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Trend definition as a support tool for managing a portfolio of investment strategies
Definícia trendu ako podporný nástroj pre riadenie portfólia investičných stratégií

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Abstract: *Investment strategies may have a positive impact from the investor's perspective on multisource financing of business activities and directly or indirectly affect the financial health of a company. However, the dynamic development of the financial market can cause that any investment strategy may show also very unpredictable behavior in terms of performance parameters. Many authors use trend definition in their trend following trading systems. In our paper, we understand respective trend definition as a decision-making algorithm tool for a company which is actively managing a portfolio of investment strategies (trading systems) to maximize profit and minimize drawdowns in its equity curve. The goal of this paper is to test and evaluate the ability of respective trend definition to bring higher performance parameters versus a passive diversification of capital.*

Abstrakt: *Investičné stratégie môžu mať z investorovho pohľadu pozitívny vplyv na viaczdrojové financovanie podnikateľských aktivít a môžu tak priamo alebo nepriamo ovplyvniť aj finančné zdravie spoločnosti. Dynamický vývoj finančného trhu môže spôsobiť, že akákoľvek investičná stratégia vie z hľadiska výkonnostných parametrov vykazovať aj nepredvídateľné správanie. Veľa autorov používa definíciu trendu vo svojich trendových obchodných systémoch. V článku však chápeme príslušnú definíciu trendu ako rozhodovací algoritmus pre spoločnosť, ktorá aktívne riadi portfólio viacerých investičných stratégií (obchodných systémov) s cieľom maximalizovať zisk a minimalizovať prepady v krivke jeho výkonnosti. Cieľom príspevku je otestovať a vyhodnotiť schopnosť príslušnej definície trendu dosiahnuť aktívnou diverzifikáciou vyššie parametre výkonnosti oproti pasívnej diverzifikácii kapitálu.*

Key words: *trend definition, active diversification, passive diversification, portfolio management.*

Kľúčové slová: *definícia trendu, aktívna diverzifikácia, pasívna diverzifikácia, riadenie portfólia.*

1 Introduction

The financial market brings investment opportunities not only to individuals but also to businesses. While an individual investor invests his savings, the company can invest its free cash. Corporate cash holding is one of the most essential issues and strategies of corporate financial management, which not only relates to corporate operation and development, but also relates to the corporate governance. Cash is the most liquid asset, but on the other hand, it is also one of the least profitable assets. Especially when we talk about today's historically lowest interest rates. The benefit of holding cash will decrease in case the company has „redundant“ cash on balance. Whether is this situation short or long term the fact is that each company can invest it on financial market. Opportunities on the capital market create space for creation investment strategies. Tomasini and Jeakle (2011) characterize the investment strategy as a detailed set of rules that automatically and without any human intervention define buy or sell signals. And 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 them a lot of new financial opportunities. The biggest advantage of these solutions is that, unlike hedge funds, they are already available at very low investments and allow investors to spread their capital into an unlimited investment strategy portfolio. The main disadvantage of these solutions may be the fact that some strategies, in terms of their risk settings, may bring the investor a total loss of invested money. Therefore, diversification plays a key role in this case. Some investors spread their capital between various managers who prefer different investment strategies and financial instruments. This approach can be understood as a passive one. On the other hand, there can be also an active approach to diversification, which in the biggest simplicity means that in some inappropriate circumstances, some investment strategy is excluded from the final portfolio. This approach requires, of course, some effective system or tool. Each investor would like to have portfolio of investment strategies that are forever only in uptrend. The dynamic development of the financial market causes that this is impossible in reality. However, from our point of view, the idea of the need for an ever-growing trend is interesting. Therefore, our article deals with three different ways of defining the trend, that we are using as a tool for actively managed investment strategies portfolio.

2 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 whether 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 Allena 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. (2018) 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. The 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 principle.

