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# DAILY EXCHANGE RATE DYNAMICS: CASE OF ALBANIA

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**Abstract**
*In this paper, we will analyze the nominal daily exchange rate of the two main currencies in Albania, the Euro and the USD, against the Albanian Lek. The study period includes the time interval from the beginning of January 2011 until the end of May 2018. These data are taken from the exchange rate archive by the Central Bank of Albania. We do the statistical analysis for the daily exchange rate of the two main currencies vs Albanian Lek. The hypotheses are checked through stationary control, autocorrelation control and marginary hypotheses test. The tests show that the exchange rate in Albania has not been a fair game with 99.95% confidence level. Also, the finding show that nominal daily exchange rate Euro / Lek and USD/ Lek during the period January 2011-May 2018 turns out not to be in line with the effective market hypothesis. In the end of the study, some recommendations are given.*
*Keywords: Exchange rate, stationary/nonstationary control, autocorrelation, fair game, market hypotheses*

## INTRODUCTION

For a long time, the exchange rate has been at the center of macroeconomic policy debates in emerging markets. In many countries, the nominal exchange rate was often used as a way to reduce inflation; in other countries the exchange rate was used as a means of taxation

(implicitly) of the export sector (Monfared & Akın, 2017). Currency crises have been common and have usually been the result of acute (real) exchange rate overvaluation.

During the 1990s academics and policymakers debated the merits of alternative exchange rate regimes for emerging economies. According to the theories based on reliability many authors argued that developing and transition countries should have strong regimes, preferably currency boards or dollarization. One of the main arguments in favor of rigid exchange rate regimes was that emerging economies exhibited a "fear to floa" (Calvo & Reinhart, 2000).

After the currency crashes in the late 1990s and early 2000s, however, a growing number of emerging economies moved away from exchange rate rigidity and adopted a combination of flexible exchange rates and "inflation targeting". Due to this movement the exchange rate has become less central to the economic policy debate in most developing countries. However, this does not mean that the exchange rate has disappeared from monetary policy discussions. Indeed, with the adoption of inflation, a significant number of questions about exchange rate rates were targeted, most of them new. This paper targets the relationship between inflation and exchange rates which are an increasingly important part in the analysis of monetary policy in developing countries (Jonas & Mishkin, 2004), as is Albania.

The exchange rate regime plays a vital role in the economic development of any country (Rajković, Bjelić, Jaćimović, & Verbič, 2020). The exchange rate represents the monetary competition of a country on a global platform (Agrawal, Gokarn, Mishra, Parikh, & Sen, 2000). A country's exchange rate directly affects its exports and imports. In the case of local currency appreciation, exports are negatively affected and in case of currency devaluation, imports become more expensive. These changes in exchange rates affect the inflation target in the central banks of the countries. There is a very strong link between a country's exchange rate and economic growth. Although it is very difficult to establish a link between the exchange rate and inflation in relation to the country's overall economic growth, the exchange rate is directly and indirectly related to inflation. (Alotaibi, 2016).

The main impact on exchange rate change is due to inflation change, but there are many other economic variables that affect exchange rates.(Pham & Wang, 1996).

The development of the Albanian economy throughout the transition period has surprised many people (Mançellari, 2011). Starting from a very low base in 1991-92, Albania quickly shifted to high GDP growth and declining inflation, along with serious efforts towards market reforms. However, these achievements were greatly jeopardized in 1997 (a period of unrest and almost anarchy in Albania at this time). During this time several large pyramid

schemes were created, in which the majority of the population deposited their savings. These pyramids collapsed greatly endangering the economy at the time. (Boka & Torluccio, 2013).

Since then, the Albanian economy has again enjoyed high levels of annual growth and low levels of Inflation. This combination has been achieved in an environment where the development of the financial sector is still at an early stage and where we still have informal markets. Therefore, the role of monetary policy in influencing inflation and growth is limited in itself. However, more and more attention is being paid in Albania to the role of monetary policy, and especially the costs and benefits of introducing new instruments and moving to clearer inflation.

## LITERATURE REVIEW

Although there are many studies and literature on exchange rate volatility, the literature is still scarce about developing countries. Some studies use panel data in kind and have traced the effects of macroeconomic shocks on exchange rate volatility. For example, Carrera and Vuletin (Carrera, J., and Vuletin, 2002) seek to analyze the relationships between exchange rate regimes and short-term real exchange rate volatility. The study determines the relative importance of these links, in particular by analyzing the impact of the exchange rate regime on inflation volatility using a dynamic analysis of panel data. For this he analyzed an example of 92 countries for the years 1980-1999. The study finds evidence of how other variables affect inflation volatility and also analyzes the sustainability of inflation shocks. The study further finds more evidence of more openness, acceleration in GDP growth per capita, reduction of instability. Conversely, positive monetary shocks and rising capital inflows and public spending increase this volatility. Evidence from the study also supports the view that the analysis of the dynamics of exchange rate regimes should distinguish between developed and developing countries.

