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THE PERFORMANCE OF MUTUAL FUNDS: EVIDENCE FROM TURKEY

Parlak, Deniz; Doğu University, İstanbul

ABSTRACT

In academic world much controversy exists regarding the performance of pension and mutual funds. Some studies have concluded that actively managed funds on average, underperform their passively managed counterparts whereas other studies have shown just the reverse. Another important debate centers on the persistence of under- and over-performance of portfolios. Still evidence from emerging markets which are characterized by high volatility in terms of terms of stock returns is scarce. Hence this study aims to fill this gap in the literature by investigating the persistence of pension and mutual fund performance in Turkey.

The results of this study revealed that out of 53 funds one had an abnormal positive risk-adjusted return and one had an abnormal negative risk-adjusted return when the entire six years are taken into consideration. The different measures employed ranked the portfolios similarly and the correlation of the portfolio rankings between consecutive years was close to zero and insignificant. Therefore it is concluded that efforts to form index and intensive stock funds with the expectation of achieving superior performance in the market-place, failed as only a few superior performances were identified, and these were limited to a single period.

Keywords: equity funds, risk-adjusted return, portfolio ranking

INTRODUCTION

In the modern globalized world, actively managed mutual and pension funds are among the most important financial instruments in which corporate and individual investors' savings are vested. Hence in today's environment, effective portfolio management is an important concern for both academicians and practitioners.

Prior to the 1960s portfolio performance was evaluated entirely on the rate of return. After the development of portfolio theory and the introduction of the capital asset pricing model (CAPM), risk, measured either with standard deviation or beta was included in the evaluation process.

In this context many indices have been developed to measure risk-adjusted portfolio returns. Consequently a large number of field studies have been conducted to determine short- and long-term portfolio performances. Although the majority of field studies have concluded that the risk-adjusted returns of actively managed portfolios are lower than those of their passive counterparts, evidence regarding the persistence of over- or under-performance of funds is mixed (Wermers, 2000).

In emerging markets, the introduction and development of a mutual and pension fund system is rather new when compared with developed economies. Hence field works conducted to investigate the risk-adjusted performance of these portfolios is scarce and results are mixed. This study aims to fill this gap in the literature by examining the persistence in the performance of equity mutual and pension funds as well as the talent and success of portfolio managers in an emerging market namely Turkey.

In Turkey, the first mutual funds were founded in 1987 whereas the private retirement system and the first pension funds were established in 2003. Still both sectors have shown great improvement over the last ten years as the total net asset value of the funds increased from 9.3 bn Turkish Lira (TL) in 2002 to 49.8 bn TL in 2010 (Capital Market Board of Turkey, 2010).

In this study the performance of 53 equity pension and mutual funds were analyzed by using the most commonly cited measures in the literature. In the first phase of the analysis Jensen's equation was applied to calculate the coefficient β which measures systematic risk of

the portfolios and the constant term α which measures the abilities of fund managers for six years from 2007 to 2012. In the second phase Sharpe, Treynor, Fama and Sortino indices were calculated for all funds for three years from 2010 to 2012 and the portfolios were ranked accordingly.

BACKGROUND

Mutual funds play an increasingly important role for individual and corporate investors in both developed and emerging markets. At the end of 2011 the total net asset value of mutual funds in the world reached \$22.8 trillion of which 49 percent was of U.S origin and 30 percent of European origin. (Öztürk, 2012).

Given the magnitude of these investments, determining the risk-adjusted performance of the funds has become an important concern for academic world since the publication of Jensen's seminal paper on the subject in 1968 (Jensen, 1968). Although some controversy remains, the majority of field studies that have been conducted concur that actively managed funds underperform their passively managed counterparts (Wermers, 2000). The most commonly cited examples are the study by Gruber (1996) who concluded that the actively managed mutual funds underperform their benchmarks by about 65 basis points and that of Carhart (1997) who found that the more actively a fund manager trades, the lower the return to investors.

In a more recent study, Glode (2011) concluded that unconditional risk-adjusted performance of actively managed U.S. equity funds were negative, and the funds' performance was systematically better in bad states of the economy than in good states, and poorly performing funds charged high fees compared to other funds. The size effect was investigated by Kleiman and Jun (2011). The results of their study indicated that smaller mutual funds had higher mean returns but also higher level of risk and were less diversified. Still their abnormal risk-adjusted return was not statistically significant.

Using a different approach some studies have investigated the performance of the stocks held by mutual funds and in contrast to studies that focus on portfolio returns, these studies have concluded that active fund managers possess a significant abilities in choosing stocks and that poor performance stems from costs and expenses. Examples include the studies of Daniel et al. (1997), Grinblatt and Titman (1994) and Wermers (1992) which showed that by using momentum strategies fund managers choose stocks that perform well outperform their benchmarks before expenses are deducted.

