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MODELLING DIVERSIFICATION EFFECT OF COMBINING TRADITIONAL AND ALTERNATIVE INVESTMENTS

The dynamic development of the market of alternative assets in the last decade opens up new opportunities for investors. This development process creates new problems related to the optimal allocation of the investor's capital between traditional and alternative assets. The article examines the economic problem of building an optimal investment portfolio by the method of specification of Markowitz's theoretical approach to the combination of these two groups of assets. As traditional assets, the paper analyzes index investments in three main US indices: S&P400, S&P500, and S&P600. These three indices represent a complete cross-section of the economy of the United States of America, as they characterize different market segments depending on capitalization. Index investments in seven main alternative indices are considered as alternative investments. This sample includes both narrow-profile indices related to investing in individual commodities, such as precious metals or oil, and related to real estate and private equity. The initial stage of the research involves a correlation analysis applied to the statistical series of index returns for the period 2015-2019. The analysis indicated the heterogeneity of the correlation dependence within the studied group. Traditional assets demonstrate a relatively high dependency of returns on each other. At the same time, alternative assets show a low level of dependence both among themselves and with traditional assets. Within the application of the Markowitz approach, the task of finding the optimal portfolio was structured into the construction and analysis of three efficient sets. The first two effective sets, corresponding to traditional and alternative assets, visualize the potential of the combination of assets in terms of risk minimization. On this basis, an optimal portfolio is built from a combination of alternative and traditional assets. Comparative analysis of optimal portfolios demonstrated that risk indicators for the combined portfolio have better values. The K-ratio indicator showed a greater degree of stability of the profitability of the combined portfolio with minimal risk.

Keywords: *investments, alternative investment assets, portfolio approach, diversification, correlation, portfolio optimization, Markowitz model.*

Problem Statement. Investors who consistently seek to expand their portfolios and minimize risks through diversification are increasingly paying attention to alternative investment assets. However, the economic and mathematical nature of this diversification remains a subject of research. Do alternative investments truly provide effective risk management? Can they ensure portfolio stability amidst financial instability? These questions define the essence of the problem that requires investigation and analysis.

Analysis of Recent Publications. Recent publications have explored the topic of alternative investment assets by M. Anson [1], L. Swedroe, D. Kizer [2], and V. Debski [3],

who presented varying perspectives on defining the concept of alternative investment assets. A. Dorsey [4], D. Chorafas [5], F. Stefanini [6], T. Schneeweis, and D. Pescatore [7] developed their classifications of assets falling into this category. In their works, K. Leitner [8] and E. Sokolowska [9] highlighted the peculiarities of such investment instruments.

Unresolved aspects of the problem are in the unclear understanding of diversification effectiveness in portfolios with traditional assets using alternative assets. Does combination of alternative and traditional investments encompass new risk-return correspondence?

Prospects for further research. The existence of a significant variety of classes of alternative investment assets, their different dynamics and essence will contribute to their widespread distribution in the future. Also, the problem related to their presentation on the market and ease of access is solved through exchange quoted funds. Further research will include a deeper analysis of non-standard dependencies between traditional and alternative investment assets, both in terms of individual funds and their entire classes using economic and mathematical modeling methods. Priority will be given to verifying the correctness of the use for alternative assets of the main risk measures currently used for traditional assets. Mathematical models based on copulas for detecting dependencies in separate parts of the distributions of individual classes of assets will be considered separately.

The research methodology involves an economic-mathematical tools for interdependency analyse asset classes from alternative and traditional assets. Methodology involves also tools of modern portfolio theory and technique of investment portfolio optimization. Performance technique portfolio management are applied for analysis.

The purpose of the article is to study the nature and effectiveness of diversification through alternative and traditional investments. This research aims to establish the extent to which alternative investments actually allow for portfolio expansion and risk reduction, as well as to assess their stability and portfolio effect impact to investment strategies.

Research results. In the modern stock market there is a stable tendency to expand the investment spectrum, which is taking place against the background of the growing needs of investors. Traditional stocks and bonds, which used to be the main components of a portfolio, are still important, but investors are looking for new opportunities to diversify and reduce portfolio risk.

