How COVID-19 Pandemic Worsens the Economic Situation of Women in South Africa

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Abstract

Little is known about the general equilibrium impact COVID-19 induces on different gender groups. This paper addresses the problem of relatively few general equilibrium studies focusing on gender impacts of COVID-19. The analysis uses a gendered Computable General Equilibrium model linked to a microsimulation model that analyses a mild and severe scenario of the pandemic on economic and distributional outcomes for females. Irrespective of scenario, findings show that because women employment tend to have unskilled labour which is more concentrated in sectors that are hurt the most by COVID-19 response measures, they suffer disproportionately more from higher unemployment than their male counterparts. The poverty outcomes show worsened vulnerability for female-headed households given that, even prior to the pandemic, poverty was already higher amongst women. These simulated results are consistent with recently observed impacts and address research gaps important for well-designed public policies to reverse these trends.

Keywords COVID-19 · Computable general equilibrium model · Gender · Poverty · South Africa

Résumé

On connait peu les impacts d'équilibre général induits par la Covid-19 sur les groupes de genre différents. Cette étude adresse le problème de la pénurie d'études en équilibre général s'intéressant aux impacts de la COVID-19 sur le genre. L'analyse te combine un modèle d'équilibre général calculable sexo-spécifique avec un modèle de micro-simulation et évalue deux scenarios de la pandémie, l'un modéré et l'autre sévère, et leurs effets sur les résultats économiques et distributionnels des femmes. Quel que soit le scenario, les résultats démontrent que les femmes souffrent du chômage d'une manière disproportionée comparé aux hommes, puisque le travail des femmes tend à être du travail non qualifié, concentré dans les secteurs qui sont les plus frappés

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par les mesures de réponse à la COVID-19. En termes de pauvreté, les foyers dirigés par des femmes sont plus vulnérables, étant donné que même avant la pandémie, la pauvreté était déjà plus élevée chez les femmes. Les résultats simulés par cette étude concordent avec les impacts récemment observés, et abordent les lacunes de recherche nécessaires pour modéliser des politiques publiques bien conçues afin de renverser ces tendances.

JEL Classification C68 · E60 · J16 · O55

Introduction

The Coronavirus disease 2019 (COVID-19) pandemic has had devastating health and economic effects globally in 2020 and beyond. Similar to other countries, South Africa has taken measures that have largely included enforcement of social distancing, which implied restricted movement of people, and lockdown of the economy. On 15 March 2020, barely 2 weeks after the first reported case in the country, South Africa declared a National State of Disaster, citing the 'magnitude and severity of the COVID-19 outbreak which has been declared a global pandemic'.[1] On 25 March 2020, amendments were made to the legislation to cater for the outbreak, with the main intervention being an initial 21-day national lock down commencing from midnight of March 26. This lockdown was subsequently extended to the end of April 2020. The overall aim was to flatten the pandemic curve so as to allow time for the health system to be readied for the increase in sick people. The amendments outlined contained measures pertaining to (a) restrictions on the movement of persons and goods, (b) prohibition of public transport and (c) resources by the state during lockdown. The government started to open the economy from the beginning of May 2020, although this was to be done in gradual steps. These measures would likely have negative effects on the economy as well as people's welfare. Prior to the Coronavirus disease 2019 (COVID-19) pandemic, the economy was already saddled with persistently low growth rates, a technical recession and the triple challenges of unemployment, poverty and inequality. Women and men will be impacted differently depending on their initial circumstances.

While South Africa has very high unemployment and poverty, these are particularly higher for women than for men. Women's unemployment rate reached 31.3% against 27.2% for men in Quarter 4 of 2019 (Statistics South Africa 2019), just before the pandemic. At all ages, women face higher unemployment than men, and this is particularly striking for the youth (aged 15 to 34), with 43.9% of women being unemployed compared to 36.4% for men (Statistics South Africa 2019).

