Impact of COVID-19 on Lesotho's Consumer Price Index: Evidence from Interrupted Time Series Analysis (ITSA)

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Abstract

This paper adopts Interrupted Time Series Analysis (ITSA) and monthly time series data from January 2017 to November 2020 to explore the impact of the March 2020 COVID-19 induced national lock down on Lesotho's Consumer Price Index (CPI) and selected sub-components. The baseline level for CPI during the pre-lockdown period was estimated at 4.61 per cent, per month, on average. The trend in CPI was positive in the post-intervention period and higher than the positive counterfactual trend by 0.002 per cent. The level of CPI declined by 0.004 per cent in the first month of the lockdown, owing to a fall in the level of the housing, water, electricity and gas price index, despite an increase in the food price index. The CPI's post-intervention trend averaged 0.006 per cent, supported by positive trends in all selected sub-components, the highest being the food price index, at 0.014 per cent. The study concludes that the impact of the COVID-19 lockdown was not large enough to result in a structural break in the long-term CPI series.

Keywords: Lesotho, Consumer price index, COVID-19, Time Series, ITSA

1. INTRODUCTION

COVID-19 has spread very quickly across and within countries, causing turmoil. Consequently, the World Health Organization (WHO) declared a global state of emergency and individual governments followed. The pandemic is having enormous pressure on governments around the world as health policy responses are being strengthened and measures including travel restrictions, border closures, manufacturing plants shutdowns, school closures, lockdown of countries and other social distancing measures to limit human contact, are being undertaken to contain the spread of the virus and the related potential overwhelming demand on health care systems. Economic lockdowns and requirements for people to stay at home have been adopted by many countries around the world. These measures disrupted economic activity and temporarily halted it in non-essential goods and services, affecting demand and supply of certain products, hence, prices. Looking at food, for example, economic lockdowns may have disrupted the food supply chain by creating shortage of workers and hindering the flow of inputs into production and produce to the market for sale. In addition, food exports restrictions by some countries in an effort to protect local supplies could have reduced food availability, particularly for import dependent countries. On the demand side, panic buying by consumers, which led to empty shelves in grocery stores (Bhattacharjee and Jahanshah 2020) could have resulted in a surge in demand. However, loss of jobs hence incomes as some companies struggled to continue with business could have caused consumption to contract. Panic behaviour due to fear of contagion could have discouraged or minimized visits to food markets. The initial closure of restaurants and lower traffic to maintain physical distancing as restrictions are slowly eased could have also reduced consumption. Closure of schools has resulted in a halt in school feeding programs in countries like Lesotho, thus reducing demand for food. These supply and demand forces present offsetting theoretical implications for food prices. On the one hand, the effect of supply disruption and demand surge could result in short-term food price inflation. On the other hand, low demand due to restricted movement could be expected to result in lower food prices.

Lesotho declared its first case of COVID-19 infection on 14th April 2020. However, a state of emergency was declared earlier in Lesotho on the 10th March 2020 as concerns mounted that exported cases could increase and cause an upsurge in domestic infections. These concerns were fuelled by the exponential increase in infection cases in neighbouring South Africa (SA). The declaration of the state of emergency was followed by a national lockdown from 29th March to 21st April, putting the economy to a standstill. The national lockdown was extended from 21st April to 5th May 2020. These policy responses manifested in disruptions to demand and supply, hence negative pressure on economic performances with dire consequences. A number of socio-economic interventions were announced by Lesotho’s Prime Minister following the implementation of lockdown and movement restrictions. These were aimed at minimizing the impact of COVID-19 and the lockdown, on specified groups of people and businesses. These measures were mainly in the form of cash payments to identified vulnerable groups of society as well as tax and license fees holidays for businesses. Collectively, they could have served to ease demand and supply pressures.

SA is Lesotho’s one and only neighbour. SA reported its first case of COVID-19 on 5 March 2020 and declared a national state of disaster on the 15th March 2020. On 26 March, the SA President announced a national lockdown, initially for 21 days, and extended it for another 14 days from 9 April. Easing of some restrictions began on 01 May and continued in the subsequent months with most normal activity being allowed from 21 September 2020. Apart from being a neighbour, SA is also the main source of Lesotho’s imports of goods and services. Following the implementation and enforcement of COVID-19 containment measures, Lesotho’s inflation rate, measured by the year-on-year percentage change in the Consumer Price Index (CPI), accelerated from 4.0 per cent in March 2020 to 5.9 per cent in September 2020. These developments challenge the assumption that any observable past patterns in the slope and trend of the CPI continue to exist in the period post the nationwide lockdown. The possibility of there being any significant shifts in the CPI’s pattern would necessitate an internalisation of these developments in any future analysis of the indicator (for e.g. modelling

CPI with consideration of the impact of outliers[1]) for purposes of informing formulation and implementation of monetary policy decisions.

The objective of this paper is to conduct a single-case experiment to evaluate the magnitude and rate of change of Lesotho's CPI and its sub-components – food and non-food price index - between January 2017 and November 2020, as a result of the COVID-19 induced nationwide lockdown on March 2020[2]. For this purpose, the study uses the Interrupted Time Series Analysis (ITSA) technique (Box and Tiao, 1965; Bower *et al.*, 1974; Glass *et al.*, 1975 and Box and Jenkins, 1976). The ITSA is sometimes known as quasi-experimental time series analysis. It is concerned with modelling the underlying process of time series data. It can be used to establish an underlying level and trend from a time series of interest. This level and trend is then 'interrupted' by an external intervention observed at an established point in time. A counterfactual is then created from a hypothetical scenario in which the intervention had not occurred and the pre-existing trend had been allowed to continue un-interrupted. This allows for a comparison between the counterfactual scenario and the developments in the post-intervention period (Cariappa *et al.*, 2020; Baicker and Svoronos, 2019; Beard *et al.*, 2019; Moon, 2018; Bernal *et al.*, 2017). In the context of our study, the ITSA provides a statistically efficient way to determine how the level and slope of the CPI has changed in Lesotho before and after the COVID-19 induced nationwide lockdown. The changes in the slope refer to discernible shifts in the direction of the CPI across phases (i.e. before lockdown and after lockdown) while changes in the series' level relate to average changes in its frequency from baseline behaviour (i.e. before lockdown). The study tests the hypothesis that the COVID-19 induced nationwide lockdowns of March 2020 led to a sizeable and immediate positive change in the level and gradient of the CPI trend that persisted in the post-intervention period.

The rest of this paper is organised as follows: Section 2 presents an overview of inflation developments in Lesotho. Section 3 provides the literature review. Section 4 discusses the data and methodology used in the study. Section 5 presents the results. Section 6 concludes and offers recommendations.

2. INFLATION DEVELOPMENTS IN LESOTHO

Table 1 presents the consumer price inflation rate, measured by the year-on-year percentage change in the CPI, between the first quarter of 2018 and third quarter of 2020. Inflation accelerated from 4.0 per cent in March 2020 to 5.9 per cent in September 2020. The main contributors to the increase in the inflation rate were Food and Non-alcoholic beverages, Health, Restaurants and Hotels. The increase in food inflation was a reflection of an escalation in food prices related to, among others, increased demand for essential goods, to ensure supplies during COVID-19 pandemic movement restriction and lockdown measures. The fall in Housing, electricity, gas & other fuels and transport categories moderated the acceleration in inflation. The fall in these components was mainly driven by the slump in fuel prices as the international

[1] According to Moon (2018), if a time-series has outliers that are not detected and explicitly incorporated into the univariate of multivariate model, this could bias the results of the model by distorting results of statistical tests and lead to misleading conclusions.

