Rolling verification of the performance of real estate investment funds

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Abstract. Currently, there is an urgent need to develop an institutional rental housing market. It is an obvious fact that this issue cannot be resolved without the formation of available investment resources. This article discusses aspects of one of these promising forms – real estate investment funds. The article uses historical data on the dynamics of profitability of the 21st real estate fund for 2013-2020 to test the method of assessing the risks of investing funds for potential investors – the method of sliding verification of groups of leaders synthesized using the “Yield-risk” model. The model is based on the basic principles of portfolio analysis. The results obtained indicate the suitability of the proposed method. Testing was carried out on current data from 2017-2020, which were not used to build the model. The constructed groups of leading funds demonstrate their continuity at all stages of rolling verification. The conducted correlation analysis showed a fairly close mutual correlation between the dynamics of profitability of the studied real estate funds, which significantly weakens by 2020. The proposed method can be used when making decisions about investing money in investment real estate, including rental housing of various categories.

Real estate is an integral part of today's widely diversified multi-component investment portfolios. Table 1 shows a number of investment portfolios [1], the structure of which corresponds to risk-taking, risk-neutral and risk-averse investors.

\begin{table}[h]
\centering
\begin{tabular}{|c|l|}
\hline
the portfolio number & portfolio structure \\
\hline
1. & Obligations – 40%,  
Stocks – 25%,  
REIT – 25%,  
Gold – 10%. \\
\hline
2. & Stocks of domestic companies – 20%,  
Stocks of foreign companies – 20%,  
Emerging market stocks – 10%,  
REIT – 20 %,  
Long-term US Treasury bonds – 15 %,  
Obligations – 15 %. \\
\hline
\end{tabular}
\caption{Investment portfolios of various types.}
\end{table}
The purpose of this article is to develop an algorithm that allows you to make decisions about investing money in real estate investment funds that will be used to develop the institutional rental housing market.

Research problem:
- based on historical data, use the training sequence to implement rolling verification of the effectiveness of exchange-traded real estate investment funds;
- conduct an adequate assessment of the effectiveness of the “Yield-risk” model based on independent material.

In the course of implementing these tasks, we analyzed historical data on the returns of the following exchange-traded real estate funds of the US stock market (REIT) for the period from 01.01.2013 to 31.08.2020: DJ Americas Select REIT, DJ Asia/Pacific Select REIT, DJ Composite REIT TR, DJ Equity REIT, DJ Equity REIT Total Return, DJ Europe Developed Markets Select REIT EUR, DJ Europe Select REIT, DJ Global ex-US Select REIT, DJ Global Select REIT, DJ Middle East & Africa Select REIT, FTSE CNBC Global 300 Real Estate REITs, MSCI US REIT, REIT Europe, REIT Europe GR, REIT Europe NR, STOXX Asia/Pacific 600 REIT EUR, STOXX Asia/Pacific 600 REIT USD, STOXX Global 1800 REIT EUR, STOXX Global 1800 REIT USD, STOXX North America 600 REIT EUR, STOXX North America 600 REIT USD. The data, with a time interval of one month, was exported from the investment portal Investing.com (global indices, major) (official website of the investment company).

The subsequent analysis was carried out based on the obtained values of the expected return, which is calculated for a given period of time as the arithmetic mean of returns and the level of expected risk, which implies the root of the variance. Calculated values of expected return and risk are rounded to one decimal place after the decimal point. The analysis is carried out in accordance with the approach proposed by the founder of modern portfolio theory G. Markowitz, in which he proposed a new approach to the study of the risk effects of investment distribution, correlation and diversification of expected investment returns [2,3,4] and to the methodology for constructing the “winner model” [5,6,7] and to the method of D. O’Shaughnessy [8].

The paper implements the method of rolling verification, the essence of which is as follows:
- A time period of 48 months (01.01.2013-31.12.2016) was used to calculate the values of profitability and risk in order to place them on the scatter chart and directly select the shares of those exchange-traded investment funds that will later be included in the “first” portfolio (figure 1, at the beginning of 2017).
The “first” portfolio will be verified based on 2017 data. The size of the training sample was selected in accordance with the recommendations of Fama E. F. [9].

Further, when you go to the analysis of funds that may be included in the “second” portfolio (at the beginning of 2018), historical data from the very first year of the training sample is excluded, namely 2013, and data from 2017 is included, and verification is performed based on 2018 data.

This procedure was repeated 4 times, i.e. sequentially for each year: 2017, 2018, 2019 and 2020, portfolios were reviewed at intervals of one year. Thus, we get a rolling sample that implies a regular (annual) review of the investment portfolio.

