Implications of COVID-19 and mitigation measures on gender and the Zimbabwean economy☆

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Highlights

- COVID-19 policy response modeling is a key feature in a gender-disaggregated model.
- COVID-19 has detrimental economic consequences, impacting poorer women the most.
- Mitigation measures reduce (increase) poverty in the short (long) term.
- We shed light on short-versus long-term policy dilemmas faced by the government.
- Mitigation measures should consider varied socioeconomic groups and time horizons.

Abstract

This paper provides a macro-micro modeling analysis of the ex-ante effects of COVID-19 mitigation and recovery policies on macroeconomic and distributional effects, particularly on female and male workers, income distribution, and poverty in Zimbabwe. With an emphasis on modeling gender-disaggregated labor markets and COVID-19 policy responses, the paper presents and combines the most recent data on poverty, gender, and the economy at the national level. The study finds that i) without any government mitigation measures, the gross domestic product will remain below business-as-usual levels; ii) poorer women are hardest hit because they are employed in sectors that are exposed and vulnerable to COVID-19 response measures; and iii) mitigation measures to counteract the negative effects of increases in poverty are effective only in the short term, and additional measures to sustain poverty reduction for the long term to sustain the poverty reductions are required. These results highlight the short-term versus long-term dilemma the government faces when contemplating responses to COVID-19.

Keywords: Poverty; Gender; COVID-19; Macro-microsimulation; Labor market; Zimbabwe

JEL classification: JEL Code: C68, E60, J16, O5

1. Introduction

The ongoing coronavirus disease (COVID-19) pandemic, coupled with extraordinary responses to combat it, is expected to have more economic impacts than many other shocks, mainly because the pandemic features a simultaneous supply and demand shock emanating from multiple and diverse sources, including domestic, regional, and global. Beyond the devastating health impacts, the effects are expected to be particularly hard on the vulnerable socioeconomic groups, particularly the unskilled and less educated women, predominantly employed in sectors most negatively affected by the pandemic responses. Furthermore, it is well known that women's roles in the economy extend beyond the market economy into important non-market economy activities, such as caring for children, the sick, and the elderly, exacerbating the negative effects of the pandemic on women. Governments have implemented several measures to mitigate the short-term impacts of the pandemic and packages to support the recovery of economies; however, there are many unknowns and implicit assumptions in these response measures. For example, the economic impact and sustainability of the response measures are unknown. Moreover, the differential gendered impacts remain uncertain, and it is unclear how any adverse spillover effects can be ameliorated.

This study aims to help fill, in part, the knowledge gaps inherent in these questions. This paper presents a macro-micro modeling analysis of the ex-ante effects of changes in COVID-19 mitigation and recovery policies on macroeconomic and distributional effects with particular emphasis on female and male workers, income distribution, and poverty in Zimbabwe.[1] This study's novel feature emphasizes modeling gender-disaggregated labor markets and COVID-19 within a macro model framework captured using a computable general equilibrium (CGE) model. The analysis is done nationwide and across diverse socioeconomic categories, particularly gender and rural/urban regions. Pandemic dynamics, such as those associated with COVID-19, create many impacts influenced by the pandemic and corresponding interventions. Studies by Goenka and Liu (2012, 2020) address these aspects in specified growth models, while this current study focuses on the impacts on women via the labor market. As such, the model functions are not specified to represent the dynamics of a pandemic. In Zimbabwe, the infection rate and mortality of COVID-19 cases were relatively low, implying that the direct health impacts were unlikely to be the most relevant economic drivers in the immediate to medium term of the analysis.

The study assumes impacts differentiated for economic sectors in the first period and an economic recovery from the shock in the second period. It is unknown how long the COVID-19 pandemic will continue to impact the Zimbabwean economy. Therefore, mild and severe scenarios are simulated, with different durations regarding the pandemic's impact and different start periods of recovery. In the mild scenario, the impacts of the pandemic last from 2020 until 2022, and the economy will recover from 2023. In the severe scenario, the impacts of the pandemic last one year longer (from 2020 until 2023), and the recovery starts one year later, from 2024 onwards. As mitigation measures, a fiscal package being implemented in 2020 and 2021 by the government is simulated under the different mild and severe scenarios.

Section 2 presents selected modeling studies on the impact of COVID-19, while Section 3 describes the gendered CGE model and data for Zimbabwe. Section 4 presents the scenarios

simulating the COVID-19 impact and policy measures to improve the welfare and living conditions of the population. Section 5 discusses the results with a focus on the gendered effects of the simulated measures, and Section 6 presents the concluding remarks and a summary.

2. Literature review

At the expansive level, the literature analyzing the economic impacts of pandemics distinguishes the health impacts from the pandemic itself and the economic consequences of COVID-19 lockdown policy responses; the former can be classified as the direct effects of COVID-19 while the latter can be thought of as the indirect effects. Studies estimating *direct costs* of outbreaks would typically include costs of funding the public health response (borne by both the public sector and private sector businesses), loss of productivity due to illness, and death of economically active workers. These studies usually use an accounting approach during and sometimes after the disease outbreak. Several sub-themes are explored, including budget reallocation effects, incomes forgone, labor supply, and labor productivity effects. Examples of work in this tradition include those of Sachs and Malaney (2002) and Brainerd and Siegler (2003).

Another strand of the literature includes studies focusing on the *long-term impacts of disease outbreaks*. These studies have typically estimated cross-country growth regressions focusing on past outbreaks, such as the 1918 Spanish Flu epidemic and AIDS. The long-run economic impact of epidemics is affected by changes in savings and investments, mortality and fertility, human and health capital destruction, and accumulation. Examples of works in this tradition include Bloom and Mahal (1997a, 1997b), Haacker (2002), and Bloom and Canning (2006); however, the findings from this type of literature on the economic growth impacts of epidemics are generally inconclusive.

Studies focusing on the indirect costs of epidemics typically have a short to medium-term horizon. They emphasize interlinkages within economies and globally and trace the transmission channels explicitly. Outbreaks such as SARS, Ebola, and, more recently, COVID-19 are the primary focus of these studies. Most of these studies project a cut in gross domestic product (GDP) growth due to the outbreak but the transmission channels used to explain the contraction differ. In all cases, the response measures to outbreaks could seriously affect labor productivity in the short and medium run, though in the long term, productivity could improve after households and firms have adjusted to the new normal (Lee and McKibbin, 2003; Chou et al., 2003; Chou et al., 2004; Chang et al., 2004; Keogh-Brown et al., 2010, 2020; Birch, 2020; Calvin et al., 2020; Zidouemba et al., 2020; World Bank Group, 2014; Fofana et al., 2015).

