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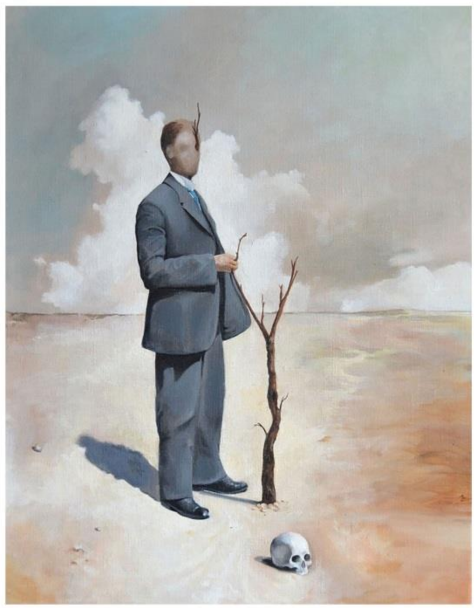


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# A new approach to modeling and analysis portfolio investment solutions

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## Abstract

The possibility of using an econometric model with a discrete dependent variable in the problems of forming portfolio decisions is investigated. On the basis of the Wiener regression, a diagonal portfolio investment model is constructed, the calculations of which made it possible to clarify the interpretation of the yield-risk relationship. As a result, the yield of each financial asset that is traded on the market depends on the investment potential of the market. In conclusion, the higher the risk, the greater the deviation of the expected level of profitability from the level guaranteed by the investment potential of the market.

**Keywords:** Regression, Binary Choice, Portfolio, Investment.

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# Un nuevo enfoque para el modelado y análisis de soluciones de inversión de cartera

**Resumen**

Se investiga la posibilidad de utilizar un modelo econométrico con una variable dependiente discreta en los problemas de formación de decisiones de cartera. Sobre la base de la regresión de Wiener, se construye un modelo de inversión de cartera diagonal, cuyos cálculos permitieron aclarar la interpretación de la relación riesgo-rendimiento. Como resultado, el rendimiento de cada activo financiero que se negocia en el mercado depende del potencial de inversión del mercado. En conclusión, cuanto mayor es el riesgo, mayor es la desviación del nivel esperado de rentabilidad del nivel garantizado por el potencial de inversión del mercado.

**Palabras clave:** regresión, elección binaria, cartera, inversión.

## 1. INTRODUCTION

The model proposed by MARKOWITZ (1952), becoming the beginning of the modern theory of an effective market, made it possible to obtain a number of fundamental results that were recommended to investors for use in their practical activities. In particular, all investors and not only investors agree with the statement that the risk is higher, the higher the desired level of profitability. This position is usually confirmed by calculations performed on the basis of optimal investment models in securities, for the construction of which real stock market data are used. These calculations are used to build a chart, the configuration of which confirms the plausibility of the reality of such a relationship of risk with profitability. The correctness of the calculations is not in doubt, and the logic of the conclusions is quite convincing. But, despite this, there are still questions that may cast doubt on such a well-founded recommendation. This article is mainly devoted to the consideration of these issues.

## 2. METHODOLOGY

First of all, we note that the statistical correctness in constructing the Markowitz model was certainly observed, but the question of adequately reflecting the real relationships between the processes of the stock market was not considered in principle. And only after 12 years, SHARPE (1963) proposed his own version of the portfolio investment model, the construction of which was based on single-index regression models

$$r_{it} = \alpha_i + \beta_i r_{It} + \varepsilon_{it} \qquad (1)$$

where

$r_{it}$ - profitability of the i-th asset at time t

$\alpha_i, \beta_i$ – coefficients of the regression model of profitability of the i-th asset

$r_{It}$ - index return at time t

$\varepsilon_{it}$ – random component of the regression model with zero mathematical expectation.

Using regression equations to build a portfolio investment model allowed Sharpe to introduce new elements into investment analysis. First of all, he managed to clarify the nature of the formation of portfolio profitability by identifying two components in it, the first of which reflected the contribution of the securities themselves to portfolio profitability, and the second reflected the portfolio profitability formed under the influence of the market (MARIA, DOBRINA & YUROVA, 2019).

