



THE INFLATION PROCESS IN ALBANIAN ECONOMY OVER THE PERIOD MARCH 2017 - FEBRUARY 2021

Aurela BIÇAKU

PhD Candidate, “Aleksandër Moisiu” University,
Albania Department of Mathematic, Durrës, Albania
aurela_bicaku@hotmail.com

Abstract

This paper intends to analyse the inflation rate in Albania using the Kolmogorov’s Central Theorem. With the help of Central Theorem, the paper analyzed whether the monthly inflation rate in Albania during the period March 2017 - February 2021 follows a normal distribution. This study also tested whether the inflation process in the Albanian economy during the specified period is a fair game hypothesis. Kolmogorov – Smirnov – Lilliefors test for normality was applied using SPSS. This was studied at the 99% confidence level. The results showed that the Kolmogorov’s Central Limit Theorem is rejected at the 90% confidence level for the monthly inflation rate in Albania over the period March 2017 – February 2021. The inflation in Albanian Economy for the period March 2017 – February 2021 concluded as a speculative game.

Keywords: Inflation, Albania, Central Limit Theorem, normal distribution, fair game

INTRODUCTION

Ackley, Johnson and Friedman define inflation in terms of a process of rising prices. Friedman (Cozzi, 2007) thinks of inflation as a process of “a steady and sustained rise in prices.” Ackley (Ackley, 1978) defines “inflation as a persistent and appreciable rise in the general level or average of prices.

Also, the term “inflation” refers to the raise in CPI (Consumer Price Index) which measures prices of a representative fixed basket of goods and services purchased by a typical consumer.

The formula for calculating the current monthly inflation rate is :

$$i(0) = \frac{P(0) - P(-1)}{P(-1)} * 100\%$$

where, $P(0)$ denotes the current average price level and $P(-1)$ denotes the average price a month ago (Eberhardt & Teal, 2011).

The official sources for monthly inflation rate in Albania are INSTAT and Bank of Albania. The data set is monthly inflation rate in Albania, compared with previous month, during the period March 2017 – February 2021 (48 months), see Table 1.

The successive differences of the monthly inflation rate in Albania, compared with previous month, during the period March 2017 – February 2021 (47 data) are presented in Table 2. For investigation speculation in monthly inflation rate process in Albania during the specified time period we recommend the following methods:

1. Testing the hypothesis for the harmonization of the data set with normal distribution, according the Kolmogorov's Central Limit Theorem.
2. Testing the fair game hypothesis (in the sense of P.A. Samuelson and E. Fama) (Fama, 1963) for the inflation process in Albania over the specified period, (Kolmogorov, 2002) .

Fama (Fama, 1963) has defined the inflation: *The inflation process in a given state over a specified period is a fair game, if the successive differences of the monthly inflation rate, compared with previous month, follows a normal distribution with mean (expectation) equal to zero (Fama, 1963). Otherwise, the inflation process is said to be speculative game (or unfair game)*

LITERATURE REVIEW

Inflation is the most challengeable factor to be kept under control; According to (Tobin_Money.Pdf, n.d.), inflation has an impact on economic growth, differently known as Tobin theorem. He states that there exists a positive influence of inflation in economic growth.

Some other studies bring mixed effects. According to m(Jonas & Mishkin, 2004), inflation targeting leads to real economic growth. (Turan & Rajta, 2015) made an analyze of inflation target impact on economy on three countries that used IT as regime for the first time like Canada, New Zealand and UK. He reached a conclusion that inflation targeting appeared to have a positive effect on economic growth, lowered inflation in these countries and served to keep inflation under control which was relatively high especially in New Zealand. Also (Loomis,

1997) found that inflation targeting had led to a decrease of inflation in the countries that used this regime and has a better economic performance than the countries that haven't adopted IT.

(Judson & Orphanides, 1999) on their paper re-examines the relationship between inflation, inflation volatility and growth, using cross-country panel data for the past 30 years. With regard to the level of inflation, they found that exploiting the time dimension of the data reveals a strong negative correlation between inflation and income growth for all but low inflation countries. To examine the role of inflation uncertainty on growth, they use intra-year inflation data to construct an annual measure of inflation volatility.

Regarding Albanian case, studies made for the impact of inflation targeting and economic growth are mixed too. (Haderi, Papapanagos, Sanfey, & Talka, 1999) discuss the relative importance of monetary, fiscal, and external variables, and in particular, they highlight the role of remittances and private transfers by emigrants. Using vector autoregression analysis, they demonstrate how shocks to remittances affect the subsequent paths of inflation and the exchange rate. They find that the presence of large-scale emigration and huge remittance flows make Albania unique among European countries in transition, to the extent that these factors aided the anti-inflation programme.

