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Echo of the Cannons ? Economic Impact of the Ukraine War on Pakistan – A macro-Micro Simulation Analysis

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Abstract (275 words)

The 2022 Ukraine conflict has contributed to a major spike in international commodity prices. In this study, we design a top-down, macro-micro simulation analysis to focus on the price shock due to four major commodities, namely wheat, vegetable oil, petroleum, and fertilizers. We combine Computable General Equilibrium simulations with household survey data from the Pakistan Household Integrated Economic Survey (HIES) 2018-19 to estimate macro- and micro-economic impact of the global commodity crisis. We come up with evidence for a significant, non-negligible negative impact of the price shock, both at the aggregate and the household level. The real GDP shrinks and households real consumption and income decrease. The drop in consumption and income is more visible among farm households, with the two falling by 5% and 3.48% respectively. In the same vein, the \$3.2 headcount poverty rate at the 2018 purchasing power parity increases by 1.15%. This is much higher than the 0.21% increase in the \$1.9 poverty rate. The drop in consumption and income appears to be proportionally greater among the lower and middle-income households than those at the bottom of the income distribution. This is reflected in a slight drop in overall income inequality. Besides, while the increase in headcount poverty is greater among farm households, it is the urban households which show the worst decline in food security, both in terms of incidence and intensity of food insecurity. This set of results underscores the vulnerability of Pakistani households to surge in commodity prices. The role of petrol prices in driving poverty among rural farm households and that of food stuff (wheat and vegetable oil prices) in aggravating urban food security is particularly evident.

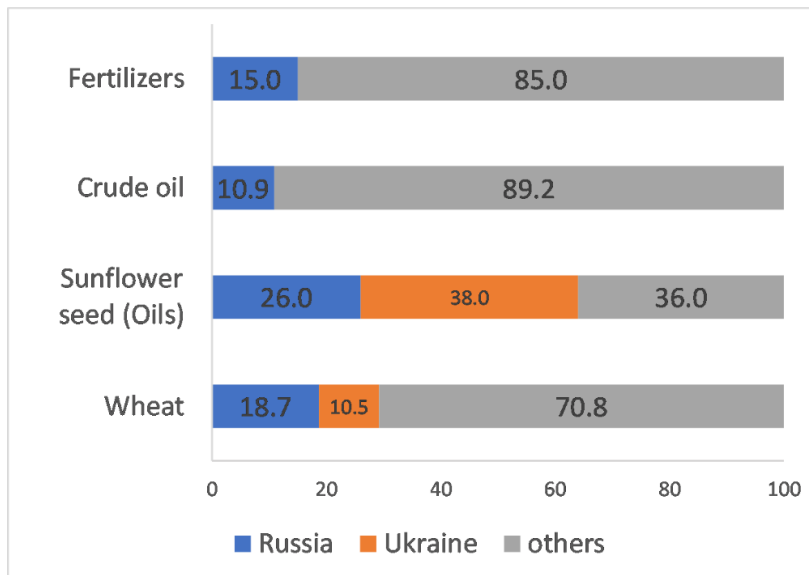
Keywords: Food security; macro-micro models; Ukraine war; Pakistan.

1. Introduction

The first half of 2022 saw intense hostilities between the Russian Federation and Ukraine. Starting from 24th February, Russia invaded parts of Ukraine in a three-pronged assault as the Ukrainians sought to defend. These military engagements brought face to face two major actors on the world agricultural commodity scene. Both countries rank amongst the top three global exporters of wheat, maize, rapeseed, sunflower seeds and sunflower oil (FAO, 2022 a). Together, the two countries account for about 29% of the international trade in wheat and 64% of the sunflower oil (Figure 1). The cereal and food exports of the two countries represent nearly 12% of the calories traded (Glauber and al., 2022). Russia also ranks among the top suppliers of nitrogen (N), potassium (K) and phosphorous (P) fertilizers (FAO, 2022 a). In addition, Russia is an important player in the global energy market, with a crude and condensate production of 10.5 million barrels per day and a share of 11% in the international oil trade (IEA, 2022).

Given this preeminence of Russia and Ukraine in the global food and energy markets, a number of countries in Africa, Eastern Europe and Central Asia inevitably rely on them for bulk of their agriculture imports (FAO, 2022 b). A case in point is Eritrea which depends on Russia for 52% and Ukraine for 48% of its wheat imports, while Armenia and Azerbaijan depended on Russia for 100% of their wheat imports.

Figure 1: Russia and Ukraine's percentage share of global exports in selected commodities (2021)



Source: based on data from Trade data monitor, FAO 2021.

The difficulties in transportation and Black Sea shipping and international financial sanctions disrupted supply from Ukraine and Russia, and caused uncertainty and increased volatility in the global commodity markets. Ukrainian wheat exports were down by 5 million tons while those from Russia fell by 3.5 million tons. As a result, the prices of cereals and other agriculture commodities, which were already high since the post-Covid-19 opening up of the economy in 2021, touched new highs. The Food and Agriculture Organization's food price index rose by 12.6% in March 2022 to reach its highest value since the index's creation in 1990. The cereals sub-index, in particular, reached the all-time record value of 170.1 in March compared to 145.2 in February, a monthly increase of 17.1%. Vegetable oils and meats indices also posted new records, while sugar and dairy too showed large gains. Not only did the prices of various staple foods increase spectacularly, those of major farm inputs such as fertilizers and energy also rose sharply, jeopardizing the prospects of upcoming cereal crops. In dollar terms, energy prices in March 2022 were four times as much in April 2020 (World Bank, 2022).

Even before the war in Ukraine, economies of developing countries were facing the aftermath of the Covid-19 pandemic, the effects of climate change, and various local and regional conflicts, and the numbers of vulnerable and food insecure population were on the rise. The economic uncertainty caused by the ongoing Russo-Ukrainian conflict, reflected in high food prices combined with costly agriculture input and energy can put large segments of world population at risk of food insecurity (Hebebrand and Laborde, 2022). In a macro-simulation study, FAO estimate that the ongoing commodity price hike and the production impact of the Ukraine war could lead to an additional 7.6 million people undernourished in 2022-23 under a moderate scenario (FAO, 2022b). The number of the undernourished could go as high as 13.1 million (severe scenario), with Asia Pacific being the region the most affected. Likewise, various IFPRI blogs analyze trade data of wheat, vegetable oils and other food commodities and highlight the impact of conflict on food security in the countries of Sub-Saharan Africa and the Middle East (Breisinger and al., 2022; Mamun et al., 2022).

