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Statistical analysis of the government expenditure for Albania: January 2008- September 2015

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"Government expenditure is what government spends in order to achieve its planned budget"
Bureau of Economic Analysis (BEA), 30 March 2016

Abstract

The main purpose of the present study is to develop a statistical analysis of the government expenditure for Albania during the period January 2008- September 2015.
The source of the official data is the Albanian Institute of Statistics.
The Kolmogorov's Central Limit Theorem, "fair game" concept in the sense of Stein-Vorobiev, Kolmogorov- Smirnov-Lilliefors test and Shapiro- Wilk test are applied. The government expenditure is estimated based on current price or as a percentage of GDP.
Some results of the present study include:

- The official data of quarterly government expenditure for Albania during the period January 2008- September 2015 satisfies Central Limit Theorem at the confidence level 99%.
- The government expenditure process for Albania during the specified period is an unfair game at the confidence level 99%.
- The official data of quarterly GDP for Albania during the specified period harmonized with Central Limit Theorem ate the confidence level 99%.
- The GDP process for Albania during the specified period is an unfair game at the confidence level 99%.
- The government expenditure as a percentage of GDP for Albania during the specified period contradicts Central Limit Theorem at confidence level 99%.
- The government expenditure process as a percentage of GDP for Albania during the specified period is an unfair game at the confidence level 99%.

These results are important for Albanian Government and Albanian citizens.

Abbreviations

CLT- Central Limit Theorem

GDP- Gross Domestic Product

KSL- Kolmogorov-Smirnov-Lilliefors

SW- Shapiro-Wilk

Key words: government expenditure, GDP, CLT, fair game, Albania.

1. Introduction

The main purpose of this study is to develop a statistical analysis of the quarterly government expenditure for Albania during the period January 2008 – September 2015. The source of the official data is the Institute of Statistics of Albania (INSTAT).

Definition 1

Government expenditure for a given country during a specified period of time is the market value of government purchases of goods and services.

Government expenditure includes government purchases of goods and services produced domestically or abroad. For the purpose of GDP accounts, government expenditure excludes transfer payments (for example, Social Security payments to retirees) and also excludes interest paid on government debt. These categories are omitted because they represent payments to other agents in the economy, who will use those payments to buy goods and services. To avoid double-counting, these government payments to other agents are not counted as government expenditure on goods and services.

According to the Keynesian Theory, increased government expenditure raises aggregate demand and increases consumption, which leads to increase production and faster recovery from recessions. Classical economists, on the other hand, believe that increased government expenditure exacerbates an economic contraction by shifting resources from the private sector, which they consider productive, to the public sector, which they consider unproductive, see Blanchard (2011), Mankiw (2011).

Government expenditure is a component of the GDP formula:

$GDP= C+I+G+X-M$,

where C denotes consumption, I denotes investments, G denotes government expenditure, X denotes exports, and M denotes imports. GDP represents gross domestic product.

GDP is the market value of all officially recognized final goods and services produced within a country in a given period of time (quarterly GDP versus annual GDP), Blanchard (2011) and Mankiw (2011).

GDP can be determined in three ways, all of which should, in principle, give the same result:

-Production Approach

-Expenditure Approach

-Income Approach

In the present study it is applied the Expenditure Approach.

The government expenditure for Albania is expressed in Albanian Lekë or as a fraction of GDP, called GDP share.

The rest of the paper is organized as follows:

- Section 2 contains the methodology of the research
- Section 3 provides the dynamics of quarterly government expenditure
- Section 4 presents the investigation of fair game hypothesis for government expenditure
- Section 5 provides the dynamics of quarterly GDP process
- Section 6 concludes the paper

2. Methodology

Theoretical approach of the present study contains CLT, Martingale Theory and Hypothesis Testing, especially for fair game hypothesis in the sense of Stein – Vorobiev.

According to 2014 Index of Economic Freedom by Heritage Foundation and The Wall Street Journal the mean of government expenditure for Albania during the specified period, as a percentage of GDP, was 28.5%. Therefore, the official data of INSTAT for government expenditure in Albania during the period January 2008-September 2015 are susceptible for fraud.

