

# Investment Decision Making of Public Administration in Terms of Emerging Economy

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**Abstract**—Investment decisions possibilities are proposed and analyzed in this paper. The equity and bond funds approved by the Czech National Bank and with long-term presence on the Czech and foreign markets are used in as examples in this analysis. Options for a single-time investment and for regular investments are analyzed on the basis of descriptive statistics and cluster analysis. The clustering was done by means of method K-means. Positive and negative features of potential individual investment options are shown on possible gains or losses of investment decisions done from 1997 to 2013. The achievement results can be used in the framework of financial decision making in public administration and in not-for-profit sectors.

**Keywords**—Bond fund, cluster analysis, equity fund, inflation, investment, public administration, volatility.

## I. INTRODUCTION

IN the current situation public administrations (PA) as well as the not-for-profit sectors usually have to deal with lack of money situations. On the other hand there are some entities that have surplus finance resources. PA has limited possibilities regarding financial markets products. One of the few options is to invest on the capital markets (CMs). The advantage of such an investment decision should be to realize yield higher than inflation, the disadvantage is the volatility of assets. Many entities, due to volatility issues, avoid CMs. Potential loss leads to loss of trust and thereby loss of political preferences.

Investing on CMs is regulated in the Czech republic (CR) mainly by Act 256/2004 Coll., on Undertaking on the CM, further by by-law No. 237/2008 Coll., on the Details of Certain Rules in the Provision of Investment Services, that originated as a result of transposition of the following European Union Directives [1]:

- The Markets in Financial Instruments Directive, and its

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by-law 2006/73/ES

- And in a limited way also by Directive 2006/48/ES and 2006/49/ES

Currently there exists no simple investment decision application tool for decision making in the area of investment decisions for PA. In the science area there currently dominate approaches based on the day trading speculation [2], [3]. Relevant authors try to predict future values on CMs by means of support vector machines or soft computing [4]-[7]. However, this approach is not suitable for PA. On top of this it has not yet been proven that this tool is demonstrably robust and that it can resist also extreme events on the CMs [2].

The objectives of the paper are:

- To describe potential individual investment options, their positive features and their negative features, to show on investment decisions done in the time period 1997 to 2013 possible gains or possible losses
- To verify the possibilities for minimizing CMs losses risks by means of statistical and cluster methods

On the basis of the model we shall take recommendations from [8]. We work with the distribution of assets on CMs between 25 - 75% for the representation of bonds and equities tools. However there can appear a moment when we would have to discard equities from the model completely.

## II. PROBLEM FORMULATION

In case of investments it is essential to define the expected time horizon [1], [8], [9]. PA advantage is stable regular income guaranteed by legislation. On the other hand the disadvantage is elections that can bring about new political representation and thus change the structure of expenditures. On top of that there is certain risk of increased need for money in case of any social problems, natural disaster etc. For the above mentioned reasons we have decided to take four year time horizon as the main investment horizon (the time duration of one single election period) and our calculations do not include investment tools with low liquidity such as term deposits and structured products (guaranteed funds, certificates, etc.).

The period 1997 - 2013 was very difficult in terms of investment opportunities in the CR. At the macroeconomic level, show strong trends that have a negative impact on investment. It is all about higher inflation that accompanied the emerging economies in the CR in 1997 - 1998 when the average annual inflation rate was 9.6% [10]. Another peak

recorded in 2008, when the economy overheating. In that time was inflation rate 6.3%, and therefore does not exceed the value of the 90-ies. Average annual inflation for the period from 1997 to 2013 is 3.49% and no values from the years 1997, 1998 and 2008 is 2.33% (CNB's inflation target is 2%).

The second factor was the high frequency of crises in this period. CR and especially its banking sector said the Asian crisis of 1997 - 1998. This was followed by the global crisis on the stock market so-called "dot com" crisis in 2001 and subsequent global economic crises that started in the fall of Lehman Brothers in 2008 (Compared Indexes PX50, SP500 and Nasdaq in Fig. 1) [11]. All these events caused high volatility in the securities markets. Another negative factor is that the Prague Stock Exchange is one of the exchanges with low liquidity, low number of titles and overpriced primary emissions. This makes it one of the few exchanges in Europe with long-term loss (Fig. 2) [11]. Investing is therefore worth only to proven equities and can not be expected superior returns.