The second component in portfolio returns is formed depending on the market. The degree of this dependence is known to be determined by portfolio beta, the value of which is equal to the weighted sum of beta coefficients of regression models of return on assets included in the portfolio. All beta coefficients are positive; therefore, the market has a noticeable effect on portfolio profitability and this effect must be taken into account in the model in a special way, which was done (LINTNER, 1965; ROSS, 2003).

By analogy with profitability, I got a structured view and variance. A share was allocated in it, for which the term non-systematic risk was fixed, which, according to the logic of portfolio construction, should be diversified. Its value is calculated as the weighted sum of the residual variances of the regression equations. The systematic component characterizes the instability of the market itself and is defined as the value equal to the product of the square of the portfolio beta and the variance of the market index.

Thus, in his model, Sharpe used, in addition to the characteristics of many investment opportunities, the average return, and stock market risk. Improving the portfolio investment apparatus, despite its theoretical significance and practical usefulness, which has received a positive assessment from investors, continues to be a very urgent task. The stimulating factor in these studies, as before, is the success of the Black-Scholes formula, which has become a tool for stock exchanges in determining the value of options (FROOT, SCHARFSTEIN & STEIN, 2011).

At the same time, noting the novelty of the results obtained by Sharpe, it is necessary to recognize the obvious simplicity of the econometric model that he used. As a model, we used a one-factor linear regression equation. Known criticism of Roll about the insufficiency of factors (only one), under the influence of which the return on assets is formed. But the most important observation, in our opinion, is that it is impossible to adequately describe the alternative mechanism for generating returns in the stock market using the linear model (ROLL, 1977).

When creating the Black-Scholes formula, the apparatus of random processes was used, in particular, the Wiener process. For the discrete case, a change in the stock's return over an infinitely small period of time $\Delta t$ can be represented by a generalized Wiener process as follows:

$$\Delta r = \mu \Delta t + \sigma \varepsilon \sqrt{\Delta t} \qquad (2)$$

$\mu$– expected stock returns

$\sigma$– instantaneous standard deviation of stock returns, characterizing a jump-like change

$\varepsilon$– standard normally distributed random variable.

Since $\varepsilon$ can take both positive and negative values, with the help of (2) a random mechanism of alternative formation of asset return is reproduced. This is exactly the mechanism that we need to reproduce using the regression equation. In the simplest case, when in his expectations the investor focuses on the average return $\overline{r}_i$ on the i-th asset, the current return $r_{it}$, by analogy with (2), can be represented by the following econometric equation

$$r_{it} = \bar{r}_i + d_i x_{it} \tag{3}$$

where $x_{it}$– a random discrete variable that takes a value of -1 if a return is expected below the average level and takes a value of +1 if a return is expected above the average level; $d_i$ - the value of a possible change in profitability, estimated in the framework of the model from the actually observed values.

To build a model (3) that describes the formation mechanism of the profitability of each asset included in the portfolio, first of all, the values of the discrete variable that describe the alternative dynamics of profitability are formed.

$$x_{it} = \begin{Bmatrix} +1, & r_{it} - \bar{r}_i \geq 0 \\ -1 & r_{it} - \bar{r}_i < 0 \end{Bmatrix}. \tag{4}$$

Using the maximum likelihood method, the parameters of the binary selection model are estimated, the values of the factor of which are used to deviate the index from its average $z_t = r_{It} - \bar{r}_I$. As a result, we obtain the conditional distribution of a random variable $x_{it}$

$$P_{it} = P(x_{it} = 1 / z_t). \tag{5}$$

More often than others, in practical calculations, probit and logit models are used. Given a known distribution of a random variable, in expression (3) we can proceed to the mathematical expectation and, for a case, for example, a logistic distribution, obtain a model in the form

