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STATISTICAL ANALYSIS OF MACEDONIAN GOVERNMENT EXPENDITURES FOR THE PERIOD 2006 – 2013

Abstract

The main purpose of the present study is to develop a statistical analysis of the government expenditure for Macedonia during the period January 2006- September 2013

The source of the official data is the Macedonian 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 Macedonia during the period January 2006-September 2013 contradicts the CLT at the confidence level 95%.*
- *The official data of quarterly government expenditure expressed as a fraction of GDP for Macedonia during the period January 2006-September 2013 satisfies CLT at the confidence level 95%.*
- *The government expenditure process in Macedonia during the period January 2006-September 2013 is an unfair game at the confidence level 95%.*
- *The government expenditure as a fraction of GDP in Macedonia during the period January 2006-September 2013 is a fair game at the confidence level 95%.*
- *The official data of quarterly GDP for Macedonia during the period January 2006-September 2013 satisfies CLT at the confidence level 95%.*
- *The quarterly GDP in Macedonia during the period January 2006-September 2013 is an unfair game at the confidence level 95%.*

Keywords: *government expenditure, GDP, CLT, fair game, Macedonia.*

Introduction. The main purpose of this study is to develop a statistical analysis of the quarterly government expenditure for Macedonia during the period January 2006 – September 2013. The source of the official data is the Institute of Statistics of Macedonia.

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 Macedonia is expressed in Macedonian Denar 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

The main **purpose** of the present study is to develop a statistical analysis of the government expenditure for Macedonia during the period January 2006- September 2013.

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

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 Macedonia 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 $\sqrt{n l_n(l_n n)}$, 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 $n \to \infty$, 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 Lillieforstest, 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 Shapiro-Wilk (SW) test for normality compares a set of sample data ($x_1, x_2, ..., x_n$) 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 Kolmogorov-Smirnov-Lilliefors (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.

Dynamics of quarterly government expenditure

The data set is quarterly government expenditure expressed in million Macedonian Denar during the period January 2006-September 2013, see table 1.

Table 1

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

		Gov exp	FD OF G.EXP	GDP	FD OF GDP	% OF GDP	FD OF %
Current prices(in million denars)							
2006	Q1	13960		68,573.00		0.20	
	Q2	15083	1123	80,311.00	11738	0.19	(0.02)
	Q3	13671	-1412	82,915.00	2604	0.16	(0.02)
	Q4	15305	1634	88,259.00	5344	0.17	0.01
2007	Q1	14803	-502	77,337.00	-10922	0.19	0.02
	Q2	14985	182	89,050.00	11713	0.17	(0.02)
	Q3	15176	191	94,807.00	5757	0.16	(0.01)
	Q4	17518	2342	103,795.00	8988	0.17	0.01
	Q1	17209	-309	90,658.00	-13137	0.19	0.02
2008	Q2	18068	859	103,902.00	13244	0.17	(0.02)
	Q3	17443	-625	108,054.00	4152	0.16	(0.01)
	Q4	22367	4924	109,114.00	1060	0.20	0.04
	Q1	19539	-2828	93,048.00	-16066	0.21	0.01
2009	Q2	20164	625	102,751.00	9703	0.20	(0.01)
	Q3	19094	-1070	104,453.00	1702	0.18	(0.01)
	Q4	19740	646	110,483.00	6030	0.18	(0.00)
	Q1	20476	736	93,481.00	-17002	0.22	0.04
2010	Q2	20285	-191	107,995.00	14514	0.19	(0.03)
	Q3	20772	487	113,619.00	5624	0.18	(0.01)
	Q4	21424	652	119,017.00	5398	0.18	(0.00)
	Q1	20837	-587	103,218.00	-15799	0.20	0.02
2011	Q2	21517	680	116,884.00	13666	0.18	(0.02)
	Q3	20345	-1172	116,700.00	-184	0.17	(0.01)
	Q4	21489	1144	122,986.00	6286	0.17	0.00
	Q1	21003	-486	104,058.00	-18928	0.20	0.03
2012	Q2	20815	-188	113,946.00	9888	0.18	(0.02)
	Q3	20744	-71	118,712.00	4766	0.17	(0.01)
	Q4	22202	1458	121,905.00	3193	0.18	0.01
	Q1	20874	-1328	102,938.00	-18967	0.20	0.02
2013	Q2	20317	-557	119,648.00	16710	0.17	(0.03)
	Q3	20034	-283	122,978.00	3330	0.16	(0.01)
	Q4	21687	1653	127,455.00	4477	0.17	0.01