Gender inequalities are predominant in labour markets as employment continues to have a gendered bias. Despite an increase in employment levels over the years, female labour force participation remains lower (at about 48.5%) compared to men's

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[1] Amended by the Disaster Management Amendment Act 16 of 2015.

participation (World Bank 2018). Mosomi (2019) reports that there was an increase in the share of employed females from 38% in 1994 to about 45% in 2015. This is attributed to various factors including various post-apartheid legislations of equalising labour market entry as well as improved education. Tracking unemployment by gender between 1994 and 2014, Mosomi (2019) shows that women unemployment was unambiguously higher than that of men throughout that period. This is especially true in the formal occupations and high-paying jobs. Indeed, women are more likely to be hired in low-skilled occupations (36.2%) than in high-skilled occupations (11.7%), while these shares are, respectively, 14.4% and 24.8% for men. Only 5.7% of women are employed as managers compared to 10% for men. Other studies also confirm the same pattern of occupational segregation (Gradín 2018; Espi et al. 2019). These studies go on to observe that in the lowest occupation ranks are Black and Coloured[2] women. In general, men occupy higher ranking positions than women.

Using Post-Apartheid Labour Market Series (PALMS) data, Mosomi (2019) shows that women are mostly represented in four sectors, domestic services (about 80%), finance (44%), trade (50%) and services (47%), where they largely occupy lower paid jobs and more elementary tasks (such as being clerks, roadside traders, etc.). In the more professional occupations, they are normally teachers and nurses. Men, on the other hand, mainly dominate in such sectors as services, trade, finance, manufacturing and construction sectors, holding in general, higher paying positions than their female counterparts (Mosomi 2019).

These statistics about women employment are consistent with the World Bank findings. According to the World Bank (2018), 84.2% of women work in the service sector, 12.1% in the industries sector and 3.7% in the agriculture sector. Within the services sector, two sub-sectors account for more than half of women's employment. These are, respectively, the community, social and personal services (CSP) sub-sector and the wholesale and retail sub-sector. The CSP services alone employ nearly one in three women (31.2%), while wholesale accounts for 21.9% of female employment (Kirkwood 2018). For instance, over a million of women work as domestic workers, often without job security and on low wages (ILO 2016). As pointed out by Mosomi (2019) and Kirkwood (2018), the fact that women are concentrated in the services sector and specifically in only four sectors (that is, domestic services, finance, trade and services), places women in a more vulnerable position especially if the services sector is affected. Indeed, the main four industries account for more than 80% of women's employment, while it represents 62% for men (Kirkwood 2018). Moreover, women have higher rates of temporary or seasonal employment, leading to a higher vulnerability than men (Kirkwood 2018).

These gendered labour market differences lead to a significant income gap between men and women, with the median monthly income of men (3,600 rand) far exceeding that of women (R2,500) (Kirkwood 2018). Consequently, women experience higher rates of poverty, especially if they are head of their household. There is ample evidence that individuals living in female-headed households are

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[2] In South Africa, Coloured is an official term for people from mixed races.

more likely to be poor compared with individuals living in male-headed households (Gelb 2003; Posel 2014; Posel and Rogan 2000). As Sulla and Zikhali (2018) have shown, female-headed households experience a higher poverty rate than male-headed households across all periods and the gap between the poverty rates of the two groups has remained unchanged, at around 20 percentage points in each period. In 2019, 49.0% of women were poor against 30.0% of men. Moreover, there is a 10% higher chance of falling into poverty for a female-headed household while the likelihood of escaping poverty is higher for a male-headed household (Sulla and Zikhali 2018).

Using the National Income Dynamics Study (NIDS)—Coronavirus Rapid Mobile Survey (CRAM) data, Casale and Posel (2020) argue that the early evidence is that the 'hard lockdown' in South Africa disproportionately negatively affected women. The authors find that, not only did more women than men lose jobs, but also more women had to reduce their hours of work compared to men. Thus, the proportion of employed women, which was already lower than that for men, reduced more than for men due to the 'hard lockdown', meaning that the employment gender gap increased due to the pandemic. Furthermore, there is emerging evidence that women, more than men, are in danger of suffering more intense effects of the COVID-19 pandemic, apart from the economic effects assessed here. For instance, women are traditionally the caregivers and are, thus, susceptible to getting infected while taking care of sick family members (Kapur 2020; Casale and Posel 2020). Girls might be forced to reduce time devoted to education compared to boys, in order to attend to chores in the home. Women and girls furthermore are responsible for home hygiene and would be expected to provide water for sanitation, (Gender in Humanitarian Action (GiHA) 2020). This is a challenge in many rural areas as well as townships in South Africa, where water has to be obtained from outside of the house, often at a considerable distance for many households. At the same time, in many traditional societies, women and girls are not prioritised when it comes to health care allocations. These and other non-economic effects could leave women in very precarious positions. A combination of all these effects could have long-term implications on the vulnerability of women and girls, further leaving them behind their male counterparts.