[2] The study assumes that the March 2020 nationwide lockdown is a completely external intervention. The nationwide lockdown was announced to take effect from the 29.03.2020 (12 AM).

crude oil prices plunged due to disruptions in supply and the fall in demand, as production and other economic activity declined due to COVID-19 containment measures.

Table 1: Consumer Price Inflation 2018 – 2020 (%)

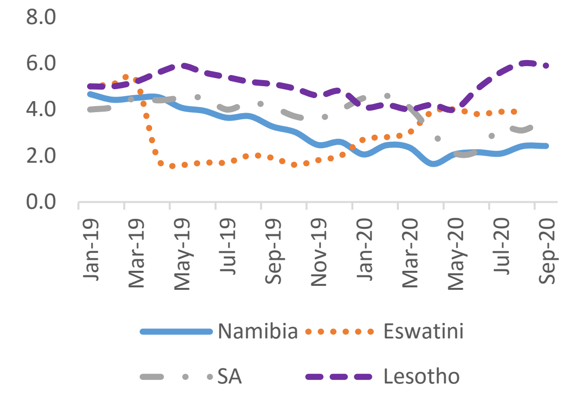
		2018				2019				2020		
	Weight	**Mar**	**Jun**	**Sep**	**Dec**	**Mar**	**Jun**	**Sep**	**Dec**	**Mar**	**Jun**	**Sep**
All Items	1000	4.8	4	5	4.9	5.2	5.6	5.1	4.8	4	4.9	5.9
Food and Non-Alcoholic Beverages	361.13	6.3	4.5	4.4	4.7	6.5	6.7	7.4	7.4	5.2	11.4	12.7
Alcoholic Beverages and Tobacco	33.31	5.7	6.3	6.3	4.4	4.9	4.9	5.2	4.1	2.8	4.7	4.6
Clothing and Footwear	130.57	1.5	1.7	2.3	2.7	3.5	3.6	3.8	4.4	3.9	4.2	3.6
Housing, Electricity, Gas & Other Fuels	123.97	7.4	7	12.4	11.8	8.3	10.5	7.5	3.3	4.6	-5.1	-3.2
Furniture, Households Equipment & Routine Maintenance	84.77	5	3.4	3.3	3.4	3.2	3	3.3	3.7	1.7	2.3	2.6
Health	15.04	0.3	0.8	1.1	1.1	1.2	0.7	0.7	1.1	1.5	2.7	3.9
Transport	48.21	-0.2	4.1	10.6	6.4	7.3	6.5	-1.4	0	4.8	-1	3.8
Communication	21.05	-1.6	-0.8	0	0	1.6	1.2	0.2	0.2	0.2	0.4	0.6
Leisure, Entertainment & Culture	57.08	5.4	4	4.4	5.6	5.4	4.8	3.3	5.1	3.1	3.5	3.4
Education	42	4.2	2.5	1.6	1.4	-0.1	1	1	1	4.1	4.1	4.1
Restaurants & Hotels	10.3	2.3	2.4	2	2.1	2.4	1.7	2.1	2.3	2.1	2.3	2.5
Miscellaneous Goods & Services	72.59	4.7	3	2.7	2.9	3	3.5	3.7	3.5	1.7	1.8	2.3

Source: Bureau of Statistics (BoS)

Figures 1 and 2, respectively, offer trends in Lesotho's monthly consumer price inflation and food price inflation relative to its partners in the Common Monetary Area[3] (CMA) between 2019M01 and 2020M09. Lesotho's inflation moved in line with inflation rates in other CMA countries, particularly Namibia and SA. However, the country's inflation rate was the highest during this period. It ranged from 4.2 per cent in April 2020 to 5.9 per cent in September 2020. In SA, the inflation rate rose from 3.0 per cent April 2020 to 3.6 per cent in September 2020, while Namibia's increased from 1.6 per cent to 2.4 per cent during the same period. Eswatini's inflation behaved rather differently from the other CMA countries. It was mostly flat during the April 2020 to September 2020 period. The rise in Lesotho's inflation rate is mostly attributable to the increase in food prices, a category that weighs the most in its CPI basket. Considering the Food and Non-alcoholic beverages category within the CPI baskets of the CMA countries, we observe an acceleration in Lesotho from 8.7 per cent in April 2020 to 12.7 per cent in September 2020. Namibia also displayed a similar trend though their inflation rate on this category was lower than Lesotho's at 4.2 per cent in April 2020 to 6.6 per cent in September 2020. In SA, the increase in prices in this category was mostly flat though tilted downwards during the April to September period.

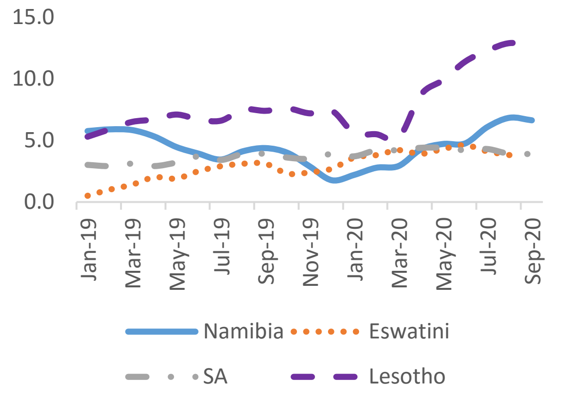
[3] Lesotho is a member of the Common Monetary Area (CMA) of Southern Africa with South Africa, Eswatini and Namibia.

Figure 1: Monthly Consumer Price Inflation in CMA - 2019M01 – 2020M09 - All Items (%)



Source: National Statistics Offices for Lesotho, Namibia and SA and Central Bank of Eswatini

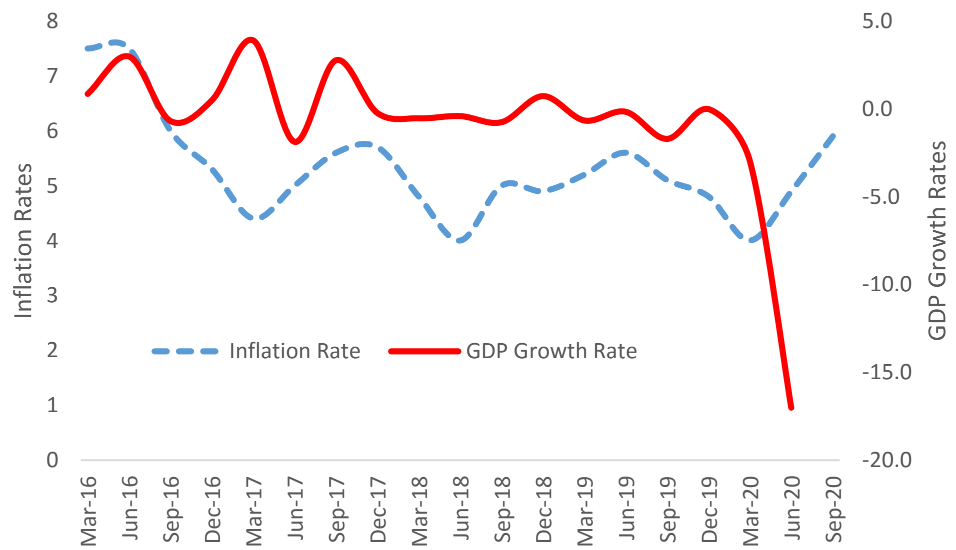
Figure 2: Monthly Food Price Inflation in CMA - 2019M01 – 2020M09 (%)



Source: National Statistics Offices for Lesotho, Namibia and SA and Central Bank of Eswatini

Figure 3 is a depiction of the relationship between quarterly consumer price inflation and real gross domestic product (GDP) from 2016Q1 to 2020Q3. During this period, the relationship between inflation and real economic growth rate has been mixed. There were periods when the rate of real GDP growth moved in the same direction as the inflation rate (June to September 2016) and periods when they moved in opposite directions (December 2016 to March 2017 and June 2020 to September 2020). However, periods of rising inflation were largely either matched or followed by moderation in GDP growth and vice versa. Time lags also play an important role in the pass through from inflation to GDP and often the impact is not instantaneous. Inflation affects economic growth with a significant lapse of time.