$$[1]\mathrm{E}(r_{it}) = \mathrm{E}(r_i + d_i x_{it}) =$$
$$= \overline{r_i} + d_i[1 \cdot P_{it} + (-1) \cdot (1 - P_{it})] =$$
$$= \overline{r_i} + d_i[2P_{it} - 1] \qquad (6)$$

$$\mathrm{P}_{it} = \frac{1}{1+\exp(b_{0i}+b_{1i}z_t)} \qquad (7)$$

The model is quite suitable for calculations. Using (7), the probability is calculated for obtaining a positive return at the current time in the stock market, if you own the i-th financial asset. And using (6), the expected return on this asset is determined, which, depending on the probability $P_{it}$ , can be higher than the average return or lower than the average return.

In principle, if we substitute probability (7) in (6), then model (6) - (7) can be easily written with one expression

$$\mathrm{E}(r_{it}) = \overline{r_i} + d_i \left[\frac{1-\exp(b_{0i}+b_{1i}z_t)}{1+\exp(b_{0i}+b_{1i}z_t)}\right] . \qquad (8)$$

The introduction of an alternative mechanism for generating asset returns with a single expression (8), on the one hand, provides a more compact calculation, but on the other hand, crosses out the meaningful interpretation obtained using (6). Therefore, in the analysis of the obtained simulation results, we will use the profitability formation model in the form (6) - (7).

In fact, a model is constructed that describes the relationship between the yield of a financial asset and the investment opportunities of the stock market. An investment opportunity relates to a specific asset and is described by the conditional probability of obtaining a positive return using this asset. From (6) it follows that the higher the probability, the higher the level of return on the asset. Moreover, with $P_{it} > 0{,}5$ investment opportunities, yield growth is achieved, while with $P_{it} < 0{,}5$ investment opportunities, profitability is reduced. The ability to measure the investment opportunities of the stock market using the probability of obtaining a positive return makes this indicator attractive to the investor. This is a very interesting result, which in the theory of justification of investment decisions has not previously been considered.

We will call model (6) - (7) Wiener regression because it is obtained from expression (3), which can be considered an econometric copy of expression (2) describing the Wiener random process without special stretches. Using Wiener regression, it is possible to obtain an adequate description of the dynamics of the dichotomous mechanism for the formation of the return on financial assets, the properties of which were taken into account when determining the value of the option and were ignored when justifying portfolio decisions.

Now we define the risk of the asset, which is the second characteristic of many investment opportunities. To do this, we calculate the variance of the yield of a financial asset, defined in the usual way as the mathematical expectation of the square of the deviation of the asset's return from its mathematical expectation

$$\sigma_{it}^2 = \mathrm{E}[(\bar{r}_i + d_i x_{it} + \varepsilon_{it} - \bar{r}_i - d_i \mathrm{E}(x_{it}))^2] =$$
$$= \mathrm{E}[\left(d_i\left(x_i - E(x_{it})\right)^2\right] =$$
$$= 4d_i^2 \mathrm{P}_{it}(1 - \mathrm{P}_{it}) \qquad (8)$$

We got an interesting result. Dispersion, and, consequently, the risk of an asset, just like the yield of an asset, depends on the likelihood of a positive return $P_{it}$. Moreover, if with an increase in this probability the yield of the asset increases, then the level of risk decreases. This does not contradict the logic of common sense but requires special clarification.

Denoting the portfolio by the vector $\boldsymbol{w_t} = (w_{1t,}\ w_{2t}, \dots, w_{mt})$, we write the expressions for the profitability and risk of the portfolio, the construction of which is based on Wiener regression. The index t in this designation indicates that the portfolio can be formed for any point in time for which the value of the index is known. This feature is provided by the Wiener regression property mentioned above. Using (6) and, taking into account the possibility of building a portfolio for any moment in time, we write the expression for portfolio profitability as follows

$$E\left(r_p\right) = \sum_1^m w_{it}\bar{r}_i + \sum_1^m w_{it}d_i\ [2P_{it} - 1],\ t = \overline{1,T}. \qquad (9)$$

In accordance with (9), portfolio returns are made up of a weighted sum of the average returns of the financial assets included in it and a weighted amount of the expected changes in the returns of these assets. From (9), it becomes clear why a growing market with $P_{it} > 0{,}5$ is preferred for operations with securities.

