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PAPER

An Assessment in Terms of Investment Efficiency in an Informal Economy. A Case Study with 30 Years Biased Data from Albanian Forex Market

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ABSTRACT

While observing the charts of the foreign exchange market in Albania, it is evident that the market in Albania is less dynamic than the market in the region. The financial system in Albania needs more information to build strategies, for there is a lack of financial transparency. It is a controlled financial system to a certain extent. Most banks contribute to the market, as do financial companies, individual speculators, and import-export companies. By examining these charts, one can discern the fractal and repetitive patterns within the behavior of the financial market. Empirical evidence indicates a notable interdependence and correlation between price movements. This paper empirically explores the possibilities of investing with an efficient risk-return ratio using the data from the Bank of Albania. This analysis presents an approach to portfolio theory while working with biased data in an informal economy. It addresses the question of which asset investments are efficient for the informal economy in Albania over a span of 30 years. The analysis encompasses nine different assets are considered for the analysis: USDALL, GBPALL, CHFALL, EURALL, XAUALL, XAGALL, JPYALL, AUDALL, and CADALL.

KEYWORDS

forex, Python, portfolio efficiency, informal economy, Albanian financial data, risk-reward

1 INTRODUCTION

Markets are dynamic, and traders should be as well. Money management differs because everyone has a different risk tolerance [1]. But traders, investors, we all have something in common. We repeat what is familiar. We develop patterns. We want to see patterns. One action triggers another. It is how we evolve. That is also the way markets work. It reflects the habits of all participants. It has memory [2]. Today does, in fact, influence tomorrow. Price changes deviate significantly following the bell curve [3]. The market in Albania is less dynamic than

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the market in the region. This is observable from charts, using a technical analysis point of view. The exchange rate is derived statistically as a daily average [4], [5]. The financial system in Albania needs more information to build strategies due to a lack of financial transparency. [4], [6]. Most financial news and analysts' recommendations come out when the market is inactive and during weekends [4]. Albania has no free market built on an open trading system yet. [6] Given this situation, this paper empirically explores the possibilities of investing with an efficient risk-return ratio using Bank of Albania data. The financial markets encompass much more than currencies, bonds, and equities [7]. There are also precious metals and commodities. As the country adapts to technologial development and standards faster than ever, the economic background relies on the banking sector alone.

Albania has yet to develop a free market. Even in 1997, the market was suspicious due to history's most significant economic and political crisis. For about eight months, the Tirana Stock Exchange (TSE) did not record any transactions being made at that time. However, October marked the largest volume of transactions in the entire period from the beginning to today. The Bank of Albania gave no opportunity to put a formal market exchange of currencies in place, although the project was supported by Kreditanstalt für Wiederaufbau (KfW) and Deutsche Börse. Consequently, TSE missed the historic opportunity at the right moment to put in place a modern platform for trading currencies when the banking system was in an initial stage, and this platform's competitiveness was higher compared with alternative trade systems (ATS) [8]. A close view of the news articles and recommendations revealed that the investment recommendations follow the day's price trend. People naturally want to make investments by imitating the major trends. As a group, we feel more secure for it is simpler to be taken by one of the crowds. In terms of financial speculation, the crowd needs to be corrected [1], [9]. Real-world evidence abounds in situations that defy consensus and challenge popular opinion. The impact of the Bank of Albania's measures to stabilize the flow of money outside the official market will be illustrated by examining the financial statistics for Albania over the past 30 years. To answer the question of which asset investment is efficient for the informal economy of these 30 years in Albania, nine different assets are considered for the analysis: USDALL, GBPALL, CHFALL, EURALL, XAUALL, XAGALL, JPYALL, AUDALL, and CADALL. These nine assets are the Albanian economy's primary nodes for trade exchanges [10]. If we choose the proper risk-return ratio, we can select a portfolio with a high return and a lower risk than any asset. We can have a much lower-risk portfolio if we combine anti-correlated assets because when one asset moves up, the other moves down, so they cancel each other out. Therefore, we have much less volatility. But we want all these assets to move up together generally. Catching the short side of a bear market allows the trader to profit far more quickly than trading the long side of a bull market [11]. This empirical observation is also a cornerstone of the technical analysis of the financial markets. Investing is a balance of reward and risk. Greater rewards, and vice versa, offset more significant risks. Topping patterns are more difficult to catch, but worth the effort. [11]. We are looking for anti-correlation in the short term and positive correlation in the long term. We plot the efficient frontier to see where the portfolio is relative to the assets we're using and where they could be in terms of efficiency.

The sections of this paper are organized as follows: A literature review is provided in Section 2. The methodology of the data collection and motivation for using Python to implement the proposed algorithm are provided in Section 3. The calculations are presented in Section 4. The results of this study are presented in Section 5. The last section of this paper contains the conclusions.

