

# The Impact of Covid-19 on Household Welfare in the Comoros

The Experience of a Small Island Developing State

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## Abstract

This paper investigates the causal impact of a Covid-19 lockdown policy on the Comoros's household welfare, poverty, and labor market outcomes. The identification strategy uses the national government lockdown policy implemented to curtail the unexpected outbreak of Covid-19. The lockdown policy coincided with the 2020 Harmonized Survey on Living Conditions of Households data collection, lending itself to a quasi-natural experiment in which households that were interviewed before the lockdown policy fall into the control group, while those that were interviewed after the lockdown fall into the treated group. The paper explores the impact of the Covid-19 using descriptive regression

analysis and estimates the causal impact using matching techniques. The analysis finds a reduction in household expenditure, increased poverty, and a reduction in the likelihood of employment. Investigation of differential impacts along the expenditure distribution finds larger impacts at the top of the distribution, suggesting that Covid-19 may have reduced inequality, although the poor were also negatively affected. The evidence also suggests that the ability to use assets as a coping mechanism was limited. In a context of limited safety nets and government interventions, stringent lockdown policies appear to increase the vulnerability of the poor.

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# **The Impact of Covid-19 on Household Welfare in the Comoros: The Experience of a Small Island Developing State**

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## **1. Introduction**

The Covid-19 pandemic took the world by surprise and has claimed more than 4.5 million lives (as of September 2021). Since the Covid-19 pandemic was first identified in December 2019, more than 100 countries worldwide resorted to either full or partial economic and social lockdowns. These interventions are detrimental to socio-economic activities at the macro level and at the micro-level (Dunford et al., 2020). The political economy evaluation of the best-possible curtailment measures or responses at the country and global levels has attracted controversial and ongoing debates (Van, 2021). The controversy around curtailment measures revolves around the trade-off between saving lives and prioritizing the economy. An emerging consensus is that the level of preparedness to deal with the health emergency that came from Covid-19 was below standard (Sathyamala, 2021).

The pandemic is estimated to have had profound socio-economic impacts. The lack of a cure for the virus, the different variant or mutation episodes and the nature of its contagion necessitated the use of non-medical interventions. Policy makers resorted to national lockdowns and international travel restrictions, resulting in the worst economic downturns experienced in decades (Dunford et al., 2020). The colossal uncertainty directly from the Covid-19 virus coupled with the distortion in market and socio-economic activities has had ripple effects on the labor market. The macro-level effects will have implications at the household and individual levels. The cost of suppressing the spread of the pandemic and the intricacy of the economic shutdown add to the challenges of policy responses in unprecedented times.

Although African countries had relatively lower infection rates at the outset, the health impacts could potentially be adverse due to the inadequate health care systems. As such, they resorted to similar curtailment measures (national lockdown, social distancing, and international travel

restrictions) observed in developed economies. Within Africa, the Comoros provides a particularly insightful case study in evaluating national lockdown measures on socio-economic outcomes for several reasons. Firstly, by April 18, 2020, a month after the World Health Organization declared Covid-19 a global pandemic, the Comoros and Lesotho were the two countries in Africa that were still virus-free (Lone and Ahmad, 2020). The Comoros's proactive measures led to the restriction of social activities following the President's address on March 16, 2020. Furthermore, the national government enacted a complete national lockdown on March 23, 2020, over a month before the first confirmed case of Covid-19 on May 1, 2020. Thus, the Comoros is a typical example of a developing country in Africa that resorted to strict lockdown measures with low confirmed cases of Covid-19.

Secondly, households and individuals in developing countries are susceptible to shocks that have an adverse impact on their livelihood. Changes in commodity prices, climate-related shocks (drought and floods) as well as idiosyncratic shocks (illness and death) have a negative impact on their economic status, especially for the poor (Dercon 2002, 2004). In addition, the Comoros is one of the poorest countries in Africa (World Population Review, 2021)<sup>2</sup> and its geographical location increases its vulnerability to climate change shocks. The country was still recovering from Cyclone Kenneth, experienced in April 2019, when the Covid-19 pandemic hit and consequently led to lockdown measures (World Bank, 2020). The tourism sector is one of the country's major contributors to economic activities and income generation, thus exposing the country to a decline in economic growth as a result of lockdown measures. Therefore, this analysis can guide future responses to similar economic shocks and crises that necessitate lockdown measures, especially for African countries.

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<sup>2</sup> The evaluation was based on gross domestic product as an economic measure and indicated the Comoros to be among Africa's 10 poorest countries.

Finally, it has been previously found that research on the African continent tends to be skewed to a few countries. The evidence base for local policy makers in neglected countries or “research deserts” is relatively small. Porteous (2020) documents statistics on economic research in Africa and shows that 87% of all published economics journal articles account for one-third of African countries and are highly skewed towards five countries.<sup>3</sup> The distribution is uneven and accounted for only 16% of the continent’s population. It is evident that the Comoros falls within the forgotten 21 countries that have an average number of publications of 0.2 per country (Porteous, 2020). Heterogenous characteristics (socio-economic and political) can limit external validity across countries, especially in Africa. Even before the pandemic, as highlighted above, the Comoros had one of the highest poverty rates in the world. It is also vulnerable to natural disasters and climatic shocks. It is thus important to understand how the pandemic has affected a small island state like the Comoros, which is already facing several development challenges but with a narrow evidence base. Our unique data consisting of pre- and post-pandemic observations provides an opportunity to make a meaningful contribution. To the best of our knowledge, this paper will be the first to evaluate the welfare consequences of the Covid-19 lockdown in the Comoros in a robust manner.

This paper aims to quantify the impact of direct lockdown measures on household welfare in the Comoros, a poor developing country and specifically an understudied developing country. The unexpected outbreak of Covid-19 coincided with data collection for the Harmonized Survey on Living Conditions of Households (EHCVM), lending itself to a quasi-natural experiment in which households interviewed prior to the lockdown could be considered as the control group and those interviewed after the lockdown as the treated group. First, this paper presents descriptive statistics, followed by ordinary least squares and probit regression analysis to control

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<sup>3</sup> These five frequently researched countries are South Africa, Kenya, Ghana, Uganda and Malawi.

for key correlates of household welfare. It then aims at obtaining causal estimates using the propensity score matching technique by exploiting the timing of the 2020 survey. Finally, we use detailed information on household and individual welfare indicators pre and post the Covid-19 lockdown to ascertain the changes in expenditure, poverty and the distributional impact on household expenditure. We also examine the channels through which Covid-19 impacts household welfare, such as asset ownership and labor market outcomes. Furthermore, we extend our analysis to assess the evolution of our indicators as the period after the lockdown elapses. This analysis informs on the immediate impact and the dynamism in the recovering trend of household welfare indicators post-Covid-19 lockdown.

The paper finds a negative impact of Covid-19 induced national lockdown on household expenditure, thereby leading to an increase in poverty. The negative effect is prominent within the first three months after the lockdown, with a somewhat sluggish recovery. The result appears to be driven by a loss of employment as evidenced by a decline in the share of working household members. Nevertheless, there was no significant impact on monthly salary for those that remain employed. Exploring the effect of the Covid-19 lockdown on coping mechanisms, we find a negligible impact on asset ownership. Our evaluation suggests that the sale of assets as a welfare mitigating strategy for Comorian households during the lockdown was limited.

The remainder of this paper is structured as follows: the following sections outline the relevant literature, context and data description. Section 4 discusses the empirical methodology and section 5 presents the key results while the final section highlights the policy implications and concludes.

## **2. Literature Review**

The emerging empirical literature on the economic impact of the Covid-19 pandemic curtailment measures (national lockdown) has relied heavily on aggregated macro-level models and data. Atkeson (2020) evaluates the use of the SIR model to determine the lockdown measures associated with a less severe economic downturn and low contagion of the virus. The author's application of the model to the US predicts social distancing of 12-18 months (in the absence of vaccine) as the best measure, compared to a strict national lockdown. The relevant research to understand the impact of the Covid-19 pandemic on income, consumption patterns, and the labor market has been at the macro level and focused on the United States and the United Kingdom. The emphasis has been on the effectiveness of mitigation policies on household and labor market structure (see Piyapromdee and Spittal, 2020; Brewer and Gardiner, 2021). The heterogeneous impact of the Covid-19 pandemic on employment patterns and welfare outcomes depicts severe consequences for workers in low-income jobs, social and flexible work in Japan (Kikuchi, Kitao and Mikoshiba 2020). In the developing country context, Schotte et al. (2021) estimated a reduction in employment with an adverse impact on the informal sector for Ghana as a result of stringent lockdown measures. Summer, Hoy and Ortiz- Juarez (2020) evaluate the potential short-term impact of the Covid-19 pandemic on global poverty incidence. They report a substantial increase in global poverty that might delay achievement of the Sustainable Development Goal of ending poverty by 2030.

The intensity of the spread of the Covid-19 infection has been more severe for developed countries than developing countries. However, the same curtailment measures as national lockdowns, social distancing and curfew implemented in developed countries have also been implemented in developing countries. Furthermore, the macro level evidence has predicted age-specific and school closure policies in developing countries as the best in curtailing the



contagion of the virus from young to old and providing a modest economic downturn (see Alon et al., 2020).

Our first contribution to the literature is to provide an empirical analysis of the impact of Covid-19 beyond aggregated economic indicators. It presents a robust causal empirical analysis of the Covid-19 lockdown measures on household welfare in a developing country based on micro data on household expenditure and labor market outcomes. It further informs on the economic cost of lockdowns for households, which can be used as a yardstick in measuring the impact of macro-level policies against micro-level welfare consequences.

Evaluations of past pandemics like HIV have shown negative impacts on economic growth and labor market outcomes (see Dixon, 2002 and Arndt and Lewis, 2001). The emerging literature has begun to investigate the effects of the Covid-19 pandemic on the economic livelihoods of households in developing countries. The research has heavily evaluated the economic lives of the poor using phone surveys on retrospective household welfare indicators (see Ceballos et al., 2020, Egger et al., 2021 and Schotte et al., 2021, among others). In extension, the empirical estimation has focused on the poor, agricultural or rural areas to understand the impact of the Covid-19 lockdown on the economic livelihoods and global food system (see Gupta et al., 2021; Janssen et al., 2021; Rönkkö, Rutherford and Sen 2021; Swinnen and Vos 2021). Gupta et al. (2021) evaluate the impact of the Covid-19 pandemic on economic outcomes of the poor and vulnerable households living in rural areas in India. They used a micro-level survey on weekly financial data for households in the high remittance regions and found a negative impact on household income. The adverse effect was exacerbated by the increasing interest rate on cash loans and reduction in remittances.

In addendum, households and individuals in developing countries are faced with a variety of shocks that can affect household livelihoods. Changes in commodity prices, climate-related shocks (drought and floods) as well as idiosyncratic shocks (illness and death) have an adverse impact on their economic status, especially for the poor (Dercon 2002, 2004). However, rarely have economic activities been distorted through strict lockdown policies such as those used in the curtailment of the Covid-19 outbreak. National lockdowns restrain households and individuals from engaging in their daily socio-economic activities and distort or cause a complete cessation of both market and non-market activities. National lockdown measures that prevent physical contact with others outside a household may distort the usual coping mechanisms observed in developing countries in mitigating welfare consequences or render them useless or impractical. Household welfare coping mechanisms like borrowing from family members and other informal risk-sharing strategies (local money lenders) and microfinance are limited or not accessible during a national lockdown (Townsend, 1994). Analysis of the impact of Covid-19 on the poor in Bangladesh using daily dairies on socio-economic activities showed variable but significant adverse effects on the poor (Rönkkö et al. ,2021). The evidence highlighted the use of cash reserves and reduction in non-food expenditure as coping mechanisms during the pandemic.

The second contribution of this paper is to go beyond assessing the effects of the pandemic on the economic lives of the poor and captures a broader impact on household welfare status and labor market outcomes of households vulnerable to falling into poverty and those holding precarious employment. Moreover, accounting for the impact of the pandemic on household welfare, which is not solely limited to the already poor, will provide policy makers evidence on the types of pro-poor policies that will not only elevate households from poverty but prevent susceptibility to poverty or reduced welfare. It is thus necessary to evaluate how the pandemic

impacts household livelihoods in developing countries and the coping mechanisms employed, regardless of individuals' economic status.

