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The macroeconomic impact of COVID-19 in Mozambique

A social accounting matrix approach

Rosário Betho,[1] Marcia Chelengo,[1] Sam Jones,[2,3] Michael Keller,[3,*] Ibraimo Hassane Mussagy,[4] Dirk van Seventer,[2] and Finn Tarp[2,3]

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Abstract: This study 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 matrix. 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 lost a total of 3.6 per cent growth in 2020 and that total employment was 1.9 per cent 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 trade and accommodation and mining. Furthermore, our simulation implies that the production factors of capital and urban labour are more affected than rural labour. Moreover, the multisector multiplier analysis brings out the high dependence of Mozambique on a small number of export items (including tourism). 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

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[1] National Directorate of Economic Policies and Development, Ministry of Economy and Finance (MEF), Mozambique; [2] UNU-WIDER; [3] Development Economics Research Group (DERG), University of Copenhagen, Denmark; [4] Universidade Católica de Moçambique, Beira, Mozambique; * corresponding author: michael.keller@econ.ku.dk

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Katajanokanlaituri 6 B, 00160 Helsinki, Finland

1 Introduction

The Government of Mozambique is doing its utmost to contain the spread of the COVID-19 pandemic while simultaneously aiming to avoid a very costly (and possibly unrealistic[1]) 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 conceived to attempt to prevent the disease, while the later 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.

While the government has so far managed to avoid the extreme of implementing a complete lockdown, the pandemic combined with the mitigation measures has come with a heavy cost to the economy. To come to better 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 (SAM) 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 Mozambique lost in total 3.6 per cent growth in 2020 due to COVID-19 and that total employment is 1.9 per cent down compared with a scenario without the pandemic.

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 trade and accommodation. Furthermore, the results indicate that the production factor capital and urban labour are more affected than rural labour. Our simulation brings out Mozambique's high dependence on a few export items (including tourism), 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 study proceeds as follows. Section 2 summarizes the development of COVID-19 and the government's response. Section 3 discusses how the pandemic affected the economy in 2020 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's response. The impact of COVID-19 began in Mozambique some time before the virus itself arrived. While Europe, Asia, and America already reported increasing numbers of COVID-19 cases during the first quarter (Q1) of 2020, Mozambique remained disease-free and initially implemented a series of countermeasures in an attempt to prevent the virus from entering. The

[1] See Jones et al. (2020) and Egger et al. (2020).

government also developed a four-stage plan to deploy mitigating measures conditional on how the COVID-19 situation would evolve (Table 1).

Table 1: Alert level in Mozambique

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

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 (Banco de Moçambique, 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 2020, President Filipe Nyusi moved the alert 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 Assembly of the Republic of Mozambique 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

Article no.	Description	Impact
3	Quarantine: Mandatory 14 days quarantine for everyone entering the country	Prevents most forms of business travel
8	Official documents: During the state of emergency the issuing of documents such as passports, identity cards, driver's licence, and company registration is suspended	Prevents most forms of business travel and hinders new companies to start a business
9	Entry visa: The issuing of entry visas to the country is suspended	Prevents any form of international tourism and business
14	Public and private events: All events are cancelled; amusement and similar commercial establishments such as discos, casinos, gyms, museums, and libraries have to close	Reduces directly the production of goods and services needed for events and forbids the work of commercial establishments
17	Public and private institutions: The mandatory measures in Article 17 mainly promote social distancing in public entities and private companies; they include the reduction of on-site workforce to one-third, promote rotation systems and home office, minimum of 1.5 m distance, and additional hygiene measures	Businesses operate on lower capacity; increase of organizational burden to implement the measures
20	Markets: Reduced opening time for markets (6 a.m. to 5 p.m.), and mandatory distance and hygiene rules for sellers	Lower business activity due to reduced opening hours; higher operational costs
26	Transportation: Passenger transport can only use one-third of the vehicle capacity (this measure has been suspended), motorcycle taxis are forbidden to operate, and hygiene and sanitary measures must be implemented	Temporarily passenger transport capacity was reduced by over two-thirds; additional costs through hygiene measures

Source: authors' compilation based on Presidential Decree 12/2020 issued by the Government of Mozambique.

Further articles of 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 3 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 powers to implement freedom-restrictive measures, and it was stated by President Nyusi that further measures are conditional on the development of the pandemic.

Since the first declaration of the state of emergency, the status was prolonged three times, which according to the Mozambican Constitution was the maximum of 120 days up until the end of July 2020. 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, the International Monetary Fund (IMF) and the World Bank injected 21 billion meticais into the state budget (CoM 2020l). The government extended the exemption of cooking oil and hygiene products from the 17 per cent value-added tax 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 the National Institute of Social Security agreed to provide funds to small and medium enterprises through the National Investment Bank of Mozambique (Banco Nacional de Investimento) 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 per cent as of June 2020 (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 was conceived with the aim to establish a 'new normal' in which the economy can open up again while the spread of the disease is contained at a manageable level.

This state of emergency defined three phases to gradually lift the restrictive mitigation measures.

1. Phase 1 started on 18 August 2020 and was 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.
2. Phase 2 started on 1 September 2020 and involved medium-risk activities, including the resumption of full operation of technical–vocational education, cinemas, theatres, and casinos.
3. Phase 3 started on 1 October 2020 and was concerned with high-risk activities, including the resumption of 12th grade classes.

On 7 September 2020, 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 did not change any of the 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).

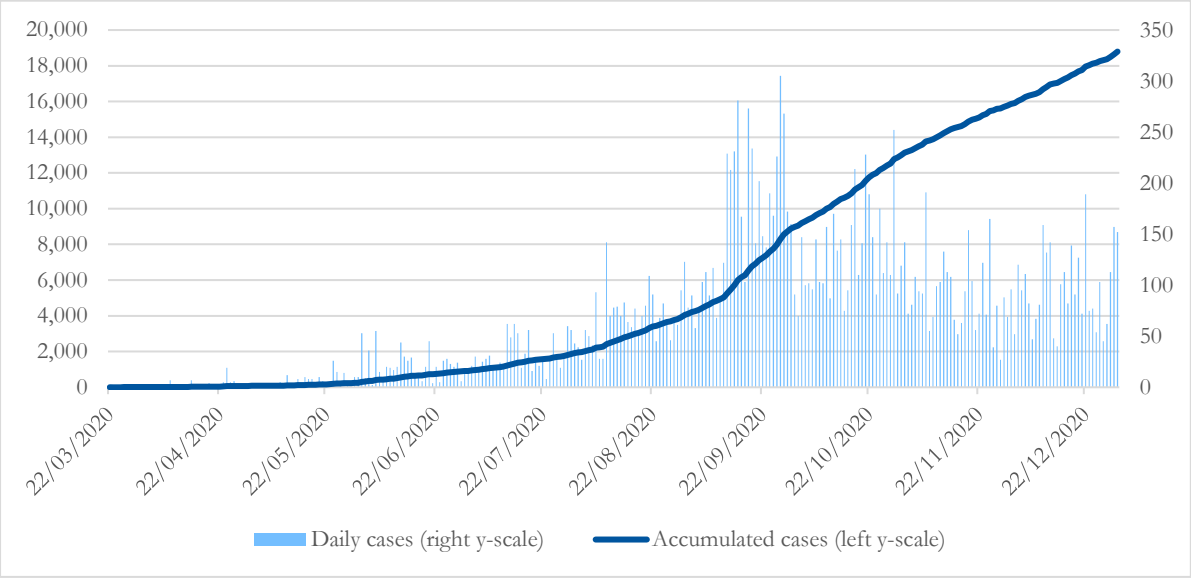
The gradual opening of the economy towards the end of 2020 seems to have happened prematurely. Especially, after the festive season of Christmas and New Year the numbers of COVID-19 cases started to increase again. This led President Nyusi to re-implement previously softened policy measures on 15 January 2021 (CoM 2021a). As it turned out, the re-established measures did not suffice to bring down the numbers of COVID-19 cases and the President announced new and stronger measures starting on 5 February 2021, including a curfew for the Greater Maputo area (CoM 2021b).

As of 31 December 2020, Mozambique had tested 271,947 people for COVID-19, and 18,642 (7 per cent) were tested positive. Among the positive cases, 18,326 were caused by local transmission and the remaining 316 cases were imported from abroad. Mozambique had registered 166 deaths due to COVID-19. Among positive cases, 16,663 cases have recovered (Ministério da Saúde 2020c). Figure 1 shows the development of COVID-19 since March 2020.

Considering the sizeable impact that COVID-19 has already had on the lives of people in Mozambique it is troubling to study existing projections and developments. For example, different models have predicted that Mozambique has not yet reached its peak. Epidemiological models from Imperial College, Neher Lab, London School of Hygiene and Tropical Medicine, and the World Health Organization suggested the peak at some point between November 2020 and January 2021[2] (Tierney and Brunt 2020), but cases have continued to rise.

[2] 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 the World Health Organization, see Cabore et al. (2020).

Figure 1: COVID-19 in Mozambique



Source: Ministério da Saúde (2020a).

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 officially reported cases. 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 with the officially detected 444 cases in the province of Cabo Delgado. A similar survey implies that 5 per cent of the population of Nampula has been infected with COVID-19. Combining the results of the two surveys 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 to be barriers in reaching the whole population (CoM 2020r, 2020p). The situation is exacerbated by the ongoing violent conflicts in the northern and central 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, the COVID-19 pandemic 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 in implementing the restriction measures with force seem to accumulate (Kyed 2020). The government is trying 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 has in many cases become a choice between risking contracting COVID-19, penalization by the police, or starvation (Kyed 2020).

3 The shocks

In this section, we discuss how the COVID-19 pandemic and the mitigation measures taken in 2020 affected (i.e. 'shocked') broad sectors of the Mozambican economy. We outline our underlying assumptions that feed into the model simulation that helps us assess the economic impact and differentiate between four channels of impact.

1. 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.
2. 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.
3. The third channel is concerned with the increased uncertainty created by the pandemic, which put investment decisions on hold.
4. Finally, the fourth channel covers the rest of the world. COVID-19 affected all 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 explained in methodology Section 4, only the largest shock (supply, demand, investment, or export) enters the model as a direct impact for each sector. This procedure is used to avoid double counting (see Section 4). The model then computes the indirect effects trickling down to other sectors. Therefore, in this section and in Appendix A we discuss 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 (Q2) of 2020. The state of emergency took effect on 1 April 2020 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 National Statistics Institute (Instituto Nacional de Estatística, INE), export data from BdM, and commodity price data from the World Bank. We stress that the 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 2020.

In other words, the data for 2020 cannot be used in any simple way to measure the impact of COVID-19 and the government's mediation measures. Yet, they can help guide our modelling assumptions and can be used as feedback on how well the model is calibrated. We based our assumptions regarding each quarter in 2020 on the best estimates available to us. Table 3 shows a summary of the assumptions made for each sector for each quarter of 2020.

Table 3: Assumptions

No.	Quarters 2–4	Impact due to emergency/distancing rules compared with pre-crisis (%)		
		Q2	Q3	Q4
	Industry-level supply shocks			
1	Other mining (graphite and rubies)	–20 to –30	–30 to –40	–20 to –30
2	Other manufacturing products (clothing, machines and equipment, etc.)	–1 to –10	0	0
3	Transport	–1 to –10	0	–1 to –10
	Macro-level demand shocks			
	Household consumption	–1 to –10	–1 to –10	0
4	Agriculture[a]	–1 to –10	–1 to –10	0
5	Processed foods	–1 to –10	–1 to –10	0
6	Utilities (electricity and water)	–1 to –10	–1 to –10	0
7	Trade	–1 to –10	–1 to –10	0
8	Telecommunication and information technology	–1 to –10	–1 to –10	0
9	Financial and insurance services	–1 to –10	–1 to –10	0

10	Business and real estate services	–1 to –10	–1 to –10	0
11	Public administration, health and education	–1 to –10	–1 to –10	0
	Investment			
12	Construction	–1 to –10	–1 to –10	–1 to –10
13	Machinery and transport equipment	–10 to –20	–10 to –20	–10 to –20
	Export			
14	Coal	–20 to –30	–20 to –30	–10 to –20
15	Aluminium	–10 to –20	–1 to –10	–1 to –10
16	Tourism	–90	–90	–75
17	Natural gas (to South Africa)	–1 to –10	–10 to –20	–1 to –10
18	Sugar	–10 to –20	–1 to –10	0
19	Tobacco	–1 to –10	–20 to –30	–10 to –20
20	Cotton	–30 to –50	–20 to –30	–10 to –20
21	Labour remittances	–30 to –50	–20 to –30	–10 to –20

Note: [a]excluding sugar, tobacco, and cotton, which are included in the export channel.