2 LITERATURE REVIEW

In 1952, Harry Markowitz introduced a new quantitative method for choosing portfolios. This approach relied on the volatility of assets and their correlations to determine the optimal portfolio for achieving the highest expected return while keeping risk at a specific level [12]. In 1963, the Capital Asset Pricing Model (CAPM) was independently developed by William Sharpe, John Lintner, and Jan Mossin [13]. Significant progress has been made in the study of GARCH models over the past 20 years, as initially defined by Bollerslev in 1986. Analysts have recently focused on daily and inter-day data, leading to new research on conditional volatility models [14]. Many researchers have conducted thorough studies of emerging markets. In 1998, Bekaert, Erb, Harvey, and Viskanta pointed out that the return distribution in these markets significantly differs from the norm [15]. According to Rasmussen (2003), three key factors aid in determining risk [16]. The first factor is frequency, which refers to how often an event occurs. The second factor is the event's magnitude, which involves assessing the likely consequences and describing them financially. The third and final factor is the risk assessment's reliability, which depends on the quality and certainty of the available information. This includes evaluating the reliability and understanding of the data. One of the premises that drives this article to shed light on the economic studies of Albania comes from the research done in 2003 by Rasmussen, who suggested that investors should actively pursue stocks in sectors or countries with a consistent and low correlation [16]. In 2003, Patev and Kanaryan empirically analyzed the stock markets in Greece, Turkey, and Romania. Their research is based on the belief that the markets in the Balkan region have unique qualities that financial analysts should consider separately [17]. Research highlights these characteristics: Balkan stock markets are typical emerging markets, and markets in this region can give investors additional diversification opportunities thanks to the low correlation of these markets with developed countries. The study also underscores the presence of a 'leverage effect' in Greece and Turkey, demonstrating a notable impact caused by the negative shock on the volatility of these market stakeholders. Volatility is proven to be higher during negative trends than during blooming periods [17]. Bonin and Wachtel (2003) analyze the financial sector's development in developing countries. In others, the authors claim that banks and banks internationally lead, while others dominate transition economies. Bonin and Wachtel (2003) conclude that institutions in these countries have made considerable progress [18]. Jagric, Hribenik, and Stajnko (2005) analyze the properties of stock markets in six economies in transition: Slovenia, Hungary, Poland, Russia, Slovakia, and the Czech Republic. The authors try to determine whether these markets satisfy the Efficient Markets Hypothesis (EMH). They analyze the long-term interdependence of the returns of selected stocks by calculating the Hurst exponent [19]. According to Andersen, Bollerslev, Christoffersen, and Diebold's (2005) research, the realized volatility of security returns follows a lognormal distribution and has long-term memory, represented by its square root [20]. Hunjak and Cingula (2005) analyze how to build a portfolio in emerging economies, focusing on the Zagreb Stock Exchange. Investors who wish to invest in the Croatian market must be based on something other than technical or fundamental analysis for their decision-making due to the market's specific conditions. Technical analysis would only be useful if the market value and liquidity were independent of the quality and the number of investors (often foreign) [21]. The authors suggest that risk factors play a crucial role in the decision-making process for investors. In emerging markets, such as Croatia, various risk factors exist. One major issue is the lack of political stability, which can negatively impact the market. Additionally, insider dealings risk the transparency and proper functioning of the capital market. Therefore, relying solely on analytical models for analysis is insufficient for market participants in Croatia. Cavusoglu (2007) tests weak-form efficiency in the Athens Stock Exchange by controling for conditional heteroskedasticity. The paper also focuses on economic changes and the consequences of stock returns and conditional volatility [22]. In their 2007 analysis, Hasanov and Omay used non-linear "unit root" tests to evaluate the effectiveness of markets in transition economies. Specifically, they investigated whether these markets exhibited a weak form of efficiency. After conducting the "unit root" test on Bulgarian, Czech, Hungarian, Polish, Romanian, Russian, and Slovak stock prices, the authors found evidence to support the presence of a weak form of efficiency in these markets [23]. Heininen and Puttonen (2009) conducted an empirical study on market efficiency and the effects (calendar anomalies) of "day-of-the-week," "month-of-the-year," "turn-of-the-month," and Halloween for 12 economies in transition [24]. In 2009, Dobša, Kero, and Radošević conducted a study on the Zagreb stock market, evaluating the performance of 20 different high-liquidity companies. The purpose of the study was to observe how the prices of shares correlate with changes in the CROBEX stock market index and analyze the dependence of these stocks on the market index. The author's analysis shows that it is possible to predict future performance by closely examining the differences between CROBEX and individual stocks [25]. In their 2010 study, Arneric, Jurun, and Rozga explore how non-financial information affects risk management. According to information efficiency, stock prices already reflect all relevant information at any given time, making them unpredictable due to their random nature. However, when markets are not efficient, speculation can occur. Knowledge of investor expectations is necessary to determine the direction and magnitude of price changes, and the CAPM model can help eliminate hidden market factors [26]. In a study conducted by Tudor (2011), the efficiency of the Romanian stock market was analyzed using monthly data from 2002 to 2008 for 60 companies listed on the Stock Exchange in Bucharest. The study examined the efficient market hypotheses defined by Fama (1970) in two ways. Firstly, the relationship between stock returns and the financial ratios of the companies was analyzed. Secondly, the study tested for information asymmetry in the market [27]. Manolakis (2012) studied the Greek stock market yields using Fama and French's three-factor model (TFM). The study examined 229 stocks on the Athens Stock Exchange from June 2001 to June 2011. The TFM model was found to be more effective in describing the total variation of stock returns compared to the CAPM formulation. The results indicated that investors with larger companies experienced higher yields than those with smaller companies in their portfolios [28].