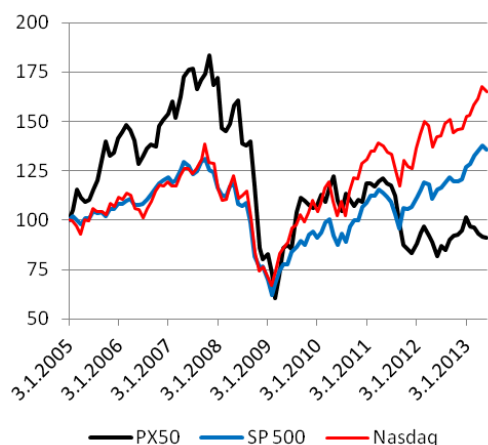


Fig. 1 Index PX50 compared with major U.S. Indexes [11]

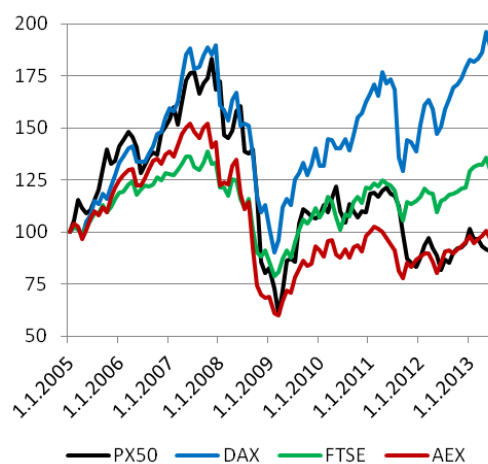


Fig. 2 Index PX50 with compare with other major European Indexes [11]

At the same time there is a problem with investing in foreign markets. In the case of currencies with freely floating exchange

rate occurs due to the currency exchange rate risk [12]. If we assume that currencies remain at their long-term averages currency risk can then be expressed as follows [1]:

$$\sigma = \sqrt{\sigma_{index}^2 + \sigma_{currency}^2} \quad (1)$$

This implies an increase in volatility especially in less risky securities. As an example it is possible to use U.S. treasury bills, which have volatility around one percent. On the contrary, exchange rate volatility is much higher (assuming 9%).

$$\sigma = \sqrt{1^2 + 9^2} = 9.1 \quad (2)$$

In this case, the increase of nine times, while the riskier securities are more volatile, the increase is not so great:

$$\sigma = \sqrt{16^2 + 9^2} = 18.4 \quad (3)$$

Compared to other major currencies except the Swiss franc (CHF), Czech crown (CZK) in this period significantly appreciated (see Table I). Especially against the U.S. dollar (USD) and British pound (GBP) gained about 50% of the value. For four years, this corresponds to losses between 10-12% appreciation or this reason, investments in foreign markets over the horizon very risky.

Table I Selected currencies

Descriptive statistics	USD	EUR	GBP	CHF
Mean	26.04	29.62	42.76	20.16
Median	24.56	28.83	43.58	20.68
Sum [%]	-50.7	-39.2	-49.5	0.42
Year mean [%]	-3.06	-2.57	-2.98	0.03
Standard deviation	7.35	4.1	10.5	2.23
Maximum	40.93	38.42	61.96	24.1
Minimum	15.16	23.9	26.97	14.64

Although there is the distribution of risk in the portfolio can take advantage of these foreign investments. The ideal would be to invest in the Swiss franc, which alone has stood up to CZK. The Swiss market is relatively small and the investment of CHF throughout the world is better not to take all currency risk and invest in global stocks held in the Fund CZK.