Pakistan too is an interesting case study in this regard. It is the world's fifth most populous country, with population estimated at 229 million in 2022 (United Nations, 2022). About a third of the population (33.7%) was reported to be food insecure, and one out of every five households

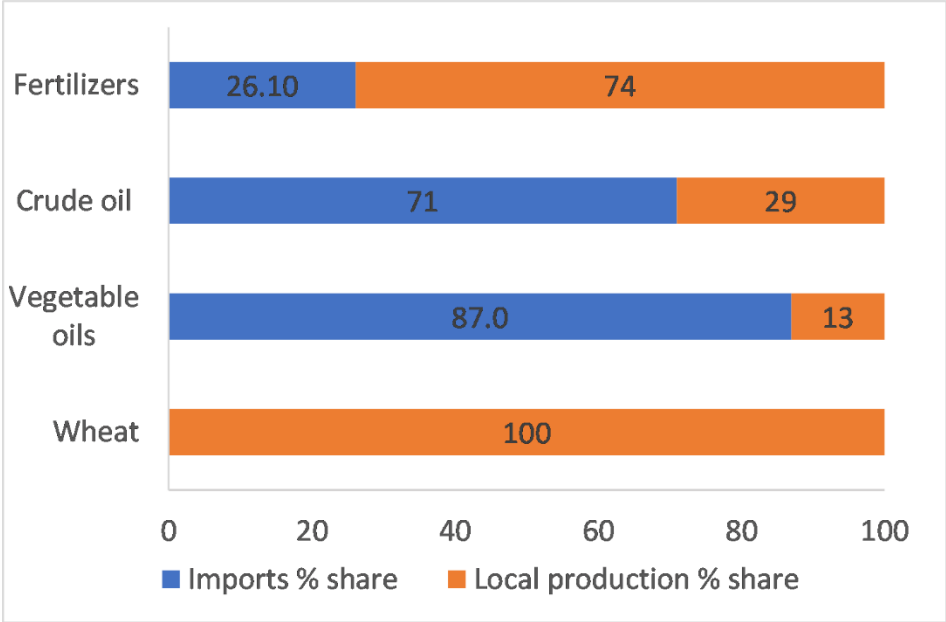
(21.81%) was living below the \$3.2 a day poverty line before the Ukrainian war¹. The inflationary impact of this price shock on the Pakistani economy and the welfare of the Pakistani households is bound to be non-negligible. Wheat, vegetable oil and petrol together account for almost a fifth of the household budget, with corresponding shares of 6.2%, 3.6% and 8.2% in the average consumption basket. Likewise, diesel and fertilizer are among the farm households' principal input costs. Accordingly, managing the prices of these commodities (particularly wheat and petrol) is a major policy concern. Pakistan's trade with Russia and Ukraine is limited, with wheat and fertilizers being the main traded commodities. In 2021, 23% and 38% of the country's wheat imports respectively came from Russia and Ukraine. In fact, the same day that Russian military started invading Ukraine, Pakistan's then Prime Minister Imran Khan was in Moscow negotiating the purchase of discounted crude oil and wheat in an attempt to shield the population from the inflationary impact of the price shock. The country's economy was struck hard by the coronavirus crisis and the subsequent weakening of the balance of payment situation. A prolonged conflict in Ukraine accompanied by sustained high food and commodity prices can aggravate the situation and make achieving the sustainable development goals of eliminating poverty and hunger still more challenging.

In this study, we use a top-down, macro-micro simulation model to quantify the economic impacts of the 2022 global commodity price shock related to four major commodities (wheat, vegetable oil, fertilizers, and petroleum) on the Pakistan economy and households. Specifically, we develop a Computable General Equilibrium (CGE) model coupled with a micro-econometric model to evaluate the impact of the price shock on households food security. CGE models are prime candidates when it comes to evaluate the impacts of external shocks such as world price increases on the economy, as they can capture the intersectoral links among the different sectors. The CGE model helps gauge aggregate, economy-level effects of price shocks. However, the nuances of the household welfare impacts are lost through aggregation into representative groups. Linking macro- (CGE) and microsimulation models sequentially allows the analysis of poverty and distributional changes at the household level, and thus benefiting from the strengths of both models.

¹ Authors' estimation using HIES 2018-19.

The four commodities whose price shock is examined in this study collectively account for the bulk of the country’s imports. Figure 2 shows average individual shares of import of the four commodities in the local demand, reaching as high as 87% for vegetable oils.

Figure 2: Percentage share of local production and imports for selected commodities (2017-18).



Source: data from PBS, Planning commission, and Hydrocarbon Development Division of Pakistan 2017-18.

To our knowledge, this is the first study on the Russo-Ukrainian conflict that evaluates country-level welfare losses using macro and micro-data. We begin by describing the CGE model and its calibration, followed by the household data, the dataset construction and the econometric methodology in Section 2. Section 3 reports macroeconomic impact on growth, consumption and employment, and the changes in the level of poverty, income distribution and food security occurring due to the surge in international commodity prices during the 2022 Ukraine war. Section 4 provides some concluding thoughts and suggests policy implications.

2. Data and Methodology

We implement a top-down, macro-micro simulation model to determine changes in the economy occurring due to the global price shock as well as the impact on household welfare due to the macro adjustments. To evaluate the impacts of international prices shocks on the Pakistani

economy, we use the static Partnership for Economic Policy (PEP) model (Decaluwé et al, 2013). The model is calibrated to the Social Accounting Matrix (SAM) for Pakistan from Debowitch, (2013) updated to 2014. The matrix consists of 62 activities and commodities, out of which 17 are agricultural, 9 factors of production (3 types of labour, 3 types of capital, livestock and two types of land). There are three representative households and three representative firms.

The macro simulation results are disaggregated at the household and regional levels, i.e., rural farm and non-farm and urban households. For this, we matched the type of commodities and items available in the SAM and the household survey data from the Pakistan Household Integrated Economic Survey (HIES) 2018-19. The micro data set includes information on 175,690 individuals from 27,194 households residing across the country. The dataset contains detailed information on household income, and food and non-food consumption expenditures. The household expenditure is grouped into 33 items and commodities which correspond to the 62 disaggregated commodities in the SAM. The details of these items and the corresponding items and commodities in the SAM are presented in Table A1 in the appendix.

2.1. Macro model

Though the model is fully described in Decaluwé et al (2013), we provide a brief description of the main characteristics of the model.

In the PEP model, production is defined by a multi-level nested structure. At the top level, output is a Leontief type of function between value added and intermediate consumption. At the second level, value added of the agriculture sector is defined in terms of a CES function between farm labour and composite capital. The latter is further disaggregated into land, livestock and agricultural capital. Note that livestock is only used in three sectors: cattle and sheep, raw milk and poultry. For the non-agricultural sectors, value added is a CES function between composite labour and capital. Composite labour is further disaggregated by skill into low- and high-skilled labour.