Focusing on COVID-19, McKibbin and Fernando (2020a, 2021) use a global hybrid of a CGE model and a dynamic stochastic general equilibrium model and find GDP losses ranging from 283 to 9170 billion United States dollars (USD) worldwide, depending on the epidemiological scenario assumed. Similarly, the European Commission uses analysis based on the Modeling International Relationships in Applied General Equilibrium and Global Trade Analysis Project (GTAP) CGE models, estimating that global trade will fall by 10 to 16% in 2020. Maliszewska et al. (2020) use the Environmental Impact and Sustainability Applied General Equilibrium

(ENVISAGE) CGE model and register a fall in global GDP by 2% due to COVID-19. At a national level, some studies investigate the impacts of COVID-19 on a single country. For instance, for South Africa, Chitiga-Mabugu et al. (2021a) show that, in a mild scenario, where GDP falls by 10%, and in a more severe scenario, where GDP drops by 14%. Furthermore, van Heerden and Roos (2021) find a similar GDP drop from the lockdown effects.

Only a few macroeconomic studies analyze the impacts on women. Chitiga et al., 2021a, Chitiga-Mabugu et al., 2021b conclude that women are hit harder economically than men due to the COVID-19 pandemic's economic impacts. This discrepancy is caused by the relatively lower skills for women workers than for men. Additionally, sectors in which women predominate in employment suffer more than male-dominated sectors. Female-headed households' poverty increases more than male-headed households because of the harsher income effect on women workers and because female-headed household poverty was already higher than male-headed households before the pandemic. Escalante and Maisonnave (2021) find that in Bolivia, women, especially those residing in rural areas, are more affected than men. While these studies shed some light on specific impacts between men and women, they do not consider government responses to COVID-19.

Given that the disease has only started recently (March 2020) and Zimbabwe currently has relatively low infection rates and deaths from the pandemic, this study does not further pursue modeling the direct health effects of the disease. The study instead considers the indirect effects of the crisis, such as reduced domestic productivity due to lockdowns, increased transport costs (domestic channels), and changes in international trade and transfers (international channels).

3. Model and data

This study uses a two-layer economic model to assess the likely economic impacts of COVID-19 and mitigation measures on poverty. The macroeconomic simulation model enables assessing the impacts on the national economy, while the distributive analysis helps assess the impacts on households regarding gender, poverty, and inequality.

3.1. CGE macroeconomic model

As a macroeconomic simulation model, a CGE model is used to evaluate the economy-wide impacts of the COVID-19 pandemic and mitigation measures undertaken on the economy. CGE models are consistent macroeconomic frameworks, representing economic sectors (e.g., agriculture, mining, services), institutions (e.g., households, government, firms), and their economic interlinkages. Our recursive dynamic CGE model is based on the PEP-1-t CGE model (Decaluwé et al., 2013). To simulate the impact of the COVID-19 crisis on the labor market and jobs in as realistic a fashion as possible, we differentiated the labor market in the model into 14 types of labor.

3.1.1. Production and the labor market

Along with the Social Accounting Matrix (SAM), the model represents 36 economic sectors (activities) and 48 products. The production function is a nested function. At the first level, the output is a Leontief-type function between value-added and intermediate consumption for each sector. Value added is a constant elasticity of substitution (CES)-type function between composite labor and capital at the second level. Composite capital is a CES function between land and agricultural capital for agricultural sectors. At the last level, composite labor is a CES-type function between the different types of labor. Given the specificity of the Zimbabwean labor market, there is a difference in the labor force between agricultural sectors and non-agricultural sectors, as indicated in Fig. 1. Indeed, labor is disaggregated for agricultural sectors between permanent employees, temporary employees, and own-account/family-contributing workers. The three categories are further split by gender (female or male), ending in six different types of labor. For production, the four agricultural sectors use these types of labor in different proportions, together with land and agricultural capital. For instance, large-scale farming mainly uses permanent and temporary workers, while small-scale farming uses own-account/family-contributing workers.

For non-agricultural sectors, the production function is slightly different as the labor types differ. At the first level, the output is a Leontief-type function between value-added and intermediate consumption. Value added is a CES-type function between composite labor and capital at the second level. Composite labor is a CES function between skilled and unskilled labor at the third level. Then at the fourth level, each skill category is a CES function between rural and urban workers. Finally, the producer can hire either a man or a woman at the fifth level.

The listed characteristics of the labor market in our model reflect our view of important properties in segmentation and producer choices when making hiring decisions. These reflect empirical realities based on country, knowledge, and research. There are three distinct labor markets modeled. First, we assume public servants would not be affected by unemployment, and the government would continue paying their income at the same nominal wage rate. For private workers, we assume workers in the agricultural sectors could not be mixed with non-agricultural workers. Our objective was to capture gender employment, especially in the agricultural sectors, where women mainly work as family workers. Consequently, we disaggregated the agricultural labor market following the available data that could represent the type of workers: permanent employees, temporary employees, and own-account/family-contributing workers. For non-agricultural sectors, we used the typology of workers we could find in the microdata. Given the situation in the Zimbabwean labor market, we found that taking into account regional dimensions of rural and urban as well as the level of skills and gender was important. Firms would start by deciding whether they hire a skilled or an unskilled worker. The elasticity of substitution between these two categories is set at 0.8, which is not based on any econometric study but is a commonly used value. This is the first level of decision.

Once the choice is made, firms would choose between rural and urban workers in the second decision-making level. Here we assume that it is more difficult to substitute a skilled worker with another than to substitute low-skilled workers among each other. To represent this, we

