IS THERE A ROOM FOR PURE INDEX FUND ON CROATIAN EQUITY MARKET?

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Abstract:

Throughout last decade, CEE countries' financial markets, including Croatian equity market, experienced rapid development that favored significant growth of mutual funds. Such funds are exclusively actively managed in Croatia. By examining whether any of Croatian mutual funds replicates stock index CROBEX, we intent to explore whether there is a room for pure index fund that would do the same job at lower cost. The baseline idea is that replicating pattern is established if observed variables exhibit a certain long run equilibrium relationship, though deviations in the short run are possible. In order to detect possible long run equilibrium relationship between particular mutual fund and stock index CROBEX for the period from October 7th 1999 to September 27th, 2007, bivariate Johansen cointegration approach is used. The empirical analysis suggests that 4 out of 10 observed mutual funds are cointegrated with the stock index, implying that these funds spontaneously follow passive investment strategy.

Keywords: mutual funds, investment strategy, cointegration, CROBEX

EFM CLASSIFICATION CODES: 350, 370

1. Introduction

Performance analysis of mutual funds has been object of ongoing interest of both investors and academics. Research of latter interest group is focused on possibility of earning above average returns by adapting active or passive trading strategy.

In case when a fund follows passive investment strategy, investing in fund would bring the same results as if directly invested in the stock exchange or more precisely, in assets that fairly represent stock index. In other words, equity indexing assumes replication of the risk and return characteristics of a benchmark, usually a wide stock market index. Arguments in favor of adopting passive strategy in fund portfolio management are based on efficient market hypothesis which implies that all available information are reflected in security prices preventing participants to gain above-average returns. In line with that, investors would be better off investing in broad market indices, since active management would fail to add value sufficient to outweigh administration costs and fees given that hard competition between investors results in lack of abnormal performance on average as well as lack of persistence in performance.

On the other hand, actively managed mutual funds attempt to add value to their shareholders in two ways:

(a) Selecting a portfolio of securities expected to provide a superior risk-return trade-off; and

(b) Monitoring and revising their portfolios continuously in response to the market conditions. However, literature finds active management to be expensive and would benefit the shareholders only if the excess returns on actively managed portfolios are larger than the incremental cost incurred by the shareholders (Shukla, 2004).

Aforementioned findings are mostly based on performance of fund industry in developed markets. On the other hand, there is serious lack of related literature on emerging markets in Central and Eastern Europe.

In particular, financial markets of Central and Eastern European countries experienced the great growth after orientation towards market-based economy was adopted, foremost due to strong performance over this period with yields in some markets far exceeding those of the

industrial financial markets (Cohen, 2001). Investors' interest in these markets became even more pronounced with beginning of a sharp rise in stock prices that coincided with the announcement of EU enlargement in 2001[1]. Hence, the growth of equity mutual funds in Croatia should be observed in light of aforementioned developments as well. Surely, investors were attracted to strong upward trend in returns that these funds experienced over mentioned period. However, the question whether the high returns reflected to a greater extent the growth of the market or were result of their superiority in performance still remains.

This paper is aimed to assess trading strategies of mutual funds investing on Croatian equity market and thereto fill the gap of existing literature on market efficiency and trading strategies of funds investing in Croatian equity market. Namely, it is our intention to exam to what extent mutual funds in Croatia, as one of the Central European emerging markets, replicates the benchmark, namely Croatian Stock Exchange Index CROBEX. The analysis is based on idea that a diversified portfolio of stocks, where allocations are determined by their weights in the index, should move in line with the index in the long run. In order to test for the possibility of bilateral long-run co-movements between ten selected mutual funds and CROBEX in time period from their start to September 27th, 2007 the bivariate Johansen cointegration procedure is employed. In cases where cointegration among certain pairs of variables (mutual fund and stock index) is found, one would be able to identify mutual funds suitable (adequate) for an investor that adopts passive investment strategy.

Moreover, randomness of prices is tested in order to determine whether employment of technical analysis on Croatian equity market would lead to above-average returns. Therefore, weak form efficiency is to be tested in order to exam whether profitable investment trading strategy can be derived based on past prices. It should be noted that even rejection of the null hypothesis of random walk, does not necessarily imply possibility of generating above average returns as profitability of trading rule depends largely on the operating cost (such as brokerage cost, interest cost, trading settlement procedure), liquidity of the market and on whether transactions can be made at the exact prices quoted in the market.

[1] In period from the announcement and July 2004 (NMS entered EU on May 1st, 2004), stock prices in the eight Central and Eastern European candidates countries increased on average by over 90 percent in dollar terms compared with the world market index returning about 8 percent during the same period (ECB, 2005).