The calculation was executed several funds. For Czech asset was used two ING company funds. The first one is "ING International Český akciový fond" (Czech equities fund) [13], hereinafter Equities fund (EF), the second is "ING International Český fond obligací" (Czech bond fund) [14], hereinafter Bond fund (BF). These Funds have been chosen for three reasons. The first reason is that BFs re-allocate dividends and yields, and thus they increase their value. Thanks to that it

is easy to define the yield on the assets [15], [16]. The second reason is that both funds were established in year 1997. In that year the funds were not influenced by any previous successes nor any previous failures in asset management. The third reason is that the Czech National Bank has never opened any administration procedure against these funds.

The funds' yield has been decreased by the management fees percentage (2% EF and 1% BF). On the other hand the subscription fee has not been charged. The subscription fee is otherwise a standard benefit for dealers but it can be bypassed by an agreement with the management company.

Two funds were selected for investment in foreign currencies. First one is HSBC company fund - Euro Equity in Euro. Second one is Parvest company fund US Equity in USD. They were selected because of their focus on developed markets where we expect lower volatility ratio than in the case of emerging or frontier markets. There was tested Fund HSBC GIF UK Equity denominated in GBP. This fund, however, was excluded from further experiments because it has long-term negative impact on the portfolio. Funds HSBC Euro Equity and Parvest US Equity have both management fees 1.5%. These charges were included in the research fund performance.

#### A. Single-time Investment in CR

Single-time investment (STI), in previous periods, dominated CMs. The advantage of STI is that on growing markets it generates higher profits. On the other hand the disadvantage is that it has dramatically higher volatility. It is claimed that this volatility is 2.5 times higher than with regular investments (RIs). It is generally used in case of one-time balances that have no immediate utilization.

In Table II there is clearly visible higher volatility of EFs. When it is necessary to avoid dramatic loses, it is more advantages for STI to hold only bonds. However, also in this case loses happen. Such loses are dramatically lower. On the executed sample we have had loses only in 5 cases out from 139 cases (beginning of investment in the period from May to September 2005, the end of investment in year 2009). The highest nominal appreciation was realized from years 1997 - 2000 and further in year 2009.

Table II Nominal appreciation in STI from year 1997 - 2009 in %

Descriptive statistics	BF	EF
Mean	16.39	21.24
Median	14.73	34.76
Minimum	-2.08	-79.71
Maximum	42.78	72.97

EFs had negative nominal appreciation in case of investment done in years 2005 - 2008. The highest appreciation is in year 2003.

In Table III there are illustrated values after including inflation. Primarily in years 1997 - 1998 inflation decreased the 4-year profit by 18%. Negative results are realized in the

BF in the period from half of 2003 to half of 2007. With the EFs we can observe long period of negative real yields in the period from end of 2004 to end of 2008.

Table III Real appreciation in STI from year 1997 - 2009 in %

Descriptive statistics	BF	EF
Mean	6.05	10.90
Median	6.24	23.78
Minimum	-15.78	-89.41
Maximum	27.44	66.77

It issues from the data that in case of STI on a 4-year horizon the equity portion should not overcome the already mentioned 25%. There are certain periods when also the long-term BF is experiencing loses. The possibility is, based on certain indicators, to identify such period and to select for this period more optimal short-term investment funds. They however do not cover the average rate of inflation (the long term yield is about 2%, thus with average inflation 3.5% there is real loss 1.5%).

#### B. Regular Investment in CR

RI is currently the most preferred method mainly for household's investments. Households do regularly save up certain amounts of money, it is their regular activity. The advantage is averaging of costs for asset purchase (dollar-cost averaging). Also in case of declining market trend this method is able to generate profits, or at least dramatically reduce loses.

In Table IV there is visible the lower profit rate for BF. Any RI is less suitable in this case. Despite that, in case when financial funds are available step-by-step it is suitable to provide for to risk minimization. For the EF there is visible both the dramatic risk decline as well as increase of potential yield. After including inflation BFs in majority cases return negative real yield. EFs are more resistant to inflation. However, high volatility risk is still visible here. In the Table V you can see real appreciation. Bond fund's mean is below null.

