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Southern Africa – Towards Inclusive Economic Development

Impact of Covid-19 on the South African economy

An initial analysis

Channing Arndt, Rob Davies, Sherwin Gabriel, Laurence Harris, Konstantin Makrelov, Boipuso Modise, Sherman Robinson, Witness Simbanegavi, Dirk van Seventer, and Lillian Anderson

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About the project

Southern Africa –Towards Inclusive Economic Development (SA-TIED)

SA-TIED is a unique collaboration between local and international research institutes and the government of South Africa. Its primary goal is to improve the interface between research and policy by producing cutting-edge research for inclusive growth and economic transformation in the southern African region. It is hoped that the SA-TIED programme will lead to greater institutional and individual capacities, improve database management and data analysis, and provide research outputs that assist in the formulation of evidence-based economic policy.

The collaboration is between the United Nations University World Institute for Development Economics Research (UNU-WIDER), the National Treasury of South Africa, the International Food Policy Research Institute (IFPRI), the Department of Monitoring, Planning, and Evaluation, the Department of Trade and Industry, South African Revenue Services, Trade and Industrial Policy Strategies, and other universities and institutes. It is funded by the National Treasury of South Africa, the Department of Trade and Industry of South Africa, the Delegation of the European Union to South Africa, IFPRI, and UNU-WIDER through the Institute's contributions from Finland, Sweden, and the United Kingdom to its research programme.

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Towards Inclusive Economic Development in Southern Africa

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Impact of Covid-19 on the South African economy: An initial analysis

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ABSTRACT

This paper reports 'first pass' estimates of the costs of the lock-down implemented by the South African government beginning on 27 March 2020. It also presents a series of recovery scenarios. Four channels by which a lockdown and other efforts are expected to influence economic activity are distinguished. In total, these lockdown measures have profound economic implications. The implications of the pandemic in the rest of the world, and hence on demand for South Africa's export, are not as large as the effects of the domestic lockdown but are still very large by any normal measure. In terms of recovery, the 'Quick' recovery scenario results in a GDP decline of about 5 per cent by the end of 2020—an economic outcome that would have been considered catastrophically bad a little more than one month ago. Persistent effects of the Covid-19 would bring even worse outcomes for GDP in line with the 'Slow' and 'Long' recovery scenarios.

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EXECUTIVE SUMMARY

South Africa finds itself at war, and the enemy is the novel coronavirus, which gives rise to the Covid-19 disease. The only tool currently available to mitigate the demographic effects of Covid-19 is some form of lockdown to reduce contagion by breaking existing social and economic forms of contact. Such measures impose a severe negative shock on the economy, with immediate loss of economic activity followed by medium-term and long-term economic effects.

This paper reports 'first pass' estimates of the costs of the lock-down implemented by the South African government beginning 27 March 2020. It also presents a series of recovery scenarios.

Four channels by which a lockdown and other efforts are expected to influence economic activity are distinguished: (i) the forced reduction in production as a result of a national lockdown and other restrictions on non-essential business operation, (ii) the impact of the lockdown on household demands for goods and, especially, services (e.g., tourism as a result of travel and movement restrictions), (iii) the effect of disrupted global production and supply chains on South African exports, and (iv) the effect of uncertainty on business investment. The combined direct effects of these shocks are illustrated in Table ES1.

These four channels of direct impact will have knock-on effects that spread through the entire economy. Reduced activity in one sector has consequences both for the suppliers of that sector, who face lower demand, and for the users of the output of the sector, who face supply disruptions. Thus, the shock spreads through the economy.

To trace these indirect impacts, a Social Accounting Matrix (SAM) multiplier framework is used. A SAM is a matrix showing the flows of goods and services around the economy over a given period. We use a SAM for South Africa in 2015, constructed using data from Statistics South Africa. The SAM depicts the economy as an inter-related system or network of transactions and illustrates the full circular flow of income in the economy in a highly disaggregated way.

In the SAM for this study, there are 62 production sectors, employing capital and four different types of labour to produce 102 different commodities. The income generated in the production sectors is distributed to 14 different household types (based on income distribution). The income they receive is used for private consumption expenditures (disaggregated by commodity), savings and paying taxes. Government receives taxes and makes expenditures, including transfers to households. There are also indirect taxes on the commodities. Finally, the economy is open, with imports of goods and services adding to domestic supplies and exports adding to demand.

Because it is unlikely that production technologies are changed significantly by the pandemic, at least in the short run, the key assumption underlying standard multiplier analysis, fixed proportions in production, is reasonably appropriate for the current task. Multiplier analysis also has the great merit of being quick to implement and relatively easy to understand, making it useful for considering the potential economic consequences of the pandemic.

Table ES1: Combined direct lockdown implications by sector.

	Mild decline (0 to -10%)	Moderate decline (-10% to -30%)	Large decline (-30% to -60%)	Severe decline (Larger than -60%)
	Agriculture, forestry, fishing			
			Mining and quarrying	
MANUFACTURING		Food and non-alcoholic beverages		Alcoholic beverages and tobacco
MANUFACTURING			Textiles, clothing, leather and footwear	
MANUFACTURING			Paper, paper products	Wood, wood products
MANUFACTURING	Pharmaceuticals, hygiene and cleaning	Petroleum	Basic chemicals, fertilizer, paint, other	
MANUFACTURING		Plastic, glass		Tyres, rubber products
MANUFACTURING				Non-metallic minerals and products (cement, concrete, etc.)
MANUFACTURING				Iron, steel, metal products
MANUFACTURING				Machinery and equipment
	Electricity, gas, water			
				Construction
			Wholesale, retail trade	Accommodation, catering
	Communication		Transport and storage	
	Finance and insurance, computing services	Real estate, legal and accounting, other support services	Rentals, research, manufacturing services, other business services	
	Health services		Education services	Recreation, other community services

Three shock scenarios are implemented using the SAM multiplier framework:

1. LOCKDOWN: A lockdown demand/supply shock at the sectoral level: the bottom-up recession.
2. LOCKDOWN PLUS: The lockdown scenario plus a macro shock reducing aggregate investment, cutting demand for investment goods (e.g., construction and machinery).
3. FULL: The lockdown scenario plus the investment shock plus reduced aggregate demand for exports, cutting sectoral exports.

Economic impacts are large. Figure ES1 presents impacts on the income components of GDP at factor cost. Overall, GDP at factor cost is down by 34 per cent in the full shock (see the set of bars on the far right). While income declines generally, there are differential distributional effects. Total wage earnings are down by about 30 per cent, but gross operating surplus is down by close to 40 per cent. However, when one disaggregates wage earnings, the negative impact is much bigger for lower

educated workers with a 40 per cent reduction for wage earnings in the lowest two educational categories and a smaller, but still very substantial, reduction of about 25 per cent for tertiary educated labour.

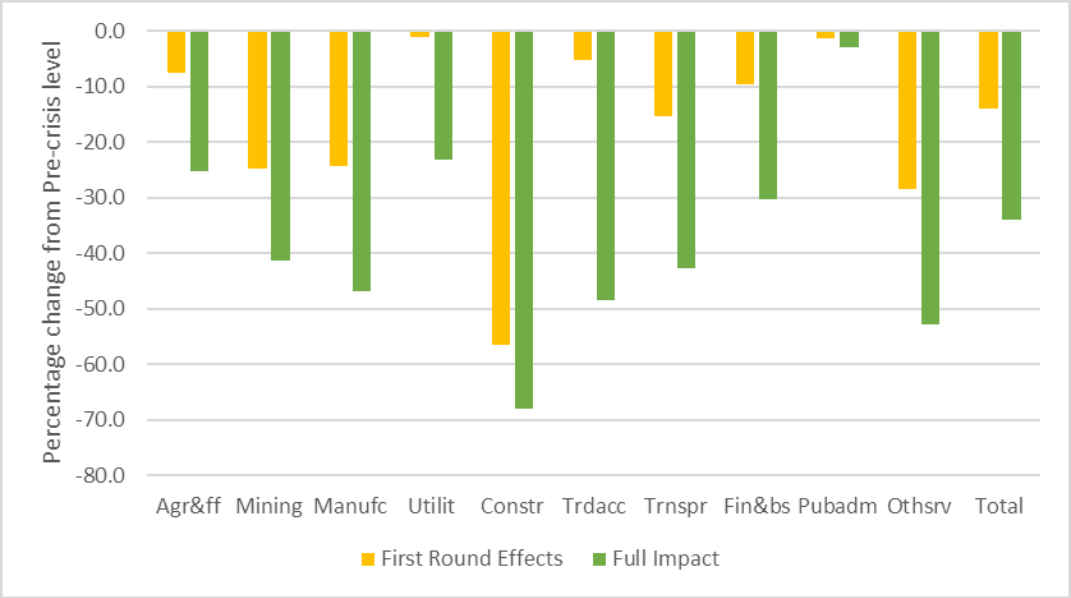
Figure ES1: Impacts on wage earnings and income GDP components, as percentage deviations from their pre-crisis levels

Source: Own calculations

It is important to highlight two items. First, these results reflect quantity adjustments and not price adjustments. Hence, a 40 per cent reduction in wage earnings in the lowest two education categories implies roughly a 40 per cent reduction in hours worked in those labour categories. Overall, approximately one third of the resources that were productive in February 2020 are idled as a result of the shocks. As shown in Figure ES1, the bulk of this impact (29 of 34 per cent) comes from the lockdown.

Second, economic adjustment to the shocks occur within the time period of the model, which we judge to be very short, probably less than a quarter (three months). The results indicate that, at the end of the shock period, the economy being delivered to the next period starts out with the labour force working 25 to 40 per cent fewer hours, depending on education category, and capital utilization similarly lower. The GDP that this shocked economy produces (a flow variable, with units of GDP per unit time) is also about 35 per cent lower. If this situation lasts for a year, then annual GDP would also be 35 per cent lower for that year.

Another way to view the shocks is via value added generation by broad industry type. This is accomplished in Figure ES2. For each industry, two bars are illustrated. The first bar shows the initial combined direct shock (corresponding to the values in Table ES1 and shock scenario 3). The second bar shows the impact on value added once all indirect or knock-on effects have been accounted for. The difference between the second bar, showing full impact, and the first bar offers a view on how shocks transmit through an economic system.



Notes: Agri&ff = Agriculture, fishing and forestry, Trdacc = Trade and accommodation services, Fin&bs = Financial and business services.

Figure ES2: Impacts on value added for broad industries for the full shock, as percentage deviations from their pre-crisis levels

Source: Own calculations

For example, as an essential industry, utilities (electricity, gas, and water) experience a mild direct shock. However, because of reductions in economic activity, indirect impacts on utilities are large at more than 20 per cent of industry GDP at factor cost. At the other end of the spectrum, construction receives a large direct shock as most construction workers are locked down. The additional indirect effects are relatively small.

The income effects illustrated in Figures ES1 and ES2 filter to households. Note that, by assumption, sources of income that are non-factor income, such as transfers from government and the rest of the world, are not impacted. Results are shown in Figure ES3.

Even though low-income households depend more on lower education wage earnings, which are strongly affected (see Figure ES1), lower income households suffer smaller percentage declines in income. This occurs mainly because transfers from government are sheltered from the downturn and these transfers comprise almost 70 per cent of total income for households in the lowest income decile. This share falls roughly linearly to 28 per cent for households in decile 5 and then quickly becomes a minor share of income for households in the upper half of the income distribution. This upper half suffers losses of about 27 per cent of household income with relatively little variation. Overall, government transfers emerge as substantially cushioning, but certainly not eliminating, the economic fallout from Covid-19 on low income households.

Next, Table ES2 shows the impact on tax revenues in each Scenario. In the Full scenario, total tax revenue is 32.5 percent below its pre-crisis level. Revenues from all the main tax headings fall. Direct taxes are impacted relatively less than indirect taxes. The reason is that a significant part of enterprise and household income (such as transfers related to private pensions) is not affected by the shocks and does not change. On the other hand, indirect taxes face the full effects of the shocks as they are linked to production and demand, and so fall with them.