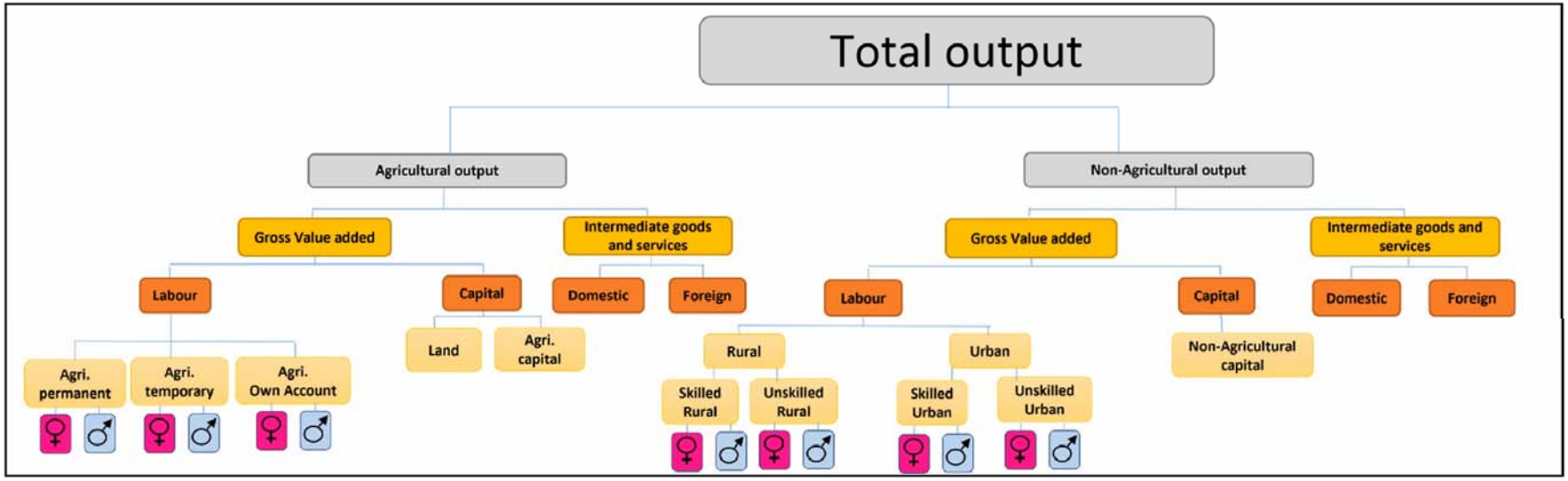

Fig. 1. Schematic presentation of the nested production function for production factors.

Source: Authors' presentation

assume that the elasticity of substitution is systematically lower when it comes to skilled workers. Specifically, substituting among skilled workers is set at 0.7, while among unskilled workers, it is set at 1.3. A lower elasticity constrains the model more. In other words, a greater change in the price ratio is needed for worker substitution to occur. Sensitivity analysis shows that the model works well and is robust to various elasticities choices (see Appendix 1). The scenarios' results hardly change after changing the elasticities on the labor production function by ±10% and rerunning the model. As expected, with a lower elasticity, the results are less favorable for the Zimbabwean economy. The third and last level of decision for the firm is whether they hire a man or a woman. While it is likely that results would have been different with a different tree in the production function, for instance, choosing first rural or urban and then picking by the level of skills; however, this disaggregation did not seem to represent the functioning of the Zimbabwean situation on the ground.

3.1.2. Institutions and income

The CGE model distinguishes four different institutions: households, firms, government, and the rest of the world. Households derive their income from labor, capital, and transfers; they spend most of their income on final consumption, with the rest spent on direct taxes, transfers to other economic institutions, and savings. Corporate income is derived from capital income and transfers from other agents. They distribute dividends to other agents, pay corporate taxes, and save the rest. Governments collect direct taxes from households and firms, indirect taxes, and receive transfers from other institutions. The government then spends its revenues mainly on non-market sector production (education, health, public administration) and makes transfers to other institutions. Public savings is the difference between the government's income and its spending.

3.1.3. Trade

To link Zimbabwe and the rest of the world, the traditional CGE modeling approach is used, in which trade is modeled based on the assumption of imperfect substitutability of products given their origin (the Armington hypothesis). Regarding exports, we assume that Zimbabwean producers can sell their products on the local or international markets; however, we assume that they cannot export as much as they wish and must be more competitive than other international producers to increase their share of the world market. Technically, this means that we assume a finite elasticity for export demand that reflects the competitiveness of local producers in international markets.

3.1.4. Macro-closures

In terms of closures, we assume that the nominal exchange rate is the numeraire of the model. Next, the small-country assumption is retained for Zimbabwe; consequently, world prices are exogenous. We also assume that the current account balance is fixed. The labor market comprises three broad labor sectors: the agricultural sector, the private non-agricultural sectors, and the public sector. Workers are not mobile across these three broad sectors but can move within the broad categories. Indeed, in Zimbabwe, it is improbable for a worker from the agricultural sector to look for another job in the mining or services sectors. If the worker loses their job, they will look for another job in another agricultural sector.

Zimbabwe is faced with unemployment, mainly for unskilled workers, with females being more affected than males (ILOSTAT, 2020a; 2020b; 2020c). Therefore, we model unemployment following the approach of Blanchflower and Oswald (1995) for agricultural sectors and each labor category except own-account/family-contributing workers. For the other private sectors, each labor category also faces unemployment. Moreover, we add another feature to the labor market to consider the Zimbabwean situation. When skilled workers cannot find a skilled job, they look for a job as unskilled workers. Indeed, many workers need to earn some form of income; therefore, they would take any other job, even if they are less skilled and paid less. The consequence of this mechanism is that if skilled workers lose their jobs in the aftermath of the economic crisis, they look for a job as unskilled workers, putting downward pressure on the wage rate of unskilled workers. Workers in the public sector are not impacted by unemployment.

3.1.5. Development of the business as usual (BAU) over time

For simulating the BAU, we assume that the stock of capital increases between periods given the new investments in the sectors. The new investment is allocated to the different sectors following Jung and Thorbecke (2003). Labor supply increases at a population growth rate of 3%. Each variable, except prices, will grow at the population rate from 2019 to 2030, allowing us to have a regular path. The results of the simulations are compared to this BAU.

3.2. Macro data: SAM

The SAM used for the model is that of Davies et al. (2018) updated to 2019 data. As mentioned earlier, the SAM describes 36 industries and 48 commodities, including 7 agricultural commodities. It has nine accounts for factors and five institutional accounts, including one for the rest of the world. To better represent the labor force in the poverty income consumption and expenditure survey (PICES) (Zimbabwe National Statistics Agency (ZIMSTAT), 2018). With this disaggregation, we can capture the differences between men and women in the different sectors. For instance, most permanent employees work in large-scale farming and are mostly male (Table 1). On the contrary, women represent the largest share of family workers and mainly work in small-scale farming.

Table 1. Percent labor types used by the different industries**.**

	Labor	Gender	Farming large scale	Farming small scale	Forestry & Fishery	Mining & Quarrying	Manufacturing	Water, electricity, construction	Services	Total
Agricultural	permanent	Male	68		67					3
		Female	19		7					1
	temporary	Male	9							0
		Female	4							0
	own-account	Male		43	17					3
		Female		57	9					4
Non-agricultural	Skilled rural	Male				14	13	16	9	10
		Female				3	4	1	6	4
	Unskilled rural	Male				2	4	4	3	3
		Female				1	1	0	2	1
	Skilled urban	Male				66	54	61	36	40
		Female				7	16	8	31	21
	Unskilled urban	Male				4	9	8	7	6
		Female				3	1	2	5	3

Source: Authors' computations based on the SAM

Table 2. Household source of income in percent.

	Labor	Capital	Land	Transfers	Total
Rural	59	18	4	18	**100**
Urban	74	1		25	**100**

Source: Authors' computations based on the SAM

Table 3. Factors income received by household.

