A New Mixed Strategy Framework (MSF) for Investment Performance Evaluation: Empirical Evidence from Tehran Stock Exchange (TES)

Ali Asghar Anvary Rostamy (PHD)*

PhD in Business Administration, Osaka University Japan

Associate Professor, Tarbiat Modares University (TMU)

General Director, Applied Research & Technology Office, TMU

Sabbatical Visiting, McMaster University, Canada (2008)

anvary@modares.ac.ir

Farideh Bakhshi Takanlou

farideba@gmail.com

*Corresponding Address

1) Department of Management, Tarbiat Modares University (TMU)

2) Applied Research &Technology Office,Tarbiat Modares University

Intersection Nasr-Chamran Express Way, Tehran, Iran.

P.O.Box 14115-175

Tel : +98-21-82883111

anvary@modares.ac.ir

For the 17th Annual Conference,

The European Real Estate Society (ERES) 2010

Abstract

- Astronomical amounts of funds invested in financial markets. Consequently, the evaluation of investment performance has created a great deal of interest among practitioners as well as academic researchers.
- Literature provides various evaluation methods. Since each method has its own weaknesses and strengths and may provide different rankings for performance, investors tend to know which method outperforms the others in a given market.
- The objective of this paper is to explain why and how to apply a new mixed strategy. It will also provide results of an empirical investigation in the TSE.
- In order to select the best investment performance evaluation method, we applied correlation tests. To remove the paradox in results of different evaluation methods, a mixed method was introduced.
- The results confirm existing significant differences among the results provided by different performance evaluation methods. Then, we run the proposed mixed strategy in the TSE.
- Authors believe that the suggested mixed strategy can help investors where they face to several and different performance evaluation rankings.

Key words

Bi-criteria

Triple criteria

Multiple criteria

Mixed strategy

Tehran Stock Exchange

Investment performance evaluation

1. Introduction

- Today, a lot of funds invested in financial markets.
- Both practitioners and academic researchers are very interested in the evaluation of investment performance.
- Literature provides various investment performance evaluation methods.
- These proposed methods can be generally classified as follows:
    1. Bi-criteria methods
    2. Triple criteria methods
    3. Multiple criteria methods.
- Since each method has its own weaknesses and strengths and may provide different rankings, it is very important for investors to know which method of evaluation outperforms the others in a given market. Aggelopoulos,S., G. Menexes, I. Kamenidou (2007)
- In these cases, because of paradox in results, a mixed strategy is recommended.
- We introduced some mixed methods and applied the methods to evaluation of investments in TSE empirically.
- The results of mixed methods have been judged more effective by investors.

2. Review of Literature

2.1. Bi-criteria Performance Evaluation Methods

In order to evaluate the performance of a selected portfolio over time interval *[0,T]*, we usually compare the actual portfolio performance to its benchmark (b_p).

Let define:

$arf_T = \frac{\sum_{t=1}^{T} \gamma ft}{T}$ as an average risk-free rat

$arpt = \frac{\sum_{t=1}^{T} \gamma pt}{T}$ as an average return of portfolio

$arpt - arf_t$ as a portfolio average excess return

$armT = \frac{\sum_{t=1}^{T} \gamma pt}{T}$ as an market average return.

$\sigma_{pT}, \sigma_{mT},$ as standard deviation for portfolio and market returns

β_{PT} as beta for the portfolio

Four Classical Bi-criteria Investment Performance Evaluation Methods:

1. We apply regression method to associate market returns to portfolio returns and we have $\alpha_{pT}=arp_T-ar_{bp}=arp_T-[arf_T+\beta_{pT}(arm_T-arf_T)]$ where ar_{bp} is average return for benchmark portfolio. If $\alpha_{pT}<0$, arp_T will be less than ar_{bp}. It means the performance of portfolio would be viewed as inferior, otherwise it outperforms market. Another approach is that we calculate $\frac{\alpha_{pT}}{\sigma_{epT}}$ where σ_{epT} is the unsystematic risk of portfolio or the standard deviation of random error term. In this case, positive value for a portfolio means that its performance is superior and outperforms market.

2. We calculate the portfolio reward to volatility ratio as $RVOLpT=\frac{arp_T-arf_T}{\beta_{pT}}$ and compare it to the benchmark where β_{pT} is systematic risk of portfolio. In this case, benchmark is the slope pf Security Market Line (SML). The slope can be calculated as $\frac{arm_T-arf_T}{\beta_{mT}}=(armT-arfT)$. If $RVOLpT>(armT-arfT)$, portfolio outperforms the market, otherwise its performance viewed as inferior.

