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What are the impacts of climate change and the Ukrainian War on the Sustainable Development Goals? A case study for Burkina Faso

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Abstract:

Repeated shocks to fragile economies call into question the achievement of sustainable development goals. This study uses a gender-dynamic computable general equilibrium model linked to a micro model to assess the impacts of the war in Ukraine and climate shocks on SDG1, SDG2, SDG5 and SDG8 for the Burkina Faso economy. The results reveal negative impacts on economic growth with an increase in food insecurity and household poverty. Urban households are the most affected by food insecurity while unskilled men are most likely to lose their job in the short run. In the long run however, women experience more job losses than men.

KEYWORDS: Sustainable Development Goals, Burkina Faso, War in Ukraine, CGE

JEL CLASSIFICATION: C68, I32, J16, O49, Q18, Q54

1. Introduction

Like other countries, Burkina Faso has been hit by a succession of global crises over the past two years: COVID-19 and the war in Ukraine. Indeed, as soon as the first case of COVID-19 appeared, the government adopted measures of social distancing, reduction of population displacement, closure of nonessential economic activities and the introduction of curfews (World Bank, 2020). These measures have reduced the productive capacity of the Burkinabe economy and reduced the number of available jobs (World Bank, 2020). Indeed, economic growth contracted by approximately 4 percentage points between 2019 and 2020 (AfDB, 2022), and several thousand people have been pushed into extreme poverty in Burkina Faso (World Bank, 2020). The economy was only just recovering when the conflict between Ukraine and Russia broke out, leading to an increase in commodity and energy prices. This was transmitted to the economy of Burkina Faso by an increase in the general price level of 18.2% (BCEAO, 2022), with further implications for economic stability, food security and poverty.

Nevertheless, Burkina's economy was already fragile long before it suffered the effects of these two global crises, particularly because of the effects of climate change. For example, Burkina Faso has experienced significant climate shocks such as floods, droughts and storms since the 1970s (Crawford et al., 2016). Among climatic shocks, droughts are the most regular. Between 1969 and 2014, droughts cumulatively affected 12.4 million people (Röhrig et al., 2021). For instance, the 2011-2012 drought caused farmers to lose 25-75% of their farming related income (USAID, 2017). After repeated droughts between 2011 and 2013, the number of undernourished people rose sharply to a quarter of the population (USAID, 2017). Moreover, the rainfall variability reduced agricultural production between 6 and 15% in 2019, which pushed 10.1% of the population into food insecurity. Future projections show a likely temperature increase of 1.4 °C to 1.6 °C by 2050 (World Bank, 2019) and a further reduction in rainfall of approximately 7.3% by 2050 (MECV, 2007)

The consequences of these shocks (climate change and, more recently, the Ukrainian conflict) cloud the prospects for achieving the Sustainable Development Goals (SDGs). Indeed, over the last decade Burkina Faso has experienced volatile economic growth: after a real GDP growth rate of 8.4% in 2010, Burkina Faso's real economic growth has slowed to 3.9% in 2015, 6.6% in 2018 and 1.9% in 2020. This is partly due to the instability of agricultural production induced by climatic disasters. The country regularly records cereal deficits, for example, in 2011 the deficit is estimated at 154 thousand tons, in 2015 at 35 thousand tons and in 2017 at 477 thousand tons (MAAH, 2020). Thus, per capita cereal availability has fallen from 266 kg in 2010 to 242 kg in 2019 (MAAH, 2020). Therefore, a national slowdown in cereal production could alter food prices, erode household purchasing power and thus access to food. Thus, the living conditions of households remain precarious. Indeed, the proportion of people living on less than a dollar a day decreased rapidly from 46.4% in 2003, to 40.1% in 2014, and increased to 41.4% in 2019 (INSD, 2020). In addition, there is an upward trend in the prevalence of moderate or severe food insecurity in the population, from 41.8% between 2014 and 2016 to

47.9% between 2018 and 2020 (FAO-FIDA-OMS-PAM-UNICEF, 2021). Indeed, despite the implementation of sustainable development plans and programmes, poverty rate remains very high (41.4% in 2019) (INSD, 2020), per capita cereal availability is 243 kg in 2020 and only 70% of households have an acceptable food consumption in 2020 (MAAHA, 2021). In addition, in 2021, real economic growth is 6.6% (World Bank, 2021c). Given the country's erratic economic performance, achieving sustained economic growth, eradicating poverty in all its forms, eliminating hunger and gender inequality by 2030 could be compromised by the Ukrainian conflict and climate shocks.

In addition, vulnerable socioeconomic groups, such as women, are severely affected. This is because prior to these crises, the economy of Burkina Faso already facilitated significant concentrated disparities between socioeconomic groups, especially in the labour market. This disparity may lead to distinct impacts between the sexes depending on their initial economic status.

There is a multidimensional gender gap in Burkina Faso, including poverty, access to employment and income level (Kobiané et al., 2020; Odusola et al., 2019). For instance, prior to the Ukraine Crisis, 41.4% of the population of Burkina Faso lived in monetary poverty, and more than a quarter suffered hunger (INSD, 2020). The poverty rate is slightly higher for women (40.6%) than for men (38.9%) (UN Women, 2020).

The gender gap is more significant in the labour market. Indeed, the labour force participation rate of women is lower (58.5%) than that of men (75.1%) (UNDP, 2019). The difference between male and female labour force participation rates increases in urban areas, where 66.2% of women work compared to 80.0% of men (Weber, 2017). More than 70% of women work in the agriculture sector (OCDE, 2018). However, although they represent 55% of the agricultural labour force, women represent less than 40% of land owners, and only 14% of them can sell their land (OCDE, 2018). In nonagricultural sectors, women face a higher unemployment rate than men (4.9% versus 3%) (INSD, 2016).

It is likely that the effects of the various crises will not only worsen Burkina's economy but also exacerbate existing inequalities. Specifically, the recurrence of these crises could jeopardise the achievement of the goals of reducing poverty (SDG1), reducing food insecurity (SDG2), improving gender equality (SDG5) and achieving sustainable economic growth (SDG8). To quantify these effects, we use a dynamic computable general equilibrium (CGE) model coupled with a microsimulation model.

To account for the direct and indirect effects of exogenous shocks, CGE models are the most advocated tool (Decaluwé et al., 1999; Devarajan & Robinson, 2002). Indeed, the strength of CGE models, in the context of exogenous shocks, lies in their ability to quantify many scenarios by identifying the transmission channels of shocks. This can advance the way we understand the effects of the war in Ukraine and climate shocks, thus providing input into the design of inclusive and sustainable growth strategies in developing countries. The remainder of the paper is organised as follows. Section 2 provides an overview of the methodology and data. Section 3 introduces the simulation scenario framework and discusses the main results. Finally, Section 4 concludes.