Source: authors' assumptions based on best available evidence.

3.1 Industry-level supply shocks

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

The industry-level supply shock dominated three economic sectors in particular: other mining (graphite and rubies), other manufactured products (clothing, machines and equipment), and transportation and storage. For the assumed size of the impact in each quarter, see Table 3; for an in-depth discussion and underlying data for the assumption for each of the three sectors, see Appendix A.

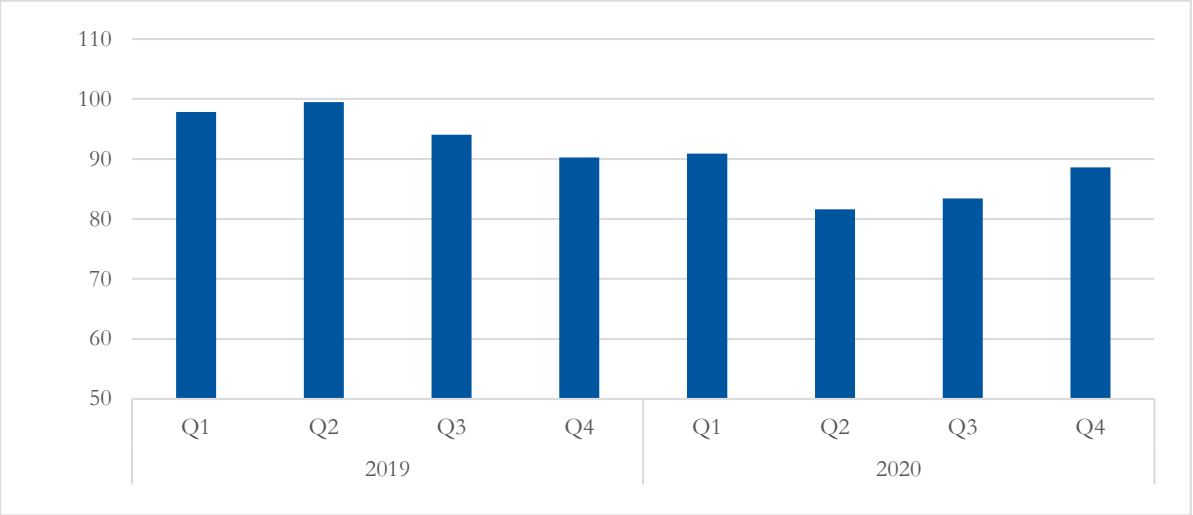
3.2 Macro-level demand shocks

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 to be 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 Confiança e de Clima Económico* (ICCE) reports the employment index shown in Figure 2 (INE 2021b). Employment was down by 10 and 8 per cent in Q2 and Q3, respectively, compared with Q1. Based on the ICCE, we assume a mild impact (−1 to −10 per cent) of COVID-19 on household consumption in Q2 and Q3. Considering the ongoing state of emergency and the slow opening of the economy towards the end of Q3, we assume an improvement to zero change in Q4 compared with Q1. This assumption is also in line with the ICCE index which is only 2.5 per cent lower in Q4 than in Q1.

Figure 2: ICCE employment



Note: the *Indice de Confiança e de Clima Económico* (ICCE) is a survey-based index measuring the economic activities by sector; base year (=100) is 2014.

Source: INE (2021b).

It should be noted that this assumed mild impact (−1 to −10 per cent) 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 already discussed. This is the case for the following sectors: agriculture,[3] 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 used by households 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.

3.3 Investment

The pandemic has created uncertainty. The size of the pandemic is unprecedented for many people and countries 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 and transport equipment.

For the size of the assumed impact by sector in each quarter, see Table 3; for an in-depth discussion and underlying data for the assumption, see Appendix A.

[3] Except for the agricultural sub-sectors sugar, tobacco, and raw cotton, which have been affected by the export channel.

3.4 Export

The pandemic spread worldwide and therefore affected 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 that 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 predicted for 2020 a growth rate of −4.9 per cent for the world economy before recovering in 2021 to 5.4 per cent growth (IMF 2020b).

To calibrate our model, we used export data for 2020 from BdM (see BdM 2021). As with the national account data used earlier it should be noted that the data show the impact of all four COVID-19 channels without distinguishing between them. As guidance for our assumptions for 2020, we combine the export data with commodity price data from the World Bank. World demand for Mozambican products is determined by the international price of the commodity because Mozambique is a price taker in all markets. This makes price data a viable option in our context. Finally, we discuss only activities/industries where the export channel dominates over the other three channels and feeds 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; for an in-depth discussion and underlying data for the assumptions, see Appendix A.

4 Methodology

The previous section discussed how broad sectors of the Mozambican economy were affected directly by COVID-19 and the mitigation measures implemented by the government. However, knock-on effects of these direct impacts spread through the entire economy, upstream as well as downstream. In this study, we focus on the former. If one sector was affected negatively, suppliers of intermediate inputs to that sector faced lower demand while users of the output of the sector faced supply disruptions. The latter may not be relevant since final demand could be constrained.

The method used to capture the economy-wide effects 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 are based on detailed industry-level observations that affect 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 is meant to provide a disciplined framework for engaging in coherent policy debates.

4.1 SAM 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 study, we use multisector multiplier

analysis in the form of a SAM approach. This approach focuses on inter-industry linkages as measured by input–output tables and expands the input–output approach to incorporate economic actors other than industries, such as the government and households. For a mathematical explanation of the SAM model, see Appendix B.

A SAM is an accounting framework: a matrix or table that maps out the income and expenditure accounts of industries and single accounts 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. We use a SAM for Mozambique that describes 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 offers 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) that 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 homogeneous 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 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:

1. Activities use intermediate inputs in fixed proportions to their total costs (or output). In other words, production technology is fixed and linear.
2. 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 term. Computable general equilibrium models allow for adjustments in both price and quantity and they will be useful for considering shocks with a longer-term horizon.

4.2 Setting up scenarios

Lockdown measures typically impact the economy in two broad ways:

1. Households are prevented from spending their income since most are not allowed to leave their homes. Unless employed in an essential sector, people cannot go to work, so their income is negatively affected.
2. 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 (1) makes intuitive sense, point (2) 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.

Therefore, 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.

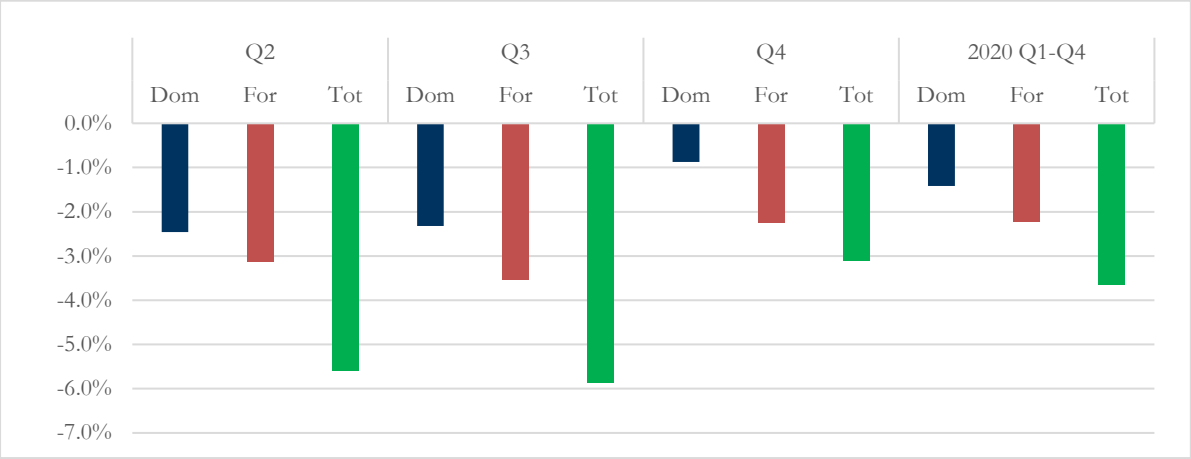
In doing so and unlike typical macro top-down recessions, what is developed here derives from shocks in demand and supply at the sectoral level: the lockdown scenario. However, this 'bottom-up' recession, leads to 'top-down' effects on macro aggregates that may or may not exacerbate the effects of the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

5 Results

When examining the results of the assumptions described in previous sections (and in Appendix A), 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 and foreign shocks are those associated with exports. Given the linear nature of the SAM 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 the gross domestic product (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 per cent while the foreign impact was −3.1 per cent; so, the total impact in Q2 was −5.6 per cent, based on the combined assumptions. In Q3 the model suggests that domestic impact was slightly smaller and the foreign impact stronger, which result in a combined negative impact on GDP in Q3 of −5.9 per cent. The Q4 assumptions result in a small domestic impact but the foreign drivers remain a bit more persistent; so, the total impact is calculated to be −3.1 per cent in Q4.

Figure 3: Total impact on GDP



Note: Dom, domestic; For, foreign; Tot, total.

Source: authors' calculations based on the multiplier model.

The interpretation of these results is as follows. In a world free of COVID-19, the Mozambican economy would have grown by 5.6 per cent more than it actually did in Q2. Put differently, because of COVID-19 and the state of emergency, the economy lost 5.6 per cent of growth in Q2. According to the national accounts data, Mozambique's economy measured in terms of value added[4] did grow by 5.8 per cent in Q2 compared with Q1 (INE 2020). Our result for Q2, therefore, implies that growth without COVID-19 would have been 5.8%+5.6%=11.4% in Q2. The 11.4 per cent 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 per cent in 2019, 2018, and 2017, respectively.

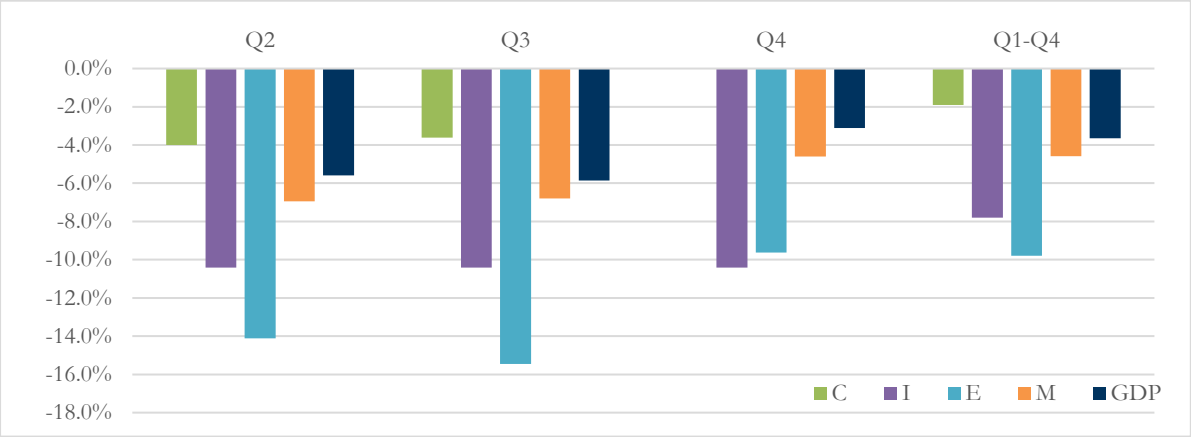
Dividing the sum of the Q2–Q4 impacts by four (assuming zero impact in Q1), the average over the calendar year can be calculated to be just −3.6 per cent in total; −1.4 per cent can be attributed to domestic shock and −2.2 per cent to foreign shock.

