The macroeconomic impact of COVID-19 in Mozambique: A social accounting matrix approach

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Abstract:

This paper aims to assess the economic costs of COVID-19 and the state of emergency implemented by the Government of Mozambique, relying on a social accounting multiplier model. It produces numerical results that represent the direct effect on (or “shocks” to) the economy associated with the pandemic. We distinguish four channels—supply, demand, investment, and export—by which the state of emergency and other efforts influence economic activity. Our simulation suggests that the Mozambican economy might lose in total 4% growth in 2020 and that total employment is 1% down compared to a scenario without COVID-19. The main part of this loss is foreign-instigated, resulting from a demand reduction for Mozambican products by the rest of the world. The most heavily affected economic sectors are mining and accommodation. Furthermore, our simulation implies that the production factors of capital and urban labour are more impacted than rural labour. Moreover, the multiplier exercise brings out the high dependence of Mozambique on a small number of export items. Accordingly, Mozambique should promote economic diversification and explore the potential of reducing Mozambique’s vulnerability to foreign shocks.

Key words: COVID-19, multisector multiplier analysis, Social Accounting Matrix, Mozambique

JEL classification: E01, E16, E17, O21
Executive Summary

The Government of Mozambique (GoM) has so far refrained from responding to the COVID-19 pandemic with a full lockdown. Instead, GoM implemented a state of emergency, effective on 1 April 2020, which was replaced on 7 September by a state of calamity. Both states include restrictive measures attempting to prevent the spread of COVID-19, and the movement of people has not been completely forbidden, only reduced.

Yet, the impact of COVID-19 and the state of emergency measures on the economy have clearly been severe, and a better understanding of the size, origins and patterns of the crisis would be useful for policymakers to navigate the nation through the pandemic. This paper aims to contribute to this effort by assessing the economic costs of imported and domestic shocks.

We identify four channels through which the state of emergency have negatively affected individual economic sectors.

- First, an industry-level supply shock, which refers to COVID-19 associated situations that hinders production, such as government mitigation measures that reduce the on-site workforce or close certain establishments.
- Second, the COVID-19 induced macro-level demand shock. Households that were laid off or mandated not to work lost income and reduced their consumption because of limited access to shops.
- Third, the increased uncertainty created by the pandemic, which put investments decisions on hold, created an investment shock.
- Fourth, COVID-19 affected most of the world and this in turn influenced Mozambique’s export markets and import conditions (export shock) as well as the amount of remittances received.

We further differentiate between domestic and foreign shock channels. The former channel includes the supply, demand, and investment shocks, while the latter refers to the export shock.

We used data from the statistical sources available to us in combination with advice from key informants to establish the assumptions that feed into the model. Accordingly, the main statistics used for the second quarter (Q2) are the preliminary national accounts, published by the Instituto Nacional de Estatística.

The national accounts portray the overall (actual) situation of the Mozambican economy, including the aggregate impact of all of the four COVID-19 channels mentioned above plus all non-COVID-19 related changes in the economy.

Ideally, we would have information on the impact of COVID-19, channel by channel for our model. Yet, this is not provided in the national accounts, so our work relies on the validity of a set of assumptions. They include that we assumed zero supply impacts on agriculture due to COVID-19. We also had to make assumptions about Q3 and Q4, which reflect the best estimates available based on evaluating the government’s plans on fighting COVID-19 and re-opining the economy.

1 If that had been the only assumption about agriculture then the simulation would have shown no impact on agriculture. Yet, we also made assumptions about the demand for food products by households, some of which is supplied directly by agriculture and some of which is supplied indirectly via food processing. The latter is part of manufacturing. Furthermore, we made assumptions about hotel and restaurant services, which have indirect implications for the demand for food products as well as exports. In sum, agriculture is impacted in our simulation, but only indirectly within the model, and demand for agricultural products has come down due to COVID-19.
while the impact on export items is in line with international price forecasts from different sources such as the IMF and World Bank.

We stress that the total impact shown in the national account data helped guide our decisions regarding the assumptions and is used as feedback on how well the model is calibrated.

The direct effects will trickle down through the economy. The shock in one sector means that demand via backward linkages to supplying sectors will decline thereby decreasing activities in them. Further, the shocked sector will supply less to the sector demanding its goods influencing sectors further down the supply chain, although lack of demand may make this not very relevant. Considering that, the state of emergency tended to influence all economic sectors in one way or another, the impact will move through the whole economy and generate a set of indirect impacts through industry linkages in addition to the direct shock.

To capture the total impact (direct and indirect shocks) of COVID-19 and the mitigation measures we apply a Social Accounting Matrix (SAM) multiplier analysis. The SAM shows the full circular flow of income in the economy, including the generation of income by production activities (value added), and how that income is distributed to households, providing them with income to buy the goods and services produced or imported by the economy.

The SAM for this study identifies 51 productive activities (industries). They employ capital of various kinds (physical capital stock, land, and livestock) as well as four different types of labour in rural as well as urban areas to produce 52 homogenous commodities. The primary income generated by the productive activities is distributed to 10 different household types, which are distinguished by urban and rural location and income quintiles. The income they receive is used for private consumption expenditure of 52 commodities, saving, transfers, and taxes. The last item is received by the government to make expenditures, including transfers to households. There are also corporate taxes and indirect taxes on commodities. The economy is open so imports of goods and services add to domestic supplies and exports and other international transfers add to demand.

It is unlikely in such a short period as the one we study here that production technologies and prices change significantly, and this includes wage rates. While profit seeking price increases may be observed in the real world, they are not considered as incentives to stimulate production. As such, a SAM multiplier analysis is a commonly used tool in contexts as the present one where we aim to come up with a quick and pragmatic assessment.

The results of our multiplier analysis confirm that the economic impact is large.

Figure ES 1 shows our assessment of the total impact of COVID-19 on GDP in 2020. Starting on the right,

Figure ES 1 indicates that the expected average impact over the full calendar year is just under -4%. Put differently, if policy makers had anticipated the Mozambican economy to grow by 5% in 2020, and assuming our estimate is approximately correct, they will now have to scale annual expectations back by 4 percentage points to 1%.

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2 The quarterly results of the model are estimated relative to a fixed base, in this case GDP in Q1 2020. Therefore the annual result is calculated by dividing the sum of the Q2-Q4 impacts by 4, reflecting we assume zero impact in Q1.
Official pre-crisis 2020 forecasts from international institutions for Mozambique ranged between 2.2% and 6%. Assuming these forecasts are in the right ballpark, our model results imply that the Mozambican economy will experience a change in GDP between −1.8% and +2% in 2020.

Figure ES 1: Total impact on GDP

Source: authors’ calculations based on the multiplier model.

Further, it can be seen in Figure ES 1 that during the second quarter (Q2), the domestic shock pushed GDP down by 2.5% while the foreign impact is -3.6%. In Q3 (relative to Q1), the total impact of -6% remains, but it is now more driven by the domestic and less by the foreign channel. Results for Q4 show a small domestic impact, while the foreign drivers still persist so that the total impact is calculated to be -2.6% compared to Q1.

The interpretation of these results is as follows. In a world free of COVID-19, the Mozambican economy would have grown by 6% more than it actually did in Q2. Put differently, because of COVID-19 and the state of emergency, the economy lost 6% of growth in Q2. According to the national accounts data, value added expanded by 5.8% in Q2 compared to Q1 (INE 2020a). Our result for Q2 therefore suggests that growth would have been 5.8+6%=11.8% without COVID-19 in Q2.

Figure ES 2a and Figure ES 2b show the impact of COVID-19 and the state of emergency on GDP by sector. In general, it would appear that mining and accommodation (the latter combined with trade) are mainly impacted through the foreign channel. From the domestic channel, the main losers are construction, trade & accommodation and manufacturing, although manufacturing also suffers from the foreign driver via the metal products (aluminium) activity.

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4 Value added growth excludes product taxes and was chosen in this context to make the results comparable. The SAM does not include product taxes (Cruz et al 2018).

5 Arguably, 11.8% might seem to be high rate of growth for Q2, but we note that this is in line with pre-crisis growth rates in previous years. Quarter on quarter change of GDP (value added) between Q1 and Q2 were 10.5%, 9.6%, and 8.5% in 2019, 2018, and 2017, respectively.
Figure ES 2a: Total (domestic + foreign) impact on GDP by sector

Source: authors’ calculations based on the multiplier model.
Note: Agr&ff = Agriculture, forestry and fishing, Mining = Mining and quarrying, Manufc = Manufacturing, Utilit = Electricity, gas and water, Constr = Construction, Trdacc = Trade, catering and accommodation. Source: model calculations

Turning to employment, Error! Not a valid bookmark self-reference.a and Error! Not a valid bookmark self-reference.b show the impact on total employment (formal and informal). While the pattern may look similar to Figure ES 2, the vertical axis is about half the length, indicating that employment impacts are relatively smaller than GDP impacts. The reason is that we have used employment–output elasticities, which consider long-term relationships between GDP and employment. They suggest that a 1% drop in GDP equates more or less to a 0.5% decline in employment.

What stands out is the large impact on trade and accommodation. This is due to higher direct employment/output ratios and higher employment–output elasticities for the services activities in general. The employment impact on mining is for similar reasons relatively smaller. The other large contributor to the loss in employment, in particular during Q3, is construction.
Figure ES 3a: Total (domestic + foreign) impact on employment by sector

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Figure ES 3b: Domestic + Foreign impact on employment by sector

Further results show that capital and urban labour are impacted more than rural labour. This reflects the above noted assumption, i.e. zero supply impacts on agriculture due to COVID-19. Furthermore, the capital-intensive mining sector is one of the most affected sectors.