Table IV Nominal appreciation in RI from year 1997 - 2009 in %

Descriptive statistics	BF	EF
Mean	8.16	30.34
Median	7.90	13.07
Minimum	-2.47	-49.92
Maximum	19.97	129.87

The last option is to spread the one time acquired money into individual tranches of regular investments. The advantage is that money does not stay on the current account, but it is on the savings account (SA) or increase the value in the short-term investments fund. It is not subjected to any high inflation negative effect and at the same time the risk of purchase in a wrong time is lower. Results are visible in Table VI.

Table V Real appreciation in RI from year 1997 - 2009 in %

Descriptive statistics	BF	EF
Mean	-2.19	19.99
Median	-1.34	1.52
Minimum	-16.37	-64.02
Maximum	6.22	122.77

Table VI Real appreciation in RI with SA combination from year 1997 - 2009 in %

Descriptive statistics	BF	EF
Mean	3.72	25.90
Median	4.63	7.68
Minimum	-11.37	-59.02
Maximum	13.94	128.77

### C. Single-timed Investment in Foreign Currencies

Investments in foreign markets affect some of the same factors as investment in CR. It is the principal global economic indicators such as global crisis and a decline in confidence in risky investments. Given that the CR is still treated as emerging market in Central European context, it should not be completely correlated with the situation in developed markets. This makes it possible to diversify the portfolio. For single-timed investment there is a great risk of bad timing (see Table VII and VIII).

Table VII Appreciation in STI on European markets from year 1997 - 2009 in %

Descriptive statistics	Nom. in EUR	Real in EUR	Nom. in CZK	Real in CZK
Mean	4.76	-9.19	-5.66	-19.6
Median	-15.24	-38.15	-24.2	-38.16
Minimum	-44.51	-67.77	-53.82	-67.77
Maximum	112.91	106.38	120.33	106.38

Table VIII Appreciation in STI on US market from year 1997 - 2009 in %

Descriptive statistics	Nom. in USD	Real in USD	Nom. in CZK	Real in CZK
Mean	14.76	0.81	-0.98	-14.93
Median	1.65	-12.3	-18.8	-32.75
Minimum	-33.3	-47.25	-50.17	-64.12
Maximum	100.94	86.99	173.18	159.23

When investing in the European market is a nominal profit only in 52 cases and real earnings in 39 out of 151 of all time. Good results are linked to the beginnings investment from January to June 1997, then from February 2003 to July 2004 and the end of the investment period, i.e. in the summer of 2009.

In the case of a single investment markets in the U.S. is realized nominal gain in CZK in 28 cases out of 151. The difference here compared to USD, where the profit in 85 cases, is very significant. Very similar are terms of return on investment - investment in the first half of 1997, July 2003 to February 2004 and January-September 2009.

### D. Regular Investment in Foreign Currencies

For RI situation is very different from the STI. Investments are diversified over time not only in the stock price, but also in the currency market movements. Therefore, we can assume a significantly lower volatility. There is still a trend works with the strengthening crown, but no longer has such an impact on the resulting investment as a STI.

On the European market, RI successful in nominal terms in 68 cases in CZK and 79 cases in EUR. The difference is very small. Beginning in 1997, investment is not so much good, as in the case of STI. On the contrary, shows a strong positive trend in the period between February 2001 and May 2004. It is period when most of the investment is realized after the crisis of 2001 and before the crisis of 2008 (Table IX).

Table IX Appreciation in RI on European markets from year 1997 - 2009 in %

Descriptive statistics	Nom. in EUR	Real in EUR	Nom. in CZK	Real in CZK
Mean	2.06	-4.94	-3.45	-10.45
Median	2.1	-4.9	-4.77	-11.774
Minimum	-42.87	-49.87	-47.18	-54.18
Maximum	43.83	36.83	34.18	27.18

Real appreciation was performed in 85 cases in CZK and in 101 cases in USD. At the beginning of investment in 1997 is not achieved real gain due to high inflation in 1997 and 1998. On the contrary, investments in the period 2007-2009 provide a term profits. This is due to the high volatility of markets and buying opportunities at very low prices.