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) whereas imports and GDP are determined by the model (endogenous).

The strongest component in Q2 and Q3 is export, confirming that the impact is more foreign than domestic. In Q4, according to the scenario consumption is no longer negatively affected and export is also less negative. The main driver of this quarter was the negative impulses from the investment component. 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.

[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).

Figure 4: Total impact on expenditure GDP components

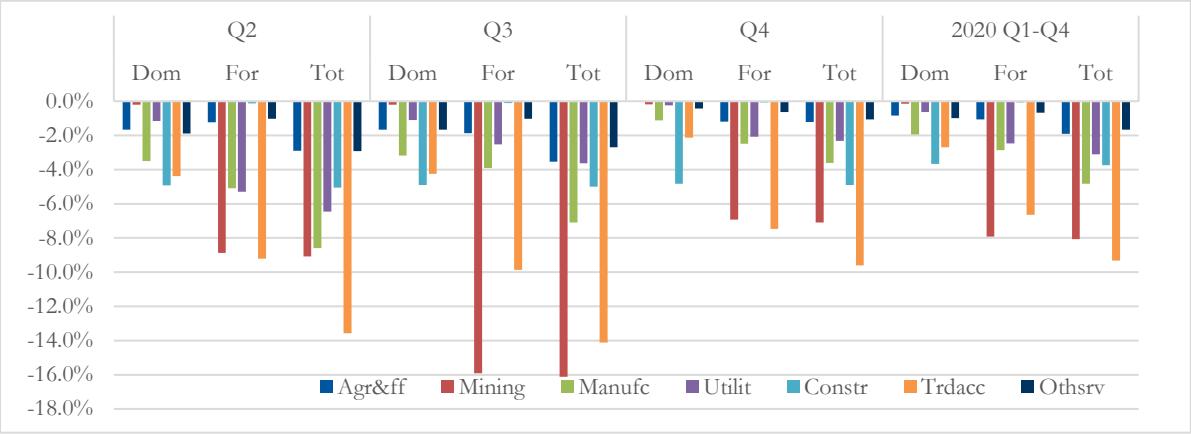


Note: C, private consumption expenditure; I, gross domestic fixed investment; E, exports; M, imports; GDP, gross domestic product at market prices.

Source: authors' calculations based on the multiplier model.

Which industries were specifically affected by the downturn is examined in Figure 5.[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 affected through the foreign channel. Through the domestic channel, construction, trade and accommodation, and manufacturing are the main victims, although manufacturing also suffers from the foreign driver of metal products (aluminium) activity (as can be seen in Table 4).

Figure 5: Total impact on production GDP by industry



Note: Dom, domestic; For, foreign; Tot, total; Agr&ff, agriculture, forestry, and fishing; Mining, mining and quarrying; Manufc, manufacturing; Utilit, electricity, gas, and water; Constr, construction; Trdacc, trade and accommodation; Othsrv, other services.

Source: authors' calculations based on the multiplier model.

[5] For a definition of which activities are included in each industry/sector, see Appendix C.

Table 4: Detailed direct and indirect impacts on GDP and employment as percentage of the total impact on GDP and employment for 2020 (calendar year)

No.	GDP	Impact (%)	No.	Employment	Impact (%)
1	Accommodation and food service	15.9	1	Wholesale and retail trade	35.4
2	Wholesale and retail trade	14.2	2	Accommodation and food service	18.8
3	Transportation and storage	10.1	3	Other services	7.5
4	Natural gas	8.6	4	Tobacco	4.2
5	Coal and lignite	5.6	5	Maize	3.4
6	Metals and metal products	3.7	6	Transportation and storage	3.3
7	Information and communication	3.6	7	Sugar cane	3.3
8	Electricity, gas, and steam	3.3	8	Information and communication	2.5
9	Other foods	3.0	9	Vegetables	2.0
10	Construction	2.8	10	Other mining	1.8
11	Education	2.3	11	Other foods	1.6
12	Tobacco	2.1	12	Education	1.5
13	Cereal and vegetable processing	2.0	13	Other crops	1.5
14	Sugar cane	1.9	14	Construction	1.4
15	Non-metal minerals	1.7	15	Cassava	1.2
16	Maize	1.7	16	Poultry	1.2
17	Other mining	1.5	17	Other livestock	1.0
18	Business services	1.3	18	Business services	1.0
19	Machinery and equipment	1.2	19	Other oilseeds	0.8
20	Finance and insurance	1.2	20	Groundnuts	0.8
21	Poultry	1.1	21	Rice	0.6
22	Fishing	1.0	22	Electricity, gas, and steam	0.6
23	Other livestock	0.9	23	Finance and insurance	0.6
24	Vegetables	0.9	24	Forestry	0.6
25	Other crops	0.7	25	Pulses	0.4

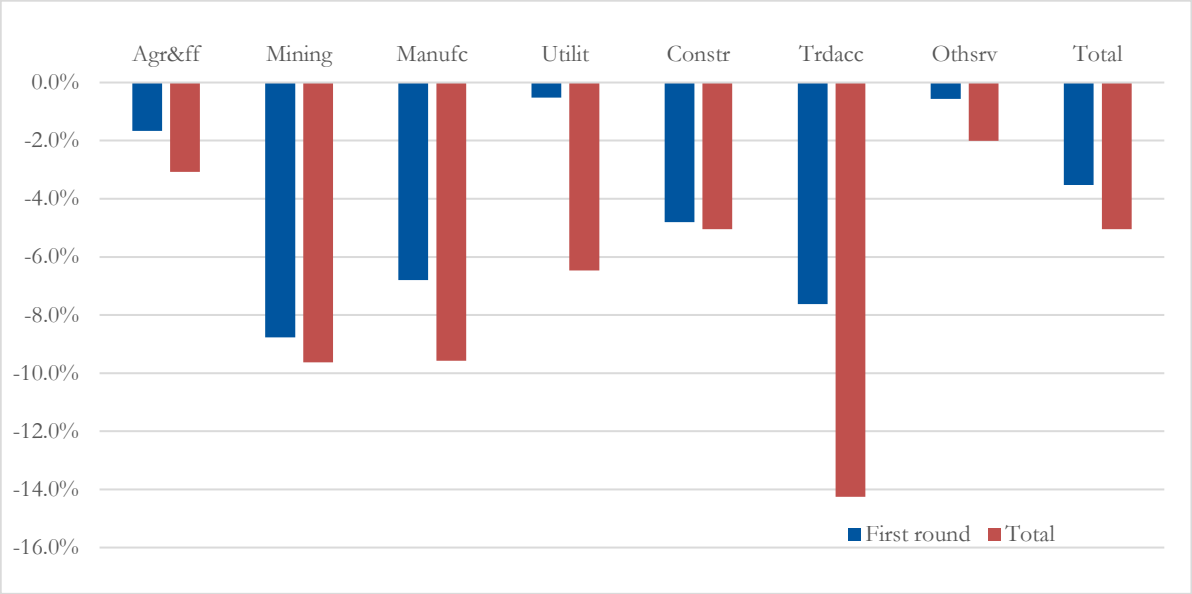
Note: total impact is due to the combined domestic and foreign shocks, averaged over the four quarters (Q1–Q4) with zero impact on Q1.

Source: authors' calculations based on the multiplier model.

The negative impact on mining is strongest in Q3 and abated somewhat as the calendar year closed out. Trade and accommodation remained persistently negative and is still the most severely affected sector during Q4 and on average for the whole year. As this is played out in the model simulation, agriculture is one of the least affected together with other services (transportation, finance, business, health, education, public administration, etc.). The most negative total impact for the year is shared by trade and accommodation and mining, followed by manufacturing, construction, 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 results are based on the sum of direct and indirect effects. But how important were each of these two effects in relation to the total impact? Figure 6 offers an indication for Q2. As explained in methodology Section 4, the exogenous drivers of the shocks are expressed in terms of commodities. We determine first-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 first-round impacts are pretty much as close as we can get to the direct impact on activities.

Figure 6: Direct (first round) and indirect impacts on production GDP by industry for Q2



Note: Agr&ff, agriculture, forestry, and fishing; Mining, mining and quarrying; Manufc, manufacturing; Utilit, electricity, gas, and water; Constr, construction; Trdacc, trade and accommodation; Othsrv, other services.

Source: authors' calculations based on the multiplier model.

In the first group of bars in Figure 6, it can be seen that agriculture is affected 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 per cent direct decline for agricultural production. Therefore, while harvesting and other agricultural activities are assumed to have continued 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 per cent to the total decline in agriculture of 3.1 per cent. Indirect impacts clearly matter as they account for almost 50 per cent 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 affected directly. Indeed, the total impact on utilities is estimated at −6.5 per cent while the first round only accounts for −0.5 per cent in this modelled economy.

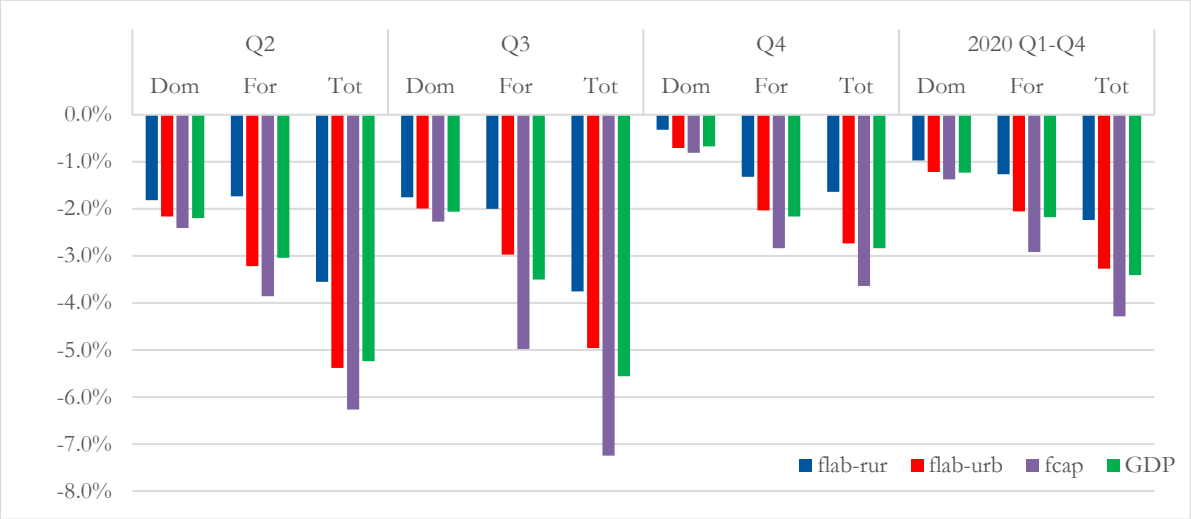
Clearly, the opposite is the case for mining and construction. The first-round impact pretty much explains the total impact. To these activities, indirect effects matter little. This is understandable and related to the nature of their activity. However, manufacturing also seems to suffer from low indirect 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.

The trade and accommodation story is somewhat different in that the latter drives the first-round direct impact while the trade sector suffers mainly indirectly from lower trading margins. Note that 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 do not 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-thirds of the negative rate of change in GDP (at basic prices) while only one-third can be attributed to 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 among 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 was more negatively affected than rural labour while capital was more negatively affected than labour.

Figure 7: Impact on income GDP by production factor with labour by rural/urban



Note: Dom, domestic; For, foreign; Tot, total; flab-rur, factor labour-rural; flab-urb, factor labour-urban; fcap, factor capital.

Source: authors' calculations based on the multiplier model.