These differences become important to uncover because they can assist in appropriate policy response by government to ameliorate the effects of the pandemic. While the outlined facts imply that the impact of COVID-19 would have different impacts on men and women, unfortunately, not much is known yet about the economic impact of diseases such as COVID-19 on gender. As pointed out by Wenham et al. (2020), there is a need to analyse the gendered impacts of the multiple outbreaks caused by the COVID-19. According to Davies and Bennett (2020), considering recent disease outbreaks, between 2014 and 2016, only 1% of publications on Zika and Ebola outbreaks were gender focused, and there is a need to integrate a gender lens in this type of outbreak (Smith 2019). For instance, during the Ebola crisis, women experienced higher unemployment rates than men, and it took them longer to find a job after the outbreak, increasing their vulnerability (Burki 2020). As mentioned by Seguino (2020, p. 28), gender inequality in 'education, health, unpaid labour, employment, and wages' manifests in important economy-wide effects.

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In a recent study, Kabeer et al. (2021) review different independent studies and databases to analyse the gendered impacts of COVID-19 on health, domestic violence and labour markets. The authors identify different research gaps and call for more work on the gendered analysis of the intersectoral dimensions and on the economic outcomes (Kabeer et al. 2021). Our study addresses these research gaps for South Africa as one of the most COVID-19 affected African countries (Roser et al. 2020; Salgotra et al. 2020). We use a static gendered Computable General Equilibrium (CGE) model as consistent framework to analyse the intersectoral dimensions of the COVID-19 crises for South Africa. Although the model used is static, it remains an appropriate and relevant tool because it allows us to compare the outcome for the South African economy with and without COVID-19. We also analyse the economic impacts of the COVID-19 crises on women by using a microsimulation and poverty analysis. The quantitative results on impacts based on a consistent representation of an economy provide important information for designing and evaluating policies for dealing with the economic crises (Kabeer et al. 2021).

Methodology and Data

CGE Model

To evaluate the impacts of the COVID-19-induced lockdown on South African women, a static CGE model is used. The CGE model is then linked to a micro model in order to assess the redistributive impacts on poverty. CGE models are able to represent the whole economy, including different institutions and agents, and more especially, women. CGE models enable the capturing of different impacts of the COVID-19 (international and domestic impacts) and are, thus, appropriate tools to use in this case. Indeed, they can capture the shocks coming from the rest of the world and transmit them to the national economy and, as well, tracking the impacts on households, firms and government. Interestingly, these models account for the existing intersectoral links and also capture the different transmission effects between sectors. Therefore, these models are the appropriate tool to analyse direct as well as indirect impacts induced by the COVID-19 shock (Zidouemba et al. 2020; Maliszewska et al. 2020; Laborde et al. 2020) and have been used to evaluate pandemic impacts in the past (Beutels et al. 2009; Keogh-Brown et al. 2010; Fofana et al. 2015). The macro model we use builds from the PEP 1-1 static model developed by Decaluwé et al. (2013) and modifies several assumptions in order to integrate the gender dimension and represent the realities of South Africa. A total of 21 activities and commodities are included in the model, with each activity using capital, labour and intermediate goods consumption to produce output. Given the specificity of the South African labour market, our labour factor is disaggregated according to skills (unskilled, semi-skilled and skilled), population groups (African, Coloured, Indian and White) and gender (male, female). Technically, the production function is a 5-level nested function. At the top, output is a Leontief between value-added and intermediate consumption. The former is a CES function between composite labour and capital. At the third level, composite capital is disaggregated

into skills following a CES type of function. Each skill category is further disaggregated into population groups that will be split between male and female at the fifth level. Activities use all the different types of labour, but in different proportions. For instance, the 'other services' sector, which accounts notably for the community, social and personal services sector, is female intensive and hires relatively more unskilled African women, while the mining sector, which is highly male intensive, hires mainly African semi-skilled men. This disaggregation according to gender and population groups is highly relevant for South Africa due to its unique historical legacy of racial discrimination. Job opportunities are not equal among the population, and despite policies to correct the inequalities inherited from the past, major differences still remain. This phenomenon of the labour market is translated into different unemployment rates. Women particularly face a higher unemployment rate for each population group (Statistics South Africa 2019), a feature that our model directly takes into account.