3 Methodology

3.1 Investment strategies portfolios

For the purposes of our research, we have used our own generator that artificially simulates the development of investment strategies. This generator randomly sorts the daily returns of Dow Jones Industrial Average in 5294 business days. These data were obtained from the web site www.finance.yahoo.com. Based on this generator we created 10 investment strategies. These strategies are divided into two groups. First group (IS1, IS2, IS3, IS4, IS5) represents only growth investment strategies, which bring to investor high final return. Second group (IS6, IS7, IS8, IS9, IS10) represents those investment strategies, which reached significant loss in a term of Total return. IS6-IS10 also represents a risky part of investment. Figure 1 shows performance of selected investment strategies (IS1-IS10) in 5294 business days.

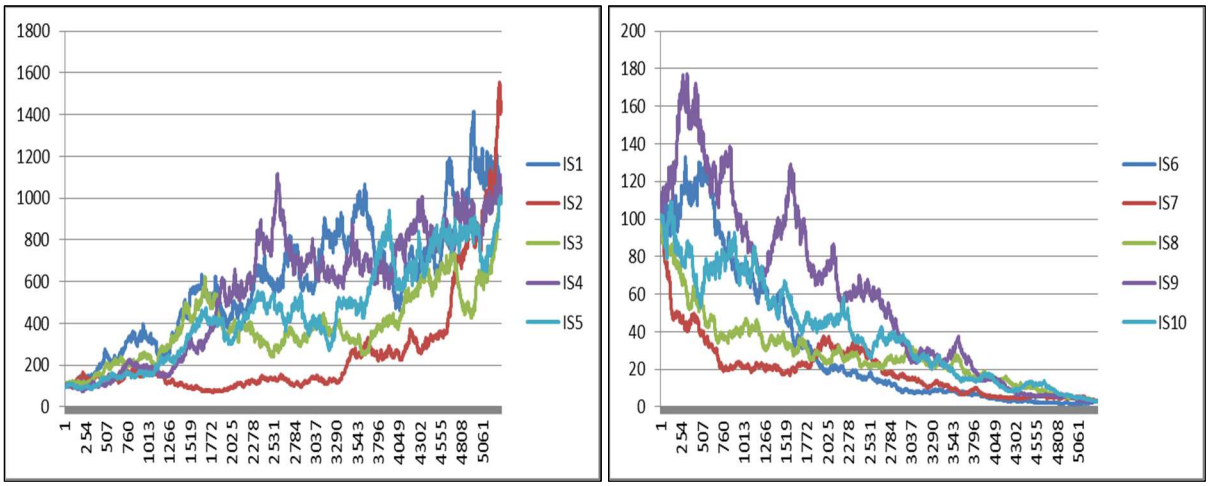

Fig. 1 Investment strategies (growth/loss) (*Source: the authors*)

From these investment strategies we created final portfolios. Each portfolio consists always of 5 investment strategies. From the point of view of combinations, we could create exactly 252 portfolios. Our first boundary portfolio consists only of 5 growth and the second only of 5 loss investment strategies. We created another 50 final portfolios using random selection without repetition. It means that each created portfolio consists of 5 different investment strategies. Each strategy has 20% weight in the portfolio (systemic benchmark = passive diversification).

3.2 Performance evaluation indicators

We evaluate performance of simulated final portfolios by Maximum drawdown, Total return and Recovery factor. We focus on return indicator (Total

return), on risk indicator (Maximum drawdown) and on whole performance indicator (Recovery factor).