Finally, to the best of our knowledge, this paper is the first in empirically analyzing the Covid-19 lockdown measures on micro-level individual and household welfare, poverty status and labor market outcomes for the Comoros. It will inform on the thin micro literature on pandemic shocks on household welfare in a developing country context and specifically for small island developing states. The analysis will provide an understanding of the effect of the pandemic on the Comoros, which falls in the “forgotten countries” category in terms of economic research (Porteous, 2020). This paper will go beyond a descriptive assessment of Covid-19 on the socio-economic status of households. The research aims to causally estimate the lockdown impact using a detailed door-to-door household survey conducted in two phases before and after the lockdown implementation in the Comoros. An understanding of the mechanisms through which the lockdown can affect the welfare coping strategies of households is important. As such, this paper examines the impact of the pandemic on the expenditure, poverty status, asset and livestock ownership and labor market outcomes of individuals and households in the Comoros.

### **3. Contextualization and Data Description**

The Covid-19 virus was reported in the Comoros in May 2020 as the world battled with the outbreak, which was declared a pandemic by the World Health Organization on March 11, 2020. The Comoros was still recovering from the devastating cyclone Kenneth that had hit the country in April 2019 when the first Covid-19 case was recorded in May 2020. The Comoros is a densely populated country with approximately 465 inhabitants per km<sup>2</sup> (World Bank, 2020) and is susceptible to higher contagion given the nature of the virus. The measures enacted by the government encompassed sensitization from the president on March 16, closure of schools

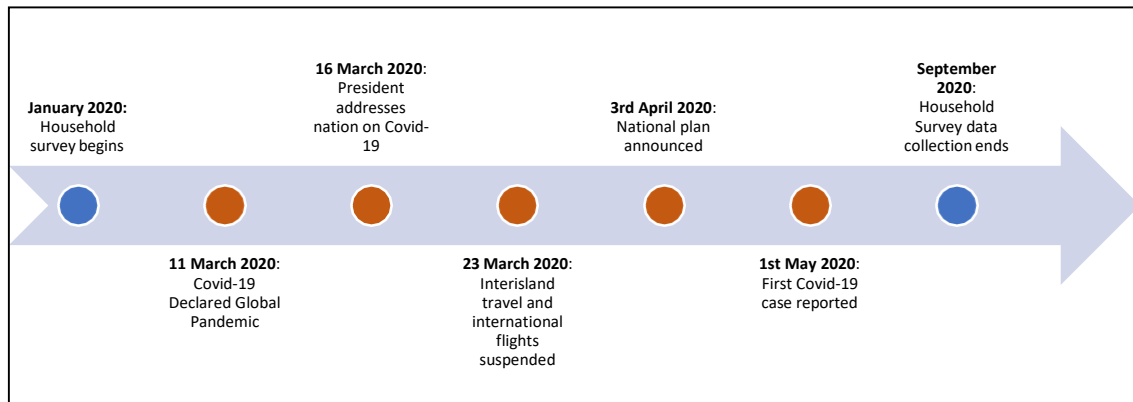
and universities on March 20, and restrictions to international and interisland movements on March 23, 2020. These measures were implemented before the first confirmed case on May 1, 2020, and aimed to reduce the potential spread of the virus.<sup>4</sup> The proactiveness of the government saw a national “state of preparedness” curtailment plan drawn and announced to the public on April 3, 2020. A curfew between 20:00 to 05:00 was implemented and this was later relaxed to from 23:00 to 04:00 in July 2020. As of August 26, 2021, there were 4,055 confirmed cases with 147 related Covid-19 deaths in the Comoros. The majority of the reported deaths took place between December 2020 and March 2021. The low confirmed cases suggest the national lockdown measures may have slowed the rate of contagion.

Nevertheless, the geography and location of the Comoros encourage tourism and interisland trade, which are major aspects of the country’s economy. Hence, the national lockdown had a high potential to increase vulnerability and worsen the economic status of households. According to the World Bank, in 2017, the Comoros's estimated annual GDP growth rate was 3.82 percent, and the growth trajectory has been declining and stood at 1.97 percent in 2019. As such, the country’s per capita rate of growth was low and averaged 1 percent between 2016-19, with consequences for household welfare. The pandemic led to a contraction of GDP growth of 0.1 percent in 2020. Early imposed lockdowns and social-distancing measures slowed the spread of the virus but weakened economic activity due to mobility restrictions and the suspension of international travel, resulting in a drop in tourism receipts. Demand and supply effects related to external trade hit the Comoros’s main earning sectors, particularly trade-related services such as restaurants, hotels, and transport.

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<sup>4</sup>Before the first confirmed cases, the president addressed the nation on March 16, 2020, on the threat of the Covid-19 pandemic and the implications for social activities and the health sector. A week later, the Government of Comoros implemented prevention measures through suspension of international flights and interisland travel.

**Figure 1: Timeline of the EHCVM Survey and Covid-19 response**



The empirical analysis of the Covid-19 outbreak’s impact on household welfare was undertaken using the 2020 Harmonized Survey on Living Conditions of Households (EHCVM) for the Comoros. The survey was conducted by the National Institute of Statistics and Economic and Demographic Studies and the World Bank and was collected between January and September 2020.<sup>5</sup> Figure 1 provides the timeline of the survey and the relevant Covid-19 intervention policies in the Comoros. Due to its timing, the survey provides informative data pre-and post-Covid-19 lockdown on household socio-economic status and characteristics. The survey was conducted across the four islands that make up the Union of Comoros and was therefore representative nationally as well as of the four (4) regional locations (Moroni, rest of Ngazidja, Ndzuwani and Mwali). We use the lockdown announcement date as a natural treatment or cut-off date for identifying households surveyed pre- and post-Covid-19 lockdown measure. The sample distribution of interviews covered before and after the Covid-19 lockdown in the Comoros is provided in Table A1 in the appendix. A total of 11,712 individuals belonging to 2,150 households were interviewed before the national lockdown. The sample for the main regions in the Comoros, Ngazidja and Ndzuwani, accounted for 39% and 42%,

<sup>5</sup> The survey included a few households interviewed in November 2018 and January 2019 and were excluded from this analysis. The country was struck by Cyclone Kenneth in April 2019. We exclude households prior to this episode to avoid conflating the impact of the cyclone with that of Covid-19.

respectively. The post-Covid-19 interview sample was 17,480 individuals belonging to 3,414 households but presented a similar regional distribution as the pre-Covid-19 sample.

Our identification strategy to assess the impact of the national lockdown measure on household welfare explores the proactive measure of the Government of Comoros's lockdown policy that came into effect on March 23, 2020 (see Figure 1). Our evaluation uses as a treatment variable a dummy that takes the value 1 if a household was surveyed after March 23, 2020 and 0 otherwise.

In validating our treatment effect, it is worth noting that the Covid-19 effect could come from the direct contagion of the virus or through the curtailment measures implemented by the national government. First, on the effect of contagion, we do not know from the survey whether individuals suffered from Covid-19, and thus this cannot be estimated in our analysis. Nevertheless, the Comoros was one of the last countries with lowest records of infection from the virus.<sup>6</sup> According to the World Health Organization's recorded Covid-19 cases, the Comoros accounted for 4,038 of the 207 million worldwide cases of Covid-19 by August 15, 2021. The number of confirmed cases in the Comoros was only 0.46% of the country's population. Second, curtailment measures are expected to have restricted and distorted socio-economic activities and markets. Hence, our treatment indicator using the dummy variable of national lockdown is a good approximation of the impact of Covid-19 curtailment measures on household welfare. It is acknowledged that the knowledge of Covid-19 was already in circulation after the President of the Comoros addressed the nation on March 16, 2020. Therefore, we may have reason to believe there may be anticipatory effects as people changed their behavior in response to the news. As such, we test the sensitivity of our analysis using the date the president addressed the nation as an alternative treatment cutoff.

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<sup>6</sup> Comoros and Lesotho were the two countries in Africa that were still virus-free (Lone and Ahmad, 2020) by April 2020 a month after the WHO announced the virus a pandemic.

The household survey data used for analysis (EHCVM 2020) contains information on household aggregated consumption expenditures in nominal terms and the monetary value of household assets. It provides extensive household and individual welfare indicators used in estimating objective and subjective poverty measurements and labor market outcomes. The aim of this paper is to empirically estimate the impact of the Covid-19 pandemic on household expenditure, asset value and ownership, poverty status, and labor market outcomes in the Comoros. To achieve the above, the paper analyzes the impact of the virus curtailment measures at both the household and individual levels. The household-level analysis explores total per capita household expenditure, asset accumulation, and poverty. We construct the log of household per capita consumption expenditures from the estimated consumption expenditure for a given household. We extend our analysis by constructing monetary and non-monetary outcome measures for household asset accumulation. The monetary measure captures the log value of total assets owned by the household. The non-monetary household welfare metric includes the total count of assets owned by a household, the different types of assets, and the total count of livestock ownership.<sup>7</sup> Our last household measure considers poverty status using both objective and subjective measures. The objective poverty status is a binary variable that takes the value 1 if a household is below the national poverty line and 0 otherwise.<sup>8</sup> The subjective poverty measures are three separate binary variables taking the value 1 if a household self-reports as “living averagely well”, “living in difficulty”, or “living rich” according to their socio-economic standards, respectively, and 0 otherwise. The binary subjective measures come from a categorical subjective measure of poverty. The motivation for creating binary subjective

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<sup>7</sup> Assets include chair, table, bed, mattress, cupboard, carpet, iron, stove, gas cylinder, oven, food processor, fruit press, refrigerator, freezer, fan, radio, TV, DVD, Satellite dish, washing machine, dryer, vacuum cleaner, air conditioner, lawnmower, generator, car, motorcycle, bicycle, camera, camcorder, stereo, landline phone, cell phone, tablet, desktop computer, laptop, printer/fax, video camera, boat, hunting rifle, guitar, piano, building/house, unbuilt land, solar panel. Livestock includes cattle, sheep, goats, rabbits, chickens, guinea fowl, duck, turkey, pigeon, geese and other poultry.

<sup>8</sup> The estimated poverty line used in this analysis is the 2020 national poverty line of 497,957 Comorian francs per person per annum.

poverty measures is to ensure comparable estimation techniques and interpretations to the objective poverty measure.

Panel A of Table 1 presents summary statistics for our selected household outcome variables. The pre-and post-Covid-19 conditions are different across the welfare outcomes, which could be the impact of Covid-19 itself or the difference in samples interviewed before and after the Covid-19 restriction. The log of per capita household expenditure shows a decline after the Covid-19 restrictions came into effect. Similarly, the different number of assets and number of livestock ownership show a decline after the lockdown. Not surprisingly then, household objective and subjective poverty measures are higher in the post-Covid-19 lockdown period.

In addition, we explore continuous and binary measures of labor market outcomes at the household and individual levels. The continuous outcomes include the share of working individuals in the household, the number of daily working hours, and the log of total monthly salary. The binary labor market outcomes include individuals in any employment and formal sector employment. Panel B of Table 1 represents the summary statistics regarding household and individual labor outcomes. The Covid-19 lockdown measure shows a negative correlation with labor market outcomes. The increase in the proportion of workers in formal employment and employment in the agricultural sector is noteworthy. By contrast, the proportion in the trade and service sector show a reduction. Table A2 in the appendix provides a detailed breakdown of employment across sectors. The employment sectoral distribution shows a high proportion of the employed in agriculture and the service sector.<sup>9</sup>

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<sup>9</sup> The service sector includes tourist related activities (hotel, restaurants, recreational and cultural activities).



