

**The Impact of COVID-19 in Angola Using Input-Output Matrix**

THIS VERSION: May 24, 2021

*Prepared by the Angola Country Office of the African Development Bank, based on the analytical tool presented at a workshop held in March 2021, in close collaboration with the National Statistics Institute (INE), Ministry of Economy and Planning (MEP), the Ministry of Finance (MINFIN), and the University of São Paulo (USP).*

**1. Introduction**

The novel coronavirus disease (COVID-19) is a new strain of the family of coronavirus that causes respiratory illness and has a high transmission rate. On 30th January 2020, the World Health Organization (WHO) declared the disease outbreak a Public Health Emergency of International Concern.

The outbreak has posed serious challenges to the global economy, including the oil-dependent giant Angola. The virus contributed to the worsening of the country’s macroeconomic situation, after which the country entered into its fifth year in recession.

The Angolan economy is classified as a lower-middle income economy whose oil industry accounts for over 30% of GDP. The country has faced challenging economic performance since the drop in oil prices in 2014, and the current COVID-19 pandemic that also affected oil prices. The country suffers from Dutch disease, where a high volume of foreign reserves was accumulated during the peak years of high oil prices and overvaluation of the local currency in turn posed challenges for the diversification of the economy, y where about 95% of export revenue is generated from the oil and gas industry.

Since the drop in Brent crude oil prices from about USD 106.00 in January 2014 to as low as USD 27.80 in January 2016, Angola has faced macroeconomic headwinds and has since been in recession. The Macroeconomic Stabilization Program (MSP) and National Development Plan (NDP) (2018-2022), adopted in November 2017 and April 2018, respectively, were designed to implement reforms towards fiscal consolidation and economic diversification. The fiscal and macroeconomic reforms implemented by the Government of Angola have since been paving the way to economic recovery, initially expected to reflect positively from 2020 onwards, however, the outbreak of COVID-19 has changed this prospect dramatically. A slowdown in the global economy due to the COVID-19 pandemic influenced the fall in oil prices in 2020. This took a toll on Angola’s economy, whose main driver of growth remains the oil and gas sector, therefore, implying economic diversification as an urgent priority for a more resilient and sustainable recovery. Angola however remains committed to implementing macroeconomic stability reforms and fiscal consolidation under budget support programs with the IMF, World Bank, African Development Bank and European Union.

Overall, as most countries in the world, Angola has been hard hit by the COVID-19 pandemic, due to a collapse in external demand and lockdown strategies that have impacted the country’s economic activity, opening hence the way for the fifth year of recession. Since the detection of the first cases of COVID-19 on March 21, strict confinement and social distancing measures were adopted worldwide. . Similarly, following the confirmation of the first cases of COVID-19, Angolan authorities have agilely implemented stringent sanitary measures through a presidential decree to contain the propagation of the virus. This strategy thus prevented a sharp increase of cases at the dawn of the declared pandemic and enabled the preparation of health infrastructures to face potentially more severe contamination waves. However, the flip side of the coin has been an economic downturn and therefore, many important questions arise. What are the economic costs of the control measures adopted in the country to prevent the spread of COVID-19? What are the impacts of mitigation measures adopted by the central government? How do flexibility measures affect the economic recovery?

The main objective of this study is to quantify the macroeconomic and sectoral economic impacts of the coronavirus pandemic in Angola, using the input-output methodology proposed by Haddad et al. (2020a). In this context, the elaboration of this report on the findings of the impact of COVID-19 on the Angolan economy using an input-output matrix is an important endeavour to provide the first formal estimate of shifts across sectors and macroeconomic aggregates. This report comprises four sections as follows: following the introduction in Section 1, Section 2 describes the input-output methodology applied; Section 3 then presents the empirical strategy adopted to assess the impact of COVID-19 on the economy; and lastly, Section 4 showcases the results that are followed by concluding remarks.

**2. Methodology**

To assess the economic costs of the pandemic in Angola and provide a comprehensive analysis of its impact, we rely on the methodology developed by Haddad et al. (2020a) for assessing the daily economic costs of control strategies for mitigating the effects of COVID-19. It is based on the partial hypothetical extraction approach to input-output systems.[[1]](#footnote-1) This method involves the partial removal of a sector or an economic block from the system and draws comparisons between the baseline scenario (before the removal) and the hypothetical scenario representing the new equilibrium (after the removal). We carry out analyses for Angola to identify, in addition to aggregate macroeconomic impacts, which sectors are most sensitive to the restrictive measures adopted by the Government.

This methodology has been used to inform regional and national governments in Brazil (Haddad et al., 2020b), Colombia (Bonet et al., 2020ab) and Morocco (Haddad et al., 2020c) on the potential regional and sectoral economic costs of different strategies of lockdown measures. Simulated scenarios based on different durations and intensities of the control measures help designing sectoral and territorial-based policies to ease lockdown against the coronavirus outbreak after reaching a downward trend in the growth rate of new infections, while monitoring economic recovery.

This section draws on Haddad et al. (2020a) to describe in detail, the methodology developed for assessing *ex ante* the potential economic costs of the pandemic. Preparations to implement and further to roll back the lockdowns include setting up expert committees to examine initial control measures and to define gradual easing of social restrictions. Nonetheless, amid significant uncertainties, combining epidemiological and socioeconomic simulation-based scenarios to examine *ex-ante* potential impacts may be fundamental for informing officials before committing to a strategy.

We consider an input-output flow-table for an *n*-sector economy (Table 1).[[2]](#footnote-2) We separate workers into *q* different age groups and identify payments by producers to wage earners to each of those groups.