A study by L. Lamani (2014) analyzed the relationship between the Hurst exponent and the behavior of prices in the forex market in Albania. The aim was to estimate the persistence of the market. The study found that prices in the EURALL and USDALL have a short-term memory, resulting in a persistent market in short periods [2].

The stock exchanges of the Balkan region have unique characteristics and, therefore, should be considered separately from individual and institutional investors. Financial analysts should consider this market's viable regional investments due to their standardized specifications. Within this context, the paper provides an empirical assessment of the economic situation in Albania.

3 METHODOLOGY

The exchange rates of these nine pairs represent adequate data available to analyze the actual condition of the financial system in Albania. The daily returns are web-scraped and stored in a database. Data are available from January 1991 in JSON format for later use. The fact that Python will be used to implement the presented approach is already noted. Because of its widespread adoption by major financial systems, Python has risen to prominence as the language of choice for research, but its versatility as a data-analysis tool and its understandable syntax have also attracted a growing number of users. In addition, several tools have been designed from the beginning as open source, and their accessibility is steadily attracting more users. Several widely accessible modules and libraries can be quickly loaded and imported, allowing developers to create sophisticated applications with relatively few lines of code. The filtering and processing of data is a crucial starting step in this study, and Python makes it much simpler.

The Bank of Albania sets a fixed exchange rate based on an internal regulation. The regulation determining this value is based on a law of 1997, a period in which Albania did not register today's banks and institutions for the legal trading of the currencies [5]. This regulation aims to define the method of calculating this value (as a fixed one) to obtain a single level of reference for the exchange rate, which interested parties can later use for statistical, comparative, evaluative, and trading purposes. Further, we will look at how to estimate and optimize a variance-covariance matrix, how to discover an optimal portfolio, and how to design an efficient frontier with biased data from the Albanian forex market using Python as a programming language [29], [30], [31], [32].

One of the main pillars of financial theory is modern or mean-variance portfolio theory. [30]. It is necessary to assume that returns have a normal distribution, which can be entirely described by mean and variance [30], [33], [34]. Asset volatility is an easily usable tool for risk assessment, both in the case of individual titles and in the case of portfolios. This variable, encountered constantly in asset manager reports, originates from the well-known theory of Markowitz, "mean-variance." The main idea behind MPT is to diversify a portfolio to minimize risk or maximize returns based on a chosen level of risk [29], [35]. This is achieved by combining sufficient assets with varying degrees of variety. By purchasing different currencies, diversification can lower a portfolio's overall risk. Therefore, including multiple currencies in varying amounts can help investors reduce risk while increasing returns [31]. The asset weights can affect the portfolio's risk. As a result, we can generate portfolios at random, with each portfolio containing a unique set of asset weights. The efficient frontier is a set of portfolios that provide the best return for the least amount of risk [29], [31], [35]. The mean and variance of the log returns of the various securities are called mean-variance [34]. Quantitative portfolio optimization aims to determine: (a) the minimum variance portfolio, (b) the minimum level of volatility for a given yield level, and (c) the maximum level of yield for a given level of volatility.

4 CALCULATIONS

The number of actors participating in the market today, which is supposed to be free, is more significant than when the Bank of Albania approved the law. Nothing has changed since then. This makes the result of a calculated average insignificant and impossible to achieve for the purpose of this regulation. As commonly accepted, data quantification is the future's dimension. We see significant differences in annualized performance throughout the time series data. The data are collected, stored in a database, and retrieved as JSON. The following is a sample of data obtained in JSON format.


```
{"Data":"2023-06-01","USD":102.32,"GBP":127.15,"CHF":112.51,
"EUR":109.40,"XAU":200402.93,"XAG":2393.61,"AUD":66.56,
"CAD":75.38,"JPY":73.19},{"Data":"2023-06-02","USD":101.07,
"GBP":126.64,"CHF":111.63,"EUR":108.73,"XAU":200188.34,
"XAG":2421.01,"AUD":67.02,"CAD":75.35,"JPY":72.81}
```


We use a factor of 233 trading days to annualize the daily returns. The covariance matrix for the assets to be invested in is at the heart of the portfolio selection process. We assume that a shareholder may only establish long-term holdings. As a result, 100% of the investor's assets must be allocated among the various instruments to ensure that each position is long (positive) and that they all total up to 100%. Given the nine instruments, one could, for example, invest equal amounts in every such instrument (i.e., 25% of the available wealth in each). Based on the formula for the expected portfolio return given the weights for the single securities (1), we generate nine uniformly distributed random integers between 0 and 1 and then normalize the data so that the total of all values equals 1. ($\Sigma_I w_i = 1$), where I is the number of financial instruments and $w_i > 0$ is the weight of financial instrument i.

$$\mu_p = E\left(\sum_I w_i r_i\right) \Rightarrow \sum_I w_i E(r_i) \Rightarrow \sum_I w_i \mu_i \Rightarrow w^T \mu \tag{1}$$