Benita and Lauterbach (Benita & Lauterbach, 2007), studied the daily exchange rate volatility between the US Dollar and 43 other currencies for the period 1990-2001. The study uses several macroeconomic variables, that representation of uncertainty, wealth and the opening up of the domestic economy in international markets, as controls in the analysis. The well-known GARCH statistical behavior of exchange rate volatility was also calculated. The main finding of the study was that exchange rate volatility was positively related to the real domestic interest rate and the degree of central bank intervention. In the panel, the study finds positive correlations between exchange rate volatility, real interest rates and the intensity of central bank intervention.

**Effective Market Hypothesis**

The efficient markets hypothesis (EMH) fully holds market prices to reflect all available information. Developed independently by Paul A. Samuelson and Eugene F. Fama in the 1960s (Fama, 1963), this idea has been widely applied in theoretical models and empirical studies of financial securities pricing, generating considerable controversy as well as basic knowledge in the price discovery process. The most consistent criticism comes from behavioral psychologists and economists who argue that EMH is based on opposite assumptions about human behavior, i.e. rationality. Recent advances in evolutionary psychology and cognitive neuroscience may be able to reconcile EMH with abnormal behavior.

There is an old joke, widely said among economists, about an economist walking with a friend. They find a $ 100 coin on the ground, and as the companion reaches down to get it, the economist says, 'Don't worry - if it were an original $ 100 coin, someone would have already got it.' This humorous example of Missing Economic Logic is a fairly accurate interpretation of the efficient markets hypothesis (EMH), one of the most contested propositions in all of the social sciences. It is simply disarmed to say, has far-reaching implications for academic theories and practices of business, and yet is surprisingly resilient to empirical evidence or refutation. Even after decades of research and thousands of published studies, economists have not yet reached a consensus on whether markets are efficient — especially financial markets.

Eugene F. Fama (Fama, 1963) independently developed the basic notion of market efficiency from two very different research agendas. These changes would push researchers along two distinct trajectories leading to several advances and other milestones, all originating from their point of intersection, EMH.

Grossman and Stiglitz (Stiglitz & Grossman, 1982) developed a competitive asset equilibrium pricing model, a model with asymmetric information between informed traders receiving a one-share stock payment signal and uninformed traders' version of the private signal free of price of stock.

**Theoretical framework on the relationship between the exchange rate and inflation**

The relationship between the exchange rate and inflation is explained by Dornbusch (Carrera, J., and Vuletin, 2002) for the first time. According to them, they developed an econometric model and examined the effect of the exchange rate on prices. Dornbusch's work has been the basis for other studies (Cambazoğlu, Karaalp Orhan, & Vergos, 2013); examining the relationship between the exchange rate and domestic prices, Dornbusch spoke about market density, import volume, import substitution, and domestic production channels.

(Agénor, 1996) mentioned four main transmission mechanisms of how exchange rate fluctuations affect inflation:

• An open economy can directly affect the price of imported substitute goods and goods that are subject to trade.

• The price of final goods can be indirectly increased through the prices of imported inputs.

• Due to exchange rate fluctuations, uncertainties in foreign exchange prices may affect domestic producer prices and increase domestic prices.

• Finally, it raises prices through wages.

• Exchange rate changes experienced in an open economy affect the relative prices between domestic and foreign goods, thus triggering domestic and external demand for household goods. As a result, aggregate demand and inflation rates are indirectly affected by net exports.

## STATISTICAL ANALYSIS OF THE DAILY EXCHANGE RATE

### Statistical analysis of the daily exchange rate Euro / Lek

First, it is important to provide a statistical description of the nominal exchange rate of Euro / Lek to better understand the performance of this exchange rate over the years of study. As can be seen from the graph below (see Figure 1), during the period January 2011 - May 2018, the nominal daily exchange rate of the Euro against the Albanian Lek has fluctuated continuously. In the first two quarters of 2011 there is a strengthening of the Euro currency compared to the local currency Lek, until it reaches its highest value against the Albanian Lek, 142.84 in June (see Table 1). In continuation, this course experiences significant fluctuations, which accompany almost the whole of 2012. During the years 2013-2014 and the first two quarters of 2015, these fluctuations are smoother, while this course moves between values 138.9-141.5. In the last two years there is a downward trend of the nominal daily exchange rate Euro / Lek, reaching its lowest value of 125.42 in May 2018 (see Table 1).

