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COMPARISON OF POSITIVE AND NEGATIVE RISK INDICES AS A TOOL FOR PORTFOLIO MANAGEMENT

The article considers the problem of mismatch between the ratios of different assets parameters and the ratios of their returns. The two approaches to interpret this phenomenon are provided. One option is that pricing deformations do exist. Another option is that there are some factors unknown to investor, and the influence is already counted by the market in current prices. It is proposed to solve this problem by introducing positive and negative risk indices. It substantiates the existence of the equilibrium ratio between these indices for different assets. Based on statistical data the authors demonstrate the technique for identification of pricing deformations and approaches to arbitrage strategy creation for generating profits and increasing market efficiency.
Keywords: *capital asset pricing model; pricing deformations; arbitrage; risk indices; international portfolio investments.*

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СПІВСТАВЛЕННЯ ПОКАЗНИКІВ ПОЗИТИВНОГО І НЕГАТИВНОГО РИЗИКУ ЯК ІНСТРУМЕНТ УПРАВЛІННЯ ІНВЕСТИЦІЙНИМ ПОРТФЕЛЕМ

У статті розглянуто проблему невідповідності між співвідношеннями параметрів різних активів і співвідношеннями їх прибутковості. Обґрунтовано два підходи до інтерпретації цього явища. З одного боку, деформації ціноутворення можуть існувати, з іншого – ринок може враховувати фактори, про які інвестори можуть не знати. Запропоновано вирішити дану проблему шляхом введення показників позитивного і негативного ризику. Доведено існування рівноважного співвідношення між даними показниками для різних активів. За допомогою статистичних даних продемонстровано підходи до ідентифікації деформацій ціноутворення та створення арбітражних стратегій для отримання прибутку та підвищення ринкової ефективності.
Ключові слова: *модель ціноутворення активів; деформації ціноутворення; арбітраж; індикатори ризику; міжнародні портфельні інвестиції.*
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СОПОСТАВЛЕНИЕ ПОКАЗАТЕЛЕЙ ПОЛОЖИТЕЛЬНОГО И ОТРИЦАТЕЛЬНОГО РИСКА КАК ИНСТРУМЕНТ УПРАВЛЕНИЯ ИНВЕСТИЦИОННЫМ ПОРТФЕЛЕМ

В статье рассмотрена проблема несоответствия между соотношениями параметров различных активов и соотношениями их доходности. Обоснованы два подхода для интерпретации данного явления. С одной стороны, деформации ценообразования могут существовать, с другой – рынок может учитывать факторы, о которых инвесторы могут не знать. Предложено решить данную проблему путем введения показателей положительного и отрицательного риска. Доказано существование равновесного соотношения между данными показателями для различных активов. При помощи статистических данных продемонстрированы подходы к идентификации деформаций ценообразования и созданию арбитражных стратегий для получения прибыли и повышении рыночной эффективности.
Ключевые слова: *модель ценообразования активов; деформации ценообразования; арбитраж; индикаторы риска; международные портфельные инвестиции.*

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Introduction. There is an important principle in philosophy: several different forces must be considered in order to manage something. Engineers, for example, oppose the power of steam engine and friction force to drive the locomotive. Thus, it is necessary to identify the values of the existing forces of the system before starting operation. This is similar to the process of investment portfolio management in finance. Investment portfolio consists of various assets. Each asset has certain parameters. Investment manager compares various assets to manage the portfolio and achieve the desired results.

Economists use diversification to describe the theoretical models for financial assets construction and measurement. In addition, they develop the concept of arbitrage operations. This approach avoids questions about the true value, but it allows investors determine the equilibrium price of an asset against the others.

Overall, contemporary financial theory is looking for concepts that allow analysts identify specific parameters of financial assets for better operation. New models allow designing financial instruments with optimal parameters for the realization of spatial and intertemporal diversification.

In this paper, we will consider the concept of risk consisting of two components. Investors often see a mismatch between the ratios of different assets parameters and the ratios of their returns. There might exist two possible cases. One case is that pricing deformations exist. The second case is that the market may count unknown to investors factors. We propose to solve this problem by the introduction of positive and negative risk indices. The technique for their evaluation and the equilibrium ratio between them will be suggested.