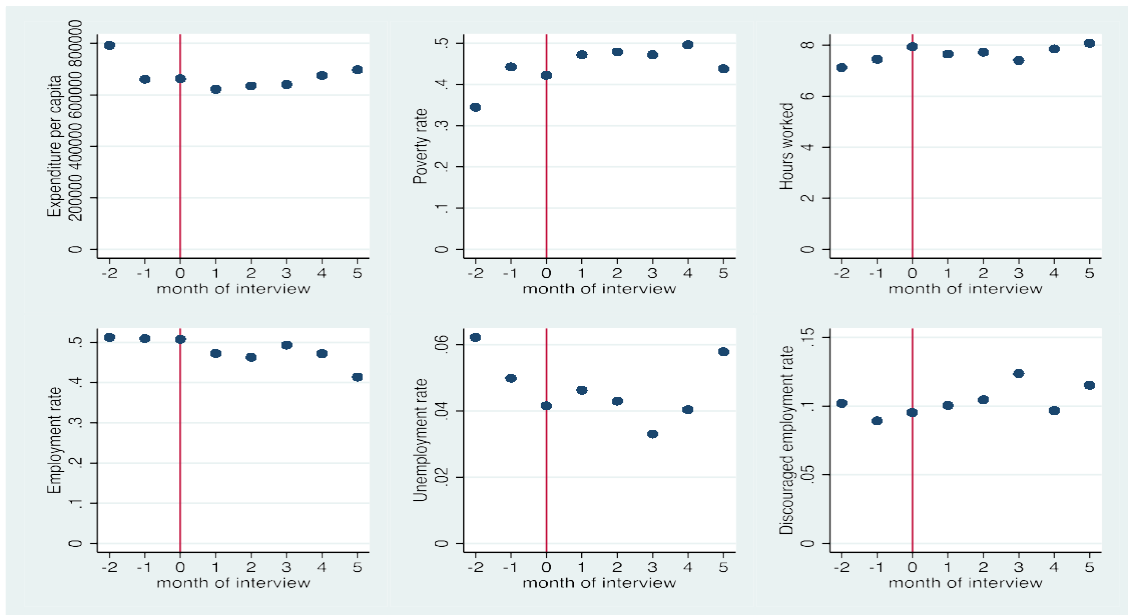
**Table 1: Summary Statistics for Household- and Individual-Level Outcome Variables by Covid-19 Status**

	Full	Control	Treatment	Difference	Standard error	P-value
<b>Panel A Household Welfare Outcomes:</b>						
log expenditure per capita	13.23	13.26	13.21	-0.05***	0.01	0.00
<b>Asset Type</b>						
Phone	0.88	0.91	0.86	-0.05***	0.00	0.00
TV	0.58	0.59	0.57	-0.01*	0.01	0.09
Motorcycle	0.02	0.03	0.02	0.00**	0.00	0.05
Car and/or truck	0.05	0.06	0.05	-0.02***	0.00	0.00
Bicycle	0.01	0.01	0.01	-0.01***	0.00	0.00
Radio	0.20	0.22	0.18	-0.04***	0.01	0.00
Furniture	0.95	0.96	0.94	-0.02***	0.00	0.00
Small appliances	0.36	0.41	0.32	-0.08***	0.01	0.00
Large appliances	0.36	0.37	0.35	-0.02***	0.01	0.00
Total number of different assets owned	6.76	7.04	6.54	-0.50***	0.05	0.00
Total number of assets owned (count)	11.79	12.26	11.44	-0.83***	0.09	0.00
Current value of all assets owned	469160	546326	416422	-129904***	11160.84	0.00
Log of value of assets	12.18	12.29	12.09	-0.20***	0.02	0.00
<b>Livestock Ownership</b>						
has livestock	0.28	0.31	0.27	-0.04***	0.01	0.00
total number of different livestock	0.39	0.43	0.36	-0.06***	0.01	0.00
total number of livestock in herd owned by household	1.80	1.72	1.88	0.16	0.17	0.35
<b>Household Poverty Status</b>						
Objective Poverty: Poor	0.45	0.42	0.47	0.05***	0.01	0.00
Objective Poverty: Multidimensional poverty index	0.39	0.38	0.39	0.01***	0.00	0.00
Subjective Poverty: I live well	0.24	0.27	0.23	-0.04***	0.01	0.00
Subjective Poverty: I live poorly	0.31	0.30	0.32	0.02***	0.01	0.00
Subjective Poverty: Rich social rank	0.32	0.34	0.31	-0.03***	0.01	0.00
<b>Panel B: Labor Market Outcomes</b>						
<b>Household Outcome:</b>						
Share of working individuals in household	0.30	0.31	0.29	-0.02***	0.00	0.00
<b>Individual Outcomes:</b>						
Daily hours worked	7.66	7.56	7.72	0.16**	0.08	0.03
Employed	0.49	0.51	0.47	-0.04***	0.01	0.00
Unemployed	0.05	0.05	0.04	-0.01	0.00	0.18
Discouraged worker	0.10	0.09	0.11	0.01**	0.01	0.04
Formally employed	0.22	0.21	0.23	0.02**	0.01	0.02
Works in agriculture sector	0.34	0.31	0.37	0.06***	0.01	0.00
Works in industry sector	0.13	0.13	0.12	-0.01	0.01	0.33
Works in trade sector	0.05	0.06	0.05	-0.02***	0.01	0.00
Works in services sector	0.48	0.49	0.46	-0.03***	0.01	0.01
Log salary	11.08	11.06	11.09	0.03	0.04	0.43
<b>Sample size</b>	<b>29,192</b>	<b>17,480</b>	<b>11,712</b>			

Note: "Difference" captures the raw difference between the post-Covid sample (treatment) and the pre-Covid sample (control).  
 Statistical significance: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

Figure 2 shows the mean distribution of selected outcomes pre- and post-Covid-19 lockdown month. Per capita expenditure shows an immediate reduction in April, which is a month after the Covid-19 lockdown, with a slight recovery in the second month (May) but still below the January 2020 average (two months pre-Covid-19 lockdown).

**Figure 2: Distribution of Household welfare indicators and labor market outcomes across the month of interview**



**Note:** The zero (0) reference line denotes the Covid-19 lockdown month (March 2020) in Comoros. We positioned the x-axis to reflect the time trend of the interviews before and after the treatment variable (covid lockdown month). Hence, the scale reads from left of the reference line as January 2020 (-2), February (-1) and to the right as April (+1) to August/September (+5). The observations for August and September 2020 interviews were pooled together given their small sample sizes, hence the absence of (+6) that would have corresponded to September 2020.

The poverty rate exhibits an increase after the Covid-19 lockdown and only starts falling in August/September 2020. The total hours worked per day also indicate a decreasing trend after the Covid-19 lockdown, increasing after three months but still below the pre-Covid-19 hours. Hours worked are observed to decline, but some evidence of recovery in July. Similarly, the employment rate is observed to recover in July before declining again. The unemployment trend shows variation but generally increases after the implementation of the Covid-19 restrictions, albeit with some recovery in July.<sup>10</sup> The level of discouragement post-Covid-19 increases until the fourth/fifth month. The differences observed across outcome variables among households interviewed before and after the Covid-19 restriction are only descriptive in nature, and these two groups of households are not necessarily comparable. As such, it is

<sup>10</sup> The descriptive analysis predicts some recovery in household welfare by July. The national government lifted the total lockdown measure in the first week of July. The lockdown lifting was accompanied by a relaxed curfew from 23:00 to 04:00, use of mask in public areas, reduced number in public transport and opening of some educational institutions.

important to check household and individual characteristics across these two groups of households.

**Table 2: Summary Statistics of Household Demographics and Individual Characteristics by Covid-19 Status**

	Full Sample	Control	Treatment (Covid)	Difference (T-C)	Standard Error	P-value
<b>Individual Characteristics</b>						
Male	0.48	0.48	0.48	0.00	0.01	0.87
Age	25.19	25.09	25.24	0.15	0.25	0.56
Literate	0.64	0.66	0.63	-0.03	0.01	0.00
<b>Location and Settlement Type</b>						
Moroni	0.11	0.12	0.10	-0.02	0.01	0.00
Rest of Ngazidja	0.40	0.39	0.40	0.00	0.01	0.72
Ndzuwani	0.43	0.40	0.45	0.05	0.01	0.00
Mwali	0.07	0.09	0.05	-0.03	0.00	0.00
Urban	0.32	0.35	0.29	-0.07	0.01	0.00
<b>Household Characteristics</b>						
<b>Amenities</b>						
Water Access	0.86	0.83	0.88	0.05	0.00	0.00
Sanitation Access	0.59	0.58	0.60	0.02	0.01	0.00
Electricity Access	0.84	0.85	0.83	-0.02	0.00	0.00
<b>Dwelling Features</b>						
Improved Roof	0.99	0.99	0.99	0.01	0.00	0.00
Improved Wall	0.48	0.48	0.48	0.00	0.01	0.85
Improved Floor	0.81	0.81	0.81	-0.01	0.01	0.14
<b>Other characteristics</b>						
Female- Headed	0.34	0.31	0.35	0.04	0.01	0.00
Dependency Ratio	1.12	1.14	1.10	-0.03	0.01	0.01
Polygamous	0.07	0.06	0.07	0.00	0.00	0.30
Single- Headed	0.10	0.10	0.11	0.00	0.00	0.24
People per Room	2.37	2.48	2.30	-0.19	0.02	0.00
<b>Head's characteristics</b>						
Age	45.76	45.92	45.66	-0.26	0.17	0.13
Literate	0.75	0.78	0.73	-0.06	0.01	0.00
No Education	0.59	0.58	0.59	0.01	0.01	0.08
Primary Educ.	0.12	0.13	0.12	-0.01	0.00	0.01
lower secondary	0.10	0.10	0.11	0.00	0.00	0.31
upper secondary	0.06	0.07	0.06	-0.01	0.00	0.03
Tertiary	0.13	0.12	0.13	0.00	0.00	0.52
<b>Samples</b>	<b>29,192</b>	<b>17,480</b>	<b>11,712</b>			

Note: "Difference" captures the raw difference between the post-Covid-19 sample (treatment) and the pre-Covid-19 sample (control).  
Statistical significance: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

The survey data provides important individual and household characteristics like age, gender, marital status, location of settlement, educational attainment, access to basic amenities, and other household demographics. Table 2 presents summary statistics of these characteristics by Covid-19 status. The regional distribution shows no difference between the pre- and post-Covid-19 samples for the rest of Ngazidja, the main island, which accounts for 40% of the total sample. About 43% of the sample is resident in Ndzuwani Island, the second largest in the Comoros, with observed differences between the treatment and control groups. The individual demographics are similar for pre- and post-Covid-19 except for the literacy rate, which is higher for the control group. There are some differences in household access to basic amenities

and dwelling features between the pre- and post-Covid-19 samples. Additionally, there is evidence of a higher dependency ratio in the pre-Covid-19 sample and a higher percentage of female household heads in the post-Covid-19 sample. The characteristics of household heads are similar across the two groups except for literacy rate.

The analysis of the summary statistics indicates a negative association of Covid-19 with household- and individual-level welfare indicators. However, a comparison of observable characteristics between treatment and control groups suggests that these may be driving the observed differences. Therefore, the objective of this paper is to go beyond the descriptive association in a bid to evaluate the causal impact of Covid-19 on household welfare in the Comoros. The empirical strategy discussed in the next section will use household and individual characteristics as control variables to identify the causal impact of Covid-19 on welfare and labor market outcomes.