There are four different institutions that the model distinguishes, namely, households, firms, government and the rest of the world. Households are disaggregated into two categories, according to whether they are a female- or male-headed household. Both households receive their income from labour, capital and transfers. Male-headed household receives a higher share of their income from labour (86.6%) compared to female-headed households who receive 71.6% of their income from labour. Transfers from the government represent 5% of female-headed households' income, compared to 1% for male-headed households. Both households spend the highest proportion of their income on final consumption with the proportion spent higher for women (87.9%) than for men (81.7%). The remainder of income is spent on direct taxes and transfers to other economic institutions and savings. Firms' income is derived from capital income and transfers from other agents. They distribute dividends to other agents, pay corporate taxes and saving the remainder. Government collects direct taxes from households and firms, indirect taxes (such as production taxes, taxes on consumption and import duties) and receives transfers from other institutions (dividends, social contributions, etc.). It then spends its income mainly on the non-tradable sectors' production (education, health, public administration) and pays transfers to other institutions (pensions, grants to households). Government savings is the difference between its income and what it consumes. At the base year, government's savings is negative. In his budget speech of February 2020, the minister of finance conceded that South Africa's budget deficit was higher than it had ever been in 27 years. The projections were at that stage for an increase in gross government debt to 71.6% of gross domestic product (GDP) by 2022–2023. At that time, the consolidated budget deficit was expected to reduce from 6.8 to 5.7% between 2020/2021 and 2022/2023 (National Treasury 2020). Since then, COVID-19 pandemic has happened, worsening the situation substantially. Indeed, the country has had to table an adjustment budget and now anticipates the budget deficit to be more than double that anticipated in February 2020.

To link South Africa and the rest of the world, the Armington assumption is used whereby trade is modelled based on imperfect substitutability of commodities given their origin. This is a standard assumption used in traditional CGE modelling. On the exports side, South African producers can either sell their production on the

local market or on the international market. However, it is assumed that these producers cannot export as much as they want, and if they want to increase their world market shares, they need to be more competitive than other international producers. Technically, this means a finite elasticity for the export demand, which reflects the competitiveness of local producers on the international markets is assumed.

South Africa has a very high unemployment rate as earlier mentioned, and this is captured in the model by assuming the so-called 'wage curve' of Blanchflower and Oswald (1995). The wage curve assumes that there is a relationship between wages and the unemployment rate. For South Africa, Kingdon and Knight (2006) have estimated the corresponding elasticities and find a similar value as that of Blanchflower and Oswald (1995).

Several closure rules are imposed to close the CGE model. First, the nominal exchange rate is the numeraire of the model. Second, South Africa is assumed to be a small open economy and therefore takes world prices as given. Third, the current account balance is assumed exogenous. Fourth, capital migration across sectors is not permitted in the short run while labour is mobile across sectors. At last, government's spending is assumed fixed. It should be noted that this paper does not evaluate any fiscal policy package intended to mitigate the adverse impacts of COVID-19. Instead, the paper is focused on evaluating how the COVID-19 is affecting women.

Data

The database used for the CGE model is a Social Accounting Matrix (SAM) by Davies and Thurlow (2013) and has been disaggregated to take into account the gender dimension and population groups using data of the South African industry by gender, occupation and population group (Statistics South Africa 2012). The SAM includes 21 sectors/products and 24 different types of labour (skilled, semi-skilled, unskilled for male and female workers belonging to African, Coloured, Indian and White population groups) and one type of capital.

Each industry uses the different types of workers but in different proportions. If we look at the distribution by type of qualification (Table 1), for example, we can see that the health sector is relatively intensive in skilled workers while the other services sector hires more than 47% of unskilled workers in its labour force.

Looking at the gender division of the labour market, Table 2 shows that the health and other services sectors are highly intensive in women labour, while the mining and the construction sectors are male intensive.

These pieces of information from the SAM are crucial as they provide information on the structure of the South African labour market and gender dimension which assists with understanding the results in the next section.