		Households	
		Rural	Urban
Labor			
Agricultural permanent	Male	2.9	
	Female	0.7	
Agricultural temporary	Male	0.3	
	Female	0.2	
Agricultural own-account	Male	2.9	
	Female	3.7	
Skilled rural	Male	10.1	
	Female	4.4	
Unskilled rural	Male	2.9	
	Female	1.2	
Skilled urban	Male		40.1
	Female		21
Unskilled urban	Male		6.3
	Female		3.3
Total labor	Male	19.1	46.4
	Female	10.2	24.3
	Total	**29.3**	**70.7**
Capital			
Land		18.4	
Agricultural		47	
Non-agricultural		28.6	6
	Total	**94**	**6**

Source: Authors' computations based on the SAM

Along with the disaggregation of the labor market, we split households according to whether they live in rural or urban areas. This disaggregation is highly relevant for Zimbabwe as two-thirds of the population live in rural areas, and the majority are women. Most household income comes from labor income, 59% for rural households against 74% for urban households (Table 2). Looking deeper into labor income, Table 3 shows that 29.3% of total labor income goes to rural households. Urban households receive more than 70% of all the incomes generated in the economy, with 40.1% of total labor income coming from skilled urban male income. In rural households, the income from female workers (10%) is about half that of male workers (19%). The volume of wage bills provides only limited information on the number of workers earning wages. For example, since wages in agricultural activities are comparably low, the volume of wages represents 11% of all wages, while the number of workers represents one-third of all workers.

3.3. Distributive analysis

By using CGE models alone, we cannot thoroughly analyze the distributional impacts. Technically, the percentage changes in a scenario on households' total consumption and

consumer price indices are passed from the macro model to the micro household data and the poverty line observations. The income distribution and poverty lines change correspondingly. The poverty indicators for the scenario are then computed based on these changed distributions and poverty lines. Comparing the poverty indices in the scenario and the BAU informs about the changes in poverty resulting from the scenario.

We compute the Foster–Greer–Thorbecke (FGT) indices oriented to the Zimbabwe Poverty Report 2017 (ZIMSTAT, 2019) using the Total Consumption Poverty Line. The index FGT0 measures the prevalence of poverty, while the index FGT1 indicates how far below the poverty line the poor households are. The index FGT2 measures poverty severity. To measure inequality, we compute the Gini index. As base data for this microeconomic analysis, we use the PICES (ZIMSTAT, 2018).

4. Scenarios

We design simulation scenarios based on two complementary approaches to analyze the impacts of the COVID-19 pandemic and the mitigation policies. We used academic literature on COVID-19 impacts and recovery policies to define the magnitude of the scenario assumptions. Additionally, we followed a participatory approach and consulted with policymakers and economic experts. Following this stakeholder-oriented approach, we thus obtained quantitative scenarios validated by local economic and policy experts.

4.1. Impact scenarios

Ex-ante, the economic impacts of the COVID-19 pandemic cannot be quantitatively estimated with sufficient certainty. Therefore, we designed two scenarios with different expressions of the economic impacts to cover for uncertainty (Calderon et al., 2020). By simulating these two scenarios, we hypothesize that the global and domestic economy develops either according to one of these scenarios or that future development finds expression between the two scenarios.

The mild scenario assumes that the economy is affected by the pandemic for 2020 and 2021, then rebounds from 2022 onwards. Under the severe scenario, it is assumed that the economy will be affected from 2020 to 2022 and then rebounds from 2023 onwards. We derived the magnitude of changes in economic parameters based on studies quantifying the expected economic impact of COVID-19 (Fofana and Sall, 2020). The scenario assumptions and results were then presented, discussed, and revised according to a Zimbabwean expert group convened by the authors (Mabugu et al., 2021, 2023a, 2023b).

Combining the information from academic literature with stakeholders' and experts' knowledge, we defined the magnitudes for the mild scenario in 2021 as lower than observed in 2020 since we assumed that a part of the recovery would already occur in 2021. For the severe scenario, we applied the same historical data in 2020, but the magnitude of the negative shock increased in 2021, and the negative impacts lasted until 2022. Table 4 presents the magnitude of economic variables' impacts via international and domestic channels. The sector-specific impacts are differentiated according to mild and severe, as explained in Table 5.

Table 4. Hypothesis for the mild and severe scenarios.

	Mild and severe scenario	Mild scenario	Severe scenario	
	2020	2021	2021	2022
International channels				
Decrease in exports of all commodities	−27.2%	−5%	−27.2%	−5%
Decrease in the world price of primary commodity exports (a)	−4.7%	−2%	−4.7%	−15%
Decrease in world prices of primary commodity imports	−25.8%	−20%	−25.8%	−15%
Increase in remittances	+33%			
Domestic channels				
Decrease in productivity for the sectors	−2% for mildly affected −5% for moderate −7% for largely affected −15% for severely affected	−1% for mildly affected −3% for moderate −5% for largely affected −10% for severely affected	−2% for mildly affected −3% for moderate −5% for largely affected −10% for severely affected	−1% for mildly affected −2% for moderate −3% for largely affected −5% for severely affected
Increase in transportation cost	2%			

Source: Authors' construction on Government of Zimbabwe (2020a), expert's knowledge, (a) based on Fofana and Sall (2020).

We do not consider the direct impacts (i.e., the health impacts) in the scenario for two reasons. First, in Zimbabwe, the infection rate and mortality of COVID-19 cases were relatively low, implying that in the immediate to medium term of the analysis, the direct health impacts were unlikely to be the most relevant economic drivers. Second, and as outlined earlier, the CGE model framework that we use is based on macroeconomic data and microeconomic theory of different aspects of the economic system in its "optimal" equilibrium; thus, the model based on PEP-1-t does not consider the epidemiological impacts on the economy and dynamics. Therefore, we simulate the COVID-19 impacts from domestic and international channels as multiple shocks; the scenario results represent the summation of these impacts, including their anticipated real-world interaction. We simulate the COVID-19 impacts from domestic and international channels as multiple shocks; the scenario results represent the summation of these impacts, including their anticipated real-world interaction.

Table 5. Degrees of sector impact from the COVID-19 pandemic.