Equation 1. General formula for expected portfolio return

Assuming that historical mean performance is the best predictor of future (expected) performance, this is an expected portfolio return. Here, r_i is the state-dependent future returns (vector with return values assumed to be normally distributed), and μ_i is the expected return for instrument i. Finally, w^T is the transpose of the weights vector, and μ is the vector of the expected security returns. The predicted portfolio variance is another important consideration [36], [37]. A matrix that depicts the correlation of daily returns and defines the covariance between two financial assets:

$$\sigma_{ij} = \sigma_{ji} = E(r_i - u_i)(r_j - u_j) \tag{2}$$

$$\Sigma = \begin{bmatrix} \sigma_1^2 & \sigma_{12} & \cdots & \sigma_{1I} \\ \sigma_{21} & \sigma_2^2 & \cdots & \sigma_{2I} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{I1} & \sigma_{I2} & \cdots & \sigma_I^2 \end{bmatrix} \tag{3}$$

A security's variance is a subset of its covariance with itself:

$$\sigma_i^2 = E((r_i - \mu_j)2) \tag{4}$$

We then complete the following formula (5) for the expected portfolio variance, with the covariance matrix of an equal weight 1 for every security.

$$\sigma_p^2 = E((r-\mu)^2) \Rightarrow \sum_{i\in I}\sum_{j\in I} w_i w_j \sigma_{ij} \Rightarrow w^T \Sigma w \tag{5}$$

Equation 5. General formula for expected portfolio variance

Given the portfolio variance, equation 6 then gives the portfolio's expected standard deviation or volatility.

$$\sigma_p = \sqrt[2]{\sigma_p^2} \tag{6}$$

Given the portfolio weights, we get annualized portfolio variance and volatility. Risk and reward are trade-offs that we deal with in finance [11], [29]. The Sharpe ratio, defined by equation 7, is a widespread criterion [38].

$$SR \equiv \frac{\mu_p - R_f}{\sigma_p} \tag{7}$$

The portfolio's expected excess return above the risk-free short rate R_f is divided by the portfolio's expected standard deviation. Based on the value the Bank of Albania determined, $R_f \equiv 0.0124$ [10]. An investor is often interested in the highest return given a specified risk level or the smallest risk given a fixed return expectation. This collection of portfolios is thus referred to as the efficient frontier [30], [35]. For portfolio optimization, the portfolio is made up of nine financial instruments. We perform a maximization of the Sharpe ratio, followed by a minimization of the variance of the portfolio. This portfolio mix leads to the so-called minimum volatility or variance portfolio [31]. An efficient frontier might be formed by connecting those efficient portfolios. We utilize historical returns to represent expected returns and historical correlation instead of expected correlation [29], [30].

5 RESULTS

By calculating and plotting the data using Python [32], [39], we get the following results.

For all 9 assets (Figures 1–3)

Table 1. Maximum Sharpe ratio portfolio allocation

	USD	GBP	CHF	EUR	XAU	XAG	AUD	CAD	JPY
Allocation	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0

Table 2. Minimum volatility portfolio allocation

	USD	GBP	CHF	EUR	XAU	XAG	AUD	CAD	JPY
Allocation	11.47	0.0	0.0	70.45	0.0	0.0	5.82	12.26	0.0

Table 3. Individual stock returns and volatility

	USD	GBP	CHF	EUR	XAU	XAG	AUD	CAD	JPY
Annualized return	0.0	0.0	0.02	–0.01	0.06	0.05	0.0	0.0	0.0
Annualized volatility	0.09	0.1	0.1	0.04	0.16	0.29	0.09	0.07	0.14

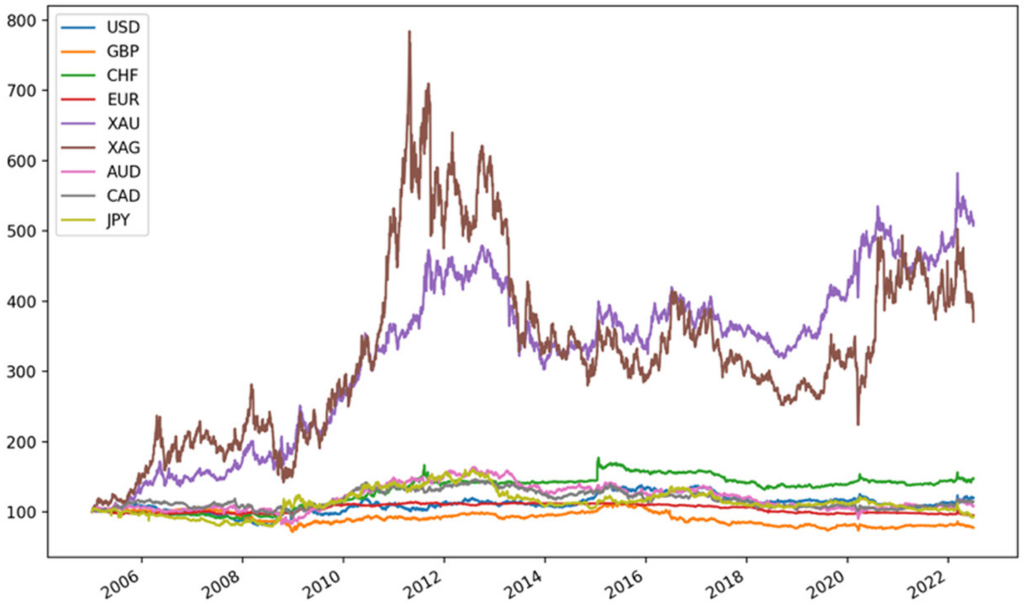

Fig. 1. Logarithmic returns (normalized); data from year 2005; 9 assets; USD, GBP, CHF, EUR, XAU, XAG, AUD, CAD, JPY

