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Active Diversification Tools in the Portfolio of Investment Strategies

Peter KUBAŠKA

Matej Bel University in Banská Bystrica, Banská Bystrica, Slovakia; peter.kubaska@umb.sk

Abstract: Investment strategy can by defined as set of rules that identifies BUY or SELL trading signals. There are a lot of investment strategies based on different analysis of capital markets. Investment strategies can be seen for example in mutual fund, hedge funds but also in PAMM systems. Investor invests through these strategies in order to maximize the value of his trading account. Dynamic development of capital markets can cause that single investment strategy can stop working. Main question is how can be investor protected from this situation? Basic way to avoid the situation of one loss strategy is the diversification. In this paper the author tests two tools of active diversification – Moving average and Ideal equity curve. Both of these tools are tested on two different data samples. On the one hand simulated data sample shows that Ideal equity curve is able to protect investment capital. On the other hand, active diversification tools did not prove predict power on real data sample. This situation was caused due to the fact, that real data sample is created only by two loss strategies. Goal of this paper is to test active diversification tools in environment of simulated and real data.

Keywords: active diversification; investment strategy; moving average; ideal equity curve

JEL Classification: G11; G17; G32

1. Introduction

According to Tomasini and Jaekle (2009) the term investment strategy can be characterized as set of rules that identifies buy or sell signals. These signals are defined exactly so investment strategies can be executed by different algorithms (without human intervention). Graphical representation of changes in the value of trading account (performance of trading account) in time is called Equity Curve.

Today, there is not only the possibility of investing cash in conventional financial instruments (stocks, bonds, ETF, mutual funds etc.), but thanks to advances in the financial industry also in new financial services. These solutions allow investors to invest in complex investment strategies (trading systems). PAMM (percent allocation money management) systems and other similar financial services bring to investors a lot of new financial opportunities. Compared to the hedge funds, PAMM systems are available with lower starting capital. However, the dynamic development of the financial market can cause that any investment strategy can completely stop working. For example, Stonham (1999) analyses hedge fund called Long Term Capital Management (LTCM). This fund ran into trouble in 1998 mainly as a result of the late 1997 financial crisis in Asia spreading in 1998 to Latin American countries and Russia. Fund lost 44 % (2.1 billion USD) of investors' money in august, and more than 52 per cent from the beginning of the year. After this fall LTCM generate net return (after fees) 21% in its first year, 43% in the second year and 41% in the third year.

If we look at fatal failure of the individual investment strategy there is a question how can be investor protected from this situation. Basic method of protection investment capital is diversification. The principle of diversification consists in redistributing the investor´s capital into the various financial instruments. The basic capital distribution approach is naive diversification. The principle of this kind of diversification means, that the investor evenly distributes his capital into the financial instruments. This approach is also understood as passive, because naive diversification concept does not require a deeper analysis of assets included in the portfolio. Conversely, the concept of active diversification requires a deeper analysis of assets and selects only potentially better assets into the portfolio. The goal

of an active approach is to overcome the passive approach. The main question is how these active approaches are capable to overcome the passive diversification of capital.

DeMiguel et al. (2009) compared 14 different diversification models with 1 / N approach. All these models were constructed with regular portfolio rebalancing. Author´s results point to the fact that none of 14 diversification models was consistently better than naive diversification in terms of Sharpe ratio. This fact was due to author´s opinion caused by estimation error in parameters. Their results are confirmed by Allen et al. (2016). By analyzing portfolios created from European indices, these authors did not confirm the higher performance of actively diversified portfolios over the naive diversification performance. Authors Hwang et al. (2013) also tested the performance of naive diversification compared to the optimal portfolio. Like DeMiguel et al. (2009), they demonstrated that the naive diversification overcame by its performance the optimal portfolio. They argue that the portfolio created on the base of naive diversification is characterized by increased exposure in the left tail. It means that such a portfolio tends to have not only a negative coefficient of skewness, but also an increased positive coefficient of kurtosis compared to normal distribution. Statistical data has rather concaved properties, which again confirms the fact, that naive diversification tends to overcome the optimal portfolio. The last factor that results in an increase in performance is associated with the number of assets held in the portfolio. A higher number of assets in the portfolio results in an increase the characteristics in the naive diversification. According to Tu and Zhou (2011) Markowitz´s modern theory of portfolio and all its extensions lag behind the principle, what is in line with the results of previous authors. Authors understood the concept of total portfolio diversification as a combination of principle with four other models. Ultimately, the authors achieved better results of the risk-return profile compared to the naive principle.

