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Systematic Analysis of World Market and Domestic Production Shocks

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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 across economic sectors and key population groups to answer two questions: (1) How vulnerable are Ghana's national economy and population to world market and domestic production shocks? (2) What are the largest risks to Ghana's overall economic performance, private consumption, and reductions in poverty and undernourishment?

Overview

Achieving development goals is subject to economic uncertainties, yet policymaking rarely accounts for these risks. This Country Brief quantifies the risks facing Ghana's economy and population, focusing on two primary sources:

1) **External risks** stemming from shocks in international commodity prices and foreign capital flows and
2) **Domestic risks** associated with production shocks in volatile sectors of the Ghanaian economy, such as primary agriculture and hydropower electricity generation, are often caused by extreme weather.

The significance of these risks is assessed based on the range of the shocks' impacts on four main economic and development indicators: total GDP, private consumption, poverty rate, and prevalence of undernourishment.

The analysis uses data mining methods to simultaneously sample many shocks from historical data, constructing a comprehensive set of realistic shock scenarios for Ghana. A country-specific, economywide Computable General Equilibrium (CGE) model then simulates the impacts of these shocks on both total and sector-specific economic outcomes, deriving changes in poverty and undernourishment for each

shock scenario. Finally, machine learning techniques are applied to obtain metrics for the relative importance of different risk factors.

The results suggest that Ghana's trade-oriented economy is predominantly exposed to external risks, with fluctuations in world prices of key exports—particularly energy and metals—significantly influencing economic activity and the country's ability to finance imports. Poverty and undernourishment risks present a more complex picture, with a significant difference between urban and rural risk factors. Rural households, which are generally poorer than urban households and constitute the majority of the poor and undernourished population, are more exposed to domestic production volatility factors.

Understanding these economic risks is a critical first step in facilitating discussions on potential risk management strategies, such as promoting domestic productivity growth and diversifying economic activity away from high-risk sectors.

1. Background and Objectives

An examination of the historical dynamics of Ghana's key economic indicators helps identify some of the main influences on the country's development (Figure 1). Since the beginning of the 1980s, the country has experienced consistent growth (Figure 1A). According to the Systematic Country Diagnostic by the World Bank (2018), the key to Ghana's success was a combination of factors, including structural reforms that led to rapid increases in total factor productivity, commodity exports, political stability, investment in infrastructure, and human capital development. As a result, the country became less dependent on agriculture and experienced structural transformation, with the services and industry sectors gaining economic importance (Figure 1B). Ghana reached middle-income status in 2011 (World Bank, 2018).

At the same time, despite the country's success, several factors pose risks to its development. Ghana remains relatively reliant on gold, cocoa, and crude oil and gas exports, with natural resource rents fluctuating between 8 and 16 percent of GDP in recent years (Figure 1D). Fluctuations in world market commodity prices (Figure 1E) frequently lead to trade and current account volatility (Figure 1F), which in turn affects government fiscal stability (World Bank, 2018). Additionally, while agricultural productivity has gradually improved over time, year-on-year production remains volatile (Figure 1C).

Governments in Ghana and around the world rely on economic projections to inform policy decisions and achieve development goals. However, the accuracy of projected trends and, even more so, the occurrence of economic shocks are naturally uncertain. Recent economic crises such as the global COVID-19 recession and global food and market disruptions due to Russia's invasion of Ukraine are stark reminders of the unpredictability of future events and the severity of these crises' impacts on the national economies and populations of many countries highlighted the unpreparedness of their governments. Major impacts in developing countries included setbacks in poverty and hunger reduction, jeopardizing the achievement of the first two Sustainable Development Goals of UN Member States by 2030.

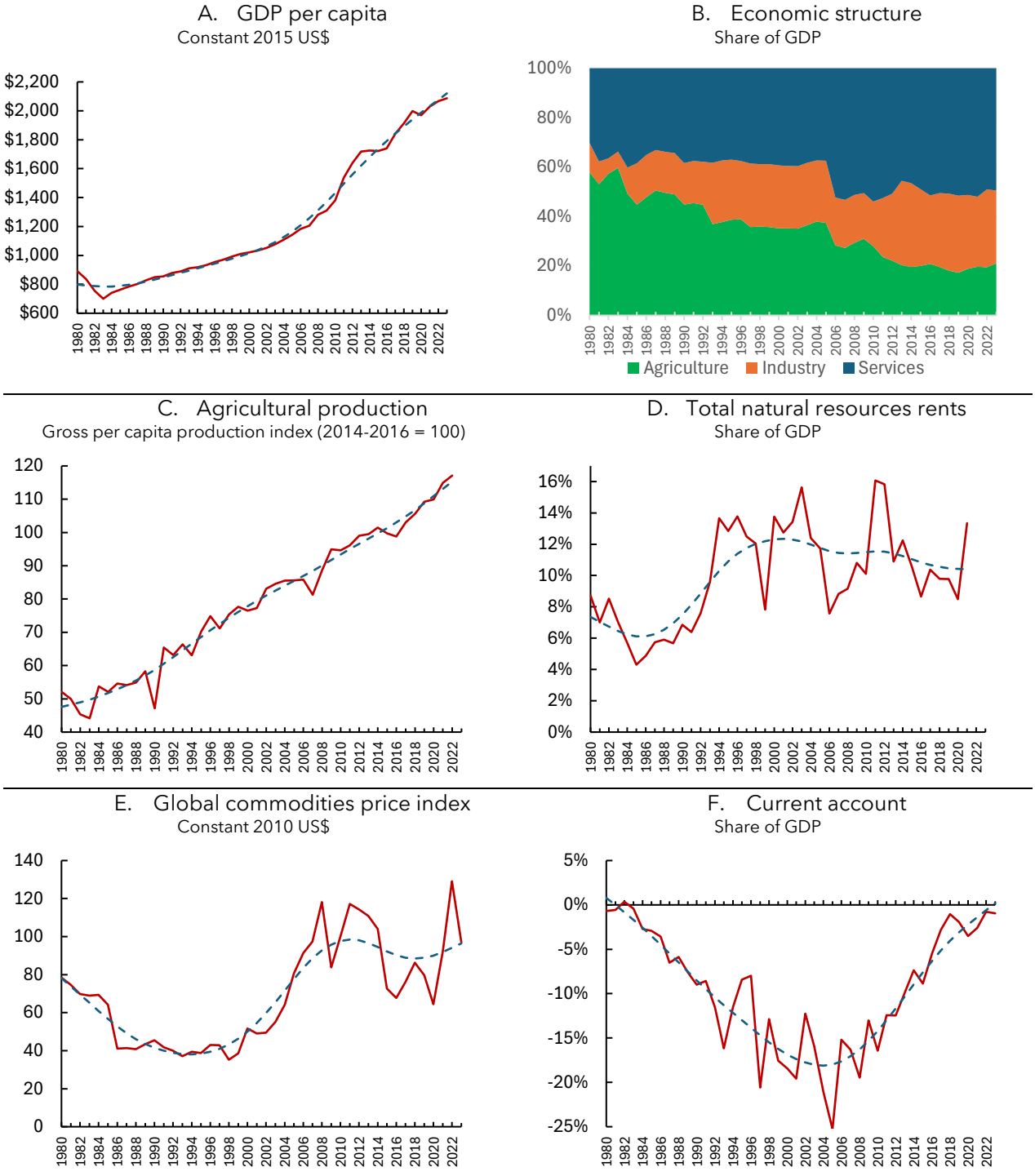
Policymaking rarely considers the economic risks around projections and shock occurrence. This is mainly because systematic analyses of economic shocks and quantification of the associated risks are lacking, especially for developing countries. We address this gap by providing country-specific economywide risk assessments and detailed risk profiles for key economic and development indicators.