Similar to the rural-urban distinction, further results show an equivalent pattern for high and low educational attainment. People with higher educational attainment lost relatively more compared to people with lower educational attainment. This result again is driven by the fact that agriculture was assumed to be only affected indirectly. The results for high and low-income groups seem to
show a more egalitarian outcome. This can be explained by the impact on urban low-income households who are being disproportionally harder hit.

In sum, by and large we expect the Mozambican economy to stagnate or contract slightly in 2020. The impact is mainly foreign driven and the burden hits the capital-intensive mining sector and urban labour in particular. The simulations clearly bring out Mozambique’s dependency on a small number of export items and the associated vulnerability to foreign shocks. Accordingly, Mozambique should promote the diversification of the country’s export basket and explore how to develop domestic markets.

Moreover, while the impact is stronger for the urban population and for capital income, with the capital intensive mining sector as impact driver, the agricultural sector is impacted much less, which contributes to the result that the impact in rural areas is lower. Considering the significant importance of the agricultural sector for value added and livelihoods in the Mozambican economy this is under the circumstances helpful for many low-income families. However, regardless of the result that capital and urban labour is affected more severely than rural labour, it must be kept in mind throughout that even a minor loss for poor and vulnerable people can make a major difference for their livelihoods and incentives. A household below the poverty line will more likely take the risk of being infected by COVID-19 if this is required to obtain basic necessities. Consequently, they may risk not only their own lives but potentially become spreaders of the disease, worsening the pandemic. The government should carefully factor this in when deciding on how to respond to COVID-19. Relatedly, we suggest that punishing poor people for COVID-19 related offences is questionable. They have few livelihood options, and such actions may lead to further resentment and loss of trust in public sector institutions during the pandemic.
1 Introduction

The Government of Mozambique is trying hard to contain the spread of the COVID-19 pandemic while simultaneously avoiding a very costly (and possibly unrealistic) lockdown. At the end of March 2020, President Filipe Nyusi announced the implementation of a state of emergency. It was initially in place for 120 days and after a short interim period got renewed for another 30 days before new legislation covering calamities took effect. The first 120 days were coined by the attempt to prevent the disease, while the latest stage of the emergency/calamity seems to accept both the existence of the virus, and the need for envisaging a “new normal” combined with a slow opening up of the economy.

So far, the government managed to avoid the extreme of implementing a complete lockdown. Nevertheless, the pandemic combined with the mitigation measures likely came at a heavy cost to the economy. To come better to grips with the impact and the policy dilemmas involved, with a view to designing optimal policy responses, it is of the utmost importance to improve our understanding of the impact of the pandemic and its consequences across the economy.

This study relies on a Social Accounting Matrix for Mozambique (Cruz et al., 2018) to assess the impact of COVID-19 and the state of emergency on the Mozambican economy. The simulation suggests that the Mozambican economy can expect to lose in total 4% growth in 2020 and that total employment is 1% down compared to a scenario without the existence of COVID-19.

The main part of the growth and employment losses results from a demand reduction for Mozambican products by the rest of the world. The most affected economic sectors are mining and accommodation. Furthermore, the results indicate that the production factor capital and urban labour are more impacted than rural labour. Our simulation brings out Mozambique high dependence on a few export items leading us to recommend in a forward-looking perspective that the government promotes diversification and explores the potential of developing domestic markets to reduce Mozambique’s vulnerability to foreign shocks.

The paper proceeds as follows. Section 2 summarizes the development of COVID-19 and the government responses. Section 3 discusses how the pandemic affected the economy through supply, demand, investment and export channels. Section 4 explains the methodology applied to address the research question, while Section 5 presents results. Section 6 concludes and provides policy recommendations.

2 COVID-19 in Mozambique

In this section, we discuss the development of the COVID-19 pandemic and the government response in Mozambique. The impact of COVID-19 arrived in Mozambique some time before the virus itself. While Europe, Asia and America already reported increasing numbers of COVID-19 cases during the first quarter of 2020, Mozambique remained disease free and implemented first counter measurements in an attempt to prevent the virus from entering. The government developed a four-stage plan to deploy mitigating measures conditional on how the COVID-19 situation would evolve (Table 1).

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Table 1: Alert level in Mozambique

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual prevention measures:</td>
<td>Additional prevention measures:</td>
<td>Additional prevention measures:</td>
<td>Lock down:</td>
</tr>
<tr>
<td>Gatherings with more than 300 people are banned.</td>
<td>Gatherings with more than 50 people are banned.</td>
<td>Gatherings with more than 10 people are banned.</td>
<td>Prohibition on leaving the house</td>
</tr>
<tr>
<td>Non-essential travel should be avoided.</td>
<td>Quarantine for all people arriving from abroad.</td>
<td>Severe agglomeration restrictions in the commercial sector.</td>
<td>Closing of all activity in the public, private and commercial sectors</td>
</tr>
<tr>
<td>Quarantine for people arriving from countries with active COVID-19 cases and high transmission rates.</td>
<td>Cancellation of the issuing of visas.</td>
<td>Mandatory measures to reduce the contact between employees (only 1/3 present, rotation, shift work)</td>
<td>Prohibition of travel</td>
</tr>
<tr>
<td></td>
<td>Mandatory prevention measures in the public, private, and commercial sector to be implemented.</td>
<td>All sports, cultural and religious activities are banned</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Creation of a technical-scientific commission.</td>
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</tbody>
</table>

Source: (Ministério da Saúde 2020b)

The measures in Table 1 become gradually stricter and more restrictive with each level. Level 1 was put in place during the beginning of March. The implemented measures included the screening of people entering the country from countries with high numbers of active cases, quarantining travellers arriving from high risk countries, training of technical health teams to detect and investigate suspicious cases, and the procurement of individual protection material (CoM 2020b). Furthermore, state travel was banned as well as events with more than 300 participants (CoM 2020c).

While these efforts managed to delay the pandemic, the first COVID-19 case was reported on 22 March 2020 (CoM 2020d). As a response, the government moved to level 2 and introduced further measures to reduce the spread of COVID-19 such as the closure of all schools, the banning of gatherings with more than 50 people and the suspension of issuing entry visas. A Technical Committee was also created to analyse the trend of the pandemic (CoM 2020g; 2020h).

Furthermore, the government revised the state budget prioritizing the health sector and increasing the initial allocation to the sector by a further US$20 million to US$50 million (CoM 2020f). The Bank of Mozambique (BdM) introduced a currency credit line of over US$500 million to provide liquidity to the economy, relaxed customer credit restructuring conditions, and reduced the level of mandatory foreign and national currency reserves (CoM 2020e). H.E. Adriano Maleiane, Minister of Economics and Finances, also requested US$700 million from Mozambique’s external partners to help mitigate the impact of COVID-19 (CoM 2020f).

At the end of March, President Filipe Nyusi moved the alert level to level 3 (Table 1) of the government plan and declared for the first time in Mozambique’s modern history that the country
was in a state of emergency, which started on 1 April for an initial 30 days (CoM 2020i). The state of emergency was announced in Decree 12/2020 and ratified by the Assembleia de República in Law 01/2020 on 31 March. The decree and law include a set of measures to prevent the spread of COVID-19 and some of the measures affect economic activities. These measures are of particular interest for our analysis and a summary is provided in Table 2.

Table 2: State of emergency measures affecting economic activities

<table>
<thead>
<tr>
<th>Art.</th>
<th>Description</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Art. 3</td>
<td>Quarantine: Mandatory 14 days quarantine for everyone entering the country.</td>
<td>Prevents most forms of business travel</td>
</tr>
<tr>
<td>Ar. 8</td>
<td>Official documents: During the state of emergency the issuing of documents such as passports, ID, driver license, company registration are suspended.</td>
<td>Prevents most forms of business travel and hinders new companies to start a business.</td>
</tr>
<tr>
<td>Art. 9</td>
<td>Entry visa: The issuing of entry visas to the country is suspended.</td>
<td>Prevents any form of international tourism and business.</td>
</tr>
<tr>
<td>Art. 14</td>
<td>Public and private events: All events are cancelled. Amusement and similar commercial establishments such as discos, casinos, gyms, museums, or libraries have to close.</td>
<td>Reduces directly the production of goods and services needed for events and forbids the work of commercial establishments.</td>
</tr>
<tr>
<td>Art. 17</td>
<td>Public and private institutions: The mandatory measures in Art. 17 mainly promote social distancing in public entities and private companies. They include the reduction of the on-site workforce to 1/3, promote rotation systems and home office, minimum of 1.5m distance, and additional hygiene measures.</td>
<td>Businesses operate on lower capacity. Increase of organizational burden to implement the measures.</td>
</tr>
<tr>
<td>Art. 20</td>
<td>Markets: Reduced opening time for markets (6am to 5 pm), mandatory distance and hygiene rules for sellers.</td>
<td>Lower business activity due to reduced opening hours. Higher operational costs.</td>
</tr>
<tr>
<td>Art. 26</td>
<td>Transportation: Passenger transport can only use 1/3 of the vehicle capacity (this measure has been suspended), motorcycle taxis are forbidden to operate, and hygiene and sanitary measures must be implemented.</td>
<td>Temporarily passenger transport capacity was reduced by over 2/3. Additional costs through hygiene measures.</td>
</tr>
</tbody>
</table>
Further articles of the Decree 12/2020 have indirect impacts on the economy. For example, the closure of all educational institutions and the prohibition of religious and cultural meetings reduces the need for transportation. The measures implemented through the state of emergency correspond to level three of the government’s plan to fight the spread of COVID-19 in the country (Table 1). Level 3 is less severe than a complete lockdown (level 4), equivalent to the one implemented in South Africa (CoM 2020i). The state of emergency also provided the government with legal power to implement freedom restrictive measures, and it was stated by President Nyusi that further measures are conditional on the development of the pandemic in Mozambique.