Blumenthal (2014) states that diversification is effective only with low-correlation assets. But also, correlation can change through time. In time of financial globalization, there can observed higher correlation coefficient not only with same asset classes but also in different. This globalization effect is stronger in turbulent times (Sandoval and Franca 2011). Moldavan (2011) investigated increased correlation at the time of financial crisis. By the regression analyzes, he follows two time periods: the pre-crisis 2003-2006 and the crisis period 2007-2010. His results point to the fact that in the time of financial crisis there is a higher degree of interconnection of the capital markets. Thus, synchronized stock market meltdowns can be problems also for diversified portfolios.

This paper is focused on two diversification tools – Moving averages as a tool of active diversification and Ideal Equity Curve as a tool of active diversification.

2. Methodology

In this session is described methodological concept. The author divides methodology session in to three parts – Data (2.1.), Tools of active diversification and Final portfolio algorithm (2.2.) and Performance indicators of active management in investment strategies portfolio (2.3.)

2.1. Data

In this paper are used two different data samples. First, the author uses simulated data of Equity curves based on the simulator, which generates individual equity curves in 5293 trading days. The generator principle is based on random distribution of monthly deviations calculated from real monthly DJIA 30 data during the whole monitored period. The obtained simulated data will thus not have the character of randomly generated data, which are characterized by a normal distribution of deviations in the form of a Gaussian curve. From these simulations are chosen five Equity Curves with growth trend and five investment strategies with loss trend. This sample is used for the purpose of first test of active management with same number of growth and loss Equity Curves. These data are also useful to reach minimum level of correlation. From these Equity Curves the author randomly choose 30 portfolios construct by five investment strategy. In the first 10 portfolios there will be only one randomly chosen Equity curve with strong loss trend. In next ten simulations there will be two Equity curve with strong loss trend and in the last ten simulations there will be three investment

strategies with strong loss trend. With loss equity curves there is an option to get closer look on active tools ability to protect investor's portfolio.

Table 1. Types of strategies (simulated data).

Strategy type	Strategies	Average return correlation
Growth strategy	EC1, EC2, EC3, EC4, EC5	-0.0019
Loss strategy	EC6, EC7, EC8, EC9, EC10	-0.0020

Second, in the article are used real investment strategies form quantopedia.com. This portal concentrates academical papers, which discuss about methods of investment strategies construction. From this database the author chooses 17 available ideas of constructing individual investment strategies. All of 17 ideas were set from starting date 1.1.2005 and to end date 30.11.2019. From this data sample are also created 30 random and different portfolios, which consist of five different investment strategies.

Table 2. Types of strategies (real data).

Strategy type	Strategies	Average return correlation
Market timing	EC9, EC11, EC12, EC 14, EC16	0.2128
Stock Picking	EC8, EC10, EC13, EC6	0.0299
Momentum-equity	EC1, EC2, EC3, EC5, EC7, EC12, EC15	0.1592
Forex	EC4	N/A
Arbitrage	EC17	N/A

2.2. Tools of active diversification and final portfolio algorithm

Moving averages

First, the author uses the Moving average system as a tool for selecting investment strategies into the portfolio. In this article are used three different moving average periods (X=50, X=100 and X=200). The algorithm for selecting investment strategies into the final portfolio is based on the cutting principle. If the closing value of the investment strategy is higher than its moving average, investment strategy is selected into the final portfolio. Table 1 summarizes entry and exit condition for investment strategies.

Table 3. Buy and sell conditions for Moving average.