Sector	Severely Affected	Largely Affected	Moderately Affected	Mildly Affected
Agriculture			Agriculture	
Mining and quarrying	Mining			
Manufacturing		Non-Food Manufacturing		Foodstuffs Manufacturing
Electricity and Water				Electricity and Water
Services	Distribution, Hotels, and Restaurants	Financial Services	Education	

Source: Author construction based on Government of Zimbabwe (2020a)

4.2. Mitigation scenario

To simulate mitigation policies, we develop scenarios oriented to the response policies implemented by the Zimbabwe government. In the CGE model framework, we mimic the stimulus package of Zimbabwean dollars (ZWL) 18.2 billion (USD 996.71 million) to mitigate the pandemic's economic consequences (Government of Zimbabwe, 2020b).[2] The stimulus package is intended to scale up production in all sectors, support small-scale industries, improve health facilities, and cushion vulnerable groups from the adverse effects of the pandemic. The simulated amount for 2020 is calculated starting with the initial budget (ZWL 18.2 billion), out of which items that could not be modeled are subtracted. The remaining ZWL 12.8 billion is then converted to USD 35 million. This amount is then split according to a government table. For 2021, the government initially planned a larger stimulus of USD 5 billion, according to a workshop discussion held with policymakers (Mabugu et al., 2021); however, this amount was too big for the model and, indeed, the economy to absorb. Therefore, we lowered the amount to USD 811 million for the 2021 split according to 2020 shares. The result is the amount simulated for 2021, and as it turns out in retrospect, even this reduced amount has proven too high for authorities to realize as the economy continues to grapple with a liquidity crunch. The listed characteristics of our model reflect our view of what we consider important properties to assess the impact of a fiscal stimulus shock. These reflect certain modeling realities and limitations, such as concerns about current real economy macroeconomic models and the need to maintain model tractability. The model assumes that the financing for this stimulus would be available to the government and does not simulate a scenario to compensate for the revenue. From the stimulus package, some items are not considered in the model because the model is not well suited to analyze those, such as the working capital fund, the small and medium enterprises (SME), and the liquidity. For SMEs, the portion we have not modeled pertains to part of the support facilitating access to credit, offering loans, and so on, which we cannot model. The non-financial aspect of SME support is handled the same way as for other firms in the model and considered in the transfer sections and households. Our model is a real economy model (like most CGE models) and hence cannot address these aspects of the package, which act via the financial market. Therefore, we removed these elements from the total budget and computed shares for the remaining items. The working capital and liquidity are relatively important, constituting 16.5% and 11%, respectively, of the stimulus package of ZWL 18.2 billion (USD 996.71 million). In contrast, support for SMEs omitted is relatively smaller at 2.7% of the stimulus package. Table 6 shows the funding proportions for the different items considered in the mitigation scenario.

Table 6. Split of the fiscal package for 2020 and 2021 (in % of the total amount).

	Mitigation scenario in	Mitigation scenario in
	2020	2021
Total amount	35 M USD	870 M USD
Share of GDP in 2019		
Agriculture Sector Support	48.0%	48.0%
Working Capital Fund for Industry	0.0%	0.0%
Mining Sector Facility	7.9%	7.9%
SME Support Fund	0.0%	0.0%
Tourism Support Fund	3.9%	3.9%
Liquidity from Statutory Reserves	0.0%	0.0%
Health Sector Support Fund	7.9%	7.9%
Broad Relief Measures	11.8%	11.8%
COVID Cash Transfer	18.9%	18.9%
Arts and Sport Grant	1.6%	1.6%
Total	100%	100%

Source: Author computations based on Government of Zimbabwe (2020a)

5. Results and discussion

5.1. Macroeconomic impacts

Table 7 shows that the macroeconomic impacts of the COVID-19 pandemic are substantial since the economy simultaneously gets affected on both the demand and supply sides. This combined effect reduces 6.33% in GDP for 2021 in the mild scenario and 8.4% in the severe scenario. Without any government mitigation measures, what is striking is that even after five years, the GDP levels are still below the BAU levels under both COVID scenarios. As expected, the severe scenario shows a steeper decline in GDP growth compared to the mild scenario, with a decrease in GDP of 0.98% in the mild scenario and 1.65% in the severe scenario compared to the BAU in 2025. The persistence of economic decline is an indication of the need for intervention.

The decline in the economy and the original shocks cause an increase in unemployment. Indeed, under both COVID-19 scenarios, the economy is affected on one side by the drop in primary export prices and quantities. On the other side, it is impacted by a reduced production supply, given the lockdown and the social distancing measures applied in the country. Consequently, firms face a decrease in their production and therefore lay off workers leading to an increase in the unemployment rate for all categories of workers.

Table 7. Impact on selected macroeconomic indicators in percentage change from BAU under mild COVID-19 impact.

	MILD_COVID		SEVE_COVID		MILD_MITIG		SEVE_MITIG	
	2021	2025	2021	2025	2021	2025	2021	2025
GDP real	−6.33	−0.98	−8.41	−1.65	−3.00	−2.17	−7.63	−2.91
Total investment	−13.12	−1.65	−38.12	−2.71	−68.24	−3.60	−92.92	−4.85
Consumer price index	3.19	0.73	−1.91	1.31	4.85	1.79	−0.55	2.45
Reall HH.cons.rura	−2.67	−0.31	−6.47	−0.52	6.19	−0.76	2.57	−1.03
Real HH.cons.urba	−2.71	−0.29	−5.56	−0.48	1.55	−0.66	−0.84	−0.90
UN Agri.Perm.Men	4.06	−0.51	19.11	−0.65	−7.88	−0.74	3.62	−0.98
UN Agri.Perm.Women	4.38	−0.51	20.55	−0.63	−8.04	−0.70	4.23	−0.93
UN Agri.Temp.Men	4.62	−0.51	21.62	−0.62	−8.17	−0.68	4.69	−0.90
UN Agri.Temp.Women	4.62	−0.51	21.62	−0.62	−8.17	−0.68	4.69	−0.90
UN skil.rura.Men	0.94	0.00	4.91	−0.01	0.87	−0.01	4.54	0.00
UN skil.rura.Women	1.19	−0.02	5.57	−0.03	0.16	−0.04	3.54	−0.05
UN unsk.rura.Men	2.40	−0.10	13.12	−0.20	1.41	−0.29	11.40	−0.37
UN unsk.rura.Women	1.83	−0.12	11.49	−0.27	−2.01	−0.45	6.03	−0.61
UN skil.urba.Men	1.00	0.01	5.16	0.00	1.01	0.01	4.95	0.02
UN skil.urba.Women	0.88	−0.06	4.35	−0.11	−0.48	−0.14	1.85	−0.19
UN unsk.urba.Men	3.37	−0.09	17.87	−0.19	2.55	−0.27	16.26	−0.34
UN unsk.urba.Women	2.13	−0.15	12.07	−0.33	−1.99	−0.51	6.02	−0.69

Notes: MILD_COVID = Scenario assuming mild impacts and fast recovery shock from COVID-19. MILD_MITIG = Scenario MILD_COVID with mitigation measures, MILD-RECOV = MILD-MITIG with recovery measures. MILD_GENDE = MILD_RECOV with gender-specific recovery measures. MILD_GEND2 = MILD_RECOV with alternative gender-specific recovery measures. Finally, rura = rural, urba = urban, HH.cons = total household consumption, UN = unemployment rate, Agri.Perm. = agricultural workers with permanent contracts, Agri.Temp. = agricultural workers with temporary contracts, skil = skilled workers, and unsk = unskilled workers.