Our analysis addresses two main questions:

1) How vulnerable are Ghana's national economy and population to world market and domestic production shocks?

2) What are the largest risks to Ghana's overall economic performance, private consumption, and progress toward ending poverty and hunger?

Figure 1. Historical movements of main economic indicators in Ghana



Note: Dashed blue lines indicate long-term trends. The trend calculation uses the Hodrick–Prescott filter for annual data (Hodrick and Prescott 1997).
Source: Own presentation based on GDP per capita, economic structure, and total natural resources rents data from World Bank (2024a), global commodity price index data from World Bank (2024b), agricultural production data from FAO (2024), and current account data from IMF (2024).

2. Concept and Methodological Overview

Unlike conventional economic projection analysis, our assessment of economic risks does not require speculation of Ghana's future long-term economic performance. Instead, we focus on economic *volatility* and analyze simulated outcomes for the entire bandwidth of potential but realistic shock scenarios. Innovatively, we adopt the concept of *risk* as understood in finance to a macroeconomic policy analysis framework (Box 1).

We assess risks to the national economy and population of Ghana belonging to two risk types:

1) **External risks** associated with shocks in international commodity prices and foreign capital flows (*world market shocks*)[1] and
2) **Domestic risks** associated with production shocks in volatile sectors of the Ghanaian economy (*domestic production shocks*) caused by extreme weather, for example.

The considered commodities are the goods and services that Ghana trades. The considered sectors are primary agriculture and hydropower electricity generation, which are essential to Ghana's economic performance and Ghanaian's wellbeing. Given the size and diversity of the agricultural sector and its crucial role in achieving development goals such as rural development, food security, and poverty and hunger eradication, we disaggregate agriculture into different crop and livestock production, forestry, and fishery subsectors. Our analysis focuses on exogenous shocks, which are beyond the government's direct control.

We examine the external and domestic risks in Ghana's current economic volatility environment using available historical information for realistic scenario formulation. To do that, we developed a novel methodology – called *Systematic Risk Profiling (SRP)* – that integrates CGE modelling, data mining, and machine learning methods (Mukashov et al. 2024).

Box 1. Terminology

Risk is defined as the measurable likelihood of variation in an economic variable and, therefore, differs from *uncertainty*, which broadly refers to the (unquantifiable) unknown. *Risk* can be quantified by using statistical metrics such as variance or standard deviation that measure the degree of variation around a variable's average. Following the terminology in finance, *risk* and *volatility* have similar meanings in our analysis, but we use *volatility* in a more generic sense. *Risk* is inherent in both economic *shocks* and *outcomes*, with the risks of shocks influencing the risks of outcomes. We refer to the contribution of a given shock variable to the volatility of an outcome as a *risk factor*. The representation of the *risk factors* of an economic or development outcome ranked by their relative importance is referred to as *risk profile*. A *shock* is a sudden, measurable change that significantly disrupts the functioning of an economy or a part thereof, and an *outcome* is the resulting, measurable change in an indicator of economic performance or development.

The SRP consists of three sequential steps:

1) **Data mining methods** are employed to simultaneously sample world market and domestic production shocks from annual time-series data spanning over four decades (1980 – 2023) to construct a comprehensive set of shock scenarios that realistically represent all possible combinations of exogenous shocks for Ghana.

[1] International trade flows and foreign capital flows are closely linked, and both affect Ghana's trade balance and exchange rate (see Section 4). We therefore refer to sudden changes in either or both flows as "world market shocks" for brevity.

2) An **economywide CGE model** for Ghana is used to simulate the impacts on various (sub)sector-specific economic outcomes for each shock scenario and derive corresponding changes in development outcomes from a linked microsimulation model and
3) **Data mining and machine learning techniques** are applied to quantify the contributions of individual shock variables to the volatility of key economic and development outcomes that are then used to rank these risk factors and produce detailed risk profiles.

The selected economic outcomes are (1) the overall performance of the national economy, as measured by GDP per capita, and (2) private (or household) consumption, as measured by total consumer spending. The development outcome indicators are (3) the poverty headcount rate (measured at the official national poverty line and using per capita expenditure as a proxy for income) and (4) the prevalence of undernourishment (i.e., the share of people with insufficient calories, interchangeably referred to as "hunger" in this brief). The results of our analysis are summarized in separate risk profiles that rank the risk factors by their relative importance for each of these four outcomes.

3. Structure of the National Economy

To contextualize our SRP analysis and identify vulnerabilities in Ghana's national economy that may predefine its exposure to exogenous shocks, we first examine the economy's current structure. Ghana is a lower-middle-income country with a GDP per capita of 2,186 USD (2019), a national poverty rate of 23.4 percent (based on the most recent household survey in 2016), and an undernourishment rate[2] of 6.9 percent (2019) (World Bank, 2024a).

The sectoral decomposition of Ghana's economy (Table 1) exhibits features that are not typical for a country at its stage of development, as the economy is already skewed toward tertiary sectors despite having only recently attained lower-middle-income status (for a discussion, see Rodrik, 2016). The primary sectors—agriculture and mining—still constitute a significant share of economic activity (agriculture accounts for 18.5 percent of GDP and 29.2 percent of employment, and mining accounts for 11.8 percent of GDP and 2.9 percent of employment). The secondary sector remains relatively underdeveloped, with nonfood manufacturing contributing 9.8 percent to GDP despite comprising 27.2 percent of total domestic demand, and the agro-processing sector contributing 3.4 percent to GDP despite comprising 10.1 percent of total domestic demand. The services sector, on the other hand, is the largest economic sector, accounting for 48.2 percent of GDP, 50.9 percent of employment, and 40 percent of total demand. In terms of trade, Ghana's largest export sector is mining (primarily energy and gold ore), accounting for 44.3 percent of total exports, while the largest import sector is manufacturing, comprising 52.8 percent of total imports (8.4 percent processed food and 44.4 percent nonfood manufacturing). The services sector (mostly transport, finance, and business) is the second-largest import and export sector (42.2 percent of total imports and 39.9 percent of total exports). Finally, beverage crops, which in the case of Ghana primarily consists of cocoa, despite having a relatively small share of GDP (1.7 percent) and employment (2.6 percent), are Ghana's most export-intensive sector, with 84.5 percent of its output exported. This surpasses even the mining sector, which exports 82.6 percent of its output.

The decomposition of GDP by expenditure (Figure 2) also highlights some distinct features of Ghana's economy. In particular, the country is characterized by a high trade intensity, with exports accounting for

2 Share of the population whose adult-equivalent daily consumption is below the minimum calorie requirement defined by the Food and Agriculture Organization of the United Nations (approximately 1,800 kilocalories per person per day).

