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Risk and Return on the Romanian Currency Market

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Abstract. Regarding the actual framework we are facing nowadays globally, the foreign exchange market plays more and more a definite role. The real exchange rate represents the most important and sensitive instrument for determining the macroeconomic stability of a country. From this perspective, the interest of this paper falls upon the most volatile currencies traded within our country, the exchange rates of EUR/RON and USD/RON.

Keywords: Risk, return, efficient portfolio, utility function, variance, standard deviation

1. Introduction

The efficient portfolio theory, developed by Harry Markowitz, is extremely actual nowadays. It represents the starting point of modern portfolio theory, known as the *Capital Assets Pricing Model*, but its important contribution refers to the fact that it suggests, for the first time, both to the academic and investors' world, the mathematical model that quantifies the risk and return for a security title, and going further, develops the computation methodology for determining those important variables for a multiple assets portfolio. Starting from identifying the risk and return model, the final contribution of Markowitz's theory lies in defining the terms of *efficient portfolio* and *efficient frontier*. The application of this optimal portfolio theory on the currency market offers an interesting perspective, from two reasons :

1. the efficient portfolio can be determined by identifying the optimal weights that have to be invested in the two currencies, for obtaining a determined rate of return, corresponding to a minimum risk the investor is willing to take.

2. the mathematical model for constructing the optimal portfolio does not represent, as in the case of capital market, a forecasting model of rates of risk and return of the two currencies, but they represent only computations of the rates of return and risk of those currencies, based on historical values. The reason behind this explanation lies in the fact that the classical theories do not function applied in forecasting exchange rates, as the exchange rate is hardly or impossible to predict, only using theories like Purchasing Power Parity and others (Solnik, 1991)[4].

A main consideration of this theory is the one according to which every investor wishes to maximize the rate of return of his investment. A second consideration is that investors are generally risk averse, meaning that, having to decide between two security titles having the same rates of return, they will prefer the one which has a lower risk (Reilly and Brown, 2006)[5]. By the means of his theory, Harry Markowitz makes proof of the fact that variance of the rates of return is the appropriate method of determining the risk for a security title, or for a portfolio of titles, everything expressed under a set of hypothesis A single security title or a

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single portfolio of titles is considered to be efficient if there is no other portfolio that can offer a greater rate of return for the same level of risk or a smaller level of risk for the same rate of return (Markowitz, 1991)[6].

2. Optimization of a Portfolio Composed of Two Assets

Going further, one may consider the following observation: if an investor can determine the maximum level of risk he may accept, than the portfolio optimization problem becomes maximizing the expected rate of return for this level of risk. Alternatively, if investor specifies which is the expected rate of return of an investment alternative, the efficient portfolio becomes the one that is minimizing the risk for that expected rate of return. The mathematical expression of what has been described may be written in the following manner :

For the first possibility – maximizing the expected rate of return

$$MaxE(Rp) = \sum_{i=1}^{n} WiRi. \text{ with the constraint}$$

$$\sigma p = \sqrt{(\sum_{i-1}^{n}\sum_{j=1}^{n} WiWj \operatorname{cov} ij)} \le \sigma \text{^, where:}$$

σ^ = investor's desired level of risk

For the second possibility – minimizing standard deviation of the rates of return

$$Min\,\sigma p = \sqrt{(\sum_{i=1}^{n}\sum_{j=1}^{n} WiWj \operatorname{cov} ij)}, \text{ with the constraint:}$$

$E(Rp) = \sum_{i-1}^{n} WiRi = E(R)$ ^, where: E(R)^ = investor's expected rate of return (Damodaran,1996)[7].

Above presented equations represent the generalised formula for optimised portfolios, that may contain "n" security titles. The multitude of all optimised market portfolios form "efficient frontier".