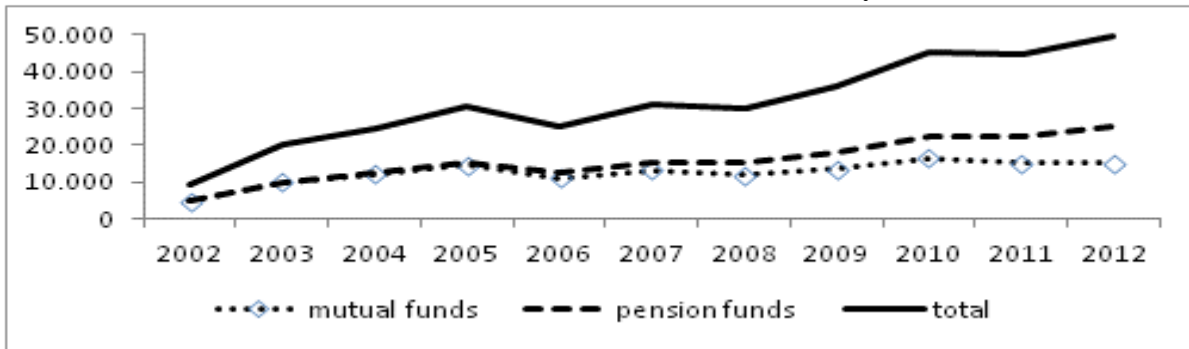
Similarly Fama & French (2010) concluded that if there were fund managers with enough skill to produce benchmark adjusted expected returns that cover costs, their tracks were hidden in the aggregate results by the performance of managers with insufficient skill. When returns were measured before the costs in expense ratios, there was stronger evidence of manager skill, negative as well as positive.

Another important debate in the literature centers on the persistence of risk-adjusted portfolio performance over the years. Hendricks, Patel & Zeckhauser (1993) found that high return can predict high return in the short run whereas Elton, Gruber & Blake (1995) demonstrated that past performance is predictive of future risk-adjusted performance both in the short run and long run. Aggarval and Jorion (2010) investigated the persistence of performance of hedge funds and concluded that the performance of new hedge funds deteriorated over time. Emerging funds and managers, narrowly defined as the first two years of a hedge fund's life, generate an abnormal performance of 2.3% relative to the later years and furthermore large funds from multi-product management companies performed better than small size funds.

The majority of field studies have investigated this topic in developed economies. Hence evidence from emerging markets is scarce and the results obtained are mixed. The purpose of the present study is to fill this gap by investigating the performance of mutual funds in the emerging economy of Turkey.

Compared to developed economies, the history of Turkish mutual and pension funds is relatively new. The first mutual funds were offered to the public in 1987 whereas the first pension funds were established in 2003. Still, as shown in Figure 1, over the course of the last ten as years the total net asset value of these funds increase fivefold from 9.3 bn to 49 bn TL. (Capital Markets Board of Turkey, 2010)

Figure.1
Net Asset Value of Funds in Turkey



Source: Capital Market Boards

Several studies have examined the performance of mutual and pension funds in Turkey. Gursoy and Erzurumlu (2001) analyzed the performance of 77 funds from 1998 to 2000 by using Sharpe, Treynor, Jensen and Harvey Graham indices and concluded that the performance of all funds was below that of their benchmark. Arslan (2005) analyzed the performance of 45 funds by using Sharpe M2, Jensen and Treynor measures from 2003 to 2005 and found that all of the analyzed funds underperformed when compared with their benchmarks. Karacabey and Gökgöz (2005) investigated the performance of 11 pension funds and concluded that while funds were keen to invest in low-risk assets their risk-adjusted return was nonetheless above that of the market. Finally, Korkmaz and Uygurtürk (2008) analyzed the performance of 17 pension and 17 mutual funds from 2004 to 2006 and concluded that the performance of both groups of funds was below their benchmarks although pension funds performed better than mutual funds.

In a more recent study, Arslan & Arslan (2010) found that all funds had positive alpha coefficient, indicating positive selection capability of managers; but in terms of timing capability only one fund manager showed success. They further concluded that the funds' returns didn't have any stability leading to poor ex-ante forecast modeling capability.

METHODOLOGY

Measures

Five different measures were calculated to analyze the performance of the funds.

1. Treynor index: The Treynor index measures portfolio risk with beta and calculates portfolio's market risk premium relative to its beta:

$$T_i = (R_p - R_f) / \beta_p$$

Where :

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Ti= Treynor index

Rp= Portfolio return

Rf = Risk-free rate of return

β_p = Systematic risk of the portfolio

A larger T value means a better portfolio for all investors when $R_p > R_f$ and $\beta_p > 0$. (Treynor,1965).

2. Sharpe index: The Sharpe index measures portfolio risk with its standard deviation and calculates a portfolio's market risk premium relative to its standard deviation.

$$S_i = (R_p - R_f) / \sigma_p$$

Where:

S_i= Sharpe index

σ_p = Portfolio standard deviation

A higher Sharpe ratio indicated a higher reward for volatility.(Sharpe, 1966)

3. Sortino index: The Sortino index is a modification of the Sharpe ratio; however this index penalizes only those returns falling below a user-specified target, or a required rate of return, while the Sharpe ratio equally penalizes both upside and downside volatility.

$$ST_i = (R_p - MAR) / DR$$

Where :

ST_i= Sortino index

MAR = Minimum acceptable return

DR = Downside risk.

$$DR = \sqrt{\sum_{t=0}^{\infty} [(R_{pt} - MAR)^2 / 2]}$$

A higher Sortino index indicates a higher return for risk. (Gökgöz,2006)

4. Fama index: The Fama index measures portfolio performance with return above minimum acceptable level against total risk.

$$F_i = (R_p - R_f) - (\sigma_p / \sigma_m)(R_m - R_f)$$

Where:

R_m = Market portfolio return

σ_m = Standard deviation of the market portfolio

A positive Fama index indicated that the portfolio's return is above minimum acceptable level and is therefore above capital market line (Fama,1972)

5. Jensen index: The Jensen index considers the following equation assuming that CAPM is valid.

$$R_p - R_f = \alpha + \beta (R_m - R_f) + e$$

In Jensen's equation, the constant term α measures the talent of the portfolio manager.