There are three types of households: rural farming, non-farming rural and urban households. Their income is derived from three sources: labour, capital and transfers from other institutions (remittances, government transfers). The main source of income for rural-farming households is capital income (especially livestock income), while for the two other categories, transfers

represent the greatest share. For instance, remittances represent 10% of the non-farm households income. All households use their income to consume, pay direct taxes, pay transfers to other institutions and save. Household behaviour on the consumption side is modelled as a Linear Expenditure System. Income elasticities for each category of households are estimated². There are three representative firms: agricultural, formal and informal. The income of agricultural and informal firms comes from agricultural capital and informal capital respectively. Formal firms' income is derived from formal capital income and transfers from the government and the rest of the world. All firms pay dividends to other agents and save, and only formal firms pay direct taxes.

Government income is composed of transfers income (from formal firms), and direct and indirect taxes. It spends most of its income on consumption (administration, education...), transfers to other institutions and saves the rest.

To represent the links between Pakistan and the rest of the world, we follow the traditional hypothesis assuming that Pakistan is a small country and world prices are exogenous. However, in order to export more, Pakistani producers must be more competitive on the international market. Pakistan exports mainly textile related commodities (over 50% of its total exports) and imports mainly petrol, chemicals and vegetable oil. The import penetration rate is particularly important for petrol, machineries, vegetable oil and chemicals, making Pakistan vulnerable to fluctuations in their international prices.

In terms of closure rules, we assume that the nominal exchange rate is the numeraire of the model. Then, as mentioned above, Pakistan is considered a small open economy and therefore world prices are taken as given. The current account balance is assumed to be exogenous. Capital and land are sector specific while labour is mobile. We assume that there is unemployment among each type of labour following the Blanchflower and Oswald (1995). According to these authors, there is an empirical relation between unemployment rate and wage rates. Specifically, there is a negative slope between these two variables.

We implement the increases in world prices for wheat, petrol, fertilizer and vegetable oil in the CGE. The increase is measured by comparing the average prices of the selected commodities in

² The corresponding elasticities are given in Table-A1 in the appendix.

March and April 2022 to the corresponding average of the previous year (January to December 2021). The reason for comparing the average prices in March-April to the average prices in the preceding year rather than the corresponding period (March-April) of the previous year is to capture the seasonality effect and the effect of general post-Covid19 price increase. Table A2 in the appendix shows the average prices of selected commodities before and after the Russo-Ukraine war, as well as the corresponding change over time.

Once the model is run, the new prices and volumes are transmitted to the micro module (top-down) in order to estimate changes in poverty, income distribution and food security.

2.2. Micro model

The extent and nature (positive or negative) to which a household is affected by the global price shock is determined by the chosen consumption basket and the accompanying price change. The CPI_i for each household is computed using the consumption basket as follows:

$$CPI_i^1 = \prod_{j=i}^J \left(\frac{P_j^1}{P_j^0} \right)^{s_{j,i}} \quad (1)$$

P_j^0 and P_j^1 represent the price of commodity ‘ j ’ before and after the price shock, respectively. $s_{j,i}$ is the proportion of commodity ‘ j ’ in the consumption basket of the household ‘ i ’.

The micro data is used to measure changes in income distribution, poverty and food insecurity at the household-level. Income per capita z_i is used for measuring income distribution across households, while expenditure per capita q_i is used to calculate poverty estimates. Income includes earnings in cash or kind from primary or secondary employment, as well as pension. The per capita expenditure includes household's food and non-food expenditure divided by family size. Income, expenditure, and all other monetary metrics are converted to US dollar equivalents using the Purchasing Power Parity (PPP) 2018 standard. According to World Bank (World Development Indicators), one US dollar equals 35.9 PKR on a purchasing power parity basis in 2018.

We calculate the shares of wheat, vegetable oils, and petroleum products in the total family expenditure by income deciles to account for the vulnerability of the top and bottom income deciles to the price shock. [Table 1](#) provides descriptive statistics on income per capita and expenditure per capita (wheat, vegetable oils, petroleum product, and total). According to the

data, petroleum products account for a sizable portion of household spending (8.2 percent). Similarly, wheat related products (wheat, flour, and bread) and vegetable oils (edible oils and fats) account for 6.2 percent and 3.6 percent of household expenditure, respectively. Rural farming households spend 7% of their expenditure on wheat, 4.2% on vegetable oil and 8.5% on petrol. The corresponding shares for rural non-farming households are 7%, 4% and 8.6%. For urban households, the shares are somewhat smaller, with 5% of the budget dedicated to wheat, 2.9% to vegetable oils, and 8.1% to petrol. Average per capita income is estimated at US\$ 2896.3, and the average per capita expenditure q_i at US\$ 1901.8.

Table 1: Descriptive statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Income PC	27150	2896.3	3123.2	0	37872.4
Total expenditure PC	27150	1901.8	1932.5	0	39221.3
Petroleum expenditure PC	24768	190.1	288.1	0	7025.8
Vegetable oils expenditure PC	24768	62.2	33.6	0	802.0
Wheat expenditure PC	24768	99.9	46.0	0	1086.1
Petroleum share in HH expenditure	24768	.082	.073	0	.603
Vegetable oils share in HH expenditure	24768	.036	.018	0	.252
Wheat share in HH expenditure	24768	.062	.035	0	.505

Source: Authors' estimations using HIES 2018-19.

Note: All figures are reported in 2018 USD PPP.

We compare the income distribution before and after the price shock using the Gini index. For poverty, we construct three indicators: P_0 , P_1 , and P_2 , corresponding to poverty headcount, poverty gap and poverty severity, respectively. We use the two World Bank definitions of poverty lines, \$1.9/day and \$3.2/day to generate the poverty measures, and use expenditure per capita q_i instead of household income³.

³ The poverty and inequality measures are generated using the Stata DASP package.

Finally, we construct two measures of food insecurity using the answers to eight questions on food insecurity asked from the households in HIES 2018-19⁴. The first constructed indicator of food insecurity is a binary variable which measures whether a household is food secure. The household is deemed food secure if it answers in negative to all the eight questions. According to the data, 33% of the households are food insecure. The second indicator measures the severity of food insecurity by using the number of criteria (1 – 8) by which a household falls into food insecurity. A household which responds yes to only one of the questions is taken as less food insecure than the household which answers in positive to more than one questions. 9.67% of the households are food insecure based on 2 questions while 2.92% report being food insecure on all the eight criteria.