The GDP formula (or National Income Accounting Identity) confirms that the market value of domestic production is equal to total expenditure of domestic economic agents (C+I+G), plus the expenditure of foreign agents on exports (X) minus the value of domestic expenditure that was imported (M).

Government expenditure in Albania occurs in several levels of government, including primarily central and local governments.

Changes in government expenditure is a major component of fiscal policy, used to stabilize the macroeconomic business cycle.

The Central Limit Theorem (CLT) explains why many probability distributions tend to be very close to the normal distribution. The CLT is also known as the second fundamental theorem of Probability Theory. The Law of Large Numbers is the first fundamental theorem, and the Law of the Iterated Logarithm is the third fundamental theorem of Probability Theory. The Law of the Iterated Logarithm tells us what is happening "in between" The Law of Large Numbers and The CLT. Specifically, it says that the normalizing function $\sqrt{nl_n(l_n n)}$, intermediate in size between n of The Law of Large Numbers and $\sqrt{n}$ of The CLT, provides a nontrivial limiting behavior, see Shiryaev (2006). A contemporary version of the CLT is given by A.N.Kolmogorov.

Theorem 1 (CLT)
If all random samples $(x_1, x_2, \dots, x_n)$ of a reasonably large size n > 30 are selected from any random variable (population) X with finite expectation μ and variance σ^2 then the probability distribution of the sample mean $\bar{x}$ is approximately normal with expectation μ and variance $\frac{\sigma 2}{n}$. This approximation improves with larger samples, as n → ∞, see Kolmogorov (2002).

Theorem 2 (Berry – Esséen)
If the third central moment $E(X- \mu)^3$ exists and is finite, then the above convergence is uniform for all $x \in (-\infty, +\infty)$ and the speed of convergence is at least on the order $\frac{1}{\sqrt{n}}$, see Shiryaev (2006).

Theorem 3 (Arstein – Ball – Barthe – Naor)
The convergence to normal distribution is monotonic in the sense that the entropy of the random variable

$$Z_n = \frac{n(\bar{x} - \mu)}{\sigma\sqrt{n}}$$

increases monotonically to that of the standard normal distribution (Arstein, Ball, Barthe, and Naor, 2004).
The amazing and counterintuitive thing about CLT is that no matter what the probability distribution of the parent population X, the probability distribution of the sample mean $\bar{x}$ approaches a normal curve.

Theorem 1

If a stochastic process $X(t)$ is F_t^0 – martingale, then $E[X(t)]$ = constant, $\forall t \in \mathrm{N}$.

Theorem 2

If a stochastic process is not F_t^0 – martingale, then it is not also F_t – martingale.

Theorem 3

The stochastic process $\{X(t)\}, t \in \mathrm{N}$, is a F_t^0 – martingale if and only if the process

$$\{Z(t) = X(t) - X(t-1)\},\ t \geq 2,$$

is a **fair game**. That is, Z(t) follows normal distribution and

$$E[Z(t) \mid F_{t-1}^0] = E[Z(2)] = 0 \quad ,\ \forall t \geq 3.$$

The definition of fair game was given by J. Stein (1974), Nobel Award Winner in Economic Sciences and by Vorobiev (1974), Professor of Mathematics at Moscow University.

"Unfair game" in the sense of Stein -Vorobiev means "speculative game".

In most applications where we wish to test for normality, the population mean μ and variance σ^2 are unknown. In order to perform the Kolmogorov–Smirnov test, we must assume that μ and σ^2 are known. The Lilliefors test, which is quite similar to the Kolmogorov – Smirnov test, overcomes this problem. The major difference between the two tests is that, with the Lilliefors test, the sample mean $\bar{x}$ and the sample standard deviation *s* are used (instead of μ and σ) to calculate the cumulative distribution function *F(x)*. The sample cumulative function *S(x)* and the test statistic

$$D = \max_i \left| F(x_i) - S(x_i) \right|$$

are both computed as in the Kolmogorov – Smirnov test. In the Lilliefors test we compare the computed value D with the critical value D_c provided by the table of the Lilliefors test.