The SAM includes as well four different types of institutions: firms, government, the rest of the world and households. The latter is disaggregated between female-headed households and male-headed households. Finally, the SAM includes four different tax accounts (direct taxes, import duties, commodities taxes and production taxes), and two savings/investment accounts (consumption for investment purposes and changes in inventories). Along with the SAM, additional data such as income elasticity from

Table 1 Skills labour per activity (in %). *Source* Computations from the SAM

	Unskilled	Semi-skilled	Skilled
Agriculture	39.45	39.85	20.71
Mining activities	10.32	66.82	22.86
Food industry (incl bev and tobacco)	21.78	48.36	29.86
Textile	9.26	56.86	33.88
Petroleum	11.52	49.04	39.44
Non-metallic minerals	16.92	55.57	27.50
Basic iron and steel, casting of metals	11.25	60.44	28.31
Electrical machinery and apparatus	6.99	59.58	33.43
Radio equipment and medical	8.69	43.58	47.73
Transport equipment	9.10	53.39	37.51
Other manufacturing	13.19	54.01	32.79
Electricity	8.63	53.43	37.94
Water	13.83	54.59	31.58
Construction	14.10	57.25	28.65
Hotel and restaurants	16.11	52.45	31.44
Trade	7.08	44.27	48.65
Transport	11.96	41.86	46.18
Business activities	9.74	40.59	49.67
Administration	12.71	53.31	33.98
Health	7.78	26.13	66.09
Other services	47.84	11.25	40.91

Burger et al. (2017) and trade elasticities from Ntombela et al. (2018) are used to operationalise the rest of the model.

Micro Simulation Module

The CGE model does not allow us to explicitly assess the poverty and impacts of the COVID-19 pandemic. To deal with this, a micro module is linked to the CGE model using a top-down technique. This enables feeding of the macro results on households' income and prices into the micro component of the model. Foster et al. (1984) poverty indices are then computed by making use of the NIDS survey (NIDS, Wave 5) (SALDRU 2018). As reported in Statistics South Africa (2012), women's poverty is higher than that of men irrespective of the poverty line used. Using the upper bound poverty line on the NIDS data, we find that in the base year, 46% of women are poor compared to 30% of men.

Table 2 Gender repartition of the wage bill per activity (in %). *Source* Computations from the SAM

	Male	Female
Agriculture	70.50	29.50
Mining activities	82.53	17.47
Food industry (incl bev and tobacco)	70.60	29.40
Textile	61.08	38.92
Petroleum	73.45	26.55
Non-metallic minerals	73.12	26.88
Basic iron and steel, casting of metals	78.39	21.61
Electrical machinery and apparatus	72.32	27.68
Radio equipment and medical	66.91	33.09
Transport equipment	76.34	23.66
Other manufacturing	70.19	29.81
Electricity	73.46	26.54
Water	72.11	27.89
Construction	79.92	20.08
Hotel and restaurants	54.63	45.37
Trade	69.19	30.81
Transport	60.18	39.82
Business activities	67.35	32.65
Administration	59.33	40.67
Health	44.68	55.32
Other services	37.90	62.10

Results and Findings

Scenarios

The COVID-19 pandemic is affecting the South African economy in many ways through international and domestic channels of transmission. On the international side, we identify three shocks induced by the COVID-19. First, we expect that South Africa faces a decrease in demand for its exports as most of South Africa's major trading partners have had some form of lockdown. China, the United States and European countries are amongst the country's major trading partners (World Bank 2018). The economic turmoil in these major trading partners leads them to reduce their imports, including those coming from South Africa. Second, the world had experienced a drop in oil price and mineral prices. While South Africa is a net oil importer, it exports many different minerals, constituting 20% of the country's total exports. Finally, the last international channel is via remittances. South African households receive remittances from the rest of the world (relatives or friends residing and working overseas, etc.), which are assumed to substantially reduce during the COVID-19 pandemic. Indeed, given the reduced activity overseas, the income coming from abroad is likely to be reduced. On the domestic channels, we identify two channels. First, the lockdown forces the majority of the population to stay at home and, where possible, to work remotely. However, for many workers, especially

Table 3 Scenarios

	Mild scenario	Severe scenario
International channels		
Decrease in exports	10% for all commodities	15% for all commodities
Decrease in world prices for oil and minerals	20% decrease for oil price	20% decrease for oil price
	8% decrease for minerals	8% decrease for minerals
Decrease in remittances	10%	10%
Domestic channels		
Decrease in productivity for the sectors	2% for mildly affected	2% for mildly affected
	5% for moderate	5% for moderate
	10% for largely affected	10% for largely affected
	15% for severely affected	15% for severely affected
Decrease in labour productivity	2% for skilled workers	2% for skilled workers
	3% for semi-skilled	3% for semi-skilled
	10% for unskilled	10% for unskilled
Increase in transportation cost	2%	2%