3. According to the third approach, $arp_T=arf_T+\left(\frac{arm_T-arf_T}{\sigma m_T}\right)\sigma p_T$. Calculate the reward to variability ratio $RVAR_{pT}=\left(\frac{arp_T-arf_T}{\sigma p_T}\right)$. If $RVAR_{pT}>\left(\frac{arm_T-arf_T}{\sigma m_T}\right)$, portfolio outperforms market, and otherwise its performance would be viewed as inferior. In this approach, the benchmark is based on Capital Market Line (CML). If $RVOL_{pT}>(arm_T-arf_T)$, it is also possible for $RVAR_{pT}$ to indicate inferior performance because $RVAR_{pT}$ includes unsystematic risk as well as systematic risk.

4. According to the fourth approach, we apply a regression equation that provides a coefficient of determinant statistic (R_p^2), indicating the percentage of total variation in the individual excess return explained by variation in the market excess return as stated by Comp and Eubank (1981). A lower $(R_p)^2$ means the regression line is associated with a lower explanatory power and greater unsystematic risk present in the portfolio. Then a new adjusted measure of total risk could be defined instead of systematic risk as follow:

$$R_p^2 = \frac{\beta_{pT}^2(\sigma_{mT}^2)}{\sigma_{pT}^2} \rightarrow \sigma_{pT}^2 = \frac{\beta_{pT}^2(\sigma_{mT}^2)}{R_p^2} = \frac{\beta_{pT}^2}{R_p^2}\left(\sigma_{mT}^2\right) \rightarrow \sigma_{pT} = \frac{\beta_{pT}}{R_p}\left(\sigma_{mT}\right)$$

Defining portfolio adjusted beta as $\beta_{pAT} = \frac{\beta_{PT}}{R_p}$, then $\sigma_{pT} = \beta_{pAT}(\sigma_{mT})$ where β_{pT}, and *RP* denote beta for portfolio and the coefficient of correlation for market and portfolio excess returns, respectively. For market we have $\sigma_{mT} = \frac{\beta_{mT}}{R_{mm}}\left(\sigma_{mT}\right)$. Since $\beta_{mT} = R_{mm} = 1$, then $\beta_{mAT} = \frac{\beta_{mT}}{R_{mm}} = 1$. Having returns and excess returns for different portfolios and calculating this new measure of portfolio total risk (β_{pAT}) for each portfolio, portfolio outperforms market when $\frac{arp_T - arf_T}{\beta_{pAT}}$ *>(armT-arfT)* where $\beta_{mAT} = 1$ Then, portfolio *i* outperforms portfolio *j* when $\frac{arpi_T - arf_T}{\beta iA_T} > \frac{arpj_T - arf_T}{\beta jA_T}$.

2.2. Difficulties with Mean-Variance of Markowitz an Triple-criteria Models (DEA)

- Some believe that there is a theoretical difficulty with mean-variance theory of Markowitz (1952) because of assuming normal probability distribution and a quadratic form of investors' utility function. (Tobin, 1958; Hanoch and Levy, 1969; Arditti and Levy,1975; Leland, 1999, Lau et al., 1990; Turner and Weigel, 1992; Campbell and Hentschel, 1992, Arditti, 1975; Kraus and Linzenberger, 1976; Ho and Cheung, 1991)

- There are inherently theoretical difficulties with most of existing **performance measures** because they are based on CAPM and mean-variance theory. (such as Treynor, 1965; Sharp, 1966; Jensen, 1968)

- Some researchers implied that investors' utility functions are not quadratic and they prefer Skewness. In order to remove the difficulties of CAPM based performance measures applied non-parametric efficiency analysis tool named **Data Envelopment Analysis (DEA)** to evaluate mutual fund performance. McMullen and Strong (1998), Wilkens and Zhu (2001) and Bosso and Funari (2001)

- Also, Joro and Na (2006) developed a portfolio performance measure based on mean-variance-skewness framework by utilizing a non-parametric efficiency analysis tool named Data Envelopment Analysis (DEA). They added **the third dimension of Skewness** to traditional bi-criteria, mean and variance models, and defined the distance as a ratio between the variance of the projection point (on efficient frontier) and the variance of the asset under evaluation.

- Triple criteria methods tried to remove the most important weaknesses of bi-criteria investment performance evaluation methods, but they are unable to consider and incorporate investors' preference structures and desires, effectively.

