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Recovering from COVID-19

Economic Scenarios for South Africa

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EXECUTIVE SUMMARY

As the South African economy emerges from the downturn induced by COVID-19, policy makers are concerned with recovery, reconstruction, and transformation. This paper focuses on the recovery from the severely depressed levels of economic activity that occurred in April 2020. However, before considering the period after the economic trough of April 2020, a mention of economic conditions prior to the pandemic is worthwhile. In brief, economic performance was terrible by almost any metric. Furthermore, economic performance had been poor since 2008, with evidence pointing to ongoing deterioration culminating in the fourth quarter of 2019, when per capita GDP contracted, unemployment ticked upwards to its highest level since 1994, productivity declined, and inequality worsened. The striking difficulties of the South African economy in avoiding/absorbing shocks—whether internally generated, such as shocks to electricity supply, or externally generated, such as changes in terms of trade or investor sentiment in relation to emerging markets—have been an integral part of this disappointing economic performance over time. In short, the situation prevailing prior to the onset of the COVID-19 pandemic was one of economic weakness.

Beginning from this position of weakness, the economic shock related to COVID-19 was enormous, likely the largest single economic shock in the history of South Africa. According to official statistics, GDP in the second quarter of 2020 was approximately 17% below the level registered in the second quarter of 2019. In assessing this shock, it is important to recall that GDP is a flow concept. One can, in principle, consider the volume of flow over any arbitrary period: a day, a week, a month, a quarter, a semester, a year, and so forth. The lockdown associated with COVID-19 precipitated an extraordinarily rapid decline in economic activity. Indeed, the available analytics and data point to a trough in economic activity, or flow value of GDP, at less than 70% of the level that would have pertained in the absence of the pandemic, or a greater than 30% decline in the flow rate of GDP (Arndt et al 2020).

If we accept a 17% reduction as the average flow rate of GDP over the quarter and we accept that the economic shock related to COVID-19 was unprecedently rapid and drove a decline in the flow value of GDP of much more than 17% at the trough (which probably occurred sometime in late April or early May), then we must also accept a rapid recovery in economic activity in May and June in order to achieve an average decline of 17% over the quarter. Furthermore, this relatively rapid recovery continued. GDP in the third quarter of 2020 was "only" about 6% below the levels recorded for the third quarter of 2019, with the corresponding figure for the fourth quarter at about 4%. Other figures, including recent ones, broadly support this basic story. For example, retail sales in February 2021 were up 2.4% year-on-year, with the previous two months, January and December, having registered only a slight decline year-on-year. Correspondingly, manufacturing production and sales were down by 2.1% in February 2021 year-on-year.

A few broad observations emerge from this history and the available data. First, the South African economy has exhibited more resilience to the COVID-19 shock than performance up to December 2019 might have led one to expect. In Mexico, for example, the distance between fourth quarter GDP in 2020 and that in 2019 was greater than for the same comparison in South Africa. At the same time, Mexico registered close to twice as many deaths related to COVID-19 per million population as South Africa. Second, multiplier effects are important. As discussed in Arndt et al (2020), multiplier effects accounted for the bulk of the initial economic contraction. However, they also operate positively, buoying the recovery experienced to date and bringing economic activity back towards the levels of 2019. Third, while having GDP about 4% down year-on-year is much better than the 17% decline observed in the second quarter, 4% down is still a deep recession by ordinary standards. While some sectors are producing at close to levels observed in the fourth quarter of 2019, others are more strongly affected. The incidence of these depressed levels of economic activity remains likely to be tilted toward lower-income households, which are more vulnerable to begin with. Overall, there remains substantial slack in the economy, multiplier effects still apply, and many households remain deeply vulnerable to severe economic hardship.

Finally, prospects for economic growth remain circumscribed by the pandemic over the near term. The experience of India in April and May 2021 provides a stark warning of the social and economic implications of easing public health restrictions too soon. These public health restrictions constrain the pandemic but also limit the potential for further growth/recovery, at least until a significant share of the South African population has been vaccinated. This milestone may be obtained sometime in the first quarter of 2022. Hence, the 'recovery period' looks likely to extend for an additional nine months or more.

To analyse recovery, we model policy impacts over four quarters. However, the distinguishing feature of recovery policies is not the time horizon over which they will run; rather it is in how quickly they can be implemented and take effect. Recovery is not a stage that has to be completed before reconstruction and transformation can begin. Instead, it is a process that will morph into reconstruction over time. We therefore confine our modelling to measures that have been proposed and which, in our judgement, could be implemented quickly.

Simulations examine COVID-19 income support interventions to households considered by the government of South Africa under alternative financing options. All scenarios are run from the fourth quarter of 2020 to the third quarter of 2021. The most aggressive option, funded by reduced government savings, adds 2% to GDP (at market prices) over the period of observation, i.e. the year to the third quarter of 2021 relative to a scenario with no intervention. Less aggressive options contribute significantly less, due to counter balancing multiplier effects. Thus, financing matters. If the most aggressive intervention is financed by raising taxes of the top decile, a 0.7% increase in GDP is achieved. The reason for the lower impact, despite the full amount of income support being disbursed, is that high-income households will spend less, in order to pay for higher taxation.

All intervention plans are strongly progressive. Further, even in the most aggressive scenario financed by reduced government savings, the government debt-to-GDP ratio declines, as higher GDP and higher tax collections more than fully offset the increment to government debt. These are important results.

The paper concludes that the South African government has been justified in considering and implementing aggressive intervention policies. Maintenance of these policies is appropriate as long as public health measures to restrain spread of COVID-19 also constrain economic activity. Looking forward, and assuming vaccines will allow return to more normal behaviour either towards the end of 2021 or in early 2022, government needs to consider tapering of extraordinary COVID-19 support programs. More importantly, attention needs to be devoted now to kindling and maintaining much more rapid economic growth rates than have been attained over the past dozen years. If there is a silver lining to this terrible pandemic, it most plausibly lies in the creation of the policy space to enact measures and reforms that lead to equitable, sustainable, and much more rapid economic growth.

Keywords: Covid-19, South Africa, recovery, GDP, lockdown.

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1. INTRODUCTION

Discussions of post-COVID-19 economic policy all recognize that there is an opportunity to address structural issues that have long confounded the South African economy. The South African government's own words refer to a reconstruction and transformation phase (SA Government 2020), as do other proposals (Business for South Africa 2020), political documents (from the African National Congress and the Confederation of South African Trade unions, for example) and a Nedlac (National Economic Development and Labour Council) proposal. At the same time, it is recognized that there is an urgent need for rapid recovery. The pandemic has hit the least well-off hardest. Where those people were already living on the margins, the pandemic and policy response has not simply reduced their well-being but has pushed them below the survival line. There is thus an urgent need to restore jobs and livelihoods as quickly as possible.

This report is concerned with the recovery phase and measures that can be taken to accelerate it in the short term. Although we model policy impacts over four quarters, the distinguishing feature of recovery policies is not the time horizon over which they will run, but rather how quickly they can be implemented and take effect. Recovery is not a stage that has to be completed before reconstruction and transformation can begin. Rather it is a process that will morph into reconstruction over time.[1] We therefore confine our modelling to measures that have been proposed and which, in our judgement, could be implemented quickly. Our primary concern is with both the size and the speed of the impact of the policies on welfare of the poor. The impact will work both directly and indirectly. Giving income support to the poor helps recipients directly but also helps others through the demand injection when they spend it. The approach we take emphasizes these indirect effects.

While we are concerned with these welfare effects, it would also be reasonable to assess recovery policies according to whether they might complement or obstruct reconstruction. The latter possibility

1 Indeed, there is not a clear-cut boundary between the pandemic and recovery. Recovery is a process which began unfolding as the pandemic and lockdown hit, as firms and households adapted to their new circumstances. Periodization into pandemic-recovery-reconstruction phases divides a path into somewhat arbitrary stages.

arises because the foundations of recovery necessarily rest on existing institutions, norms, and behaviours. Given that the pandemic led to capacity underutilization, it seems likely that the quickest way to recover is to reverse that impact. If there are underutilized productive resources, the low-hanging fruit must surely be their utilization. But that is building back the past. If the negative impact of the pandemic could be quickly unwound, South Africa could recover rapidly – but it would be to the *status quo ante*. If that is done, the debate on constructing a better future will be the same debate that has taken place over the last twenty-six years in South Africa. This trade-off needs to be considered. However, this is not our main concern, and we confine our consideration to a discussion of the possibilities, after our more technical modelling.

Recovery was initially seen as a process that would begin once the health crisis was under control, perhaps around the third quarter of 2020. Successive waves of pandemic and lockdown have extended that. We now assume that the roll-out of the vaccine will turn COVID-19 into a "normal" health risk, which may require special interventions but is nonetheless like other major diseases with which we have learned to live. The longer than anticipated pre-recovery period complicates the analysis of recovery. Impacts that were initially regarded as temporary have become more permanent. Firms that were able to survive the significant loss of business for a few months, by drawing on savings or extending loans with banks, may be unable to continue to do so. Adaptations of production processes to the "temporary" negative shock become embedded as permanent technical changes. Firms are closing offices as they have learned they can manage differently with work from home. Government welfare policies that could be financed for some months may not be sustainable for a longer period. The closure of most of the channels for human capital formation – not only schools and universities, but also many formal and informal on-the-job processes for skills acquisition – has consequences for the future path of the economy.

These affect the recovery process and the policies that might speed it and should be considered in modelling recovery. Ideally, evidence-based policy analysis takes as its starting point the structure of the economy when the policies are implemented. However, although there are data on the path of the economy over the past year, they do not allow us to dig into this level of impact. The evidence base for

recovery policies is necessarily limited. When the pandemic struck and lockdown policies were implemented, little was known in detail about either the pandemic or the effects of the lockdowns, other than that both would be harmful. Early attempts to assess likely impacts were necessarily speculative. Models were used to examine the wider consequences of direct impacts that were judged to be likely, providing a consistent framework for analysis. More than a year after the first South African case and the first lockdown measures, we know a lot more. We also have data that has emerged during the year indicating what the impacts have been. But, looking forward, towards short term recovery and building back fairer in the longer term, there are still many unknowns, and many gaps in the availability of the data that might help us answer questions around the continuing unknowns.

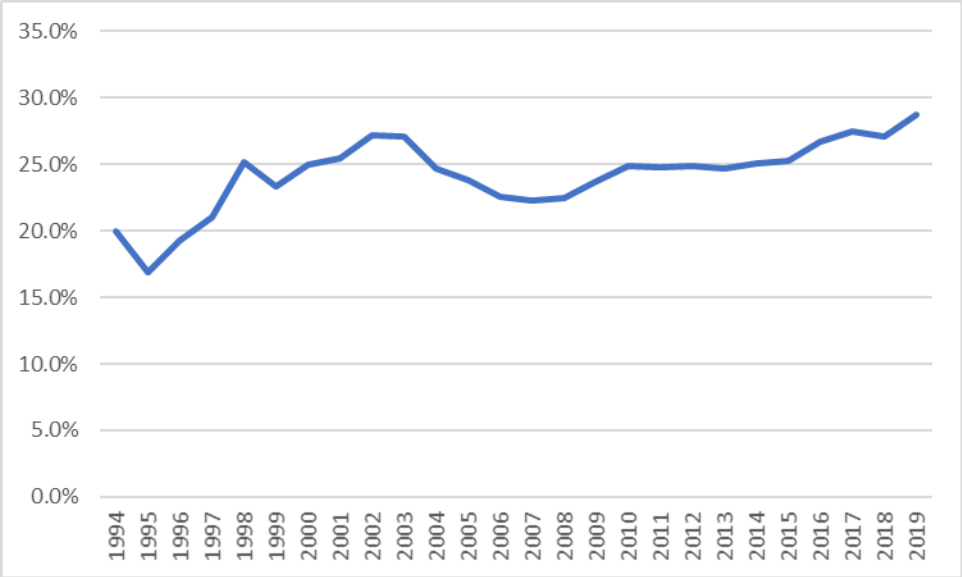
This paper is concerned with recovery. Since this entails looking ahead, we use a model to evaluate different scenarios. Since recovery policies and plans should be based on evidence, much of which is unavailable, we use a broad modelling framework to put existing data into a consistent framework so that we can infer what some of the missing data might look like. Our broad approach is an economy-wide framework in which the direct and indirect consequences of policies can be evaluated. Specific policies are evaluated both for their direct consequences and for their impact on the economy as a whole.

The paper has three major components. Firstly, we assemble the available data into a framework on which we can base our model. Secondly, we use that data with the model to assess some alternative policy scenarios. Thirdly, recognising the shortcomings of the data we discuss how they affect the policy implications of our results. In Section 2 we look briefly at the state of the economy before the pandemic hit, and briefly discuss the relation between recovery and policies for reconstruction. We also look at the performance of the economy during the pandemic. We then present a brief account of the model and data in Section 3. In Section 4 we present the results of simulating transfers and alternative ways of financing them. We also discuss some limitations of the modelling, particularly given data constraints, before concluding in Section 5.

2. THE ECONOMIC CONTEXT

Historical context

Figure 1: Official unemployment rate, 1994-2019.

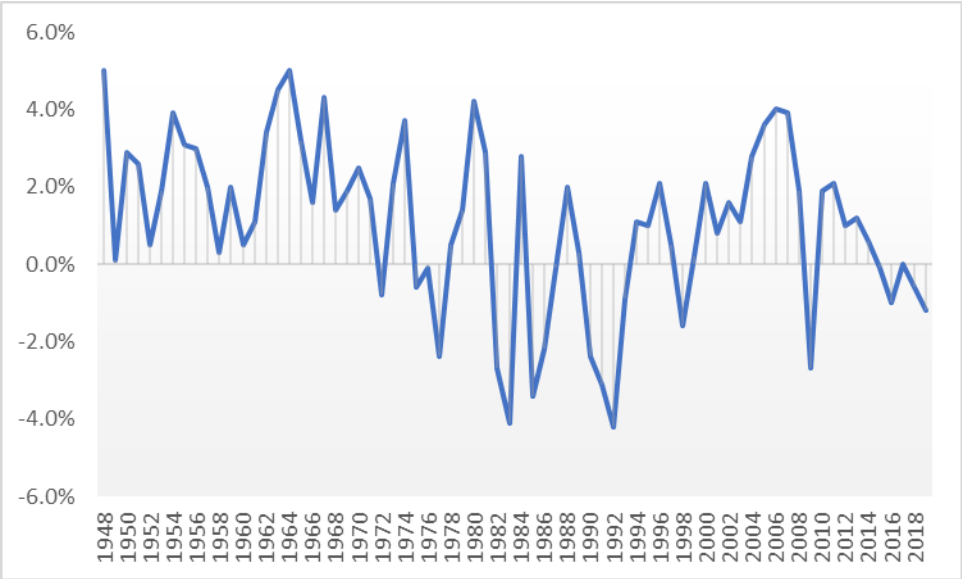


Source: South African Reserve Bank (2021) KBP7019J.

Before looking at the impact of the pandemic we need to remind ourselves that the South African economy was not in good shape before pandemic. Unemployment was persistently high and growing. Figure 1 shows the official rate. The expanded rate of unemployment, which includes people who are too discouraged to seek work, is even more horrifying, reaching 38.7 per cent in the fourth quarter of 2019. Inequality is among the worst in the world (Statistics South Africa 2019). While it may be disputed, there is some evidence that it has worsened in recent years. Relatedly, poverty is high and growing.

Underlying these trends is the poor growth performance of the economy, as shown in Figure 2. South Africa's growth rates have never been spectacular. The growth rate of GDP per capita rose after 1994, but it peaked at 4.0% pa in 2006. After the global financial crash, it averaged 0.4% pa between 2010 and 2019, with three years (2015, 2016 and 2019) in which it was negative. GDP growth simply did not keep pace with population growth. While higher growth rates do not automatically reduce poverty, given the unequal distribution of the fruits of growth, low growth rates make it harder to address it.

Figure 2: Annual growth rates of real GDP per capita, 1948-2019.



Source: Constructed from South African Reserve Bank (2021) using the KBP6270Z series.

This is the well-known historical context in which COVID-19 hit. It is well documented that the pandemic and economic responses to it have worsened these trends. The growth rate in 2020 was 7.0 per cent. Unemployment and poverty rose, and it is likely that inequality has increased. There is ample evidence that the negative impact was disproportionately borne by the poor, despite measures to shield them through transfers.