Since the first declaration of the state of emergency, the status was prolonged three times which is the maximum according to Mozambique constitution of 120 days up until the end of July. During the first 120 days of the state of emergency further measures were introduced by the government, the central bank and external partners. On 9 April IMF and the World Bank injected 21 billion meticais into the State Budget (CoM 2020). The government extended the exemption of cooking oil and hygiene products from the 17% Value Added Tax (VAT) and discharged the payment of late tax payments fees. Furthermore, the use of masks became mandatory in all public and private passenger transport (CoM 2020k). The government and INSS will provide funds to small and medium enterprises (SMEs) through the National Bank of Investment (BNI) in the amount of 1,600 million meticais to support affected sectors by the state of emergency (CoM 2020m) and the electricity price was reduced by 10% as of June (CoM 2020n).

After the maximum constitutional length of 120 days the state of emergency expired. President, Nyusi compiled the necessary report for the assembly to ratify and waited a couple of days to be able to announce a new state of emergency. The second state of emergency is coined by the aim to encounter a “new normal” in which the economy can open up again while the spread of the disease is contained at a manageable level.

The new state of emergency defines three phases lifting gradually the restrictive mitigation measures.

- Phase 1, started on 18 August and is concerned with the resumption of low risk activities, including higher education, Defence and Security Forces academies, primary and adult education teacher training institutions, public health and vocational training centres, and resumption of religious services.
- Phase 2, started on 1 September and involved medium-risk activities, including the resumption of full operation of technical-vocational education, cinemas, theatres and casinos.
- Phase 3, is scheduled to start on 1 October and is concerned with high-risk activities, including the resumption of 12th grade classes.

On 7 September, the state of emergency was officially abolished and replaced by a situation of public calamity. A new law was ratified by the Assembly in August. It allows the government to implement restrictive measures in the face of a pandemic without resorting to the state of emergency. The situation of public calamity does not change any of the currently implemented measures. The main motivation to implement the state of public calamity was to avoid the constitutional time constraints (renewal every 30 days and maximum length of 120 days) which apply for the state of emergency (CoM 2020o).

As of 23 September, Mozambique had tested 127,378 people for COVID-19, and 7,114 (6%) were tested positive. Among the positive cases, 6,829 were caused by local transmission and the remaining 285 cases were imported from abroad. Mozambique had registered 45 deaths due to
COVID-19. Among positive cases, 4,064 cases have already recovered (Ministério da Saúde 2020a). Figure 1 shows the development of COVID-19 since March 2020.

Figure 1: COVID-19 in Mozambique

![COVID-19 in Mozambique](https://example.com/covid图表.png)

Source: (Ministério da Saúde 2020a)

Considering the sizeable impact that COVID-19 has already had on the lives of people in Mozambique it is worrisome to look into the future based on projections. Different models predict that Mozambique has not yet reached its peak. Epidemiological models from Imperial College, Neher Lab, London School of Hygiene and Tropical Medicine, and WHO show the peak at some point between November 2020 and January 2021 (Tierney and Brunt 2020).

While the Government of Mozambique puts a lot of effort into testing and tracing COVID-19 cases, it is very likely that the real number is significantly higher than the official one. An epidemiological survey conducted by the National Health Institute suggests that the real COVID-19 figure is around 5,500 cases in the city of Pemba compared to the officially 444 detected cases in the corresponding province of Cabo Delgado. A similar survey implies that 5% of the population of Nampula has been infected with COVID-19. Combining the results of the two surveys would suggests a number of at least 40,000 COVID-19 cases in Mozambique (CoM 2020s).

Rigorous testing is complicated in Mozambique for several reasons. The country lacks infrastructure in rural areas and the damages due to the recent cyclones Idai and Kenneth continue as barriers in reaching the whole population (CoM 2020r; 2020p). The situation is exacerbated by the ongoing violent conflicts in the north and centre regions of the country which has displaced many people from their homes, making COVID-19 less of a priority (SAPO 2020; RM 2020). As in other countries, COVID-19 also highlights social problems leading to increased trust issues between the population, the government and the police. Especially, reports about the misuse of power by the police as implementing force of the restriction measures seem to accumulate (Kyed 2020). The government tries hard to avoid a full lockdown knowing very well that many Mozambicans are too poor and cannot simply remain at home (Egger et al. 2020a). For the poor it becomes a question between COVID-19, penalization by the police or starvation (Kyed 2020).

7 For the models from Imperial College see (MRC 2020), for Neher Lab see (Noll et al. 2020), for London School of Hygiene and Tropical Medicine see (CMMID 2020), and for WHO see (Cabore et al. 2020).
3 The shocks

In this section, we discuss how the COVID-19 pandemic and the mitigation measures affected (i.e. ‘shocked’) broad sectors of the Mozambican economy and outline our underlying assumptions that feed into the model simulation that helps us assess the economic impact. We differentiate four channels.

- The first channel is an industry-level supply shock, which captures COVID-19 encumbered situations that hinder production. Examples are government mitigation measures reducing the on-site workforce or closure of certain establishments.
- The second channel is the COVID-19 induced macro-level demand shock. Households that were laid off or mandated not to work lost income and reduced consumption, and others reduced consumption by shopping less to mitigate the risk of infection.
- The third channel is concerned with the increased uncertainty created by the pandemic, which put investments decisions on hold.
- Finally, the fourth channel covers the rest of the world. COVID-19 affected most of the world and in turn influenced Mozambique’s export markets and import conditions as well as the amount of remittances received.

The impact of each channel is assumed for each economic sector. As will be explained in the methodology section only the largest shock (supply, demand, investment, or export) enters the model as a direct impact for each sector. This procedure is done to avoid double counting (see Section 4). The model will then compute the indirect effects trickling down to other sectors. Therefore, we discuss in this section each broad sector under the channel in which the sector suffered from the biggest shock.

As a start date for the shocks, we chose the second quarter of 2020. The state of emergency took effect on April 1st and some form of it (emergency or calamity) has been in place since. For our analysis, this makes it easy to identify the timing of the shock. The main data used are preliminary national account data, published by the Instituto Nacional de Estatística. We stress that the national account data show the overall situation of the Mozambican economy. They show the outcome of all four identified COVID-19 channels of impact plus all other non-COVID-19 related changes in the economy during Q2.

In other words, the data for Q2 cannot be used in any simple way to measure the impact of COVID-19 and the government mediation measures. Yet, they can help guide our assumptions and can be used as a feedback on how well the model is calibrated. We based our assumptions regarding Q3 and Q4 on the best estimates available to us and price forecasts from different sources including the IMF and World Bank. Table 3 shows a summary of the assumptions we made for each sector for each quarter of 2020.
Table 3: Assumptions

<table>
<thead>
<tr>
<th>Quarter 2,3,4</th>
<th>Impact due to Emergency / Distancing Rules Compared to Pre-Crisis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Industry Level Supply Shocks</strong></td>
<td>Q2</td>
</tr>
<tr>
<td>1</td>
<td>Other Mining (Gas &amp; Other)</td>
</tr>
<tr>
<td>2</td>
<td>Other Manufacturing Products (Cloth, Machines &amp; Equipment, etc.)</td>
</tr>
<tr>
<td>3</td>
<td>Transport</td>
</tr>
<tr>
<td><strong>Macro Level Demand Shocks</strong></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Household Consumption</td>
</tr>
<tr>
<td>5</td>
<td>Agriculture</td>
</tr>
<tr>
<td>6</td>
<td>Processed Foods</td>
</tr>
<tr>
<td>7</td>
<td>Utilities (Electricity &amp; Water)</td>
</tr>
<tr>
<td>8</td>
<td>Trade</td>
</tr>
<tr>
<td>9</td>
<td>Telecommunication &amp; Information Technology</td>
</tr>
<tr>
<td>10</td>
<td>Financial &amp; Insurance Services</td>
</tr>
<tr>
<td>11</td>
<td>Business &amp; Real Estate Services</td>
</tr>
<tr>
<td><strong>Export</strong></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Construction</td>
</tr>
<tr>
<td>13</td>
<td>Machinery &amp; Transport Equipment</td>
</tr>
<tr>
<td><strong>Investment</strong></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Coal</td>
</tr>
<tr>
<td>15</td>
<td>Aluminium</td>
</tr>
<tr>
<td>16</td>
<td>Tourism</td>
</tr>
<tr>
<td>17</td>
<td>Natural Gas (to South Africa)</td>
</tr>
<tr>
<td>18</td>
<td>Sugar</td>
</tr>
<tr>
<td>19</td>
<td>Tobacco</td>
</tr>
<tr>
<td>20</td>
<td>Cotton</td>
</tr>
<tr>
<td>21</td>
<td>Labour Remittances</td>
</tr>
</tbody>
</table>

Source: authors’ assumptions based on best available evidence.
Notes: 1) excluding sugar, tobacco and cotton, which are included in the export channel.

### 3.1 Industry Level Supply Shocks

COVID-19 and the resulting state of emergency affect the supply side of all sectors in Mozambique. Companies’ production has been influenced by the state of emergency mainly through Article 17 and 22 of the Decree 12/2020. They must ensure the protection of personnel (Article 17) and reduce on-site employees to 1/3 and/or ensure 1.5 m distance between workers and promote shift work (Article 22). These measures complicated production; however, the impact is likely to be smaller in many sectors compared to a full lockdown as observed in South Africa.