Based on the proposed theoretical approach, we will analyze financial data from various regions of the world. The results demonstrate the viability of our assumptions and the possibility of using these parameters for international portfolio management.

Literature review. Economists have developed a number of theories to interpret the concept of risk in general and securities risk in particular. Unilateral models of risk assessment have been developed over the last 10 years. However, most models predict future price movements of financial assets based on past prices and indicators. In this paper, we focus on the comparison of positive and negative risk indices. We believe that this ratio helps identify pricing deformations and interpret possible future deviations.

Investors want to buy different assets to reduce the level of their specific risks. However, this procedure requires assets ranking. H. Markowitz (1952) suggested determining the level of expected return on the basis of previous results. In addition, he proposed to calculate risk indices for assets in the form of their historical volatility. Therefore, investors are able to calculate the number expected return units relative to one unit of the expected risk. In addition, assets have different sensitivity to external shocks. Investors can combine different assets to increase the amount of the expected return for a fixed level of risk or to reduce the amount of expected risk for a fixed level of return. There are different approaches to estimation of the expected risk and return of assets (Doan et al., 2010). Some researchers identify features of risk assessment at emerging financial markets (Estrada and Serra, 2005).

Under the influence of the neo-classical economic theory, researchers have proposed a new financial model to describe the behavior of rational investors at financial

market. H. Roberts (1967) suggested the impossibility of predicting prices at the financial market because the possibility of their using changes future prices. Later E. Fama (1970) proposed the efficient market hypothesis (EMH). He proposed consider several levels of information efficiency. The weak form of informational efficiency of the market means that prices include information about past values. The average form of information efficiency of the market means that prices include all available publicly information. The strong form of market informational efficiency means that prices include all information, including inside one.

Some scientists offered other forms of market efficiency classification and tests for their determination. However, a pricing model should be created to determine the equilibrium state of prices and returns. W. Sharpe (1964) proposed capital assets pricing model (CAPM) to show the behavior of the investor, if he has the opportunity to use risk-free assets. He showed that investor creates a portfolio of risky and risk-free assets. In addition, he showed that all investors would choose the same risky portfolio in equilibrium state. However, there is the problem of relations between CAPM and EMH. We cannot validate CAPM and EMH using their tools, because they can exist only together.

We cannot determine the fair price of the asset, but we can determine what price is unacceptable. S. Ross (1976) developed the theory of arbitrage pricing model (APM) on the basis of this approach. Comparison of different assets shows that despite differences between them, prices behavior cannot deviate far from certain boundaries. Arbitrage provides this condition, because rational trading operations help achieve equilibrium state in the case of large deviations (Ross, 1978). Models for derivatives valuation were created based on arbitrage operations (Black and Scholes, 1973).

These models suggest that the market always correctly identifies the price of the asset. The price of the asset reflects future expectations, so it may both match its current characteristics and not match its characteristics (Shiller, 1981). However, some investors began to question the absolute truth of prices when behavioral finance (Simon, 1978; Kahneman and Tversky, 1979) was developed. Some scientists are trying to develop a neo-classical financial school, explaining variation by random factors (Estrada, 2009). There are studies, where authors suggest approaches to assets evaluation at developing markets (Javid, 2009; Iqbal et al., 2010). There are attempts to combine the methodology of various scientific schools (Lo, 2004).

It is important to find methods for identification of gaps between market prices and assets characteristics in order to make effective investment decisions.

The goals of this paper are theoretical analysis and practical interpretation of the comparison of positive and negative risk indices as a tool in portfolio management.

Key research findings.

We consider that investors have two estimates of the value of a financial asset at each time moment. The investor should be able to assess the value of different assets to calculate the risks. However, the concept of asset value is different from the concept of asset price. On the one hand, the investor can take a decision without valuation, when the price of an asset corresponds to its characteristics. There are very few such assets, and they usually have low return. On the other hand, there are incorrectly valued assets. The price of such asset does not match its current characteristics. The investor

doesn't trust the price of the asset. Such assets can be overvalued or undervalued. Otherwise, the price of the asset is correct and reflects future expectations.