2.3. Multiple Criteria Performance Evaluation Models

- Investment performance evaluation, especially in most of practical situations, is naturally a multiple criteria problem.
- The selection and the evaluation process of a portfolio may be not only based on risk and return, but on the other important non-classical criteria such as taxability, liquidity or marketability, growth in portfolio value, portfolio current incomes, and ease of management.
- In these cases, we have to use of MCDM models to incorporate decision maker's non classical criteria as well as his classical criteria in both of the selection and the evaluation steps.
  - **Tax** : Garland (1987)
  - **Liquidity**: Amihud and Mendelson (1991)
  - **Price-to-Earning (P/E) ratio** : Oppenheimer (1987)
  - **The realization of return over the time**: Kumar et al. (1978).
  - **Multiple Objectives and Goals**: Lee and Lerro (1973) and Lee and Chesser (1980), (Anvary Rostamy and Tabata (1997 , 1998)

3. Results of MCDM Evaluation methods in TSE

Table 1: Statistical Samples Distribution

Industry Types	No. of Companies in each Industry	Average Value of Assets	No. of Companies Having Assets Higher than Average	No. of Companies Having Assets Lower than Average	Number of Samples in each Industry
Motor Industry	**29**	3186773	13	16	**3**
Machinery Manufacturing Industry	**38**	360367	18	20	**5**
Chemical Industry	**64**	276409	38	26	**8**
Textile Industry	**17**	199330	9	8	**2**
Industry Fabric Metal Product	**17**	351030	10	7	**2**
Plastic and Tire Industry	**13**	327673	5	8	**2**
Basic Metal Industry	**22**	506745	12	10	**3**
Mine Non Metal Product Industry	**59**	745816	30	29	**8**
Mine Metal Product Industry	**10**	386123	6	4	**2**
Food and Beverage Industry	**48**	437664	27	21	**6**
Financial services Industry	**16**	2891368	7	9	**2**
Petroleum Refinery Product Industry	**9**	1341729	6	3	**2**
Housing and Real States Industry	**11**	161946	6	5	**2**
Wooden Product Industry	**8**	121193	4	4	**2**
Other Industries	**21**	415250	9	11	**3**
Total	**382**				**52**

Table 2: MCDM Ranking Methods and Indices

MCDM Methods	Input Variables	Output Variables
Simple Additive Weighting	Cost to Revenue Ratio	Net Profit Growth
Hierarchical Additive Weighting Method	Financial Cost to Revenue Ratio	Net Profit to Revenue Ratio
Interactive Simple Sum of Weighting	Market Value of Share	Current Assets to Revenue Ratio
LINMAP		EBIT
TOPSIS		Operating Profit to Revenue
MRS		Working Capital to Total Assets
MDS		Operating Cash Funds to Total Assets
ELECTRE		Profit Before Tax to Total Assets
Linear -Assignment		Firms' Size
Permutation		Total Assets Turnover
Data Envelopment Analysis		
Taxonomy		
Vikor		

Table 3: Final Financial Indices

Row	Indices Sources	کاراکاسولو 2009	ساعي 1380	انواري رستمي 1385	ناصري نيک 1385	عباس نژاد 1384	سونن 2003	مهراني 1383	قلي زاده 1383	گنجي 1387	قدرتيان کاشان 1383
1	Net Profit Growth						■				
2	Net Profit to Revenue Ratio				■				■		■
3	Current Assets to Revenue Ratio				■				■		■
4	EBIT			■							
5	Operating Profit to Revenue	■		■	■	■	■	■			■
6	Working Capital to Total Assets				■						
7	Operating Cash Funds to Total	■					■				
8	Profit Before Tax to Total Assets	■	■								
9	Firms' Size	■	■								
10	Total Assets Turnover	■	■								■
11	Cost to Revenue Ratio		■							■	
12	Financial Cost to Revenue Ratio						■			■	
13	Market Value of Share						■				

Table 4: Relative Importance Weights Using Shannon Entropy Method

	Net Profit Growth	Net Profit to Revenue Ratio	Current Assets to Revenue Ratio	EBIT	Operating Profit to Revenue	Working Capital to Total Assets	Operating Cash Funds to Total	Profit Before Tax to Total Assets	Firms' Size	Total Assets Turnover	Cost to Revenue Ratio	Financial Cost to Revenue Ratio	Market Value of Share
Ej	.99	.99	.99	.99	.99	.99	.99	.99	.999	.8052	.9946	.8429	.9994
dj	.0036	.001	.001	.001	.001	.0046	.09	.003	.01	.1948	.0054	.1571	.006
Wj	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.08	0.026	0.42520	0.014	0.37422	0.02

Table 5: Firms' ranks using DEA method

Ranks	Efficiency Ratio	Firms' Code	Ranks	Efficiency Ratio	Firms' Code
44	0.739	27	**26**	0.793	1
46	0.734	28	**19**	0.818	2
23	0.801	29	**33**	0.766	3
6	1.14079	30	**10**	1.03565	4
8	1.0771	31	**4**	1.26289	5
11	0.999	32	**32**	0.773	6
1	2.10745	33	**39**	0.747	7
31	0.774	34	**47**	0.732	8
2	1.827376	35	**24**	0.795	9
20	0.804	36	**25**	0.795	10
52	0.712	37	**51**	0.72	11
34	0.764	38	**18**	0.836	12
21	0.804	39	**5**	1.20302	13
49	0.722	40	**48**	0.727	14
29	0.78	41	**37**	0.749	15
28	0.793	42	**14**	0.963	16
35	0.762	43	**9**	1.05957	17
41	0.746	44	**15**	0.863	18
22	0.802	45	**16**	0.851	19
7	1.111246	46	**27**	0.793	20
45	0.739	47	**43**	0.743	21
3	1.398615	48	**40**	0.747	22
38	0.748	49	**50**	0.721	23
36	0.754	50	**17**	0.85	24
42	0.743	51	**12**	0.982	25
13	0.982	52	**30**	0.778	26

