THE DOUBLE-TRUMP DECISION MANAGEMENT MODEL IN GLOBAL EXCHANGE

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The main goal of the article is to reveal the content of the so-called "double trump" decision management model in the global currency market and to present possibilities and results of its practical application. This model is developed on the basis of the author's earlier proposed model of adequate investment decision evaluation portfolio, and it was experimentally implemented with the aid of a special currency rate change forecasting system using the FOREX global currency rate market data. The investigation was carried out using real FOREX data for the period from 11 December 2004 to 10 October 2005.*

The conceptual aim of the article is to broaden the discussion about financial market efficiency by testing market efficiency theory not through an attempt to defeat the market, but through proving market homogeneity, i.e. proving that there are always non-efficiency shoals in the market, when it is possible to elaborate a decision strategy allowing an advantage over the real market decisions over a rather long period of time.*

The pragmatic aim of the research is to find the possibilities and means of decision management in the currency market strategies advantageous over particular market decisions in general. Continuous development and practical use of such strategies should help in forming market intelligence.*

Key words: double trump portfolio management model, portfolio strategy, adequate portfolio for investment decision reliability assessment.

1. Introduction

As a result of natural factors in different markets, payments for the products of certain industries (oil industry, development of modern technologies, military production, etc.) depending on the geographical position – South and North America, Arabian countries, Japan, Europe, Russia, etc. – are made using only one certain currency – USD, JPY or other. It is a typical situation when those goods are sold using a currency different from the national currency of a buyer. For example, Europeans buy oil prod-ucts and pay for them in dollars in Arabian countries; in Japan for new technologies they pay in yens. In such cases the behavior of certain currency exchange rate and its impact on the transaction are very relevant.

The buyer is interested in the situation when his currency portfolio would have a maximum purchasing power when he buys oil products or military products, purchases new technologies, etc. It requires using currency portfolio strategy maximizing the purchasing power of a portfolio at a certain moment, or allowing to choose the

maximum purchasing power value in every step in the chosen period.

If the national currency of a subject and the currency which he uses to settle an account are the same, then the problem of a disposable currency portfolio is the same as the general currency portfolio management problem – to maximize the purchasing power of the portfolio using a certain currency.

Further we will call a chosen currency a trump currency, probably without distorting the meaning of the word. The solution methods and algorithms of the problem mentioned above usually depend on the available information and the information which is possible to generate concerning the currency rate behavior.

However, if the basic currency of a subject and the currency of the purchasing operation are different (e. g., a corporation of a European country purchases oil products for dollars) the optimization of a currency portfolio purchasing power, e. g., on the basis of the Swiss frank, is not the most suitable decision. There is no doubt that the portfolio purchasing value maximization is best met by the strategy aimed at the maximization of the portfolio purchasing value with respect to the two mentioned currencies together. This is a partial case of the total purchasing power of a portfolio with respect to trump currencies. In the paper, EUR and USD are chosen as such currencies. In general, seven currencies are analysed: EUR, USD, GBP, CHF, AUD, JPY. The rebalancing of the portfolio, i. e. the selection of an optimal portfolio, is carried out step by step. The scheme of every step of portfolio management strategy looks like this:

- we choose EUR and USD as trump currencies;
- make prognoses of the EUR/USD, EUR/GBP, EUR/CHF, EUR/CAD, EUR/AUD, EUR/JPY ir USD/GBP, USD/CHF, USD/CAD, USD/AUD, USD/JPY rates, or evaluate them on the basis of gathered FOREX historical data;
- if the EUR exchange rate increases ($>>$), then EUR is considered to be the trump currency, the diversification of a portfolio is performed on the basis of prognoses of EUR and exchange rates of other currencies. If EUR$<<$USD, the USD is chosen as the trump currency.
- After we have chosen the trump currency, we choose the currency portfolio which makes it possible to maximize the profitability of the subject at the end of each step, in the concrete case – which makes it possible to maximize the purchasing power of the portfolio both in euros and dollars (Fig. 1).

It is time to remember that the currency exchange rates considered and the value of the currency portfolio are stochastic values or processes and their functions. Therefore, if we could conditionally use for historical currency market data the logic based on the unambiguous understanding of the probability, then, speaking of currency rate prognoses or utility in the future, it is necessary to remember that actually they are stochastic values and processes.

So, speaking further about decision making, or portfolio alternation (rebalancing) management strategy, we have to treat the future currency rates, portfolio utility and its purchasing power as stochastic events, values or processes. Therefore their comparison or choice is possible only in respect to separate quantitative parameters – averages, standard deviations or the reliability of possibility; for example, the possibility is unity and so on. For attaining the goal of the current work, the following issues will be dealt with:

- features of general decision management in currency and capital markets in the FOREX market will be discussed;
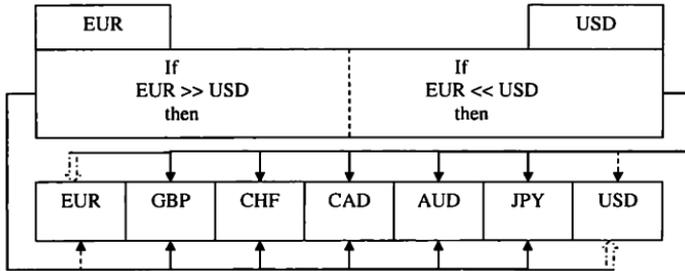
Fig. 1. *Double trump (EUR and USD) decision management in currency (EUR, GBP, CHF, CAD, AUD, JPY, USD) market model.*

- objectives and possibilities of application of an adequate portfolio for investment decision guarantee evaluation in currency markets will be specified;
- principles of application of elementary strategies – maximas will be discussed;
- application of the so-called double trump model in currency markets will be discussed, results of application of this model will be analyzed;
- general analysis of decisions will be carried out, decision evaluation results will be obtained;
- conclusions and suggestions will be presented.

2. General decision management system in the currency and stock market (DMCSM) pecularities in the FOREX market

As in the work [1], analysing the general DMCSM system, three stages of portfolio decision management cycle are distinguished:

- elucidation of the basic objectives and principles of portfolio decisions in the currency markets;
- substantiation of the portfolio decision idea and information provision for the decision-making process;

- selection of optimal portfolio decision evaluation principles.

The monitoring of the interaction between historical trajectories and development possibilities, offered at the end of the cycle, allows to gradually reveal not only the current, usually abrupt, alterations, but also the fundamental changes in the market behaviour.

Although the DMMECM system is intended for the management of portfolio decisions, the non-portfolio decision making management subsystem and the suggested currency rate forecasting system have a value of their own. They were used while implementing the decision management system in the currency market.