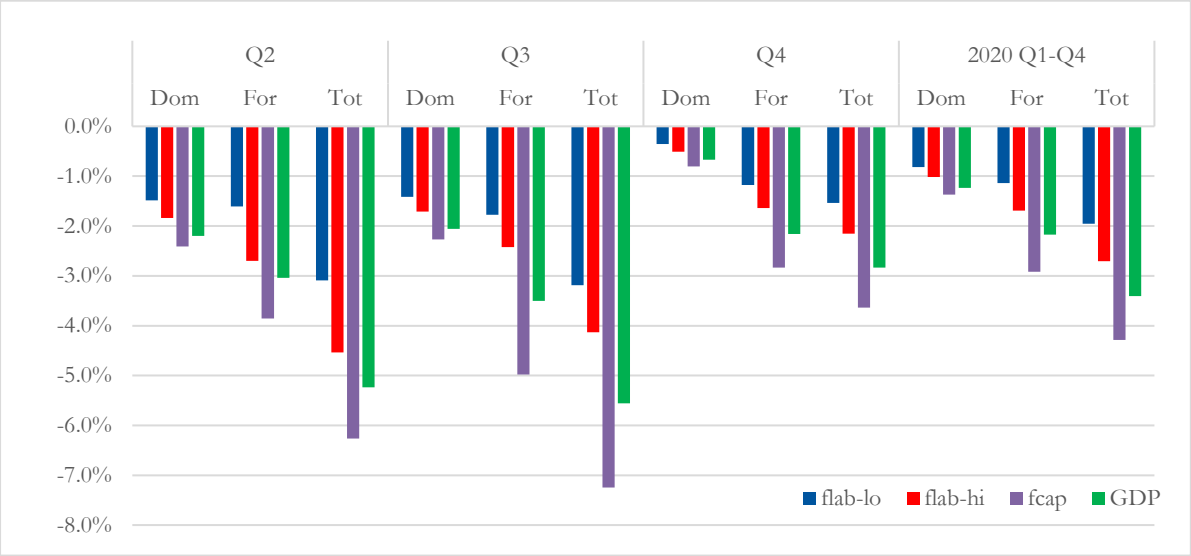
The reason for capital being affected more than labour has to do with the functional distribution of income within the industries that are mostly affected. In Figure 5, it was shown that apart from trade and accommodation, mining, utilities and manufacturing are the most negatively affected sectors by the shocks. These sectors are typically more capital-intensive, thereby biasing total factor payments towards 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 affected much more negatively from foreign shock than from domestic shock.

The patterns of results for labour earnings according to the rural and urban distinction in Figure 7 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.

Figure 8: Impact on income GDP by production factor with labour by educational attainment



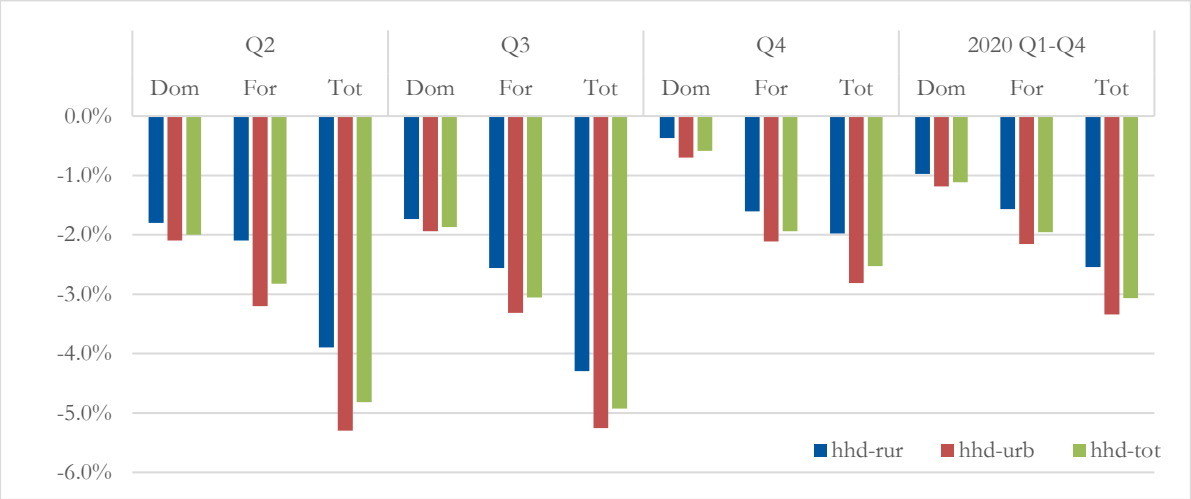
Note: Dom, domestic; For, foreign; Tot, total; flab-lo, labour with primary and unfinished secondary education as highest education attained; flab-hi, labour with secondary and tertiary education as highest education attained; fcap, factor capital.

Source: authors' calculations based on the multiplier model.

It can also be seen from Figures 7 and 8 that capital and urban as well as highly educated labour suffered relatively more from foreign shock than from 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 in Figure 8 have implications for the impact on income distribution and possibly follows the same patterns. Household income is distinguished by urban and rural in Figure 9 and the income distinction of the bottom 80 per cent (low-income households) and top 20 per cent (high-income households) is shown in Figure 10.

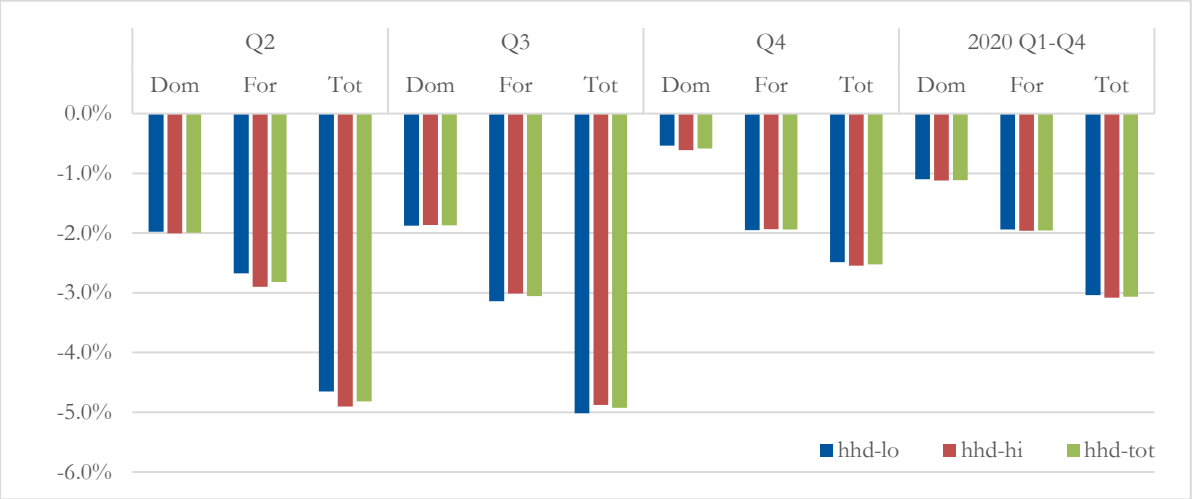
Figure 9: Impact on household income by urban/rural population



Note: Dom, domestic; For, foreign; Tot, total; hhd-rur, rural household; hhd-urb, urban households; hhd-tot, total households.

Source: authors' calculations based on the multiplier model.

Figure 10: Impact on household income by low- and high-income groups



Note: Dom, domestic; For, foreign; Tot, total; hhd-lo, household income quintiles 1-4; hhd-hi, household income quintile 5; hhd-tot, household income total.

Source: authors' calculations based on the multiplier model.

Indeed, it appears that the pattern of the functional distribution results shown in Figure 8 repeat when considering the urban/rural distinction, with rural households suffering relatively less throughout all periods.

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 disproportionally harder, as shown in Figure 9 where urban households suffered more.

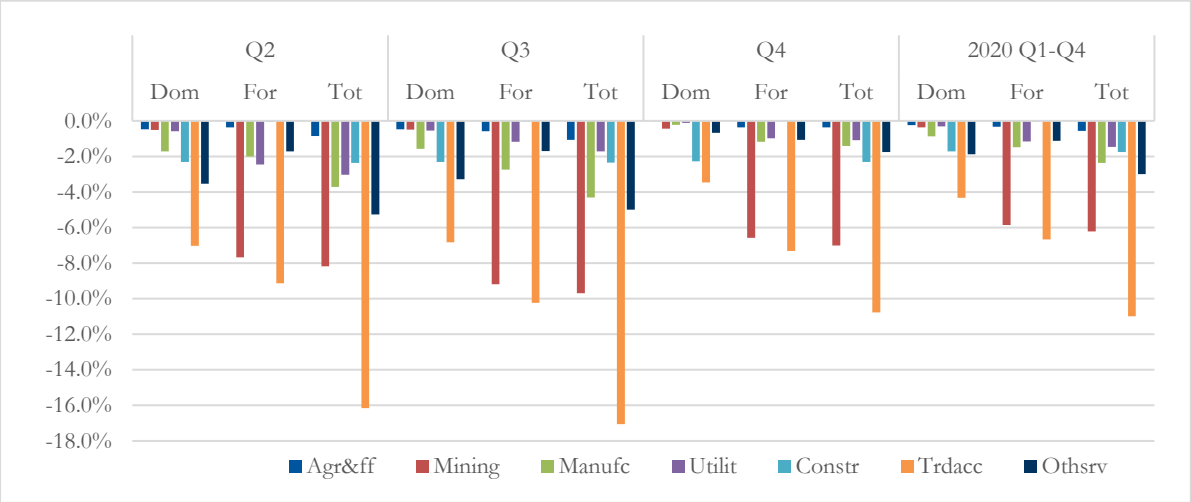
Of particular concern to policy makers is the impact of the pandemic on Mozambique's employment situation. Figure 11 shows the industry-level employment effects. We estimated the employment impact by using employment–output elasticities that consider long-term relationships between GDP and employment. A 1 per cent drop in GDP equates more or less to a 0.5 per cent decline in employment.[6]

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. Further, trade and accommodation are strongly affected through both the domestic and the foreign channel, while most other sectors only suffer through one channel.

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.

[6] The exact employment–output elasticities are 0.32 for the agricultural sector, 0.47 for the manufacturing sector (including the extractive industry) and 1.54 for the service sector. The values are retrieved from Kapsos (2005).

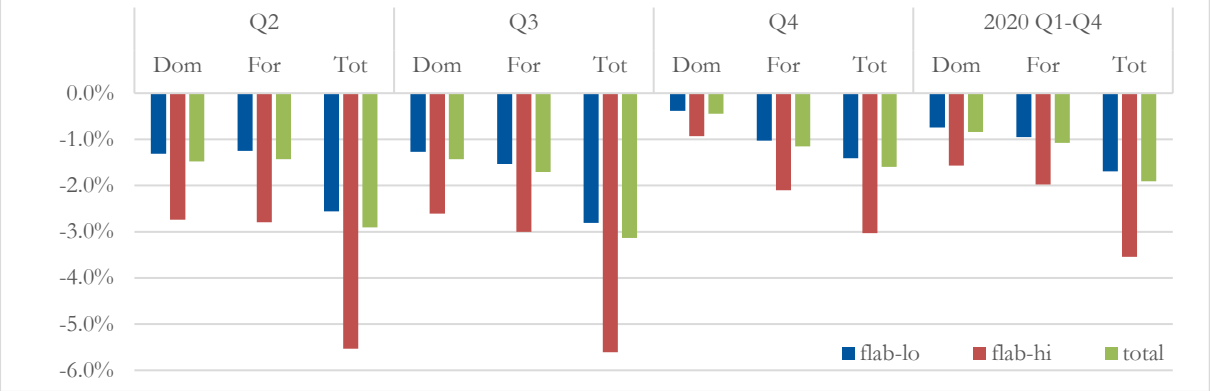
Figure 11: Total impact on employment by broad industry



Note: Dom, domestic; For, foreign; Tot, total; Agr&ff, agriculture, forestry, and fishing; Mining, mining and quarrying; Manufc, manufacturing; Utilit, electricity, gas, and water; Constr, construction; Trdacc, trade and accommodation; Othsrv, other services.