The SW test for normality compares a set of sample data $(x_1, x_2, \dots, x_n)$ against the normal distribution. The SW test for normality is a very powerful test. This test is of regression type and assesses how well the observed cumulative frequency distribution curve fits the expected normal cumulative curve. The SW test for normality is sensitive to both skewness and kurtosis. In general, SW test is more accurate that KSL test, Cramer – Von Mises test, Durbin test, Chi-squared test, and b_1 test. (Wackearley, Mendenhall, and Schaeffer 2007, Hogg 2009, Field 2013). We use SPSS version 22.

3.Dynamics of quarterly government expenditure

The data set is quarterly government expenditure expressed in million Albanian Lekë during the period January 2008-September 2015, **see table 1** in Appendix. The source of the official data is INSTAT.

Using SPSS (version 22, 2014), compute the statistical parameters for the data.

Descriptives

Government Expenditure		Statistic	Std. Error
Mean		34931.60322581	840.291745784
99% Confidence Interval for Mean	Lower Bound	32620.80457762	
	Upper Bound	37242.40187399	
5% Trimmed Mean		35072.97831541	
Median		35373.70000000	
Variance		21888796.759	
Std. Deviation		4678.546436554	
Coefficient of variation		0.125624186441678	
Minimum		21823.300000	
Maximum		45985.400000	
Range		24162.100000	
Interquartile Range		4556.800000	
Skewness		-.728	.421
Kurtosis		1.755	.821

Tests of Normality

Kolmogorov-Smirnov-Lilliefors			Shapiro-Wilk		
Statistic	df	Sig.	Statistic	df	Sig.
.152	31	.066	.926	31	.034

Test the hypothesis:

H_0: The quarterly government expenditure for Albania during the period January 2008-September 2015 follow a normal distribution.

H_1: The quarterly government expenditure for Albania during the period January 2008-September 2015 follow a non-normal distribution.

Using SPSS, find the significance level p=0.066 for KSL test and p=0.034 for SW test.

Decision Rule:

$p>\alpha=0.01$ in both cases. Therefore, accept the null hypothesis H_0 at the confidence level 99%.

In other words, the official data of quarterly government expenditure for Albania during the period January 2008-September 2015 satisfies CLT at the confidence level 99%.

-The data set is quarterly government expenditure expressed as a fraction of GDP for Albania during the period January 2008-September 2015. The source of the official data is INSTAT.

Using SPSS (version 22, 2014), compute the statistical parameters for the data.

Descriptives

Government expenditure as a % of GDP		Statistic	Std. Error
Mean		.1100	.00154
99% Confidence Interval for Mean	Lower Bound	.1058	
	Upper Bound	.1142	
5% Trimmed Mean		.1098	
Median		.1100	
Variance		.000	
Std. Deviation		.00856	
Coefficient of variation		0.07495622	
Minimum		.09	
Maximum		.13	
Range		.04	
Interquartile Range		.00	
Skewness		.340	.421
Kurtosis		1.067	.821

Tests of Normality

Kolmogorov-Smirnov- Lilliefors			Shapiro-Wilk		
Statistic	df	Sig.	Statistic	df	Sig.
.306	31	.000	.852	31	.001

Test the hypothesis:

H_0: The quarterly government expenditure for Albania during the period January 2008-September 2015 follow a normal distribution.

H_1: The quarterly government expenditure for Albania during the period January 2008-September 2015 follow a non-normal distribution.

Using SPSS, find the significance level p=0.00 for KSL test and p=0.001 for SW test.

Decision Rule:

$P<\alpha=0.01$ in both cases. Therefore, reject the null hypothesis H_0 at the confidence level 99%.

In other words, the official data of quarterly government expenditure expressed as a fraction of GDP for Albania during the period January 2008-September 2015 contradicts CLT at the confidence level 99%.

4. The investigation of fair game hypothesis for government expenditure

-The data set is the successive differences in million lekë of quarterly government expenditure for Albania during the period January 2008-September 2015. The source of the official data is INSTAT.