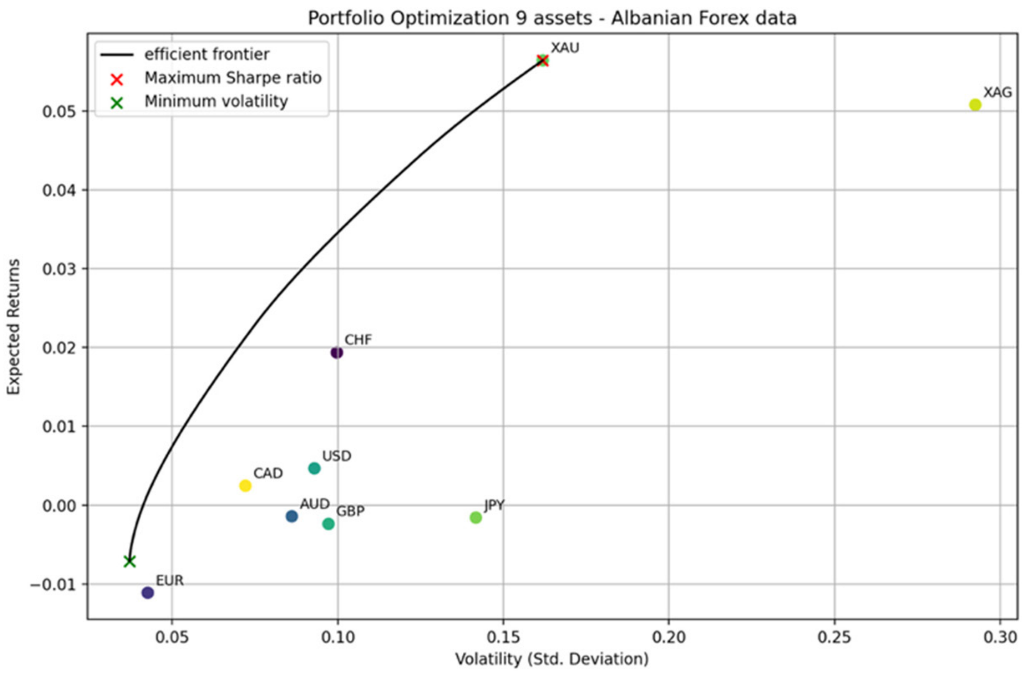

Fig. 2. Portfolio optimization, 9 assets; USD, GBP, CHF, EUR, XAU, XAG, AUD, CAD, JPY; data from year 1991

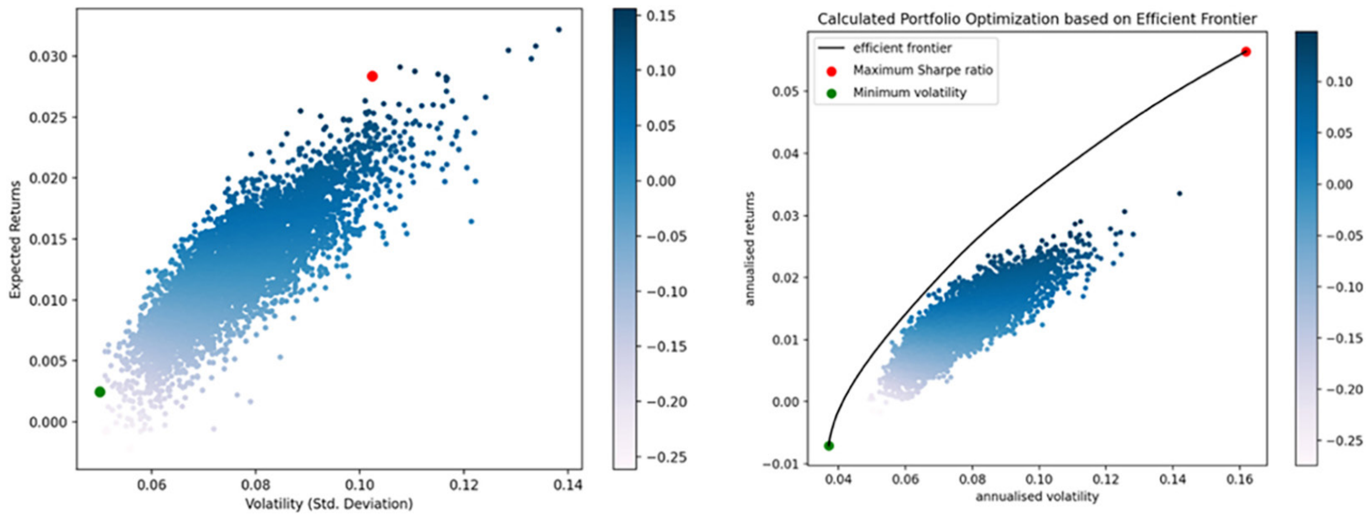

Fig. 3. Simulated portfolio optimization (left); calculated portfolio optimization based on efficient frontier (right)