A positive α which indicates the return is above the risk-adjusted average return denotes success whereas a negative α denotes the failure of the portfolio manager (Jensen,1968).

Sample and Data Collection

Turkish legislation classifies both mutual and pension funds as either type A or type B. Type A funds are those that invest a minimum of 50 percent of their assets in national or foreign stocks whereas type B funds are those that invest a minimum of 50 percent of their assets in T-bills and bonds. Among type A funds those that invest a minimum 75 percent of their assets in stocks are called intensive stock funds. Index funds are those that track the components of a market index (Capital Market Boards of Turkey,2010).

At the end of 2012 110 intensive stock and index funds were traded in the Turkish market. From these 110 funds 53 funds all of which were established before 2009 were added to the sample. Thirteen of the 53 were index funds, 25 were intensive stock mutual funds and 15 were intensive stock pension funds. The analysis period spanned 6 years from 2007 to 2012.

The data used in this study included weekly returns of mutual and pension funds (R_p), weekly benchmark returns (R_m) and weekly repo returns (R_f). Weekend prices of all funds in the sample were obtained from Capital Market Board statistics and weekly returns were calculated thereupon. For each fund, benchmark assets and their maximum and minimum holding percentages were obtained from the funds' prospectuses. Thirty-five out of the 53 funds invested 70 percent to 90 percent of their assets stocks listed on the National 100 index and 18 out of the 53 invested in stocks listed on the National 30 index. The remaining 10 percent to 30 percent of the assets were invested in T-bills and bonds. The Friday closing prices for the National 100 and the National 30 and T-bill indices and the overnight repo index which was used as a proxy for both risk-free rate and minimum acceptable return (MAR) were obtained from the statistics of the Istanbul Stock Exchange and weekly returns were calculated thereupon.

Standard deviations for both portfolio and benchmark returns and the beta coefficients were calculated for the entire period as well as the six sub-periods from 2007 to 2012.

ANALYSIS AND FINDINGS

In the first phase of the analysis Jensen's equation was applied to calculate the coefficient β which measures systematic risk of the portfolios and the constant term α which measures the abilities of fund managers. For this purpose portfolios' excess returns are regressed against benchmarks' excess returns for the entire period and for all sub-periods. Regression statistics are presented at Table 1.

Table 1
Regression Statistics

FUND TYPE	YEAR	R^2			β			Sign. β	α			Sign. α
		Min	Max	Mean	Min	Max	Mean		Min	Max	Mean	
Index Funds	2007	56%	74%	65%	0,854	1,157	0,965	0.0*	-0,004	0,001	-0,000	none
	2008	57%	79%	64%	0,736	0,967	0,841	0.0*	-0,007	0,000	-0,003	none
	2009	64%	84%	70%	0,721	0,976	0,763	0.0*	0,736	0,967	0,841	none
	2010	65%	84%	72%	0,739	0,883	0,785	0.0*	0,721	0,976	0,763	none
	2011	58%	82%	67%	0,877	1,020	0,930	0.0*	-0,002	0,000	-0,001	none
	2012	60%	79%	64%	0,670	0,901	0,734	0.0*	-0,001	0,003	0,002	none
	6 years	63%	68%	66%	0,791	0,988	0,848	0.0*	-0,002	0,001	-0,000	none
Intensive Stock Mutual Funds	2007	31%	66%	54%	0,329	0,974	0,747	0.0*	-0,003	0,003	-0,001	none
	2008	36%	68%	59%	0,332	0,923	0,679	0.0*	-0,009	0,001	-0,002	1 of 19
	2009	25%	69%	51%	0,280	0,931	0,566	0.0*	0,000	0,014	0,004	6 of 25
	2010	16%	72%	52%	0,259	1,037	0,563	0.0*	-0,002	0,006	0,002	1 of 25
	2011	39%	67%	58%	0,607	1,095	0,844	0.0*	-0,005	0,006	-0,001	1 of 25
	2012	22%	63%	42%	0,279	0,767	0,552	0.0*	-0,001	0,005	0,003	16 of 25
	6 years	41%	69%	55%	0,436	0,969	0,681	0.0*	-0,003	0,003	0,000	2 of 25
Intensive Stock Pension Funds	2007	54%	66%	60%	0,725	1,038	0,886	0.0*	-0,002	0,002	-0,000	none
	2008	61%	87%	66%	0,759	1,133	0,890	0.0*	-0,011	0,000	-0,002	none
	2009	55%	63%	59%	0,622	0,762	0,705	0.0*	0,000	0,007	0,004	5 of 15
	2010	47%	59%	56%	0,570	0,719	0,632	0.0*	0,000	0,003	0,002	none
	2011	59%	63%	61%	0,880	1,024	0,952	0.0*	-0,002	0,000	-0,001	none
	2012	39%	49%	47%	0,558	0,633	0,598	0.0*	0,000	0,005	0,003	7 of 15
	6 years	56%	63%	61%	0,730	0,930	0,818	0.0*	-0,001	0,002	0,000	none

* All regressions are significant at 5% confidence level.