3. Adequate currency rate forecasting system

3.1. Short comparison of proposed forecasting system and methods of technical analysis

As one can see in Fig. 1, the preparation of our system of decision making in exchange markets formally begins with selecting the methods of currency rate forecast. Since in this system, as in technical analysis, a particular research object is historical currency rate indices, the suggested
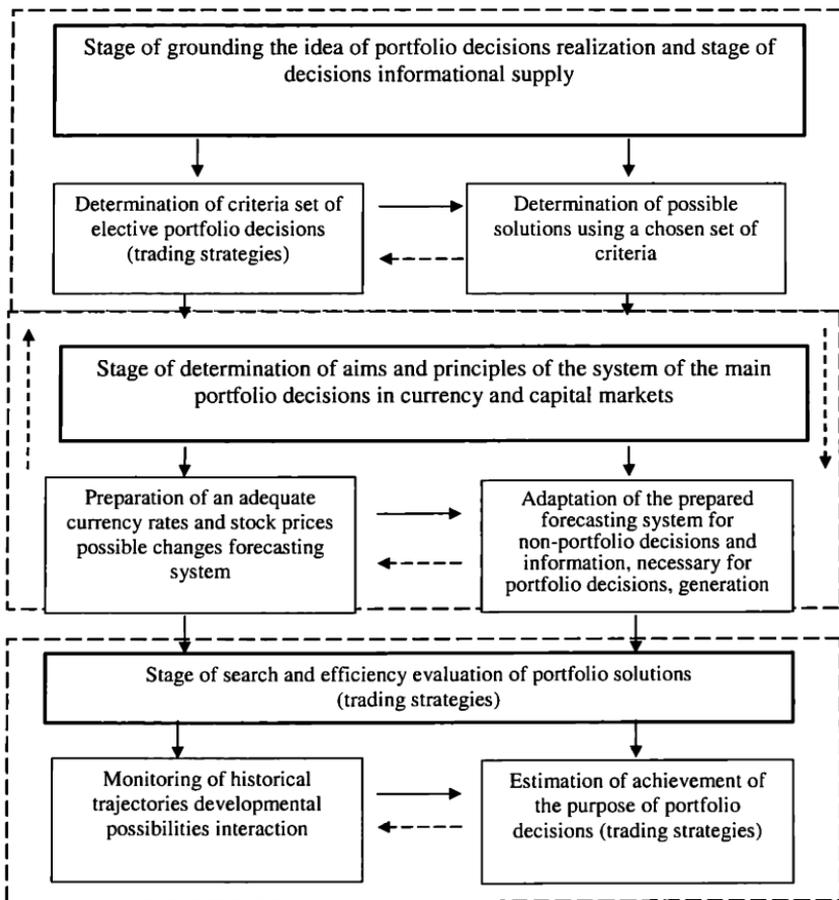
86

Fig. 1. Scheme of portfolio solutions (trading strategies) and taken actions

methods of forecast should be compared with the forecasting methods already in use in technical analysis, which are numerous and various. Here, next to traditional methods of forecast used in all areas of activities (various traditional models, regression models, moving averages models, etc.), intensively used is also the principle of pattern identification. The essence of the latter method is that particular patterns are being tried to identify, according to which the changes of future indices should repeat changes of historical data.

Knowing that the set of technical analysis forecasting models is wide and diverse, it would be negligent to specify the summarized characteristics of this set. Therefore, even though many technical analysis forecasting methods are theoretically suitable for currency rate and stock price forecast and have a long-time practice of utilization not only in this area, we have to admit that they do not satisfy all the main attributes necessary for forecasting methods:

- a currency rate forecasting method must be adaptive, i.e. it should help in considering that in each point of variation of currency rate both the set and importance of the factors and the functional dependence of currency rates on the factors that modify them and the forms of interdependence of the factors are accounted for;

- the forecasting methods of currency rates and stock prices must be flexible, i.e. they must be applicable in every forecasting system, be it a complex system of mathematical models or subjective experimental decisions;

- in the forecasting method, actions and results must be clearly separated, i. e. it must be consistent. It is very important when determining and using the analytical interrelation between the result and the factor as well as among the factors themselves;

- employment of one or another method of forecast should allow to quantitatively measure the reliability of the obtained results;

- forecasting methods must be constructive, i.e. allowing to select the most probable values of forecast variables or processes.

3.2 The main principles of an adequate forecasting system

Further we will illustrate the main utilization principles of a one-step currency rate and stock price forecasting system. The core of the forecasting system consists in the regression dependence of the forecasted index value at a $(t+1)$ moment on the value of the index under analysis at a t-th and previous moments:

$$\overline{y}^{t+1} = f\left(\overline{x}_1^t, \overline{x}_2^t, ..., \overline{x}_n^t; \Theta(0, t)\right) \qquad (1)$$

where:
$\overline{y}^{t+1}$ – probability distributions of the forecasted currency rate or stock price possible values at $(t+1)$ moment;

$\overline{x}^t$ – I-th factor possible values probability distribution at a t-th moment;

$\Theta(0, t)$ – the resultant of the influence of the other factors on $(t+1)$-th moment index;

f – regression.

Dependency (1) was used to determine the $(t+1)$ day currency rate value possibility distribution when in the $[1, t]$ period the currency rate values are known. So, the $(t+1)$ day forecast becomes the most important information while choosing the optimal portfolio for the $(t+1)$ step (day). Its efficiency, i.e. the efficiency of the relevant decision, becomes clear as the real $(t+1)$ data appear. In turn, the data of $(t+1)$ day become the basic forecasting data, and on the basis of $[2, (t+1)]$ day data we forecast a possible value distribution for $(t+1)$ day currency rate. By this method we "covered" the distance from 11 December 2004 to 10 October 2005 (Table 1). The first 40 days of this period were used as the initial forecasting base, while the first day for which currency rate probability distribution was evaluated was 27 January 2005. The process was repeated till 1 October 2005. These prognoses as well as correlation prognoses between separate currency rates were used for portfolio rebalancing, or simply for selecting the optimal hypothetical model for that day. The historical and hypothetical (prognostic) data are presented in Table 1.