#### **4. Empirical Methodology**

##### **Descriptive Regression Estimations**

We first explore descriptive econometric analysis examining the impact of the Covid-19 lockdown measure on household and individual welfare indicators and labor market outcomes. We specify three models of the correlates of continuous indicators of household welfare. The first captures the Covid-19 treatment related to the exact month the national lockdown came into effect, and the last two evaluate the time-elapsd variation in interview month relative to the start of the national lockdown.

$$welfare_i = \beta_0 + \beta_1 (Post) + X_i + \theta_j + e_i \quad (1)$$

$$welfare_i = \beta_0 + \beta_1 (Post * monthselapsed) + X_i + \theta_j + e_i \quad (2)$$

$$welfare_i = \beta_0 + \beta_1 (Post) + \beta_2 (Post * (1to3monthselapsed)) + \beta_3 (Post * (morethan3monthselapsed)) + X_i + \theta_j + e_i \quad (3)$$

Where:  $welfare_i$ , is a continuous variable that represents a variety of indicators of welfare measures (i.e., log of per capita household expenditure, related asset ownership indicators, and livestock ownership) for household  $i$  or individual  $i$ ;  $Post$  is a dummy variable that indicates whether the interview occurred after the Covid-19 lockdown measure to curtail the outbreak of the pandemic;  $monthselapsed$  is a continuous variable capturing the total count of months that elapsed from the month of the national lockdown; the other important explanatory variables  $1to3monthselapsed$  and  $morethan3monthselapsed$  are dummy variables representing samples that were interviewed between 1 to 3 months and more than 3 months after the month of the national lockdown month, respectively;  $X_i$  is a vector for the  $i$ th household and individual that includes covariates relating to, among others, age, gender, marital status, and educational attainment, and is further comprised of household dependency ratio, access to basic amenities, dwelling features, and settlement type;  $\theta_j$  represents location fixed effects; and  $e_i$  represents a random idiosyncratic error term. The estimations from models 1, 2, and 3 are important for understanding the overall and monthly variation of the effect of Covid-19 on our selected welfare outcomes. The estimators of interest are  $\beta_1$ ,  $\beta_2$ , and  $\beta_3$  which provide the average impact of the Covid-19 lockdown measures and the variation of the effect over time elapsed from the lockdown month on our selected welfare indicators. Pandemic outbreaks have dynamic effects on socio-economic indicators; hence, an understanding of the evolution of the effect after a curtailment measure is key for policy analysis. The above equations are estimated by ordinary least squares regression analysis with robust standard errors.

In addition to the continuous measures of household welfare indicators, we also use binary (0/1) poverty measures for households. The estimation of the Covid-19 impact on household poverty (both objective and subjective) is obtained from the probit model specification as follows:

$$prob[poverty_i = 1] = \phi(\beta_0 + \beta_1 post + X_i) \quad (4)$$

Where  $\phi(\cdot)$  is the cumulative distribution function operator for the standard normal;  $poverty_i$  is a binary variable that represents whether a household or individual is below the national poverty line or the three subjective poverty measures computed from self-assessed economic status as living in difficulty, living well, and living rich, respectively; and  $post_i$  and  $X_i$  are the variables for the Covid-19 lockdown measures and the related poverty determinants as defined in equation 1 above. Our probit model estimation does not consider the month-elapsing variables from the national lockdown, as the interpretation of interaction marginal effect from probability model estimation lacks theoretical justification and entails computational difficulties (Williams, 2012).

In addition to the analysis of welfare indicators, we explore the effect of Covid-19 on household and individual labor market outcomes. Labor market outcomes can be separated into continuous and binary measures. The continuous labor market outcomes of interest include the share of working members in the household, the total hours worked, and the log of total monthly salary. The first outcome is a household level variable, and the last two are individual level outcomes. The relevant estimation technique follows the forms specified for models 1, 2, and 3 above, with continuous measures of the labor outcomes replacing the welfare indicator on the left-hand side of the specifications. The estimation provides the average effect for post-Covid-19 and time-elapsing effect on the labor market outcomes for households in the Comoros.

The estimation follows an Ordinary Least Squares (OLS) regression analysis. In addition, our labor market binary outcomes (employed and formally employed) are estimated for model 1 only using Probit estimation analysis. The aim of this evaluation is to provide an understanding of the mechanisms through which the associated government lockdown measure during the pandemic affected the general welfare.

### **Causal Impact Estimation: Propensity Score Matching**

The above analysis provides an initial descriptive empirical outlook of the estimation of the impact of Covid-19 on welfare, poverty, and labor market outcomes for the Comoros. In order to estimate a causal impact of Covid-19 on our selected outcome variables, we expand our analysis using the Propensity Score Matching (PSM) technique. The PSM methodology allows for the estimation of the average treatment effect of Covid-19 on household and individual welfare, poverty status, and labor market outcomes. Given that the analysis uses observational data for one time period, the PSM approach is appropriate in an attempt to causally identify the key effects of interest.

The PSM approach simulates a random allocation of households and individuals into treatment and control groups based on their estimated propensity scores. The propensity score estimation in the PSM empirical approach begins with an estimation of a treatment assignment equation using a logistic regression model. The case of the Covid-19 government lockdown measure is unique as it provides a natural demarcation of households and individuals interviewed pre- and post-lockdown. The treatment assignment equations empirically predict the probability that a household or individual is in the post-Covid-19 sample (the treatment group). The logistic model includes sets of household and individual covariates that are not necessarily informed

by economic theory and may comprise polynomial and interaction terms. The motivation behind the logistic specification is the need to achieve strong predictions of treatment and control group allocation probabilities and effective covariate balancing in the matching procedure. The model estimates are used to compute the propensity scores on which the households and individuals from the two groups are subsequently matched. In specifying the logistic regression, the included explanatory variables should not be pre-determined by the treatment variable (Covid-19 lockdown measure) but should be correlated with the outcome variables (welfare indicators and labor market outcomes). The included covariates in the treatment equation are the same welfare determinants used in equations 1, 2, and 3. The above consideration limits potential concerns on the internal validity of the approach. The crucial identifying assumption is that, conditional on the input variables, the assignment to the treatment group (post-Covid-19 lockdown sample) and the control group (pre-Covid-19 lockdown sample) can be simulated as random and independent of the treatment. This is the Conditional Independence Assumption (CIA) (see Heckman, Ichimura and Todd, 1997; Smith and Todd, 2005; among others for details on the PSM technique). The assumption overcomes the problem of counterfactual simulation in natural experiments using observational data, and the matching quality can be assessed through the distribution of the included covariates after matching.

The estimation of the average treatment effect subjects the treatment and control groups to a common support which eliminates the possible bias from non-overlapped observations from the two groups. The kernel density matching technique is used for matching purposes. However, an extension to the use of other matching technique will be evaluated in the robustness section. After the implementation of the matching exercise, the uninfluenced explanatory variables for the treatment and control groups should exhibit a similar



distributional pattern. A satisfactory outcome is achieved only if the households assigned to the treatment and control groups provide identical observations in terms of the marginal distributions of the input variables. If this balancing property is satisfied, this implies that no measured confounder bias remains. The property is assessed using several different diagnostics. These include the standardized bias approach suggested by Rosenbaum and Rubin (1985), which measures the distance in the marginal (or unconditional) distributions of the input variables between the control and treatment groups prior to and after matching. In addition, t-statistics and variance ratios (i.e., F-tests) for each variable included in the treatment assignment equation are also used to determine if there are statistical differences between the means and variances (of the continuous input variables) after matching.

In investigating the balancing property, the logistic treatment assignment model is also re-estimated using the set of matched data. The expectation is that with good matching, the regression model's pseudo-R<sup>2</sup> should be close to zero, and the corresponding Likelihood Ratio Test (LRT) for the overall statistical significance of the logistic regression model should yield a low value. We also use Rubin's B and R statistics (see Rubin, 2001), which provide a set of criteria for comparing the distribution of the propensity scores between the treatment and control groups. These latter two test statistics indicate whether the regression-based procedure adequately eliminates any measured confounder bias using an appropriate set of confidence intervals.

Once the balancing property is satisfied, we continue with the estimation of the treatment (post-Covid-19 sample) impact by computing the weighted average difference between the post-Covid-19 units and the average of the pre-Covid-19 counterfactual units in the control group.

The standardized weights are calculated on the magnitude of differences in the propensity scores between the individual treated units and the compared control units. The average treatment effect on the treated (ATT) is computed for our data to inform on the causal impact of Covid-19 on selected welfare indicators and labor market outcomes.

## **5. Empirical Results**

The empirical results are presented and analyzed, starting with the descriptive regression results. The first sets of results encapsulate the impact of the three treatment variables capturing the Covid-19 lockdown on i) household welfare indicators using OLS estimations, ii) poverty indicators using the Probit estimation, and iii) labor market outcomes.

Table 3 below presents the results of the OLS estimates of the impact of the Covid lockdown on expenditure and asset ownership indicators, both overall average and time elapsed effect. Table 3 gives an overview of household wealth status using three different but complementary indicators. In the literature, household livestock and assets are viewed as stored wealth or savings accounts for households in developing countries (Andersson, Mekonnen and Stage, 2011). Therefore, it is important to understand the impact of economic shocks like the Covid-19 on household asset and livestock ownership in a context like Covid-19 where restricted movement may limit access to markets. The first panel (A) in Table 3 represents the results for each of the three models for the log of household expenditure and livestock ownership. The second panel (B) of Table 3 represents the results for household asset status across three different measures.

**Table 3: Ordinary Least Square Results (Welfare Indicators)**

PANEL A	Log of Household Expenditure			Household Livestock Ownership					
	1	2	3	Different Types Owned			Total Owned		
	1	2	3	1	2	3	1	2	3
Post-Covid	-0.068*** (0.006)		-0.150*** (0.011)	-0.067*** (0.008)		-0.143*** (0.018)	0.223 (0.178)		0.688* (0.412)
Post-Covid*months elapsed (continuous)		-0.030*** (0.002)			-0.029*** (0.002)			0.129* (0.078)	
Post-Covid*months elapsed (1-3)			0.026*** (0.009)			0.022 (0.015)			-0.094 (0.135)
Post-Covid*months elapsed (>3)			0.114*** (0.008)			0.109*** (0.013)			-0.719* (0.387)
<b>R-squared</b>	0.415	0.420	0.420	0.078	0.080	0.080	0.005	0.006	0.006
<b>Observations</b>	28,902	28,902	28,902	28,902	28,902	28,902	28,902	28,902	28,902
PANEL B	Number of Different Assets Owned			Household Asset Ownership Number of Assets Owned			Log Value of Assets Owned		
	1	2	3	1	2	3	1	2	3
Post-Covid	-0.395*** (0.042)		-0.542*** (0.086)	-0.521*** (0.076)		-1.146*** (0.157)	-0.167*** (0.017)		-0.335*** (0.035)
Post-Covid*months elapsed (continuous)		-0.144*** (0.013)			-0.206*** (0.023)			-0.069*** (0.005)	
Post-Covid*months elapsed (1-3)			-0.136** (0.068)			0.164 (0.123)			0.040 (0.028)
Post-Covid*months elapsed (>3)			0.443*** (0.064)			0.919*** (0.120)			0.252*** (0.027)
<b>R-squared</b>	0.297	0.298	0.299	0.286	0.287	0.288	0.242	0.244	0.245
<b>Observations</b>	28,902	28,902	28,902	28,902	28,902	28,902	28,902	28,902	28,902

Note: Robust standard errors in parentheses

Statistical significance: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

The controls include head of household and individual member age, education, and marital status; polygamous household; female-headed household; dependency ratio; number of working-age individuals in household; access to water, sanitation and electricity; improved floor and roof; location (region and urban settlement)

In Panel A of Table 3, the impact of the Covid-19 lockdown shows an average reduction in household expenditure of 6.8%, with a 3% reduction for each month that elapsed after the lockdown month, *ceteris paribus*. The interaction of our post-Covid-19 sample and the number of months that elapsed shows the effect lingered strongly during the first three months after the lockdown. There is some evidence of recovery, with the magnitude of the negative impact slowly reducing within the first 3 months. The rate of recovery improves post three months of the national lockdown.

The last six columns of Panel A in Table 3 present the estimation for the household livestock ownership across two measures (different types and total livestock owned) for the three models. The impact of the Covid-19 lockdown was a small decrease in the different types of livestock owned by a household, on average. Nevertheless, there was no significant impact on the total number of livestock owned after the lockdown. The results on the impact of the Covid-19

lockdown on the three household asset ownership measures are presented in Panel B. The number of different asset types owned by households decreased slightly by 0.4 asset counts, on average, after the Covid-19 lockdown policy. The negative impact lingers but becomes even weaker for the months that elapsed after the Covid-19 lockdown policy. In a similar line, the total number of assets owned by a household also declined slightly, with the loss being equivalent to a decline in number by 0.5. The impact on the number of assets lingers within the first three months, with no substantial evidence of recovery after three months. The last three columns of Panel B, in Table 3, represent the Covid-19 impact on the monetary value of total assets for a household, and there was a 16.7% reduction on average, *ceteris paribus*. In addition, for each month after the Covid-19 lockdown, there was a 6.9% reduction in the value of total assets, which translates to a loss of approximately 37,696.5 Comorian francs using the pre- Covid-19 sample mean value. There is no evidence of recovery as the months elapsed after the Covid-19 lockdown policy implementation for the monetary value of asset ownership.