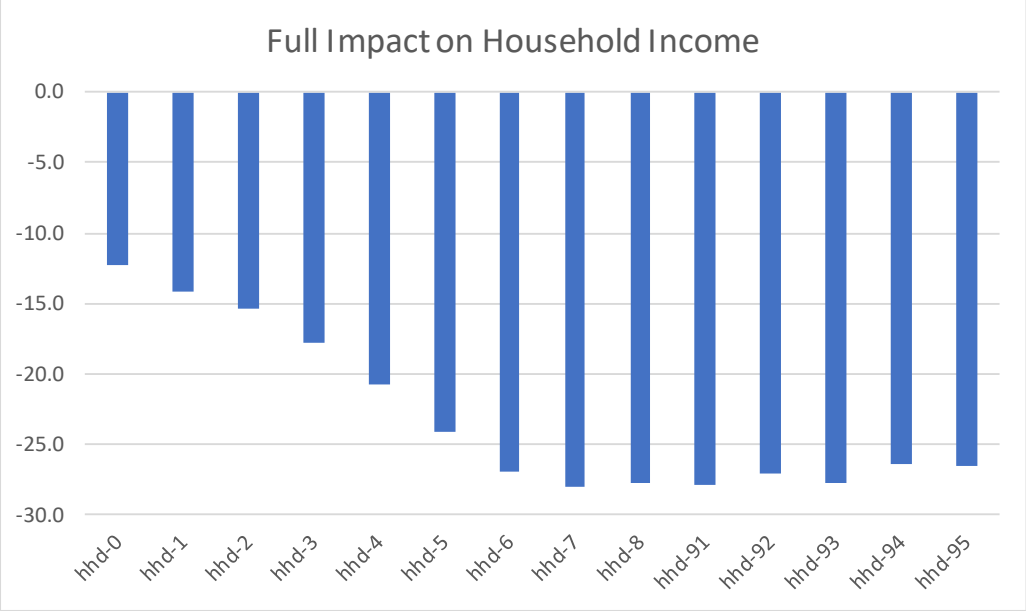


Figure ES3: Impacts on household incomes for the full shock, as percentage deviations from their pre-crisis levels

Source: Own calculations

Table ES2: Impacts on tax revenues for all scenarios, as percentage change from pre-crisis levels

	Share in base	Lockdown	Lockdown Plus	Full
Production tax	6.5	-27.9	-29.9	-33.8
Import tax	4.0	-44.5	-45.8	-55.6
Domestic sales tax	34.5	-34.1	-34.8	-41.8
Direct tax on households and enterprises	55.0	-21.1	-21.8	-24.8
Total Tax	**100.0**	**-27.0**	**-27.8**	**-32.5**

Source: Own calculations

Direct taxes are impacted relatively less than indirect taxes. The reason is that a significant part of enterprise and household income (such as transfers related to private pensions) is not affected by the shocks and does not change. On the other hand, indirect taxes face the full effects of the shocks as they are linked to production and demand, and so fall with them.

Finally, we turn to assessing the impact of possible recovery options following the 21 days lock down looking forward over the next three quarters to the end of 2020.

The three scenarios modeled are:

1. ***Quick:*** the pandemic is contained quickly, and the economy bounces back;
2. ***Slow:*** the pandemic takes longer to contain, and the economy is slower to recover;
3. ***Long:*** the pandemic endures even longer, and the recovery thereafter is spread over a longer period than in the *Slow Scenario* (although in this study we cut off considering it at the end of 2020)

The starting point is the *Full impact scenario* described above. However, we now need to take time into account. To do this, we use the model to generate results on a quarterly basis. The shocks in each quarter differ, representing different stages along the recovery path for each scenario. The model then calculates the annualized quarterly impact of the shock on key variable for each quarter. We also construct annual rates as a weighted average of the results for all four quarters and annualized quarter on quarter growth rates.

The previous modelling looked at the economic flow implications of the shocks assuming all indirect/knock-on effects are realized. The implications of these shocks for the level of, for example, GDP depends upon the time period for which these GDP impacts pertain. The full lockdown in the *Quick Scenario* endures for three weeks (current policy) and then is released relatively rapidly. Under *Slow* and *Long,* the full lockdown is assumed to endure for eight weeks in both scenarios. The rate of return towards normalcy is more gradual under *Slow* and even more gradual under *Long.*

Figure ES4 shows the pattern of quarterly impacts on GDP at market prices. It illustrates how the different paths have been calibrated under the assumption that all effects begin in Q2.

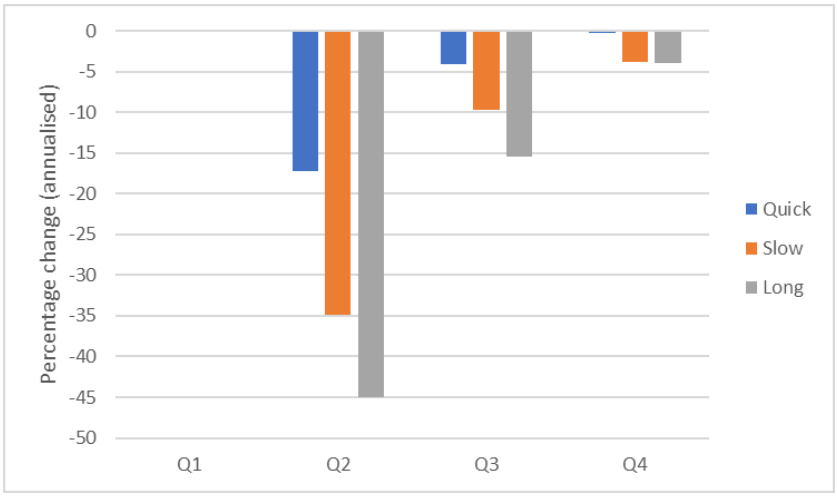


Figure ES4: Annualized change from pre-crisis level per quarter: GDP at market prices
Source: Own calculations

Figure ES5 shows how the quarterly profiles in Figure ES4 translate into annual growth rates for 2020 in each scenario, depicted a deviation from the pre-crisis level of GDP. They can be interpreted as the percentage points GDP growth will be below any projection without the ensemble of Covid impacts.

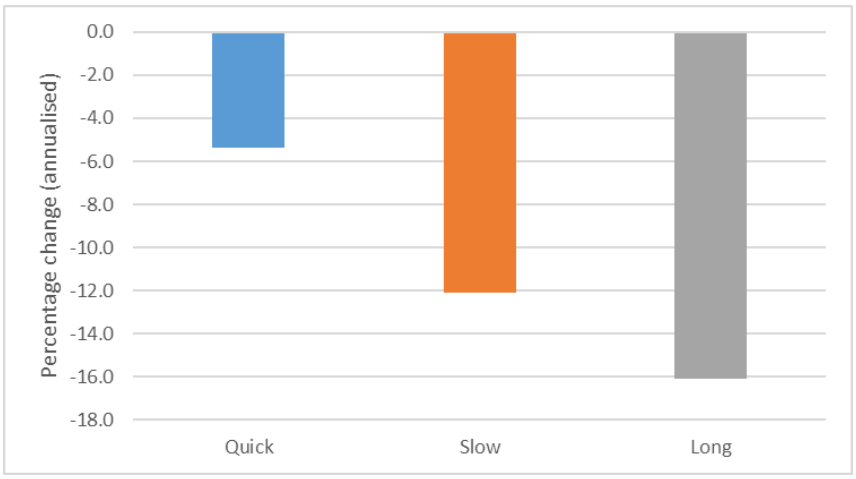


Figure ES5: Average annual growth rates for 2020 in each scenario: GDP at market prices
Source: Own calculations

Although the impact assessment gave the impact drop in GDP at market prices of 35 per cent on a flow basis (34 per cent for GDP at factor cost), this quarterly analysis is more muted for three reasons. Firstly, we now confine the impact to a portion of Q2. Second, the effects in the other quarters are less, reflecting the conjectured recovery paths. Third, there is no impact in Q1, which therefore enters as zero into the annual average.

Figure ES6 presents the implied quarter on quarter growth rates. After the sharp drop in GDP levels in Q2, Q3 and Q4 show positive rates as economic recovery proceeds off the low base of Q2. As the previous two figures show, these recovery growth rates are insufficient to get GDP back to pre-crisis levels.

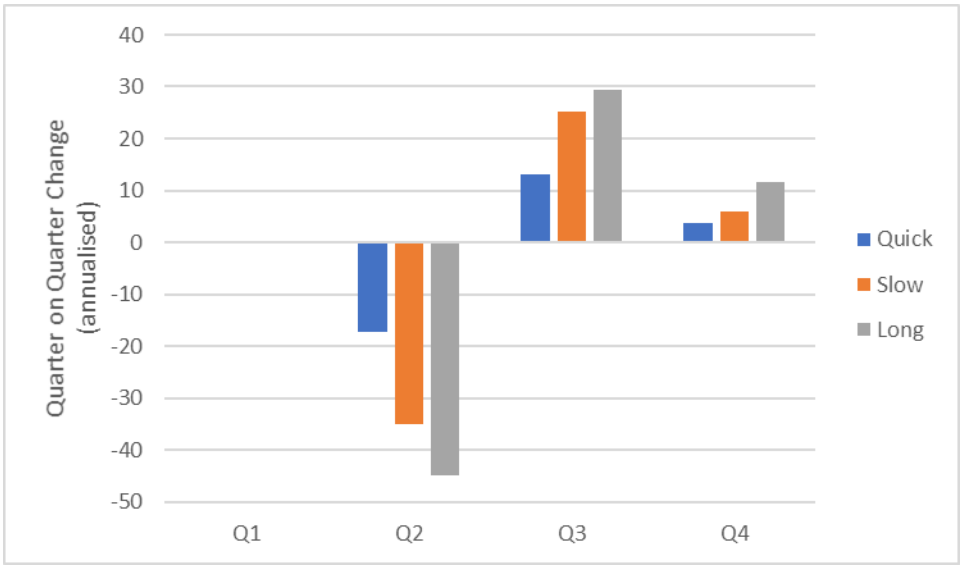


Figure ES6: Annualized quarter on quarter growth rates: GDP at market prices
Source: Own calculations.

In summary, South Africa's economic fortunes are currently closely tied to the Covid-19 pandemic brought on by the novel coronavirus. The lockdown measures that South Africa has put into place have profound economic implications. The implications of the pandemic in the rest of the world, and hence on demand for South Africa's export, are not as large as the effects of the domestic lockdown but are still very large by any normal measure.

Even the 'Quick' recovery scenario results in a GDP decline of about 5 per cent by the end of 2020—an economic outcome that would have been considered catastrophically bad a little more than one month ago. Instead, that outcome now looks optimistic. Rather, the effects of the Covid-19 look more likely to persist bringing outcomes for GDP closer to those described in 'Slow' and 'Long'.

Beyond describing economic impacts, at least two important policy conclusions emerge from this analysis. First, South Africa's transfer programs to low income households are providing critical support to the most vulnerable in this time of crisis. Efforts to maintain these payments will significantly reduce the burdens placed on low income households. Second, Because the policies imposed to contain the coronavirus have enormous economic implications, coordination of containment policies and economic policies designed to partially blunt negative economic implications of those policies is a good idea.

While this note illuminates a great deal, it also points to a large analytical agenda, particularly if the pandemic endures both within South Africa and internationally. We do not address, to give just one example, the specific economic policies that should be put in place to minimize the implications of the pandemic—how to put the economy on life support, minimizing the damage and preparing a foundation for a rapid recovery when the pandemic abates.. Overall, attention should now turn to developing a long-run strategy for navigating the pandemic that addresses both the health dimensions of containment and their economic fallout.

1. INTRODUCTION AND CONTEXT

South Africa finds itself at war, and the enemy is the novel coronavirus, which gives rise to the Covid-19 disease. In the current stage of the Covid-19 pandemic's evolution and South Africa's contagion path, the country faces difficult policy choices. The only tool currently available to mitigate the demographic effects of Covid-19 is some form of lockdown of households and non-essential producers to reduce contagion through breaking existing social and economic forms of contact. Such measures impose a severe negative shock on the economy, with immediate loss of economic activity followed by medium-term and long-term economic effects. Policy makers must balance the positive health effects of a lockdown against the economic costs.

To fight the spread of Covid-19, President Ramaphosa declared a National State of Disaster with countermeasures on 15 March, and then a three-week lockdown (national stay at home order) on March 23rd, but effective 27 March 2020. These measures are likely to buy South Africa time to develop and then implement a long-run response to Covid-19. The three-week lockdown will impose immediate economic costs, but the pandemic is certain to impose significant human and economic costs well into the future.

