INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
IFPRI

ECONOMYWIDE RISK ASSESSMENT

COUNTRY SERIES

COUNTRY BRIEF 2 | DECEMBER 2024

KENYA

Systematic Analysis of Domestic Production and World Market Shocks

Askar Mukashov, Juneweenex Mbuthia, Lensa Omune, Eleanor Jones, and James Thurlow

This study is part of a series of country briefs by IFPRI that leverages economywide models to deliver detailed risk assessments of key economic indicators. This initial analysis evaluates vulnerabilities in countries and across key population groups to answer two questions: (1) What is the country's current vulnerability to world market prices and domestic production risks that are consistent with historical data? (2) How much do these shocks contribute to the country's current vulnerability, and which shocks contribute most to economic uncertainty?

Abstract

This study explores Kenya's vulnerability to economic shocks and identifies those contributing most to economic uncertainty. The Kenyan Computable General Equilibrium (CGE) model was employed to simulate a range of potential economic outcomes under various sampled shock scenarios developed using historical data to capture domestic agricultural yield volatilities and world market prices uncertainty for traded goods. Data mining and machine learning methods were applied to quantify the contribution of each shock to the uncertainty of economic outcomes (gross domestic product [GDP], private consumption, poverty, and undernourishment). Key findings suggest that domestic yield volatility is the key risk factor for GDP, urban consumption and poverty, while external risks, particularly world beverage crop prices, are more significant for rural consumption and poverty. As the majority of those below the poverty line are rural farmers, world beverage price volatility is the top risk for national poverty levels. Finally, for undernourishment outcomes, domestic cereal yield volatility is the dominant risk factor for all household types. Understanding how possible shocks would impact various segments of the Kenyan economy and population is a critical first step in facilitating discussions on relevant risk mitigation strategies, such as increasing average crop yields, adopting technologies and practices that narrow yield uncertainties, or diversifying production away from risky crops and sectors.

Keywords: risk profiling; yield volatility; world market uncertainty; CGE modeling, machine learning.

1. Analyzing the impacts of simultaneous variability of exogenous shocks

Exogenous shocks, such as droughts and floods or global economic crises, are a significant concern for developing economies like Kenya. These shocks can have profound and complex social, economic, and environmental implications. For instance, household income, consumption, and well-being, particularly for those engaged in agriculture and other vulnerable economic activities are significantly affected. (Pajaron, 2016; Malik & Temple, 2008).

The Kenyan economy has historically been subject to a diverse array of exogenous shocks, which have had significant impacts for the country's economic stability and growth trajectory. (Malik & Temple, 2008). These shocks range from weather-related events such as droughts and floods to global economic crises and commodity price fluctuations. Therefore, understanding the variability of these shocks, and the mechanisms through which they transmit and magnify across interconnected markets is crucial for informing policy decisions, risk management strategies, and effective crisis mitigation. (Mitra & Iyer, 2016; Polson & Scott, 2011).

An examination of the historical dynamics of Kenya's key economic indicators (Figure 1) reveals the main aspects of the country's development. Since the structural trend break in the early 2000s, the country has been rapidly developing, and from 2014, Kenya is classified as a lower-middle-income country by the World Bank. However, periodic shocks hinder the country's economic progress. For example, droughts in 1984, 1990, 1997, 2000, and 2017, and the 1998 El Niño rains reduced agricultural production and contributed to inflation and GDP volatility; the 2008 spike in world market prices coupled with political unrest in 2007-08 significantly affected the Kenyan economy, leading to the worst growth and highest inflation since the political crisis of 1992-93.

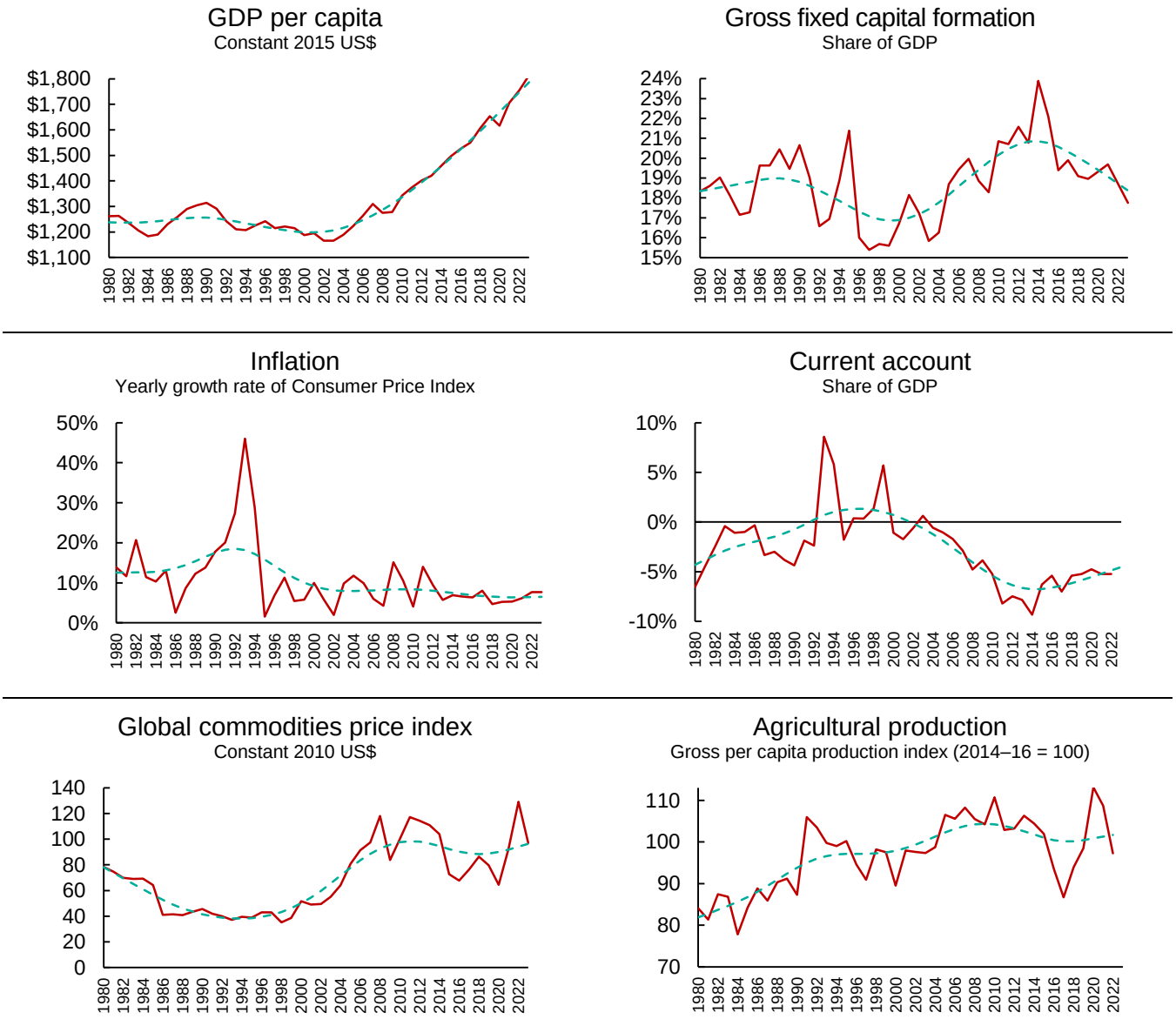
According to the Systematic Country Diagnostic by the World Bank (2020), besides governance and institutional challenges (e.g., macro fiscal disciple, business environment, human capital, political stability, etc.), exogenous risks associated with world market prices and domestic agricultural production remain highly topical for the country.