Motivation to seek randomness in CROBEX developments stems from the fact that none of mutual funds on Croatian market is pure index fund. Therefore, if inefficiencies are spotted, one can make above average returns by pure replication of CROBEX while employing technical analysis.

The rest of the paper is organized as follows. After reviewing some of the literature on mutual fund performance with respect to chosen investment strategy and weak form efficiency in section 2, in section 3 data and methodology employed are presented. Last two sections, 4 and 5, offer discussion of results of the paper and concluding remarks.

2. Literature review

Throughout last couple of decades, a wide range of financial literature was dedicated to performance analysis of mutual funds. Majority of these studies, started with study of Jensen (1968), suggest that actively managed funds fail to outperform passive benchmark portfolios, and in some cases even passive indices. Arguments in favor of adopting passive strategy in fund portfolio management are based on efficient market hypothesis.

By definition, a financial market informational efficiency represents the security prices capacity to instantly and fully reflect all relevant available information affecting them. According to Fama (1970), depending on completeness and speed of information incorporation in securities prices, there are three levels of informational efficiency: (a) the weak form, (b) the semi-strong form, and (c) the strong form[2].

Empirical analyses of weak form efficiency have been offering different conclusions depending on stage of development of the observed equity market(s) and techniques employed in analysis. Therefore, early studies on testing weak form efficiency performed on the developed market mostly provide evidence in line with efficient market hypothesis considering a low degree of serial correlation and transaction cost (Kendall, 1943; Fama,

[2] Weak form tests use an information set that includes only past prices, semi-strong tests of market efficiency augment the information on past prices with all other publicly available information, and strong-form tests include all information (public and private) in the information set.

1965). In other words, studies imply price changes are random and thereto past changes not being useful in forecasting future price changes particularly after transaction costs were taken into account. In light of aforementioned argument, there are some studies which found the predictability of share price changes (Fama and French, 1988; Poterba and Summers, 1988) in developed markets but they did not reached to a conclusion about profitable trading rules.

However, more controversial findings have been provided when testing weak form efficiency in emerging markets. Since most of those markets are accompanied by thin trading issues and potential manipulation by larger players, it is general belief that inefficiency is inherent to the emerging markets. Two groups of studies dealing with emerging market efficiency can be distinguished. On the one hand, Dickinson and Muragu, 1994 (on the Nairobi Stock Exchange) and Ojah and Karemera 1999, (on the four Latin American countries market) confirmed weak form efficiency despite the problems of thin trading.

There are several studies confirming weak efficiency of some Central European stock markets. Using daily BUX data for 1992-1997, Chun (2000) finds that the Hungarian market is weakly efficient. He also provides some evidence, using the PX and the WIG indexes, that the Czech and Polish stock prices do not follow a random walk during that time period. Abrosimova and Diddanaike (2002) tested Russian equity market for weak form efficiency using daily, weekly and monthly RTS index time series. It was found that the null hypothesis of the random walk could not be rejected for the monthly data while it was rejected for the daily and weekly data. Moreover, ARIMA and GARCH models that were build in order to study linear and non-linear dependence in the daily and weekly data, failed to identify any notable weak form inefficiencies.

On the other hand, Claessens, Dasgupta and Glen (1995), report significant serial correlation in equity returns from 19 emerging markets suggesting that stock prices in emerging markets violates weak form efficiency. Similar findings are reported by Harvey (1994) for most emerging markets. Nivet (1997) examines the performance of the Warsaw exchange using daily and weekly index data from the WIG for the period 1991-94. On the basis of autocorrelation coefficients, he concludes that the model of a random walk for the Warsaw stock market cannot be supported for those years.

Gilmore and Mcmanus (2001) examined the behavior of the Czech, Hungarian, and Polish stock markets using weekly index data for period from 1995 to 2000. By eliminating the early years when the Central European exchanges were just being established, they were able to provide a picture of their evolution toward the model of markets in more developed countries. Results of the study rejected the random-walk model in favor of models which made use of dependency in the returns. Overall, study concluded that there is strong evidence that stock prices in these markets do not follow a random-walk process but do exhibit some dependency which is captured by ARIMA and GARCH models.

Aforementioned studies offered evidence on index performances in emerging and developed equity markets, suggesting that above average return can be expected only if accompanied by greater risk. On the other hand, idea of earning above average returns is the main driver behind managed funds. There are a number of different types of investment strategies managed funds may adopt. However, the primary dichotomy is on the basis of whether the portfolio manager implements either an active or index approach. Active managers attempt to outperform the market through the use of price-sensitive information, whereas a passive manager's objective is to replicate the returns and risk of a target benchmark index. Investment strategy is equally important to users of index funds, active funds and enhanced index funds. For index investors, investment manager strategy includes specification of the target benchmark index as well as the replication strategy to be adopted. For active investors, fund managers exhibit different beliefs concerning the way capital markets operate and how market inefficiencies can be exploited to deliver active returns to unit holders.