Portfolio monitoring and adjustment (as necessary) is consistent with a passive financial management strategy. Each of the synthesized portfolios undergoes rolling verification based on data from 2017, 2018, 2019 and 2020, respectively.

Due to the “time-moving” interval of historical data under consideration, which implies the exclusion of outdated yield values and the inclusion of more “fresh” data in the analysis, the investor is able to track the trend of movement of the main parameters of the “Yield-risk” model. First of all, it is profitability, risk, and the ratio of profitability to risk. The investor’s attention should be drawn to the identified downtrends or uptrends according to the above criteria. Moreover, upward trends in profitability and the ratio of profitability to risk, coupled with a decreasing trend in risk, should inspire optimism, and the reverse situation means that the market situation is changing and not for the better for the investor.

In the following initial scatter diagrams, which are formed sequentially for all investment portfolios, the risk is located on the abscissa axis, and the expected return of securities considered by exchange – traded investment funds is located on the ordinate axis. Then, according to the algorithm presented below, starting sequentially from the original set of real estate funds, subgroups of leading funds are synthesized, i.e. the simplest investment portfolios with equal weights for 2017 (figure 1), 2018 (figure 2), 2019 (figure 3) and 2020 (figure 4).

Synthesis of a sequence of subgroups of funds that are leaders in the following manner. At each step of the algorithm (for each year under consideration), the funds that are excluded from the analysis are:

1) show a lower return value with equal risk levels (two expected return values are considered equal if the absolute value of the difference between their values does not exceed 0.1 (%)).

2) or, on the contrary, they are characterized by a high risk value with equal values of profitability,

3) also excluded from further analysis are funds that show obviously worse values of the risk-return ratio, the so-called outliers [11,12,13].

To facilitate the process of excluding outsiders from further consideration and forming an investment portfolio, we recommend:

1) Place a trend line on the original scatter chart.

2) The procedure for excluding outsider funds in each pair under consideration should be organized in such a way that each such deletion does not impair the quantitative criteria for the quality of the trend line.

When implementing the above procedure for forming a group of leaders, outsiders should be excluded with caution. If the scatterplot shows that the analyzed field is more than one cluster, then the described procedure is performed separately for each cluster, otherwise the resulting group of leaders is not very informative.
Tables 2-5 for each of these leading funds consistently indicate: $Dx(H)$ expected return on historical data and $Dx(V)$ – return at the verification stage of the corresponding fund, the level of risk – $Rs(H)$ and $Rs(V)$, as well as the ratio $Dx(H)/Rs(H)$.

**Table 2.** Results of verification of the group of funds-leaders of the “first” portfolio according to 2017 data.

| №  | Name of the foundation                 | $Dx(H)$ | $Rs(H)$ | $Dx(H)/Rs(H)$ | $Dx(V)$ | $Rs(V)$ |
|----|----------------------------------------|----------|----------|---------------|----------|---------|
| 1. | STOXX Global 1800 REIT USD             | 0.36     | 3.81     | 0.09          | 0.62     | 1.48    |
| 2. | DJ Global Select REIT                  | 0.44     | 3.98     | 0.11          | 0.23     | 1.58    |
| 3. | STOXX North America 600 REIT USD       | 0.49     | 4.06     | 0.12          | 0.58     | 1.68    |
| 4. | STOXX Asia/Pacific 600 REIT EUR        | 0.65     | 4.30     | 0.15          | -0.63    | 2.30    |
| 5. | DJ Equity REIT Total Return            | 0.89     | 4.13     | 0.22          | 0.71     | 1.55    |
| 6. | STOXX North America 600 REIT EUR       | 0.97     | 4.50     | 0.22          | -0.49    | 2.45    |

Minimum: 0.36 3.81 0.09 -0.63 1.48
Minimum: 0.97 4.50 0.22 0.71 2.45

On average, for the “first” portfolio in 2017, the yield per instrument was 0.17%, and the risk was 0.42%. Tables 2 – 5 highlight the extreme values for each of the analyzed criteria. In the time interval 2013-2016, the maximum values for all three analyzed criteria are shown by the STOXX North America 600 REIT EUR fund, and the minimum values are: STOXX Global 1800 REIT USD.
Figure 2. Scatter chart: exchange-traded investment funds-leaders for 2018 (“second” portfolio).