METHODOLOGY

The Central Limit Theorem (CLT) is a statistical concept that states that the sample mean distribution of a random variable will assume a near-normal or normal distribution if the sample size is large enough. In simple terms, the theorem states that the sampling distribution of the mean approaches a normal distribution as the size of the sample increases, regardless of the shape of the original population distribution. (Ploberger, 2008)

Kolmogorov's Central Limit Theorem - If all random samples $(x_1, x_2, x_3, \dots, x_n)$ of a reasonably large size $n > 40$ are selected from any random variable (population) X with expectation μ and variance σ^2 , then the probability of the sample mean \bar{x} is approximately normal (Gaussian) with expectation μ and variance $\frac{\sigma^2}{n}$. This approximation improves with larger samples, as $n \rightarrow \infty$, (Stored & Remarks, n.d.)

Berry – Essén Theorem (Weisstein, n.d.) says that if the third central moment $E(X - \mu)^3$ exists, then the above convergence is uniform for all $x \in (-\infty, +\infty)$ and the spread of the uniform convergence is at least of the order $\frac{1}{\sqrt{n}}$, (Becker, Bohnet, & Kummert, 2021).

In most applications where we wish to test for normal distribution, the population mean μ and population variance σ^2 are unknown.

The Lilliefors test, which is quite similar to the Kolmogorov – Smirnov test, overcomes this problem , (Hogg, 2009). In the Kolmogorov – Smirnov – Lilliefors test for normality, we compare the computed value D of the test statistics with the critical value D_c , provided by the table of the Lilliefors test , (Hogg, 2009).

The data set is the monthly inflation rate in Albania, compared with previous month, over the period March 2017 – February 2021, see Table 1. The data uses are secondary data collected from the INSTAT, Ministry of Finance of Albania and Central Bank of Albania.

For investigation the speculation in monthly inflation rate process in Albania over the period March 2017 – February 2021 we used two methods :

1. Testing for the harmonization of the data set with Central Limit Theorem.
2. Testing the fair game hypothesis versus speculative (or unfair) game hypothesis for (of) the monthly inflation rate in Albania over the specified period.

The appropriate statistical test is Kolmogorov – Smirnov – Lilliefors test for normality, (Field, 2020).

ANALYSIS AND FINDINGS

Statistical analysis of the monthly inflation rate in Albania

We calculate the statistical parameters for the monthly inflation rate in Albania over the period March 2017 – February 2021, see Table 1.

Table 1 Statistical parameters for the monthly inflation rate in Albania
over the period March 2017 – February 2021

sample size	n = 48
Sample mean	1.70
95% confidence interval for mean	1.58 ; 1.82
Median	1.80
sample variance	0.157
sample standart deviation	0.396
minimum	0.40
maximum	2.40
range	2

Test the hypothesis :

H_0 :The monthly inflation rate in Albania over the period March 2017 – February 2021 follows a normal (gaussian) distribution.

H_1 :The monthly inflation rate in Albania over the period March 2017 – February 2021 follows a non - normal distribution.

The critical values of Kolmogorov – Smirnov – Lilliefors test for $n = 48$ and $\alpha = 0.05 = 5\%$ or $\alpha = 0.10 = 10\%$ are $D_{48;0.05} = 0.1269$ and $D_{48;0.10} = 0.1165$ see Field (2020), where α denotes the significance level and $\gamma = 1 - \alpha$ denotes the confidence level. The computed value of the test statistics is calculated, using SPSS : $D = 0.117$

Decision Rule :

At the confidence level $\gamma = 90\%$, reject the null hypothesis H_0 (and accept the alternative hypothesis H_1), since $D_{48;0.10} = 0.1165 < 0.117$.

In other words, the monthly inflation rate in Albania over the period March 2017 – February 2021 contradicts the Kolmogorov`s Central Limit Theorem at 90% level of confidence.

Investigating the fair game hypothesis of the monthly inflation rate in Albania over the period March 2017 – February 2021

or

Investigating the speculation hypothesis in Albania`s market over the period March 2017 – February 2021

Test the hypothesis :

H_0 : The successive differences of the monthly inflation rate in Albania over the period March 2017 – February 2021 follow a normal distribution.

H_1 : The successive differences of the monthly inflation rate in Albania over the period March 2017 – February 2021 follow a non - normal distribution.

The appropriate test statistics is Kolmogorov – Smirnov – Lilliefors test. Statistical parameters are calculated for the successive differences of the monthly inflation rate in Albania during the over the period March 2017 – February 2021 (refer Table 2).

Table 2 Statistical parameters for the successive differences of the monthly inflation rate in Albania during the over the period March 2017 – February 2021

sample size	n = 47
Sample mean	-0.017
95% confidence interval for mean	-0.109; 0.075

median	-0.100	Table 2...
sample variance	0.098	
sample standart deviation	0.3137	
minimum	-0.70	
maximum	0.90	
range	1.60	

The critical value of Kolmogorov – Smirnov – Lilliefors test for 47 *d. f.* and $\alpha = 0.01 = 1\%$ is $D_{47;0.01} = 0.1499$ Using SPSS , calculate the computed value of test statistics (Kolmogorov – Smirnov – Lilliefors test) $D = 0.150$

Decision Rule :

At the confidence level $\gamma = 1 - \alpha = 99\%$, reject the null hypothesis H_0 (and accept the alternative hypothesis H_1), since $D = 0.150 > D_{47;0.01} = 0.1499$

That is, the inflation process in Albania over the period March 2017 – February 2021 is a speculative game, at the confidence level 99%.