The industry level supply shock dominated for three economic sectors in particular: Other Mining (gas and other), other Manufactured Products (Clothing, Machines and Equipment), and Transportation and Storage. For the assumed size of the impact in each quarter see Table 3 and for an in-depth discussion and underlying data for the assumption see the Appendices: The shocks by sector.

14
3.2 Macro Level Demand Shocks

Household consumption (Urban/Rural)

Household consumption in rural and urban areas has been affected by COVID-19 mainly through a reduction in disposable income. Lower production reduced the need for employment and therefore income. This effect is assumed stronger in urban areas where the density of people restricts movement proportionally more under social distancing rules than in spacious rural areas.

The Indice de Actividade Economica (IAE) reports employment indices and they are shown in Figure 2. Employment is down by 2% and 6% in April and May respectively compared to Q1. Based on the IAE we assume a mild impact of COVID-19 on household consumption (-1% to -10%) in Q2. Considering the ongoing state of emergency and the slow opening of the economy towards the end of Q3, we assume the impact to be unchanged in Q3 and improve to zero change compared to Q1 in Q4.

Figure 2: IAE Employment

Source: INE (2020b).

Notes: The Indice de Actividades Economicas (IAE) is a survey based index measuring the economic activities by sector. Base year (=100) is 2014.

It should be noted that this assumed mild impact (-1% to -10%) in Q2 and Q3 is applied to all sectors. However, due to the model properties only the largest impact by channel will feed into the model directly. This means for example that if we assume zero impact for supply, investment and export for the financial sector then the assumed impact will come through the demand household channel in the magnitude discussed above. This is the case for the following sectors: agriculture, processed foods, utilities, trade, financial and insurance services, business and real estate services, public administration, education, and health. For all these sectors, the supply shock was considered to be less relevant than the demand shock.

Furthermore, subsistence demand has been excluded from the demand shocks. This is because production that is used by the households as in subsistence farming should not be affected by the state of emergency. Therefore, only marketed (as opposed to non-marketed) demand for unprocessed agricultural products is accounted for.

8 Except for the agricultural sub-sectors sugar, tobacco and raw cotton, which have been impacted by the export channel.
3.3 Investment

The pandemic creates uncertainty in Mozambique. The size of the pandemic is for many people and countries unprecedented and the mere idea of locking down whole nations was alien a year ago. Not knowing how the pandemic will develop means that any investment decision has to take into consideration the new situation. In most cases, this means that uncertainty and therefore the risk of an investment increases. Higher risk typically leads to a reduction in investments. The main investment driving sectors in Mozambique are construction and machinery & transport equipment.

For the size of the impact in each quarter see Table 3 and for an in-depth discussion and underlying data for the assumption see Appendices: The shocks by sector.

3.4 Export

The pandemic is spreading worldwide and therefore affecting not only Mozambique’s domestic economy but also the markets to which Mozambique sells its products abroad. Comparing the spread of COVID-19 and the implemented mitigation measures between Mozambique and other countries like South Africa until now shows that the impact abroad has been severe. Therefore, the way COVID-19 influences the rest of the world is affecting the external sector of Mozambique. In this section, we discuss the activities, which are mainly influenced through the export channel. The negative impact through the export channel in comparison to the other channels (supply, demand, and investment) seems to be more persistent. The IMF predicts for 2020 a growth rate of -4.9% for the world economy before it will grow again in 2021 by 5.4% (IMF 2020c).

To calibrate our model we used export data for Q2 from BdM. As with the national account data used above it should be noted that the data show the impact of all four COVID-19 channels mentioned above without making any distinction between them. As guidance for our assumptions for Q3 and Q4, we rely primarily on price forecasts from IMF, the World Bank, and Trade Economics. World demand for Mozambican products will be primarily determined by the international price of the commodity because Mozambique is a price taker in all markets. This makes price forecasts a viable option in our context. Finally, we discuss only activities/industries where the export channel dominates over the other three channels and feed into the model.

The export shock is in particular important for eight economic sectors: Coal, Aluminium, Tourism, Natural Gas (to South Africa), Tobacco, Cotton, Sugar and Labour Remittances. For the size of the impact in each quarter see Table 3 and for an in-depth discussion and underlying data for the assumptions see Appendices: The shocks by sector.

4 Methodology

The previous section discussed how broad sectors of the Mozambican economy are likely to be affected directly by COVID-19 and the mitigation measures implemented by the government. However, knock-on effects of these direct impacts can be expected to spread through the entire economy, upstream as well as downstream. In this paper, we focus on the former. If one sector is impacted negatively, suppliers of intermediate inputs to that sector are likely to face lower demand while the users of the output of the sector could face supply disruptions. The latter may not be relevant since final demand could be constrained.
The method used to capture the economy-wide effects on the Mozambican economy is similar to the one discussed in Arndt et al. (2020). An economy-wide simulation model is employed that produces empirical results from reasonable scenarios that represent the direct impact or “shocks” to the economy associated with the pandemic. The model provides “what-if” projections of a variety of economic indicators given the specified scenario. The indicators may be based on detailed industry level observations that effect supply of goods and services or their demand. In addition, it is possible to specify macro constraints. Results of scenario analysis should not be seen as forecasts of the future. Rather, they represent possible outcomes given the shocks assumed which are then forced to be internally consistent. As such, this may provide a disciplined framework for engaging in coherent policy debates.

4.1 Social Accounting Matrix multiplier model

There are several methods for exploring the economy-wide effects of shocks to the economy (for a more detailed discussion see Arndt et al. (2020)). In this paper, we use multisector multiplier analysis in the form of a Social Accounting Matrix (SAM) approach. This approach focusses on inter-industry linkages as measured by input-output tables and expands it to incorporate other economic actors than just industries, like the government and households.

A SAM is an accounting framework: a matrix or table that maps out the income and expenditure accounts of not only industries but also of (a single account for) enterprises, households, government, savings/investment and the rest of the world (exports, imports and various transfers). The SAM integrates these accounts with the national income and product accounts in accordance with the UN System of National Accounts (SNA). We use a SAM for Mozambique that describe its economy for the year 2015. For further details see Cruz et al. (2018).

SAMs show the full circular flow of income in the economy, including the generation of income by production activities (value added), and how that income is distributed to households, providing them with income to buy the goods and services produced or imported by the economy. Although a SAM can offer a somewhat disaggregated picture of the economy, it is not as detailed as the micro-level survey data it is partly based on.

The SAM for this study identifies 51 productive activities (industries) which employ capital of various kinds (physical capital stock, land, livestock) as well as four different types of labour in rural as well as urban areas, to produce 52 homogenous commodities. The primary income generated by the productive activities is distributed to 10 different household types, which are distinguished by urban and rural location and income quintiles. The income they receive is used for private consumption expenditure of 52 commodities, saving, transfers, and taxes. Taxes are received by the government to make expenditures, including transfers to households. There are also corporate taxes and indirect taxes on commodities. The economy is open such that imports of goods and services add to domestic supplies and exports and other international transfers add to demand.

The SAM described above is combined with linear behaviour assumptions for households, firms and other agents, along with other assumptions, to build not only a descriptive model of the Mozambican economy but also one that shows how it may respond to short-term demand shocks. In standard multiplier analysis, there are two key assumptions:

- Activities use intermediate inputs in fixed proportions to their total costs (or output). In other words, production technology is fixed and linear.
The model assumes that prices are fixed. Instead, adjustments to shocks bring about changes in quantities (gross output).

The COVID-19 shocks impact on the economy in months or quarters, not multiple years. It is unlikely that in such a short period production technologies and prices change significantly. This includes wage rates (the price of labour). While profit seeking price increases may be observed in the real world, they are not considered as incentives to stimulate production. As such, SAM multiplier analysis is a reasonable tool to use in the short terms. Computable General Equilibrium (CGE) models allow for adjustment in both price and quantity adjustments and they will be useful for considering shocks with a longer-term horizon.

4.2 Setting up scenarios

While a strict lockdown has not been observed in Mozambique, it is still useful to consider it even if only a mild form of it was implemented. A lockdown typically impacts the economy in two broad ways as follows:

(i) Preventing households from spending their income since most are not allowed to leave their homes. Unless employed in an essential sector, they cannot go to work, so their income is negatively impacted.

(ii) Make non-essential industries close down with declines in production and possibly large numbers of workers being laid off, temporarily at least.

The SAM multiplier model is a demand driven framework, so the driver of the scenarios is a change in exogenous final demand (by households, government, investors and exports). While point (i) above makes intuitive sense, point (ii) appears to be a “supply” shock. But here, it is assumed that the lockdown of activities is effectively the same as a decline for the demand of the goods and services they produce. To capture the impact on supply of a strict lockdown of industries, all final demand for the commodities produced by the industry would hypothetically be eliminated. This essentially cuts production in those industries (for a more detailed discussion see Arndt et al. (2020), in particular Figure A1 in the Appendices). The other reason for doing this is that the SAM’s final demand is expressed in terms of goods and services and not as outputs of activities.

Given the above, scenarios can be constructed from the bottom up. In addition, industries will be facing an uncertain future and the bottom-up impacts may have macroeconomic ramifications. Industries may be hesitant to engage in investment projects, resulting in a decline in aggregate investment. Moreover, the pandemic is not limited to Mozambique. It has resulted in a major decline in world trade. To accommodate this, macro investment and exports are assumed to decline and this could serve as a benchmark to the bottom-up commodity level changes.

In doing so and unlike typical macro top-down recessions, what is developed here derives from shocks in demand and supply at the sectoral level: the lockdown scenario. However, this ‘bottom-up’ recession, leads to ‘top-down’ effects on macros aggregates that may or may not exacerbate the effects of the bottom-up shock. To avoid possible double counting the larger of the supply and demand shock is taken to be as the final one submitted to the model and imposed on the modelled economy.