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

Descriptives

			Statistic	Std. Error
GOVEXP	Mean		19029.5625	468.84472
	95% Confidence Interval for Mean	Lower Bound	18073.3474	
		Upper Bound	19985.7776	
	5% Trimmed Mean		19139.2639	
	Median		20224.5000	
	Variance		7034091.867	
	Std. Deviation		2652.18624	
	Minimum		13671.00	
	Maximum		22367.00	
	Range		8696.00	
	Interquartile Range		3597.25	
	Skewness		-.794	.414
	Kurtosis		-.770	.809

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	Df	Sig.
GOVEXP	.210	32	.001	.868	32	.001

a. Lilliefors Significance Correction

Test the hypothesis:

H_0: The quarterly government expenditure for Macedonia during the period January 2006-September 2013 follow a normal distribution.

H_1: The quarterly government expenditure for Macedonia during the period January 2006-September 2013 follow a non-normal distribution.

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

Decision Rule:

P<α=0.05in both cases. Therefore, reject the null hypothesis H_0 at the confidence level 95%.

In other words, the official data of quarterly government expenditure for Macedonia during the period January 2006-September 2013 does not satisfy CLT at the confidence level 95%.

The data set is quarterly government expenditure expressed as a fraction of GDP for Macedonia during the period January 2006-September 2013..

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

			Statistic	Std. Error
GDPPERC	Mean		.1819	.00278
	95% Confidence Interval for Mean	Lower Bound	.1762	
		Upper Bound	.1876	
	5% Trimmed Mean		.1812	
	Median		.1800	
	Variance		.000	
	Std. Deviation		.01575	
	Minimum		.16	
	Maximum		.22	
	Range		.06	
	Interquartile Range		.03	
	Skewness		.516	.414
	Kurtosis		-.450	.809

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
GDPPERC	.181	32	.009	.923	32	.026

a. Lilliefors Significance Correction

Test the hypothesis:

H_0: The quarterly government expenditure for Macedonia during the period January 2006-September 2013 follow a normal distribution.

H_1: The quarterly government expenditure for Macedonia during the period January 2006-September 2013 follow a non-normal distribution.

Using SPSS, find the significance level p=0.009 for KSL test and p=0.026 for SW test.

Decision Rule:

P>α=0.05in both cases. Therefore, accept the null hypothesis H_0 at the confidence level 95%.

In other words, the official data of quarterly government expenditure expressed as a fraction of GDP for Macedonia during the period January 2006-September 2013 satisfies CLT at the confidence level 95%.

The investigation of fair game hypothesis for government expenditure

- The data set is the successive differences in million denar of quarterly government expenditure for Macedonia during the period January 2006-September 2013.

Descriptives

			Statistic	Std. Error
FIDGOVEX	Mean		249.26	248.098
	95% Confidence Interval for Mean	Lower Bound	-257.43	
		Upper Bound	755.94	
	5% Trimmed Mean		183.49	
	Median		182.00	
	Variance		1908132.931	
	Std. Deviation		1381.352	
	Minimum		-2828	
	Maximum		4924	
	Range		7752	
	Interquartile Range		1416	
	Skewness		1.008	.421
	Kurtosis		3.620	.821

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
FIDGOVEX	.104	31	.200*	.928	31	.039

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

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 denar in Macedonia over the specified period follow a normal distribution.

H_1: The successive differences of the quarterly government expenditures in million denar in Macedonia 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= .104 and associated significance level= .200.The computed value of SW statistics is .928, which corresponds to a significance level of .039.

Decision Rule: Reject the null hypothesis H_0 at the confidence level 95 %. In other words, the government expenditure process in Macedonia during the period January 2006-September 2013 is an unfair game at the confidence level 95%.

--The data set is the successive differences of quarterly government expenditure as a fraction of GDP for Macedonia during the period January 2006-September 2013.

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

Descriptives

			Statistic	Std. Error
FIDPERC	Mean		.02	.003
	95% Confidence Interval for Mean	Lower Bound	.01	
		Upper Bound	.03	
	5% Trimmed Mean		.02	
	Median		.02	
	Variance		.000	
	Std. Deviation		.012	
	Minimum		0	
	Maximum		0	
	Range		0	
	Interquartile Range		0	
	Skewness		.672	.616
	Kurtosis		-.185	1.191

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
FIDPERC	.219	13	.089	.885	13	.084

a. Lilliefors Significance Correction

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 Macedonia over the specified period follow a normal distribution.

