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Comparative Analysis of Investment Funds Stocks-based Portfolios and BET Stocks-based Portfolios

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Abstract. *In this paper we intend to find out what is the best choice of stocks-based portfolio. The major goal is to find whether is more efficient to invest the whole capital in a single sector, like financial investments, or to create a diversified portfolio, taking into account assets from various economic sectors. Capital allocation will be based on the concept of cointegration. We have chosen this method because it can be applied on non-stationary data series, and, besides, it has the advantage of using the whole set of information provided by the financial assets. Another goal is to study how the portfolio structure adjusts if a shock occurs during the period under analysis so that to preserve a certain return or minimize a potential loss. The study will result in an investment solution in the Romanian capital market, even in the context of financial crisis.*

Keywords: stocks-based portfolio; diversified portfolio; cointegration; financial crisis; long-short strategy.

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REL Code: 11F.

Theoretical foundations

This paper follows another research which was intended to study the allocation of capital and the building of portfolios with the help of cointegration. Thus, in order to build optimal portfolios we have analyzed six stocks that are traded on the Bucharest Stock Market, for which we have the longest and most complete data series. Another criterion that has been used to select the stocks is their liquidity. In the first part of our paper we test the existence of stationarity of the price series, using the ADF method. After this stage we have created the index that has to be tracked by the portfolios. In the second part of the paper we create two artificial indexes by adding and decreasing respectively a certain expected return. Then we have used the cointegration notion in order to study closely the two indices in a long-short strategy. After testing, the study has shown that there are portfolios that can bring a certain expected return, even if this conclusion does not hold for all portfolios and all strategies.

We based our research on the work of C. Alexander and A. Dimitriu (2002) – „The Cointegration Alpha: Enhanced Index Tracking and Long-Short Equity Market Neutral Strategies". These authors present several strategies of capital allocation based on the concept of cointegration, building portfolios using the DJIA (Dow Jones Average Index). Tests have shown that the results depend on the expected target.

Data

The portfolios that we intend to build will include only stocks traded at the Bucharest Stock Market (BVB); the first category of stocks represents securities that are included in the BET Index (6 stocks: ATB, AZO,BRD, OLT, SNP, TLV); the other category represents the 5 SIFs (BET-FI). We have selected these stocks because they present the longest time data series and a high market liquidity. The period under analysis is between January 3, 2002 and April 30, 2009.

Methodology

I. Strategy to target the index

1. Testing for stationarity with ADF test

To explain the concept of stationarity we will use the following process:

$y_t = \rho \times y_{t-1} + u_t$

Given that $\rho = 1$ we can say that variable y_t is non-stationary, while if $\rho < 1$ we say variable y_t is stationary. A stationary series has the median, variance and

covariance constant and independent in time, and they tend to fluctuate around the median within a relatively fixed band.

To test whether data series are stationary or not, a number of tests can be applied; one of the most widely used tests is Dickey – Fuller (DF) test, because of its simplicity and wide application. Because testing for stationarity leads to the generation of an autoregressive process (AR), the median of which is zero, we will use another variant of DF test, namely ADF (Augmented Dickey – Fuller test). As for y_t that follows an AR(p) process a DF is used, then we can expect that error variable to compensate the differences occurring in the dynamic structure of y_t that is tested with the other variant of DF test – ADF test. In this case, errors' auto-correlation will invalidate the employment of DF distribution, which is based on the fact that u_t is a „white noise".

In these conditions y_t follows an auto-regressive process of order p^{th}:

$$y_t = \psi_1 \times y_{t-1} + \psi_2 \times y_{t-2} + \ldots + \psi_p \times y_{t-p} + u_t$$

The null hypothesis is $\psi = 0$ as compared to the alternative $\psi < 0$. To test the null hypothesis we calculate statistics for DF test and compare them with the critical value.

The ADF test was used in this paper in order to test if the data series were stationary or non – stationary. The existence of the stationary in the data series was tested in this paper, in level and in the first difference, for all data series.

2. Building the index

The second stage of tracking the index consists in creating a market index including all the stocks analyzed in the paper. This index is built after each series has been normalized and each stock has received an equal weight. Thus, stocks will have each an equal influence on the index variation.