**Table 1. Input-Output Flows**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | *Processing sectors* | | |  | *Final demand* | | | | *Total output* |
|  |  | *1* | *…* | *n* |  |
|  |  |  |  |  |  |  |  |  |  |  |
| *Processing sectors* | *1* |  | … |  |  |  |  |  |  |  |
| *…* | … | … | … |  | … | … | … | … | … |
| *n* |  | … |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| *Indirect taxes* | |  | … |  |  |  |  |  |  |  |
| *Imports* | |  | … |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| *Labor payments* | *1* |  | … |  |  |  |  |  |  |  |
| *…* | … | … | … |  |  |  |  |  | … |
| *q* |  | … |  |  |  |  |  |  |  |
| *Other payments* | |  | … |  |  |  |  |  |  |  |
|  | |  |  |  |  |  |  |  |  |  |
| *Outlays* | |  | … |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| *Employment* | *1* |  | … |  |  |  |  |  |  |  |
| *…* | … | … | … |  |  |  |  |  | … |
| *q* |  | … |  |  |  |  |  |  |  |

, with represents interindustry sales of sector *i* to all sectors *j*

and with represent, respectively, indirect taxes payments (*t*), and imports (*m*).

and with and represent, respectively, payments by sectors for labor services, and total number of workers

, with represents payments by sectors for all other value-added items

, , ,and with represent the components of final demand (), respectively, household purchases, investment purchases, government purchases, and exports

, with is the total sectoral output

We assume that a given lockdown strategy may initially restrict part of the labor force to perform their tasks. In the context of the COVID-19 pandemics, lockdown strategies are usually both age and sector-specific. Thus, we define *q*x*n* factors, , , defining the share of non-restricted workers in each group in each sector. Therefore, for instance, if you do not want to restrict activities by workers from the telecommunications or the health sectors, we set the factor to unity. For activities that would face stronger restrictions, such as those in the entertainment sector, we set the factor closer to zero.

We then apply each factor to its corresponding element in both the employment matrix and the labor payments matrix. In the former case, we are able to define the number of workers facing lockdown; in the latter case, we can calculate the contribution of those workers to total labor income in each sector. Once we know the aggregate income associated with restricted (and non-restricted) workers, we use its share in total labor payments by sector together with the sectorial labor payment coefficients, . Based on the properties of the Leontief production function, we can then define a new set of sector-specific penalty factors, , , identifying the share of output in each sector associated with non-restricted workers.

This approach also allows performing different scenarios based on targets for compliance to the measures. Suppose we want to examine a scenario that is both consistent with the set of pre-defined factors, , and a desirable level of compliance, α. We can then find an adjustment factor or weight, ω to be applied across all so that

|  |  |
| --- | --- |
| = α | (1) |

Once we have computed the factors, , the next step is to use this set of information to partially extract some of the sectorial flows in the input-output table, considering both demand and supply reductions.

Interindustry demand:

, we compute a corresponding restricted flow of interindustry sales, , such that

|  |  |
| --- | --- |
|  | (2) |

In other words, the restriction is based on the smallest F, which means the stronger penalty factor between two sectors.

Final demand:

In addition to supply-side restrictions, associated with the factor , additional demand-side constraints can be added to complete the decision rule.

For each final demand user, a demand-side factor, , , can be specified. We define each as follows:

is calculated based on changes in foregone earnings by workers affected by the control strategies for mitigating the effects of COVID-19. Informal and formal workers affected by the lockdown face a loss of income denoted by parameter, We then assume labor income changes are fully translated into household demand changes. Other possible income-related changes, such as government transfers to specific groups of workers as a measure to attenuate the effects of the crisis, would also affect after properly mapped into household purchases.

and are set to unity. The implicit assumption is that investment decisions that are taking place are not affected in the very short-run, while government expenditures are kept unchanged from the demand perspective, so that we can use government reactions to simulate policy scenarios and provide alternative values for .

is set based on available projections for short-term declines in export revenues. In the Angolan case, we have specific factors for oil exports and other exports.[[3]](#footnote-3)

Thus, considering each component of final demand, , we apply the following rule:

, we compute a corresponding restricted flow, , such that

|  |  |
| --- | --- |
|  | (3) |

In the case of household demand, we apply both the supply and the demand constraints, such that

, we compute a corresponding restricted flow, , such that

|  |  |
| --- | --- |
|  | (4) |

Using the information from the original and the diminished sectoral flows, we have now two matrices of interindustry flows, and , and two vectors of final demand, and . For a given vector of sectoral output, , we can also derive two matrices of technical coefficients, and **.**

The extraction method, initially proposed by Dietzenbacher et al. (1993)[[4]](#footnote-4), consists of the hypothetical extraction of a sector in the input-output matrix. The purpose is to quantify how much the total output of an economy with *n* sectors could change (or reduce) if a particular sector were removed from this economy. This technique allows analyzing the importance of a sector in an economic structure given its extraction and consequent reduction in the level of activity in the economy. It should be emphasized that the greater the level of interdependence of such a sector in relation to the others, the greater the impact, in a systemic way.

We use a variant of the extraction method. Instead of hypothetically extracting completely a particular sector, we extract all sectors partially, according to the information combined in , and .

In the complete model, withthe original sectoral flows (i.e. F=1 for all flows), the output of the economy is given by:

|  |  |
| --- | --- |
|  | (5) |

Using as the matrix associated with restricted intersectoral trade flows due to the lockdown, and , the lockdown-related final demand, gross output in the economy would be given by:

|  |  |
| --- | --- |
|  | (6) |

Therefore, after the partial extraction:

|  |  |
| --- | --- |
|  | (7) |

where is the aggregate measure of annual loss in the economy – decrease in total output if the output associated with the lockdown measures is reduced or eliminated due to partial extraction. In other words, it is a measure of the relative importance of activities performed by workers affected by the lockdown.

We can translate sectoral gross output outcomes in other variables’ outcomes, as usual. We simply pre-multiply the vector of gross output, or , by a diagonal matrix, , whose main diagonal contains the variable’s coefficients, i.e. the ratios of the variable’s values by sector divided the respective sectoral gross output.