Table 3. Results of verification of the group of funds-leaders of the “second” portfolio according to 2018 data.

| №   | Name of the Foundation                      | Dx(H) | Rx(H) | Dx(H)/Rx(H) | Dx(V) | Rx(V) |
|-----|---------------------------------------------|-------|-------|-------------|-------|-------|
| 1.  | FTSE CNBC Global 300 Real Estate REITs       | 0.42  | 3.28  | 0.13        | -0.86 | 3.54  |
| 2.  | STOXX Global 1800 REIT USD                  | 0.56  | 3.22  | 0.17        | -0.60 | 3.41  |
| 3.  | DJ Global ex-US Select REIT                 | 0.25  | 3.31  | 0.07        | -0.87 | 2.50  |
| 4.  | DJ Asia/Pacific Select REIT                 | 0.39  | 3.36  | 0.12        | 0.18  | 2.35  |
| 5.  | DJ Global Select REIT                       | 0.51  | 3.43  | 0.15        | -0.70 | 3.51  |
| 6.  | STOXX North America 600 REIT USD            | 0.72  | 3.57  | 0.20        | -0.44 | 4.12  |
| 7.  | DJ Equity REIT Total Return                 | 0.99  | 3.64  | 0.27        | -0.26 | 4.38  |
| 8.  | STOXX Global 1800 REIT EUR                 | 0.86  | 3.71  | 0.23        | -0.18 | 3.72  |
| Minimum |                                          | 0.25  | 3.22  | 0.07        | -0.87 | 2.35  |
| Maximum |                                         | 0.99  | 3.71  | 0.27        | 0.18  | 4.38  |

On average, for the “second” portfolio at the stage of its verification, according to historical data in 2018, the return on one instrument was -0.62% (risk 0.37), while the average return on the whole for the original set was -0.80%. The resulting estimate of expected return can be identified with the result of naive diversification [5], if the entire initial set of funds is taken as an investment portfolio. Despite the fact that the synthesized group of funds is the leader in terms of verification results based on 2018 data (table 3) showed a negative result, it significantly exceeded the results of the analyzed group of funds in general by investment criteria.

A comparison of the composition of the “first” and “second” portfolios shows that among the eight leading funds in 2018, there are four leading funds from the 2017 set: STOXX Global 1800 REIT USD, DJ Global Select REIT, STOXX North America 600 REIT USD and DJ Equity REIT Total Return, i.e. 50% of the total number of funds. According to the authors of the article, this fact indicates a low continuity of investment analysis results, which is due to the insufficient frequency of revision of the composition of leading funds.
Figure 3. Scatter chart: exchange-traded investment funds-leaders for 2019 (“third” portfolio) – two clusters.

Figure 3 shows that in the considered historical data interval, the synthesized group of leading funds for the 3rd investment portfolio (for 2019) is represented by two subgroups (two clusters [14,15]. The first (left) and second (right) clusters show different levels of risk with almost equal expected returns.

Table 4. Results of verification of the group of funds-leaders of the “third” portfolio according to 2019 data.

| №  | Name of the Foundation | $D_x(H)$ | $Rs(H)$ | $D_x(H)/Rs(H)$ | $D_x(V)$ | $Rs(V)$ |
|----|------------------------|----------|---------|----------------|----------|---------|
| 1  | DJ Asia/Pacific Select REIT | 0.23     | 3.19    | 0.07           | 1.27     | 2.72    |
| 2  | STOXX Asia/Pacific 600 REIT EUR | 0.30     | 3.32    | 0.09           | 1.50     | 3.05    |
| 3  | DJ Composite REIT TR     | 0.40     | 3.72    | 0.11           | 2.14     | 3.30    |

The second cluster (right subgroup)

| №  | Name of the Foundation | $D_x(H)$ | $Rs(H)$ | $D_x(H)/Rs(H)$ | $D_x(V)$ | $Rs(V)$ |
|----|------------------------|----------|---------|----------------|----------|---------|
| 1  | STOXX Global 1800 REIT USD | 0.02     | 3.34    | 0.01           | 1.78     | 3.08    |
| 2  | FTSE CNBC Global 300 Real Estate REITs | 0.01     | 3.41    | 0.00           | 1.84     | 3.68    |
| 3  | DJ Equity REIT          | 0.07     | 3.81    | 0.02           | 1.86     | 3.41    |
| 4  | STOXX North America 600 REIT USD | 0.14     | 3.70    | 0.04           | 1.88     | 3.26    |
| 5  | STOXX Global 1800 REIT EUR | 0.17     | 3.81    | 0.04           | 1.95     | 3.33    |
| 6  | STOXX North America 600 REIT EUR | 0.29     | 4.45    | 0.07           | 2.05     | 3.69    |
| Minimum |                         | 0.01     | 3.19    | 0.00           | 1.27     | 2.72    |
| Maximum |                         | 0.40     | 4.45    | 0.11           | 2.14     | 3.69    |