Using SPSS (version 22, 2014), compute the statistical parameters for the data.

Descriptive

Successive differences of government expenditures in million Albanian Lekë	Statistic	Std. Error
Mean	2187.5467	466.56921

	99% Confidence Interval for Mean	Lower Bound	901.5019	
		Upper Bound	3473.5915	
	5% Trimmed Mean		1944.3981	
	Median		1124.8500	
	Variance		6530604.822	
	Std. Deviation		2555.50481	
	Coefficient of variation		0.735695262381889	
	Minimum		.00	
	Maximum		9520.40	
	Range		9520.40	
	Interquartile Range		4294.60	
	Skewness		1.082	.427
	Kurtosis		.755	.833

Tests of Normality

Kolmogorov-Smirnov- Lilliefors			Shapiro-Wilk		
Statistic	df	Sig.	Statistic	df	Sig.
.237	30	.000	.826	30	.000

Using KSL test as well as SW test for normality we test the hypothesis:

H_0 : The successive differences of the quarterly government expenditures in million lekë in Albania over the specified period follow a normal distribution.

H_1 : The successive differences of the quarterly government expenditures in million lekë in Albania over the specified period follow a non- normal distribution.

We apply the KSL test as well as the SW test for normality Using SPPS (2014) we find the computed value of KSL test= .237 and associated significance level= .000.The computed value of SW statistics is .826, which corresponds to a significance level of .000.

Decision Rule: Reject the null hypothesis H_0 at the confidence level 99 %. In other words, the government expenditure process in Albania during the period January 2008-September 2015 is an unfair game at the confidence level 99%.

--The data set is the successive differences of quarterly government expenditure as a fraction of GDP for Albania during the period January 2008-September 2015.

Using SPSS (version 22, 2014), compute the statistical parameters for the data.

Descriptives

Successive differences of quarterly government expenditure as a fraction of GDP			Statistic	Std. Error
	Mean		.0037	.00110
	99% Confidence Interval for Mean	Lower Bound	.0007	
		Upper Bound	.0068	
	5% Trimmed Mean		.0029	
	Median		.0014	
	Variance		.000	
	Std. Deviation		.00601	
	Coefficient of variation		0.883823529411765	
	Minimum		.00	
	Maximum		.03	
	Range		.03	
	Interquartile Range		.01	

	Skewness	2.496	.427
	Kurtosis	7.543	.833

Tests of Normality

Kolmogorov-Smirnov- Lilliefors			Shapiro-Wilk		
Statistic	df	Sig.	Statistic	Df	Sig.
.267	30	.000	.673	30	.000

Using KSL test as well as SW test for normality we test the hypothesis:

H_0 : The successive differences of quarterly government expenditure as a fraction of GDP in Albania over the specified period follow a normal distribution.

H_1 : The successive differences of quarterly government expenditure as a fraction of GDP in Albania over the specified period follow a non- normal distribution.

We apply the KSL test as well as the SW test for normality Using SPPS (2014) we find the computed value of KSL test= .267 and associated significance level= .000.The computed value of SW statistics is .673, which corresponds to a significance level of .000.

Decision Rule:

Reject the null hypothesis H_0 at the confidence level 99 %. In other words, the government expenditure as a fraction of GDP in Albania during the period January 2008-September 2015 is an unfair game at the confidence level 99%.

5.The dynamics of quarterly GDP process

The data set is quarterly GDP in million Albanian Lekë during the period January 2008-September 2015. The source of the official data is INSTAT.

Using SPSS (version 22, 2014), compute the statistical parameters for the data.

Descriptives

GDP		Statistic	Std. Error
Mean		319828.2581	6487.722977
99% Confidence Interval for Mean	Lower Bound	301987.0481	
	Upper Bound	337669.4680	
5% Trimmed Mean		320873.4050	
Median		324160.0000	
Variance		1304807031.265	
Std. Deviation		36122.11277	
Coefficient of variation		0.10697476731891	
Minimum		233444.00	
Maximum		384806.00	
Range		151362.00	
Interquartile Range		59340.00	
Skewness		-.349	.421
Kurtosis		-.287	.821

Tests of Normality

Kolmogorov-Smirnov- Lilliefors			Shapiro-Wilk		
Statistic	df	Sig.	Statistic	df	Sig.
.093	31	.200*	.981	31	.827

Test the hypothesis:

H_0: The quarterly GDP for Albania during the period January 2008-September 2015 follow a normal distribution.