We use Probit model to estimate the likelihood of a household being food insecure y_i^0 . A household is food insecure if the predicted probability of $Pr(y_i^0|X)$ is greater than 0.5. The model can be given as follows:

$$\begin{cases} Pr(y_i^0 = 1|X) = \varphi + \delta z_i^0 + \sum_{k,i} \gamma_k x_{ki} + \mu_i & (2) \\ \text{where } X \in (z_i^0, x_{ki}) \end{cases}$$

Where z_i is income per capita and x_k denotes the set of controls, which includes labor skills, family size, proportion of children under 10 in the family, region (urban-rural), livestock production, farming, own wheat production, and the proportion of wheat, vegetable oils, and petroleum products in the household expenditure.

We use order Probit model to estimate the likelihood of a household falling into each of the eight food severity group y_{gi}^1 :

$$Pr(y_{gi}^0 = 1|X) = \varphi + \delta z_i^0 + \sum_{k,i} \gamma_k x_{ki} + \varepsilon_i \quad (3)$$

We represent the original estimates before the world price shock by the superscript '0' (scenario 1) and the comparable estimates after the shock by the superscript '1' (Scenario-2). The real change in the household income, consumption per capita, poverty and food insecurity following

⁴ The detail of eight food insecurity related indicators is provided in Table A3, Appendix-A.

the world price shock to the selected commodities is simulated at the household level using a top-down approach (Scenario-2). The macro estimates produced from the CGE simulation are disaggregated at the household level to model the magnitude to which a given household is affected by the world price shock. The household income and consumption per capita numbers are deflated by the household CPI_i^1 //using equation (1) as follows:

$$z_i^1 = \frac{z_i^0}{\prod_{j=i}^J \left(\frac{P_j^1}{P_j^0} \right)^{s_{j,i}}}$$

$$y_i^1 = \frac{y_i^0}{\prod_{j=i}^J \left(\frac{P_j^1}{P_j^0} \right)^{s_{j,i}}}$$

Subsequently, the associated changes in poverty and income inequality are estimated. The change in food insecurity y_i^1 is estimated by predicting the likelihood of food insecurity of households using simulated income per capita z_i^1 as follows:

$$\left\{ \begin{array}{l} \Pr(y_i^1 = 1|X) = \varphi + \delta z_i^1 + \sum_{k,i} \gamma_k x_{ki} + \mu_i \\ X \in (z_i^1, x_{ki}) \end{array} \right.$$

Similarly, the change in severity of food insecurity y_{gi}^1 after the price shock is estimated as follows:

$$\Pr(y_{gi}^1 = 1|X) = \varphi + \delta z_i^1 + \sum_{k,i} \gamma_k x_{ki} + \epsilon_i$$

3. Results

3.1. Macro model:

The increase in world prices impacts Pakistan's economy through two main channels. On the one hand, imports of these products become more expensive and depending on the significant internal dependency, lead to higher prices for consumers and industries that use them as input. For instance, a high proportion of vegetable oil and wheat is bought by households, while petrol and fertilizer are mainly bought as input by industries and farms. On the other hand, if the

country exports any of these products, then an increase in the world price will tend to induce local producers to turn their production to the external market.

As discussed earlier, Pakistan depends on a large extent on imports for covering its domestic demand for these goods and their exports is small and infrequent. The share of exports in total production for these products is very modest (-0.03% for fertilizers and 0.02% for wheat for instance). As a result, the main impact of the price shock due to the Russo-Ukrainian crisis appears in the form of higher import prices.

Table 2: Macroeconomic impacts (in %)

Wage rate Farmers	-1,69
Wage rate Low skilled	-2,49
Wage rate High skilled	-1,88
Real consumption Rural Farm HH	-4,97
Real consumption Rural Non-Farm HH	-4,26
Real consumption Urban	-3,38
Real GDP	-0,97
CPI	1,57
Total investment	-1,71

Source: Results from the CGE model.

As expected, the large increase in the world price of the four commodities has dramatic impact on the Pakistani economy (Table 2). First, given the dependency of the economy on the imported oil, there is an increase in production cost for different activities. Firms and businesses reduce their production and lay off workers. This reduction of workers leads to a decrease in their wage rate. At the same time, households face an increase in the consumer price index, leading to a drop in their real consumption. Urban households are relatively less affected than rural ones, with a drop in real consumption of 3.38%. Rural farm households are hit the most, with their real consumption falling by nearly 5%.

Overall, real GDP decreases by 0.97%. All sectors of the economy are impacted by rising world prices but to varying degrees. For example, electricity generation and transport sectors, both oil-intensive, face a production decrease of more than 3%. For other sectors, such as wearing

apparel, the decrease is a more modest 0.25%. All the sectors whose production falls decrease their intermediate consumption and reduce employment. Thus, sectors that were not initially impacted by the increase in world prices are affected by intersectoral effects. However, the sectors involved in the production of wheat, fertilisers, vegetable oil and petroleum observe an increase in production. For these specific sectors, the rental rate of capital increases.

The impact on employment is different among the three categories of workers. Indeed, the unskilled labour-intensive sectors are the most affected, which explains why unskilled workers suffer a greater decrease in their wage rate (-2.49%).

Households' income is derived from wages, capital and land income and transfers they receive from the other institutions. All the three components of household income witness a decrease. However, the endowments of different type of households differ substantially. About 80% of rural farm households income comes from factor income (mainly capital income), while the share is smaller for the two other types of households. Consequently, the drop in income is greater for rural farm households (-3.48%) than for the two other groups of households (-2.76% for rural non-farm and -1.87% for urban). Given the drop in their income, all types of households pay less direct taxes and save less.

3.2. Micro results

The negative impact of price shock is also visible at the household level. The \$3.2/day poverty rate increases by 1.15 percentage point while the \$1.9/day poverty headcount increases by 0.21 percentage point (Table 3). The increase in poverty from 21.81% to 22.97% corresponds to 2.657 million additional individuals falling below the poverty level⁵. There is also a 10 – 11% increase in \$1.9 poverty gap and severity and a 7 – 8% increase in \$3.2 poverty gap and severity.

Table 3: Poverty headcount, gap and severity before and after the price shock

Poverty line	Variable	Obs	before shock	after shock	% change
	Poverty headcount	27194	2.009	2.227	10.865
UDS 1.9/day	Poverty gap	27194	0.257	0.285	10.813
	Poverty severity	27194	0.052	0.058	11.767

⁵ Based on estimated population of 229,489,000 on June 1, 2022 (United Nations, 2022).