In this context, our goal is to create a realistic map of the country's exogenous shocks and develop a detailed risk profile of the country's baseline economic structure. The methods and analyses used in this note seek to answer two questions:

- What is the country's current vulnerability to world market prices and agricultural risks that are consistent with *historical data*?
- How much do these shocks contribute to the country's current vulnerability, and which shocks contribute most to economic uncertainty?

To answer these and related questions, we use a novel methodology for country Systematic Risk Profiling (SRP). The method uses machine-learning and data-mining techniques to dissect complex relationships between sampled shocks and outcome variables in an economywide Computable General Equilibrium (CGE) model constructed for Kenya. Our SRP approach consists of three sequential steps: (1) we first use historical data and sample scenarios that sufficiently and realistically represent the parameter space of potential exogenous shocks; (2) we then create potential shock scenarios and supply them to the CGE model of Kenya to estimate the economic outcomes corresponding to sampled shock scenarios; and (3) we use machine-learning and data-mining methods to quantify the contribution of each shock to the uncertainty of various economic outcomes. For details on SRP, see Mukashov et al. (2024).

Figure 1. Historical dynamics of key indicators (long term trend line in dashed blue)



Note: Trend calculation using Hodrick–Prescott filter for yearly data (see Hodrick and Prescott 1997).
Source: Own calculations using World Bank (2024a) data (GDP per capita, gross fixed capital formation), IMF (2024) data (inflation, current account), World Bank (2024b) data (global commodities price index), and FAO (2024) data (agricultural production).

2. Current economic structure and shock scenarios

2.1 The Structure of the Kenyan Economy

Kenya is a lower-middle-income African country with a GDP per capita of 1,970 USD (in 2019), a national poverty rate of 36.1% (in 2015), and an undernourishment rate[1] of 23% (in 2019) (World Bank, 2024a).

The sectoral structure is typical of lower-middle-income countries (Table 1a). Primary agriculture accounts for a large share of economic activity (22.7 percent of GDP and 43.3 percent of employment), of which crops contributes the largest share (16.5 percent of GDP and 31.4 percent of employment). The industrial sector remains underdeveloped, with agroprocessing at 5.0 percent of GDP, and other manufacturing at 3.6 percent of GDP. In terms of share of total demand, services dominate, accounting for 50.0 percent of the total demand, while other manufacturing goods make up 16.0 percent of total demand. Overall, Kenya is a net importer, with manufactured goods constituting the largest share of imports (91.3 percent). Beverage crops (mostly coffee and tea) are the most export-intensive sectors (in terms of export share of output), but the services sector holds the greatest overall export weight due to its sheer size.

On the demand side, Kenyan economy also exhibits characteristics typical of a lower-middle-income countries (Table 1b). Notably, the country has a relatively high share of investment demand (19 percent of GDP, primarily for construction goods and imported machinery), a significant share of net import expenditures (exports account for 9 percent of GDP, while imports represent 18 percent of GDP), and a substantial public sector, with government consumption expenditure amounting to approximately 12 percent of GDP.

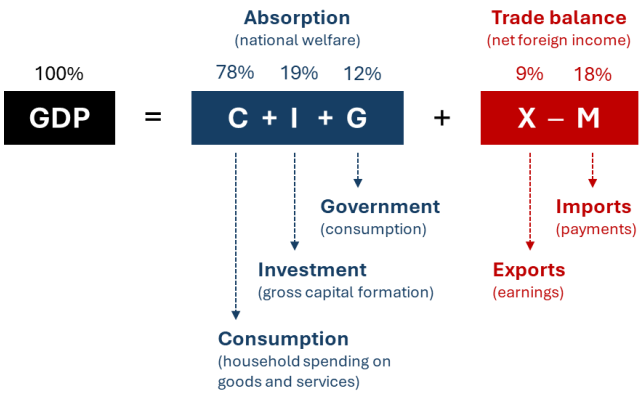
Table 1. Structure of Kenya's Economy

a. Sectoral decomposition

	% of total GDP	% of employment	% of total demand	Export		Import	
				% of sectoral output	% of total export	% of sectoral demand	% of total import
Primary Agriculture	22.7	43.3	14.2	7.7	24.1	1.3	1.5
Crops	16.5	31.4	10.1	10.6	24.1	1.9	1.5
Cereals	3.7	7.1	2.1			9.0	1.5
Roots	2.8	5.3	1.7				
Beverage crops	2.4	4.5	1.0	37.4	13.1		
Livestock	4.0	7.5	2.6				
Forestry	1.7	3.2	1.1				
Fishing	0.6	1.2	0.4				
Mining	1.6	1.1	1.0			4.0	0.3
Manufacturing	8.6	5.8	25.4	11.8	34.0	46.1	91.3
Agroprocessing	5.0	2.5	9.4	12.1	21.0	11.3	8.3
Other manufact.	3.6	3.3	16.0	11.3	12.9	66.6	83.0
Utilities	2.4	1.6	1.5				
Construction	6.1	4.3	7.9				
Services	58.6	43.9	50.0	3.7	41.9	1.8	6.9
Food services	1.3	2.2	1.7	5.9	2.3		
Social services	12.6	9.1	9.9				
Other services	44.7	32.6	38.4	4.5	39.6	2.3	6.9
Total	**100.0**	**100.0**	**100.0**	**5.1**	**100.0**	**12.8**	**100.0**

1 Share of the population whose adult-equivalent daily consumption below the minimum calorie requirement defined by the Food and Agriculture Organization of the United Nations.