Turning to the consideration of the expression determining the variance of the portfolio, and remembering that in addition to the variances of the portfolio assets, covariances of these assets should be present in this expression, we will make an assumption on the independence of random variables that underlie the construction of winer-regression and verify the validity of this assumption. In terms of meaning, discrete random variables for which probability distributions $P_i$ are determined during the construction of the wiener regression are used to easily calculate covariance values. Consider what the covariance between any two random variables is equal to. It turns out that covariance is zero

$$\sigma_{ij} = E[(x_i - 2P_i + 1)(x_j - 2P_j + 1)] = 0 \qquad (10)$$

A null result gives the mathematical expectation of the expression obtained after multiplying the expressions in parentheses.

Considering (10) and expression (8), with the help of which the variance of an asset is determined, we write the formula for the variance of the portfolio

$$\sigma_{pt}^2 = \sum_{i=1}^{m} w_{it}^2 d_i^2 \left[4P_{it}(1 - P_{it})\right], \quad t = \overline{1,T}. \qquad (11)$$

Thus, the variance of the portfolio, as well as its profitability, depends on the state of the market, taken into account using the probability of each i-th asset receiving a positive return at time t. Taking risk as the square root of the variance, we can analyze formula (11) to conclude that in order to reduce portfolio risk, it is necessary that the proportion of funds invested in an asset with a greater dispersion be less than the proportion invested in an asset with lower dispersion. It is clear that an important point in the practical implementation of this approach is the forecast of the average stock market return. At the same time, the nature of this risk contains an element of a shocking nature, since the state of the market on which the risk depends often changes after events, the predictability of which is in principle impossible (YENDOVITSKY, 2001).

Another feature that needs to be considered when forming a portfolio investment model within the framework of the proposed approach. In the formula (11), for obvious reason, there are no mixed products, which means that the matrix using which the variance of the portfolio in the model of optimal portfolio investment is determined is diagonal. This simplifies calculations and makes portfolio analysis more transparent. But the most important thing is that the model built using (9) and (11) provides for the possibility of tuning to the market situation, which allows the investor, making his own choice, to take into account the current capabilities of the stock market.

If we introduce designations

$$\Sigma_{dp} = \begin{bmatrix} 4d_1^2 P_{1t}(1-P_{1t}) & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & 4d_m^2 P_{mt}(1-P_{mt}) \end{bmatrix},$$

$$\boldsymbol{r}_{dp} = \begin{bmatrix} \overline{r_1} + d_1[2P_{1t}-1] \\ \vdots \\ \overline{r_m} + d_m[2P_{mt}-1] \end{bmatrix}, \qquad \boldsymbol{w}_t = \begin{bmatrix} w_{1t} \\ \vdots \\ w_{mt} \end{bmatrix}, \qquad \mathbf{i} = \begin{bmatrix} 1 \\ \vdots \\ 1 \end{bmatrix},$$

$$P_{it} = \frac{1}{1 + \exp(b_{0i} + b_{1i} z_t)}$$

then the portfolio investment model can be written as follows:

$$\boldsymbol{w}_t' \Sigma_{dp} \boldsymbol{w}_t \rightarrow min \quad (12)$$

$$\boldsymbol{w}_t' \boldsymbol{r}_{dp} = \mu \quad (13)$$

$$\boldsymbol{w}_t' \mathbf{i} = 1 \quad (14)$$

The main feature of this model is that with its help the portfolio structure of the current time is calculated, for which the average stock market return is known. The meaning of this feature is that using the well-known portfolio investment models, the average portfolio structure was determined, which is unique for the entire historical period. Using the model (12) - (14), it is possible to build portfolios for each point in time of this period, depending on the current market situation. Such an opportunity, provided in the model, focuses on the construction of forecast portfolio structures, which in principle can be considered the preferred opportunity (DOBRINA, 2017).