2. Methodology framework and data

A dynamic gendered CGE capable of addressing economic growth, gender disparities in the labour market, household expenditure and food production is used to evaluate the impact of the Russo-Ukrainian conflict and climate shocks. The use of a dynamic model helps to capture the short- and long-term effects of the impacts of exogenous shocks and of the policies implemented by the government. The model we use is based on the PEP-1-t model developed by (Decaluwé et al., 2013), and we modify several assumptions to consider the conditions in Burkina Faso. To capture the gender dimensions in the CGE model, the distribution of labour and capital factors in the sectors of activity is gendered.

The production function is assumed to have constant returns to scale and is represented by a four-level production process. At the first level, output is a combination of the industry's total intermediate consumption and its value added through a Leontief-type function. At the second level, the constant elasticity of substitution (CES) functions to represent imperfect substitution between composite labour and composite capital. Total intermediate demand by industry is the combination between the different intermediate inputs through a Leontief-type function. At the third level, composite labour is modelled according to the particularities of the agricultural and nonagricultural sectors. In the agricultural sector, composite labour is an imperfect combination of family farm labour and hired farm labour. Each type of labour is further disaggregated by gender. In the nonagriculture sector, composite labour is an imperfect combination of skilled composite labour and unskilled labour. Each type of skill is further disaggregated by gender. To reflect the rigidity of gender roles, female/male substitution is limited in the model; additionally, we use a low value of elasticity of substitution (0.5). The composite capital is a combination of male and female capital through a CES function. The remaining capital employment specifications are similar to the standard PEP 1-t model of (Decaluwé et al., 2013). In addition, each sector uses intermediate goods and services and different types of capital and labour in different proportions. However, a large number of industrial and service sectors rely on intermediate consumption to produce. For example, compared to value added, intermediate inputs account for 71.1% of the output of cotton, 72.0% of the agrifood sector, 61.7% of the beverage and tobacco sector, 85.4% of the textile processing sector, 55.0% of the manufacturing sector, 61.3% of the electricity, water and gas supply sector, 57.4% of the construction sector, and 86.8% of the hotel and restaurant sector. Consequently, sectors that use oil, fertiliser, wheat and maize as intermediate consumption would be expected to be negatively affected by the conflict in Ukraine. On the other hand, the agricultural sectors that use approximately 80% of labour and capital for production would be negatively affected depending on the degree of sensitivity to climate shocks.

The model considers four types of institutions or agents (households, firms, government and the rest of the world). In relation to the SAM, the model has two groups of households, rural households and urban households. Each household derives their income from the remuneration of labour and capital and from income transfers from institutional sectors. They spend their income on the consumption of goods and services, pay direct taxes to the government and then save the rest. On the consumption side, household behaviour is

modelled as a linear expenditure system (LES) and is subject to its budget constraint. Indeed, based on household consumption expenditure data from the SAM, the LES utility function allows the consumption patterns of household groups to be modelled. This makes it possible to identify the impacts of price shocks and crop productivity shocks on the costs of goods consumed by household groups and, in particular, on the costs of food consumed. Income losses and food price shocks will affect the food security of different household groups to different extents, as rural households spend 64.8% of their income on food consumption and urban households spend 52.6% of their income on food consumption. The threats of the war in Ukraine and climate shocks arise from reductions in the incomes of rural and urban people due to income losses in agriculture, but a significant share comes from losses in nonagricultural income.

Then, firms derive their income mainly from capital rents and transfers from other institutions. After paying income taxes and transfers to other institutions, the remaining income is the savings of firms. The government derives its income from capital income, direct taxes paid by households, transfers from the rest of the world, indirect taxes on products, taxes on imports and the remainder from taxes on production. It spends part of its income on the provision of public goods, then makes transfers, especially to households, and saves the rest.

Burkina Faso trades with the rest of the world. It imports mainly manufacturing (32.0%), petroleum (23.5%), chemicals (fertiliser) (13.4%), agri-food (7.8%) and other private services (5.7%). Based on this information, it can be expected that with rising crude oil, fertiliser and food prices, Burkina Faso's economy will be hit hard. The rest of the world receives a share of our capital income, import income, and transfers. Burkina Faso exports mainly mining products (gold) (59.6%) and cotton (16.6%) and makes transfers to the rest of the world. Indeed, the increase in the cotton and gold prices would positively affect the economy. To model the relationship between Burkina Faso and the rest of the world, we use the traditional Armington approach and assume that if Burkina Faso wants to increase its market share in the world market, then it must become more competitive.

With respect to macroeconomic closures, the current account balance is fixed. Since Burkina Faso is a small country, world import and export prices are fixed. The nominal exchange rate is the numeraire of the model. In our model, total investment is equal to the sum of savings in the economy. We also assume the existence of unemployment in the economy and depart from the full employment assumption of the standard PEP 1-t model. Finally, we incorporate rigidity in the skilled and unskilled nonagriculture labour markets for women and men following the wage curve approach of Blanchflower & Oswald, (1995).

The dynamics are introduced by the growth of the supply of factors of production. Labour supply, like most exogenous variables, grows at the rate of population growth. The capital stock is equal to its level in the previous period, minus depreciation, plus new investment. The distribution of new private capital across categories and industries follows the investment demand specification of (Jung & Thorbecke, 2003). Furthermore, the PEP-1-t model incorporates several approaches to calculating gross domestic product (GDP). Indeed,

to measure the impact of shocks on economic growth trend (SDG 8), the changes in real GDP per year is the indicator used.

According to the Food and Agriculture Organisation (FAO), there are four pillars of food security: food availability, food access, stability and utilisation (FAO, 2006). To capture the impacts of the war in Ukraine and climate change on food security, two of these pillars are used: food availability and food access. These two indicators are directly calculated by the CGE model. The first is the food availability index, which measures the volume of food production per capita in rural and urban areas. The second is the food access index, which measures the households' real consumption per capita of food products.

Finally, since the CGE model does not directly analyse poverty, we combine our CGE model with a micro model in a top-down approach. This means that once the simulations are done with the CGE model, the changes in household expenditure and prices of goods and services are passed on to the micro model. Thus, the usual FGT poverty indicators from (Foster et al., 1984) are generated for poverty analysis. Poverty is measured at national level for both male- and female-headed households. So, in addition to the difference in the level of employment between men and women in nonagricultural sectors, male to female wage ratio, the difference in the poverty rate of female-headed households and male-headed households are indicators that capture gender inequality.