The beta coefficients were significant in all regressions for both the entire period and all sub-periods at a 99 percent confidence level. The constant term α however, which reflects abnormal returns, was statistically significant only in limited cases. This constant was not significant for any of the index funds for any of the sub-periods. For intensive stock mutual funds, 2009 and 2012 were the most successful years as in the former year (2009) six funds and in the latter year (2012) 16 funds out of 25 had abnormal positive risk-adjusted return. Finally out of 17 intensive stock pension funds at year 2009 five of these funds and at year 2012 seven of these funds have earned abnormal positive return. The fund distribution of statistically significant constant α terms is presented at Table 2.

Table 2
The Constant Term α

Fund Category	Fund number	α	α	α	α	α	α
		All 5 years	2008	2009	2010	2011	2012
Mutual funds	14						0,003**
	15						0,004*
	17						0,004*
	18						0,000*
	19						0,004*
	20						0,004**
	21			0,006*			0,003**
	23						0,004**
	25			0,009*			0,004*
	26						0,005*
	30			0,004*			0,003**
	31						0,000*
	32	-0,003*	-0,009*				
	34	0,003**		0,014*	0,006**	0,006**	0,005**
	35						0,004*
37			0,004**			0,002**	
38			0,003*			0,003**	
Pension Funds	42						0,004**
	43						0,003**
	44						0,000**
	46			0,007**			0,005*
	47			0,005**			0,003**
	48						0,003**
	49			0,005**			
	50			0,005**			
	51			0,006*			
	53						0,004**
* significant at 5% confidence level							
** significant at 10% confidence level							

The regression analysis results revealed that when the entire six years were considered, one out of 53 funds earned an abnormal positive and one an abnormal negative return whereas all other funds fell on the security market line.

Yearly data analysis showed that the intensive stock mutual funds which performed well in 2009 also performed well in 2012. In terms of persistence, only one fund showed persistently abnormal positive return for four consecutive years from 2009 to 2012. With regard to intensive stock pension funds, two of the strong performers of 2009, also performed

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well in 2012. All others were single-year strong performers of the success of which can be attributed to chance factor rather than the talent of the portfolio manager.

In the second phase of the analysis Sharpe, Treynor, Fama and Sortino indices were calculated for all funds for three years from 2010 to 2012. The statistics are presented at Attachment 1. Prior years were not included in the analysis due to the unavailability of data. The funds were separately ranked according to the four above-mentioned indices and Jensen's α for all three years. The Spearman ranks correlation test was performed for each pair of indices to detect differences in rankings. The results of the analysis are presented at Table 3.

Table 3
Correlation of the Measures

spearman signed ranks correlations				
year 2010				
	treynor	jensen α	fama	sortino
sharpe	0,977	0,878	0,931	0,994
treynor		0,860	0,904	0,979
jensen α			0,878	0,866
fama				0,923
year 2011				
	treynor	jensen α	fama	sortino
sharpe	0,746	0,781	0,955	0,932
treynor		0,822	0,782	0,863
jensen α			0,808	0,860
fama				0,918
year 2012				
	treynor	jensen α	fama	sortino
sharpe	0,919	0,833	0,978	0,958
treynor		0,777	0,887	0,913
jensen α			0,823	0,827
fama				0,943
All correlations are significant at the 0.01 level (2-tailed).				

The calculated Spearman correlations between rankings of the four indices were quite high and were significant for all sub- periods at a 99 percent confidence level. This means that the index used to evaluate the funds is of no consequence.

In view of the fact that index rankings were highly correlated, to attain consistency with the first phase of the analysis, the Jensen index was chosen to compare the performances of funds within the years. The Spearman rank correlation test was applied to each pair of

years in the analysis to determine whether rankings of funds within the years were correlated. The results are presented at Table 4.

Table 4
Correlations Within the Years

spearman signed ranks correlations		
	2011	2012
2010	0.170	0.596*
2011		-0,173
*significant at the 0.01 level (2-tailed).		

The analysis revealed that the only statistically significant correlation was between the years 2010 and 2012; the coefficient was positive but low. The correlation between the consecutive years was insignificant; the coefficient was close to zero between the years 2010 and 2011 and negative between the years 2011 and 2012. The results revealed that there was an absence of persistence in the performance of funds for consecutive years.

Finally the funds were classified into five groups according to their rankings. The first group consisted of the best performers and the fifth group was comprised of the worst performers. Group distribution of the funds for the three years of this analysis is presented at Table 5.

Table 5
Classification of Funds

index funds				intensive stock mutual funds				intensive stock pension funds			
fund number	2010 group	2011 group	2012 group	fund number	2010 group	2011 group	2012 group	fund number	2010 group	2011 group	2012 group
1	4	4	4	14	4	3	3	39	1	1	3
2	4	2	5	15	1	1	1	40	2	3	2
3	4	3	4	16	5	4	5	41	2	5	3
4	4	3	4	17	5	5	1	42	1	5	2
5	5	1	5	18	5	1	5	43	2	3	2
6	3	2	4	19	2	5	1	44	5	1	5
7	4	4	4	20	3	3	1	45	3	3	2
8	5	4	5	21	1	3	2	46	1	5	1
9	4	3	4	22	3	2	3	47	1	4	2
10	3	2	4	23	5	5	1	48	2	4	2
11	2	2	3	24	3	2	4	49	4	4	3
12	4	2	3	25	2	5	1	50	2	5	4
13	4	4	4	26	1	2	1	51	2	2	3

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27	2	1	3	52	3	5	3
28	5	5	4	53	3	3	2
29	4	4	4				
30	2	2	2				
31	5	1	5				
32	5	5	5				
33	2	3	5				
34	1	1	1				
35	3	3	1				
36	1	1	5				
37	1	1	4				
38	4	2	2				

Only three out of 13 index funds fell into the same group (group 4) for all three years of analysis. Among 25 intensive stock mutual funds, two were classified in group one, one in group two, one in group four and one in group five for all three years of analysis. Among 15 pension funds, none of the funds fell into the same group for all three years.