b. GDP decomposition by expenditure



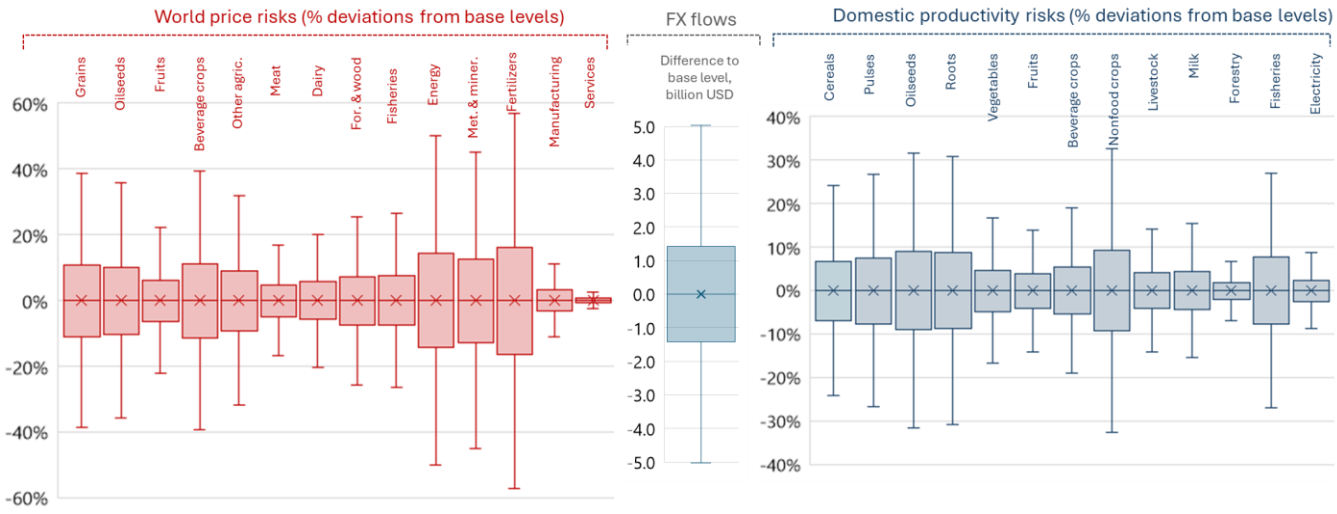
Source: Own calculations based on official national accounts data for 2019 presented in the form of the Social Accounting Matrix (for details, see IFPRI 2021).

2.2 Characteristics of sampled shocks

In this context, the first step of the SRP—estimating the historical volatility of shocks—helps us understand the scale of potential shocks that the *current* Kenyan economy faces. We consider two broad categories of shocks: (1) changes in world prices of goods and services in which Kenya trades and that are mostly affected by global business cycles; and (2) abrupt shifts in domestic agricultural production[2], often linked to droughts and other natural shocks such as pest infestations and diseases. Although the variation of shocks around historical trends is not strictly symmetric around zero, we remain agnostic about *future* shocks. We draw random hypothetical scenarios from a multivariate normal distribution with zero means and a history-based estimated variance-covariance matrix depicted in Figure 2 (panel A shows the modeled individual (marginal) distributions of sampled shocks, and panel B shows correlation structure of sampled shocks).

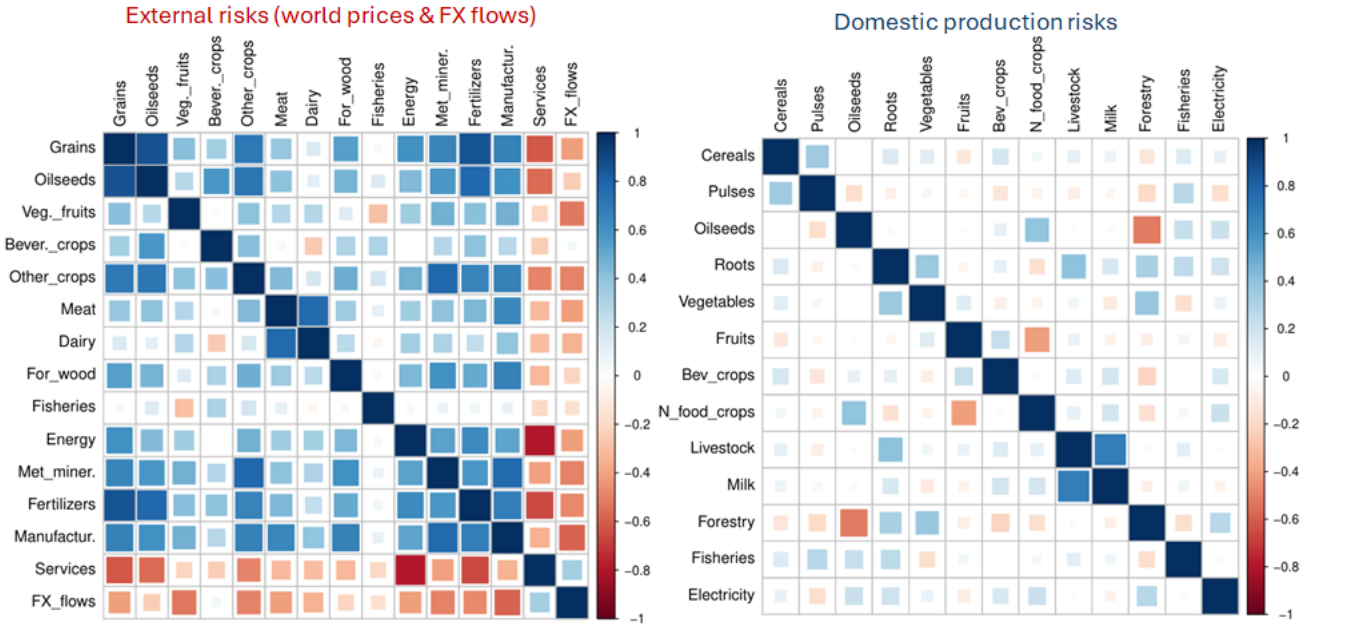
Figure 2. Sampled risks

a. Marginal distributions



2 Whenever possible, we use yields agricultural yield as a measure of productivity. For some sectors where historical yield data do not exist (livestock, milk, forestry, electricity), we use historical per capita production as a proxy for total factor productivity (see Mukashov et al. (2024) for details).

b. Correlation structure



Note: Each cell in the correlation figure is a correlation between two variables, with cell sizes ranging from empty (0 correlation) to full squares (max correlation=1) and colors ranging from red (-) to blue (+).

Source: Own calculations using World Bank (2024a, 2024b), FAO (2024), and IMF (2024) data.

