the official poverty rate for each country based on the distribution of sample households. For example, if the official poverty rate is 20 percent, we define the poverty line as the 20<sup>th</sup> percentile of adjusted per capita consumption expenditure, taking into account household size and the sampling weights.

## Assessment

In interpreting the results of this analysis, it is important to be aware of the assumptions and limitations behind the method:

- It is assumed that increases in the real domestic price of the commodity are due to increases in the price of the same commodity on international markets.

- It measures the direct, first-order welfare impact of price changes, whereas the long-term welfare impact would be slightly smaller as households are able to adjust to price changes.
- It does not take into account general equilibrium effects such as the effect of commodity prices on wages, land rent, and interest rates and the second-round effect of these variables on welfare.

On the other hand, the approach gives reasonable estimates of the welfare and poverty impact of international price changes with only modest data requirements. More specifically, the income and poverty impact can be estimated for any country with monthly price data for staple food crops and either household survey data or inclusion in the Povana database, which covers more than 100 countries. The approach does not require estimates of price elasticities of demand or supply. Although our analysis does not delve into other dimensions of the distributional impact, this approach can also generate impact estimates for various subgroups of households, such as by urban/rural, by region, by income category, by sex of head of household, and by occupation.

*This study is part of a series of case studies that IFPRI is undertaking to assess the impact of higher commodity prices on income and poverty in developing countries. The analysis presented is an initial impact assessment designed to estimate the impact of higher food prices on poverty in selected countries. The initial set of case studies covers Ethiopia, Kenya, Nigeria, Niger, Burkina Faso, and Mali. The analysis may be extended to cover other countries in the future.*

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## ACKNOWLEDGMENTS

This study was conducted by IFPRI with financial support from the UK Foreign, Commonwealth, and Development Office (FCDO) and the US Agency for International Development (USAID). The authors are grateful for guidance and technical input from Rob Vos (IFPRI) and Donald Menzies (FCDO). For further information, please contact Nicholas Minot ([n.minot@cgiar.org](mailto:n.minot@cgiar.org)) or Will Martin ([w.martin@cgiar.org](mailto:w.martin@cgiar.org)).

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Funding for this work was provided by the UK Foreign, Commonwealth, and Development Office (FCDO) and the US Agency for International Development (USAID). The analysis makes use of the Povana database of household income and expenditure patterns. This publication has not been independently peer reviewed. Any opinions expressed here belong to the author(s) and are not necessarily representative of or endorsed by IFPRI.

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