Finally, assuming that production is continuous on weekdays, daily foregone losses can be approached by dividing (or ), by the number of weekdays in the benchmark year.[[5]](#footnote-5)

|  |
| --- |
| **Box 1. Input-Output Analysis**  The input-output model can be depicted as an “economic photograph” of the economy itself. In this photograph, the sectors are related to each other, capturing the degree of interdependence among sectors in any economy. The result is a unique and understandable view of how the economy works, how each sector becomes more or less dependent on the others.  It is important to first define basic assumptions in input-output framework in order to facilitate the interpretation of the results. Firstly, there exists a fixed input structure in each industry which is described by fixed technological coefficients. Secondly, all products of an industry are identical or are produced proportionally, in fixed proportions, to each other. With respect to returns to scale in production, the underlying assumption of input-output analysis states that it is constant in each industry.  The input-output framework fits well to systemic analysis. This methodology enables us to better understand sectorial degree of interdependence among economic agents. It is also important to highlight that the estimated system is able to capture the specifics present in the productive structure of each economic region. In the case of this work the input-output matrix represents the economic structure of Angola for the year 2012. It is important to be cautious with the year of the calibration and the interpretation of the results. As the IO is a “photograph of the economy” and shows the structure of interdependence in the economy, any modification can impact the results. This can be a limitation if we are dealing with a long span of time, because the production technology (*i.e.* the use of the inputs) could modify. On the other hand, if we are dealing with a short span of time this can be minimized. For example, the automotive industry nowadays uses more plastic as input than 30 years ago. In that case, using an old IO matrix could be a limitation, due to a change in the “recipe” of production. Thus, for the Angola input-output matrix, we interpret all the results/numbers keeping in mind the structure of sectorial interdependence of the Angolan economy in 2012.  The matrix calibrated therefore shows, for example, the amount in monetary terms that the agriculture sector buys inputs from itself and from other sectors domestically. If for some reason there is a substitution of domestic inputs for imported inputs by the agricultural sector, this will change the technical coefficient of production and, consequently, the structure of interdependence and the results. Hence, the more updated the input-output matrix, the better the picture of the economy, and subsequently, the more efficient the policy discussion based on it. We have used National Accounts data to update the information system to 2019, however, as indicated, the production structure simulates that of the Angolan sectorial interconnections in 2012.  For complete information on the use of input-output analysis and its limitations, please refer to Miller and Blair (2009). |

**3. Empirical Strategy**

We calibrate the Angolan model using the interregional input-output system developed for the country (Haddad et al., 2019), and the micro data from “*Inquérito sobre Despesas, Receitas e Emprego em Angola (IDREA) 2018-2019*”.[[6]](#footnote-6) Additionally, we have used National Accounts data to update the information system to 2019, which serves as the benchmark for our results (Box 2). Therefore, it means that all comparisons presented are related to 2019 values. We estimate economic loss by comparing the base scenario with the hypothetical scenarios. The model takes into account sectoral interdependence in Angola through sectoral linkages. We disaggregate workers in each sector by age group, and we segment the labor market into formal and informal workers. The adopted methodology allows to include the effects of isolation both on the supply and on the demand sides. Additional effects on household demand and external demand are included. Household demand is related to the direct loss of income in each sector, as production is partially disrupted, and exports are affected by changes in foreign demand. Government transfers to households also affect consumption demand.

Considering the start of implementation of lockdown measures in Angola (March 27), we simulate the model for every week in 2020 since then. The simulations take into account three of the main channels of the short-run impacts, namely: (i) supply shocks and domestic value chain effects[[7]](#footnote-7); (ii) income effects on household and government demands; and (iii) external demand effects.

|  |
| --- |
| **Box 2. Database for the National Input-Output Matrix**  As a starting point, to build the input-output (IO) system for Angola, we use information contained in the System of National Accounts (SCN), made available by INE. We use the following information in a structured way, made available for the year 2012, to anchor the national IO estimation: (i) Table 4.21. Resources at Current Prices; (ii) Table 4.22. Resources at Current Prices Production Value of Activities; (iii) Table 4.23. Uses at Current Prices; and (iv) Table 4.24. Uses at Current Prices Gross Value Added.  The transformation of original information from the *product x sector* dimension (Tables 4.21 and 4.23), to the *sector x sector* dimension, as used in the present study, is done by multiplying them by a matrix of proportions obtained from the share of each element of the production matrix in the total production of each sector (Table 4.22).  The absence of official information on intersectoral flows to fill basic intermediate flows, the imported flows of goods and services and taxes net of subsidies to form the Total Resources at Consumer Prices for each product/sector was supplied with data obtained from the input-output matrix of Angola made available by the Eora Global MRIO project. Once completed the sectorial compatibility between Angolan MIP from Eora with the sectors of INE’s SCN, we calculate sectoral shares in intermediate consumption at current prices to distribute the values ​​of the row “intermediate consumption”. This procedure allowed us to obtain a first estimate of the structure of intersectoral relations in Angola. To ensure consistency with the INE data, a bi-proportional adjustment was made using the RAS method[[8]](#footnote-8), with the aim of targeting the estimates of the intermediate consumption of the SCN, presented both in the row as in the column “intermediate consumption”. Thus, we obtained a first consistent version of Angola’s national MIP.  However, given the importance of the oil value chain for the economy of Angola, a final step was taken to disaggregate sector 3 (“Extraction and Refining of Crude Oil and Natural Gas ”) into two subsectors: (i) Extraction of Crude Oil and Natural Gas (3A); and (ii) Refining of Crude Oil and Natural Gas (3B). The main source of information for the sectoral disaggregation procedure was the “Management Report & Consolidated Accounts 2017” published by Sonangol, E.P. and Subsidiaries.  For the opening of the MIP row, sector 3 intra-sector transactions were allocated as sales from sector 3A to sector 3B. Sector 3 exports were distributed between the two sectors considering the information made available in the report of the Sonangol - Crude Oil Exports by Rama, and Quantity of Exported Refined Products - conversion of the exports of refining products for comparison purposes. Finally, the remaining sales transactions in sector 3 were allocated to sector 3B.  Once the allocation of production from sectors 3A and 3B to the different MIP users, and in the absence of specific information on the cost structure of the sub-sectors, the column of sector 3 was disaggregated using the respective estimated shareholdings in production resulting from the breakdown of rows, in order to guarantee the systemic consistency of the input-output matrix.  Finally, we used National Accounts data to update the information system to 2019, which serves as the benchmark for our results, and disaggregated labor market information using the micro data from “*Inquérito sobre Despesas, Receitas e Emprego em Angola (IDREA) 2018-2019*”. |