Stocks have been selected on the basis of the following criteria:

- Series shall be as large as possible.
- Stocks have to be included in a stock market index.
- Stocks have to present a higher liquidity.

After stocks' selection and index building, the next step consists in the creation of portfolios to track the index accurately. Portfolios are built taking into account their cointegration with the index. This consideration has a number of merits: tracking error fluctuates around a certain median point, information reflected by stocks' prices is better used, shares' weight in portfolios is stable and, consequently, portfolios need not be frequently rebalanced.

3. The concept of cointegration and Engle – Granger method

Two series are cointegrated if their relation is stable (stationary) in the long run. This relation is possible even when each series is stochastic (non-stationary). The cointegration notion can be considered as a long run equilibrium toward which a system converges, and ε_t can be seen as a disequilibrium error (the gap between the system's current and equilibrium position at the moment t).

Engle – Granger method says that if two variables x_t and y_t, are integrated of order I and between them there is a stable long-run relation, then the two variables are cointegrated CI(1,1).

4. The construction of portfolios

To build portfolios able to track the index as close as possible, one fact must not be overlooked, namely, the correct estimation of portfolios structure. This condition is fulfilled for each portfolio by using OLS for the cointegration equation, which regress the index price based on the stocks' return for a certain calibration period.

$$index_t = c_1 + \sum_{i=1}^{n} c_{i+1} \times p_{i,t} + \varepsilon_t$$

The calibration period of portfolios is between 1 and 3 years, the remaining time being used for testing. We have created portfolios based on 3, 4 or 5 shares, when we refer to stocks included in the BET Index, respectively 3 or 4 stocks when these are included in the BET-FI Index. The rebalancing period for each portfolio is 10 days.

After portfolios were built, the next step is the application of Engle – Granger test of cointeration for each of them. The cointegration test consists in the application of ADF test on the residuals of each cointegration equation, in order to find if this is stationary or not. The ADF regression equation for testing cointegration is the following:

$$\Delta\hat{e}_t = \alpha_1 \times \hat{e}_{t-1} + \sum_{i=1}^{n} \alpha_{i+1} \times \Delta\hat{e}_{t-1} + \varepsilon_t$$

The null hypothesis of this test is the assumption that the two variables are not cointegrated.

II. The long – short strategy

This strategy follows the same stages as the first strategy, but included the creation of two indexes in order to imitate the evolution of the index built at the beginning. These two new indexes are built starting from the value of the original index, by adding or substracting a certain expected annual return – evenly distributed among daily returns.

Testing results

We first attempted to study stationarity. The first step was to test the stationarity of data series in level and we noticed that these are not stationary. In the second stage we have studied stationarity for the first difference, and we have obtained a stationary data series. The results of ADF test are shown in the following tables (table 1, table 1.1, table 2 and table 2.1).

Table 1

Testing stationarity with ADF test (in level - BET)

	ATB	AZO	BRD	OLT	SNP	TLV
H0	False	False	False	False	False	False
pValue	0.5267	0.3476	0.5074	0.4036	0.5101	0.4733
tStat	-0.3419	-0.8308	-0.3946	-0.6781	-0.3874	-0.4876
cValue	-1.9416	-1.9416	-1.9416	-1.9416	-1.9416	-1.9416

Table 1.1

Testing stationarity with ADF test (first difference - BET)

	ATB	AZO	BRD	OLT	SNP	TLV
H	True	True	True	True	True	True
tStat	-40.28	-37.021	-41.038	-40.516	-42.359	-48.683
cValue	-1.9416	-1.9416	-1.9416	-1.9416	-1.9416	-1.9416

Table 2

Testing stationarity with ADF test (in level – BET-FI)

	SIF 1	SIF 2	SIF 3	SIF 4	SIF 5
H0	False	False	False	False	False
pValue	0.5185	0.4913	0.4629	0.5076	0.4973
tStat	-0.3643	-0.4387	-0.5159	-0.3942	-0.4223
cValue	-1.9416	-1.9416	-1.9416	-1.9416	-1.9416

Table 2.1

Testing stationarity with ADF test (first difference – BET - FI)

	SIF 1	SIF 2	SIF 3	SIF 4	SIF 5
H	True	True	True	True	True
tStat	-37.37	-39.74	-38.62	-37.96	-39.59
cValue	-1.9416	-1.9416	-1.9416	-1.9416	-1.9416

Before building portfolios and reconstruct the index we have used the cointegration concept to establish the weight of each share in the portfolio, both for BET stocks-based and for BET-FI stocks-based portfolios.