South Africa is experiencing Covid-19 contagion later than continents such as Europe. Without intervention, South Africa would very likely follow the path countries that delayed implementing measures designed to slow the pandemic. As of April 5, the country had 1655 confirmed cases, and only two identified deaths. South Africa has increased its testing programme and the Ministry of Health states that 35,593 tests were conducted by 30 March. Although testing has been expanded, it is recognized, as in other countries, that due to lack of universal testing the "hidden" incidence is greater than 1280 cases, perhaps significantly so.

Both the pandemic's impact on health and mortality, and the lockdown are severe economic shocks. Unlike most economy-wide disruptions, these comprise both demand and supply shocks. Business and other closures have economy wide effects during the lockdown and continuing direct and indirect effects after their end. Estimates of the post-lockdown path of the economy should enable the authorities to design policies that aid recovery. That task is particularly important because South Africa enters this crisis and the lockdown with an already weak economy, with real GDP growth estimated at 0.3 and 0.9 per cent for 2019 and 2020 respectively.

Macroeconomic imbalances in South Africa are dominated by fiscal fragility marked by deterioration of fiscal revenue in recent years, alongside high unemployment (29.1 per cent in Q4 2019) and low investment. The debt-to-GDP ratio has been steadily rising, leading to downgrades and a debt service burden that accounts for nearly 15 per cent of public revenues.[1] Domestically, multiple sectors have fragile balance sheets, including low-income households who have recently experienced high growth in unsecured debt.

This paper reports 'first pass' estimates of the costs of the lockdown and then provides three recovery scenarios. The estimates are based on internationally accepted modelling methods and are robust. As with any estimates, quality of input data is key to correctly identifying the impacts. The estimates presented are not forecasts but scenario projections that are amenable to re-estimation as new information becomes available and to test alternative policy options (such as the length of a lockdown). The paper is structured as follows. Section 2 summarizes the shocks that the lockdown imposes on the economy, while Section 3 describes the methods used for estimating economic costs. Section 4 discusses the results for the lockdown while Section 5 describes the recovery scenarios. Section 6 briefly presents conclusions and policy implications.

[1] Before the Covid-19 crisis, the debt-to-GDP ratio was already projected to reach 71.6 per cent by 2022/23, up from 26 per cent in 2009 (National Treasury, 2020; SARB).

2. THE SHOCKS

To evaluate the potential impact of Covid-19 containment measures on South African sectors, we distinguish four channels by which a lockdown and other efforts are expected to influence economic activity. These include the forced reduction in production as a result of a national lockdown and other restrictions on business operation, the impact on demand as households are locked down (e.g., on tourism as a result of travel and movement restrictions), the effect of disrupted global production and supply chains on South African exports, and the effect of uncertainty on business investment.

2.1 Forced reduction in production and demand

To prevent an unmanageable surge in Covid-19 cases, a National State of Disaster was declared on 15 March to augment existing measures by the state to deal with the outbreak. New regulations under the Disaster Management Act were introduced to slow the speed of Covid-19 transmission. These included size limitations of public gatherings, travel restrictions, suspension of schools, closures ports of entry, and cancellation of government events, and were later refined. Other efforts from business and civil society included the suspension of major religious gatherings over Easter and discouraging outpatient and elective procedures at health facilities. A three-week lockdown (national stay at home order) was announced on March 23rd, but effective 27th March 2020.

The deliberate reductions in demand and production are not uniform. Notices of lockdown regulations contain exemptions under which certain activities considered essential may continue to operate, and a complete cessation of activity is not expected. In the tourism sector, for example, although front-line services such as accommodation and car rental may not be active during lockdown, other activities, such as reservations and other support services, are expected to continue with limited staff.

2.1.1 Agriculture, forestry, and fishing

The impact of a lockdown on agriculture is likely to be mildly negative over the lockdown period. Lockdown regulations permit harvesting and storage activities, to prevent wastage of crops already planted and to tend to livestock. Certain activities, such as planting, may be restricted, although it is unlikely that planting activity is high in April. Over the very short term, South Africa is assessed to be food-secure, and precautionary health measures to guard workers in the food value chain have been introduced.

Beyond the initial containment measures, demand for agricultural exports may come under greater pressure due to low external demand.

2.1.2 Mining and quarrying

Large contractions in mining production are expected, as the sector confronts imposed closures of certain mines, as well as temporarily lower global demand. Gold, PGM and coal production are deemed essential and have been allowed to continue operating, although at reduced scale. More generally, care and maintenance on mines, are allowed to continue, to prevent safety delays once extractive mining activity is allowed to resume.

2.1.3 Manufacturing

A majority of segments in the manufacturing sector will be subject to lockdown. Certain activities within manufacturing – such as food, and the production of packaging, hygiene and medical products – are broadly exempted. However, other segments are expected to be severely affected by the lockdown period. Production of food and non-alcoholic beverages is expected to continue, although mild reductions in production may occur. Retailers have indicated a shift towards pre-packaged food, to avoid any contamination that may occur in open food items such as bread and prepared fruit and salads.

Alcohol sales and transport are prohibited during the lockdown, and production is expected to largely stall over the lockdown period.

Activity in the textiles, clothing, leather, and footwear segments is expected to fall considerably. The provision of medical textiles and apparel (personal protective equipment, bedsheets, etc.) is expected to continue, and some firms may refocus production to contribute to increased demand for those goods. However, this represents a small part of overall activity in the sector and is unlikely to offer considerable support to activity during the lockdown.

Producers of wood, paper, and related products are also subject to lockdown restrictions. In paper, certain products – particularly food and medicine packaging, and hygiene products such as toilet paper – may continue to be produced during the lockdown period.

While petrochemicals production is allowed to proceed during the lockdown period, fuel demand is expected to fall, due to a temporary lack of own-vehicle and passenger transport, and a lower level of freight transport expected during the lockdown. Specific activities, such as the production of medicines, medical supplies, and packaging, are expected to continue, which will help limit the expected decline in production in this segment.

Remaining segments in the manufacturing sector – metals, machinery, vehicle production, and furniture – are all expected to show sharp declines in production as a result of the lockdown. These segments produce mostly capital or export goods, or household durable items such as domestic appliances and televisions. As exports, investment, and household demand is expected to decline considerably over the short term, it is likely that production would have fallen even without a forced lockdown. Some smelters remain operational during the lockdown period, though not operating at full capacity and only fed by ore stockpiles.

2.1.4 Electricity, gas and water

The production of electricity and water is exempted from strict lockdown regulations, even as some noncore activities are shifted towards home-based work. Supply-side disruptions due to lockdown and containment measures are not expected. Instead, demand for electricity is expected to fall due to lower industrial demand, even as household use rises during the lockdown period.

2.1.5 Construction

Construction activity is expected to stall, affected by movement restrictions and constraints on supply and demand. A small amount of construction activity is expected, in order to provide necessary infrastructure to support medical efforts (providing temporary medical and quarantine facilities) and enforce containment, although it is unlikely to offer significant offset to a reduction in building and construction activity.

2.1.6 Trade, catering, and accommodation

Retail trade of essential food, hygiene, and medical products is allowed to continue to trade during the lockdown. Other physical retail activity, including clothing stores, furniture and appliance retailers, and hardware stores, have been closed. Online retailers in these segments remain active, however, purchases may not be delivered until restrictions are lifted.

Movement restrictions on individuals and explicit restrictions on restaurants will severely impact accommodation and catering activities. Some skeleton staff may be deployed to continue ongoing operations that do not require front-line staff, such as bookings and other administration, however hotels are expected to remain shut for regular business.

2.1.7 Transport, storage, and communication

Passenger transport is restricted to the transportation of workers that provide essential goods and services, and transportation of sick people for medical attention. Freight transport, warehousing, and logistics services are expected to be limited to the transport of essential medical, hygiene and food items, as well as essential mining outputs (e.g. coal) in the absence of production in most segments of manufacturing.

Telecommunications services are expected to improve slightly, as adaptation to the lockdown prompts employees to work remotely where possible. This is likely to encourage demand by business and other services for telecommunication and internet products.

2.1.8 Financial, insurance, real estate, and business services

Continued operation of the banking sector, payments system, pension and medical aid activities is expected. Activity in physical branches and back office is expected to be limited to skeleton staff, although the increase in online transactions will provide minor offsetting effects.

In many segments of the real estate and business services sectors, operations are expected to slow, although less severely than expected declines in industrial sectors. Many firms are expected to adapt by promoting telework where feasible, as many activities may not necessarily require workers to be in a specific location. A few exceptions to this include rentals, where lockdown restrictions would reduce demand for rented industrial equipment and vehicles; manufacturing support services, particularly where manufacturing production activity is expected to stall.

2.1.9 Community, social, and personal services

Restrictions on movement and social distancing will adversely affect social activities. Adaptation is expected to be extremely limited, and mainly take the form of online provision of services such as education and religious services.

Although medical and health activities are expected to be focused on handling cases of Covid-19 and other urgent medical needs, a large increase in medical services is not expected. The provision of outpatient, elective procedures, dentistry, and allied health services is expected to only respond to urgent cases.

Early childhood development centers, schools, universities and other learning centers are closed. Although some institutions have introduced online delivery, it is unlikely to reach a majority of students.

Recreation activities, such as movie theatres, sports, and cultural events, have been closed. Public gatherings, including church services and strikes, have been strongly restricted and discouraged. Despite some activity in informal retail and transport being permitted to provide essential goods and services, the bulk of informal sector activity is expected to be suppressed during the lockdown period.

Essential government services are expected to continue. These include municipal services such as sanitation, waste removal, and sewerage.

2.1.10 Inbound and domestic tourism

Inbound and domestic tourism have been negatively affected since late January 2020, when various organizations had started to place precautionary measures for staff and postpone or cancel events scheduled in the near term. Large scale social distancing and travel restrictions were introduced from February 2020, and most tourism-related activities have been suspended under lockdown regulations. Movement restrictions have effectively curtailed domestic demand for transport and tourism over the Easter period.

Tourism consists of a group of different economic activities, all of which will be severely impacted by lockdown. Demand for vacation travel, meetings and events are likely to remain strained until effective prevention and treatment strategies for Covid-19 are found. Lower tourism activity will deeply affect activities such as accommodation and catering, road and air transport, recreation activities, food, and textiles.

2.2 Exports

As many countries use similar containment measures to respond to the spread of Covid-19, factory shutdowns and reductions in global commodity demand are expected to have adverse effects on exports.

The extent to which export demand falls – beyond what is expected from the lockdown in South Africa – depends largely on the duration and magnitude of shutdowns in other economies, and their relative importance as an export destination. For the purposes of this analysis, export demand is expected to fall by 40-75 per cent, excepting agricultural exports which are expected to match pre-crisis expectations, at least in the near term.

2.3 Investment

Sharp contractions in the level of fixed investment are expected, as a highly uncertain outlook on economic activity leads firms to reconsider or postpone decisions on capital projects. Investment expenditure by commodity is expected to drop by 65-80 per cent. In many instances, the shutdown of heavy industries and the construction sector pre-empts the reduction in investment demand.

2.4 Summary

The expected severity of the lockdown by different industries is illustrated in Table 1. These direct shock estimates take into account provisions for certain economic activity to continue over the lockdown period, as well as expected reductions in foreign and capital expenditure and tourism demand.

3. METHODOLOGY: ECONOMYWIDE MULTISECTOR MULTIPLIER MODEL

The previous section has pulled together a view of which sectors will be affected and a narrative account of the nature of the direct impacts that might be expected. These direct impacts will have knock-on effects that spread through the entire economy. Reduced activity in one sector has consequences both for suppliers of intermediate inputs to that sector, who face lower demand, and for the users of the output of the sector, who face supply disruptions. The shock spreads through the economy, as a stone thrown into a pond creates a splash where it lands and also sends ripples across the pond, disturbing lily pads on a distant shore.

Table 1: Combined direct lockdown implications by sector

	Mild decline (0 to -10%)	Moderate decline (-10% to -30%)	Large decline (-30% to -60%)	Severe decline (Larger than -60%)
	Agriculture, forestry, fishing			
			Mining and quarrying	
MANUFACTURING		Food and non-alcoholic beverages		Alcoholic beverages and tobacco
			Textiles, clothing, leather and footwear	
			Paper, paper products	Wood, wood products
	Pharmaceuticals, hygiene and cleaning	Petroleum	Basic chemicals, fertilizer, paint, other	
		Plastic, glass		Tyres, rubber products
				Non-metallic minerals and products (cement, concrete, etc.)
				Iron, steel, metal products
				Machinery and equipment
	Electricity, gas, water			
				Construction
			Wholesale, retail trade	Accommodation, catering
	Communication		Transport and storage	
	Finance and insurance, computing services	Real estate, legal and accounting, other support services	Rentals, research, manufacturing services, other business services	
	Health services		Education services	Recreation, other community services

We now turn to look at these economy-wide effects. In this section, we discuss the method used, leaving the results to section 4.