Figure 3: Quarterly Consumer Price Inflation and Real GDP Growth Rates 2016Q1 – 2020Q3 (%)



Source: Lesotho Bureau of Statistics

3. LITERATURE REVIEW

The two main schools of thought at the forefront of inflation studies that are suggested by the literature are the monetarists and structuralists (Adu and Marbuah, 2011 and Diouf, 2008). The monetarists relate inflation to demand-side factors emanating from expansionary fiscal and monetary policies. They subscribe to the view that inflation is mainly driven by excessive supply of money relative to demand. Nonetheless, they do not rule out the structural factors as determinants of inflation. Consequently, the monetary model of inflation is usually augmented with structural variables such as labour cost, import prices and real effective exchange rate (Boujelbene and Boujelbene, 2010).

Structuralist theories of inflation are based on the view that the major causes of inflation are structural imbalances in an economy (Dwivedi, 2005). These include food scarcity, resource imbalance, foreign exchange bottlenecks, infrastructural bottlenecks and social and political constraints. Akinboade *et. al.* (2004) identify the key structural bottlenecks that emit inflationary pressures as distortionary government policies, the conflicts between capitalists and workers over the distribution of income between profits and real wages, the inelastic supply of food stuffs, the foreign exchange constraint and the government budget constraint. Despite these, Bernanke (2005) argues that structuralism places emphasis on the supply-side determinants of inflation emanating from the increase in the costs of production. For example, inflationary financing of the budget deficit is a result of the struggle over the distribution of resources between the public and private sectors, hence the argument by structuralists that; "the factors that the orthodox view regards as the causes of inflation should rather be seen as symptoms of underlying structural rigidities in developing countries" (Akinboade *et. al.*, 2004).

The theoretical underpinnings notwithstanding, Reinsdorf (2020) underscores that the CPI, as a method for compiling an economic indicator of developments in consumer prices is not designed with due consideration to the possibility that a country's economic conditions could experience an overnight transformation. Economic lockdowns and associated COVID-19 infection control measures (stay at home, social distancing etc.) have created challenges for the compilation and interpretation of such statistical indices.

4. DATA AND METHODOLOGY

4.1 Data

This section provides a discussion on the data used in the study and its sources. The study makes use of monthly secondary time series data on Lesotho's overall consumer price index (CPI) (December 2016 - base year) and its respective sub-components, as sourced from the national Bureau of Statistics (BoS). Table 3 presents the study variables, their definitions as well as classifications (food and non-food). The components of food and non-food price index were chosen on the basis of their relative weights in the CPI basket. Technically, Bread and cereals together with Meat are classified under Food items. Maize meal, although also a food item, is a sub-component of Bread and cereals. The disaggregation of the food item component in this way is done purposefully to add granularity to the evaluation of the domestic consumer food price index and unmask any detail that might be hidden by aggregation, especially since food carries the biggest weight (348.519) in the overall CPI basket. Given that the data is of a high frequency (monthly), it is seasonally adjusted using the STL decomposition[4] method in EViews 11. If the data is not seasonally adjusted, the uneven distribution of months before and after the external intervention could lead to biased results. The seasonal adjustment also helps to eliminate any possible autocorrelation in the series. The variables used in the analysis are expressed in logarithm terms. This is done to induce stationarity and normality in the data and also to allow for interpretation of model coefficients as rates (Beard *et al*, 2019).

Table 3: Study Variables

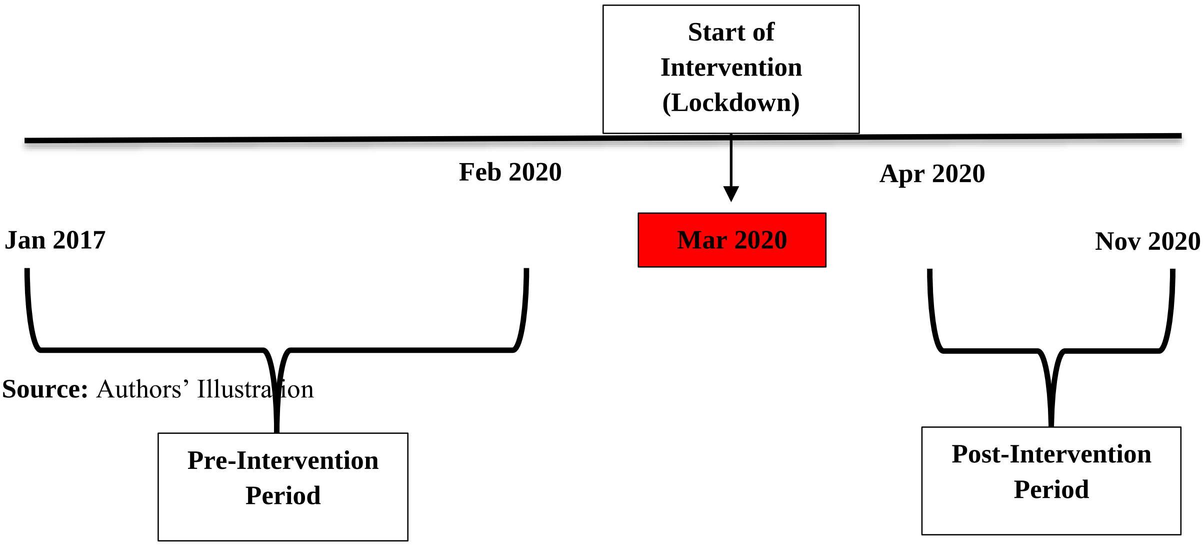
Classification	Name of Variable	Notation in study	Weight in CPI Basket
	Consumer Price Index	l_cpi_sa	1000
Food	Food Price Index	l_foodcpi_sa	348.519
	Bread and cereals Price Index	l_bread_cereal_sa	138.356
	Maize meal Price Index	l_maizemeal_sa	68.534
	Meat Price Index	l_meat_sa	49.044
Non-Food	Clothing and Footwear Price Index	l_clothing_sa	130.571
	Housing, Water, Electricity & Gas Price Index	l_housing_sa	123.969

Source: Bureau of Statistics (BoS).