For only currencies, 7 assets (Figures 4–6)

Table 4. Maximum Sharpe ratio portfolio allocation

	USD	GBP	CHF	EUR	AUD	CAD	JPY
Allocation	0.0	0.0	100.0	0.0	0.0	0.0	0.0

Table 5. Minimum volatility portfolio allocation

	USD	GBP	CHF	EUR	AUD	CAD	JPY
Allocation	11.5	0.0	0.0	70.4	5.82	12.27	0.0

Table 6. Individual stock returns and volatility

	USD	GBP	CHF	WUR	AUD	CAD	JPY
Annualized return	0.0	0.0	0.02	0.01	0.0	0.0	0.0
Annualized volatility	0.09	0.1	0.1	0.04	0.09	0.07	0.14

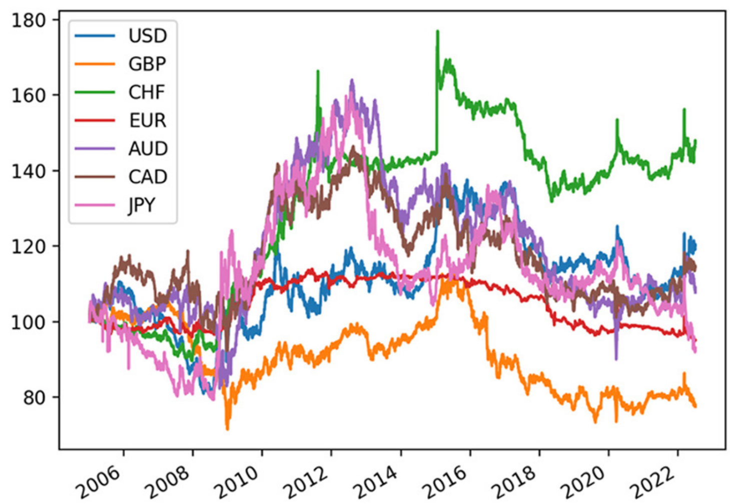

Fig. 4. Logarithmic returns (normalized); data from year 2005; 7 assets; USD, GBP, CHF, EUR, AUD, CAD, JPY