Maximum drawdown

Maximum drawdown is the largest % difference between the local maximum and minimum over the observed period. It expresses the largest percentage decline in the value of a fund, financial instrument or investment strategy over time. Pospisil and Vecer (2008) understand the maximum drawdown as a contingent claim that is valuable and so the investor (or the manager) can hedge against it by using hedging tools. If P_t is the close price of an investment strategy at time t, then maximum price in time t is defined as:

$$P_t = max\{P_u, u \in [0, t]\}. \quad (1)$$

Then maximum drawdown (MDD_t) at the close price of an investment strategy is defined as:

$$MDD_t = max\{M_u - P_u, u \in [0, t]\}. \quad (2)$$

Total return

Investment strategy return is an important quantitative indicator of overall strategy performance. Fernandez (2018) points to the way, in which was easy to outperform the US S&P 500 index performance. The author states that if a rational investor invests in the long-term, he cares about the state of his investment at the end of the investment horizon (e.g. retirement). Furthermore, he defines a rational investor as one that diversifies the portfolio in order to prevent concentration of risk in individual investments. Rational investors do not care about using the "best model" on the market. 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 final return when the investment horizon is met. He demonstrates his thoughts on 137 students. He shows to these students 2 types of investment for 10 years. The first investment reaches an average annual return of 16% with a Sharpe ratio of 0.4 and the second investment reaches an average annual return of 13%, but the Sharpe ratio is higher, reaching 1.3. All the students surveyed preferred the first investment.

In this paper we use discrete returns.

Recovery factor

Recovery factor is calculated as the ratio of the final return (%) and the absolute value of the maximum drawdown over observed time (%). This indicator shows how many return units the investor earned for 1 unit of maximum risk in form of the largest % loss he had to "survive" as an investor in the past. It compares the return per unit of risk measured by the maximum drawdown in the investment strategy. The recovery factor (RF) is defined as:

$$RF = \frac{total\ return\ of\ investment\ strategy}{|MDD|}, \tag{3}$$

where MDD is defined by (2).

3.3 Trend definition

We have decided to test 3 kinds of trend definitions: moving average, moving minimums and ideal equity curve. First two are very good known for each trading system developer and the third is our own idea.

1. Moving average – if the investment strategy equity curve > moving average of the respective period, then we can say, that this investment strategy is in uptrend.
2. Moving minimums - if the investment strategy equity curve > moving minimums of the respective period, then we can say, that this investment strategy is in uptrend.
3. Ideal equity curve - if the investment strategy equity curve > line of the respective slope (exponential curve), then we can say, that this investment strategy is in uptrend.

Moving average (MA) and breakout system (BO)

We use the Moving average system as a tool for selecting investment strategies into the portfolio. We decided to use 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.

Second tool for managing investment strategy portfolio is Breakout system. This tool generates entry or exit signals based on closing the strategy out of defined range. We define the range based on moving maximums and minimum in investment strategy values. Entry signal is defined if the closing value of

respective investment strategy is higher than its moving maximum (Mmax) and exit signal is defined if the closing value of investment strategy is below its moving minimum (Mmin). We decided to test the same three different periods as in case of moving averages (X = 50, X = 100 and X = 200). Compared to Moving average strategy, entry or exit signals are given by 2 variables (Mmax and Mmin). But we set them both always at the same level.

Table 1 shows the condition for entering/exiting investment strategies in the final portfolio.

Tab. 1 Buy and sell conditions for the MO and BO system (*Source: the authors*)

	Condition for ENTRY	**Condition for EXIT**
Moving Average System	Close price > MA (X)	Close price < MA (X)
Breakout System	Close price >Mmax (X)	Close price < Mmin (X)

Ideal equity curve (IEC)

Third tool is our own idea for managing the investment strategies portfolio. It is a curve that represents the condition of a hypothetical and ideal investment strategy over time. A hypothetical ideal investment strategy may be that which only grows at the same rate and without any volatility (exponential curve), or that which never grows or falls and has no volatility (straight line). We decided to test three different “slopes” - parameters (0%, 0.0297%/day = 7.7% per year, 0.0382%/day = 10% per year). These parameters were estimated by counting changes displayed by the MSCI World Index available on the internet at https:// www.msci.com/end-of-day-data-search. An example of an EIC is displayed in Figure 2.