This happens for several reasons. First, increased volatility in traditional markets has forced investors to look for ways to balance their portfolios. Second, rapid technological development promotes the emergence of new forms of assets, such as cryptocurrencies, alternative funds, real estate, art, and others, which become attractive to investors due to their potentially high returns or ability to diversify risks. This thesis is confirmed by the growth of the market of alternative investment assets. The total capitalization of such assets in 2021 was $13 trillion. According to research firm Preqin, the total value of alternative assets more than doubled between 2015 and 2021 and is forecast to reach $23 trillion by 2026 [10]. In addition, in addition to the quantitative growth of the popularity of

such assets among investors, it is worth noting the qualitative aspect of this process, because only in the last 10 years, such alternative assets as cryptocurrencies, non-fungible tokens (or NFTs), and others have emerged and become widespread. This movement towards alternative investment assets shows the constant evolution of the market, adapting to changes in the global economy and finding new opportunities to achieve financial goals.

So, in part, the rapid growth of the volumes of this market can be connected to a certain extent with the variety of objects for investment. For the purposes of covering this topic, it will be important to reveal the concept of alternative investments and limit the set of their researched types.

Two main approaches to defining this concept are most often used in the literature. The first approach consists in the definition of alternative assets from the position "by exception": alternative investment assets are those that do not belong to traditional asset classes (shares, bonds and banking instruments of the depository type). Applying this method of defining the concept of alternative assets or investments, it is possible to reach to the conclusion that this economic category is quite significant and includes a wide variety of financial products and services. In part, this is related to the concept of "investment", which is also quite broad, as an investment can be interpreted as quite a lot of things: from a bank deposit to obtaining a higher education. However, in order to understand the possibilities of choosing investment objects, it is necessary to develop a classification that will most fully characterize all available alternative investment assets.

The opposite approach to the above-mentioned approach consists in clearly distinguishing certain categories of assets that can be classified as alternative. There are five main groups of alternative investments: real assets, hedge funds, commodities, private equity and structured products.

It is clear that this list is not an exhaustive list of all alternative investment assets (individual scientists distinguish up to 75 subcategories of alternative assets), in addition, certain assets from one category can be attributed to another or to a certain extent classified as traditional investments, and not as alternative.

With this in mind, it is worth analyzing different approaches to the definition and classification of alternative assets to limit the research sample. M. Anson characterizes alternative assets as having a higher level of risk than traditional assets, which is compensated by a higher expected level of return, even during financial crises. The author includes the following categories of assets as alternative investments: hedge funds, commodities, managed futures, private capital, credit derivatives. [1] L. Swedroe and D. Kizer support the "exception" approach and define alternative investments as those that are outside such categories of investments as: shares, bonds and traditional banking products. [2] V. Debski puts forward a similar position regarding the definition of alternative investments, and characterizes this category as all investments that do not fall within the scope of traditional forms of investment in the financial market. [3]

According to A. Dorsey, alternative investments include: hedge funds, private equity funds, currency instruments, real estate, goods and raw materials. However, this definition

seems controversial, since certain categories of assets from this list, such as goods or raw materials, can at the same time be classified as traditional investments. [4]

D. Chorafas singles out a significant list of alternative assets, but suggests that the exact definition of this concept causes many difficulties, and the comparison of individual categories of alternative investments is not easy due to their diversity and non-standard characteristics. The author tries to identify alternative investments in view of what investment strategies the investor uses. [5]

F. Stefanini divides alternative investments into so-called traditional alternative investments, hedge funds, private and venture capital funds, securitization and physical assets. In the category of traditional alternative investments, the author includes: "junk" bonds, investments in developing markets and real estate funds. To physical alternative assets, the author includes: land, real estate, as well as raw materials, precious metals and oil. [6]

According to the classification of T. Schneeweiss and D. Pescatore, alternative investments were divided into four main groups: hedge funds, managed futures, commodities and so-called traditional alternative investments. The author refers to the category of raw materials: agricultural goods, precious metals and energy, and to the traditional alternative investments were included: private capital funds, venture capital funds and real estate. [7]

K. Leitner [8] and E. Sokolovska [9] propose an approach based on the qualitative characteristics of alternative assets. The authors include the main features of such investment instruments:

- a higher level of investment risk compared to traditional assets;
- negative or zero correlation of their profitability with the profitability of traditional ones and low correlation with the market;
- trading outside the traditional stock market, which implies difficulties associated with their evaluation and lack of access to historical data;
- infrequency of operations and, accordingly, their reduced liquidity;
- long-term investment horizon, which means a longer period of capital freezing;
- the influence of state regulatory instruments is lower than that of traditional assets;
- higher costs and limited availability of such investments;
- the need for specialized knowledge for investing;
- high barriers to entry, that is, the minimum amount of capital that allows you to initiate a certain alternative investment is quite significant;
- focus on wealthy investors;
- mostly, private nature of investments.