Table 6: Firms' ranks using TOPSIS method

Ranks	Relative Closenes (CL)s	Negative Ideal (d-)	Positive Ideal (d+)	Firms' Code	Ranks	Relative)Closeness (CL	Negative Ideal (d-)	Positive Ideal (d+)	Firms' Code
5	0.248045	0.075922	0.230158	27	36	0.039943	0.012227	0.293889	1
17	0.070243	0.021501	0.284596	28	24	0.053928	0.016508	0.289602	2
40	0.037401	0.01145	0.294688	29	21	0.0593	0.018153	0.287965	3
4	0.451958	0.138335	0.167745	30	39	0.037417	0.01146	0.294817	4
3	0.575446	0.176137	0.129951	31	49	0.022271	0.006821	0.299435	5
46	0.024981	0.007647	0.298465	32	41	0.036744	0.011252	0.294966	6
32	0.046567	0.014254	0.291846	33	51	0.019491	0.005969	0.300273	7
44	0.030165	0.009234	0.296869	34	42	0.035083	0.01074	0.295385	8
13	0.075557	0.02313	0.283002	35	2	0.985451	0.30206	0.00446	9
10	0.085745	0.026248	0.279868	36	25	0.053803	0.016469	0.28963	10
48	0.024706	0.007564	0.298592	37	45	0.026603	0.008143	0.297955	11
38	0.038638	0.011831	0.294361	38	35	0.042957	0.013149	0.29295	12
7	0.182338	0.055815	0.250292	39	18	0.067603	0.020694	0.285421	13
26	0.049918	0.015279	0.290813	40	27	0.048453	0.014832	0.291268	14
20	0.062578	0.019155	0.286947	41	50	0.020983	0.006425	0.299773	15
8	0.16712	0.051155	0.254941	42	47	0.024785	0.007588	0.298561	16
52	0.002925	0.000898	0.306069	43	43	0.034608	0.010595	0.295558	17
28	0.04724	0.014463	0.291695	44	14	0.075126	0.022997	0.283121	18
33	0.045776	0.014015	0.292157	45	31	0.046961	0.014376	0.291754	19
22	0.058477	0.017902	0.288241	46	6	0.235322	0.072029	0.234059	20
19	0.062918	0.019259	0.286841	47	37	0.039886	0.01221	0.293911	21
30	0.04708	0.014413	0.291715	48	9	0.089373	0.027366	0.278837	22
23	0.054635	0.016722	0.289352	49	16	0.072547	0.022207	0.283892	23
15	0.073826	0.022599	0.283506	50	11	0.078985	0.024177	0.281919	24
34	0.043711	0.013381	0.292739	51	29	0.047124	0.014427	0.29172	25
12	0.076179	0.023321	0.282816	52	1	0.992721	0.306059	0.002244	26

Table 7: Firms' ranks using SAW method

Ranks	Simple Additive Weighted Value	Firms' Code	Ranks	Simple Additive Weighted Value	Firms' Code
6	0.016606	27	41	0.015475	1
20	0.016093	28	30	0.014928	2
42	0.015468	29	24	0.015752	3
4	0.015625	30	34	0.013381	4
3	0.011972	31	47	0.055201	5
45	0.01317	32	36	0.015354	6
31	0.016658	33	48	0.029654	7
38	0.016446	34	34	0.013411	8
13	0.013741	35	2	0.010701	9
51	0.013282	36	29	0.015657	10
40	0.029898	37	19	0.091601	11
8	0.012014	38	27	0.012825	12
9	0.045903	39	16	0.015165	13
26	0.011466	40	28	0.013989	14
23	0.091374	41	50	0.012905	15
7	0.012596	42	49	0.011714	16
52	0.012674	43	46	0.01407	17
25	0.014922	44	18	0.023734	18
44	0.012441	45	32	0.012631	19
14	0.012673	46	5	0.012227	20
17	0.013338	47	43	0.023734	21
35	0.016297	48	10	0.011457	22
22	0.015268	49	21	0.012765	23
11	0.015209	50	12	0.012843	24
33	0.010797	51	39	0.010451	25
13	0.023881	52	1	0.01471	26