This history raises the question, "recovery to what?" It emphasizes the importance of the restructuring of the economy as envisaged by government. Recovery in the sense of regaining the economic losses due to COVID-19, is important because even the parlous state of the economy before COVID-19 was better than the immediate post-COVID economy. But it will not be enough. In South Africa, as in many other countries, the pandemic has turned the spotlight on the shortcomings of the economy and previous economic policies. Some commentators have suggested that it not only highlights the need to change the economy but also provides an opportunity to do so. That debate would be the focus of a different paper. But it is useful to consider the performance of the economy during the pandemic, not only as background to the subsequent modelling, but also because it points to some of the shortcomings that the pandemic has highlighted.

Economic performance during the pandemic

The previous section provided a broad longer-term context against which the pandemic and recovery can be viewed. In this section we review economic performance in 2020, during the pandemic. This performance necessarily reflects the outcomes contingent on all influences, not simply those of the pandemic and various levels of lockdown. However, it is reasonable to assume that measured performance in the second quarter of 2020 was predominately because of the impact of pandemic and lockdown. Outcomes in the third and fourth quarters of 2020 continued to reflect their impact but were somewhat mitigated by agents learning to live with them (what we have called autonomous recovery) as well as the stimulative effects of government interventions.

Describing the performance over this period sets the stage for considering recovery policies in 2021 and provides some insights into which sectors are able to recover. A review of the economy's performance in 2020 shows that recovery has been rapid compared to that in many other countries, but it has also been uneven. The unevenness manifests itself across many dimensions. In production and output there have been differences between broad sectors, between subsectors, and between firms within sectors. This unevenness transmits into employment and wages, which works further into uneven impacts on income distribution. We do not explore these aspects of uneven recovery in detail, since they have been dealt with by other authors (see NIDS-CRAM papers). But we provide some illustrations from manufacturing, below.

Production

Broad restrictions to contain the spread of COVID-19 led to a sharp contraction in economic activity in the second quarter of 2020. Real GDP fell by 17.8 per cent year-on-year. Declines were broad-based, but especially pronounced in the construction, manufacturing, mining, transport, and trade sectors. The agriculture industry was less suppressed by lockdown restrictions, and a favourable growing season supported higher production. Economic activity resumed as lockdown restrictions were lifted in a phased approach. By the end of 2020, manufacturing and trade activity had recovered beyond 2019 levels.

The recovery in South Africa's construction sector has lagged behind other industries, reflecting not only uncertainties caused by the pandemic, and policy responses to it, but also the reduction of the country's sovereign credit rating, which fell to sub-investment grade in early 2020. Construction activity remains severely affected, with production and employment falling to levels seen in 2010.

As we have outlined, recovery in construction and transport have lagged behind other sectors, such as manufacturing. But recovery in manufacturing itself is uneven between sub-sectors as shown by comparing the evolution of indices of their physical volume seasonally adjusted. The paths of recovery shown in Appendix 4, illustrate that unevenness.

Investment and capital stock

Unlike other types of expenditure, capital spending has been very slow to recover from the lockdown. Gross fixed capital formation fell to 15.0 per cent of GDP in the fourth quarter of 2020, matching the historical low observed in 2002. Losses have been broad-based, with the largest losses in civil construction and machinery.

Growth in capital stock, which had been decelerating from 2013, deteriorated to 0.2 per cent in 2020. Services sectors experienced lower levels of real capital stock for the first time in decades, while persistent declines in agricultural and manufacturing capital stock quickened in 2020.

Industrial and commercial inventories fell to 8.2 per cent of GDP by the end of 2020, well below a five-year average of around 10.7 per cent of GDP. The largest drawdowns in inventories over the year were in mining, manufacturing, and trade services. It might be expected that inventories would diminish under the pandemic, although a more detailed analysis is required. Inventories comprise stocks of raw materials, work in progress, and of finished goods. The movements in each of these could give some insights into whether production was supply or demand constrained. Re-building inventories to their normal levels could be a boost for production over the short term.

These movements in gross capital formation are matched by movements in savings. These are discussed in the section below.

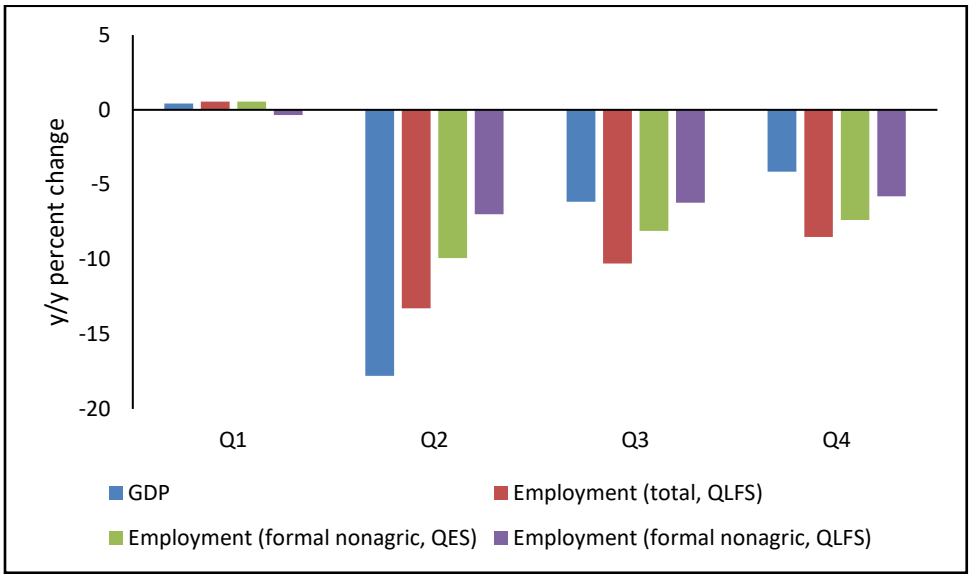
Employment

Official employment statistics suggest that the decline in employment and payrolls in the second quarter of 2020 was much less than production data would indicate, particularly in the formal, non-agricultural sector. The larger decline in GDP relative to employment indicates a sharp loss in productivity in the second quarter, which is expected given the restrictiveness of lockdown measures in that period. More likely, it is a combination of lower productivity, and an increase in furloughed workers, which are not adequately captured in labour statistics.

Estimates by Robinson, et al (2021) suggest that the decline in employment during the most restrictive part of the lockdown is closer to 45 per cent. However, the social accounting matrix (SAM) multiplier model in that study does not explicitly account for losses in labour or total productivity, so all losses in labour effort are captured through a decline in employment. Using survey data able to distinguish between active employment, paid leave workers, and workers temporarily laid off, Bassier, Budlender and Zizzamia (2021) find that, relative to February 2020, active employment was 40 per cent lower in April, and 20 per cent lower in June.

In the second half of the year, losses in employment did not recede as quickly as losses in production, at least in official statistics. By the fourth quarter of 2020, formal non-agricultural employment was around 5 per cent lower than the 2019 average. Sectors such as food production, gold mining, and local and provincial government, saw sharp increases in employment, recovering beyond lockdown losses. Employment in the construction sector declined to multi-year lows.

Figure 3: GDP and employment growth rates, first to fourth quarters of 2020.



Source: Statistics South Africa (2021).

The recovery from the pandemic and associated lockdowns is uneven in a variety of areas: production, employment, and stocks of capital and inventories. Despite low inflation and low borrowing costs, financial and fiscal uncertainty, as well as ongoing structural barriers to growth, keep the recovery fragile. As these continue, adapting to a "new normal" may reflect in changes to the structure of economic transactions, including the stimulatory reactions of higher demand, or multiplier effects. To account for the change in economic structure, we construct a social accounting matrix to capture the economic effects of the pandemic. This serves as a starting point for simulation modelling of the recovery.

Despite an increase in government support to vulnerable households, hunger – particularly child hunger – has increased across the country (Van der Berg, Patel, and Bridgman 2021). The persistence of high levels of hunger, amid a recovery in household spending, suggests that the economic recovery has been uneven across different households. Top-ups to existing social grants were removed in November 2020. Temporary support measures for low-income households, as well as additional unemployment benefits, were extended twice, and are expected to expire in April 2021 (South Africa National Treasury 2021).

Using a multiplier model based on a modified dataset incorporating the likely structure of the South African economy after the lockdown, we explore the effects of a recovery policy scenario – extending government support for households – under different financing schemes.

3. MODEL AND DATA

The modelling in this paper builds on the approach adopted in Arndt et al (2020). That work, undertaken in the early stages of the pandemic and lockdown, used a multiplier model based on a SAM in a bottom-up approach to estimate the likely impact of the pandemic and policy responses. Expert judgements were made of likely direct effects on demand and supply for a range of goods and services. Most of the direct effects were expected to be negative, but their size varied, depending on presumptions about both voluntary and mandated reductions in demand (both domestic and foreign), and, from the supply side, whether the goods were deemed essential or not. The multiplier model was then used to calculate the full (direct and indirect) effects of the anticipated direct shocks. These were then used to generate likely effects on the usual macroeconomic aggregates, tax revenues, employment, and income distribution.

The work behind this modelling was largely forward looking, since there was little evidence of what the economic impacts would be. The approach had many merits. It brought separate judgements about specific bottom-up shocks into a framework that forced consistency. It allowed indirect spillovers, through interindustry linkages, to be estimated. Having calculated the impact, the approach was also used to estimate possible recovery scenarios, simply by reducing the sizes of the negative shocks. Since that exercise was undertaken, some data on the actual impact has become available. These have been used to improve the design of the shocks.

Our starting point for modelling recovery scenarios is a SAM that captures the impacts of economic fall-out of the first six months of the pandemic. The detailed economic trajectories of many economic variables over the period April–September 2020 were imposed on a multiplier model based on a provisional 2019 SAM for South Africa.[2] The results were used to create a SAM that represents the annual flows that would result if the economy had the same structure as it had during the third quarter of 2020. The SAM is of the same dimension as in Arndt et al (2020). It identifies 64 productive activities,

2 Appendix 3 describes how a provisional 2019 SAM was constructed based on 2017 supply and use tables, 2019 national accounts, 2018/19 Labour Market Dynamics and Quarterly Labour Force Survey, and the 2015 Living Conditions Survey.

103 commodity markets, 4 types of labour according to highest level of education attained, and 14 types of households by income deciles, with the highest decile further broken down into 5 double percentiles. More detail can be found in Appendix 1. The third quarter of 2020 SAM allows recovery policies to be modelled as positive shocks to the economy at the start of recovery rather than following Arndt et al (2020) and modelling recovery as reduced negative shocks to the pre-pandemic economy.[3] The multiplier model allows for comparative static analysis, which identifies the impact of the shock by comparing the economy before and after.

3 That approach was adopted in Arndt et al (2020) because there was no data on how COVID would proceed. We now have some indicators of what the economy looks like at the (hopefully) bottom of the downturn.

4. SCENARIOS

Recovery and reconstruction policies

In this section we use a multiplier model to examine the impact of a narrow range of recovery policies, policies providing income support to affected households. Recovery and reconstruction policies are not distinguished by the instruments used. Nor can they be distinguished in a dichotomous and mutually exclusive way. It is likely that the same instruments will be used for both purposes. Our main criterion for an intervention to be regarded as a recovery policy is that it can be implemented, and will start having an effect, quickly. "Quickly" is not a precise length of time. There is a continuum between more recovery and more reconstruction. However, it does rule out interventions that require lengthy reviews or creating state capacity or new institutions.

Policies that can be implemented through existing mechanisms will be more biased towards the recovery end of the continuum. Thus, topping up an existing grant can in principle be done very quickly. However, introducing new grants which require application and registration of recipients can take longer, as evidenced by the slow roll out of the social relief of distress grants (see Köhler and Bhorat 2020). Infrastructure projects are likely to require planning, contracting, sourcing of materials, all of which take time. Many of the effective recovery programmes will work through demand stimulation. However, their effectiveness does depend on whether there is underutilized supply capacity. To this extent, support to firms should be seen as maintaining capacity.

While we focus on policies, we recognize that some recovery will occur independently of such policies. There has been some autonomous recovery as pre-COVID-19 behaviours return and as agents learn new coping behaviours. There may be some conflict between the desired outcomes of policy-driven recovery and the trajectory of autonomous recovery. Policy makers must weigh the extent to which they want to control autonomous recovery (which will likely slow it) or to complement it.

Simulating specific COVID-19-related interventions

Income support has been undertaken for many years in South Africa. It received a considerable boost during the 1990s and early 2000s (Woolard, Harttgen, and Klasen 2012). Arndt et al. (2020) have argued that this shielded low-income households somewhat from the economic fall-out of the COVID-19 pandemic. Although they were negatively impacted by the contraction caused by COVID-19, they would have been worse off without income support. It has been argued that current levels of COVID-19 related support are, however, insufficient and should be expanded (Köhler and Bhorat 2020, 20).

A SAM multiplier model, based on a SAM for the year ending in the third quarter of 2020, is used to explore various COVID-19-related income support options. The SAM multiplier model (described in Appendix 2) is a useful tool to consider some of the trade-offs that are worth considering. For all interventions, we use the SAM multiplier model in which factor income and distribution thereof as well as household income and expenditure are endogenous. To implement the COVID-19 income support intervention in the modelled economy, incomes of all household deciles are raised by amounts obtained from unpublished National Treasury data, shown in Table 1.

Apart from the specific COVID-19-related income support during the pandemic, reported in rows 16-18, income support is composed of top-ups for a range of existing social benefit channels including child support (rows 1-3), old age support (rows 4-6), disability (rows 7-9), foster care (rows 10-12) and care dependency (rows 13-15). However, in November these top-ups were stopped and only the specific COVID-19 income support was maintained. Since the base SAM that describes the modelled economy represents the year up to the third quarter of 2020, the July-September income support intervention are, in principle, already captured in the underlying model data. Thus, the SAM used for modelling here incorporates some aspects of the grants but not all. It is derived by only applying demand shocks to the 2019 SAM. These demand shocks are 'measured' by looking at the data, so they are in fact outcomes of the working of the economy. In the third quarter 2020 SAM, the household expenditure shocks, which are derived from the expenditure GDP figures, will include the impact of the grants on household expenditure. While government expenditure shocks would also be captured by the national accounts they

do not include transfers. The SAM described in Appendix 1 accounts for these transfers assuming that they are in the same ratio to government expenditure as they were in 2019 in an effort to match savings of enterprises, households, and government to the national accounts as well as possible. For purposes of modelling transfers here, i.e., beyond the third quarter of 2020, the base SAM does not account for these transfers in government finance and related savings–investment to avoid possible double counting. This SAM is therefore a slight variation on the one described in Appendix 1.

Table 1: Income support details for the period July–December 2020.

		July	August	September	October	November	December
	Child support						
1	Beneficiary	7,176,924	7,201,867	7,215,275	7,227,030		
2	Top-up value per beneficiary	500	500	500	500		
3	Expenditure (Rm)	**3,588**	**3,601**	**3,608**	**3,614**		
	Old age, including war veterans						
4	Beneficiary	3,695,946	3,697,156	3,697,549	3,705,893		
5	Top-up value per beneficiary	250	250	250	250		
6	Expenditure (Rm)	**924**	**924**	**924**	**926**		
	Disability						
7	Beneficiary	1,064,944	1,060,392	1,056,921	1,053,996		
8	Top-up value per beneficiary	250	250	250	250		
9	Expenditure (Rm)	**266**	**265**	**264**	**263**		
	Foster care						
1	Beneficiary	361,175	359,852	370,005	373,528		
1	Top-up value per beneficiary	250	250	250	250		
1	Expenditure (Rm)	**90**	**90**	**93**	**93**		
	Care dependency						
1	Beneficiary	157,157	157,056	157,260	157,542		
1	Top-up value per beneficiary	250	250	250	250		
1	Expenditure (Rm)	**39**	**39**	**39**	**39**		
	Social relief of distress						
1	Paid recipients	5,565,222	5,962,787	6,023,725	6,115,659	5,943,494	5,255,609
1	Value per beneficiary	350	350	350	350	350	350
1	Cost based on paid recipients (Rm)	1,948	2,087	2,108	2,140	2,080	1,839
	TOTAL (Rm)	**6,856.10**	**7,006.50**	**7,036.40**	**7,076.70**	**2,080.20**	**1,839.50**

Source: Adapted from unpublished South African National Treasury data

As a hypothetical set of scenarios, the impact of the full third quarter intervention will be explored against the trimmed-down fourth quarter intervention package over the period from the fourth quarter of 2020 to the third quarter of 2021, given:

- a flexible budget deficit;
- increased taxes for the highest income decile; and
- cutbacks in government general expenditure on goods and services.