For active equity managers, the methods used in constructing portfolios and implementing the investment strategy include security selection, in terms of 'top-down' or 'bottom-up' strategies, value-biased, growth-biased or style-neutral strategies, and portfolios exhibiting market capitalisation biases (i.e. preferences to large or small-cap securities).

Since 2000, market neutral strategies have attracted lot of attention of investment managers, as their key characteristic is that, if constructed and implemented properly, the underlying stock market behaviour does not impact the results of the portfolio. In other words, returns generated by an equity market neutral portfolio should be independent of the general stock

market returns (Dunis et al, 2005). A long-short equity market neutral strategy is pretty much about buying a portfolio of attractive stocks, the long portion of the portfolio, and selling a portfolio of unattractive stocks, the short portion of the portfolio. The spread between the performance of the longs and the shorts provides the value added of this investment strategy, with final performance depending heavily on frequency of rebalancing.

Number of studies was dealing with performance of mutual funds. Evaluation of managed funds has overwhelmingly been concerned on assessing the performance of actively managed investment portfolios. In line with that, the empirical evidence overwhelmingly finds that actively managed mutual funds on average have been unable to earn superior returns to an appropriate benchmark proxy portfolio or index, which is consistent with the efficient markets hypothesis.

Grossman & Stiglitz (1980) argue that market efficiency in a strict sense cannot occur without accounting for informed investors holding costly information. Active investment managers will only incur expenses in obtaining information to become informed when they can be compensated for acquiring price sensitive information. In line with that, these managers should be able to at least earn excess returns equal to the fees levied on the actively managed portfolio in order for capital market efficiency to be in equilibrium.

Among studies that support Grossman & Stiglitz (1980) hypothesis one should distinguish those by Carhart (1997), Daniel et al. (1997) and Wermers (2000). Carhart (1997) finds that the top-decile of funds is the only category that delivers returns proportional with their expenses, while net returns of other funds in the sample are negatively correlated with expense levels, which are generally much higher for actively managed funds. Moreover, Carhart finds that the more actively a mutual fund manager trades, the lower the fund's benchmark-adjusted net return to investors, concluding that investors are better off, on average, buying a low-expense index fund. Studies by Daniel *et al.* (1997) and Wermers (2000) suggest that the average mutual fund outperforms the benchmark, attributing much of this performance to the characteristics of the stocks held by funds.

While abovementioned studies have documented superior performance, a wide range of financial literature provides empirical evidence that active funds do not outperform the market

(for example Jensen (1968); Grinblatt and Titman (1989); Malkiel (1995); and Gruber (1996)). The literature also confirms that funds do not successfully 'time' the market. In most cases, conclusions on performance evaluation are based primarily on the risk-adjusted measures, bringing some concerns regarding misspecification of the model, misspecification of the benchmark or survivor-biased samples of funds.

Studies by Grinblatt and Titman (1989), Kothari and Warner (2001) and Cornell (1979) attribute underperformance of mutual funds relative to the benchmark to the inappropriateness of the benchmark and the managers' effort to time the market.

Frequent trade has generally been perceived as an indicator of active management, causing high turnover in the mutual fund portfolios. Shukla (2004) concludes that mutual fund shareholders are not getting any return for the expenses associated with the frequent portfolio revision component of active management. Funds that generate the highest excess returns have small and more concentrated portfolios, and do not have the highest turnover.

4. Data and methodology

4.1. Data

In this study we use daily closing prices of the general index of Croatian stock exchange (CROBEX) denominated in local currency. With respect to equity investment funds, the data set consists of ten series representing net asset value of particular investment fund. For the purpose of this study, among more than 30 investment funds in Croatia we selected ten of them according to following criteria:

- more than 50% of the fund's portfolio represents investment in equity,
- fund holds more than one third of its portfolio in stocks listed on Zagreb Stock Exchange and
- fund has been operating for more than one year.

Those criteria were set to be in line with the aim of this study, i.e. to be able to investigate the possible presence of long run relationship between certain investment fund and CROBEX in

order to determine which fund, if any, follows passive investment strategy replicating CROBEX. Thus the data were collected for those investment funds in whose portfolio investments in Croatian stocks represents significant relative share in fund's total portfolio. Funds that failed to follow set criteria were eliminated from the sample given that CROBEX in those cases could not be taken as a benchmark.