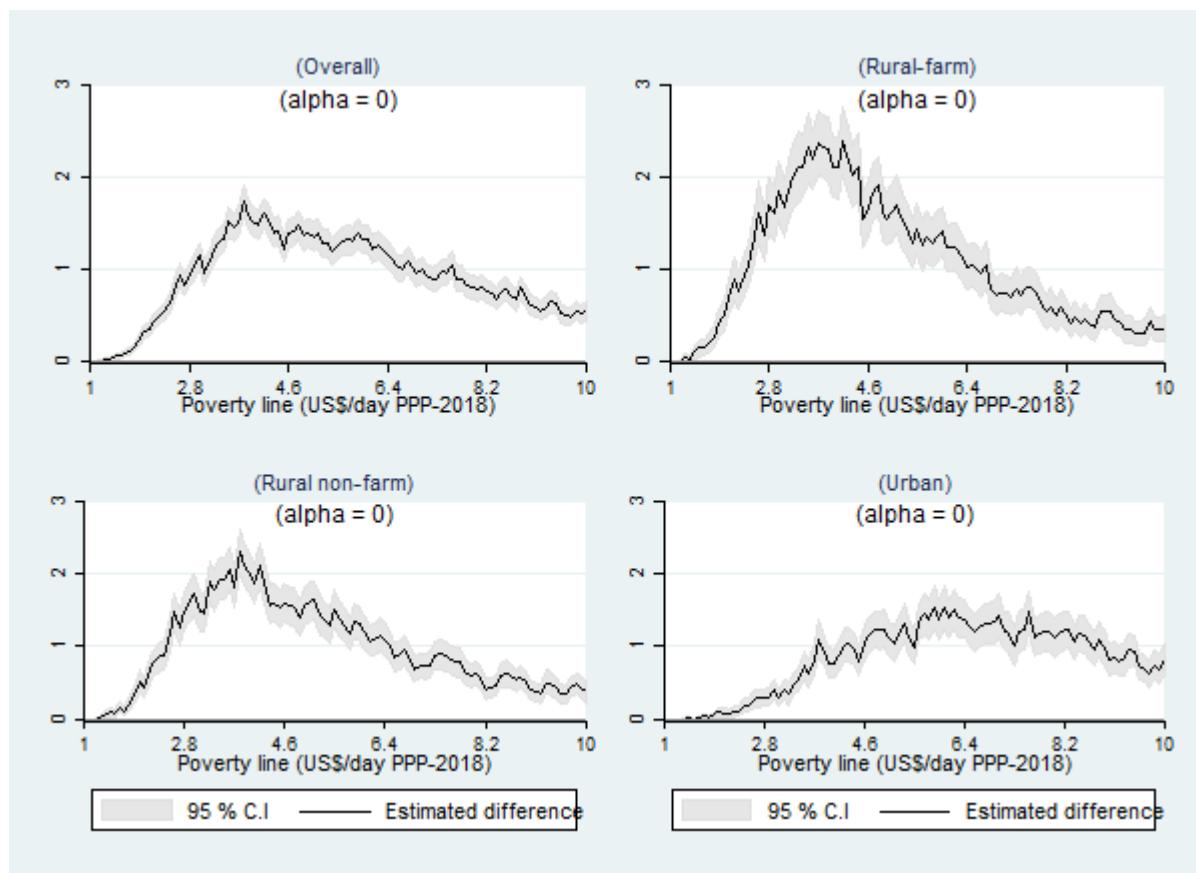
	Poverty headcount	27194	21.815	22.973	5.307
UDS 3.2/day	Poverty gap	27194	4.436	4.749	7.052
	Poverty severity	27194	1.322	1.430	8.191

Source: Authors' estimates using HIES 2018-19.

Note: All figures are reported in 2018 USD PPP.

Figure 3 depicts percentage point change in poverty by population sub-groups over poverty levels ranging from \$1 per day to \$10 per day. The results indicate that the rural farm sector is the one most influenced by global commodity price shock with a 2.4 percentage point increase in poverty at the \$3.2/day poverty threshold. The increase in rural farm household poverty is lower at above or below this threshold. For comparison, the increase in poverty among rural non-farm households at the \$3.2/day threshold is 2.2%. The impact of the global commodity price shock on urban poverty is somewhat lower, with a maximum of 1.5% increase at the \$6/day level. Production in the urban economy, and consequently the income of the urban population, is able to partially adjust itself to the rising prices in the international commodity markets due to its reliance on manufacturing and exports. Importers and businesses pass on the increasing import prices on to consumers. However, rising prices of petroleum and fertilizers increase the production cost of rural farms. According to Agriculture Statistics of Pakistan, diesel-powered tube wells account for more than 80% of the country's farm irrigation tube wells. Besides, farm households are unable to take advantage of higher wheat prices in the international markets as the country's production is entirely consumed internally, leaving little exportable surplus. Consequently, rural households, particularly farm households, are more vulnerable to a shock to the global commodity prices.