Bernal *et al.* (2017) explain that the study methodology (i.e. ITSA) works best with outcomes that are short-term and expected to change either relatively quickly in the wake of the intervention, or after a well-defined lag. According to Fretheim *et al.* (2015) and Ramsay *et al* (2003), irrespective of the statistical analysis used, in order to have meaningful results, there should be at least ≥ 3 time points (preferably ≥ 6) before and after the intervention, with the intervention occurring at a clearly defined time. The study timeline is in months. It starts from January 2017 to November 2020. Figure 4 offers a representation of the timeline, reflecting March 2020 as the month of the external intervention (the pandemic induced nationwide lockdown). The rest of the timeline comprises the *pre-intervention period* and the *post-intervention period*, respectively. The sample size (N=47) is selected on the basis of data availability and the assumption that no other significant event could have affected CPI movements in that period (the problem of confounding events). Long event study timelines are discouraged since they can undermine the power of the test statistic and lead to false inferences. Moreover, long timelines can increase the likelihood of contemporaneous and inter-temporal correlations of residuals which can underestimate standard errors (Damane, 2019; Rani *et al.*, 2016 and Linden, 2015).

[4] STL decomposition is a seasonal adjustment method that decomposes a series into seasonal, trend and remainder components using a filtering algorithm based upon LOESS regressions. It has two main advantages over other seasonal adjustment methods; it works on any frequency of data, and can be calculated on time series data with irregular patterns and missing values (EViews, 2021).

Figure 4: The Study Timeline in Months



Source: Authors' Illustration

4.2 Methodology

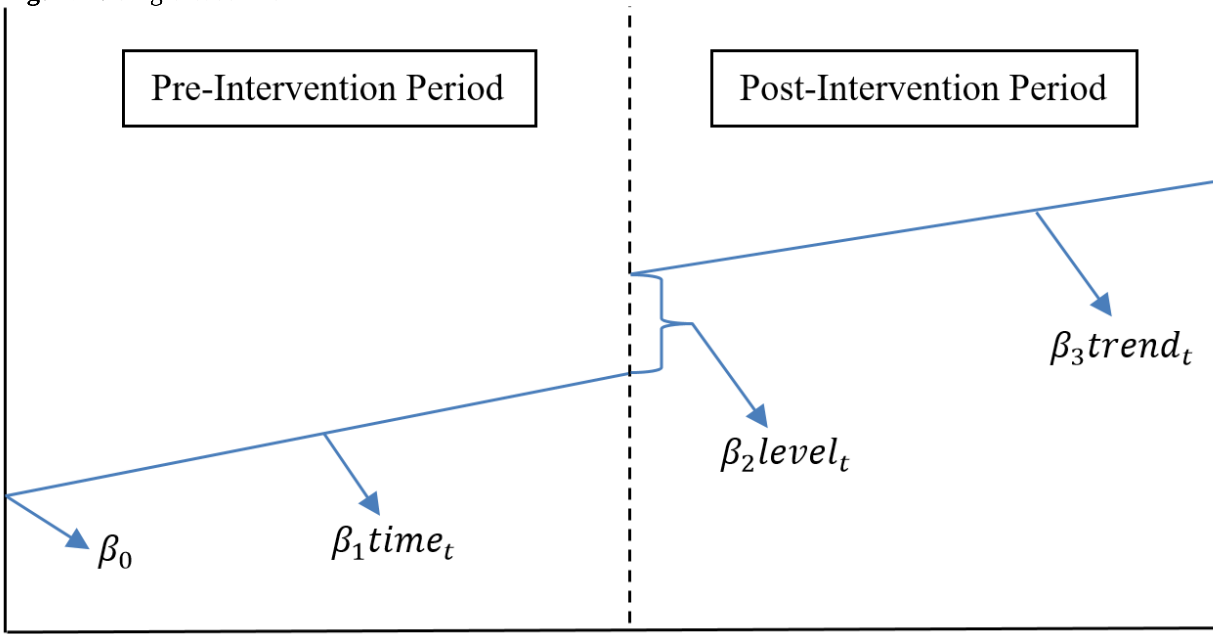
This section provides a discussion on the Interrupted Time Series Analysis (ITSA) technique and how it will be used in the study. The ITSA can be traced to the work of Box and Tiao (1965); Bower *et al.*, (1974); Glass *et al.* (1975) and Box and Jenkins (1976). It is a statistical tool for examining the effects of external interventions in single and/or multiple-case study designs. It is a form of univariate time series analysis that evaluates temporally ordered scores (observations) to determine if, for example, policy intervention; experimental manipulation; clinical intervention or a random occurrence have resulted in a discernible and reliable change in the slope and trend properties of the observations.

The ITSA has four key strengths. First, it is a special case of ARIMA that can be used to evaluate the effects of an external intervention on a series if the results of a unit root test reveal that a series contains a stochastic trend component and requires differencing. In this case, the ITSA performs as a step function, wherein the intervention term takes on the value of zero for all observations in the pre-intervention period, and the value of one, for all observations from the onset of the intervention. Second, it has the ability to model the structure of the stochastic components of time series observations and subtract the systemic part of the error from each observation. In this way, it develops scores (residuals) that contain no serial dependency. This enables the credible use of significance tests in the evaluation of changes in the behaviour of single unit observations from one phase to another. Third, the technique is generally robust to typical confounding effects that are assumed to evolve slowly over time (for e.g. population age distribution and socioeconomic status). Fourth, it does not require any fixed limits with respect to the number of data points needed for the technique to be implemented. Its power depends on other factors such as the distribution of the data points before and after the intervention, the variability within the data, the strength of the external intervention's effect and the presence of fast moving confounding effects (for e.g. seasonality). A notable limitation of the ITSA is that is only able to evaluate associations at a series' temporal granularity. That is, if the data are monthly, it only assesses the month by month changes. The implication is that there is a chance of dissimilarities in the associations, if the temporal nature of the data is changed (i.e. monthly vs. annually). (Cariappa *et al.*, 2020; Moon, 2018; Bernal *et al.*, 2017; Harrington and Velicer, 2015; Kim *et al.*, 2015; Linden, 2015; Crosbie, 1993; Hartmann *et al.*, 1980; Bower *et al.*, 1974 and Glass *et al.*, 1975). The standard ITSA regression model for single-case study designs is presented in equation 1. According to Bernal *et al.* (2017), an ITSA requires a minimum of three variables:

$$Y_t = \beta_0 + \beta_1 time_t + \beta_2 level_t + \beta_3 trend_t + \varepsilon_t \qquad (1)$$

where Y is the aggregated outcome variable (i.e. the relevant price index) measured at each equally spaced time point (i.e. monthly); β_0 is the intercept, or the price index at baseline level, at time $t = 0$. It shows the starting point of the outcome variable. β_1 is the slope or trend during the pre-intervention period. It can be interpreted as the change in outcome associated with a unit increase in the time unit, pre-intervention (Bernal *et al.*, 2017). The β_2 parameter captures the series' immediate level change in the post-intervention period (relative to the counterfactual baseline in the pre-intervention period). The β_3 parameter reflects the difference between the pre-intervention and post-intervention slopes; ε_t is the error term, that captures the variability not explained by the model. Model 1 assumes that the nationwide lockdown of March 2020 is a completely exogenous shock, one whose impact will be captured by the parameters; β_2 and β_3. Significant p-values in β_2 reflect the immediate treatment effect (lockdown) while those associated with β_3 indicate the intervention's effect over time (Linden, 2015). A graphical illustration of the single-case experiment and the respective parameters under the ITSA, is provided in Figure 4.

Figure 4: Single-case ITSA



Source: Linden and Adams (2011).