Table 8: Firms' ranks using ELECTRE method

Ranks	Firms' Code	Ranks	Firms' Code
5	27	**11**	1
13	28	**15**	2
19	29	**18**	3
4	30	**25**	4
3	31	**28**	5
23	32	**27**	6
7	33	**29**	7
3	34	**21**	8
7	35	**2**	9
7	36	**9**	10
13	37	**1**	11
24	38	**16**	12
7	39	**18**	13
14	40	**10**	14
10	41	**26**	15
8	42	**22**	16
4	43	**16**	17
3	44	**13**	18
8	45	**17**	19
18	46	**6**	20
7	47	**12**	21
17	48	**9**	22
5	49	**8**	23
10	50	**10**	24
11	51	**20**	25
10	52	**1**	26

Table 9: Firms' ranks using VIKOR method

Ranks	Q	R	s	Firms' Code	Ranks	Q	R	s	Firms' Code
6	0.386364	0.390992	0.447944	27	45	0.617734	0.49928	0.582782	1
15	0.556996	0.483492	0.533753	28	29	0.584953	0.491997	0.554986	2
37	0.606129	0.500642	0.568692	29	16	0.557999	0.489218	0.528668	3
4	0.175479	0.284932	0.332981	30	21	0.567999	0.500869	0.526979	4
3	0.073862	0.220715	0.291726	31	26	0.58014	0.50871	0.531727	5
46	0.618247	0.507052	0.574958	32	19	0.564669	0.501122	0.523084	6
47	0.627992	0.495808	0.597683	33	27	0.580774	0.510134	0.53088	7
50	0.772175	0.504339	0.745289	34	35	0.602954	0.501825	0.563963	8
20	0.565595	0.480791	0.546019	35	1	-0.35785	0.015775	0.043242	9
13	0.553518	0.47546	0.538634	36	34	0.601691	0.492039	0.573143	10
48	0.644534	0.507269	0.603312	37	52	0.98632	0.506177	0.9762	11
22	0.568927	0.500092	0.528827	38	36	0.605726	0.497682	0.571446	12
7	0.416348	0.425217	0.443642	39	14	0.556133	0.484896	0.531301	13
33	0.601402	0.494048	0.570663	40	40	0.609197	0.494825	0.578303	14
28	0.583302	0.487485	0.558056	41	39	0.608513	0.509281	0.561967	15
8	0.446314	0.433107	0.467722	42	42	0.614834	0.50722	0.571065	16
51	0.799165	0.519972	0.757782	43	41	0.61105	0.50212	0.57245	17
25	0.577748	0.495557	0.543311	44	10	0.543765	0.48099	0.522062	18
43	0.615261	0.496346	0.583256	45	31	0.587854	0.495657	0.554193	19
18	0.562216	0.489688	0.532749	46	5	0.381343	0.397626	0.435328	20
32	0.599323	0.487305	0.575675	47	44	0.615493	0.499318	0.580304	21
30	0.587256	0.495591	0.553614	48	9	0.513439	0.473718	0.496925	22
49	0.651453	0.491579	0.627759	49	23	0.570151	0.482295	0.549351	23
17	0.560333	0.481642	0.539378	50	12	0.548337	0.478944	0.529241	24
38	0.607812	0.497329	0.574096	51	24	0.573243	0.4956	0.538364	25
11	0.547942	0.480473	0.527163	52	17	-0.35257	0.017966	0.046621	26

Table 10: Firms' ranks using LINMAP method

Ranks	Distance (t_i)	Firms' Code	Ranks	Distance (t_i)	Firms' Code
19	2.607917375	27	31	2.48469514	1
21	2.576599635	28	22	2.567673193	2
28	2.528966056	29	33	2.439644703	3
5	2.929911003	30	9	2.727567005	4
1	3.306947666	31	17	2.622622855	5
40	2.334492669	32	8	2.747172516	6
38	2.378987925	33	6	2.782563702	7
49	2.111662054	34	41	2.333348425	8
18	2.617610161	35	29	2.508513992	9
43	2.269175932	36	51	1.122790024	10
25	2.547437641	37	52	1.122790024	11
11	2.665689131	38	47	2.210510293	12
3	3.071264383	39	32	2.455132665	13
48	2.125144453	40	44	2.268813456	14
39	2.344654983	41	12	2.660399773	15
34	2.410055173	42	23	2.558366486	16
36	2.387863364	43	13	2.651295492	17
42	2.295421454	44	16	2.626675761	18
4	2.935005382	45	20	2.607833316	19
45	2.231504523	46	24	2.550050568	20
46	2.231355598	47	27	2.540196593	21
14	2.650640292	48	2	3.115675658	22
50	1.732134199	49	26	2.542409279	23
37	2.385815895	50	35	2.392311903	24
10	2.6923641	51	7	2.754478471	25
30	2.493563063	52	15	2.628424687	26