The market situation in the U.S. is similar to that in Europe. Improved performance of the U.S. economy balances greater fall USD to the CZK. In nominal terms, the investor is successful in 105 cases, and in real terms in 86 cases out of 151. It reflects a similar trend as in the European market, the same period suitable for investment (Table X).

Table X Appreciation in RI on US market from year 1997 - 2009 in %

Descriptive statistics	Nom. in USD	Real in USD	Nom. in CZK	Real in CZK
Mean	7.22	0.22	-1.65	-8.65
Median	11.32	4.32	-1.42	-8.4
Minimum	-40.56	-47.56	-41.82	-48.82
Maximum	37.64	30.64	52.84	45.84

Overall, the one-time investment in foreign markets was not in the previous 16 years, suitable for such a short horizon as

four years. In the case of regular investment, foreign investment opportunities to diversify a portfolio and avoid losses related primarily to the Central European region. With the current state of the economy and surpluses a permanent balance of payments can say that will still CZK to foreign currencies strengthen. This increase, however, will not be as significant and especially the U.S. market in terms of diversification of assets for Central European investors interesting.

### III. PROBLEM SOLUTION

From long term research it is evident that CM and economic indicators (primarily GDP) mutually correlate. It is usually true that negative development on the market is projected into the GDP development in about half year time period. However, if we strive to predict the situation on CMs based on macroeconomic indicators it is a difficult task. In a number of macroeconomic indicators there is evident mutual correlation. In many other indicators (e.g. rate of unemployment) there are demonstrated strong cyclical elements that make such research much more difficult. Such indicators must be cleaned from seasonal fluctuation [9], [10].

The structure of investment strategy analysis model is in Fig. 3.

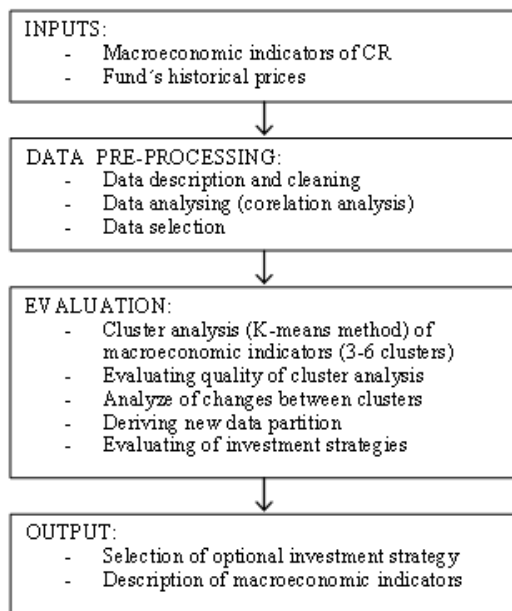


Fig. 3 Model of investment strategy analysis

#### A. Macroeconomic Factors

Further it is essential to point at some factors that are overlooked on a long term basis. These factors are for instance inhabitants' savings rate, rate of personal and state debt, etc. For the research in the area of economic indicators it was not possible to use data from the CR, since a growing economy that had not for a long period of time been open, did not make

such research possible. For this reason we have used as the base for our research data from the U.S. of America [17].

From among 33 economic indicators the most important indicators have proven to be the following indicators:

- Inflation (INF)
- Unemployment (UEM)
- Personal expense costs (PEC)
- Government consumption expenses and gross investments (GCE)
- Export (EXP)
- Import (IMP)

These indicators point to individual sections of economy and are mutually very little correlated [18] (see Table XI).