World price volatility: World prices of primary commodities are highly volatile, whereas manufactured goods and services exhibit much greater stability (Figure 2a). Among agricultural commodities, beverage crop prices are the most volatile, followed by grains. The prices of primary commodities show a strong positive correlation (Figure 2b), suggesting that price shocks often occur simultaneously due to their dependence on global business cycles (see Erten and Ocampo, 2013). In contrast, services exhibit a moderate negative correlation with most commodities, suggesting that when the prices of other commodities rise in real USD terms, the price of services in real USD may sometimes decline (however, the overall variation in service prices remains very low, see Figure 2a).

Volatility of FX flows: We assume that foreign exchange (FX) flows enter the economy as foreign savings denominated in USD, influencing both the exchange rate and investment demand (primarily in construction). To estimate changes in FX flows, we use current account data from the IMF (2024), which indicates that FX flows deviate by approximately ±5 billion 2019 USD (Figure 2a), equivalent to ±5% of 2019 GDP.

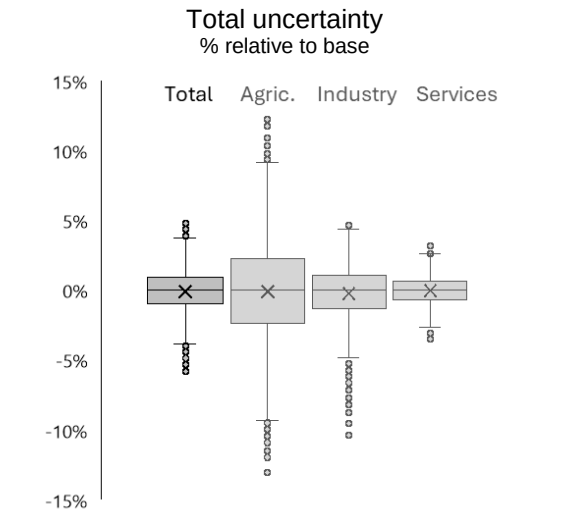
Domestic production volatility: According to our analysis based on FAO data (2024), the yields of oilseeds, roots, non-food crops and pulses are the most uncertain in Kenya (Figure 2a). These yield uncertainty patterns are explained by the heavy reliance on rain-fed agriculture coupled with unsustainable agricultural practices thus enhancing Kenya's vulnerability to weather events like floods and droughts. At the same time, livestock and milk production exhibit moderate volatility, likely due to seasonality in the availability of livestock feed and water resources. In terms of correlation structure, milk and livestock production have a high positive correlation, while cereals-pulses, oilseeds-non-food crops, and roots-livestock exhibit moderate positive correlations (Figure 2b).

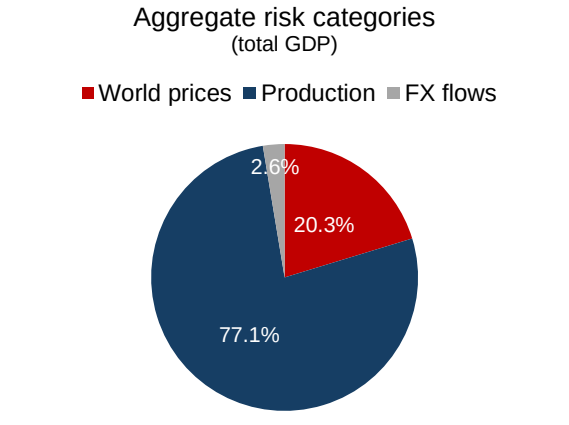
3. Measuring and understanding Kenya's economic uncertainty

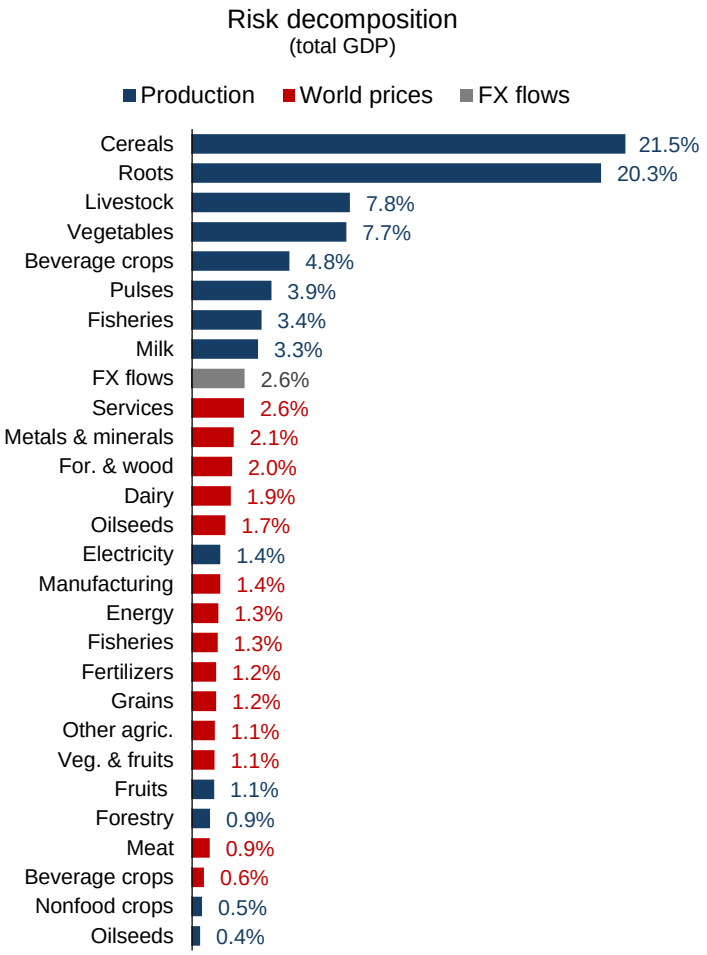
The second step of the SRP models the economic uncertainty resulting from the 10,000 sampled scenarios supplied to the CGE model of Kenya, while the third step employs machine-learning and data-mining methods to quantify each shock's contribution to outcomes' uncertainty[3]. Figures 3 to 6 represent the total uncertainty and its decomposition for GDP, private consumption, poverty, and undernourishment economic outcomes, respectively.

Potential Variation of GDP (Figure 3): Total GDP can fluctuate from -5.8 percent (worst case) to +4.8 percent (best case) relative to the base year GDP. Agriculture, directly exposed to productivity shocks, is the most uncertain sector, with growth ranging from -13 percent to +12.3 percent relative to the sector's base year value. Domestic yield volatility of cereals and roots are the most important risk factors, accounting for 21.5 percent and 20.3 percent of total GDP uncertainty. Overall, domestic production risks account for 77.1 percent of total GDP uncertainty, with external risks contributing another 22.9 percent.