**Table 4: Probit Regression Analysis Results (Poverty Status) (Marginal Effects)**

	Objective Poverty	Subjective Poverty Outcomes		
		I live well	I live in difficulty	I am rich
Post-Covid	0.081*** (0.007)	-0.047*** (0.006)	0.017*** (0.006)	-0.048*** (0.009)
Observations	28,902	28,005	28,005	27,131

Note: Robust standard errors in parentheses  
 Estimation by Probit. Marginal effect at means reported  
 Statistical significance: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

Table 4 represents the result of the Probit regression of household poverty status for both objective and subjective measures. An evaluation of the objective poverty indicator, measured by households below the poverty line, revealed an 8.1 percentage point increase, on average, post-Covid-19 lockdown. Regarding the subjective poverty measures, the results revealed a 4.7 and 4.8 percentage points reduction for households that self-assessed as living well and as socio-economically rich, respectively. In addition, the estimation showed an increase of 1.7 percentage points for households that self-assessed as living in difficulties. The overall impact

of the Covid-19 lockdown measures was an increase in poverty status across the objective and subjective measures.

**Table 5: OLS Regression and Probit Analysis Results (Labor Market Outcomes)**

	Continuous Outcomes									Binary Outcomes	
	Share of working members			Total hours worked per day			Log salary			Employed (Model 1)	
	1	2	3	1	2	3	1	2	3	Total	Formal
<b>Post-Covid</b>	-0.028*** (0.002)		-0.038*** (0.005)	0.173** (0.075)		-0.113 (0.153)	0.008 (0.035)		0.078 (0.077)	-0.060*** (0.009)	0.022** (0.011)
<b>Post-Covid*months elapsed (continuous)</b>		-0.008*** (0.001)			0.021 (0.022)			0.001 (0.011)		N/A	N/A
<b>Post-Covid*months elapsed (1-3)</b>			0.002 (0.004)			0.198 (0.126)			-0.096 (0.061)	N/A	N/A
<b>Post-Covid*months elapsed (&gt;3)</b>			0.016*** (0.003)			0.264** (0.111)			-0.007 (0.057)	N/A	N/A
<b>R-squared</b>	<b>0.186</b>	<b>0.186</b>	<b>0.187</b>	<b>0.062</b>	<b>0.061</b>	<b>0.062</b>	<b>0.176</b>	<b>0.176</b>	<b>0.176</b>		
<b>Observation</b>	<b>28902</b>	<b>28902</b>	<b>28902</b>	<b>8,697</b>	<b>8,697</b>	<b>8,697</b>	<b>1670</b>	<b>1670</b>	<b>1670</b>	<b>8,697</b>	<b>8,697</b>

Note: Robust standard errors in parentheses

Statistical significance: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

**Share of working members estimation:** the controls include head of household and individual age, education, and marital status; polygamous household; female-headed household; dependency ratio; number of working-age individuals in household; access to water, sanitation and electricity; improved floor and roof; location (region and urban)

**Other Estimations:** the controls include individual age, education, and marital status; polygamous household; female-headed household; dependency ratio; number of working-age individuals in household; access to water, sanitation, and electricity; improved floor and roof; location (region and urban)

Table 5 presents the results of the descriptive OLS and Probit analysis on the impact of Covid-19 on labor market outcomes. The outcomes of interest include the share of working individuals in the household and the log of salary for an individual, across the three models using OLS. In addition, the results (marginal effects) of binary outcomes of being employed and being formally employed are highlighted for model 1, estimated by Probit estimation method. The share of working household members decreased by an average of 2.8% after the Covid-19 lockdown, with no significant recovery as the months elapsed and a 0.8% reduction in the share of working members for an additional month after the Covid lockdown measure, *ceteris paribus*. The total individual hours worked reduced slightly by 0.2 hours per day but no significant impact was found as the months elapsed. Similarly, the estimated effect of Covid-19 on individual monthly salary shows no significance across the three models. However, the estimated impact on employment status was a significant 6 percentage points reduction in the

likelihood of being employed, while probability of formal employment increased by 2.2 percentage points, on average, *ceteris paribus*.<sup>11</sup>

The descriptive regression analysis above shows that some of the negative impacts observed in the raw differences in Table 1 are still statistically significant even after controlling for other characteristics that may be affecting the outcome variables. Specifically, Covid-19 is found to be associated with lower household expenditure, total asset value and ownership, the share of employed household members and individual level employment. In addition, both objective and subjective poverty measures are found to be worse.

We now discuss the PSM results of the estimation of the average treatment effect on the treated (ATT) of Covid-19 lockdown on selected household welfare indicators. Table A3 in the appendix presents the logit estimates for the treatment assignment model used to compute the propensity scores for the post-Covid-19 treatment variable. As discussed in the empirical methodology section, the specification of the logistic treatment assignment equation is not motivated by any economic theory, and the estimates do not need an economic interpretation. The aim of the treatment assignment equation is to provide a good predictive outcome of the propensity scores for the matching exercise. However, certain conditions need to be satisfied to ensure the ATT is valid and captures the causal impact of Covid-19 on household welfare. First, the estimations were done within the common support, and only seven observations failed to satisfy the common support condition and were excluded from the empirical analysis (see Figure A1 in the appendix for the propensity score distribution for the treatment and control groups).

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<sup>11</sup> However, after matching, the impact on formal employment is found not to be statistically significant (Table 6).

Second, the matching procedure yielded good balancing quality for the covariates across the different diagnostic checks. The mean and the median standardized bias estimates are below the required threshold, and none of the individual covariates yields a standardized bias outside of the  $\pm 5\%$  interval. The variance ratios for the continuous variables for the two groups (treatment and control) lie within the specified 95% confidence intervals. In addition, the pseudo- $R^2$  values for the logistic regression model re-estimation using the matched data are negligible, and the Likelihood Ratio Test (LRT) values for the overall significance of the regression are statistically insignificant. The estimated Rubin criteria for good balancing on the propensity score are all satisfied and reinforce a good balancing achievement. The full array of statistics and diagnostics for the balancing property is contained in Tables A4, A5 and A6 of the appendix.

Table 6 below represents the average treatment effect of the Covid-19 lockdown measure on household welfare indicators, poverty, and labor market outcomes separately. In Panel A of Table 6, the average causal impact on the post-Covid-19 lockdown sample is a 3.3% (i.e.,  $[e^{-0.034}-1] \times 100$ ) reduction in household per capita expenditure, *ceteris paribus*. The estimated ATTs also predict a negative, albeit small, impact on household asset ownership status. The number of different assets owned by a household decreased slightly by 0.4, and the total number of assets owned decreased by 0.6 asset counts. A significant negative impact is also observed for the total monetary value of assets within a household, with a 14% (i.e.,  $[e^{-0.151}-1] \times 100$ ) reduction as a result of Covid-19 lockdown. The number of different types of livestock owned by a household also decreased slightly by 0.1, but there was no significant impact on the total livestock counts.

**Table 6: Average Treatment Effect (ATT) of Covid-19 on Household Welfare and Labor Market Outcomes**

Panel A: Household Indicators	Impact
Log expenditure per capita	-0.034*** (0.008)

Number of different types of asset owned	-0.418*** (0.059)
Total number of assets owned (count)	-0.596*** (0.108)
Log value of assets	-0.151*** (0.023)
Number of different types of livestock owned	-0.111*** (0.010)
Number of livestock owned	-0.003 (0.208)
<b>Panel B: Household Poverty Status</b>	
Objective Poverty: Poor	0.036*** (0.007)
Subjective Poverty: I live well	-0.039*** (0.006)
Subjective Poverty: I live poorly	0.002 (0.007)
Subjective Poverty: I am rich	-0.060*** (0.007)
<b>Panel C: Labour Market Outcomes</b>	
Share of working household members	-0.025*** (0.003)
Employed	-0.051*** (0.008)
Formal employment	0.013 (0.009)
Total hours worked per day	0.199*** (0.072)
Log salary	0.002 (0.039)
<b>Sectoral Employment</b>	
Agriculture	0.043*** (0.011)
Industry	-0.001 (0.007)
Trade	-0.017*** (0.005)
Service	-0.029** (0.111)

Note: The observations across the treatment and control groups for each outcome vary in the estimation in accordance with the available data.  
Robust standard errors in parentheses  
\* p < 0.01, \*\* p < 0.05, \* p < 0.1

Panel B of Table 6 presents the estimated ATT of Covid-19 on the poverty status of a household. The overall impact is an increase in objective poverty by 3.6 percentage points for the post-Covid-19 sample. Subjective poverty analysis supports a general reduction in the proportion of households that self-reported as living well or as rich by 3.9 and 6.0 percentage points, respectively. However, the subjective view of living in difficulty showed no significant impact from the Covid-19 lockdown. The results from Panel A and B of Table 6 represent a substantial loss in household welfare post-Covid-19.

The last panel of Table 6 outlined the ATT for the household and individual labor market outcomes. The share of working individuals within a household decreased by 2.5 percentage



points, with an overall 5.1 percentage points reduction in employment rate, on average. There was no significant impact on formal employment as opposed to the estimated 2.2 percentage points increase from the Probit marginal effect. Similarly, there is no significant impact on individual monthly salary. However, the total number of working hours per day slightly increase by 0.2 hours per day (12 minutes per day) post-Covid-19, on average, *ceteris paribus*. The evaluation on the employment sectoral impact of Covid-19 shows a significant 4.8 percentage point increase in the likelihood of employment in agriculture. By contrast, there was a significant reduction in the likelihood of employment in the trade and services sectors by 1.7 and 2.9 percentage points respectively.

### Robustness Checks

The above empirical results provide an overview of the causal impact of Covid-19 on household welfare, individual and household labor market outcomes. To ensure the robustness of our findings, we first check for internal validity to our preferred estimation using other estimation techniques, namely inverse probability weighting and nearest neighbor matching.

**Table 7: ATT Estimates of Covid-19 impact on Household Welfare and Labour Market Outcomes using alternative matching methods**

	Inverse Probability weighting	Nearest Neighbour Matching
<b>Panel A: Household Indicators</b>		
Log expenditure per capita	-0.061*** (0.006)	-0.074*** (0.008)
Number of different types of asset owned	-0.433*** (0.042)	-0.539*** (0.057)
Total number of assets owned (count)	-0.572*** (0.077)	-0.702*** (0.101)
Log value of assets	-0.162*** (0.017)	-0.184*** (0.022)
Number of different types of livestock owned	-0.089*** (0.009)	-0.098*** (0.011)
Number of livestock owned	0.028 (0.167)	-0.014 (0.218)
<b>Panel B: Household Poverty Status</b>		
Objective Poverty: Poor	0.054*** (0.006)	0.063*** (0.006)
Subjective Poverty: I live well	-0.039*** (0.005)	-0.046*** (0.007)
Subjective Poverty: I live poorly	0.008 (0.006)	0.006*** (0.007)
Subjective Poverty: I am rich	-0.057*** (0.006)	-0.067*** (0.007)

<b>Panel C: Labour Market Outcomes</b>		
Share of working household members	-0.026*** (0.002)	-0.033*** (0.003)
Employed	-0.049*** (0.008)	-0.047*** (0.007)
Formal employment	0.022*** (0.008)	0.002 (0.009)
Total hours worked per day	0.213*** (0.072)	0.200*** (0.074)
Log salary	0.018 (0.038)	0.023 (0.039)
<b>Employment Sector</b>		
Agriculture	0.044*** (0.010)	0.041*** (0.010)
Industry	-0.002 (0.007)	-0.006 (0.007)
Trade	-0.018*** (0.005)	-0.0161** (0.005)
Service	-0.024 (0.011)	-0.0184* (0.011)

**Note:** The observations across regression analysis for each outcome vary in the estimation in accordance with the available data.  
Robust standard errors in parentheses  
\*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

Table 7 above shows negative impacts of Covid-19 on welfare indicators and labor market outcomes as observed in our main estimates. The magnitudes tend to be slightly on the lower bound for the PSM estimation. The nearest neighbor estimates are on the upper bound. Nevertheless, the internal validity process affirms the Covid-19 lockdown impact on our selected outcomes, and the magnitudes are broadly consistent with our main findings.