Separately, it is worth noting the fact that the topic of alternative investments is rather poorly studied in domestic science, and scientists primarily research their individual specific classes But summarizing all approaches to the definition of alternative investment assets, they can include all investment opportunities, other than shares, bonds and bank deposits, which are characterized by at least some of the following requirements:

- a higher level of risk than traditional assets;
- low correlation with yields of traditional shares and bonds;

- trading outside the stock market;
- low liquidity;
- low level of state regulation;
- higher costs and limited availability of such investments.

As mentioned above, investing in alternative assets is more difficult for investors to understand, and more complex in general, as it partly involves investing in a specific physical asset. Therefore, investors needed the creation and availability of a certain investment tool, which would be identical to traditional stock market assets in terms of operational management format. Such an investment instrument became exchange traded fund (hereinafter – ETF). ETF is an exchange-traded investment fund that consists of assets such as stocks, bonds, commodities or other financial instruments. ETFs allow investors to gain access to different markets and sectors by purchasing a single financial instrument that represents a portfolio of assets.

The main features of ETFs are the ability to trade them on an exchange during the trading day at a price that usually reflects the value of the assets in the basket, and their liquidity, as they can be bought or sold during the day. ETFs allow investors to gain investment diversity and efficiency by being a convenient tool for creating diverse portfolios with minimal fees and expenses. Alternative asset ETFs allow investors to gain access to a variety of markets that were previously unavailable or required significant investment. These funds may include private equity, real estate, commodities, infrastructure, art investments, and other alternative assets in their portfolio.

One of the key advantages of using ETFs to invest in alternative assets is the easy access to these markets without the need to directly purchase or manage individual assets. This makes investing in alternative assets more accessible and convenient for a wide range of investors, as ETFs are traded on an exchange and therefore can be bought and sold in the same way as shares of traditional companies.

Additionally, alternative ETFs typically have lower expenses compared to direct investments in alternative assets. This can include reduced fees, lower operating costs and a reduced administrative burden. This approach allows investors to take advantage of alternative assets while maintaining greater liquidity and ease of portfolio management.

However, the availability of opportunities to invest in alternative investment assets in the form of ETFs is not a key factor in their popularity among investors. First of all, this is related to the benefits that investors receive from adding these assets to their investment portfolios. Therefore, it is worth separately analyzing what advantages they provide. First, they may have less correlation with traditional financial markets such as stocks and bonds. This means that their prices may react differently to economic and market changes compared to traditional assets. Including alternative assets in the portfolio allows investors to reduce the overall risk. If one type of asset suffers a loss, another can maintain or even increase its value, which helps to balance the portfolio and reduce its vulnerability to market fluctuations. Additionally, alternative assets can have potentially high returns. They may represent new markets or sectors not normally represented on traditional stock exchanges. This gives investors access to possible sources of income that are not limited to traditional stocks or bonds. In general, the inclusion of alternative assets in a portfolio helps create a

more diversified and balanced approach to investing, which helps reduce risk and can increase the potential return of the portfolio as a whole.

Let's consider the advantages of such a combined investment in practice based on the financial data of a single issuer. This will make it possible to calculate a unified approach to the formation of incoming financial information. To analyze interdependencies between traditional and alternative investment assets, S&P agency indices representing each category were used. Using indices only from S&P allows you to get a comprehensive view of the stock market through the use of standardized and widely recognized indicators that reflect the movements of various sectors and companies as a whole.

The S&P500, S&P600 and S&P400 indeces were used as indicators of traditional assets. Comprehensively, these are indices that reflect the state and movement of the American stock markets through the inclusion of certain companies in their composition. Here's a quick overview of each:

S&P 500 (Standard & Poor's 500): This is one of the broadest indeces of American shares, which includes the 500 largest companies by capitalization on the US stock market. These companies represent different sectors of the economy and are a reflection of the general state of the US stock market.

S&P 600 (SmallCap 600): This index includes 600 small companies that are smaller in capitalization compared to those included in the S&P 500. This provides an opportunity to track the movement of smaller companies and their impact on the market.

S&P 400 (MidCap 400): The S&P 400 index includes 400 mid-cap companies whose market capitalization lies between the large companies of the S&P 500 and the smaller companies of the S&P 600. It reflects the movement of this "mid" segment of the market.