The main database used to calibrate our CGE model is the 2013 Burkina Faso social accounting matrix (SAM) constructed by MAAH (2016), which we updated for 2019. We use income elasticities and Armington elasticities from (Sawadogo & Maisonnave, 2021), and production function elasticities of substitution between male and female labour are taken from Fontana & Wood, (2000). Finally, for the microsimulation model, we use data from the 2018/2019 Burkina Faso Harmonized Survey of Household Living Conditions (INSD, 2020).

3. Simulation scenarios and main results

3.1. Simulation scenarios

In this paper, two types of crises are modelled. The Russo-Ukrainian conflict through the fluctuation of food and energy prices and climate change impacts through the future change in agricultural crop productivity. The simulations are conducted over the period 2022 to 2030. Depending on the course of the crises, we simulate for the period 2022-2024 the price shocks of the Ukrainian conflict and the productivity shocks related to climate shocks take over from 2025 to 2030. Given the uncertainties surrounding the two crises, we construct two types of scenarios based on existing data: moderate and severe scenarios.

For the Ukrainian crisis, the scenario of world price fluctuations is taken from the commodity market outlook of World Bank, (2022a). The effect of this war on world prices is due to the importance of the two countries in the world commodity market. Indeed, Russia and Ukraine are two major players in several agricultural and food markets. The two countries are responsible for 53% of world trade in sunflower oil and seeds, wheat (27%), barley (23%), rapeseed (16%) and corn (14%) (UNCTAD (United Nations Conference on Trade and Development), 2022). Russia is also a major supplier of fossil fuels, such as crude oil and natural gas, as well as fertilisers and agricultural products. The war has disrupted global trade

in food and energy products, leading to higher prices (World Bank, 2022). The consequence of the war in Ukraine on the economy of Burkina Faso is an increase in the price of food and energy products, mainly the international price of wheat, corn, rice, fertiliser and oil (see Table 1). However, according to World Bank, (2022a) projections, for the years 2023 and 2024, world food and energy prices would decrease compared to the year 2022 but remain very high compared to the year before the conflict (2021). Thus, in our severe scenario, we are careful to take into account the level of variation compared to the year before the start of the Russian-Ukrainian conflict (see Table 1 for the magnitudes of the shocks calculated on the basis of the World Bank commodity market outlook for April 2022).

For 2022, we consider the same magnitude of shock for both the moderate and severe scenarios. In the moderate scenario of price fluctuations, the change in shock magnitude occurs in 2023 and 2024. We assume that in these years, the prices of commodities such as wheat, maize and fertilisers would be reduced, and the prices of other commodities would be maintained, as shown in Table 1. This is because Russia and Ukraine are two major suppliers of wheat in the world. Russia and Belarus are the two major suppliers of fertiliser. Ukraine, in addition to wheat, is a major exporter of maize to the world. Thus, we assume that the agreement between Russia and Ukraine on 22 July 2022 allows grain exports, and by the end of 2022, a solution will be found to end the war and the easing of sanctions against Russia. Thus, in our moderate scenario, we assume that in 2023, the price of wheat is \$245/mt, the price of maize is \$235/mt and the price of fertiliser is \$307/mt, that in 2024 wheat is sold at \$247/mt, maize at \$237/mt, and fertiliser at \$282/mt as predicted by World Bank, (2021b) before the start of the Russian invasion of Ukraine. In the severe scenario, we apply the forecasts of the World Bank (2022a) (see Table 1). The severe scenario is seen as a situation showing what could happen if a solution is not found to Ukrainian conflict.

The climate scenario (2025-2030) is based on estimates of future climate change impacts in Burkina Faso. Thus, existing studies have shown that climate change would reduce crop yields in Burkina Faso (Jalloh et al., 2015; Waongo et al., 2015). In addition, estimates of the effects of climate change are based on assumptions of CO₂ emissions, for example, low and high CO₂ emission scenarios. Moreover, in view of the uncertainties surrounding the estimates of future impacts of climate change on agricultural yields, we develop a mild and a severe scenario.

In the context of Burkina Faso, the empirical literature predicts a sorghum yield loss of 5-25% by 2000-2050 (Ouedraogo et al., 2006). Hidalgo et al., (2015) estimated average yield reductions over the period 2000-2050 of -25%, -15% and -5% for cowpea, millet and groundnut, respectively. Lam et al., (2012) found in the context of West Africa that climate shocks would lead to a reduction in fish production yields between 25.9% and 8.0% between 2000 and 2050. Similarly, Thornton et al., (2009) estimate a decline in livestock yields between 20.0% and 30.0% over the period 2000 and 2050 in West Africa. More recently, in the context of Burkina Faso, World Bank, (2019a) shows that climate change negatively affects agricultural crops. Table 1 summarises the future impacts of climate change on the yields of different crops in Burkina Faso identified in the relevant literature. Then, climate shocks are introduced in the CGE model by changing the productivity parameter in the value-added function. This channel

has been identified in other studies (Arndt et al., 2011; Arndt & Thurlow, 2015; Barbier & Hochard, 2018; Bosello et al., 2017; Montaud et al., 2017) and specifically in Burkina Faso (Sawadogo & Fofana, 2021; Zidouemba, 2017).

Given that our model is dynamic, the moderate and severe scenarios are introduced into the model gradually until the level of decline in the productivity of each crop predicted in 2050 by the above studies is reached. As mentioned above, the price shocks due to the war in Ukraine are simulated between 2022 and 2024, and the climate shocks start in 2025. All of these simulation scenarios are compared to a baseline scenario (BAU) that is calibrated using real GDP growth rates from World Bank, (2021). Table 1 summarises the different simulation assumptions.

Table 1: Assumptions of the simulated scenario (in %)

	Productivity change by 2050	mild scenario	Severe scenario	
Climatic shock on crops	Livestock	-8.0	-26.0	
	Fisheries	-8.0	-25.9	
	Corn	-16.3	-21.7	
	Millet and sorghum	-5.0	-20.0	
	Fonio	-13.0	-18.0	
	Forestry	-5.0	-15.0	
	Fruit and vegetables	-2.2	-11.0	
	Tubers	-7.0	-10.0	
	Oilseeds	-4.0	-10.0	
	Pulses	-1.3	-9.6	
	Rice	-2.0	-3.8	
Ukraine war shock	World price change	2022	2023	2024
	Gold	+4.3	-5.6	-8.3
	Fertilisers	+69.3	+50.0	+27.5
	Crude oil, Brent	+42.0	+30.7	+13.6
	Oils and meals	+29.8	+11.6	+10.6
	Corn	+19.4	+7.7	+6.9
	Rice, Thailand	-7.3	-9.4	-7.6
	Wheat	+42.7	+20.6	+17.5
	Other food	+15.2	+10.3	+10.6
	Cotton index	+39.0	+30.0	+28.3
	Tobacco	+1.1	-1.3	-0.9

Source: Authors' compilation from (Lam et al., 2012; World Bank, 2019a, 2022a).