For BET stocks-based portfolios we have used one, two and three years for calibration, the rest of the period being used for rebalancing portfolios so that they can track the index as close as possible. Each portfolio rebalancing was achieved from ten to ten days and transaction costs have been omitted. These portfolios included three, four or five stocks, with the above mentioned calibration and rebalancing period; overall, we built nine portfolios.

For BET-FI stocks-based portfolios we have used one, two and three years for calibration, the rest of the period being used for rebalancing portfolios so that they can track the index as close as possible. These portfolios included three or four stocks, with the above mentioned calibration and rebalancing period; overall, we built six portfolios.

Taking into account that in the analyzing period a shock occurs – the actual financial crisis – the results obtained from these portfolios do not fit exactly into our expectations, but at least we managed to minimize the loss.

Only some of the 15 portfolios have accomplished the conditions for being included in an investment strategy.

In the charts presented bellow (Figure 1 and Figure 2) one can see how close the index has been tracked by the 3 stocks -1 year calibration period portfolios.

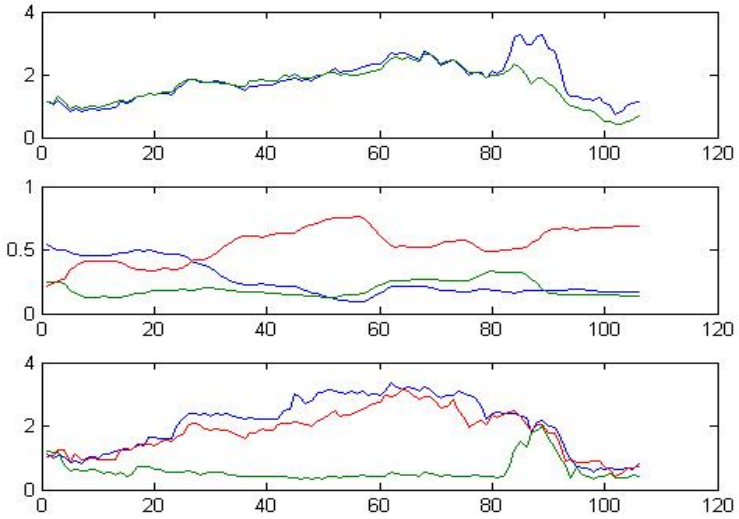

Figure 1. *Portfolio with three securities (ATB, AZO, BRD) and index tracking*

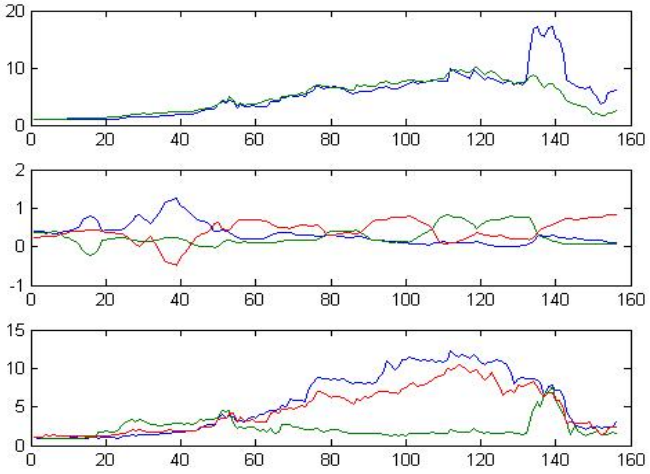

Figure 2. *Portfolio with three securities (SIF1, SIF2, SIF3) and index tracking*

In the second part of our paper we have tried to replicate the two new-built indexes by creating two artificial indexes: thus, we have added and substracted an expected annual return of 20% that will be evenly distributed among daily returns.