	Condition for ENTRY	Condition for EXIT
Moving average	Close price > MA (X)	Close price < MA (X)

Moving average concept in investment strategies portfolio was tested by authors Kisela et. al. (2015). Authors managed investment strategies portfolio by technical analysis indicators. Their study point to the fact, that the worst results achieved moving average.

Ideal equity curve (IEC)

The idea of Ideal Equity Curve (IEC) was presented by Virdzek et al. (2018). Authors defined IEC as a hypothetical curve (hypothetical benchmark) with growing trend without negative volatility. This curve represents at least wanted equity curve performance in the future. Authors also points to a problem of setting the slope for IEC. They state that the basic slope for IEC is 0. In this situation the investor protects his capital from loss situation. Due to authors higher slope for IEC pushes on individual performance of investment strategies. IEC is used in three different slopes. First IEC=0 (basic slope), second IEC= 0.00026 (as a daily return captured from MSCI world index) and third IEC= 0.00038 (as daily return when investor requires 10% return per year). Entry algorithm is set again on cutting principle. If Equity Curve performance is greater than IEC performance than investor invest

into the investment strategy and vice versa if performance of the investment strategy is lower than performance of IEC investor extracts investment strategy from portfolio.

Final portfolio algorithm

From simulated and real data, the author creates thirty different portfolios. Each of this portfolio is made by five different Equity Curves. Individual EC are managed by active portfolio tools (Moving average and Ideal Equity Curve). If any of five EC in time is in BUY mode the investment strategy is included to final portfolio and investor's capital is evenly divided into BUY mode strategies. The author compares these final portfolios with benchmark that is always set as naive diversification from five selected strategies.

2.3. Performance indicators of active management in investment strategies portfolio

The author evaluates performance of Final portfolio by Total return, Maximum drawdown and Recovery factor.

Total return

In the article is used a Total return indicator as a representant of yield part of investments. Fernandez and Fernandez (2018) state that if a rational investor invests in the long-term, he cares about the state of his investment (Total return) at the end of the investment horizon (e.g. retirement). Due to author, rational investor diversifies his portfolio to minimalize risk. The author says that investors are not even interested in maximizing Sharp's ratio or minimizing the volatility of their portfolios. The only thing the investor is interested in is the total return when the investment horizon is met

In this paper are used discrete returns $r_{t_0}^{t}$ defined as:

$$r_{t_0}^{t} = \frac{P_t}{P_{t_0}} - 1 \tag{1}$$

where $T > t_0$, P_T is close price of investment strategy at time t, P_{t_0} is close price of investment strategy at time t_0.

Then total return is set as percentage rate of return (loss) observed from whole period under review.

Maximum drawdown

As a representant of risk measure is chosen Maximum drawdown indicator. Pospisil and Vecer (2008) defined as the largest drop of the asset price within a certain time period. Due to authors Maximum drawdown can be viewed as a contingent claim that can be priced and hedged using the standard risk-neutral valuation techniques. If P_t is close price of investment strategy at time t, then maximum price in time t is defined as:

$$M_t = \max_{u \in [0,t]} P_u . \tag{2}$$

Then Maximum drawdown (MDD_t) at close price of investment strategy is defined as:

$$MDD_t = \max_{u \in [0,t]} (M_u - P_u) . \tag{3}$$

Recovery factor

Recovery factor indicator is used as a representant of overall final portfolios performance. It compares both sides of investment: risk part and yield part. Recovery factor is defined as:

$$\text{RF} = \frac{\text{Total return of investment strategy}}{|\text{MDD}|} . \tag{4}$$

3. Results

3.1. Individual performance of investment strategies

Table 4 represents individual performance indicators for both data samples. Simulated data are characterized by stronger performance indicator compared to real data sample. Due to this fact, there is an ability to test both active management tools in the environment of high gains and losses. In the real database, there is only two investment strategy with negative value of Total return (EC6 and EC15). These strategies are based on momentum principle. The best constructed strategy (from the point of view of the highest value of Recovery factor) is strategy EC12 which is based on market timing. Market timing trading strategy is based on rotation between two risky assets.