Figure 3 Percentage point Change in poverty by population subgroups



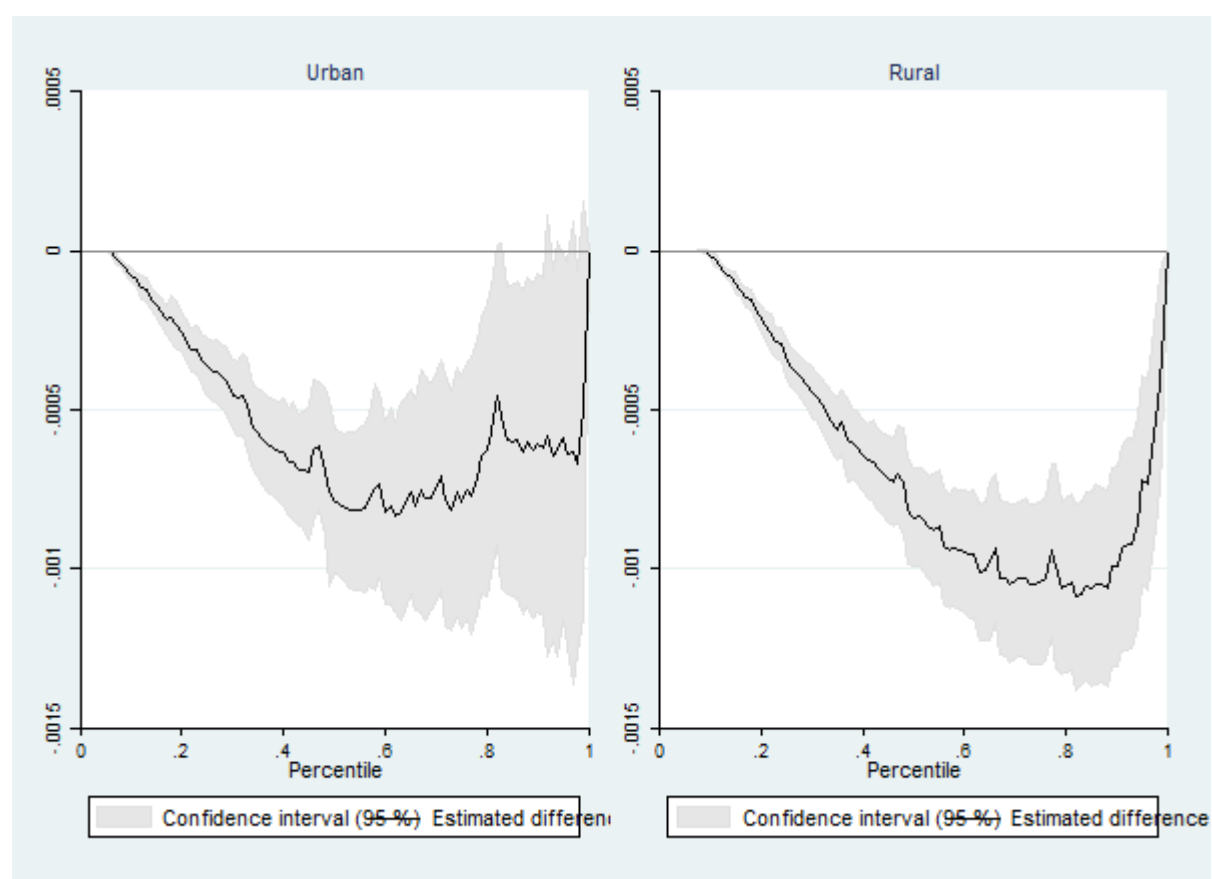
Source: Authors' estimates using HIES 2018-19.

This trend is also borne out in Figure 4 which shows the proportionate change in income by income-percentiles and urban-rural population subgroups. The above-median income groups (60th to 90th percentiles of the rural households, 50th to 80th percentiles of the urban households) are affected more than the top and bottom percentiles. This owes to the fact that in both the urban and rural areas, upper-middle income households spend a higher proportion of their income on

petrol compared to low-income and top-income households. Households in the bottom five deciles as well as the top income decile, all allocate between 5 and 5.5% of their income to petrol, while the households in the 6th to 9th decile spend between 5.6 and 6% of their income on petrol.

In part due to this greater hit to above-median income households, overall inequality slightly decreases (Table 4). The income Gini decreases from 0.428 to 0.427 as a result of the price shock. The fall in inequality is similar across rural and urban households.

Figure 4 Proportionate change in income by percentiles and population subgroups



Source: Authors' estimates using HIES 2018-19.

Table 4: Income Gini before and after the price shock by population sub-groups.

Gini index	Overall	Urban	Rural-farm	Rural non-farm
before shock	0.428	0.417	0.391	0.359

after shock	0.427	0.416	0.39	0.358
difference	-0.001	-0.001	-0.002	-0.001
P-value	0	0	0	0

Source: Authors' estimates using HIES 2018-19.

As regards food insecurity, we find evidence for all-round detrimental effects. Tables A4 and A5 in the appendix give results of the Probit and Ordered Probit model estimations for the two food insecurity measures. Panels A and B of Table 5 respectively show the percentage prevalence and intensity of food insecurity and changes in it due to the commodity price shock. The incidence of food insecurity increases by 2.94%, ranging from 2.96% among farm households to 3.6% among urban households. Similarly, the intensity of food insecurity increases by 2.5% on average, ranging from 1.9% among farm households to 2.9% among non-farm households. The increase in food insecurity intensity was as high as 83% for households reporting food insecure in seven out of eight relevant questions. The corresponding increase in intensity was 171%, 78% and 71% for urban, rural non-farm and farm households. These results pertaining to the incidence and intensity of food insecurity point to a differential dimension of the impact of the price shock. In contrast with what we saw relative to poverty and household income, the effect of the commodity price shock is stronger among urban and rural non-farm households. This owes mainly to the role of wheat, the country's principal cereal, in the households' consumption basket. 94% of Pakistani farms are small or medium in size (less than 12.5 acres), nearly all of whom cultivate wheat in the Rabi (winter) season (Ayaz and Mughal, 2022). Part of this production is kept for home consumption and shields the rural farm households from rising wheat prices.

Table 5: Food insecurity – incidence and intensity

Food insecurity	before shock (%)	after shock (%)	% change
Urban	10.560	10.943	3.629
Rural farm	35.739	36.798	2.962
Rural non-farm	33.625	34.783	3.445
Total	27.200	28.000	2.941
Food severity			
Urban	2.016	2.057	2.041

Rural farm	14.503	14.784	1.938
Rural non-farm	14.154	14.577	2.982
Total	11.900	12.200	2.521

Source: Authors' estimates using HIES 2018-19.

4. Concluding remarks and policy recommendations

While the war rages in Ukraine, the boom of its economic impact could be heard in distant lands.

In this study, we combine Computable General Equilibrium simulations with household survey data from the Pakistan Household Integrated Economic Survey (HIES) 2018-19 to estimate macro- and micro-economic impact of the turbulence in the global commodity markets. We focused on the price shock due to four major commodities for the top-down analysis, namely wheat, vegetable oil, petroleum and fertilizers. We come up with evidence for a significant, non-negligible negative impact of the commodity price shock, both at the aggregate and the household level.

The real GDP shrinks by about one percent, wage rates fall, with unskilled workers being the most affected. Households real consumption and income decrease. The drop in consumption and income is more visible among farm households, with the two falling by 5% and 3.48% respectively. In the same vein, the \$3.2 headcount poverty rate at the 2018 purchasing power parity increases by 1.15% (from 21.81% to 22.97%). This is much higher than the 0.21% increase (from 2.0% to 2.227%) found using the \$1.9 poverty rate.

The drop in consumption and income appears to be proportionally greater among the middle-income households (60th to 90th percentile in the rural areas, 50th to 80th percentile in the urban areas) than those at the bottom of the income distribution. This is reflected in a slight drop in overall income inequality (from Gini = 0.428 to 0.427).

Besides, while the increase in headcount poverty is greater among farm households, it is the urban households which show the worst decline in food security, both in terms of incidence and intensity of food insecurity.