Pearson's asymmetry coefficient, S = .51.537, indicates that the data are asymmetric left (negative), while the flatness coefficient greater than 3 indicates that the data ours are leptocortical, $\kappa = 5.23$, which means that their central crest is longer thinner than the normal distribution (see Figure 1). So we can notice deviation of our data distribution from normal distribution. This fact is reinforced even more by the Jarque-Bera criterion whose value is 1113.75 and p-value ≈0.000, which indicates that the distribution of nominal daily exchange rate data Euro / Lek deviates from the normal standard distribution.

Figure 1 Exchange Rate during January 2011 – May 2018

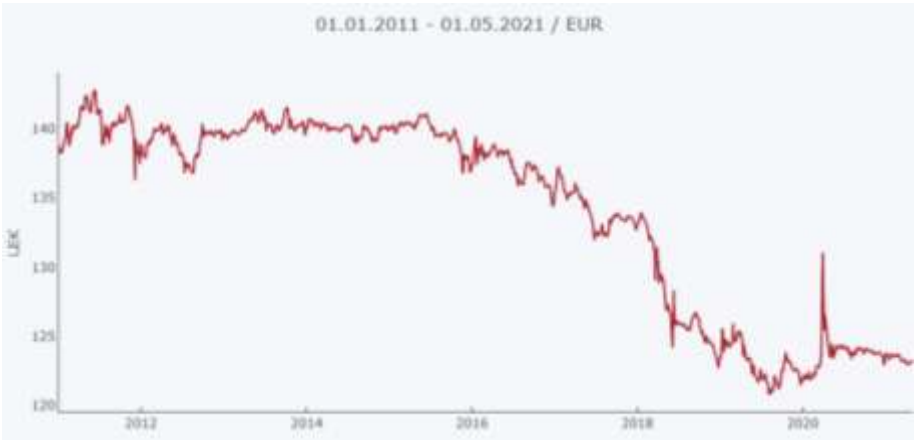



Table 1 Statistical description of the daily exchange rate Euro / Lek

| | Jan. 2011-Maj 2018 | Viti 2011 | Viti 2012 | Viti 2013 | Viti 2014 | Viti 2015 | Viti 2016 | Viti 2017 | Viti 2018 |
|---|---|---|---|---|---|---|---|---|---|
| Mean | 138.266 | 140.33 | 139.008 | 140.271 | 139.96 | 139.75 | 137.373 | 134.132 | 130.681 |
| Median | 139.510 | 140.42 | 139.36 | 140.21 | 140.08 | 139.98 | 137.51 | 133.74 | 131.450 |
| Max | 142.840 | 142.84 | 140.40 | 141.57 | 140.76 | 141.13 | 139.48 | 137.29 | 133.990 |
| Min | 125.420 | 136.31 | 136.80 | 139.24 | 138.94 | 136.8 | 134.39 | 131.98 | 125.420 |
| Dev. Standard | 2.956 | 1.230 | 0.989 | 0.538 | 0.411 | 0.965 | 1.098 | 1.3157 | 2.54309 |
| Coef. i asym. i Pearson-it | -1.537 | -0.249 | -0.675 | 0.495 | -0.662 | -1.211 | -0.523 | 0.435 | -0.382 |
| Coef. Pearson-it | 5.230 | 2.681 | 2.239 | 2.525 | 2.626 | 4.130 | 2.506 | 2.206 | 1.747 |
| Jarque-Bera | 1113.75 | 3.7040 | 25.158 | 12.62 | 19.967 | 74.157 | 13.776 | 14.172 | 9.241 |
| p-value | 0.000 | 0.1569 | 0.000 | 0.001 | 0.000 | 0.000 | 0.001 | 0.000 | 0.009 |
| Sum | 256070.1 | 35505.8 | 34891.02 | 35208.1 | 35412.04 | 34799.2 | 33931.1 | 32862.5 | 13460.1 |
| Number of data | 1852 | 253 | 251 | 251 | 253 | 249 | 247 | 245 | 103 |

***Stationary control***

One of the basic properties of a financial time series is its stationarity. The analysis of the stationarity of the series is important because its stationarity (non-stationarity) can affect the behavior and properties of this series. Also, in if the series is not stationary then the results of the regression analysis can be untrue. To test the hypotheses:

$H_0$: Nominal daily exchange rate Euro / Lek for the period January 2011-May 2018 has been stationary;

$H_1$: Nominal daily exchange rate Euro / Lek for the period January 2011-May 2018 has not been stationary,

We used two stationarity criteria, the ADF criterion and the PP criterion. The results of these the two criteria are presented below (Table 2).