For the third quarter of 2020, the full COVID-19 intervention, including top-ups, amounts to just under R21 billion income support. In the second month of the fourth quarter (November) the top-up measures dropped out and the total amount was reduced to almost R11 billion. Both interventions will be explored as hypothetical scenarios. Since the base SAM represents annual data for the third quarter of 2020, the interventions are modelled as if they will last for the next four quarters. Results are reported as annual change from the base SAM to the third quarter of 2020. The trimming of the top-ups came into effect during the 2nd month of the fourth quarter of 2020. The annual version of this "Covid lite" intervention assumes that these top-ups are not making a come-back and the next three quarters only account for the COVID-19 specific income support. This amounts to R6 billion per quarter. Thus, the annual amount of the "Covid lite" intervention is therefore R11 billion plus three times R6 billion, a total of R29 billion on an annual basis. The full COVID-19 intervention is 4 times the R21 billion (i.e., R84 billion).

The hypothetical interventions described here are initially funded by government savings (scenarios 1 and 2). Therefore, the initial impact on government finance is a reduction in its gross savings by the same amount. This may or may not be offset by increased domestic non-government savings on the back of increased incomes of the relevant institutions (enterprises and households) and foreign savings (given changes to imports) but this is not accounted for here. Moreover, investment is assumed to be exogenous and its matching to total changes in savings is also ignored in this model. Both possible macro-adjustments are the domain of a CGE model.

It is not the intention here to explore the impact on poverty as this has been done in great detail elsewhere by the National Income Dynamics Study – Coronavirus Rapid Mobile Survey (NIDS-CRAM) investigations (see for example, Köhler and Bhorat (2020)). Rather, the focus is on examining some of the economy-wide impacts that do not enter the poverty equations. However, to do so requires the intervention to be specified at the level of the household categories identified in the SAM. In that way, differential household income and expenditure patterns are accounted for. The values of the income support measures reported in Table 1 need to be distributed across households by income group. Bhorat et

al. (2020: 8) offer estimates of such distributions by income decile for a range of support measures, as shown in Table 2.

Table 2: NIDS/CRAM (Wave2) income distributions for COVID-19 income support.

	Old age grant	Disability grant	Child support grant	COVID-19
D1	4.5	2.8	15.6	12.7
D2	10.7	10.1	15.2	12.9
D3	11.5	13.4	14.8	14.3
D4	15.3	13.5	13.5	11.2
D5	13.8	14.2	13.2	12.0
D6	13.2	17.6	11.1	8.9
D7	12.9	15.0	8.2	9.3
D8	8.3	7.0	5.3	10.0
D9	7.4	4.8	2.8	5.9
D10	2.4	1.4	0.2	2.9
	100	100	100	100

Source: Adapted from Bhorat, Oosthuizen and Stanwix (2020: 8)

Note: The authors also identify a broad COVID-19 recipient category. For the strict definition individuals must be aged 18 years and above; unemployed according to the narrow definition; have no income from any source; not be a grant recipient; not be receiving income from UIF; and not be a student studying for a certificate without matric to bachelor's degree, or NCV2-4, N1-N6 qualifications.

In addition to funding the COVID-19 interventions described above by initially reducing government savings with the same amount, it may be of interest to explore other budget balancing options. One could be to raise taxes of high-income households, in particular those in the top decile. This can be approximated by reducing their income with the same amount of the COVID-19 interventions. The SAM identifies five income groups in the top decile. The shares of these income groups in total tax payments of the full decile are used to distribute the burden of financing the COVID-19 interventions. While this approach is hypothetical, including timing of introducing legislation to this effect, modelling it in this way allows for the impacts to be combined and assessed as a package in the setting of a laboratory environment in which the rest of the economy does not change. Similarly, it would be possible to reduce government spending on goods and services as a way of initially financing the COVID-19 interventions.

Finally, during the pandemic there has been talk about income support as discussed in a stylized way in the previous sections, as well as wage support. In the case of the latter, the government makes transfers to firms who use it to keep their workers employed although they do not undertake any work. As

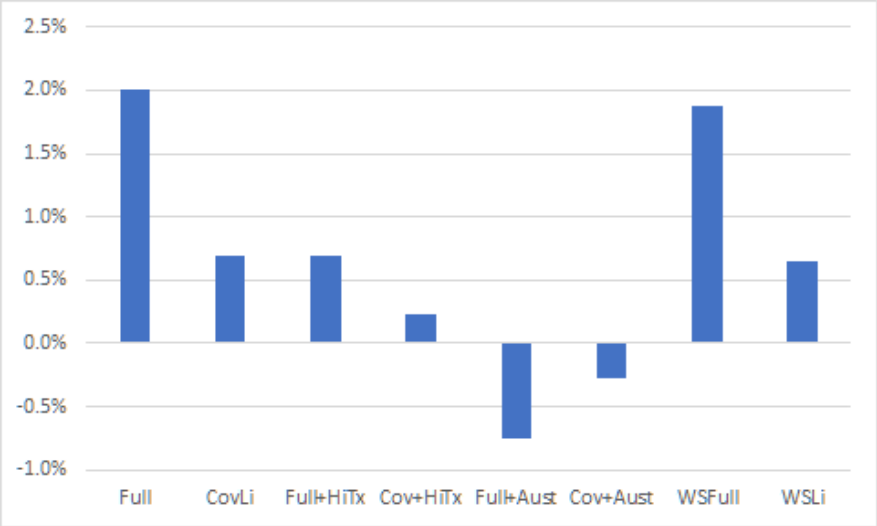
the South African economy started opening up, the need for wage support may have become less but could still be considered. While this intervention can easily be implemented in a SAM-based multiplier model, there may be more practical issues on the ground than in an income support program, since the latter is largely already in place and only needs expansion in order to transfer more funds. In the modelled economy we credit the two least educated labour categories, i.e., those with primary education or less and those with unfinished secondary education. The underlying data drawn from the Labour Force Survey does not account for on-the-job training or similar. Another complication is that the transfer directly impact GDP since wage earnings are part of it. A correction is made so as to maintain consistency when comparing the impact on GDP across scenarios.

Given the above, the scenarios given in Table 3 will be explored for the year from the fourth quarter of 2020 to the third quarter of 2021 (with the scenario code for this paper in parenthesis).

Table 3: List of simulations undertaken

1	Full	Full COVID-19 intervention (R84 billion) financed by reducing government savings
2	CovLi	Reduced COVID-19 intervention (R29 billion) financed by reducing government savings
3	Full+HiTx	Full COVID-19 intervention (R84 billion) financed by raising high income (Decile 9) taxes
4	CovLi+HiTx	Reduced COVID-19 intervention (R29 billion) financed by raising high income (Decile 9) taxes
5	Full+Aust	Full COVID-19 intervention (R84 billion) financed by reducing government expenditure
6	CovLi+Aust	Reduced COVID-19 intervention (R29 billion) financed by reducing government expenditure
7	WSFull	Wage support intervention (R84 billion) financed by reducing government savings
8	WSLi	Wage support intervention (R29 billion) financed by reducing government savings

Figure 4: Impact on GDP (in the third quarter of 2020 at market prices)

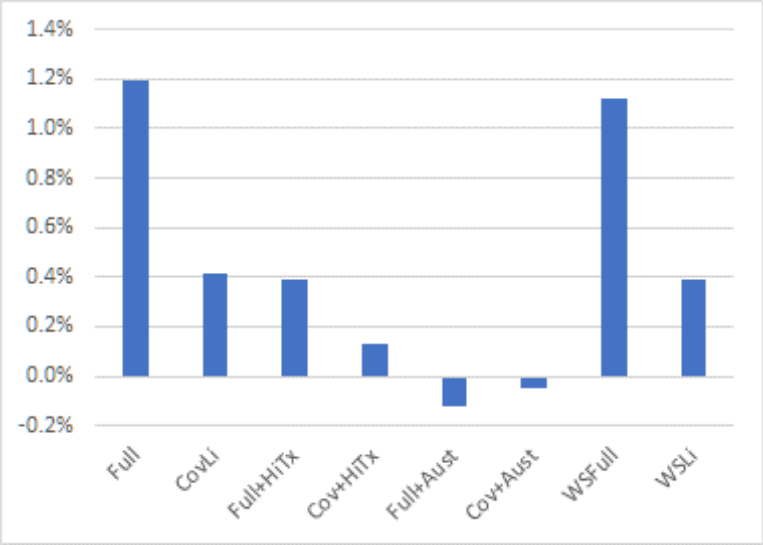


Source: Own calculations

Headline results for GDP at market prices are shown in Figure 4. The full intervention (Full) funded by reduced government savings adds 2% to GDP (at market prices) over the period of observation, i.e., the year to the third quarter of 2021. In comparison, the "Covid lite" option (CovLi) which cuts the top-ups of the existing social benefits, contributes less than half, or 0.7%, to GDP. An increase in GDP of 0.7% is achieved if the full COVID-19 intervention is matched by raising taxes of the top decile (Full+HiTx). The reason for the lower impact, in spite of the full amount of income support being disbursed, is that high-income households will spend less in order to pay for higher taxation. This will bring GDP down from 2% as shown in the first bar of the graph to 0.7%. There is no such off-setting mechanism at play for the first scenario, in which government savings were reduced in a multiplier model (as discussed earlier) since investment is not affected by reduced government (or any other) savings in this model. Similarly, the combination of the "Covid Lite" intervention and higher taxation of the top decile households (CovLi+HiTx) is down to 0.2% from 0.7%.

Such reductions in GDP are even greater when, in scenarios 5-6, the COVID-19 interventions are funded by matching cuts in general government expenditure on goods and services (Full+Aust) and (CovLi+Aust) to the point that the impact on GDP is negative. The reason that the impact is more negative than taxing high-income households to the same amount is that it is assumed that their income is reduced, and part of that reduced income would have been saved and used for paying tax. Thus, only part of the reduced income is translated into reduced demand while the offsetting reduction in government expenditures are assumed to impact demand initially to the full extend. Moreover, government expenditure is directly (i.e., without indirect effects) less import-intensive than expenditure of high-income households and therefore hits the local economy harder, in this case in a negative way.

Figure 5: Impact on employment.



Source: Own calculations

Wage support to the same value as the COVID-19 interventions funded by lower government savings (WSFull and WSLi) have a similar but slightly lower impact as the first two scenarios (Full and CovLi). The reason here is that based on income distribution patterns of the underlying SAM, a higher share of the hypothetical wage support (to the lowest two labour categories) trickles through to high-income households than the distributions of the COVID-19 interventions, as shown in Appendix 2. Since high-income households save more and pay more tax, the demand leakage out of multiplier process is higher and the impact on GDP is lower.

A similar, but not identical, pattern of results for employment can be found in Figure 5. In general, impacts vary across macro variables such as GDP and employment, because they are weighted averages of detailed activity-level results. In the case of employment, the weights depend on the degree of labour intensity of activity-level production. Moreover, as discussed in Appendix 2, the impact on employment is also adjusted for employment-output elasticities. The estimates of these elasticities vary across industries as well as across labour category and are typically less than one. As a result, the impact on employment is typically more muted than on GDP. This applies in particular to the scenarios in which the funding of the COVID-19 interventions is achieved by government expenditure cuts (Full+Aust and

Cov+Aust). These (direct and indirect) impacts appear to weigh less on activities with high employment – output ratios as well as employment – output elasticities than in the case of, for example, the first scenario in which the full COVID-19 intervention is funded by government savings. Employment losses are therefore somewhat limited for these scenarios.

Table 4: Detailed GDP impacts for the top 15 industries (scenarios 1,3, 5 and 7), off base SAM levels.

#	Full	Impact on GDP (%)	Full+HiTx	Impact on GDP (%)	Full+Aust	Impact on GDP (%)	WSFull	Impact on GDP (%)
1	Food	4.70	Food	3.10	Food	2.70	Food	3.90
2	Agriculture	4.40	Agriculture	3.00	Agriculture	2.60	Apparel	3.70
3	Apparel	4.20	Air transport	2.60	Forestry	2.10	Agriculture	3.60
4	Air transport	4.10	Forestry	2.60	Apparel	2.00	Air transport	3.50
5	Footwear	3.90	Land transport	2.50	Air transport	1.90	Footwear	3.40
6	Forestry	3.90	Apparel	2.40	Footwear	1.80	Land transport	3.40
7	Land transport	3.80	Footwear	2.30	Land transport	1.70	Beverages+	3.20
8	Beverages+	3.40	Water transport	2.00	Water transport	1.40	Forestry	3.00
9	Water transport	3.20	Beverages+	1.70	Beverages+	1.40	Health & social	3.00
10	Fishing	3.20	Other chemicals	1.50	Fishing	1.30	Education	3.00
11	Health & social	3.10	Other manufacturing	1.40	Electricity & gas	1.10	Water transport	2.90
12	Other chemicals	3.10	Electricity & gas	1.30	Textiles	1.00	Electricity & gas	2.80
13	Electricity & gas	3.10	Textiles	1.30	Other chemicals	0.90	Real estate	2.80
14	Textiles	2.80	Fishing	1.20	Other manufacturing	0.80	Other chemicals	2.80
15	Education	2.80	Glass	1.20	Plastic	0.80	Fishing	2.70

Source: Own calculations.

Detailed industry level results for GDP are shown in Table 4 for the four variations (scenarios 1, 3, 5 and 7 described above) of the full COVID-19 intervention.

Food, agriculture, apparel, footwear and textiles, transport, health, education and electricity are the typical industries that are likely to benefit directly and indirectly from the interventions. The results closely follow household expenditure patterns with only slight differences. Some industries, such as agriculture and other chemicals, are more likely to be impacted indirectly.

Employment results are reported in Table 5. Industries with relatively high employment-output ratios and employment-output elasticities benefit more such as agriculture and forestry but as mentioned

above, the impact is more likely to be indirect. Some services activities, including real estate, other business services, and computer services now appear in the top 15 for similar reasons.

Income distribution impacts of COVID-19 interventions have been examined elsewhere (see Bhorat, Oosthuizen and Stanwix (2020); Köhler and Bhorat (2020)) in more detail. Given the limited number of household groups, there is not much that can be added to this growing body of literature. However, with the multiplier model it is possible to add features to this analysis that would otherwise not be possible. In particular, the question can be raised what the direct *and indirect* impacts on income distribution are. Results for the Full scenarios funded by government savings (Full, columns 1–3), higher taxes (Full+HiTx, columns 4-6) and government expenditure reduction (Full+Aust, columns 7-8) scenarios are shown in Table 6, respectively.

Broadly speaking, and given the crude estimation of income using the 2015 Living Conditions Survey (LCS, see Appendix 3 for discussion) in the base SAM, all scenarios appear to bring about a progressive redistribution of income. The difference is in the way that the COVID-19 intervention is financed. In the standard configuration (columns 1–3), government saving is reduced but that does not impact output nor incomes. In the other two scenarios shown in Table 6 , the intervention is either financed by higher taxes and therefore reduces income of high-income households (columns 4–6) or by cutting government expenditure on goods and services (columns 7–9), both to the same amount as the COVID-19 intervention. The standard scenario (columns 1–3) reveals that, although high-income households do not gain as much directly (column 1), they are expected to gain relatively more from the indirect impact (column 3).

Table 5: Detailed employment impacts for the top 15 industries (scenarios 1,3, 5 and 7), off base SAM levels.