We use an economywide simulation model to generate empirical results from plausible scenarios of the direct impact of "shocks" to the economy arising from the Covid-19 pandemic. The model provides "what-if" projections of a variety of economic indicators given the specified scenario. The results of scenario analysis are not "forecasts" of the future. They represent possible outcomes given the assumed shocks. Using a consistent empirical model in this way provides a disciplined framework for analysts, supporting coherence in policy debates.

3.1 Social accounting multiplier model

Economists have several methods for exploring the economy-wide effects of shocks to the economy, each with their own strengths and limitations. We use multisector multiplier analysis, a well-established technique that has been part of the economics toolkit since the 1950s. The approach was developed to capture the complexity of an inter-connected economy, focusing on inter-industry linkages (supply chains) as measured by input-output tables. An extension of that work is based on a Social Accounting Matrix (SAM) that expands the input-output table to include (or "endogenize") more linked economic actors than just industries.

A SAM is an accounting framework: a matrix (spreadsheet) showing the receipt/expenditure accounts of industries, households, savings/investment, government, and the rest of the world (exports and imports). The SAM integrates the input-output accounts with the national income and product accounts (or, in UN terms, the "system of national accounts", SNA). The SAM shows the flows of goods and services around the economy, and the corresponding income and expenditures of all economic actors. We use a SAM for South Africa in 2015, constructed using data from Statistics South Africa. The SAM and its documentation are available at UNU-WIDER (van Seventer, Bold, Gabriel, & Davies, 2018). Fuller detail is given in the appendix.

SAMs show the full circular flow of income in the economy, including the generation of income in production value chains (value added), and also how that income is distributed to households and government (through taxes), providing households with income to buy the goods and services produced in the economy. The SAM can provide a highly disaggregated picture of the economy. In the SAM for this study, there are 62 production sectors (industries), employing four different types of labour and capital to produce 102 different commodities. The income generated in the production sectors is distributed to 14 different household types (differentiated by income level). The income they receive is used for private consumption expenditure (disaggregated by commodity), saving, transfers, and taxes. Government receives taxes and makes expenditures, including transfers to households. There are also indirect taxes on commodities. Finally, the economy is open, with imports of goods and services adding to domestic supplies and exports and other international transfers adding to demand.

SAMs are widely used in economy-wide analysis. We combine the disaggregated description of the economy in the SAM with assumptions about behaviour of households, firms and other agents, along with other assumptions, to build a model of how we think the economy not only fits together, but how it responds to shocks.

In standard multiplier analysis there are two key assumptions:

- Industries demand inputs in fixed proportions to output; technology and preferences are linear.
- Prices are fixed. Adjustments to shocks work through changes in quantities, not prices.

These assumptions, while strong, are reasonable for analyzing the impact of the pandemic. The shocks we are observing are working through the economy in weeks or months, not years. In such a short period, it is unlikely that production technologies are changed significantly by the pandemic. In the short run, the pandemic will not cause significant changes in relative prices or wages of employed labour. While there appears to be some profiteering price increases, they have not acted as signals or incentives to stimulate production but rather as short run rent seeking and rationing devices. In this environment, multiplier analysis is a good tool to use, likely better than more sophisticated methods such as computable general equilibrium (CGE) models. In CGE models, adjustment works through changes in prices and wages operating smoothly in commodity and factor markets. While CGE models are very useful for considering shocks that work through market mechanisms, that is not what is happening in the lockdown due to the novel coronavirus crisis. As economies recover, CGE models will be a useful tool to consider how economies will operate in the changed, post-crisis, economic environment.

3.2 Specific application

The channels through which the lockdown directly impacts the economy are discussed in Section 2. The initial shock has two components:

1. The lockdown involves preventing individuals from leaving their homes except under exceptional circumstances. Unless employed in an essential sector, they cannot go to work and are restricted in how and where they can spend their income.
2. The lockdown also involves closing non-essential industries, leading to declines in production and possibly large numbers of workers being laid off.

From both the demand and supply sides, the lockdown results in a massive decline in demand/supply of many industries. The effect is widespread across industries, but especially large in the service sectors (e.g., restaurants, entertainment, tourism, travel, hotels, etc.).

The lockdown alone causes major impacts on employment, production, and demand. In addition, these impacts spill over into the macro economy. Industries are facing an uncertain future and are hesitant to engage in investment projects, resulting in a decline in aggregate investment. The pandemic is global, leading to a major decline in world trade.

While it is relatively easy to speculate about which sectors are likely to be impacted, it is much more difficult to estimate what the size of the impacts will be. Given the unprecedented nature of the pandemic, quantitative assessments are necessarily speculative. However, making assessments, however rough and conditional, is an important input into designing appropriate policy responses. It is better to start with a scenario using explicit rough estimates rather than make suggestions such as "the cure may be worse than the disease" that include a strong, implicit, quantitative judgement not based on much evidence. For policy purposes, it is important to make the judgement explicit, which informs discussion, revision as new information becomes available, and improvement in the analysis.

The multiplier model is an empirical model and requires specific numerical data to represent the shocks. The model works by specifying exogenous demands for commodities by households (consumption), investment, government, and the world (exports). In the multiplier model, any changes in demand for commodities are directly translated into a change in the production of industrial output that supplies that demand. For household demand shocks, we specify exogenous changes in consumption demand. To capture the impact on supply of a lockdown of industries, we cut all final demand for the commodities produced by the industry, which effectively cut production in those industries.[2]

In addition to the lockdown impact on demand/supply, we also considered the impact of the crisis on macro aggregates: investment and exports. These macro shocks are assumed to operate on demand for all commodities for exports and investment. We also consider that the macro shock might involve a more general hit on consumer demand as it adds to the general fall in employment and household income. In effect, we are observing a recession that emanates from shocks in demand and supply at the sectoral level rather than the "usual" recession that emanates from shocks in the financial system and asset markets—the sort of recession studied by macro economists. This 'bottom-up' recession, however, leads to 'top-down' effects on macro aggregates that exacerbate the effects of the bottom-up shock.

[2] See the Appendix for a discussion of the handling of activities that produce many commodities.

We implement three scenarios:

1. LOCKDOWN: A lockdown demand/supply shock at the sectoral level: the bottom-up recession.
2. LOCKDOWN PLUS: The lockdown scenario plus a macro shock reducing aggregate investment, cutting demand for investment goods (e.g., construction and machinery).
3. FULL: The lockdown scenario plus the investment shock plus reduced aggregate demand for exports, cutting sectoral exports.

These scenarios effectively decompose the full shock, scenario 3 and Table 1, into bottom-up shocks and two aggregate macro shocks on investment and exports. These scenarios should facilitate communication between analysts focusing on the sectoral impacts and macro economists focusing on potential interactions at the macro level. The first scenario indicates to macro economists what is the nature of the bottom-up shock that will need to be addressed at the macro level. The macro economists, in turn, will focus on the macro shocks, which can then be considered in the SAM-multiplier model to produce a combined lockdown and macro shock scenario.

3.3 Limitations

As with all methods of making sense of the world, the multiplier approach has limitations that should be borne in mind when using the results of this scenario analysis to inform policy. Given the unprecedented nature of the shocks and their large magnitude, all approaches will have to contend with high levels of uncertainty.

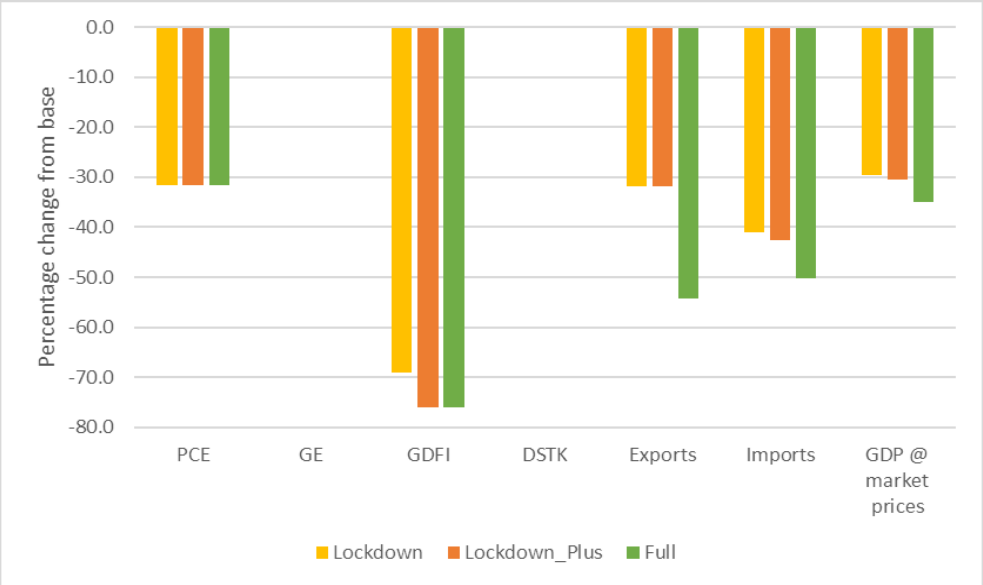
In the current context, a potential limitation of multiplier analysis relates to the speed of realization of indirect effects. For example, cessation of production of a key intermediate good, such as ball bearings, will have implications for manufacturers as soon as their stocks of ball bearings disappear. A second example relates to business services. A manufacturer may regularly purchase business services such as accounting; however, the absence of accounting services is unlikely to halt production in the near term. In the multiplier framework deployed, all adjustments occur in the time period of the model.

Nevertheless, the likelihood is that any overstatement of indirect impacts, due to the assumption that all adjustments occur in the time period of the model, is relatively small for two reasons. First, the lockdown shocks are weighted towards final demand with services sectors, and their demands for intermediates, particularly strongly affected. For example, closed restaurants will reliably use less electricity. Looking downstream, many critical and non-essential items (e.g., ball bearings) are in short supply in the current circumstances, but the critical shortages will predominate. In other words, when a firm is not producing because it is locked down or because it lacks access to critical intermediates like ball bearings, it matters little if that firm is capable of operating without accounting services for a period of time.

4. PRESENTATION AND DISCUSSION OF SELECTED RESULTS OF THE LOCKDOWN SCENARIOS

In this section, we present and discuss indicative results of the scenarios outlined in Section 2 using the SAM multiplier model described in Section 3. Note that these results are tentative, as assumptions underlying the scenarios as well as the model's configuration will change as the pandemic unfolds, new information becomes available, and the government adjusts policies.

In Figure 1, the first five items on the horizontal axis present the assumptions of all three scenarios for household expenditure (PCE), government expenditure (GE), gross domestic investment (GDFI), change in stocks (DSTK), exports, imports and GDP at market prices respectively. There is no change in government expenditure or change in stocks, since they are not shocked by assumption. The bars show the per cent change in a component relative to its base value, not the size of the shock relative to shocks on other components.



Notes: PCE = Household expenditure, GE = Government expenditure, GDFI = Gross domestic fixed investment, DSTK = Change in stocks.

Figure 1: Impacts on expenditure GDP components, as percentage deviations from their pre-crisis levels
Source: Own calculations

The last two bar clusters on the right represent impacts on imports and GDP at market prices and show results for all three scenarios. These are endogenous variables solved in the model. Figure 1 displays the cumulative impacts of the imposed sequence of scenarios. The Lockdown scenario results in a 30 per cent decline in GDP at market prices. The addition of a drop in investment demand under the Lockdown Plus scenario brings it further down by 1 percentage point to -31 per cent. Adding the export shock adds a further 4 percentage points to the decline, so that the Full scenario results in a drop of 35 per cent in GDP at market prices. For imports, the declines are 41 per cent, 43 per cent and 50 per cent, respectively.

The changes to the balance of trade are interesting. Although exports are reduced exogenously in all three scenarios, imports also fall endogenously. In the first two scenarios, these improve the balance of trade, which rises from -1.3 per cent of GDP pre-crisis to 2.9 per cent under Lockdown and 3.7 per cent under Lockdown Plus. However, in the Full scenario, where we assume a further fall in exports emanating from pandemic induced declines in South Africa's export markets, the balance of trade falls to -2.8 per cent of GDP.