CONCLUSION

The study was conducted based on data on the Albanian market and economy during the period of March 2017 – February 2021. The purpose of this study is to contribute to the discussion of whether the monthly inflation rate for Albania during the defined period follows a normal distribution and whether the inflation process in Albania is a fair and non-speculative game. These issues are very important for both the government of Albania and the country's economy.

The study showed clear evidence regarding the divergence of the inflation rate in Albania over the period March 2017 – February 2021 from the Central Limit Theorem. Also, this study shows the processes of speculative game inflation process in the Albanian economy during the period of March 2017 – February 2021. An important feature of the study is the severity of rejecting the fair game hypothesis for inflation process in Albania over the specified period, at the 99% confidence level. It is estimated that Albanian households have lost approximately six to eight billion euros as a result of inflation for this period.

REFERENCES

- Ackley, G. (1978). The Costs of Inflation. *The American Economic Review*, 68(2), 149–154. Retrieved from <http://www.jstor.org/stable/1816680>
- Becker, C., Bohnet, M., & Kummert, S. (2021). Rate of Convergence in the Central Limit Theorem for iid Pareto Variables. *Journal of Stochastic Analysis*, 2(1). <https://doi.org/10.31390/josa.2.1.03>
- Cozzi, T. (2007). Milton Friedman: Liberalism, Money And Inflation. *History of Economic Ideas*, 15(2), 23–31. Retrieved from <http://www.jstor.org/stable/23722834>
- Eberhardt, M., & Teal, F. (2011). Econometrics for grumblers: A new look at the literature on cross-country growth empirics. *Journal of Economic Surveys*, 25, 109–155. <https://doi.org/10.1111/j.1467-6419.2010.00624.x>
- Fama, E. F. (1963). *Mandelbrot and the Stable Paretian Hypothesis*. *Journal of Business*, 36, 420-429. <https://doi.org/10.1086/294633No Title>.
- Field, A. (2020). *Discovery Statistics Using SPSS* (6th editio). Sage, London.
- Haderi, S., Papapanagos, H., Sanfey, P., & Talka, M. (1999). Inflation and Stabilisation in Albania. *Post-Communist Economies*, 11(1), 127–141. <https://doi.org/10.1080/14631379996075>
- Hogg, R. V. (2009). *Probability and Statistical Inference* (8th editio). Prentice Hall.
- Jonas, J., & Mishkin, F. (2004). Inflation Targeting in Transition Economies Experience and Prospects. In *National Bureau of Economic Research*.
- Judson, R., & Orphanides, A. (1999). Inflation, Volatility and Growth. *International Finance*, 2, 117–138.
- Kolmogorov, A. N. (2002). *Probability Theory*. Moscow : Nauka.
- Loomis, J. B. and R. G. W. (1997). *Recreation Economic Decisions: Comparing Benefits and Costs*. State College, PA: Venture Publishing, Inc.
- Ploberger, W. (2008). Functional Central Limit Theorems. *The New Palgrave Dictionary of Economics*, 512–515. <https://doi.org/10.1057/9780230226203.0609>
- Stored, D. S., & Remarks, M. (n.d.). *Quick start Options for two-sample test*. 1–5.
- Tobin_Money.Pdf, n.d.
- Turan, G., & Rajta, O. (2015). Inflation Targeting and Economic Growth: Case of Albania. *Academic Journal of Interdisciplinary Studies*, 4(3), 403–408. <https://doi.org/10.5901/ajis.2015.v4n3s1p403>
- Weisstein, E. W. (n.d.). “*Berry-Esséen Theorem*.” Retrieved from <https://mathworld.wolfram.com/Berry-EsseenTheorem.html>

APPENDICES

Table 1. Monthly inflation rate in Albania over the period March 2017 – February 2021

Year / Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
2017			1.9	2	2	2.2	2	1.6	1.6	1.9	1.7	1.8
2018	1.7	2.1	2	2.1	2.1	2.4	2.3	2.2	2.1	1.9	1.8	1.8
2019	1.9	1.7	1.1	1.4	1.5	1.3	1.5	1.4	1.3	1.3	1.4	1.1
2020	1.5	1.2	2.1	1.9	2.1	1.8	1.4	1.3	1.5	2	1.6	1.1

2021	0.4	1.1
------	-----	-----

Table 2. Successive differences of the monthly inflation rate in Albania over the period March 2017 – February 2021

Year / Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
2017				0.1	0	0.2	-0.2	-0.4	0	0.3	-0.2	0.1
2018	-0.1	0.4	-0.1	0.1	0	0.3	-0.1	-0.1	-0.2	-0.1	-0.1	0
2019	0.1	-0.2	-0.6	0.3	0.1	-0.2	0.2	-0.1	-0.1	0	0.1	-0.3
2020	0.4	-0.3	0.9	-0.2	0.2	-0.3	-0.4	-0.1	0.2	0.5	-0.4	-0.5
2021	-0.7	0.7										