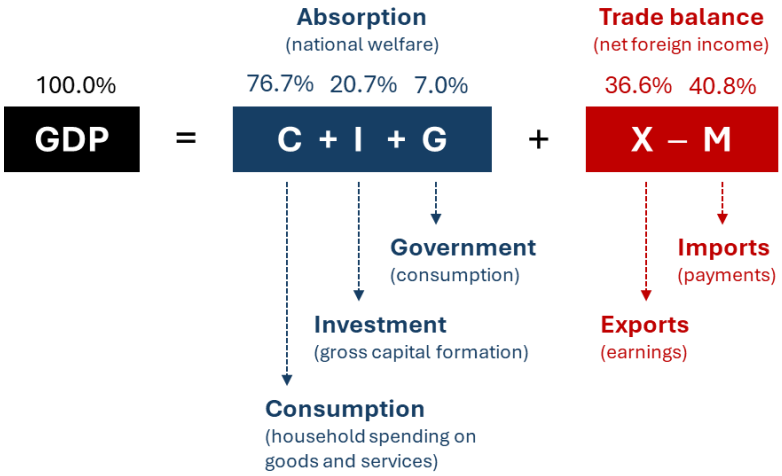
36.6 percent of GDP and imports for 40.8 percent of GDP,[3] as well as a relatively high investment share (construction and machinery), which makes up 20.7 percent of GDP.

In sum, Ghana's economy exhibits structural characteristics that predispose it to greater vulnerability to world market shocks than to domestic production shocks. This is evident from the country's strong trade orientation and the relatively small share of primary agriculture, which is typically the most volatile sector of the economy. However, a snapshot of the current economic structure does not provide sufficient detail. The SRP analysis, with its specification of exogenous shock sizes and economic linkages—captured in the CGE model—offers a more comprehensive foundation for developing Ghana's economic risk profile.

Table 1. Composition of Ghana's economy by sectors

	% of total GDP	% of employ-ment	% of total demand	Export		Import	
				% of sectoral output	% of total export	% of sectoral demand	% of total import
Primary Agriculture	18.5	29.2	10.4	12.0	5.3	11.9	4.9
Crops	14.6	23.1	6.5	16.0	4.7	9.3	2.4
Roots	6.0	9.4	2.4				
Cereals	2.2	3.5	1.8			28.1	2.0
Beverage crops	1.7	2.6	0.2	84.5	4.2		
Livestock	1.7	2.7	1.4			11.1	0.6
Forestry	1.2	1.9	1.2	9.2	0.5	0.1	0.0
Fishing	0.9	1.5	1.3	6.4	0.2	35.4	1.9
Mining	11.8	2.9	2.0	82.6	44.3	0.9	0.1
Manufacturing	13.3	15.0	37.3	9.3	10.5	35.9	52.8
Agroprocessing	3.4	4.8	10.1	4.0	1.6	21.2	8.4
Other manufact.	9.8	10.2	27.2	12.4	8.8	41.3	44.4
Utilities	2.0	0.5	3.7				
Construction	6.2	1.5	6.6				
Services	48.2	50.9	40.0	20.0	39.9	26.7	42.2
Food services	3.7	4.6	3.3	15.6	3.0	10.4	1.4
Social services	8.7	9.1	7.2				
Other services	35.8	37.2	29.4	26.2	36.9	35.0	40.8
Total	**100.0**	**100.0**	**100.0**	**21.5**	**100.0**	**25.3**	**100.0**

Figure 2. Composition of Ghana's economy by expenditure



Source: Own calculations based on official national accounts data for 2019 presented in the form of the Social Accounting Matrix for 2019 (GSS, ISSER, and IFPRI, 2023).

3 For comparison, in 2019, lower-middle-income countries had average exports equivalent to 27.8 percent of GDP, imports at 24.1 percent of GDP, and government consumption at 11.2 percent of GDP (World Bank, 2024a).

4. Exogenous Shocks

In the first step of our SRP analysis, we use historical time-series data and data mining methods to simultaneously sample world market and domestic production shocks.

World market shocks consist of international commodity price shocks and foreign capital flow shocks. International commodity price shocks are changes in export and import prices of the goods and services in which Ghana trades. The volatility of these prices is typically driven by global economic and financial market conditions. Foreign capital flow shocks are changes in the flow of foreign capital into the national economy. These capital inflows (comprising foreign direct investment, government and private borrowing abroad, and central bank operations) finance Ghana's trade deficit.[4] The volatility of foreign capital inflows is influenced by both Ghana's attractiveness to foreign investors and global financial market conditions.

Domestic production shocks represent productivity changes in primary agriculture and hydropower electricity generation. These sectors are most susceptible to extreme weather events (particularly droughts and river floods in the case of Ghana) and other natural hazards (such as crop pest infestations and livestock diseases).[5]

The time-series data consists of 28 shock variables over the period of 1980 – 2023. These include international commodity prices, foreign capital flow, agricultural production activities, and power electricity generation.

All observations form the dataset from which we randomly sample 10,000 shock scenarios.[6] These shock scenarios together provide a realistic representation of Ghana's economic volatility at present and in the future, as they capture all possible combinations of all observed exogenous shocks, as well as the shocks' size and direction.

The procedure involves three steps:

1) **Trend Calculation:** for each shock variable, we calculate the long-term trend over the 44-year period that is represented by a smoothed curve (shown as a dashed blue line in the graphs of Figure 1).[7]
2) **Shock Derivation:** We derive the shocks for each variable by calculating the relative deviations of the annual observations from the long-term trend.
3) **Multivariate Estimation:** From the relative deviations of all shock variables, we estimate a multivariate normal distribution and sample 10,000 multivariate shock scenarios. By randomly drawing

[4] The link of foreign capital flows to international trade flows, as well as the implications of both flows for Ghana's exchange rate, relates shocks in foreign capital flows to international commodity price shocks, but the different mechanisms of the two shock categories make them distinct. We therefore combine international commodity price shocks and foreign capital flow shocks in our simulations of world market shocks but discuss the two shock categories and the related risks separately.

[5] Domestic production shocks enter the CGE model as sector-specific total factor productivity (TFP) changes. We therefore use productivity metrics (e.g., agricultural yields) as TFP proxy indicators, whenever possible. For some (sub)sectors for which productivity metrics unavailable (that are meat and milk production, forestry, and hydropower electricity generation), we use per capita production as a proxy. See Mukashov et al. (2024) for details.

[6] The configuration of our data mining exercise to 28 shock variables and 10,000 shock scenarios is chosen to balance tradeoffs between data availability and computational intensity. It ensures that shock sampling and scenario building are well-supported by the historical data while keeping simulation and post-simulation calculations computationally feasible.

[7] To calculate the long-term trend, we use the Hodrick-Prescott filter for annual data (Hodrick & Prescott 1997). The resulting smoothed curve is less sensitive to short-term than long-term fluctuations.

shocks from this distribution (with assumed zero means and an estimated variance-covariance matrix), our analysis remains agnostic about future shocks, as the deviations found in the historical data are not strictly symmetric around zero.

Figure 3 shows the estimated marginal distributions for the 28 shock variables as box plots in Panel A and the variables' correlation structure as heatmaps in Panel B. Hence, the graphs in Figure 3A compare the scales of the sample shocks, highlighting the most and least volatile shock variables, and the graphs in Figure 3B illustrate which shocks are most and least likely to occur at the same time. In the following, we discuss the results of the first step of our SRP analysis organized by shock category.