To define a first-order approximation of the extent of initial sectorial exposure to the pandemic shock, we rely on the seasonally adjusted estimates by INE for the sectoral GDP results for the second quarter of 2020 (“*Contas Nacionais IV Trimestre 2020 – Ajustado Sazonalmente*”). The impact varies widely across sectors. The results available for 14 sectors enables to provide an initial snapshot of the damage caused by the COVID-19 to the domestic economy.[[9]](#footnote-9)

The extent of exposure per sector will serve then as the benchmark to calibrate supply parameters in the input-output system, denominated from now on as adjustment factors **F**. We calculate the output of the economy in a hypothetical scenario of isolation through the partial extraction of the sectorial flows in the input-output matrix. We define, for each sector, an adjustment factor **F**, which measures the degree of exposure of the sector considering those sectors that must continue in operation (**F**=1) up to those that may stop operating (**F**=0). The **F** factors were calibrated according to information provided in the abovementioned INE report: (i) for those sectors that presented a negative performance in the second quarter, we imputed a **F** factor equals to 1 plus the negative percentage change in quarterly output, and (ii) for those sectors that presented a positive performance in the second quarter, we set their factors to unity. Figure 1 presents the calibrated values for the benchmark week (April 08-14). Further variation in the adjustment factor F will be done weekly using the Community Mobility from Google that will be presented later.

We then extract from the employed labor force a hypothetical percentage of formal and informal workers in each sector in each week. The percentages used to “remove” workers from each sector are defined directly by the initial values of adjustment factors **F**. Thus, according to values presented in Figure 1, workers in agriculture would not face any restriction as the factor F is one, while 29% of workers in the fishery sector would be restricted as the factor F is 0.71 for this sector.**Figure 1. Initial Adjustment Factors F (benchmark week: April 08-14 2020)**

According to this modeling strategy, we estimate in the most restricted week of confinement[[10]](#footnote-10) (benchmark week of April 8 to April 14), 418 thousand workers (4.2% of the employed workforce) affected by the lockdown measures, 8.0% of the employed male workforce (Table 1).

**Table 2. Estimates of Number of Workers in Lockdown: Angola, by sectors**

**(Week 4: April 8 to April 14)**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Sector* | | Employment | |  |  | Workers in isolation | |  | Workers in isolation (%) | |
| Female | Male |  |  | Female | Male |  | Female | Male |
| 1 | Agriculture | 2,641,450 | 1,916,537 |  |  | 0 | 0 |  | 0.0 | 0.0 |
| 2 | Fishing | 4,790 | 45,405 |  |  | 1,375 | 13,031 |  | 28.7 | 28.7 |
| 3A | Extraction of crude petroleum | 1,580 | 17,736 |  |  | 144 | 1,614 |  | 9.1 | 9.1 |
| 3B | Oil refinery | 0 | 4,043 |  |  | 0 | 368 |  | 0.0 | 9.1 |
| 4 | Extraction of diamond and mining | 3,613 | 60,251 |  |  | 531 | 8,857 |  | 14.7 | 14.7 |
| 5 | Manufacturing | 95,049 | 215,420 |  |  | 2,471 | 5,601 |  | 2.6 | 2.6 |
| 6 | Electricity and water collection | 5,997 | 55,274 |  |  | 0 | 0 |  | 0.0 | 0.0 |
| 7 | Construction | 4,520 | 373,982 |  |  | 1,202 | 99,479 |  | 26.6 | 26.6 |
| 8 | Wholesale and retail trade | 1,542,467 | 582,718 |  |  | 0 | 0 |  | 0.0 | 0.0 |
| 9 | Transportation and storage | 7,681 | 353,382 |  |  | 4,816 | 221,570 |  | 62.7 | 62.7 |
| 10 | Telecommunications | 9,165 | 31,213 |  |  | 0 | 0 |  | 0.0 | 0.0 |
| 11 | Financial service activities | 11,372 | 28,600 |  |  | 0 | 0 |  | 0.0 | 0.0 |
| 12 | Public administration and defence | 151,049 | 514,400 |  |  | 8,610 | 29,321 |  | 5.7 | 5.7 |
| 13 | Real estate activities | 2,759 | 8,355 |  |  | 486 | 1,470 |  | 17.6 | 17.6 |
| 14 | Other service activities | 586,669 | 649,198 |  |  | 8,213 | 9,089 |  | 1.4 | 1.4 |
|  | **Angola** | **5,068,161** | **4,856,514** |  |  | **27,848** | **390,401** |  | **0.5** | **8.0** |

We define, for each group of workers, the fraction of income maintained during the isolation period. We assume that on average 30% of formal and informal worker’s income is lost during the lockdown period based on the results found in Arnd et al., 2020. Then households receive lump sum income transfer from the government, according to parameters described in the “*Programa de Transferências Monetárias*” that aims to mitigate the income impact through targeted social assistance. The fall in overall income will proportionally hit the household final demand.