Figure 2 presents impacts on the income components of GDP (at factor cost). As explained in the previous section, several labor types are identified in the underlying SAM data, along the lines of education attainment. The format of the clustering is the same as in Figure 1. The first four clusters show results for wage earnings by type of education, the 5th for total wage earnings, followed by the impact on gross operating surplus and GDP (at factor cost) respectively.

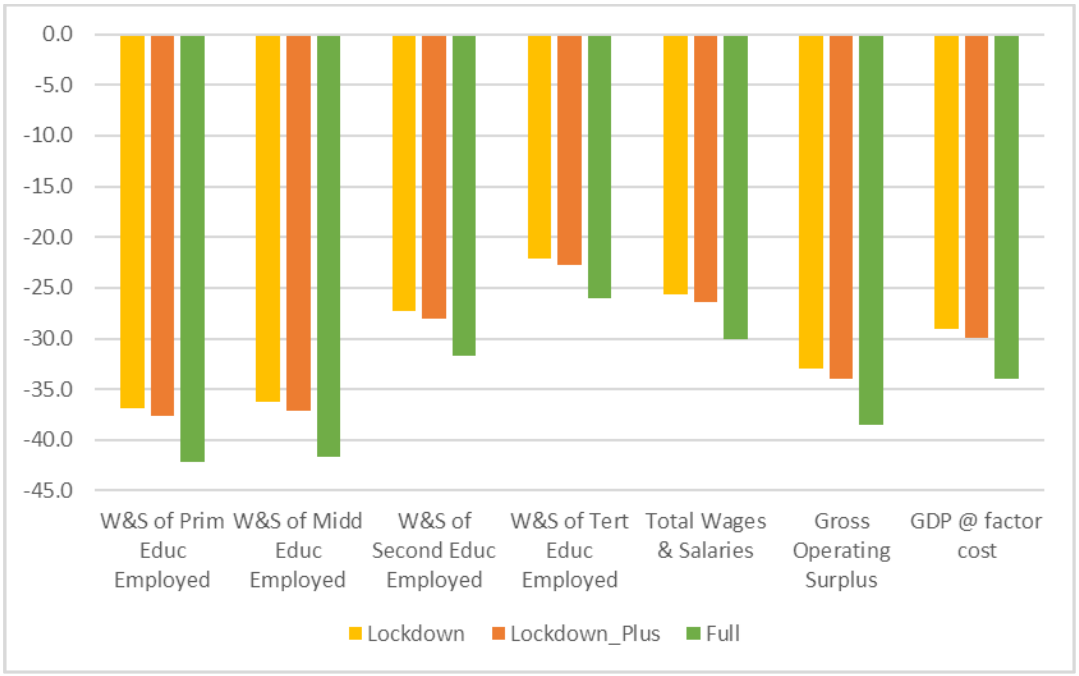


Figure 2: Impacts on wage earnings and income GDP components, as percentage deviation from their pre-crisis levels

Source: Own calculations

Figure 2 suggests that the negative impact is proportionately bigger for lower educated workers. Under the Full scenario, wage earnings fall by just over 40 per cent for the lowest education levels and about 25 per cent for tertiary educated labour. Overall, wage earnings are down by about 30 per cent but gross operating surplus is down by close to 40 per cent.[3] These differentiated impacts are the results of how detailed industries in the SAM, are impacted and their contribution to industry value added. This will have an impact on the distribution of income. Overall, GDP at factor cost falls by 34 per cent in the Full scenario, slightly less than GDP at market prices (see Figure 1).

It is important to highlight two items. First, these results reflect quantity adjustments and not price adjustments. Hence, a 40 per cent reduction in wage earnings in the lowest two education categories implies roughly a 40 per cent reduction in hours worked in those labour categories. Overall, approximately one third of the resources that were productive in February 2020 are idled as a result of the shocks. As shown in Figure 2, the bulk of this impact (29 of 34 per cent) comes from the lockdown.

Second, economic adjustment to the shocks occur within the time period of the model, which we judge to be very short, probably less than a quarter (three months). The results indicate that, at the end of the shock period, the economy being delivered to the next period starts out with the labour force working 25 to 40 per cent fewer hours, depending on education category, and capital utilization similarly lower. The GDP that this shocked economy produces (a flow variable, with units of GDP per unit time) is also about 35 per cent lower. If this situation lasts for a year, then annual GDP would also be 35 per cent lower for that year.

Industry level impacts can be presented at a detailed and at broad level for the Full scenario only. Results are shown in Figure 3. The selection of industries is the same as reported in the Stats SA GDP releases. The bars represent percentage changes from industries' pre-crisis GDP values.

[3] A possible explanation is that most such workers are employed in the sectors hardest hit by the Covid-19 crisis, particularly hospitality, tourism and informal sector.

Notes: Agri&ff = Agriculture, fishing and forestry, Trdacc = Trade and accommodation services, Fin&bs = Financial and business services.

Figure 3: Impacts on value added for broad industries for the Full scenario, as percentage of their pre-crisis values

Source: Own calculations

Figure 3 distinguishes between 'first round' effects and total multiplier effects. Since the shocks are administered at the commodity level, i.e., household demand, investment and exports, and the SAM makes a distinction between commodities and industries (activities), the latter are not impacted directly as is the case in a standard Input-Output model. In SAM-based multiplier models, when demand for a commodity changes, the immediate or "first round" impact, before any knock-on effects take place, will be on the industries that produce that commodity. The indirect knock-on effects only come into play subsequently because the activities producing the commodity require more (or in this case less) intermediate commodity inputs. The difference between the full impact, i.e., including all the indirect effects, and the first-round effects offers a view of how shocks transmit through the economic system. These indirect effects represent a key contribution of this type of analysis as they show indirect effects on industries that are not affected directly.

A number of observations can be made when viewing Figure 3. Several industries display very small first round effects. Some, such as utilities, financial services and public administration, can be explained easily as they are considered to be essential services. Nevertheless, albeit apart from public administration, these industries are likely to face considerable negative indirect impacts. This is also the case for agriculture.

The explanations for the low first round effects on the trade sector, and to a lesser extent the transport sector, are different. Both have large segments that have been closed, either by regulation or because of lack of demand. We might therefore expect the direct impact to be large. However, in the SAM data, as in the real world, the payment for trade and transport margins is included in the price of the good. When one pays a retailer for an article of clothing, it is only the retailer's markup that is a payment for the retail service provided. The cost of the article itself is paid to its supplier. In the SAM, the margins embodied in the price of the goods to the user are recycled to the trade and transport sectors indirectly, and this shows up in the multiplier analysis. Hence, the first-round impacts on trade and transport are low while the indirect effects are very large.

Mining, manufacturing, construction and other services on the other hand face considerable negative first round effects which explain a large part of their full negative impacts.

Results at the most detailed level of activities are presented in Table 2. The variables are GDP at factor costs and total employment. Sectors are ranked in descending order of the impact relative to their pre-crisis values. Only the results of the Full scenario are shown.

With few exceptions, service activities are at the top of the list, in terms of both labour and output. There are a few exceptions. Construction is hit hard, by assumption. It is also at the top of the employment ranking because it is relatively more labour intensive. Mining subsectors are hit hard in terms of GDP but less so in terms of employment because they are capital intensive. Food and beverages suffer by assumption, the shocks administered are high. Their ranking in terms of employment is similar for food but much lower for beverages. The latter is much less labor intensive. Some manufacturing activities start appearing only further down the list in terms of GDP but feature somewhat higher in terms of employment losses. They include fabricated metal products, machinery and equipment, basic iron and steel, casting of metals and motor vehicles, trailers and parts. Some services activities drop in the employment impact ranking as they are relatively less labor intensive.

Activities that are less affected are found at the bottom of the table. They include not only essential services such as the public sector and health but also some activities that have been earmarked as suppling these services such as medical equipment. Other activities are relatively small such as footwear, furniture, glass, water transport and fishing because they do not have strong backward linkages with those activities that are hit the hardest. Other activities are less impacted in terms of employment because their employment output ratios and elasticities are relatively low, including some specialized manufacturing, air transport, financial intermediation and research and development.

Table 2: Impacts in the Full scenario on GDP at factor cost and hours worked for detailed sectors, as percentage change from their pre-crisis values

	Impacts3	%ch in gdp @ fc		Impacts3	%ch in tot emp
1	Other transport equipment	-77.4	1	Construction	-67.8
2	Land transport, transport via pipe lines	-74.0	2	Retail trade	-60.5
3	Construction	-68.2	3	Other business activities	-59.9
4	Wholesale trade, commission trade	-68.1	4	Education	-59.5
5	Retail trade	-67.8	5	Non-observed, informal, non-profit, households,	-59.1
6	Real estate activities	-67.6	6	Agriculture	-59.1
7	Mining of metal ores	-66.9	7	Sale, maintenance, repair of motor vehicles	-52.2
8	Other business activities	-66.4	8	Hotels and restaurants	-47.3
9	Financial intermediation	-64.4	9	Other activities	-46.7
10	Activities to financial intermediation	-64.4	10	Land transport, transport via pipe lines	-45.9
11	Sale, maintenance, repair of motor vehicles	-63.0	11	Fabricated metal products	-44.8
12	Electricity, gas, steam and hot water supply	-61.5	12	Machinery and equipment	-42.7
13	Food	-61.0	13	Basic iron and steel, casting of metals	-41.2
14	Mining of coal and lignite	-60.0	14	Motor vehicles, trailers, parts	-40.7
15	Hotels and restaurants	-58.5	15	Food	-37.7
16	Beverages and tobacco	-58.4	16	Financial intermediation	-37.5
17	Machinery and equipment	-55.9	17	Wholesale trade, commission trade	-36.1
18	Education	-55.5	18	Mining of metal ores	-34.6
19	Other mining and quarrying	-54.4	19	Computer and related activities	-34.4
20	Mining of gold and uranium ore	-53.4	20	Real estate activities	-33.6
21	Agriculture	-53.1	21	Non-metallic minerals	-33.5
22	Auxiliary transport	-52.6	22	Spinning, weaving and finishing of textiles	-33.2
23	Motor vehicles, trailers, parts	-50.4	23	Recreational, cultural and sporting activities	-32.3
24	Post and telecommunication	-50.0	24	Mining of gold and uranium ore	-32.3
25	Fabricated metal products	-48.6	25	Renting of machinery and equipment	-32.2
26	Coke oven, petroleum refineries	-48.1	26	Beverages and tobacco	-32.1
27	Insurance and pension funding	-47.2	27	Knitted, crouched fabrics, wearing apparel, fur articles	-31.7
28	Basic iron and steel, casting of metals	-47.2	28	Publishing, printing, recorded media	-31.2
29	Manufacturing n.e.c, recycling	-45.3	29	Furniture	-30.1
30	Sawmilling, planing of wood, cork, straw	-44.8	30	Sawmilling, planing of wood, cork, straw	-28.8
31	Nuclear fuel, basic chemicals	-44.1	31	Electricity, gas, steam and hot water supply	-27.6
32	Air transport	-43.3	32	Activities of membership organisations	-26.1
33	Non-metallic minerals	-43.3	33	Mining of coal and lignite	-25.1
34	Paper	-43.1	34	Plastic	-24.5
35	Collection, purification and distribution of water	-41.3	35	Post and telecommunication	-23.7
36	Basic precious and non-ferrous metals	-41.2	36	Insurance and pension funding	-23.4
37	Other chemical products, man-made fibres	-41.1	37	Paper	-23.4
38	Recreational, cultural and sporting activities	-39.2	38	Coke oven, petroleum refineries	-22.9
39	Plastic	-39.2	39	Forestry	-22.8
40	Electrical machinery and apparatus	-37.7	40	Other mining and quarrying	-22.7
41	Other transport equipment	-37.0	41	Electrical machinery and apparatus	-22.3
42	Publishing, printing, recorded media	-36.8	42	Basic precious and non-ferrous metals	-21.9
43	Research and experimental development	-36.7	43	Other chemical products, man-made fibres	-21.8
44	Renting of machinery and equipment	-35.9	44	Manufacturing n.e.c, recycling	-21.5
45	Furniture	-35.7	45	Other transport equipment	-21.4
46	Rubber	-34.4	46	Auxiliary transport	-20.7
47	Spinning, weaving and finishing of textiles	-33.6	47	Research and experimental development	-20.1
48	Knitted, crouched fabrics, wearing apparel, fur articles	-32.3	48	Tanning and dressing of leather	-19.7
49	Computer and related activities	-32.1	49	Footwear	-19.6
50	Forestry	-31.2	50	Rubber	-19.2
51	Government	-28.8	51	Air transport	-18.8
52	Radio, television, communication equipment and appara	-26.4	52	Nuclear fuel, basic chemicals	-18.6
53	Medical, precision, optical instruments, watches and clo	-26.1	53	Collection, purification and distribution of water	-16.3
54	Fishing	-24.5	54	Glass	-16.2
55	Glass	-23.7	55	Activities to financial intermediation	-15.9
56	Tanning and dressing of leather	-23.2	56	Health and social work	-13.6
57	Footwear	-21.7	57	Medical, precision, optical instruments, watches and clo	-12.7
58	Activities of membership organisations	-21.0	58	Fishing	-12.5
59	Health and social work	-17.3	59	Government	-11.8
60	Other activities	-1.3	60	Water transport	-0.5
61	Water transport	-1.1	61	Radio, television, communication equipment and appara	-0.3
62	Sewerage and refuse disposal	-0.3	62	Sewerage and refuse disposal	-0.2

Note: Full impacts include the direct as well as indirect knock-on effects. The full shock includes the shock on all components of GDP.
Source: Own calculation.