5 Results

When examining the results of the assumptions described earlier in this study (and in the appendix), it may be useful to make a distinction between domestic and foreign shocks. In what
follows domestics shocks are those associated with the supply/demand shock as well as gross domestic investment, while those associated with exports are considered foreign shocks. Given the linear nature of the model, the impacts of each sub-shock are additive. Note, that the foreign shock will have domestic consequences, as will be seen later. With that in mind, we start by considering GDP in Figure 3.

It can be seen that during the second quarter (Q2), the domestic shock pushed GDP down, directly and indirectly, below the start of the pandemic by 2.5% while the foreign impact was -3.6% so that the total impact in Q2 was -6%, based on the combined assumptions. In Q3 the domestic impact is expected to be worse and the foreign impact less, for the reasons discussed below, which result in a combined negative impact on GDP in Q3 of -6%. The Q4 assumptions result in a small domestic impact but the foreign drivers remain persistent so that the total impact is calculated to be -2.6% in Q4.

The interpretation of these results is as follows. In a world free of COVID-19, the Mozambican economy would have grown by 6% more than it actually did in Q2. Put differently, because of COVID-19 and the state of emergency, the economy lost 6% of growth in Q2. According to the national accounts data Mozambique’s economy measured in terms of value added did grow by 5.8% in Q2 compared to Q1 (INE 2020a). Our result for Q2 therefore implies that growth without COVID-19 would have been 5.8+6%=11.8% in Q2. The 11.8% may seem high but is in line with pre-crisis growth rates in previous years. Variation of GDP (value added) between Q1 and Q2 were 10.5%, 9.6%, and 8.5% in 2019, 2018, and 2017, respectively.

Figure 3: Total Impact on GDP

<table>
<thead>
<tr>
<th></th>
<th>Q2 Dom</th>
<th>Q2 For</th>
<th>Q2 Tot</th>
<th>Q3 Dom</th>
<th>Q3 For</th>
<th>Q3 Tot</th>
<th>Q4 Dom</th>
<th>Q4 For</th>
<th>Q4 Tot</th>
<th>2020 Q1-Q4</th>
<th>Dom</th>
<th>For</th>
<th>Tot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.0%</td>
<td>-1.0%</td>
<td>-1.0%</td>
<td>0.0%</td>
<td>-1.0%</td>
<td>-1.0%</td>
<td>0.0%</td>
<td>-1.0%</td>
<td>-1.0%</td>
<td>0.0%</td>
<td>-2.6%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: authors’ calculations based on the multiplier model.

Dividing the sum of the Q2-Q4 impacts by 4 (assuming zero impact in Q1), the expected average over the calendar year can be calculated to be just under -4% in total. -1.5% can be attributed to the domestic shock and -2.2% to the foreign shock. Accordingly, if policy makers were at the start of the year expecting the Mozambican economy to grow by say 5%, they will have to scale their ambitions back by about 4%.

A slightly different view on GDP is shown in Figure 4 by presenting the results for their components. Here, consumption (C), investment (I) and exports (E) are derived by assumption (exogenous) while imports and GDP are determined by the model (endogenous).

---

9 Value added growth excludes product taxes and was chosen in this context to make the results comparable. The SAM does not include product taxes (Cruz et al 2018).
We noted in relation to the previous figure that the impact of GDP from the domestic component is expected to be larger in Q3 than Q2. The reason is shown in Figure 4 where it can be seen that investment is driving the domestic component of GDP further down while consumption remains at the same negative rate. This is offset by the lower foreign impact through exports, hence the almost identical negative impact on GDP for Q2 and Q3.

In Q4, consumption is not negatively impacted anymore and investment is also less negative. The main driver of this quarter is expected to be the negative impulses from the rest of the world. Note that the combined impacts on GDP are not simply the sum of these components, since there is also the matter of what happens to imports. Still, as in Figure 3, the downturn in Mozambique is mainly a foreign story, with domestic drivers playing a lesser role.

Which industries are specifically impacted by the downturn is examined in Figure 5. Production GDP is reported here for seven broad activities. Even with this limited number of industries, the figure becomes rather cluttered and we will only mention broad patterns in our discussion. In general, it would appear that mining and accommodation (the latter combined with trade) are mainly impacted through the foreign channel. Through the domestic channel, construction and trade & accommodation and manufacturing are the main victims, although the latter also suffers from the foreign driver via the metal products (aluminium) activity (as can be seen in
The negative impact on mining is expected to abate somewhat as the calendar year closes out but trade & accommodation remain persistently negative during Q4. As this is playing out, agriculture is one of the least affected together with other services (transportation, finance, business, health, education, public administration etc.). On the far right hand side, it can be seen that the most negative total impact for the year is shared by trade & accommodation and mining, followed by construction, manufacturing and electricity with agriculture and other services affected less negatively.

One of the key features of the SAM multiplier analysis is that it accounts for direct and indirect impacts. Thus, the above results are based on the sum of direct and indirect effects. But how important are each of these two effects in relation to the total impact? Figure 6 offers an indication for Q2. As explained in the methodology section, the exogenous drivers of the shocks are expressed in terms of commodities. We determine 1st round impacts on activities by modelling the question who is making or supplying these products directly from a local source, that is, before the knock-on indirect effects come into play. Such 1st round impacts are pretty much as close as we can get to the direct impact on activities.

In the first group of bars, it can be seen that agriculture is impacted negatively in spite of there not being any lockdown supply-side constraints imposed on it. Moreover, we have been careful to exclude from the demand shock the subsistence demand. Thus, only marketed (as opposed to non-marketed subsistence) demand for unprocessed agricultural products is accounted for. This explains the 1.7% direct decline for agricultural production. Therefore, while harvesting and other agricultural activities are assumed to continue as normal, as noted earlier in our discussion, demand for (unprocessed) agricultural products still declines, not only directly but also more importantly, indirectly.

The latter adds another 1.4% to the total decline in agriculture of 3.1%. Indirect impacts clearly matter as they account for almost 50% of the total negative impact on agriculture. These indirect effects emanate from lower demand for processed food, which in turn results in further downward pressure on agricultural products. This relatively high share of indirect effects is even more noticeable for industries such as utilities and other services, which are hardly impacted directly.
Indeed, the total impact on utilities is -6.7% while the 1st round only accounts for -0.5% in this modelled economy.

Clearly, the opposite is the case for mining and construction. The 1st round impact pretty much explains the total impact. To these activities, indirect effects matter little. This is understandable and related to the nature of their activity. However, manufacturing also seems to suffer from low indirect effects, which may be kind of a blessing in disguise during a downturn but masks the feature of very limited integration into the Mozambican economy.

Figure 6: Direct (1st Round) and Indirect Impact on Production GDP by Industry for Q2

Source: authors’ calculations based on the multiplier model.

The trade & accommodation story is somewhat different in that the latter drives the 1st round direct impact while the trade sector suffers mainly indirectly from lower trading margins. Note that as such no specific direct supply-side lockdown assumptions were imposed on trade since the economy-wide negative demand assumptions will result in effectively the same thing in that customers don’t show up at the shops whether they are locked out or not. The lower trade margins only become noticeable as an indirect impact in the model. The overall picture is that the direct impact accounts for more than two third of the negative rate of change in GDP (at basic prices) while only one third can be attributed to the indirect effects. The spreading of the negative economic impact of the pandemic through the Mozambique economy is limited mainly because of the lack of integration amongst production activities.

So far, we have considered the expenditure and the production side of GDP. The third method of GDP accounting is from the income side. In Figure 7, income earned by the two broad factors of production labour and capital is shown. In addition, labour is broken down by urban and rural. Across all quarters and for domestic as well as foreign drivers it would appear that urban labour is more negatively impacted than rural labour while capital is more negatively impacted than labour.

The reason for capital being impacted more than labour has to do with the functional distribution of income within the industries that are mostly impacted. In Figure 5, it was shown that apart from trade and accommodation, mining, utilities and manufacturing are the most negatively impacted sectors by the shocks. These sectors are typically more capital intensive thereby biasing total factor payments toward capital. The production factor capital is therefore likely to earn relatively less in this type of downturn. This is notwithstanding the high negative impacts on trade and accommodation as well as construction.
The relatively low impact on agriculture and other services, which are typically more labour intensive, may explain the relatively lower impact on labour as a whole. Similarly, the large weight of agriculture in the Mozambique economy may do the same for the relatively low impact on rural labour.

During Q4, the negative shock on coal becomes less persistent while the shock on tourism remains relatively high. The result is that rural labour is impacted negatively more than from the foreign shock than the domestic shock.

Figure 7: Impact on Income GDP by Production Factor with Labour by Rural/Urban

![Figure 7: Impact on Income GDP by Production Factor with Labour by Rural/Urban](image)

Source: authors’ calculations based on the multiplier model.

Note: flab-rur = factor labour-rural, flab-urb = factor labour-urban, fcap = factor capital.

The patterns of results for labour earnings according to the rural and urban distinction in Figure 7 above is more or less the same as for low (primary and unfinished secondary) and high (secondary and tertiary) educated labour, as can be seen in Figure 8 below.

Figure 8: Impact on Income GDP by Production Factor with Labour by Educational Attainment

![Figure 8: Impact on Income GDP by Production Factor with Labour by Educational Attainment](image)

Source: authors’ calculations based on the multiplier model.
It can also be seen from both figures that capital and urban as well as highly educated labour suffer relatively more from the foreign shock compared to the domestic shock. The reason is the heavy reliance of the Mozambican economy on agriculture and the relatively low negative shock assumed for this activity.