Table 1. Comparison of historical (H) and forecasted (F) indicators: currency rates in the FOREX market

Historical and forecasted indexes	Currency rates										
	USD/EUR		USD/GBP		USD/CHF		EUR/CAD		USD/AUD		USD/JPY	
Days	F	H	F	H	F	H	F	H	F	H	F	H
1		0.7563		0.5222		1.1609		1.2251		1.3319		105.15
2		0.7579		0.5237		1.1629		1.2265		1.3358		105.56
3		0.7512		0.5197		1.1534		1.2275		1.3168		104.69
40	-	0.7710		0.5365		1.1928	-	1.2359	-	1.3063	-	103.97
41	0.7608	0.7651	0.5297	0.5314	1.1763	1.1838	1.2080	1.2326	1.2732	1.2927	105.07	103.14
42	0.7694	0.7670	0.5346	0.5294	1.1897	1.1848	1.2564	1.2373	1.3109	1.2860	104.14	102.81
43	0.7714	0.7666	0.5237	0.5297	1.1918	1.1854	1.2225	1.2407	1.2843	1.2913	102.83	103.36
242	0.8204	0.8222	0.5501	0.5544	1.2753	1.2746	1.1706	1.1816	1.3005	1.3055	110.47	111.47
243	0.8221	0.8242	0.5534	0.5550	1.2757	1.2788	1.1748	1.1678	1.2995	1.3051	111.24	111.49
244	0.8248	0.8254	0.5559	0.5559	1.2832	1.2811	1.1872	1.1693	1.3012	1.3048	111.61	111.96
245	0.8198	0.8181	0.5532	0.5522	1.2783	1.2694	1.1738	1.1667	1.2937	1.2968	111.82	111.25
246	0.8262	0.8233	0.5575	0.5587	1.2848	1.279	1.1752	1.1723	1.3012	1.3118	107.81	111.62
247	0.8254	0.8302	0.5650	0.5626	1.2788	1.2918	1.1723	1.171	1.3117	1.3210	111.95	112.4
248	0.8318	0.8314	0.5671	0.5642	1.3010	1.293	1.1578	1.1733	1.3214	1.3208	112.64	112.39
249	0.8253	0.8286	0.5649	0.5623	1.2851	1.289	1.1652	1.1722	1.3157	1.3224	112.42	112.15
250	0.8362	0.8324	0.5697	0.5659	1.3024	1.2952	1.1777	1.1781	1.3365	1.3228	112.67	113.22
251	0.8238	0.8305	0.5585	0.5656	1.2825	1.2912	1.1641	1.1741	1.3151	1.3180	112.75	113
252	0.8281	0.8310	0.5656	0.5679	1.2892	1.2934	1.1703	1.1713	1.3208	1.3158	113.07	113.11
253	0.8244	0.8296	0.5634	0.5655	1.2816	1.2891	1.1273	1.1596	1.3089	1.3098	113.11	113.25
Number of direction coincidences	136 (213)		128 (213)		148 (213)		117 (213)		121 (213)		109 (213)	

3.3 Peculiarities of the proposed forecasting system

Before describing the possibilities of the proposed method of forecasting, let's have a look at Fig. 6, because it will be the base for empirical conclusions. In this figure, empirical historical data and the forecasted EUR/CHF rate change probability distributions of 95% level reliability confidence intervals are presented. In section *a* of Fig. 6, the upper and bottom lines of the reliability zones are identified, with forecasted probability distribution average ± standard deviation with the corresponding values. In section *b*, these lines are identified by mode ± standard deviation from the mode's corresponding

values. In section *c*, maxima of the lines analyzed in sections *a* and *b* are taken for the bottom line and the minima for the upper line.

Accuracy and reliability of the forecast. Speaking about the accuracy and reliability of the currency rate and stock price forecast, it is possible to use Fig. 3 with diagrams of the limit zones of currency rate variation, which we shall call confidence zones of currency rate variance. These are analogues of confidence zones or confidence intervals of stochastic processes or random variables, if to assume that a forecasted currency rate or stock price is a stochastic value whose forecast is obtained using only historical data. In the diagrams, together with forecasted confidence zones, the corresponding historical data are presented. The dislocation of these historical parameters in confidence zones indicates that the behavior of the currency rates and stock prices is compatible with the consistent patterns of the behavior of stochastic variables in their confidence intervals. Examination of the corresponding stochastic hypotheses completely confirms it.

Thus, if we rank the proposed method among the technical analysis methods, we may consider the possibility of quantitative assessment of technical analysis methods and an interpretation of the conditionality of random step theory. It hardly follows from the diagrams of reliability zones that price movements are equally conditioned for the states in the centre or on the edge of a zone, what should be the case if we presume about changes of the behavior of a price to be a chaotically random value. So, price behavior is a stochastical process, but not chaotically stochastical.

Constructiveness of the forecasting methods. Above, the constructiveness of the forecasting method has been denoted as its ability to foresee in each step the most probable value of all possible ones. That is why, while speaking about

formation of reliability zones, it is necessary to remember the circumstance that the zone presented in Fig. 3 section *a* is formed by using the medium value of the forecast, at each step selecting the most probable value from those forecasted, and as a standard deviation the standard deviation of the most likely value is used. In Fig. 3 section *b*, the traditional reliability zone is the average value while choosing the mathematical average, and the average standard deviation from the mean value is used as a standard deviation. In Fig. 3 section *c*, the maximum of the lowest levels in sections *a* and *b* is chosen as the lowest level of the reliability zone, and the minimum of the upper levels in sections *a* and *b* is used as the upper level. The high coincidence of the empirical data scatter inside the zone with the prognosticated confidence intervals implies that this forecasting method enables not only to reveal the motives of market behavior but also increases the accuracy of the forecast.

On the basis of empirical observations it is possible to assert that the market, from a set of possibilities, is oriented towards the most possible value, if the latter does exist. On this basis it is possible to speak about the "invisible hand" and "invisible brain". Thus, speaking about the distinctive features of currency rates and capital market, the epithets of intellectual market should be used to describe their behavior.