Next, we look at impacts on household income. Factor income generated endogenously by the model finds it way, directly or indirectly, to the households. Other sources of income, such as transfers from government and the rest of the world are assumed to be unaffected by the shocks. Results are shown in Figure 4.

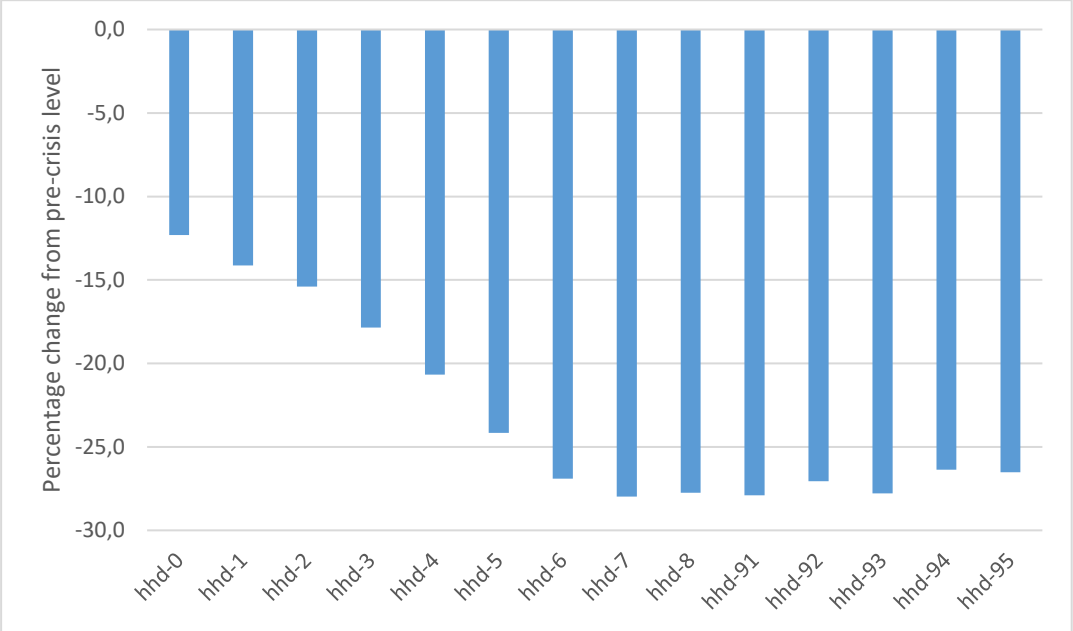


Figure 4: Impacts on household incomes for the Full scenario, as percentage falls from their pre-crisis values

Source: Own calculations

The overall pattern suggests that lower income households suffer less than those at the upper end of the distribution scale. Several channels of impacts influence these results, and some may counterbalance others. In Figure 2, it was found that lower educated wage earnings suffer more than wages of higher educated labour. Since low income households depend more on lower education earnings one would expect their incomes to suffer more. This is not the case in Figure 4. The major reason is that lower income households receive significant exogenous transfers from the government, and these transfers are unaltered during the shocks. This transfer income makes up a larger share of the income of poor households than at the top end of the distribution. As Table A1 in the Appendix shows, transfers from government make up some 69% of the lowest decile's income. By the 7th decile, this has dropped to 16%. This is an important consideration for policy makers. Given that low-skilled labour is hit harder than other labour categories, it is very important for the government to maintain, or increase, income support to the poorer households.

Figure 2 also suggests that income received by the production factor capital suffers more than total wage earnings. Most of this income is transferred to households either directly or indirectly via the enterprises. Lower income households receive disproportionally less of this income than higher income households. Combining these three effects then results in higher impacts at the upper end of the household income distribution scale. There is an indication that the education attainment effect of wage earnings become stronger than the capital income effect right at the top. Middle income households rely more on lower educated wage earnings and therefore suffer more while their cushion via government transfers is less. Their exposure to capital income is also less.

Turning to revenues, Table 3 shows the impact on tax revenues in each Scenario. In the Full scenario, total tax revenue is 32.5 percent below its pre-crisis level. Revenues from all the main tax headings fall. This is a linear estimate based on the average effective tax rates. Although the average and marginal

rates are similar for the indirect taxes, they are not for the direct taxes. As income falls, personal income tax is likely to fall faster. The table thus probably understates the likely fall.

Table 3: Impacts on tax revenues for all scenarios, as percentage change from pre-crisis levels.

	Share in base	Lockdown	Lockdown Plus	Full
Production tax	6.5	-27.9	-29.9	-33.8
Import tax	4.0	-44.5	-45.8	-55.6
Domestic sales tax	34.5	-34.1	-34.8	-41.8
Direct tax on households and enterprises	55.0	-21.1	-21.8	-24.8
Total Tax	**100.0**	**-27.0**	**-27.8**	**-32.5**

Source: Own calculations

Direct taxes are impacted relatively less than indirect taxes. The reason is that a significant part of enterprise and household income (such as transfers related to private pensions) is not affected by the shocks and does not change. On the other hand, indirect taxes face the full effects of the shocks as they are linked to production and demand, and so fall with them.

5. RECOVERY

In the previous sections, we examined the impact of the shocks of the pandemic and policy response (lockdown) on the economy. The analysis compared the economy before and after the shock, with no consideration of the time horizon involved. In this section, we consider both how long these impacts might last and what recovery path the economy might follow after the pandemic has abated.

No one yet knows what the course of the pandemic and its economic impacts will be. However, it is possible to speculate about what the main influences will be and develop plausible scenarios of the evolution of the shocks over time and the impact of policy interventions. There are widely different views about likely trajectories in both policy and public discussions, and it is useful to tease out the implications of these views. Incorporating different speculative scenarios into our SAM-multiplier modelling framework constrains them to be internally consistent and enables us to draw some inferences that we might not have anticipated. Hence, we are here engaging in an exercise of rigorous speculation.[4] In this section, we explicitly introduce time into the model, solving for economic impacts over four quarters in 2020, labelled Q1 to Q4.

We consider three archetypical scenarios that we think capture the debates. The first is that the lockdown will soon arrest the spread of the virus, ending the pandemic. This will allow people to get back to work relatively soon. Furthermore, in this view, the economy will bounce back relatively quickly. We label this the *Quick Scenario*.

A second more pessimistic view, which we label the *Slow Scenario,* is that, as in other countries, the lockdown will have to continue past the initial 21 days. This extension will make recovery harder, since firms that might have coped with a 3-week shut down will not be able to survive a much longer one. The capacity of the economy at the end of the COVID-19 tunnel will be significantly impaired. Recovery will take longer.

Finally, the more-pessimistic case is that, even after an eight-week lockdown, the medical crisis will not have ended, but that it will be politically and socially difficult to continue the lockdown. The period of disruption to the economy will therefore extend much further. This will make it even harder to recover as the economy will have been damaged even more. We label this the *Long Scenario.*

[4] See (Noland, Robinson, & Wang, 2000) who used the term in their work on North Korea.

When we take the disaggregated view of the economy that we have followed in the previous section, we can see that the effects of the lockdown beyond its immediate impact will vary from sector to sector. Most obviously, international tourism will likely be reduced beyond 2020 and for some time thereafter. Even if South Africa manages to contain the virus domestically, it is likely that exports will be down until there is a global recovery of some sort. Export-oriented sectors in South Africa will therefore face sluggish demand for some time into the future. In these circumstances, investment will remain down, negatively affecting construction and other capital good producers.

We explore these three recovery scenarios constructed around optimistic, gloomy and pessimistic views. In the next subsection we provide a narrative account of the main contours of each, attaching some high-level numbers. We will then model them. We again emphasize that we are not producing forecasts, but rather scenarios.

5.1 Contours of the scenarios

In this section, we assess the impact of possible recovery options following the 21 days lockdown. As in the previous section, we show the direct and indirect impacts on a set of economic indicators based on our initial view of demand over the next three quarters.

We summarize the main features of the three scenarios in Table 4. The three scenarios modeled are:

1. ***Quick:*** the pandemic is contained quickly, and the economy bounces back.
2. ***Slow:*** the pandemic takes longer to contain, and the economy is slower to recover.
3. ***Long:*** the pandemic endures even longer, and the recovery thereafter is spread over a longer period than in the Slow scenario (although in this study we cut off considering it at the end of 2020)

Our starting point is the Full scenario developed in the previous sections. The impacts modelled there will be carried forward to the current exercise as the starting point for all three scenarios. We now need to take time into account. To do this, we use the model to generate results on a quarterly basis. The lockdown will be for some number of weeks or, more likely, months. Breaking the paths into quarterly periods seems a reasonable compromise. Furthermore, producing quarterly results meshes with standard macroeconomic models and forecasts, which are also important inputs into the process of thinking about recovery paths.

As shown in Table 4, the shocks in each quarter differ, representing different stages along the recovery path for each scenario. The model produces the quarterly impact of the shock for each quarter. Annual rates are constructed as a weighted average of the results for all four quarters. In practice, having examined the contribution of each quarter to annual GDP in South Africa's historical national income statistics, we weight each quarter equally. We also produce annualized quarter-on-quarter growth rates. Although the lockdown started towards the end of Q1 and spreads into Q2, we model it as occurring entirely within Q2, with adjustments for the different recovery scenarios within the quarter.

Table 4: Broad details of the scenarios

			Scenario 1: Quick	Scenario 2: Slow	Scenario 3: Long
1a		Path of the pandemic	South Africa manages to control the growth in new infections by the end of Q2.	The epidemic is not controlled within the 21 days and the lockdown period is extended to 8 weeks. The health system can provide enough ICU beds.	South Africa experiences Italian type of scenario across its major cities, exacerbated by winter and the inability to sustain a lockdown beyond 8 weeks. The health system is not able to provide enough ICU beds.
1b		Lockdown	The complete lockdown is limited to 21 days but social distancing and partial lockdowns continue to affect economic activity well beyond the 21 days. This is in line with results from current epidemiological models.	The complete lockdown is extended to 8 weeks.	Complete lockdown for 8 weeks but attempts to extend it beyond that are partially successful
2	Q2		The economy operates at about 80 per cent of its pre-crisis levels on average.	The economy operates at 65 per cent of its pre-crisis levels on average.	The economy operates at 55 per cent of its pre-crisis levels on average.
2a-d			The impacts on household consumption, tourism, investment and exports are generated by the model		
			All percentages below refer to the pre-crisis level		
3	Q3	Narrative	Economic recovery accelerates in Q3 supported by stronger global growth, improved confidence and low borrowing costs.	Economic recovery accelerates in Q3, but the global recovery is weaker and South Africa's fiscal situation generates larger crowding out effects than in Scenario 1	Economic recovery accelerates in Q3 but it is weaker than in Scenario 2. The fiscal situation deteriorates further.
3a		Household consumption	90 per cent	70 per cent	60 per cent
3b		Tourism	50 per cent	50 per cent	the same as in Q2
3c		Investment	90 per cent	70 per cent	60 per cent.
3d		Exports	90 per cent	80 per cent	80 per cent
4	Q4	Narrative	Household consumption, investment and exports recover to their pre-crisis levels, while tourism demand remains down	Household consumption, investment and exports reach the Scenario 1:Q3 levels, while tourism demand does not recover as much	Household consumption, investment and exports reach Scenario 2:Q3 levels, while tourism demand is below Scenario 2:Q4 levels.
4a		Household consumption	100 per cent	90 per cent	60 per cent
4b		Tourism	80 per cent	70 per cent	The same as in Q2
4c		Investment	100 per cent	90 per cent	60 per cent
4d		Exports	100 per cent	90 per cent	80 per cent

Source: Own construction

5.2 Results

Figure 5 shows the pattern of quarterly impacts on GDP at market prices. It illustrates the way the different paths have been calibrated, following the scenarios spelled out in Table 4.