Source: authors' calculations based on the multiplier model.

Figure 12: Impact on employment by educational attainment



Note: Dom, domestic; For, foreign; Tot, total; 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.

Source: authors' calculations based on the multiplier model.

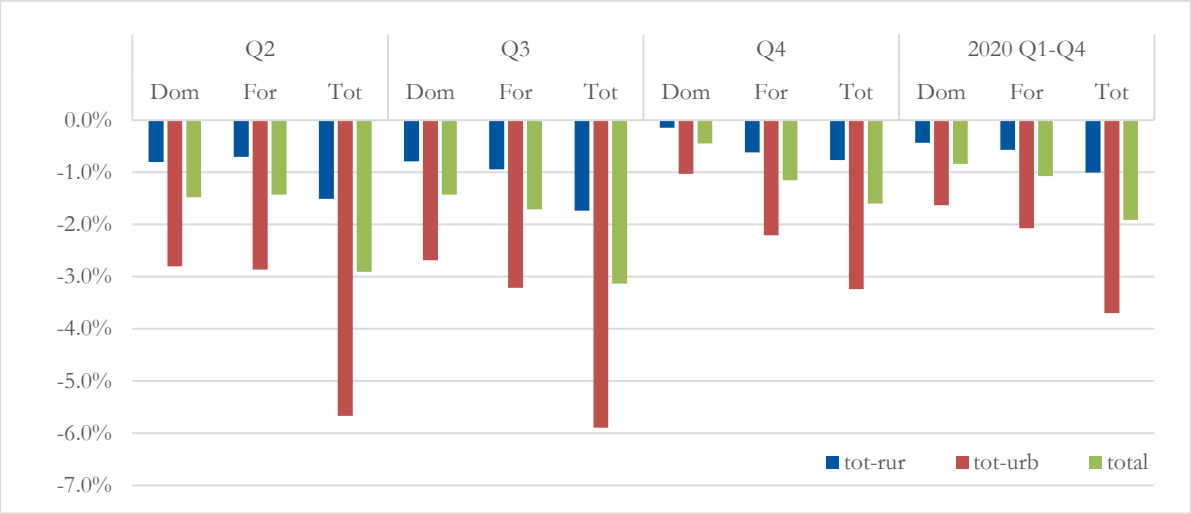
Overall, according to the model employment was 1.9 per cent down on average over the full calendar year compared with a COVID-free world.

Figure 13 features the urban/rural distinction and displays similar patterns to those in Figure 12. Over the full year, employment in urban areas reached levels that in this scenario are almost 4 per cent down compared with a COVID-free world. Again, in rural areas this impact is more muted.

Detailed results for the 25 most affected 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 do not 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 is not 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 sub-sectors are affected badly in terms of GDP and a number of agricultural and other services sub-sectors are so in terms of employment.

Figure 13: Impact on employment by urban/rural population



Note: Dom, domestic; For, foreign; Tot, total; tot-rur, total rural; tot-urb, total urban.

Source: authors' calculations based on the multiplier model.

6 Conclusion and policy recommendations

This study offers an analysis of the macroeconomic impact of COVID-19 on the performance of the Mozambican economy in 2020. We used a SAM approach, which allows us to estimate the total impact of the COVID-19 pandemic and distinguish between foreign and domestic shares of the impact on production and employment for a range of economic sectors.

The modelling results show that economic growth in 2020 was 3.6 per cent lower because of COVID-19 than it would otherwise have been. Accordingly, and given the overall contraction of the Mozambican economy by −1.3 per cent, reported by INE (2021a), growth would have been 2.3 per cent in 2020 without the COVID-19 shock. Furthermore, the results show that employment was 1.9 per cent lower due to COVID-19 in 2020 and that the two sectors hit the hardest by the pandemic were the mining and trade and accommodation sectors.

In this study, we have not analysed in detail the impact of COVID-19 for the estimates of poverty in Mozambique.[7] However, adopting the growth–poverty elasticity in the period 2008/09–2014/15 of 0.68 estimated by the World Bank (see Baez et al. 2018), a 3.6 per cent loss in GDP is associated with an increase in monetary poverty of 2.45 percentage points. A different way of putting this is that the equivalent of more than half the progress in terms of poverty reduction realized between 2008/09 and 2014/15 is likely to have been wiped out in 2020 due to the COVID-19 pandemic. This is particularly serious because Egger 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

[7] This is the topic of a separate study forthcoming shortly (Barletta et al. 2021).

that of 2015. The implication is that Mozambique may have ended 2020 with a national poverty rate markedly higher than that of 2015.

In conclusion, we note, first, that most of the COVID-19 impact on the economy came in 2020 through the export channel. 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 was stronger for the urban population and for capital income. This is related to the first point, especially with the mining sector, which is a capital-intensive industry, identified as an impact driver. The agricultural sector, on the other hand, seems to have been affected less negatively, which contributes to the result that the impact in rural areas was 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 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 healthcare facilities. Many vulnerable households in rural areas, even if they are above the poverty line, are right now very close to being pushed below it due to the dynamics of the COVID-19 pandemic. Accordingly, it should be kept in mind that even small absolute losses for poor households may matter a lot for their welfare.

The results in this study reflect the implications of a consistent simulation of the impact of COVID-19 on the Mozambican economy in 2020. We stress that our results are conditional on the assumptions made. Any assumption may in hindsight prove imprecise. In a forward-looking perspective, it is critical to keep in mind that the future impact of COVID-19 will depend on how the pandemic develops. At the same time, the analytical platform developed in this study can easily be updated and adjusted as and when new information becomes available.

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Appendix A: The shocks by sector

In this appendix, we discuss the assumption (shock) for each economic sector that fed into the model. For each sector we determine the size of the shock through each of the four identified channels (supply, demand, investment, and export) for each quarter in 2020. Note that only the biggest shock enters the model as first-round shock and the remaining trickle-down effects are calculated by the model. For this reason we focus and arrange the sectors keeping in mind the dominant channel. For a more detailed discussion about the channels and methodology, see Section 4.

A1.1 Supply-side channel

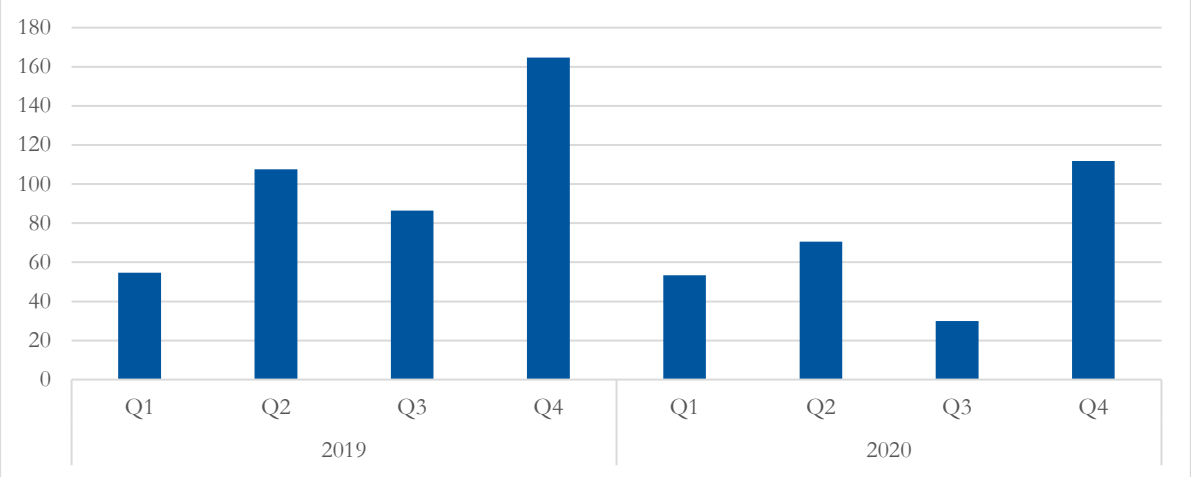
Other mining

In Mozambique, the main mining activities other than coal and gas include ruby mining (Montepuez Ruby Mine, MRM), graphite (Syrah Resources), and heavy sands.

Ruby mine operators have been affected on the supply side by COVID-19 mainly 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 per cent of the revenues and influenced business significantly in 2020 (CoM 2020j). The mining companies are also directly affected on the supply side by COVID-19. MRM and Syrah Resources reported cases of COVID-19 in their mines and production had to be shut down (CoM 2020s).

Export data for 2020 show an initial large impact in Q2 followed by an even stronger negative impact in Q3 and a backdrop into a large impact in Q4 again (see Figure A1). Other mining export contracted by 35, 65 and 32 per cent in Q2, Q3, and Q4 compared with the values in 2019 (BdM 2021). Based on the export data we assumed that due to the direct impact of COVID-19 (cases) and mitigation measures (suspension of visas) the other mining sector was affected with a large impact (−20 to −30 per cent) in Q2, followed by a severe impact (−30 to −40 per cent) in Q3 and a drop to a large impact (−20 to −30 per cent) in Q4.

Figure A1: Other mining export (in million US dollars)



Note: other mining includes rubies, sapphires, emeralds, and heavy sand.

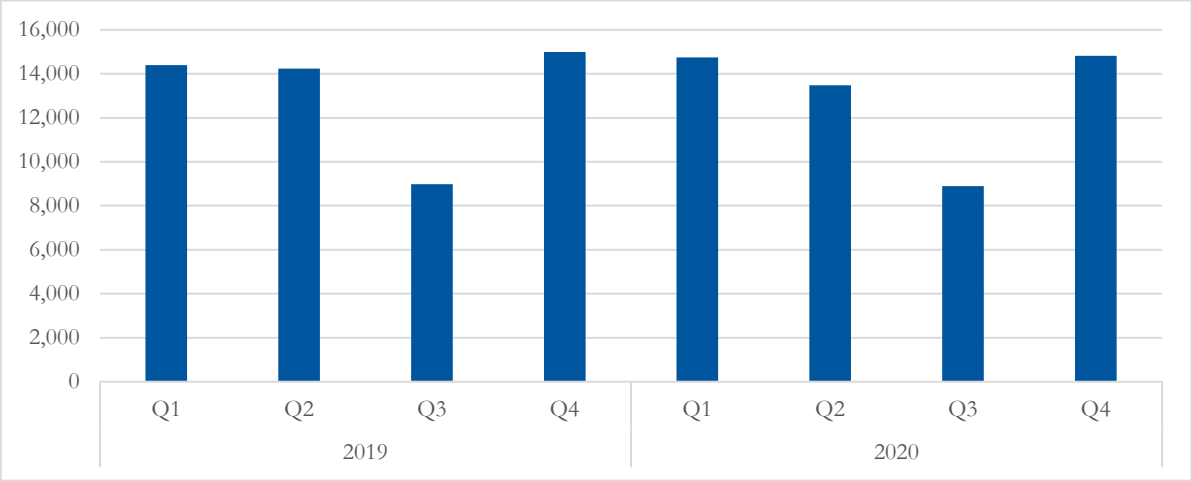
Source: BdM (2021).

Other manufactured products (clothing, machines, and equipment)

The supply side of the manufacturing sector was 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, 40, and 0 per cent in Q2, Q3, and Q4, respectively, compared with Q1. However, in a year-on-year comparison the industry sector contracted by only 5.3, 0.9, and 1.1 per cent in Q2, Q3, and Q4, respectively, in 2020 (Figure A2). It should be noted that the data show the overall industry values and not only values for other manufacturing production. Furthermore, the data show the overall effect and not the direct impact of COVID-19 for industry supply.

We assumed the COVID-19 impact to be in proportion to the whole industry and that supply was affected mildly (−1 to −10 per cent) in Q2 and zero for Q3 and Q4.