There are ten investment funds that meet aforementioned requirements: Aureus Equity, Erste Adriatic Equity, FIMA Equity, HI-Growth, Ilirika South East Europe, KD Victoria, PBZ Equity, Raiffeisen C. Europe, Select Europe and ST Global Equity. Table 1 shows some properties of that characterize selected investment funds.

It is important to outline that none of these investment funds are pure index funds with a declared aim to replicate the performance of the market portfolio or benchmark exactly. However, our analysis seeks to find whether any of these funds is managed in a way that its portfolio tracks the benchmark performance.

Table 1. Selected Croatian investment funds and related properties.

INVESTMENT FUND (date of start of doing business)	**Assets in million HRK in 09/2007**	**Growth in 2007 01/01 – 15/10**	**Investment in equities (% of total portfolio)**	**Investment in equities on world's markets (% of total portfolio)**	**Investment in equities on ZSE**	
					% of total portfolio	**% of equity portfolio**
AUREUS EQUITY (30-11-2005)	537.8	51.7	82.8	21.8	36.4	43.9
ERSTE ADRIATIC EQ. (10-10-2005)	1437.7	42.2	75.9	8.9	51.3	67.6
FIMA EQUITY (01-06-2004)	274.1	30.0	83.2	2.3	42.3	50.8
HI – GROWTH (25-02-2002)	245.5	38.8	70.9	0.0	59.1	53.3
ILIRIKA SEE (26-10-2004)	442.8	66.0	67.3	4.8	53.0	78.8
KD VICTORIA (07-10-1999)	649.4	39.7	89.0	3.3	76.9	86.4
PBZ EQUITY (05-09-2005)	2746.9	41.7	74.7	21.2	41.1	55.0
RAIFFEISEN C. EUROPE (19-04-2005)	2238.2	35.8	83.0	25.9	35.3	42.5
SELECT EUROPE (18-06-2001)	338.9	47.2	66.0	6.1	56.0	84.8

ST GLOBAL EQUITY (02-01-2002)	66.3	47.2	88.0	31.2	54.8	62.3

Source: TO ONE, 2007.

Time span for various series in data set is not unique given that investment fund industry in Croatia is rather young and great part of the investment funds started to operate during last couple of years. Thus, particular data series representing NAV of the investment funds begins with the fund's first working day, while all data series terminate on September 27th, 2007. As one might observe from the table 1, the longest series in data set refers to KD Victoria which started to work on October 7th, 1999, and correspondingly to CROBEX. Time span for other series is shorter due to shorter period of doing business. The source for investment funds data was web portal www.to-one.com, while the data for official index of Zagreb Stock Exchange CROBEX were taken from Bloomberg's database.

4.2. Methodology

In order to test for a potential long run relationship between particular mutual fund and CROBEX, Johansen cointegration method will be employed. Although cointegration technique is quite common in empirical analyses of financial time series, its usage for investment analyses is still a rarity, since the latter generally relies on correlation analysis of returns. Cointegration analyses consider a setting where time series of individual variables "can wander extensively and yet some pairs of series may be expected to move so they do not drift too far apart" (Engle and Granger 1987). In different words, when two time series are cointegrated, they move together over time maintaining long term equilibrium, although short term disturbances are allowed. This long-run cointegration relationship can be expressed on a bivariate level as

$$Y_t = \alpha + \beta X_t + u_t \qquad (1)$$

where Y indicates the net asset value of particular mutual fund and X a benchmark-SBI20 value, while ut indicates the (estimated) error correction term. The error correction term measures the deviation from the long-run equilibrium as represented in following equations:

$$\Delta X_t = \alpha_x (Y_{t-1} - \beta X_{t-1}) + u_{xt}$$

$$\Delta Y_t = -\alpha_y (Y_{t-1} - \beta X_{t-1}) + u_{yt} \quad (2)$$

where αx and αy are parameters that determine speed of adjustment of X (mutual funds' NAV) and Y (CROBEX) after past error. The larger α the quicker a series adjusts to long-run equilibrium after momentary disturbance. Namely, changes in the cointegrated variables can generally be attributed to changes in variables in previous periods, but it is also possible that after the impact of a shock the two series deviate from long term equilibrium and in subsequent periods react to deviation by returning towards the pre-shock position following error correction mechanism (Matallin and Nieto, 2002). Therefore, to prevent separating of the series over time, the error correction term of at least one series must be embedded in cointegration equation. It should be noted that all variables in the error-correction model are stationary and therefore standard regression analysis applies.