To cushion the pandemic wave over the Angolan economy, authorities have put in place mitigation measures through lump sum transfers and other economic buffers.[[11]](#footnote-11) The “*Banco de Desenvolvimento de Angol*a – BDA” used credit lines to the agriculture and fishery sectors (Kz 41 billion).[[12]](#footnote-12) These sectors also benefitted from availability of resources from the “*Fundo Activo de Capital de Risco Angolano* – *FACRA*” (Kz 7 billion)[[13]](#footnote-13) and the “*Fundo de Apoio ao Desenvolvimento Agrário* – *FADA*” (Kz 15 billion). The central government accelerated the implementation of the “*Plano Integrado de Intervenção nos Municípios PIIM*”, dedicated to the upgrading of local public goods (USD 2 billion withdrawn from the Sovereign Wealth Fund). The “*Programa de Transferências Monetárias*” focused on lump sum income transfers to vulnerable households (Kz 448 million). Finally, the “*Programa, Diversificação das Exportações e Substituição de Importações* – *PRODESI*” provided help for hard-hit export companies (Kz 14.3 billion). From an input-output perspective, such expenses are included as extra demand in the economy and are expected to mitigate the initial losses. Therefore, the household final demand will rebound by the equivalent lump sum transfers, the government final demand will adjust by the extra current expenses, and specific sectorial demands may be affected by the access to credit lines. The distribution of the additional demand will align to the initial structure.

Angola entered a lockdown in late March 2020 and since then, the containment strategy underwent different phases, with a less than perfect compliance to the restriction measures. The question to ask then is how to account for this in our simulations? We rely on community mobility data available by Google on a daily basis, that show movement trends across different categories of places, including commuters to work (Figure 2).

**Figure 2. Changes in Community Mobility to Workplaces**



Source: Google Covid-19 Community Mobility Report

Community mobility to workplaces shrank significantly at the end of March, the starting date for the strict confinement in Angola. During the benchmark week, workers mobility reduced more than 50%[[14]](#footnote-14) for about a month, when compared to pre-pandemic patterns of mobility, which can be seen as the period required for some activities to put in place safety measures for a gradual business resumption. Then, people’s mobility to workplaces went on an upward trend, reaching a 20% change below the baseline at the end of May, remaining stable with a few peaks in specific weeks. Therefore, the mobility to working places trend will enable to fine-tune the factor **F** along the confinement period, on a weekly basis. Each week, the factor **F** will be adjusted proportionally upward (downward) if mobility to working places increases (decreased). Unfortunately, the indicator is available at national level with no meaningful sectoral disaggregation. In these circumstances, the factor **F** is rescaled by the same proportion across all the sectors.

**4. Results**

How do the hypotheses described in the previous section translate into economic impacts? We have first computed the sectoral weekly GDP loss during the pandemic, comparing two scenarios: with lockdown and, without lockdown. Table 3 and Figure 3 present the summary of the results for Angola both in monetary values and as a percentage of the 2019 GDP. We observe a potential accumulated total flow loss of 8.22% of the annual GDP, according to the input-output simulations. The largest loss in monetary values occurs in Extraction of crude petroleum (Kz 1,509,039 million), corresponding to 10.86% of sectoral GDP, and the largest relative loss in sectoral GDP occurs in Transportation and storage (22.68% of sectoral GDP), corresponding to Kz 110,677 million.[[15]](#footnote-15)

**Figure 3. Sectorial GDP Loss**

Note: Percentage number in parenthesis is the overall share of GDP loss.

**Table 3. Summary of Economic Impacts**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Sector* | | GDP Loss (in Kz millions) | | | |  | GDP Loss (% of Annual GDP) | | | |
| *2nd Quarter* | *3rd Quarter* | *4th Quarter* | *Quarter: Q2-Q4* |  | *2nd Quarter* | *3rd Quarter* | *4th Quarter* | *Quarter: Q2-Q4* |
| 1 | Agriculture | -17,068 | -5,572 | -6,526 | -29,166 |  | -1.31 | -0.43 | -0.50 | -2.24 |
| 2 | Fishing | -17,081 | -8,598 | -10,574 | -36,253 |  | -4.92 | -2.48 | -3.05 | -10.45 |
| 3A | Extraction of crude petroleum | -1,210,768 | -168,452 | -129,819 | -1,509,039 |  | -8.72 | -1.21 | -0.93 | -10.86 |
| 3B | Oil refinery | -28,559 | -8,575 | -9,385 | -46,519 |  | -6.53 | -1.96 | -2.14 | -10.63 |
| 4 | Extraction of diamond and mining | -25,916 | -4,765 | -4,511 | -35,191 |  | -7.91 | -1.45 | -1.38 | -10.73 |
| 5 | Manufacturing | -32,087 | -11,891 | -13,740 | -57,718 |  | -2.53 | -0.94 | -1.08 | -4.55 |
| 6 | Electricity and water collection | -10,505 | -2,581 | -2,662 | -15,748 |  | -4.71 | -1.16 | -1.19 | -7.06 |
| 7 | Construction | -139,720 | -63,478 | -77,440 | -280,637 |  | -4.30 | -1.95 | -2.38 | -8.64 |
| 8 | Wholesale and retail trade | -40,750 | -13,138 | -14,609 | -68,496 |  | -2.69 | -0.87 | -0.97 | -4.53 |
| 9 | Transportation and storage | -55,901 | -25,006 | -29,769 | -110,677 |  | -11.46 | -5.13 | -6.10 | -22.68 |
| 10 | Telecommunications | -42,237 | -15,498 | -17,570 | -75,305 |  | -4.98 | -1.83 | -2.07 | -8.88 |
| 11 | Financial service activities | -26,666 | -8,190 | -8,980 | -43,836 |  | -5.74 | -1.76 | -1.93 | -9.43 |
| 12 | Public administration and defence | -28,557 | -12,141 | -15,766 | -56,464 |  | -0.75 | -0.32 | -0.41 | -1.48 |
| 13 | Real estate activities | -31,095 | -15,894 | -19,796 | -66,785 |  | -2.65 | -1.35 | -1.69 | -5.69 |
| 14 | Other service activities | -130,986 | -40,902 | -45,020 | -216,908 |  | -4.54 | -1.42 | -1.56 | -7.52 |
|  | **Accumulated losses** | **-1,837,894** | **-404,681** | **-406,167** | **-2,648,742** |  | **-5.70** | **-1.26** | **-1.26** | **-8.22** |

In what follows, we present further highlights of the results, focusing on different dimensions of the main findings.