Accuracy of the forecasting methods. The diagrams of reliability zones could be a good illustration to explain the correctness of the models. The employment of the cause and effect relations is not as easy as it looks on the face of it. We shall try to understand why at such a high currency rate variation, the historical data under analysis do not drop out of a rather small reliability zone shown in Fig. 3 section *c*, which is formed considering only the historical data of the market.
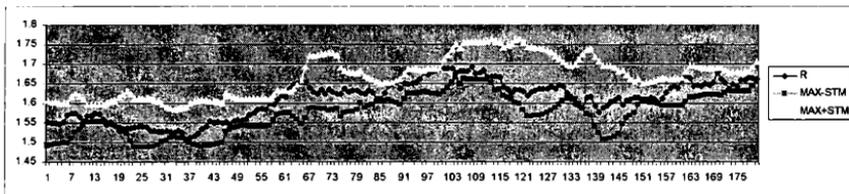
a. Mode ± standard deviation of mode
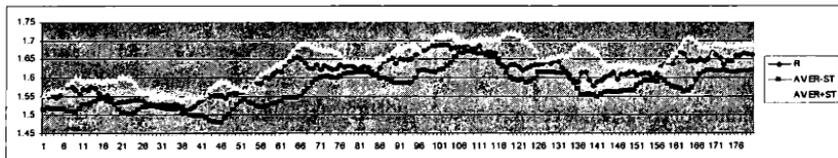
b. Average ± standard deviation (of average)
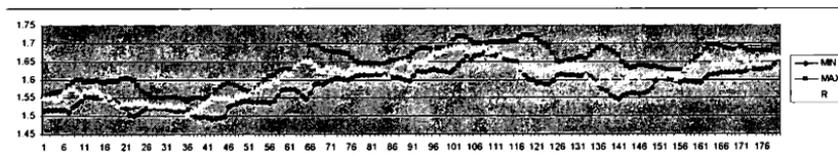
c. The upper line is equal to maximum of *a* and *b* cases and the bottom line to the minimum

*Fig 3. Geometrical view of EUR/CHF rate empirical-historical data
and a comparison of forecasted reliability intervals.*

There should be real reasons behind, which are hidden in the structure of a zone, and the search of primary causes would not be purposeful and constructive. Therefore, among the factors of regressive (stochastical) dependence, $\bar{x}_1$, $\bar{x}_2$,..., $\bar{x}$, there are certain structural parameters of reliability zones.

The requirement of flexibility and adaptivity of forecasting methods is obvious from Fig. 6. Changes of conditions, i.e. directions of movement from the point which is on the edge of the reliability zones, their motives and factors strongly differ from those that define the direction of movement on the most possible events or similar lines.

3.4. Assessment of maxim utilization possibilities in the DMMECM system

The obtained prognostic data were also used for elaborating simple trading strategies, which in the text are called maxims. The content of a maxim is the elementary statement: buy the share at the closing price if its price will rise the next day, and sell it if its price will fall. For currency

91

rates this statement can be described as follows: capital must be treated as the first currency if its rate compared to the second currency is rising and conversely, as the second currency, if the rate is falling.

In implementing the maxims, a very important step is to determine if the currency rates or stock prices change trends (increasing or decreasing) will be guesses in the forecast. Therefore, in every column of Table 2 where historical and forecasted data for the period 11 December 2004 – 1 October 2005 are presented, also the number of congruence cases is shown when the forecasted and the real indices were moving in one direction. Since the forecasts in the forecasting system under discussion are showed as stochastical variables, the question arises with which forecast probability distribution characteristics real data must be compared. In this case, the comparative index from the possibilities of the forecasts is the index having the biggest probability.

In Fig. 4 left side diagrams a comparison of graphical historical and forecasted data is presented, while Fig. 4 right side shows the possibility of using the results of naïve trading strategies – maxims. Every chart is composed according to the following principle: the initial capital is evaluated as 100 units; number-1-marked line means initial capital change in case it would become a deposit yielding 8% of annual interest rate; number 2 marks the change of the real market initial capital, which was kept in the second currency equivalent to 100 trump units and held in trump currency, i.e. the trump currency rate change versus that currency; number 3 marks the possibility of rise of the initial capital which is held in trump currency, if the simple strategy – maxim – was used.

# 4. Portfolio decision making management – the core of DMMECM

4.1. Short introduction to anatomy and management of adequate portfolio

The theory of securities portfolio is the means for an investor to get theoretically the largest profit from various – risky and non-risky – sets of securities and other assets, including currencies. The key problems solved by the portfolio theory are determining the set of all possible portfolios, finding the effective portfolio line (efficiency line) and choosing an optimal portfolio for every investor.

For an easier understanding of the solution of the mentioned problems, we need to go deeper in its geometry, more precisely to the plane where the decision criteria and solutions are introduced. It's common to present the average probabilities of portfolio on the ordinate axis and the standard deviation – the measure of profit risk – on the abscissa axis. So, on different coordinate axes we put the mean and standard deviation of distribution probability of the same value. After choosing a set of assets with known values of profitability and standard deviation, and after assuming that every asset in the investor portfolio can take any share, w, varying in Markovitz' portfolio case from 0 to 1, we will have the so-called feasible set of portfolios (see Fig. 5, section a). Such shape of the feasible set is obtained only because of the mathematical features of random values and their weighted sums. The YB-line is called the efficiency line and is part of the convex curve AB. They have a very significant meaning when analyzing separate portfolio features.

In this paragraph, using core categories and characteristics of modern portfolio, we will
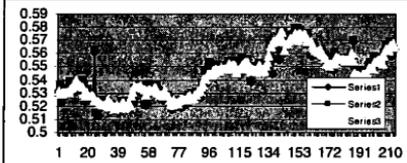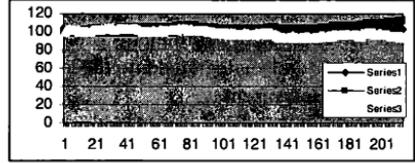
1. USD/EUR
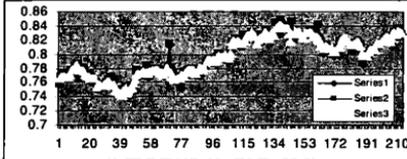
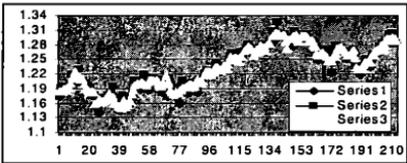## 2. USD/GBP