Presenting a two assets portfolio in order to identify the mathematical algorithm for its optimization process represent another objective of this paper. In order to be reached, we shall consider a two assets portfolio, composed by two assets, asset X and asset Y. Every one of this assets is being characterised by an expected rate of return $E(X)$, respectively $E(Y)$, and by a variance $\delta^2(X)$, respectively $\delta^2(Y)$. Also, $\rho(XY)$ should be considered as the correlation coefficient between the two assets. Still from defining the model, we know that $w(X)$ is the proportion of the portfolio invested in asset X, and respectively, $[1-w(X)]$ is the proportion of the portfolio invested in asset Y.

The new composite portfolio will have the following characteristics :

Expected rate of return: $E(p) = w(X)E(X) + [1-w(X)]E(Y)$

Variance: $\sigma^2(p) = w^2(X)\sigma^2(X) + [1-w(X)]^2\sigma^2(Y) + 2w(X)[1-w(X)]\sigma(X)\sigma(Y)\rho(XY)$

Due to the benefits of diversification, standard deviation of a two assets portfolio is lower that their individual standard deviations, taken separately, if the investment in made in two equal parts of the two assets.

There is a point in which, for a certain rate of return it can be obtained a minimum risk, depending on the weights of the two assets.

So, an accurate estimation of the weights that should be invested in the two assets for minimizing the risk should be obtained from the composite portfolio equation:

Variance: $\sigma^2(p) = w^2(X)\sigma^2(X) + [1-w(X)]^2\sigma^2(Y) + 2w(X)[1-w(X)]\sigma(X)\sigma(Y)\rho(XY)$

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[6] Markowitz, H.M. (1991). *Portofolio selection: efficient diversification of investments*. Malden: Blackwell Publishing

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The variance function can be considered a second degree function, in which the exogenous variable is x=w(X). In the point of minimum, the partial derivate of that function is 0, so we may write:

$$\delta\sigma^2(p)/\delta w(X) = 2w(X)\delta^2(A) + [2w(X) - 2]\delta^2$$

$$(Y) + 2\rho(XY)\delta(X)\delta(Y) - 4w(X)\rho(XY)\delta(X)\delta(Y) = 0$$

Solving the above equation, we obtain:

$$W(X)* = [\delta^2(Y) - \rho(XY)\delta(X)\delta(Y)]/[\delta^2(X) + \delta^2(Y) - 2\rho(XY)\delta(X)\delta(Y)]$$

The value that is obtained represent, as a mathematical interpretation, the weights of the two assets, asset X and asset Y, for the risk of the composite portfolio to be mínimum. Corresponding to this mínimum risk, we have an expected rate of return that can be described, as a value, between the rates of return of the two assets, taken separately (Damodaran, 1996)[8].

Going further, the purpose of this paper is to put into practice all the theoretical approach above mentioned, so, in order to be reached, we should proceed from real time series, in order to build the initial model in a practical dimension. There will be used monthly exchange rates time series of EUR/RON and USD/RON, for the period January 2008 – April 2011. Intention of choosing these time series from the currency market is to stimulate the interest of research upon this vital economic area, taking into account the global challenges the society has to deal with.

For the exchange rate USD/RON, the expected rate of return, computed according to the Harry Markowitz's methodology, is $E(USD/RON) = 0.39$, based on historical values.

For the exchange rate EUR/RON, the expected rate of return, computed according to the Harry Markowitz's methodology, is $E(EUR/RON) = 0.2$, based on historical values.

As a comparison, it can be easily noticed that the expected rate of return for EUR/RON is 50% smaller that the expected rate of return for USD/RON, meaning that, from investors' point of view, they will prefer USD/RON exchange rate due to the fact that brings to them a greater return.

In the capital markets theory, the risk for a portfolio of titles is represented by the standard deviation or variance, according to Harry Markowitz theory. So, the risk of the two currencies is represented by the standard deviation computed for the same set of data.