Both criteria show that the series of nominal daily exchange rate Euro / Lek has a unit root, i.e. this series is not stationary. Often to turn series into stationary the differences of their terms are taken. In this study we took the first logarithmic differences natural data, $\Delta xt = \ln(xt) - \ln(xt - 1)$, which indicates the growth rate of the series of the exchange rate. Both criteria indicate the absence of the unit root in the first differences. So the series is integrated of the first order, I (1). We can notice graphically that the mean of the series of differences is close to zero.

Table 2 ADF and PP criteria for the nominal daily exchange rate Euro / Lek

| | Level | | First Diff. Log | |
|---|---|---|---|---|
| Method | Obs. values | p-value | Obs. values | p-value |
| ADF | 1.298 | 0.998 | -28.845 | 0.000 |
| PP | 1.676 | 0.999 | -27.558 | 0.000 |
| Critical Value | Level 1% | | -3.433 | |
| | Level 5% | | -2.862 | |
| | Level 10% | | -2.567 | |

Source: calculations are made with Eviews

***Autocorrelation control***

For a financial series to be a marting process, the serial correlation of its rate must be zero. To test if the series of differences suffers from the presence of serial correlation, we used the LB criterion. The following table (Table 3) presents the results of this criterion for steps 1, 5, 10, 15, 20. As can be seen the basic hypothesis that the serial correlation of this series is zero is rejected with a confidence level of 99.9%.

To check if the data of our series are random, we used the rane criterion both in relation to the mean and in relation to the median. The hypotheses that are tested are: $H0$: The observed values of the first differences of the nominal daily exchange rate Euro / Lek\ are random; $H1$: The observed values of the first differences of the nominal daily exchange rate Euro / Lek are not random. The results of this criterion are given in the Table 4. This Criterion rejects the null hypothesis, that the data are random, with a level of 99.9% reliability. This result is not consistent with the martingale or effective market hypothesis.

Table 3 Correlation for ∆ln (Euro/Lek)

| | Statistic Q (Ljung-Box) | | | | |
|---|---|---|---|---|---|
| | K=1 | K=5 | K=10 | K=15 | K=20 |
| ∆ln (Euro/Lek) | 252.84 | 274.54 | 286.45 | 327.86 | 356.21 |
| p- value | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |

Table 1.4 Criterion of rane for ∆ln (Euro/Lek)

| | Mean | Median |
|---|---|---|
| ∆ln (Euro/Lek) | 642.00 | 592.00 |
| p- value | (0.000) | (0.000) |

***Testing the martingale hypothesis***

Hypotheses that are tested:

$H0$: Nominal daily exchange rate Euro / Lek is a martinginal process, for the period January 2011- May 2018;

$H1$: The nominal daily exchange rate Euro / Lek is not a marting process, for the period January 2011- May 2018.

To test if the nominal daily exchange rate Euro / Lek is subject to the marting hypothesis, the criterion of the ratio of variance. The results of this criterion are presented in Table 5.

The multiple Chow-Denning criterion rejects the martingale hypothesis for the nominal daily exchange rate of the Euro against the Albanian Lek with 99.9% reliability, so this exchange rate has not been effective. While the ratio of variances in steps 2, 4, 8 is different from the unit with a high confidence level, respectively 99.99%, in the first two steps and 99.97% in step 8. While in step 16 the confidence level drops to 80%. This means that regression residues ln (Euro / Lek) = ln (Euro / Lek) + suffer from serial correlation. This contradicts the martingale hypothesis.

Table 5 VR criterion for ln (Euro / Lek)

| **Chow-Denning multiple variance ratio criterion** | | **Individual criterion of variance ratio** | | | | |
|---|---|---|---|---|---|---|
| | | Period | 2 | 4 | 8 | 16 |
| $H_0$: Ln(Euro/Lek) is martingal | | Rap. Var. | 1.369 | 1.488 | 1.426 | 1.335 |
| Max\|z\| | 5.428 | Gab. std. | 0.068 | 0.136 | 0.195 | 0.242 |
| Nr of degrees of freedom | 1850 | Stat. Z | 5.428 | 3.577 | 2.183 | 1.387 |
| Prob. | 0.000 | p-value | 0.000 | 0.000 | 0.029 | 0.165 |