***Macroeconomic impacts***

The estimated overall GDP loss during the three last quarters of 2020 is close to Kz 2.7 trillion, equivalent to -8.22% of GDP. Figures 4 and 5 present results from a structural decomposition analysis comparing the structural changes during the pandemic in 2020, with the pre-crisis structure of the Angolan economy at each quarter. At the aggregate level, it reveals the contribution of different macroeconomic components to the quarterly results, with GDP losses driven by changes in final demand in the three quarters as shown in Figure 5 (responsible for 90.86% of total losses in the 2nd quarter, 75.46% in the 3rd quarter, and 69.93% in the 4th quarter of 2020). Changes in final demand were the main factor during the three quarters, reducing overall GDP in Angola by around Kz 2.3 trillion.

The weak intersectoral linkages in the economy also contributed to the negative result of GDP growth during the pandemic. A lower income multiplier associated with domestic value chain effects also tends to decrease national income in the three periods (intermediate consumption in Figure 5), contributing with 9.14% of total GDP loss in the 2nd quarter, 24.54% in the 3rd, and 30.07 in the 4th.

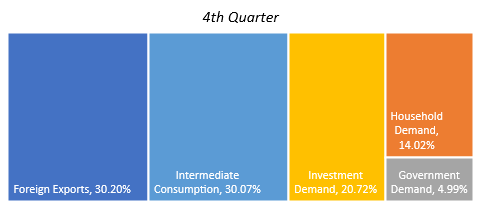
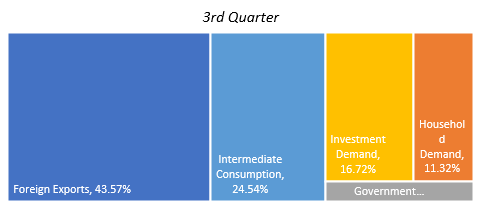
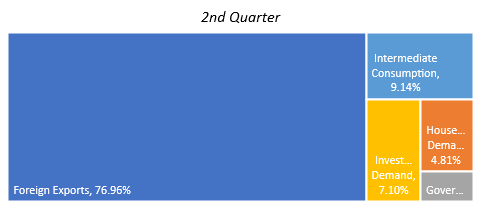
It is however worth noting the changing relevance of specific final demands components when comparing the second and the fourth quarters. While foreign exports had a more relevant role in GDP fall in the beginning of the pandemic, as government mitigation policies came into the scene together with the flexibility of control measures in some areas of the country and recovery of oil prices, decreasing investment demand became the leading component of final demand affecting GDP growth. Throughout the whole period, lower household demand also had a prominent role in explaining GDP reductions, while government demand helped mitigating the economic impacts.

**Figure 4. Contribution of Macroeconomic Aggregates to GDP Changes**

**(% change)**

**Figure 5. Contribution of Macroeconomic Aggregates to GDP Changes**

**(% of total)**



***Economic vulnerability***

The economic consequences of the COVID-19 crisis are likely to affect sectors within Angola very differently. An index that indicates which sectors are more vulnerable to crises such as the COVID-19 crisis can be useful to policy makers. We define economic vulnerability as the share of a sector in total GDP loss in relation to the sector’s contribution to GDP. We then create an economic vulnerability index by normalizing the results so that the index varies from zero to one. This measure was divided in five degrees of vulnerability (e.g. high, medium-high, medium, medium-low, and low).[[16]](#footnote-16) We present in Figure 6 the index for the 15 sectors of the model, for each quarter and for the whole period. We observe that two sectors present high and medium-high economic vulnerability. The worst case is the Transportation and storage sector, followed by the construction sector. It is noticeable the higher vulnerability of the oil sector in the beginning of the pandemic.

**Figure 6. Sectorial Economic Vulnerability to Lockdown Measures in Angola**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 2nd Quarter | |  |  |  | 3rd Quarter | |
| *Rank* | *Sector* | *Index* | *Vulnerability* |  | *Rank* | *Sector* | *Index* | *Vulnerability* |
| 1 | Transportation and storage | 1.000 | High |  | 1 | Transportation and storage | 1.000 | High |
| 2 | Extraction of crude petroleum | 0.744 | Medium-High |  | 2 | Fishing | 0.449 | Medium-Low |
| 3 | Extraction of diamond and mining | 0.668 | Medium |  | 3 | Oil refinery | 0.341 | Medium-Low |
| 4 | Oil refinery | 0.539 | Medium |  | 4 | Construction | 0.340 | Medium-Low |
| 5 | Financial service activities | 0.466 | Medium-Low |  | 5 | Telecommunications | 0.314 | Medium-Low |
| 6 | Telecommunications | 0.395 | Medium-Low |  | 6 | Financial service activities | 0.300 | Medium-Low |
| 7 | Fishing | 0.390 | Medium-Low |  | 7 | Extraction of diamond and mining | 0.236 | Medium-Low |
| 8 | Electricity and water collection | 0.370 | Medium-Low |  | 8 | Other service activities | 0.229 | Medium-Low |
| 9 | Other service activities | 0.354 | Medium-Low |  | 9 | Real estate activities | 0.215 | Medium-Low |
| 10 | Construction | 0.332 | Medium-Low |  | 10 | Extraction of crude petroleum | 0.186 | Low |
| 11 | Wholesale and retail trade | 0.182 | Low |  | 11 | Electricity and water collection | 0.174 | Low |
| 12 | Real estate activities | 0.177 | Low |  | 12 | Manufacturing | 0.129 | Low |
| 13 | Manufacturing | 0.166 | Low |  | 13 | Wholesale and retail trade | 0.114 | Low |
| 14 | Agriculture | 0.052 | Low |  | 14 | Agriculture | 0.023 | Low |
| 15 | Public administration and defence | 0.000 | Low |  | 15 | Public administration and defence | 0.000 | Low |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 4th Quarter | |  |  |  | Quarter: Q2-Q4 | |
| *Rank* | *Sector* | *Index* | *Vulnerability* |  | *Rank* | *Sector* | *Index* | *Vulnerability* |
| 1 | Transportation and storage | 1.000 | High |  | 1 | Transportation and storage | 1.000 | High |
| 2 | Fishing | 0.463 | Medium-Low |  | 2 | Extraction of crude petroleum | 0.442 | Medium-Low |
| 3 | Construction | 0.346 | Medium-Low |  | 3 | Extraction of diamond and mining | 0.436 | Medium-Low |
| 4 | Oil refinery | 0.304 | Medium-Low |  | 4 | Oil refinery | 0.431 | Medium-Low |
| 5 | Telecommunications | 0.291 | Medium-Low |  | 5 | Fishing | 0.423 | Medium-Low |
| 6 | Financial service activities | 0.267 | Medium-Low |  | 6 | Financial service activities | 0.375 | Medium-Low |
| 7 | Real estate activities | 0.224 | Medium-Low |  | 7 | Telecommunications | 0.349 | Medium-Low |
| 8 | Other service activities | 0.201 | Medium-Low |  | 8 | Construction | 0.337 | Medium-Low |
| 9 | Extraction of diamond and mining | 0.169 | Low |  | 9 | Other service activities | 0.285 | Medium-Low |
| 10 | Electricity and water collection | 0.137 | Low |  | 10 | Electricity and water collection | 0.263 | Medium-Low |
| 11 | Manufacturing | 0.117 | Low |  | 11 | Real estate activities | 0.198 | Low |
| 12 | Wholesale and retail trade | 0.097 | Low |  | 12 | Manufacturing | 0.144 | Low |
| 13 | Extraction of crude petroleum | 0.092 | Low |  | 13 | Wholesale and retail trade | 0.144 | Low |
| 14 | Agriculture | 0.015 | Low |  | 14 | Agriculture | 0.036 | Low |
| 15 | Public administration and defence | 0.000 | Low |  | 15 | Public administration and defence | 0.000 | Low |