One would expect that the impacts on the functional distribution above has implications for the impact on income distribution and possibly follows the same patterns. In Figure 9, household income is distinguished by urban and rural while the income distinction of the bottom 80% (low-income households) and top 20% (high-income households) is shown in Figure 10.

Figure 9: Impact on Household Income by Urban/Rural population

Figure 10: Impact on Household Income by Low and High Income
In terms of household income groups, the rather crude distinction in Figure 10 between low- and high-income households suggests a more egalitarian negative outcome. This implies that the impact on urban low-income households is disproportionately harder as was shown in Figure 9 where urban households suffered more.

Of particular concern to policy makers is the impact of the pandemic on Mozambique’s employment situation. Figure 11 shows the industry-level employment effects. While the pattern may look similar to Figure 5, the vertical axis is about half the length, indicating that employment impacts are relatively less than GDP impacts. The reason is that we made use of employment – output elasticities which consider long-term relationships between GDP and employment. A 1% drop in GDP equates more or less to a 0.5% decline in employment.

What stands out in particular is the large impact on trade and accommodation. This is the result of relatively higher direct employment/output ratios and relatively higher employment–output elasticities for the services activities in general. The employment impact on mining is for similar reasons relatively less. The other large contributor to the loss in employment, in particular during Q3, is construction.

Figure 11: Total Impact on Employment by broad Industry

Source: authors’ calculations based on the multiplier model.
Note: hhd-lo = household income quintiles 1-4, hhd-hi = household income quintile 5.
Impacts on employment by level of education attained are shown in Figure 12. The results could be compared to the impacts on wage earnings shown in Figure 8.

Figure 12: Impact on Employment by Educational Attainment

Source: authors’ calculations based on the multiplier model.
Note: flab-lo = labour with primary and unfinished secondary education as highest attained education level, flab-hi = labour with secondary and tertiary education as highest attained education level.

Again, note the more muted impacts on employment. The Q3 employment impacts are relatively more negative than in Q2 due to the bigger knock assumed on the construction sector.

Overall, employment is expected to be over 1% down on average over the full calendar year compared to a COVID-free world.

The final figure, Error! Not a valid bookmark self-reference, features the urban/rural distinction and displays similar patterns to those in Impacts on employment by level of education attained are shown in Figure 12. The results could be compared to the impacts on wage earnings shown in Figure 8.

Figure 12. Over the full year, employment in urban areas can be expected to reach levels that are almost 2% down compared to before the pandemic. Again, in rural areas this impact is more muted.

Figure 13: Impact on Employment by Urban/Rural population
Source: authors’ calculations based on the multiplier model.
Note: tot-rur = total rural, tot-urb = total urban.

Detailed results for the 25 most impacted activities for the calendar year 2020 are shown in
Table 4 for GDP and employment. It can be seen that accommodation and trade services share most of the burden. In terms of GDP, gas, coal, metals and electricity feature high but they don’t feature in the top 25 of employment. On the other hand, other services can expect rather large employment impacts although the impact on GDP is so low it isn’t even shown. Such apparent outliers are the results of the marginal employment intensities of these activities. In broad terms, a number of mining and manufacturing subsectors are impacted badly in terms of GDP and a number of agricultural and other services subsectors are so in terms of employment.
Table 4: Detailed Direct and Indirect Impacts on GDP and Employment as % of the Total Impact on GDP and Employment for 2020 (calendar year)

<table>
<thead>
<tr>
<th>GDP Total Shock (Av.Q1-Q4)</th>
<th>% of Impact</th>
<th>Employment Total Shock (Av.Q1-Q4)</th>
<th>% of Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Accommodation and food serv.</td>
<td>15.6%</td>
<td>1 Wholesale and retail trade</td>
<td>26.0%</td>
</tr>
<tr>
<td>2 Wholesale and retail trade</td>
<td>12.5%</td>
<td>2 Accommodation and food serv.</td>
<td>15.4%</td>
</tr>
<tr>
<td>3 Transportation and storage</td>
<td>10.3%</td>
<td>3 Other services</td>
<td>6.4%</td>
</tr>
<tr>
<td>4 Natural gas</td>
<td>8.4%</td>
<td>4 Maize</td>
<td>5.7%</td>
</tr>
<tr>
<td>5 Coal and lignite</td>
<td>5.7%</td>
<td>5 Sugar cane</td>
<td>5.0%</td>
</tr>
<tr>
<td>6 Metals and metal products</td>
<td>5.0%</td>
<td>6 Construction</td>
<td>3.9%</td>
</tr>
<tr>
<td>7 Construction</td>
<td>4.5%</td>
<td>7 Vegetables</td>
<td>3.3%</td>
</tr>
<tr>
<td>8 Electricity, gas and steam</td>
<td>4.0%</td>
<td>8 Tobacco</td>
<td>2.9%</td>
</tr>
<tr>
<td>9 Information and communication</td>
<td>3.6%</td>
<td>9 Transportation and storage</td>
<td>2.8%</td>
</tr>
<tr>
<td>10 Other foods</td>
<td>2.7%</td>
<td>10 Other crops</td>
<td>2.5%</td>
</tr>
<tr>
<td>11 Non-metal minerals</td>
<td>2.4%</td>
<td>11 Other foods</td>
<td>2.4%</td>
</tr>
<tr>
<td>12 Education</td>
<td>2.3%</td>
<td>12 Information and communication</td>
<td>2.1%</td>
</tr>
<tr>
<td>13 Cereal and vegetable processing</td>
<td>2.0%</td>
<td>13 Cassava</td>
<td>2.0%</td>
</tr>
<tr>
<td>14 Sugar cane</td>
<td>1.7%</td>
<td>14 Poultry</td>
<td>1.9%</td>
</tr>
<tr>
<td>15 Maize</td>
<td>1.7%</td>
<td>15 Other livestock</td>
<td>1.7%</td>
</tr>
<tr>
<td>16 Business services</td>
<td>1.3%</td>
<td>16 Other oilseeds</td>
<td>1.4%</td>
</tr>
<tr>
<td>17 Finance and insurance</td>
<td>1.2%</td>
<td>17 Other mining</td>
<td>1.4%</td>
</tr>
<tr>
<td>18 Poultry</td>
<td>1.1%</td>
<td>18 Groundnuts</td>
<td>1.4%</td>
</tr>
<tr>
<td>19 Fishing</td>
<td>1.0%</td>
<td>19 Electricity, gas and steam</td>
<td>1.3%</td>
</tr>
<tr>
<td>20 Machinery and equipment</td>
<td>1.0%</td>
<td>20 Education</td>
<td>1.3%</td>
</tr>
<tr>
<td>21 Other livestock</td>
<td>0.9%</td>
<td>21 Rice</td>
<td>1.1%</td>
</tr>
<tr>
<td>22 Vegetables</td>
<td>0.9%</td>
<td>22 Forestry</td>
<td>1.0%</td>
</tr>
<tr>
<td>23 Tobacco</td>
<td>0.9%</td>
<td>23 Business services</td>
<td>0.8%</td>
</tr>
<tr>
<td>24 Wood and paper</td>
<td>0.8%</td>
<td>24 Pulses</td>
<td>0.8%</td>
</tr>
<tr>
<td>25 Other crops</td>
<td>0.7%</td>
<td>25 Fishing</td>
<td>0.7%</td>
</tr>
</tbody>
</table>

Source: authors’ calculations based on the multiplier model.
Note: Total impact is due to the combined domestic and foreign shock, averaged out over the four quarters with zero impact on Q1.

6 Conclusion and policy recommendations

This study offered an analysis of the macroeconomic impact of CODID-19 on the performance of the Mozambican economy. We used a Social Accounting Matrix approach, which allows us to estimate the total impact of COVID-19 and distinguish between the foreign and domestic share of the impact on production and employment for a range of economic sectors.

The results show that economic growth in 2020 can be expected to be 4% lower because of COVID-19. Considering, that various growth forecasts conducted before the pandemic estimated a 4%-6% growth for Mozambique would mean that the Mozambican economy is likely to stagnate in 2020 with between 0% and 2% growth. Furthermore, the results show that employment will be 1% lower due to COVID-19 in 2020 and that the two sectors hit the hardest by the pandemic are the mining and accommodation sector.

In this study we have not analysed in detail the impact of COVID-19 for the estimates of poverty in Mozambique. However, adopting the growth-poverty elasticity in the period 2008/09-2014/15
of 0.68 estimated by the World Bank, this entails that a 4% loss in GDP could be associated with an increase in monetary poverty of 2.72 percentage points. A different way of putting this is that the equivalent of more than half the progress in terms of poverty reduction realised between 2008/09-2014/15 is likely to be wiped out in 2020 due to the COVID-19. This is particularly serious because Eggert et al. (2020b) have already suggested that the impact of the cyclones Idai and Kenneth and the economic crisis following the hidden debt scandal may have left Mozambique in 2018 with a poverty rate not that different from that of 2015. The implication is that Mozambique may at the end of 2020 end up with a poverty rate markedly higher than that of 2015.

In conclusion, we note, first, that most of the impact on the economy comes through the export channel and therefore is foreign born. This vividly illustrates Mozambique’s dependence on a small number of export items and its vulnerability to foreign shocks. Diversification of the export basket and exploring how to develop the potential of the domestic market are two obvious recommendations.

Second, the economic impact is stronger for the urban population and for capital income. This is related to the first point, especially with the mining sector identified as impact driver, which is a capital-intensive industry. The agricultural sector, on the other hand, seems to be impacted less negatively which contributes to the result that the impact in rural areas may be lower. Considering the high importance of the agricultural sector in the Mozambican economy this might be interpreted as sort of a blessing in disguise for many low-income families. However, this blessing is fragile. Mozambique already has very high poverty rates as noted above and the situation could quickly degrade if COVID-19 spreads into rural areas, where the impact on health could be more severe due to a lack of proper health care facilities. Many vulnerable households in rural areas are even if they are above the poverty line right now very close to being pushed below due to the dynamics of the COVID-19.