The effects of rising world prices for each food commodity listed in Table 1 on the economy of Burkina Faso depend on the share of imports or exports of the commodity in the total supply of the product. They also depend on the ability of domestic producers and consumers to easily find substitutes when prices rise and on the importance of the product in total household food consumption. For example, wheat is a product consumed in Burkina Faso that is completely imported. The increase in world prices has an impact on consumers, but the effect could be relatively small, since the shares of sorghum, millet and rice in total food consumption are each much higher than the share of wheat.

In addition, Burkina Faso is a net importer of petroleum and related products. Indeed, increases in the price of oil and related products have significant negative effects on the economy as a whole. As oil products are used as inputs in the production of other goods and services (notably transport services), rising oil prices affect the price of all goods and services traded in the economy. This will cause a deterioration in the purchasing power of households.

Increases in cotton and gold prices have important effects on the overall economy. Burkina Faso produces cotton and gold and exports almost all of these products and imports the byproducts. Higher cotton and gold prices benefit producers and create additional revenues for the government. However, the increase in the price of byproducts will negatively affect households.

The impact on households also depends on the share of individual products in the household consumption basket. Cereals and edible oils account for 30.2% of the total value of household consumption and approximately half of total food expenditure. However, sorghum and millet are much more important staple cereals than maize and rice in the total consumption of all food and nonfood items. The particularity of maize is that it is a cereal used as an input in the production of industrial beverages, yet its import is less than one percent. For cereals, households, especially rural households, consume more locally produced than imported cereals.

Finally, rising fertiliser prices have an impact on some farmers. Indeed, increases in fertiliser prices can force farmers to reduce their use of fertiliser, leading to a decrease in agricultural production and an increase in food prices. The magnitude of the impacts depends on the responsiveness of fertiliser demand to price changes, the amount of fertiliser currently used per crop, and the expected productivity losses for producers who reduce their fertiliser use.

3.2. Macroeconomic results

Burkina Faso's economy is negatively affected by climate shocks and world price shocks due to the war in Ukraine. In the short term, the impacts of the increase in world prices due to the war in Ukraine are very hard on the economy of Burkina Faso. Indeed, the results show that in the short term, macroeconomic indicators are negatively affected by the increase in food and energy prices. Similarly, in the long term, reductions in crop productivity due to climate shocks are detrimental to macroeconomic variables. In fact, economic sectors are becoming less productive due to increased production costs. The increase in world prices for cereals and energy, especially the rise in the price of cotton, gold and livestock products, has led to an increase in the value of exports in the short term. However, the reduction in crop productivity due to climate shocks has led to a decrease in the value of exports. Specifically, the rise in world prices has led to a reduction in production, i.e., by 1.79% for the agricultural sector, 0.98% for the industrial sector and 1.03% for the services sector in the short term in both scenarios. As a result, total employment decreases by 1.79% in 2022 in the moderate and severe scenarios, by 0.95% in 2023 and 0.23% in 2030 in the moderate scenario and by 2.40% in 2023 and 0.48% in 2030 in the severe scenario. The decrease in employment is more significant in the industrial and service sectors. These sectors use petroleum products and

agricultural products as intermediate inputs. In the short term, rising oil prices and related products have increased the energy bill for industries and transport services.

On the other hand, the long-term reduction in agricultural production due to climate change reduces the demand for intermediate consumption in the industrial and service sectors. The short-term increase in production in the agricultural sector in response to the rise in world grain prices leads to an increase in the agricultural wage rate for men and women.

In the industrial and service sectors, the reduction in output has led to a freeing up of jobs and a fall in wage rates in both the short and long term for both the moderate and severe scenarios. However, the decline in the wage rate is more important for female and male unskilled workers. The rate of return on capital decreases in most sectors due to lower capital utilisation. With the increase in the wage rate in the agricultural sector, the income from agricultural labour increases (main source of income for rural households), while the decrease in the wage rate in the nonagricultural sectors has led to a decrease in nonagricultural income (main source of income for urban households). Similarly, the decline in the rental rate of capital in most nonagricultural sectors has caused a reduction in capital income, especially for urban households.

In addition, the reduction in production and the increase in world prices of goods and services have led to an increase in domestic prices. Indeed, the world price shock has led to a decrease in total imports in the short term, especially agri-food products. Urban households that depend on off-farm income and the market for food supplies are experiencing a significant drop in consumption due to high inflation. Thus, in the short term, real consumption of urban households declines by 10.31% (2022), and in the long term, in 2030, consumption falls by 1.12% in the moderate scenario and by 3.01% in the severe scenario. The results reveal a decline in the final consumption of rural households, especially for the severe scenario. In summary, the combined effects described above cause a reduction in real GDP of 8.31% in 2022, 3.53% in 2023 for the moderate scenario and 8.03% in 2023 for the severe scenario, and in 2030 real GDP falls by 1.12% in the moderate scenario and 3.09% in the severe scenario (Table 2).

Table 2: Impact on macroeconomic results (in % difference to base)

	Mild and severe	Mild				Severe			
	2022	2023	2024	2025	2030	2023	2024	2025	2030
Real GDP	-8.31	-3.53	-2.49	-0.72	-1.12	-8.03	-5.48	-2.40	-3.09
Consumer price index	7.46	9.18	7.34	-0.90	0.68	4.22	6.53	1.70	2.67
Real consumption of rural households	-1.87	-0.25	4.26	1.25	-0.60	-3.11	-1.91	0.60	-1.93
Real consumption of urban households	-10.31	-6.40	-5.05	-0.61	-1.12	-9.54	-7.39	-2.11	-3.01
Total investment expenditures	-8.61	7.93	-0.44	-5.92	-1.24	-11.14	-1.04	-5.79	-1.89
Employment	-1.79	-0.95	-0.39	-0.21	-0.23	-2.40	-1.50	-0.45	-0.48

Source: Calculation based on the CGE model

3.3. Sectoral results: production and employment

The results show that in the short term, on average, the production of all industries falls by 1.35% in both scenarios. In the long run, the loss of productivity of agricultural crops leads to a decrease in output by 1.03% in the moderate scenario and by 2.73% in the severe scenario. Furthermore, the effects on production are not evenly distributed across sectors, depending on whether the sector is export-oriented in the case of global price shocks or whether the sector is highly sensitive to climate shocks. Thus, the cotton and oilseed sectors and the agro-industry benefit from the price surge. In the cotton sector, production increases by 29.90% for both scenarios by 2022, but the climate shock leads to a reduction in cotton production of 2.81% in the moderate scenario and 7.53% in the severe scenario by 2030 (see Table 6 in annex). The other chemical products sector, which is linked to the cotton sector by demand in terms of intermediate consumption, experiences an increase in production of 6.34% in both scenarios; and for the long term an increase of 5.54% in the moderate scenario and 18.51% in the severe scenario. Sectors such as fonio, other crops, carpentry, drugs and soaps, and finance experience an increase in output because these products are used as intermediate consumption in the cotton and agro-industry sectors whose output has increased with short-term price shocks, but these sectors are negatively affected by long-term crop productivity shocks.