The technique only requires a variable's statistical information and structure of past values. It assumes that the past trend in the time-series, continues to the present day. That is, the trend in the pre-intervention period is stable and slow moving so that any sharp jump in the series due to the external intervention can be distinguished. (Cariappa *et al.*, 2020; Baicker and Svoronos, 2019; Moon, 2018; Bernal *et al.*, 2017; Harrington and Velicer, 2015; Kim *et al.*, 2015; Linden, 2015; Crosbie, 1993 and Hartmann *et al.*, 1980). Computationally, the technique is executed in four steps:

- **a.** Estimate the univariate OLS model and assess the pattern of autocorrelations and partial autocorrelations. This is done to determine the number of autoregressive, moving average and differenced parameters to most accurately explain the data.
- **b.** Determine the least squares estimates of the autoregressive and moving average parameters
- **c.** Subtract terms based on the estimated autoregressive and moving average parameters from the original scores to remove the autocorrelation
- **d.** Use the General Linear Model (GLM) and associated *t* tests to determine whether the uncorrelated post-intervention scores differ significantly in slope and level from the uncorrelated pre-intervention scores.

According to Baicker and Svoronos (2019), the validity of the ITSA lies on the following three assumptions: (i) the pre-intervention level and trend would have the same expectation irrespective of whether the sample received an intervention; (ii) the post-intervention trend line would have been equivalent in expectation to an expectation of an extrapolated pre-intervention trend, in the absence of the intervention and (iii) the pre and post periods time trends can be expressed as a linear combination of parameters.

The literature mentions possible alternatives to the ITSA. These include multiple regression, multivariable time-series analysis, Randomized control trials (RCTs), visual analysis of graphical displays and the Analysis of variance (ANOVA). Multiple regression offers a way to develop a causality analysis between the dependent variable and a set of independent covariates. The method is hampered by the impracticality of isolating and incorporating all the factors that affect the dependant variable into a model. Although theory can be leveraged to identify some factors, they are hardly exhaustive and their impact on the dependent variable is likely to vary with time, leading to possible errors in credibly explaining developments in the dependent variable. Multivariate time-series analysis involves the use multiple independent variables in a vector autoregressive (VAR) setting. A major shortcoming of using such models is that their results are often biased by the model builder's discretion in choosing the study variables, lag length and the ordering of variables in the model. Although Randomized control trials (RCTs) are considered the gold standard design for assessing the impact of an external intervention on a target unit/case, these forms of experiments are not always possible, due to their cumbersome nature. They also attract ideological and ethical criticisms coupled with exorbitant costs. This often leads to a bias in disseminated results (Cariappa *et al.*, 2020; Moon, 2018; Bernal *et al.*, 2017; Harrington and Velicer, 2015; Kim *et al.*, 2015; Linden, 2015 and Crosbie, 1993).

When the effects of the external intervention on a time series are small or difficult to detect by the naked eye, yet statistically significant, the visual analysis of graphical displays faces challenges. This means the baseline trends or cycles are not easily distinguished from the changes brought about by an external intervention. Similarly, the use of the ANOVA or *t* test to assess changes in single subject data is often criticised because the technique cannot accommodate violation of the independent observations assumption. This renders the independent groups *t* test, which calculates the *t* statistic from the difference in the group means divided by the error variance, vulnerable to the presence of autocorrelation. Positive autocorrelation (i.e. when scores are more similar to each other, than the mean) results in an artificially deflated error variance, leading to an inflated value of the *t* statistic. Conversely, negative autocorrelation (i.e. when scores are more dissimilar to each other, than the mean) inflates the error variance and artificially deflates the *t* statistic. If the independence of successive observations is not addressed, this can lead to a bias in all conventional tests of significance and thus a high likelihood of Type I or Type II error (Cariappa *et al.*, 2020; Moon, 2018; Bernal *et al.*, 2017; Harrington and Velicer, 2015; Kim *et al.*, 2015 and Linden, 2015).

The single-case ITSA technique is used to evaluate change within Lesotho's consumer price index and its sub-components – food and non-food price index. The study's sample size of 47[5] (January 2017 to November 2020) is suitable for the use of ITSA in our experiment. The experiment shall establish a stable baseline (counterfactual) in a pre-intervention period (before the nation-wide lockdown of March 2020), for comparison with subsequent phases (i.e. post-intervention period). In a similar way to Cariappa *et al.* (2020), the coefficients of equation 1 are estimated with the use of the STATA package; 'itsa', as advanced by Linden (2015).

[5] Although the ITSA does not prescribe any fixed limits regarding the number of data points, it is advised that the most ideal sample size for single-case studies based on time series data is 40 observations and above (Harrington and Velicer, 2015 and Bernal *et al.*, 2017).

STATA's 'itsa' package provides users with two OLS regression based models for evaluating changes in single and/or multiple-case study design. The first model (ITSA – Newey) uses OLS regression to produce Newey-West standard errors to handle autocorrelation and possible heteroskedasticity in the series. The selection of suitable lag length as well as the tests for autocorrelation in the model are performed with STATA's 'actest' package[6] (advanced by Baum and Schaffer, 2013). The second model (ITSA - Prais) runs the 'itsa' command with the Prais-Winsten and Cochrane-Orcutt regression, which uses the generalized least squares method to estimate the parameters of equation 1. It does so with the assumption that the errors follow an AR(1) process. In our study, the ITSA – Newey model is used as the main assessment tool in our study. The results of the ITSA – Prais model are used for purposes of robustness.

5. DATA ANALYSIS AND INTERPRETATION

This section offers a discussion on the analysis of the data. It is divided into three sections, namely: descriptive analysis, results of unit root tests and lastly, evidence from the ITSA model.

5.1 Descriptive Analysis

As is the case with all statistical analyses, the first step entails the development of initial summary statistics and plots. The advantage of this exercise Appendix A1 presents scatter plots of the study variables. Each of the plots is fitted with a trend line and all the lines reflect positive slopes. Visually, all the series except for; (l_maizemeal, l_maizemeal_sa) and (l_bread_cereal, l_bread_cereal_sa), show negligible differences between respective pairs of series. Appendix A2 provides the summary statistics. Initial evidence suggests that all price indices are normally distributed, with minimum deviation from their respective means. All the indices were positively skewed, expect for the meat price index (l_meat_sa) and the housing, clothing, electricity and gas price index (l_housing_sa), which were both moderately negatively skewed. Positive skewness' implies that the series' distribution tails are longer on the right side. According to Cariappa *et al.* (2020) and Sendhil *et al.* (2019), this feature is a typical trait of high frequency data and denotes that the price indices were clustered around their respective means (left side) with very few of the observations on the right hand side (i.e. greater than the mean).

5.2 Results of Unit Root Tests

Chatfield (2004) and Wooldridge (2015) underscore that knowledge of the presence of a unit root in a series is important since it informs how the underlying trend of the series should be modelled. It also provides information on the extent (degree) of persistence in the output variable. Common tests for unit roots, such as the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller,1981) and the Phillips and Perron (PP) test (Phillip and Perron, 1988) have received criticism due to their bias towards non-rejection of null hypothesis of a unit root when compared to an alternative hypothesis of (trend) stationarity in the presence of a structural break (Baicker and Svoronos, 2019). In light of this, our study makes use of two-unit root tests that incorporate a structural break component and a possible shift in regime. These are (i) Break-Point (BP) unit root test (Perron, 1997). and (ii) Zivot-Andrews (ZA) unit root test (Zivot and Andrews, 1992). Both tests are further made suitable for our study by their ability to explore

[6] The 'actest' package uses the Cumby and Huizinga (1992) general autocorrelation test.

structural breaks within the sample period. The breakpoint in the ZA test is selected as the *t*-statistic on the coefficient of the autoregressive variable and tests whether the null of a unit root is the most negative. Conversely, the BP test selects the breakpoint at either the absolute value of the *t*-statistic of the autoregressive variable's coefficient, or at a point where the slope of the break term is maximized (Baicker and Svoronos, 2019 and Ruslan and Mokhtar, 2020). If the tests for a structural break point to a break in the data at any point other than the predetermined intervention point (i.e. March 2020), the implication could be that a different event took place within the study window and its impact could be more significant than that of the intervention of interest.