International commodity price shocks

Our analysis of international commodity price shocks, derived from data from the World Bank (2024b) and other public databases, reveals *significant differences in volatility across sectors*. Primary commodities show particularly high volatility. Fertilizer, energy, and metal and mineral prices are the most volatile (in respective order). Within agricultural commodities, prices of beverage crops (coffee, cocoa, and tea), followed by grain prices, are the most volatile. In contrast, prices of manufactured goods and services exhibit greater stability (Figure 3A).

International price shocks for energy, metals and minerals, and fertilizers are strongly, positively correlated (Figure 3B), as global production of these commodities is interconnected. Energy and fertilizer are critical inputs into the production and processing of main agricultural crops such as grains and oilseeds, which explains the strong and positive correlation between the price shocks for these primary commodities. Similarly, the correlations between grain and oilseed price shocks and price shocks for livestock products (meat and milk and dairy products) are strong and positive because grains and oilseeds are used for animal feed in addition to direct human consumption. Altogether, the correlation patterns suggest that international price shocks are likely to affect multiple primary commodities simultaneously, mainly due to their joint dependence on global business cycles (Erten and Ocampo, 2013). The international price shocks for all goods are negatively correlated with the international price shocks for services. Thus, when the prices of goods in global markets rise above their long-term averages, the price of services tends to drop below its long-term average. Price fluctuations for services, however, are small (Figure 3A).

Foreign capital flow shocks

Ghana's current account deficit (Figure 1F) needs to be financed through foreign capital inflows. For our analysis, we assume that these flows enter the economy as foreign savings denominated in foreign currency, influencing both the exchange rate and investment demand, particularly in the construction sector.

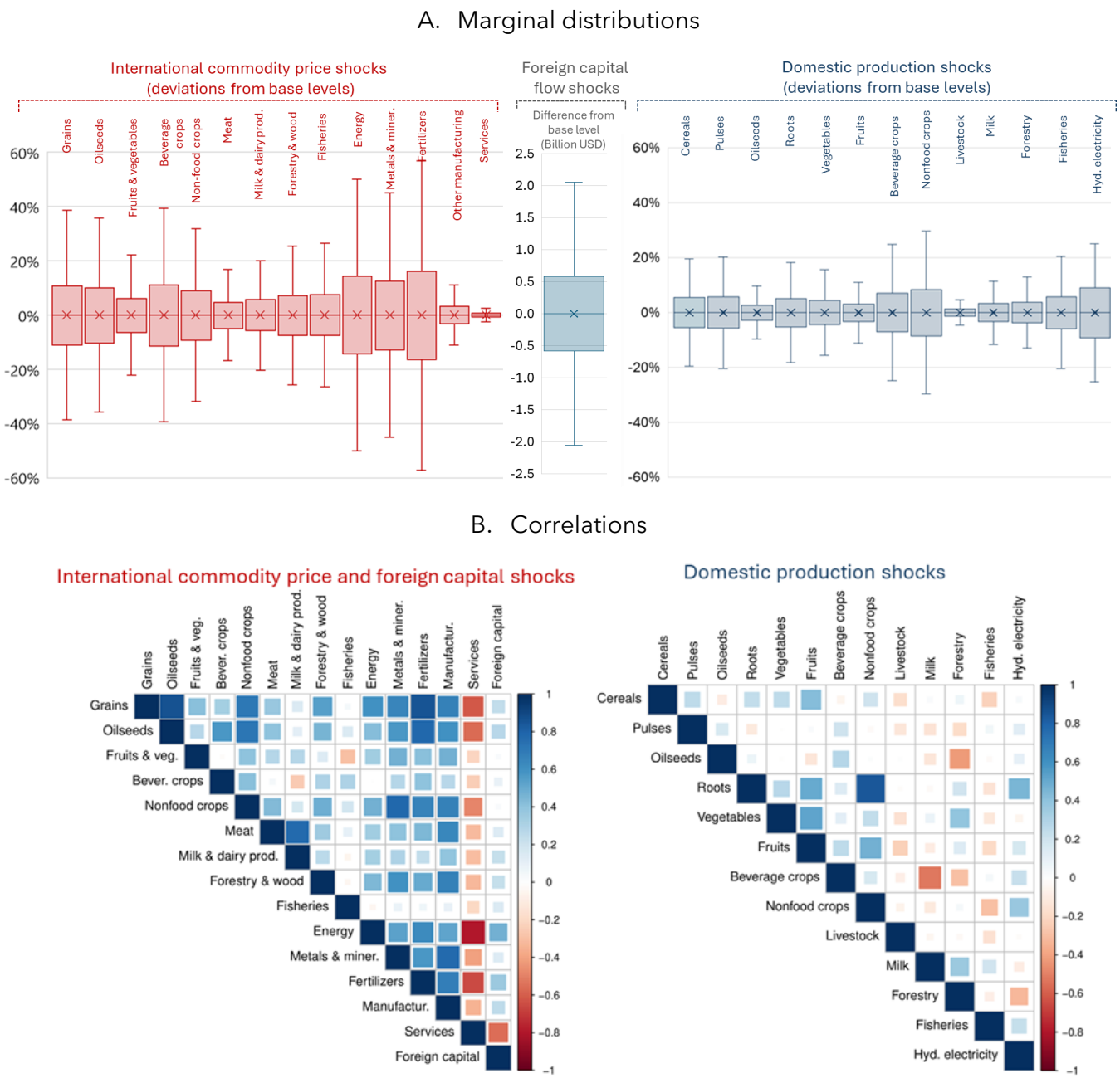
Based on current account data from IMF (2024), fluctuations in estimated foreign savings can reach up to ±US$ 2.1 billion around the long-term average, equivalent to about 3 percent of total GDP (Figure 3A). Moreover, foreign capital flows in Ghana are positively correlated with world energy prices, suggesting that the country experiences higher inflows of foreign direct investment, as well as increased government and private borrowing from abroad, during periods when its major export—crude oil—has high prices (Figure 3B).

Domestic production shocks

According to our historical analysis of domestic production, based on data from the World Bank (2024a) and FAO (2024), Ghana's nonfood sector (primarily natural rubber) has exhibited the highest volatility, with annual yield variations of ±30 percent from long-term averages. This is followed by hydropower electricity

generation (±26 percent) and beverage crop yields (primarily cocoa, ±25 percent). Notably, the yields of roots, fruits, and nonfood crops show a moderate correlation, indicating that shocks to these sectors may occur simultaneously.

Figure 3. Descriptive statistics of the sampled shocks for all shock variables



Note: The cells in the correlation heatmaps in Panel B show the strength and direction of the correlations between two variables. The sizes of the squares indicate the strength of the correlations, with non-colored cells indicating no or near zero correlations and full-colored cells indicating perfect or near-perfect correlation. Blue-colored squares indicate positive correlations, and red-colored squares indicate negative correlations.

Because of missing data, the international prices for some commodities are approximated using related price indexes or prices of similar commodities as available from the World Bank's Commodity Price Outlook Database (World Bank 2024b): The grain price index is used as a proxy for cereal, pulse, root, and milled grain prices. Orange and banana prices are used as proxies for all fresh fruit and vegetable prices (while international vegetable prices are unavailable). Energy and metal price indexes are used as proxies for all energy and metal prices, respectively. For prices of all other (non-agricultural/energy/metal) manufacturing goods, the manufacturing unit value index is used as a proxy. Additionally, the United States consumer price index for services from FRED (2024) is used as a price proxy for all internationally traded services in Ghana.