The optimal solution according to model (12) - (14) is obtained in the usual way using Lagrange multipliers. To understand whether an investor gets additional opportunities when forming a portfolio of securities using the proposed model, it is necessary to conduct a comparative analysis with the well-known Markowitz model, having performed computational experiments on the same set of source data (DAVNIS, VOISHCHEVA, KOROTKIKH, 2014).

## 3. RESULTS AND DISCUSSION

To carry out the calculations necessary to build a portfolio investment model based on win regression, eight stocks were selected: Gazprom, Surgutneftegaz, Lukoil, Rosneft, Aeroflot, MosEnergo, Megafon. As an argument to the wiener-regression models, we used data on the average market yield described by the RTS index. The calculations were carried out on data on stock price quotes for three months.

Previously, all data on the value of assets were converted into profitability and smoothed using the moving average procedure. Based on the values obtained in this way, the average returns of the assets $\bar{r}_i$ and the market index $\bar{r}_I$ were calculated, the standard deviations of the assets were determined, discrete values of the dependent variables $x_{it}$ were generated, and the values of the factor variable of the Wiener-regression model were obtained in the form of deviations $z_t = r_{It} - \bar{r}_I$.

The coefficients of the logit model of binary choice

$$P(r_{it} \geq \bar{r}_i / z_{it}) = \frac{1}{1+\exp(b_{0i}+b_{1i} z_{It})} \qquad (15)$$

and their statistical reliability characteristics were obtained using the MATLAB package. The results of these calculations are shown in table 1.

Table 1: Logit-models of binary choice

| COEFFICIENTS AND CHARACTERISTICS OF LOGIT MODELS | | | | |
|---|---|---|---|---|
| Design. | Coef. | ст.ош. | t-disp. | p-value |
| Gazprom | | | | |
| b0 | 0,2707 | 0,3182 | 0,8506 | 0,3949 |
| b1 | -2,3220 | 0,7100 | -3,2703 | 0,0011 |
| Sberbank | | | | |
| b0 | -0,0365 | 0,3239 | -0,1128 | 0,9102 |
| b1 | -2,5877 | 0,7574 | -3,4168 | 0,0006 |
| SurgutNefteGaz | | | | |
| b0 | -0,3758 | 0,3412 | -1,1016 | 0,2706 |
| b1 | -2,8725 | 0,8175 | -3,5138 | 0,0004 |
| Lukoil | | | | |
| b0 | -0,1371 | 0,3227 | -0,4249 | 0,6709 |
| b1 | -2,5095 | 0,7449 | -3,3689 | 0,0007 |
| Rosneft | | | | |
| b0 | 0,3441 | 0,3027 | 1,1368 | 0,2556 |
| b1 | -1,7146 | 0,6172 | -2,7780 | 0,0054 |
| Aeroflot | | | | |
| b0 | -0,2607 | 0,3349 | -0,7783 | 0,4363 |
| b1 | -2,8075 | 0,8019 | -3,5009 | 0,0004 |
| MosEnergo | | | | |
| b0 | 0,4083 | 0,3441 | 1,1866 | 0,2353 |

| | | | | |
|---|---|---|---|---|
| b1 | -3,0171 | 0,8453 | -3,5691 | 0,0004 |
| Megafon | | | | |
| b0 | 0,0678 | 0,3244 | 0,2092 | 0,8343 |
| b1 | -2,6096 | 0,7607 | -3,4306 | 0,0006 |

The simulation results presented in Table 1 allow us to determine probabilities using (15), and then using expressions

$$r_{it} = \bar{r}_i + d_i[2P_{it} - 1] \quad (16)$$

$$\sigma_{it}^2 = 4d_i^2 P_{it}(1 - P_{it}) \quad (17)$$

for any level of average market profitability, calculate the expected return on all assets included in the portfolio and evaluate the level of uncertainty of these expectations with the corresponding variance values. The calculation results are shown in Table 2.