**5. Concluding Remarks**

This report uses the most recently available input-output tables for Angola to provide estimates of the impact of the COVID-19 pandemic in the economy. The report presents simulations of how the pandemic affects economic sectors and macroeconomic aggregates. The quantitative results shown in the previous section can be used by policy makers to inform decision-making during the pandemic, as well as draw lessons for future measures to place buffers and build resilience in the most vulnerable sectors.

Finally, it is important to note that such economic tools can be better built and more depictive based on the quality of data available. The current version of the input-output table for Angola has some constraints such as limited sectoral and regional disaggregation. It is paramount for the country to continue to enhance the capacity to produce more refined sector and regional data that will allow for better economic analyses that are crucial for enhanced and more precise academic and policy-oriented research.

**References**

Ali, Y. (2015). Measuring CO2 Emission Linkages with the Hypothetical Extraction Method (HEM). *Ecological Indicators*, 54, 171-183.

Allen, R. I. G. 1974. Some Experiments with the RAS Method of Updating Input-Output Coefficients. Oxford Bulletin of Economics and Statistics. Volume 36. Issue 3. Pages 215–228. ISSN 0305-9049. <https://doi.org/10.1111/j.1468-0084.1974.mp36003005.x>.

Arndt, C; Davies, R; Gabriel, S; Harris, L; Makrelov, K; Robinson, S; SLevy, S; Witness, W; van Seventer, Dirk; Anderson, L. (2020). Covid-19 lockdowns, income distribution, and food security: An analysis for South Africa, Global Food Security, Volume 26, 2020.

Bacharach, M. 1970. Biproportional Matrices and Input-Output Change. London. Cambridge University Press. ISBN 978-0-521-07594-7. https://books.google.com/books?id=jfM8AAAAIAAJ.

Bonet, J. M., Ricciulli, D. M., Valbuena, G. J. P., Galvis, L. A., Haddad, E. A., Araújo, I. F., & Perobelli, F. S. (2020a). Regional Economic Impact of COVID‐19 in Colombia: An Input‐Output Approach. *Regional Science Policy & Practice*, 12, 1123-1150.

Bonet, J. M., Ricciulli, D. M., Valbuena, G. J. P., Haddad, E. A., Perobelli, F. P., & Araújo, I. F. (2020b). *Diferencias regionales en el impacto económico del aislamiento preventivo por el COVID-19: estudio de caso para Colombia*. Documento de Trabajo sobre Economía Regional y Urbana, Banco de la República. Link: https://doi.org/10.32468/dtseru.290

Dietzenbacher, E., Van der Linden, E., & Steenge, A. E. (1993). The Regional Extraction Method: EC Input-output Comparisons. *Economic Systems Research*, 5, 185-206.

Guerra, A. I. & Sancho, F. (2010). Measuring Energy Linkages with the Hypothetical Extraction Method: An Application to Spain. *Energy Economics*, 32, 831-837.

Haddad, E. A., Perobelli, F. S. e Araújo, I, F. (2019). *Matriz de Insumo-Produto para Angola, 2012 (Nota Técnica)*. Texto para Discussão NEREUS, n. 08-2019, Núcleo de Economia Regional e Urbana da Universidade de São Paulo. Link: <https://ideas.repec.org/p/ris/nereus/>2019\_008.html

Haddad, E. A., Perobelli, F. P., & Araújo, I. F. (2020a). *Input-Output Analysis of COVID-19: Methodology for Assessing the Impacts of Lockdown Measures*. Texto para Discussão NEREUS, n. 01-2020. Núcleo de Economia Regional e Urbana da Universidade de São Paulo. Link: https://ideas.repec.org/p/ris/nereus/2020\_001.html

Haddad, E. A., Perobelli, F. P., Araújo, I. F., & Bugarin, K. (2020b). Structural Propagation of Pandemic Shocks: An Input-Output Analysis of the Economic Costs of COVID-19. *Spatial Economic Analysis*. DOI: https://doi.org/10.1080/17421772.2020.1844284

Haddad, E. A., Aynaoui, K., Ali, A., Arbouch, M., & Araújo, I. (2020c). The Impact Of Covid-19 In Morocco: Macroeconomic, Sectoral And Regional Effects. Research Paper, RP 20-17. Policy Center for the New South. Link: <https://www.policycenter.ma/publications/impact-covid-19-morocco-macroeconomic-sectoral-and-regional-effects>

Lahr, M. L., Mesnard, L. 2004. Biproportional Techniques in Input-Output Analysis: Table Updating and Structural Analysis. Economic Systems Research. Volume 16. Issue 2. Pages 115–134. ISSN 0953-5314. https://doi.org/10.1080/0953531042000219259 .