Source: Own calculation based on data from World Bank (2024a, 2024b), FRED (2024), FAO (2024), and IMF (2024).

5. Risk Profiles

In the second step of our SRP analysis, we feed the shock scenarios into an **economywide CGE model** for Ghana to simulate their impacts on various (sub)sector-specific economic outcomes.

We use IFPRI's standard CGE model, which forms part of the larger Rural Investment and Policy Analysis (RIAPA) modeling system (IFPRI 2025a). The model is calibrated to a Social Accounting Matrix (SAM) for Ghana for 2019 (GSS, ISSER, and IFPRI, 2023; IFPRI 2025b). The SAM has 46 separate domestic production activities and an equal number of separate commodity groups. A survey-based microsimulation module is linked to the CGE model to translate the simulation results into changes in household-level development outcomes such as poverty or undernourishment.

In the third step of the SRP analysis, we apply **data mining and machine learning** to:

1) Quantify how individual shocks contribute to the volatility of our four key economic and development outcomes [8]
2) Rank risk factors by their importance for overall economic performance, private consumption, poverty, undernourishment

The resulting risk profiles are discussed below.

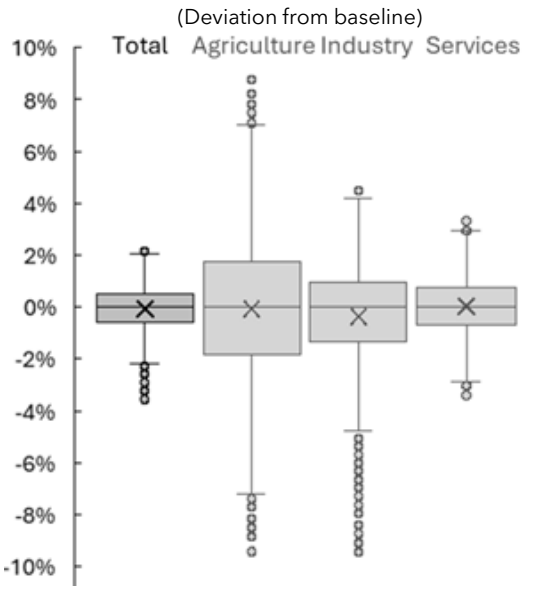
Risk profile for overall economic performance

The results of our SRP analysis show that exogenous shocks can lead to an increase of Ghana's total GDP by 2.2 percent from the baseline in the *best-case scenario* and a reduction by 3.6 percent in the *worst-case scenario* (Figure 4A) (the baseline reflects a situation in which exogenous shocks are absent). Domestic production risks account for 70.7 percent of total GDP volatility, with roots and nonfood crop yields being the most significant risk factors. Volatility in foreign capital flows, which influences the exchange rate and investment demand (primarily construction), explains 2.5 percent of total GDP volatility, and world market prices account for the remaining 26.7 percent of total GDP volatility.

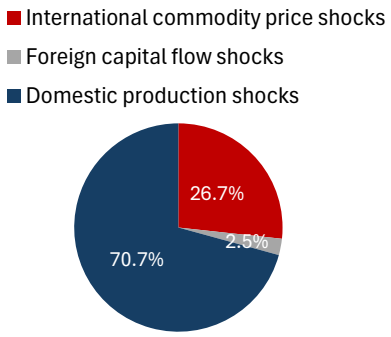
[8] We use relative importance methods by Lindeman et al. (1980) and Random Forest methods (Breiman 2001), as described in Mukashov et al. (2024) in detail.

Figure 4. Components of the risk profile for overall economic performance

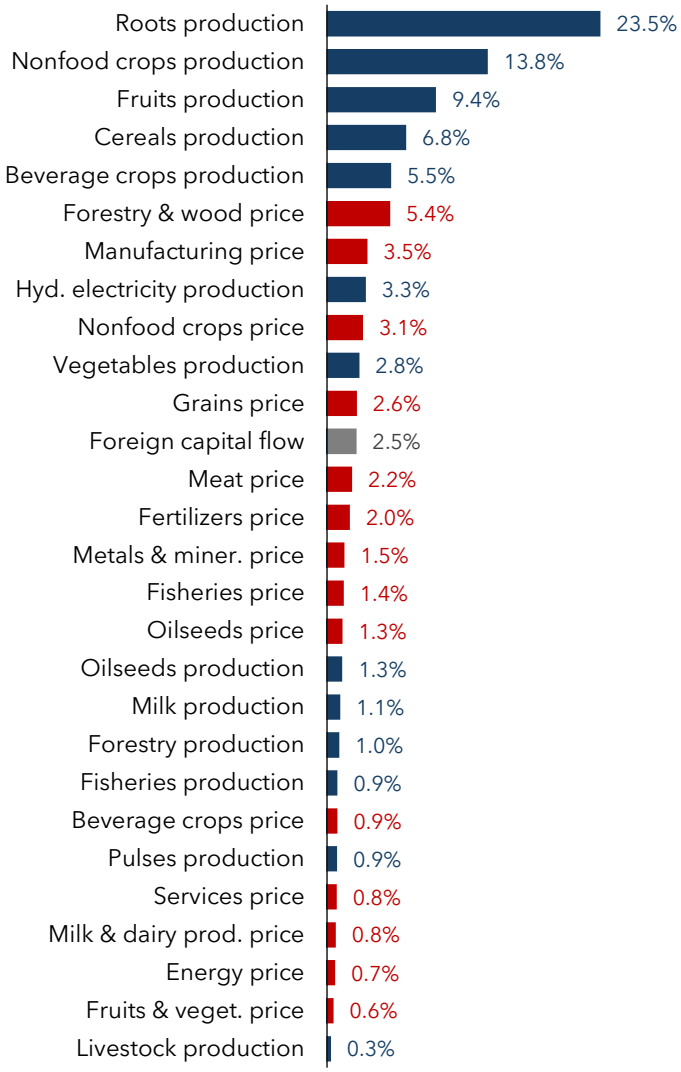
A. Volatility of total and sector GDP



B. Categories of risk factors of total GDP



C. Individual risk factors of total GDP



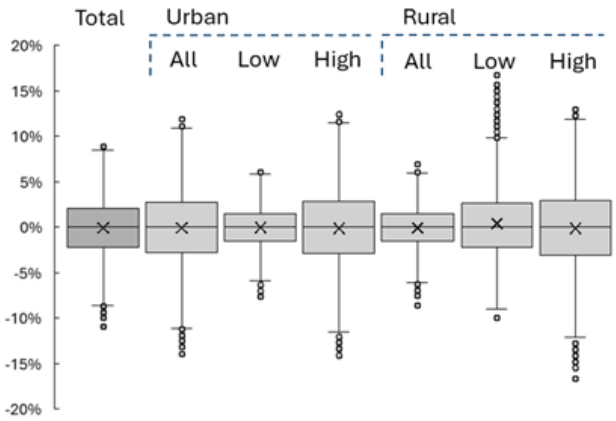
Risk profile for private consumption

Due to high trade dependence, private consumption is more volatile than GDP, with total consumption fluctuating from -10.9 to +9.2 percent relative to the base in the worst- and best-case scenarios. In terms of standard deviation, private consumption in Ghana is *four times more volatile than GDP*. Furthermore, urban households and high-income rural households, which have a higher dependence on imported goods, experience greater consumption volatility than lower-income rural households. For total consumption, factors influencing Ghana's trade dominate, with world market price volatility accounting for 78.0 percent and foreign capital flows explaining 6.8 percent of total consumption volatility. However, there are significant differences across household types (Table 2).