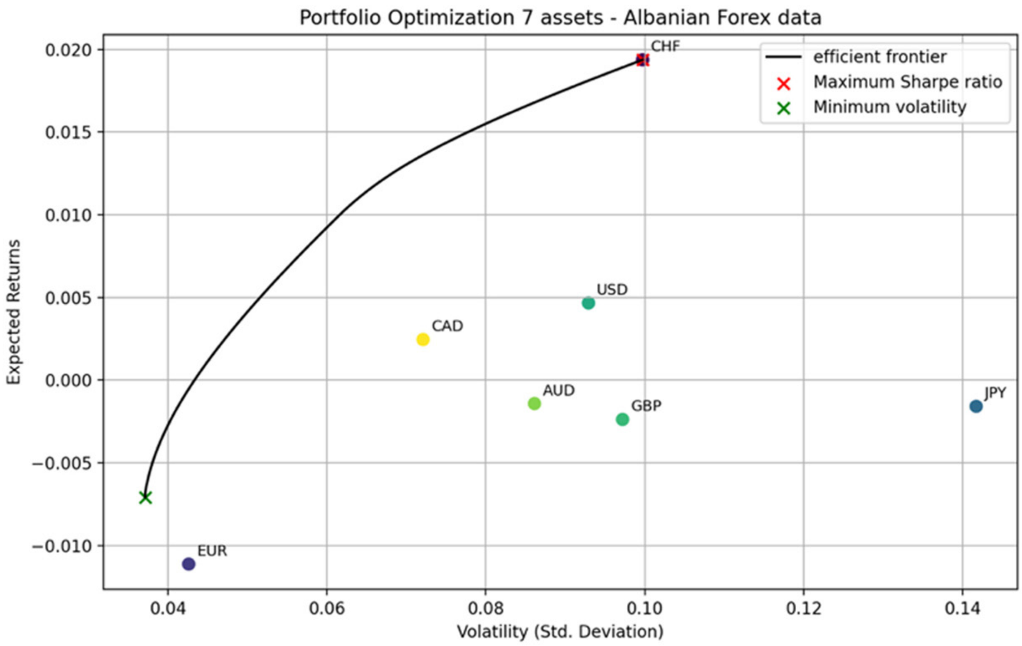

Fig. 5. Portfolio optimization, 7 assets; USD, GBP, CHF, EUR, AUD, CAD, JPY

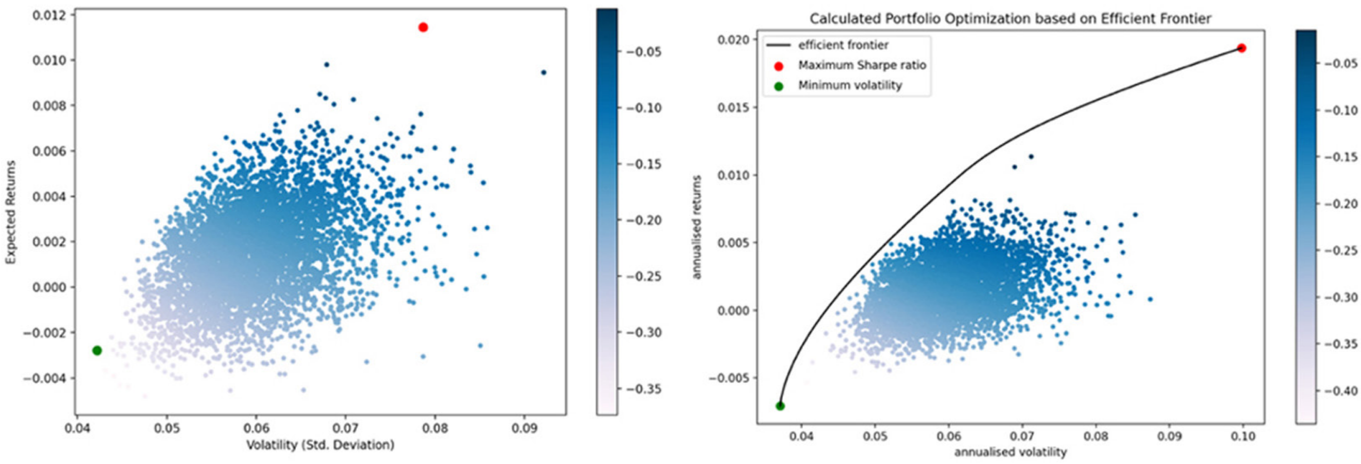

Fig. 6. Simulated portfolio optimization (left); calculated portfolio optimization based on efficient frontier (right)

For main currencies, 4 assets (Figures 7–9)

Table 7. Maximum sharpe ratio portfolio allocation

	USD	GBP	CHF	EUR
Allocation	0.0	0.0	100.0	0.0

Table 8. Minimum volatility portfolio allocation

	USD	GBP	CHF	EUR
Allocation	16.69	0.0	0.0	83.31

Table 9. Individual stock returns and volatility

	USD	GBP	CHF	EUR
Annualized return	0.0	0.0	0.02	–0.01
Annualized volatility	0.09	0.1	0.1	0.04

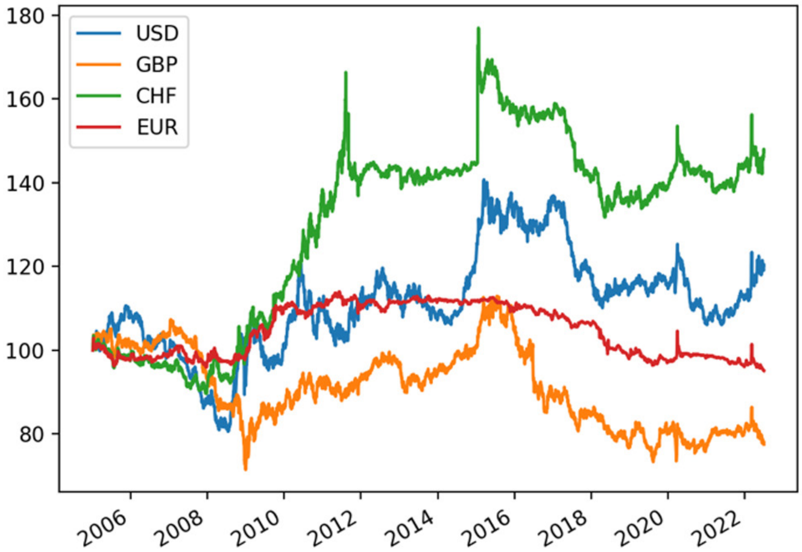

Fig. 7. Logarithmic returns (normalized); data from year 2005; 4 assets; USD, GBP, CHF, EUR