In addition, we can identify four other sectors that are severely affected by price and agricultural productivity shocks, with production declines of over 10%. The most affected sector is the rice sector, with a drop of 18.27% for both scenarios in 2022 due to the price shock; for the long-term, rice is less sensitive to the climate shock, production drops by 1.81% in the moderate scenario and 3.96% for the severe scenario. Next come millet and sorghum, tubers and pulses, where production falls by 11.53%, 11.36% and 11.54%, respectively, in the short term for the two world price shock scenarios. These decreases are a response to rising fertiliser prices. In the long term, productivity declines due to climate shocks cause a reduction in the production of millet and sorghum, tubers and pulses of 1.29%, 2.47% and 2.07%, respectively, in the moderate scenario and of 4.34%, 3.86% and 3.59%, respectively, in the severe scenario. The sectors most sensitive to climate shocks are other crops, cotton and oilseeds, livestock, fruit and vegetables, and fishing and hunting, whose production declines in the long term by 14.09%, 7.56%, 6.74%, 5.77% and 5.09%, respectively, for the severe scenario (see Table 6 in the Annex).

Price and climate shocks in the agricultural sectors were transmitted to the nonagricultural sectors either through the reallocation of production factors or through price changes. Price shocks (especially hydrocarbons) led to a reduction in the output of the mining sector by 1.50%, the textile sector by 2.68%, the beverage and tobacco sector by 2.10%, the electricity, water and gas distribution sector by 3.16% and the hotel and restaurant sector by 4.32% in the short run in both scenarios. In the long term, the reduction in the supply of intermediate inputs of agricultural products led to a decrease in the production of mining, agro-industry, textiles, hotels and restaurants, beverages and tobacco and the distribution of electricity, water and gas by 2.42%, 0.80%, 0.88%, 0.81%, 0.53% and 0.75%, respectively, and the reductions in their output are 3.31%, 3.96%, 3.05%, 2.83%, 2.10 and 3.16%, respectively, for the moderate and severe scenarios (see Table 6 in the Annex).

Finally, the effects on output led to movements in the labour market. As shown in Table 2 above, price and productivity shocks have a negative impact on overall employment. At the sectoral level, Table 3 shows that demand increases in the short term in the agricultural sectors for both scenarios, which is more favourable to male employment. This increase is mainly driven by the growth in labour demand in the cotton, other crops and fonio sectors, which are export-oriented and respond favourably to the increase in world prices by increasing their production. In the other agricultural sectors (maize, rice, millet and sorghum, tubers), which are labour intensive for women, they are negatively affected due to the high cost of fertiliser. Moreover, in the industrial sectors (too hydrocarbon-intensive), world price shocks lead to a reduction in labour demand for men by 4.96% and for women by 2.42% in both scenarios in 2022. In addition, in the long term, especially for the severe scenario, labour demand decreases by 1.85% for women and 1.47% for men. Finally, the female labour-intensive service sectors experience a reduction in female labour demand of 2.74% and male labour demand of 2.29% in the short term in both scenarios, and female labour demand falls by 0.45% and male labour demand by 0.34% in the long term. These results show that in the long run, women in Burkina Faso are slightly more affected than men by the loss of jobs in the industrial and service sectors. While women are more affected by price and climate shocks, the impacts differ when skills and residence are taken into account. The employment of unskilled women in the service sector experiences the largest decline in both scenarios. Being more active in agricultural activities explains why rural women are less affected by price and climate shocks than urban women.

Table 3: Impact on the labour market according to gender and sector

Scenarios	Mild and severe	Mild				Severe			
	2022	2023	2024	2025	2030	2023	2024	2025	2030
Agriculture sectors									
Female labour	0.19	0.14	0.14	0.01	0.00	0.16	0.14	0.01	-0.01
Male labour	0.49	0.35	0.38	0.03	-0.01	0.42	0.38	0.02	-0.02
Industry sectors									
Female labour	-2.42	-5.05	1.06	1.37	-0.98	-6.58	-7.13	-0.31	-1.85
Male labour	-4.96	-9.27	-5.46	0.19	-0.90	-10.93	-11.15	-0.67	-1.47
Service sectors									
Female labour	-2.74	0.70	-0.47	-0.94	-0.14	-1.84	0.21	-1.01	-0.45
Male labour	-2.29	0.19	0.11	-0.50	-0.11	-2.01	-0.16	-0.56	-0.34

Source: Calculation based on the CGE model.

3.4. Impact on agents and household food consumption change

The results reveal that economic agents are negatively affected in both simulations. It is noted that the severe scenario is more detrimental. Firms that derive most of their income from capital income are affected by a reduction in their income of 6.56% in 2022 due to the increase in world prices and 1.40% in 2030 due to the climate shocks that caused a sharp decline in the return on capital. The reduction in corporate income led to a reduction in savings of 5.45% in 2022 for both simulations and 1.12% in 2030 in the severe scenario and 0.70% in the moderate scenario.

The impact on household income varies according to the area and the main source of income. The income of poor rural households, which rely mainly on income from agricultural capital and agricultural labour, is affected by an increase in the rental rate of agricultural capital and the agricultural wage rate, leading to an increase of 14.00% of their income in 2022 for both scenarios and of 1.06% in 2030 in the moderate scenario and of 3.46% in 2030 in the severe scenario. This increase in income leads to an increase in savings and in the amount of direct taxes paid. Poor urban households that derive some of their income from agricultural capital, agricultural labour, nonagricultural capital and transfers from other agents experience an income gain in both scenarios of 0.35% in 2022, 0.15% in 2030 in the moderate scenario and 1.89% in 2030 in the severe scenario. Nonpoor rural households experience an increase in income of 3.17% in both simulations in 2022 and a reduction in income of 0.19% in the moderate scenario and 0.04% in the severe scenario due to the decline in the nonfarm wage rate in the long run. Finally, nonpoor urban households face significant income declines due to lower wage rates in nonfarm activities and lower income from nonfarm capital. This leads to a decline in their savings and in the value of direct taxes paid. It is because of the reduction in their income coupled with the increase in the price of goods and services that the consumption of urban households decreases more than that of rural households (see Table 2). The government's income falls by 2.29% in 2022 in both simulations and by 0.89% in the severe scenario in 2030 and by 0.61% in the moderate scenario in 2030. The decrease in government revenue is due to the decline in direct taxes collected from households (especially nonpoor ones) and businesses, as well as in indirect tax revenues.