Full	Impact on employ-ment (%)	Full+HiTx	Impact on employ-ment (%)	Full+Aust	Impact on employ-ment (%)	WSFull	Impact on employ-ment (%)
Agriculture	4.40	Agriculture	3.00	Agriculture	2.60	Agriculture	3.60
Forestry	3.90	Forestry	2.60	Forestry	2.10	Forestry	3.00
Footwear	3.30	Food	2.00	Food	1.70	Footwear	2.80
Fishing	3.20	Footwear	1.90	Footwear	1.50	Real estate	2.80
Food	3.00	Air transport	1.40	Fishing	1.30	Fishing	2.70
Electricity & gas	2.80	Fishing	1.20	Air transport	1.00	Electricity & gas	2.60
Real estate	2.80	Land transport	1.20	Electricity & gas	1.00	Food	2.50
Rent equipment	2.70	Electricity & gas	1.20	Land transport	0.80	Rent equip	2.50
Textiles	2.30	Rent equip	1.00	Textiles	0.80	Other bus. services	2.20
Air transport	2.20	Textiles	1.00	Beverages+	0.70	Water	2.10
Other bus. services	2.20	Beverages+	0.90	Plastic	0.60	Textiles	2.10
Water	2.10	Plastic	0.90	Water transport	0.60	Air transport	1.90
Paper	2.00	Paper	0.90	Apparel	0.60	Paper	1.80
Plastic	2.00	Water transport	0.90	Rent equip	0.60	Computer services	1.80
Computer services	1.90	Apparel	0.80	Leather	0.50	Plastic	1.80

Source: Own calculations.

Table 6: Detailed household income impacts for scenarios 1, 3 and 5, off base SAM levels (percentages).

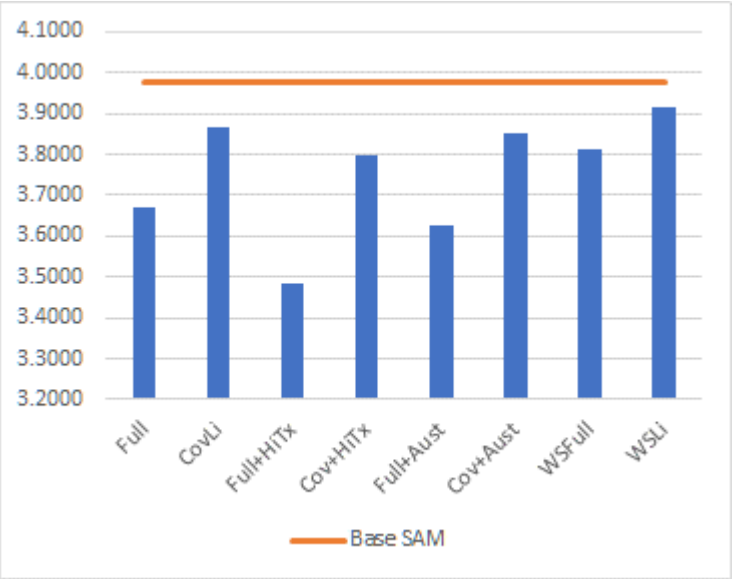
		Full			Full+HiTx			Full+Aust		
		Direct	Dir+Ind	Indirect	Direct	Dir+Ind	Indirect	Direct	Dir+Ind	Indirect
		1	2	3	4	5	6	7	8	9
hhd-0	Decile 1	12.80	13.80	1.00	12.80	13.20	0.40	12.80	12.20	-0.60
hhd-1	Decile 2	10.10	11.20	1.10	10.10	10.50	0.40	10.10	9.50	-0.60
hhd-2	Decile 3	9.00	10.20	1.20	9.00	9.40	0.40	9.00	8.40	-0.60
hhd-3	Decile 4	6.80	8.10	1.40	6.80	7.20	0.40	6.80	6.20	-0.60
hhd-4	Decile 5	6.20	7.70	1.50	6.20	6.60	0.50	6.20	5.60	-0.60
hhd-5	Decile 6	3.80	5.40	1.60	3.80	4.30	0.50	3.80	3.10	-0.70
hhd-6	Decile 7	2.70	4.40	1.70	2.70	3.10	0.50	2.70	1.90	-0.80
hhd-7	Decile 8	1.40	3.10	1.70	1.40	1.80	0.40	1.40	0.50	-0.90
hhd-8	Decile 9	0.50	2.20	1.70	0.50	0.80	0.30	0.50	-0.60	-1.10
hhd-91	tile 90-92	0.10	1.90	1.80	-4.20	-3.90	0.30	0.10	-0.90	-1.00
hhd-92	tile 92-94	0.10	1.90	1.80	-4.20	-4.00	0.20	0.10	-0.90	-1.00
hhd-93	tile 94-96	0.10	1.80	1.70	-4.20	-3.90	0.30	0.10	-1.20	-1.20
hhd-94	tile 96-98	0.10	1.80	1.70	-4.20	-4.00	0.20	0.10	-1.10	-1.20
hhd-95	tile 98-100	0.00	1.80	1.80	-4.30	-4.10	0.20	0.00	-1.10	-1.10

Source: Own calculations.

In the taxation-financed COVID-19 intervention, the direct (column 4) and the final (column 6) distributions are more progressive, although high-income households do manage to claw back some of their income losses from higher taxation, due to the general expansion of economic activity. Still, the indirect income gain is less for high-income than for low-income households. The reason here is that the negative impact of high-income expenditure, due to the tax increase, hits high-income households more than low-income ones, while the opposite is the case of the expansion of low-income expenditure. For high-income households, their own expenditure seems to be more important (negatively) than low-income expenditure (positive).If government expenditure is reduced across the board, all households see their initial gain reduced to some extent. However, high-income households tend to lose more than low-income households.

Another way of considering income distribution aspects is seen in Figure 6, in which the Palma index is shown. This index calculates the ratio of income earned by the top decile to that earned by the bottom four deciles (UNU-WIDER 2015). The share of deciles 4–8 tends to be relatively steady, and most of the income distribution action is likely to take place at the bottom and the top end of the spectrum. The solid horizonal orange line represents the Palma index in the base SAM. A lower value for the index means that low-income households have improved their share in total income relative to high income households. It can be seen that for all scenarios the index has improved. Moreover, the bigger the intervention, the lower the index and the more low-income households improve relatively.

Figure 6: Impact on the Palma Index for total household income.



Source: Own calculations.
Note: Household incomes are measured as base SAM values plus (or minus) the COVID-19 Intervention impacts.

As was mentioned earlier, it should be noted that implementation of such interventions and their financing brings to bear a range of issues that are ignored in this analysis. For one, the timing of introducing new tax legislation is ignored, while, secondly, the detrimental impacts of cutbacks in health and education (as part of scenarios 5 and 6) will put a heavier burden on low-income households, which is also ignored here. Still, the above results are useful in framing the discussion around such issues.

One additional issue that is often raised in the discussion is the impact on government debt. As such, this is not a variable that is typically part of a multiplier model. We can, however, work out ex-post what the impact on tax revenues is, due to the change in the level of economic activity for each scenario, and subtract this from the initial outlay of the interventions to arrive at a net impact on government savings, assuming that its consumption of fixed capital that is part of gross savings remains constant. Debt servicing costs are also ignored in what follows. The results are shown in Table 7.

Table 7: Impacts on government savings and the government debt-to-GDP ratio.

	Scenarios	1	2	3	4	5	6	7	8
		Full	**CovLi**	**Full+HiTx**	**Cov+HiTx**	**Full+Aust**	**Cov+Aust**	**WSFull**	**WSLi**
1	Endogenous direct tax impact (ent and hh)	17	6	-12	-4	-4	-1	19	7
2	Exogenous direct tax change (hi inc hh)	0	0	84	29	0	0	0	0
3	Net direct tax impact (row 1 + row 2)	**17**	**6**	**71**	**25**	**-4**	**-1**	**19**	**7**
4	Net indirect tax impact	16	6	5	2	1	0	15	5
5	Net all tax impact (incl indirect tax, row 3 + row 4)	**33**	**11**	**77**	**27**	**-3**	**-1**	**34**	**12**
6	Reduced government expenditure	0	0	0	0	84	29	0	0
7	Government COVID intervention	84	29	84	29	84	29	84	29
8	Impact on government savings (row 5 + rows 6–7)	**-51**	**-18**	**-7**	**-2**	**-3**	**-1**	**-50**	**-17**
9	Government debt to GDP ratio in base (av. for year to third quarter of 2020	61.70%	61.70%	61.70%	61.70%	61.70%	61.70%	61.70%	61.70%
10	GDP in base SAM	5,010	5,010	5,010	5,010	5,010	5,010	5,010	5,010
11	Government debt in base (row 9 x row 10)	3,090	3,090	3,090	3,090	3,090	3,090	3,090	3,090
12	Government debt in base + impact on govt savings (row 11–row 8)	3,141	3,108	3,097	3,093	3,093	3,091	3,140	3,108
13	GDP in base SAM + impact on GDP	5,111	5,045	5,045	5,022	4,973	4,997	5,104	5,043
14	Government debt-to-GDP ratio in scenarios (row 12, row 13)	61.50%	61.60%	61.40%	61.60%	62.20%	61.90%	61.50%	61.60%
15	Percentage point change in government debt-to-GDP ratio (row 14 – row 9)	**-0.20%**	**-0.10%**	**-0.30%**	**-0.10%**	**0.50%**	**0.20%**	**-0.20%**	**-0.10%**

Source: Own calculations.

Government tax revenues in the multiplier modelled economy consist of direct taxes (corporate tax on enterprises and income tax on households), as well as indirect taxes on activities (production taxes) and on goods and services (sales taxes and import duties). Direct tax revenues are affected because the multiplier impact on economy activity changes incomes of enterprises and households. These impacts are shown in the first row of Table 7. Because the tax rate of high-income households is higher than that of low-income households, the former outweighs the latter when negative shocks are introduced in scenarios 3-6, where the income transfers are initially funded by higher taxes on high-income (scenarios 3–4) and government expenditure reductions (scenarios 5–6). Moreover, scenarios 3–4 assume that tax on high-income households will increase to offset the government outlay on the COVID-19 intervention. This is a straight fiscal redistribution and reported as additional government revenues in row 2. The net impact on direct tax revenues in row 3 is the sum of rows 1–2. The impact on indirect taxes is reported in row 4, and the net impact on all tax revenues in row 5 as the sum of rows 3–4. Scenarios 5 and 6 assume a reduction in government expenditure to initially balance the government books, as can be seen in row 6, while the government's COVID-19 intervention is shown in row 7. The change in the fiscal position is the impact on government savings, the results of which are shown in row 8. Scenarios 1–2 and 7–8 have a marked negative impact on government savings since there is no offsetting non-savings measure associated with them. The other scenarios (3–6) seek to off-set the government outlay by raising taxes (scenarios 3–4) or reducing expenditure (5–6), and the initial impact on government savings is therefore relatively small, as can be seen in row 8.

Row 9 shows the government debt to GDP ratio in the base. For this purpose, the unweighted average of these ratios for the 4 quarters that make up the year to the third quarter of 2020 is taken from the SARB Quarterly Bulletin's total net loan debt (SARB. 2021a:S-55). Given the base level of GDP at market prices in the SAM (see row 10), the matching level of average government debt for the year to the third quarter of 2020 is calculated in row 11 as the product of rows 9 and 10.

In row 12 the reduction in government savings (row 8) is then added to base level government debt (see row 11) while the impact on GDP (see Figure 4) is added to the base level of GDP in row 13.

The implied government debt to GDP ratio for each scenario is taken as the ratio of rows 12 and 13. Thus, both the numerator and denominator of the new government debt to GDP ratio have changed. The percentage point difference in the base (row 11) and new (row 14) ratio is shown in row 15.

The government debt to GDP ratio declines in all scenarios except those that aim to offset the COVID-19 intervention by means of reduced government expenditure, in spite of these scenarios having the least negative impact on government savings. The reason is that the reduction in government expenditure in and of itself has a negative impact on GDP and reduces the denominator of the debt to GDP ratio. The government savings financed options of COVID-19 interventions (columns 1–2), and wage support (columns 7-8) reduce the government debt to GDP ratio mainly because of the positive impact on GDP. The straight redistribution scenarios of taxing high-income households to fund COVID-19 interventions has a combination of impacts on the debt to GDP ratio. On the one hand it limits the reduction in savings while it has a relatively smaller positive impact on GDP.

This is not to say that these measures will play out as suggested above. Higher taxation may reduce incentives for high-income households to continue making their endowments of the factors of production (scarce highly skilled labour and capital) available for productive use. Micro-level research may be required. Therefore, actual impacts on direct tax revenues are unclear. Finally, government debt financing costs are also ignored here.

Other considerations

The above analysis was based on the third quarter 2020 SAM we constructed. As emphasized in the introduction, not all the data we require for constructing a robust SAM representation of the third quarter of 2020 are available. There is little available to say how consumption expenditure patterns or income distribution changed during the pandemic.[4] We have used what are available as best we can to construct the base SAM. In this section we highlight some of the areas in which we are aware that the constructed

[4] This is surprising given the concern of policy makers with poverty and inequality.

SAM has shortcomings, and discuss what their implications may be for the foregoing analysis. The third quarter 2020 SAM does not capture the behaviour of savings and of imports well. We discuss each of these below.

Savings

Two striking aspects of savings under the pandemic emerge from the national accounts data for the period of the first to fourth quarters of 2020. The level of national savings (and thus investment) dropped significantly, and its composition changed. The movement of savings under the pandemic is relevant for recovery as it provides some indication of how the economy is positioned to grow. The position of institutional savings and debt at the end of the period gives some indication of how savings might be able to perform in the future. So it is interesting to look at both the level and the compositional change in savings.

Savings in the SAM are based on proportions in 2019. As such they overstate the level of savings. SARB publishes quarterly flow of funds (FoF) accounts, with some relevant data. When we constructed the third quarter 2020 SAM, the latest FoF accounts available were for the first quarter of 2020. We now have the second and third quarters of 2020. We refer to these data in this paper, even though they are not entirely consistent with the SAM used in the multiplier analysis. The FoF data are available only in current price, not seasonally adjusted terms. We deflated using a deflator derived from gross domestic expenditure. But we cannot easily take care of seasonality. The FoF shows institutional savings and investment, where the institutions are households, financial corporations, non-financial corporations government, and the rest of the world. There is some disaggregation of these categories, which we will use to explore further.

Table 8: Gross savings and its components as a percent of GDP.

Year	Households	Corporations	Government	Domestic	Foreign	Total
2019 average	-1.2%	13.5%	-0.2%	12.1%	3.1%	15.1%
First quarter 2020	-0.7%	14.1%	-0.7%	12.7%	0.6%	13.3%
Second quarter 2020	6.3%	15.3%	-9.0%	12.5%	1.2%	13.7%
Third quarter 2020	5.4%	21.1%	-11.1%	15.4%	-4.8%	10.6%
Fourth quarter 2020*	-0.5%	16.6%	-0.9%	15.2%	-4.8%	10.3%

Source: Author's estimations using SARB flow of funds.
Note: This quarter of 2020 is based on national accounts data different from the flow of funds used for the other periods

Total savings fell relative to GDP in each quarter of 2020, reaching 10.3 percent in quarter 4 (see Table 8). Given that GDP itself was falling, the contraction in level terms was substantial. In current price terms, national savings in the third quarter of 2020 were 57% of their level in the same quarter of 2019. The figures refer to gross savings, so they include consumption of fixed capital.

Despite the problems of estimating depreciation in national accounts, these numbers are sufficiently large to suggest that net investment was negative. This accords with our intuition that the pandemic would have induced firms to put on hold any expansionary plans. But the negative net investment suggest capital was lost in during the pandemic. Lost productive capacity was not replaced.

Based on the 2019 and third quarter 2020 SAMs, there is a marginal improvement in household non-retirement saving. It is concentrated among the wealthiest 2 per cent of households, where savings rose from 0.8 percentage points to 6.6% of gross income. An increase in transfers from households to enterprises is also observed across households, particularly in the top decile.

There is a high risk that increases in savings could be reversed, particularly as demand for liquid assets and precautionary savings are likely to ease as growth returns. However, with low employment and heightened uncertainty, this reversal is likely to be slow.

Interpreting depreciation from the national accounts as showing loss of physical productive capacity is problematic, since consumption of fixed capital is essentially an accounting concept which in practice is strongly related to tax allowances for depreciation, rather than as actual scrapping of machines. It would be useful if we had other data to confirm this macroeconomic observation.

Table 9: Net savings and its components as a percentage of GDP.