Setting IEC slope to 0 is a specific situation when investor does not gain any returns, but he also never gains negative returns. From this point of view, IEC is therefore "ideal" and only theoretical, so investor cannot invest in it. However, the IEC concept may be helpful in investment strategies selecting process. The investor will never know the future performance of investment strategies portfolio, but he can have minimum performance requirements on these investment strategies. If these investment strategies do not comply with his requirements, they are excluded from the final portfolio. The additional capital can be invested in those investment strategies which comply with requirements.

ll three approaches (tools) are based on the idea that, if some investment strategy is excluded from the final portfolio, weights of the other investment strategies will proportionally rise (e.g. if one investment strategy is excluded = then weight of other strategies in portfolio will rise up to 25%). In case that all

investment strategies are exited from the portfolio, we calculate only with holding cash.

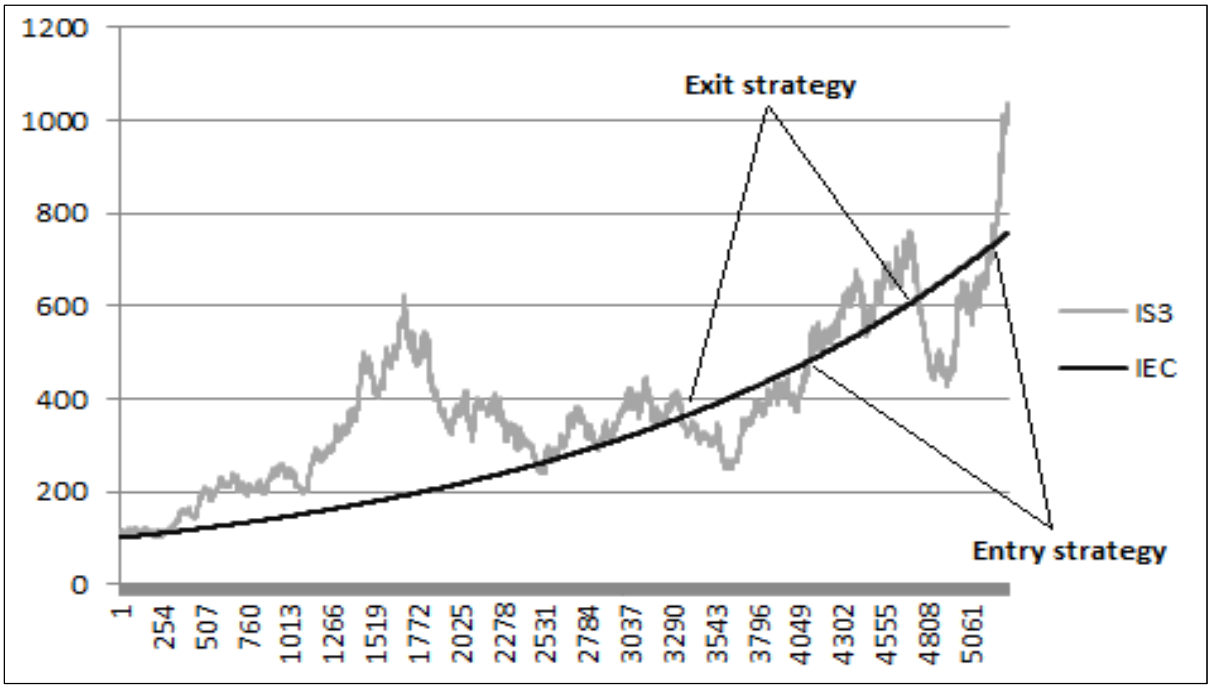

Fig. 2 Ideal equity curve *(Source: the authors)*

4 Results and discussion

Table 2 summarizes the most important results of our research. The figures in the table (# 1, # 2) represent the number of cases in which the use of portfolio investment management tools has achieved a better performance parameter than the passive diversification.