Rising grain and energy prices and reduced crop productivity have increased domestic prices and reduced household purchasing power. These changes are likely to lead to fairly significant changes in food consumption patterns, with negative nutritional effects. Supply-side disruptions have led to a significant reduction in demand for staple foods such as rice, maize, millet, sorghum and fonio and for nutrient-rich foods such as fruits and vegetables, tubers, beans, vouandzou, animal products, fish and agro-processing products (see Table 5). The results show that the reduction in food expenditure is very significant in the short term in both residential settings, but the effect grows faster in the long term for both the moderate and severe urban scenarios.

Table 4: Change in household consumption expenditure by product (in % difference to base)

Rural households	Mild and severe	Mild				Severe			
	2022	2023	2024	2025	2030	2023	2024	2025	2030
Millet & sorghum	-17.37	-2.89	2.48	0.36	-1.22	-16.14	-11.74	0.19	-3.52
Maize	-4.46	-1.35	-0.62	-0.57	-1.02	-4.16	-3.16	-0.51	-1.38
Rice	-20.32	-11.21	-11.16	-2.68	-1.93	-18.69	-15.17	-2.88	-3.21
Fonio	11.09	-9.41	8.47	9.00	-0.55	1.46	-6.02	10.79	-0.76
Tubers	-8.86	-8.15	-8.10	-1.79	-2.15	-8.62	-8.13	-2.28	-3.29
Beans	-10.14	-7.97	-8.14	-1.55	-1.12	-9.71	-8.64	-2.23	-3.08
Voandzou	-10.20	-7.92	-8.14	-1.59	-1.12	-9.73	-8.62	-2.27	-3.08
Fruit & vegetable	-5.28	-3.56	-2.36	0.03	-0.68	-5.23	-4.38	-0.41	-2.68
Livestock	2.47	2.36	3.42	-0.36	-1.77	3.24	1.41	-7.91	-7.19
Fish	5.28	5.25	3.91	0.96	-0.96	6.33	3.88	-6.61	-4.59

Agrifood	-0.63	0.40	5.58	2.02	-0.31	-2.35	-1.92	2.19	-0.94
Urban households	Mild and severe	Mild				Severe			
	2022	2023	2024	2025	2030	2023	2024	2025	2030
Millet & sorghum	-24.03	-9.32	-7.31	-1.70	-1.76	-21.57	-16.57	-2.48	-4.45
Maize	-5.99	-2.81	-2.91	-1.07	-1.14	-5.39	-4.27	-1.24	-1.63
Rice	-27.51	-17.35	-20.06	-4.79	-2.47	-24.34	-20.06	-5.83	-4.27
Fonio	0.14	-14.98	-2.52	6.40	-1.14	-5.90	-11.26	7.06	-1.93
Tubers	-12.81	-11.10	-12.50	-2.89	-2.40	-11.68	-10.68	-3.78	-3.80
Beans	-14.41	-11.26	-13.08	-2.88	-1.49	-13.04	-11.47	-4.14	-3.78
Voandzou	-14.45	-11.21	-13.08	-2.91	-1.49	-13.06	-11.44	-4.18	-3.78
Fruits & vegetables	-10.15	-7.26	-8.08	-1.33	-1.04	-8.98	-7.54	-2.37	-3.36
Livestock	-6.60	-4.29	-6.22	-2.26	-2.23	-3.87	-4.24	-10.08	-7.94
Fish	-4.50	-1.88	-6.18	-1.13	-1.49	-1.34	-2.16	-9.10	-5.53
Agrifood	-7.83	-5.44	-4.63	-0.03	-0.84	-7.00	-5.82	-1.11	-2.85

Source: calculation based on the CGE model

3.5. Impact on SDG indicators: real GDP, food security and poverty

As described in the previous sections, the Russo-Ukrainian war and climatic shocks are negatively affecting the economy of Burkina Faso. As a result of these crises, the country's economy is experiencing a reduction in production, employment and household consumption. This results in a reduction in real GDP of 8.31% in 2022 for the moderate and severe scenarios due to the Russo-Ukrainian conflict and a reduction of 1.12% and 3.09% for the moderate and severe scenario respectively in 2030 (see Table 2 above).

Secondly, the contraction in production has led to a reduction in employment in the industrial and service sectors. In the industrial sector, the reduction in jobs in the short term is more pronounced for men but the trend reverses to the disadvantage of women in the long term in both scenarios (moderate and severe). In addition, the Ukrainian and climate crises have widened the gender pay gap. The gender wage gap is larger for unskilled workers (male/female) than for skilled workers (male/female). The impact on this gap is even more pronounced when it comes to climate shocks, especially in the long term, as in the short term there is a reduction in the gap (see Table 8 in the Annex).

As mentioned above, two pillars of food security, food availability per capita and food access per capita, are analysed in this study. Indeed, the surge in world grain and energy prices due to the war in Ukraine and the reduction in agricultural crop productivity have strong repercussions on real per capita consumption for rural and urban households (see Table 2). The effects on food security are negative (Table 4). Due to the decline in agricultural production, per capita food supplies decrease by 6.05% in rural areas and 3.05% in urban areas for both scenarios in the short term. In the long term, food availability decreases for rural households by 1.67% in the moderate scenario and by 5.33% in the severe scenario, and for urban households, food supply declines by 1.33% in the moderate scenario and by 4.68% in the severe scenario. Similarly, due to rising food prices and falling per capita income, especially in urban households, per capita food consumption declines, especially in urban areas (-8.77% by 2022 for both scenarios and -1.64% and -4.41% in the moderate and severe scenarios,

respectively, by 2030) compared to households in rural areas (-7.20% by 2022 for both scenarios and -1.45% and -4.36% in the moderate and severe scenarios, respectively, by 2030) (Table 4).