Table XI Correlation matrix of economic indicators

Indicators						
	<i>INF</i>	<i>UEM</i>	<i>PEC</i>	<i>GCE</i>	<i>EXP</i>	<i>IMP</i>
<i>INF</i>	1					
<i>UEM</i>	0.045	1				
<i>PEC</i>	-0.204	0.037	1			
<i>GCE</i>	-0.006	-0.187	0.465	1		
<i>EXP</i>	0.197	0.001	-0.061	0.145	1	
<i>IMP</i>	-0.091	-0.052	0.1956	0.303	0.315	1

#### B. Cluster Analysis

These indicators have been the starting base for the classification of the CR macroeconomic indicators [10], [19]. The clustering was done by means of method K-means (non-hierarchical clustering) [20], for 3, 4, 5 and 6 clusters. From the given number the highest quality clustering proved to be clustering for 5 clusters. This is the reason why this value was selected for further processing.

186 cases were selected for the final processing (they were distributed into 5 clusters with 52, 2, 27, 51 and 54 cases). With regard to the fact that we predict for the four year period it has not been possible to use younger values that cannot be currently verified. As the critical value we have used the situation in the past 9 months (it is based on the so-called trigger approach and it is used in technical analysis).

The cluster analysis is not a standard prediction tool [20]. It is a statistics tool for measuring the level of similarity between elements. However it has been verified, on the U.S. data set, that this method can be used for the description of some long term manifestation of macroeconomic indicators. It is important to observe long term (longer than 3 months) changes in the division of clusters. Clusters that include elements with low UEM, low GCEs and higher IMP have negative impacts on the future equity markets yields. On the other hand high yields are linked to high EXP levels, higher GCEs and medium to higher UEM.

### C. Experiment Results

Properly verifiable prediction was therefore done on 131 values. We have fully used spread on bonds that was from 25% to 100%. With equities we have used spread from 0% to 75%. In 80 cases the portfolio was dominated by equities, in 11 cases there were 50% equities, in 26 cases the portfolio did not include any equities and in the remaining 14 cases the equities represented 25% of the portfolio. Changes in the time are in Fig. 4.

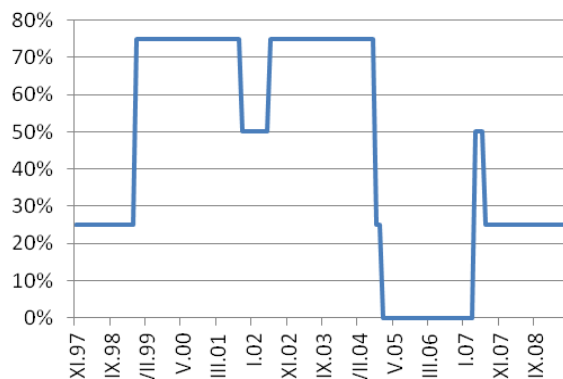


Fig. 4 The evolution of the Equity in the portfolio over time

With RI there were negative nominal yields in ten cases (beginning of investment is November 2004 – January 2005). In this period it would had been essential to completely omit CMs or to prolong investment horizon by at least 5 months. In other 51 cases when there were real negative yields, there were not experienced negative nominal yields. Thus there was successfully eliminated volatility risk, however the inflation risk was not eliminated.

With STI there were negative real yields in 44 cases. Out of that in 5 cases there were experienced negative nominal yields (April – June 2007, December 2007 and January 2008).

The last option is, in case of money acquired in one time, to deposit such money, to separate such money into individual deposits, and later use this money for regular deposit by deposit investment. Nominal loss is shown in three identical cases as regular investment (November 2004 - January 2005). Real loss is realized in another 21 cases. Results are in Table XII.

Table XII Appreciation in RI on U.S. market from year 1997 - 2009 in %

Descriptive statistics	STI	RI	RI with SA
Mean	16.97	17.41	23.19
Median	20.57	3.59	11.59
Minimum	-21.09	-23.57	-18.57
Maximum	51.42	82.12	88.12

In case of investments in foreign markets will use 20% of investments in investment markets and the euro 20% to U.S. markets. The remaining 60% leave invest in tourism. In this

case, the negative nominal gain is in 13 cases. The analysis is missing the beginning of 1997, when the foreign funds very well, and vice versa Czech funds at the time did not have such performance. The results in Table XIII show that the majority of values between 0 and 15%.