When testing the “third” portfolio, according to 2019 data, the average yield per instrument for the first (left) cluster was 1.64%, the yield per instrument for the second (right) cluster was 1.89%, and the overall yield per instrument for the group of leading funds was 1.83%. Accordingly, the risk is 0.45 for the first cluster, 0.09 for the second, and 0.27 for the “third” portfolio as a whole. The continuity of the “third” portfolio was slightly higher than that of the “second”: five funds out of nine were presented earlier (about 56%). These are DJ Asia / Pacific Select REIT, STOXX Global 1800 REIT USD, FTSE CNBC Global 300 Real Estate REITs, STOXX North America 600 REIT USD, STOXX Global 1800 REIT EUR, STOXX North America 600 REIT EUR.
Figure 4. Scatter chart: exchange-traded investment funds-leaders for 2020 (“fourth” portfolio).

Table 5. Results of verification of the group of funds-leaders of the “fourth” portfolio according to 2020 data.

| No | Name of the Foundation | $D_x$ | $R_s$ | $D_x/R_s$ | $D_x(V)$ | $R_s(V)$ |
|----|------------------------|-------|-------|-----------|----------|----------|
|    |                        |       |       |           |          |          |
| The first cluster (left subgroup) | | | | | | |
| 1. | DJ Global ex-US Select REIT | **0.29** | 3.10 | **0.09** | **-2.51** | **10.77** |
| 2. | STOXX Global 1800 REIT EUR | 0.41 | 3.18 | 0.13 | -1.79 | 8.17 |
| 3. | STOXX Global 1800 REIT USD | 0.48 | 3.23 | 0.15 | -0.98 | 8.60 |
| 4. | STOXX Asia/Pacific 600 REIT EUR | 0.57 | 2.89 | 0.20 | -2.00 | 10.19 |
| The second cluster (right subgroup) | | | | | | |
| 1. | FTSE CNBC Global 300 Real Estate REITs | 0.38 | 3.53 | 0.11 | -0.09 | 5.70 |
| 2. | STOXX North America 600 REIT USD | 0.55 | 3.59 | 0.15 | **-0.53** | 7.83 |
| 3. | DJ Equity REIT Total Return | 0.86 | 3.52 | 0.24 | -0.93 | 8.35 |
| 4. | DJ Composite REIT TR | **0.87** | **3.62** | **0.24** | -1.08 | 9.15 |
| Minimum | 0.29 | 2.89 | 0.09 | -2.51 | 5.70 |
| Maximum | 0.87 | 3.62 | 0.24 | -0.53 | 10.77 |

When testing the “fourth” portfolio according to 2020 data, the average yield per instrument for the first (left) cluster was -1.82, the average for the second (right) cluster -0.66, and in General for the group of leading funds -1.24.

The most stable results over time were shown by the group of funds-leaders of the “third” portfolio: six funds included in it are represented in the “fourth” portfolio: STOXX Global 1800 REIT EUR, STOXX Global 1800 REIT USD, STOXX Asia / Pacific 600 REIT EUR, FTSE CNBC Global 300 Real Estate REITs, STOXX North America 600 REIT USD, DJ Composite REIT TR, i.e. 75%.

Negative results of verification of investment funds in 2018 and 2020 are due to the fact that:
1. In 2018, there was a drop in the profitability of individual REITs for various asset classes. The main reasons for the fall in markets during this period were:
   A). Trade wars between the US and China,
   B). Tightening of the fed's monetary policy. In 2018, the US FRR the rate from 1.5% to 2.5%, which negatively affected the market for bonds and other long-term securities. The flow of investment from China to the US decreased by one and a half times. According to statistics, Chinese investor's investments decreased from $25.6 billion in the first half of 2017 to $5.3 billion in the same period in 2018. Experts attribute this to tighter control over the movement of capital from the country.
2. The 2020 COVID pandemic almost brought down the real estate sector, as many people were forced to switch to remote work and did not leave their homes, so the demand for real estate from retailers and entertainment companies fell to almost zero, and there was also a drop in office space...
traffic. Thus, the widespread deterioration of the epidemiological situation has put additional pressure on the cost of REIs that specialize in these commercial real estate sectors [15,16,17].

Conclusions and future directions. The proposed and implemented method of rolling verification allows you to adjust the composition of the group of leading funds with a given frequency. The formation of leading funds and the elimination of “outsiders” is based on the “classic” criteria of portfolio analysis – expected return, risk level and the ratio of return to risk. The results of testing dynamic verification of real estate funds with an annual audit of the investment portfolio showed the need to optimize this parameter in the future. For this purpose, it is planned to evaluate the performance of rolling verification with the frequency of reviewing the composition of the group of leading funds for one month, quarter, and six months.

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