Contemporary financial science cannot separate these two situations. Investors look at financial data and want to know, when such discrepancy is the result of pricing deformations, and when prices correctly reflect the expected future return. The authors want to propose an approach allowing increase the likelihood of identification of pricing deformations. Based on our theoretical proposals, we will show how investors can calculate positive and negative risk indices both for assets and for international indexes. We can identify and compare the value of the asset from the point of probability of getting (V^+) from this asset and from the point of its losing (V^-) based on the opinions of many investors. Based on these data, we can more accurately assess the investors' estimations of assets.

We argue that this proportion should be true for any two assets:

$$\frac{V_i^+}{V_i^-} = \frac{V_{i+1}^+}{V_{i+1}^-}, \quad (1)$$

where V_i^+ s the value of the i-th asset from the point of its getting; V_i^- s the value of the i-th asset from the point of its losing; V_{i+1}^+ is the value of the $(i + 1)$ asset from the point of its getting; V_{i+1}^- is the value of the $(i + 1)$ asset from the point of its losing.

In equilibrium, these values indicators (V_i^+ and V_i^-) should strive to each other, because we value the same object (Nagapetyan et al, 2015). There are opportunities for arbitrage if these two estimates have significant differences.

Positive and negative risk indices can be determined by measuring the reaction of security return compared to change of the relevant market indices. We cannot measure the gaps and correlations between indicators V^+ and V^- on practice. Positive and negative beta coefficient should be counted. We propose to use the Sharpe methodology with our changes (Sharpe, 1964). We try to calculate and compare both $Beta^+$ (B^+) and $Beta^-$ (B^-) while investors estimate only Beta (B).

We propose the following way for identification of pricing deformations. Firstly, it is necessary to divide financial data into two parts. In the first part, we consider the reaction of security return compared to positive change of the relevant market indices. In the second part, we consider the reaction of security return compared to negative change of the relevant market indices. Our indicators show differences between values estimation in the context of future getting and losing, while the ordinary Beta shows the same estimation for these indicators. Investors should consider the reaction of security return, industry indices return or even market index return compared to positive and negative changes of the relevant high-level market indices return.

For example, we can estimate the sensitivity of particular asset return compared to changes of the average national index. On the other hand, the investor can calculate the sensitivity of national sectoral indices return compared to changes in international sectoral indices. Secondly, it is necessary to compare the differences between B^+ and B^- for the construction of optimal investments portfolio.

Let's consider companies, which operate in the consumer goods sector in different parts of the world. We use financial data from America, Europe, Asia and Russia during period from 2009 to 2014 (www.finam.ru, 2015). To do this, we first find the national and global aggregate indices. Table 1 presents the results of B, B^+ and B^- calculations.

Table 1. **The results of B, B^+ and B^- calculation for the consumer goods sector for different regions and countries, 2009–2014,** *authors' have calculated indices using data from* www.finam.ru

	B	B^+	B^-
America	0.887	0.928	0.865
Europe	1.283	1.364	1.186
Asia	0.762	0.67	0.757
Russia	0.668	0.575	0.831

The results in Table 1 show different reactions of the aggregate consumer goods index return for companies in different regions as compared to positive and negative changes of the global consumer goods index return. For example, the positive change (one percentage point) of global consumer goods index return leads to positive changes of consumer goods index return (the aggregate changes of assets return for this sector) in the amount of 0.887 percentage points in America and 1.283 percentage points in Europe. Figure 1 shows different reaction of the aggregate consumer goods index return for companies in different regions as compared to positive and negative changes of the global consumer goods index return.