Source: Simulation results

The drop in unemployment rates is not uniform across the different worker categories and depends on the sector in which they work. In the agricultural sectors, female workers face a relatively higher unemployment rate when permanently employed than their male counterparts (+4.4 percentage points compared to +4.1 percentage points for males). In the case of temporary workers, males and females experience an increase in the unemployment rate of 4.6 percentage points. For private non-agricultural sectors, unskilled workers face higher unemployment than skilled workers. In rural areas, the male unskilled unemployment rate increases by 2.4 percentage points while the female unskilled unemployment rate increases by 1.8 percentage points. Skilled workers in rural areas also face an increase in their unemployment rate, but the increase is relatively lower at 0.9 percentage points for men and 1.2 percentage points for women.

There is a similar pattern in urban areas, with the unemployment rate increasing more for unskilled workers than for skilled workers. Male unskilled workers face an increase of 3.4 percentage points, while the unemployment rate for unskilled female workers increases by 2.1 percentage points. Urban skilled workers are relatively spared, with an increase of 1 percentage point for men and 0.9 percentage points for women. These findings for the labor market with unskilled being more affected than skilled workers are in line with other recent studies in similar countries (Chitiga et al., 2021a; 2021b; Escalante and Maisonnave, 2021).

This impact on employment has negatively affected households' income, which is highly reliant on labor income. Rural households are affected relatively more than their urban counterparts, dropping by 1.1% compared to 0.9% for urban households (see Table 7). The fall in income reduces actual consumption by 2.7% in the mild scenario (Table 7). Without any mitigation measures, we can see that the negative impacts continue over time, even if we assume that the economy returns to normal in 2022 in the mild scenario. At the end of the period, the economy still performs below the BAU levels.

The mitigation plan implemented in 2021 offers some relief to the activities and provides cash transfers to households and firms. Table 7 shows that in 2021 the mitigation measures helped to reduce the GDP losses by 3.3 percentage points in the mild scenario and by 0.8 percentage points in the severe scenario. In terms of unemployment, the mitigation measures help to reduce unemployment for both men and women. The unemployment rate for women is even further reduced compared to the BAU in 2021, which means that the mitigation measures result in sectors hiring more women than in the baseline, as some targeted sectors are women-intensive.

Rural households benefit from the government mitigation plan, with an increase of their income by 14.8%, compared to 7.2% for urban households (see Table 7). The positive impact on households lasts until the end of the period, which is a positive outcome. Thus, at the macroeconomic level, the mitigation measures help households and different activities; however, the fiscal package sharply decreases government savings, reduces total investment, and hampers future growth. Under both COVID-19 scenarios, investment is already decreasing, but in the mitigation scenario, if the fiscal package provides some relief in the short term, the consequences on total investment, in the long run, are dramatic. This increase in the public deficit leads to a decrease in total investment with a crowding-out effect on

private investment. Therefore, the sustainability of financing such a policy becomes a significant consideration.

Table 8 presents the primary production and labor demand results under mild and severe COVID-19 impact. Less impacted are the agriculture, food, and business sectors. Without mitigation measures, the less impacted sectors (except small-scale farming) reach close to the baseline output. Small-scale farming, mining, and construction sectors will face higher production losses in 2025. The mitigation measures helped most sectors reduce losses in 2021 and 2025; however, the construction sector was hit more severely because of the public funds spent on mitigation measures, not investments.

The total labor demand reacts according to decreased production, laying off more workers from the sectors, which reduces their production more strongly. More men than women work in the mining and construction sectors, whereas women are more represented in the less impacted agriculture and food production sectors. Thus, in 2021 the unemployment rate for men decreased more. The recovery policy scenario helps the sectors return to productivity. Given the subsidies on investment, investments increase in the private sectors and increase the stock of capital of the sectors the following year. With increased capital stock, the sectors can hire more workers to produce more, positively impacting employment.

Table 9 presents the impacts on institutions under mild and severe COVID-19 scenarios. The increase in unemployment and falling wage rates in the sectors in 2021 led to a decrease in household income and, consequently, to a drop in consumption. In 2021, firms' savings and income dropped, given the decrease in capital income. In the mild and severe scenarios, the government's income is decreasing during the pandemic, given the reduction in the receipts from direct and indirect taxes. Overall, total savings in the economy decreased, leading to a drop in total investment. In the mitigation scenario, household income increases due to increased income from transfers from the government as part of the mitigation measures. Government and firm income will recover in 2025 in the mild and severe scenarios with and without mitigation measures.

5.2. Impacts on inequality and poverty

As expected, poverty increases under both COVID-19 scenarios. The poverty headcount index (FGT0) increases by about 2 percentage points in the mild scenario and by 5 percentage points in the severe scenario in 2021 (Fig. 2). Applied to approximately 4 million households (ZIMSTAT, 2022), this would mean that in the mild scenario, 80 thousand more households fall into poverty. In the severe scenario, the number of households falling into poverty would be 200 thousand. The mitigation measures offer some relief by reducing the increase of poor households to 8 thousand (i.e., 0.2 percentage points) in the mild and 144 thousand (i.e., 3.6 percentage points) in the severe scenario. Especially for rural households, the specific measures targeting agricultural sectors allow a drop in the poverty rate, reducing it even below the BAU.

Table 8. Impacts on the production and labor demand in selected sectors in percentage change from BAU under Mild COVID-19 impact.

	MILD_COVID		SEVE_COVID		MILD_MITIG		SEVE_MITIG	
	2021	**2025**	**2021**	**2025**	**2021**	**2025**	**2021**	**2025**
Production								
Agriculture Large-Scale Farming	−7.80	−0.79	−22.09	−1.54	2.66	−1.60	−7.96	−2.24
Agriculture Small-Scale Farming	−3.86	−1.46	−3.75	−2.24	−4.02	−3.21	−3.94	−4.30
Mining	−13.91	−1.76	−21.33	−2.97	−8.31	−3.50	−14.74	−4.71
Food	−3.60	−1.06	−7.68	−1.89	5.42	−2.15	4.33	−2.99
Construction	−16.41	−2.34	−24.51	−3.88	−43.25	−5.05	−56.12	−6.62
Business	−3.75	−0.92	−2.20	−1.57	1.83	−2.30	4.18	−3.11
Labor demand								
Agriculture Large-Scale Farming	−5.73	0.62	−26.42	0.74	10.07	0.80	−5.95	1.06
Agriculture Small-Scale Farming	−0.02	−0.04	0.18	−0.06	−0.23	−0.08	−0.07	−0.11
Mining	−5.29	0.09	−19.58	0.02	6.01	−0.37	−6.87	−0.57
Food	−2.79	0.60	−8.22	0.74	13.35	1.05	13.30	1.34
Construction	−8.82	−1.55	−21.07	−2.62	−47.87	−3.64	−64.75	−5.06
Business	3.53	0.24	6.51	0.36	14.53	0.60	19.20	0.84

Notes: MILD_COVID = Scenario assuming mild impacts and fast recovery shock from COVID-19. MILD_MITIG = Scenario MILD_COVID with mitigation measures. MILD-RECOV = MILD-MITIG with recovery measures, MILD_GENDE = MILD_RECOV with gender-specific recovery measures. MILD_GEND2 = MILD_RECOV with alternative gender-specific recovery measures.