LIMITATIONS OF THIS STUDY

Three limitations of this study should be considered. First, the returns of both mutual and pension funds were calculated on net basis after costs and expenses were deducted from the overall returns. Due to data restrictions the funds' performance on gross basis was not analyzed in this study.

Second, due to data restrictions, bond funds were not included in the analysis and consequently sample size was restricted to 53 observations which limited the possibility to apply more sophisticated statistical techniques.

Finally, due to time restrictions the study was conducted in a single market which avoided the possibility of making multi-environmental comparisons.

RECOMMENDATION FOR FUTURE RESEARCH

Future research may concentrate on the three main limitations of this study. First, the analysis may be extended to cover funds' performance calculated using the returns before costs and expenses are deducted; second a larger sample size may be obtained by adding bond funds to the present sample and the analysis may be enriched by using more sophisticated statistical techniques. Finally the analysis could be repeated for different emerging markets to enable multi-market comparisons.

CONCLUSION

In this study the performance of 53 equity and index funds was analyzed over a six-year period. Regression analysis revealed that for the entire six years, only two funds were able to earn an abnormal return. The first result was positive demonstrating the success of the

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portfolio manager and the second result was negative indicating the portfolio manager's failure.

Portfolio performance was measured in accordance with the methodologies developed by Sharpe, Treynor, Fama, Sortino and Jensen. The Spearman rank correlation test demonstrated that all methods ranked the funds in the same manner for the three-year periods analyzed for this purpose. The same test revealed that there was no correlation between fund rankings in consecutive years finding only a low positive correlation between the first and the third year of the analysis. When classified into five groups according to yearly performances, only eight of the 53 funds fell into the same group for all years of analysis. Among 53 funds in the sample only one fund was found to have earned abnormal return for both the entire period and for consecutive sub-periods. This singular fund fell into the first group designating the fund as a best performer for three consecutive years.

Therefore it is concluded that efforts to form index and intensive stock funds with the expectation of achieving superior performance in the market-place, failed over the course of the analysis period. Only a few superior performances were identified during the six-year period under review, and these were limited to a single period. As a result their performance is attributable to chance factors rather than the performance of portfolio manager.

About the Authors:

Parlak, Deniz (Ph.D. in Finance) is working as Assistant Professor of Finance at Doğuş University, İstanbul. After obtaining a bachelor degree in business administration at Boğaziçi University in 1990, Deniz Parlak earned an MBA in finance at İstanbul Technical University in 2004 and a Ph.D. at Boğaziçi University in 2009. She authored and coauthored many articles in the Finance and Accounting disciplines.