The results in this paper reflect the implications of a consistent simulation of the impact of the COVID-19 on the Mozambican economy. We stress that our results are conditional on the assumptions made about what has happened so far in 2020 and about the future. Any assumption may prove imprecise. It is therefore critical to keep in mind that the validity of our results will depend on how the pandemic develops during the remainder of 2020. However, the present analytical platform can easily be updated and adjusted as new information becomes available.

References


Bulmer-Thomas, Victor. 1982. *Input-Output Analysis in Developing Countries: Sources, Methods and Applications*. John Wiley & Sons, Australia Limited.


accounting-matrix-sam-mozambique.


Appendices

The shocks by sector

*Other mining (Gas and Other)*

The main mining activities other than coal in Mozambique include natural gas (SASOL), ruby mining (Montepuez Ruby Mine (MRM)) and graphite (Syrah Resources).

Natural gas production for SASOL should not be affected by the supply side. This is mainly because the pipelines used to transport gas from Mozambique to South Africa do not need much labour. The situation is different on the demand side where it depends on the South African economy (for a discussion of the demand side see further below).

Ruby mine operators has been mainly affected on the supply side by COVID-19 through the imposed travel restrictions. Article 9 of Decree 12/2020 suspends visa issuing. This restriction made it impossible for the ruby companies to hold auctions and therefore to sell their products. These auctions are usually responsible for over 90% of the revenues and will influence their business significantly in Q2 (CoM 2020j).

The mining and gas companies are also directly affected on the supply side by COVID-19. The Afungi camp from Total had to close temporarily as employees were infected with the disease. Also, MRM and Syrah Resources graphite, reported cases of COVID-19 and production had to be shut down because of it (CoM 2020s). Due to the direct impact of COVID-19 (cases) and mitigation measures (suspension of visas) we assumed an initial moderate impact (-10% to -20%) in Q2 followed by a gradual improvement of the situation in Q3 and Q4.

Improvement in Q3 and Q4 is possible if the government is planning to open its boarders again. If so, by the next ruby auction in December the situation could be back to normal. Considering the mining shut down for MRM and Syrah Resources due to active COVID-19 cases we assume that this issue could be solved in a couple of weeks. Therefore, the impact on the supply side in Q3 is assumed to be mild (-1% to -10%). Moreover, conditional on no further COVID-19 outbreaks in the mines, we assumed that Q4 production could be back to pre-pandemic levels.

*Other Manufactured Products (Clothing, Machines and Equipment)*

The supply side of the manufacturing sector has been affected during the state of emergency mainly through the mandatory reduction in on-site employees, social distancing and hygiene measures. National account data show that the whole industry sector contracted by around 9% in Q2 compared to Q1 (Figure A 1). It should be noted that the data show the overall industry values and not only Other Manufacturing Production. Furthermore, the data show the overall effect and not the direct impact of COVID-19 for industry supply.

Nevertheless, we assumed the impact to be in proportion to the whole industry and that the supply was impacted mildly (-1% to -10%). Furthermore, we assumed that the effect will still be noticeable in Q3 before a recovery to Q1 levels is reached in Q4.
Domestic passenger transport was severely affected on the supply side for a short period by the state of emergency. Article 26 of Decree 12/2020 regulates that the transport sector is only allowed to use 1/3 of their vehicle capacity, bans motorcycle taxis, and makes travel business owners accountable to implement hygiene and sanitary measures creating additional costs. However, the initial strict rules to reduce capacity by 2/3 has been lifted briefly after its implementation, reducing the impact on supply considerably.

International passenger transport has been affected severely through the state of emergency. The suspension of visa issuing and cancelation of almost all international flights reduced activity significantly. Cargo transport is reduced because of lower demand and international cargo mainly because of new complicated boarder procedures. However, other transport of goods is only minimally affected on the supply side by the state of emergency measures.

Indirect effects of the state of emergency on the trade sector such as the discouragement of movement by the government, closure of schools, and promotion of home office reduces the demand for transportation. These indirect effects are part of the demand side and will be picked up by the model through other channels.

For Q2 and Q3 we assume the supply impact to be mild (-1% to -10%) and for Q4 we assume that the situation will move back to Q1 levels (0%).

**Construction**

The impact of COVID-19 on the construction sector will take time to materialize. The ongoing crisis will make people hesitant to invest in new building, the government has not announced any form of investment program in infrastructure and companies will hold back investments.

However, data shows that the construction sector was not negatively impacted in Q2. National account data actually revealed an increase in activities by 4% compared to Q1 (Figure A 2, right). Nevertheless, the sentiment in the sector was not very positive. The Indicadores de Confiança e de Clima Económico (ICCE) for the construction sector decreased by 11% in Q2 (Figure A 2, left).
The discrepancy between sentiment (ICCE) and actual activities (national account data) could be explained by the high informality of the construction sector. Informal construction workers and projects would be the first to close down in a crisis but are less likely to show up in the national account data. Another explanation could be a mismatch in the considered period by the respondents of the ICCE survey. Construction can take a while to finish and ongoing projects would have continued. The reduction in the ICCE could imply that new orders for construction projects are low and that the actual impact will be felt in Q3 or Q4.

The impact of COVID-19 on investments in the construction sector will likely take time to materialize and that ongoing projects in Q2 continued with stored materials. Therefore, we assume the direct impact to be mild (-1% to -10%) in Q2, somehow stronger to moderate (-10% to -20%) in Q3 and back to mild (-1% to -10%) in Q4 again.

Machinery and transport equipment

As guidance to determine the impact of COVID-19 and the mitigation measures on investments for machines and transport equipment, we used the value of imported capital goods (machines, tractors and semi-robotic machines) from BdM. Overall, the imported values decreased in Q2 by 34% compared to Q1 and by 30% compared to Q2-2019 (Figure A 3). This would indicate a large impact of around 30%. It could be that some machines were not delivered because of supply chain problems abroad. We assume the impact on investment somewhat smaller at moderate (-10% to -20%) in Q2.

The immediate reduction for machinery investments shows that this sector reacts faster than the construction sector. For Q3, we continue to assume a moderate impact (-10% to -20%) because the opening of the economy happens slowly towards the end of Q3. Further out for Q4 we assume a small improvement to a mild impact (-1% to -10%).
Coal

The coal sector has been severely affected by the pandemic. On the supply side, Article 17 and 22 of the Decree 12/2020, the state of emergency obliges companies to ensure the protection of personal and reduce on-side employees to 1/3 and/or ensure 1.5 m distance between workers. Considering that coalmines in Mozambique are open pitch it would be feasible to implement such measures at some costs and still produce some coal. Therefore, the supply side effect should be small. However, the impact on the supply side is clearly overshadowed by the impact on the demand side. World demand and prices for coal decreased significantly because of the economic slowdown worldwide due to COVID-19. Vale –the biggest coal producer in Mozambique stopped extracting coal due to low world demand in June and announced to keep the production stop in place until the end of the year (CoM 2020a).

Total coal exports declined in Q2 by 28% compared to Q1 (Figure A 4, left) and the international coal price by 26% (Figure A 4, right). The export reduction of 28% would indicate an almost severe impact (-30% to -50%), however, this is again the total effect. The export effect should be lower because not everything can be attributed to COVID-19 some could also be because of other factors such as continued global development in renewable energy and the climate change debate. The export shock for coal was set to be large (-20% to -30%) in Q2.

Figure A 4: Coal export (left) and coal price (right)
For the second half of 2020 it seems that the overall outlook will not improve. The forecast from Trading Economics\textsuperscript{11} predicts the coal price to continue to decrease until the end of the year. However, it should be noted that the decrease in world price is also triggered by an increase in renewable energy and gas power production and therefore not only because of COVID-19.

In conclusion, we assume that the overall situation will not improve but the impact of COVID-19 will reduce slightly. Therefore, the impact is assumed to continue to be large (-20% to -30%) for Q3 but improve to moderate (-10% to -20%) in Q4.

\textit{Aluminium}

The international aluminium price decreased by 11% in Q2 (Figure A 5, right) and at the same time total aluminium exports also declined by 11% in Q2 (Figure A 5, left). Therefore, the reduction in aluminium export seems to be driven mainly by the price decline. Because most Mozambican aluminium is exported, this implies that the sector has been mainly influenced by the export channel. The export shock is therefore classified as moderate (-10% to -20%) in Q2.

Figure A 5: Aluminium export (left) and Aluminium price (right)

The aluminium price seems to recover somewhat after the initial shock in July (Figure A 5, right). However, Trading Economics predicts a downward trend for the rest of the year.\textsuperscript{12} IMF and World Bank also predict that the aluminium price will be lower in 2020 compared to 2019 and the price will only improve slightly in 2021 (Table A 1). Therefore, we continue to assume that the shock will be moderate (-10% to 20%) in Q3 and for Q4 we assume a small improvement to a mild shock (-1% to -10%)

Table A 1: Aluminium price predictions

<table>
<thead>
<tr>
<th>Aluminium</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMF</td>
<td>1,794 US$/Mt</td>
<td>1,583 US$/Mt</td>
<td>1,618 US$/Mt</td>
</tr>
<tr>
<td>World Bank</td>
<td>1,804 US$/Mt</td>
<td>1,616 US$/Mt</td>
<td>1,661 US$/Mt</td>
</tr>
</tbody>
</table>

Source: IMF (2020a) and The World Bank (2020).
Notes: Mt = metric tonne.