Each index has its own characteristics and reflects different market segments. The S&P 500 is considered a greater indicator of overall market movement due to the inclusion of the largest companies, while the S&P 600 and S&P 400 focus more on smaller and mid-sized companies, respectively. Analysis of these indices allows you to get an idea of different segments of the economy and their impact on the stock market.

As examples of alternative investment assets of different classes, 7 indices S&P GSCI, S&P GSCI Energy & Metals, S&P United States REIT, S&P GSCI Precious Metals, S&P Oil & Gas Exploration & Production Select Industry Index, S&P Listed Private Equity Index, S&P GSCI were used Agriculture.

S&P GSCI (Goldman Sachs Commodity Index): This is an index that reflects the price movements of various commodities such as energy resources, agricultural products, metals and other commodities. It is one of the most well-known commodity indices and serves as an important indicator for traders and investors interested in commodity markets.

S&P GSCI Energy & Metals: This index focuses on energy resources and metals, including commodities such as oil, natural gas, gold, silver and other metals. It reflects the price movement of these key raw materials in the context of their impact on the economy.

S&P United States REIT (USD): This index reflects the price movement of stocks and real estate investment trusts in the United States. REITs (Real Estate Investment Trusts) own and manage real estate, and this index reflects their performance in the stock market.

S&P GSCI Precious Metals: This index focuses on precious metals such as gold, silver, platinum and others, reflecting their price movements and their impact on global markets.

S&P Oil & Gas Exploration & Production Select Industry Index: This index tracks the movement of shares of companies specializing in the exploration and production of oil and gas. It provides insight into the dynamics of companies in this sector.

S&P Listed Private Equity Index: This index tracks the performance of shares of publicly traded private equity companies. It provides insight into the dynamics of companies in this investment sector.

S&P GSCI Agriculture: This index includes price movements for agricultural commodities such as grain, sugar, cotton and other agricultural products. It reflects the dynamics of prices for agricultural products in global market conditions.

First of all, it is necessary to analyze the degree of connection between the selected indices, both in individual cases and across the "traditional" and "alternative" categories. Table 1 shows the correlation matrix of 10 investigated assets.

Table 1

Correlation matrix of traditional and alternative investment assets

	S&P 500	S&P 600	S&P 400	S&P GSCI	S&P GSCI Energy & Metals	S&P United States REIT (USD)	S&P GSCI Precious Metals	S&P Oil & Gas	S&P Listed Private Equity Index	S&P GSCI Agriculture
S&P 500	100,00%									
S&P 600	86,73%	100,00%								
S&P 400	92,91%	96,57%	100,00%							
S&P GSCI	39,91%	42,66%	41,54%	100,00%						
S&P GSCI Energy & Metals	39,37%	41,10%	40,30%	98,83%	100,00%					
S&P United States REIT (USD)	78,58%	78,48%	83,20%	32,45%	31,07%	100,00%				
S&P GSCI Precious Metals	2,56%	2,66%	1,71%	18,14%	16,54%	7,87%	100,00%			
S&P Oil & Gas Exploration & Production	61,12%	70,55%	68,79%	71,25%	70,78%	49,86%	3,45%	100,00%		
S&P Listed Private Equity	84,91%	82,97%	87,08%	41,32%	40,60%	76,71%	2,62%	63,75%	100,00%	
S&P GSCI Agriculture	12,15%	17,50%	15,08%	41,69%	29,04%	13,31%	13,50%	24,75%	13,80%	100,00%

Source: compiled and calculated by the author based on [13].

Correlations between assets are calculated based on the weekly returns of the relevant indices for a 10-year period (November 2013-November 2023). Thus, the average correlation between traditional indices was 0,9207. At the same time, this indicator for exclusively alternative assets is 0,3625. The average indicator for the entire sample is 0,4725. This indicates not only a significantly lower dependence between traditional and alternative investment assets as a whole, but also the multidirectional nature of returns between individual classes of alternative assets.

Such correlations create opportunities for building efficient portfolios that maximize returns while minimizing risk. It is advisable to choose the year 2023 and the weekly

periodicity of the data as the period for constructing effective sets. Given the relative stability of the market since the COVID-19 crisis, where markets have gone through unpredictable swings and increased challenges for investors. and relevance of the data, we will be able to separate the relationships between assets that can provide scope for finding optimal combinations.