The figures in the third part of the table (# 3) reflect the frequency of cases where:

a) Final portfolios achieved total return > 0 (profit) while passive diversification reached total return > 0 (profit);
b) Final portfolios reached total return < 0 (loss) while passive diversification reached total return > 0 (profit);
c) Final portfolios achieved total return > 0 (profit) while passive diversification reached total return < 0 (loss);
d) Final portfolios achieved total return < 0 (loss) while passive diversification reached total return < 0 (loss).

The first part of the table (# 1) compares the results of the final portfolios with the passive approach based on the values of the monitored performance indicators. These results point to the fact that the use of tools based on the moving parameter concept on the one hand contributes to higher returns (TR) than passive diversification but on the other hand also to higher maximum

drawdowns (especially when using a lower period). In this comparison, the IEC tool seems to be the most capable of ensuring a lower maximum drawdown and a higher overall return on invested capital.

At first sight, the use of MA, BO and IEC systems seem to be a suitable management tool. In the first part of the table (# 1) we compared the performance of passive diversification and active portfolio management approach. However, there are also situations in which the active approach is better than passive diversification but shows low values of the TR and RF indicators, or very high maximum drawdowns values (for example - BO 50 system: TR= -88%; passive diversification: TR= -95%).

Tab. 2 Testing portfolios results *(Source: the authors)*

#1: Performance indicator comparison (52 simulations)									
BO, MA length	50			100			200		
IEC parameter ("slope")	IEC=0			IEC= 0,0297			IEC=0,038		
Performance indicators	TR	MDD	RF	TR	MDD	RF	TR	MDD	RF
MA	46	10	42	49	14	50	52	20	48
BO	46	27	43	51	27	44	51	29	49
IEC	51	39	51	51	38	51	51	37	51
#2: Performance indicator comparison (52 simulations)									
BO, MA length	50			100			200		
IEC parameter	IEC=0			IEC= 0.0297			IEC=0.038		
Performance indicators	TR	MDD	RF	TR	MDD	RF	TR	MDD	RF
MA	26	null	18	37	null	35	40	null	36
BO	33	null	30	41	null	34	44	null	42
IEC	50	null	50	50	null	50	50	null	50
#3: Total return comparison (52 simulations)									
Length/parameter	50	100	200	50	100	200	0	0.0297	0.038
Strategy	MA	MA	MA	BO	BO	BO	IEC	IEC	IEC
Strategy + Naive +	26	26	26	26	26	26	26	26	26
Strategy - Naive +	0	0	0	0	0	0	0	0	0
Strategy + Naive -	2	11	14	13	16	19	25	25	25
Strategy - Naive -	24	15	12	13	10	7	1	1	1

For this reason, in the second part of the table (#2) we added the non-negative condition of the TR and the RF indicator. Thus, figures in the second part of the table represent the number of cases (out of 52 simulations) in which the use of the active management tool (MA, BO, IEC) is more advantageous than the benchmark, but the investment also has to achieve positive values of TR and RF indicator. The maximum drawdown takes values from the interval <-1.0> and therefore the non-negativity condition is unfounded. The most significant change in the figures versus the first part of the table (# 1) is observed in MA and BO systems. Especially with the MA tool, we can see an increase in the number of cases when final portfolio (strategy) claims better TR and RF values than benchmark by using a longer period for MA. Kisela et al. (2015) also deal with the management of individual equity curves of investment strategies in their research. The authors' study looked at the use of various technical analysis tools, one of which was the moving average. Their research indicates that the use of moving averages to manage an individual investment strategy is linked to the optimization process. However, results from the second part of the table (# 2) show that the IEC tool was the only one capable to achieve a positive return in 50 cases or positive value of the RF indicator while at the same time overcoming naive diversification.