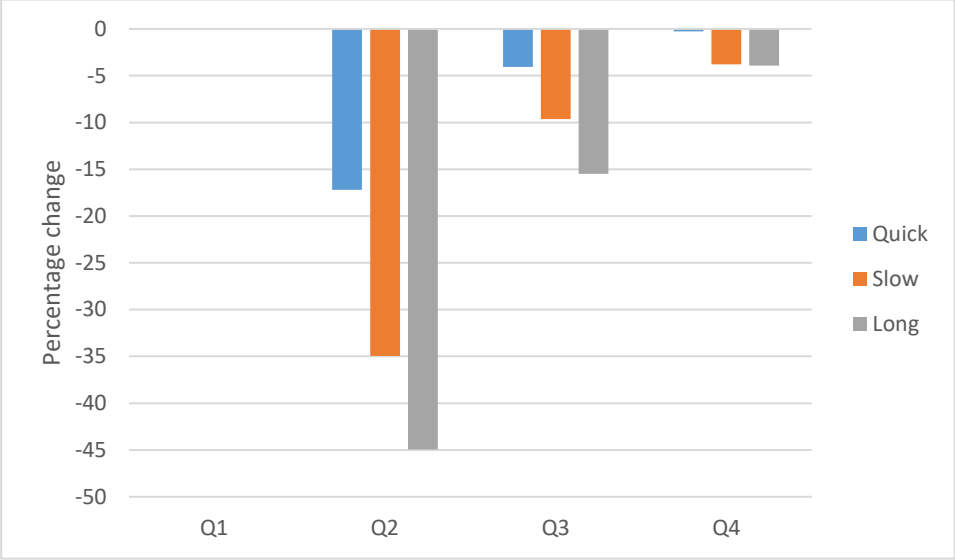


Figure 5: Change from pre-crisis level per quarter: GDP at market prices
Source: Own calculations

Figure 6 shows how the quarterly profiles in Figure 5 translate into annual growth rates for 2020 in each scenario. These rates are deviations from the pre-crisis level of GDP. They can be interpreted as the percentage points that GDP growth will be below any projection without the ensemble of COVID impacts. Thus, if South Africa was projected to grow at, say, 2 per cent before COVID, we would expect the post COVID growth rate to be -3 percent in the quick scenario, and -10 per cent and -14 per cent in the other two scenarios, respectively. Notice that all three scenarios imply that recovery, in the sense of getting back to pre-crisis levels, will not be completed by the end of the year.

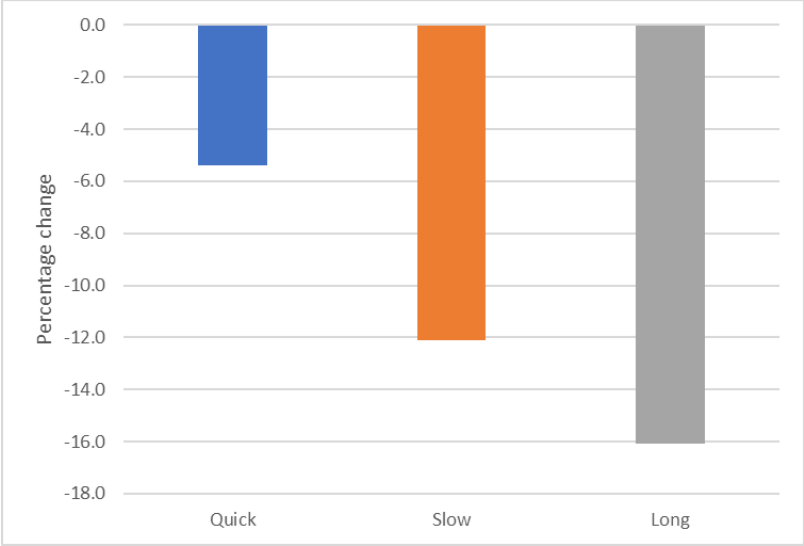


Figure 6: Average annual growth rates for 2020 in each scenario: GDP at market prices
Source: Own calculations

Although the impact assessment in the previous section gave the impact drop in GDP of 35 percent, this quarterly analysis is more muted for three reasons. Firstly, we now confine the impact to a portion of Q2. Second, the effects in the other quarters are less, reflecting the conjectured recovery paths. Third, there is no impact in Q1, which therefore enters as zero into the annual average.

While the -5% drop in the *Quick Scenario* is reassuring after the -35% of the *Full Scenario* in the previous section, we should keep in mind how such a fall would be viewed in normal circumstances.

Finally, Figure 7 presents the implied quarter-on-quarter growth rates. After the sharp drop in Q2, Q3 and Q4 show positive rates. It should be remembered that these are positive rates as the economy recovers off the low base of Q2. As noted, they are insufficient to get the economy back to its pre-crisis levels.

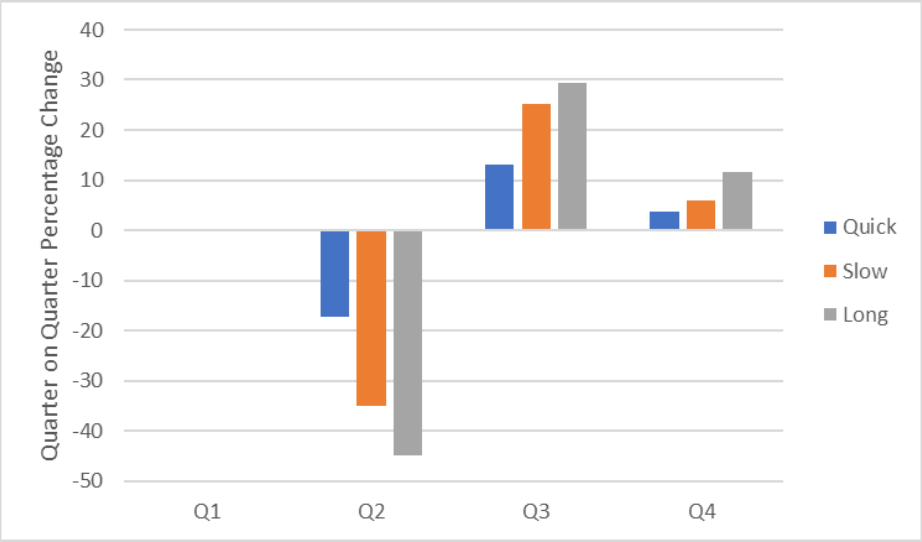


Figure 7: Average annual growth rates for 2020 in each scenario: GDP at market prices
Source: Own calculations

These high-level results for each of the recovery scenarios are constructed from the bottom up but they reflect the broad sectoral calibration of each scenario according to the expectations for the trajectories of each of the aggregate GDP components. They do go beyond those imposed targets by incorporating the indirect effects described in the previous sections. But they are driven in large measure by the assumptions set out in Table 4. To learn the most from the model, we can dig into more disaggregated results.

Details for expenditure GDP components are reported in Tables 5-7.

Table 5: Annual average growth rates for 2020: GDP components, percentage

	Quick	Slow	Long
PCE	-5.1	-11.4	-16.8
GE	0.0	0.0	0.0
GDFI	-11.4	-26.6	-33.8
DSTK	0.0	0.0	0.0
Exports	-8.1	-17.6	-20.8
Imports	-7.7	-17.3	-22.7
GDP @ market prices	-5.4	-12.1	-16.1

Source: Own calculations

Table 6: Percentage deviation from pre-crisis levels of expenditure GDP components, by quarter

	Quick				Slow				Long			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
PCE	0.0	-15.2	-4.5	-0.7	0.0	-31.6	-10.1	-3.8	0.0	-44.7	-18.4	-4.2
GE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GDFI	0.0	-38.0	-7.6	0.0	0.0	-76.0	-22.8	-7.6	0.0	-91.2	-36.5	-7.6
DSTK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exports	0.0	-27.1	-5.4	0.0	0.0	-54.1	-10.8	-5.4	0.0	-65.0	-13.0	-5.4
Imports	0.0	-24.8	-5.8	-0.4	0.0	-50.2	-13.8	-5.4	0.0	-63.5	-21.7	-5.6
GDP @ market prices	0.0	-17.2	-4.1	-0.3	0.0	-34.9	-9.6	-3.8	0.0	-44.9	-15.5	-3.9

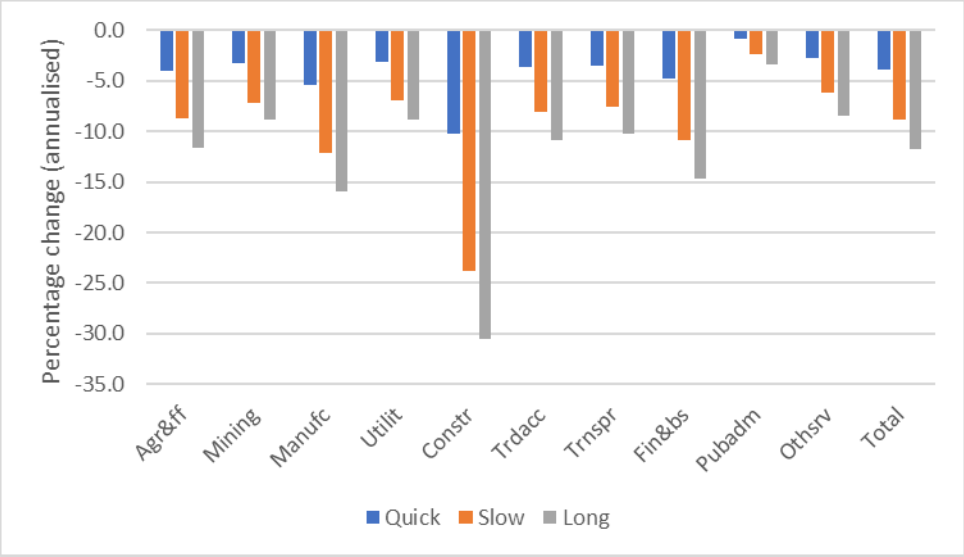
Source: Own calculations

Table 7: Quarter on quarter growth rates for expenditure GDP components, percentage

	Quick				Slow				Long			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Private Consumption Expenditure	0.0	-15.2	10.7	3.8	0.0	-31.6	21.5	6.3	0.0	-44.7	26.4	14.2
Government Expenditure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gross Fixed Capital Formation	0.0	-38.0	30.4	7.6	0.0	-76.0	53.2	15.2	0.0	-91.2	54.7	28.9
Change in Inventories	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exports	0.0	-27.1	21.7	5.4	0.0	-54.1	43.3	5.4	0.0	-65.0	52.0	7.6
Imports	0.0	-24.8	19.0	5.4	0.0	-50.2	36.4	8.4	0.0	-63.5	41.8	16.1
GDP at market prices	0.0	-17.2	13.2	3.8	0.0	-34.9	25.3	5.9	0.0	-44.9	29.4	11.6

Source: Own calculations

Annual impacts on employment by broad sector for each scenario are shown in Figure 8. The selection of industries is the same as reported in the Stats SA GDP releases.



Notes: Agri&ff = Agriculture, fishing and forestry, Trdacc = Trade and sccommodation services, Fin&bs = Financial and business services

Figure 8: Annual impact on employment, percentage

Source: Own calculations

Tax revenue results for the three scenarios are shown in Figure 9. Direct tax shows a lower decline relative to the other tax components in all scenarios for reasons discussed earlier.