Figure 5 Components of the risk profile for private consumption

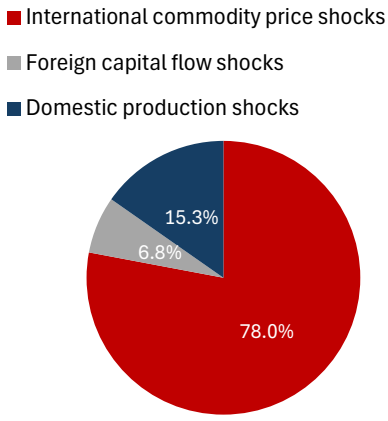
A. Volatility of private consumption by population strata

(Deviation from baseline)

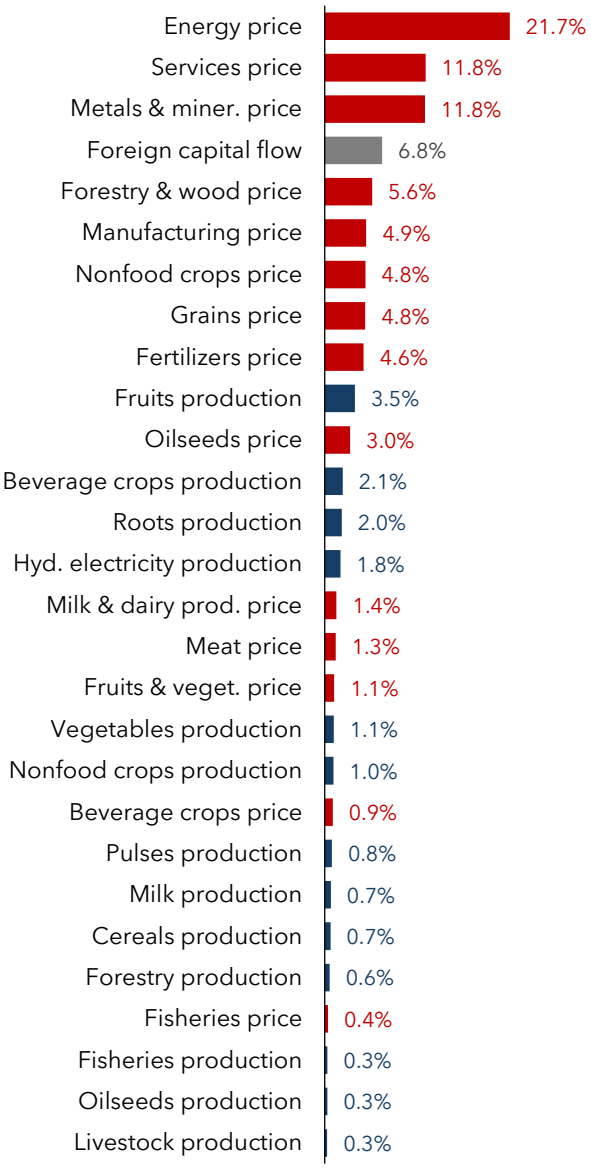


Note: "Low" and "high" refer to household income groups. Low-income households are households in the first and second quintiles of the urban or rural income distribution. High-income households are households in the fifth income quintile.

B. Categories of risk factors of total private consumption



C. Individual risk factors of total private consumption



World risks are significant for all households except low-income rural households, with the world prices of Ghana's key foreign exchange-earning sectors—energy and metals—being the most important risks to their consumption. At the same time, low-income rural households are the only group whose consumption is distinctly more dependent on domestic production volatility, which accounts for 69.0 percent of total uncertainty (among these, the yield volatilities of roots and nonfood crops emerge as the most significant individual risk factors). The world price of beverage crops—unlike the yield of beverage crops—is a more critical risk factor for Ghanaian farmers (for low-income rural households, it is the third most important individual risk factor, accounting for 15 percent of consumption uncertainty, while for middle-income rural households, it is the most important individual risk factor, explaining 14.4 percent of consumption uncertainty).

Table 2. Detailed decompositions of risk factors in consumption across household types