Figure 3. Potential variation of GDP







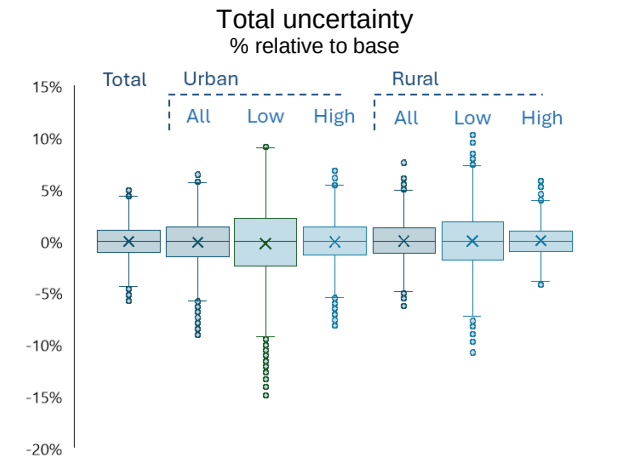
Source: Own calculations using simulation data.

3 We use Random Forest and Lindeman, Merenda, and Gold relative importance metrics; for details, see Mukashov et al. (2024).

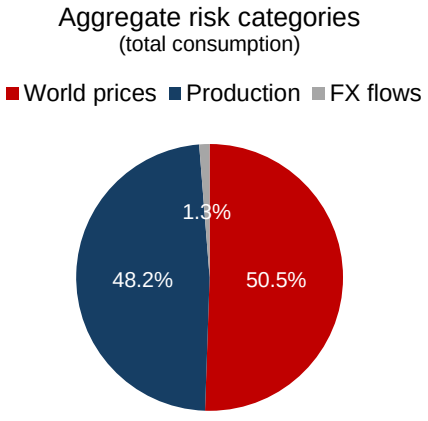
Potential variation of private consumption (Figure 4 and Table 2): Total consumption can fluctuate from +5.2 percent to -5.8 percent relative to base values, but low-income household consumption is more uncertain: +9.5 percent to -14.9 percent for urban poor and +10.2 percent to -10.8 percent for rural poor. For total consumption uncertainty, external factors and domestic yield volatility are nearly equally important risk factors. However, significant differences exist across household types (Table 2).

For urban households, domestic production uncertainty is more important (ranging from 64.7 percent for low-income to 59.3 percent for high-income). Cereal yield volatility is the most important risk factor for all urban households, but its relative importance is the highest for the urban low-income (31.8 percent) and the lowest for the high-income (13.2 percent, but still the most important risk). For urban high-income households, productivity variability in roots and livestock becomes an additional important risk factor (11.7 percent and 11.2 percent, respectively).

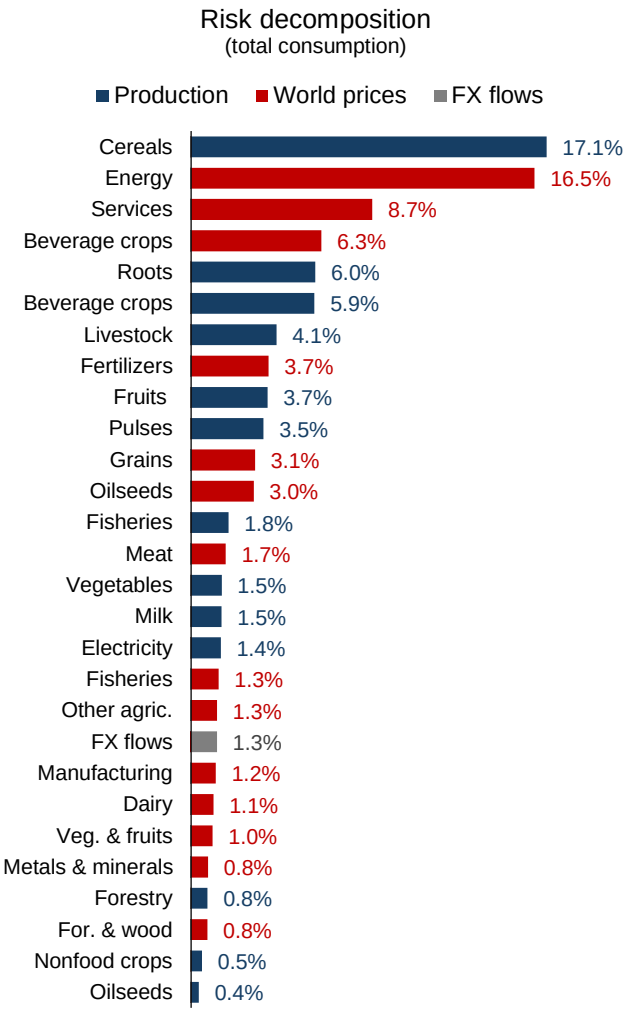
Figure 4. Potential variation of private consumption



Note: Low comprises the first- and second-income quintiles and high comprises the fifth income quintile of urban and rural households, respectively.



Source: Own calculations using simulation data.



In contrast, for rural households, external uncertainty is more significant (ranging from 60.6 percent for low-income to 80.4 percent for high-income). The world price of Kenya's main export, beverage crops, is the key risk factor for farmers' incomes and consumption. This risk is most significant for medium-income

rural households (22.7 percent) but also important for rural low-income (16.8 percent) and rural high-income (13.5 percent, second only to world energy prices at 23 percent).