Table 2: Data for multivariate modeling of portfolio decisions

| Data for building a diagonal probability model | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Gazprom | Sberbank | SurgutNeftegaz | Lukoil | Rosneft | Aeroflot | MosEnergo | Megafon | RTS |
| Constants | | | | | | | | |
| Aver.val. | 0,1970 | 0,0937 | 0,0766 | 0,1169 | 0,1584 | 0,0738 | 0,0599 | 0,2536 |
| Sq.m | 0,5901 | 0,7825 | 0,4104 | 0,4219 | 0,4642 | 0,5977 | 0,4683 | 0,4310 |
| Variables (0.0) | | | | | | | | |
| var. | 0,4327 | 0,5091 | 0,5928 | 0,5342 | 0,4147 | 0,5648 | 0,3993 | 0,4830 |
| Calc.val. | 0,1176 | 0,1079 | 0,1528 | 0,1457 | 0,0793 | 0,1512 | -0,0344 | 0,2390 |
| dispers. | 0,3419 | 0,6120 | 0,1626 | 0,1772 | 0,2092 | 0,3512 | 0,2104 | 0,1855 |
| Variables (0.05) | | | | | | | | |
| var. | 0,4614 | 0,5413 | 0,6270 | 0,5652 | 0,4357 | 0,5989 | 0,4359 | 0,5156 |
| Calc.val. | 0,1515 | 0,1584 | 0,1808 | 0,1719 | 0,0987 | 0,1920 | -7,2E-05 | 0,2671 |
| dispers. | 0,3461 | 0,6080 | 0,1575 | 0,1749 | 0,2119 | 0,3432 | 0,2157 | 0,1855 |
| Variables (0.1) | | | | | | | | |
| var. | 0,4904 | 0,5733 | 0,6600 | 0,5958 | 0,4569 | 0,6322 | 0,4734 | 0,5481 |
| Calc.val. | 0,1857 | 0,2084 | 0,2079 | 0,1977 | 0,1184 | 0,2318 | 0,0349 | 0,2951 |
| dispers. | 0,3481 | 0,5991 | 0,1512 | 0,1715 | 0,2139 | 0,3323 | 0,2187 | 0,1840 |
| Variables (0.2) | | | | | | | | |
| var. | 0,5483 | 0,6351 | 0,7212 | 0,6545 | 0,4997 | 0,6947 | 0,5486 | 0,6116 |
| Calc.val. | 0,2540 | 0,3051 | 0,2581 | 0,2473 | 0,1581 | 0,3065 | 0,1054 | 0,3498 |
| dispers. | 0,3450 | 0,5675 | 0,1355 | 0,1610 | 0,2155 | 0,3031 | 0,2173 | 0,1765 |
| Variables (0.3) | | | | | | | | |
| var. | 0,6049 | 0,6927 | 0,7751 | 0,7089 | 0,5425 | 0,7508 | 0,6217 | 0,6715 |
| Calc.val. | 0,3208 | 0,3953 | 0,3024 | 0,2931 | 0,1978 | 0,3736 | 0,1739 | 0,4015 |
| dispers. | 0,3329 | 0,5213 | 0,1174 | 0,1470 | 0,2139 | 0,2673 | 0,2063 | 0,1639 |
| Variables (0.4) | | | | | | | | |
| var. | 0,6588 | 0,7449 | 0,8212 | 0,7578 | 0,5845 | 0,7995 | 0,6896 | 0,7263 |
| Calc.val. | 0,3845 | 0,4769 | 0,3402 | 0,3344 | 0,2369 | 0,4319 | 0,2375 | 0,4487 |
| dispers. | 0,3131 | 0,4653 | 0,0989 | 0,1306 | 0,2093 | 0,2289 | 0,1877 | 0,1476 |

For each option provided in table 2, portfolios were formed that were used in the calculations to establish the relationship risk-return. The scheme for conducting multivariate calculations using the proposed model differs significantly from the scheme that was used in the calculations carried out, for example, with the Markowitz model. If the calculation options usually differed only in the value of the expected return, then when using the proposed model, the difference between the options from each other is described by two characteristics: the expected portfolio return and the investment opportunity of the market. The calculation results are shown in Table 3.