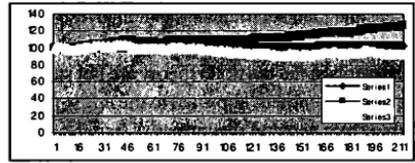

3. USD/CHF

4. USD/CAD

5. USD/AUD

5. USD/AUD

1. USD/EUR
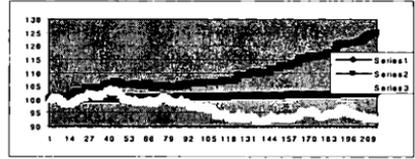
2. USD/GBP

3. USD/CHF
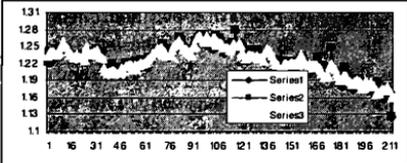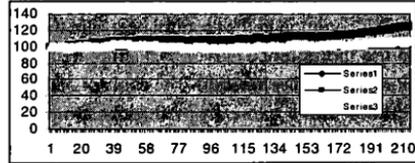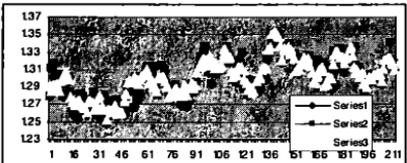
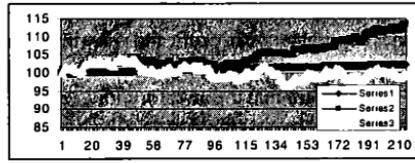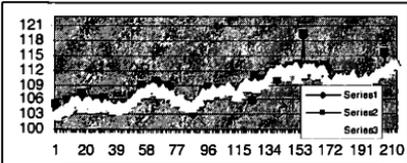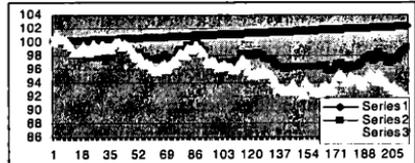## 4. USD/CAD

5. USD/AUD

5. USD/AUD

*Fig 4. Comparison of historical and prognostic currency exchange
rate indices (left side) and possibilities of using maxims (right side)*

93

briefly introduce the main formation and management problems of adequate investment portfolio, i.e. a portfolio composed of investment actives whose profitabilities are described with the help of distributions of stochastical measures. The idea and techniques of adequate portfolio allows the investor to operate not only the indices of profitability and riskiness, but also the concept of profitability guarantee, which is naturally integrated into the logic of decision management.

It has been already mentioned that one of the three basic problems solved by applying portfolio theory is choosing the optimal portfolio from a feasible their set for an individual investor. Indeed, it is very important to emphasize that investments in the portfolio theory are not studied in the environment impartial to the investor, but taking into account the investor's benefit. It is a specific feature of maximizing the criteria of portfolio theory.

It is common in the modern portfolio theory to use indifference curves as a simplified version of the utility function. The concept of indifference curve came from the consumption theory, where it expresses the combinations of two goods that are equally useful for a consumer. In portfolio theory, the indifference curve defines a combination of profit and risk which are equally acceptable for the investor. We see from Fig. 5 section *a* that the investor should choose the portfolio most useful to him, taking into account a feasible set of portfolios and own utility (indifference) function. Figure 5 section *b* can help us to develop the idea about portfolio theory maximization principles oriented to increasing common utility. It illustrates how investors, who have different indifference curves A'A" and B'B", choose different optimal portfolios maximizing their utility and at the same time maximizing common utility.

However, such logic of portfolio optimizing is correct only in the case when in the portfolio there are only risky investments. In this case, it is correct that these are the most profitable portfolios, from the set of possible portfolios and present on the map of indifference. But this assumption of existence of only risky investments does not reflect the investor's possibilities in the real investment world, where there are also non-risky securities exist - such as government bonds. If this happens, then the investor has a possibility to achieve the higher utility point than A* and B* in the indifference map (see e. g., [9], [10], [11], [12]). This is illustrated in Fig. 5 section c [see 1].

4.2. Formation of adequate portfolio model

The classical scheme of analysis, management or other use of the portfolio is rather clear and convenient for practical application, but the way to this simplicity is quite sophisticated. The functional expression of the effectiveness and envelope curves, which is necessary in the practical portfolio utilization, is not obvious in the general case. But if we want to choose and manage a portfolio, it is necessary to present (imagine) different states of that portfolio, to describe the interactions of those states or to study the other properties of the portfolio. The portfolio, when it is presented only by its average profitability and standard deviation, in some respects is no more stochastic and gives no possibility to evaluate the reliability of many events related to the portfolio.

Moreover, the scheme of modern portfolio selection is not yet adequate to some urgent needs of portfolio owners:
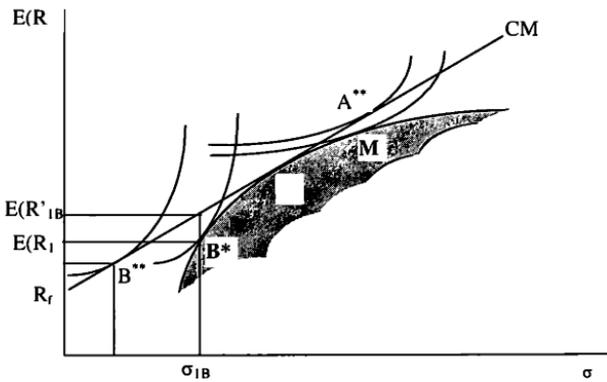
- many of risk recipients could hardly present their own impartial curve, while for many of
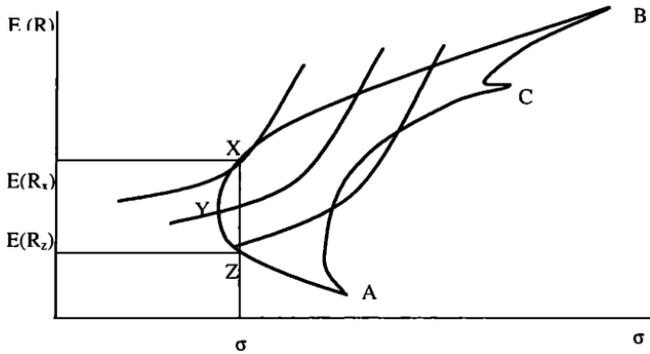
a. The best alternative from the available, with the degree of risk
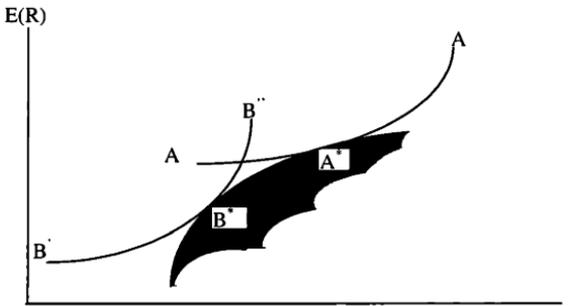
b. Convex curve with indifference curves of two investors

c. The capital market line

Fig. 5. Scheme of analysis of portfolio decision making

95

them the idea of utility function is naturally understandable;

- expected profitability, which in modern portfolio theory is identified with mean profitability, is not the most expected profitability value, i.e. it doesn't have the highest probability;

- the scheme does not guarantee the needed level of reliability. For this purpose it is necessary to select portfolios not only on the basis of two targeted indicators as in the modern portfolio scheme (mean and standard deviation), but for all fractile levels – standard deviation or another measure of risk combinations;

- it is not suitable for definition of efficiency zone, i.e. a zone which shows all profit possibilities with each given risk (standard deviation) level.