Year	Households	Corporations	Government	Domestic	Foreign	Total
2019 average	-0.2	2.8	-2.2	0.5	3.1	3.5
First quarter 2020	-2.2	3.7	-2.6	-1.1	0.6	-0.4
Second quarter 2020	4.8	2.7	-11.7	-4.3	1.3	-3.0
Third quarter 2020	4.2	11.0	-13.9	1.4	-5.1	-3.7
Fourth quarter 2020*	-1.9	6.0	-2.7	1.3	-4.9	-3.6

Source: Authors' calculations based on SARB FoF
Note: * This quarter of 2020 is based on national accounts data, differently from the flow of funds used for the other periods

The data presented in Tables 7 and 8 show that, not only did the level of savings fall relative to GDP, but the institutional composition of savers changed significantly. The striking changes are that:

- domestic savings remain roughly proportional to GDP, but foreign savings became negative; and
- within domestic savings, government became a significant dis-saver and corporations increased their savings.

It is the decline in foreign savings that has driven the overall decline. This reflects the much faster recovery of exports than of imports. The shift in the composition of domestic savings reflects the government deficit rising in part through providing support to households and businesses as it attempted to offset the effects of the pandemic and lockdown. So that is to be expected. The overstatement of savings in the SAM does not change the multiplier since that depends on interindustry flows and the composition of the supply of products.

Imports

The SAM for the third quarter of 2020 also overstates imports. In the multiplier model imports are endogenous and estimated assuming that the composition of supply of each product remains fixed. However, the national accounts reveal that imports fell relative to GDP during the pandemic and have been slow to recover.

Table 10: Indices of imports in 2020 by quarter.

	Description	Shares 2019	Index (average 2019 = 100)			
			First quarter	Second quarter	Third quarter	Fourth quarter
1	Intermediate inputs	40.7%	93.3	79.3	81.9	90.0
2	Consumption	16.3%	92.9	94.3	99.4	104.7
3	Capital	25.1%	84.3	87.0	93.9	98.9
4	Transport equipment	12.2%	84.9	55.4	60.1	79.6
5	Mixed	5.7%	112.0	61.6	99.2	75.7
6	Total	100.0%	91.0	79.8	86.1	92.5

Source: Authors' estimates based on (South African Revenue Service various dates)
Note: Current price imports are deflated by the implicit import deflator derived from the national accounts

To see whether the decline in imports was focused on particular types of imports, we converted the SARS data to the basic economic classification. This allows us to consider the changes in imports according to the broad groups shown in Table 10. Imports for consumption fell the least and had recovered to their pre-COVID-19 levels (in current price terms, by the third quarter. Capital goods imports also recovered rapidly. The data in Table 11 refer to imports of goods only.

Table 11: Quarterly indices of real service receipts and payments (2019 = 100).

Description	2019 average	First quarter	Second quarter	Third quarter	Fourth quarter
Service receipts	100.0	99.8	41.4	39.1	43.6
Service payments	100.0	90.7	64.0	59.9	63.2

Source: Authors' estimates based on South African Reserve Bank (2021)
Note: Current price imports are deflated by the implicit import deflator derived from the national accounts

The implied import intensity of household consumption has fallen and is relatively higher for the third through sixth consumption deciles. A comparison of the 2019 and third quarter of 2020 SAM shows a decline in the import share (imports as a percentage of total commodity supply) of key consumer goods. These include fats and oils (67% to 56%), wearing apparel (53% to 35%), and domestic appliances (75% to 54%). A lower import intensity suggests that the stimulatory effect of household spending on domestic production is higher. Whether these reflect a temporary pause in import demand, or a more durable substitution towards locally produced goods, remains uncertain.

The implied import intensity of capital goods has not changed dramatically, and more likely reflects temporary stoppages to import orders. Import intensity of aircraft fell from 59% of total supply in

2019, to 37 per cent in the third quarter of 2020. Purchases of foreign-based legal, accounting, and related services increased, representing 39 per cent of total supply in the third quarter of 2020, from 27 per cent in 2019.

Unlike savings, the overstatement of imports in the SAM of the third quarter compared to the level reported in the national accounts does affect the multiplier used in the earlier analysis. On the face of it, we might expect the actual multiplier to be higher than that derived from the SAM of the third quarter, since it means that less demand leaks out of the economy, but the issue is more complicated than that.

SAM multipliers depend in part on the shares of domestic and foreign sources in the supply of each product. As the share of domestic supply rises, so the multiplier rises. However, that views the issue from the demand side. It assumes that imports can easily be replaced by domestic production, which depends on whether or not the imported products are close substitutes for domestic products. If imports cannot be easily replaced, their drop will constrain production from the supply side. It is also possible that producers are supply constrained for other reasons.

We thus do not know whether the overstatement of imports in the SAM of the third quarter leads to an over- or under-estimation of the multiplier. Resolving this is an empirical question requiring more detailed data than we have available. Table 10 shows that intermediate imports were more heavily hit in the second quarter, and have recovered less rapidly, than consumer goods. This might suggest that the supply reducing effects on the multiplier dominate the demand expanding effects, but this is speculative.

It would be interesting, and potentially useful, to explore this issue in more depth. The dependency school of thought argued that import-substituting industrialization in Latin America was stimulated by the collapse in global trade in the 1930s, which provided a form of natural protection. One might expect the disruption to global trade under the pandemic to provide a similar stimulus. However, the more integrated nature of global production and global value chains now will likely offset these potential protective effects.

These effects also depend on whether the decline in imports is sustained over a long enough period to allow the structure of the economy to move permanently towards import-substituting and thus higher multipliers. This is a question that has to be addressed when exploring longer term reconstruction paths.

Employment

We have not reported on the implications of the multiplier analysis for employment. The impact of the pandemic on employment is complicated by the question of how to treat furloughed workers, who might have received wages (perhaps reduced) from their employers even though they were not working (in the sense of contributing to production). Although it is agreed that employment fell due to the pandemic, the data on recovery is ambiguous and subject to dispute. Casale and Shepherd (2021), based on the NIDS-CRAM survey, reported that "the data from Wave 3 show a substantial recovery, with just over 2.1 million additional jobs recorded in October compared to June". However, the Quarterly Labour Force Survey, which appeared subsequently, showed employment increasing by 0.3 million in that quarter.

It is not possible to undertake a full examination of the labour market implications of COVID-19 in this paper. Köhler, et al. (2021) provide a thorough descriptive and analytical investigation of its impact on the labour market. Their most relevant conclusion for this study is that the most marginalized workers have suffered most, by almost whatever measure of marginalization one chooses. This accords with stylized facts about the impact of the pandemic on employment in many countries.

5. CONCLUSIONS

We chose an economy-wide approach because it allows for macro-economic considerations as well as meso-level detail, at broad industry and household level. The latter is important since the distribution of the burden of the pandemic is unequal. Poor members of society carry relatively more of the burden, so we used a framework that integrates distribution with production and growth. Macro models overlook this dimension.

Since the massive decline in economic activity observed in April 2020, production in most sectors has returned close to 2019 levels. However, the recovery has been unbalanced, with construction and transport services continuing to lag. The decline in construction activity is linked to lower investment, which, despite lower borrowing costs, has been affected by the pandemic and responses to it, policy uncertainty, and structural constraints. Employment in the construction sector – which employs more than 10 per cent of primary- and middle-educated labour - is weakening further.

On aggregate, household spending has recovered beyond 2019 levels, reflecting both the recovery of production and high levels of government support to households. But poorer households remain vulnerable, particularly those without access to income support measures.

In our modelling, we simulate the impact of financial support to poorer households as a recovery policy, using different financing methods. We find that net effects on GDP are positive when financed through higher taxes or debt, and negative when financed through reprioritization of government expenditure. Food, agriculture, apparel, footwear production, and employment increase as income support boosts expenditure at lower deciles. The modelled policy scenarios are all pro-poor, with lower-income deciles benefiting relatively more than wealthier household groups. Notably, except where austerity measures are used to fund income support, increases in government dis-savings are more than offset by increases in broader economic activity including associated tax revenue. Thus, government debt ratios ease in those scenarios.

Overall, we conclude that the South African government has been justified in considering and implementing aggressive intervention policies. Maintenance of these policies is appropriate as long as public health measures to restrain the spread of COVID-19 also constrain economic activity. At the same time, there is little scope to expand interventions before the economy encounters the structural constraints that were severely depressing economic growth rates before the pandemic. Assuming that vaccines allow return to more normal behaviour towards the end of 2021, government needs to consider both tapering off extraordinary COVID-19 support programs and addressing structural growth constraints.

South Africa's structural reform agenda already emphasizes improvements in network industries and competitiveness to improve economic performance, and employment. The impact and consequences of COVID-19 have also brought forward the importance of building resilience and adequate policy space to support vulnerable groups. An inclusive, post-pandemic trajectory should also give focus to interventions that support the development of health and food systems, skills development in a rapidly transforming business landscape, urban structure, and the role of public and private institutions in driving these changes.

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APPENDICES

Appendix 1. Data and construction of the third quarter of 2020 social accounting matrix

Data in an economy-wide framework

Many sources of data exist for tracking the course of the economy over the past year. Statistics South Africa (SSA) and the South African Reserve Bank (SARB) have produced their regular quarterly GDP, which provide an overview of the economy's performance. SSA has also published its standard monthly and quarterly series related to performance in various subsectors, as well as employment data. There are detailed figures related to exports and imports of goods available from SARS. There have also been numerous publications related to COVID-19 itself. NIDS-CRAM have carried out surveys of households that give remarkable insights into the impact of the pandemic and lockdown on individuals and households. SSA has several surveys. Various other organizations, such as Trade and Industrial Policy Strategies (TIPS), have tracked aspects of the pandemic. All of these data do permit fairly extensive stories to be told. However, they do not cover everything we would like to know. And the stories they tell are not always consistent.

Our main interests are in what has happened to production and income distribution. While we can get some idea of this from individual sources, it is hard to get data which show how movements in the two might be related. Social Accounting Matrices (SAMs) provide a framework which brings together data from disparate sources in a way which describes the circular flow of income from the generation of income and outputs in production, how it is distributed to households, government, and other institutions, and how those institutions use it in created demand for goods and services, savings, and taxation. SAMs also provide the data for estimating multipliers and constructing computable general equilibrium and other economy-wide models. This is a useful framework for discussing data and how it casts light on the nature of the economy after COVID, while reviewing the available evidence is also useful for getting some insights into where recovery might happen.

Recovery depends on many things. If we think of the shocks as having come from the demand and supply sides, it is useful to consider recovery from this angle too. Many of the drivers of recovery come from demand. In modelling the shocks, we considered that sectors might be affected by both falling demand and by falling capacity to supply. In such circumstances, the actual outcome depends on the short side of the market. Output will be determined by which is the binding constraint. So it is for recovery also: if there is insufficient demand, it does not matter what the capacity to produce is. If supply is constrained, it does not matter what demand is.[5] Recovery consists of removing the binding constraint. We can summarise this in a simple accounting identity:

$$\underbrace{X}_{\text{Gross Output}} + \underbrace{M}_{\text{Imports}} = \underbrace{PCE}_{\text{Private Consumption Expenditure}} + \underbrace{G}_{\text{Government Expenditure}} + \underbrace{GFCF}_{\text{Gross Fixed Capital Formation}} + \underbrace{DSTK}_{\text{Net Change in Inventories}} + \underbrace{E}_{\text{Exports}} + \underbrace{INT}_{\text{Intermediate Use}} \quad (1)$$

The supply of any good or service (henceforth "product") in the economy is a composite of what is produced locally plus what is imported plus anything drawn from inventories previously accumulated.[6] Demand is for final and intermediate use. Final demand is for household consumption, government, gross fixed capital formation, addition to inventories, and exports. Of course, for any particular product any of these may be missing. A specific good might only be suitable for final consumption by households, and not for intermediate use. For most data we use, the products are relatively aggregated and thus are likely to have multiple uses.

This standard material balance equation provides a simple framework for systematizing our thinking about recovery. The demand components on the right are driven by different influences. Export demand depends largely on recovery in the global economy, although the strength of the rand also matters. Investment, or gross fixed capital formation depends on firms' expectations of recovery but may be influenced by monetary policy. This item included public sector investment, and so any government

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5 In terms of real output. It is possible that this leads to price increases.

6 In Equation 1 we have combined inventory drawdowns with additions to inventories to show the net change in inventories.

driven infrastructure investment will show up in it. Infrastructure investment may be based on different considerations than private investment decisions; government plays an important role, as it does with government expenditure. And private consumption expenditure by households depends on incomes, wealth, expectations, and a host of other influences.

The accounting identity in Equation 1 applies to each product and in the aggregate national accounts. The national account data are available for each quarter of 2020. Some disaggregated data for products are available, but are patchy, and often refer to outputs and sales of sectors rather than demands and uses of products.[7] Where product data are available, such as for imports, exports, and private consumption expenditure, they are aggregated in using different classifications which makes matching them to each other and to the model categories difficult.

Constructing the third quarter SAM

We constructed a SAM for the third quarter on the basis of a provisional 2019 SAM using a multiplier approach. Firstly, we identified shocks to demand from published data as follows:

1. *Private consumption expenditure:* The quarterly GDP data on household consumption expenditures are grouped into 12 categories. We used final consumption expenditure by households in constant 2010 prices, seasonally adjusted, annualised to derive each quarter's change from the average of 2019. We mapped each of the 104 products in the SAM to these 12 categories and assigned the growth rate for the category to the mapped products. We then scaled these so that the estimated aggregate value matched the aggregate current price value in the national accounts.
2. *Gross fixed capital formation:* The quarterly GDP data on GFCF separate it into 7 types of assets. We used gross fixed capital formation by type of asset at constant 2010 prices, seasonally adjusted, annualised. We mapped the asset types to the GFCF commodities in the SAM (34 of the 104 products in the SAM show flows to investment). We constructed growth rates as deviations from the average for 2019 and scaled these to match the aggregate current price value in the national accounts.
3. *Government consumption expenditure:* We took the general government consumption expenditure from the national accounts.
4. *Exports:* We mapped SARS data to the SUT classification. Since these are current price data, we took year-on-year ratios for each quarter to account for seasonality. However, these remain current price growth rates. The SARS data covers trade in goods. We assumed that

[7] That is, to the left-hand side of Equation 1, rather than the right. Strictly speaking, since they are outcome data, they refer to the interaction between both the left- and the right-hand sides.

exports of individual services change uniformly at the rate that aggregate service exports change at in the balance of payments data.

5. *Other components of final demand.* There are other components of final demand that we do not adjust, in particular change in inventories. These are relatively small.

Having assembled these demand shocks, we applied them to a multiplier model and generated a new SAM. The MacroSAM derived in this way is shown in Figure A1. Effectively we derive the SAM by applying the exogenously determined shocks to SAM12. The multiplier model then generates the elements of SAM11 and SAM21 consistent with these exogenous shocks. SAM22 is entirely exogenous. We derive prior estimates of its elements by applying the appropriate column coefficients from 2019. However, this does not give values that balance the SAM. We therefore use a standard statistical balancing technique to do the final balancing.

We have no external validation of this process. We can however consider how it matches, in aggregate, to GDP and some of its components. GDP is endogenous to the model. However, we expect the model GDP to be close to actual GDP since we have forced consumption, government expenditure, gross fixed capital formation and exports to match the actual figures in aggregate. Subtracting intermediates from both sides of Equation 1, we can rewrite it in its more normal GDP form:

$$\underbrace{GDP}_{\text{Gross Domestic Product}} = \underbrace{\overline{PCE}}_{\text{Private Consumption Expenditure}} + \underbrace{\overline{G}}_{\text{Government Expenditure}} + \underbrace{\overline{GFCF}}_{\text{Gross Fixed Capital Formation}} + \underbrace{DSTK}_{\text{Net Change in Inventories}} + \underbrace{\overline{E}}_{\text{Exports}} - \underbrace{M}_{\text{Imports}} \quad (2)$$

The overbars indicate the exogenous variables we have forced to match their published counterparts. We have left DSTK at its base level and imports are determined predominantly by their shares in total product supply (with marginal adjustments by the balancing procedure). Since imports in practice fell more than GDP, our procedure leads to an overestimate of the actual imports.

Figure A.1.1: MacroSAM for the third quarter of 2020, in billion rands.