The following tables give the test result of the martingale hypothesis for each of the years under consideration, from 2011 to the first quarter of 2018. The multiple Chow-Denning

criterion rejects the martingale hypothesis for the nominal exchange rate Euro / Lek for the years 2012-2017, but does not reject this hypothesis for the year 2011 and the first five months of 2018. This means that in the years 2012-2017 the nominal exchange rate Euro / Lek has not been effective

**Statistical analysis of the daily exchange rate USD / Lek**

The nominal daily exchange rate of the US Dollar against the local currency, the Albanian Lek, during the period January 2011-May 2018, has undergone significant changes. During the period January 2011 until the second quarter of 2014, the local currency remained at an average value of 100.13 against the US currency unit. From the second quarter of 2014 and throughout 2015, the US dollar has appreciated against the Albanian Lek, reaching its maximum value, 133.35, in March 2015. During the following period until May 2017, the dollar has remained at a average of 125.25 units of local currency. The following is an underestimation of the US currency against our currency.

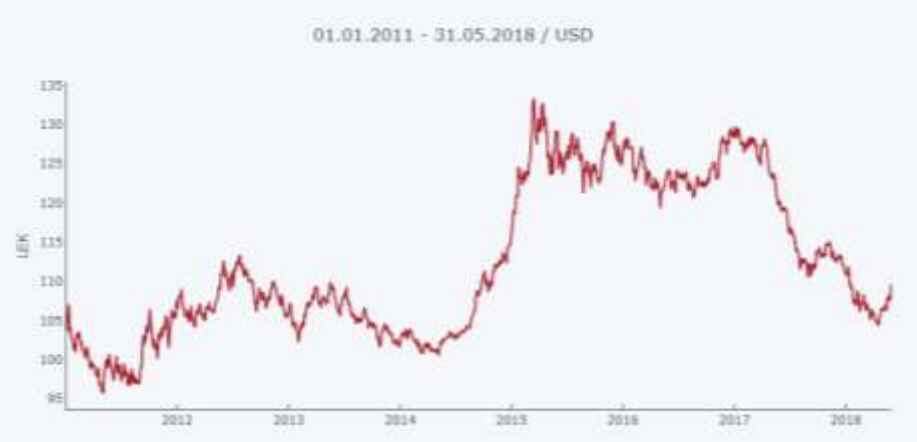
Pearson's coefficient of asymmetry, S = 0.393, indicates that the data are asymmetric to the right (positive), while the flatness coefficient less than 3 indicates that our data is flat, κ = 1.76, which means that the crest their central is lower and wider than that of normal distribution (see Figure 2). So, there is a deviation of the distribution of our data from the normal distribution, a fact which is also supported by the Jarque-Bera statistics whose value is 166.28 (p - value ≈ 0.000), which shows that the distribution of exchange rate data Dollar / Lek exchange deviates from the normal standard distribution.