Let us thus turn back to the portfolio geometry. We see that the averages of random profit are put on the ordinate axis, and standard deviations of these values are put on the abscissa axis. Thus, we have a very obvious geometric illustration of basic portfolio analysis. This geometric evidence will not disappear if instead of the average and/or deviation we take their linear functions, i.e. scroll them in the same direction on the ordinate/abscissa axes.

In turn, remembering the definition of portfolio profitability or, more precisely, the profitability of investments, belonging to the portfolio, we have to agree that the average portfolio profit value is not the best index for the portfolio state evaluation. The average profitability is a generalized state of profit possibilities of all investments. Besides, it is only one of many possibilities, it often does not attract as much attention as does the fractile of a certain level or even completely not belonging to the heap of possible states. In every specific case, the profit will be just one of all profit possibilities, which are comprehensively defined by their probability distribution. The necessity of interpretation of portfolio profitability as a random variable is confirmed by the circumstance that the price of separate investments (bonds, stocks, projects, etc.) and portfolio price are stochastic values. Thus, we can have the whole view of possible portfolio profit values only after presenting this profit as a random variable, which is like a logic financial-mathematical model of this profit. In turn, only such description of a portfolio's profit possibilities allows to find the interaction between risk as a measure of profit volatility and investor's utility function. This is necessary for systemic risk evaluation and for creation of its adequate management model.

So, if we want to retain the geometrical clearness of the established set of portfolio value analysis when on the abscissa axis there is portfolio probability fluctuation, i.e. the parameters describing portfolio risk such as variance, standard deviation, or other parameters more adequate for risk description, also if we want to have the parameters generalizing portfolio efficiency – quintiles, including median, mode and others, then it is not enough to have a two-dimensional plane to show this evidence.

This is why the further analysis of the portfolio should be shifted from the rather obvious "portfolio probability risk (abscissa) – portfolio probability spectrum (ordinate) – portfolio probability guarantee (coordinate)" plane to the portfolio space. For a faster understanding, let's assume that for every point X_R which is on any risk level R_X line parallel to the ordinate axis, there is a probability $P_X = Px\{X_R \le x \le Max\, R_X\}$ calculated for this axis, where $Max\, P_X$ is maximum portfolio profitability probability at the risk level R_X. If X_R is a quintile of the p level, then $Px = 1-p$.

We can see that the effective line of the "p level fractiles' standard deviation maxim" set of

portfolios is the intersection of the survival function surface with the plane parallel to the plane "standard deviation – fractiles of all levels" portfolios set and having the ordinate p, a projection on the mentioned earlier plane. Figure 7 presents: section a – density functions family; section b – survival functions family, section c – effective lines of values of all the portfolios of all levels of quartiles and the mean. Thus, the discussed effective line is a 1–p level isoguarantee, i.e. a line for which every point of a statement that the possibility to exceed the ordinate of this point at a fixed level of standard deviation probability (guarantee) equals 1-p is valid. The effective zone is a set of isoguarantees or simply an equivalent of isoquantiles in the efficiency zone.

Further on the ordinate axis the effective zone is plotted, whose accent is that here we do not analyze the means of portfolio profitabilities (as in modern portfolio theory); instead, the maxims of the corresponding fractiles of these portfolios are analyzed.

A possible portfolio profitability interval will be considered as an interval of the corresponding profitabilities in the reliability zone. An event will be considered as a certain set of profitability possibilities. The events can be different, for example: A. profitability will not exceed 3% (A: $e = 3\%$); B. profitability will be between 2% and 5% (B: $2\% = 5\%$). The p level fractile of the possibility interval within the chosen level of risk will be considered as the values of such possibilities ep whose event "$e<ep$" probability P $\{e = ep\} = p$. The probability of the event "$e<ep$" will be noted as q and it will be called the event guaranty. There is no doubt that $q = 1 - p$, though we have to remember that events are being analyzed in the reliability zone, which is the sum of isoguarantees and isoquantiles.

For a better understanding of the adequate scheme of investment portfolio risk analysis (see Fig. 6), let us consider both the scheme of a classic portfolio study and an adequate one. As already mentioned, according to the modern portfolio theory the investor should be interested only in the portfolios that are located on the efficiency line. The efficiency line is understood as a set of maximal possible values of profit (averages) calculated for a specific standard deviation value of a portfolio set. Uniting the existing investments into a portfolio in all possible proportions creates a feasible set of portfolios; the total portfolio's profit averages and standard deviations are evaluated.

However, in a real situation the profitability of portfolios, i.e. portfolio investments, are observed and realized not as the average values of their profit, but as the possible values which depend on investment market and acquisition price. Thus, it is important for the investor to see a whole set of portfolio's profit possibilities, but not only the portfolios that are on the efficiency line of the modern portfolio. So, the investor is interested in the whole efficiency zone, which is understood as a set of efficiency lines of all possible fractiles. Therefore, studying the efficiency line on which we have the maxim of profitability means for each value of the standard deviation of feasible portfolios turns into analyzing the efficiency zone. Thus, in turn, the investor's impartialy curves should be expanded into the utility functions.

There is no doubt that it is best for the investor that from the interval of profitabilities the maximum profitability would be chosen. Therefore, it is quite natural that the solution of the problem is moved to the reliability zone. However, the question whether the market, i.e. its participants, is capable to use this information needs separate
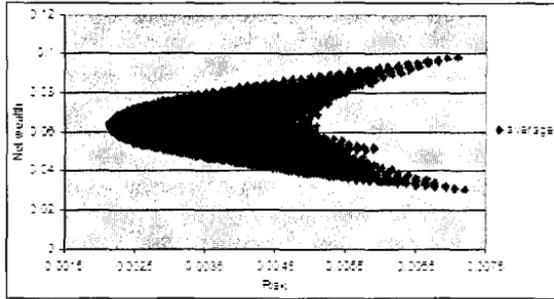
a) geometric view of average standard deviation set of portfolio values
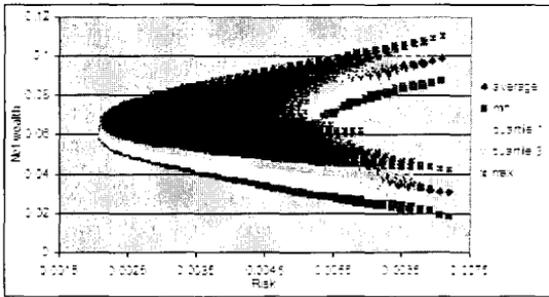
b) set of values of quartiles standard deviation portfolios
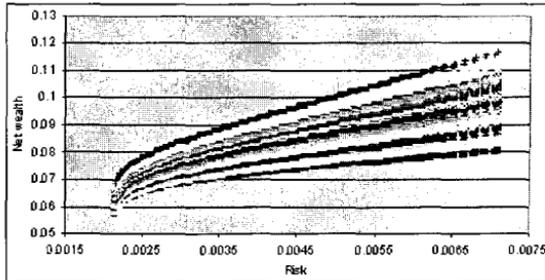
c) geometric view of efficiency zone