The charts below show the new-built indexes.

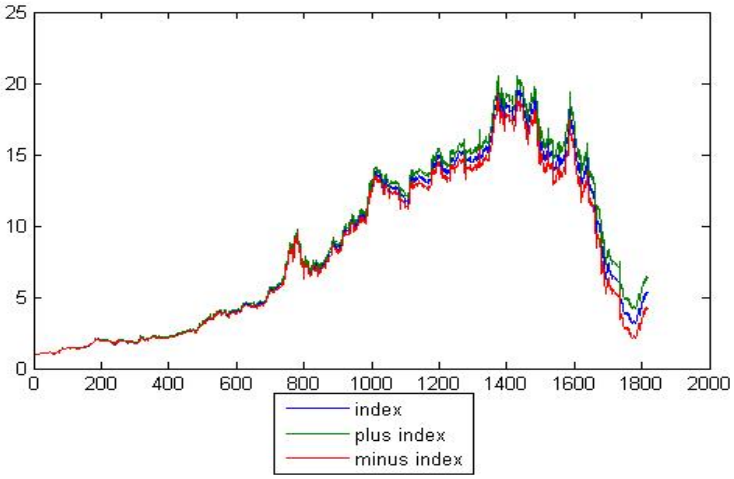

Figure 3. *„Plus" index and „Minus" index for the BET stocks-based index*

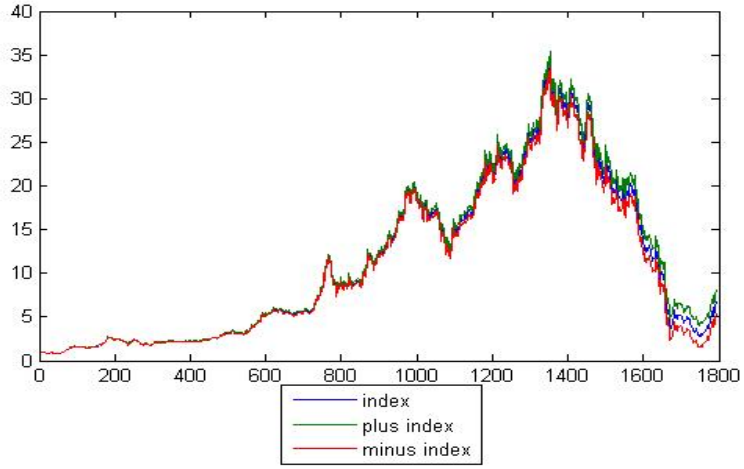

Figure 4. *„Plus" index and „Minus" index for the BET-FI stocks-based index*

After the construction of these new indexes we have pursued again the whole analysis presented in the first part of the paper: we built portfolios to target both the „Plus" and the „Minus" indexes and search for the best strategies.

In the charts below one can see how close the index is tracked by the portfolios, what is the best portfolio's structure, how this changes as stocks' price evolves, and what was the evolution of stocks' prices during the period under analysis. It is obvious that BET stocks-based portfolios do not manage to change their structure adequately to target the „Plus" or the „Minus" index, even if they are well-diversified. Instead, as far as BET-FI stocks-based portfolios are concerned, the results are better: the portfolios manage to change their structure fast enough to target adequately the „Plus"/"Minus" index.

The above mentioned results are reflected in the following charts.