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Appendix 1
Measures

fund	fund	measures														
		sharpe index			treynor index			jensen α			fama index			sortino index		
category	number	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
i n d e x f u n d s	1	11,87	-17,96	36,08	0,215	-0,325	0,565	0,001	-0,001	0,003	0,014	-0,031	0,010	0,80	-0,89	3,43
	2	13,66	-17,51	33,19	0,248	-0,310	0,479	0,001	-0,001	0,002	0,005	-0,015	-0,018	0,94	-0,88	3,06
	3	11,03	-17,67	35,03	0,202	-0,318	0,533	0,001	-0,001	0,002	0,002	-0,027	-0,002	0,73	-0,87	3,29
	4	10,43	-18,05	34,07	0,189	-0,331	0,524	0,001	-0,001	0,002	-0,006	-0,032	-0,012	0,68	-0,90	3,18
	5	11,66	-16,96	34,03	0,223	-0,325	0,551	0,000	0,000	0,000	0,012	-0,015	-0,013	0,78	-0,86	3,21
	6	12,25	-16,93	34,33	0,222	-0,306	0,541	0,001	-0,001	0,002	0,020	-0,013	-0,009	0,83	-0,85	3,29
	7	12,19	-19,08	32,47	0,216	-0,335	0,446	0,001	-0,002	0,002	-0,017	-0,045	-0,028	0,85	-0,95	2,87
	8	15,51	3,05	18,38	0,289	0,055	0,291	0,000	-0,002	-0,001	0,033	0,348	-0,235	1,15	0,19	1,25
	9	12,42	-18,08	34,76	0,222	-0,325	0,531	0,001	-0,001	0,002	0,021	-0,032	-0,005	0,82	-0,89	3,27
	10	15,83	-17,34	36,42	0,283	-0,287	0,508	0,002	-0,001	0,002	0,034	-0,012	0,016	1,14	-0,86	3,58
	11	14,95	-15,78	36,70	0,271	-0,283	0,564	0,002	0,000	0,003	0,058	0,006	0,016	1,03	-0,79	3,59
	12	11,58	-17,50	36,60	0,223	-0,332	0,563	0,000	-0,001	0,003	-0,025	-0,015	0,019	0,77	-0,87	3,52
	13	10,92	-18,45	34,07	0,200	-0,334	0,525	0,001	-0,001	0,002	0,001	-0,038	-0,013	0,72	-0,91	3,17
i n t e r n a t i o n a l f u n d s	14	13,44	-21,63	41,88	0,230	-0,288	0,628	0,001	-0,001	0,003	0,006	-0,053	0,062	0,91	-0,95	3,94
	15	24,09	-10,74	45,16	0,428	-0,185	0,706	0,003	0,001	0,004	0,121	0,070	0,092	1,83	-0,51	4,44
	16	-1,96	-28,18	1,43	-0,036	-0,371	0,030	-0,001	-0,002	-0,001	-0,072	-0,094	-0,193	-0,10	-1,09	0,09
	17	11,03	-29,24	43,78	0,195	-0,374	0,642	0,000	-0,003	0,004	-0,018	-0,142	0,074	0,73	-1,18	4,30
	18	17,90	-18,21	35,30	0,348	-0,243	0,484	0,000	0,000	0,000	0,042	-0,019	0,003	1,29	-0,80	3,00
	19	20,54	-24,06	51,98	0,339	-0,377	0,751	0,003	-0,002	0,004	0,091	-0,080	0,116	1,44	-1,11	4,66
	20	15,65	-20,92	45,10	0,273	-0,274	0,569	0,001	-0,001	0,004	0,025	-0,058	0,098	1,14	-0,90	4,59
	21	20,86	-20,66	41,68	0,387	-0,308	0,623	0,003	-0,001	0,003	0,097	-0,056	0,063	1,58	-0,89	4,08
	22	13,82	-15,66	35,60	0,251	-0,284	0,545	0,002	0,000	0,003	0,046	0,008	0,005	0,95	-0,80	3,42
	23	7,03	-22,07	44,17	0,136	-0,352	0,748	0,000	-0,002	0,004	-0,036	-0,085	0,083	0,41	-0,96	4,24
	24	15,92	-18,58	31,14	0,283	-0,247	0,525	0,001	-0,001	0,002	0,024	-0,023	-0,027	1,08	-0,85	2,49
	25	21,27	-25,43	46,75	0,464	-0,380	0,665	0,002	-0,002	0,004	0,083	-0,105	0,100	1,59	-1,13	4,44