the low-skilled, telework is not a feasible option (Kerr and Thornton 2020). Moreover, it places a very heavy burden on women, as they have to attend to many domestic chores including home care and schooling while schools are closed as well as preparing meals. As a result, women have very limited time to do other work. Being at home, workers are not using the capital in the factories, which becomes less productive. This decreased productivity of factors of production impacts the production of all sectors, although with different intensities. Following Arndt et al. (2020), Bhorat et al. (2020), as well as the pronouncements of the government on essential and non-essential sectors during lockdown, the sectors of the economy are classified according to their degree of exposure to the shock. For example, the food sector is considered mildly affected, as this is an essential good whose sale continues during lockdown, while the tourism as an example is considered non-essential and is hence considered severely affected. Bhorat et al (2020) using data from the Business Impact Survey from StatSA, compute that only a quarter of agricultural firms were operating at full capacity, while this share falls to less than 5% for firms in the trade sector and to 0% for firms in the construction sector. Mildly affected sectors represent 28.89% of South African GDP, while moderately, largely and severely affected sectors represent, respectively, 9.65%, 44.13% and 17.33% of South African GDP before the pandemic. Second, it is expected that local transport costs will increase during the pandemic due for example to increased amount of time it now takes to load a truck fully.

A mild scenario and a severe scenario are designed (see for example Calderon et al. (2020) for different scenarios on the global economy). Table 3 summarises the simulations. The severe scenario adds to the mild scenario, an assumption that it will take longer for South Africa's major trading partners to recover fully and this assumption implies that South African import demand remains lower than in the mild scenario. We model this additional assumption by imposing a further reduction

Table 4 Macroeconomic impacts (in % change). *Source* Computation from the CGE model

	Mild	Severe
Real consumption (male-headed household)	− 7.58	− 7.84
Real consumption (female-headed household)	− 7.86	− 8.22
Real GDP	− 9.20	− 11.14
Consumer index price	− 0.51	− 2.15
Total investment	− 22.06	− 26.02

of exports by 15% to the mild scenario simulations. In fact, at the time of writing this paper, China is expected to reach a GDP growth of 1% in 2020, while the USA would experience a drop of 8% and the European countries experience a drop of 10.2% (IMF 2020). It is important to point out that little is known about the magnitude of the shocks as the effects of the pandemic are ongoing. Therefore, to build a reasonable scenario, we have used some magnitudes from existing studies (Arndt et al. 2020; Calderon et al. 2020); Laborde et al. 2020) and adopted them to our model. For instance, while Laborde et al. (2020) evaluate the transport costs increase at 3% we impose a lower magnitude of a 2% increase given that our model is not a global model as that of Laborde et al. (2020). Inevitably, there has to be an element of learning from other studies as well as making some reasonable assumptions due to the novelty and still evolving nature of the coronavirus pandemic.

Results

Macro and Sectoral Results

The macroeconomic impacts of the COVID-19 pandemic are substantial, since the economy simultaneously gets affected on the demand and supply sides as previously discussed. This combined effect results in a reduction by 9.20% in GDP in the mild scenario and 11.14% in the severe scenario (Table 4). On the supply side, given that workers are less productive, either because they cannot work properly from home, especially low-skilled workers, or because they lose some time when applying the social distancing and sanitation rules, as well as because capital is less used, production in all sectors is decreasing. The reduction in total production also leads to a fall of total labour demand for each industry, increasing the unemployment rates for each labour category. The increase in unemployment rates and drop in wage rates for households lead to a decrease in their income, and consequently on their consumption, with female-headed households experiencing higher reduction in consumption under both scenarios than male-headed households.

As explained above, all the sectors face a decrease in their production, induced by the drop in the productivity of production factors. However, the impacts are not uniform across sectors as some sectors may also face a decrease in the external demand. Indeed, the sectoral impacts differ according to whether they have been characterised as essential or not and whether export oriented or not. Thus, those sectors negatively affected experience-reduced production, lay-off workers and scale down on