Table 11: Firms' ranks using TAXONOMY method

Ranks	Closeness Index	Distance (t_i)	Firms' Code	Ranks	Closeness Index	Distance (t_i)	Firms' Code
10	0.785	11.74	27	24	0.828	12.38	1
28	0.835	12.48	28	40	0.856	12.81	2
15	0.81	12.1	29	22	0.823	12.31	3
7	0.769	11.5	30	12	0.795	11.89	4
5	0.743	11.11	31	3	0.72	10.77	5
46	0.886	13.25	32	20	0.821	12.27	6
37	0.849	12.7	33	27	0.835	12.48	7
50	0.911	13.62	34	38	0.85	12.7	8
6	0.763	11.4	35	2	0.706	10.55	9
42	0.863	12.9	36	32	0.841	12.57	10
48	0.898	13.42	37	52	1.241	18.55	11
9	0.777	11.61	38	45	0.872	13.03	12
1	0.693	10.36	39	16	0.81	12.12	13
47	0.889	13.3	40	43	0.863	12.91	14
29	0.835	12.49	41	39	0.854	12.76	15
21	0.821	12.28	42	44	0.864	12.92	16
30	0.836	12.5	43	41	0.859	12.84	17
35	0.848	12.68	44	18	0.814	12.17	18
8	0.77	11.52	45	14	0.806	12.06	19
36	0.849	12.69	46	11	0.794	11.88	20
34	0.845	12.63	47	25	0.831	12.42	21
23	0.828	12.37	48	13	0.8	11.96	22
51	1.079	16.14	49	49	0.9	13.46	23
19	0.82	12.26	50	26	0.834	12.47	24
33	0.843	12.61	51	17	0.812	12.14	25
31	0.837	12.51	52	5	0.748	11.19	26

Table 12: Firms' ranks using Linear Allocation (LA) method

Ranks	Firms' Code	Ranks	Firms' Code
52	27	40	1
35	28	18	2
5	29	22	3
4	30	51	4
1	31	45	5
46	32	7	6
13	33	19	7
16	34	25	8
48	35	38	9
10	36	27	10
50	37	47	11
26	38	12	12
9	39	3	13
44	40	30	14
24	41	32	15
49	42	34	16
14	43	43	17
39	44	8	18
21	45	37	19
15	46	6	20
29	47	42	21
20	48	11	22
23	49	31	23
28	50	41	24
36	51	33	25
2	52	17	26

Table 13: Results of Differential Test between Different MCDM Methods

	DEA	SAW	TOPSIS	ELECTRE	LA	VIKOR	TAXONOMY	LINMAP
DEA	-	Δ	Δ	Δ	Δ	Δ	°	Δ
SAW		-	°	Δ	°	Δ	°	°
TOPSIS			-	Δ	Δ	Δ	°	°
ELECTRE				-	Δ	°	°	°
LA					-	°	°	°
VIKOR						-	Δ	°
TAXONOMY							-	°
LINMAP								-

	DEA	SAW	TOPSIS	ELECTRE	LA	VIKOR	TAXONOMY	LINMAP
DEA	-	14/6	14/3	16/05	14/92	10/5	9/75	10/96
SAW		-	4/75	10/96	14/48	7/44	12/5	17/79
TOPSIS			-	9/94	13/12	6/23	12/13	17/27
ELECTRE				-	15/84	14/79	15/36	19/48
LA					-	13/19	15/13	16/73
VIKOR						-	8/9	14/04
TAXONOMY							-	9/86
LINMAP								-

Table 14: Results of Friedman Test

N	8
Chi-Square	175.146
df	51
Asymp. Sig.	.000

Table 15: Firms' ranks using MCDM and mixed methods

Universe Average Rank	Universe Average	Copland	Borda	Average	TOPSIS	SAW	ELECTRE	LINMAP	LA	Vikor	Taxonomy	DEA	Firms Code
41	38.25	43	40	31.7	36	41	11	31	40	4	24	2	1
26	26.54167	28	27	24.6	24	30	15	22	18	2	40	1	2
20	20.875	21	18	23.6	21	24	18	33	22	1	22	3	3
28	27.70833	26	32	25.1	39	34	25	9	51	2	12	1	4
39	36.45833	39	43	27.3	49	47	28	17	45	2	3	4	5
21	21.58333	20	21	23.7	41	36	27	8	7	1	20	3	6
34	31.58333	31	33	30.7	51	48	29	6	19	2	27	3	7
43	38.79167	42	39	35.3	42	34	21	41	25	3	38	4	8
4	5.5	2	2	12.5	2	2	2	29	38	1	2	2	9
31	30	33	28	29	25	29	9	51	27	3	32	2	10
52	47.95833	52	52	39.8	45	19	1	52	47	5	52	5	11
37	34.83333	38	37	29.5	35	27	16	47	12	3	45	1	12
12	14.08333	13	14	15.2	18	16	18	32	3	1	16	5	13
42	38.58333	41	41	33.7	27	28	10	44	30	4	43	4	14
46	42.20833	45	46	35.6	50	50	26	12	32	3	39	3	15
48	43.45833	48	48	34.3	47	49	22	23	34	4	44	1	16
45	41.16667	47	45	31.5	43	46	16	13	43	4	41	9	17
14	15.33333	17	15	14	14	18	13	16	8	1	18	1	18
33	30.25	32	34	24.7	31	32	17	20	37	3	14	1	19
6	7.083333	5	5	11.2	6	5	6	24	6	5	11	2	20
44	40.70833	44	44	34.1	37	43	12	27	42	4	25	4	21
7	10.29167	9	9	12.8	9	10	9	2	11	9	13	4	22
23	24.33333	22	23	28	16	21	8	26	31	2	49	5	23
16	17.5	15	17	20.5	11	12	10	35	41	1	26	1	24
25	25.20833	27	26	22.6	29	39	20	7	33	2	17	1	25