Separately, it should be noted that the correlation situation between certain types of assets for this period repeats the general trend. Thus, the average correlation between traditional indices was 0,7182, for alternative indices – 0,2358. The average indicator for the entire sample is 0,2701.

In our analysis, we consider two broad categories of assets: traditional and alternative. For each category, we will build an effective set of portfolios consisting of assets of this class and determine the amount of risk for each of the yield levels.

One of the key tools for analyzing portfolios is the Markowitz model, which allows you to determine the optimal balance between risk and profitability based on statistical data on the movement of asset prices. This model is used to construct efficient sets of portfolios representing different combinations of assets.

The Markowitz model used in our study involves analyzing weekly data for the year 2023 on the return and risk of each individual asset. This data is used to construct a covariance matrix that reflects the relationships between different assets.

After determining the characteristics of individual assets, we proceed to the construction of the two-factor Markowitz optimization problem [12]. With the help of this optimization, we determine the portfolio that minimizes the risk (standard deviation of the return) at a given level of return. To do this, we divide the interval between the minimum risk and the maximum return into 10 levels. For each rate of return, we use two-factor Markowitz optimization to determine the lowest possible portfolio risk at a given rate of return. This gives us 11 points on the risk-return graph representing the efficient portfolio sets for each asset class.

The Markowitz model is based on a quadratic formula for portfolio risk:

$$\sigma^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} w_i w_j \sigma_i \sigma_j p_{ij} \quad (1)$$

σ^2- the variance of the portfolio, w_i та w_j – the weights of assets in the portfolio;

σ_i та σ_j – the standard deviations of individual assets;

p_{ij} – the coefficient of covariance between assets.

A graphical representation of the efficient sets of portfolios for the two asset classes is shown in Figure 1.

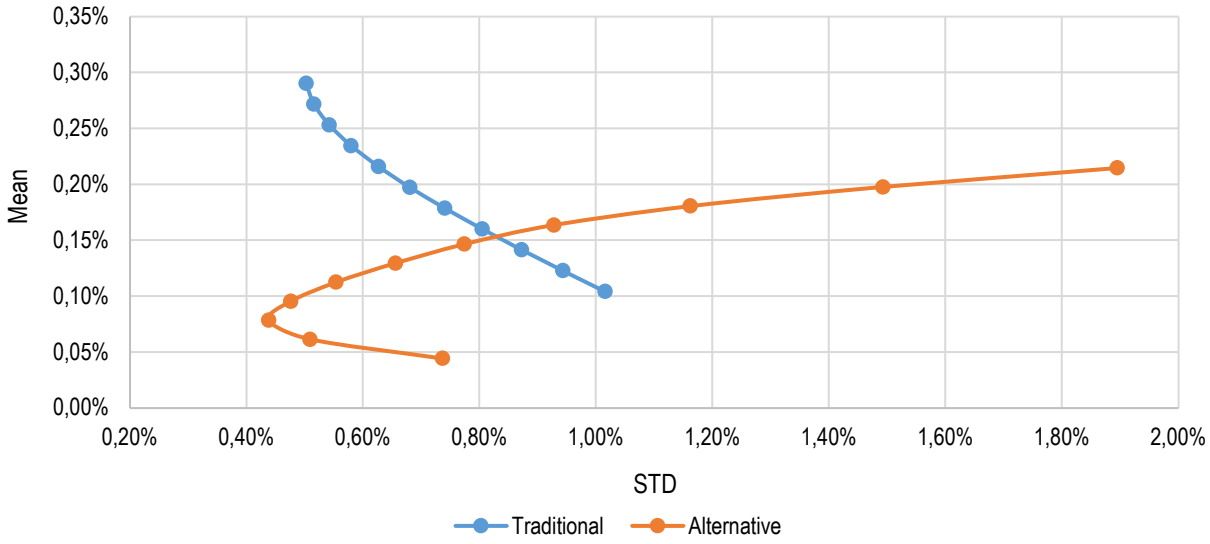


Fig. 1. Efficient frontiers of portfolios for traditional and alternative assets
Source: calculated by the author based on [13]

Therefore, it can be concluded that since part of the effective set of portfolios of alternative investment assets is characterized by higher rates of return at the same levels of risk, this creates the possibility of obtaining the effect of portfolio diversification. Let's build an efficient set of portfolios for all 10 possible assets by an approach similar to that described above.