Miller, R. E., & Lahr, M. L., (2001). A Taxonomy of Extractions. In: Lahr, M. L., Miller, R. E. (Eds.), *Regional Science Perspectives in Economic Analysis: A Festschrift in Memory of Benjamin H. Stevens*. Elsevier Science, Amsterdam, pp. 407-441

Perobelli, F. S., Haddad, E. A., Moron, J. B., & Hewings, G. J. (2010). Structural Interdependence among Colombian Departments. *Economic Systems Research*, 22(3), 279-300.

Song, Y., Liu, C., &Langston, C., (2006). Linkage Measures of the Construction Sector Using the Hypothetical Extraction method. *Construction Management and Economics*, 24, 579-589.

Temurshoev, U. (2010). Identifying Optimal Sector Groupings with the Hypothetical Extraction Method. *Journal of Regional Science*, 50(4), 872-890.

Zhang, Y. J., Bian, X. J., &Tan, W. (2018). The Linkages of Sectoral Carbon Dioxide Emission Caused by Household Consumption in China: Evidence from the Hypothetical Extraction Method. *Empirical Economics*, 54(4), 1743-1775.

Zhao, Y., Zhang, Z., Wang, S., Zhang, Y., &Liu, Y. (2015). Linkage Analysis of Sectoral CO2 Emissions Based on the Hypothetical Extraction Method in South Africa. *Journal of Cleaner Production*, 103, 916-924.

Wang, Y., Wang, W., Mao, G., Cai, H., Zuo, J., Wang, L., &Zhao, P. (2013). Industrial CO2 Emissions in China Based on the Hypothetical Extraction Method: Linkage Analysis. *Energy Policy*, 62, 1238-1244.

1. For more details on the extraction methods, please see Miller, R.E., Lahr, M.L., (2001). [↑](#footnote-ref-1)
2. The sectors used in the elaboration of the input-output matrix are according to INE’s sector classification. The oil sector was further disaggregated into oil extraction and refinery as in Haddad et al., (2019). [↑](#footnote-ref-2)
3. INE – Estatísticas de Comércio Externo. Folha de Informação Rápida – II e III Trimestres de 2020. [↑](#footnote-ref-3)
4. There are broad aspects that are studied using the extraction method such as regional issues (Perobelli et al. 2010); emissions (Ali, 2015; Zhang et al., 2018; Zhao, 2015, Zhao et al., 2013); sectoral analysis (Song et al., 2006; Temurshoev, 2010); and energy analysis (Guerra and Sancho, 2010). [↑](#footnote-ref-4)
5. Given intra-week seasonality, weekly output is assumed to concentrate in weekdays. [↑](#footnote-ref-5)
6. https://andine.ine.gov.ao/nada4/index.php/catalog/15 [↑](#footnote-ref-6)
7. See Haddad and Araújo (2020). [↑](#footnote-ref-7)
8. See Bacharach (1970), Allen (1974) and Lahr and Mesnard (2004). [↑](#footnote-ref-8)
9. The use of the second quarter might overestimate the effect of COVID-19 in the economy as it was the toughest quarter regarding measures that restricted movement of people. [↑](#footnote-ref-9)
10. According to data for Angola from Google’s “COVID-19 Community Mobility Report” (https://www.google.com/covid19/mobility/). [↑](#footnote-ref-10)
11. Please refer to the World Bank/UNDP Policy Document: “Confrontar as Consequências Socioeconómicas da COVID-19 em Angola: Perspectivas e Respostas Políticas para uma Crise Multidimensional em Evolução”. [↑](#footnote-ref-11)
12. The BDA credit lines considered are as follows: *Linha de crédito de Kz 26,4 mil milhões para financiar a compra de produtos agrícolas e de pesca produzidos localmente. O BDA também aprovou uma linha de crédito de Kz 13,5 mil milhões para financiar a compra de sementes melhoradas, fertilizantes e pesticidas por empresas agrícolas nacionais, assim como um crédito adicional de Kz 750 milhões para financiar a modernização e a expansão das cooperativas agrícolas e pesqueiras nas províncias*. [↑](#footnote-ref-12)
13. The FACRA initiatives considered are as follows: *Kz 3 mil milhões para apoiar os investimentos de capital pelas cooperativas nos sectores da agricultura e pescas. O FACRA também irá disponibilizar uma linha de crédito de Kz 4 mil milhões para apoiar as instituições de microfinanças, escolas agrícolas e bancos de crédito agrícola para financiar jovens e mulheres empresárias que investem na agricultura, pecuária, pesca, turismo e cultura, reciclagem de lixo, serviços de formação vocacional e desenvolvimento de software*. [↑](#footnote-ref-13)
14. In Figure 2, we have for each date, the percentage change in mobility from a baseline scenario, related to mobility in a normal time. [↑](#footnote-ref-14)
15. The GDP loss reported in Table 3 should not be directly compared to the more accurate and official GDP numbers produced by INE. The input-output method is not designed to provide a precise estimate regarding GDP but provides an assessment on how shocks in the economy affect different sectors. [↑](#footnote-ref-15)
16. Intervals: i) high -1 and -0.9, ii) medium-high -0.9 and -0.7, iii) medium -0.7-0.5, iv) medium-low -0.5 and -0.2, and v) -0.2 and -0.0 [↑](#footnote-ref-16)