However, it is important to recognize that time series for both net asset values and stock index typically exhibit non-stationarity in levels. Before Engle and Granger introduced the concept of cointegration in 1987, it was considered that non-stationary variables should be differenced to make them stationary before including them in multivariate models, because generally, a linear combination of two non-stationary series results in another series of the same integrability order. However, there may exist a linear combination of two or more non-stationary series of the same "d" integrability order that exhibit I(<d) property. In this case the variables are said to be cointegrated. Hence, cointegration has emerged as a powerful technique for investigating common trends in multivariate time series, and provides a sound methodology for modelling both long-run and short-run dynamics in a system.

Financial data series usually follow a random walk pattern and are in most cases integrated of order I(1) implying that should be differentiated once to become a stationary series by removing unit roots. Since it is normally the case that log net asset values will be cointegrated when the actual net asset values are cointegrated it is standard, but not necessary, to perform the cointegration analysis on log values in order to eliminate possible exponential behavior of time series. To determine integrability order of time series, namely of log net asset value of particular mutual fund and log stock index CROBEX, Augmented Dickey-Fuller procedure

(ADF) will be used to test for existence of unit roots. The test for a unit root has the null hypothesis that $\gamma = 0$. Optimal number of time lags is to be determined by AIC.

In the second part of our empirical exercise we test weather above-average returns could be earned in Croatian equity market by merely using technical analysis. The baseline idea is following: if employing technical analysis can indeed lead to above average capital gains, it makes sense establishing pure index fund tied with stock index that would take advantage of market inefficiency and bring its investors high returns at lower administrative cost. Empirical analysis includes tests most frequently applied to studying less developed capital markets. Firstly, the Augmented Dickey-Fuller test will be performed in order to identify the existence and type of nonstationarity in logs of daily data. However, if the time series is difference stationary, further analysis is needed since a presence of a unit root is not a sufficient condition for a random walk (Campbell, Lo, MacKinlay, 1997). Therefore, tests of autocorrelation are employed in order to examine randomness in data. Autocorrelation measures either dependence or independence of random variables in a series. In other words, the serial correlation coefficient measures the relationship between the values of a random variable at time t and its value in the previous period. Autocorrelation function is defined as

$$\tau_k = \frac{\sum_{i=1}^{N-k} (Y_i - \overline{Y})(Y_{i+k} - \overline{Y})}{\sum_{i=1}^{N} (Y_i - \overline{Y})^2} \qquad (4)$$

for variable $Y_1, Y_2, ..., Y_N$ at time $t=1,2,...,N$ at the lag k.
Autocorrelation tests examine whether the correlation coefficients are significantly different from zero.

To sup up, the empirical exercise will be continued as follows:

- Test all time series for unit roots.
- If the series are found to be I(1), in order to test for a possibility of cointegration between particular mutual fund and CROBEX, bivariate Johansen procedure will be applied. For the pairs of series found to be cointegrated, the error correction term will be determined in order to explain short run dynamics in the relationship between Y and X, i.e. to estimate how fast long term equilibrium relationship between particular mutual fund and CROBEX is achieved after a disturbance.

- In order to examine random walk on Croatian equity market, after running unit root tests, tests of autocorrelation to detect randomness in data will be employed.

5. Results

The results of the empirical analysis are reported in tables 2-11. Table 2 shows results of unit root tests in levels and first differences for logarithmic transformation of CROBEX and net asset values of investment funds. Closer look at the results confirms that indeed all time series exhibit nonstationarity in levels and stationary in first differences. Empirical exercise will be proceeded to the second step by assuming that mutual funds' NAVs and CROBEX are integrated of order 1, i.e. I(1).

Table 1: ADF unit root tests – in levels and in differences

Variable	Time period (dd-mm-yy)	ADF in levels		ADF in differences	
		t-value (trend included)	p-value for Z(t)	t-value (trend included)	p-value for Z(t)
CROBEX	07.10.99 – 27.09.07	-0.871 (2)	0.9592	-7.614* (30)	0.0000
KDVIC	07.10.99 – 27.09.07	-3.213 (12)	0.0818	-7.681* (30)	0.0000
SELEUR	18.06.01 – 27.09.07	-1.190 (13)	0.9126	-7.412* (28)	0.0000
STGLOBEQ	02.01.02 – 27.09.07	-2.607 (27)	0.2767	-6.326* (30)	0.0000
HIGROWTH	25.02.02 – 27.09.07	-3.024 (14)	0.1254	-6.043* (27)	0.0000
FIMAEQ	01.06.04 – 27.09.07	-1.212 (1)	0.9080	-3.695** (27)	0.0227
ILIRJIE	26.10.04 – 27.09.07	-1.362 (2)	0.8717	-3.767** (27)	0.0183
RBACEUR	19.04.05 – 27.09.07	-3.256*** (1)	0.0739	-7.524* (8)	0.0000
PBZEQ	05.09.05 – 27.09.07	-1.878 (1)	0.6658	-4.661* (12)	0.0008
ERSTEADEQ	10.10.05 – 27.09.07	-2.527 (1)	0.3147	-3.443** (25)	0.0459
AUREUS	30.11.05 – 27.09.07	-1.844 (1)	0.6831	-2.925* (25)	0.1544
PROSGE	28.07.06 – 27.09.07	-1.185 (4)	0.9135	-3.015* (29)	0.1281