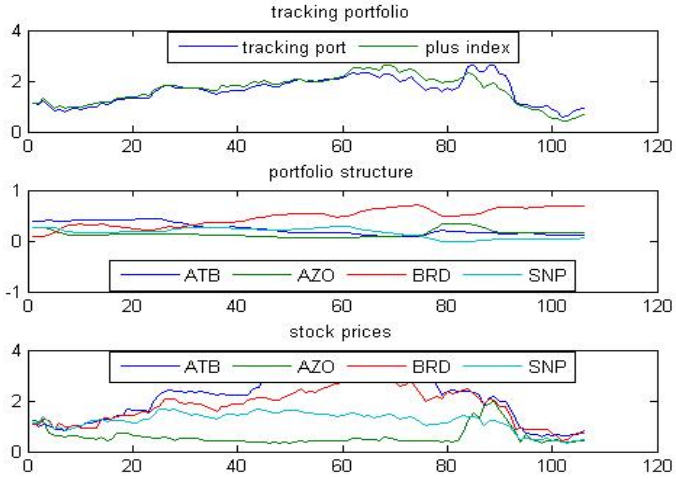

Figure 5. *Portfolio with four BET stocks and „Plus" index*

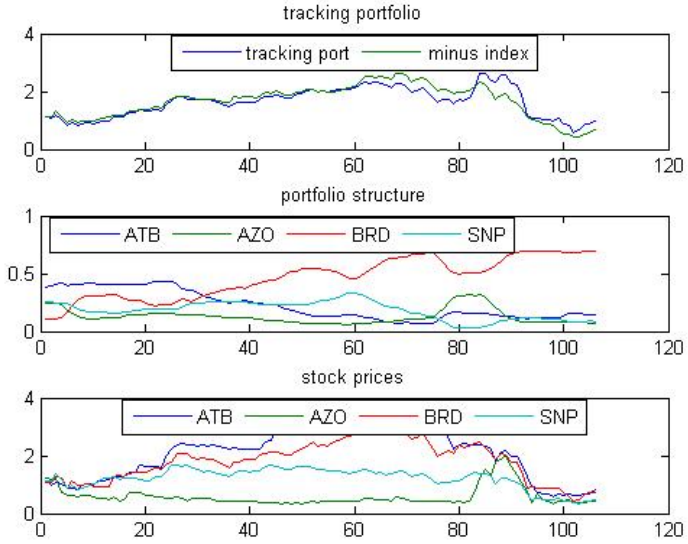

Figure 6. *Portfolio with four BET stocks and „Minus" index*

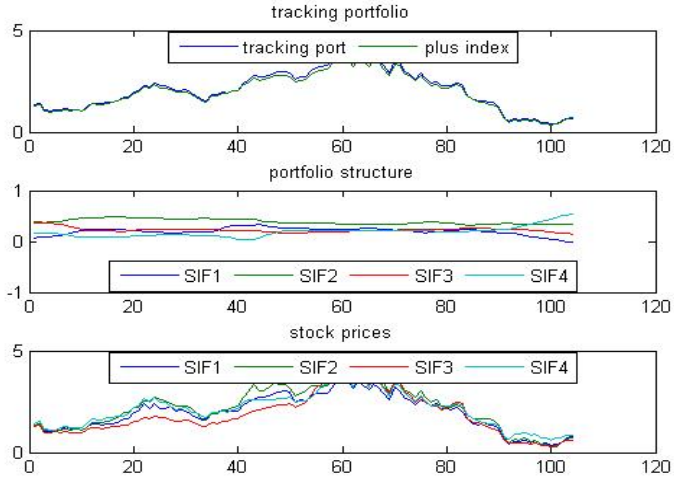

Figure 7. *Portfolio with four BET – FI stocks and „Plus" index*

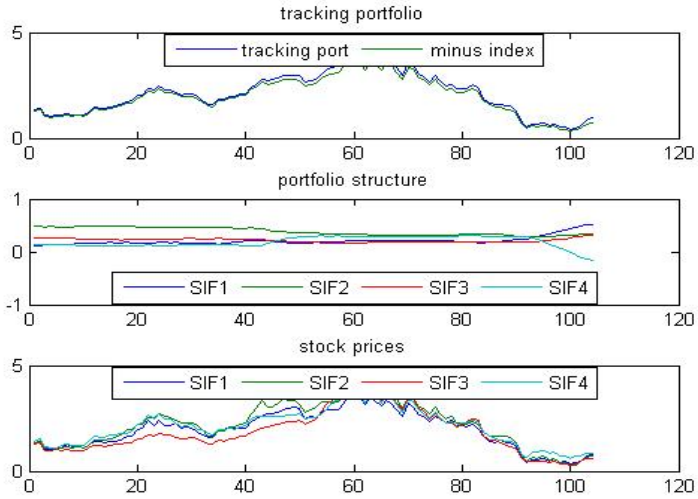

Figure 8. *Portfolio with four BET – FI stocks and „Minus" index*

At the end, we have created strategies for both BET and BET–FI stocks-based portfolios. Because of the unfavorable events that impacted the capital market, resulting strategies did not delivered significant better outcomes.