consumption of intermediate inputs which impacts other sectors of the economy. The indirect effects are significant to the extent that some of the sectors that had not been classified as severely affected before the pandemic now find themselves heavily impacted by the resultant decline in the activity of other sectors. A case in point is production in the mining sector that drops by more than 13%, 14% for the other services sector and slightly more than 5% for the food sector under the mild scenario. This is despite the food sector not identified as a heavily impacted sector ex ante. All the sectors of the economy see their production declining but for three of them, the decrease is quite big: the construction sector experiences a drop by 17.20%. As 78% of the construction commodities are sold as investment goods, the drop in investment budget (− 22.06%) is explained by the sharp drop in construction sector's output. The production of the electrical machineries and apparatus sector drops by 15.25% given the drop in investment and the drop in the construction sector, as the construction sector uses this commodity as an input. Finally, the production of the other services sector drops by more than 14%. This sector is particularly interesting as it is highly labour-intensive utilising more women as they represent a little more than 60% of the labour force. The drop of production in this sector leads to a drop by 14.07% of its labour demand, mainly affecting women. Indeed, in this sector, the labour demand for unskilled African and Coloured women decreases by more than 10% for each type. Unemployment rates are increasing for all categories of workers, but it is mainly unskilled workers who are experiencing the biggest increase, and among them, Coloured and Indian women are most affected given that they work in the highly affected sectors. For instance, 25% of unskilled Coloured women work in the 'other services' sector. This granular information on the effects of the pandemic will be important for targeted policy responses.

The decline in the output of the sectors has a direct impact on exports, which are decreasing. The reductions in factor demands as well have a negative impact on the remuneration of people working in those sectors. Indeed, given the general slowdown, sectors are retrenching workers and wage rates are decreasing.

Gendered Results and Poverty Impacts

Overall, households face a decrease in income by 8.04% for male-headed households and 8.33% for female-headed households in the mild scenario and 9.82% and 10.19% for male and female-headed households, respectively, in the severe scenario. Given this decrease, households reduce their consumption levels. Firms' income, which is mainly based on capital income, is decreasing respectively by 9.63% in the mild scenario and 11.81% in the severe scenario. This drop in firms' income leads to a decrease in their savings and direct taxes paid. Government's income is dropping as well given the decrease in direct taxes from households and firms, and the decrease in the receipts of indirect taxes. All in all, government's income decreases by 9.91% in the mild scenario against 11.88% in the severe one. This drop in government's income and fixed spending leads to a massive increase of the government's current deficit, which was already worryingly high before the crisis. The decrease in the income and savings of each of the agents leads to a decrease in the
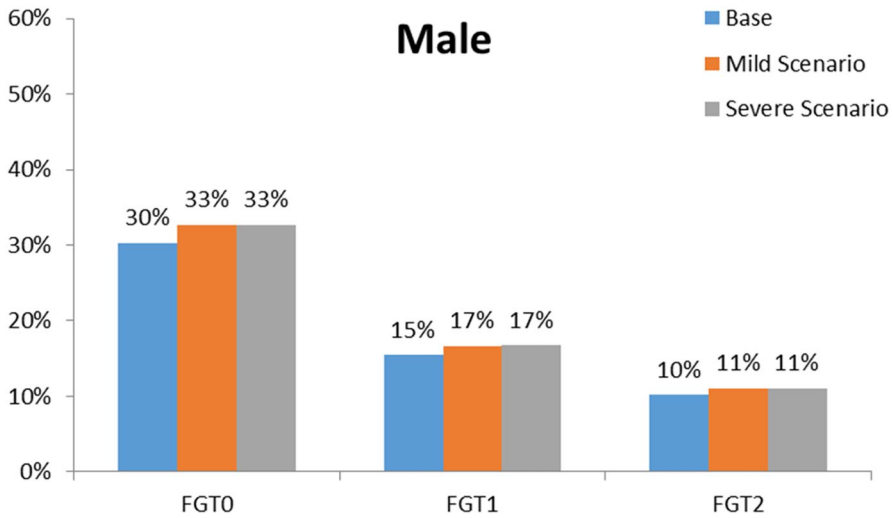
Fig. 1 Impacts on male poverty. *Source* Computations from the micro model. *Note* FGT0 is poverty head count ratio; FGT1 is poverty gap index and FGT2 is poverty depth
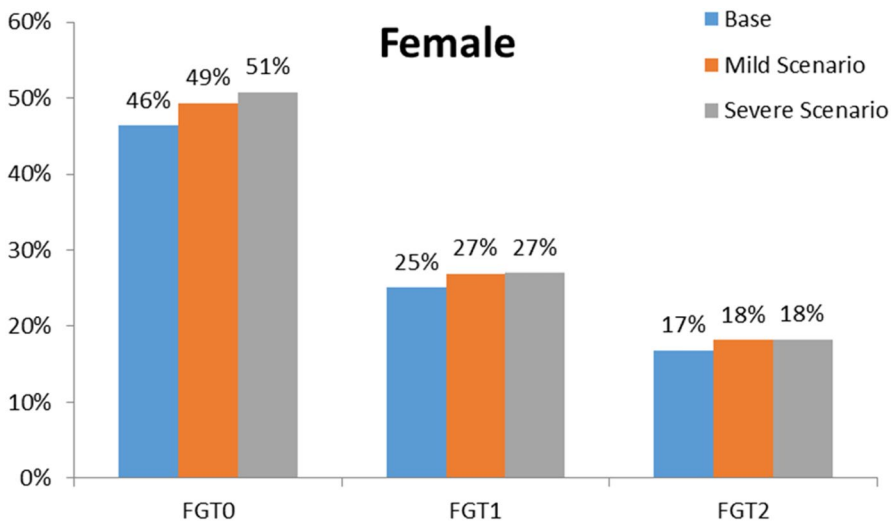