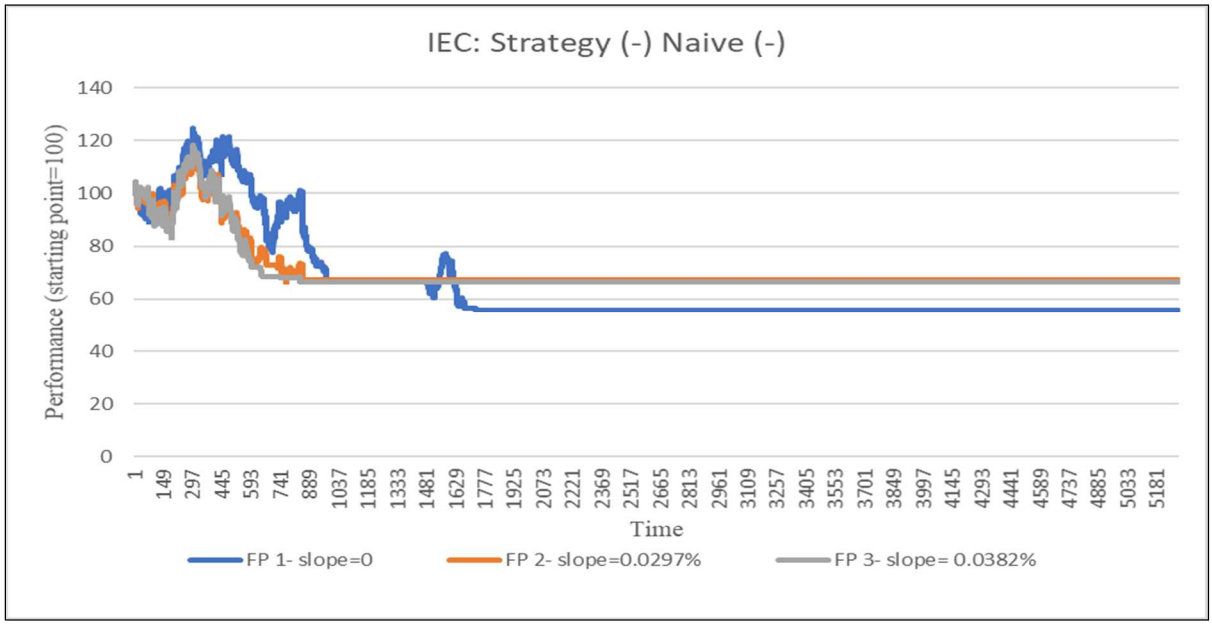

Fig. 3 Performance of IEC final portfolios (FP) in case of result: Strategy (-) Naive (-) *(Source: the authors)*

An interesting finding from the last part of the table (#3) is the fact that none of the simulations had a situation where final portfolio (strategy) would made loss and passive approach made profit (Strategy - Naive +). Our attention was logically most interested in the situation when the IEC tool made loss same as

the passive approach. Each investor would like to avoid tools that bring him a low possibility of outperforming the passive approach plus with loss result. And there was only one situation for each slope, when the IEC tool made loss same as the passive approach (Figure 3). So, the rest of the simulations ended with making IEC tool a profit for the investor (51 simulations). The fact is that this situation is different when using MA or BO systems.

Our last Table 3 summarizes some additional figures. We tested our performance parameters (indicators) from the point of view of all 52 simulations.

Tab. 3 Testing portfolios results (*Source: the authors*)

Length/slope	50	100	200	50	100	200	0	0.0297	0.038
Strategy	MA	MA	MA	BO	BO	BO	IEC	IEC	IEC
MDD Max	-0.96	-0.97	-0.94	-0.92	-0.90	-0.91	-0.69	-0.61	-0.60
MDD Avg.	-0.62	-0.61	-0.57	-0.55	-0.56	-0.52	-0.38	-0.37	-0.42
RF Min	-0.99	-0.99	-0.96	-0.96	-0.92	-0.95	-0.8	-0.78	-0.77
RF Avg.	5.06	7.32	9.91	5.03	7.31	10.79	28.25	27.53	18.97
TR Min	-0.95	-0.95	-0.91	-0.89	-0.83	-0.86	-0.44	-0.33	-0.34
TR Avg.	1.99	3.12	3.64	2.00	3.23	4.44	8.97	8.98	6.70