Source: Simulation results

Table 9. Impacts on households, firms, and government in percentage change from BAU under Mild COVID impact.

	MILD_COVID		SEVE_COVID		MILD_MITIG		SEVE_MITIG	
	2021	**2025**	**2021**	**2025**	**2021**	**2025**	**2021**	**2025**
Households rural								
Total income	−1.06	0.26	−11.66	0.50	14.82	0.60	3.39	0.83
Income from labor	−1.33	0.57	−13.16	0.99	6.38	1.24	−6.27	1.70
Income from capital	−1.18	−0.37	−13.40	−0.46	9.15	−0.74	−4.57	−0.96
Income from transfers	−0.03	0.01	−4.73	0.08	48.78	0.14	44.02	0.21
Savings	3.65	0.78	−0.85	1.40	3.76	1.92	−0.98	2.63
Households urban								
Total income	−0.90	0.31	−9.86	0.60	7.21	0.82	−1.76	1.12
Income from labor	−1.20	0.42	−10.72	0.76	1.48	1.03	−8.04	1.39
Income from capital	−0.07	0.04	−13.57	0.24	4.88	0.39	−8.80	0.60
Income from transfers	−0.04	0.02	−7.19	0.13	24.24	0.21	16.99	0.32
Savings	3.72	0.79	−0.87	1.40	4.54	1.92	−0.39	2.63
Firms								
Disposable income	−0.07	0.04	−13.57	0.24	4.88	0.39	−8.80	0.60
Government								
Total income	−2.25	0.00	−13.20	0.05	−9.52	0.10	−20.56	0.15

Notes: MILD_COVID = Scenario assuming mild impacts and fast recovery shock from COVID-19. MILD_MITIG = Scenario MILD_COVID with mitigation measures. MILD-RECOV = MILD-MITIG with recovery measures. MILD_GENDE = MILD_RECOV with gender-specific recovery measures. MILD_GEND2 = MILD_RECOV with alternative gender-specific recovery measures.

Source: Simulation results

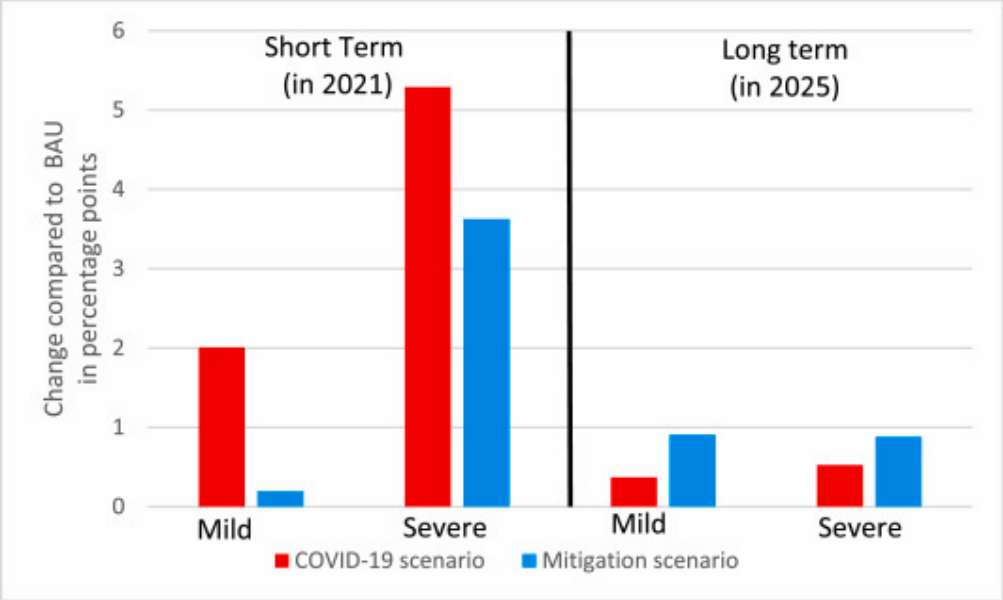

Fig. 2. Impact on poverty headcount in 2021 and 2025 (in percentage compared to the BAU).

In the long term (2025), what is noticeable from the results is that although poverty is still higher than in the baseline in the COVID-19 scenarios (either mild or severe), the mitigation scenario that is meant to alleviate poverty inadvertently brings an increase in poverty instead (Fig. 3). The driving mechanism behind this result is that the costs of the mitigation scenario are prohibitively high (e.g., to fund transfers), and the consequent fall in investment negatively impacts the whole economy. Furthermore, increases in the consumer price index are higher than the increase in households' income, leading to a decrease in real households' income and a drop in purchasing power.

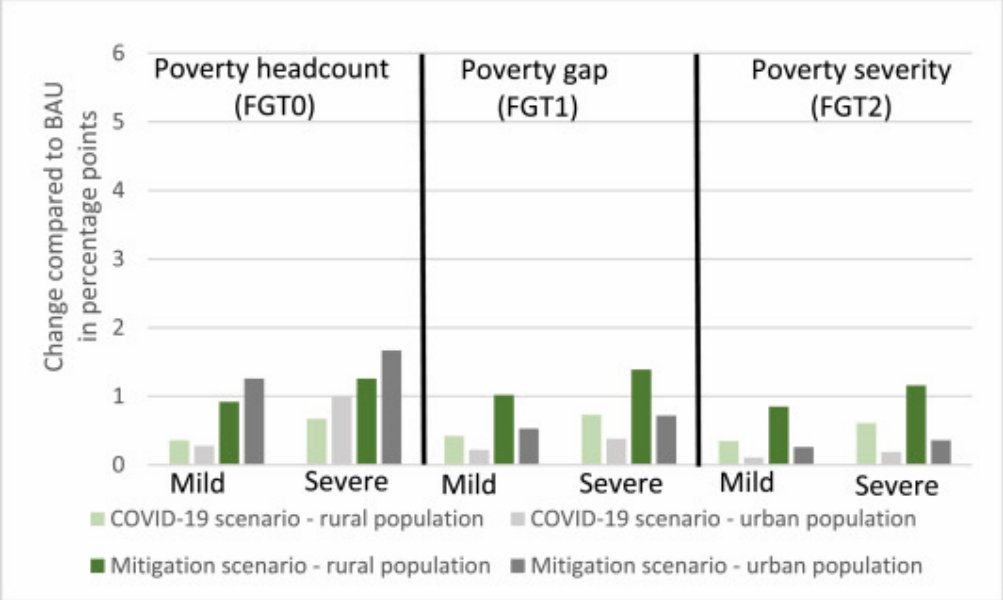

Fig. 3. Development of poverty indices for rural and urban households in the scenarios compared in 2025. Source: Simulation results

In the severe COVID-19 scenario without mitigation, the headcount index (FGT0) increases higher for the urban population (gray columns) than for the rural population (green columns), while for the poverty gap and severity, the impacts are more significant for the rural population. Thus, the COVID-19 impact is relatively stronger in terms of the number of people falling into poverty in urban areas than in the rural population; however, since the rural population exceeds the urban population, the absolute number of newly poor rural households is higher than in urban regions. In absolute terms, more households fall into poverty, and poverty worsens for more households in rural regions than urban regions. Furthermore, the situation of the poor appears to be worse for the rural population than for the urban population, indicated by a higher increase in the poverty gap and severity (FGT1 and FGT2). Thus, mitigation measures are essential to limit the increase in poverty in the short run; however, reducing poverty, in the long run, requires additional measures addressing the low fiscal space.