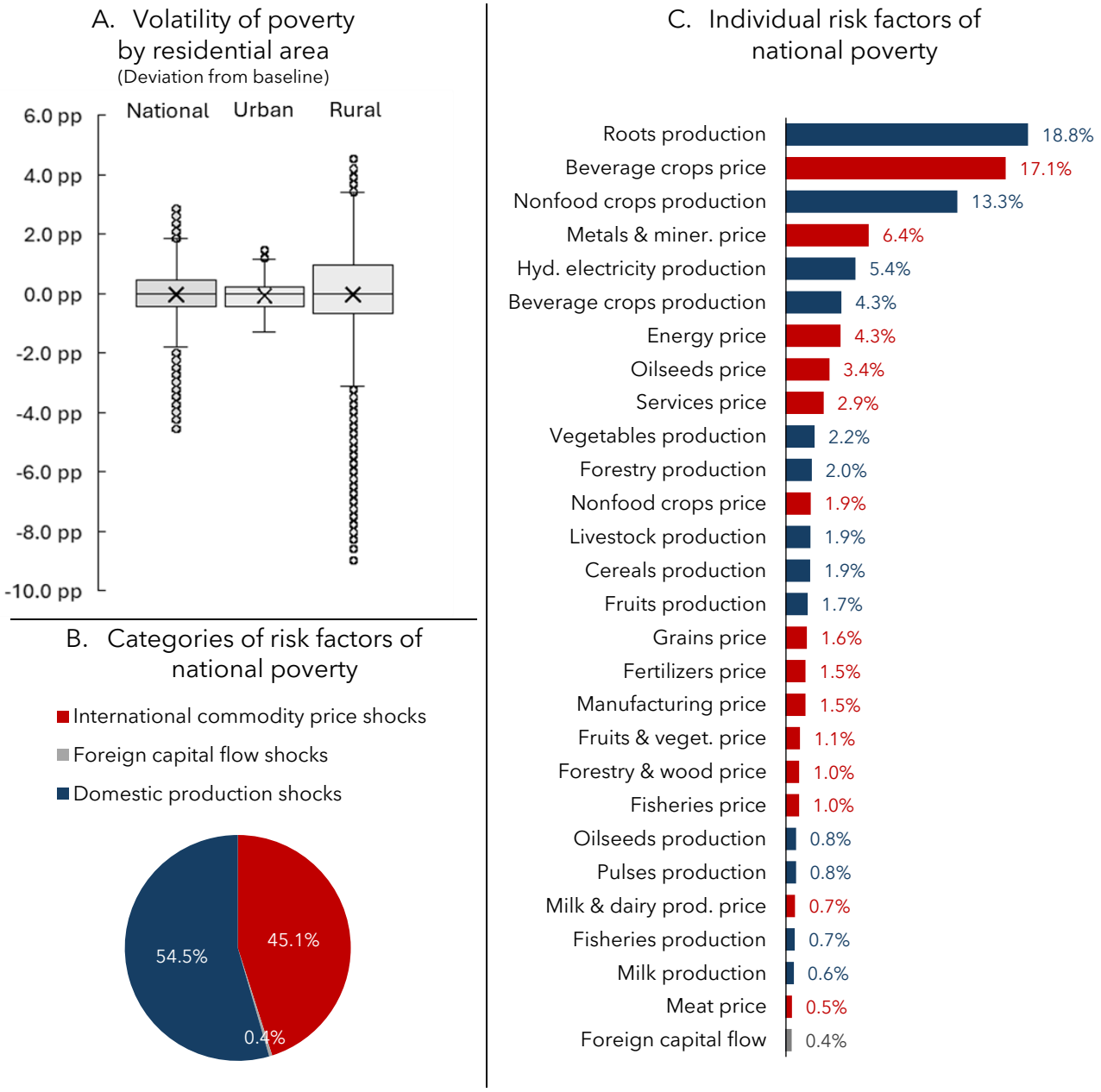
		Total	Urban				Rural			
			Total	Low	Middle	High	Total	Low	Middle	High
Total external		**84.7**	**79.8**	**86.6**	**72.1**	**82.3**	**72.9**	**31.0**	**69.4**	**63.2**
World prices	Grains	4.8	4.4	3.9	3.8	4.6	3.7	0.9	3.5	3.8
	Oilseeds	3.0	2.4	2.6	2.0	2.5	4.8	2.4	4.9	2.1
	Fruits & vegetables	1.1	1.0	1.1	0.9	1.1	1.2	1.2	1.2	0.7
	Beverage crops	0.9	1.1	2.0	1.4	1.0	13.0	15.0	14.4	0.8
	Nonfood crops	4.8	4.3	4.3	3.8	4.5	4.0	1.1	3.9	3.5
	Meat	1.3	1.3	1.1	1.3	1.3	0.8	0.5	0.7	1.2
	Milk & dairy products	1.4	1.7	1.1	1.8	1.6	0.6	0.9	0.6	1.3
	Forestry & wood	5.6	5.5	5.4	5.5	5.3	3.2	1.1	3.0	6.3
	Fish	0.4	0.5	0.4	0.6	0.5	0.7	1.2	0.7	0.9
	Energy	21.7	21.2	25.0	18.9	21.7	11.7	0.8	10.0	14.0
	Minerals	11.8	9.9	13.5	8.2	10.4	11.1	3.0	10.4	5.9
	Fertilizers	4.6	4.2	3.9	3.6	4.4	3.7	0.7	3.4	3.6
	Manufacturing	4.9	4.5	4.9	4.4	4.5	3.6	0.7	3.2	3.9
	Services	11.8	10.9	11.6	9.5	11.3	8.3	0.8	7.3	8.7
Foreign capital		6.8	7.1	5.8	6.3	7.4	2.6	0.6	2.0	6.3
Total domestic		**15.3**	**20.2**	**13.4**	**27.9**	**17.7**	**27.1**	**69.0**	**30.6**	**36.8**
Domestic productivity	Cereals	0.7	0.6	0.9	0.7	0.6	1.5	2.1	1.9	0.7
	Pulses	0.8	0.9	0.8	1.0	0.9	0.6	1.1	0.6	1.1
	Oilseeds	0.3	0.4	0.3	0.5	0.3	0.5	0.7	0.7	0.3
	Roots	2.0	4.7	0.6	8.4	3.6	4.3	27.2	4.9	12.3
	Vegetables	1.1	0.8	1.1	0.8	0.8	2.6	1.4	2.8	1.4
	Fruits	3.5	3.9	3.1	4.7	3.6	1.7	3.6	1.8	6.8
	Beverage crops	2.1	1.4	2.6	1.3	1.4	5.6	3.0	6.1	1.4
	Nonfood crops	1.0	2.7	0.4	4.8	2.1	3.6	18.2	4.2	7.0
	Livestock	0.3	0.3	0.4	0.3	0.3	1.4	1.6	1.3	0.2
	Milk	0.7	0.6	0.9	0.6	0.6	0.9	0.4	0.9	0.5
	Forestry	0.6	0.5	0.6	0.5	0.5	2.2	1.5	2.5	0.9
	Fisheries	0.3	0.4	0.3	0.4	0.4	0.4	0.8	0.4	0.4
	Hyd. electricity	1.8	2.9	1.3	3.9	2.6	2.0	7.4	2.4	3.7

Note: "Low," "Middle," and "high" refer to household income groups. 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.

Risk profile for poverty

The national poverty rate fluctuates with changes in low-income household consumption, ranging from -4.5 to +2.9 percentage points relative to the baseline poverty headcount rate of 23.4 percent. In absolute terms, this means that up to 1.4 million people could rise above the national poverty line in the best-case scenario, while 0.9 million people—mostly in rural areas—could fall below it in the worst-case scenario. At the national level, domestic and external risks contribute almost equally to poverty uncertainty, accounting for 54.5 percent and 45.5 percent of total poverty risk, respectively. However, there are significant differences between the factors driving urban and rural poverty (Table 3).

Figure 6. Components of the risk profile for poverty



Note: The baseline reflects a situation in which exogenous shocks are absent.

Similar to the consumption uncertainty of low-income households, the profile of rural poverty is distinct from that of urban poverty. For urban poverty, external factors—particularly those affecting the country's ability to finance imports—are the dominant drivers, accounting for 79.9 percent of total poverty risk. In contrast, for rural poverty, domestic production volatility factors dominate, making up 65 percent of total poverty risk. Individually, the key risks for rural poverty include yield volatility of root crops (24 percent), world prices of beverage crops (17.3 percent), and yield volatility of nonfood crops (16.7 percent).