Table 2. Detailed risk decompositions of consumption uncertainty

		Total	Urban				Rural			
			Total	Low	Middle	High	Total	Low	Middle	High
Total external		**51.8**	**39.2**	**35.3**	**38.0**	**40.7**	**74.0**	**60.6**	**77.2**	**80.4**
World prices	Grains	3.1	2.3	2.5	1.8	2.4	3.3	3.4	2.9	3.6
	Oilseeds	3.0	5.0	5.3	4.8	4.9	2.8	2.3	3.4	2.4
	Vegetables & fruits	1.0	1.6	2.5	2.9	1.2	1.3	1.2	1.4	1.4
	Beverage crops	6.3	1.4	2.3	2.7	1.2	19.8	16.8	22.7	13.5
	Other agriculture	1.3	1.5	0.9	0.9	1.9	2.1	2.1	2.2	1.8
	Meat	1.7	1.4	0.9	1.1	1.5	2.2	1.6	2.3	2.5
	Dairy	1.1	1.7	0.8	1.3	1.9	5.8	5.0	6.4	4.6
	Forestry & wood	0.8	0.7	0.7	0.8	0.7	1.6	1.5	1.3	2.2
	Fish	1.3	1.0	1.6	1.2	0.9	2.5	4.2	2.0	1.0
	Energy	16.5	9.3	4.1	5.8	10.5	14.1	8.3	14.3	23.0
	Metals & minerals	0.8	0.9	0.9	1.2	0.9	1.4	1.0	1.3	2.6
	Fertilizers	3.7	2.1	2.8	1.5	2.3	5.1	5.9	4.1	4.6
	Manufacturing	1.2	0.8	0.9	1.2	0.9	2.6	1.7	2.7	4.3
	Services	8.7	7.1	4.5	4.4	8.0	4.2	3.0	3.7	7.1
FX flows		1.3	2.5	4.5	6.3	1.7	5.2	2.9	6.6	5.8
Total domestic		**48.2**	**60.8**	**64.7**	**62.0**	**59.3**	**26.0**	**39.4**	**22.8**	**19.6**
Domestic production	Cereals	17.1	14.9	31.8	15.9	13.2	5.5	17.7	2.0	0.6
	Pulses	3.5	3.5	5.3	3.2	3.3	1.1	2.0	0.7	0.8
	Oilseeds	0.4	0.8	0.4	0.9	0.9	2.0	1.7	2.4	1.3
	Roots	6.0	12.5	8.9	14.7	11.7	2.3	2.9	2.1	1.6
	Vegetables	1.5	4.0	4.5	4.4	3.7	2.5	1.7	2.9	2.5
	Fruits	3.7	3.2	1.3	3.2	3.3	1.7	0.9	2.0	3.3
	Beverage crops	5.9	3.5	3.7	4.4	3.2	4.7	4.1	4.3	5.1
	Nonfood crops	0.5	0.6	0.4	0.6	0.7	0.6	0.7	0.6	0.6
	Livestock	4.1	9.9	2.4	6.6	11.2	2.0	3.5	1.9	0.5
	Milk	1.5	3.2	0.9	1.9	3.9	0.9	1.7	0.8	0.4
	Forestry	0.8	1.0	0.8	0.8	1.1	1.1	0.9	1.5	0.9
	Fisheries	1.8	2.3	2.7	3.3	2.0	0.9	0.8	0.9	1.4
	Electricity	1.4	1.2	1.7	2.1	1.0	0.8	0.8	0.8	0.8

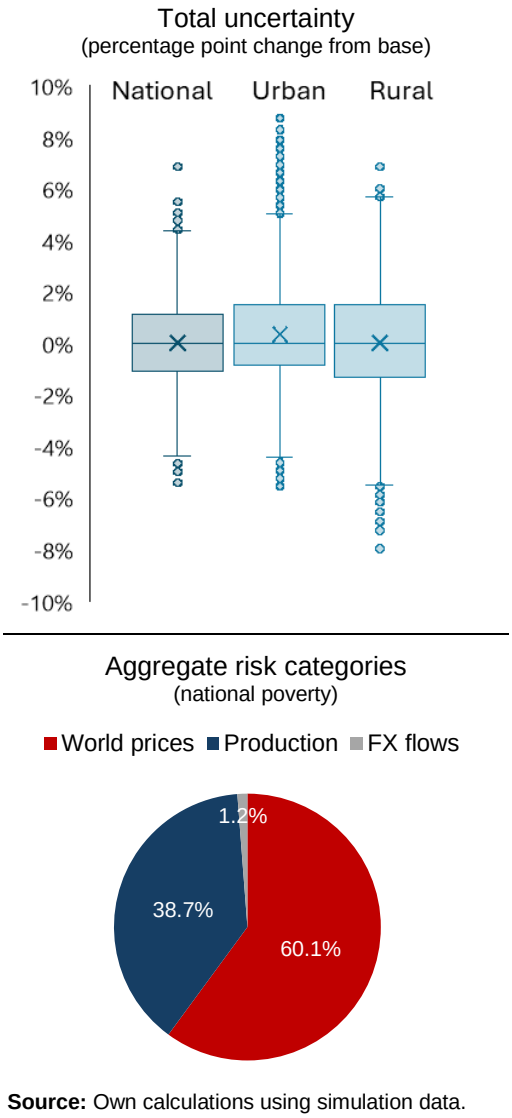
Note: Low comprises the first- and second-income quintiles, middle comprises the third- and fourth-income quintiles, and high comprises the fifth income quintile of urban and rural households, respectively.

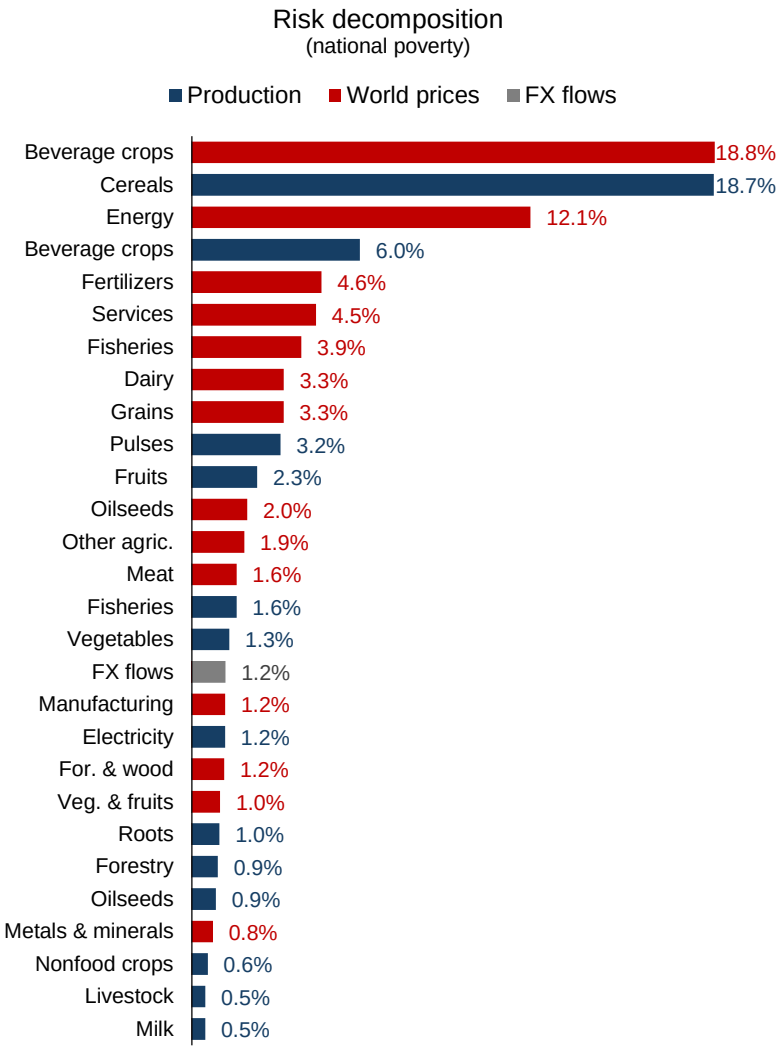
Source: Own calculations using simulation data.