Table 5: Impact on food access and availability per capita by area (in % difference to base)

	Mild and severe		Mild			Severe			
	2022	2023	2024	2025	2030	2023	2024	2025	2030
Food access per capita									
Rural households	-7.20	-2.52	-0.39	-0.38	-1.45	-6.50	-5.53	-2.99	-4.36
Urban households	-8.27	-6.03	-7.98	-1.92	-1.64	-5.57	-5.88	-4.95	-4.41
Food availability per capita									
Rural households	-6.05	-3.12	-2.88	-0.95	-1.67	-5.30	-4.57	-4.47	-5.33
Urban households	-3.05	-1.41	-1.98	-0.62	-1.34	-1.43	-2.07	-3.81	-4.68

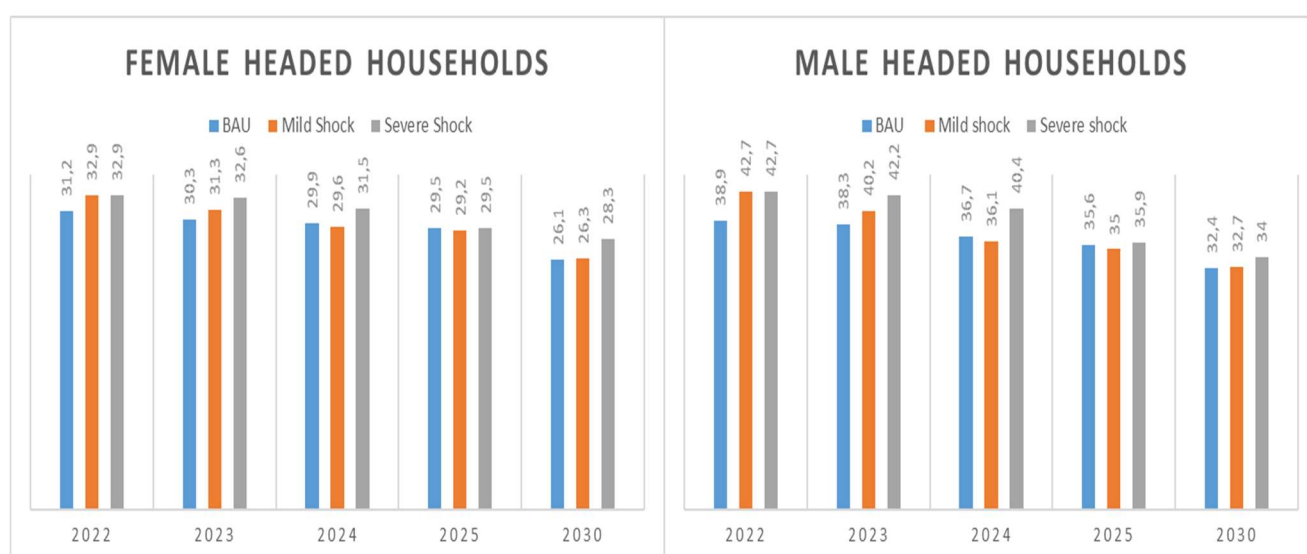
Source: calculation based on the CGE model

To assess the impact of the shocks of rising world food and energy prices due to the war in Ukraine and the climate shocks on poverty, we use the FGT indices of Foster et al., (1984) These indicators are calculated for male-headed households and female-headed households for the periods before and after the shocks.

At the national level, the poverty rate increases from 38.2% (baseline) to 41.8% in 2022 for both scenarios (see Table 7 in annex). In the severe scenario in the long run, the climate shock increases the poverty rate by 33.4% compared to 31.8% at the baseline at the national level, including 41.8% in rural areas.

Figure 1 presents the impacts of the war in Ukraine and the climate shocks on poverty by the head of household gender. Regarding the basic situation, we note that poverty rates are higher among households headed by men than among those headed by women. This increase in male proportion is because in Burkina Faso, according to the latest survey on household living conditions in 2018, 90.6% of households are headed by men compared to 9.4% of households headed by women (INSD, 2020). In addition, in male-headed households, 50.5% of the residents are women compared to 49.5% of men, and in female-headed households, 64% are women compared to 36% of men. Indeed, the impacts of the war in Ukraine and climatic shocks are increasing poverty and the gender gap. The poverty rate of male-headed households increases by 3.8 percentage points in 2022 for both scenarios and by 0.3 percentage points for the moderate scenario in 2030 and by 1.6 percentage points in the severe scenario in 2030, while the poverty rate in female-headed households increases by 1.7 percentage points. In the long run, the incidence of poverty increases in this group of households by 2.2 and 0.2 percentage points in the severe and moderate scenarios, respectively. In addition, the results show a widening of the depth of poverty and the severity of poverty, and this is more important in male-headed households (see Table 7 in annex). In terms of household structure composition, women will be more affected by the increase in poverty levels than men.

Figure 1: Impacts on the poverty head count ratio by gender (in % difference from base).



Source: Calculation based on the microsimulation model

4. Conclusion and policy implications

The world was already living under the influence of climate shocks, and the war in Ukraine has now triggered a major shock on world grain and energy prices. In this paper, we study the economic and gender effects of the Ukraine crisis coupled with climate shocks in Burkina Faso using a dynamic gendered CGE model with microsimulation. The results show adverse effects on the economy and population of Burkina Faso, and furthermore, the target of economic growth of approximately 7% in 2030 could be compromised.

The results show that economic activities are affected to varying degrees, with activities such as trade, hotels and restaurants, textile manufacturing, beverage manufacturing and agri-food being more labour intensive and affected to a greater extent. For example, in service activities, the gender-specific impacts on employment show that women suffer more than men from the negative impacts of climate change and price increases due to the war in Ukraine. In both scenarios, there is a decrease in employment in the industrial and service sectors, which are sectors that provide decent jobs, showing that the target of decent job creation by 2030 becomes problematic. In addition, unskilled workers, especially unskilled women in the service and industrial sectors and even in agriculture, are the most affected, as they suffer job losses and face heavier economic costs. The results reveal that price shocks and reduced agricultural productivity are likely to further widen existing gender gaps in the labour market. This will be even more detrimental to women who were already heavily affected, especially in the long term.

This Ukrainian and climatic crisis deepens the food insecurity crisis that people are experiencing. The results reveal that urban households are the most affected by the surge in food prices. The reduction in rural and urban household expenditure on cereals, root and tuber crops and animal products (milk, meat, fish) shows that the crisis threatens the majority of the population with food and nutrition insecurity. In addition, the combined effects on production, household income, increasing prices and environmental shocks increase poverty

among the population. Under the severe scenario, poverty in female-headed households increases faster.

Our results are important for understanding the impacts of the Ukrainian crisis and climate shocks on the economic sectors and for guiding the government of Burkina Faso towards the adoption of policies that might be appropriate in the context of the Ukrainian crisis in the short term and climate shocks in the long term while taking into account the large disparities that exist in the labour market and the consequences for the living standards of rural and urban households. In the short term, policy options should target vulnerable households through transfers and subsidies to female labour-intensive sectors such as retail trade, food processing and hotels and restaurants. Additionally, reducing import tariffs on staple foods such as rice and maize could help people. In addition, in the long term, policy options should promote investments in sectors that can offer better wages (e.g., industry and services) and in sectors that reduce women's burdens (e.g., the water sector or health and education). Investments to diversify agricultural production (hydroagricultural schemes for irrigation), renewable energy production and to boost economic growth are needed to avoid economic dependence on hydrocarbon imports or on maize and fertiliser production. Overall, policies that increase household purchasing power and reduce the increase in poverty and food insecurity and prioritise the vulnerable (especially women) would be effective measures. Finally, these results, in addition to Burkina Faso, provide an evidence base for other countries in sub-Saharan Africa that are affected by the effects of the Ukrainian crisis and climatic shocks (floods and droughts) and have labour market disparities and an unstable economic structure.