Secondly, we address the concern that anticipatory information regarding the Covid-19 lockdown was already in circulation after the President of the country made an official address to the nation on March 16, 2020. We provide estimates using a binary treatment assignment, which takes the value one if a household was interviewed before the presidential address held on March 16, 2020 and zero otherwise. The preferred estimates are the average treatment effects from the propensity score matching method. However, we extend the analysis and implement the two other matching techniques to validate our estimates internally. Table 8 below represents the average treatment effect of Covid-19 anticipation on our outcome variables across the three estimation methods.

In Panel A of Table 8, the first column highlights the results from the propensity score matching technique. The estimated impact of the Covid-19 anticipation measure is a significant reduction in household expenditure by 4.3% (i.e.,  $[e^{-0.044}-1] \times 100$ ), on average, ceteris paribus. In addition, the effect on household asset counts negatively changed by a magnitude of 0.4 units. However, the measure used for anticipation of Covid-19 lockdown is linked with a 14% (i.e.,  $[e^{-0.151}-1] \times 100$ ) reduction in the monetary value of assets. There is evidence of a reduced number of types of livestock owned, but the magnitude of change is low, and the number of livestock owned shows no significant change. The anticipation of Covid-19 accounted for an increase in household objective poverty by 4.4 percentage points, on average. Similarly, subjective poverty measures also estimate a reduction in welfare as the proportion of households self-reported to be living well and subjectively rich reduced by a significant 4.2 and 6.6 percentage points, respectively.

Panel C of Table 8 shows the Covid-19 anticipation effect on household and individual labor market outcomes. The results depict a reduction in the share of working-age individuals within a household by 2.8 percentage points, on average. In addition, the probability of employment reduced by 5.4 percentage points, with a slight increase in working hours per day of 0.29 hours for the employed, on average. In addition, the likelihood of employment in agriculture increased by 4.5 percentage points in anticipation of the Covid-19 lockdown while likelihood of employment in Trade and Service sector reduced by 1.8 and 3.4 percentage points, respectively.

**Table 8: ATT Estimates of Covid Anticipation on Household Welfare and Labor Market Outcomes**

	Propensity Score Matching	Inverse Probability Weighting	Nearest Neighbor Matching
<b>Panel A: Household Indicators</b>			
Log expenditure per capita	-0.044*** (0.008)	-0.046*** (0.006)	-0.052*** (0.008)
Number of different types of asset owned	-0.377***	-0.361***	-0.401***
	(0.061)	(0.044)	(0.058)
Total number of assets owned (count)	-0.5340*** (0.113)	-0.540*** (0.080)	-0.539*** (0.104)
Log value of assets	-0.151*** (0.024)	-0.159*** (0.018)	-0.175*** (0.022)
Number of different types of livestock owned	-0.095***	-0.082***	-0.085***

	(0.011)	(0.009)	(0.011)
Number of livestock owned	-0.018	0.004	0.027
	(0.197)	(0.157)	(0.199)
<b>Panel B: Household Poverty Status</b>			
Objective Poverty: Poor	0.044***	0.043***	0.048***
	(0.007)	(0.006)	(0.006)
Subjective Poverty.: I live well	-0.042***	-0.041***	-0.041***
	(0.007)	(0.006)	(0.007)
Subjective Poverty.: I live poorly	0.007	0.008	0.005
	(0.007)	(0.006)	(0.007)
Subjective Poverty.: I am rich	-0.066***	-0.059***	-0.069***
	(0.007)	(0.006)	(0.007)
<b>Panel C: Labour Market Outcomes</b>			
Share of working household members	-0.028***	-0.023***	-0.027***
	(0.003)	(0.003)	(0.003)
Employed	-0.054***	-0.056***	-0.050***
	(0.008)	(0.008)	(0.007)
Formal employment	0.009	0.021**	0.000
	(0.009)	(0.008)	(0.008)
Total hours worked per day	0.286***	0.259*	0.232*
	(0.074)	(0.159)	(0.161)
Log salary	-0.006	0.017	-0.009
	(0.039)	(0.039)	(0.039)
<b>Individual Employment Sector</b>			
Agriculture	0.045***	0.044***	0.039***
	(0.011)	(0.010)	(0.011)
Industry	0.008	-0.006	-0.007
	(0.008)	(0.008)	(0.008)
Trade	-0.018***	-0.019***	-0.017***
	(0.005)	(0.005)	(0.005)
Service	-0.034**	-0.031**	-0.029**
	(0.011)	(0.011)	(0.011)

Note: The observations across regression analysis for each outcome vary in the estimation in accordance with the available data.

Robust standard errors in parentheses

\*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

The overall impact of the Covid-19 presidential address was a reduction in household welfare, an increase in poverty and worsening labor market outcomes with evidence of increased participation in agricultural activities. Analysis on assets shows that the total asset value declined significantly, but the average number of assets lost was less than one. The small magnitude of decline in number of assets suggests limited sale of assets as a coping mechanism. Additionally, the large decline in reported current value of assets may reflect households' perception or reduced valuation of the worth of their assets given their limited ability to sell them. The other two estimation techniques give internal validity to our analysis as the results are consistent across the different measures.

It is worth noting that our evaluation of the impact of Covid-19 on household welfare and labor market outcomes did not account for the direct contagion of the virus. Due to data unavailability, we were unable to capture the impact of direct case contagion of the Covid-19 pandemic on socio-economic status. Nevertheless, the proactiveness of the Comoros government in enacting a lockdown before the first recorded case alleviated the potential risk of the impact of the virus contagion on household welfare. As noted previously, the recorded number of Covid-19 cases in the Comoros is among the lowest in the world. Thus, impacts from the containment measures as analyzed in this paper are likely to outweigh direct impacts.

Thirdly, we evaluate the impact of the Covid-19 pandemic on individual household asset types. The disaggregation allows the investigation of what asset is responsible for the negative, albeit small, reduction in asset ownership. It further informs on the role of asset type on the coping mechanism of households due to the Covid-19 lockdown in the Comoros. It is important to note that in the case of the Comoros, it is plausible that there could have been an impact on assets since the existence of a curfew (see context) implies that individuals could have moved around within islands during permitted hours and some trade in assets could have occurred. Table A7 in the appendix shows the ATT effect of both the Covid-19 lockdown and anticipation on the likelihood of ownership of household asset types. The estimates showed a decrease in the likelihood of owning a radio by 4.5 percentage points, while the likelihood of owning a radio declined by 3.1 percentage points. The impact on the probability of ownership of motorcycle and bicycles was negligible (0.7 percentage points) while there was no statistically significant impact on the likelihood of owning furniture. Likewise, the Covid-19 anticipation follows the same pattern with overall low changes in likelihood of asset ownership across the different types. In short, ownership of assets appears to have been only slightly impacted. During Covid-19, especially a month after the lockdown, the market had limited opening hours. It is

possible households could have sold assets as markets opened for limited hours hence the decline observed. Nevertheless, magnitude is small, therefore suggesting that in times of crises like Covid-19, markets do not function as well and therefore, households cannot effectively use assets as a coping mechanism.

Finally, our estimates include the possible mitigating effect from support received during the Covid-19 lockdown in the Comoros. The United Nations Development Programme (UNDP) contributed a total of US\$10 million to the Comoros Covid-19 pandemic preparedness and response strategy. This has a potential downward bias to our estimated impact. However, an evaluation from United Nations Development Program (UNDP) reveals that delivery of support to the Comoros during the pandemic was limited due to the absence of other international humanitarian agencies to support the three United Nations agencies (UNDP Comoros, 2020).<sup>12</sup> Therefore, the limitations in aid delivery reduce the potential bias stemming from mitigating economic policies at the aggregate level on our empirical estimates. Nevertheless, we acknowledge that our estimates capture the broader effect of the Covid-19 lockdown without separating it from the mitigating impact of economic support.

### **Extension: The Distributional Impact of Covid-19 in the Comoros**

To better understand the welfare consequences of the pandemic and how to mitigate its negative impact, an evaluation of distributional implications is necessary. Our above analysis estimates the average welfare consequences of the Covid-19 lockdown, showing a reduction in household expenditure and increased poverty. Post-pandemic policy formulation aimed at promoting development and reducing poverty can benefit from an assessment of the impacts

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<sup>12</sup> The three United Nations resident agencies were the World Health Organisation (WHO), United Nations Children's Fund (UNICEF) and United Nations Development Programme (UNDP).

at different levels of welfare. Table A6 in the appendix presents the raw differences across household expenditure quantiles for the pre-and post-Covid-19 samples. The table shows a negative correlation across the distribution. We therefore investigate the impact of Covid-19 lockdown and its anticipation on the distribution of household expenditure at different quantiles using the Quantile Treatment Effect (QTT) estimation technique proposed by Firpo (2007). A brief description of the QTT approach in the context of our analysis is provided below.

The QTT represents the differences in the marginal distributions of the potential treatment (post-Covid-19) and control (pre-Covid-19) outcomes between quantiles. Firpo (2007) invoked the above definition to estimate the QTT with an additional strong assumption of homogeneity of the treatment conditional on selected covariates. The relevant restriction imposed in the estimation by Firpo (2007) is the assumption that selection into the treatment is based on observable characteristics. The assumption is simply a re-statement of the exogeneity assumption based on the conditional independence assumption, which implies that the assignment of individuals to either the treatment or control group given a set of observables is random. The assumption is also known as the unconfoundedness assumption in the literature (Rubin, 1977) and is used to compute the conditional average treatment effects on the treated (ATT). A similar approach is applied in estimating the unconditional quantiles treatment on the treated (QTT) estimates.

We first estimate a model of the probability of a household being among the post-Covid-19 interviewed households based on the included set of observable variables relative to those in the pre-Covid-19 group. The observable characteristics included should be pre-determined and should not be affected by the Covid-19 lockdown measure but may be associated with household expenditure. The non-parametrically estimated propensity scores predict the

probability of a household being in the post-Covid-19 interview samples. The included covariates are similar to those used in the propensity score matching discussed in our principal methodology. Second, we consider the case of the QTT estimation in the context of the Comoros Covid-19 lockdown and its anticipation. Both treatment variables (Covid-19 lockdown impact and Covid-19 anticipation) are defined as a dummy taking the value 1 if a household is interviewed either post-Covid-19 lockdown or after the president’s address on Covid-19, and zero otherwise, respectively. Finally, we explore the impact of Covid-19 at different points of the household expenditure distribution. We focus on household expenditure as it provides an outcome that can be observed in understanding household welfare distribution.<sup>13</sup>

**Table 9: Quantile Treatment Effects using Log Per Capita Household Expenditure**

	10 <sup>th</sup>	20 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>
<b>Covid-19 Impact</b>	-0.044***	-0.057***	-0.053***	-0.055***	-0.077***
	(0.011)	(0.010)	(0.010)	(0.012)	(0.015)
<b>Observations</b>	28902	28902	28902	28902	28902
<b>Covid-19 Anticipation</b>	-0.042***	-0.056***	-0.064***	-0.065***	-0.089***
	(0.011)	(0.010)	(0.010)	(0.012)	(0.015)
<b>Observations</b>	28902	28902	28902	28902	28902

Note: Statistical significance: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

Controls in the treatment assignment equation: head of household age, education, and marital status; polygamous household; female-headed household; dependency ratio; the number of working-age individuals in the household; access to water, sanitation, and electricity; improved floor and roof; location (region and urban settlement)

Table 9 provides the estimated impacts. The first sets of results show a reduction in household expenditure across the different quantiles. Households in the bottom quantile had a 4.3% (i.e.,  $[e^{-0.044}-1] \times 100$ ) reduction in household expenditure due to the Covid-19 lockdown, with a similar pattern in the middle of the distribution. However, the negative impact observed is stronger for households in the upper distribution with a magnitude of 7.4% (i.e.,  $[e^{-0.077}-1] \times 100$ ) reduction. Thus, the effect of the Covid-19 lockdown is a reduction in household expenditure distribution with a more substantial impact at the top of the distribution. Similarly,

<sup>13</sup> A detailed guide and understanding of the estimation method of the QTT can be found in Firpo (2007). The approach is based on close work on semiparametric estimation of the ATE (see Hahn, 1998; Heckman, Ichimura, Smith, and Todd, 1998). The semiparametric efficiency bounds are estimated as an asymptotic variance of the QTT estimator (Newey, 1990; Bickel, Klaassen, Ritov, and Wellner, 1993).



the Covid-19 anticipation indicator also negatively impacts household expenditure across the distribution and the effect increases as we move up the household expenditure distribution, with an 8.5% (i.e.,  $[e^{-0.089}-1] \times 100$ ) reduction for the top quantile.