Potential variation of poverty headcount (Figure 5 and Table 3): Poverty rates fluctuate with low-income households' consumption, ranging from -5.8 to +5.2 percentage points relative to the baseline national poverty headcount rate of 36.1%. In absolute numbers, this equates to 2.8 million people above the poverty line in the best case and 3.5 million below the poverty line in the worst case. Nationally, external risks are the dominant factors (60 percent of total risk), mainly contributed by the world prices of beverage crops (18.8 percent), followed by energy (12.1 percent) and fertilizer (4.6 percent) world prices, but there are notable differences across household types (Table 3).

For urban poverty, domestic yield volatility of cereals and roots is the most significant risk (19.4 and 10.9 percent, respectively), with domestic factors making up 60 percent of total risk. This is explained by the high reliance of urban households on the distribution of food from surrounding rural regions. For instance, when the yields of staple crops such as maize or cassava fluctuate due to weather events such as droughts, food prices in the urban markets become unstable due to supply constraints. This directly impacts the urban poor who spend a substantial proportion of their income on food. For rural poverty, external risks make up 66.7 percent, with the world price of beverages being the most significant risk (20.8 percent) followed by world energy prices (9.4 percent). Any change in the global market price significantly influences the income of rural households, especially those dependent on cash crops for their livelihoods, making these changes a significant risk for rural poverty.

Figure 5. Potential variation of poverty headcount rate

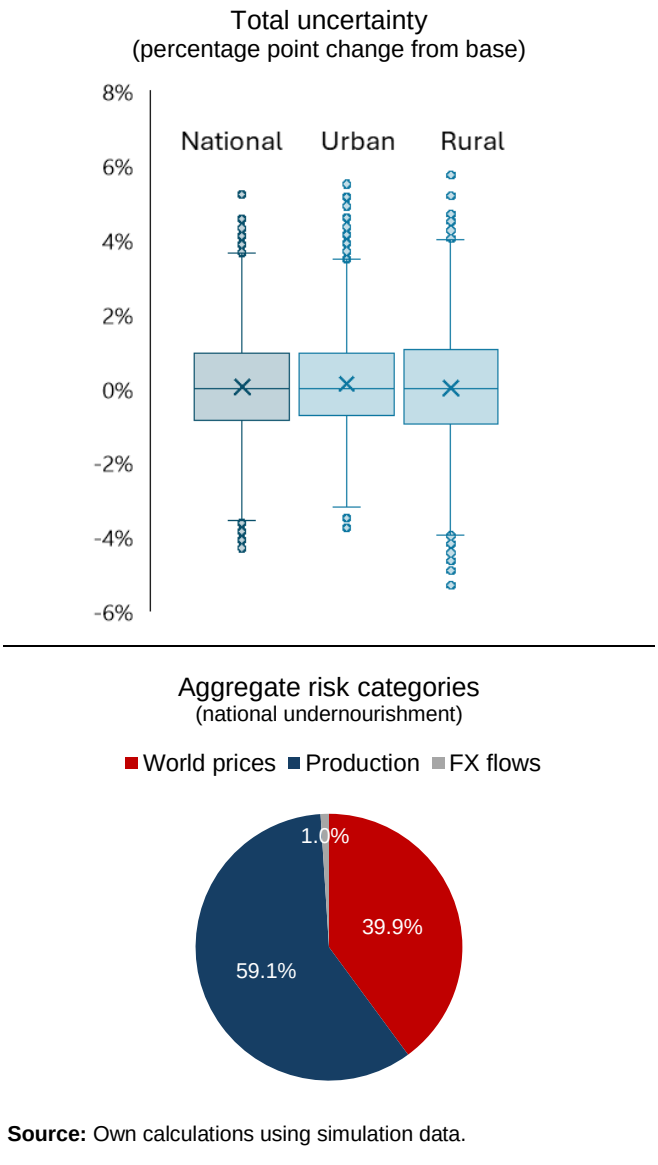




Source: Own calculations using simulation data.

Potential variation of undernourishment headcount (Figure 6 and Table 3): Undernourishment rates fluctuate from -4.3 to +5.2 percentage points relative to the baseline national undernourishment rate of 23%. This translates to 2.2 million people above the undernourishment line in the best case and 2.7 million below in the worst-case scenario. Unlike other outcomes, undernourishment uncertainty is similar across households and primarily driven by a narrow set of risks. Cereal yield variability is the most significant risk factor for all households (32.4 percent for urban, 35.4 percent for rural). Since staple food production drives calorie supply in Kenya, it is unsurprising that cereal yields are the key risk factor for undernourishment.

Figure 6. Potential variation of undernourishment headcount rate



Source: Own calculations using simulation data.

Table 3. Detailed risk decompositions of poverty and undernourishment uncertainty

		Poverty			Undernourishment		
		National	Urban	Rural	National	Urban	Rural
Total external		61.3	40.0	66.7	40.9	36.7	45.7
World prices	Grains	3.3	2.1	3.2	4.3	3.2	4.3
	Oilseeds	2.0	4.9	2.8	3.6	6.9	2.4
	Vegetables & fruits	1.0	2.5	1.2	1.2	1.8	1.1
	Beverage crops	18.8	3.7	20.8	4.2	1.5	6.6
	Other agriculture	1.9	0.9	2.4	1.1	1.2	1.3
	Meat	1.6	1.1	1.8	0.8	0.8	1.0
	Dairy	3.3	1.1	5.8	0.7	1.1	1.7
	Forestry & wood	1.2	0.6	1.7	1.3	0.6	1.8
	Fish	3.9	1.4	4.2	3.2	1.5	3.9
	Energy	12.1	6.7	9.4	6.4	3.8	6.8
	Metals & minerals	0.8	1.0	1.0	0.8	0.9	0.9
	Fertilizers	4.6	1.9	4.9	6.6	3.5	7.4
	Manufacturing	1.2	1.0	1.9	1.0	0.9	1.4
	Services	4.5	4.7	2.6	4.7	4.6	4.0
FX flows		1.2	6.4	2.8	1.0	4.4	1.2
Total domestic		**38.7**	**60.0**	**33.3**	**59.1**	**63.3**	**54.3**
Domestic production	Cereals	18.7	19.4	9.3	40.0	32.4	35.4
	Pulses	3.2	4.3	1.5	7.4	7.4	5.9
	Oilseeds	0.9	0.8	1.9	0.4	0.7	0.7
	Roots	1.0	10.9	4.6	0.9	6.3	1.5
	Vegetables	1.3	2.6	3.6	0.5	2.0	1.1
	Fruits	2.3	3.1	1.3	0.6	0.9	0.6
	Beverage crops	6.0	4.4	3.9	3.9	2.9	3.6
	Nonfood crops	0.6	0.5	0.7	0.4	0.3	0.5
	Livestock	0.5	5.7	3.0	0.3	3.0	1.0
	Milk	0.5	1.7	1.2	0.4	1.1	0.6
	Forestry	0.9	1.0	1.0	1.3	1.6	1.1
	Fisheries	1.6	3.7	0.8	2.2	3.5	1.4
	Electricity	1.2	1.8	0.6	0.8	1.1	0.7