Figure A2: Quarterly industry production



Note: national account data, values in constant 2014 10^6MT.

Source: INE (2021a).

Transportation and storage

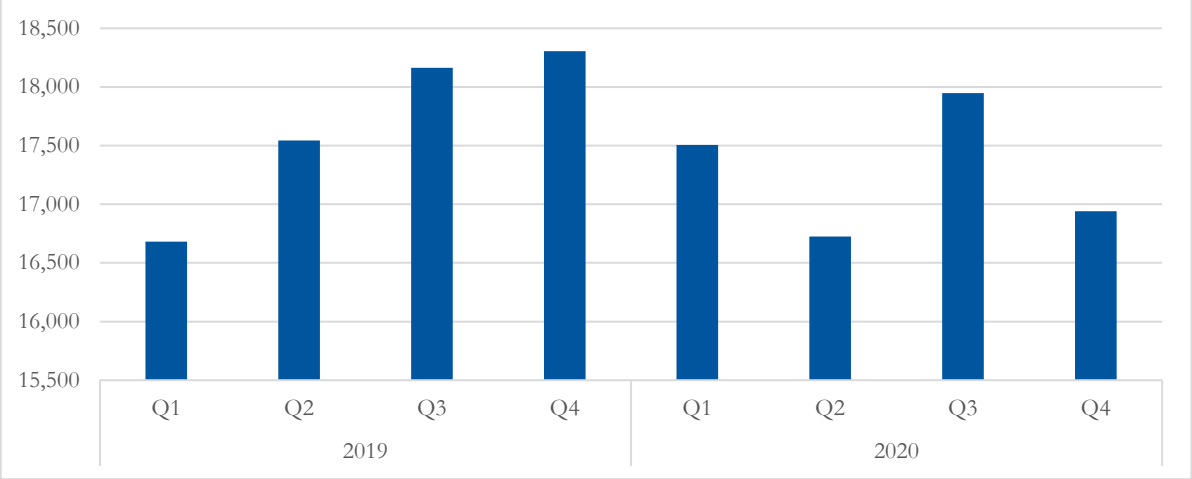
Domestic passenger transport was severely affected on the supply side for a short period by the state of emergency. Article 26 of Decree 12/2020 regulates that the transport sector is only allowed to use one-third of their vehicle capacity, bans motorcycle taxis, and makes travel business owners accountable to implement hygiene and sanitary measures creating additional costs. However, the initial strict rule to reduce capacity by two-thirds was lifted shortly after its implementation, reducing the impact on supply considerably.

International passenger transport was affected severely through the state of emergency. The suspension of visa issuing and cancellation of almost all international flights reduced activity significantly. Cargo transport reduced because of lower demand and international cargo mainly because of new complicated border procedures. However, other transport of goods was 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, reduce the demand for transportation. These indirect effects are part of the demand side and are picked up by the model through other channels.

National account data show a contraction of the sector in Q2, a recovery in Q3 followed by a new contraction in Q4 (Figure A3). Production in the transport, storage, and information technology (IT) sector was 5, 1, and 8 per cent down in Q2, Q3, and Q4, respectively, compared with 2019 levels. For Q2 we assume the supply impact to be mild (−1 to −10 per cent) and for Q3 we assume that the situation moved back to pre-crisis levels (0 per cent), while Q4 again is assumed to be mildly affected (−1 to −10 per cent).

Figure A3: Quarterly transport, storage, and information technology production



Note: national account data, values in constant 2014 10^6MT.

Source: INE (2021a).

A1.2 Demand-side channel

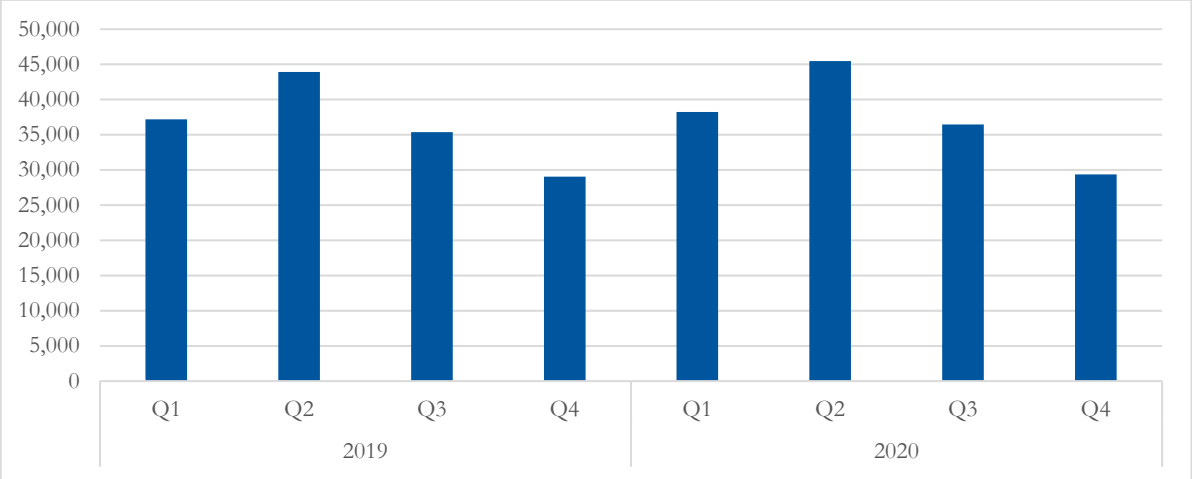
The assumption regarding the size of the effect through the demand channel is discussed in Section 3.2 and we assume that the demand changed accordingly throughout the whole economy (i.e. for each sector). The assumed impact is mild (−1 to −10 per cent) in Q2 and Q3 and 0 per cent in Q4. Remember that only the biggest sectorial effect from the four channels (supply, demand, investment, and export) enters the model as first-round impact. The impacts through the remaining three channels were then calculated in the model. This means that for sectors where we assumed zero impact in Q2 and Q3 for the supply, investment, and export channels, the applied first-round impact in the model works through the demand channel.

This is the case for the following economic sectors: agriculture, processed foods, utilities (electricity and water), trade, telecommunication and IT, financial and insurance services, business and real estate services, public administration, health, and education.

Most of these sectors are part of the service sector industry (financial and insurance services, business and real estate services) and many of their jobs are desk based, which minimized the disruption from a supply-side perspective. Many of these services could still be offered during the pandemic in 2020 via online platforms, phone, or adjusted office services. Telecommunication and IT might even have benefited from the pandemic. Home offices should have created an incentive to invest more in IT solutions. A similar positive effect could have occurred for the utility sector. Public administration and education faced a disruption in supply (school closure and home office/rota systems). However, government employees were still paid and therefore the supply side was not disrupted in terms of monetary values.

Agriculture activities take place in rural areas and the low population density there makes it easy to conform to social distancing rules. Further, the government recognizes the importance of the sector in terms of employment and livelihood and minimized any possible disruptions. Taking the seasonality of the agriculture sector into account and comparing only on a year-on-year basis, national account data show a 3.5, 3, and 1 per cent increase in activities in Q2, Q3, and Q4, respectively, compared with 2019 (Figure A4). Therefore, the supply does not seem to have been interrupted due to COVID-19. It could still be argued that some of the agriculture production is mainly exported and therefore the export channel should be dominant. This is a valid point and we took care of it in our analysis by treating the main agricultural export items in which we found a disruption through a change in world demand separately. This was the case for sugar, tobacco, and cotton and we discuss each of these sub-sectors in the export channel Section A1.4.

Figure A4: Quarterly agriculture production



Note: national account data, values in constant 2014 10^6MT.

Source: INE (2021a).

A1.3 Investment channel

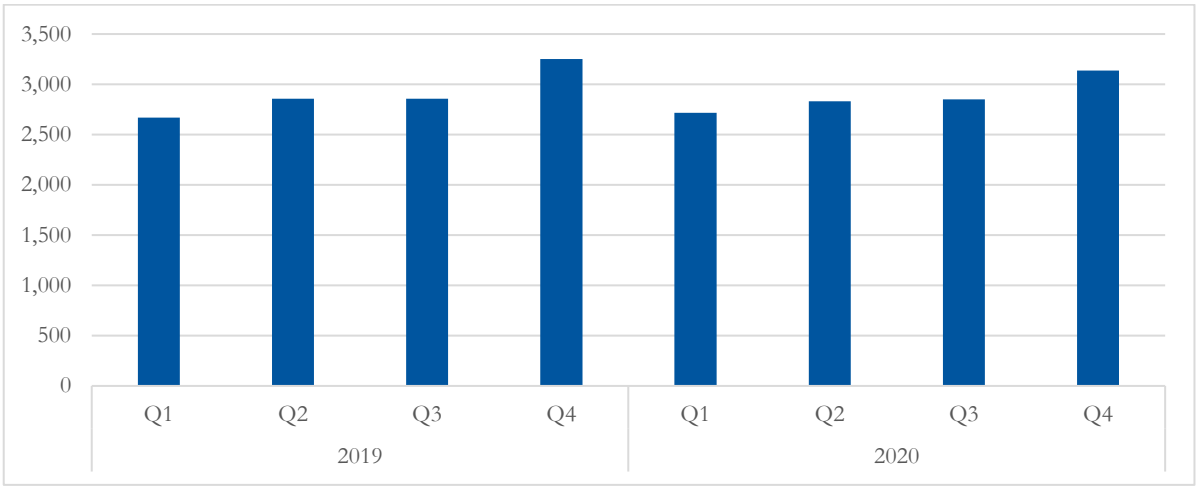
Construction

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 buildings, the government has not announced any form of investment programme in infrastructure, and companies will hold back investments.

However, data show that the construction sector was only mildly affected in 2020. National account data actually revealed increase in activities by 4, 5, and 15 per cent in Q2, Q3, and Q4, respectively, compared with Q1 (Figure A5). Nevertheless, on a year-on-year comparison the growth was negative (−0.9, −0.2 and −4 per cent, respectively).

Considering that the construction sector normally operates under a positive trend and in combination with the stagnation or mildly negative growth in 2020, we assume a mild impact (−1 to −10 per cent) in Q2, Q3, and Q4.

Figure A5: Quarterly construction production



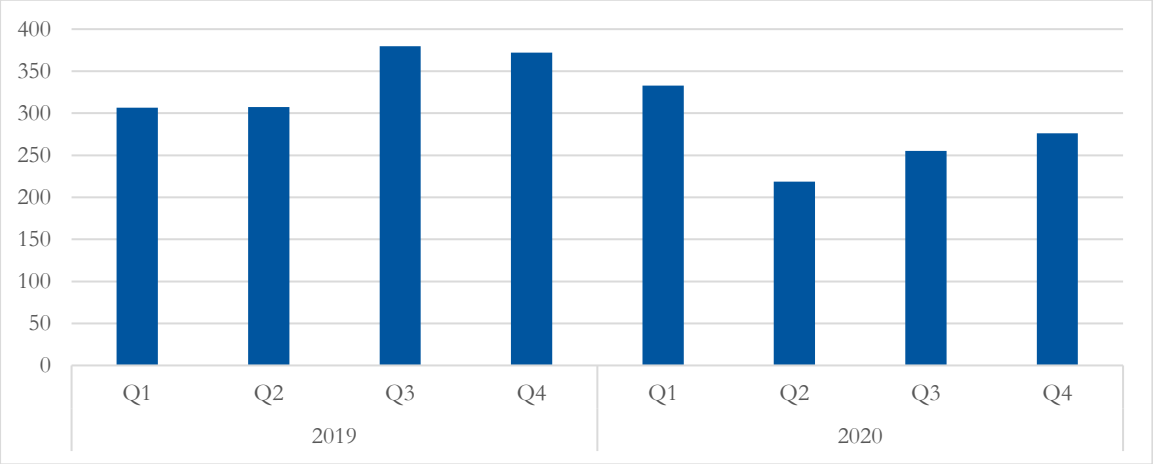
Notes: national account data, values in constant 2014 10^6MT.