	26	19,79	-19,81	46,36	0,420	-0,348	0,855	0,003	-0,001	0,005	0,129	-0,056	0,118	1,40	-0,87	4,84
	27	23,61	-12,79	40,02	0,449	-0,185	0,561	0,003	0,001	0,003	0,098	0,044	0,045	1,85	-0,61	3,32
	28	9,82	-25,67	35,49	0,173	-0,353	0,500	0,000	-0,002	0,002	-0,038	-0,113	0,005	0,65	-1,08	3,08
	29	13,01	-27,10	36,68	0,246	-0,372	0,512	0,001	-0,002	0,002	-0,002	-0,098	0,015	0,91	-1,13	3,20
	30	18,20	-21,01	44,33	0,345	-0,295	0,702	0,002	-0,001	0,003	0,068	-0,047	0,069	1,28	-0,88	3,97
	31	12,52	-19,49	48,85	0,198	-0,275	0,768	0,000	0,000	0,000	0,034	-0,044	0,133	0,80	-0,83	5,29
	32	-1,57	-31,51	22,93	-0,037	-0,535	0,411	-0,002	-0,005	0,000	-0,168	-0,243	-0,123	-0,10	-1,29	1,75
	33	24,10	-23,06	32,56	0,407	-0,259	0,417	0,002	-0,001	0,002	0,084	-0,061	-0,015	1,87	-0,96	2,40
	34	31,92	-16,10	45,10	0,678	-0,263	0,856	0,006	0,000	0,005	0,235	0,008	0,095	2,60	-0,75	4,37
	35	16,35	-20,56	44,65	0,314	-0,306	0,649	0,002	-0,001	0,004	0,038	-0,058	0,090	1,13	-0,92	4,49
	36	20,82	-15,40	29,76	0,658	-0,207	0,439	0,003	0,000	0,001	0,074	0,013	-0,041	1,52	-0,69	2,28
	37	25,85	-3,96	41,60	0,572	-0,062	0,719	0,004	0,002	0,002	0,131	0,121	0,040	2,16	-0,19	3,45
	38	16,24	-19,07	42,04	0,278	-0,280	0,615	0,001	-0,001	0,003	0,032	-0,026	0,063	1,04	-0,85	3,91
p e n s i o n f u n d s	39	20,20	-15,72	37,73	0,371	-0,209	0,508	0,003	0,000	0,003	0,087	0,018	0,030	1,48	-0,71	3,33
	40	18,14	-19,29	43,13	0,337	-0,289	0,654	0,002	-0,001	0,003	0,042	-0,054	0,047	1,25	-0,85	4,01
	41	19,07	-24,34	41,36	0,397	-0,374	0,700	0,002	-0,002	0,003	0,078	-0,142	0,030	1,41	-1,04	4,12
	42	20,58	-22,77	43,89	0,425	-0,351	0,741	0,003	-0,002	0,004	0,096	-0,118	0,054	1,54	-0,98	4,43
	43	18,40	-21,13	41,58	0,346	-0,312	0,622	0,002	-0,001	0,003	0,063	-0,065	0,062	1,33	-0,93	3,78
	44	18,87	-20,48	42,42	0,358	-0,303	0,631	0,000	0,000	0,000	0,067	-0,055	0,068	1,34	-0,91	3,99
	45	14,96	-22,47	40,93	0,284	-0,333	0,613	0,001	-0,001	0,003	0,020	-0,083	0,055	1,02	-0,97	3,73
	46	22,10	-25,18	44,85	0,422	-0,369	0,766	0,003	-0,002	0,005	0,109	-0,129	0,096	1,71	-1,08	4,64
	47	21,66	-21,32	42,78	0,405	-0,317	0,634	0,003	-0,001	0,003	0,106	-0,066	0,072	1,62	-0,95	4,37
	48	20,22	-21,54	42,62	0,388	-0,322	0,622	0,003	-0,001	0,003	0,081	-0,069	0,070	1,53	-0,95	3,98
	49	13,33	-21,68	38,58	0,256	-0,331	0,569	0,001	-0,001	0,003	0,000	-0,069	0,033	0,92	-0,95	3,31
	50	16,95	-24,60	37,13	0,343	-0,368	0,550	0,002	-0,002	0,002	0,044	-0,106	0,020	1,28	-1,05	3,18
	51	17,30	-18,46	41,00	0,335	-0,274	0,600	0,002	0,000	0,003	0,049	-0,027	0,053	1,22	-0,82	3,65
	52	17,07	-25,00	39,23	0,319	-0,364	0,585	0,002	-0,002	0,003	0,042	-0,123	0,038	1,18	-1,06	3,67
	53	16,87	-20,97	43,30	0,309	-0,309	0,662	0,002	-0,001	0,004	0,168	-0,227	0,342	1,14	-0,92	4,13