Note: optimal number of time lags determined with Akaike Information Criterion (AIC) and is presented in parenthesis; * null hypothesis about existence of unit root rejected at 1 percent level, ** null hypothesis about existence of unit root rejected at 5 percent level, *** null hypothesis about existence of unit root rejected at 10 percent level.

Results of bivariate Johansen cointegration procedure are summarised in Table 3. We found one cointegration vector in four cases, more precisely between Fima Equity, Ilirika Southeast Europe, Raiffeisen Central Europe and PBZ Equity Fund on the one side and CROBEX on the other. This means that those four investment funds exhibit long run relationship with the official index of Zagreb Stock Exchange. Tables 4-7 present the evidence of those four cases where existence of the same trend co-movements was established.

Table 3: Review of results of Johansen procedure for pairs of variables

Equity fund	Cointegration with CROBEX
KDVIC	Not found
SELEUR	Not found
STGLOBEQ	Not found
HIGROWTH	Not found
FIMAEQ	Found
ILIRSEE	Found
RBACEUR	Found
PBZEQ	Found
ERSTEADEQ	Not found
AUREUS	Not found
PROSGE	Not found

Table 4: Testing the integration between CROBEX and FIMAEQ

Maximum rank	LL	Eigen value	λtrace	5 % critical value	λmax	5 % critical value
0	5965.55	-	28.3956	19.96	25.1099	15.67
1	5978.10	0.02945	3.2857*	9.42	3.2857	9.42
2	5979.74	0.00390	-	-	-	-

Note: LL - log likelihood; optimal number of time lags selected using Akaike Information Criterion (AIC) obtained after VAR estimation of all endogenous variables; maximum likelihood estimation includes a constant in order to account for the trend present in the data; * null hypothesis accepted at 5 percent level.

Table 5: Testing the integration between CROBEX and ILIRSEE

Maximum rank	LL	Eigen value	λtrace	5 % critical value	λmax	5 % critical value
0	5121.81	-	32.0382	19.96	27.0980	15.67
1	5135.36	0.03605	4.9402*	9.42	4.9402	9.24
2	5137.83	0.00667	-	-	-	-

Note: LL - log likelihood; optimal number of time lags selected using Akaike Information Criterion (AIC) obtained after VAR estimation of all endogenous variables; maximum likelihood estimation includes a constant in order to account for the trend present in the data; * null hypothesis accepted at 5 percent level.

Table 6: Testing the integration between CROBEX and RBACEUR

Maximum rank	LL	Eigen value	λtrace	5 % critical value	λmax	5 % critical value
0	4543.55	-	30.9468	19.96	22.7261	20.20

1	4554.91	0.03628	8.2207*	9.42	8.2207	12.97
2	4559.02	0.01328	-	-	-	-

Note: LL - log likelihood; optimal number of time lags selected using Akaike Information Criterion (AIC) obtained after VAR estimation of all endogenous variables; maximum likelihood estimation includes a constant in order to account for the trend present in the data; * null hypothesis accepted at 5 percent level.

Table 7: Testing the integration between CROBEX and PBZEQ

Maximum rank	LL	Eigen value	λtrace	5 % critical value	λmax	5 % critical value
0	3896.38	-	43.7597	19.96	36.0929	15.67
1	3914.43	0.06718	7.6668*	9.42	7.6668	9.24
2	3918.26	0.01466	-	-	-	-

Note: LL - log likelihood; optimal number of time lags selected using Akaike Information Criterion (AIC) obtained after VAR estimation of all endogenous variables; maximum likelihood estimation includes a constant in order to account for the trend present in the data; * null hypothesis accepted at 5 percent level.

After identifying the presence of cointegration, vector error correction test was run in order to estimate how fast long term equilibrium relationship between particular mutual fund and CROBEX is achieved after a disturbance. From Table 8 one might observe that after a disturbance FIMA Equity will tend to correct disequilibrium decreasing its net asset value for 0.29 percent each day, while CROBEX will decrease its value for 0.43 percent each day to return to equilibrium path.