2	3.666667	1	1	9	1	1	1	15	17	2	5	3	26
8	10.79167	7	7	18.3	5	6	5	19	52	6	10	4	27
17	19.45833	18	16	24.3	17	20	13	21	35	1	28	4	28
35	32.04167	35	35	26.1	40	42	19	28	5	3	15	2	29
3	4.25	4	4	4.75	4	4	4	5	4	4	7	6	30
1	3.125	3	3	3.37	3	3	3	1	1	3	5	8	31
50	45.29167	49	49	37.8	46	45	23	40	46	4	46	1	32
36	32.58333	36	36	25.7	32	31	7	38	13	4	37	1	33
49	45.04167	50	50	35.1	44	38	3	49	16	5	50	3	34
11	12.29167	10	11	15.8	13	13	7	18	48	2	6	2	35
19	20.83333	19	19	24.5	10	51	7	43	10	1	42	2	36
51	47.5	51	51	40.5	48	40	13	25	50	4	48	5	37
13	15.16667	12	12	21.5	38	8	24	11	26	2	9	3	38
5	6.666667	6	6	8	7	9	7	3	9	7	1	2	39
47	42.95833	46	47	35.8	26	26	14	48	44	3	47	4	40
24	24.41667	24	24	25.2	20	23	10	39	24	2	29	2	41
10	12.125	8	8	20.3	8	7	8	34	49	8	21	2	42
38	36.41667	37	38	34.2	52	52	4	36	14	5	30	3	43
27	26.58333	25	25	29.7	28	25	3	42	39	2	35	4	44
18	19.625	16	20	22.8	33	44	8	4	21	4	8	2	45
22	22.29167	23	22	21.8	22	14	18	45	15	1	36	7	46
30	28.875	29	29	28.6	19	17	7	46	29	3	34	4	47
29	28.5	34	30	21.5	30	35	17	14	20	3	23	3	48
40	38.20833	40	42	32.6	23	22	5	50	23	4	51	3	49
15	16.20833	14	13	21.6	15	11	10	37	28	1	19	3	50
32	30.20833	30	31	29.6	34	33	11	10	36	3	33	4	51
9	12.08333	11	10	15.2	12	13	10	30	2	1	31	1	52

4. Conclusions and Final Remarks

- This research calculated and compared the results of ranks of firms in TSE using 8 different MCDM techniques.

- The empirical evidence confirms existing significant differences among the results.

- In order to remove the ambiguous in investment performance evaluation decision making process, a new mixed strategy (some mixed methods) was introduced.

- Although the results of 8 MCDM methods are significantly different but the results of mixed methods are significantly stable.

- The new mixed strategy and mixed methods help to incorporate decision makers' utility more effectively and try to maximize investors' universe utility function.