H_1: The quarterly GDP for Albania during the period January 2008-September 2015 follow a non-normal distribution.

Using SPSS, find the significance level p=0.200 for KSL test and p=0.827 for SW test.

Decision rule:

p>α=0.01 in both cases. Therefore, accept the null hypothesis H_0 at the confidence level 99%.

In other words, the official data of quarterly GDP for Albania during the period January 2008-September 2015 satisfies CLT at the confidence level 99%.

--The data set is the successive differences of quarterly GDP in million Albanian Lekë for Albania during the period January 2008-September 2015. The source of the official data is INSTAT.

Using SPSS (version 22, 2014), compute the statistical parameters for the data.

Descriptives

Successive differences of quarterly GDP in million Albanian Lekë		Statistic	Std. Error
Mean		17459.7300	4050.12853
99% Confidence Interval for Mean	Lower Bound	6296.0128	
	Upper Bound	28623.4472	
5% Trimmed Mean		15900.2444	
Median		716.7500	
Variance		492106233.386	
Std. Deviation		22183.46757	
Coefficient of variation		0.77501034082296	
Minimum		.00	
Maximum		66855.80	
Range		66855.80	
Interquartile Range		33615.98	
Skewness		.892	.427
Kurtosis		-.698	.833

Tests of Normality

Kolmogorov-Smirnov- Lilliefors			Shapiro-Wilk		
Statistic	df	Sig.	Statistic	df	Sig.
.302	30	.000	.773	30	.000

Using KSL test as well as SW test for normality we test the hypothesis:

H_0: The successive differences of the quarterly GDP in million lekë in Albania over the specified period follow a normal distribution.

H_1: The successive differences of the quarterly GDP in million lekë in Albania over the specified period follow a non- normal distribution.

We apply the KSL test as well as the SW test for normality Using SPPS (2014) we find the computed value of KSL test= .302 and associated significance level= .000.The computed value of SW statistics is .773, which corresponds to a significance level of .000.

Decision Rule: Reject the null hypothesis H_0 at the confidence level 99 %. In other words, the quarterly GDP in Albania during the period January 2008-September 2015 is an unfair game at the confidence level 99%.

6. Conclusion

In the present study developed a statistical analysis of the quarterly government expenditure for Albania during the period January 2008-September 2015. The source of the official data is INSTAT. The government expenditure is estimated based on current price or as a fraction of GDP.

Using Kolmogorov's CLT and the "fair game" concept in Stein-Vorobiev sense, are obtained the following results:

- The official data of quarterly government expenditure for Albania during the period January 2008-September 2015 harmonized with CLT at the confidence level 99%.
- The government expenditure process in Albania during the specified period, related to quarterly data, is an unfair game at the confidence level 99%.
- The government expenditure as a percentage of GDP in Albania during the period January 2008-September 2015 contradicts the CLT at the confidence level 99%.
- The government expenditure process in Albania during the specified period, related to quarterly data as a percentage of GDP, is an unfair game at the confidence level 99%.
- The official data of quarterly GDP for Albania during the period January 2008-September 2015 harmonized with CLT at the confidence level 99%.
- The GDP process in Albania during the specified period, related to the quarterly data, is an unfair game at the confidence level 99%.
- The mean of the quarterly government expenditure as a fraction of GDP in Albania during the period January 2008-September 2015 is 11%, the maximum value is 13% and the minimum value 9%.
- The severity of unfair game government expenditure in Albania during the specified period is an obvious feature of the present study.

These results are important for Albanian Government and especially for Albanian citizens.

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Appendix, Table 1:

Table 1. Quarterly Government expenditure, quarterly GDP, and their successive differences for Albania during the specified period January 2008-September 2015.