However, keeping in mind the goal of the present paper, namely the comparative analysis of portfolios based on various sectors and portfolios based on stocks from the same sector, it is obvious that in Romania, during the present financial crisis, it is not optimal to diversify, but to invest in the same economic field. This conclusion results also from the following charts.

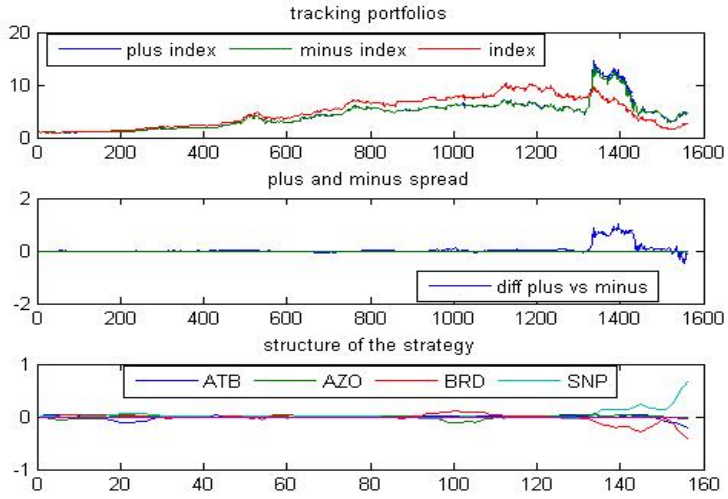

Figure 9. *Long-short strategy for BET stocks -based portfolios*

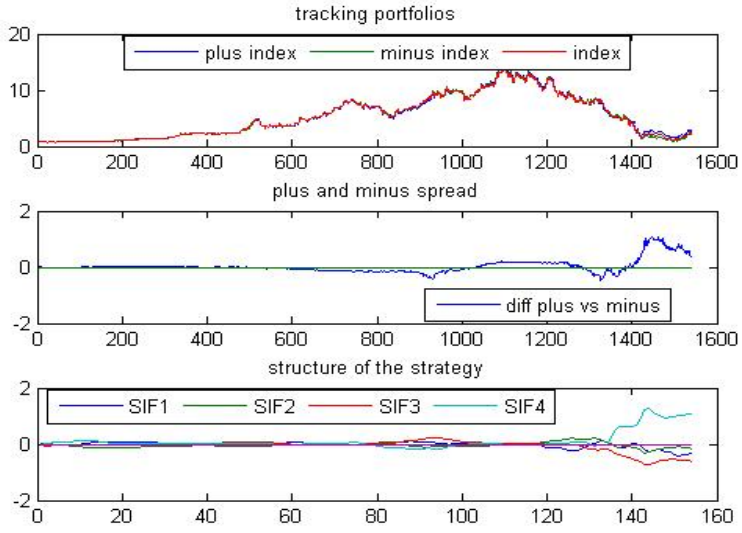

Figure 10. *Long-short strategy for BET-FI stocks-based portfolios*

Conclusions

This research has shown, in the first part of the paper, that portfolios that were built to track the index managed to accomplish this goal quite well, given that transaction costs associated to portfolios' rebalancing have been omitted. In the second part of the paper, where we attempted to create a long-short strategy for targeting two artificial indices, the cointegration analysis did not bring spectacular results.

As results have demonstrated, the strategy built on BET-FI stocks-based portfolios brings a higher return than the strategy built on BET stocks-based portfolios, precisely at the time when the shock occurs.

Probably, these strategies' results will be better if portfolios would have been based on stocks traded on mature capital markets, with a longer trade record than those available on Romanian stock market.

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