Fig. 6. Complex picture of portfolio risk analysis:

a) set of mean standard deviation portfolios; b) portfolios of all quartiles or quartiles – standard deviation portfolios; c) efficiency zone
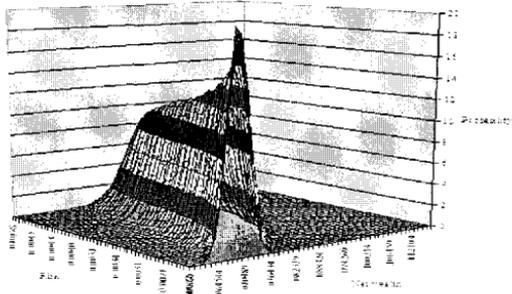
a) family of density functions, standard deviation is changing
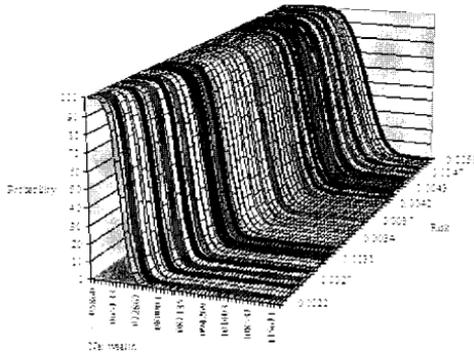
b) family of survival functions
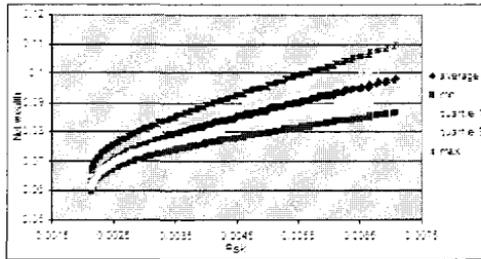
c) isoguarantees at minimum and all quartiles level

Fig. 7. General view and main properties of the efficiency zone:
a) family of distribution (density) functions at different level of risk; b) family of survival functions at
different level of risk (3-dimensional view of modern portfolio); c) isoguaranties of minimal and all
quartiles confidence levels

99

investigation. By the way, in the modernized portfolio a premise is made that the investor should select maximal profitability in the same risk level circumstances. However, this is not a perfect premise, because the guarantee of mean maximum can be much smaller than the guarantee of median maximum. Some cases are possible when a higher than average guaranty (in the lowest point of risk) fractile maxim start to exceed the maximum of means as the risk grows.

The currency rate and stock price forecasting system described in chapter 2.3 is a component of information support for portfolio decisions in currency and capital markets. If while using elementary strategies – maxims – for forecasting systems the task was to show the directions of changes of currency rates or stock prices possibly more often, then talking about portfolio decisions the reliability and accuracy of the portfolio is important.

Portfolio decisions started in the investment market were directed to the compatibility of optimal investments with profitability and risk. This purpose of portfolio decisions is valid also in currency and capital markets – to optimally balance the desirable capital growth and the risk.

4.3. Portfolio decision management in currency market subsystem and its practical implementation results

The currency rate forecasting system presented in Section 3 of the paper is a consistent part of information supply for portfolio decision making in the currency market. The elementary strategies of using graphical views presented in Fig. 2.3 reflect the possibilities of using real maxims. Let us remind here a notion in the elementary strategy to keep the capital in the currency whose rate versus the second currency is expected to rise.

However, the main objective of this paper is to analyse portfolio decision strategies and to

evaluate their efficiency in the real currency rate change. We will shortly remind the main statements and organizing principles of the strategy:

- by using the historical data for the $[t_0, t]$ period we prepare the probability distribution of rate change for the $t+1$ step;
- on the basis of the current portfolio and the forecasts we choose a new currency portfolio for the $t+1$ step;
- as the historical dada for the $t+1$ period appear, we evaluate the effect of the decision made;
- combining the $t+1$ period data with the historical database, we perform forecasts and make a portfolio for the $t+2$ period.

In Scheme 1, we present the results of using one of the portfolio categories. In the 1st column of the table there are numbers of days included in the experiment – these are conditional numbers of an experiment. Column 2 shows the currency which became the trump currency at the corresponding day. In 3–9 columns there are shares of the respective portfolio structures which diversified the trump currency: 3 – EUR (USD), 4 – GBP, 5 – CHF, 6 – CAD, 7 – AUD, 8 – JPY, 9 – EUR (USD). Columns 10–11 show an increase in EUR and USD rates depending on the currency rate changes and the chosen portfolio. Column 12 shows the accumulated sum, with the assumption that the initial sum equals 1. It should be noted that portfolio rebalancing costs were evaluated according to the FOREX rules.

Blocks b and c contain the graphs of invested capital increase and accumulated sum, respectively.

In Scheme 2 another strategy is presented, which is oriented to the growth stability and not only to the growth tempo. The structure of this scheme is the same as the structure of Scheme 1.

Step	Currency	Portfolio structure							Increase		Accumulated sum
1	2	3	4	5	6	7	8	9	10	11	12
191	USD	0	0	0	0.5	0.5	0	0	0.006629	0.008599	1.006629
192	USD	0	0	0.0833	0	0	0	0.9167	-0.00011	-0.00013	1.00652
193	USD	0	0.3333	0	0.6667	0	0	0	-0.00204	-0.00266	1.004478
194	USD	0	0	0	0.0833	0	0	0.9167	-1.3E-05	-1.7E-06	1.004465
195	EUR	0	0.0833	0	0	0	0	0.9167	-0.00024	-0.00032	1.004221
										.	
395	EUR	0	0	0.0833	0	0	0	0.9167	5.14E-05	6.22E-05	1.098916
396	USD	0	0	0	0	0	1	0	-0.00387	-0.00472	1.09505
397	USD	0	0	0	0	0.0833	0	0.9167	-0.00071	-0.00086	1.094336
398	EUR	0	0	1	0	0	0	0	0.000563	0.000678	1.094898
399	EUR	0	0	0	0.0833	0	0.9167	0	-0.00148	-0.00178	1.093419
400	USD	0	0	0	0	0	0.0833	0.9167	-0.00096	-0.00115	1.092457
401	USD	0.1667	0.25	0	0.5833	0	0	0	0.002934	0.003525	1.095391
402	EUR	0	0	0	1	0	0	0	0.003342	0.004024	1.098732
403	EUR.	0	0.0833	0	0.9167	0	0	0	0.0093	0.011191	1.108032