This set of results underscores the vulnerability of Pakistani households to global price shocks. The role of petrol prices in driving poverty among rural farm households and that of food stuff (wheat and vegetable oil prices) in aggravating urban food security is particularly evident. No wonder the government attempted to limit the price rise. On 28th February 2022, the then Prime Minister Imran Khan announced to bring taxes and levies on petroleum down to zero as a temporary relief measure. However, after the change of government in April 2022, the policy was discontinued, and petrol prices were raised from PKR. 150 per liter to PKR. 248 per liter, a 65% increase in less than two months, not without a significant political cost. At the same time, the plans to import cheaper Russian oil and wheat were shelved given objections of the US government. Some acts of the tragic play being enacted in Ukraine may after all be taking place away from the stage.

These findings highlight the poverty and food security-worsening dimension of the Russo-Ukrainian conflict that is increasingly being realized in the public policy circles as the war enters in its fifth month. On June 28th 2022, heads of G7 made a declaration on global food security, reaffirming their commitment to bring 500 million humans out of hunger and malnutrition by 2030⁶. Seven actions were recommended to limit the consequences of the Ukraine war and an additional 4.5 billion dollars were committed to achieve the objective. This takes the total sum allocated to fighting global hunger and food insecurity to USD14 billion. This commitment requires coordination between partner organizations under the newly-created Global Alliance for Food Security.

⁶ <https://www.g7germany.de/resource/blob/974430/2057824/b4c9113bec507f0bd4b0389f6ac15ea7/2022-06-28-statement-on-global-food-security-data.pdf?download=1>

References

- Ayaz, M., Mughal, M., 2022. Farm Size and Productivity -The Role of Family Labor, Working Paper HAL -03669234, Université de Pau et des Pays de l'Adour.
- Blanchflower, D.G., Oswald, A.J., 1995. An Introduction to the Wage Curve. *Journal of Economic Perspectives* 9, 153–167.
- Breisinger, C., Kirui, O., Dorosh, P., Glauber, J., Laborde, D., 2022. The Russia-Ukraine conflict is likely to compound Sudan's existing food security problem, IFPRI Blog.
- Debowicz, D., Dorosh, P., Haider, H.S., Robinson, S., 2013. A Disaggregated and Macro-consistent Social Accounting Matrix for Pakistan. *Economic Structures* 2, 4.
- Decaluwé, B., Lemelin, A., Robichaud, V., Maisonnave, H., 2013. The PEP Standard Computable General Equilibrium Model Single-Country.
- FAO, 2022a. Impact of the Ukraine-Russia conflict on global food security and related matters under the mandate of the Food and Agriculture Organization of the United Nations.
- FAO, 2022b. The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the current conflict.
- Glauber, J., Laborde, D., Mamun, A., 2022. From bad to worse: How Russia-Ukraine war-related export restrictions exacerbate global food insecurity, IFPRI Blog.
- Hebebrand, C., Laborde, D., 2022. High fertilizer prices contribute to rising global food security concerns, IFPRI Blog.
- IEA (International Energy Agency), 2022. Oil Market Report.
- Mamun, A., Glauber, J., Laborde, D., 2022. How the war in Ukraine threatens Bangladesh's food security, IFPRI Blog.
- United Nations, 2022. World Population Prospects, Population Division.
- World Bank, 2022. Commodity Markets Outlook: The Impact of the War in Ukraine on Commodity Markets. World Bank Group.

Appendix

Table A1: Commodities matched across SAM and micro models and corresponding elasticities.

S.N 0	Micro- model	SAM	Elasticities		
			Urban	Farm rural	Non-farm rural
1	Wheat and related products	1. Wheat	0.42	0.395	0.5
2	Fats and vegetable oils	1. Oilseeds (sunflower, soyabean, mustard & rapeseed, linseed etc.) 2. Vegetable & animal oils & fats - may include non-edible products as well (waxes). Also, includes rendering & refining of edible fats (in meat processing).	0.56	0.562	0.685
3	Oil expenditure	1. Mining of crude oil 2. Petroleum products incl. petroleum gases	1.68	1.45	1.71
4	Sugar	1. Sugarcane 2. Sugar	0.78	0.477	0.69
5	Rice	1. Paddy – IRRI 2. Paddy - Basmati	0.822	0.798	0.973
6	wheat and rice husking	1. Rice Husking & Milling – IRRI 2. Rice Husking & Milling – Basmati 3. Wheat Milling (Wheat Flour)	0.37	0.595	0.758
7	Cereals and pulses	1. Maize 2. All other crops (bajra, jowar, pulses, fodders, tobacco, flowers etc.)	0.9	0.694	0.935
8	Fruits and vegetables	1. Potato 2. Other vegetables 3. Fruits & edible nuts (almond, pistachio etc.; groundnuts also included here).	0.77	0.559	0.726
9	Raw milk	1. Raw milk	0.65	0.507	0.638

10	Fish	1. Fishing	0.78	0.657	0.801
11	Gas	1. Mining of natural gas	0.66	0.328	0.698
12	Cattle meat	1. Cattle, sheep, goats etc. - including wool & hair, raw fur skin & hides, and animal husbandry services; but not raw milk.	0.73	0.495	0.607
13	Other meat	1. Poultry (& other domestic. birds) - including eggs 2. Meat & Meat Products: slaughtering, prep. of meat products, processing of raw hides & skins, offal etc. (Rendering of edible fats excluded - see EDOIL).	0.67	0.533	0.659
14	Dairy products	1. Milk, cream, ghee, butter, curd, cheese, ice-cream	1.1	0.634	1.04
15	hotel and readymade food	1. Hotels & restaurants	1.1	0.817	0.82
16	condiments	1. Condiments	0.87	0.716	0.93
17	Health	1. Public and private health and social work services	0.83	0.621	0.85
18	Culture and sports	1. Services of domestic staff 2. All other services (renting of machinery, sport recreation culture, membership org, other) as well as repair of M. Vehicles, personal services	1.7	0.7477	0.81
19	Education	1. Public and private education services	2	1.51	2.26
20	paper and publishing	1. Paper, publishing, furniture	1.1	0.825	1.07
21	Information and communication technology	1. Telecomm, courier, post, cable TV providers, & internet services providers.	1.63	1.083	1.44
22	Housing and	1. Ownership of Dwellings 2. Services of real estate agents and housing	0.82	0.491	0.71