Table 4. Individual performance of simulated and real data samples.

	Real data				Simulated data		
EC	**Total return**	**Max. DD**	**Recovery Factor**	**EC**	**Total Return**	**Max. DD**	**Recovery factor**
EC1	103.54%	-29.49%	3.511	EC1	880.25%	-56.5%	15.57
EC2	278.78%	-70.34%	3.963	EC2	1329.68%	-60.3%	22.04
EC3	312.94%	-53.84%	5.812	EC3	890.05%	-61.4%	14.49
EC4	70.38%	-25.66%	2.743	EC4	903.74%	-49.2%	18.36
EC5	268.42%	-54.64%	4.912	EC5	906.91%	-50.6%	17.94
EC6	-64.51%	-67.93%	-0.950	EC6	-97.27%	-99.0%	-0.98
EC7	56.80%	-29.00%	1.959	EC7	-97.07%	-97.2%	-1.00
EC8	2.05%	-70.56%	0.029	EC8	-97.09%	-97.3%	-1.00
EC9	158.66%	-36.70%	4.324	EC9	-97.10%	-98.4%	-0.99
EC10	182.25%	-44.67%	4.080	EC10	-97.13%	-97.4%	-1.00
EC11	13.79%	-24.76%	0.557				
EC12	268.69%	-18.69%	14.375				
EC13	110.62%	-25.58%	4.325				
EC14	15.63%	-10.51%	1.488				
EC15	-44.72%	-50.70%	-0.882				
EC16	22.00%	-47.52%	0.463				
EC17	678.93%	-62.71%	10.826				

3.2. Results from simulated data

This part is focused on results from simulated data. Table 5 is divided into three parts (first 10, second 10 and third 10 simulations). Each of these groups represents different number of loss strategies (see 2.1. Data). The motivation is to test Moving average and Ideal equity curve tools in different investment strategy environment. The main goal of active diversification tool is to protect investor's capital against fatal fall in investment capital. Second goal is to test the ability of active tools to gain better performance indicators than benchmark (naive diversification).

There are tested combinations that can be observed from results. If final portfolio reaches better value in each performance indicators (Total return, Maximum drawdown and Recovery factor), this state is coded by 111. There are two possible combination that can not be reached -110 and 001.In the Table 5 there is also presented number of simulations, when Total return of Final portfolio (FP) is greater than 0.

Table 5. Results from simulated data

First 10 simulations						
Combination	**MA50**	**MA100**	**MA200**	**IEC=0**	**IEC=0.00026**	**IEC=0.00038**
000	1	0	0	0	0	0
010	0	0	0	0	0	0
011	0	0	0	0	0	0
100	5	2	1	0	0	0
101	4	8	9	5	6	6
111	0	0	0	5	4	4
Total return of FP>0	10	10	10	10	10	10
Second 10 simulations						
	MA50	**MA100**	**MA200**	**IEC=0**	**IEC=0.00026**	**IEC=0.00038**
000	4	0	0	0	0	0
010	0	0	0	0	0	0
011	0	0	0	0	0	0
100	0	1	1	0	0	0
101	6	9	9	5	6	6
111	0	0	0	5	4	4
Total return of FP>0	10	10	10	10	10	10
Third 10 simulations						
	MA50	**MA100**	**MA200**	**IEC=0**	**IEC=0.00026**	**IEC=0.00038**
000	0	0	0	0	0	0
010	0	0	0	0	0	0
011	0	0	0	0	0	0
100	0	0	0	0	0	0
101	8	7	4	1	2	2
111	2	3	6	9	8	8
Total return of FP>0	2	8	8	10	10	10

In terms of the success of active portfolio tools, the best situation is represented by combination 111. In the first 10 simulations which are characterized by four randomly chosen growth Equity curves and by one randomly chosen loss strategy there was only one simulation, that reach worse value in all performance indicators (MA50). Moving average tool is characterized mainly by two combinations-100 and 101. From the point of view of investor, the combination 100 is not acceptable, due to the fact that Moving average tool is not capable to reach higher value of Recovery factor indicator. On the other hand, the Ideal equity curve is mainly characterized by combinations 101 and 111. The author understands both of these combinations as acceptable for the investor. For the combination 101 the investor takes higher risk, but he gains higher Recovery factor. It means that he gets higher return per unit of the risk measured by Maximum drawdown.