\textsuperscript{11} https://tradingeconomics.com/commodity/coal
\textsuperscript{12} https://tradingeconomics.com/commodity/aluminum
Tourism

Activities in the tourism sector have been shocked through all four channels. Supply was hindered through the state of emergency, domestic demand reduced through fear of infections, and investments decisions for new hotels have been delayed or cancelled. However, the biggest shock is assumed to take effect through the export channel. The cancellation of entry visas, border closure and cancellation of international flights made it impossible for any international tourist to enter the country.

Therefore, we assume that the impact of COVID-19 on the tourism export sector to be above 90% in Q2. Furthermore, we assume that this impact will continue in Q3. It was initially planned to start issuing visas again towards the end of Q3 but that has not materialised yet in September. Therefore, it is unlikely that the situation will still improve in Q3. For Q4 we assume a small improvement to a severe shock (-75%) but still far away from Q1 levels.

Natural gas (to South Africa)

Natural gas produced in Mozambique is exported to South Africa via a pipeline. This technology does not require much labour and therefore can operate during the state of emergency without interruptions on the supply side. The situation is different on the South African side of the border. The pandemic affected South Africa severely up to the point that the government implemented a full lockdown. South African demand is what determines the export volume and as can be seen in Figure A 6 (left) natural gas export decreased in Q2 by 5% compared to Q1. South African Revenue Services (SARS) report a similar decrease of 4.1% for the same period (Figure A 6, right). Therefore, we assume a mild impact (-1% to -10%) in Q2.

Figure A 6: Natural gas export from Mozambique to South Africa (left) and Natural gas import from Mozambique to South Africa

Natural gas price is likely to continue to stay below 2019 levels for the rest of 2020. Furthermore, IMF and World Bank predict only a small improvement in 2021 (Table A 2). Natural gas demand from South Africa will still be impacted in Q3 and Q4 because of the situation in South Africa. Because of the low demand from South Africa and the pessimistic price forecasts for natural gas, we assume the shock to continue in Q3 and Q4.
It should be noted that the supply shock for gas discussed above is larger than the export shock in Q2, both shocks are the same in Q3 and in Q4 the export shock is larger. Therefore, for Q2 and Q3 the supply shock will feed into the model and for Q4 the export shock.

Table A 2: Natural gas price predictions

<table>
<thead>
<tr>
<th>Natural gas</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMF (index, 2016=100)</td>
<td>92.7</td>
<td>64.3</td>
<td>82.8</td>
</tr>
<tr>
<td>World Bank</td>
<td>10.6 US$/MMBtu</td>
<td>8.7 US$/MMBtu</td>
<td>8.9 US$/MMBtu</td>
</tr>
</tbody>
</table>

Source: IMF (2020a) and The World Bank (2020).
Note: IMF shows the Commodity Natural Gas Price Index including European, Japanese, and American Natural Gas Price Indices with 2016 as base year(=100). World Bank shows the Japanese natural gas price in US$/MMBtu.

Sugar

FAO’s food outlook of June 2020 estimates that Mozambique’s sugar production and export does not change (FAO 2020). Nevertheless, the international sugar price (FAO’s sugar price index) decreased in Q2 by 18% (Figure A 7). Therefore, the impact in Q2 is assumed to be moderate (-10% to -20%) due to the price effect in Q2.

Figure A 7: Sugar price index

Notes: Index from the International Agreement prices with 2014-2016 as base. Source: FAO (2020)

Trading Economics expects sugar to trade at 12.28 Cents/LB by the end of Q3. Looking forward, TE estimate the sugar price to further decline until the end of the year. The IMF sugar index predicts a similar negative price trend for this and the next year (Table A 3). Therefore, we assume that the moderate impact (-10% to -20%) in Q2 will continue in Q3 and Q4.

Table A 3: Sugar price predictions

<table>
<thead>
<tr>
<th>Sugar</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMF (index 2016=100)</td>
<td>70.72</td>
<td>68.69</td>
<td>67.47</td>
</tr>
</tbody>
</table>

Source: IMF (2020a)
Notes: Commodity Sugar Index includes European, Free market, and U.S. Price Indices

Tobacco

Tobacco export data shows that Q1 and Q2 are not harvesting seasons. Harvesting and most export happens in Q3 and Q4. Comparing Q1 with Q2 therefore does not really show the impact of COVID-19. Comparing the annual change shows, that tobacco export is down by 78% in Q2-
2020 compared to Q2-2019 and 64% down compared to Q2-2018 (Figure A 8). We assumed a mild impact (-1% to -10%) in Q2 for tobacco which will most likely continue in Q3 and Q4.

Figure A 8: Tobacco export

Source: BdM (2020)
Notes: in million US$.

*Cotton*

The cotton price decreased in Q2 by 12% (Figure A 9, left) and at the same time cotton export (Figure A 9, right) decreased by 75% in Q2 compared to Q1 and by 82% compared to Q2-2019. Considering the price and export value decline we assume a large impact (-20% to -30%) for Q2.

Figure A 9: Cotton price (left) and cotton export (right)

Source: BdM (2020).
Notes: Cotton price a index $/kg (left). Cotton export in million US$ (right).

Cotton is expected to trade at 62.09 US$/Lbs by the end of Q3 and decline even further for the rest of the year according to Trading Economics\textsuperscript{13}. IMF and World Bank also predict a low price in 2020 and 2021 (Error! Reference source not found.). Because of the low price forecast, we assume that the large impact in Q2 continues in Q3 and Q4.

\textsuperscript{13} https://tradingeconomics.com/commodity/cotton
Table A 4: Cotton price predictions

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>World Bank (Cotton A index, US$/kg)</td>
<td>1.73</td>
<td>1.62</td>
<td>1.63</td>
</tr>
<tr>
<td>IMF (A index, US cents/pound)</td>
<td>77.88</td>
<td>65.58</td>
<td>66.49</td>
</tr>
</tbody>
</table>

Source: The World Bank (2020) and IMF (2020a)

Labour Remittances

We assume a severe impact (-30% to -50%) on labour remittances in Q2 and that the situation gradually improve in Q3 (-10% to -20%) and Q4 (0%). The main reason to assume a severe reduction in labour remittances is that COVID-19 is spreading worldwide and any Mozambican migrant could be affected abroad as much as in Mozambique or likely even more. For example, many Mozambican are employed in South African mines. The lockdown in South Africa and the closed boarders between the two countries most likely reduced remittances significantly. It is estimated that due to the boarder closer between Mozambique and South Africa families of an estimated 28,000 miners are affected (CoM 2020q). The assumed improvement of the situation in Q3 and Q4 is because the governments in South Africa and Mozambique are implementing procedures for miners to return to their work place (CoM 2020a).
Setting up a multiplier model

A SAM multiplier model is an extended version of a basic IO model. A generic IO model can be written in the following way:

Eq. 1 \[ \mathbf{x} = \mathbf{Zi} + \mathbf{f} \]

Eq. 2 \[ \mathbf{x} = \mathbf{Ax} + \mathbf{f} \]

Eq. 3 \[ \mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{f} \Leftrightarrow \mathbf{x} = \mathbf{L} \mathbf{f} \]

Eq. 4 \[ \Delta \mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\Delta \mathbf{f} \Leftrightarrow \Delta \mathbf{x} = \mathbf{L}\Delta \mathbf{f} \]

In which

\( \mathbf{x} \) = a column vector of industry outputs in an economy (\( \Delta \mathbf{x} \) denotes a change in outputs)

\( \mathbf{Z} \) = a matrix of intermediate sales / demands in an economy

\( \mathbf{f} \) = a column vector of final demand of goods and services supplied by industries in an economy (\( \Delta \mathbf{f} \) denotes a change in final demands)

\( \mathbf{i} \) = a column vector of unit values, so that \( \mathbf{Zi} \) is a column vector of intermediate demands summed over all industries

\( \mathbf{A} \) = a matrix of intermediate demands per unit of industry output for an economy which is derived by dividing \( \mathbf{Z} \) with the transpose of \( \mathbf{x} \), i.e., the column totals

\( \mathbf{L} \) = the Leontief matrix of direct and indirect impacts on each of the activities labelled in the row headings as a result of a one unit increase in final demand for goods and services produced by the activity in the column heading. The column totals of \( \mathbf{L} \) are referred to as the “output multipliers”. Comparison of output multipliers offers an indication which industry is more connected to the domestic economy.

Additional induced effects are captured by expanding the model by making a distinction between activities and commodities, and by including detailed factor income and detailed household income and their expenditure. The generation and distribution of factor income to households depends on what happens to production, which is endogenous to the model. Household expenditure will generate an additional “induced” impact on output \( \mathbf{x} \) in such an expanded version. The column totals (or sum over activities in case of a SAM) of \( \mathbf{L} \) can be calculated for each activity as indicators of backward linkages.
Employment impact adjustment

Results of the base model include impacts on gross sectoral output. Using further linear relationships, the model generates results for value added, household income, imports, tax revenues and employment, amongst others. Impacts on value added (GDP at factor costs) are based on economy-wide industry level value added to gross output ratios. These ratios are assumed to hold at the margin and multiplied with the output impacts. The same applies to imports and taxes.

The typical assumption about the employment impacts is the same, in that the elasticity of employment with respect to output is equal to 1. In other words, if output goes down by 1%, employment will also go down by 1%. This may be considered as a more heroic assumption than the linearity of the base model itself (Bulmer-Thomas 1982, 61). Firms may hold on to labour in downturns in order to avoid costly search and training and when there is an upturn, the demand for labour may not increase. Econometric analysis is required to estimate such elasticities. Broad estimates have been made for Mozambique by Kapsos (2006) and their results have been mapped to the industries (activities) and labour categories (by education).