a) portfolio table
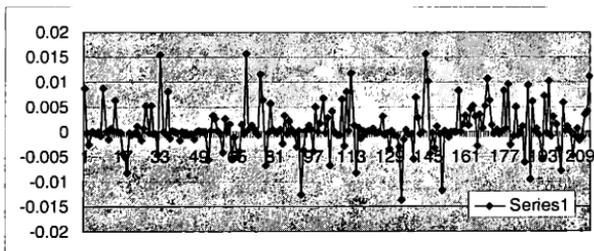
b) graphical view of the increase
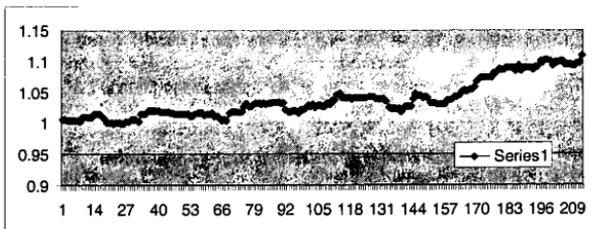
c) accumulated capital sum

Scheme 1. Results of the first strategy application

Step	Currency	Portfolio structure							Increase		Accumulated sum
1	2	3	4	5	6	7	8	9	10	11	12
191	USD	0.0833	0.0833	0.1667	0.4167	0.25	0	0	0.006453	0.008371	1.006453
192	USD	0	0	0.0833	0	0	0	0.9167	-0.00011	-0.00013	1.006344
193	USD	0	0.5	0	0.5	0	0	0	-0.00169	-0.0022	1.004654
194	USD	0	0	0	0.0833	0	0	0.9167	-1.3E-05	-1.7E-06	1.004641
195	EUR	0	0	0.0833	0	0	0	0.9167	-3.4E-05	-4.4E-05	1.004607
.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.
395	EUR	0	0	0.0833	0	0	0	0.9167	5.06E-05	6.13E-05	1.082219
396	USD	0	0	0	0	0	1	0	-0.00381	-0.00465	1.078412
397	USD	0	0	0	0	0.0833	0	0.9167	-0.0007	-0.00085	1.077707
398	EUR	0	0	0.0833	0	0	0	0.9167	5.61E-05	6.75E-05	1.077763
399	EUR	0	0	0	0	0	0.0833	0.9167	-0.0001	-0.00012	1.07766
400	USD	0	0	0	0	0	0.0833	0.9167	-0.00095	-0.00114	1.076711
401	USD	0.1667	0.1667	0.0833	0.5833	0	0	0	0.003142	0.003776	1.079853
402	EUR	0	0	0	0.0833	0.0833	0	0.8333	0.000497	0.000599	1.080351
403	EUR	0	0	0.0833	0	0	0	0.9167	0.000143	0.000172	1.080494

a) portfolio table
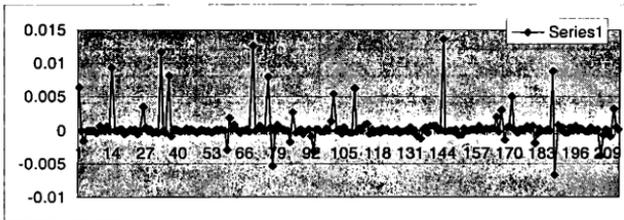
b) graphical view of the increase
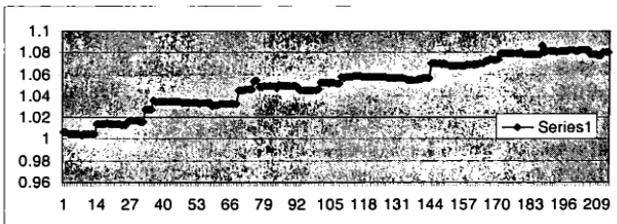
c) accumulated capital sum

Scheme 2. Results of the second strategy application

Suggestions and conclusions

Despite the fact that a lot of attention is paid to decision management in currency markets in research and practical literature, it is necessary to emphasize certain specific aspects of decision making in capital and currency markets:

- while determining the decision management criteria and developing the decision making technique we do not pay proper attention to the evaluation of reliability (guarantee) of the decisions,
- the methods of forecast of the financial market behavior should be adaptable, flexible, correct and constructive.

The adequate portfolio model of investment profit stochasticity assessment, suggested by the author, allows to evaluate the probability of an-ticipated results of investments according to profitability (effectiveness), reliability (guarantee) and riskiness.

The characteristics of the currency exchange rate fluctuation forecasting system, discussed in the article and used practically, such as adaptation, flexibility, correctiness and constructiveness, made it possible to generate currency exchange rate prognoses which have ensured the effectiveness of the decision strategies.

Considering the practical results of the portfolio decision strategies presented in the paper, we can state that not the possibility to conquer the market but its inhomogeneity should be stressed, i.e. the possibilities to form, having only historical data, decision management strategies which would guarantee an advantage over the overall market decisions.

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DVIGUBO KOZIRIO SPRENDIMŲ VALDYMO GLOBALINĖJE VALIUTŲ RINKOJE *FOREX* MODELIS

Aleksandras Vytautas Rutkauskas

Santrauka

Straipsnyje nagrinėjamas sprendimų valdymo globalioje valiutų ir kapitalo rinkoje FOREX modelis. Šis modelis sudarytas remiantis autoriaus anksčiau pasiūlyto adekvataus investicijų pelningumo stochastinei prigimčiai, kartu ir sprendimų patikimumo įvertinimui portfelio ir valiutų kursų kaitos prognozavimo sistemos pagrindu. Iliustruojamos praktinės šio modelio pritaikymo galimybės.

Eksperimentiniai modelio taikymo rezultatai leidžia teigti, kad globali valiutų, kaip ir kapitalo, rinkos nėra homogeniškos, t. y. praktiškai visuomet egzistuoja galimybės, remiantis tik istoriniais rinkos duomenimis, parinkti sprendimų valdymo strategijas, leidžiančias turėti pranašumą prieš apskritai priimtus rinkos sprendimus.

Įteikta 2005 m. lapkričio mėn.