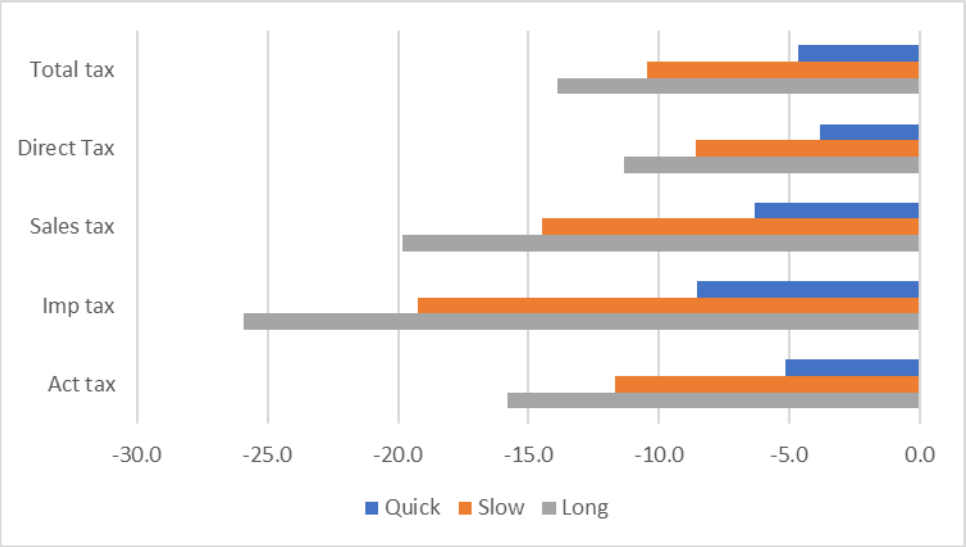


Figure 9: Annual changes in components of tax revenue, percentage
Source: Own calculations

6. CONCLUSIONS, POLICY IMPLICATIONS, AND FUTURE ANALYTICAL NEEDS

South Africa's economic fortunes are currently closely tied to the Covid-19 pandemic brought on by the novel coronavirus. The lockdown measures that South Africa has put into place to contain the virus have profound economic implications. The implications of the pandemic in the rest of the world, and hence on demand for South Africa's export, are not as large as the effects of the domestic lockdown but are still very large by any normal measure.

Even the 'Quick' recovery scenario results in a GDP decline of about 5 per cent by the end of 2020—an economic outcome that would have been considered catastrophically bad a little more than one month ago. Instead, that outcome now looks optimistic. Rather, the effects of the Covid-19 look more likely to persist bringing outcomes for GDP closer to those described in 'Slow' and 'Long'.

Beyond describing economic impacts, at least two important policy conclusions emerge from this analysis. First, South Africa's transfer programs to low income households are providing critical support to the most vulnerable in this time of crisis. Efforts to maintain these payments will significantly reduce the burdens placed on low income households. Second, Because the policies imposed to contain the coronavirus have enormous economic implications, coordination of epidemiological containment policies and economic policies designed to partially blunt negative economic implications of the containment policies is a good idea.

While this note illuminates a great deal, it also points to a large analytical agenda, particularly if the pandemic endures both within South Africa and internationally. We do not address, to give just one example, the specific economic policies that should be put in place to manage the implications of the pandemic—how to put the economy on life support, minimizing the damage and preparing a foundation for a rapid recovery when the pandemic abates. Overall, attention should now turn to developing a long-run strategy for navigating the pandemic that addresses both the health dimensions of containment and their economic fallout.

APPENDICES

Setting up a multiplier model

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

Eqn 1 $$X = Z + F$$

Eqn 2 $$X = A \cdot X + F$$

Eqn 3 $$X = (I - A)^{-1} \cdot F$$

Eqn 4 $$\Delta X = (I - A)^{-1} \cdot \Delta F$$

In which

X = a column vector of industry outputs in an economy (ΔX denotes a change in outputs)

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

A = a matrix of intermediates demands per unit of industry output for 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)

A vector of changes in final demand, ΔF, can be created in such a way that it represents an exogenous change or policy intervention in the relevant economy. In our case ΔF is broadly tuned to be a change each of the GDP final components (C+I+G+E) such that target change in supply of output, ΔX, is matched to what is understood to be then case in reality.

Additional induced effects are captured by expanding the model by making a distinction between activities and commodities, and by including detailed factor income. The generation and distribution of factor income to households depends on what happens to production, which is endogenous to the model. While households are treated as an exogenous account, and household demand for commodities is exogenous, household income (which is a payment by an endogenous account to an exogenous account) is endogenous in the model.

Employment impact adjustment

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

The typical assumption about the employment impacts is the same, in that the elasticity of employment with respect to output is equal to 1. In other words, if output goes down by 1%, employment will also go down by 1%. This may be considered as a more heroic assumption than the linearity of the base model itself (Bulmer–Thomas,1982, 61). Firms may hold on to labor in downturns in order to avoid costly search and training and when there is an upturn, the demand for labor may not increase. Econometric analysis is required to estimate such elasticities. Such estimates have been made for South Africa by Moolman (2003) and their results have been mapped to the industries (activities) and labor categories (by education).

The 2015 SAM for South Africa

The 2015 SAM for South Africa identifies 62 and 104 commodities. The activities and commodities are listed in (van Seventer, Bold, Gabriel, & Davies, 2018). SAM flows are valued at basic prices for the industry (activity) accounts and at purchaser prices for the commodity accounts. The latter includes indirect commodity taxes and trade and transport margins. Commodity supply is output that is produced by local industries that is either exported or sold domestically, and imports. Industries make payments to commodity accounts for intermediate demand and factors of production (value-added, consisting of operating surplus and compensation of employees broken down by education attainment (discussed later) as well as production-based taxes. Commodity accounts make payments to domestic industries, various product tax accounts (domestic and import), for trade and transport margins and to the rest of the world. The government is disaggregated into different tax collection accounts and a core government account. Direct payments between the institutions (enterprises, households, government and the rest of the world) are for transfers, as reported in the national accounts.

Factors of production earn incomes from their use in the production process. The receipts (income) is distributed to enterprises, households, government and the rest of the world. Enterprise income from the production factor capital is taxed by the average corporate tax rates. Some profits may be repatriated abroad. The remaining capital earnings (dividends) and distributed to households. Together with labor earnings and transfers received directly from capital (for self-employed) as well as transfers from government and the rest of the world constitute household income. Households are broken down into household expenditure groups according to deciles. The lowest expenditure group (decile 0 or hhd-0) represents households that cover 0-10% of all households when they are ranked from low to high total expenditure. The top decile, 90-100%, is disaggregated into an additional 5 groups, each representing 2% of all households. Household income is used to pay taxes, make transfers, save, and consume domestically produced and imported commodities.

Using demand shocks to simulate supply shocks

Some of the shocks – such as the lockdown – are essentially supply shocks.

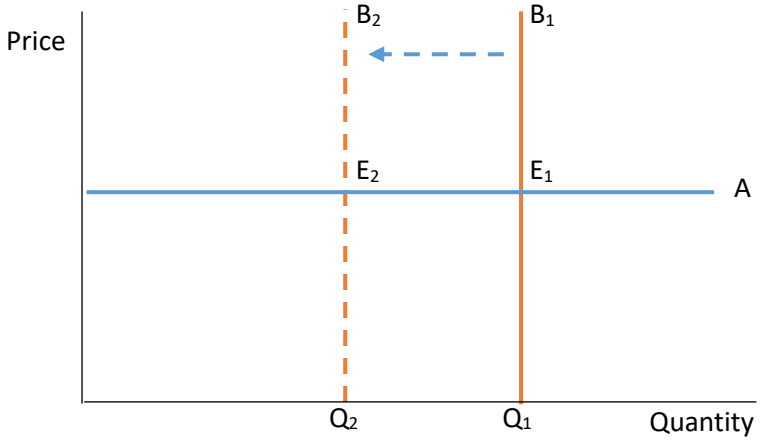


Figure A1: Demand and supply shocks

The driver of a standard Leontief model is a shock to an exogenous vector of final demands. It is a demand shock. Supply shocks are difficult to incorporate explicitly into multiplier models. However, we can use demand shocks to simulate a supply shock. The model assumes fixed prices and quantity adjustments. So, in Figure A1, the standard Leontief model assumes that A is the supply curve. Final demand is exogenous – and so could be represented by B_1. An exogenous fall in demand to B_2 causes the quantity demanded to fall. This is fed into the multiplier model, which estimates the direct and

indirect changes in gross outputs of sectors (supply) that would be needed to be consistent with the fall in final demand. We would use

$$\Delta \mathbf{x} = \mathbf{L} \cdot \Delta \mathbf{f} \quad (1)$$

where $\Delta \mathbf{x}$ is a vector of the changes in gross outputs, $\mathbf{L}$ is the Leontief matrix and $\Delta \mathbf{f}$ is the vector of changes in final demands.

Were we to think in supply terms, we would want to say A is the fixed price *demand* curve, and the B's are the fixed *supply* quantities before and after the shock. We can instead simulate the supply shock in the demand driven model by reducing final demand to drive down the gross output. In practice, we are imposing an exogenous shock on the model – a change in **Q**, and it is immaterial in technical terms whether that was driven by the demand curve or the supply curve shifting leftwards.

Although we specify **f** as a vector, final demand normally comprises private consumption expenditure (PCE) (assuming households are exogenous), government current consumption expenditure, gross capital formation and exports. In a demand led model it makes sense to ask how the impact of a change in one of these impacts the economy. The multipliers are the same for all of them and the only difference in shocking each is the size of the shock we impose. So, a 10% fall in PCE has a different impact from a 10% fall in exports only if the original levels of the two differ. Put another way a one unit drop in PCE for a good has the same impact as a 1 unit drop in exports of the same good. However, in the demand model it makes sense to distinguish them, because that will be the nature of the questions we are asking: what happens if there is a fall in demand for consumption, investment, or exports?

When we are using the demand-led model to simulate a supply shock, we are no longer particularly interested in the question of which demand components drive the change. Rather we reduce overall final demand categories so that the $\Delta \mathbf{x}$ meets our target. To drive this, we simply need a single vector of exogenous drivers of the change. We call it "final demand" because that is the driver in the demand-driven model, but the shock need not be linked to any single component of final demand. If PCE and Exports each comprise 50% of final demand and we determine that a 50% fall in FD will be sufficient to drive the output down by the amount determined by the target, it would not matter if we eliminated PCE entirely, or exports entirely or shocked them in any combination that sums to 50%.

We are interested in what happens to GDP and its component aggregates. Although the shocks we impose on the final-demand components are exogenous, having a notion of how much the components might change in aggregate adds a further constraint to our guesstimates. Ideally these could come from macroeconomic analysis. The disaggregated changes in, say, export demand for each commodity provides our view of the structure of the changes in export demand. This view, in the current exercise, is formed partly by our understanding of changes in export demand for commodities (paying attention to the impact of the pandemic on the various destination countries) and partly by our understanding of the impacts on our capacity to supply exports because of reduced production capacity caused by the lockdown. These capacity constraints are at the level of the individual supply of commodities by industries.

The changes in aggregates reflects our view of the impacts at the macroeconomic level. If it comes from a different source, it allows us to scale the disaggregated changes. When we do this, we may find that the impact on industry capacity is different from the what was determined at the disaggregated level. This inconsistency can lead to a fruitful discussion between macroeconomists and the economy-wide, industry-focused modellers.

Income distribution

In the text we refer to the different sources of income for the household groupings.

Table A1 provides details of the share of income derived from each source for each decile.

Table A1: Household sources of income

	Income from Wages				Capital Income	Transfers from Gov and RoW	Total
	flab-p	flab-m	flab-s	flab-t			
hhd-0	15.4	9.4	1.7	0.1	4.3	69.1	100.0
hhd-1	14.3	9.5	4.8	0.9	7.7	62.9	100.0
hhd-2	9.6	11.2	8.3	1.7	11.8	57.4	100.0
hhd-3	9.0	11.9	12.2	1.6	15.6	49.6	100.0
hhd-4	7.5	13.6	14.8	3.9	19.8	40.4	100.0
hhd-5	6.9	14.0	19.8	8.3	22.5	28.6	100.0
hhd-6	4.3	9.7	26.9	13.1	29.5	16.4	100.0
hhd-7	2.5	9.4	22.5	24.2	32.0	9.4	100.0
hhd-8	1.0	4.4	18.2	40.1	32.7	3.7	100.0
hhd-91	1.0	3.0	13.1	42.5	38.2	2.2	100.0
hhd-92	0.3	2.8	14.0	39.9	41.0	2.0	100.0
hhd-93	1.9	1.0	11.1	50.2	34.4	1.5	100.0
hhd-94	0.5	0.9	7.7	53.3	36.2	1.4	100.0
hhd-95	0.1	0.1	5.9	51.4	41.4	1.0	100.0

Source: Estimated from the 2015 SAM (van Seventer, Bold, Gabriel, & Davies, 2018)

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