PUBEXP	FIRDIFFP	GDP	FIRDIFFGDP	%	FIRDIFF%
21,823.3		233,444		0.09	
26,380.4	4,557.1	277,130	43,685.7	0.10	0.0017
27,219.4	839.0	277,394	264.2	0.10	0.0029
36,739.8	9,520.4	292,707	15,312.7	0.13	0.0274
26,873.4	(9,866.3)	256,195	(36,511.9)	0.10	(0.0206)
31,752.2	4,878.8	308,518	52,323.3	0.10	(0.0020)
32,700.7	948.5	289,027	(19,491.2)	0.11	0.0102
35,758.5	3,057.8	290,197	1,169.3	0.12	0.0101
31,690.6	(4,067.9)	271,181	(19,015.4)	0.12	(0.0064)
34,333.8	2,643.2	325,806	54,624.5	0.11	(0.0115)
33,842.1	(491.7)	313,525	(12,280.9)	0.11	0.0026
38,445.1	4,603.0	329,133	15,607.9	0.12	0.0089
33,476.5	(4,968.6)	296,401	(32,731.3)	0.11	(0.0039)
36,720.6	3,244.1	326,661	30,259.4	0.11	(0.0005)
34,502.2	(2,218.4)	324,160	(2,501.1)	0.11	(0.0060)
38,033.3	3,531.1	353,402	29,242.2	0.11	0.0012
35,373.7	(2,659.6)	298,731	(54,670.6)	0.12	0.0108
36,674.9	1,301.2	346,625	47,893.8	0.11	(0.0126)
34,785.4	(1,889.6)	335,407	(11,218.0)	0.10	(0.0021)
37,706.9	2,921.5	352,047	16,640.3	0.11	0.0034
34,560.7	(3,146.2)	311,031	(41,015.9)	0.11	0.0040
38,767.8	4,207.1	358,689	47,657.5	0.11	(0.0030)
35,737.7	(3,030.0)	325,784	(32,905.0)	0.11	0.0016
37,731.5	1,993.8	355,050	29,266.5	0.11	(0.0034)
34,985.5	(2,746.0)	314,106	(40,944.1)	0.11	0.0051
40,046.7	5,061.2	369,365	55,259.0	0.11	(0.0030)
38,770.9	(1,275.7)	349,674	(19,691.3)	0.11	0.0025
45,985.4	7,214.5	367,404	17,729.8	0.13	0.0143
33,836.3	(12,149.1)	317,950	(49,453.3)	0.11	(0.0187)
38,940.4	5,104.1	384,806	66,855.8	0.10	(0.0052)
38,684.0	(256.4)	363,126	(21,680.4)	0.11	0.0053

Short Bio

Fejzi Kolaneci holds a PhD diploma in Mathematics from 1972 and a Doctor of Sciences diploma (second degree) from 1990. He was awarded the title Professor for distinguished contribution in Mathematical Sciences from 1994. During the period 2003 – 2011 he was the Head of Mathematics and Natural Sciences Departmen at the University of New York Tirana. From 1997 to 2002, Dean of the Teaching Faculty, University Fan Noli, Korca, Albania. During the period 1993 – 1997, the Scientific Secretary for Natural and Technical Sciences, Academy of Sciences, Tirana, Albania. His recent interests are in Stochastic Partial Differential Equations, Probability Theory, Mathematical Statistics and their applications in Physics, Biomedicine and Economics. Currently he is a full time Professor of Mathematics at the University of New York Tirana.

Brunilda Hoxhalli is currently a third year student at University of New York Tirana, majoring in Finance. She has been interested in natural sciences and economic sciences where she had very good results. Brunilda has been an active participant in several International Scientific Conferences and has published papers in scientific journals.

Juxhen Duzha is currently a third year student at University of New York Tirana, majoring in Finance. She has been interested in natural sciences and economic sciences where she had very good results. Juxhen has been an active participant in several International Scientific Conferences and has published papers in scientific journals.

Enxhi Lika is currently a second year student at The Economic Faculty of Tirana University. She has always been interested in research and collaborated in different publications or presentations in International Scientific Conferences.