Appendix 2
Rankings

fund	fund	measures														
		sharpe index			treynor index			jensen α			fama index			sortino index		
category	number	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
index	1	11,87	-17,96	36,08	0,215	-0,325	0,565	0,001	-0,001	0,003	0,014	-0,031	0,010	0,80	-0,89	3,43
	2	13,66	-17,51	33,19	0,248	-0,310	0,479	0,001	-0,001	0,002	0,005	-0,015	-0,018	0,94	-0,88	3,06
	3	11,03	-17,67	35,03	0,202	-0,318	0,533	0,001	-0,001	0,002	0,002	-0,027	-0,002	0,73	-0,87	3,29
	4	10,43	-18,05	34,07	0,189	-0,331	0,524	0,001	-0,001	0,002	-0,006	-0,032	-0,012	0,68	-0,90	3,18
	5	11,66	-16,96	34,03	0,223	-0,325	0,551	0,000	0,000	0,000	0,012	-0,015	-0,013	0,78	-0,86	3,21
	6	12,25	-16,93	34,33	0,222	-0,306	0,541	0,001	-0,001	0,002	0,020	-0,013	-0,009	0,83	-0,85	3,29
	7	12,19	-19,08	32,47	0,216	-0,335	0,446	0,001	-0,002	0,002	-0,017	-0,045	-0,028	0,85	-0,95	2,87
	8	15,51	3,05	18,38	0,289	0,055	0,291	0,000	-0,002	-0,001	0,033	0,348	-0,235	1,15	0,19	1,25
	9	12,42	-18,08	34,76	0,222	-0,325	0,531	0,001	-0,001	0,002	0,021	-0,032	-0,005	0,82	-0,89	3,27
	10	15,83	-17,34	36,42	0,283	-0,287	0,508	0,002	-0,001	0,002	0,034	-0,012	0,016	1,14	-0,86	3,58
	11	14,95	-15,78	36,70	0,271	-0,283	0,564	0,002	0,000	0,003	0,058	0,006	0,016	1,03	-0,79	3,59
	12	11,58	-17,50	36,60	0,223	-0,332	0,563	0,000	-0,001	0,003	-0,025	-0,015	0,019	0,77	-0,87	3,52
	13	10,92	-18,45	34,07	0,200	-0,334	0,525	0,001	-0,001	0,002	0,001	-0,038	-0,013	0,72	-0,91	3,17
international stocks	14	13,44	-21,63	41,88	0,230	-0,288	0,628	0,001	-0,001	0,003	0,006	-0,053	0,062	0,91	-0,95	3,94
	15	24,09	-10,74	45,16	0,428	-0,185	0,706	0,003	0,001	0,004	0,121	0,070	0,092	1,83	-0,51	4,44
	16	-1,96	-28,18	1,43	-0,036	-0,371	0,030	-0,001	-0,002	-0,001	-0,072	-0,094	-0,193	-0,10	-1,09	0,09
	17	11,03	-29,24	43,78	0,195	-0,374	0,642	0,000	-0,003	0,004	-0,018	-0,142	0,074	0,73	-1,18	4,30
	18	17,90	-18,21	35,30	0,348	-0,243	0,484	0,000	0,000	0,000	0,042	-0,019	0,003	1,29	-0,80	3,00
	19	20,54	-24,06	51,98	0,339	-0,377	0,751	0,003	-0,002	0,004	0,091	-0,080	0,116	1,44	-1,11	4,66
	20	15,65	-20,92	45,10	0,273	-0,274	0,569	0,001	-0,001	0,004	0,025	-0,058	0,098	1,14	-0,90	4,59
	21	20,86	-20,66	41,68	0,387	-0,308	0,623	0,003	-0,001	0,003	0,097	-0,056	0,063	1,58	-0,89	4,08
	22	13,82	-15,66	35,60	0,251	-0,284	0,545	0,002	0,000	0,003	0,046	0,008	0,005	0,95	-0,80	3,42
	23	7,03	-22,07	44,17	0,136	-0,352	0,748	0,000	-0,002	0,004	-0,036	-0,085	0,083	0,41	-0,96	4,24
	24	15,92	-18,58	31,14	0,283	-0,247	0,525	0,001	-0,001	0,002	0,024	-0,023	-0,027	1,08	-0,85	2,49
	25	21,27	-25,43	46,75	0,464	-0,380	0,665	0,002	-0,002	0,004	0,083	-0,105	0,100	1,59	-1,13	4,44
	26	19,79	-19,81	46,36	0,420	-0,348	0,855	0,003	-0,001	0,005	0,129	-0,056	0,118	1,40	-0,87	4,84
	27	23,61	-12,79	40,02	0,449	-0,185	0,561	0,003	0,001	0,003	0,098	0,044	0,045	1,85	-0,61	3,32
	28	9,82	-25,67	35,49	0,173	-0,353	0,500	0,000	-0,002	0,002	-0,038	-0,113	0,005	0,65	-1,08	3,08
	29	13,01	-27,10	36,68	0,246	-0,372	0,512	0,001	-0,002	0,002	-0,002	-0,098	0,015	0,91	-1,13	3,20
	30	18,20	-21,01	44,33	0,345	-0,295	0,702	0,002	-0,001	0,003	0,068	-0,047	0,069	1,28	-0,88	3,97
	31	12,52	-19,49	48,85	0,198	-0,275	0,768	0,000	0,000	0,000	0,034	-0,044	0,133	0,80	-0,83	5,29
	32	-1,57	-31,51	22,93	-0,037	-0,535	0,411	-0,002	-0,005	0,000	-0,168	-0,243	-0,123	-0,10	-1,29	1,75
	33	24,10	-23,06	32,56	0,407	-0,259	0,417	0,002	-0,001	0,002	0,084	-0,061	-0,015	1,87	-0,96	2,40
	34	31,92	-16,10	45,10	0,678	-0,263	0,856	0,006	0,000	0,005	0,235	0,008	0,095	2,60	-0,75	4,37
	35	16,35	-20,56	44,65	0,314	-0,306	0,649	0,002	-0,001	0,004	0,038	-0,058	0,090	1,13	-0,92	4,49
	36	20,82	-15,40	29,76	0,658	-0,207	0,439	0,003	0,000	0,001	0,074	0,013	-0,041	1,52	-0,69	2,28
	37	25,85	-3,96	41,60	0,572	-0,062	0,719	0,004	0,002	0,002	0,131	0,121	0,040	2,16	-0,19	3,45
	38	16,24	-19,07	42,04	0,278	-0,280	0,615	0,001	-0,001	0,003	0,032	-0,026	0,063	1,04	-0,85	3,91
pension funds	39	20,20	-15,72	37,73	0,371	-0,209	0,508	0,003	0,000	0,003	0,087	0,018	0,030	1,48	-0,71	3,33
	40	18,14	-19,29	43,13	0,337	-0,289	0,654	0,002	-0,001	0,003	0,042	-0,054	0,047	1,25	-0,85	4,01
	41	19,07	-24,34	41,36	0,397	-0,374	0,700	0,002	-0,002	0,003	0,078	-0,142	0,030	1,41	-1,04	4,12
	42	20,58	-22,77	43,89	0,425	-0,351	0,741	0,003	-0,002	0,004	0,096	-0,118	0,054	1,54	-0,98	4,43
	43	18,40	-21,13	41,58	0,346	-0,312	0,622	0,002	-0,001	0,003	0,063	-0,065	0,062	1,33	-0,93	3,78
	44	18,87	-20,48	42,42	0,358	-0,303	0,631	0,000	0,000	0,000	0,067	-0,055	0,068	1,34	-0,91	3,99
	45	14,96	-22,47	40,93	0,284	-0,333	0,613	0,001	-0,001	0,003	0,020	-0,083	0,055	1,02	-0,97	3,73
	46	22,10	-25,18	44,85	0,422	-0,369	0,766	0,003	-0,002	0,005	0,109	-0,129	0,096	1,71	-1,08	4,64
	47	21,66	-21,32	42,78	0,405	-0,317	0,634	0,003	-0,001	0,003	0,106	-0,066	0,072	1,62	-0,95	4,37
	48	20,22	-21,54	42,62	0,388	-0,322	0,622	0,003	-0,001	0,003	0,081	-0,069	0,070	1,53	-0,95	3,98
	49	13,33	-21,68	38,58	0,256	-0,331	0,569	0,001	-0,001	0,003	0,000	-0,069	0,033	0,92	-0,95	3,31
	50	16,95	-24,60	37,13	0,343	-0,368	0,550	0,002	-0,002	0,002	0,044	-0,106	0,020	1,28	-1,05	3,18
	51	17,30	-18,46	41,00	0,335	-0,274	0,600	0,002	0,000	0,003	0,049	-0,027	0,053	1,22	-0,82	3,65
	52	17,07	-25,00	39,23	0,319	-0,364	0,585	0,002	-0,002	0,003	0,042	-0,123	0,038	1,18	-1,06	3,67
	53	16,87	-20,97	43,30	0,309	-0,309	0,662	0,002	-0,001	0,004	0,168	-0,227	0,342	1,14	-0,92	4,13