Separately, it is worth highlighting portals with minimal risk for each of the effective sets. A practical calculation of the shares of each asset in the portfolio with the lowest risk is carried out with the help of the "Solver" add-in for Microsoft Excel, based on the above-mentioned Markowitz approach. The standard deviation of the portfolio, which we minimize, is used as a target indicator.

These are the points that occupy the extreme left positions on each of the graphs.

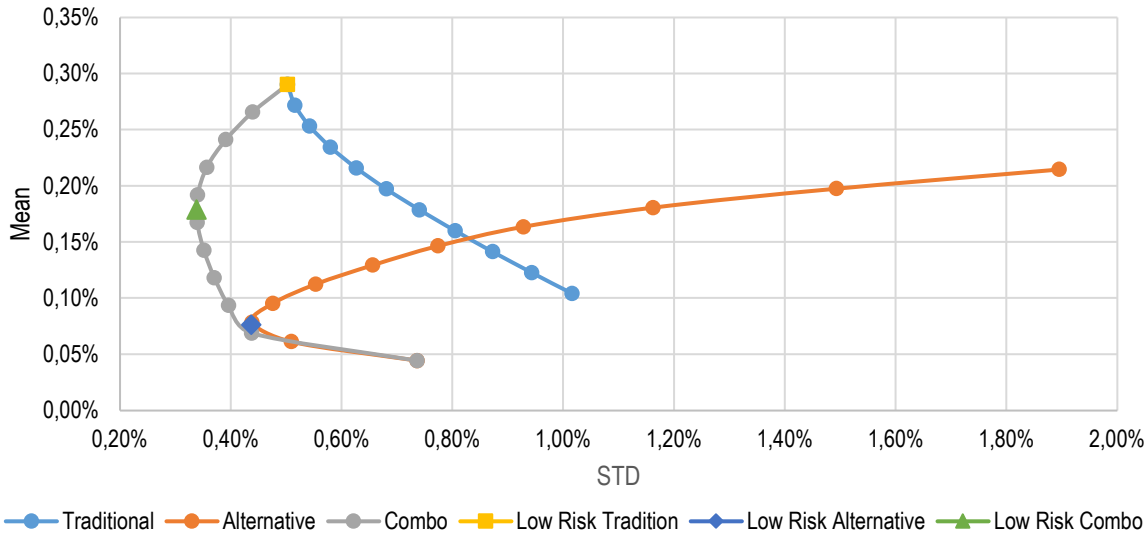


Fig. 2. Efficient frontiers of portfolios for traditional, alternative assets and their combinations
Source: calculated by the author based on [13]

Thus, the expansion of the list of investment instruments in the direction of alternative investment assets makes it possible to form investment portfolios with a lower level of risk at the current level of profitability than when using only traditional investment assets, which is confirmed by the location of the effective sets on the corresponding graphs. Thus, the combination of alternative and traditional assets creates opportunities to significantly reduce the overall risk of the portfolio, including - to values not available to each of the classes separately.

In addition to consideration of portfolios with minimal risk, it is worth paying special attention to optimal portfolios.We optimized investment portfolios of relevant samples using the Sharpe ratio. The Sharpe ratio is a metric used to assess the risk-return of a portfolio or a specific asset. It measures the excess of return over the risk-free rate relative to the total risk of an investment [14].

$$\text{Sharpe Ratio} = \frac{R_p - R_0}{\sigma_p} \quad (2)$$

R_p - portfolio (or asset) yield;

R_0 - risk-free rate (the return rate of bonds with a long-term maturity is usually used);

σ_p - the standard deviation of a portfolio's (or asset's) return.

This ratio compares the level of return an investor receives with the level of risk he takes and takes into account the risk-free rate, which is considered the main relative measure. The higher the value of the Sharpe ratio, the better the investor compensates for the risk by accepting this level of profitability in the portfolio. Practically, the maximization of the Sharpe ratio was also carried out through the "Solver" add-on. Maximization of the Sharpe ratio allows finding optimal combinations of investment portfolios.

To assess the risk among the optimized portfolios of each category, several indicators of the quantitative assessment of the risk of the investment portfolio were calculated: among them standard deviation (1), Value at Risk and Conditional Value at Risk.

The possibility of applying these measures of risk to alternative investment assets was considered by us in [15].

Value at Risk (hereinafter - VaR) determines the amount of money that an investor can lose with a certain probability for a certain period of time. It is a measure of risk that indicates the maximum possible loss in a given time interval and at a certain level of confidence (for example, 95% or 99%).