The results of the BP and ZA unit root tests are presented in Tables 4 and 5, respectively. The unit root tests generally reveal that the variables, were non-stationary both in the trend and intercept. With regard to structural breaks, both tests reveal that breaks in the variables existed in either the intercept or the intercept and trend. According to Ruslan and Mokhtar (2020), a break in the intercept can represent a one-time change in the level of a series, while a break in the intercept and trend shows a combined change in the series' level and the slope of its trend function. Notably, most breaks were identified in the first to second quarter of 2020. The finding provides further impetus of the study's objectives, to evaluate the extent to which the March 2020 national lockdown poses a statistically significant and sizeable structural break in the CPI series. The presence of a unit root makes the ITSA particularly useful, since it is a special form of ARIMA that can account for the series autocorrelation and possible heteroscedasticity (Linden, 2015).

Table 4: Results of BP Unit Root Test

Variable	Intercept	Critical Value 1%	5%	10%	Month of Break	Variable	Intercept & Trend	Critical Value 1%	5%	10%	Month of Break
l_cpi_sa	-1.09	-4.95	-4.44	-4.19	2020M04	l_cpi_sa	-4.55	-5.72	-5.18	-4.89	2019M12
l_foodcpi_sa	-2.01	-4.95	-4.44	-4.19	2020M03	l_foodcpi_sa	-5.80***	-5.72	-5.18	-4.89	2019M02
l_bread_cereal_sa	-0.24	-4.95	-4.44	-4.19	2020M03	l_bread_cereal_sa	-2.03	-5.72	-5.18	-4.89	2018M02
l_maizemeal_sa	-0.32	-4.95	-4.44	-4.19	2018M08	l_maizemeal_sa	-3.81	-5.72	-5.18	-4.89	2018M03
l_meat_sa	-4.44**	-4.95	-4.44	-4.19	2020M02	l_meat_sa	-4.12	-5.72	-5.18	-4.89	2018M08
l_clothing_sa	-1.43	-4.95	-4.44	-4.19	2018M07	l_clothing_sa	-2.85	-5.72	-5.18	-4.89	2017M11
l_housing_sa	-3.37	-4.95	-4.44	-4.19	2017M11	l_housing_sa	-4.26	-5.72	-5.18	-4.89	2019M03.

Note: ***, ** and * denote that a series is stationary at 1%, 5% and 10% level of significance, respectively.

Table 5: Results of ZA Unit Root Test

Variable	Intercept	Critical Value 1%	5%	10%	Month of Break	Variable	Intercept & Trend	Critical Value 1%	5%	10%	Month of Break
l_cpi_sa	-4.45	-5.34	-4.80	-4.58	2020M06	l_cpi_sa	-4.62	-5.57	-5.08	-4.82	2020M01
l_foodcpi_sa	-6.29***	-5.34	-4.80	-4.58	2020M04	l_foodcpi_sa	-3.89	-5.57	-5.08	-4.82	2020M01
l_bread_cereal_sa	-3.39	-5.34	-4.80	-4.58	2020M04	l_bread_cereal_sa	-2.07	-5.57	-5.08	-4.82	2018M02
l_maizemeal_sa	-2.35	-5.34	-4.80	-4.58	2017M08	l_maizemeal_sa	-3.87	-5.57	-5.08	-4.82	2018M04
l_meat_sa	-4.17	-5.34	-4.80	-4.58	2017M07	l_meat_sa	-4.14	-5.57	-5.08	-4.82	2017M09
l_clothing_sa	-3.10	-5.34	-4.80	-4.58	2019M09	l_clothing_sa	-2.89	-5.57	-5.08	-4.82	2017M12
l_housing_sa	-3.89	-5.34	-4.80	-4.58	2020M04	l_housing_sa	4.32	-5.57	-5.08	-4.82	2019M04

Note: ***, ** and * denote that a series is stationary at 1%, 5% and 10% level of significance, respectively.

5.3 Evidence from ITSA model[7]

This section captures the impact of the March 2020 COVID-19 induced nationwide lockdown on Lesotho's consumer price index and selected sub-components, using the ITSA technique. The discussion is divided into two sub-sections. The first presents ITSA-Newey model results, with respect to each of the seven price indices considered in the study. The second section offers robustness checks in the form of results from seven corresponding ITSA-Prais models.

a. ITSA – Newey Results

Model A1: The impact of lockdown on consumer price index

The single group ITSA – Newey results with respect to the seasonally adjusted natural log of monthly consumer price index (CPI) are presented in Table 6.

Table 6: ITSA – Newey results of lockdown impact **(l_cpi_sa)**

```
Regression with Newey-West standard errors          Number of obs     =        47
maximum lag: 1                                      F(  3,        43) =   2891.52
                                                    Prob > F          =    0.0000

------------------------------------------------------------------------------
             |             Newey-West
    l_cpi_sa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          _t |   .0039647   .0000579    68.51   0.000      .003848    .0040814
 _xmarch2020 |  -.0042533   .0018709    -2.27   0.028    -.0080262   -.0004803
_x_tmarch2020 |   .0019621   .0003936     4.98   0.000     .0011683    .0027558
       _cons |   4.613072   .0013934  3310.58   0.000     4.610262    4.615883
------------------------------------------------------------------------------


                   Postintervention Linear Trend: march2020

Treated: _b[_t]+_b[_x_t722]
------------------------------------------------------------------------------
Linear Trend |      Coeff    Std. Err.      t       P>|t|    [95% Conf. Interval]
-------------+----------------------------------------------------------------
   Treated   |      0.0059   0.0004     15.2532    0.0000     0.0051     0.0067
------------------------------------------------------------------------------
```

Note: Maximum lag length is chosen following an evaluation of suitable lag length using the STATA's 'actest' package (Baum and Schaffer, 2013).

The starting level of the CPI was estimated at approximately 4.61 per cent. The index experienced a statistically significant increase of 0.004 per cent every month, on average, prior

[7] The STATA command used in the study can be found in appendix A4. To recreate the study, one would also need access to study data set 'CovidPrice_cpi.dta', which can be made available on request.

to the March 2020 intervention (P = 0.000, CI = [0.0038, 0.0041]). In the first month of the national lockdown (i.e. March 2020), the CPI declined by a statistically significant magnitude of 0.004 per cent (P = 0.02, CI = [-0.008, -0.0004]). This was followed by an increase of 0.002 per cent in the monthly CPI trend (compared to the pre-lockdown trend) (P = 0.000, CI = [0.001, 0.003]). When the post -intervention trend is considered, the CPI increased at a statistically significant average rate of 0.006 per cent, per month, since March 2020 (P = 0.000, CI = [0.005, 0.007]). A graphical depiction of the results is presented in Appendix A3. The results of the STATA 'actest' (Baum and Schaffer, 2013) test for the presence of autocorrelation, is available upon request. It shows that the estimated model adequately accounts for the autocorrelation in the data.