Standard deviation for USD/RON = 25.36%

Standard deviation for EUR/RON = 25.98%

We observe that the EUR/RON currency offers a smaller rate of return, with a sensible greater risk, and the USD/RON curreny offers a greater rate of return, with a sensible smaller risk.

From this point of view, we may conclude that the USD/RON currency is preferred by investors to the EUR/RON currency, due to its effect to offer a higher total utility to investor.

The next step is computing the covariance of the rates of return – indicator that shows the way the two currencies move together. In this respect, the covariance of the rates of return of the two currencies has a value of $\text{cov}(EUR/RON; USD/RON) = 7.36\%$, fact that indicates the movement of the two currencies in the same direction. In order to find out more about this relationship between these two currencies, it must be calculated the coefficient of correlation. In our case, coefficient of correlation has the value of 0.87, indicating a direct positive relationship, the two currencies being extremely positively correlated, with a high intensity between them.

The intention is to optimize the two securities portfolio by identifying the proportion in which the two currencies should be optimally combined for a minimum risk.

[8] Ibidem 4

The value that is obtained represents a point described by a minimum risk for a certain rate of return. Replacing X with currency USD/RON and Y with currency EUR/RON, and replacing within the last equation the values obtained before, we obtain the following:

$$W^*(USD/RON) = (25.98^2 - 0.87 \times 25.98 \times 25.36)/(25.98^2 + 25.36^2 - 2 \times 0.87 \times 25.98 \times 25.36)$$

W*(USD/RON) = 59.3 represents the weight that should be invested in USD/RON Exchange rate, and, as a consequence, 40,7% represents the weight that should be invested in EUR/RON exchange rate in order to optimize the two currencies portfolio.

In this way, the rate of return corresponding to the mínimum risk is: $E(port) = 0.593 \times 0.39 + 0.407 \times 0.2 = 0.3114$, expressing the rate of return of the composite portfolio.

In order to provide more simulation results, and also that the results to be more confident to the economic reality, we have computed the some calculus for the period after April, 2011 to the present. This means that we have used the real time series of data for the same currencies, for the period May, 2011 to February, 2012.

For the exchange rate USD/RON, the expected rate of return, for the above mentioned period, is $E(USD/RON) = 1.28$, based on historical values, meaning an extremely high rate of return (128%), with a risk of 18%.

For the exchange rate EUR/RON, the expected rate of return, for the above mentioned period, is $E(EUR/RON) = 0.54$, based on historical values, meaning that it has been more profitable to invest in that period that in the one the economic crisis has settled up.Also, the risc, measured by the standard deviation, is quantitatively smaller, of 7.8%, meaning that investing in this currency for the period April, 2011-February 2012 brings a certainly greater rate of return with a completely reduced risk.

Standard deviation for USD/RON =18%

Standard deviation for EUR/RON = 7,8%

We observe that the EUR/RON currency offers a much smaller rate of return, with a sensible smaller risk, and the USD/RON curreny offers a greater rate of return, with a sensible higher risk.

The next step is computing the covariance of the rates of return. In this respect, the covariance of the rates of return of the two currencies for the period April 2011-Feb 2012 has a value of $\text{cov}(EUR/RON; USD/RON) = 1{,}1\%$, fact that indicates the movement of the two currencies is in the same direction.Also, the coefficient of correlation has the value of 0.89, higher than the previous period, indicating a direct positive relationship, the two currencies being extremely positively correlated, with a high intensity between them.

Even if recent studies appeared, offering a more accurate approach, from example Fama – French Model, still Harry Markowitz's theory, proceeding Capital Assets Pricing Model, remains the benchmark for capital markets valuation, due to its actuality and high degree of generalization (Bartholdy, Peare, 2005)[9]. On the other hand, its correctitude recommends it as a functional model also for currency market, not for forecasts, but for computing the rates of return and the risk for different composite portfolios, resulted from different currency combinations, and having as starting point the historical data time series.

2.1. Important Information

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