Table 3: Risks of portfolio decisions

| COMPUTATIONAL EXPERIMENT RESULTS | | | | | | |
|---|---|---|---|---|---|---|
| Portfolio return | MARKET INVESTMENT OPPORTUNITY | | | | | |
| | 0.0 | 0.05 | 0.1 | 0.2 | 0.3 | 0.4 |
| | Portfolio risks | | | | | |
| 0,01 | 0,0906 | 0,1316 | 0,1813 | 0,2934 | 0,3957 | 0,4621 |
| 0,05 | 0,0550 | 0,0828 | 0,1196 | 0,2105 | 0,3007 | 0,3651 |
| 0,1 | 0,0319 | 0,0438 | 0,0649 | 0,1286 | 0,2018 | 0,2608 |
| 0,15 | 0,0326 | 0,0293 | 0,0350 | 0,0708 | 0,1248 | 0,1754 |
| 0,18 | 0,0444 | 0,0324 | 0,0289 | 0,0477 | 0,0891 | 0,1332 |
| 0,25 | 0,1052 | 0,0738 | 0,0496 | 0,0275 | 0,0365 | 0,0612 |
| 0,3 | 0,1771 | 0,1329 | 0,0942 | 0,0421 | 0,0252 | 0,0324 |
| 0,35 | 0,2728 | 0,2164 | 0,1636 | 0,0807 | 0,0359 | 0,0225 |
| 0,4 | 0,3922 | 0,3244 | 0,2578 | 0,1435 | 0,0685 | 0,0315 |
| 0,45 | 0,5354 | 0,4569 | 0,3768 | 0,2304 | 0,1231 | 0,0594 |

How the table is arranged is understandable? Horizontally, the parameter was changed, with the help of which the investment opportunity of the market is described. The parameter was changed vertically, with the help of which the expected portfolio return is set.

In fact, each column of the table can be considered the result of risk modeling based on the principle that Markowitz used. In accordance with this principle, an increase in expected return should be followed by an increase in risk or, what is the same, the lower the return, the lower the risk. Naturally, the investor should know this and in practice follow this recommendation. But the results presented in the table contradict these statements. How to explain this contradiction?

To explain this contradiction, it is necessary to introduce the concept of the investment potential of the market. The yield of each financial asset that is traded on the market depends on the investment potential of the market. The degree of this dependence is estimated using the probability of a positive return on the corresponding asset. This probability is conditional and depends on the average profitability of the market. Consequently, the investment potential of the market for each asset is measured by the conditional probability of obtaining a positive return by this asset. In turn, profitability and risk depend on this probability, as follows from (16) and (17). Thus, the multitude of investment opportunities of an investor is determined by the investment potential of the market.

It follows from the foregoing that the results obtained are quite explainable and, without contradicting the fundamentals of the theory of an effective market, clarify its individual provisions, and also supplement them with new results.

## 4. CONCLUSIONS

The article develops the idea of Sharpe, who proposed not using the actually observed values, but their regression model to build a portfolio investment model. Despite the simplicity of this model, he managed to obtain results that turned out to be a significant contribution to the theory of portfolio investment. Therefore, the idea of reflecting an alternative mechanism for the formation of the return on financial assets in the stock market using a special model, which was called Wiener regression, was intended to provide new results. These results really managed to get.

First of all, the concept of the investment potential of the market was introduced and its quantitative measure was proposed, which makes it possible to assess the degree of influence of this potential on the set of investment opportunities of the investor. But the main result is that the need for a change that has become practically law is shown, the rules on the relationship of risk with profitability. In accordance with the proposed rule, the higher the risk, the greater the deviation of the expected level of profitability from the level guaranteed by the investment potential of the market. This does not simplify the procedure for forming an investment decision but makes this procedure purposefully focused on identifying potential market opportunities. In our opinion, in addition to clarifying certain provisions of the theory of portfolio investment, these results should be of interest to investors.

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