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Annex:

Table 6: Impact of world price and climate shocks on production (in % difference from base)

	Mild and severe					Severe			
	2022	Mild							
		2023	2024	2025	2030	2023	2024	2025	2030
Maize	-5.53	-3.00	-1.76	-0.54	-1.30	-5.54	-4.41	-0.89	-2.07
Rice	-18.27	-11.28	-11.83	-2.28	-1.81	-16.22	-13.37	-3.58	-3.96
Millet-sorghum	-11.53	-2.07	1.68	0.32	-1.29	-10.73	-7.95	-1.47	-4.34
Fonio	11.44	-19.56	5.45	12.20	-1.61	-2.07	-13.09	13.98	-2.49
Tubers	-11.36	-10.33	-11.30	-2.62	-2.47	-10.57	-9.87	-3.44	-3.86
Pulses	-11.54	-9.23	-9.95	-2.07	-1.32	-10.81	-9.65	-3.13	-3.59
Cotton	29.90	20.69	18.30	0.10	-2.81	29.37	24.82	-3.43	-7.53
Fruits & vegetables	-7.83	-6.47	-7.99	-1.34	-1.41	-6.40	-5.59	-4.03	-5.77
Other crops	0.93	-18.65	-24.27	-7.00	-8.23	5.25	6.90	-1.55	-14.09
Livestock	-0.04	0.54	-0.39	-0.90	-1.68	0.54	-0.07	-7.08	-6.74
Forestry	-0.56	0.08	-0.35	0.69	-1.01	-0.02	-0.53	-3.99	-3.77
Fishing & hunting	-0.02	2.19	-1.17	-0.18	-1.20	2.22	1.17	-7.23	-5.09
Extraction	-1.50	-3.74	-5.33	-3.91	-2.42	-4.76	-6.51	-4.18	-3.31
Agro-industry	0.59	0.33	1.56	1.10	-0.80	0.67	0.42	-1.21	-3.96
Beverage & Tobacco	-2.10	-0.89	3.11	1.56	-0.59	-3.28	-2.82	0.67	-1.81
Textile	-2.68	-7.60	0.16	3.21	-0.88	-2.61	-5.37	2.51	-3.05
Carpentry	0.02	0.51	0.13	0.28	-0.03	0.43	0.88	0.71	-0.94
Drugs & Soaps	0.14	0.75	0.09	0.25	0.10	0.91	1.49	1.24	-0.06
Manufacturing	-1.62	-0.74	-0.08	0.04	-0.33	-1.79	-1.70	-0.94	-1.78
Other chemical	6.34	15.93	9.98	10.13	5.54	26.66	36.90	35.31	18.51
Electricity, water & gas	-3.16	-3.25	-0.40	-0.16	-0.75	-2.84	-1.46	-0.24	-1.86
Construction	-1.84	0.23	-0.77	-1.54	-0.90	-3.30	-1.81	-2.34	-1.88
Trade	-1.20	-0.63	1.37	0.06	-1.02	-2.33	-1.60	-1.30	-2.91
Hotel & restaurant	-4.32	-2.14	-0.66	0.18	-0.81	-4.16	-3.17	-1.65	-2.83
Transport & telecom	-0.91	-0.52	-0.30	-0.48	-0.64	-0.97	-0.55	-0.49	-1.71
Finance	0.02	0.26	0.32	-0.03	-0.21	0.25	0.78	0.78	-0.70
Public administration	-0.36	-0.56	-0.17	0.15	0.07	-0.13	-0.12	0.20	0.09
Other private services	-0.82	-1.41	-0.54	-0.36	-0.52	-1.16	-0.63	0.20	-1.21

Source: calculation based on the CGE model

Table 7: Impact on poverty at the national level and by head of household gender

	2022	2023	2024	2025	2030
National poverty rate					
Headcount Poverty (P0)					

BAU	38.2	37.5	36.1	35.0	31.8
Mild Scenario	41.8	39.3	35.5	34.4	32.1
Severe Scenario	41.8	41.3	39.6	35.3	33.4
Poverty gap (P1)					
BAU	10.9	10.6	10.1	9.7	8.4
Mild Scenario	12.4	11.3	9.9	9.6	8.6
Severe Scenario	12.4	12.1	11.4	9.8	9.0
Poverty severity (P2)					
BAU	4.3	4.2	3.9	3.8	3.2
Mild Scenario	5.0	4.5	3.8	3.7	3.3
Severe Scenario	5.0	4.9	4.6	3.8	3.4
Female head of household					
Headcount Poverty (P0)					
BAU	31.2	30.3	29.9	29.5	26.1
Mild scenario	32.9	31.3	29.6	29.2	26.3
Severe scenario	32.9	32.6	31.5	29.5	28.3
Poverty gap (P1)					
BAU	9.9	9.7	9.3	9.0	8.4
Mild scenario	11.0	10.2	9.1	8.9	8.1
Severe scenario	11.0	10.9	10.3	9.1	8.4
Poverty severity (P2)					
BAU	4.3	4.1	3.9	3.8	3.3
Mild scenario	4.9	4.4	3.8	3.7	3.3
Severe scenario	4.9	4.8	4.5	3.8	3.5
Male head of households					
Headcount Poverty (P0)					
BAU	38.9	38.3	36.7	35.6	32.4
Mild scenario	42.7	40.2	36.1	35.0	32.7
Severe scenario	42.7	42.2	40.4	35.9	34.0
Poverty gap (P1)					
BAU	11.0	10.6	10.2	9.8	8.5
Mild scenario	12.5	11.4	10.0	9.7	8.7
Severe scenario	12.5	12.3	11.5	9.9	9.1
Poverty severity (P2)					
BAU	4.3	4.2	3.9	3.8	3.2
Mild scenario	5.1	4.5	3.8	3.7	3.3
Severe scenario	5.1	5.0	4.6	3.8	3.4

Source: Calculation based on the microsimulation model

Table 8: Male-Female wage rate ratio (change in %)

	Mild and Severe		Mild				Severe			
	2022		2023	2024	2025	2030	2023	2024	2025	2030
Male-Female unskilled wage ratio	-0.37		-0.69	-0.79	0.62	2.48	0.37	0.61	0.89	2.55

Male-Female skilled wage ratio	-0.16	0.06	0.43	0.63	1.32	-0.12	0.41	0.62	1.26
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Source: calculation based on the CGE model