	01_Act	02_Com	03_Mar	04_Lab	05_Cap	06_Ent	07_Hhd	08_Gov	09_Atx	10_Dtx	11_Mtx	12_Stx	13_Acc	14_Stk	15_RoW	Total
01_Act	-	9,582	-	-	-	-	-	-	-	-	-	-	-	-	-	9,582
02_Com	5,101	-	1,031	-	-	-	3,028	1,125	-	-	-	-	760	3	1,545	12,594
03_Mar	-	1,031	-	-	-	-	-	-	-	-	-	-	-	-	-	1,031
04_Lab	2,410	-	-	-	-	-	-	-	-	-	-	-	-	-	13	2,423
05_Cap	1,977	-	-	-	-	-	-	-	-	-	-	-	-	-	104	2,081
06_Ent	-	-	-	-	1,069	566	730	170	-	-	-	-	-	-	-	2,534
07_Hhd	-	-	-	2,408	654	1,026	-	274	-	-	-	-	-	-	25	4,386
08_Gov	-	-	-	-	118	82	13	-	94	781	52	477	-	-	1	1,618
09_Atx	94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	94
10_Dtx	-	-	-	-	-	245	537	-	-	-	-	-	-	-	-	781
11_Mtx	-	52	-	-	-	-	-	-	-	-	-	-	-	-	-	52
12_Stx	-	477	-	-	-	-	-	-	-	-	-	-	-	-	-	477
13_Acc	-	-	-	-	-	616	66	2	-	-	-	-	-	-	80	764
14_Stk	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	3
15_RoW	-	1,453	-	15	241	-	12	47	-	-	-	-	-	-	-	1,768
Total	9,582	12,594	1,031	2,423	2,081	2,534	4,386	1,618	94	781	52	477	764	3	1,768	

SAM11 SAM12 SAM21 SAM22

01_Act	Activities	06_Ent	Enterprises	11_Mtx	Import duties
02_Com	Commodities	07_Hhd	Households	12_Stx	Sales taxes
03_Mar	Margins	08_Gov	Government	13_Acc	Accumulation
04_Lab	Wages	09_Atx	Activity taxes	14_Stk	Change in inventories
05_Cap	Gross Operating Surplus	10_Dtx	Direct Taxes	15_RoW	Rest of the world

Source: Authors' construction as described in the text.

Appendix 2. Notes on setting up a SAM multiplier model

The standard input-output model (IOT) is driven by an exogenous increase in final demand for an industry's goods and services. The critical assumption is that all industries in the economy that are directly and indirectly supplying intermediate inputs to satisfy this exogenous increase in final demand can do so. Supply (or output) is perfectly elastic which implies that prices are fixed. A generic IOT model can be presented in the following way:

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

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

$$\mathbf{x} = \left(\mathbf{I} - \mathbf{A}\right)^{-1}\mathbf{f} = \mathbf{L}\mathbf{f} \quad (3)$$

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

In which

x = a column vector of industry outputs in an economy (**Δx** denotes a change in outputs)

Z = a matrix of intermediate sales / inputs in an economy

f = a column vector of final demand of goods and services supplied by industries in an economy (**Δf** denotes a change in final demands), consisting of the sum of household demand, government expenditure, investment demand and exports

i = a column vector of unit values, so that **Zi** is a column vector of intermediate sales summed over all industries

A = a matrix of intermediate demands per unit of industry output for an economy. This is derived by dividing **Z** with the transpose of **x**, i.e., the column totals

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 **L** are referred to as the "output multipliers". Comparison of output multipliers offers an indication which industry is more connected to the domestic economy and therefore acts more as a catalyst for an economy-wide increase in output.

This model can be extended by making a distinction between activities and commodities as in a supply-use table SUT), and by including factor income as well as household income and their expenditure as reported in a SAM. The generation of factor income depends on what happens to production, which is endogenous to the model. The distribution of this income to households will generate an additional "induced" impact on output **x** in such an expanded version by assuming that this results in additional expenditure for goods and services. The **A** matrix of the above equations is then replaced by a **B** matrix which represents not only the per unit intermediate inputs of the activities but also the per unit marketed supply of commodities, the per unit distribution of factor incomes, and the per unit expenditures on goods and services of household incomes. In addition to activity output, the vector **x** now includes total marketed supply, factor as well as household income.

In the first application, which aims to examine the economy-wide impact of building additional electric power stations, the change in final demand (**Δf** of Equation 4) represent the inputs to the build program. These inputs include building materials, labour inputs, machinery and various services.

Results of the base model include impacts on gross sectoral output. Using further linear relationships, the model can present impacts for industry level 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 are multiplied with the output impacts (**Δx** of Equation 4). The same applies to imports and taxes.

The applications described in the report aim to examine the economy-wide impact of various government income transfer options. These are represented in **Δf** of equation 4as exogenous changes in household and labour incomes and demand for government services.

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 up 1%, employment will also go up by 1%. This may be considered as a rather 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. This may in particular be relevant during the COVID-19 recovery period. Econometric analysis is required to estimate such elasticities. Broad estimates have been made for South Africa by Moolman (2003) and the results have been mapped to the industries (activities) and labour categories (by education).

References for this appendix

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Appendix 3. A provisional 2019 social accounting matrix for South Africa

List of acronyms

GDP	Gross domestic product
LCS	Living Conditions Survey
LMD	Labour market dynamics
NA	National Accounts
SAM	Social accounting matrix
SARB	South Africa Reserve Bank
SSA	Statistics South Africa
ST	Supply table
SUT	Supply-use table
SUTSAM	Supply-use SAM, contains a single household and single labour type
UT	Use table

Introduction

This appendix outlines the construction of a provisional 2019 SAM for South Africa. A SAM is a consistent data framework that captures the information contained in the national accounts (SARB 2020), a supply table and a use table (SSA 2020b), as well as the monetary flows between institutions. A SAM is an ex-post accounting framework. Within its square format, total receipts must equal total payments for each of its accounts. Since the required data is not drawn from a single source, information is manipulated in order to make it internally consistent. SAMs are economy-wide databases that are used in conjunction with analytical techniques to strengthen evidence-based policy analysis.

A SAM is an economy-wide data framework that usually represents the real economy of a single country. More technically, a SAM is a square matrix in which single entry bookkeeping is undertaken for a set of accounts that represent various economic agents, such as productive activities, commodities and factors of production, and a range of institutions such as households, government and the rest of the world. Each account is represented by a row and a matching column. Each cell shows the payment from the account of its column to the account of its row – the incomes of an account appear along its row, its expenditures down its column. The underlying principles of double-entry accounting are applied and in the SAM they require that, for each account in the SAM, total revenue (the row total) equals total

expenditure (the column total). Table A1 shows an aggregate SAM for South Africa (with verbal explanations instead of numbers).

Construction of a 2019 SAM for South Africa

The first step in constructing the provisional 2019 SAM for South Africa is consolidating the national accounts (SARB, 2020) and StatsSA's ST and UT (StatsSA, 2020b) data sources into a consistent SAM framework. This results in what can be labelled the "SUTSAM" since it only identifies a single type of labour and a single household. The second step draws on the latest available labour market and household income and expenditure survey data to disaggregate labour and household accounts of the SUTSAM respectively.

The provisional 2019 SAM distinguishes 62 "activities" (the entities that carry out production) and 104 "commodities" (representing markets for goods and non-factor services). A list of activities and commodities as well as more detail on SAMs in general can be found in van Seventer et al (2018). Labour market detail is extracted from the 2018 Labour Market Dynamics data set (SSA 2020a) and disaggregates the single labour category of the SUTSAM into 4 categories by highest level of education attained. Household detail is derived from the 2015 Living Conditions Survey (SSA 2017) and identifies expenditure deciles, with the highest household group split into five categories of 2%.

Table A.3.1: Basic structure of a provisional 2019 SAM for South Africa.

	Activities	Commodities	Labour	Capital	Enterprises	Households	Government	Net activity taxes	Net product taxes	Import duties	Income taxes	Changes in inventories	Accumulation	Rest of the world	Total
Activities		Output of total domestic economy													Gross output
Commodities	Intermediate consumption	Transactions Margins				Final consumption expenditure by households	Final consumption expenditure government					Change in inventories + residual item	Gross fixed capital formation	Exports of goods & services	Total demand
Labour	Compensation of employees													Compensation SA residents in RoW	Labour income
Capital	Net operating surplus + Depreciation													Property income paid: RoW	Capital income
Enterprises				Gross operating surplus of corporations, adjusted for property income paid to / received from RoW	Net property income + other current transfers received: corporations - non-life insurance claims paid: corporations	Property income paid: households + net non-life insurance premiums: households	Social contributions received: financial corporations + property income paid: general government								Enterprise earnings
Households			Compensation of residents	Gross operating surplus / mixed income of households	Misc transfers paid: corporations + property income received: households + non-life insurance claims: households + adj for the change in net equity in pension fund reserves: households		Misc current transfers paid: general government + social benefits received: households							Misc current transfers paid: RoW	Household earnings
Government				Gross operating surplus of general government	Social benefits paid by corporations property income received by General government	Misc transfers received: general government + Social contributions paid: households	Net social contributions received: General government	Net other taxes on production in all industries	Net taxes on products - import duties	Import duties	Current taxes on income and wealth			Current international co-operation paid: RoW	Government receipts
Net activity taxes	Net other taxes on production in all industries														Net other taxes on production in all industries
Net product taxes		Net taxes on products - import duties													Net taxes on products - import duties
Import duties		Import duties													Import duties
Income taxes					Current taxes on income and wealth paid by corporations	Current taxes on income and wealth of households									Current taxes on income and wealth
Changes in inventories													Change in inventories + residual item		Change in inventories + residual item
Accumulation					Residual: corporations + Gross saving of corporations	Residual: households and NPISHs + Gross saving of households and NPISHs	Gross saving of General government							Current external balance: RoW	Savings
Rest of the world		Imports of goods & services	Compensation of South African employees	Property income received: RoW		Misc current transfers received: RoW	Current international co-operation received: RoW								Foreign exchange outflows
Total	Gross output	Total Supply	Distribution of labour income	Distribution of capital income	Enterprise outlays	Household outlays	Government outlays	Net other taxes on production in all industries	Net taxes on products - import duties	Taxes on international trade and transactions: Import duties	Current taxes on income and wealth paid by corporations + current taxes on income and wealth of households	Change in inventories + residual item	Gross fixed capital formation (investment) + change in inventories + residual item	Foreign exchange inflow	

Source: Own descriptions and labels.

Table A.3.2: A 2019 macro SAM for South Africa (billions of rands).

	Activities	Commodities	Labour	Capital	Enter-prises	House-holds	Govern-ment	Net activity taxes	Net product taxes	Import duties	Income taxes	Changes in inventories	Accumulation	Rest of the world	Total
Activities		9,732													9,732
Commodities	5,208					3,059	1,081					3	909	1,516	11,776
Labour	2,419													13	2,431
Capital	2,010													104	2,114
Enterprises				1,097	567	727	237								2,628
Households			2,416	664	1,037		275							26	4,418
Government				108	77	13		95	498	56	783			1	1,631
Net activity taxes	95														95
Net domestic product taxes		498													498
Import duties		56													56
Income taxes					247	537									783
Changes in inventories													3		3
Accumulation					701	70	-12							153	912
Rest of the world		1,490	15	245		13	50								1,813
Total	9,732	11,776	2,431	2,114	2,628	4,418	1,631	95	498	56	783	3	912	1,813	

Source: Own accounting of South Africa's National Accounts from the SARB Quarterly Bulletin, June 2020.

The macro SAM shown in Appendix Table A.3.2 is an aggregation of the micro SAM. The list below explains how each macro SAM entry is derived and broadly how, where necessary, it is disaggregated to arrive at the unbalanced prior micro SAM. The notation for SAM entries is (row, column) and the values are in billions of 2019 South African Rand. KBP refers to the SARB series of National Accounts in their Quarterly Bulletin of the South African Reserve Bank.[8]

i (Commodities,Activities)…Rb5,208

KBP6871J: Production account: Intermediate consumption of total domestic economy. Total (sum of all) intermediate inputs are initially disaggregated across activities identified in the SAM according to shares in the 2017 UT. For each activity identified in the SAM, the ratio of total intermediates to GDP at basic prices is derived from the 2017 UT. This is multiplied with matching 2019 values of GDP that aggregate up 1 digit national accounts' higher level control totals using disaggregation shares from the UT. Adjustment has been made for difference in treatment of informal sector GDP between the 1 digit activity national accounts measure and the UT. Intermediate inputs are subsequently disaggregated across commodities according to its shares for each activity based on the SSA Use Table (UT).

ii (Labour,Activities)…Rb2,419

KBP6000J: Compensation of employees. Total labour income is disaggregated across activities according to shares in the 2017 UT. For each activity identified in the SAM, the labour income share in GDP at basic prices is derived from the 2017 UT. This is multiplied with matching 2019 GDP values which are forced to sum to 1 digit national Accounts' higher level control totals by using disaggregation shares from the 2017 UT. Adjustment has been made for difference in treatment of informal sector GDP between the 1 digit activity national accounts measure and the UT. Labour income is subsequently split across four educational groups:

-“primary” refers to workers with some or no primary schooling, i.e., grades 1-7

-“middle” includes workers who have completed grade 10

-“secondary” includes workers who have completed grade 12

-“tertiary” includes workers who have some post-secondary or higher education.

Workers’ earnings are drawn from the 2018 LMD (StatsSA 2020a).

iii (Capital,Activities)…Rb2,010

KBP6001J: Net operating surplus + KBP6002J: Consumption of fixed capital (Depreciation). Total capital income is disaggregated across activities according to shares in the 2017 UT. For each activity identified in the SAM, the capital income share in GDP at basic prices is derived from the 2017 UT. This is multiplied with matching 2019 GDP values which are forced to sum to 1 digit national accounts' higher level control totals by using disaggregation shares from the 2017 UT. Adjustment has been made for difference in treatment of informal sector GDP between the 1 digit activity national accounts measure and the UT.

iv (Net activity taxes,Activities)…Rb095

KBP6600J: Other taxes on production in all industries - KBP6601J: Other subsidies on production in all industries. Net activity taxes are derived by multiplying the activity tax rates for each activity according to the 2017 UT with 2019 GDP at factor cost. The latter is the sum of ii and iii above.

v (Activities,Commodities)…Rb9,732

KBP6870J: Production account: Output of total domestic economy. It is equal to the sum of the activites' total costs which is the sum of i - iv above, i.e., intermediate costs, labour costs, rewards for the production factor capital and activity tax. Total costs of production is what local producers supply to the market. Total domestic production of each activity is disaggregated across the commodities that they make according to the shares in the 2017 ST.

vi (Net dom prod taxes,Commodities)…Rb498

KBP6603J: Taxes on products - KBP6604J: Subsidies on products-KBP4590J: National government tax revenue: Taxes on international trade and transactions: Import duties. Domestic taxes less subsidies on products together with import duties is equal to taxes on products as reported by the national accounts. Disaggregation of this control total (sum of taxes less subsidies on products less import duties) across products is based on 2017 ST shares after import duties, discussed below in (vii), are subtracted.