Second 10 simulations are characterized by higher number of combination where MA50 can not outperformed benchmark. This state is due to the fact that there are at least two Equity curves with loss trend in the portfolio. Other MA tools occur mainly in the combination 101. Compared to the first 10 simulations, Ideal equity curve tool is still able to outperformed benchmark at least in two performance indicators.

Last 10 simulations set the hardest conditions for active tools. Compared to the previews results there is no 000 combination for MA50, but using MA50 there are only two portfolios where Total return

was greater than zero. Other MA tools are represented by 101 and 111 combinations, but there are also simulations where Total return of Final portfolio is less than zero. On the other hand, Ideal equity curve tool was able to protect investor's capital in all simulations. In terms of all combinations MA tool is higher sensitive to change in length parameter. With higher number of loss equity curve Moving average tools loses the power to protect portfolio from negative loss.

From the simulated data both of the testing active tools were able to outperformed benchmark. In the discussion part are tested both of these active tools in environment of real investment strategy data.

4. Discussion

In this session the author is testing active diversification tools in the portfolios of real investment strategy data. Again, the author is focusing on different possible combination of performance indicators.

Table 6. Results from real data

Combination	MA50	MA100	MA200
000	20	9	14
010	5	6	2
011	0	1	1
100	2	1	3
101	1	3	1
111	2	10	9
Combination	**IEC=0**	**IEC=0.00026**	**IEC=0.00038**
000	5	10	28
010	0	1	0
011	0	0	0
100	13	12	1
101	12	4	1
111	0	3	0

Compared to the Moving average tool, Ideal equity curve prove as a capable tool to protect invested capital in simulated data sample. Main difference against simulated data sample, real data sample is characterized by the fact that from all seventeen Equity curves there are only two which have negative value of total return, so individual equity curves are not tested in strong loss environment.

MA50 tool was not able to outperformed benchmark strategy at least at one performance indicator in 20 simulations. On the other hand, Ideal equity curve with the highest slope (IEC= 0.00038) was not able to outperform benchmark in 28 simulations. This situation was caused due to the high slope. In this simulations, performance of Ideal equity curve was too high compared to the performance of individual equity curves. Final portfolio algorithm did not include these strategies to the final portfolio, so investor can not benefit from a fast growth of Equity curve performance until the performance of individual Equity curve is not higher than actual performance of Ideal equity curve.

Ideal equity curve in the basic state (IEC=0) could outperformed benchmark strategy 25 times in a term of Total return indicator. From these simulations there are only twelve where final portfolio outperformed benchmark strategy at least in two performance indicators. But there is negative result that there was no situation where Ideal equity curve in basic mode was able to outperform benchmark strategy in combination 111.

5. Conclusion

Goal of this paper was to test active diversification tools in environment of simulated and real data. In this paper was used two active diversification tools – Moving averages tool and Ideal equity curve tool. The author focused mainly on protection if investor's capital against fatal fall in equity curve. Moving average tool was characterized mainly by two combinations (100 and 101) in the environment of simulated data sample. This situation was not acceptable for investor. On the other hand Ideal equity curve prove its ability to protect investor's capital in the environment of simulated data sample.

Compared to the simulated data sample, active tools of diversification did not prove predictable power using the real data sample. On the one hand, Ideal equity curve tool show as strong tool in term of fatal loss in Equity curve performance. On the other hand, in environment of real data sample, this tool was not able to outperform benchmark in terms of all three performance indicators.

Both of tested active tools seems to be sensitive on individual parameters. Main finding from analysis is that Ideal equity curve can be used at risk tool to prevent investor from fatal failure in individual equity curve.

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