A final extensive analysis includes the disaggregation of some of our main estimates across urban and rural settlements. Our estimation technique follows the PSM approach. Our evaluation matches households within each settlement type (urban or rural) across treatment and control groups and the ATTs generated separately. The results in Table 10 showed a reduction in household expenditure for urban and rural households and an increase in objective poverty by 2.7 and 4.8 percentage points for urban and rural residents, respectively. Interestingly, the proportion of households self-reporting living well reduced by 4.8 percentage points for rural households but no changes for urban households. However, on average, urban households are reporting a higher reduction in self-reported welfare status by 7.8 percentage points.

**Table 10: Average Treatment Effect (ATT) of Covid on Household Welfare and Labour Market Outcomes – Urban and Rural Disaggregation**

	Urban	Rural
<b>Panel A: Household Indicators</b>		
Log expenditure per capita	-0.030*** (0.014)	-0.044*** (0.009)
<b>Panel B: Household Poverty Status</b>		
Objective Poverty: Poor	0.027*** (0.011)	0.048*** (0.009)
Subjective Poverty: I live well	-0.009 (0.012)	-0.048*** (0.008)
Subjective Poverty: I live poorly	0.005 (0.011)	-0.003 (0.008)
Subjective Poverty: I am rich	-0.078*** (0.013)	-0.050*** (0.008)
<b>Panel C: Labour Market Outcomes</b>		
Employed	-0.031*** (0.014)	-0.058*** (0.009)

Note: The observations across the treatment and control groups for each outcome vary in the estimation in accordance with the available data.

Robust standard errors in parentheses

\* p < 0.01, \*\* p < 0.05, \* p < 0.1

## 6. Conclusions

The ongoing research on Covid-19 has predominantly revolved around the macro-economic impact, labor market implications, and mitigating social aids or policies undertaken by developed countries. Yet, the pandemic and the associated lockdown measures were observed across developing and developed countries, regardless of the number of confirmed Covid-19 cases (Dunford et al., 2020). Although overall findings point to reduced economic growth at the macro level (see Alon et al., 2020), the lockdown policies have a potentially heterogeneous impact on countries' socio-economic and labor markets, providing dynamic outcomes from country to country.

This paper examines the impact of the Covid-19 pandemic on household expenditure, poverty status, asset ownership, and labor market outcomes for the Comoros, a small island developing country that was already grappling with a recent climatic shock to its economy. We use unique door-to-door household survey data collected during the Covid-19 outbreak in the Comoros, covering the pre-lockdown and post-lockdown periods. The data provide detailed information on household expenditure, asset count and monetary value, livestock ownership, and relevant household and individual labor market outcomes. In addition, the availability of other household and individual characteristics allowed us to address endogeneity concerns in the estimation of the effect of the national lockdown policy on the welfare of households in the Comoros.

We first evaluated the impact of the national lockdown implemented on March 23, 2020 by the Government of the Comoros on our welfare indicators and labor market outcomes. Then, we extended our analysis to evaluate the distributional impact on household expenditure. Our empirical research benefitted from descriptive analysis and causal estimation methods. Our empirical study found a negative effect of the national lockdown on household expenditure,

and an increase in the poverty rate. The impact is observed across the expenditure distribution with increasing magnitude at the top of the distribution. Thus, the findings suggests that poverty increased but inequality appeared to have declined. Households were also found to subjectively assess their living status as having experienced difficulties due to the pandemic. These results validate the argument that lockdown measures cause tremendous economic downturns.

Our estimation supports the argument that the mechanism of the impact of the Covid-19 lockdown on household welfare is driven by the breakdown in socio-economic activity and marketdisruption. Therefore, there is a need to look beyond expenditure or income levels to understand the implications of Covid-19 for households' living standards and poverty status, as well as its distributional impact. The evidence of socio-economic disruption of daily living activities can be assessed through the labor market consequences and the different coping mechanisms households employed during the Covid-19 pandemic to mitigate the unexpected loss in welfare.

Firstly, during the Covid-19 lockdown, there was a natural limitation on spending of household resources; the inability to spend on social functions or hospitality and non-food items was characteristic of the strict lockdown experienced in the Comoros. Nevertheless, the observed decline in household expenditure seems to have been driven by a decline in the share of people employed in a household and individuals in employment leading to a temporal shock in income. Our findings are in close comport with Simone et al. (2021) as their evaluation provides evidence of a negative impact of the Covid-19 lockdown on employment in Ghana. We did not find evidence of a change in working hours and total salary for those that remain employed. The loss of employment was mostly observed in the service and trade sectors, while there was

an increase in employment in agriculture. These results are complemented by the finding that rural households experienced larger declines in their welfare as compared to urban households.

Secondly, existing studies suggest that the Covid-19 pandemic may lead households to resort to unconventional coping mechanisms since the nature of the pandemic rendered typical coping mechanisms such as borrowing from family and friends difficult (see Gupta et al., 2021; Rönkkö et al., 2021). Since in developing studies assets are the equivalents of savings, it is important to examine the impact on assets. Our results showed a small decline in the count of assets and livestock and in the probability of asset ownership. The evidence thus indicates that the ability of households to use assets as a coping strategy may be limited in contexts such as Covid-19. Additionally, the substantial decline in current monetary value of assets may reflect households' perception of the reduced value of their assets in times of crisis.

Furthermore, the analysis also highlighted a pronounced negative impact within three months of the lockdown measure. There is some evidence of recovery post-three months, but welfare indicators remain below pre-lockdown levels. Our findings suggest that the pandemic's negative effect on the Comoros's household welfare status goes far beyond the immediate lockdown period and may be long lasting.

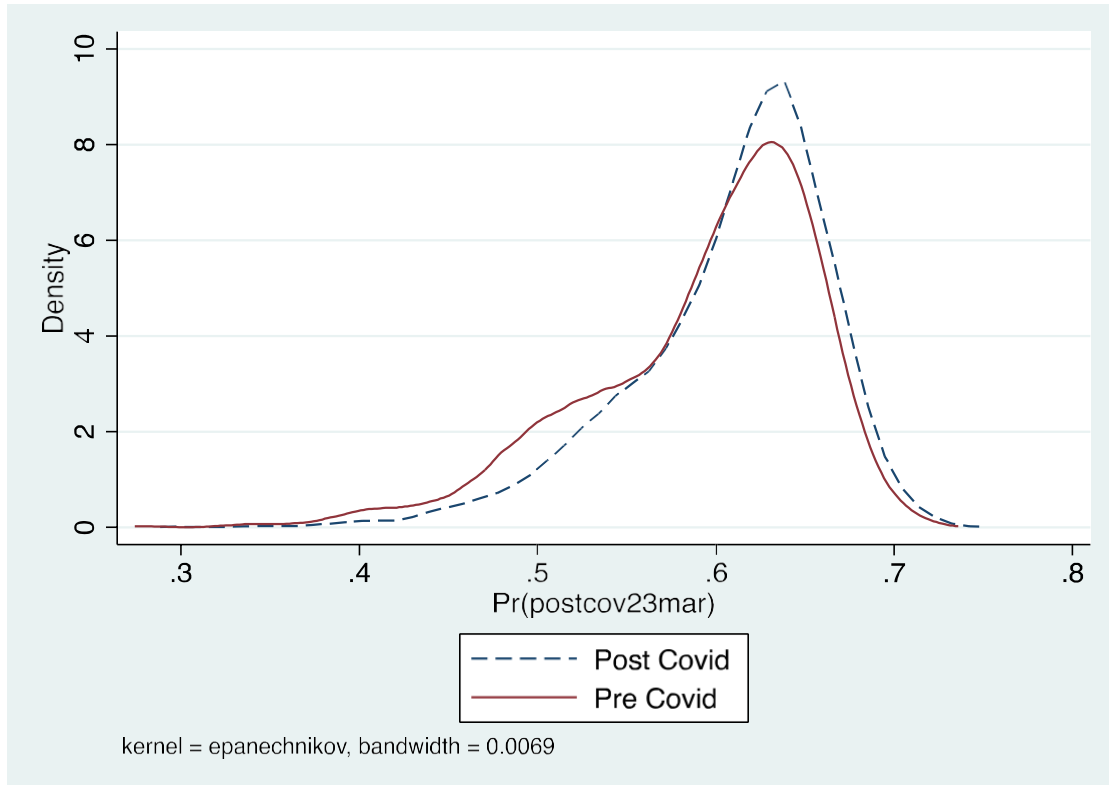
Our study contributes to the understanding of the micro-level impact of national lockdown policies during the Covid-19 pandemic on household welfare in a developing country context where direct impacts from Covid-19 cases may be low but the impacts from disruptions in economic activity may be large. Development is a holistic process, and an unprecedented shock from a disease outbreak can put pressure on the economic status and goals of developing

countries. Small island developing states are particularly vulnerable given their dependence on tourism and external trade. The cost-benefit approach to understanding the trade-off between pandemic curtailment and socio-economic consequences is vital in these cases. During the Covid-19 pandemic, developed and developing countries resorted to the same lockdown measures, regardless of the number of confirmed cases. However, the welfare policies enacted in developed countries like wage security and other income benefits for households are lacking in developing countries. The repercussions for the health sector, deaths, and the potential destruction of trust in governance are policy considerations when considering lockdown measures. Nevertheless, the trade-off between economic gains and managing such crisis can exacerbate vulnerability to poverty.

The pandemic not only stopped economic activities, but the overall outcome for the Comoros was a reduction in welfare and an increase in poverty and limited use of assets as a coping mechanism. In the absence of other possible welfare coping mechanisms when a household is hit by a shock, such as help from families and borrowing from banks or informal lending agents, government safety nets may have mitigated the impact. Our finding that the loss of employment was mostly observed in the service and trade sectors suggests that for small island states it is important to ensure that these safety nets are directed at all vulnerable households, not limited to only the poor. This is because vulnerability may be linked to economic sector. Therefore, while pro-poor policies remain important, mitigating the impacts for less poor households in vulnerable sectors will also be important to prevent their falling into poverty. This is an important policy implication that can also extend to disaster preparedness given the susceptibility to natural disasters of small island states. The limited availability of government safety nets and direct welfare-enhancing policies is likely to prolong the negative impact of the lockdown, with a slow recovery for the Comoros.