[8] The final disaggregated SAM is available on request.

vii (Import duties,Commodities)…Rb056

KBP4590J: National government tax revenue: Taxes on international trade and transactions: Import duties. Total Import duties are part of national government tax revenue as reported in the Public Finance Statistics of the SARB Quarterly Bulletin and together with net domestic product tax [see (vi) above] make up net product tax that is reported in the national accounts. Commodity level import duties collected were obtained from 2009 SARS import duty collection rates. These rates were manually adjusted so as to avoid negative domestic commodity tax.

viii (Rest of the world,Commodities)…Rb1,490

KBP6014J: Imports of goods & services. Disaggregated to commodity level based on 2017 ST shares. Adjustments are made for purchases of residents abroad while benchmarking on the 2019 national accounts.

ix (Households,Labour)…Rb2,416

KBP6240J: Compensation of residents. Disaggregated across types of labour and household income classes according to 2014/15 LCS shares.

x (Rest of the world,Labour)…Rb015

KBP6207J: Compensation of South African employees abroad. Disaggregated across types of labour according to total labour income received by households using 2014/15 LCS shares.

xi (Enterprises,Capital)…Rb1,097

KBP6706J: Generation of income account: Gross operating surplus of Financial corporations+KBP6746J: Generation of income account: Gross operating surplus of non-financial corporations+KBP6904J: External account of primary incomes and current transfers: Property income paid: ROW-KBP6901J: External account of primary incomes and current transfers: Property income received: ROW

xii (Households,Capital)…Rb664

KBP6826J: Generation of income account: Gross operating surplus / mixed income of households and NPISHs. Distribution is based on 2014/15 LCS shares

xiii (Government,Capital)…Rb108

KBP6786J: Generation of income account: Gross operating surplus of General government. Income earned by government from holdings

xiv (Rest of the world,Capital)…Rb245

KBP6901J: External account of primary incomes and current transfers: Property income received: ROW.

xv (Enterprises,Enterprises)…Rb255

KBP6707J: Allocation of primary income account: Property income received: Financial corporations+KBP6710J: Allocation of primary income account: Property income paid: Financial corporations-KBP6747J: Allocation of primary income account: Property income received: Non-financial corporations+KBP6752J: Allocation of primary income account: Property income paid: Non-financial corporations+KBP6716J: Secondary distribution of income account: Other current transfers received: Financial corporations-KBP6720J: Secondary distribution of income account: Non-life insurance claims paid: Financial corporations.

xvi (Households,Enterprises)…Rb801

KBP6721J: Secondary distribution of income account: Miscellaneous transfers paid: Financial corporations+KBP6762J: Secondary distribution of income account: Miscellaneous current transfers paid: Non-financial corporations+KBP6827J: Allocation of primary income account: Property income received: Households and NPISHs+KBP6838J: Secondary distribution of income account: Non-life insurance claims: Households and NPISHs+KBP6845J: Use of disposable income account: Adjustment for the change in net equity in pension fund reserves: Households & NPISHs. Disaggregated across household income classes according 2014/15 LCS shares. The following items are included: “Income from letting of fixed property”, “Interest received”, “Dividends of Listed Companies”, “Dividends of Unlisted Companies”, “Pension from previous employment”, “Annuities from own investment”, “Payments received from boarders and other non-members”, “Claims”, “Non-refundable bursaries”, “Benefits, donations and gifts” and “Cash”

xvii (Government,Enterprises)…Rb306

KBP6718J: Secondary distribution of income account: Social benefits paid by Financial corporations+KBP6759J: Secondary distribution of income account: Social contributions paid by non-financial corporations+KBP6787J: Allocation of primary income account: Property income received: General government.

xviii (Income taxes,Enterprises)…Rb247

KBP6717J: Secondary distribution of income account: Current taxes on income and wealth paid by Financial corporations+KBP6758J: Secondary distribution of income account: Current taxes on income and wealth paid by non-financial corporations.

xix (Accumulation,Enterprises)…Rb701

KBP6724J: Use of disposable income account: Residual: Financial corporations+KBP6725J: Use of disposable income account: Gross saving of Financial corporations+KBP6764J: Use of disposable income account:

Residual: Non-financial corporations+KBP6765J: Use of disposable income account: Gross saving of non-financial corporations.

xx (Commodities,Households)…Rb3,059

KBP6007J: Final consumption expenditure by households: Total (PCE). Disaggregated across products according to the expenditure shares in the 2017 UT and across household income classes using shares from the 2014/15 LCS.

xxi (Enterprises,Households)…Rb427

KBP6832J: Allocation of primary income account: Property income paid: Households and NPISHs+KBP6842J: Secondary distribution of income account: Net non-life insurance premiums: Households and NPISHs. Disaggregated across household income classes using shares from the 2014/15 LCS for the following outlay items: “interest on mortgage bonds”, “contribution to pension, provident and annuity funds” and “employer contribution to pension, provident and annuity funds”.

xxii (Government,Households)…Rb313

KBP6797J: Secondary distribution of income account: Miscellaneous transfers received: General government+KBP6840J: Secondary distribution of income account: Social contributions paid: Households. Disaggregated across household income classes using shares from the 2014/15 LCS for income tax payments (see next item for details).

xxiii (Income taxes,Households)…Rb537

KBP6245J: Current taxes on income and wealth of households. Disaggregated across household income classes using shares from the 2014/15 LCS based on the distribution of outlays for income tax purposes for the following items: “SITE - income tax”, “PAYE - income tax”, “According to assessment - income tax”, “Amnesty tax”, “Penalty late submission of tax”.

xxiv (Accumulation,Households)…Rb070

KBP6846J: Use of disposable income account: Residual: Households and NPISHs+KBP6848J: Use of disposable income account: Gross saving of households and NPISHs. Disaggregated across household income classes using shares from the 2014/15 LCS for the following items: “Listed company - shares 12 months”, “Unlisted company - shares 12 months”, “Unit trusts 12 months”, “Investment plans 12 months”, “Other investments 12 months”, “Deposits into savings 12 months” and offset by “Withdrawals from savings”.

xxv (Rest of the world,Households)…Rb013

KBP6909J: External account of primary incomes and current transfers: Miscellaneous current transfers received: ROW. Disaggregated across household income classes using total income shares from the 2014/15 LCS for the same items as transfers by households to enterprises (see item xxi above).

xxvi (Commodities,Government)…Rb1,081

KBP6008J: Final consumption expenditure by general government. Disaggregated across products according to the expenditure shares in the 2017 UT.

xxvii (Enterprises,Government)…Rb531

KBP6715J: Secondary distribution of income account: Social contributions received: Financial corporations+KBP6791J: Allocation of primary income account: Property income paid: General government.

xxviii (Households,Government)…Rb511

KBP6801J: Secondary distribution of income account: Miscellaneous current transfers paid: General government+KBP6836J: Secondary distribution of income account: Social benefits received: Households and NPISHs. Disaggregated across household income classes using shares from the 2014/15 LCS for the following items: “Old age pensions”, “Disability grants”, “Family and other allowances” and “Workmen's compensation Funds”.

xxix (Government,Government)…Rb266

KBP6794J: Secondary distribution of income account: Social contributions received: General government+KBP6798J: Secondary distribution of income account: Social benefits paid: General government.

xxx (Accumulation,Government)…Rb-012

KBP6803J: Use of disposable income account: Gross saving of General government.

xxxi (Rest of the world,Government)…Rb050

KBP6908J: External account of primary incomes and current transfers: Current international co-operation received: ROW.

xxxii (Government,Net activity taxes)…Rb095

KBP6600J: Other taxes on production in all industries - KBP6601J: Other subsidies on production in all industries. The sum of (iv) above.

xxxiii (Government,Net dom prod taxes)…Rb498

KBP6603J: Taxes on products - KBP6604J: Subsidies on products-KBP4590J: National government tax revenue: Taxes on international trade and transactions: Import duties. The sum of (vi) above.

xxxiv	(Government,Import duties)…Rb056
	KBP4590J: National government tax revenue: Taxes on international trade and transactions: Import duties. The sum of (vii) above.
xxxv	(Government,Income taxes)…Rb783
	KBP6717J: Secondary distribution of income account: Current taxes on income and wealth paid by Financial corporations+KBP6758J: Secondary distribution of income account: Current taxes on income and wealth paid by non-financial corporations. The sum of (xviii) and (xxiii) above.
xxxvi	(Commodities,Ch in inventories)…Rb003
	KBP6010J: Change in inventories+KBP6011J: Residual item. Disaggregated across products according to the expenditure shares in the 2017 UT.
xxxvii	(Commodities,Accumulation)…Rb909
	KBP6009J: Gross fixed capital formation (Investment). Disaggregated across products according to the expenditure shares in the 2017 UT.
xxxviii	(Ch in inventories,Accumulation)…Rb003
	KBP6010J: Change in inventories+KBP6011J: Residual item. Disaggregated across products according to the expenditure shares in the 2017 UT.
xxxix	(Commodities,Rest of the world)…Rb1,516
	KBP6013J: Exports of goods & services. Commodity level adjustments are made for purchases of non-residents while benchmarking on national accounts. Disaggregation to commodity level is based on the 2017 UT.
xl	(Labour,Rest of the world)…Rb013
	KBP6208J: Compensation of South African residents in the rest of the world. Disaggregated across types of labour according to shares in total labour income using 2018 LMD data
xli	(Capital,Rest of the world)…Rb104
	KBP6904J: External account of primary incomes and current transfers: Property income paid: RoW.
xlii	(Households,Rest of the world)…Rb026
	KBP6912J: External account of primary incomes and current transfers: Miscellaneous current transfers paid: RoW. The distribution across household income classes is the same as for what households receive from enterprises (see xvi above.
xliii	(Government,Rest of the world)…Rb001
	KBP6911J: External account of primary incomes and current transfers: Current international co-operation paid: RoW.
xliv	(Accumulation,Rest of the world)…Rb153
	KBP6913J: External account of primary incomes and current transfers: Current external balance: RoW.

Balancing the prior SAM

The range of datasets used to construct the SAM described in the previous section suggests that there may be imbalances (i.e., row and column totals are unequal). The reason is that 2017 SUT data is matched to 2019 NA data. Balancing is achieved by means of the cross-entropy approach as described by Robinson et al (1998).

After balancing the SUTSAM, it was disaggregated across labour and household groups using the 2018 LMD data (StatsSA 2020a) and the 2014/15 LCS (StatsSA 2017) survey data. Since the SUTSAM is balanced, this can be set up such that it results in imbalances for the household accounts only. This is achieved by first disaggregating wages and salaries for each activity by education attainment using the

2018 LMD data (StatsSA 2020a). Summing across activities and including foreign earnings results in total labour income for each education attainment group. Next, household outlays are disaggregated across household income groups for each commodity and for each of the other outlays (taxes, transfers and savings) across household income groups using LCS data for 2014/15 (StatsSA 2017). Summing across all commodities and other types of outlays, yields total household outlays for each household income group. Since total household outlays must equal total household income for each household income group we use the former as our benchmark for the latter. Initial shares of household income by sources (wages & salaries by educational attainment, capital income, dividends and various transfers) are obtained from LCS data for 2014/15 (StatsSA 2017). These shares are then applied to the total outlays of each household income group. Finally, the household accounts were balanced using the biproportional scaling method, also known as RAS, while holding all other non-household-related entries of the SUTSAM constant. The result is a fully disaggregated micro SAM with detailed labour and household categories which remains consistent with the national accounts aggregates.

Although SAMs are typically presented in monetary values, modellers and other users might wish to refer to the physical quantities that are associated with certain flows. In particular, employment figures related to the wage flows recorded in the SAM can be useful. We derived these figures from the 2018 LMD (StatsSA, 2020a) using the same method of allocating labour as we did for wage earnings. Informal sector employment (of employees, employers and own account worker) is allocated to the last activity in the SAM (Non-observed, informal, non-profit, households). 2018 employment data were updated to 2019 using higher level control totals from the QLFS for total employment by level of education attained (Stats SA, 2020c, Table 3.3) and total employment of 1 digit industries (Stats SA, 2020c, Table 6) based on disaggregation shares of the 2018 LMD. Final balancing was achieved using the biproportional scaling method.

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Appendix 4. Uneven recovery in manufacturing

In this Appendix we look at manufacturing sub-sectors. We use manufacturing sales and production data from Statistics South Africa (2021), which provides data on 44 subsectors. There are four different measures provided: value of sales (R1000) and indices of physical volume (2015=100), each in actual and seasonally adjusted values. We use indices of physical volume production seasonally adjusted, taking out both price and seasonal effects.

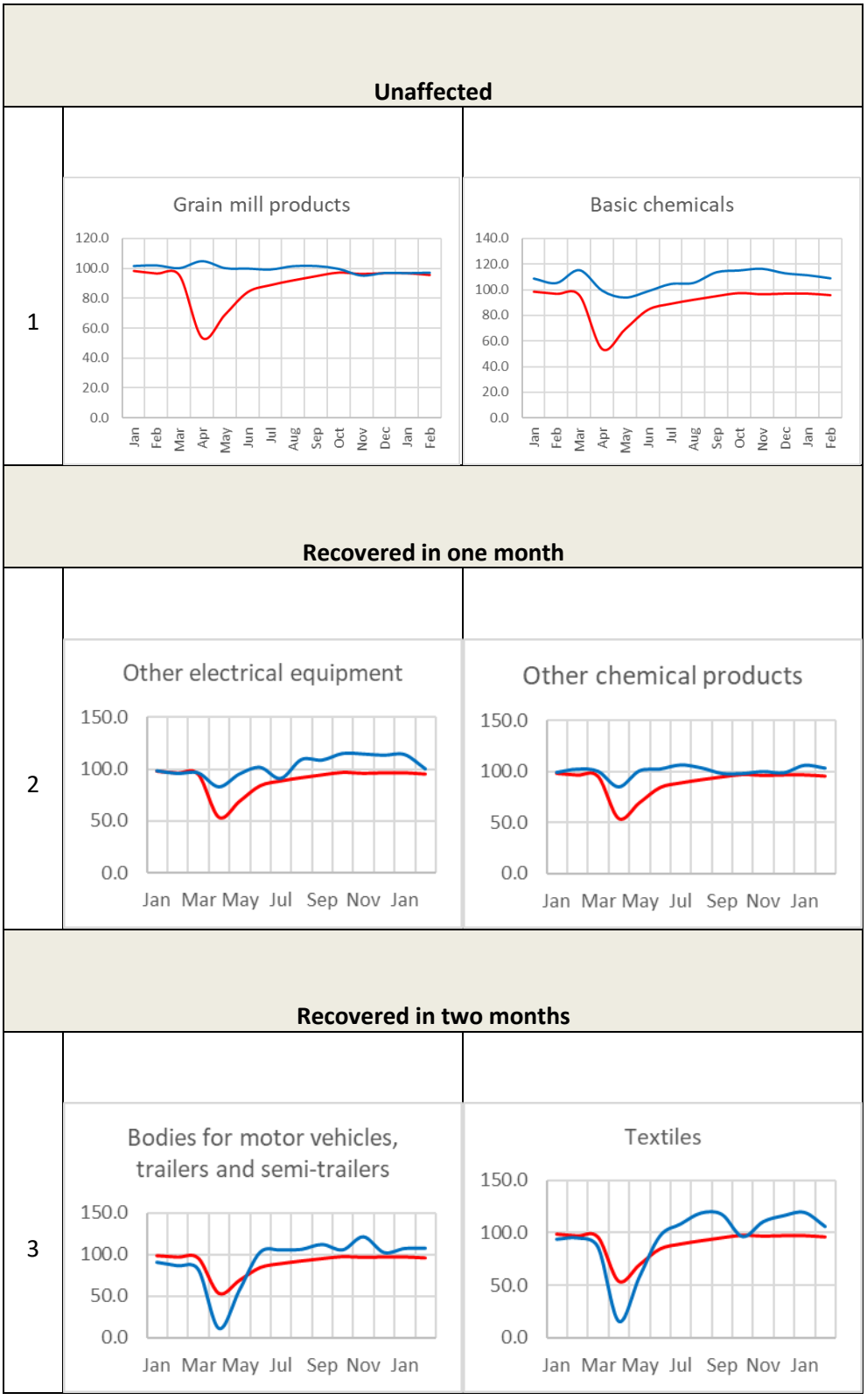
For each subsector we take the average of monthly values for 2019 (which we refer to as the reference value) and construct an index for each month, January 2020 through February 2021, relative to this reference value. We take April 2020 as the initial impact month, and the month in which the index subsequently reaches 95 percent of the reference value as the recovery month even if the sub sector subsequently fell below the threshold again.[9] The 95 percent threshold is arbitrary. Raising it not only changes the recovery month but may also change the order in which sectors recover since some rise above 95% but fall subsequently.[10]