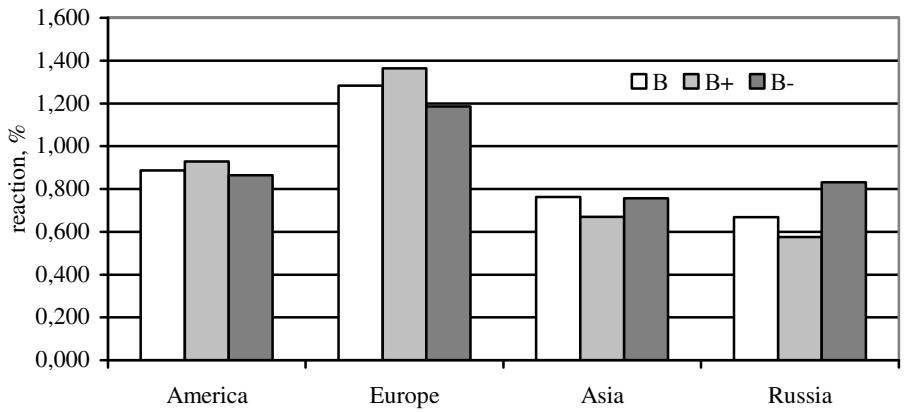

Figure 1. **Comparison of B, B^+ and B^- indicators for the consumer goods industry in various regions and countries, 2009–2014,** *authors'*

This information can be useful in decision-making. Investors make more effective decisions if they can find and compare B^+ and B^- for different assets. For example, when the global consumer goods index has positive changes, consumer goods indexes in America and Europe rise faster as compared to their reaction to the global index decrease. While, Asian companies demonstrate the opposite behavior.

Different industries in different countries have different positive and negative risk indices. Let us now consider financial data in the field of Consumer Goods, Finance, Industry, Oil and Gas, Technology, Telecommunications in various parts of the world. We go on using companies data from America, Europe, Asia and Russia during the period 2009 to 2014 (www.finam.ru, 2015). Table 2 presents the results of B, B^+ and B^- calculations.

Table 2. **Calculation B, B^+ and B^- for the Finance, Industry, Oil and Gas, Technology, Telecommunications sectors for different regions and countries, 2009–2014,** *authors' have calculated indices using data from* www.finam.ru

Region	Kind of B	Finance	Industry	Oil and Gas	Technology	Telecommunications
America	B	1.106	1.038	1.046	1.121	1.013
	B^+	1.176	1.039	0.967	1.127	1.097
	B^-	1.099	1.037	1.104	1.127	0.957
Europe	B	1.246	1.263	0.936	1.044	1.259
	B^+	1.218	1.298	0.969	0.986	1.257
	B^-	1.195	1.189	0.842	1.098	1.211
Asia	B	0.546	0.648	0.531	0.510	0.437
	B^+	0.492	0.643	0.539	0.446	0.362
	B^-	0.577	0.637	0.533	0.470	0.489
Russia	B	0.913	0.799	0.914	N/A	0.999
	B^+	1.037	0.716	1.161	N/A	0.971
	B^-	0.899	0.945	0.871	N/A	1.197

Positive reaction of American companies return in the sectors of Finance, Industry and Telecommunications during the positive changes of their global indices is higher than their negative reaction during the negative changes in the global indices. This means that B^+ is higher than B^- for these sectors during this time. Nevertheless, B^- is higher than B^+ for companies in Oil & Gas. Restrictions in the sphere of energy resources export in the United States are the prerequisite for such behavior of investors. When oil prices grow this brings few benefits for American companies as compared to the losses when oil prices fall.

The results in Table 2 show that investors have similar estimations of B indicator for European and American companies. However, gaps and correlations between positive and negative risk indices are different for companies in Europe and in the USA. There are differences between pricing characteristics in various industries. For example, B^+ is higher than B^- for the Oil and Gas sector for European companies. However, when global Technology index has negative changes, Technology index in Europe decrease faster as compared to its positive reaction to the global index decrease. This sector in Europe has less competitive advantages as compared to companies in America.

Positive reaction of assets return during the positive changes of global indices is less than their negative reactions during the negative changes the these indices for Asian companies. This is true for companies in the fields of Finance, Technology, and Telecommunications. The results in Table 2 show that B^+ is less than B^- in all these sectors in Asia. B^+ is higher than B^- in the sectors of Industry, Oil and Gas in Asian

economy. High share of Asian region in global GDP in these sectors, as well as low production cost are the preconditions of these findings.