Model A2: The impact of lockdown on food price index

The single group ITSA – Newey results of the lockdown's impact on the seasonally adjusted natural log of the monthly food price index are presented in Table 7.

Table 7: ITSA – Newey results of lockdown impact **(l_foodcpi_sa)**

```
Regression with Newey-West standard errors      Number of obs     =        47
maximum lag: 1                                  F(  3,        43) =   1340.56
                                                Prob > F          =    0.0000

------------------------------------------------------------------------------
             |             Newey-West
l_foodcpi_sa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          _t |   .0048968   .0001257    38.94   0.000     .0046432    .0051504
 _xmarch2020 |   .0149601   .0084461     1.77   0.084    -.0020731    .0319934
_x_tmarch2020 |     .00881   .0015586     5.65   0.000     .0056668    .0119532
       _cons |   4.610882   .0028715  1605.73   0.000     4.605091    4.616673
------------------------------------------------------------------------------


                    Postintervention Linear Trend: march2020

Treated: _b[_t]+_b[_x_t722]
------------------------------------------------------------------------------
Linear Trend |      Coeff    Std. Err.      t       P>|t|    [95% Conf. Interval]
-------------+----------------------------------------------------------------
   Treated   |     0.0137    0.0015     8.8625    0.0000     0.0106    0.0168
------------------------------------------------------------------------------
```

Note: Maximum lag length is chosen following an evaluation of suitable lag length using the STATA's 'actest' package (Baum and Schaffer, 2013).

The food price index experienced a statistically significant increase of approximately 0.005 per cent every month, on average, prior to the March 2020 intervention (P = 0.000, CI = [0.0046, 0.0051]). This result was 0.001 per cent higher than the average increase in overall CPI estimated during the same period. Contrary to the decline in the CPI in the first month of the national lockdown (i.e. March 2020), the food price index increased by a statistically significant

0.015 per cent (P = 0.084, CI = [-0.002, 0.032]) during the same period. This was followed by an increase of 0.009 per cent in the monthly trend (compared to the pre-lockdown trend) (P = 0.000, CI = [0.006, 0.012]). The post -intervention trend increased at a statistically significant average rate of 0.014 per cent, per month, since March 2020 (P = 0.000, CI = [-0.011, 0.017]), relative to the 0.006 per cent upward trend in CPI in the same period. A graphical depiction of the results is presented in Appendix A3. Results of the test for autocorrelation are available upon request. They show that the estimated AR(1) model is an adequate account for the autocorrelation in the data.

Model A3: The impact of lockdown on bread cereal price index

The results of the single group ITSA – Newey, with respect to the seasonally adjusted natural log of monthly bread and cereals price index are presented in Table 8.

Table 8: ITSA – Newey results of lockdown impact **(l_bread_cereal_sa)**

```
Regression with Newey-West standard errors      Number of obs     =        47
maximum lag: 2                                  F(  3,        43) =    296.24
                                                Prob > F          =    0.0000

-------------------------------------------------------------------------------
                |             Newey-West
l_bread_cereal_sa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+-----------------------------------------------------------------
          _t   |   .0048197   .0005911     8.15   0.000     .0036278    .0060117
   _xmarch2020 |   .0412944   .0176981     2.33   0.024     .0056027     .076986
 _x_tmarch2020 |   .0133723   .0019949     6.70   0.000     .0093492    .0173954
       _cons   |   4.577585    .013879   329.82   0.000     4.549595    4.605575
-------------------------------------------------------------------------------


                    Postintervention Linear Trend: March 2020

Treated: _b[_t]+_b[_x_t722]
-------------------------------------------------------------------------------
Linear Trend |      Coeff   Std. Err.      t       P>|t|     [95% Conf. Interval]
-------------+-----------------------------------------------------------------
   Treated   |      0.0182   0.0020     9.2116    0.0000      0.0142    0.0222
-------------------------------------------------------------------------------
```

Note: Maximum lag length is chosen following an evaluation of suitable lag length using the STATA's 'actest' package (Baum and Schaffer, 2013).

The bread and cereals price index measures price developments in the biggest sub-component of the food price index. During the first month of the lockdown, it increased by a statistically significant level of 0.041 per cent (P = 0.024, CI = [0.056, 0.076]), which was 0.026 per cent higher than the level increase in the food price index during the same time. The monthly post-intervention trend in the index increased by approximately 0.013 per cent (P = 0.000, CI = [0.009, 0.018]). Evidence from tests of autocorrelation (available upon request) reflects that the model accounted for the autocorrelation in the series.

Model A4: The impact of lockdown on maize meal price index

The maize meal price index is the biggest sub-component of the bread and cereals price index. The results of the single group ITSA – Newey model, with respect to the seasonally adjusted natural log of monthly maize meal price index are presented in Table 9.

Table 9: ITSA – Newey results of lockdown impact **(l_maizemeal_sa)**

```
Regression with Newey-West standard errors          Number of obs     =        47
maximum lag: 2                                      F(  3,         43) =    251.25
                                                    Prob > F          =    0.0000

------------------------------------------------------------------------------
                   |             Newey-West
l_maizemeal_sa     |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
            _t     |   .0075061   .0009647     7.78   0.000     .0055606    .0094516
     _xmarch2020   |   .0575482   .0241537     2.38   0.022     .0088376    .1062588
   _x_tmarch2020   |   .0124569   .0021575     5.77   0.000     .0081059    .0168079
         _cons     |   4.556978   .0232051   196.38   0.000     4.510181    4.603776
------------------------------------------------------------------------------


                  Postintervention Linear Trend: March 2020

Treated:  _b[_t]+_b[_x_t722]
------------------------------------------------------------------------------
Linear Trend |      Coeff    Std. Err.      t        P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   Treated   |      0.0200   0.0020     9.8120     0.0000      0.0159    0.0241
------------------------------------------------------------------------------
```

Note: Maximum lag length is chosen following an evaluation of suitable lag length using the STATA's 'actest' package (Baum and Schaffer, 2013).

The maize meal price index experienced a statistically significant increase of 0.007 per cent every month, on average, before the nationwide lockdown of March 2020 (P = 0.000, CI = [0.0055, 0.0094]). In the first month of the national lockdown (i.e. March 2020), the index increased by a statistically significant 0.058 per cent (P = 0.022, CI = [0.008, 0.106]). This was followed by an increase of 0.012 per cent in the monthly trend (compared to the pre-lockdown trend) (P = 0.000, CI = [0.008, 0.017]). The post-intervention trend increased at a statistically significant average rate of 0.02 per cent, per month, since March 2020 (P = 0.000, CI = [0.016, 0.024]). A graphical depiction of the results is presented in Appendix A3. The autocorrelation results (not reported, but available on request) indicate that the model captures the serial correlation in the data.

Model A5: The impact of lockdown on meat price index

The meat price index is the second largest sub-component of the food price index (in terms of weight) after the bread and cereals price index. The single group ITSA – Newey results, with respect to the seasonally adjusted natural log of the monthly meat price index are presented in Table 10.