Table 6 VR criterion for the nominal daily exchange rate Euro / Lek by years

| | **Chow-Denning multiple variance ratio criterion** | | **Individual criterion of variance ratio** | | | | |
|---|---|---|---|---|---|---|---|
| | | | Period | 2 | 4 | 8 | 16 |
| **Year 2011** | $H_0$: Ln Euro/Lek ) is martingal | | Rap. Var. | 1.329 | 1.268 | 1.203 | 1.080 |
| | Max\|z\| | 2.186 | Gab. std. | 0.150 | 0.317 | 0.450 | 0.540 |
| | Nr.degree of freedom | 252 | Stat. Z | 2.186 | 3.846 | 0.451 | 0.148 |
| | Prob. | 0.110 | p-value | 0.028 | 0.397 | 0.651 | 0.882 |
| **Year 2012** | $H_0$: Ln( Euro/Lek ) is martingal | | Rap. Var. | 1.337 | 1.661 | 1.719 | 1.720 |
| | Max\|z\| | 4.463 | Gab. std. | 0.086 | 0.148 | 0.212 | 0.289 |
| | Nr.degree of freedom | 250 | Stat. Z | 3.913 | 4.463 | 3.391 | 2.487 |
| | Prob. | 0.000 | p-value | 0.000 | 0.000 | 0.000 | 0.012 |
| **Year 2013** | $H_0$: Ln( Euro/Lek ) is martingal | | Rap. Var. | 1.364 | 1.446 | 1.408 | 1.335 |
| | Max\|z\| | 3.489 | Gab. std. | 0.104 | 0.196 | 0.285 | 0.378 |
| | Nr.degree of freedom | 249 | Stat. Z | 3.489 | 2.273 | 1.430 | 0.885 |
| | Prob. | 0.001 | p-value | 0.000 | 0.023 | 0.152 | 0.376 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Year 2014** | $H_0$: Ln( Euro/Lekë) is martingal | | Rap. Var. | 1.322 | 1.497 | 1.472 | 1.578 |
| | Max\|z\| | 3.928 | Gab. std. | 0.081 | 0.157 | 0.243 | 0.335 |
| | Nr.degree of freedom | 252 | Stat. Z | 3.928 | 3.168 | 1.943 | 1.725 |
| | Prob. | 0.000 | p-value | 0.000 | 0.001 | 0.051 | 0.084 |
| **Year 2015** | $H_0$: Ln( Euro/Lek ) is martingal | | Rap. Var. | 1.453 | 1.793 | 1.585 | 1.551 |
| | Max\|z\| | 3.680 | Gab. std. | 0.126 | 0.215 | 0.330 | 0.447 |
| | Nr. Degree of freedom | 248 | Stat. Z | 3.597 | 3.680 | 1.772 | 1.232 |
| | Prob. | 0.000 | p-value | 0.000 | 0.000 | 0.076 | 0.217 |
| **Year 2016** | $H_0$: Ln Euro/Lek ) is martingal | | Rap. Var. | 1.346 | 1.483 | 1.314 | 1.002 |
| | Max\|z\| | 3.202 | Gab. std. | 0.108 | 0.190 | 0.278 | 0.384 |
| | Nr. Degree of freedom | 246 | Stat. Z | 3.202 | 2.539 | 1.127 | 0.006 |
| | Prob. | 0.005 | p-value | 0.001 | 0.011 | 0.259 | 0.995 |
| **Year 2017** | $H_0$: Ln( Euro/Lek ) is martingal | | Rap. Var. | 1.491 | 1.917 | 2.076 | 2.273 |
| | Max\|z\| | 5.685 | Gab. std. | 0.091 | 0.161 | 0.239 | 0.322 |
| | Nr. Degree of freedom | 244 | Stat. Z | 5.354 | 5.685 | 4.494 | 3.946 |
| | Prob. | 0.000 | p-value | 0.000 | 0.000 | 0.000 | 0.000 |
| **Year 2018** | $H_0$: Ln (Euro/Lek ) is martingal | | Rap. Var. | 1.452 | 1.468 | 0.993 | 0.556 |
| | Max\|z\| | 2.113 | Gab. std. | 0.214 | 0.380 | 0.540 | 0.697 |
| | Nr. Degree of freedom | 102 | Stat. Z | 2.113 | 1.231 | -0.011 | -0.635 |
| | Prob. | 0.131 | p-value | 0.034 | 0.218 | 0.990 | 0.525 |

Figure 2 Exchange rate USD/Lek (source Central Bank of Albania)




***Stationary control***

Hypotheses are tested:

$H_0$: Nominal daily exchange rate USD / Lek for the period January 2011-May 2018 has been stationary;

$H_1$: Nominal daily exchange rate USD / Lek for the period January 2011-May 2018 has not been stationary

Table 7 presents the results of the ADF and PP criteria for the presence of unit roots in the time series of the US Dollar exchange rate against the Albanian Lek. Both criteria indicate the presence of unit roots at the level of this series, but not in the first differences of the series. This means that the exchange rate series is integrated first order, I (1). This is a result that supports the effective market or martingale hypothesis. From the graph of the first differences in the logarithm, as well as their statistical description it is noticed that the average of the data fluctuates around zero. Also the distribution of this series is different from that of the normal distribution, the observed value of the JB statistic is 516.39 (p-value 0.000).

Table 7 Unit root criterion for the nominal daily exchange rate USD / Lek

| | Level | | Log diferencial | |
|---|---|---|---|---|
| Method | Obs. value | p-value | Obs. value | p-value |
| ADF | -1.376 | 0.595 | -42.518 | 0.000 |
| PP | -1.385 | 0.591 | -42.514 | 0.000 |
| Critical Value | Level 1% | | -3.433 | |
| | Level 5% | | -2.862 | |
| | Level 10% | | -2.567 | |

***Serial autocorrelation control***

Ljung-Box (Q) criterion for controlling the basic hypothesis, H0: ρ1 = ρ2 = ⋯ = ρk = 0, versus the alternative, H1: ρi ≠ 0, for any i from 0 to k, indicates the absence of serial correlation in the USD / Lek exchange rate during the period January 2011-May 2018, for k = 1, 5, 10, 15 and 20.