Conditional Value at Risk (hereinafter - CVaR) or Expected Shortfall is an extension of VaR that determines the average value of losses if they exceed the VaR value at a certain confidence level. CVaR expresses the conditional average value of losses, assuming that they exceed the calculated VaR value.

Both metrics are used to assess risk in financial instruments, but VaR simplistically indicates the potential maximum loss, while CVaR complements this by looking at the average loss if the VaR level is exceeded. These metrics help make risk management decisions and build the necessary capital reserve. In our case, the calculated indicators mean what value with a probability of 95% will not exceed the losses from investing in

these investment portfolios. The calculated risk indicators for the three optimal portfolios are shown in Table 2.

Table 2

Risk indicators of optimized portfolios by class of included assets

	Traditional	Alternatives	Combination
Mean	0,29%	0,09%	0,25%
SD	0,50%	0,89%	0,41%
95% VaR	-0,61%	-1,49%	-0,54%
95% CVaR	-0,96%	-1,57%	-0,79%

Source: calculated by the author based on [13]

Therefore, the quantitative value of the risk indicators for the optimal combined portfolio has better values than the corresponding indicators for the optimal portfolios formed exclusively from traditional and alternative assets, respectively. This indicates a favorable diversification of the portfolio risk, which arises under the condition of the formation of a combined portfolio.

Our goal was to analyze obtained results for consistency of portfolios with minimum risk returns. For these purposes, it will be quite appropriate to use the K-ratio indicator. K-ratio in the field of investments serves as an indicator that evaluates the relationship between risk and yield of investment strategies or portfolios during a certain period. A high K-ratio value indicates a better return-to-risk ratio, which can indicate the stability of a strategy or portfolio. K-Ratio as statistical measure was calculated by formula (3).

$$K - ratio = \frac{\boldsymbol{Slope\ logVAWI\ regression\ line}}{\boldsymbol{N \times SE}} \quad (3)$$

Slope logVAWI regression line – slope of logarithmized Value added weekly Index line;

SE – Standart error of slope;

N – return periods in the weekly return data.

K-ratio estimation for each class of assets: 0,28 for traditional, 0,15 for alternative and 0,38 for combined portfolio. Our analysis indicated that combined portfolio has more consistency returns because K-ratio is higher for it. This one of the essential factors for focusing to combination of traditional and alternative assets.

Conclusions. The paper examines the task of investment management caused by the active development of the market of alternative assets. This provides new opportunities for investors to form investment portfolios. The paper examines the dependencies between individual indices representing traditional and alternative investment assets. It was found that their relationship, established through correlation coefficients, is quite low. Thus, the average ratio between traditional assets was 0.9207. At the same time, for exclusively alternative assets, this indicator is 0.3625, and for the full sample - 0.4725. The low correlation of traditional and alternative assets is determined by the difference in their nature. Thus, the traditional assets represented by the S&P500, S&P400, and S&P600 indices actually represent the entire market of the real US economy. At the same time, alternative investment assets represent separate narrow classes of assets, such as investing in quoted exchange funds related to precious metals, fuel, real estate, etc. As a result, the application of the conceptual approach of the modern portfolio theory to the

construction of efficient sets, both from separate classes of assets (traditional and alternative) and for their combination in the portfolio, is substantiated. The application of the economic-mathematical apparatus of portfolio optimization based on the Markowitz and Sharpe approaches made it possible to find optimal portfolios and portfolios with minimal risk. Taking into account the indicated low correlation and the resulting diversification, it was found that the effective set of portfolios is characterized by a lower level of risk at the same rate of return than traditional or alternative sets. An analysis of optimal portfolios for several types of risks was carried out (standard deviation, Value at Risk, and Conditional Value at Risk). For each of them, the combined portfolio showed a better risk profile than traditional or alternative assets. For optimized portfolios, the relative risk reduction of the combined portfolio is lower than the relative return difference. In addition, the stability of portfolios was considered using the K-Ratio indicator for portfolios with minimal risk for each asset category and their combination. The combined portfolio is characterized by a higher stability value than portfolios from individual groups of assets. Thus, it can be argued that the inclusion of alternative investment assets in the portfolio (Core-Satellite Approach) allows investors to obtain an additional diversification effect.