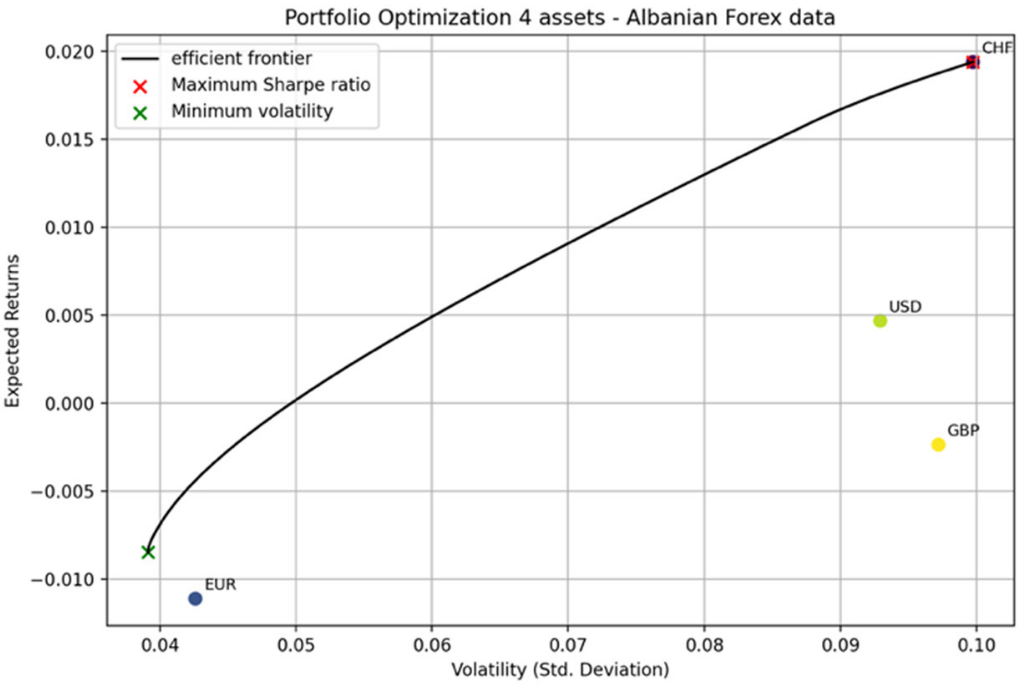

Fig. 8. Portfolio optimization, 4 assets; USD, GBP, CHF, EUR

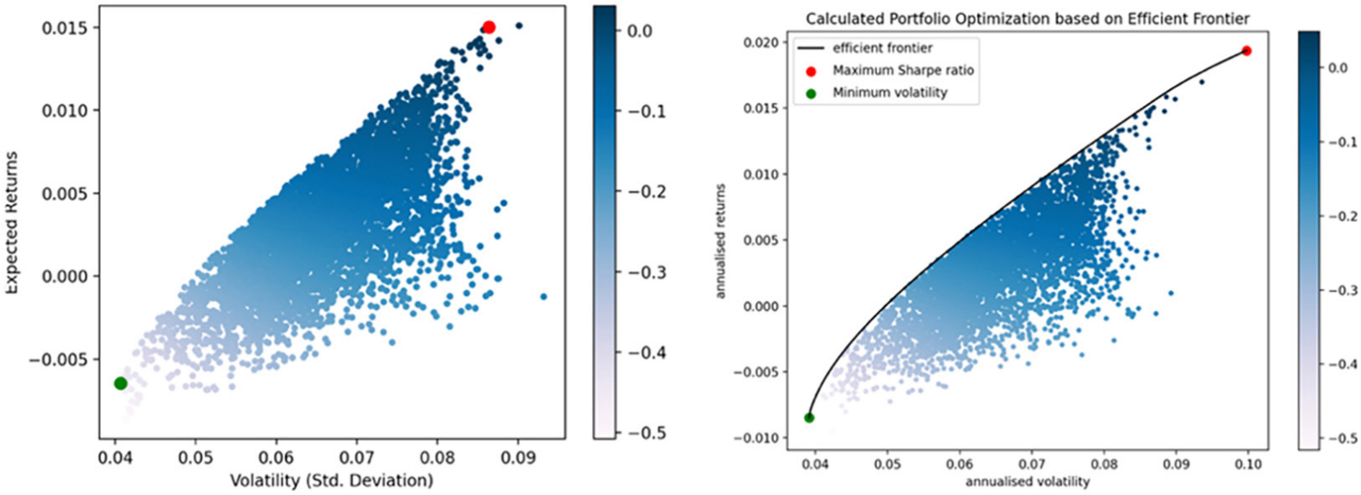

Fig. 9. Simulated portfolio optimization (left); calculated portfolio optimization based on efficient frontier (right)

6 CONCLUSIONS

In the Albanian financial market, the data from the Bank of Albania is considered the official value. What this market does not show is the actual value of assets. Informal market interventions alienate this value, consequently, by artificially fluctuating the performance of prices at different times. The Bank of Albania also makes interventions to control the market, inflation rate, and economic stability. Despite the intervention, it is evident that the changes observed in the chart are merely temporary, and the market invariably reverts to its previous performance. The impact on the euro was significant. The effects on the euro are evident, as shown visually by the EURALL chart (Figure 10) and the portfolio analysis in this paper.

Fig. 10. EURALL chart; the price fluctuations correlate with the updates provided by the Bank of Albania regarding their actions in buying or selling euros and political changes such as local elections

The impact of the Bank of Albania and the government and the informality of the market exclude the actual value by keeping the euro currency under partial control with low volatility and risk. This aligns with the research conducted by [26]. Based on the results, it appears that the EUR is the most stable currency, but it has a low yield of approximately 0.04. With portfolio optimization, we can achieve even lower risk at 0.03 and a higher return than EUR. Silver is one of the assets with the highest investment risk, followed by gold. In the group of currencies, we have the Japanese Yen and the Swiss Franc, followed by the British Pound. The most suitable investment of the four assets (USDALL, GBPALL, CHFALL, and EURALL) is in USD. To invest efficiently, it is recommended to begin by selecting currency groups based on the distribution presented in this paper. Afterward, the focus should be on the currencies that are closest to the efficient frontier.

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