The fact of serial correlation of data is also supported by the run criterion which shows that the observations are random (see Table 8). The P-value of this criterion in relation to both the mean and the mean are greater than 0.05. This result is in coherence with the martingale hypothesis (effective market in weak form).

Table 8 Falling criteria for ∆ln (USD / Lek)

| | Meam | Median |
|---|---|---|
| ∆ln (USD/Lek) | 941.00 | 928.00 |
| p-value | | |
| | (0.465) | (0.409) |

***Testing the martingale hypothesis***

We test the following hypotheses:

$H_0$: Nominal daily exchange rate USD / Lek is a martinginal process, for the period January 2011- May 2018;

$H_1$: Nominal daily exchange rate USD / Lek is not a martinginal process, for the period January 2011- May 2018.

Criteria of the ratio of variance, both individual (with steps 2, 4, 8, 16) by Lo - MacKinlay as well even the Chow-Denning multiple, suggest that the nominal USD / Lek exchange rate for the period January 2011-May 2018 has been a martinginal process. The results of these criteria are presented in the table below. The ratio of variances in steps 2, 4, 8 and 16 is no different from 1, for the significance level ë 5%.

Table 9 Criteria of the ratio of variance for USD / Lek

| **Chow-Denning Multiple variance ratio criterion** | | **Individual criterion of variance ratio** | | | | |
|---|---|---|---|---|---|---|
| | | Period | 2 | 4 | 8 | 16 |
| $H_0$: Ln (USD/Lek) is martingal | | Rap. Var. | 1.009 | 1.007 | 0.980 | 0.944 |
| Max\|z\| | 0.489 | Gab. Std. | 0.026 | 0.049 | 0.077 | 0.114 |
| Nr.degree of freedom | 1850 | Stat. Z | 0.354 | 0.150 | -0.252 | -0.489 |
| p-value | 0.980 | p-value | 0.726 | 0.880 | 0.800 | 0.624 |

The results of these criteria for each of the years under consideration are given in Table 10. The statistics of the Chow-Denning variance ratio show that the basic hypothesis, that the nominal daily exchange rate USD / Lek was a martinginal process, cannot be rejected for any of the years examined. This conclusion is also supported by the individual criterion of the variance ratio for steps 2, 4, 8 and 16. Note that this ratio is approximately equal to one, for the significance level 5%, for each of the years from 2011 to 2017, as well as for the first five months of 2018.

Table 10 Criteria of the ratio of variance for USD / Lek by years

| | **Chow-Denning Multiple variance ratio criterion** | | **Individual criterion of variance ratio** | | | | |
|---|---|---|---|---|---|---|---|
| | | | Period | 2 | 4 | 8 | 16 |
| **Year 2011** | $H_0$: Ln(USD/Lek) is martingal | | Rap. Var. | 1.027 | 1.001 | 0.887 | 0.813 |
| | Max\|z\| | 0.677 | Gab. Std. | 0.066 | 0.121 | 0.187 | 0275 |
| | Degrees of freedom | 252 | Stat. Z | 0.417 | 0.013 | -0.597 | -0.677 |
| | Prob. | 0.936 | p-value | 0.676 | 0.989 | 0.550 | 0.498 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Year 2012 | $H_0$: Ln (USD/Lek) is martingal | | Rap. Var. | 0.990 | 1.011 | 0.996 | 0.949 |
| | Max\|z\| | 0.188 | Gab. Std. | 0.066 | 0.118 | 0.180 | 0.270 |
| | Degrees of freedom | 250 | Stat. Z | -0.145 | 0.093 | -0.019 | -0.188 |
| | Prob. | 0.999 | p-value | 0.884 | 0.925 | 0.984 | 0.850 |
| Year 2013 | $H_0$: Ln (USD/Lek) is martingal | | Rap. Var. | 0.905 | 0.954 | 1.102 | 1.143 |
| | Max\|z\| | 1.591 | Gab. Std. | 0.059 | 0.105 | 0.173 | 0.264 |
| | Degrees of freedom | 250 | Stat. Z | -1.591 | -0.436 | 0.591 | 0.543 |
| | Prob. | 0.377 | p-value | 0.111 | 0.662 | 0.554 | 0.586 |
| Year 2014 | $H_0$: Ln (USD/Lek) is martingal | | Rap. Var. | 0.982 | 0.939 | 0.927 | 0.998 |
| | Max\|z\| | 0.507 | Gab. Std. | 0.062 | 0.118 | 0.191 | 0.290 |
| | Degrees of freedom | 252 | Stat. Z | -0.279 | -0.507 | -0.376 | -0.005 |
| | Prob. | 0.977 | p-value | 0.780 | 0.611 | 0.706 | 0.995 |
| Year2015 | $H_0$: Ln (USD/Lek) is martingal | | Rap. Var. | 1.068 | 1.080 | 1.101 | 0.991 |
| | Max\|z\| | 1.062 | Gab. Std. | 0.064 | 0.118 | 0.187 | 0.279 |
| | Degrees of freedom | 248 | Stat. Z | 1.062 | 0.675 | 0.539 | -0.029 |
| | Prob. | 0.743 | p-value | 0.288 | 0.499 | 0.589 | 0.976 |
| Year 2016 | $H_0$: Ln (USD/Lek) is martingal | | Rap. Var. | 0.905 | 0.920 | 0.876 | 0.751 |
| | Max\|z\| | 1.637 | Gab. Std. | 0.057 | 0.109 | 0.174 | 0.256 |
| | Degrees of freedom | 246 | Stat. Z | -1.637 | -0.730 | -0.710 | -0.970 |
| | Prob. | 0.348 | p-value | 0.101 | 0.465 | 0.477 | 0.331 |
| Year 2017 | $H_0$: Ln (USD/Lek) is martingal | | Rap. Var. | 1.003 | 0.982 | 1.011 | 1.001 |
| | Max\|z\| | 0.140 | Gab. Std. | 0.069 | 0.126 | 0.190 | 0.273 |
| | Degrees of freedom | 244 | Stat. Z | 5.354 | 5.685 | 4.494 | 3.946 |
| | Prob. | 0.999 | p-value | 0.963 | 0.888 | 0.953 | 0.994 |
| Year 2018 | $H_0$: Ln (USD/Lek) is martingal | | Rap. Var. | 1.180 | 1.089 | 0.917 | 0.986 |
| | Max\|z\| | 1.610 | Gab. Std. | 0.111 | 0.204 | 0.302 | 0.426 |
| | Degrees of freedom | 102 | Stat. Z | 1.610 | 0.440 | -0.273 | -0.031 |
| | Prob. | 0.361 | p-value | 0.107 | 0.659 | 0.784 | 0.975 |