Source: Own calculations using simulation data.

4. Summary and next steps in the analysis

We use a new method to construct a systematic risk profiling of exogenous shocks for the Kenyan economy. By analyzing historical data, we derive a consistent parameter space for both world market and domestic production volatility, sampling realistic shock scenarios that can impact the Kenyan economy. These scenarios are applied to the Kenyan CGE model to estimate economic uncertainty, and decomposition methods are used to identify the most important sources of uncertainty.

We find that domestic yield volatility is the key risk factor for GDP and urban consumption and poverty, while external risks, particularly world beverage prices, are more significant for rural consumption and poverty. As the majority of the poor are rural farmers, world beverage price volatility is the top risk for national poverty levels. For undernourishment, cereal yield volatility is the key risk factor.

This study is part of a series by IFPRI that uses economy-wide models to provide detailed risk assessments of key economic indicators. The analysis presented here is an initial impact assessment aimed at gauging the vulnerability of countries and key population groups. Future analyses will focus on comparing risk management strategies, which fall into three main categories: 1. Increasing average yields to reduce the impact of negative risks; 2. Adopting technologies and practices that narrow yield uncertainty; 3. Diversifying production toward less risky crops and sectors.

Acknowledgments

This work was undertaken as part of the “Future Food Systems” project funded by the Gates Foundation and the International Affairs Office (IAO) at the Presidential Court of United Arab Emirates. The modeling and data systems and analytical techniques were developed with financial support from the CGIAR Research Initiative on Foresight and the United States Agency for International Development (USAID). We thank all funders who contribute to the CGIAR Trust Fund. USAID support was provided by the Office of Policy, Analysis and Engagement, Bureau for Resilience, Environment and Food Security (REFS) under the Policy, Evidence, Analytics, Research, and Learning (PEARL) (award #720RFS22IO00003), and by the Feed the Future (FtF) Innovation Lab for Food Security Policy, Research, Capacity, and Influence (PRCI) and the Comprehensive Action for Climate Change Initiative (CACCI).

We are also grateful to Karl Pauw, Senior Research Fellow at the International Food Policy Research Institute, for his valuable assistance in improving an earlier version of this paper.

References

Erten, B., and J. A. Ocampo. 2013. “Super Cycles of Commodity Prices Since the Mid-Nineteenth Century.” *World Development*, 44: 14–30. doi:10.1016/j.worlddev.2012.11.013

Food and Agriculture Organization of the United Nations (FAO). 2024. FAOSTAT. Database, Food and Agriculture Organization. Retrieved from http://www.fao.org/faostat/en/#home

Hodrick, R. J., and E. C. Prescott. 1997. “Postwar U.S. Business Cycles: An Empirical Investigation.” *Journal of Money, Credit and Banking*, 29: 1. doi:10.2307/2953682

IFPRI (International Food Policy Research Institute). 2021. 2019 Social Accounting Matrix for Kenya. Harvard Dataverse, Version 1. Washington, DC: International Food Policy Research Institute. https://doi.org/10.7910/DVN/ALUXSI

International Monetary Fund (IMF). 2024. *International Monetary Fund. World Economic Outlook Database April 2024 Edition.* Database. Retrieved from https://www.imf.org/en/Publications/WEO/weo-database/2024/April

Malik, A., and Temple, J. (2008). The geography of output volatility. In A. Malik & J. Temple, Journal of Development Economics (Vol. 90, Issue 2, p. 163). Elsevier BV. https://doi.org/10.1016/j.jdeveco.2008.10.003

Mitra, A., and Iyer, V. (2016). Transmission of Volatility across Asia-Pacific Stock Markets: Is There a Pattern? In A. Mitra & V. Iyer, IIM Kozhikode Society & Management Review (Vol. 6, Issue 1, p. 42). SAGE Publishing. https://doi.org/10.1177/2277975216676118

Mukashov, A., S. Robinson, J. Thurlow, C. Arndt, and T. Thomas. 2024. “Systematic Risk Profiling: A Novel Approach with Applications to Kenya, Rwanda, and Malawi.” IFPRI Discussion Paper 02286, October 2024. https://hdl.handle.net/10568/158180

Pajaron, M. (2016). The role of remittances as a risk-coping mechanism: Evidence from agricultural households in rural Philippines. In M. Pajaron, Asian and Pacific migration journal (Vol. 26, Issue 1, p. 3). SAGE Publishing. https://doi.org/10.1177/0117196816680625

Polson, N. G., and Scott, J. G. (2011). Explosive Volatility: A Model of Financial Contagion. In N. G. Polson & J. G. Scott, Cornell University. https://arxiv.org/pdf/1110.5789

World Bank. (2020). Kenya - Systematic Country Diagnostic. Retrieved from https://documents1.worldbank.org/curated/en/531731600090213005/pdf/Kenya-Systematic-Country-Diagnostic.pdf

World Bank. 2024a. World Development Indicators. Database. Retrieved from https://databank.worldbank.org/source/world-development-indicators

World Bank. 2024b. Commodity Markets Outlook. Database. Retrieved from https://thedocs.worldbank.org/en/doc/5d903e848db1d1b83e0ec8f744e55570-0350012021/related/CMO-Historical-Data-Annual.xlsx

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

A world free of hunger and malnutrition

IFPRI is a CGIAR Research Center

1201 Eye Street, NW, Washington, DC 20005 USA | T. +1-202-862-5600 | F. +1-202-862-5606 | Email: ifpri@cgiar.org | www.ifpri.org | www.ifpri.info