	accommodation	societies			
23	Housing maintenance	<ol style="list-style-type: none"> 1. Cement, and all quarry-related products: lime, plaster, mixed concrete. Also included here: articles of fibre cement, concrete, plaster, mortars etc. for construction... 2. Baked construction products: ceramic tiles & flags, construction products of glass and baked clay. 	0.97	0.778	0.97
24	Other fuels	<ol style="list-style-type: none"> 1. Other mining and mining of coal, lignite, peat. Coke oven products also included here (coke of coal, tar, other coke) 	0.31	0.16	0.29
25	electricity	<ol style="list-style-type: none"> 1. Electricity generation 2. Electricity distribution 	0.82	0.02	0.42
26	Textile and clothing	<ol style="list-style-type: none"> 1. Raw Cotton 2. Cotton Ginning (lint) 3. Cotton Spinning & Preparation of fibres (yarn) but may include other yarns of natural fibres (wool, silk) 4. Cotton Weaving (cloth incl. cotton fabrics, terry towelling, weaving on khadi/handloom) 5. Knitted, crocheted textile articles 6. Wearing apparel (excluding articles of leather & fur) 7. Manufacture of all other textiles (synthetic fibres, yarns & fabrics; carpets, rugs, ropes & cordage, embroidery etc.) 	0.97	0.72	0.93
27	Foot ware	<ol style="list-style-type: none"> 1. Tanning of leather, manufacture of leather garments, fur garments, all footwear, luggage & saddlery 	1.2	0.854	1.15
28	Transport cost and	<ol style="list-style-type: none"> 1. Transport, cargo-handling & storage 	1.84	1.03	1.36

	maintenanc e				
29	Tobacco and beverages products	1. All other food, beverage and tobacco products	0.88	0.72	0.81
30	furniture and wood	1. Forestry (timber, logging & wild forest materials) and Hunting 2. Sawmilling, chipping, shaping, treating of wood; and manufacture of wood products (panels, boards, plywood, veneer sheets, containers etc.)	1.75	0.565	1.26
31	home appliances	1. Metal products (cutlery, buckets, etc.) 2. Domestic appliances and office machinery	1.55	0.866	1.55
32	transport vehicles	1. Vehicles and transport equipment	0.87	0.259	0.478
33	Miscellane ous	1. Iron, steel and nonferrous metals 2. General and specialized machinery (e.g., for use in production processes) 3. Construction 4. Wholesale & retail trade 5. Finance (public and private financial sector inst.) 6. Business services 7. Public services other than health & education (public admin & defence, other) 8. Chemicals (not including: fertilizers, pesticides - see FNP).	1.2	0.946	1.2
34	Fertilizers	1. Fertilizers & Pesticides - Fertilizers & nitrogen compounds; and pesticides & agrochemical products	0.82	0.683	0.756

Source: Authors' estimates using HIES 2018-19.

Table A2: Global increase in selected commodity prices.

Commodity	March-April 2022	Jan-Dec 2021	% Change	Frequency	Data Source
Wheat (US soft red wheat Euro/ton)	384.7	241	59.3	Daily	International food policy research institute
Brent oil (US\$ per barrel)	109.4	70.9	54.3	Daily	Market Insider
Vegetable oils (price index 2014-16=100)	249	165	51	Monthly	Market Group Limited; Bloomberg; ISTA Mielke GmbH, Oil World; US Department of Agriculture; World Bank.
Fertilizers (index)	237.6	132.15	79.8	Monthly	Bloomberg L.P. - Green Markets (formerly Kennedy Information LLC)

Note: The Fertilizers index is based on the following fertilizers based on monthly data: DAP (diammonium phosphate), spot, f.o.b. US Gulf. Phosphate rock, f.o.b. North Africa. Potassium chloride (muriate of potash), f.o.b. Vancouver. TSP (triple superphosphate), spot, import US Gulf. Urea, (Ukraine), f.o.b. Black Sea.

Table A3: Household food insecurity experience indicators.

Questions: during the last 12 months, was there a time when:	Yes=1 (%)	No=0 (%)
1. You or others in yours household worried about not having enough food to eat because of a lack of money or other resources?	18.77	80.64
2. Still thinking about the last 12 MONTHS, was there a time when you or others in your household were unable to eat healthy and nutritious food because of a lack of money or other resources?	32.93	66.39
3. Was there a time when you or others in your household ate only a few kinds of foods because of a lack of money or other resources?	31.43	67.71
4. Was there a time when you or others in your household had to skip a meal because there was not enough money or other resources to get food?	9.96	88.73
5. Still thinking about the last 12 MONTHS, was there a time when you or others in your household ate less than you thought you should because of a lack of money or other resources?	14.95	83.44
6. Was there a time when your household ran out of food because of a lack of money or other resources?	6.88	91.76
7. Was there a time when you or others in your household were hungry but did not eat because there was not enough money or other resources for food?	6.78	91.99
8. Was there a time when you or others in your household went without eating for a whole day because of lack of money or other resources?	4.87	93.93

Source: Authors' estimates using HIES 2018-19.

Table A4: Regression results of food insecurity (Probit estimates).

Dependent var: Food insecurity	Coefficient	S.E.	t-value	p-value
Farming with livestock (Y/No)	.062	.031	1.97	.049
Livestock (Y/No)	-.0000092	0	-3.29	.001
Wheat production Y/N	-.176	.03	-5.93	0
Wheat share in exp	5.061	.297	17.04	0
Vegetable oils share in exp	6.479	.554	11.70	0
Petroleum products share in exp	-1.681	.133	-12.68	0

Income	-.0000237	.00000083	-28.25	0
Family size	.025	.003	7.48	0
children under 10	.181	.055	3.28	.001
Mean age	-.004	.001	-3.17	.002
Skilled labor (Y/No)	-.225	.031	-7.33	0
Region				
urban	-.098	.021	-4.73	0
Constant	-.406	.058	-7.07	0
Pseudo r-squared	0.133	observations	24809	

Source: Authors' estimates using HIES 2018-19.

Table A5: Regression results of food insecurity intensity (order Probit estimates).

Dependent var: Food Severity	Coefficient.	S.E.	t-value	p-value
Farming with livestock (Y/No)	.01	.028	0.36	.715
Livestock (Y/No)	0	0	-4.04	0
Wheat production Y/N	-.108	.027	-4.02	0
Wheat share in exp	5.409	.261	20.75	0
Vegetable oils share in exp	5.181	.484	10.71	0
Petroleum products share in exp	-1.087	.121	-8.97	0
Income	.0000212	.00000079	-26.75	0
Family size	.016	.003	5.21	0
children under 10	.331	.05	6.67	0
Mean age	-.002	.001	-1.45	.148
Skilled labor (Y/No)	-.307	.029	-10.57	0
Region				
Urban	-.139	.019	-7.40	0
Cut 1	.478	.052		

Cut 2	.608	.052	
Cut 3	.975	.052	
Cut 4	1.372	.052	
Cut 5	1.696	.053	
Cut 6	1.872	.053	
Cut 7	2.027	.054	
Cut 8	2.189	.054	
Pseudo r-squared	0.069	Observations	24809

Source: Authors' estimates using HIES 2018-19.