Table 8: Results of vector error correction test for pairs of variables CROBEX and FIMAEQ

Variables	α coef.	β coef.	chi^2 - value	z-value	P>|z|
CROBEX	-0.0043028	1.00	13.46777	-3.67	0.000
FIMAEQ	-0.0029213	-1.217889	19.1362	-4.37	0.000

Note: number of time lags is 2

Moreover, results of vector error correction test for pair of variables CROBEX and Ilirika SEE presented in Table 9, suggest that after a disturbance Ilirika SEE will tend to correct disequilibrium increasing its net asset value for 0.46 percent each day, while CROBEX will increase its value for 0.35 percent each day to return to equilibrium path.

Table 9: Results of vector error correction test for pairs of variables CROBEX and ILIRJIE

Variables	α coef.	β coef.	chi^2 - value	z-value	P>|z|
CROBEX	0.0035182	1.00	6.351107	2.52	0.012

ILIRJIE	0.0046452	-1.137594	26.05072	5.10	0.000

Note: number of time lags is 2

Table 10 presents results of vector error correction test for pairs of variables CROBEX and RBACEUR. One might observe that removal of disequilibrium in this case will occur if CROBEX decrease its value on daily basis for 0.49 percent or RBA Central Europe's net asset value decrease for 0.39 percent also on daily basis.

Table 10: Results of vector error correction test for pairs of variables CROBEX and RBACEUR

Variables	α coef.	β coef.	chi^2 - value	z-value	P>|z|
CROBEX	-0.0049225	1.00	11.22299	-3.35	0.001
RBACEUR	-0.0039519	-1.424537	21.44445	-4.63	0.000

Note: number of time lags is 2

Finally, somewhat more significant error correction mechanism can be detected in the last pair of variables, CROBEX and PBZ Equity that will adapt after a disturbance lowering their values on daily basis for 1.68 percent and 1.25 percent, respectively.

Table 11: Results of vector error correction test for pairs of variables CROBEX and PBZEQ

Variables	α coef.	β coef.	chi^2 - value	z-value	P>|z|
CROBEX	-0.0167678	1.00	14.6498	-3.83	0.000
PBZEQ	-0.0125417	-1.344521	35.73812	-5.98	0.000

Note: number of time lags is 2

Having commented on results of cointegration analysis, focus is again on the results presented in Table 2 showing that CROBEX index exhibits nonstationarity in levels and stationary in first differences. Regarding the fact that presence of a unit root is a necessary but not a sufficient condition for a random walk process, further analysis is needed in order to examine weather CROBEX developments are predictable. Therefore, autocorrelation analysis is performed for 30 lags of daily data[3]. Results of autocorrelation analysis performed on daily

[3] Aforementioned number of lags is considered as most appropriate taking into account the facts that small number of lags could prevent test from detecting serial correlation at high-order lags. On the other hand, small

returns are presented in Table 12. Within entire observed period significant (positive sign) autocorrelation coefficient at 3rd, 8th and 18th lag while significant (negative sign) autocorrelation coefficient is detected at 1st, 4th, 7th, 17th and 19th lag. .

Table 12. Autocorrelation of daily index returns, 1997-2007 (entire period and sub-periods)

	1997-2007	
Lag	Autocorr coef.	Q statistics
1	-0.0697*	11.98**
2	0.0373	15.40**
3	0.0518*	22.01**
4	-0.0450*	27.01**
5	0.0252	28.57**
6	-0.0326	31.19**
7	-0.0646*	41.50**
8	0.0509*	47.89**
9	-0.0112	48.21**
10	0.0360	51.41**
11	0.0172	52.14**
12	0.0024	52.16**
13	0.0037	52.19**
14	0.0334	54.95**
15	0.0283	56.93**
16	0.0069	57.05**
17	-0.0494*	63.09**
18	0.0695*	75.06**
19	-0.0483*	80.85**
20	0.0147	81.39**
21	-0.0114	81.71**
22	-0.0119	82.06**
23	-0.0083	82.23**
24	-0.0070	82.35**
25	0.0224	83.60**
26	0.0192	84.51**
27	-0.0155	85.11**
28	0.0138	85.59**

number of lags employed could reduce the power of test as the significant correlation at one lag may be diluted by insignificant correlations at other lags.

29	0.0243	87.05**
30	-0.0056	87.13**

*significant auto-correlation at two standard error limits;** LB statistics significant at 1% level of significance with 30/12 d.f.

Distinction between positive (or persistence) over short horizons and negative (or mean reversion) autocorrelations over long horizons can be practically employed in different trading strategies. In this instance, as the investment horizon lengthens, an investor would invest more (less) in stocks if the relative risk aversion is greater (less) than unity, than if the returns were serially independent.