Source: INE (2021a).

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 per cent compared with Q1 and by 30 per cent compared with Q2-2019 (Figure A6). This would indicate a large impact of around 30 per cent. It could be that some machines were not delivered because of supply chain problems abroad. However, we assume the impact on investment to be somewhat smaller at a moderate level (−10 to −20 per cent) in Q2. This is because other political events such as the conflicts in the northern and central regions of the country also increased uncertainty with negative consequences for investment decisions. The value of imported capital goods decreased by 23 and 17 per cent in Q3 and Q4, respectively, compared with Q1 and is around 33 and 26 per cent less compared with that in Q3/Q4-2019 (Figure A6). Therefore, it seems that the negative impact continued for the rest of the year and, therefore, for Q3 and Q4 we assumed a moderate impact (−10 to −20 per cent) as well.

Figure A6: Imported capital goods (in million US dollars)



Source: BdM (2021).

A1.4 Export channel

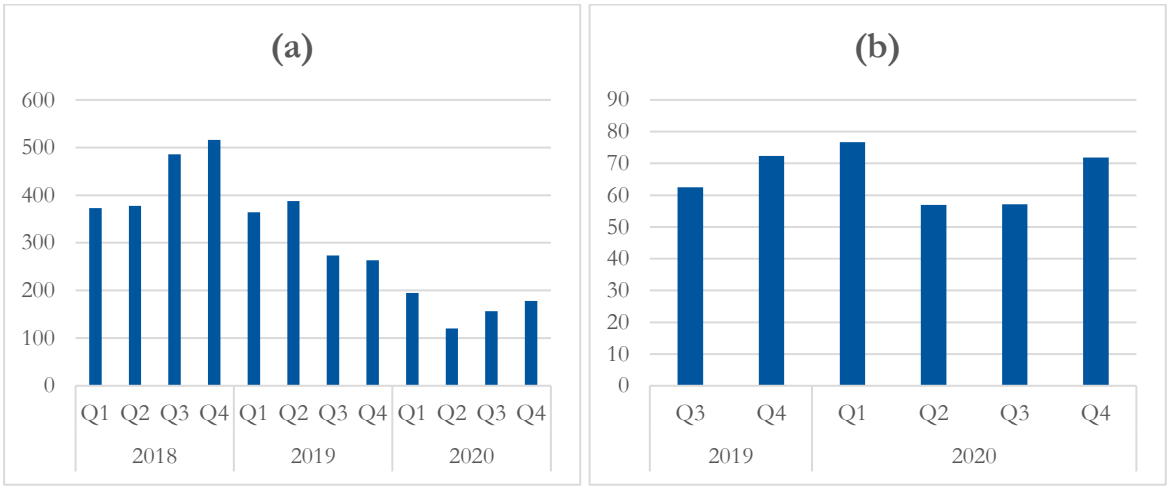
Coal

The coal sector has been severely affected by the pandemic. On the supply side, Articles 17 and 22 of Decree 12/2020, the state of emergency obliges companies to ensure the protection of personnel and reduce on-side employees to one-third and/or ensure a distance of 1.5 m 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 because of low world demand in June 2020 and announced to keep the production stop in place until the end of the year (CoM 2020s).

Total coal export declined in Q2 by 28 per cent compared with Q1 (Figure A7a) and the international coal price by 26 per cent (Figure A7a). The export reduction of 28 per cent would indicate an almost severe impact (−30 to −50 per cent); however, this is again the total effect. The export effect should be lower because not everything can be attributed to COVID-19. Some of the effect 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 per cent) in Q2.

Coal exports in Q3 were also below pre-pandemic levels but already improved somewhat compared with the initial shock in Q2, even though the coal price continued to stay low. Therefore, we assume that the large initial shock in Q2 continued in Q3. For Q4, we assume an improvement of the situation based on the fact that the international coal price increased by 26 per cent in the last quarter of the year and reached almost pre-pandemic levels. Even if the price reached pre-pandemic levels the export data show that complete recovery in terms of volume will take a bit longer; therefore, for Q4 we assume an improvement but still no complete recovery to pre-pandemic levels (i.e. a moderate impact of −10 to −20 per cent).

Figure A7: (a) Coal export of Mozambique (in million US dollars) and (b) international coal price (South Africa, in US dollars per metric ton)

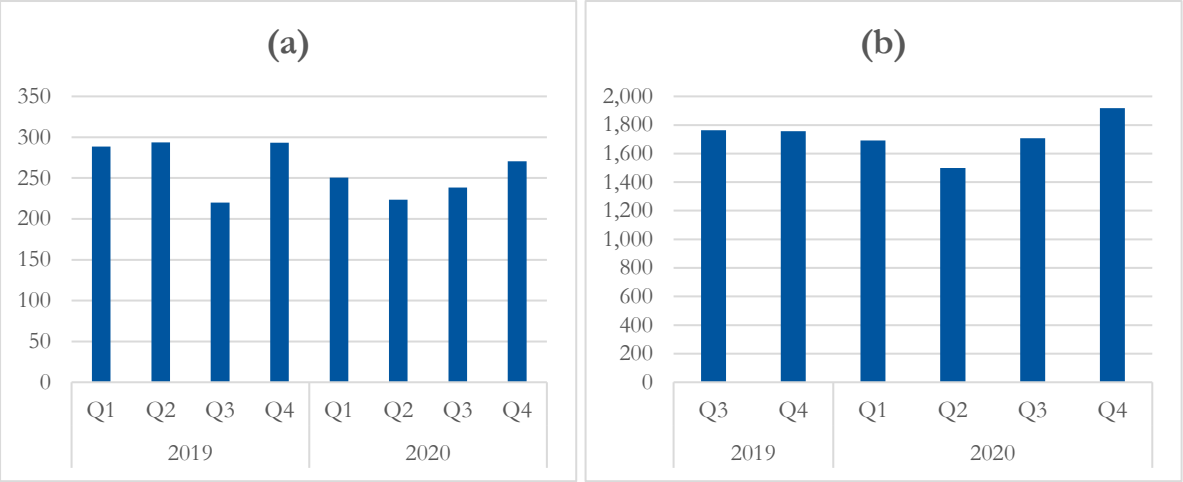


Source: BdM (2021) and World Bank (2020b).

Aluminium

The international aluminium price decreased by 11 per cent in Q2 (Figure A8a) and at the same time total aluminium exports declined by 11 per cent in Q2 (Figure A8b). 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 the main channel and the impact is quantified as moderate (−10 to −20 per cent) in Q2.

Figure A8: (a) Aluminium export (bars and cables, in million US dollars) and (b) international aluminium price (in US dollars per metric ton)



Source: BdM (2021) and World Bank (2020b).

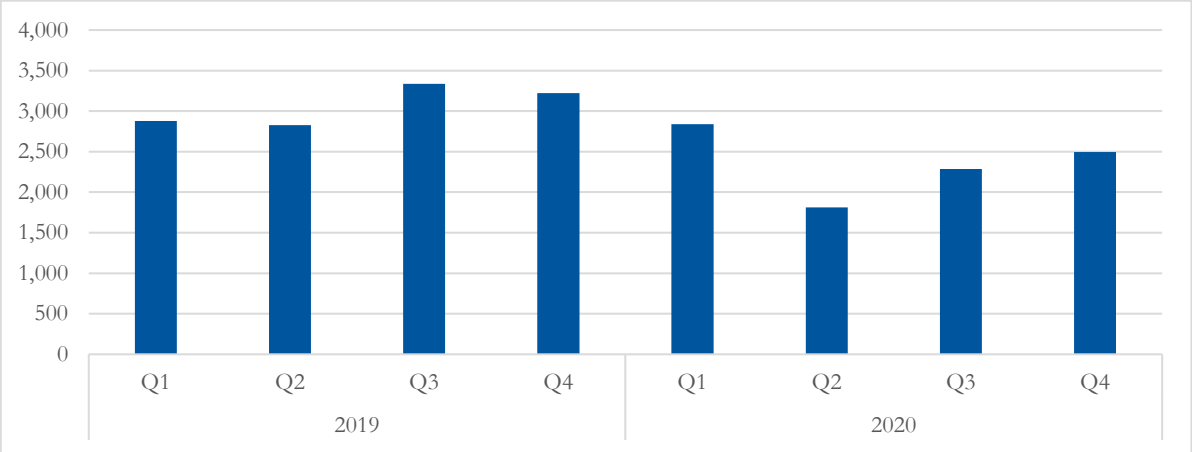
The aluminium export value recovered in Q3 as did the aluminium price. Therefore, we assume an improvement of the situation with only a mild impact (−1 to −10 per cent) in Q3. Further, the positive price development of aluminium in Q4 continued but did not suffice to lift aluminium export to the same level as in 2019. Aluminium export was still 8 per cent lower in Q4-2020 than it was in Q4-2019. Therefore, we assume that the mild impact (−1 to −10 per cent) continued in Q4.

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 investment decisions for new hotels has been delayed or cancelled. However, the biggest shock is assumed to have taken 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.

National accounts data show that activities in the hotel and restaurant sector decreased by 36, 19, and 12 per cent in Q2, Q3, and Q4, respectively, compared with Q1. On a year-on-year comparison the sector decreased 36, 31, and 23 per cent in Q2, Q3, and Q4, respectively (Figure A9). The figures imply a huge impact and the high level of informality in the tourism sector makes it most likely that the real effect is even higher. Considering that tourism and related activities almost succumbed, we assumed the impact of COVID-19 on the tourism export sector to be above 90 per cent in Q2 and Q3. The government initially planned to start issuing visas again towards the end of Q3 but that did not materialize until the beginning of Q4. For Q4, we assume a small improvement to a severe shock (−75 per cent) but still far away from Q1 levels.

Figure A9: Quarterly production in the hotel and restaurant sector



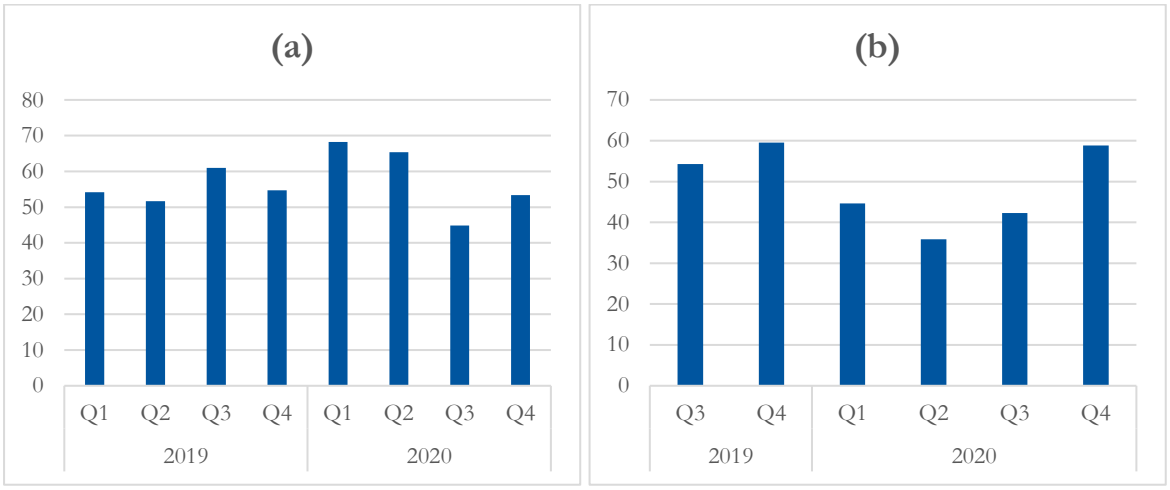
Note: values in constant 2014 10^6MT.

Source: INE (2021a).