Table 10: ITSA – Newey results of lockdown impact **(l_meat_sa)**

```
Regression with Newey-West standard errors          Number of obs     =        47
maximum lag: 2                                      F(  3,        43) =    349.94
                                                    Prob > F          =    0.0000

------------------------------------------------------------------------------
             |             Newey-West
   l_meat_sa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          _t |   .0073322   .0006777    10.82   0.000     .0059655    .0086988
 _xmarch2020 |  -.0390126   .0142196    -2.74   0.009    -.0676893   -.010336
_x_tmarch2020 | -.0018171   .0006888    -2.64   0.012    -.0032062   -.000428
       _cons |   4.644008     .01489   311.89   0.000      4.61398    4.674037
------------------------------------------------------------------------------


                  Postintervention Linear Trend: March 2020

Treated: _b[_t]+_b[_x_t722]
------------------------------------------------------------------------------
Linear Trend |      Coeff   Std. Err.      t       P>|t|    [95% Conf. Interval]
-------------+----------------------------------------------------------------
   Treated   |     0.0055    0.0002    23.6258    0.0000     0.0050    0.0060
------------------------------------------------------------------------------
```

Note: Maximum lag length is chosen following an evaluation of suitable lag length using the STATA's 'actest' package (Baum and Schaffer, 2013).

Unlike the bread and cereals price index which increased by an approximate level of 0.041 per cent in March 2020, the level of meat price index fell by an approximate 0.039 per cent in the same period (P=0.009, CI = [-0.068, -0.010]). The post-intervention trend was lower than the pre-intervention trend by 0.002 per cent. This was in contrast to the positive increase in the post-intervention trend of the bread and cereals price index. However, in a similar way to the bread and cereals price index, the meat price index showed a statistically significant post-intervention trend of 0.006 per cent, per month since March 2020 (P = 0.000, CI = [0.005, 0.006]). Results of the autocorrelation test (not reported, but available on request) support the efficacy of the model in accounting for any serial dependency in the data.

Model A6: The impact of lockdown on clothing and footwear price index

The clothing and footwear price index is one of the two biggest sub-components of the non-food price index (together with the housing, water, electricity and gas price index). The single group ITSA – Newey results, with respect to the seasonally adjusted natural log of monthly clothing and footwear price index are presented in Table 11.

Table 11: ITSA – Newey results of lockdown impact **(l_clothing_sa)**

```
Regression with Newey-West standard errors          Number of obs     =        47
maximum lag: 2                                      F(  3,        43) =    789.09
                                                    Prob > F          =    0.0000

------------------------------------------------------------------------------
                   |             Newey-West
l_clothing_sa      |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
             _t    |    .002444   .0001673    14.61   0.000     .0021065    .0027814
     _xmarch2020 |   .0074814   .0041038     1.82   0.075    -.0007947    .0157576
   _x_tmarch2020 |  -.0000928   .0002107    -0.44   0.662    -.0005177    .0003322
           _cons   |   4.597255   .0032784  1402.27   0.000     4.590643    4.603866
------------------------------------------------------------------------------


                    Postintervention Linear Trend: March 2020

Treated:  _b[_t]+_b[_x_t722]
------------------------------------------------------------------------------
Linear Trend |      Coeff    Std. Err.      t       P>|t|    [95% Conf. Interval]
-------------+----------------------------------------------------------------
   Treated   |      0.0024    0.0002    14.7748    0.0000     0.0020     0.0027
------------------------------------------------------------------------------
```

Note: Maximum lag length is chosen following an evaluation of suitable lag length using the STATA's 'actest' package (Baum and Schaffer, 2013).

Although the monthly trend of the clothing and footwear price index declined in the post-intervention period, (compared to the pre-intervention period), this development was not statistically sifinficant. The post-intervention period showed a statistically significant positive trend of 0.002 on average, per month, since March 2020. Results of tests for autocorrelation (available on request) shows that the model adequately catered for the data's autocorrelation properties.

Model A7: The impact of lockdown on housing, electricity, water and gas price index

The single group ITSA – Newey results, pertaining to the seasonally adjusted natural log of monthly housing, water, electricity and gas price index are presented in Table 12.

Table 12: ITSA – Newey results of lockdown impact **(l_housing_sa)**

```
Regression with Newey-West standard errors          Number of obs     =        47
maximum lag: 1                                      F(  3,        43) =    153.39
                                                    Prob > F          =    0.0000

------------------------------------------------------------------------------
                   |             Newey-West
l_housing_sa       |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          _t       |   .0065779   .0003568    18.44   0.000     .0058583    .0072974
    _xmarch2020 |  -.0709786   .0195687    -3.63   0.001    -.1104426   -.0315146
  _x_tmarch2020 |  -.0079803   .0026458    -3.02   0.004    -.013316    -.0026446
        _cons      |   4.623293   .0069935   661.08   0.000     4.609189    4.637397
------------------------------------------------------------------------------

                    Postintervention Linear Trend: march2020

Treated: _b[_t]+_b[_x_t722]
------------------------------------------------------------------------------
Linear Trend |      Coeff    Std. Err.      t       P>|t|    [95% Conf. Interval]
-------------+----------------------------------------------------------------
   Treated   |     -0.0014    0.0027    -0.5238    0.6031    -0.0068    0.0040
------------------------------------------------------------------------------
```

Note: Maximum lag length is chosen following an evaluation of suitable lag length using the STATA's 'actest' package (Baum and Schaffer, 2013).

The level of the index fell by a statistically significant rate of 0.071 per cent in March 2020 (P=0.001, CI= [-0.114, 0.032]). This was followed by a decline in the index slope by 0.008 per cent (P=0.004, CI= = [-0.013, -0.003]) during the post-intervention period, relative to the pre-lockdown period. Interestingly, the post-intervention period showed a statistically insignificant negative trend of 0.002 on average, per month, since March 2020 (P=-.603, CI= -0.0068, 0.0040]). The autocorrelation in the data was sufficiently controlled for, as evidenced from tests for autocorrelation (not reported, but available on request), the model adequately catered for any autocorrelation in the data.

b. ITSA – Prais Results

For robustness purposes, the study estimates the ITSA regression with the STATA Prais option with robust standard errors for the CPI and selected sub-components. The detailed results are not reported but can be made available on request. In general, the results all meet required time series assumptions on Lesotho's consumer price index and selected sub-components.

6. CONCLUSION AND RECOMMENDATION

The objective of this paper was to conduct a single-case experiment to evaluate the magnitude and rate of change of Lesotho's CPI and its sub-components as a result of the COVID-19 induced nationwide lockdown on March 2020. The study uses interrupted time series analysis and monthly data from January 2017 to November 2020. The results revealed that the baseline level for CPI during the pre-lockdown period averaged 4.61 per cent, per month. The post-intervention period showed a positive trend in the CPI that was higher than the positive counterfactual trend by an average of 0.002 per cent. The level of CPI declined by 0.004 per cent in the first month of the lockdown (i.e. March 2020). This was on account of a fall in the level of the housing, water, electricity and gas price index, despite an increase in the food price index. The CPI's post-intervention trend averaged 0.006 per cent, supported by positive trends in all selected sub-components, the highest being the food price index, at 0.014 per cent. The study concludes that the impact of the COVID-19 lockdown was not large enough to result in a structural break in the long-term CPI series, thus rejecting the hypothesis of an immediate and persistent structural break on account of the COVID-19 induced lockdown. The study recommends for the continued use of the ITSA as a monitoring tool of any statistically significant changes in the CPI and its sub-components. This will complement relevant data generation process in the causal or time-series analysis of the country's CPI.

References and Appendix

Note: Document References and Appendix can be accessed via the link below: https://moetidamane.gemalpha.com/view/91d8dda1639748f5a42c1ea483ff61fcc676f0a946894c4484fd508ce1275350/REFERENCES%20and%20APPENDIX%20-%20HelpRange.pdf