The results of autocorrelation tests are consistent with the findings of significant predictability in emerging market returns by Harvey (1994) and Claessens, Dasgupta and Glen (1995). One of the possible acceptable reasons for pronounced serial correlation in daily returns is low market liquidity. In particular, very infrequent trading was especially characteristic for period 1997-2000 at Zagreb Stock Exchange[4]. However, Chun (2000) offers evidence against crucial impact of illiquidity on positive autocorrelations.

Wrapping up, mentioned results indicate that over time Croatian equity market is moving in the direction of lower levels of autocorrelations in returns. In addition to infrequent trading other reasons such as improved regulatory and institutional structure, valuation of listed shares and higher degree of financial integration may be offered as a possible explanation of such tendency.

Based on presented results of autocorrelation analysis one can conclude the return series do not follow random walk model. However, the overall conclusion on possibility of generating above-average returns in short run can not be derived from the rejection of random walk hypothesis and determined dependency of returns series. Although results of performed analysis indicate non-randomness as well as predictability of returns on index, there is great possibility that market participants are not in position of beating the market. Sheffrin (1983) argues that the evidence of significant autocorrelation does not mean that markets are not efficient. Namely, one should not forget that a joint hypothesis of market efficiency and constant expected returns is being tested. Any correlation in equilibrium expected returns

[4] It should be noted that authors have performed more extensive empirical analysis of CROBEX developments. In particular, CROBEX was tested for autocorrelation in daily, weekly and monthly returns as well as in different subperiods. Aforementioned data are available upon request from the authors.

would generally lead to some autocorrelation in actual returns. In testing market efficiency with daily returns, the assumptions about equilibrium returns are not supposed to be critical, because changes in the equilibrium return for stocks on a daily basis are only a small part of the actual changes in prices. Most of the changes in prices of stocks are attributed to the arrival of new information to the market.

In addition, transaction costs and infrequent and non-synchronous trading that are usually inherent to emerging equity markets, should be accounted when deciding on market efficiency. Therefore, return should be readjusted for liquidity premium.

In line with aforementioned arguments, our hypothesis about possibility of earning above average returns by simply using technical analysis can not be neither accepted nor rejected. In further research, more developed predictive models should be built. Moreover, potential profitability of the formed trading rules should be examined.

Conclusion

Financial markets of Central and Eastern European countries experienced great growth in the near past. Similar developments took place on Croatian equity market as well. Consequently, investors were attracted by strong upward trend in returns that these funds experienced over mentioned period. However, the question whether the high returns reflected to a greater extent the growth of the market or were result of their superiority in performance still remains.

In light of aforementioned facts, intention of this paper was to explore main features of the Croatian stock market and investment fund industry. In particular, this paper was aimed to determine which mutual funds in Croatia, if any, follows passive investment strategy, replicating CROBEX. Replicating pattern is assumed to be established in case bilateral long run equilibrium relationship between particular mutual fund and CROBEX exists. In order to test for possible common long-run trend, the Johansen cointegration procedure was used. Results of empirical study showed that in case of four out of ten observed mutual funds 1 cointegration vector was found, implying that these four funds (FIMA Equity, Ilirika SEE, PBZ Equity, RBA Central Europe) move in line with index developments. However, none of those funds is pure index fund. On the other hand, absence of cointegration vectors in other six cases does not categorically imply that these funds fail to share common trends with the benchmark CROBEX, but only with respect to econometric procedure employed in analysis.

If fund is following passive investment strategy, investing in fund would bring the same results as if directly invested in the stock exchange or more precisely, in assets that fairly represent stock index. Therefore, investors would be better off investing in broad market indices, since active management often fails to add value sufficient to outweigh administration costs and fees given that hard competition between investors results in lack of abnormal performance on average as well as lack of persistence in performance.

Second part of empirical analysis was dealing with testing CROBEX for weak form efficiency. The results for the tests of serial correlation are in broad agreement; conclusively reject the presence of random walks in returns. The results of this analysis are consistent with the generalization that emerging markets are unlikely to be associated with the random walks required for the assumption of weak form market efficiency. However, the results presented in the study should be considered with certain prudence because the presence of autocorrelation that violates the assumption of random walk model does not necessarily assume inefficiency (Summers, 1986). Literature supports the idea of impossibility of generating above-average returns in emerging markets even if prices are predictable due to loose disclosure requirements, thinness and discontinuity in trading, some institutional factors such as illiquidity, market fragmentation, trading and reporting delays and absence of official market makers or due to the delay in operations and high transaction cost.

To wrap up, authors believe that there is space for pure index fund on Croatian equity market. Conclusion is delivered based on several facts. Firstly, empirical analysis showed that four investment funds, formally being actively managed, follow indeed stock market index. Having in mind market high growth rates accompanied with inefficiencies of the market itself, one might conclude that investors could make profit by simply investing in pure index fund at substantially lower fees.

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