Russian companies demonstrate an excess of positive reactions over the negative ones in Finance and Oil & Gas sectors. The support of the Central Bank and non-participation in oil cartels are the prerequisites for such results. The dominance of negative reaction is observed for Industry and Telecommunications. The main reason for this behavior is relatively low competitiveness of these industries.

All countries and regions have their own distinctive features including gaps and correlations between positive and negative risk indices in different sectors.

Identification of differences between positive and negative risk indices can give very useful information for international portfolio investments. Investors always seek to diversify their investments. Table 2 shows both the reasons for this behavior and demonstrate the approaches how it can be done. Calculation of the proposed indicators allows exploiting new opportunities of arbitrage whenever the current reactions of assets return as compared to positive and negative changes in global indices begin to contradict the regularity, shown in formula (1).

We can demonstrate the possibility of arbitrage operations using the example of the Oil and Gas sector in America and Russia. The positive reaction of Oil and Gas index return in Russia during the positive changes in global index is higher than the positive reaction of Oil and Gas index return in America. However, the negative reaction of Oil and Gas index return in America during the negative changes of the global index is higher than the negative reaction of Oil and Gas index return in Russia. These ratios violate our proposed rule shown in formula (1). Arbitrage operations are possible in this case. For example, if an investor buys a portfolio of securities reflecting the Oil and Gas index return in Russia and simultaneously sells a diversified portfolio of securities reflecting the Oil and Gas index return in America, he can obtain a riskless profit. He can do it during a certain period until the ratios between B^+ and B^- in different countries violate our proposed rule shown in formula (1).

Other opportunities to build arbitrage strategies can be found by comparing Telecommunication sector indices return in America and Europe. The negative reaction of Telecommunications index return in America during the negative changes in the global index is less than the negative reaction of the Telecommunications index return in Europe. However, the positive reaction of Telecommunications index return in America during the positive changes of the global index is higher than the positive reaction of Telecommunication index return in Europe. Thus, an investor buying a portfolio of securities reflecting the Telecommunication index return in America and simultaneously sells a diversified portfolio of securities reflecting the Telecommunications index return in Europe, can obtain a riskless profit. Any investor can use this strategy selling both European assets and Russian assets, because in this sector these companies have less competitive advantages as compared to companies from America. Investment funds can use challenging strategies with risk-free assets to create more profitable arbitrage operations.

Such investments are useful for market effectiveness because they help achieve arbitrage-free condition, reducing differences, gaps and correlations between positive and negative risk indicators for any asset.

Conclusion. Many investors try to forecast future price changes in their attempt to develop a profitable strategy. However, we offer to find opportunities to conduct arbitrage operations by identifying differences between positive and negative risk indicators for any asset, which violate the ratio in formula (1).

We believe that it is impossible to predict future price changes, but we can identify current pricing deformations. Investors cannot know the exact value of various assets. Nevertheless, every time, when we identify assets with differences between positive and negative risk indicators, there is a probability of violation of the regularity described by formula (1). This means that we can carry out an arbitrage operation. This operation will allow investors get profit and help the market achieve more efficient state.

There are two interpretations, when the ratio between the assets characteristics doesn't correspond to the ratio of assets returns. On the one hand, the market can incorrectly assess the value of assets, on the other hand, perhaps investors cannot take into account all the factors and market assessments are correct. It is impossible to choose correct interpretations without additional information. We propose to use the ratio between positive and negative risk indices to identify pricing deformations. In this paper, we demonstrate the method for calculating these indicators and creating arbitrage operations based on them.

In future studies, we plan to build a dynamic model for investors which then would be able to detect pricing deformations and to determine their character. For example, underestimation or overestimation of assets may cause pricing deformations. Embedding of suggested parameters into the model for valuation and design of financial assets, as well as approaches to financial institutions reform will allow increasing financial markets information efficiency, especially in developing countries.

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