Fig. 2 Impacts on female poverty. *Source* Computations from the micro model. *Note* FGT0 is poverty head count ratio; FGT1 is poverty gap index and FGT2 is poverty depth

total investment budget (see Table 4), which will particularly affect sectors such as construction or machinery.

Figures 1 and 2 show the gendered impacts on poverty of the two scenarios. The results in terms of poverty show that poverty rates, (FGT0) among women increase by 3 to 5 percentage points depending on the scenario, ending up with 51% of female-headed households who are poor in the severe scenario (Fig. 2). Poverty

rates also increase for male-headed households but by a slightly lower magnitude compared to women (increases by only 3 percentage points for men in the severe scenario). Furthermore, the increase in the poverty depth (FGT2) indicator tells us that the poorest among women will be particularly more affected. As a result, COVID-19 will increase women's vulnerability.

Conclusion

This paper, by using a general equilibrium model that is linked to a microsimulation model, investigates the economic and gender effects of COVID-19 in South Africa. Responses to COVID-19 pandemic are shown to have varied and devastating effects on the economy and the population. With the reduction in economic activity being more pronounced the more severe as assumed in a severity scenario, the main findings are that there are differences, by gender, in the way employment and poverty are impacted. Women suffer disproportionately more negative impacts of the pandemic compared to men even though the differences are small. Our results that women have been affected relatively more than men go in the same direction as Casale and Posel (2020) and Ranchhod and Daniels (2021). The negative effect on women in our analysis is because the sectors that are female labour intensive see more negative effects as a result of both the direct and indirect effects caused by the pandemic. This leads to women receiving less labour income than their male counterparts. These impacts have been described already by Kabeer et al. (2021) as observation based on statistical data. Our CGE analysis extends this empirical observation by the insight on the intersectoral impacts between the economic sectors (i.e. the direct and indirect impacts). Concerning poverty, given that poverty for female-headed households was already higher in South Africa, than for male-headed households, this pandemic worsens the vulnerability of females. These results are important in informing evidence-based responses by government to the COVID-19 pandemic. Although this study is for South Africa, many other African countries can take lessons from this study as the situation of inequality in women employment is comparable to that of many developing countries where most women are employed in service sectors [International Labour Office (ILO 2016)] and tend to occupy low-skilled positions. For governments to respond in a manner that responds to such labour market biases, such detail as uncovered in this study would be crucial. In concluding, we must urge caution to be exercised when interpreting the results in this paper as pointed out, much uncertainty about data, magnitude of the shocks and future evolution of the pandemic and the economies. Furthermore, as was already mentioned, our model does not take into account any fiscal stimulus or social transfer plan setup by the government which is an important subject of further research [see for instance Habiyaremye et al. (2021), Bhorat et al (2021), or Chitiga et al (2021)]. Nevertheless, our results, simulated with a gendered CGE, are consistent with the impacts which have been empirically observed for labour markets, labour and poverty for South Africa (Ranchhod and Daniels (2021)) or other developing countries (see for instance Cuesta and Pico (2020); Escalante

and Maisonnave (2021)). These model results offer consistent quantitative information on intersectoral dimensions of the COVID-19 crises on the economic situation of women. Thus, they are valuable information to assist policy making to support women in South Africa. Furthermore, this information can be used to support analysis in other developing countries, where women face similar situations by being employed in hard hit sectors (like services) and suffer stronger economic impacts than men.

Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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