This table brings us some new findings. For example:

- IEC was always the best in case of Maximal Drawdown (each slope).
- IEC was always the best in case of average Maximal Drawdown (each slope).
- IEC was always the best in case of minimal Recovery Factor (each slope).
- IEC was always the best in case of average Recovery Factor (each slope).
- IEC was always the best in case of minimal Total Return (each slope).
- IEC was always the best in case of average Total Return (each slope).
- The second best in terms of active management was BO system and the worst MA system (nearly in all periods).
- Setting the “signal” period (MA, BO) just like slope (IEC) plays key role for better final results (performance indicators), thus from our results “more is better” (MA, BO period) and “less is more” (IEC slope).

5 Conclusion

Today's historically lowest interest rates make from free cash one of the least profitable assets. The benefit of cash holdings will be reduced if the company has "redundant" cash. Whether this situation is short-term or long-term, the fact is that every company can invest it in the financial market, just as individual

investors do with their savings. Today, financial market brings opportunities not only in form of conventional financial instruments like stocks, bonds, ETF etc., but due to advances in the financial industry also in new financial services. The biggest advantage of these solutions is that, unlike hedge funds, they are already available at very low investments and allow investors to spread their capital into an unlimited investment strategy portfolio. These strategies may often bring a high return in a relatively short time, but also a very risky environment. Thus, diversification plays a key role for final portfolio creating. There are two main approaches to diversification - passive and active. In active diversification an investor or company needs some tool that will signalize some inappropriate circumstances in strategy performance and thus some investment strategy have to be excluded from the final portfolio. We have tested 3 such tools via different trend definitions.

We simulated 10 investment strategies in 5294 business days, based on Dow Jones Industrial Average returns. From these 10 investment strategies (IS1 – IS10) we randomly choose 52 simulations. Each of this simulation was created by 5 different investment strategies. In these simulations we tested 3 tools via different trend definitions: moving average system, breakout system and ideal equity curve. We compared final portfolios performance with passive approach by three indicators: return indicator (Total return), risk indicator (Maximum drawdown) and whole performance indicator (Recovery factor).

At first sight, the use of MA, BO and IEC systems seemed to be a suitable management tool. One interesting finding was the fact that none of the simulations had a situation where final portfolio (strategy) would make loss and passive approach profit (Strategy - Naive +). However, there were also situations (in case of MA and BO) in which the active approach was better than passive diversification but showed low values of the TR and RF indicators, or very high maximum drawdowns values. Results from our research showed that the IEC tool was the only one capable to achieve a positive TR in 50 cases or positive value of the RF indicator while at the same time overcoming naive diversification. There was only one situation for each slope, when the IEC tool made loss same as the passive approach (Strategy - Naive -). In another comparison and in case of all 52 simulations, IEC was always the best tool from the point of view of Maximal Drawdown, average Maximal Drawdown, minimal Recovery Factor, average Recovery Factor, minimal Total Return and average Total Return. We have found out that setting the “signal” period (MA, BO) just like slope (IEC) plays key role for better final results (performance indicators), thus from our results “more is better” (MA, BO period) and “less is more” (IEC slope).

From our point of view, the trend definition via IEC has the most effective impact on final performance parameters. Surely and of course, we used in our research 5 plus 5 absolutely different investment strategies on one clear purpose. To demonstrate, that only very simple method (IEC) can be very useful and effective in active diversification of investment strategies portfolio. In fact, no investor or company knows in advance what direction of investment will occur, but IEC was able in absolute most cases bring to investor positive TR, RF and also better results than naive (passive) diversification.

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