H_1: The successive differences of quarterly government expenditure as a fraction of GDP in Macedonia 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= .219and associated significance level= .089.The computed value of SW statistics is .885, which corresponds to a significance level of .084.

Decision Rule:

Accept the null hypothesis H_0 at the confidence level 95 %. In other words, the government expenditure as a fraction of GDP in Macedonia during the period January 2006-September 2013 is a fair game at the confidence level 95%.

The dynamics of quarterly GDP process

The data set is quarterly GDP in million Macedonian Denar during the period January 2006-September 2013.

Descriptives

			Statistic	Std. Error
GDP	Mean		104157.8125	2625.16869
	95% Confidence Interval for Mean	Lower Bound	98803.7457	
		Upper Bound	109511.8793	
	5% Trimmed Mean		104750.9792	
	Median		104255.5000	
	Variance		220528340.222	
	Std. Deviation		14850.19664	
	Minimum		68573.00	
	Maximum		127455.00	
	Range		58882.00	
	Interquartile Range		23681.75	
	Skewness		-.556	.414
	Kurtosis		-.335	.809

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
GDP	.150	32	.066	.958	32	.247

a. Lilliefors Significance Correction

Test the hypothesis:

H_0: The quarterly GDP for Macedonia during the period January 2006-September 2013 follow a normal distribution.

H_1: The quarterly GDP for Macedonia during the period January 2006-September 2013 follow a non-normal distribution.

Using SPSS, find the significance level p=0.066 for KSL test and p=0.247 for SW test.

Decision rule:

p>α=0.05 in both cases. Therefore, accept the null hypothesis H_0 at the confidence level 95%.

In other words, the official data of quarterly GDP for Macedonia during the period January 2006-September 2013 satisfies CLT at the confidence level 95%.

The data set is the successive differences of quarterly GDP in million Macedonian Denar for Macedonia during the period January 2006-September 2013.

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 denar in Macedonia over the specified period follow a normal distribution.

H_1: The successive differences of the quarterly GDP in million denar in Macedonia 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= .210 and associated significance level= .001.The computed value of SW statistics is .864, which corresponds to a significance level of .001.

Descriptives

			Statistic	Std. Error
FIDGDP	Mean		1899.42	1907.828
	95% Confidence Interval for Mean	Lower Bound	-1996.89	
		Upper Bound	5795.72	
	5% Trimmed Mean		2278.38	
	Median		4766.00	
	Variance		112834068.318	
	Std. Deviation		10622.338	
	Minimum		-18967	
	Maximum		16710	
	Range		35677	
	Interquartile Range		9887	
	Skewness		-.884	.421
	Kurtosis		-.365	.821

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
FIDGDP	.210	31	.001	.864	31	.001

a. Lilliefors Significance Correction

Decision Rule: Reject the null hypothesis H_0 at the confidence level 95 %. In other words, the quarterly GDP in Macedonia during the period January 2006-September 2013 is an unfair game at the confidence level 95%.

Conclusion. In the present study developed a statistical analysis of the quarterly government expenditure for Macedonia during the period January 2006-September 2013. 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-Vorobievsense, are obtained the following results:

1. The official data of quarterly government expenditure for Macedonia during the period January 2006-September 2013 contradicts the CLT at the confidence level 95%.
2. The official data of quarterly government expenditure expressed as a fraction of GDP for Macedonia during the period January 2006-September 2013 satisfies CLT at the confidence level 95%.
3. The government expenditure process in Macedonia during the period January 2006-September 2013 is an unfair game at the confidence level 95%.

4. The government expenditure as a fraction of GDP in Macedonia during the period January 2006-September 2013 is a fair game at the confidence level 95%.

5. The official data of quarterly GDP for Macedonia during the period January 2006-September 2013 satisfies CLT at the confidence level 95%.

6. The quarterly GDP in Macedonia during the period January 2006-September 2013 is an unfair game at the confidence level 95%.

7. The mean of the quarterly government expenditure as a fraction of GDP in Macedonia during the period January 2006-September 2013 is 18.19%, the maximum value is 22% and the minimum value 16%.

8. The severity of unfair game government expenditure in Macedonia during the specified period is an obvious feature of the present study.

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

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