## Appendix

**Figure A1: The post-match distribution of propensity scores across treatment and control**



**Table A 1: Sample Distribution of individuals interviewed by Region and Lockdown Measure**

	FREQUENCY	PERCENT
<b>TOTAL PRE-COVID SAMPLE</b>	<b>11,712</b>	
<b>REGIONAL COMPOSITION:</b>		
MORONI	704	6.01
NGAZIDJA	5,715	48.8
NDZUWANI	4,476	38.22
MWALI	817	6.98
<b>TOTAL POST-COVID SAMPLE</b>	<b>17,480</b>	
<b>REGIONAL COMPOSITION:</b>		
MORONI	2,535	14.5
NGAZIDJA	6,851	39.19
NDZUWANI	7,277	41.63
MWALI	817	4.67

**Table A 2: Summary Statistics of Employment Distribution across the four main Sectors\***

<i>Employment Type</i>	<i>Freq.</i>	<i>Percent</i>	<i>Cum.</i>
<i>Agriculture and forestry</i>	3,148	33.93	33.93
<i>extractive activities</i>	52	0.56	34.49
<i>Manufacturing activities</i>	429	4.62	39.11
<i>Water, Electricity and Gas</i>	84	0.91	40.02
<i>Construction</i>	606	6.53	46.55
<i>Wholesale, retail and repair</i>	483	5.21	51.75
<i>Hotel and catering</i>	121	1.3	53.06
<i>Transport, auxiliary activities</i>	402	4.33	57.39
<i>Financial activities</i>	176	1.9	59.28
<i>Real estate, rentals and services</i>	70	0.75	60.04
<i>Public administration activities</i>	742	8	68.04
<i>Education</i>	856	9.23	77.26
<i>Health and social action activities</i>	148	1.59	78.86
<i>Sanitation, roads and waste management</i>	11	0.12	78.97
<i>Community activities</i>	72	0.78	79.75
<i>Recreational, and cultural</i>	18	0.19	79.94
<i>Personal service activities</i>	1,349	14.54	94.48
<i>Household activities as an employee</i>	474	5.11	99.59
<i>Activities of extraterritorial organizations</i>	38	0.41	100

Note: \*the main sectors are agriculture, Industry, Trade, and Service

**Table A3: Logit PSM Regression for Treatment Assignment**

VARIABLES	Main Analysis-Covid	Anticipation-Covid
Age of household head	0.030*** (0.006)	0.027*** (0.006)
Squared age of head of household	-0.000*** (0.000)	-0.000*** (0.000)
Education of head of household (primary)	-0.094* (0.050)	-0.036 (0.051)
Education of head of household (lower secondary)	-0.012 (0.054)	-0.077 (0.055)
Education of head of household (upper secondary)	-0.114* (0.065)	-0.181*** (0.066)
Education of head of household (tertiary)	-0.025 (0.054)	-0.100* (0.056)
Marital status head of household (married)	0.333*** (0.075)	0.441*** (0.076)
Marital status head of household (widowed)	0.298*** (0.101)	0.275*** (0.102)
Marital status head of household (divorced)	0.346*** (0.095)	0.338*** (0.096)
Polygamous household	-0.095* (0.057)	-0.124** (0.058)
Number of working-age individuals in household	-0.060*** (0.008)	-0.060*** (0.008)
Access to water	0.343*** (0.042)	0.358*** (0.042)
Access to sanitation	0.079*** (0.030)	0.118*** (0.031)
Access to electricity	0.012 (0.043)	0.084* (0.044)
Improved floor	0.005 (0.042)	0.002 (0.043)
Improved roof	0.594*** (0.160)	0.804*** (0.160)
Location (rest of Ngazidja)	-0.127* (0.071)	-0.242*** (0.073)
Location (Ndzuwani)	-0.091 (0.070)	-0.145** (0.072)
Location (Mwali)	-0.517*** (0.090)	-0.619*** (0.091)
Male	0.000 (0.029)	-0.004 (0.030)
Age	0.015*** (0.005)	0.014*** (0.005)
Squared Age	-0.000*** (0.000)	-0.000*** (0.000)
Education attainment (primary)	0.090* (0.053)	0.093* (0.055)
Education attainment (lower secondary)	0.079 (0.051)	0.111** (0.053)
Education attainment (upper secondary)	0.190*** (0.057)	0.166*** (0.059)
Education attainment (tertiary)	0.113* (0.058)	0.085 (0.059)
Marital status (married)	-0.081 (0.054)	-0.122** (0.055)
Marital status (widowed)	0.055 (0.105)	0.056 (0.108)
Marital status (divorced)	-0.072 (0.097)	-0.078 (0.099)
Urban Settlement Type	-0.385*** (0.035)	-0.356*** (0.036)
Constant	-1.334*** (0.233)	-1.279*** (0.235)
Observations	21,295	21,295

Standard errors in parentheses  
\*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1



**Table A4: Covariate Balancing Test Using Post-Covid Treatment Measure**

Variable	Treated	Control	%bias	t	p>t	V(C)
Age of Head of Household	47.98	47.88	0.70	0.57	0.57	1.01
Squared Age of Head of Household	2485.90	2474.80	0.80	0.63	0.53	1.00
Educ. Head of HH (Primary)	0.11	0.12	-1.40	-1.12	0.26	.
Educ. Head of HH (Lower Secondary)	0.10	0.10	-0.20	-0.19	0.85	.
Educ. Head of HH (Upper Secondary)	0.06	0.06	0.10	0.08	0.94	.
Educ. Head of HH (Tertiary)	0.12	0.12	0.60	0.47	0.64	.
Marital Status Head of HH (Married)	0.84	0.85	-1.60	-1.30	0.19	.
Marital Status Head of HH (Widowed)	0.05	0.05	0.80	0.66	0.51	.
Marital Status Head of HH (Divorced)	0.07	0.07	1.00	0.79	0.43	.
Polygamous Household	0.07	0.07	-0.90	-0.75	0.45	.
Share of working age in HH	3.62	3.66	-2.00	-1.65	0.10	0.98
Water Access	0.88	0.88	-0.20	-0.20	0.84	.
Sanitation Access	0.58	0.57	2.10	1.68	0.09	.
Electricity Access	0.85	0.85	0.40	0.33	0.74	.
Improved Floor	0.83	0.84	-0.20	-0.20	0.85	.
Improved Roof	0.99	0.99	-0.10	-0.06	0.96	.
Location (Rest of Ngazidja)	0.52	0.52	-1.50	-1.21	0.23	.
Location (Ndzuwani)	0.39	0.39	1.10	0.90	0.37	.
Location (Mwali)	0.04	0.04	-0.10	-0.08	0.94	.
Individual is Male	0.48	0.48	-0.20	-0.13	0.90	.
Age of Individual	33.60	33.39	1.10	0.89	0.37	1.00
Squared Age of Individual	1474.10	1461.70	0.80	0.64	0.52	1.01
Educ. Att. of Individual (Primary)	0.17	0.18	-1.00	-0.83	0.41	.
Educ. Att. of Individual (Lower Secondary)	0.19	0.20	-1.00	-0.80	0.42	.
Educ. Att. of Individual (Upper Secondary)	0.12	0.11	1.50	1.16	0.25	.
Educ. Att. of Individual (Tertiary)	0.11	0.11	1.10	0.89	0.37	.
Marital Status of Individual (Married)	0.46	0.46	-0.20	-0.13	0.90	.
Marital Status of Individual (Widowed)	0.04	0.03	1.30	1.03	0.30	.
Marital Status of Individual (Divorced)	0.04	0.04	0.60	0.47	0.64	.
Urban Settlement Type	0.29	0.30	-1.20	-1.00	0.32	.

Notes: \* 'of concern', i.e. variance ratio in [0.5, 0.8) or (1.25, 2];  
 \*\* 'bad', i.e. variance ratio < 0.5 or > 2

**Table A5: Covariate Balancing Test Using Post-Covid Treatment Measure- Covid Anticipation**

Variable	Treated	Control	%bias	t	p>t	V(C)
Age of Head of Household	47.86	47.87	0.00	-0.03	0.98	1.00
Squared Age of Head of Household	2474.20	2473.80	0.00	0.02	0.98	0.99
Educ. Head of HH (Primary)	0.12	0.12	-0.40	-0.32	0.75	.
Educ. Head of HH (Lower Secondary)	0.10	0.10	-1.20	-0.99	0.32	.
Educ. Head of HH (Upper Secondary)	0.06	0.06	-0.40	-0.31	0.76	.
Educ. Head of HH (Tertiary)	0.12	0.12	-0.40	-0.34	0.73	.
Marital Status Head of HH (Married)	0.84	0.84	0.00	0.01	0.99	.
Marital Status Head of HH (Widowed)	0.05	0.05	-0.80	-0.65	0.51	.
Marital Status Head of HH (Divorced)	0.07	0.07	0.00	-0.04	0.97	.
Polygamous Household	0.07	0.07	-1.10	-0.95	0.34	.
Share of working age in HH	3.62	3.65	-1.20	-1.05	0.29	1.00
Water Access	0.88	0.88	-0.20	-0.19	0.85	.
Sanitation Access	0.59	0.57	3.00	2.53	0.01	.
Electricity Access	0.85	0.85	0.80	0.67	0.51	.
Improved Floor	0.83	0.84	-0.50	-0.42	0.67	.
Improved Roof	0.99	0.99	-0.20	-0.25	0.80	.
Location (Rest of Ngazidja)	0.51	0.52	-2.50	-2.04	0.04	.
Location (Ndzuwani)	0.40	0.38	2.80	2.34	0.02	.
Location (Mwali)	0.04	0.05	-0.60	-0.59	0.56	.
Individual is Male	0.48	0.48	0.00	0.01	0.99	.
Age of Individual	33.53	33.45	0.40	0.37	0.71	1.00
Squared Age of Individual	1471.00	1465.00	0.40	0.32	0.75	1.02
Educ. Att. of Individual (Primary)	0.17	0.17	-0.20	-0.14	0.89	.
Educ. Att. of Individual (Lower Secondary)	0.20	0.20	-0.50	-0.44	0.66	.
Educ. Att. of Individual (Upper Secondary)	0.12	0.11	0.50	0.44	0.66	.
Educ. Att. of Individual (Tertiary)	0.11	0.11	0.00	0.04	0.97	.
Marital Status of Individual (Married)	0.46	0.46	-0.20	-0.21	0.84	.
Marital Status of Individual (Widowed)	0.04	0.04	0.70	0.62	0.54	.
Marital Status of Individual (Divorced)	0.04	0.04	-0.30	-0.27	0.79	.

Urban settlement Type	0.30	0.31	-2.20	-1.86	0.06
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Notes: \* 'of concern', i.e. variance ratio in [0.5, 0.8) or (1.25, 2];  
\*\* 'bad', i.e. variance ratio < 0.5 or > 2

**Table A6: Rubin's Balancing Property Diagnostics**

	Sample	Ps R2	LR chi2	p>chi2	Mean Bias	Med Bias	B	R	%Var
<b>Main Analysis</b>	Unmatched	0.03	67.78	0	4.8	4.3	40.6*	0.88	20
	Matched	0.00	20.74	0.90	0.90	0.90	5.70	0.99	0.00
<b>Covid Anticipation</b>	Unmatched	0.02	404.78	0.00	3.30	1.30	28.9*	0.80	100.00
	Matched	0.00	28.85	0.53	0.70	0.40	6.50	0.99	0.00

Note: \* B > 25%, R outside [0.5; 2]

**Table A7: Average Treatment Effect (ATT) of Covid on Selected Household Asset Types**

Household Asset Types	Main Impact	Anticipation
Phone	-0.031*** (0.004)	-0.026*** (0.004)
Television	0.013*** (0.007)	0.015*** (0.007)
Motocycle	-0.007*** (0.002)	-0.009*** (0.002)
Car	-0.019*** (0.003)	-0.013*** (0.004)
Bicycle	-0.007*** (0.001)	-0.004*** (0.001)
Radio	-0.045*** (0.006)	-0.032*** (0.006)
Furniture	-0.004 (0.003)	-0.000 (0.003)

Note: The observations across the treatment and control groups for each outcome vary in the estimation in accordance with the available data.  
Robust standard errors in parentheses  
\* p < 0.01, \*\* p < 0.05, \* p < 0.1

**Table A8: Raw Difference in the Log of Per Capita Household Expenditure between treatment and control by Quantiles**

Quantiles	Control	Treatment Covid-19	Difference
10 <sup>th</sup>	12.577 (0.008)	12.540 (0.006)	-0.037*** (0.010)
20 <sup>th</sup>	12.884 (0.008)	12.836 (0.006)	-0.047*** (0.010)
50 <sup>th</sup>	13.233 (0.007)	13.197 (0.006)	-0.036*** (0.009)
75 <sup>th</sup>	13.623 (0.008)	13.598 (0.007)	-0.025** (0.011)
90 <sup>th</sup>	14.015 (0.009)	13.988 (0.010)	-0.027** (0.013)

Note: Statistical significance: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1  
Difference" captures the raw difference between the post-Covid sample (treatment) and the pre-Covid sample (control).  
Standard errors in parenthesis

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