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 a 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 A10a natural gas export decreased in Q2 by 5 per cent compared with Q1. The situation worsened in Q3 when natural gas export decreased 34 per cent compared with Q1. Considering that the price index for natural gas increased in Q3 indicates that the Q3 decrease in natural gas export was mainly due to lower volumes delivered to South Africa. In Q4, the natural gas price further increased which should have had a positive impact on Mozambique's export earnings (Figure A10b). However, in Q4 export values were still 3 per cent lower than in 2019 and 22 per cent lower than in Q1.

Figure A10: (a) Natural gas export from Mozambique to South Africa (in million US dollars) and (b) natural gas price index from the World Bank (2010=100)



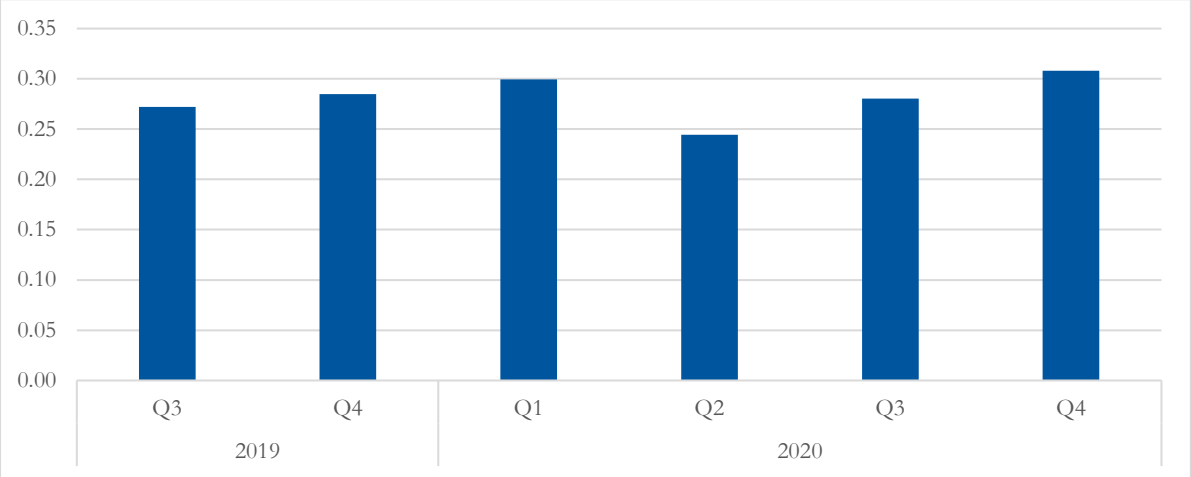
Source: BdM (2021) and World Bank (2020b).

Based on the export and price data we assumed a mild impact (–1 to –10 per cent) in Q2, a moderate impact (–10 to –20 per cent) in Q3, and again a mild impact (–1 to –10 per cent) in Q4.

Sugar

The food outlook of the Food and Agriculture Organization for June 2020 estimates that Mozambique's sugar production and export do not change (FAO 2020). Nevertheless, the international sugar price decreased in Q2 by 18 per cent (Figure A11). Therefore, the impact in Q2 is assumed to be moderate (–10 to –20 per cent) due to the price effect. In Q3 and Q4, the sugar price recovered gradually above pre-pandemic level. Based on the price development we assumed a gradual improvement and set the impact to be mild (–1 to –10 per cent) in Q3 and zero in Q4.

Figure A11: World sugar price (in US dollars per kilogram)



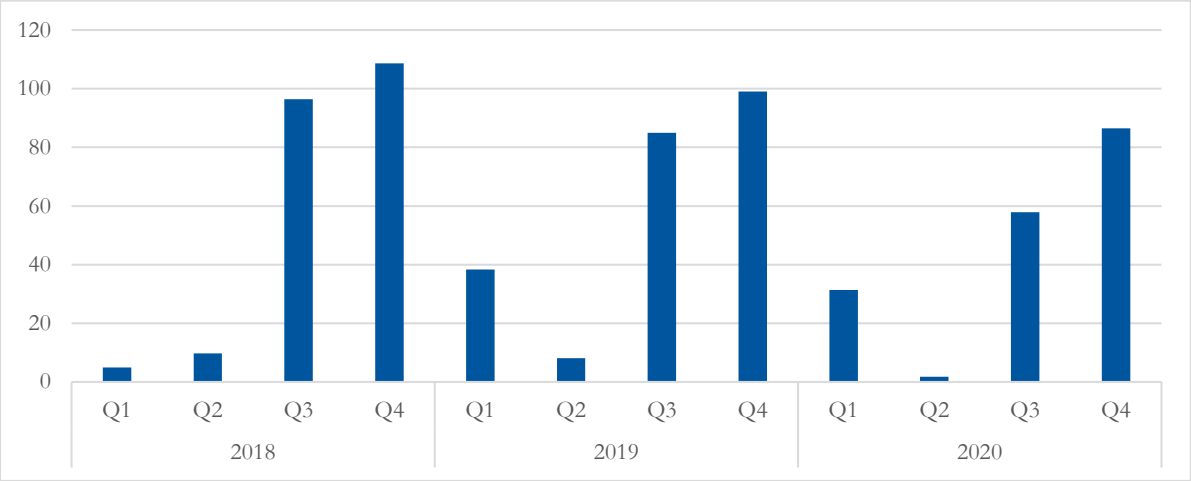
Source: World Bank (2020b).

Tobacco

Harvesting and most export of tobacco happen in Q3 and Q4. Therefore, comparing Q2 with Q1 or the previous year (2019) does not really show the impact of COVID-19. Nevertheless, the annual change shows that tobacco export is down by 78 per cent in Q2-2020 compared with Q2-2019 and by 64 per cent compared with Q2-2018 (Figure A12). We still assumed only a mild impact (–1 to –10 per cent) in Q2 for tobacco due to the fact that Q2 is not a harvest period.

In Q3 tobacco export was down by 32 per cent compared with Q3-2019, which in combination with a decreasing trend in the last two years amounts to a large impact (–20 to –30 per cent). The situation improved slightly in Q4. Tobacco export was 'only' 13 per cent lower than a year before. Therefore, we assumed a moderate impact (–10 to –20 per cent) in Q4 for the tobacco industry.

Figure A12: Tobacco export (in million US dollars)

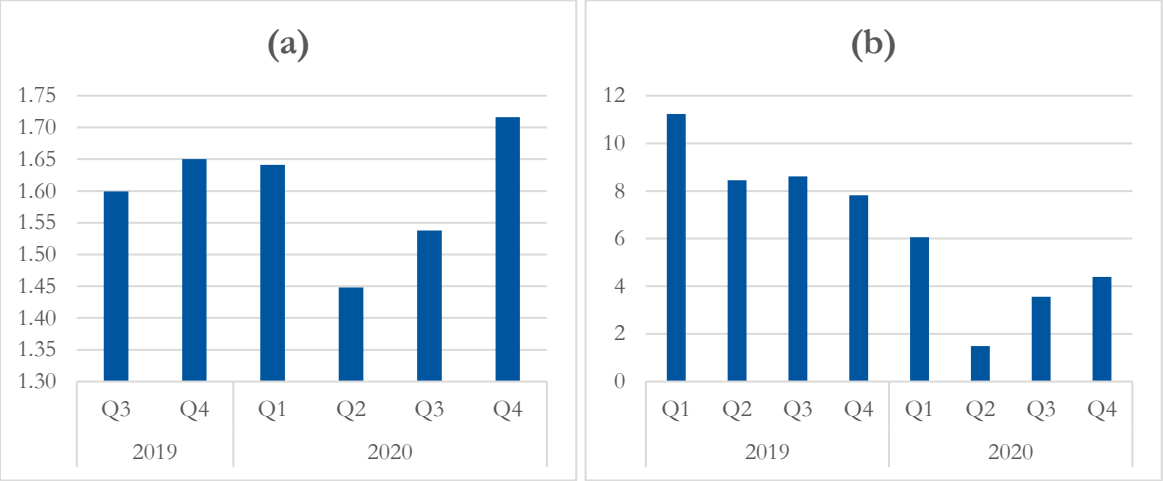


Source: BdM (2021).

Cotton

The cotton price dropped in Q2 by 12 per cent (Figure A13a); at the same time, cotton export (Figure A13b) decreased by 75 per cent in Q2 compared with Q1 and by 82 per cent compared with Q2-2019. Considering the price and export value decline, we assume a severe impact (–30 to –50 per cent) for Q2. In Q3 the export value of cotton slightly recovered but still remained below pre-pandemic levels. In Q4 the cotton price recovered even more and exceeded pre-pandemic levels. The price development in Q3 and Q4 and the export data indicate that the cotton sector did recover partly. Therefore, we assumed a large impact (–20 to –30 per cent) in Q3 and a moderate impact (–10 to –20 per cent) in Q4.

Figure A13: (a) Cotton price index (in US dollars per kilogram) and (b) cotton export (in million US dollars)



Source: World Bank (2020b) and BdM (2021).

Labour remittances

We assume a severe impact (–30 to –50 per cent) on labour remittances in Q2 and that the situation gradually improved in Q3 (–20 to –30 per cent) and Q4 (–10 to –20 per cent). 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 Mozambicans are employed in South African mines. The lockdown in South Africa and the closed borders between the two countries most likely reduced remittances significantly. It is estimated that due to the border closure between Mozambique and South Africa, families of an estimated 28,000 miners were 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 workplace (CoM 2020a).

Appendix B: Setting up a multiplier model

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

$$\mathbf{x} = \mathbf{Zi} + \mathbf{f} \quad (1)$$

$$\mathbf{x} = \mathbf{Ax} + \mathbf{f} \quad (2)$$

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{f} \Leftrightarrow \mathbf{x} = \mathbf{Lf} \quad (3)$$

$$\Delta\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\Delta\mathbf{f} \Leftrightarrow \Delta\mathbf{x} = \mathbf{L}\Delta\mathbf{f} \quad (4)$$

in which

- **x** is a column vector of industry outputs in an economy (**Δx** denotes a change in outputs);
- **Z** is a matrix of intermediate sales/demands in an economy;
- **f** is a column vector of final demand of goods and services supplied by industries in an economy (**Δf** denotes a change in final demands);
- **i** is a column vector of unit values, so that **Zi** is a column vector of intermediate demands summed over all industries;
- **A** is a matrix of intermediate demands per unit of industry output for an economy which is derived by dividing **Z** with the transpose of **x** (i.e. the column totals); and
- **L** is 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 **L** are referred to as the 'output multipliers'. Comparison of output multipliers offers an indication of 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 **x** in such an expanded version. The column totals (or sum over activities in case of a SAM) of **L** can be calculated for each activity as indicators of backward linkages.

Appendix C: Sector definition

Table D1: Sector definition

No.	Broad sectors	Included activities
1	Agriculture	Maize, sorghum and millet, rice, other cereals, pulses, groundnuts, other oilseeds, cassava, other roots, vegetables, sugar cane, tobacco, cotton and fibres, fruits and nuts, coffee and tea, other crops, cattle, poultry, other livestock, forestry, fishing
2	Mining	Coal and lignite, natural gas, other mining (rubies, graphite, heavy sands)
3	Manufacturing	Meat, cereal and vegetable processing, other foods, beverages and tobacco processing, textiles, clothing, leather and footwear, wood and paper, chemicals, non-metal minerals, metals and metal products, machinery and equipment, other manufacturing
4	Utility	Electricity (gas and steam), water supply and sewage
5	Construction	Construction
6	Trade and Accommodation	Wholesale and retail trade, accommodation, hotels, restaurants, food services
7	Transportation	Transportation and storage, information and communication
8	Other services	Finance and insurance, real estate activities, business services, public administration, education, health and social work, other services

Note: sector definition follows the social accounting matrix (SAM) created by Cruz et al. (2018); for a mapping of sector, SAM activities, INE activity description, and INE commodity code, see Appendix A of Cruz et al. (2018).

Source: authors' compilation.