Table XIII Real appreciation on all funds from year 1997 - 2009 in %

Descriptive statistics	RI	RI with SA
Mean	1.52	4.13
Median	7.02	11.03
Minimum	-26.67	-22.57
Maximum	49.93	54.01

### D. The Limits of the Method and Options for Further Solutions

From the available data it has not been possible to acquire information about the need to leave the market. Most likely it is not possible to look for solutions on the given time horizon. The only option thus seem to be to abandon the defined horizon and to prematurely leave the market (Stop-loss Method) or to prolong the chosen horizon by about four months (by 6 months optimally). With regard to that fact that this is in the time period of strong “bear” market, the prolongation of the investment is not so easily justifiable.

There is a problem in the use of cluster analysis Czech macroeconomic data for portfolio diversification in foreign markets. This analysis gives an overview of Czech macroeconomic environment, but in the international context has only limited use. In developed Western markets and Czech market has shown a relatively high correlation in the prices of equity funds. Therefore, do not provide adequate portfolio diversification. Other option to explore is bringing markets such as South Korea, Australia and New Zealand. These markets are developed, but with different economic profile.

## IV. CONCLUSION

For PA the suitable objective is to decrease volatility risk and inflation risk for the four year investment horizon.

In this article the behavior of investments is described. These investments are investments into EF and BF in the period from 1997 to 2013. The investments were classified as STI, RI, and financial resources acquired in a one-time acquisition deposited in SA and then regularly invested. Their median, mean, maximum and minimum values have been demonstrated.

Further in this work we have used the knowledge of macroeconomic indicators correlation analysis. Out of these those indicators that have no mutual correlation and those that belong under economic rules to different macroeconomic indicators have been selected. Clusters (3, 4, 5 and 6) have been created from them by utilizing the method of non-hierarchical clustering (algorithm K-means). SPSS Modeler 14.1 has been used for the proposal of cluster analysis

algorithm. The best statistical features proved to have the division into 5 clusters. This division has been used in further steps.

There were identified various levels of future yields on CMs by means of this division and changes in this division. The portfolio has been later put together in a certain proportion of equities and bonds. Positive profits have been realized in nominal values in 96.18% with STI and in 97.71% in case of RI (see Table XIV). Thus a dramatic decline of nominal loss risk has been achieved, while at the same time the maximum nominal loss is only up to 8% from the portfolio. Inflation has been overcome with each of the methods in at least the overall majority of cases. It is necessary to point out the fact that in the period that was the subject of the research there were two major shocks on financial markets (in year 2001 and 2008). These shocks caused much higher asset volatility in RI that it had been usual prior to this period. If we look at the global, diversified portfolio (results are in Table XV), it shows in this period worse result.

Table XIV Parameters of success rate of prediction and maximum nominal loss in % on Czech market

Parameter	STI	RI	RI with SA
Rate of periods with nominal profit	96.18	97.71	97.71
Rate of periods with real profit	64.41	58.78	80.92
Maximal nominal loss	6.87	7.56	2.56

If we look at the global, diversified portfolio (results are in Table XV), it shows in this period worse result.

Table XV Real appreciation on all funds from year 1997 - 2009 in %

Parameter	RI	RI with SA
Rate of periods with nominal profit	90.65	94.96
Rate of periods with real profit	51.08	71.22
Maximal nominal loss	9.35	5.03

Yet it is a very useful tool for portfolio diversification in the future, because it is possible to assume that CZK no longer enough to strengthen against foreign currencies and developed markets may be significantly less dependent on the car industry such as CR [21].

In the future it shall be possible to exchange standard funds for Exchange Traded Funds that follow the index values. These funds are much less expensive in management fee, and they are also more diversified than regular EFs.

In any following research it shall be possible to improve the settings of the model by means of fuzzy sets theory. Any potential losses should be eliminated by not using the usual stop loss method that brings about potential losses, but by using for instance neural networks.

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