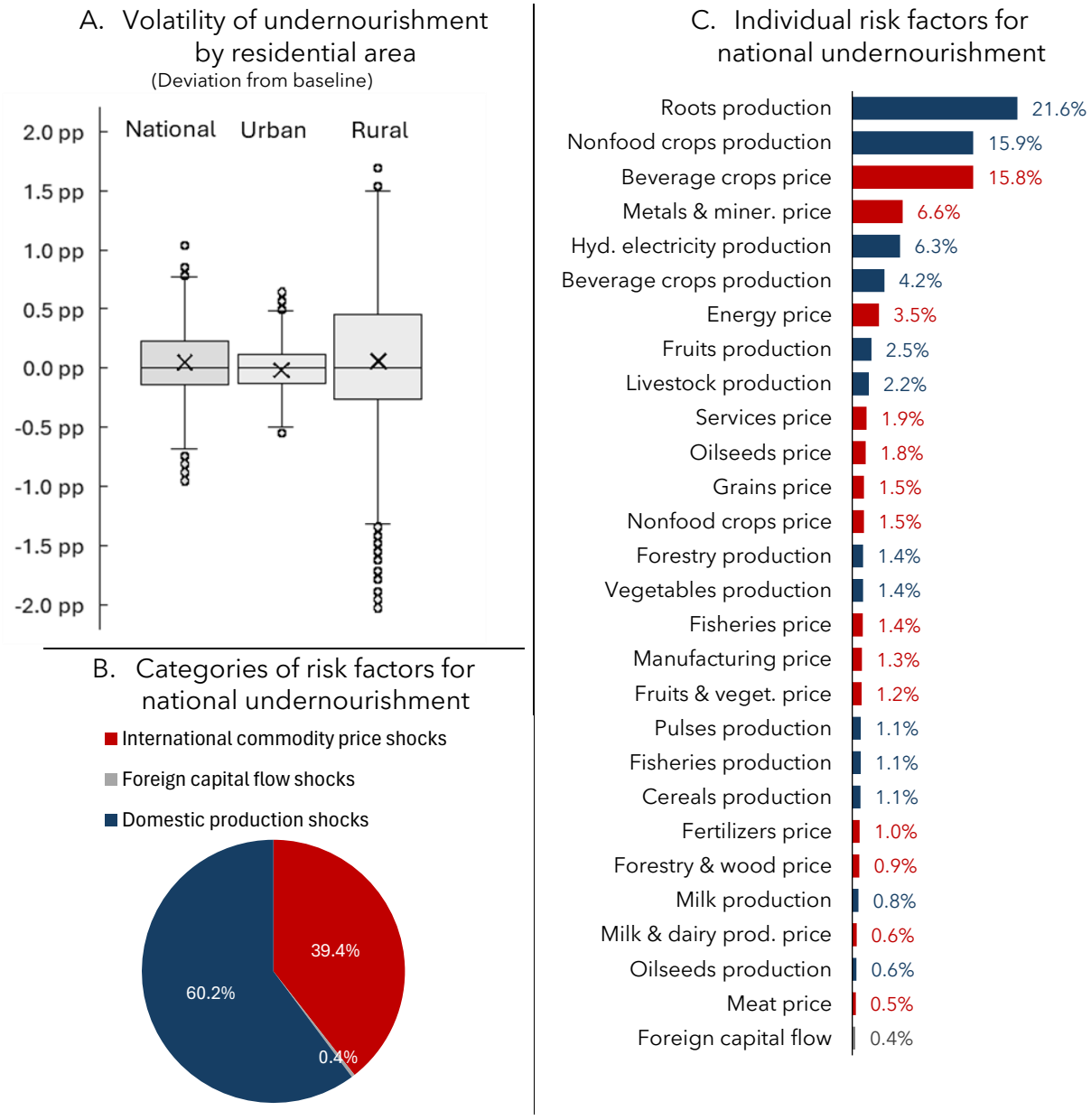
Table 3. Detailed decompositions of risk factors in poverty and undernourishment across household types

		Poverty			Undernourishment		
		National	Urban	Rural	National	Urban	Rural
Total external		45.5	79.9	35.0	39.8	84.2	30.5
World prices	Grains	1.6	4.0	1.1	1.5	3.8	1.0
	Oilseeds	3.4	2.4	3.0	1.8	2.2	1.6
	Fruits & vegetables	1.1	0.9	1.0	1.2	0.9	1.1
	Beverage crops	17.1	0.9	17.3	15.8	1.6	15.3
	Nonfood crops	1.9	4.2	1.2	1.5	3.5	1.1
	Meat	0.5	1.1	0.5	0.5	1.3	0.5
	Milk & dairy products	0.7	1.2	0.9	0.6	1.9	0.9
	Forestry & wood	1.0	6.2	0.9	0.9	5.2	1.3
	Fish	1.0	0.5	1.1	1.4	0.9	1.3
	Energy	4.3	22.6	1.2	3.5	25.3	0.8
	Minerals	6.4	10.2	3.5	6.6	13.7	2.5
	Fertilizers	1.5	4.0	0.9	1.0	3.0	0.7
	Manufacturing	1.5	4.6	0.8	1.3	5.2	0.7
	Services	2.9	11.0	1.2	1.9	10.7	0.7
Foreign capital		0.4	6.2	0.5	0.4	5.3	1.2
Total domestic		**54.5**	**20.1**	**65.0**	**60.2**	**15.8**	**69.5**
Domestic productivity	Cereals	1.9	0.8	2.1	1.1	1.5	1.1
	Pulses	0.8	0.9	1.0	1.1	0.7	1.4
	Oilseeds	0.8	0.3	0.8	0.6	0.6	0.5
	Roots	18.8	3.4	24.0	21.6	1.0	26.8
	Vegetables	2.2	1.4	1.9	1.4	0.8	1.3
	Fruits	1.7	5.0	2.7	2.5	3.1	4.3
	Beverage crops	4.3	1.8	3.6	4.2	2.7	3.0
	Nonfood crops	13.3	1.9	16.7	15.9	0.5	18.7
	Livestock	1.9	0.3	1.9	2.2	0.7	1.8
	Milk	0.6	0.7	0.5	0.8	1.3	0.5
	Forestry	2.0	0.6	1.9	1.4	0.7	1.3
	Fisheries	0.7	0.3	0.8	1.1	0.6	0.9
	Hyd. electricity	5.4	2.5	7.2	6.3	1.5	7.9

Risk profile for undernourishment

The national undernourishment rate fluctuates between -1.0 and +1.0 percentage points relative to the baseline undernourishment rate of 6.9 percent. This translates to approximately 0.3 million people moving above or below the undernourishment line. Similar to poverty, undernourishment risk primarily affects rural households (which tend to be poorer than urban households), and key factors influencing their calorie consumption are the primary drivers of undernourishment levels in Ghana. In particular, the yield of root crops emerges as the most significant risk factor for rural undernourishment, accounting for 26.8 percent of undernourishment risk (Table 3), followed by the yield of nonfood crops (18.7 percent) and the world price of beverage crops (15.3 percent). The first determines their direct calorie consumption, while the second and third affect their incomes and thus their ability to afford sufficient calories.

Figure 7. Risk profile for undernourishment



Note: The baseline reflects a situation in which exogenous shocks are absent.

6. Conclusions

Achieving development goals —like becoming a higher middle-income country or ending poverty and hunger by 2030—is subject to economic uncertainties. Yet policymaking rarely incorporates risk assessments, relying instead on deterministic trend projections.

To address this gap, inform national development strategies, and complement standard economic projections, *Systematic Risk Profiling* (SRP) provides a novel approach integrating CGE modeling, household microsimulation, and machine learning. Our SRP exercise for Ghana assesses the risks from exogenous shocks for the national economy and population and simulates the potential impacts of these shocks on the country's overall economic performance, private consumption, poverty, and undernourishment.

Our findings indicate that Ghana's GDP is primarily exposed to domestic production volatility risks, which account for 73.5 percent of total risk. The most significant contributors to this uncertainty are yield fluctuations for root crops, nonfood crops, and cereals. Household consumption exhibits far greater volatility than GDP, being four times more uncertain, reflecting the economy's high trade intensity and its heightened exposure to external risks. Overall, household consumption is more dependent on fluctuations in world prices of Ghana's key exports, particularly energy (e.g., crude oil) and metals (e.g., gold), which influence the country's economic activity and ability to finance imports.

At the same time, poverty and undernourishment risks present a more complex picture, with a clear distinction between urban and rural risk factors. Rural households, which are generally poorer than urban households and make up the bulk of the poor and undernourished population in the country, are particularly exposed to domestic production volatility factors. Among these, yields of root crops emerge as the most significant risk, followed by yields of nonfood crops and the world price of beverage crops.

The analysis presented in this Country Brief provides an initial assessment of major economic risks in Ghana. Understanding these risks is a critical first step in facilitating discussions on potential risk management strategies such as promoting domestic productivity growth, adopting technologies and practices for reducing production uncertainty, and diversifying economic activity away from high-risk sectors. The next step would be for national policymakers or advisors to evaluate alternative risk management strategies.

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