5. References and Further Readings

1. Aggelopoulos,S., G. Menexes, I. Kamenidou (2007). “Implications for the financing and sustainability of enterprises based on a ranking methodology for categorical financial data”, *Euro Med Journal of Business*, Vol. 2 No. 2.
2. Amihud, Y., and Mendelson, H., (1991) “Asset Prices and Financial Policy”, *Financial Analysts Journal*, **47/6**, pp. 56-66.
3. Anvary Rostamy, A. A., and Tabata, Y., (1998) “Appraising the Effectiveness GP in Incorporating the Decision Marker’s Preferences”, *Journal of the Operations Research Society of Japan*, **41/2**, pp. 297-288.
4. Anvary Rostamy, A. A., and Tabata, Y., (1997) “On the Performance Evaluation of multiple Criteria Security Portfolio”, A paper presented at the fourth international conference of Asia-pacific Operational Research Societies, held at Melbourne, Australia, proceeding of APORS’ 97.
5. Arditti, F. D., (1967) "Risk and the Required Return on Equity", *Journal of Finance,* **22**, 19-36.
6. Arditti, F. D., (1971) "Another Look at Mutual Fund Performance", *Journal of Financial and Quantitative Analysis" ,* **6**, 909-912.
7. Arditti, F. D. and H. Levy (1967) "Portfolio Efficiency Analysis in three Moments: The Multiperiod Case", *Journal of Finance,* 30, 797-809.
8. Basso, A. and Funari, S. (2001) "A Data Envelopment Analysis Approach to Measure the Mutual Fund Performance", *European Journal of Operational Research,* **135,** 477-492.
9. Campbell, J. Y. and Hentschel, L. (1992) "No New News is Good News: An Assymetric Model of Changing Volatility in Stock Returns"", *Journal of Financial Economics,* **31**, 281-318.
10. Comp, R. C., and Eubank, A. A., (1981) “Beta Quotient: A Measure of Portfolio Risk”, *The Journal of Portfolio Management*, **7/4**, pp. 53-57.
11. Elton, E. J., and Gruber, M. J., (1991) *“Modern Portfolio Theory and Investment Analysis”*, John Wiley & Sons.
12. Garland, J. P., (1987) “Taxable Portfolios: Value and Performance”, The *Journal of Portfolio Management*, **13/2**, pp. 19-24.
13. Hanoch, G. and Levy, H. (1969) "The efficiency Analysis of Choices Involving Risk", *Review of Economic Studies,* **36**, 335-345.
14. Hasbrouck, J., and Schwartz, R. A., (1988) “Liquidity and Execution Costs in Equity Markets*”, The Journal of Portfolio Management*, **14/3**, pp. 10-16.
15. Ho, Y. K. and Cheung, Y. L. (1991) "Behavior of Intra-daily Stock Return on an Asian Emerging Market-Hong Kong", *Applied Economics,* **23**, 957-966.
16. Jensen, M. C. (1968) "The Performance of Mutual Funds in the Period 1945-1964", *Journal of Finance,* **23**, 389-416.

17. Jahnke, G. S., and Oppenheimer, H. R., (1987) “Price-earning Rations and Security Performance”, *The Journal of Portfolio Management*, **14/1**, pp. 39-46.
18. Joro, T. and Paul Na, (2006) "Portfolio Performance Evaluation in Mean-variance-skewness Framework", *European Journal of Operational Research,* **175(1),** pp. 446-461.
19. Kraus, A. and Litzenberger, R. H. (1976) "Skewness Preference and the Valuation of Risk Assets", *Journal of Finance,* **31,** 1085-1100.
20. Kumar, P. G., Philippatos, G. G., and Ezzell, J., (1978) “Goal Programming and the Selection of Portfolio by Dual – purpose Funds”, *Journal of Finance*, **33/1**, pp. 303-310.
21. Lau, A. H. L., Lau, H. S. and Wingender, J. R. (1990) "The Disrtibution of Stock Returns: New Evidence against the Stable Model", *Journal of Business and Economic Statistics,* **8,** 217-223.
22. Lee, S. M., and Lerro, A. J., (1973) “Optimization the Portfolio Selection for Mutual Funds”, *Journal of Finance*, **28/5**, pp. 1068-1101.
23. Lee, S. M., and Chesser, D. L., (1980) “Goal Programming for Portfolio Selection”, *The Journal of Portfolio Management*, **6/3**, pp. 22-26.
24. Leland, H. E. (1999) " Beyond Mean-variance: Performance Measurement in a nonsymmetrical World", *Financial Analysis Journal,* **55,** 27-36.
25. Markowitz, H. M., (1959) “Portfolio Selection, Efficient Diversification of Investments”, Wiley, New York.
26. Markowitz, H. M., (1952) “Portfolio Selection", *Journal of Finance,* **7,** 77-91.
27. McMullen, P. R. and Strong, R. A. (1998) "Selection of Mutual Funds Using Data Envelopment Analysis", *Journal of Business and Economic Studies,* **4,** 1-12.
28. Mohammad Kazem Sayadi, Majeed Heydari, Kamran Shahanaghi (2009) “Extension of VIKOR method for decision making problem with interval numbers”. *Applied Mathematical Modelling*, 33.
29. Sharp, W. F. (1966) "Mutual Fund Performance" *Journal of Business,* **39,** 119-138.
30. Sharp, W. F. (1964) "Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk", *Journal of Finance,* **19,** 425-442.
31. Tobin, J. (1958) "Liquidity Preference as Behavior toward Risk", *Review of Economic Studies,* **25**, 65-86.
32. Treynor, J. L. (1965) "How to Rate Management of Investment Funds", *Harvard Business Review,* **43**, 63-75.
33. Turner, A. L. and Weigel, E. J. (1992) "Daily Stock Market Volatility: 1928-1989", *Management Science,* **38**, 1586-1609.
34. Wilkens, K. and Zhu, J. (2001) "Portfolio Evaluation and Benchmarking Selection: A Mathematical Programming Approach", *Journal of Alternative Investment,* **4,** 9-20.