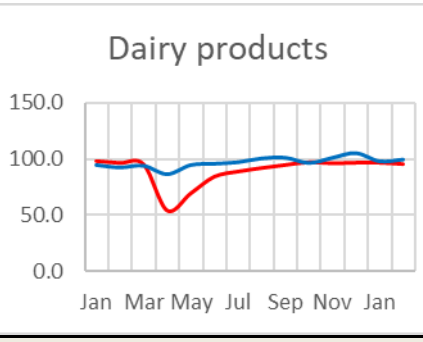
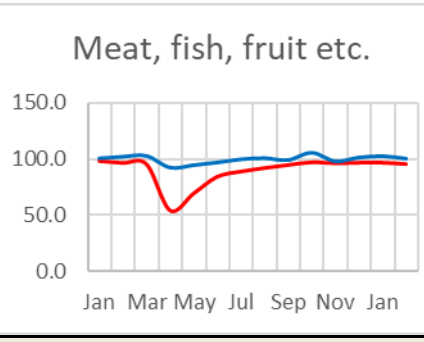
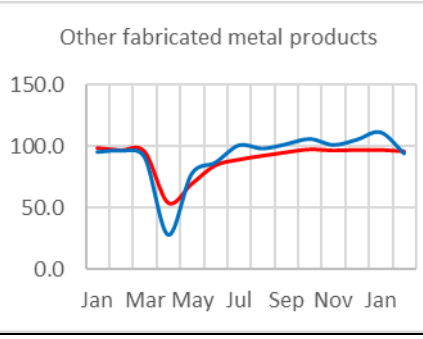
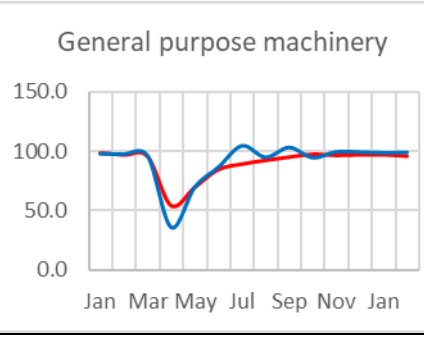
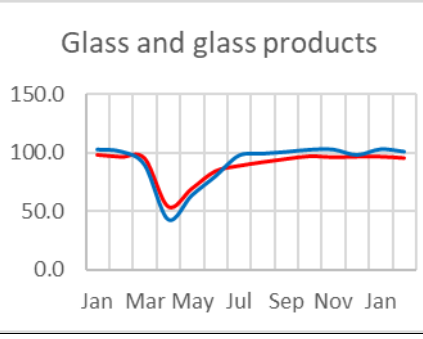
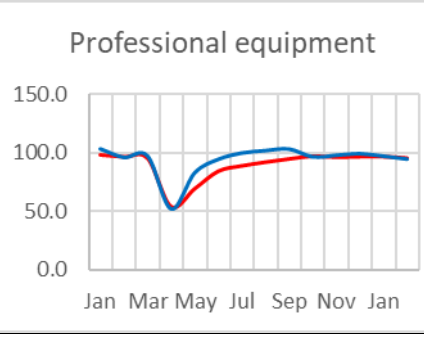
The paths of each subsector over the period January 2020 to February 2021 are shown in Figure A.4.1, arranged in order of months taken to recovery. The path of total manufacturing is shown in red in each chart as a reference. The figure shows that there have been substantial differences between the time paths of subsectors over the period. We have not undertaken a detailed analysis of them and possible reasons for differences, although such an analysis might be useful for policy purposes. Casual inspection suggests that the time to recovery does not depend on the depth of the initial shock, since there are several subsectors with the same initial shock but different times to recover.

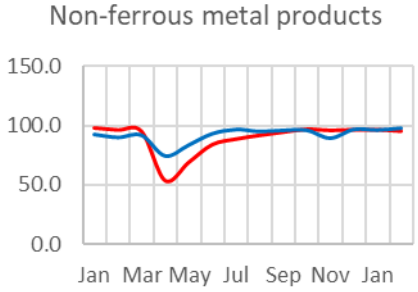
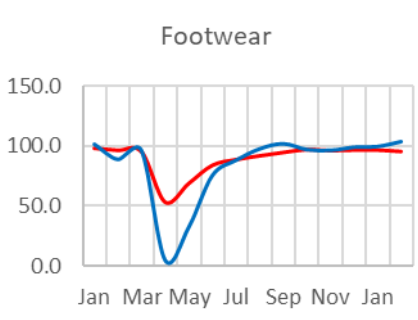
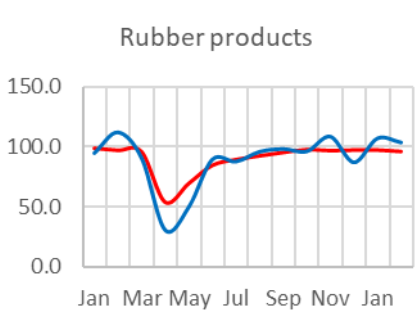
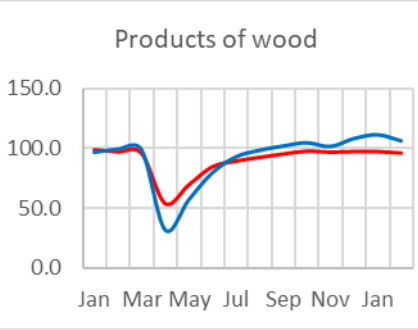
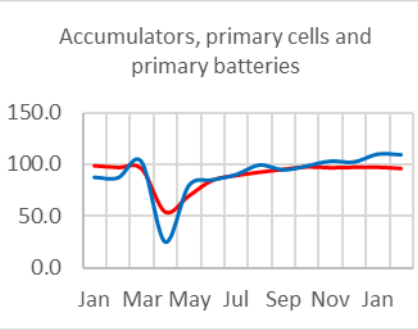
9 It might be more appropriate to call this the "reversal month", since we are simply looking at the reversal of the initial fall in output. If subsectors were on a strong trend before the pandemic, we would want to measure recovery with reference to a projection of the trend.

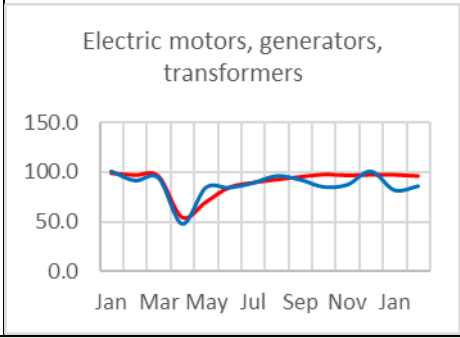
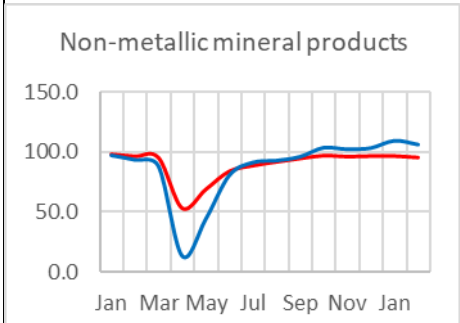
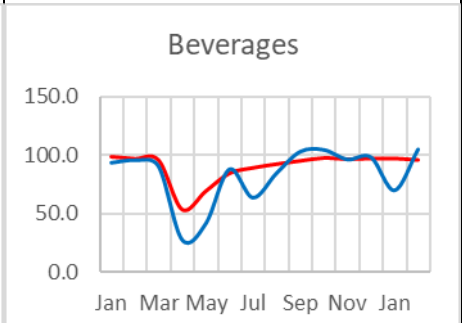
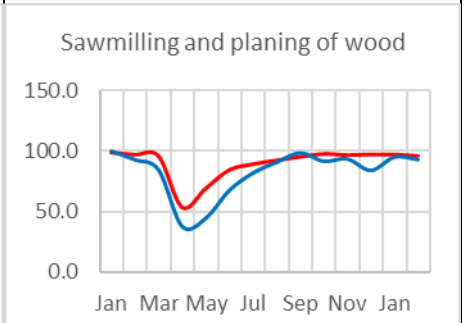
10 Raising the threshold to 100% means that 14 subsectors had not recovered by February 2021, compared to the nine under the 95 percent threshold.

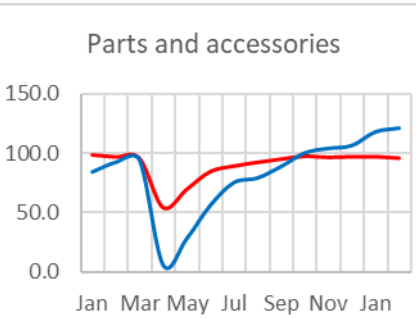
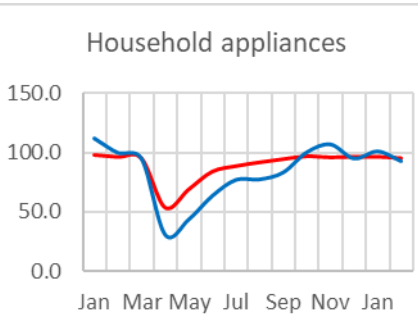
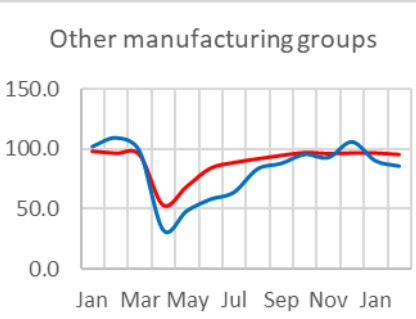
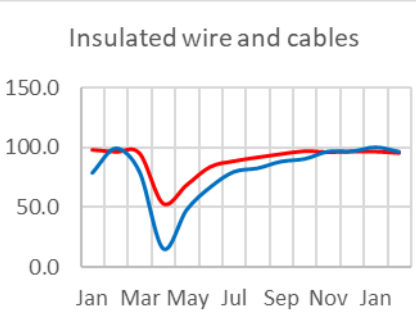
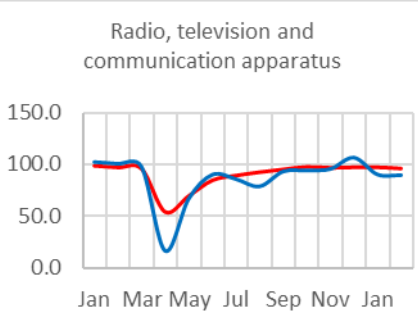
Figure A.4.1: Production and sales of manufacturing subsectors January 2020–February 2021

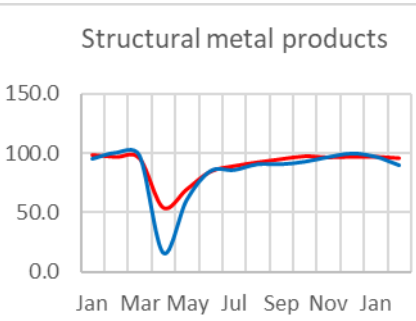
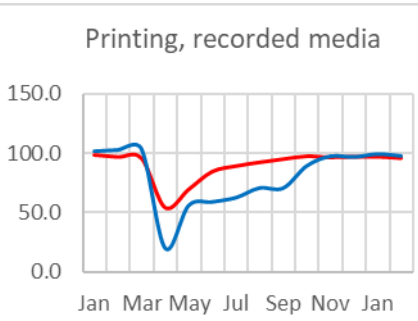
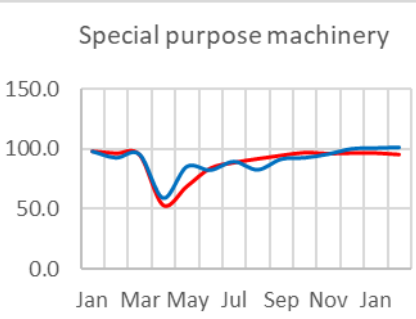
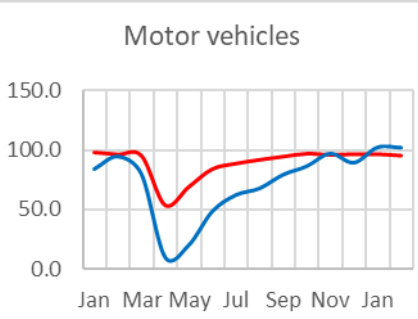
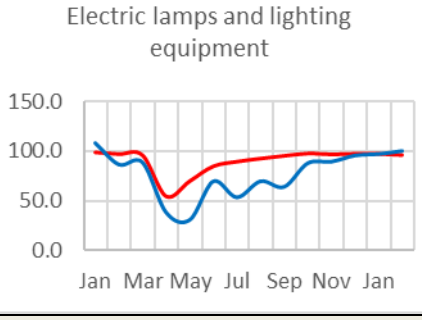
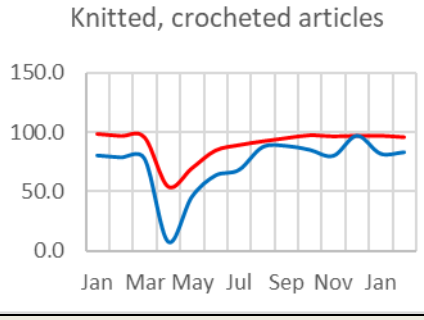


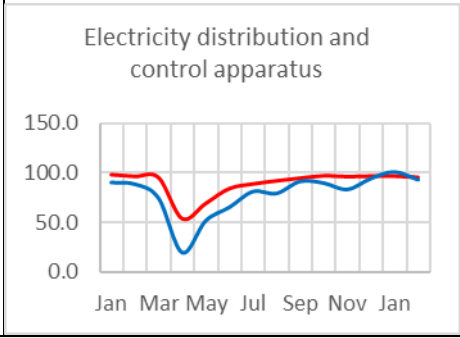
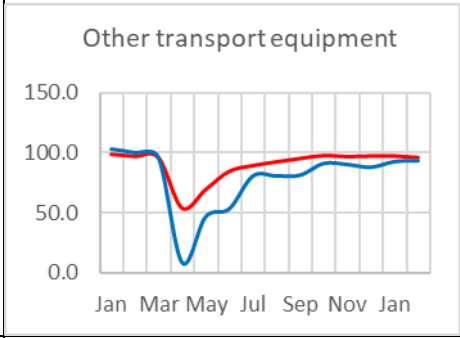
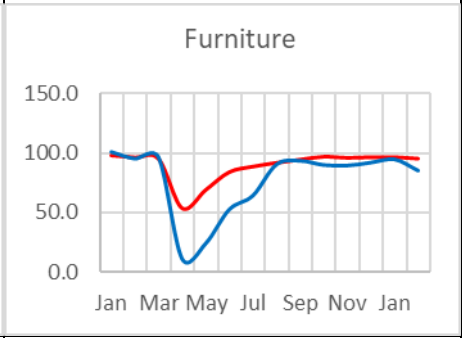
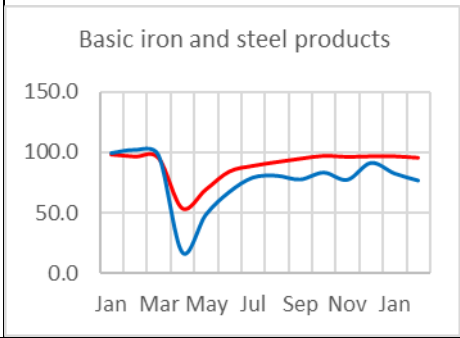
4		
Recovered in three months		
5		
6		

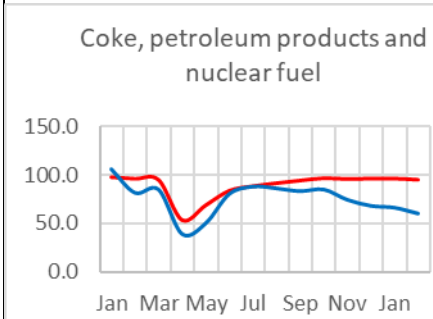
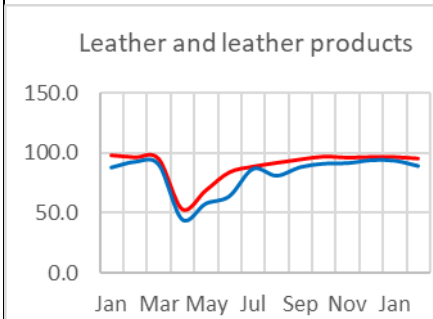
7		
Recovered in four months		
8		
9		

10		
Recovered in five months		
11		
12		
Recovered in six months		

13		
14		
Recovered in seven months		
15		

16		
17		
Recovered in eight months		
18		
Recovered in nine months		

19		
Unrecovered after twelve months		
20		
21		

22		
23		

Source: Authors' calculations using Statistics South Africa (2021)
Notes: The red line in each chart represents the path of total manufacturing.

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