6. Conclusion

This study has presented a macro-micro modeling framework with particular emphasis on female and male workers for analyzing and discussing the extent to which COVID-19 mitigation and recovery policies affect the poor and the economy. The analysis highlights the importance of disaggregating labor by gender and sectors into agricultural and non-agricultural sectors, ending up with six different types of labor for the four agricultural sectors to capture the difference between men and women among these sectors. A data set of a SAM updated to 2019 and a 2017 household survey is used to operationalize the models. The study finds that i) without government mitigation measures, GDP will remain below BAU levels. ii) Poorer women are hardest hit because they are employed in exposed and vulnerable sectors to COVID-19 response measures. iii) Mitigation measures to counteract the increase in poverty in the short term require additional measures to reduce poverty in the long term. The mitigation measures increase poverty in the long run because reduced investments slow economic growth. The mitigation measures are funded by the government budget and do not leave fiscal space for investments to stimulate economic growth.

The main findings of this study are comparable to those emerging from the literature that asks similar questions to ours. Our finding that poorer women are hardest hit because they are employed in sectors exposed and vulnerable to COVID-19 response measures is comparable to other relevant literature (Oliveira and Alloatti, 2022; Alon et al., 2022; Deshpande, 2022; Abraham et al., 2022). Oliveira and Alloatti (2022) found that policy responses to address the differences in the impact of the COVID-19 crisis on men and women were either absent or inadequately addressed the effects in cases when implemented in Brazil. Corroborating this finding, Alon et al. (2022) found that the COVID-19-induced recession led to declines in women's employment, with mothers of school-age children experiencing the largest employment decline during the pandemic. Deshpande (2022), in a study on India, also found that the burden of domestic chores worsened for both women and men during the pandemic, but the average male hours had declined to below pre-pandemic levels by December 2020, women's average housework hours had increased sharply. Similarly, Abraham et al. (2022) found that conditional on being in the workforce before the pandemic; women were seven times more likely to lose work during the nationwide lockdown. They also found that women were 11 times more likely not to return to work

subsequently compared to men with religion (Muslim or non-Muslim), further exacerbating the disproportionate negative impact on women. Like the short-term impact, we found on the need for mitigation measures, Egger et al. (2021) report falling living standards during the COVID-19 crisis using evidence from nine developing countries. Oliveira and Alloatti (2022) found that most measures taken to address the pandemic were short term, emergency, and insufficient to address structural inequality and long-term disparity.

These findings highlight the importance of analyzing the effects of COVID-19 at both the macro–meso and household levels since considerable variations in impacts exist within gender groups. Ignoring these differential gendered effects can mislead policy responses. Future work on poverty and COVID-19 needs to be aware of these results and could extend the modeling to capture the following: i) fiscal responses/reactions to COVID-19 and ii) updated changes of projections about the pandemic, which may be key for adaptation and recovery. Moreover, the CGE-microsimulation approach in this study follows the top-down approach, and there is no further behavior from households. The microsimulation modeling could be improved by integrating household-level behavioral responses, especially in the labor market (Robichaud et al., 2014). Finally, yet importantly, we use a CGE model framework focusing on women's labor market. As is now well known, the COVID-19 pandemic and crisis have created many economic impacts driven by the dynamics of epidemiological effects and the counteracting measures (e.g., distance teaching). With the employed model, we do not simulate macro and microeconomic impacts resulting from these complex impacts; however, they are important for economic development in the short and long term (e.g., children's education, psychological health, and dynamics of resource allocation in enterprises). In future research, these aspects could be addressed by extending the general equilibrium model framework by a model specification explicitly modeling these epidemiological impacts (e.g., epidemiological dynamics, schooling sector). The CGE model could also be complemented by linked models, e.g., by growth models considering epidemiological dynamics, as presented by Goenka and Liu (2012, 2020).

Credit author statement

Equal authorship is assigned to this article.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix 1. Sensitivity analysis

	2021			2025		
	Low (-10%)	Paper	High (+10%)	Low (-10%)	Paper	High (+10%)
GDP real	-3.005	-3.004	-3.003	-2.171	-2.171	-2.171
Total investment	-68.240	-68.238	-68.236	-3.602	-3.602	-3.602
Consumer price index	4.850	4.845	4.840	1.791	1.791	1.791
Real HH.cons.rural	6.187	6.189	6.191	-0.763	-0.763	-0.763
Real HH.cons.urban	1.548	1.550	1.552	-0.657	-0.657	-0.657
Labour demand						
Agriculture Large Scale Farming	10.066	10.074	10.081	0.804	0.804	0.804
Agriculture Small Scale Farming	-0.231	-0.231	-0.231	-0.081	-0.081	-0.081
Mining	6.032	6.011	5.993	-0.363	-0.365	-0.367
Food	13.341	13.348	13.355	1.052	1.052	1.053
Construction	-47.847	-47.868	-47.887	-3.635	-3.639	-3.642
Business	14.644	14.529	14.426	0.607	0.599	0.592
Total income rural	14.823	14.821	14.819	0.597	0.597	0.596
Total income urban	7.216	7.214	7.212	0.817	0.816	0.816

Data availability

We have included our data and code with model, business as usual scenario, policy scenarios and results generation as supplementary materials.

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Notes

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[1]On March 20, 2020, Zimbabwe reported its first COVID-19 case. The country immediately implemented lockdown measures entailing restrictions on travel and movement of people, closures of certain businesses and public places, bolstering of hygiene control, and general behavioral controls. By November 23, 2021, the number of confirmed COVID-19 cases had risen to 133,707, with 128,494 recoveries and 510 active cases, whereas the number of deaths was at 4703. Poor women are facing the biggest impact through income loss, food insecurity, and unpaid care-giving burdens.

[2]The government has also put in place other Fiscal Policy Relief Measures, which include Import Duty on Raw Materials, Corporate Tax Credits for COVID-19 Donation, and Tax Relief Measures. (2020 Mid-Year Budget Review).