References

1. Anson, M. J. (2006). Handbook of alternative investments. *Willey*.
2. Swedroe, L. E., & Kizer, J. (2008). The only guide to alternative investments you'll ever need: The good, the flawed, the bad, and the ugly. *Bloomberg Press.* [in English]
3. Debski, W. (2006). Structured products and hedge funds as alternative investments of the capital market. In H. Mamcarz (Ed.), *Financial markets. Lublin: UMCS*.
4. Dorsey, A. H. (2008). Active alpha: A portfolio approach to selecting and managing alternative investments. *Hoboken: Wiley*.
5. Chorafas, D. N. (2003). Alternative investments and the mismanagement of risk. *Palgrave Macmillan.*
6. Stefanini, F. (2006). Investment strategies of hedge funds. *Wiley*.
7. Schneeweis, T., & Pescatore, J. F. (1999). The handbook of alternative investment strategies. *Institutional Investor.*
8. Leitner, C., Mansour, A., & Naylor, S. (2007). Alternative investments in perspective. *RREEF Research Paper.*
9. Sokołowska E. (2014). Alternative Investments in Wealth Management. A Comprehensive Study of the Central and East European Market. *Springer*. P.134
10. Preqin. (2022). Alternative Investment Market Report 2022.
11. Khomutenko L.I., & Usenko A. V., (2017). Alternatyvne investuvannya yak sporyb diversyfikatsiyi investytsiynoho portfelya: investytsiyi v kolektsiyi vyn. Ekonomichnyy Analiz., vol. 27, no. 4..
12. Markowitz, H. (1952). "Portfolio Selection". The Journal of Finance, 7(1), 77-91.
13. S&P Dow Jones Indices. (2023). Indices by Category. Retrieved from: [https://www.spglobal.com/]
14. Sharpe, W. F. (1966). "Mutual Fund Performance". The Journal of Business, 39(1), 119-138.
15. Kaminskyi A., Nehrey M., Butylo D. (2022). Traditional and Alternative Assets in Portfolio Management: ETF Using Approach. In: Distributed Sensing and Intelligent Systems: Proceedings of ICDSIS 2020. Springer Nature Switzerland. – p.41-57.

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МОДЕЛЮВАННЯ ДИВЕРСИФІКАЦІЙНОГО ЕФЕКТУ ПОЄДНАННЯ ТРАДИЦІЙНИХ І АЛЬТЕРНАТИВНИХ ІНВЕСТИЦІЙ

Динамічний розвиток ринку альтернативних активів в останнє десятиріччя відкриває нові можливості для інвесторів. Цей процес розвитку породжує нові задачі, пов'язані із оптимальністю розподілу капіталу інвестора між традиційними та альтернативними активами. В статті досліджується економічна задача побудови оптимального інвестиційного портфеля методом специфікації теоретичного підходу Марковіца до комбінації цих двох груп активів. В якості традиційних активів в роботі аналізуються індексні інвестиції в три основні індекси США: S&P400, S&P500, та S&P600. Фактично 3 цих індекси представляють повний зріз економіки Сполучених Штатів Америки, оскільки характеризують різні сегменти ринку в залежності від капіталізації. В якості альтернативних інвестицій розглядаються індексні інвестиції в сім основних альтернативних індексів. До даної вибірки включено як і вузькопрофільні індекси, повязані із інвестуванням в окремі сировинні, такі як дорогоцінні метали чи нафту, та і повязані з нерухомістю і приватним акціонерним капіталом. Вихідним етапом дослідження виступив кореляційний аналіз, застосований до статистичних рідів доходностей індексів за період 2015-2019 рр. Аналіз показав неоднорідність кореляційної залежності в середині досліджуваної групи. Традиційні активи демонструють відносно високу залежність доходностей між собою. У той же час альтернативні показують низький рівень залежності як між собою, так з традиційними активами. В межах застосування підходу Марковіца було структуровано задачу знаходження оптимального портфеля в побудову та аналіз трьох ефективних множин. Перші дві ефективні множини, відповідні традиційним та альтернативним активами, візуалізують потенціал комбінації активів з точки зору мінімізації ризику. На цій основі побудований оптимальний портфель з комбінації альтернативних та традиційних активів. Компаративний аналіз оптимальних портфелей показав кращі показники ризику для комбінованого портфеля. Показник K-ratio показав більший ступінь стабільності доходності комбінованого портфеля з мінімальним ризиком.

Ключові слова: *інвестиції, альтернативні інвестиційні активи, портфельний підхід, диверсифікація, кореляція, оптимізація портфелю, модель Марковіца.*