## CONCLUSIONS

Nominal daily exchange rate Euro / Lek, during the period January 2011-May 2018 turns out not to be in line with the effective market hypothesis. This statement is based on a series of criteria used over the time series of this course.

- The ADF and PP criteria show that the growth rate of the nominal daily exchange rate Euro / Lek is a stationary process (in line with the effective market hypothesis).
- This time series suffers from serial correlation, with a confidence level of 99.9%. The rane criterion also refutes the hypothesis that the observations are random.
- The VR criterion rejects the hypothesis that this exchange rate was a marting process with a 99.9% confidence level (i.e. not effective in weak form).
- This exchange rate has not been a fair game, with 99.95% confidence level (not effective in poor form). V. Nominal daily exchange rate Euro / Lek suffers from the calendar anomaly of "day of the week" (ineffective in weak form). Specifically, the effect

of Monday is observed, with a negative daily average, as well as the effect of Wednesday, with a positive average.

Nominal daily exchange rate USD / Lek, during the period January 2011-May 2018 turns out to have been in line with the effective market hypothesis.

- The ADF and PP criteria show that the growth rate of the nominal daily exchange rate Euro / Lek is a stationary process.
- The time series of the growth rate does not suffer from serial correlation, with 95% confidence level, and the Raner criterion accepts the hypothesis that the observations are random with 95% confidence level (effective in weak form).
- The VR criterion accepts the hypothesis that this exchange rate was a marting process with a 95% confidence level (i.e. effective in weak form).
- This exchange rate has not been a fair game, with 99.9% confidence level (not effective in poor form).
- Also this exchange rate does not suffer from the calendar anomaly of the "day of the week"

## RECOMMENDATIONS

Since the exchange rate in Albania is an unfair process, then the Central Bank of Albania, as a monetary authority in Albania, must undertake a concrete strategy, so that the exchange rate is a fair game.

Also, the presence of excessive speculation in the foreign exchange rate causes the repeal of the law of supply and demand and harms fair competition. Competent bodies should stop "bad policies" which allow for excessive speculation.

This study was limited to calculating the variability of the nominal exchange rate and a not very detailed statistical analysis of it, while it remains to study the impact and role of exchange rate variability on other macroeconomic variables in Albania, for example. impact on the level of exports, imports, foreign direct investment, etc. This study may require special statistical procedures, e.g. use of econometric methods and models. A field of study can also be research for better strategies, so that the exchange rate becomes effective and attracts more foreign or even domestic investors.

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